YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

TECHNICAL AND MANAGEMENT SUPPORT SERVICES

PROJECT STATUS REPORT APRIL 1994

PROJECT STATUS REPORT
APRIL 1994

TABLE OF CONTENTS

PROJECT STATUS

ACRONYMS

The following is a list of acronyms used throughout the following report.

AFP	Approved Funding Plan
AP	Administrative Procedure
AT	Assessment Team
CMCS	Contract Management Control System
CPAF	Cost Plus Award Fee
CRWMS M&O	Civilian Radioactive Waste Management Systems Management and Operating Contractor
DIGE	Determination of Importance and Grading Enhancement
DOE	U.S. Department of Energy
ESF	Exploratory Studies Facility
ESFDR	Exploratory Studies Facility Design Requirements
FCR	Field Change Report
FDDI	Fiber Distributed Data Interface
FM	Forty Mile Wash
FMP	Field Management Procedures
FOC	Field Operations Center
FOI	Field Operating Instructions
GET	General Employee Training
HQ	Headquarters
ISD	Information Systems Division
JP	Job Package
LRPW	Long-Range Planning for Workstation
M&O	Management & Operating Contractor
NCR	Nonconformance Report
NRG	North Ramp Geologic
NV	Nevada
NWTRB	Nuclear Waste Technical Review Board
OSHA	Occupational Safety and Health Administration
OTCR	Official Tribal Contact Representative
PAA	Project Accumulation Area
PACS	Planning and Control System
PI	Principal Investigator
QA	Quality Assurance
QC	Quality Control
QFR	Quality Finding Report
RDR	Repository Design Requirements
REECO	Reynolds Electric and Engineering Company

ACRONYMS, (Continued)

SAIC	Science Application International Corporation
SD	Systematic Drilling
SMF	Sample Management Facility
SMPGS	Site Maintenance Plan Guidance Survey
SOC	Sample Overview Committee
SP	Special Procedure
SR	Surveillance Report
T&MSS	Technical and Management Support Services
TBM	Tunnel Boring Machine
TPP	Test Planning Package
UE	Underground, Exploratory
USGS	U.S. Geological Survey
USW	Underground, Southern Nevada, Waste
UZ	Unsaturated Zone
VAX/VMS	Mainframe Computer/Operating System
WIEB	Western Interstate Energy Board
YAP	Yucca Mountain Administration Procedure
YMP	Yucca Mountain Site Characterization Project
YMSCO	Yucca Mountain Site Characterization Office
YMSC	Yucca Mountain Science Center

EXECUTIVE SUMMARY
APRIL - 1994

The AT completed a review of the DIGE management plan records package and a recommendation was made for cancellation of the plan.

A notice of technical closure and a monthly report on the results of Quest Integrated Incorporated Research contract was issued.

Completed a technical analysis of the Baker/Hughes drilling research proposal.

Completed a white paper on the "Ejector Sub" assembly in satisfaction of the YMSCO established performance criteria.

Completed and approved JP-94-07, "Drilling and Testing of Borehole SD-9 (Phase 1)," and T-94-01, "Drilling and Testing of Borehole SD-9."

Completed the SMPGS as requested by the DOE/HQ.

Finalized the May AFP input and distribution of prior year uncosted balances.

Conducted an external audit of Net One Northwest.

Completed the Novell Phase II conversion and Phase I installation.

The Spring 1994 OTRC visit was held March 14-16, 1994 in Las Vegas, NV. Native American oversight support, funding initiatives, and archaeological data recovery efforts were discussed.

Staff scientists met with Nevada State Health Department representatives to tour the Yucca Mountain site and discuss the ESF potable water systems, including a design drawing and construction progress review.

The Underground Injection Control permit quarterly report was submitted to the Nevada Division of Environmental Protection.

The Environmental Compliance Summary was submitted to the Office of Environmental, Safety and Health as required by DOE Order 5400.1, "General Environmental Protection Program.

The PAA for hazardous wastes was opened. The PAA is the central location for Project wastes prior to offsite transport.

The initial assessment of radon working levels at the ESF personnel working level area was completed as required for DOE Radcon Manual and OSHA compliance.

The socioeconomic monitoring program procurement data report for the period from April 1993 through September 1993 was distributed to representatives of the State of Nevada and effected units of local government.

Thirty tours to Yucca Mountain were arranged and coordinated.

Forty Public Speaking presentations were given during the reporting period.

1.2.1 SYSTEMS

Progress During the Report Period:

The AT completed the first draft of the determination of importance plan, including development of review criteria for both classification of items and impact analysis of activities.

Also completed was a review of the DIGE management plan records package and a recommendation was made for cancellation of the plan.

Issues and Concerns:

No issues or concerns during this report period.

1.2.3 SITE INVESTIGATIONS

Progress During the Report Period:

Test Planning and Support

Initiated the following JPs and TPPs:

- JP-94-08 Construction of Access Road and Drill Pad for SD-7
- JP-94-09 Ghost Dance Fault Trenches
- JP-94-10 Rock Valley Trenches and Test Pits
- JP-94-11 Drilling and Testing of Borehole SD-9
- JP-94-12 Seismic Reflection Program
- JP-94-14 Construction of Access Road and Drill Pad for UZ-7A
- T-94-12 FM-2 Artificial Infiltration
- T-94-13 UZN-7 Artificial Infiltration
- T-94-14 Drilling and Testing of UZ-7A

JP-94-07, SD-9, "Drilling and Testing," was completed and approved.

Completed a review of the ESFDR and RDR current revisions.

1.2.3 SITE INVESTIGATIONS, (Continued)

To satisfy the YMSCO established performance criteria, a white paper on the "Ejector Sub" assembly was completed.

Performed a technical review of SP 8.3.1.17.3.1, Revision 1, "Relevant to Earthquake Services."

Issued a notice of technical closure and a monthly report on the results of the Quest Integrated Incorporated Research contract.

Completed a technical analysis of the Baker/Hughes drilling research proposal.

Reviewed and approved a REECo Dual Wall Failure Analysis Report.

Prepared a geologic description of the "tube structures" at Yucca Mountain for the YMSCO.

Drilling

Sampled core from 290.8' to 588.8' from USW SD-12. Drilling continued in the Upper Lithophysal Zone of the Topopah Springs.

Core and cuttings from 1596.3' to 2206.7' from USW UZ-14 were sampled and processed. A water table was encountered through a natural fracture at 2185.5' in the Bullfrog Member of the Crater Flats Tuff, and the planned depth will be re-evaluated.

Conducted geophysical logging activities on USW NRG#6 and UE-25 UZ-16 using a Numar Corporation magnetic resonance imaging tool.

Approximately 726 specimens were removed from core at the PI's request.

Conducted 81 core examinations at the SMF for various participants.

Issues and Concerns:

No issues or concerns during this report period.

1.2.7 TEST FACILITIES

Progress During the Report Period:

Fifty-seven photographic service requests for still and video photography and 16 work order requests were processed.

The following JP activities were completed:

- a records list for JP 94-07, "Drilling and Testing of Borehole USW SD-9"
- text to be included in the SD-7 JP and associated documents
- JP 93-01, "NRG-3 Borehole"
- JP 92-19, "NRG-2 Borehole"
- a draft FCR revising JP 92-02, "North Portal Soil and Rock Properties and NRG-1 Borehole"

As requested by the DOE/HQ, the SMPGS was completed.

Prepared 212 badging requests for site visits and daily field work.

Completed revisions and/or draft revisions of the following documents:

- YAP 5.4Q, "Technical Field Work Request"
- GET Manual
- Implementation Plan for ESF Test Operations and Maintenance Support Services

Completed two CPAF Action Items: II.1A, "Review of the FMP and FOI," and II.2A, "Review of the JP Approval Process." Recommendations were made for improvements on both items.

Issues and Concerns:

No issues or concerns during this report period.

1.2.9 PROJECT MANAGEMENT

Progress During the Report Period:

Planning and Control

Statused the LRPW and revised the CMCS and PACS databases to reflect all current month changes. All Summary Accounts were reviewed with the CRWMS M&O to ensure consistency of information.

Finalized the May AFP input and distribution of prior year uncosted balances.

Management Improvement

Conducted Quality Strategic Planning and Team Building Sessions for 21 DOE personnel, and two Covey training sessions for 45 students.

Issues and Concerns:

No issues or concerns during this report period.

1.2.11 QUALITY ASSURANCE

Progress During the Report Period:

A revision of the T&MSS Qualified Supplier's List was approved and issued.

Conducted an external audit of Net One Northwest.

Surveillance Report SR-94-01 was opened for the quarterly surveillance of Document Control.

The following is a summary of QA program activity for this report period:

- QFRs: 2 opened; 2 closed; 5 remaining open
- NCRs: 6 opened; 0 closed; 10 remaining open

1.2.11 QUALITY ASSURANCE, (Continued)

- Plans and Procedures reviewed: 6
- QC Receipt Inspections Performed: 6
- Procurement documents Reviewed: 1
- Supplier Evaluation Reports: 1

Issues and Concerns:

No issues or concerns during this report period.

1.2.12 INFORMATION MANAGEMENT

Progress During the Report Period:

Support to the YMSCO

Performed approximately 200 user work requests which included an initial draft of Wyandotte move and identification of potential scheduling concerns regarding availability of funding.

Support to the YMP Participants

Conducted classes in Lotus Notes, computer fundamentals, Novell, and Timeline.

Telecommunications

Coordination regarding additional proposed leased lines continued at the following locations:

- SAIC and Wyandotte
  Coordinated with DOE/NV communication staff regarding planned data requirements.

- SAIC and DOE/NV
  Received final approval and performed update to route Internet traffic.

1.2.12 INFORMATION MANAGEMENT, (Continued)

- The FOC and various site buildings
  Received approval to procure and install InfraRed 10mb systems from DOE/NV.

System Development

A review of VAX/VMS privileged accounts and the policy regarding the granting of the accounts has been completed. Recommendations were made to reduce the number of privileged user accounts.

A draft disk allocation plan has been produced and is being reviewed.

Performed an informal design review on the FDDI design document.

Novell Transition:

- Completed Novell Phase II conversion and installation of Phase I
- Updated and distributed the transition procedure "Novell Workstation Installation Checklist," to the technicians

Planning, Control, and Compliance Support

A Computer and Telecommunication Systems Configuration Management Plan has been developed and is under ISD review.

The baseline documents for the YMP Computer Room have been created and are now under review by the YMSCO.

Issues and Concerns:

No issues or concerns during this report period.

1.2.13 ENVIRONMENTAL, SAFETY AND HEALTH

Progress During the Report Period:

The Spring 1994 OTCR visit was held March 14-16, 1994 in Las Vegas, Nevada. Native American oversight support, funding initiatives, and archaeological data recovery efforts were discussed.

Staff scientists met with Nevada State Health Department representatives to tour the Yucca Mountain site and discuss the ESF potable water systems, including a design drawing and construction progress review.

The Underground Injection Control Permit quarterly report was submitted to the Nevada Division of Environmental Protection.

A site tour was conducted for Nevada Division of Environmental Protection Representatives.

Environmental Compliance Summary was submitted to the Office of Environment, Safety and Health as required by DOE Order 5400.1, "General Environmental Protection Program."

Staff scientists participated in the 90 percent review of Design Package 2C.

Six environmental approval requests were processed in support of site characterization activities, including a comprehensive review of each activity for permit and land access approvals.

The PAA for hazardous wastes was opened. The PAA is the central location for Project wastes prior to offsite transport.

Environmental compliance and safety surveillances were conducted at the Yucca Mountain site ensuring compliance with permit and programmatic requirements.

All findings of the July 1993 REECo functional appraisal and September 1993 USGS Safety and Health Compliance Inspection were closed.

The initial assessment of radon working levels at the ESF personnel working level area was completed as required for DOE Radcon Manual and OSHA compliance.

1.2.13 ENVIRONMENTAL, SAFETY, AND HEALTH, (Continued)

The description of the methods, process, and schedule for implementing the 1994 survey of DOE-related workers in Nevada was submitted to the YMSCO for review.

The socioeconomic monitoring program procurement data report for the period from April 1993 through September 1993 was distributed to representatives of the State of Nevada and affected units of local government.

Efforts to complete the socioeconomic monitoring program employment data report for the period from January 1994 through March 1994 are ongoing.

Issues and Concerns:

No issues or concerns during this report period.

1.2.14 INSTITUTIONAL

Progress During the Report Period:

A "Neighborhood Dialogue" to discuss studies at Yucca Mountain was held with scientists from the DOE and the State of Nevada, in Las Vegas, Nevada. The event was co-sponsored by the state, the YMP, and Clark County.

Thirty tours to Yucca Mountain were arranged and coordinated, and forty public speaking presentations were given during the reporting period. These included 22 educational presentations and 18 general YMP overviews.

In addition to the special groups tours, a Public Open House tour of Yucca Mountain was coordinated and conducted on April 16, 1994 for 330 people. Tour participants visited the YMSCs, the FOC, two laboratories, the ESF North Portal construction area, and the top of Yucca Mountain.

An Affected Units of Government meeting was held on April 8, 1994 in Las Vegas, Nevada. The agenda included discussions of the Administration's Funding Proposal, a variety of technical issues, and preparations for the Stakeholders Meeting to be held on May 21, 1994 in Las Vegas, Nevada.

1.2.14 INSTITUTIONAL, (Continued)

Supported the YMP staff at a meeting of the Steering Panel for the Independent Management and Financial Review, the Clark County Nuclear Waste Division Peer Review Committee meeting, and the Clark County Steering Committee meeting in Las Vegas, Nevada; the NWTRB meeting in Reno, Nevada; and the WIEB meeting in Lake Tahoe, Nevada.

Assisted the YMP in conducting four "Of Science and Mountains" teacher workshops and four "Critical Thinking" teacher workshops. Twenty teachers participated in each of the workshops.

Development of new ESF exhibit at the Las Vegas YMSC was completed. The exhibit features a large three-dimensional model of the ESF, as well as a brief video, four dioramas on planned tests, and a diorama on the LM-300 Drill Rig at Yucca Mountain.

Supported Various YMP staff who participated in a Discovery Day at the Las Vegas YMSC. Approximately 100 people participated in the hands-on geology and science activities.

A media availability conference was held on April 11, 1994 in Las Vegas, Nevada to brief local reporters on the arrival of the TBM. A completed revision of the fact sheet, "Drilling and Blasting the TBM Starter Tunnel," was made available at the media availability briefing.

Ten groups of fifth grade students toured the Las Vegas YMSC and attended educational presentations on geology. A total of 630 students participated.

The Yucca Mountain Speaker Series presentation, "Tunneling Your Way Through a Mountain," was presented at the Las Vegas YMSC and at the Pahrump YMSC. A total of approximately 58 people attended these presentations. April Speakers Series flyers were completed and distributed.

A scoreboard was presented by the YMP to the Beatty community for Little League events. Over 250 children and parents attended the season's opening day event on April 9, 1994.

1.2.14 INSTITUTIONAL, (Continued)

Assisted various YMP staff with a science experiment competition. For this event, students engineered devices to protect an egg when dropped from several heights, and approximately 300 students participated in the event.

Supported the YMP set up and staff four exhibits. These included the Clark County Fair, the Las Vegas Home and Garden Show, an exhibit for Churchill County in Fallon, Nevada, and the Earth Day Fair in Las Vegas, Nevada. A total of approximately 1,411 people visited the displays.

Completed 174 external information requests. This was accomplished by providing written responses to written and verbal queries and/or by supplying existing literature.

Issues and Concerns:

No issues or concerns during this report period.

1.2.15 SUPPORT SERVICES

Progress During Report Period:

Training

Conducted 100 training sessions and trained 1,154 personnel for a total of 4,183 contact hours and processed 423 training records.

Conducted the following special training sessions:

- Introduction to Federal Records
- Special General Employee Training
- General Employee Radiological Training
- Initial Instructor Training
- PACS Planning, Scheduling and Cost Estimating
- Introduction to Conduct of Operations

Issues and Concerns:

No issues or concerns during this report period.

Science Applications International Corporation

WBS 1.2.9.2
QA: N/A

May 31, 1994

Robert M. Nelson, Jr., Acting Project Manager
ATTN: Vince F. Iorii
U.S. Department of Energy
Yucca Mountain Site Characterization Office
P.O. Box 98608
Las Vegas, Nevada 89193-8608

I-35823

TRANSMITTAL OF TECHNICAL AND MANAGEMENT SUPPORT SERVICES PROJECT STATUS REPORT FOR THE MONTH OF APRIL 1994, CONTRACT #DE-AC08-87NV10576 (SCP: N/A)

This letter transmits the subject report showing accomplishments for the month of April 1994. A Cost Performance Report, the Milestone Schedule and Status Report for the reporting period have not been included due to system problems encountered. We should be able to reinstate these reports in subsequent periods. Please contact Mary Brodeur at 794-7682 if you have comments or suggestions.

for Michael D. Voegele, Project Manager
Technical and Management
Support Services

MDV:MB:brk:L94-207

Enclosure:
1. Project Status Report

101 Convention Center Dr., Ste. 407, Las Vegas, NV 89109 (702) 794-7000
Other SAIC Offices: Albuquerque, Ann Arbor, Arlington, Atlanta, Boston, Chicago, Huntsville, La Jolla, Los Angeles, McLean, Orlando, Santa Barbara, Sunnyvale, and Tucson

ENCLOSURE 9

cc:
J. M. Schrecongost, YMSCO, NV, MS/523
G. K. Beall, SAIC, Las Vegas, NV, 517/T-17
R. S. Bostian, SAIC, Las Vegas, NV, 517/T-28
D. K. Chandler, SAIC, Las Vegas, NV, 517/T-44
J. B. Harper, SAIC, Las Vegas, NV, 517/T-38
M. W. Harris, SAIC, Las Vegas, NV, 517/T-29
T. K. McCusker, SAIC, Las Vegas, NV, 517/T-31
B. E. Reilly, SAIC, Las Vegas, NV, 517/T-18
K. K. Shrivastava, SAIC, Las Vegas, NV, 517/T-31
T. D. Tait, SAIC, Las Vegas, NV, 517/T-46
M. D. Voegele, SAIC, Las Vegas, NV, 517/T-44
J. D. Weaver, SAIC, Las Vegas, NV, 517/T-04

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

WBS 1.2.13.4
NQA

July 6, 1994
LV94-RAG-040

Wendy Dixon, Director
Project and Operations Control Division
Yucca Mountain Project Office
DOE Field Office, Nevada
P. O. Box 98518
Las Vegas, NV 89193-8518

I-35919 BAH

JUNE 1994 PROGRESS REPORT

Attached is the June 1994 progress report on biological studies and support activities conducted by EG&G/EM for the Yucca Mountain Site Characterization Project. Please contact Tom O'Farrell (293-7762) or me (794-7474) if you have questions regarding this report.

W. Kent Ostler, Manager
Environmental Science Department

RG:vk

Attachment

cc: G. Ryder, DOE/YMP
D. Sorensen, SAIC
P. Schilling, SAIC

258
DIXON
RYDER
WILSON
Bradley
CRAWFORD-M
McCANN-SAIC
PYSTO-SAIC
URSDITH-JC
7-7-94 Williams-D
Nelson-R

RPS 7-6-94

ENCLOSURE 2

YUCCA MOUNTAIN PROJECT
BIOLOGICAL RESOURCES PROGRAM
MONTHLY PROGRESS REPORT
JUNE 1994

Summary of Work Accomplished During Report Period

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

ISSUES and CONCERNS

- None

WORK PROGRESS

- EG&G/EM conducted two preactivity surveys to assess potential impacts on biological resources and one reclamation inventory. Resurveys for tortoises were conducted at three construction sites. Four casual access surveys were conducted. The C-Well pipeline was monitored for tortoises throughout the month to ensure tortoises were not trapped or injured.

- Measurements of vegetation production were completed on the 12 ecological study plots in the *Larrea-Lycium-Grayia* association and on the six ecological study plots with small mammal trapping grids in the *Coleogyne, Larrea-Ambrosia*, and *Lycium-Grayia* associations. All vegetation measures to monitor the effects of Site Characterization Activities now have been completed for FY94.

- Seedling density measurements were completed at Site #1E (soil quality and depth study). All reclamation monitoring measurements (cover and seedling density) have been completed for FY94.

- All other work was part of continuing studies. Radiomarked desert tortoises were located at least twice each week. Blood samples were drawn from desert tortoises to assess and monitor health condition. Small mammals were captured, marked, and released on eight plots to monitor the effects of site characterization activities on population abundance and survival.

- EG&G/EM (R. Green and M. Hessing) met with USGS (A. Flint, L. Flint, B. Guertal, J. Hevesi, and D. Hudson) and DOE/EPA (J. D'Lugoza and R. Keeler) to discuss common data needs related to plant communities and plant-water dynamics.

- A draft of EG&G/EM's scope of work for FY95 was provided to the Project Office.

Lawrence Livermore National Laboratory

LLYMP9406134
June 27, 1994

WBS 1.2.9
QA: N/A

Robert M. Nelson, Jr., Acting Project Manager
Yucca Mountain Site Characterization Office
Department of Energy
P.O. Box 98518
Las Vegas, Nevada 89193-8518

SUBJECT: Yucca Mountain Project Status Report - May 1994
SCP: N/A

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

If further information is required, please contact Carol Passos at 702-794-7511 or Jim Blink at 702-794-7157.

Sincerely,

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

WC/CP

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.

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ENCLOSURE 3

I-359206

Recycled

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

May 1994

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

1) **WBS 1.2.1.5, Special Studies:** LLNL has conducted a series of analyses in support of the Thermal Loading Systems Study, to evaluate an assumption of TSPA-93. The Total Systems Performance Assessment assumed that Waste Packages (Wps) re-wet at the end of the boiling period. The new calculations show that the assumption, which resulted in accelerated corrosion at the end of the boiling period for high thermal loads, is flawed. For example, areal mass loadings of 55.3 and 110.5 MTU/acre were compared. The inner half of the low thermal load repository has a relative humidity of 81% at the end of boiling (1760 yr). The same region of the high thermal load repository boils until 6130 yr, and has a much lower relative humidity (44%) at the end of boiling. It doesn't re-wet to 81% relative humidity until 29,000 yr, and the temperature at that time is only 53°C. Clearly, assumption of hot wet conditions at 6130 yr for the high thermal load repository was overly conservative. Since the same conservatism was not applied to the lower thermal load, the comparison between the two cases was not appropriate.

2) **WBS 1.2.2.3.1.1, Waste Form Testing - Spent Fuel:** There has been a suspension of radiological work in Pacific Northwest Laboratories Bldg. 325. Work conducted by the YMP was not a contributory element in the closure of this facility; however, this action has had a major impact on our work schedule. Formal documentation of the justification for closure of the building has been requested; it will be provided to LLNL and placed in the YMP records. At this time, there is no projected date for re-opening the facility; therefore, overall impact on the YMP cannot be determined. More information should become available in June.

3) **WBS 1.2.2.3.1.1, Waste Form Testing - Spent Fuel:** A comparison has been made for unsaturated (drip) tests on spent fuel fragments in a Zircaloy retainer conducted at Argonne National Laboratory and earlier saturated tests on bare spent fuel conducted at Pacific Northwest Laboratory. Both sets of tests are sponsored by Lawrence Livermore National Laboratory. Leachates from the tests were compared with regard to the amount of cesium and actinides in ionic (passes a 50A filter) and colloidal forms. Acid stripping was used to determine the amounts of the radionuclides precipitated on the vessel. There was considerable variability between the two PWR fuels (which had different variables) and between them and the bare samples. Preliminary conclusions are that the plutonium, americium and curium are not being removed congruently with the uranium matrix. These conclusions, even if upheld for the two year tests, may not hold for longer

experiment durations; that was the case when UO_2 tests were extended from two years out to eight years.

4) **WBS 1.2.2.3.1.2, Waste Form Testing - Glass:** Samples taken from the high level waste dissolution tests have been analyzed. The dissolution rate of lithium from the glass has been fairly constant over a period of eight years. Silicon is being removed from the liquid, but the rate is leveling off. There appear to be two competing processes: addition of silicon to the liquid due to spallation of glass layers and removal of silicon as iron silicates which form on the metal sample holders.

5) **WBS 1.2.3.11.3, Geophysics - ESF Support, Subsurface Geophysical Testing:** The LLNL/LANL Geotechnical Engineering Group took delivery of the ENVIROLOG-4 Logging Winch manufactured by AUSLOG and purchased through Weber International on May 31st. The ENVIROLOG-4 includes a depth system, housing, 100 m 4-conductor cable, cable head, winch, 12 VDC motor drive, speed control, tripod, operational software, and downhole electronics. A preliminary performance test was conducted on the ENVIROLOG-4 winch unit on May 31st. A final performance test will be conducted after delivery of the color video tool, four arm caliper and neutron tool.

6) **WBS 1.2.3.12.2, Hydrologic Properties of the Waste Package Environment:** A primary concern for repository performance is how water contacts a waste package (WP), thereby affecting its integrity and, if containment is breached, radionuclide dissolution and transport. There are two primary modes of water contact: advective liquid flow, and condensation of water vapor on the WP surface. For the first water contact mode, *liquid-phase advective flow in fractures*, the primary sources are episodic infiltration of meteoric water and repository-heat-driven condensate drainage. Drainage can be due to boiling conditions; mountain-scale, buoyant vapor flow; sub-repository-scale, buoyant vapor flow, and focused vapor flow and condensate drainage due to heterogeneity. The last three sources of condensate can occur under either sub-boiling or boiling conditions. For the second water contact mode, *condensation on WP surfaces*, the critical concerns are the relative humidity and temperature on the WP surfaces. Ambient conditions are quite humid, with a relative humidity of 98-99%. Two ways to reduce the relative humidity on the WP surfaces are to drive a large fraction of the initial water content away from the repository, and to maintain a moderate temperature gradient in the vicinity of the WP. The primary means of reducing the water content near the repository are ventilation and repository-heat-generated boiling conditions. LLNL's thermal hydrological calculations are directed to evaluating the sensitivity of water contact to site characteristics and design parameters.

7) **WBS 1.2.3.12.4, Engineered Barrier System (EBS) Field Tests (Large Block Test):** The Large Block Test excavation work started at the beginning of May and continues. A wire saw was used to trim the top of the block. The entire sawing activity took two days. The original top of the block was successfully lifted off as a single piece and provided to RSN for use at the Colorado School of Mines. A

preliminary fracture mapping was conducted on the exposed top surface of the block.

8) **WBS 1.2.3.12.5, Characterization of the Effects of Man-Made Materials on Chemical & Mineralogical Changes in the Post-Emplacement Environment:** The Diesel Exhaust study is underway. Sampling was conducted in N-tunnel, EQ 3/6 simulations have begun, and planning to add microbial effects to the study is underway. Results are required by August to support a Diesel vs. Electric decision for the ESF.

LLNL DELIVERABLES MET

Milestone	WBS	Planned Date	Actual Date	Description	Comment
MOL46	1.2.2.3.2	03-15-94	05-31-94	Submit degradation mode survey on iron-base materials to YMSCO	Draft received from subcontractor; in LLNL review
MOL75	1.2.3.12.3	03-31-94	05-31-94	Calibration of equip. for Scoping exp.	Delayed by procurement and requirements coordination with the LBT
MOL16	1.2.3.12.3	06-01-94	05-31-94	Approve Activity Plan	
MOL77	1.2.3.12.4	01-31-94	04-05-94	Submittal of SP comment responses	

LLNL DELIVERABLES NOT MET

Milestone	WBS	Planned Date	Projected Date	Description	Comment
MOL45	1.2.2.3.2	01-31-94	06-30-94	Submit updated Metal Barriers SIP	Delayed by TPR & NWTRB preparation
MOL03	1.2.3.10.3.1	03-31-94	07-29-94	Report on colloid characterization	Delayed by equip.malfunction related to MOL04 and delays in hiring new staff
MOL04	1.2.3.10.3.1	01-12-94	08-15-94	Document core flow experiment protocol	Delayed by equip.malfunction and delays in hiring new staff
MOL05	1.2.3.10.3.1	05-31-94	09-30-94	Report on Cs and Sr static diffusion test	Delayed by equip.malfunction and delays in hiring new staff
MOL26	1.2.3.12.1	03-31-94	07-01-94	Submit near-field geochemistry topical report	Delayed by TPR & NWTRB preparation
MOL15	1.2.3.12.4	03-31-94	07-29-94	LBT excavation and small block delivery	Construction delays have delayed test start to Dec. 94
MOL70	1.2.3.12.4	05-15-94	07-25-94	LBT frame delivery	Delay by fabricator
MOL73	1.2.3.12.5	05-31-94	06-22-94	Report on stability of organic compounds at elevated temperatures	Delayed by TPR & NWTRB preparation
MOL91	1.2.5.4.2	03-31-94	07-29-94	Submit plan for code qualification	Individual Software Plan is currently in technical review

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 31-MAY-94

PARTICIPANT: LLNL PEM: SMITH WBS: 1.2.2.3.1.1

WBS TITLE: WASTE FORM TESTING - SPENT FUEL

P&S ACCOUNT: 0L2311

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
1189	1229	1051	40	3.4	103.4	178	14.5	116.9	1785	1785	0	0.0	1527	75.7

Analysis

Cumulative Cost Variance:
The cost variance is due to two FY93 summary accounts being carried over into FY94 awaiting completion of milestones. The milestones required reports from PNL that were delayed by 30 days and as a result were not received by LLNL until mid October. These reports were immediately processed by LLNL and submitted to the Project Office for review. No actual costs were incurred but earned value was calculated upon closing of these summary accounts. These FY93 accounts were not removed during the FY93 Close-Out exercise in PACs and will continue to contribute an inaccurate $120k to both the cost and schedule variance. The correct cost variance is 58.

Cumulative Schedule Variance:
Same as above. The correct schedule variance is -80.

Variance At Complete:

Roy B Stout June 14, 94
P&S ACCOUNT MANAGER DATE

W. L. Adams 6/15/94
TPO DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 31-MAY-94

PARTICIPANT: LLNL PEM: SIMMONS WBS: 1.2.3.12.4

WBS TITLE: ENGINEERED BARRIER SYSTEM (EBS) FIELD TESTS

P&S ACCOUNT: 0L3C4

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
1778	1599	1586	-179	-10.1	89.9	13	0.8	101.8	2530	3064	-534	-21.1	2510	63.0

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:
Excavation delays and frame delivery postponment has delayed block characterization activity. Do not anticipate recovery within the current fiscal year.

Variance At Complete:
Variance at completion caused by current estimates for instrumentation and loading devices for the large block. The test is in a state of evolution as are the models being developed to interpret the data. Several additional channels are required in the data acquisition system. Side loading of the blocks initially was going to be accomplished by a single bladder. Complications in the fabrication of the bladder rising from the need to insert instrumentation through the bladder, forced considerations of other options. The current resolution is to achieve loading by using several bladders. This increased cost was identified and discussed during the midyear review at YMSCO. Complications with frame fabrication is requiring addition of project engineer and more design effort. Subcontractor underbid a fixed price contract and has stated that they are unable to complete frame within budget. LLNL is researching legal requirements and options to accomplish Large Block loading.

P&S ACCOUNT MANAGER 6/14/94 DATE TPO 6/15/94 DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 31-MAY-94

PARTICIPANT: LLNL PEM: SIMMONS WBS: 1.2.3.12.5

WBS TITLE: CHAR. OF EFFECTS OF MAN-MADE MAT. ON CHEM/MIN. CHGS.

P&S ACCOUNT: 0L3C5

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	ICPI
180	146	190	-34	-18.9	81.1	-44	-30.1	76.8	248	438	-190	-76.6	323	41.1

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:

Variance At Complete:
Workscope was added for studies of diesel fuel impacts on the ESF. Additional funding has not been processed. LLNL cannot change BCWS until change has been worked through Change Control.

Dale D. Wilder 6/14/94
P&S ACCOUNT MANAGER DATE

W. L. Clarke 6/15/94
TPO DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 31-MAY-94

PARTICIPANT: LLNL PEM: GIL WBS: 1.2.5.2.2

WBS TITLE: SITE CHARACTERIZATION PROGRAM

P&S ACCOUNT: 0L522

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
160	160	241	0	0.0	100.0	-81	-50.6	66.4	240	322	-82	-34.2	361	98.8

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:

Variance At Complete:
As of May 31, 1994, all funds budgeted for this element have been depleted, ($240,000 budget; $240,333 cost). Request for additional funding will be processed through Change Control, coordinated with Element PEM.

W. L. Gilbert 6/15/94
P&S ACCOUNT MANAGER DATE

W. L. Gilbert 6/15/94
TPO DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 31-MAY-94

PARTICIPANT: LLNL PEM: IORII WBS: 1.2.9.2.2

WBS TITLE: PARTICIPANT PROJECT CONTROL

P&S ACCOUNT: 0L922

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
401	401	461	0	0.0	100.0	-60	-15.0	87.0	601	661	-60	-10.0	691	100.0

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:

Variance At Complete:
Increased staff by 2 full-time positions:

1.) Technical Coordinator - Interacts with Principal Investigators regarding project control activity.

2.) Assistant Resource Manager - Assists with Finance/Accounting/Reporting/Procurement functions.

Acceleration of LLNL activity in Large Block area and general ramping-up of testing activity has produced increase in project control functions. Anticipate future increases as LLNL role expands.

6/14/94
P&S ACCOUNT MANAGER DATE

6/15/94
TPO DATE

Participant LLNL

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Yucca Mtn. Site Char. Project-Planning & Control System
PACS Participant Work Station (PPWS)
WBS Status Sheet (WBS02)

01-May-94 to 31-May-94
Page - 1
Inc. Dollars in Thousands

WBS No.	- 1.2	WBS Manager	-
WBS Title	- YUCCA MOUNTAIN PROJECT		
Parent WBS No.	-	Parent WBS Manager	-
Parent WBS Title	-		

Statement of Work

See the current WBS Dictionary

Cost/Schedule Performance

		Current Period					FY1994 Cumulative to Date					FY1994 at Completion		
Id	Description	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	BAC	EAC	VAC
1.2.1	SYSTEMS ENGINEERING	14	14	15	0	-1	107	107	93	0	14	160	160	0
1.2.2	WASTE PACKAGE	308	251	266	-57	-15	2256	2360	2205	104	155	3443	3507	-64
1.2.3	SITE INVESTIGATIONS	584	408	507	-176	-99	4426	4202	4182	-224	20	6348	7213	-865
1.2.5	REGULATORY	160	126	130	-34	-4	972	922	953	-50	-31	1462	1502	-40
1.2.9	PROJECT MANAGEMENT	103	103	106	0	-3	815	815	870	0	-55	1232	1271	-49
1.2.11	QUALITY ASSURANCE	54	54	31	0	23	433	433	347	0	86	650	650	0
1.2.12	INFORMATION MANAGEMENT	21	21	21	0	0	166	166	154	0	12	250	249	1
1.2.13	ENVIRONMENT, SAFETY, & REA	2	2	5	0	-3	17	17	8	0	9	25	25	0
1.2.15	SUPPORT SERVICES	32	32	34	0	-2	254	254	200	0	54	382	375	7
Total		1278	1011	1115	-267	-104	9446	9276	9012	-170	264	13942	14952	-1010

Resource Distributions by Element of Cost

Fiscal Year 1994
Budgeted Cost of Work Scheduled

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBAHRS	8281	7278	7559	7931	7764	7742	7988	7922	7912	7794	7746	7454	93341
LABOR	762	654	658	749	711	720	725	743	722	730	709	706	8589
SUBS	109	298	264	233	315	269	218	206	226	200	142	169	2649
TRAVEL	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	155	193	147	199	175	189	181	248	212	216	220	237	2372
CAPITAL	0	0	11	21	146	59	7	81	7	0	0	0	332
Total BCWS	1026	1145	1080	1202	1347	1237	1131	1278	1167	1146	1071	1112	13942

Participant LLNL

Prepared - 06/14/94:11:04:24

Yucca Mtn. Site Char. Project-Planning & Control System
PACS Participant Work Station (PPWS)
W&S Status Sheet (WBS02)

01-May-94 to 31-May-94
Page - 2
Inc. Dollars in Thousands

WBS No. - 1.2 -YUCCA MOUNTAIN PROJECT

Resource Distributions by Element of Cost

Fiscal Year 1994 Actual Cost of Work Performed	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	8301	6113	5630	6247	6390	7092	7097	7530	0	0	0	0	54400
LABOR	762	413	383	497	513	552	513	558	0	0	0	0	4191
SUBS	114	303	254	233	315	246	218	101	0	0	0	0	1784
TRAVEL	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	152	385	243	355	388	452	388	456	0	0	0	0	2819
CAPITAL	0	0	11	21	138	33	15	0	0	0	0	0	218
Total ACWP	1028	1101	891	1106	1354	1283	1134	1115	0	0	0	0	9012

Resource Distributions

Fiscal Year 1994	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
BCWS	1026	1145	1080	1202	1347	1237	1131	1278	1167	1146	1071	1112	13942
BCWP	1188	1062	944	1048	1810	1177	1036	1011	0	0	0	0	9276
ACWP	1028	1101	891	1106	1354	1283	1134	1115	0	0	0	0	9012
ETC	0	0	0	0	0	0	0	0	1323	1534	1536	1547	5940

Fiscal Year Distribution

	Prior	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	Future	At Complete
BCWS	11048	13942	43192	46455	35899	25532	17825	12021	8684	3594	823	705	219720
BCWP	10882	9276	0	0	0	0	0	0	0	0	0	0	
ACWP	10846	9012	0	0	0	0	0	0	0	0	0	0	
ETC	0	5940	42682	45613	34901	25892	18815	12262	9167	3624	823	705	220282

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

PARTICIPANT: LLNL

DATE PREPARED: 6/10/94

FISCAL MONTH/YEAR: MAY,1994

WBS ELEMENT	CURRENT MONTH END								FISCAL YEAR		
	ACTUAL COSTS	PARTICIPANT FTES	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS#	CAP EQPT ACCURAL	APPROVED BUDGET	CURRENT FY94 AFP	CUMULATIVE COSTS
1.2.1.5	22,600	0.80	120		0	0			160,000		92,200
SUBT 1.2.1	22,600	0.80	120	0	0	0	0	0	160,000	122,061	92,200
1.2.2.1	31,400	1.30	210		88	0	0		400,000		297,300
1.2.2.3.1.1	8,400	0.30	40	378	119	250,901	602,500		1,785,000		411,200
1.2.2.3.1.2	3,800	0.20	32		364	6,043	75,000		280,000		120,000
1.2.2.3.2	96,000	4.90	772		22,875	821	63,750		880,000		514,700
1.2.2.3.5	18,400	1.00	152		0	0	0		100,000		70,500
CAPITAL EQUIP.	1,689				10,477	0	0	0	****	91,000	133,823
SUBT 1.2.2	159,689	7.70	1,206	378	33,923	257,765	741,250	0	3,445,000	7664034*	1,547,523
1.2.3.12.1	37,400	1.60	250		6,804	176,000			610,000		413,000
1.2.3.12.2	68,300	3.30	630		2,850	0	0		861,000		524,100
1.2.3.12.3	14,400	0.50	132		4,300	0	1,800		230,000		124,600
1.2.3.12.4	207,300	6.70	1,164		12,185	495,856	34,795		2,530,000		1,147,700
1.2.3.12.5	20,300	0.40	63		50	0	10,774		248,000		177,400
1.2.3.10.3.1	18,200	0.90	138		1,344	0	0		392,000		174,400
1.2.3.10.3.2	14,900	0.20	162		2	0	0		301,000		112,400
1st SUBT 1.2.3*	380,800	13.60	2,538	0	27,535	671,856	47,369	0	5,172,000	*	2,673,600
1.2.3.1	44,000	2.10	337		0	0	0		245,000		183,800
1.2.3.4.2	28,100	1.10	254		103	0	0		381,000		220,000
1.2.3.5.2.2	10,600	0.70	112		0	0	0		25,000		57,000
1.2.3.10.1	0	0.00	0		0	0	0		75,000		91,300
1.2.3.10.2	14,100	0.90	134		0	0	0		175,000		161,600
1.2.3.11.3	2,400	0.10	20		36,525	0	0		180,000		22,600
CAPITAL EQUIP.	0	0.00	0		16,650	0	0		****	15,000	0
2nd SUBT 1.2.3	99,200	4.90	857	0	53,278	0	0	0	1,081,000	1,116,109	736,300
1.2.5.1	7,400	0.30	48		0	0	0		150,000		88,200
1.2.5.2.2	22,100	0.70	105		0	0	0		240,000		240,300
1.2.5.3.4	23,400	1.60	250		4,652	0	0		342,000		180,300
1.2.5.3.5	3,700	0.20	36		0	0	0		50,000		29,500
1.2.5.4.2	81,500	4.40	736		598	0	0		660,000		404,700
1.2.5.5.2	600	0.00	0		0	0	0		20,000		6,900
CAPITAL EQUIP.	0				0	0		0	**	34,000	0
SUBT 1.2.5	138,700	7.20	1,175	0	5,250	0	0	0	1,462,000	1,294,237	949,900

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

PARTICIPANT: LLNL
DATE PREPARED 6/10/94
FISCAL MONTH/YEAR: MAY,1994

WBS ELEMENT	CURRENT MONTH END								FISCAL YEAR		
	ACTUAL COSTS	PARTICIPANT FTES	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS#	CAP EQPT ACCURAL	APPROVED BUDGET	CURRENT FY94 AFP	CUMULATIVE COSTS
1.2.9.1.2	45,100	2.00	309		382	0	0		621,000		406,900
1.2.9.2.2	61,200	5.00	778		765	0	49		601,000		461,800
SUBT 1.2.9	106,300	7.00	1,087	0	1,147	0	49	0	1,222,000	1,057,812	868,700
1.2.11.1	31,100	1.60	200		0	0	0		650,000		346,300
SUBT 1.2.11	31,100	1.60	200	0	0	0	0	0	650,000	609,812	346,300
										(FUNDED UNDER 1.2.16)	
1.2.12.2.2	11,600	0.40	59		0	0	0		116,000		66,200
1.2.12.2.3	9,700	0.20	34		97	0	0		134,000		88,000
SUBT 1.2.12	21,300	0.60	93	0	97	0	0		250,000	215,606	154,200
										(FUNDED UNDER 1.2.17)	
1.2.13.2.5	5,400	0.30	60		0	0	0		25,000		8,400
SUBT 1.2.13	5,400	0.30	60	0	0	0	0	0	25,000	18,750	8,400
1.2.15.2	26,400	2.60	401		99	0	0		290,000		146,500
1.2.15.3	7,600	0.10	24		0	0	0		92,000		51,200
SUBT 1.2.15	34,000	2.70	425	0	99	0	0	0	382,000	300,010	197,700
TOTAL LLNL	999,089	46	7,761	378	121,329	929,621	788,668	0	13,849,000	4,734,397	7,574,823

* This work was moved to WBS 1.2.3; however, funding for this work remains in Budget and Report Category DB010202 in the AFP.
**** Capital equipment budgets are included in the individual WBS Elements.
\# Per instructions letter dated 4/27/93 V.F. Iorii to W. L. Clarke

Issues and Concerns

WBS 1.2.3.12.5: The CSCR to provide $160k for DOE directed Man-Made Materials work in support of the August ESF Diesel vs. Electric decision was rejected by the Change Control Board Screening Group. An indication by YMSCO of how the funds will be provided to LLNL is needed.

TECHNICAL SUMMARY

1.2.1. SYSTEMS ENGINEERING

1.2.1.1 Systems Engineering Coordination and Planning

No significant activities.

1.2.1.5 Special Studies

Analysis of Thermo-Hydrological Conditions in the Repository

Degradation rates for aqueous corrosion of the WPs may be significantly enhanced if the WP environment is sufficiently hot and humid. A preliminary survey of aqueous corrosion indicates temperatures above 60°C and relative humidity (RH) above 70% may result in significantly enhanced degradation rates. It is important to recognize that with the use of large multiple purpose containers (MPCs), all thermal loading options are hot for some period of time. The critical question is whether the repository system can be managed such that repository conditions are hot and dry rather than hot and humid. For "hot and dry", issue is whether we can demonstrate (through *in situ* heater testing and bounding analyses) that hot and relatively dry conditions will prevail for some period of time in the vicinity of WPs. A related question is whether (with respect to WP corrosion) the WP environment becomes relatively cool before becoming relatively humid (or wet). The answer to this question must be addressed by both the near-field environment characterization studies and the WP material characterization studies which will determine the range of temperature and relative humidity conditions that result in significantly enhanced degradation rates for the WP materials under consideration. With the use of large MPCs, there are two boundary thermal strategies:

1) minimize how long a humid repository remains hot
2) maximize how long a hot repository remains relatively dry.

The goal of the first strategy is to minimize the negative consequences of a humid repository. The goal of the second strategy is to maximize the fraction of WPs that will remain relatively dry until they have become relatively cool. Both strategies aim to minimize the likelihood and duration of hot and humid WP conditions. A primary motivation for both strategies is to avoid the most corrosive WP conditions.

T. Buscheck continued to support the thermal loading systems study by re-examining the repository-scale model calculations for AMLs of 55.3, 70, 83.4, 110.5, and 150 MTU/acre with an emphasis on the temperature and relative humidity conditions at various locations in the repository. We assume a Youngest Fuel First SNF receipt scenario with a 10 yr cut-off for the youngest fuel [referred to as YFF(10)] and account for the emplacement of BWR waste packages containing 40 assemblies per WP, and PWR WPs containing 21 assemblies per WP. The waste receipt schedule was supplied by John King of the M&O.

Table 1 summarizes the duration of the boiling period at various repository locations and the relative humidity attained at the end of the boiling period for a bulk permeability, k_b,

of 280 millidarcy. These results are presented in order to improve the TSPA-93 analyses concerning the WP re-wetting time. For some of the TSPA-93 analyses, it was assumed that the WPs re-wet at the end of the boiling period. For point of comparison, the 55.3- and 110.5-MTU/acre cases (Table 1) are similar to the 57 and 114 kW/acre cases considered in TSPA-93. At the end of the boiling period for the 55.3-MTU/acre case, RH = 80.8% in the driest region of the repository (the inner half), while it never becomes drier than ambient conditions (98.4%) at the outer perimeter (outer 3%) of the repository. At the end of the boiling period, RH in the driest region of the repository (the inner half) is 81, 68, 57, 44, and 47%, for the five listed AMLs and 150 MTU/acre, respectively. For all repository locations, RH at the end of the boiling period decreases with increasing AML. For the inner half of the repository, this trend of decreasing temperature with increasing AML levels off at about 110.5 MTU/acre. For the outer edge of the repository, RH decreases with AML for the entire AML range considered. The importance of AML is illustrated by noting that the outer perimeter of the 150-MTU/acre repository is drier at the end of the boiling period than the driest region of the 55.3-MTU/acre repository.

Clearly, the end of the boiling period is not a consistent indication of how wet (or humid) WP conditions are. Some of the results and conclusions of TSPA-93 were undoubtedly affected by the assumption that WP conditions have become equally wet at the end of the boiling period. To further illustrate the shortcoming of assuming that re-wetting occurs at the end of the boiling period, it is useful to compare:

1) how long it takes the driest repository location to re-wet to RH = 81% (RH attained at the end of the boiling period in the 55.3-MTU/acre case) and
2) the temperature attained when RH = 81%.

For the five listed AMLs between 55.3 and 150 MTU/acre, re-wetting to RH = 81% requires 1760, 9820, 18,690, 29,000, and 36,150 yr, respectively. The corresponding temperatures for these cases is 96, 69, 57, 53, and 50°C, respectively. In comparing the two cases (55.3 and 110.5 MTU/acre) that roughly correspond to the 57 and 114 kW/acre cases in TSPA-93, we find that it requires 1760 and 29,000 yr for the inner half of the two repositories to re-wet to RH = 81%. Because the boiling period is 6130 yr for the 110.5-MTU/acre case, the assumption of equal "wetness" at the end of the boiling period is inconsistent with the observation that it requires an additional 22,870 yr (beyond the end of the boiling period) for the 110.5-MTU/acre case to attain the value of RH (80.8%) that was present in the 55.3-MTU/acre case at the end of its boiling period. Moreover, the 110.5-MTU/acre repository has a temperature of only 53°C when RH = 81% is attained (at 29,000 yr) as compared to 96°C for the 55.3-MTU/acre case (at 1760 yr). Therefore, the 110.5-MTU/acre case re-wets to relatively humid conditions at much lower temperatures (and much later times) than the 55.3-MTU/acre case.

For further illustration, the driest region (inner 50%) of the 110.5-MTU/acre repository has cooled to 68°C when RH = 70% is attained (at 15,960 yr). By the time the driest region (inner 50%) of the 55.3-MTU/acre repository has cooled to 68°C, (at 6180 yr) it has already re-wetted to RH = 97.8%. As far as aqueous corrosive processes are concerned, the 110.5-MTU/acre case is subjected to *far less* corrosive conditions than the 55.3-MTU/acre repository.

A "surprising" conclusion of TSPA-93 was "the insensitivity of total systems performance to AML," due to "advantages of high APD in delaying WP corrosion being offset by higher corrosion rates". Artificially assuming that equally humid (wet) conditions can be imposed onto the respective AML cases at the end of the boiling period has the effect of imposing very corrosive conditions onto the high-AML case which, as noted above, does not correspond to the repository-scale thermo-hydrological calculations.

An alternative TSPA-93 assumption for when WP conditions are "wet" is when the liquid saturation, S_l exceeds 8%. For the 110.5-MTU/acre case, this corresponds to a RH of approximately 41%, while RH for the 55.3-MTU/acre case never becomes drier than 66%. For the 24.2-MTU/acre case, which roughly corresponds to the low-AML case in the TSPA-93 study, RH is never less than 98.4%. This alternative TSPA-93 re-wetting assumption is effectively equivalent to saying that, for WP corrosion, there is no difference between 41 and 98% relative humidity.

Table 1 is based on the smeared-heat-source, repository-scale model. Consequently, the listed value of RH is applicable to average liquid saturation conditions. Because RH = 70% approximately corresponds to a liquid saturation 13%, it does not require very much re-wetting to attain this value of RH. Had a discrete representation of WPs been done, we would find that the local liquid saturation conditions surrounding the emplacement drift are generally drier than the average saturation conditions. In that regard, the repository-scale model indicates a RH that is wetter than the local value of RH in the emplacement drift. Thermo-hydrological heterogeneity and variability in the heat output among the WPs will also cause local behavior to deviate from average behavior.

Table 1
Duration of the boiling period at various repository locations and the relative humidity attained at the end of the boiling period for 22.5-yr-old Spent Nuclear Fuel , various Areal Mass Loadings and a bulk permeability of 280 millidarcy. The locations are identified as the percentage of the repository area enclosed, with 0 percent corresponding to the repository center and 100 percent corresponding to the outer perimeter.

Percentage of repository area enclosed (%)	Duration of the boiling period and relative humidity at the end of the boiling period for indicated AMLs									
	55.3 MTU/acre		70 MTU/acre		83.4 MTU/acre		110.5 MTU/acre		150 MTU/acre	
50	1760 yr	80.8%	2830 yr	68.1%	3870 yr	57.2%	6130 yr	44.3%	9590 yr	46.8%
75	1160 yr	83.7%	2000 yr	70.5%	2740 yr	65.2%	4290 yr	51.4%	7210 yr	45.1%
90	440 yr	92.7%	1090 yr	81.0%	1700 yr	76.6%	2870 yr	67.6%	5010 yr	54.1%
97	80 yr	98.5%	410 yr	95.5%	990 yr	92.5%	2150 yr	86.6%	3960 yr	66.8%

1.2.1.6 Configuration Management

No significant activity.

1.2.2. WASTE PACKAGE

1.2.2.1 Waste Package Coordination and Planning

An FY95 LLNL Metal Barriers Planning Meeting was held in Livermore on May 10, 11, and 12. W. Clarke chaired the meeting. Other LLNL staff members in attendance were J. Blink, T. Buscheck, D. Chesnut, E. Dalder, J. Farmer, J. Gansemer, B. Glass, W. Glassley, G. Gdowski, W. Halsey, R. Hamati, G. Henshall, D. Jones, G. Kaiper, A. Lamont, D. McCright, R. Monks, B. O'Connell, J. Podobnik, M. Revelli, R. Stout, R. Van Konynenburg, D. Wilder, K. Wilfinger, M. Whitbeck, B. Bryan, and M. Lewis. Other participants in the meeting were A. Simmons, D. Stucker (DOE); H. Benton, W. Cowles, L. Ramspott, R. Fish, K. McCoy, A. Roy, D. Stahl (M&O); D. Bullen (Iowa State); H. Cleary (Weston); D. Diercks, J. Park (ANL); and C. DiBella (NWTRB).

J. Blink presented "On the Benefits of an Integrated Nuclear Complex for Nevada" at the International High-Level Radioactive Waste Management Conference on May 23 in Las Vegas. Over 100 people were in the audience, and a lively discussion followed the presentation. The paper was highlighted in both Las Vegas newspapers, and several Nevada political figures and candidates have asked for a copy.

1.2.2.2 Waste Package Environment

This work is now being reported in WBS 1.2.3.12.

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

There has been a suspension of radiological work in Pacific Northwest Laboratories (PNL) Bldg. 325. Work conducted by the YMP was not a contributory element in the closure of this facility; however, this action has had a major impact on our work schedule. Formal documentation of the justification for closure of the building has been requested; it will be provided to LLNL and placed in the YMP records. At this time, there is no projected date for re-opening the facility, therefore, overall impact on the YMP cannot be determined. More information should become available in June.

Spent Fuel Dissolution

There are no activities to report for the month of May due to the total shutdown of all radiological work in Pacific Northwest Laboratories (PNL) Bldg. 325 for a safety assessment. This shutdown will further delay installation of the new liquid

radioactive waste disposal holding tank for the analytical hot cells that has been discussed in previous reports.

W. Gray (PNL) presented a paper entitled "Interlaboratory Comparison of UO_2 Dissolution Rates" at the Fifth Annual International High-Level Radioactive Waste Management Conference in Las Vegas.

D-20-43, Unsaturated Dissolution Tests with Spent Fuel and UO_2

Spent Fuel

Tests are in progress at ANL to evaluate the long-term performance of spent fuel under unsaturated conditions at 90°C in a potential repository. These tests examine the leach and/or dissolution behavior of two types of well-characterized irradiated fuels, ATM-103 and ATM-106 (both PWR) in three types of tests: two with saturated water vapor atmospheres; two with a drip rate of 0.075 mL/3.5 d; and two with a ten times higher drip rate of 0.75 mL/3.5 d. A control test without fuel but with a 0.075 mL/3.5d drip rate is also included. EJ-13 water for the tests came from well J-13 and was initially equilibrated with volcanic tuff for approximately 80 days at 90°C. The seven tests have undergone ~20 months of testing at 90°C.

Aliquots of the leachate removed in April from the high drip rate tests were filtered sequentially through several filters (1, 0.1, and 0.05 μm) to determine the distribution of the colloidal material. The filters were submitted for alpha analyses. The sequential filtered samples were submitted for alpha, gamma, and cation analysis.

The data for cesium and the actinides for the first two test periods (four and five months) for the high drip-rate tests are compared to the results reported by C. Wilson for saturated tests in Tables 2 and 3, for unprecipitated fraction and maximum fraction, respectively. The unprecipitated fraction is defined for each isotope as the sum of ionic and colloidal species in the leachate. The maximum fraction is defined for each isotope as the fraction that the total amount released is of the original amount in the fuel. The total test time for Wilson was 18 months, versus 9 months for the unsaturated tests. The temperatures are comparable. The ratio of fuel weight to total volume of fluid in contact with the fuel is slightly greater for the unsaturated tests.

The major differences in the two sets of tests are these: First, a much larger fraction of the material was unprecipitated in the unsaturated tests. The one exception is cesium in the ATM-106 test. The low cesium solubility may indicate formation of a cesium uranate phase since formation of an insoluble cesium uranate phase has been noted previously.[1] Second, the maximum fraction of material released for the unsaturated tests is approximately an order of magnitude less for, uranium, plutonium, and cesium than that released in the saturated tests. However, the maximum fraction of americium and curium released in the unsaturated tests is

about an order of magnitude greater than that in the saturated tests. The reason for these differences in release behavior appears to be linked to the higher unprecipitated fraction in the unsaturated tests. For longer test periods, these differences may not be observed.

$\underline{UO_2}$

The objective of the tests at ANL is to evaluate the reaction of UO_2 pellets after exposure to dripping EJ-13 water at 90°C using the unsaturated test method. More specifically, these tests are designed to examine the dissolution behavior of UO_2, formation of alteration phases, release rates, and mechanisms of uranium release, and to serve as a pilot study for similar tests with spent nuclear fuel.

A Preparedness Review was held on May 12 in order to convert the experiments to Quality Affecting Activity Status. As a result of that meeting, the scientific notebook and sampling procedures used for the UO_2 tests were revised, and the final Preparedness Review was completed May 31.

Solution analytical results were received from the nine-year UO_2 drip test samples supported by Teflon stands. Uranium release rates were comparable to previous runs, with the samples releasing relatively low amounts of uranium over the last seven years, this following the rapid uranium release period that characterized the release patterns between one and two years. Fractional uranium release trends have also been examined for a limited number of samples. Uranium release was measured from three solution aliquots, including a <50Å, an unfiltered suspended solution, and an acid strip fraction. The acid strip component was derived from a 10-minute HNO_3 soak of the test vessel and Teflon stand, and represents the largest recovered uranium fraction from the test (80 to 98%). The <50Å component is typically the smallest fraction, representing from 1 to 6% of the total release. The suspended fraction represents all uranium suspended in solution, less the fraction passing through the 50Å filter. The suspended fraction represents from 1 to 15% of the total release, with the relatively high variability probably resulting from the resuspension of particulate material during the vessel opening and sampling processes.

Cation analyses indicate continued depletion of alkali, alkaline earths, and silicon from the EJ-13 solution after contacting the UO_2 pellets. Previous scanning electron microscope/energy dispersive spectroscopy (SEM/EDS) investigations have revealed that these elements are being incorporated into secondary uranyl phases on the sample surfaces, with the uranium being derived from the dissolution of the UO_2

[1] S. Stroes-Gascoyne, L.H. Johnson, P.A. Beeley, and D.M. Sellinger, "Dissolution of Used CANDU Fuel at Various Temperatures and Redox Conditions", Mater. Res. Soc. Symp. Proc. 50, 317-326 (1986).

pellets. Magnesium is generally depleted to the greatest extent, with leachate concentrations typically reduced to ~10% of the initial EJ-13 value. Calcium and potassium are generally depleted to ~30% of the original EJ-13 values, while Si is depleted to a level that is within 50 to 60% of the original EJ-13 value. Sodium concentrations are similar to those of the starting EJ-13 solution, a finding consistent with that of the absence of any discrete sodium uranyl phases on the UO_2 pellet surfaces.

Table 2. Unsaturated (High Drip Rate, 9 months, 90°C) versus Saturated (18 months, 85°C) Test Results
Average Unprecipitated Fraction (%), the sum of the ionic and colloidal species in the leachate

	U	Pu	Am	Cm	Cs
ATM-103[a]	50	40	50	70	98
ATM-106[a]	20	50	10	30	60
Wilson[b]	10	5	3	3	85

[a] This is the total for the first two test periods
[b] C.N. Wilson, PNL-7170 (1990), using bare fuel for three test periods at 85°C.

Table 3. Unsaturated (High Drip Rate, 9 months, 90°C) versus Saturated (18 months, 85°C) Test Results
Maximum Fraction (ppm), the fraction released from the original fuel inventory

	U	Pu	Am	Cm	Cs
ATM-103 (total)[a]	10	1	600	7000	600
ATM-106 (total)[a]	50	30	90	200	1000
Wilson[b]	100	100	200	40	10,000

[a] This is the total for the first two test periods
[b] C.N. Wilson, PNL-7170 (1990) 1 using bare fuel for three test periods at 85°C.

D-20-53(a), Dissolution Tests with UO_2

Approximately 20 grams of Schoepite ($UO_3 \cdot H_2O$) were prepared at LLNL via an aqueous hydrolysis of uranyl acetate, $UO_2(C_2H_3O_2)_2$, a procedure that took place over several days. This material is being analyzed and will be used in the studies just begun on the dissolution of the higher uranium oxides, UO_3 and UO_8. The initial four Schoepite dissolution experiments in the current test matrix that were begun last month are continuing. All four experiments are at room temperature and 20% oxygen. They consist of the four combinations of pH 8 and 10 as well as total carbonate concentrations of $2x10^{-4}$ and $2x10^{-2}$ mol/L. These same

experiments will later be run at 75°C. Some flow problems were experienced and corrected. Very preliminary measurements that indicate uranium dissolution rates of the Schoepite at room temperature are similar to UO_2.

Spent Fuel Oxidation

Dry Bath Testing

The drybaths continue to operate without incident. An interim examination will be conducted for the 195°C and 255°C tests early in June. Work on the phase determinations has slowed considerably as the X-ray diffraction lab was closed with the general shutdown of Bldg. 325.

Thermogravimetric Apparatus (TGA)

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

Materials Characterization Center (MCC) Hot Cell Activities

S. Marschman (PNL) presented a paper entitled "Rationale for Determining Spent Fuel Acquisitions for Repository Testing" at the International High-Level Radioactive Waste Management Conference in Las Vegas.

1.2.2.3.1.2 Waste Form Testing - Glass

The preparedness review was completed at ANL for the Unsaturated Testing of UO_2, and the QA grading and supporting documentation were sent to LLNL. J. Bates and P. Finn (ANL) attended the International High-Level Radioactive Waste Management Conference and presented papers on spent fuel and glass performance under unsaturated conditions.

D-20-27, Unsaturated Testing of WVDP and DWPF Glass

The N2 dissolution tests (DWPF actinide-doped glass previously described as SRL glass) continue at ANL as scheduled. The tests have been ongoing for 100 months. Data from the December sampling have been compiled and were presented in part at the IHLRWM conference. Preliminary release data for Li and Si can be used to project the rate of glass reaction and the mode by which radionuclides are released from the glass. The last solution sampling period (411.5 weeks total) shows a fairly steady Li release rate increase if the data are averaged. The normalized release rate over the 411.5 week period for Li is -2.6 $mg/m^2 \cdot day$, while over the last sampling period the rate was 3.6 $mg/m^2 \cdot day$.

Silicon release is negative (Si was being removed from the solution) for the first 210 weeks. While there is divergence in the replicate tests, the overall trend is a slowing of the rate at which Si is being depleted from the solution. Based on the analysis of material in solution, this is due to an increase in Si going into solution due to spallation from the glass.

In Test N2#10, the Np release rate was quite constant for the first 160 weeks at 0.8 $mg/m^2 \cdot day$ and then increased to ~5 $mg/m^2 \cdot day$ between 160 and 411 weeks. The analogous Pu releases are 8 and 30 $\mu g/m^2$ day. The increase in actinide release rate is consistent with the Si release trend and spallation of reacted layer from the glass. These rates provide a lower limit for release from SRL-based glasses since the SRL 165 glass used in the N2 tests is the most durable glass SRL has developed, and is more durable than the current reference glass.

Preparation for the next 6 month sampling period for these tests has been initiated, and the sampling is scheduled for June. The solution saved from the last sampling period, which contains colloidal material, will be saved in the event that the investigation of colloids is pursued.

The N3 (West Valley ATM-10 glass) tests continue at ANL as scheduled, having completed about 77 months of testing. We are proceeding with the analysis of the cation and actinide solution data from the N3 tests. These data have been collected periodically since testing began in 1987 and stored in the records file, but have not been fully analyzed or comprehensively presented.

Results for the actinides (Np, Pu, and Am) through 345 weeks have been analyzed. These data have been obtained by alpha spectroscopy. Cation results (ICP-MS or CP-AES) for Li and Si have been analyzed and corrected for the contribution from the EJ-13 water, and thus represent release from the sample. In the case of Si, an uptake of Si from the water to be incorporated into secondary phases is observed. Release rate data will be calculated and reported next month.

D-20-70, Parametric Studies of WVDP and DWPF Glass

Sixteen parametric dissolution tests of DWPF and WVDP glass continue at ANL. Some have been in progress for up to 8 years. No sampling has been done in several years, and the solution injections continue. Based on calculations of the free volume in the test vessel, it appears that sampling of these tests will be required shortly or the water will directly contact the glass as it collects in the test vessel. The samplings will be done in June.

Tests on a variety of glasses exposed to 60 and 95% relative humidity at 70°C continue at ANL. No test terminations have been done for several years and none are planned for this year.

1.2.2.3.2 Metal Barriers

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission. A three day planning meeting for this WBS element is discussed in Section 1.2.2.1.

The report entitled "Survey of the Degradation Modes of Candidate Materials for High-Level Radioactive Waste Disposal Containers - Iron Base, Corrosion-Allowance Materials" is undergoing concurrent reviews at LLNL and YMSCO. This report is a collaborative activity between the LLNL Engineered Barrier System Staff and the Nuclear Engineering Staff at Iowa State University and represents completion of milestone MOL46.

1.2.2.3.3 Other Materials

This WBS element has not been funded in FY94.

1.2.2.3.4 Integrated Testing

This WBS element has been moved to WBS element 1.2.3.10.3; progress is reported in that element.

WBS 1.2.2.3.5 Non-Metallic Barrier Concepts

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission. A three day planning meeting for this WBS element is discussed in Section 1.2.2.1.

1.2.2.4 Design, Fabrication, and Prototype Testing

1.2.2.4.3 Container/Waste Package Interface Analysis

This WBS element has not been funded in FY94.

1.2.3 SITE INVESTIGATIONS

1.2.3.1 Site Investigations Coordination and Planning

LLNL staff participated in planning for the Planned Program Approach re-baseline.

D. Wilder and D. Chesnut attended a YMSCO International Program Meeting held in Las Vegas on May 9.

J. Blink met with C. Johnson of the M&O on May 3 in Las Vegas to discuss LLNL's efforts on another program to develop software that couples geologic databases to simulation codes. It may be possible to share the cost of developing the software

with the LLNL environmental remediation program and to customize the software for YMP needs.

1.2.3.2 Geology

1.2.3.2.1.2.1 Natural Analogue of Hydrothermal Systems in Tuff

This WBS element has not been funded in FY94. Funding has been requested from the YMSCO WBS manager in order to write the Study Plan.

1.2.3.4 Geochemistry

1.2.3.4.2 Geochemical Modeling

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.3.5 Drilling

1.2.3.5.2.2 Engineering, Design, and Drilling Support

Eight logging sessions to monitor water level were conducted at UZ14 during the month of May. The runs were conducted on May 2, 4, 5, 6, 10, 11, 12, and 23.

On May 25, the 100' reference marks were re-established on truck #83361, SELSYN #SSN-1, per LLNL-YMP Technical Implementation Procedure (TIP-NV-01).

1.2.3.10 Altered Zone Characterization

1.2.3.10.1 Characterization Techniques for the Altered Zone

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.3.10.2 Characterization of Thermal Effects on the Altered Zone Performance

The study plan for this WBS is being written.

1.2.3.10.3 Integrated Testing

1.2.3.10.3.1 Integrated Radionuclide Release: Tests and Models

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.3.10.3.2 Thermodynamic Data Determination

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.3.11 Integrated Geophysical Testing for Site Characterization

1.2.3.11.3 Geophysics - ESF Support, Subsurface Geophysical Testing

The LLNL/LANL Geotechnical Engineering Group took delivery of the ENVIROLOG-4 Logging Winch manufactured by AUSLOG and purchased through Weber International on May 31. The ENVIROLOG-4 includes a depth system, housing, 100 m 4-conductor cable, cable head, winch, 12 VDC motor drive, speed control, tripod, operational software, and downhole electronics. A preliminary performance test was conducted on the winch unit on May 31. A final performance test will be conducted after delivery of the color video tool, four arm caliper and neutron tool.

1.2.3.12 Waste Package Environment Testing

This WBS element was created from WBS element 1.2.2.2. Management, reporting and PACS are using the new WBS structure, but funding will apparently remain within the old WBS structure for the remainder of FY94.

1.2.3.12.1 Chemical and Mineralogical Properties of the Waste Package Environment

The revised Study Plan 8.3.4.3.4.1 for Waste Package Geochemistry and Mineralogy that was sent to YMSCO is being reformatted to meet current format guidelines specified in the NRC-DOE Agreement. Other May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.3.12.2 Hydrologic Properties of the Waste Package Environment

Analysis of Temperature and Relative Humidity Conditions in the Repository

A primary concern for the Near-Field/Altered Zone Hydrology Tasks is how water contacts a waste package (WP), thereby affecting its integrity and, if containment is breached, radionuclide dissolution and transport. There are two primary modes of water contact:

1) advective liquid flow, particularly as it occurs in fractures, and
2) condensation of water vapor on the WP surface.

For the first water contact mode, *liquid-phase advective flow in fractures*, the primary sources are:

1) episodic infiltration of meteoric water and
2) repository-heat-driven condensate drainage due to:
   a) boiling conditions,
   b) mountain-scale, buoyant vapor flow,
   c) sub-repository-scale, buoyant vapor flow, and
   d) focused vapor flow and condensate drainage due to heterogeneity.

The last three sources of condensate can occur under either sub-boiling or boiling conditions.

For the second water contact mode, condensation on WP surfaces, the critical concerns are the relative humidity and temperature on the WP surfaces. Ambient conditions are quite humid, with a relative humidity of 98-99%. There are two ways to reduce the relative humidity on the WP surfaces:

1) driving a large fraction of the initial water content from the vicinity of the repository, and
2) maintaining a moderate temperature gradient in the vicinity of the WP.

The primary means of reducing the water content near the repository are:

1) repository-heat-generated boiling conditions, and
2) ventilation.

As reported last month, a large reduction in the initial water content is required to significantly reduce the relative humidity, RH. For example, an 80% reduction in liquid saturation is required to reduce RH to less than 70%. An Areal Mass Load (AML, expressed in MTU/acre) that does not drive repository temperatures well above the boiling point will result in only a small reduction in RH (see Table 4).

Table 4. Minimum relative humidity and peak temperature as a function of areal mass loading.

AML (MTU/acre)	T_{peak} (°C)	RH min(%)
55	109	66
70	128	36
83	146	22
110.5	187	8
150	250	2.5

The relative humidity calculations are based on the smeared-heat-source, disk-shaped model of the repository. Therefore, the relative humidity is based on averaged liquid saturation. Because it is more likely that saturation conditions will be drier in the immediate vicinity of WPs than at more distant locations (such as the centerline of the pillars separating emplacement drifts), relative humidity values based on average liquid saturation conditions will tend to indicate values that are wetter than conditions in the emplacement drifts. As reported last month, when the WP is hotter than the emplacement drift wall, the relative humidity on the WP

surface will be lower than on the drift wall. Because of its relatively low thermal conductivity, a granular backfill in the drift could result in a substantial, persistent temperature drop between the WP and drift wall.

See Section 1.2.1.5 for further discussion of thermal loading strategies and their implications.

Laboratory Experiments

LLNL continues to measure electrical impedance as a function of moisture content of Topopah Spring tuff samples from the G-4 and GU-3 holes at elevated temperatures using J-13 water as pore fluid. The wetting phase measurements at 95°C using the original set of samples were completed, and the data are being analyzed. Many samples broke during the measuring process. Additional samples are being prepared to complete the measurements at 95°C. Analysis of the existing data indicates that the frequency dependent measurements may be useful in describing the manner in which water wets rock. Several conduction mechanisms are observed that change in importance with changing saturation levels. Additional study is underway to determine the nature of each conduction mechanism. A paper describing this work, entitled "Electrical Properties of Topopah Spring Tuff as a Function of Saturation", by J.J. Roberts and W. Lin, was presented in a poster session during the High Level Radioactive Waste Management Conference. Successful completion of this work will simplify the task of measuring water distribution in thermal hydrological experiments at laboratory and field scales.

For the experiment of determining the moisture retention curve and one-dimensional imbibition using G-4 core, we continued the moisture retention experiments at high temperatures. Measurements at 95°C and about 95% relative humidity continued. There are still problems associate with the humidity sensor, and we are looking into potential solutions.

LLNL continued the experiment to determine the effect of confining pressure on fracture healing, as observed previously by Lin and Daily. A fractured Topopah Spring tuff sample from G-4 hole is being used. The sample is kept at a confining pressure of 1 MPa and a pore pressure of 0.5 MPa. Permeability as a function of effective pressure (confining pressure - pore pressure) at room temperature has been determined. Permeability as a function of temperature, at a confining pressure of 1 MPa and pore pressure of 0.5 MPa, is being determined. We have completed the measurements at temperatures to 150°C and back down to 125°C. The water permeability at 125°C after been heated to 150°C is about 30% lower than that measured at the initial 125°C. So far, the total decrease in permeability is about 40%. No drastic fracture healing has been observed. We will test the effect of flowing steam through the sample at 125°C on the permeability. Then the temperature will be decreased to the room temperature.

The calibration of a resonant cavity for measuring suction potential as a function of moisture content in rock samples and in the field continues. A LabView driver for the network analyzer has been installed and tested. This allows the computerized collection

of resonant spectra. Five cavities have been tested at room temperature and humidity conditions.

The evaluation of x-ray scan as a technique of monitoring moisture content distribution in a rock sample continues. Analysis of the preliminary x-ray scans indicates that using KI doped J-13 water as the saturating fluid can improve the resolution in the water saturation level to about 2.2%. Without doped water, the resolution decreases to about 4.4%.

Meetings and Publications

J. Blink and T. Buscheck had discussions with UNLV Prof. J. Cardle. Collaboration between LLNL and UNLV was discussed. UNLV will provide a student to assist LLNL in applications of the V-TOUGH code family for YMP studies. A contract for the remainder of FY94 is being initiated. It is anticipated that the student will be supported for several years, including a YMP-related thesis. Prof. Cardle will also provide support.

T. Buscheck presented a paper entitled "The Impact of Repository Heat on Thermo-Hydrological Performance at Yucca Mountain" on May 3 at the Thermal Loading Studies Meeting held at YMSCO and attended the Scenario A Focused ACD Assumptions Meeting held on May 4. The paper provides insight for identification of critically needed site characterization data for long term thermo-hydrological performance calculations.

T. Buscheck presented two papers at the Fifth Annual International High-Level Radioactive Waste Management Conference in Las Vegas, May 22-26, "Evaluation of Thermo-Hydrological Performance in Support of the Thermal Loading Systems Study" and "The Impact of Buoyant Gas-Phase Flow and Heterogeneity on Thermo-Hydrological Behavior at Yucca Mountain". The first report meets a milestone requirement for the thermal loading systems study and both reports provide input for the FY93 Thermal Loading Systems Study final report which has been submitted to YMSCO and is currently in review.

Several LLNL staff members attended the Peer Review Planning meeting in Las Vegas on May 27. The peer review of unsaturated zone thermal hydrology calculations requested by LLNL was delayed until after an internal YMSCO group meets to define the scope of the review. D. Chesnut was appointed as the LLNL member of the group.

1.2.3.12.3 Mechanical Attributes of the Waste Package Environment

The Activity Plan AP-GM-01, GM-03, GM-05 (8.3.4.2.4.3 - Mechanical Attributes of the Waste Package Environment) has been issued. This represents completion of milestone MOL16.

1.2.3.12.4 Engineered Barrier System (EBS) Field Tests

Revision of the draft Engineered Barrier System Field Tests (EBSFT) Study Plan was started, as a result of the comment resolution meeting (see Section 1.2.5.2.2).

J. Blink, T. Buscheck, W. Clarke, W. Halsey, W. Lin, And D. Wilder met with N. Elkins (LANL) and L. Costin (SNL) on May 25, 1994 to discuss the Phase 1 EBSFT at the North Ramp Extension.

Large Block Test (LBT)

Sample preparation for electrical impedance measurements, Hg porosimetry, and wet-dry porosity measurements using the core sections from the LBT vertical instrument holes was started. Some preliminary Hg porosimetry results indicate that the porosity in the matrix increases from about 9% near the top of the block to about 13% at about 4 m depth.

J. Blink met with senior management of the LLNL Mechanical Engineering Department on May 11 to discuss the LBT load frame design. The meeting concluded with a plan to perform 3-D structural mechanics analyses to determine in more detail the stresses in the frame due to the loads being applied to the block. Following the calculations, which are expected to be completed by mid-June, LLNL will determine and document the appropriate safety factor to be used in operating the system. Because the frame fabrication is nearly complete (delivery is scheduled for late July), modifications to increase the allowable load are expected to be made at NTS or at the DOE-Atlas Facility in North Las Vegas.

The Large Block Test excavation work started at the beginning of May and continues. A wire saw was used to trim the top of the block. The entire sawing activity took two days. The original top of the block was successfully lifted off as a single piece and provided to RSN for use at the Colorado School of Mines. A preliminary fracture mapping was conducted on the exposed top surface of the block. SNL completed two more (total) fracture flow visualization tests.

Laboratory tests on the performance of the Kapton heaters (to be used as guard heaters for the large block and as heaters for the small block experiments) and the potential insulation materials under a 5 MPa stress continues. Copper plates may be used to distribute heat from the guard heaters. Tests to evaluate the lateral temperature distribution on the surface of a copper plate opposite to the heater, was continued. Thermal conduction model calculations continue to be used in designing the guard heaters.

Procurement of instruments has started. A potential manufacturer for the bladders has been selected. A meeting will be scheduled with the representative of the manufacturer to discuss detailed design criteria for the bladders. The engineering design of the bladder support/housing devices continues.

Preparation of small blocks, obtained from Fran Ridge, for scoping experiments was continued. A block assembly is ready for x-ray background measurements.

A paper entitled "The Testing of Thermal-Mechanical-Hydrological-Chemical Processes Using a Large Block", by W. Lin, D. G. Wilder, J. A. Blink, S. C. Blair, T. A. Buscheck, D. A. Chesnut, W. E. Glassley, K. Lee, And J. J. Roberts, was presented at the High Level Radioactive Waste Management Conference. This paper describes plans for the LBT and construction through December 1993.

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

New Zealand

The contract with Dr. R. Rogers, (Biodegradation Systems, Inc.) for sampling and preliminary analyses of cores obtained from cement exposed to geothermal conditions, which is essential to our determination of pH values of water in contact with cementitious materials, has now been finalized by LLNL procurement. However, because the contract involves two sampling trips to New Zealand, foreign travel approval must be obtained through DOE. We are presently completing the paper work for that approval.

Seven months of temperature data have been logged at three locations within the cooling tower near the locations of the emplaced concrete samples. The data are being transmitted every three months to LLNL.

Diesel Fuel Stability Experiments

The 200°C H_2O-fibercrete™ control experiment has been completed and the experiment disassembled. The 200°C H_2O-diesel fuel-fibercrete™ experiments are presently being conducted. In June, the 200°C H_2O-diesel fuel-fibercrete™-tuff experiment will be set up, tested and initiated. The results of the experiments to date are presently being prepared to be released as a report at the end of June.

Diesel Exhaust Historical Analog Study

This study has been initiated at the request of the M&O and YMSCO. A CSCR to provide 160K for this work was initiated by the M&O-ESF, but rejected by the M&O CCB group. Until that money is received at LLNL, the Man-Made Materials spending will appear to be in variance. The Man-Made materials Task is conducting this study now in order to support an ESF decision that must be made in August. Additional guidance is needed from YMSCO as to the status of the fund transfer.

Sample locations in N-tunnel were selected for their potential to show the greatest accumulated diesel deposits. The sites were selected as a result of an earlier reconnaisance survey and from discussions with miners regarding diesel powered haulage systems and the timing of tunnel modifications. The rock wall near the floor and from the floor adjacent to the left rib at 1900 ft. into N-tunnel displays a clay-rich deposit

that appears to have a component of soot. A number of factors lead us to believe that this deposit may contain accumulations from diesel exhaust. First, this location is well into the tunnel and therefore had less chance to ventilate than areas closer to the tunnel entrance. Second, the engines supposedly stopped at this point for loading and unloading. Third, the early hauling systems were not scrubbed and were exhausted low and to the left. Later mucking operations have removed the contaminated ground from the middle of the tunnel floor and replaced it with a thick layer of gravel. Near the wall, however, we hope to have obtained floor samples from the original 1963 tunnel that were later contaminated by the exhaust scrubbing solution (Tide™).

The pipes and cables on the left side of the tunnel, and the lack of electricity and ventilation made the collection activity a challenge. Because of the limitations of the drill, we were only able to obtain two core samples. Due to the scarcity of core samples we have very limited expectations for our ability to provide what we consider to be a key piece of information: the mobility of the various diesel exhaust constituents from the surface of the tunnel into the tuff. Data regarding the mobility of diesel fuel in soils (see Table 5) suggests that the diesel constituents will move at different rates. However, we may not be able to quantify or verify this, given the few samples. Additional sampling and testing will be done at a later date in support of Study 8.3.4.2.4.5.

Table 5. Mobility of Distillate Oil Constituents. (From Hydrocarbon Contaminated Soils. Volume 1. E. J. Calabrese P. T. Kostecki eds. (1991) p.171).

Chemical	*Solubility(mg/L)*	*Retardation (R_d[a] Coefficient*
Low Mobility (R_d >100)		
Fluorene	1.9	-
Phenanthene	1.6	1,097
Pyrene	0.16	-
Benzanthracene	0.0057	24,601
Benzo(a)pyrene	0.0030	67,801
Fluoranthene	0.265	-
Medium Mobility (10<R_d<100)		
Napthalene	31	87.94
Dimethylbenzene, 1,3-(m-xylene)	160	60.91
Dimethylbenzene, 1,4-(p-xylene)	200	54.39
Dimethylbenzene, 1,2-(o-xylene)	180	23.26
Ethylbenzene	150	53.92
Toluene	520	30.40
High Mobility (R_d<10)		
Benzene	1,800	8.80
Quinoline	60,000	5.16
Cresol (m-)	26,000	4.78
Cresol (p-)	25,000	4.21
Cresol (o-)	26,000	2.32
Phenol	67,000	2.09

[a]The retardation coefficient represents the rate of migration of the chemical constituent in comparison to that of ground water (e.g. R_d = 100 indicates that the constituent moves 100 times slower than water. The following values were used to determine R_d: foc = 0.01, porosity = 0.35, bulk density = 0.2 g/cm^3.

Our expectations for the samples of the surface coatings are much higher. An excellent suite of samples were collected using a range of substrates that will allow us to use the variety of analytical tools required to identify and quantify the organic and inorganic compounds that are expected to be present. The samples have arrived at Livermore and are presently being prepared for analysis. We would like to thank Alan Mitchell and Kevin Kinter of LANL, and Mark Owens of LLNL for their assistance during this sampling operation.

Diesel Exhaust EQ3/6 Modeling Exercise

EQ3/6 simulations are presently in preparation for the diesel exhaust work. The first modeling simulations are being prepared using simple organic-H_2O systems that will ultimately be used to evaluate the exhaust component modeling exercise.

Diesel Exhaust Microbial Study

This study was initiated independently by the Man-Made Materials Task to add value to the Diesel Exhaust Studies described above. The intention is to provide a more complete answer to the long term impact of diesel exhaust than the non-biological chemical study that was requested by the M&O.

1.2.5 REGULATORY

1.2.5.1 Regulatory Coordination and Planning

LLNL staff participated in planning for the Planned Program Approach re-baseline.

1.2.5.2 Licensing

1.2.5.2.2 Site Characterization Program

W. Lin briefed an NRC tour at the Large Block Test site on May 3.

W. Lin, J. Blink and C. Passos attended a comment resolution meeting on Study Plan 8.3.4.2.4.4 in Las Vegas on May 5. Other LLNL technical staff participated by conference call.

J. Blink and C. Passos began the process of re-working LLNL's input to Progress Report #10 based on criteria changes initiated by YMSCO and the M&O.

1.2.5.3 Technical Data Management

1.2.5.3.4 Geologic and Engineering Materials Bibliography of Chemical Species (GEMBOCHS)

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.5.3.5 Technical Data Base Input

B. Bryan attended the Technical Data Working Group meeting in Las Vegas on March 23.

1.2.5.4 Performance Assessment

1.2.5.4.2 Waste Package Performance Assessment

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.5.5. Special Projects

1.2.5.5.1 Integrated Test Evaluation (ITE)

This activity has not been funded in FY94.

1.2.5.5.2 Energy Policy Act Support

May activities will be reported in a later monthly progress report. The LLNL staff has been occupied with participation in the Planned Program Approach and in preparing input for the FY95-01 PACS submission.

1.2.9 PROJECT MANAGEMENT

1.2.9.1 Management and Coordination

1.2.9.1.2 Technical Project Office Management

D. Wilder, T. Buscheck, D. McCright, B. Halsey, and W. Clarke attended a Thermal Workshop and Key Assumptions meeting held by D. Stucker on May 3 and 4. J. Blink attended the M&O Thermal Loading Workshop on May 5.

An "All Hands" meeting for LLNL-YMP staff members was held by W. Clarke to discuss new direction brought about by the "Planned Program Approach".

J. Blink trained new LESSON Chemistry Instructors on May 2. J. Blink and C. Passos attended the LESSON-Nevada Committee meeting on May 13 in Las Vegas. J. Blink served as tour guide for the LESSON teacher workshop tour of the Weapons and YMP portions of the Nevada Test Site on Saturday, May 21. J. Blink (LLNL) and J. Calovini (RSN) taught the first day of Physics for the 1994 Nye/Esmeralda County LESSON workshop at NTS on May 31. J. Blink conducted a four hour teacher workshop at the Yucca Mountain Science Center on Saturday, May 7; seven teachers (grades 2-6) attended. J. Blink made an educational presentation at the UNR Math Institute on May 19 in Reno, Nevada. He also met with UNR faculty members interested in the LESSON teacher workshop. J. Blink and the two Tonopah winners of the YMP Egg Drop Contest participated in the Jim Butler Days Parade in Tonopah, Nevada on Saturday, May 28.

J. Blink visited the labs of Prof. R. Boehm at UNLV where bench scale thermal hydrological experiments are being conducted. Future collaboration between LLNL and UNLV was discussed.

1.2.9.2 Project Control

1.2.9.2.2 Participant Project Control

Actual schedule progress and costs were submitted to the PACS reporting system via the PACS workstation. Variance analysis explanations were developed.

1.2.11 QUALITY ASSURANCE

Quality Assurance Coordination and Planning

The YMP-QA Quality Procedures (QP) are being reviewed and edited to incorporate text and procedural changes required by QARD review. Royce Monks will travel to Las Vegas during the week of June 6 to discuss changes made thus far with YMSCO personnel.

Quality Assurance Program Development

The following change notices were distributed:

- Activity Plan E-20-18(f), Rev. 1 (D. McCright) has been completed and distributed.
- Activity Plan AP-GM-01, GM-03, GM-05 (S. Blair) has been completed and distributed.
- Addendum A to Activity Plan AP-LBT-01 (W. Lin) was issued as Change Notice AP-LBT-01-0-2.

Quality Assurance Verification

Quality Assurance Verification - Audits

Audit report 94-04 was completed and distributed on May 5, 1994.

Notification of Audit 94-05 was distributed on April 26, and an entrance meeting was conducted on May 2. This audit concentrated on LLNL-YMP Near Field Environment Characterization and included the following procedures/requirements:

- 033-YMP-QP 2.6, Readiness Reviews
- 033-YMP-QP 2.8, Quality Assurance Grading
- 033-YMP-QP 2.10, Qualification of Personnel
- 033-YMP-QP 2.4, Technical Reviews
- 033-YMP-QP 3.0, Scientific Investigation Control
- 033-YMP-QP 3.2, Software Quality Assurance
- 033-YMP-QP 3.4, Scientific Notebooks

- 033-YMP-QP 5.0, Technical Implementing Procedures
- 033-YMP-QP 8.0, Identification & Control of Items, Samples & Data
- 033-YMP-QP 9.0, Control of Processes
- 033-YMP-QP 13.0, Handling, Storage and Shipping

CAR LLNL-033 was issued as a result of this audit.

Corrective action for CAR LLNL-028 was completed and verified, and the CAR was closed on May 10.

Quality Assurance Verification - Surveillance

No significant activities.

Field Quality Assurance/Quality Control

No significant activities.

Quality Assurance - Quality Engineering

No significant activities.

1.2.12 INFORMATION MANAGEMENT

1.2.12.2 Records Management

1.2.12.2.2 Local Records Center Operations (LRC)

LLNL-YMP Document Control issued three revisions and no change notices. Follow up continues on previously distributed documents.

1.2.12.2.3 Participant Records Management

A total of 131 items were logged into the LLNL-YMP tracking system. This includes nineteen records packages that were processed through to the CRF. Six action items were closed.

1.2.12.2.5 Document Control

LLNL received no funding under this WBS element for FY94. Work performed to complete LLNL's obligation in this WBS element is funded under WBS 1.2.12.2.2.

1.2.13 ENVIRONMENT, SAFETY AND HEALTH

1.2.13.2 Safety and Occupational Health

1.2.13.2.5 Occupational Safety and Health

J. Blink attended the YMP Safety Committee meeting in Las Vegas on May 5. Several ES&H surveillance reports were submitted to the FOC.

1.2.15 SUPPORT SERVICES

1.2.15.2 Administrative Support

No significant activities.

1.2.15.3 Yucca Mountain Site Characterization Project (YMP) Support for the Training Mission

Currently there are 100 participants on the project who are to be trained and/or tracked. Six new participants added during the month of May and one participant left the program.

A new training database program has been written utilizing "user friendly" software compatible with the MacIntosh computer. Testing and implementation of this program will begin in late June.

R. Dalson, J. Haeberlin, and A. Russell received indoctrination from J. Blink via the revised indoctrination process.

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