Department of Energy
Office of Civilian Radioactive Waste Management
Yucca Mountain Site Characterization Office
P.O. Box 98608
Las Vegas, NV 89193-8608

AUG 29 1994

Joseph J. Holonich, Chief
High-Level Waste and Uranium
Recovery Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBMITTAL OF PARTICIPANTS' MONTHLY STATUS REPORTS (SCPB: N/A)

The U.S. Nuclear Regulatory Commission (NRC) has requested to be put on distribution to receive a copy of the Yucca Mountain Site Characterization Project participants' monthly status reports on a regular basis. Therefore, the enclosed EG&G Energy Measurements, Inc., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Raytheon Services Nevada, and U.S. Geological Survey monthly status reports are herewith submitted to you.

If you have any questions, please call April V. Gil at (702) 794-7622.

Stephan J. Brocoum

Stephan J. Brocoum
Assistant Manager for
Suitability and Licensing

AMSL:AVG-4836

Enclosures: (NOT RECORD MATERIAL)

1. EG&G/EM Progress Report, July 1994
2. EG&G/EM Remote Sensing Laboratory Progress Report, July 1994
3. LLNL YMP Status Report, June 1994
4. Los Alamos Monthly Activity Report, June 1994
5. Los Alamos Monthly Activity Report, July 1994
6. RSN YMP Executive Status Report, July 1994
7. USGS YMP Progress Report, July 1994

NH03 1/1
WM-11
102.8

9409080271 940829
PDR WASTE
WM-11 PDR

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

I-36026

WBS 1.2.13.4
NQA

RPTS 1.10 8-8-94

August 2, 1994
LV94-RAG-041

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

JULY 1994 PROGRESS REPORT

Attached is the July 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.

Ronald A Green

for W. Kent Ostler, Director
Environmental Science Division

RG:vk

Attachment

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

ACTION
Dixon
Ryder
CRAWFORD m-w/o

REC'D IN YMP
8/3/94

102.8

9409080271 94/09/29

ENCLOSURE 1

YUCCA MOUNTAIN PROJECT
BIOLOGICAL RESOURCES PROGRAM
MONTHLY PROGRESS REPORT
JULY 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

- EG&G/EM provides on-site monitors when tortoises are found near construction activities. REECo construction crews have failed to notify EG&G/EM when changes occur in schedules for construction activities that will be monitored. On July 25, EG&G/EM was told that grading would start on July 27th for the water tanks on Exile Hill. Arrangements were made with construction foreman, on the 25th, to have a biologist at the construction site on the 27th because a tortoise had been found nearby during a resurvey. However, no construction crew worked there on the 27th. The foreman could not be contacted until the following day (28th) at which time he said the construction was starting that morning.

  When arrangements are made with the construction foreman for a monitor, any change in the work schedule for that activity needs to be communicated to EG&G/EM or to EG&G/EM through the Project Office. Considerable time and effort is wasted when these changes are not communicated.

WORK PROGRESS

- EG&G/EM submitted two preactivity reports and three reclamation stipulation reports to the Project Office. Mitigation recommendations also were submitted for realignment of the 8-inch waterline from the top of Exile Hill to the North Portal Pad. One reclamation inventory was conducted. Resurveys for tortoises were conducted at four construction sites. Three casual access surveys were conducted. Tortoises were monitored at the shallow boreholes at the Stagecoach Road Fault and at the water tanks on top of Exile Hill.

- All other work was part of continuing studies. Radiomarked desert tortoises were located at least twice each week. Field efforts for the tortoise reproduction studies were completed for FY94. Small mammals were captured, marked, and released on eight plots to monitor the effects of site characterization activities on population abundance and survival. Spotlight surveys were conducted at Yucca Mountain to monitor lagomorph and predator populations.

- The FY93 progress report for the Biological Resources Monitoring Program for the time period October 1992-December 1993 was distributed.

- EG&G/EM participated in a Public Outreach Tour of YMP.

- Continued preparing and working with Project Office on FY95 budgets.

EG&G ENERGY MEASUREMENTS

Las Vegas Area Operations

EG&G ENERGY MEASUREMENTS, INC., P.O. BOX 1912, LAS VEGAS, NEVADA 89125

WBS 1.2.5
QA: NA

I-360970 PV RPTS 1.10 8/17/94

August 17, 1994
NV-94-622

Mr. Robert Nelson, Project Manager
Department of Energy
Yucca Mountain Site Characterization Project Office
101 Convention Center Drive
Las Vegas, NV 89109

JULY 1 - JULY 31, 1994, PROGRESS REPORT - EG&G/ENERGY MEASUREMENTS, INC. REMOTE SENSING LABORATORY SUPPORT TO THE YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Enclosed is a progress report on the EG&G Energy Measurements, Inc. (EG&G/EM) Remote Sensing Laboratory (RSL) support to the Yucca Mountain Site Characterization Project (YMP) for July 1, 1994, through July 31, 1994.

The progress report for EG&G/EM RSL support to YMP includes the following sections:

- Work Accomplished
- Expenditures
- Status of Deliverables

If you have any questions, please contact Elaine Ezra at (702) 794-7449.

for James Michael, Manager
NV Program

CE:ns

Enclosures
1. Progress Report
2. Maps

3/5
cc: (6)
cc:
cc:
cc: See cc
cc: list (7)
cc:
cc:
cc:

8/19/94

ENCLOSURE 2

cc w/Encl 1

S. Ronshaugen, DOE/NV EMD
W. Dixon, DOE/YMP
M. Dockter, DOE/NV
R. Dyer, DOE/YMP
J. Gandi, DOE/YMP
J. Lorenz, REECo/YMP (Encls 1 & 2)
C. Newbury, DOE/YMP (Encls 1 & 2)
M. Ryder, DOE/YMP
M. Tynan, DOE/YMP (Encls 1 & 2)
D. Williams, DOE/YMP
W. Wilson, DOE/YMP (Encls 1 & 2)

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.3 **SITE INVESTIGATIONS**

WBS 1.2.3.9.4 **SPECIAL STUDIES: TRACERS, FLUIDS AND MATERIALS**

SA OE394A **TRACERS, FLUIDS AND MATERIALS**

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: Jim Beckett

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. A Paradox run-time version of the TFM database has been installed at the Field Operations Center for SAIC and two Las Vegas sites for the M&O. This version is temporary until the INGRES version under development by EG&G/EM is completed. EG&G/EM will install and test the Paradox run-time upon request. It requires eight megabytes of RAM and 20 megabytes of disk space.

2. A meeting was held July 20 to discuss TFM data management and data flow. In attendance were B. Scott (QATSS/IRG) and Jim Beckett.

3. The following TFM data was received and processed into the TFM database.

R-93-008	Rock and Topsoil Storage Pads and Access Roads
R-94-005-R1	North Ramp Highwall and Boxcut
R-93-008	Rock and Topsoil Storage Pads and Access Roads
6/9/92	UE UZ-16 (VSP 2) Test Hole
R92-001	Fran Ridge Pit Mapping: Deepen Test Pit 1 to 18'
R92-002	Neutron Access B-holes
R-94-005	North Ramp Highwall and Boxcut

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. The transfer of the TFM database into GENISES will be completed and an acceptance letter provided to YMSCO after verification of the data by the M&O.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.3 SITE INVESTIGATIONS

WBS 1.2.3.9.5 SPECIAL STUDIES: THREE-DIMENSIONAL SITE MODEL

SA OE395A 3-D MODELING AND VISUALIZATION

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: D. Brickey

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. Work was initiated by David Jefferis on the Extended Site Model, including editing and converting marker data.

2. A numerical modeling requirements matrix was developed by David Jefferis and documented.

3. A planning meeting was conducted on July 25 for FY95 tasking. In attendance were Mark Tynan (YMSCO), Elaine Ezra, David Brickey, and David Jefferis.

4. The effort to hire a Senior Scientist for the group continues. Cameron Williams was interviewed on July 5.

5. A purchase requisition has been placed for an SGI UNIX workstation to support 3-D numerical modeling.

6. The new SGI Indigo^2 workstation was installed and configured with image processing, GIS, and DGI software.

7. The following products were generated:

NR94070502 Pagesize cross-sections were provided to Carl Brechtel (Agapito/SNL) for the following:

YMP-94-225.0	North Half ESF Drift; for db1.dxf
YMP-94-226.0	Cross Section for South Half ESF Drift; for db2.dxf

YMP-94-227.0	Cross Section between ESF South Ramp & Drift, #1; for db5.dxf
YMP-94-228.0	Curve Cross Section between ESF North Ramp & Drift, #1; for db6.dxf
YMP-94-229.0	Cross Section between ESF North Ramp & Drift, #2; for db7.dxf
YMP-94-230.0	Cross Section ESF South Ramp; for db8.dxf
YMP-94-231.0	Curve Cross Section between ESF South Ramp & Drift, #2; for db9.dxf
YMP-94-232.0	Location Map for Cross Sections Cut from USGS YMP.R1.0 Model
YMP-94-233.0	Borehole Location Map for USGS YMP.R1.0 Model
YMP-94-235.0	One 3.5" diskette containing the following files db1.dxf, db2.dxf, db5.dxf, db6.dxf, db7.dxf, db8.dxf, db9.dxf, README

NR94071105 Two copies of each of the following products were provided to Mark Tynan (YMSCO):

YMP-94-217.0	Structure Contour for the Top Topopah Spring middle non-lithophysal
YMP-94-218.0	Structure Contour for the Base Topopah Spring middle non-lithophysal
YMP-94-219.0	Cross Section A-A' (NRG-7, SD-9, SD-12, WT-2, SD-7)
YMP-94-220.0	Cross Section B-B' (UZ-14, G-1, NRG-7, USW-16)
YMP-94-238.0	Report of predicted versus modeled (estimated) tops

NR94071503 Two viewgraphs of the following products were provided to Mark Tynan (YMSCO) on July 20:

YMP-94-041.0	Thermal/Mechanical Stratigraphy

YMP-94-042.0 2-D View of Bedrock and Alluvium

YMP-94-096.0 3-D Model of Topopah Springs, Demonstration of Converting Lynx to EarthVision

NR94071504 Two viewgraphs of the following product was provided to Mark Tynan (YMSCO) on July 20:

EG&G Neg. No. 90G-465L (w/overlay) Yucca Mountain, Nevada CIR Image Map, with Proposed Seismic Reflection Lines

NR94072001 One copy of the following product was provided to Norma Biggar (M&O/WCFS):

YMP-94-237.0 Drillhole Prognosis for Drillhole UE-7A based on the Thermal/Mechanical Model

NR94072002 Three viewgraphs and one print of each of the following products were provided to John Gauthier (M&O/WCFS):

YMP-94-187.0 3-D View to Northeast of Surface Model showing the Scott & Bonk Geology, the Potentiometric Surface with Planned and Existing Drillholes

YMP-94-188.0 3-D View to Southeast of Surface Model showing the Scott & Bonk Geology, the Potentiometric Surface with Planned and Existing Drillholes

YMP-94-189.0 3-D View to Northeast of Surface Model showing the Potentiometric Surface with Planned and Existing Drillholes

MAJOR PROBLEMS AND CORRECTIVE ACTION: None.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. Continue effort to hire a Senior Scientist for the group.

2. Continue work on extended 3-D site model.

3. Continue work on basaltic volcanism volumetrics and data integration project.

4. Non-capital hardware and software procurements will be made to augment capabilities.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.5 **REGULATORY**

WBS 1.2.5.3.5 **GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)**

SA OE535L94 **TECHNICAL DATABASE INPUT**

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: J. Beckett

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD: None.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. The EG&G/EM Environmental Sciences Division will be submitting data to the PDA during this period.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.5 REGULATORY

WBS 1.2.5.3.6 GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)

SA OE536A GENISES TECHNICAL DATABASE

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: J. Beckett

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. A DOE audit of the YMP Technical Data Management System was conducted during the week of July 25 - 29. R. Harpster (QATSS/CER) met with Jim Beckett on July 29 to review EG&G/EM's implementation of DOE procedures for the technical database. No discrepancies were noted at the time of the interview.

2. The third quarter meeting of the Technical Data Management Working Group was held on July 12, at the USGS facilities in Denver. In attendance from EG&G/EM were Elaine Ezra, Jim Beckett, and Chris Berlien.

3. Rose Denton and Christopher Pytel joined the GENISES TDB staff on July 11.

4. The following data transfers to the GENISES Technical Database were received during this period.

GS921208315215.018 - Paleohydrologic Implications of the Stable Isotopic Composition of Secondary Calcite within the Tertiary Volcanic Rocks of Yucca Mountain, Nevada By Joseph F. Whelan and John S. Stuckless was received on 08-July-1994.

GS930108315215.009 - Uranium-Series Dating of Secondary Carbonates Near Yucca Mountain, Nevada: Applications to Tectonic, Paleoclimatic and Paleohydrologic Problems By D.R. Muhs, J.W. Whitney, R.R. Shroba, E.M. Taylor was received on 08-July-1994.

GS931031174102.002 - Survey of Deformation of 50-KM-Aperture Trilateration Network using a Geodolite, Centered on Yucca Mountain, 1983-1984 was received on 19-July-1994.

QR94071204 - Survey of Deformation of 50-KM-Aperture Trilateration Network Using GPS and a Geodolite, Centered in Yucca Mountain, 1993 was received on 19-July-1994.

5. The following submittals to the Yucca Mountain Project Technical Database were processed into the GENISES TDB.

GS900983117482.001 - Comparison of Survey and Photogrammetry Methods To Position Gravity Data, Yucca Mountain, Nevada (Accepted 18-July-1994)

GS900908314215.002 - Magnetometric Resistivity Survey Near Fortymile Wash, Nevada Test Site, Nevada (Accepted 18-July-1994)

GS900908314231.001 - Three-Dimensional Modeling of the Nevada Test Site and Vicinity From Teleseismic P-Wave Residuals (Accepted 18-July-1994)

GS900908314215.004 - Remote-Reference Magnetotelluric Survey Nevada Test Site and Vicinity, Nevada and California (Accepted 18-July-1994)

GS900908314212.011 - Electrical Studies at the Proposed Wahmonie and Calico Hills Nuclear Waste Sites, Nevada Test Site, Nye Co., Nevada (Accepted 18-July-1994)

GS900908312312.001 - Geohydrologic and Drill-Hole Data for Test Well USW H-3, Yucca Mountain, Nye County, Nevada (Accepted 18-July-1994)

GS900983115212.002 - Report on Televiewer Log and Stress Measurements in Core Hole USW G-2, Nevada Test Site October-November, 1982 (Accepted 18-July-1994)

GS900908312312.002 - Geohydrologic and Drill Hole Data for Test Well USW H-4, Yucca Mountain, Nye County, Nevada (Accepted 18-July-1994)

GS900908314211.007 - A Summary of Geologic Studies Through January 1, 1983, of a Potential High-Level Radioactive Waste Repository Site at Yucca Mountain, Southern Nye County, Nevada (Accepted 18-July-1994)

GS900908312211.002 - Hydrologic, Meteorological, and Unsaturated-Zone Moisture-Content Data, Franklin Lake Playa, Inyo County, California (Accepted 18-July-1994)

GS900983117421.002 - Preliminary Analysis of Geophysical Logs From Drill Hole UE-25p#1, Yucca Mountain, Nye County, Nevada (Accepted 18-July-1994)

GS900908314213.002 - Preliminary Interpretations of Geologic Results Obtained From Boreholes UE25a-4, -5, -6, and -7, Yucca Mountain, Nevada Test Site (Accepted 19-July-1994)

GS900983117411.002 - A study of surface and subsurface ground motions at Calico Hills, Nevada Test Site (Accepted 19-July-1994)

GS900983117412.003 - A Seismic Study of Yucca Mountain and Vicinity, Southern Nevada; Data Report and Preliminary Results (Accepted 19-July-1994)

GS900983115212.001 - Report on Televiewer Log and Stress Measurements in Core Hole USW G-1, Nevada Test Site, December 13-22, 1981. (Accepted 19-July-1994)

GS900908314213.006 - Radioelement Distribution in Drill-Hole USW-G1, Yucca Mountain, Nye County, Nevada (Accepted 19-July-1994)

GS900983117432.001 - Preliminary report on late Cenozoic faulting and stratigraphy in the vicinity of Yucca Mountain, Nye County, Nevada (Accepted 19-July-1994)

GS930383117411.001 - Analysis of earthquake data recorded by digital field seismic systems, Jackass Flats, Nevada (Accepted 20-July-1994)

GS920908315214.032 - Isotope Content and Temperature of Precipitation in Southern Nevada, August 1983-August 1986 (Accepted 20-July-1994)

GS900983115221.001 -	Analysis of Thermal Data from Drill Holes UE25a-3 and UE25a-1, Calico Hills and Yucca Mountain, Nevada Test Site (Accepted 20-July-1994)
GS900908314223.001 -	Analysis of the Magnetic Susceptibility Well Log in Drill Hole UE25a-5, Yucca Mountain, Nevada Test Site (Accepted 20-July-1994)
GS900983114221.003 -	Rock Property Analysis of Core Samples from the Calico Hills UE25a-3 Borehole, Nevada Test Site, Nevada (Accepted 20-July-1994)
GS900908314215.005 -	Magnetic Properties of Drill Core and Surface Samples from the Calico Hills Area, Nye County, Nevada (Accepted 20-July-1994)
GS900983117472.003 -	Preliminary results of gravity investigations at Yucca Mountain and vicinity, Southern Nye County, Nevada (Accepted 20-July-1994)
GS900983115221.002 -	Preliminary Interpretation of Thermal Data from the Nevada Test Site (Accepted 20-July-1994)
GS900908312211.001 -	Geohydrologic and drillhole data for test well USW H-1, Adjacent to Nevada Test Site, Nye County, Nevada (Accepted 20-July-1994)
GS900983117421.001 -	Stratigraphic and Volcano-Tectonic Relations of Crater Flat Tuff and Some Older Volcanic Units, Nye County, Nevada (Accepted 20-July-1994)
GS900908314215.006 -	Interpretations of Magnetic Anomalies at a Potential Repository Site Located in the Yucca Mountain Area, Nevada Test Site (Accepted 20-July-1994)
GS900908314213.007 -	Borehole gravity meter surveys in drillholes USW G-3, UE-25p#1 and UE-25c#1, Yucca Mountain Area, Nevada (Accepted 21-July-1994)
GS900983117473.001 -	Investigation Of An Aeromagnetic Anomaly On West Side Of Yucca Mountain, Nye County, Nevada (Accepted 21-July-1994)

GS900908312314.001 -	Identification and Characterization of Hydrologic Properties of Fractured Tuff using hydraulic and tracer tests--test well USW H-4, Yucca Mountain, Nye County, Nevada (Accepted 21-July-1994)
GS920908314211.003 -	Stratigraphic and Structural Characteristics of Volcanic Rocks in Core Hole USE G-4, Yucca Mountain, Nye County, Nevada. By Richard W. Spengler and M.P. Chornack with a section on geophysical log (Accepted 25-July-1994)
GS900908315143.001 -	Paleohydrology of the Southern Great Basin, with special reference to water table fluctuations beneath the Nevada Test Site During the Late (?) Pleistocene (Accepted 25-July-1994)
GS900908314215.009 -	Geology of the Syncline Ridge Area Related to Nuclear Waste Disposal, Nevada Test Site, Nye County, Nevada (Accepted 25-July-1994)
GS900983117472.002 -	Preliminary Results Of Gravity Investigations Of The Calico Hills, Nevada Test Site, Nye County, Nevada (Accepted 25-July-1994)
GS900983117212.001 -	A Slingram Survey at Yucca Mountain on the Nevada Test Site (Accepted 25-July-1994)
GS900983117472.001 -	Charleston Peak Gravity Calibration Loop, Nevada (Accepted 25-July-1994)
GS900908314212.004 -	Preliminary appraisal of gravity and magnetic data at Syncline Ridge, Western Yucca Flat, Nevada Test Site, Nye County, Nevada (Accepted 25-July-1994)
GS900908315131.002 -	Preliminary Assessment of Climatic Change During Late Wisconsin Time, Southern Great Basin and Vicinity, Arizona, California, and Nevada (Accepted 28-July-1994)
GS900983117475.002 -	Preliminary Analysis of Geophysical Logs from the WT Series of Drill Holes, Yucca Mountain, Nye County, Nevada (Accepted 28-July-1994)

6. The following tubular report was compiled:

NR94071402 One copy of report YMP094-223.0 " Existing borehole inventory" was compiled for Rob Clayton (WCFS) on July 14.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. Processing of submittals will continue.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.5	REGULATORY
WBS 1.2.5.3.6	GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)
SA OE536B4	GIS DATABASE, SITE ATLAS, ARCVIEW AND GIS CATALOG

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: S. Ross

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. The third quarter version of the GIS Data Catalog was completed, and 180 copies delivered to DOE on July 15. Twenty five additional copies were reproduced for customer requests. An internal version of the catalog was also produced and distributed to GIS analysts.

2. The "baseline" area of the GIS database continues to be evaluated, reformatted and verified to facilitate production activities.

3. Compilation of ARC/INFO coverage metadata into standardized formats continues in support of the Federal Spatial Data Transfer Standards and the Data Dictionary System.

4. Work continues in identifying data discrepancies and updates for data related to ongoing site characterization activities, specifically for boreholes, pits, and trenches.

5. No ArcView datasets were distributed during this report period, however, updates and dataset verification continues to occur.

6. Work continued on the design, content and format of the FY94 Site Atlas. Maps and coverages are being generated; 109 maps have been created, including 27 page formats.

7. A review of the Meteorology Study Plan was completed, as requested by SAIC.

8. A literature and data search of meteorology data was completed, as requested by SAIC.

9. Susan Ross met with John Carlson and John Rains (SAIC), on July 5 to discuss GIS database activities regarding socioeconomic studies.

10. Susan Ross met with the meteorology data users group on July 12 regarding data needs and development of a Study Plan.

11. Susan Ross met with Morrison-Knudsen personnel on July 14 regarding digital data transfers.

12. Susan Ross met with Scott Lundstrom (USGS) on July 20 regarding the automation of his surficial geologic mapping.

13. One GIS Data Catalog was transmitted to Joseph Whelan (USGS) on July 13.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN:

The FY93 Site Atlas, originally scheduled for completion on September 30, 1993, is still with the contractor of the Government Printing Office (GPO). The corrective action consists of documentation in regards to missed schedules and identification of printer problems seen in the three proof sets thus far delivered. On July 29, EG&G was informed by the GPO that printing would be complete and the product delivered on August 5.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. Verification of GIS data continues in support of the fourth quarterly update of the GIS Data Catalog.

2. Receipt of the FY93 Site Atlas from the GPO.

3. Receipt of the FY93 Site Atlas Supplement from SAIC Reproduction.

4. Data acquisition and input for the FY94 Site Atlas.

5. Finalization of content and format for the FY94 Site Atlas.

6. Transmittal of ArcView data transfers.

7. Revisions to the baseline datasets for boreholes and trenches.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP

Work Accomplished

WBS 1.2.5 REGULATORY

WBS 1.2.5.3.6 GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)

SA OE536C4 GIS, MAPPING AND ANALYSIS SUPPORT

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: J. Donovan

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. GIS map products were generated to support project participants and are detailed in the "Deliverables" statement.

2. Photo products include the following:

NR94063001 (6) 8"x10" transparencies of EG&G 89A0086 were prepared for Allison Inglett (SAIC) on July 12.

NR94052302 One 8"x10" custom color matte print and one copy negative of (38) EG&G negatives were generated for Jerry Lorenz (REECo) on July 21.

NR94063002 (17) 30"x30" custom color prints, (3) 20"x20" custom duraflex prints, and (2) 40"x40" custom matte prints were generated from EG&G negatives #931-449L and #94E-168L for Jerry Lorenz (REECo) on July 21.

NR94071501 One color print of each of the following frames was prepared for Carma Hernandez (SAIC) on July 21:

5"x7" DI 93.0052
4"x5" DI 93.0053
16"x20" 6677-20

NR94071301 The following products were generated for Sarah Flick (EG&G/ESD) on July 27:

One B&W print mounted on foam core with mylar sheet #15 of the 1:12,000 scale orthophoto;

One each B&W print of sheets #15, 20, 21, 22, 26, 27 and 28 of the 1:12,000 scale orthophotos with contours;

One each color print of Perf #7135 Frames 1-170 and Perf 7136 Frames 1-44;

One copy of flight logs and flight line maps of Perf 7135 and Perf 7136.

3. The following digital data transfers were prepared:

NR94051901 An ARC/INFO data transfer on 1/4" tape cartridge was completed and transmitted to David Eley (SNL) on July 6. The follow coverages were provided: proposed repository outline; ramps (option 30); ESF; existing boreholes; and roads.

NR94062101 An ARC/INFO data transfer on 1/4" tape cartridge was completed and transmitted to William Zelinski (SNL) on July 6. The transfer included all coverages used in the EG&G GIS map product YMP-93-337.2

NR94062802 An ARC/INFO data transfer on 1/4" tape was completed and transmitted to Bo Bodvarsson (LBL) on July 8 of the following datasets:

All existing and planned borehole locations; ESF (option 30); faults (Scott and Bonk); geologic map (Scott and Bonk); potentiometric map (Ervin, 1993).

NR94060301 One 1/4" tape cartridge (YMP-94-201.1) containing one ARC interchange file "veg1.e00 - vegetation" was provided to Bill Davies (USGS) on July 13.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. Continued level-of-effort.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.5 **REGULATORY**

WBS 1.2.5.3.6 **GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)**

SA OE536F4 **REMOTE SENSING**

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: C.E. Ezra

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD: None.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD: None.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.5 **REGULATORY**

WBS 1.2.5.3.6 **GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)**

SA OE536E4 **COMPUTER SUPPORT**

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: T. Radermacher

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. The new Indigo^2 was installed to support the 3-D modeling and visualization tasking.

2. EarthVision 2.0 was installed on the Indigo^2.

3. ERDAS Imagine 8.10 image processing software was installed on the Indigo^2.

4. EASI/PACE Version 5.2 upgrade was installed on the Indigo^2.

5. ARC/INFO for SGI was installed on the Indigo^2.

6. ArcView Rev 1.0a was installed on an YMPSAS personal computer for development of ArcView datasets.

7. The SPARCstation 10 fileserver for map production work conducted at RSL was tested.

8. The Cisco routers for the YMP Spatial Analysis Section network extension to Room P-118 were received. Approval from EG&G/EM Information Services Division was received on the planned network/security configuration.

9. INGRES Windows 4GL for the personal computer was received and installed and testing for the PC-UNIX configuration was initiated.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. Continued testing of the Sun SPARCserver 1000/GENISES system configuration in preparation for YMP participant connection.

2. Conversion of the YMPSAS SUN systems from SUNOS to Solaris operating system.

3. Transfer of the SUN SPARC10 to RSL will be completed and conversion to Solaris operating system implemented.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.5 **REGULATORY**

WBS 1.2.5.3.6 **GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)**

SA OE536G4 **CAPITAL EQUIPMENT**

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: E. Ezra

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. Capital equipment funds were transferred. Procurement documentation for the workstation has been initiated.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN:

Due to delays in receiving the capital funds, it may be difficult to purchase the workstation by the end of the fiscal year.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD: None.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
<u>Work Accomplished</u>

WBS 1.2.5 **REGULATORY**

WBS 1.2.5.3.6 **GEOGRAPHIC NODAL INFORMATION STUDY AND EVALUATION SYSTEM (GENISES)**

SA OE536D4 **PROJECT MANAGEMENT**

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: E. Ezra

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

Reporting/Tracking/Planning

1. EG&G/EM RSL June Progress report was compiled and submitted to DOE/YMSCO (NV-94-545).

2. June PACS input was compiled (NV-94-544) and submitted to Robert Spiro (M&O).

3. The Fiscal Year 1995 Information Resources Management Short-Range Plan was prepared and submitted to DOE/YMSCO (YMSO-94-164).

4. Fiscal Year 1995 PACS Summary Accounts were prepared and submitted to Bob Spiro (M&O).

Meetings:

1. Weekly Technical Data Managers staff meetings were held with Claudia Newbury (DOE/YMSCO), Steve Bodnar, Diane McAlister and Bob Lewis (M&O), Jan Statler (SAIC) and Elaine Ezra and Jim Beckett.

Conferences/Training

1. James Ephlin and Susan Weber attended and successfully completed the YMP Orientation (Sections A, B, and C) on July 5.

General:

1. Additional space has been arranged on the first floor of the Bank of America Annex. The area still needs to be painted, cleaned and the LAN connections established prior to moving. Planning for space preparation, phone line installation, and data communication configuration/installation have been completed.

Employee Actions:

1. Rose Denton and Chris Pytel joined the GENISES Technical Database staff on July 11.

Quality Assurance:

1. The Software Qualification, Configuration Management, and Computer Resource Classification procedures are drafted and in internal review.
2. July 14, Christopher Pytel and Rose Denton completed indoctrination to the GENISES TDB processes.
3. An unannounced DOE audit of the GENISES TDB was conducted on July 29. There are presently no significant findings or corrective action requests issued against the YMPSAS.

ES&H:

1. A monthly safety check was conducted in Suite 1010 on July 28.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. Continued efforts to hire a 3-D modeling Senior Scientist and Records Clerk.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.12 RECORDS MANAGEMENT AND DOCUMENT CONTROL

WBS 1.2.12.2.3 PARTICIPANT RECORDS MANAGEMENT

SA OEC23A4 RECORDS MANAGEMENT

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: J. Wiggins

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD:

1. Joanna Wiggins attended the quarterly YMP Records Council Meeting held in Albuquerque, New Mexico on July 19 and 20.

2. The following Quality Assurance Record packages were processed into the YMP Central Records Facility: QR93102001 and QR93083101.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD:

1. The backlog of quality data record packages will be completed by processing the packages into the YMP Central Records Facility.

2. The audit of Project Controlled Documents maintained by EG&G/EM will be completed.

3. Two temporary staff will be assigned to assist with processing the backlog of records.

PROGRESS REPORT FOR EG&G/EM RSL SUPPORT TO YMP
Work Accomplished

WBS 1.2.12.2.3 ADMINISTRATIVE SUPPORT

SA OE152A4 PHOTO/GRAPHICS SUPPORT

REPORT PERIOD: July 1, 1994 - July 31, 1994

REPORT DATE: August 18, 1994

RESPONSIBLE INDIVIDUAL: E. Ezra

SUMMARY OF WORK ACCOMPLISHED DURING REPORT PERIOD: None.

MAJOR PROBLEMS AND CORRECTIVE ACTION UNDERTAKEN: None.

ANTICIPATED SIGNIFICANT EVENTS PLANNED DURING NEXT REPORT PERIOD: None.

Expenditures from June 26 through July 31, 1994
(Dollars in thousands)

Task	Budget	July Cost	Total Costs To Date	Remaining
WBS 1.2.3 Site Investigations	$ 597	$ 43	$ 376	$ 221
WBS 1.2.3 TFM	$ 100	$ 0	$ 0	$ 100
WBS 1.2.5 Regulatory	$2,154	$ 210	$1,776	$ 378
WBS 1.2.12 Records Management	$ 100	$ 15	$ 58	$ 42
WBS 1.2.15 Support Services	$ 9	$ 4	$ 11	$ (2)
TOTALS	$2,960	$ 272	$2,221	$ 739
WBS 1.2.3 FY94 Capital	$ 50	$ 44	$ 44	$ 6
WBS 1.2.5 FY93 Carryover + FY94 Capital Capital Equipment	$ 373	$ 0	$ 287	$ 86

STATUS OF DELIVERABLES FOR EG&G/EM RSL SUPPORT TO YMP
July 1, 1994 through July 31, 1994

GIS MAP SUPPORT

Description	Requested by/ Organization	Date Sent	Size	No. of Copies
YMP-94-022.3 Surface Based Testing Activities with Geologic Structure, Sheet 9	Yasek/YMPO	7/1/94	Full	1
YMP-94-023.3 Surface Based Testing Activities with Geologic Structure, Sheet 10	Yasek/YMPO	7/1/94	Full	1
YMP-94-024.3 Surface Based Testing Activities with Geologic Structure, Sheet 11	Yasek/YMPO	7/1/94	Full	1
YMP-94-025.3 Surface Based Testing Activities with Geologic Structure, Sheet 15	Yasek/YMPO	7/1/94	Full	1
YMP-94-026.3 Surface Based Testing Activities with Geologic Structure, Sheet 16	Yasek/YMPO	7/1/94	Full	1
YMP-94-027.3 Surface Based Testing Activities with Geologic Structure, Sheet 17	Yasek/YMPO	7/1/94	Full	1
YMP-94-028.3 Surface Based Testing Activities with Geologic Structure, Sheet 21	Yasek/YMPO	7/1/94	Full	1
YMP-94-029.3 Surface Based Testing Activities with Geologic Structure, Sheet 22	Yasek/YMPO	7/1/94	Full	1

YMP-94-030.3 Surface Based Testing Activities with Geologic Structure, Sheet 23	Yasek/YMPO	7/1/94	Full	1
YMP-94-202.0 Population Risk Assessment	Fathauer/TRW	7/5/94	Full Page	1 1
YMP-92-192.0 General Reference	Flick/EG&G/EM	7/7/94	Full	1
YMP-94-139.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-106.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-108.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-107.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-175.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-118.1	Hennessy/USGS	7/14/94	Page	1
YMP-94-176.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-178.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-179.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-180.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-181.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-182.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-183.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-184.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-185.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-191.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-193.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-193.1	Hennessy/USGS	7/14/94	Page	1
YMP-94-194.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-194.1	Hennessy/USGS	7/14/94	Page	1
YMP-94-195.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-195.1	Hennessy/USGS	7/14/94	Page	1
YMP-94-196.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-196.1	Hennessy/USGS	7/14/94	Page	1
YMP-94-171.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-192.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-167.1	Hennessy/USGS	7/14/94	Page	1
YMP-94-167.0	Hennessy/USGS	7/14/94	Page	1
YMP-94-209.0 Plant Succession Study Plots	Gabbert/EG&G/EM	7/14/94	Full	3
YMP-94-210.0 YMP Proposed Seismic Reflection Lines	Tynan/YMPO	7/14/94	Page Vugraphs	1 4

YMP-94-102.0 Proposed Seismic Reflection Line Locations and Proposed Deep Seismic Shothole Locations SW Area	Tynan/YMPO	7/14/94	Page Vugraph	1 1
YMP-94-103.0 Proposed Seismic Reflection Line Locations and Proposed Deep Seismic Shothole Locations NE Area	Tynan/YMPO	7/14/94	Page Vugraph	1 1
YMP-94-210.0 YMP Proposed Seismic Reflection Lines	Tynan/YMPO	7/15/94	Vugraphs	2
YMP-94-102.0 Proposed Seismic Reflection Line Locations and Proposed Deep Seismic Shothole Locations SW Area	Tynan/YMPO	7/15/94	Vugraphs	2
YMP-94-103.0 Proposed Seismic Reflection Line Locations and Proposed Deep Seismic Shothole Locations NE Area	Tynan/YMPO	7/15/94	Vugraphs	2
YMP-94-222.0 Location Map	Hernandez/SAIC	7/18/94	Page	1
YMP-94-181.0 FY95 Crater Flat Activities	Banks/YMPO	7/18/94	Page	1
YMP-94-072.0 Existing and Proposed Trenches	Banks/YMPO	7/18/94	Page	1
YMP-93-304.0 Approved Roads	Banks/YMPO	7/18/94	Page	1
YMP-93-278.0 Existing Trenches	Banks/YMPO	7/18/94	Page	1
YMP-94-225.0 North Half ESF Drift	Brechtel/SNL	7/19/94	Full	1
YMP-94-226.0 Cross Section for South Half ESF Drift	Brechtel/SNL	7/19/94	Full	1
YMP-94-227.0 Cross Section between ESF South Ramp & Drift #1	Brechtel/SNL	7/19/94	Full	1

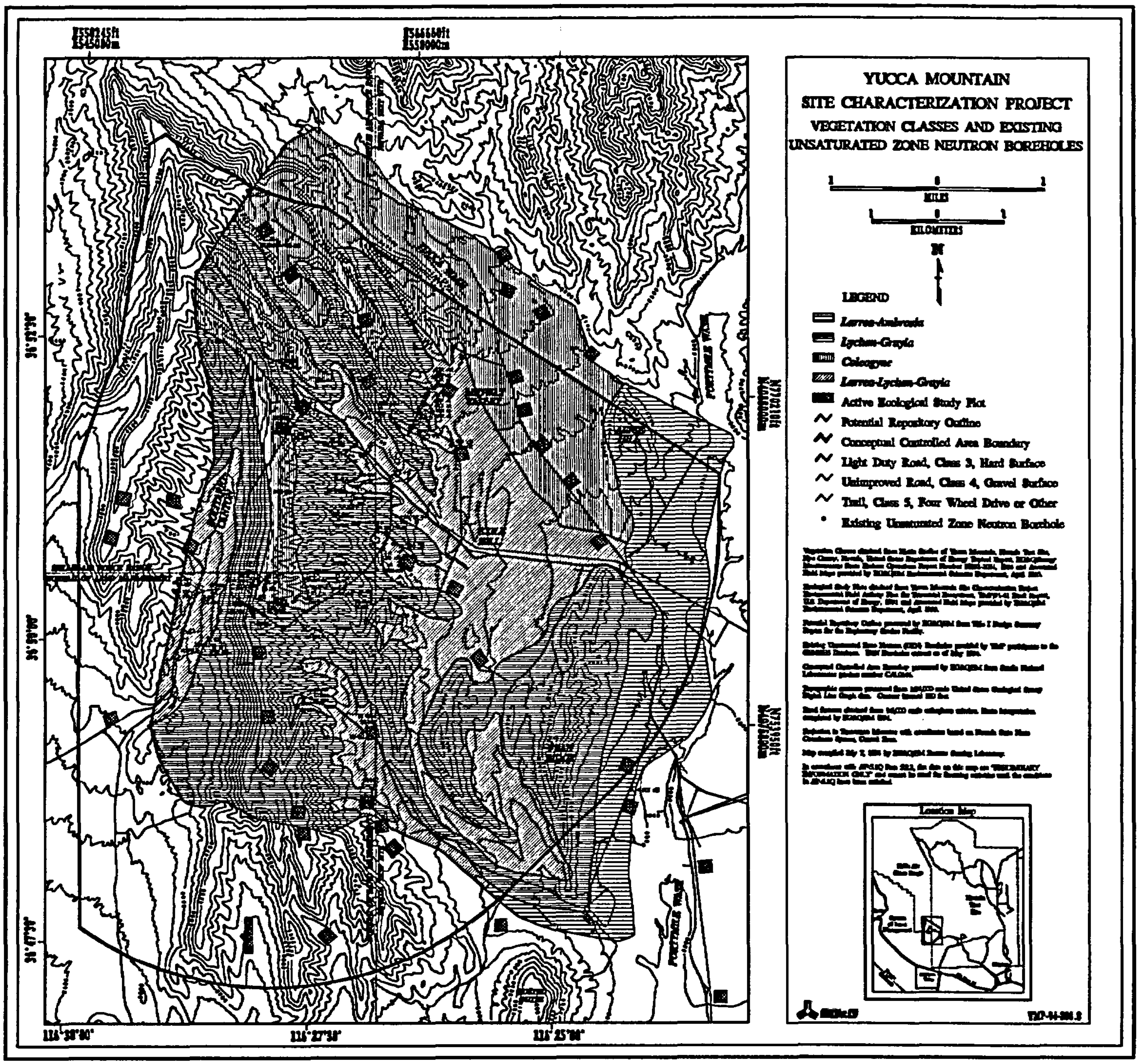
YMP-94-228.0 Curve Cross Section between ESF North Ramp & Drift #1	Brechtel/SNL	7/19/94	Full	1
YMP-94-229.0 Curve Cross Section between ESF North Ramp & Drift #2	Brechtel/SNL	7/19/94	Full	1
YMP-94-230.0 Cross Section ESF South Ramp	Brechtel/SNL	7/19/94	Full	1
YMP-94-231.0 Curve Cross Section between ESF South Ramp & Drift #2	Brechtel/SNL	7/19/94	Full	1
YMP-94-232.0 Location Map for Cross Sections Cut from USGS YMP.R1.0 Model	Brechtel/SNL	7/19/94	Full	1
YMP-94-217.0 Top Topopah Spring Middle Non-Lithophysal	Tynan/YMPO	7/20/94	Full	2
YMP-94-218.0 Base Topopah Spring Middle Non-Lithophysal	Tynan/YMPO	7/20/94	Full	2
YMP-94-219.0 Boreholes NRG-7, SD-9, SD-12, WT-2, SD-7	Tynan/YMPO	7/20/94	Full	2
YMP-94-220.0 Boreholes UZ-14, G-1, NRG-7, UZ-16	Tynan/YMPO	7/20/94	Full	2
YMP-94-022.3 Surface Based Testing Activities with Geologic Structure, Sheet 9	Yasek/YMPO	7/20/94	Full	1
YMP-94-023.3 Surface Based Testing Activities with Geologic Structure, Sheet 10	Yasek/YMPO	7/20/94	Full	1
YMP-94-024.3 Surface Based Testing Activities with Geologic Structure, Sheet 11	Yasek/YMPO	7/20/94	Full	1

YMP-94-025.3 Surface Based Testing Activities with Geologic Structure, Sheet 15	Yasek/YMPO	7/20/94	Full	1
YMP-94-026.3 Surface Based Testing Activities with Geologic Structure, Sheet 16	Yasek/YMPO	7/20/94	Full	1
YMP-94-027.3 Surface Based Testing Activities with Geologic Structure, Sheet 17	Yasek/YMPO	7/20/94	Full	1
YMP-94-028.3 Surface Based Testing Activities with Geologic Structure, Sheet 21	Yasek/YMPO	7/20/94	Full	1
YMP-94-029.3 Surface Based Testing Activities with Geologic Structure, Sheet 22	Yasek/YMPO	7/20/94	Full	1
YMP-94-030.3 Surface Based Testing Activities with Geologic Structure, Sheet 23	Yasek/YMPO	7/20/94	Full	1
YMP-93-337.2 YMP Existing and Planned Boreholes with Geologic Structure	Rogers/M&O	7/21/94	Full	5
YMP-94-187.0 3D Displays of Geology	Gauthier/M&O	7/21/94	Page Vugraph	1 1
YMP-94-188.0 3D Displays of Geology	Gauthier/M&O	7/21/94	Page Vugraph	1 1
YMP-94-189.0 3D Displays of Geology	Gauthier/M&O	7/21/94	Page Vugraph	1 1
YMP-94-214.0 Existing Boreholes	Brechtel/SNL	7/25/94	Full	2
YMP-94-215.0 Planned Boreholes	Brechtel/SNL	7/25/94	Full	2

YMP-94-240.0 YMP, Near Field Radiological Monitoring Sites NF6 & NF87	Liu/SAIC	7/25/94	Page	2
YMP-94-026.3 YMP Surface Based Testing Activities with Geologic Structure, Map Sheet 16	Nance/SAIC	7/25/94	Full	1
YMP-94-208.0 YMP Vegetation Classes and Existing Unsaturated Zone Neutron Boreholes	Green/EG&G/EM	7/25/94	Full	3
YMP-94-214.0 Existing Boreholes	Brandstetter/M&O	7/26/94	Full	1
YMP-94-215.0 Planned Boreholes	Brandstetter/M&O	7/26/94	Full	1
YMP-94-216.0 Site Features	Brandstetter/M&O	7/26/94	Full	1
YMP-94-175.1 Field Planning Map	Holt/EG&G/EM	7/27/94	Full	6
YMP-94-221.0 Rights-of-Way	Jacobs/SAIC	7/27/94	Full	2

TOTAL NEW MAPS 29

TOTAL MAPS 120



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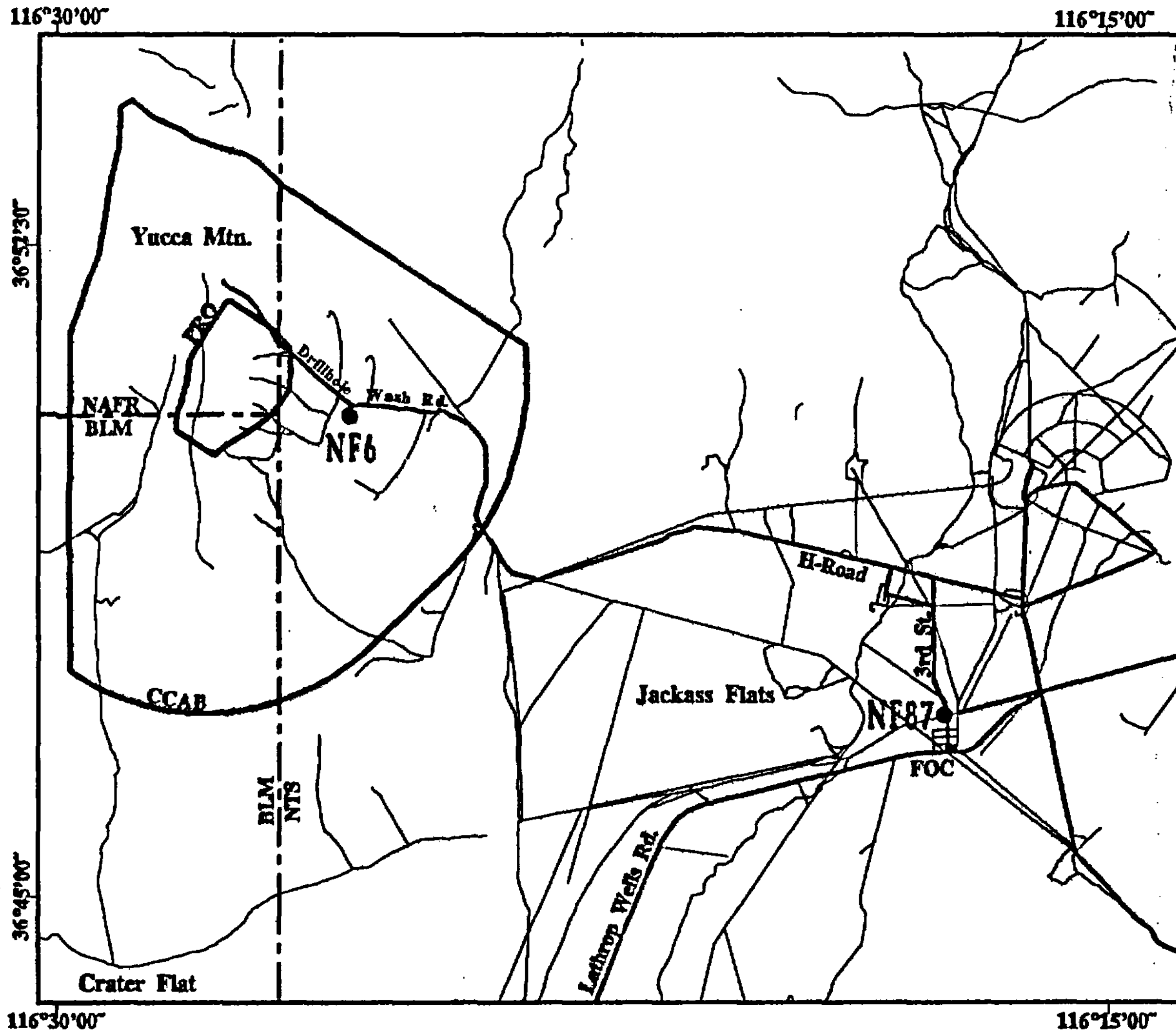
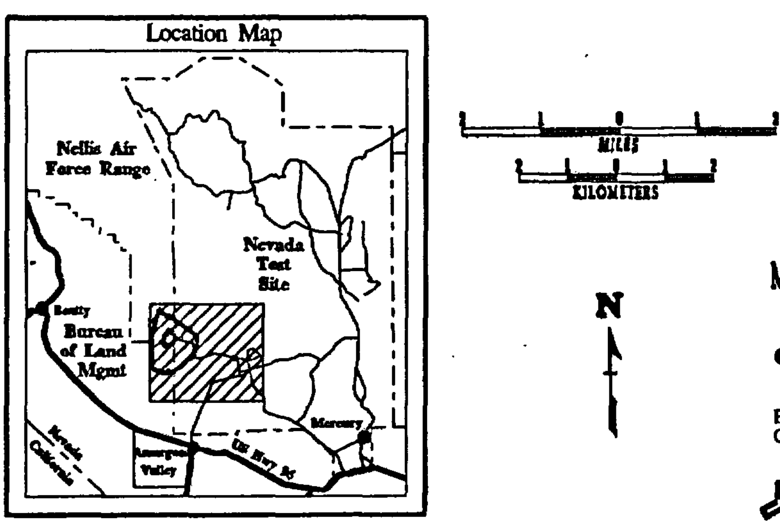




YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT

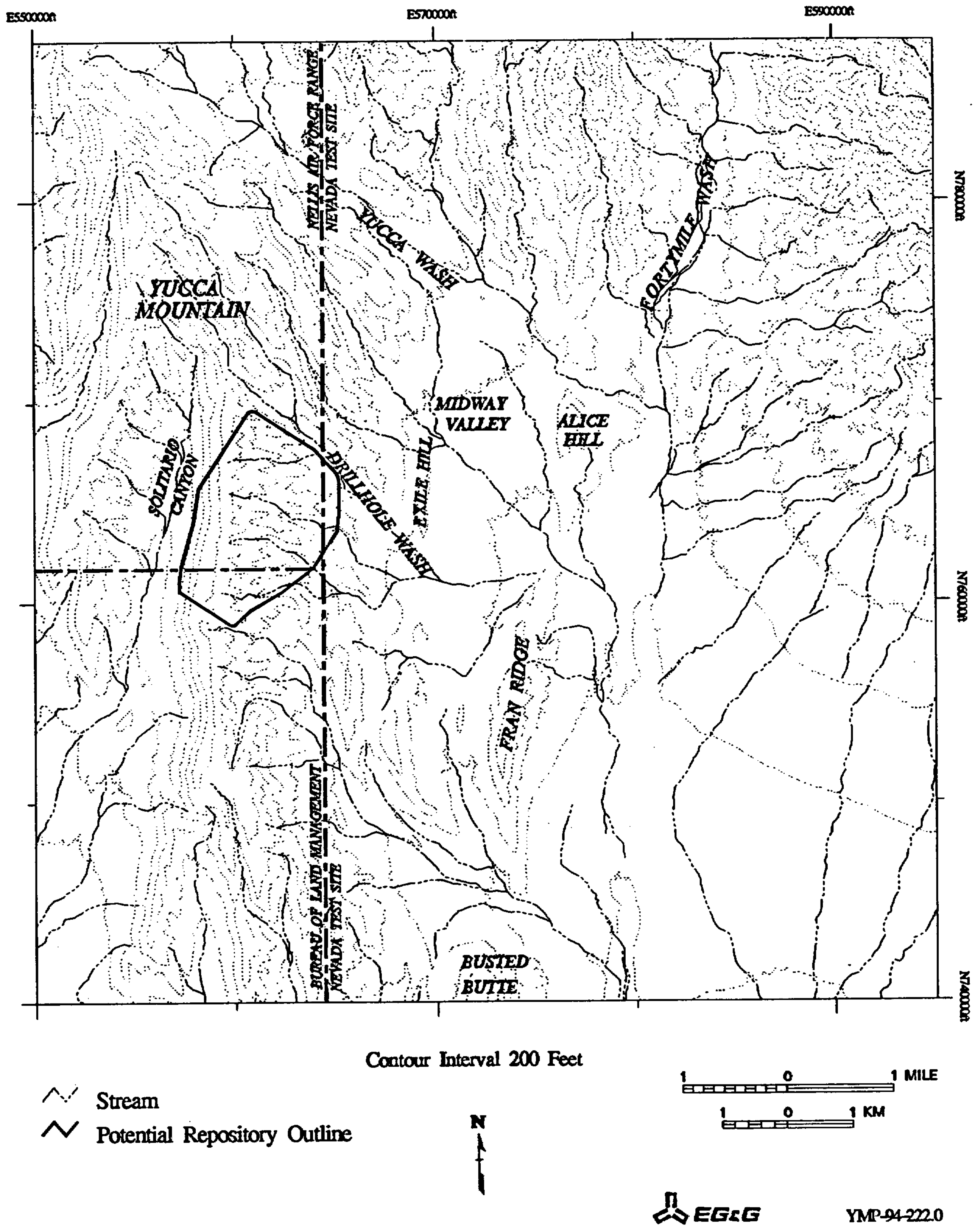
NEAR FIELD RADIOLOGICAL MONITORING SITES NF6 & NF87

● Selected Near Field Radiological Monitoring Sites. Note: site locations are preliminary at this time

PRO = Proposed Repository Outline
CCAB = Conceptual Controlled Area Boundary

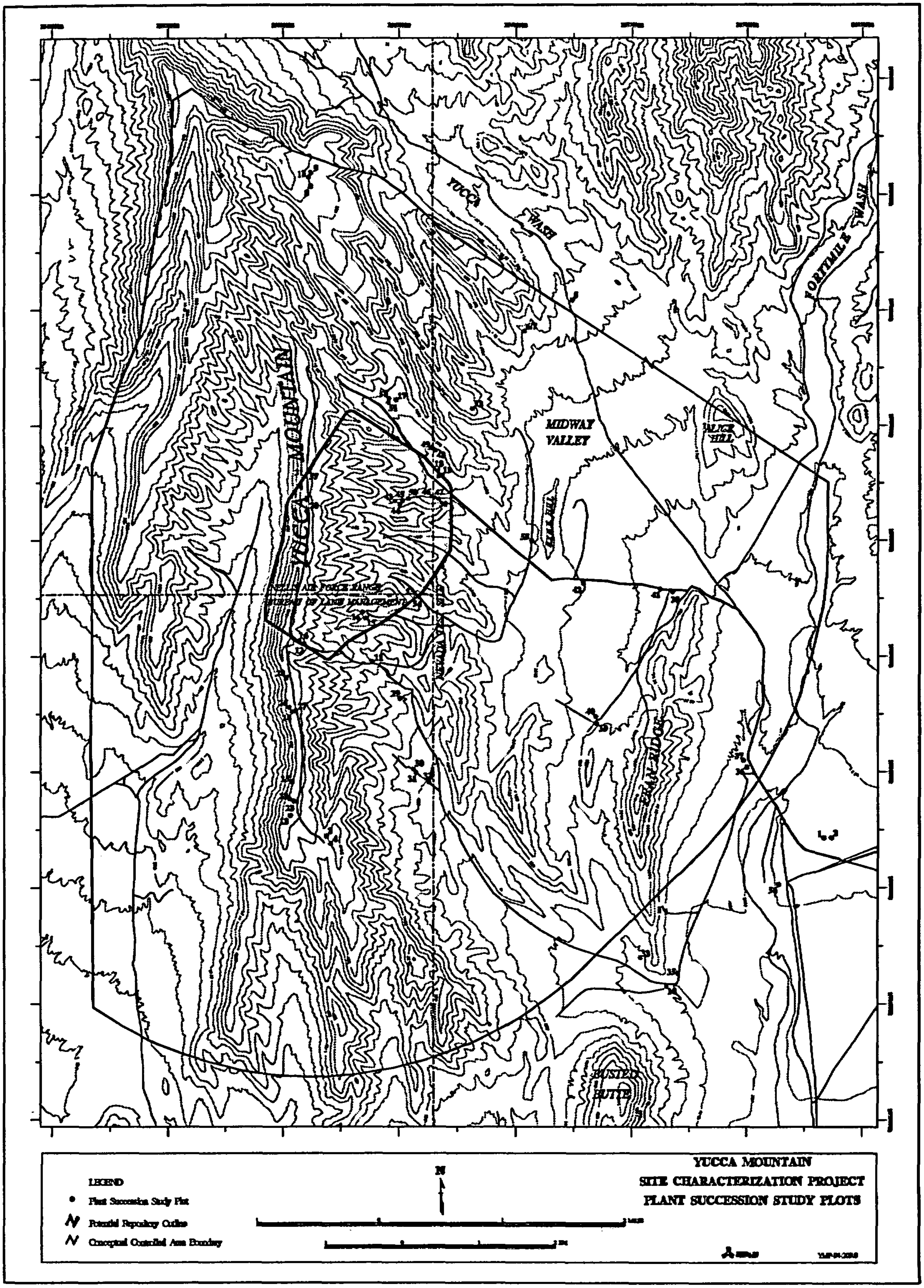
EG&G

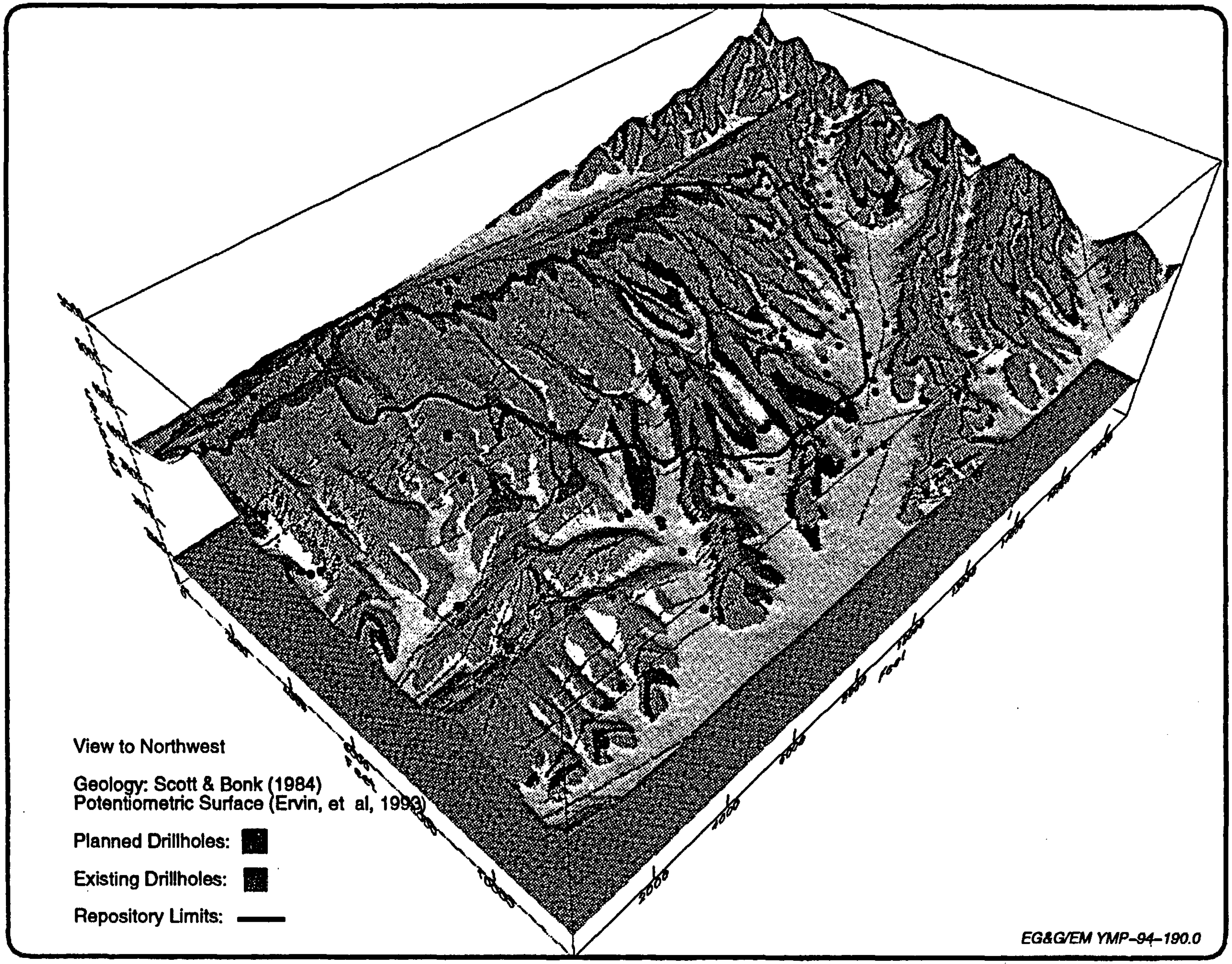
YMP-94-240.0

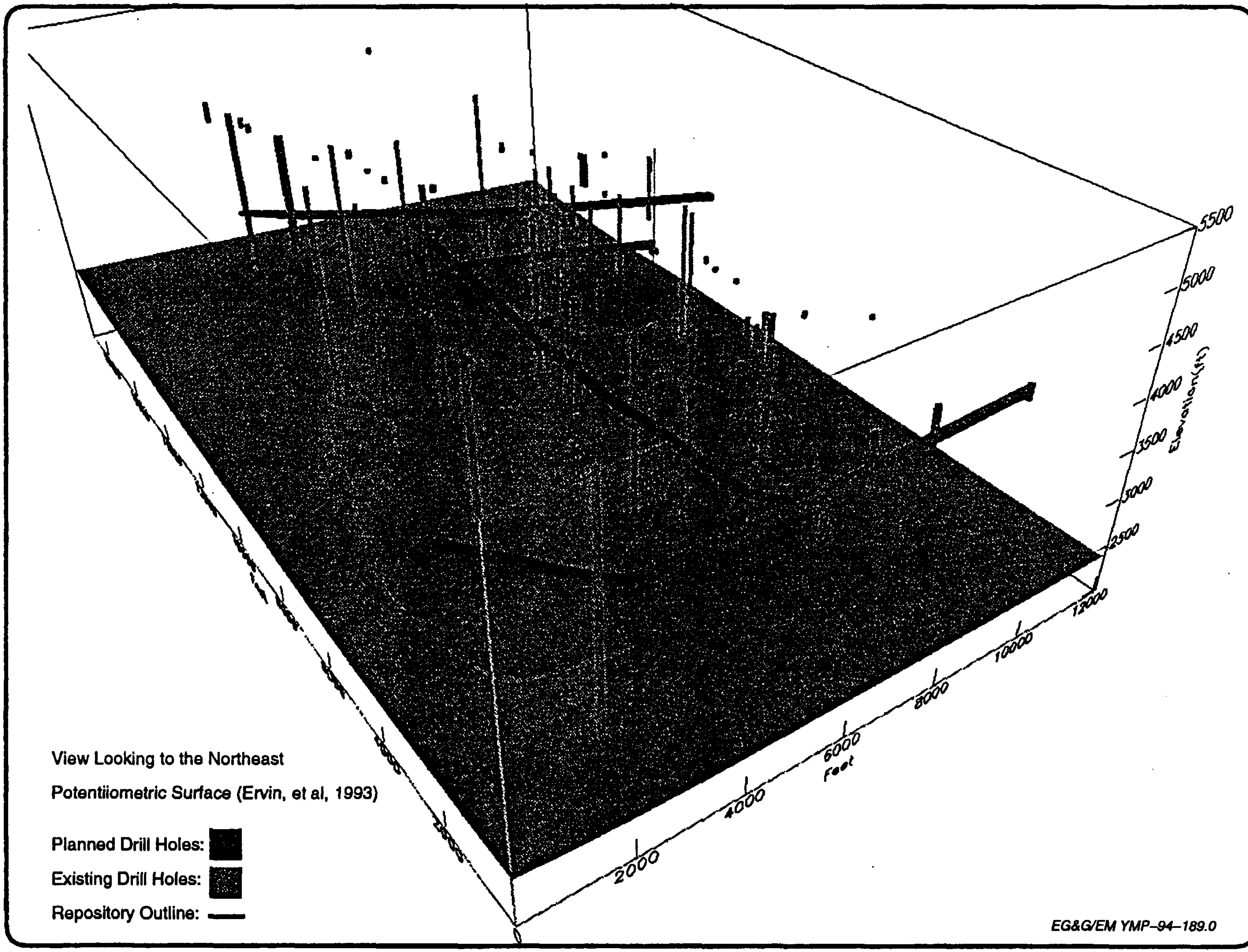


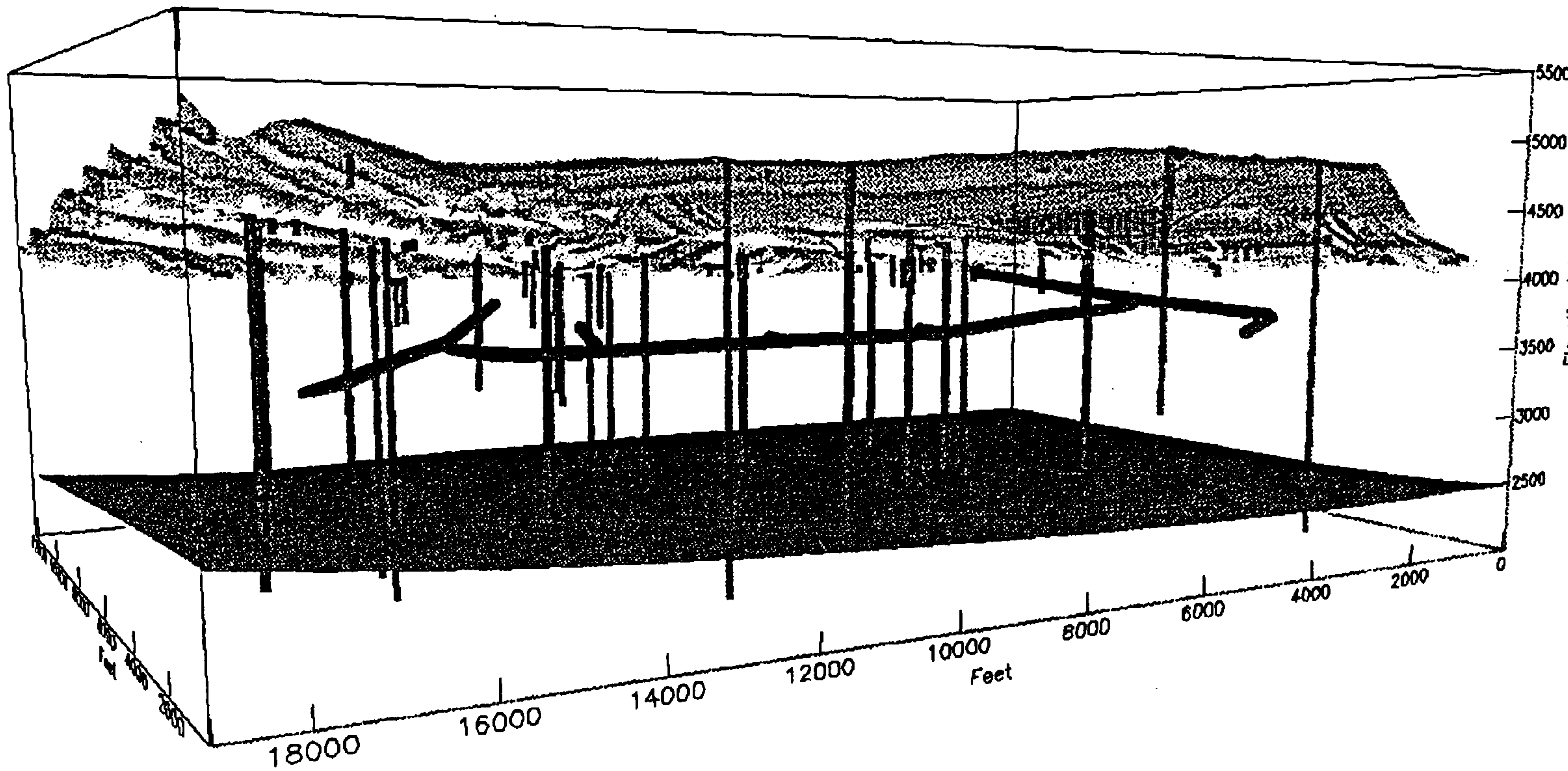
EG&G

YMP-94-222.0


YUCCA WASH
FORTYMILE WASH
MIDWAY VALLEY
ALICE HILL
EXILE HILL
YUCCA MOUNTAIN
NELLIS AIR FORCE RANGE
BUREAU OF LAND MANAGEMENT
FRAN RIDGE
BUSTED BUTTE
N
LEGEND
Plant Succession Study Plot
Potential Repository Outline
Conceptual Controlled Area Boundary
YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
PLANT SUCCESSION STUDY PLOTS


View to Northwest
Geology: Scott & Bonk (1984)
Potentiometric Surface (Ervin, et al, 1993)
Planned Drillholes:
Existing Drillholes:
Repository Limits:
EG&G/EM YMP-94-190.0


5500
5000
4500
4000
3500
3000
2500
Elevation(ft)
0
2000
4000
6000
8000
10000
12000
Feet
View Looking to the Northeast
Potentiiometric Surface (Ervin, et al, 1993)
Planned Drill Holes:
Existing Drill Holes:
Repository Outline:
EG&G/EM YMP-94-189.0



View Looking to theSoutheast

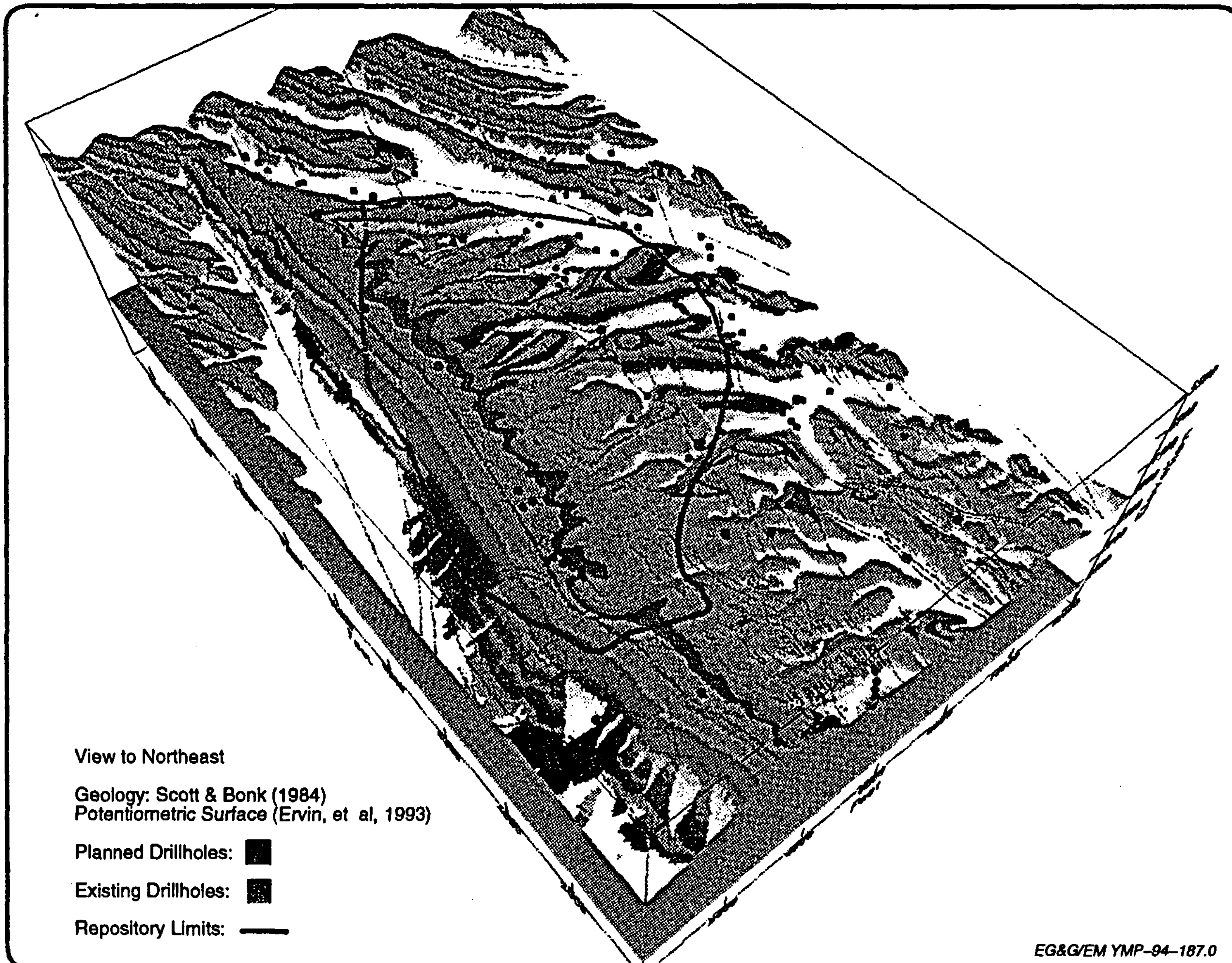
Geology: Scott & Bonk (1984)
Potentiiometric Surface (Ervin, et al, 1993)

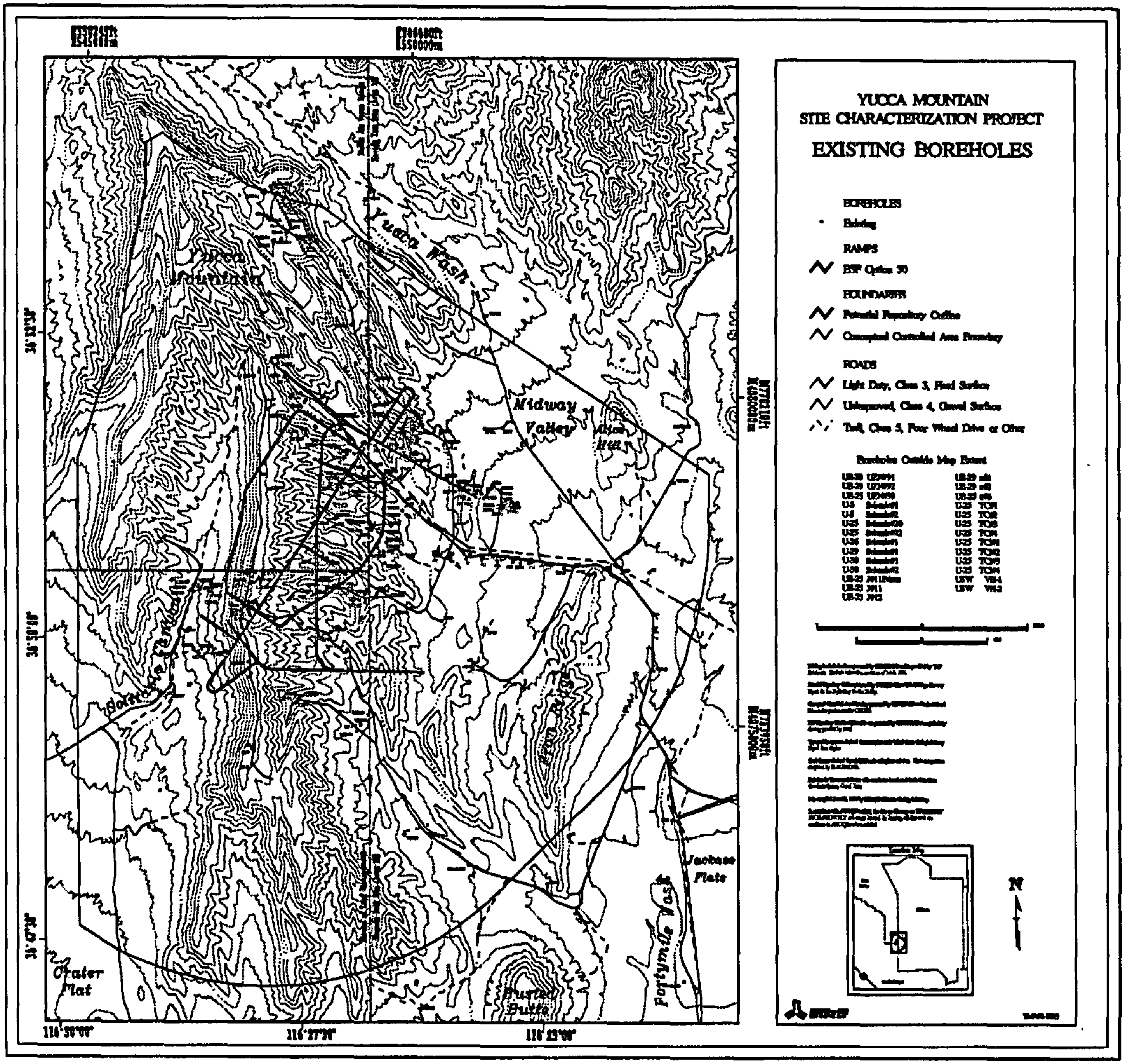
Planned Drill Holes:

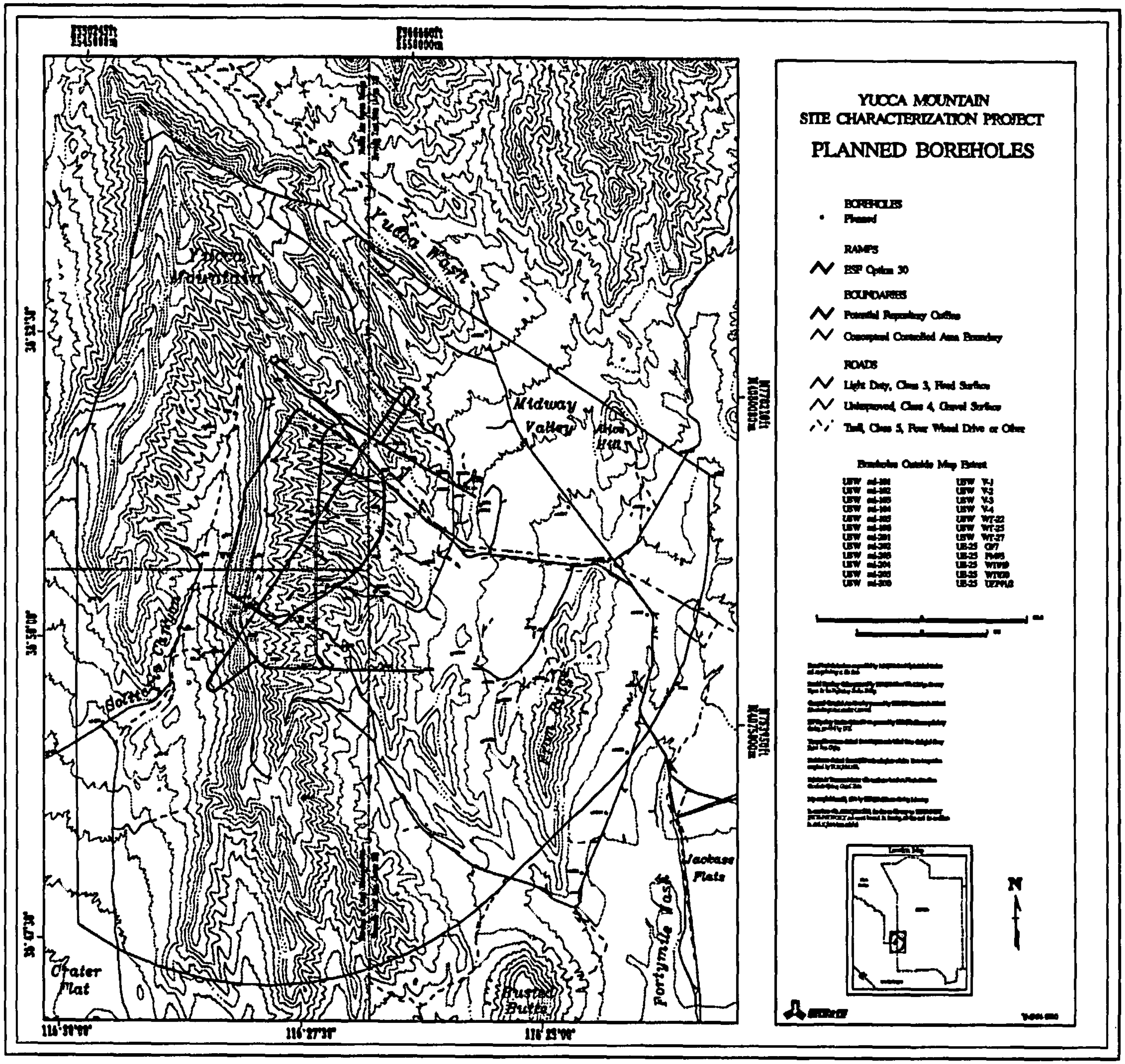
Existing Drill Holes:

Repository Outline:

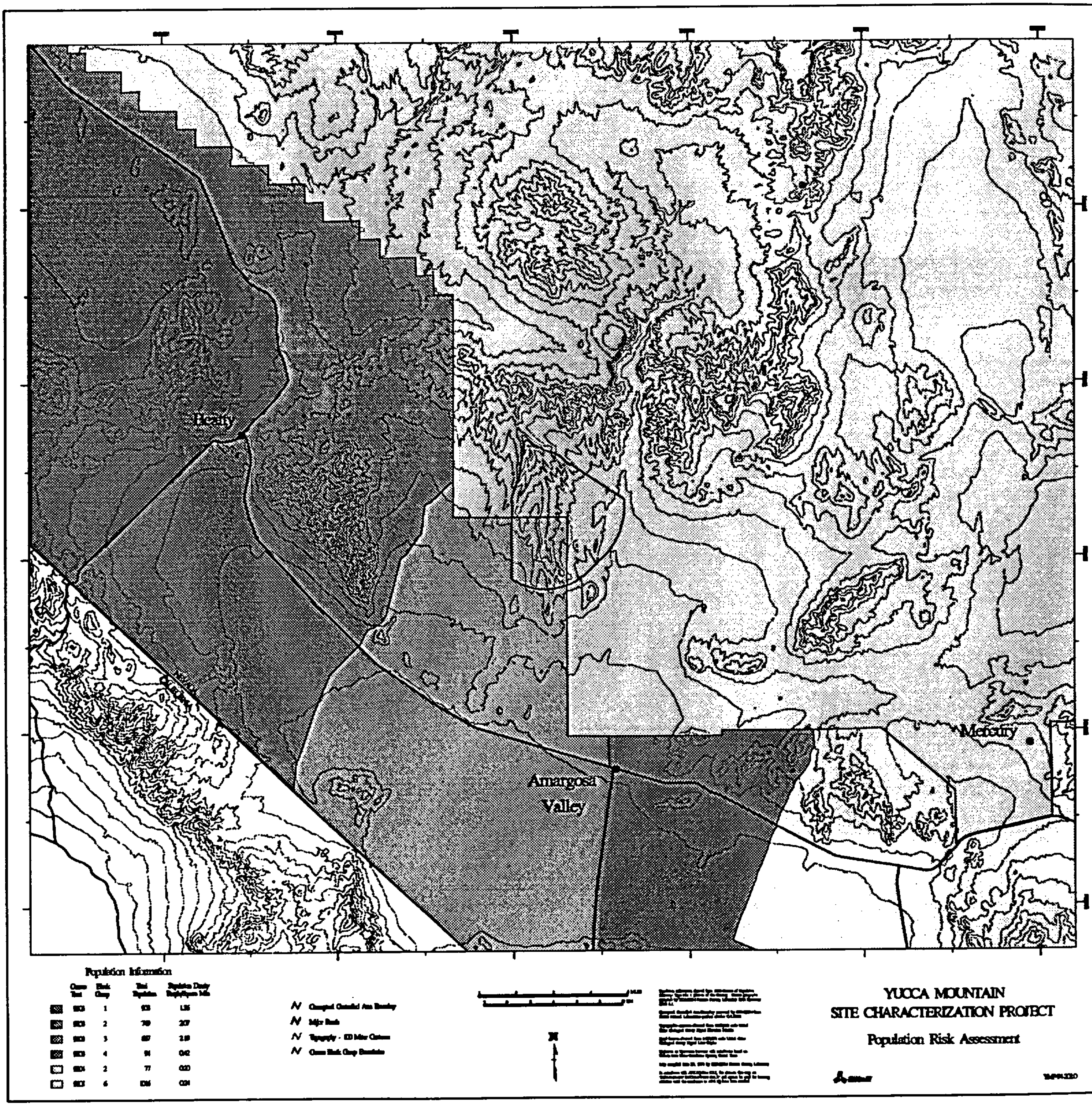
EG&G/EM YMP-94-188.0


View to Northeast
Geology: Scott & Bonk (1984)
Potentiometric Surface (Ervin, et al, 1993)
Planned Drillholes:
Existing Drillholes:
Repository Limits:
EG&G/EM YMP-94-187.0

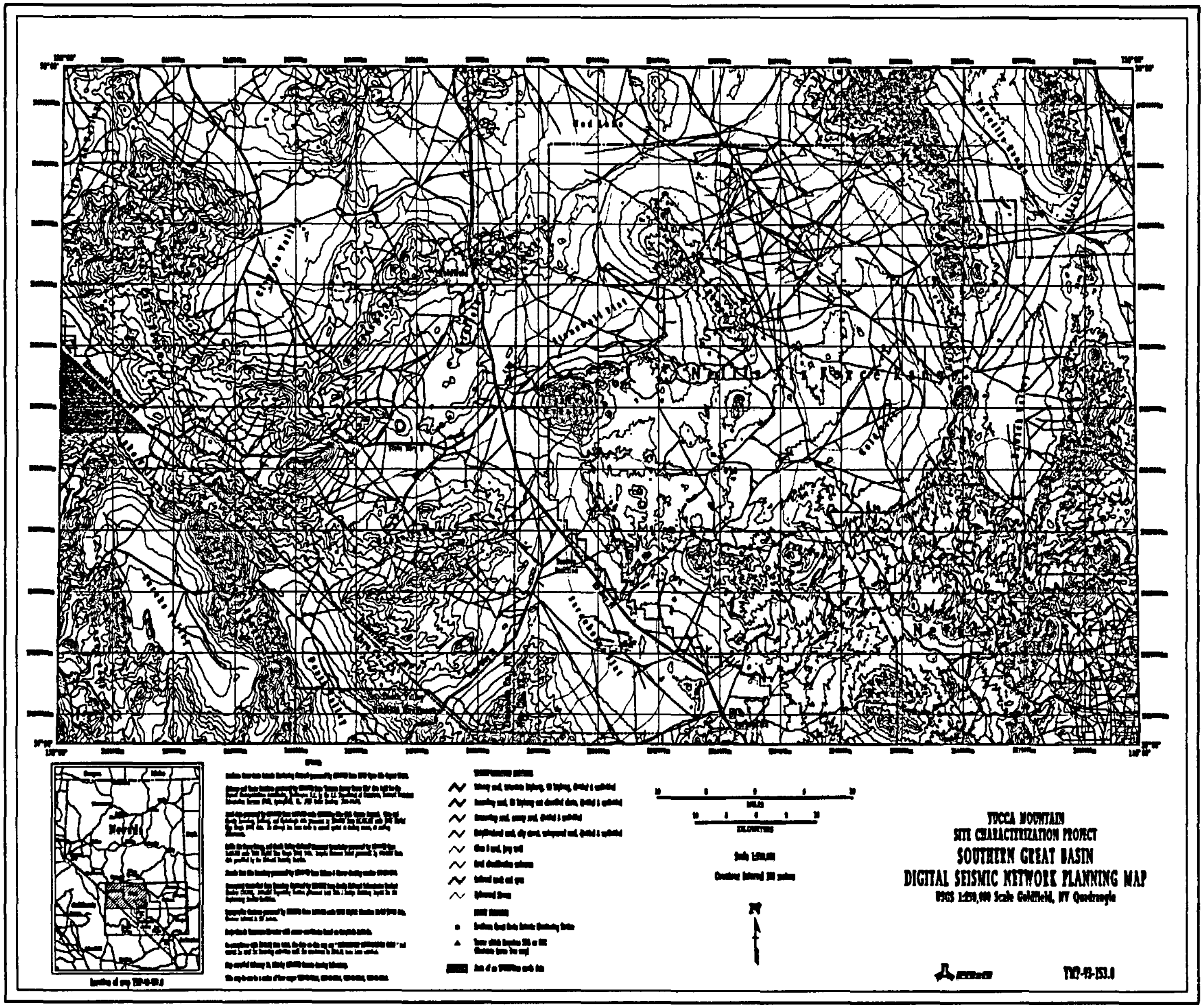

YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
EXISTING BOREHOLES
BOREHOLES
Existing
RAMPS
ESF Option 30
BOUNDARIES
Potential Repository Outline
Conceptual Controlled Area Boundary
ROADS
Light Duty, Class 3, Hard Surface
Unimproved, Class 4, Gravel Surface
Trail, Class 5, Four Wheel Drive or Other
Boreholes Outside Map Extent
Yucca Mountain
Yucca Wash
Midway Valley
Solitario Canyon
Crater Flat
Jackass Flats
Fortymile Wash
Busted Butte
116°30'00"
116°27'30"
116°25'00"
N



YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
PLANNED BOREHOLES
BOREHOLES
Planned
RAMPS
ESF Option 30
BOUNDARIES
Potential Repository Outline
Conceptual Controlled Area Boundary
ROADS
Light Duty, Class 3, Hard Surface
Unimproved, Class 4, Gravel Surface
Trail, Class 5, Four Wheel Drive or Other
Boreholes Outside Map Extent
Yucca Mountain
Yucca Wash
Midway Valley
Solitario Canyon
Crater Flat
Busted Butte
Fortymile Wash
Jackass Flats
116°30'00"
116°27'30"
116°25'00"
36°52'30"
36°50'00"
36°47'30"
N


Beatty
Amargosa Valley
Mercury
Population Information
YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
Population Risk Assessment

jupiter: zehplot Job: ymp93153_023181537_1.rgc Date: Sat Dec 24 18:20:50 1994



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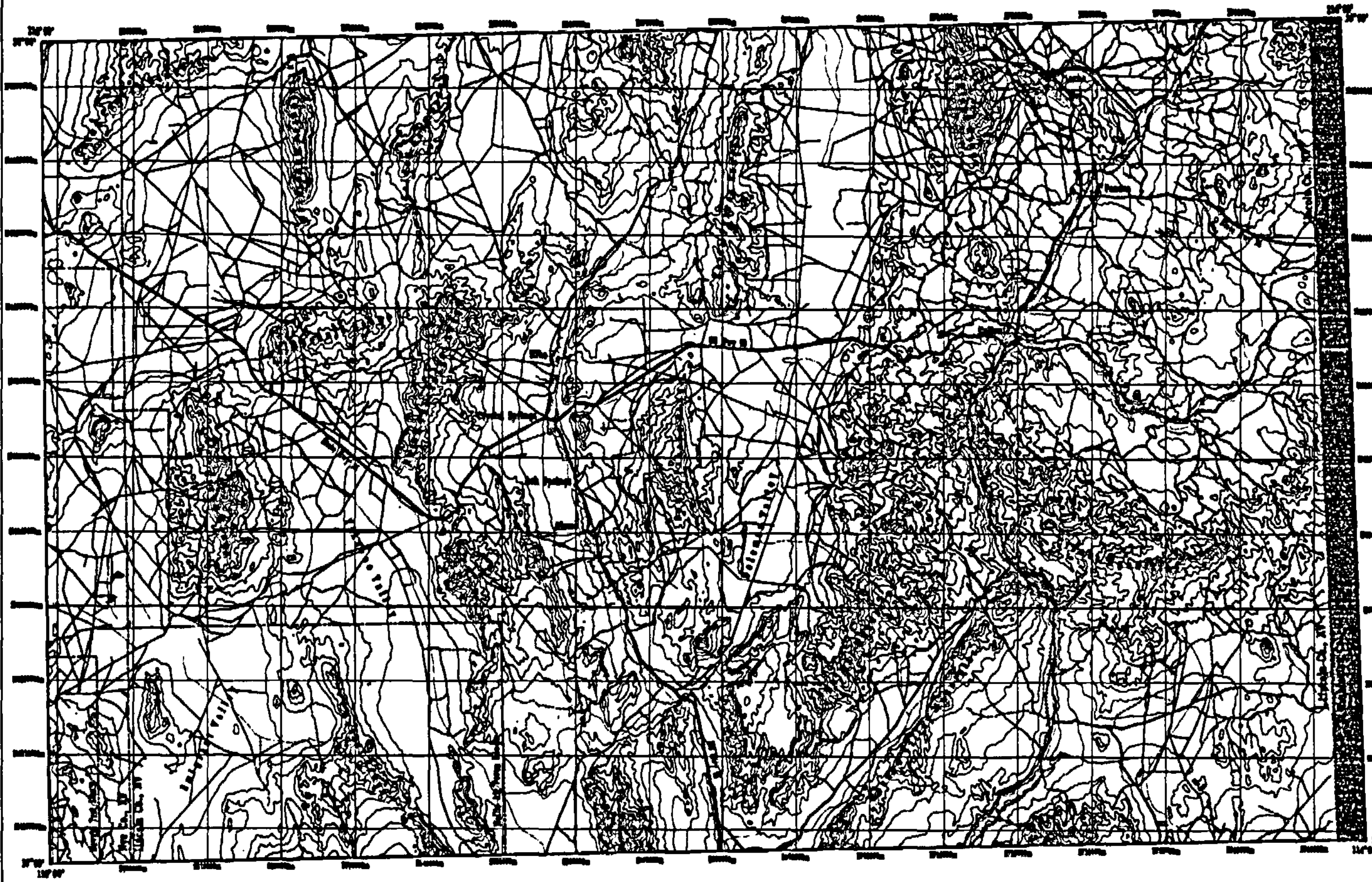
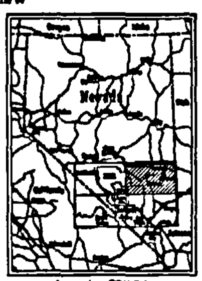


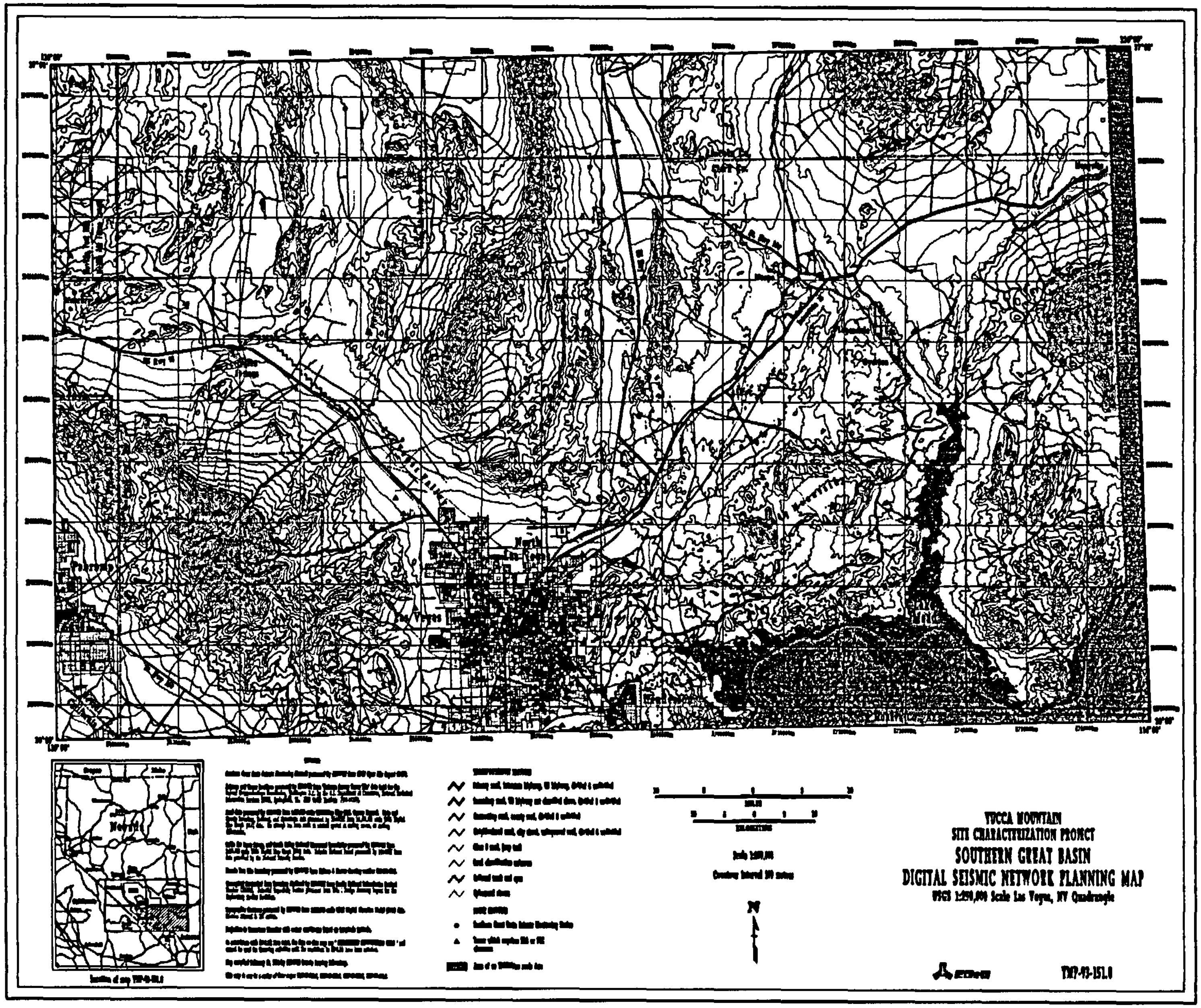


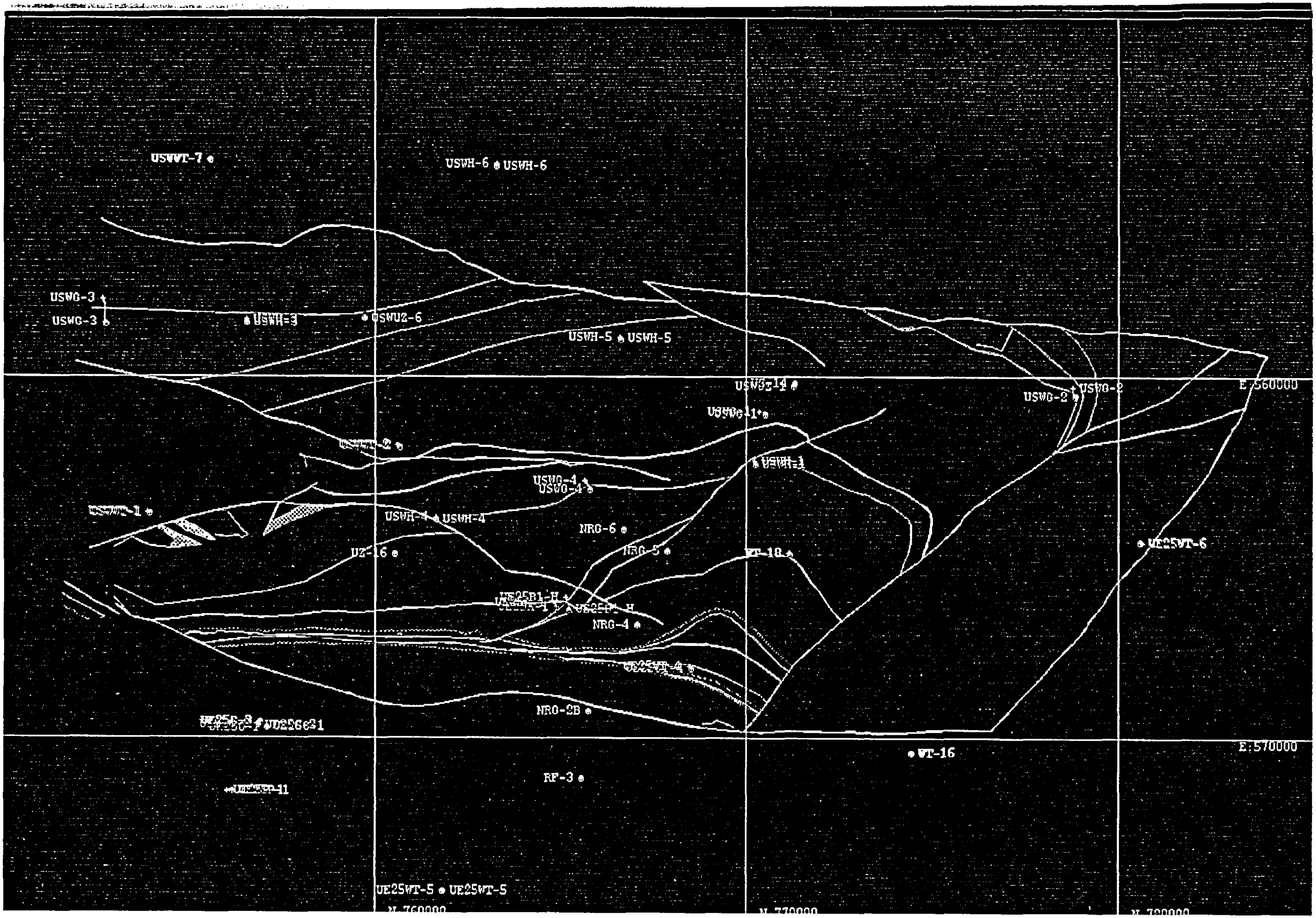
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

SOUTHERN GREAT BASIN DIGITAL SEISMIC NETWORK PLANNING MAP

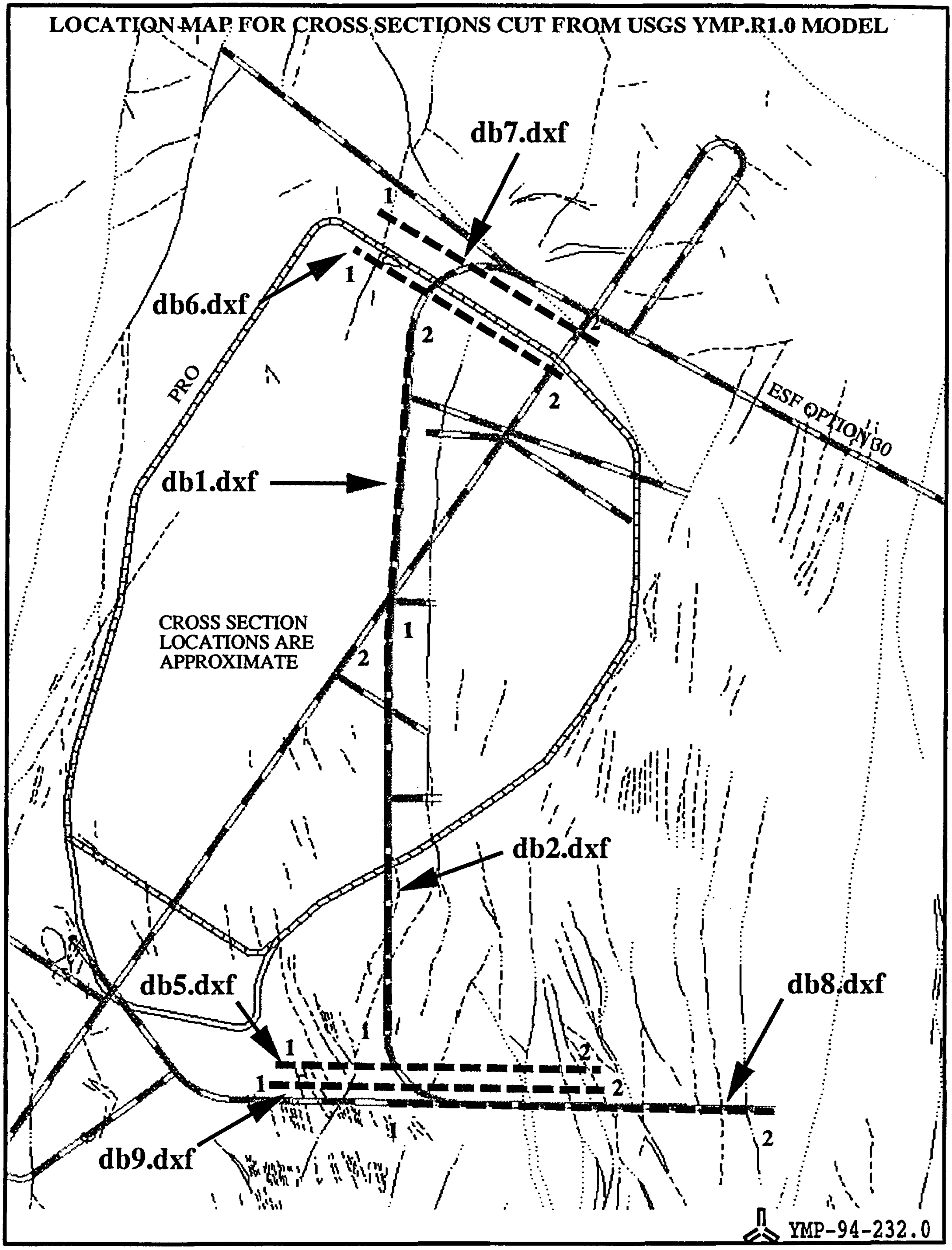
USGS 1:250,000 Scale Caliente, NV Quadrangle

YMP-93-152.8

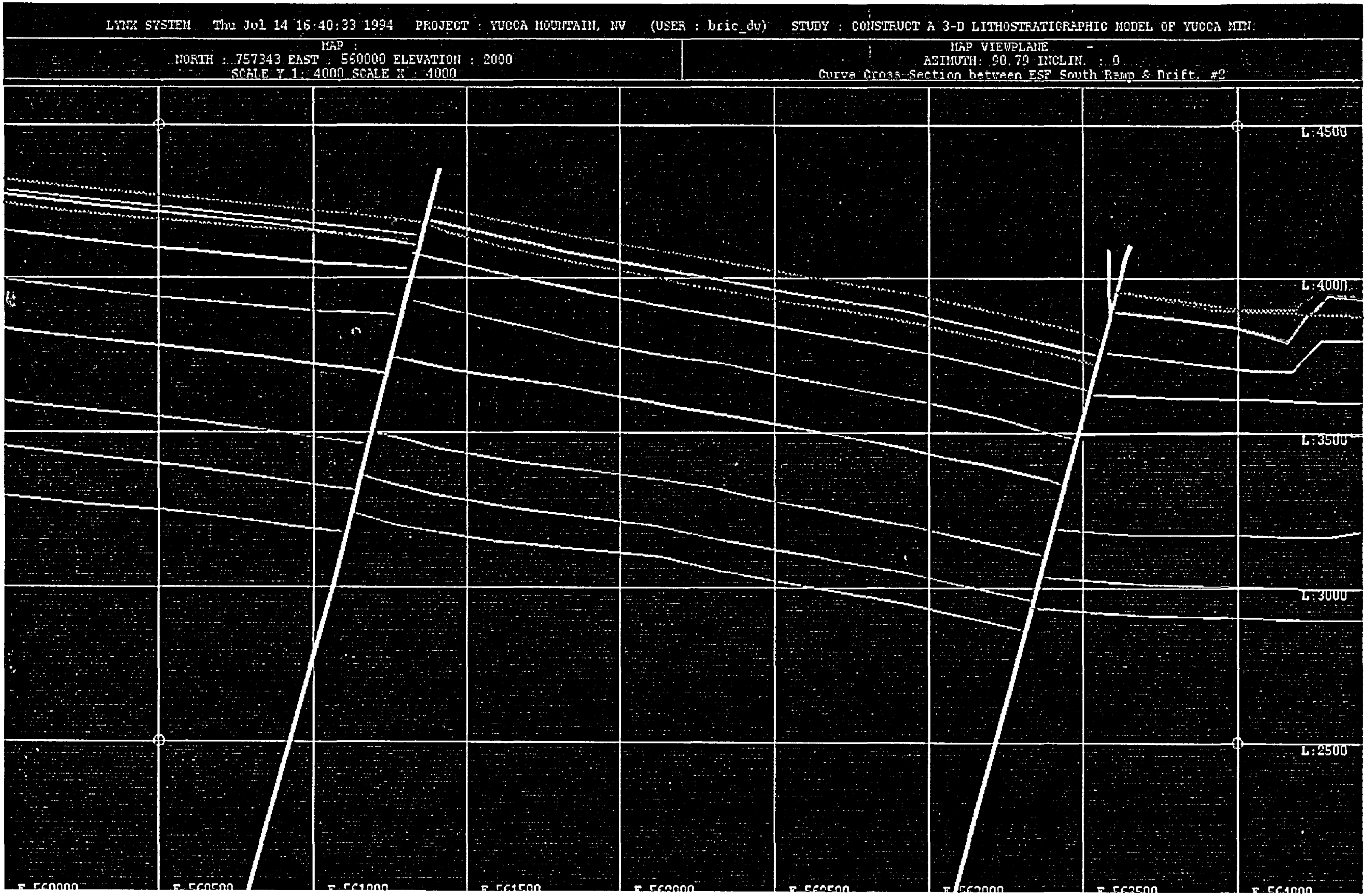

Las Vegas
YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
SOUTHERN GREAT BASIN
DIGITAL SEISMIC NETWORK PLANNING MAP
USGS 1:250,000 Scale Las Vegas, NV Quadrangle
YMP-93-151.0



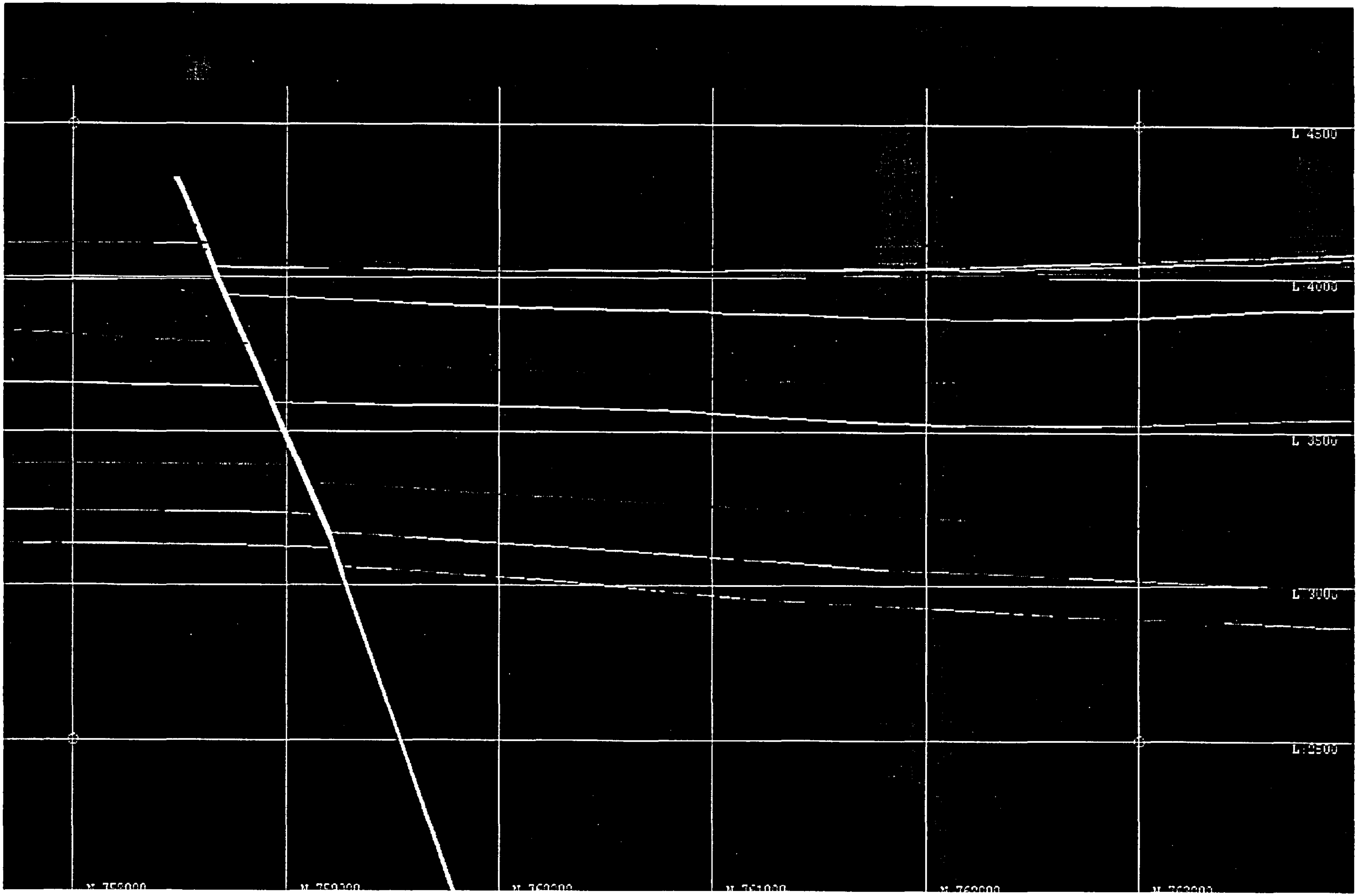
USWH-6
USWH-6
USWG-3
USWG-3
USWH-5
USWH-5
E:560000
USWG-2
USWG-2
USWG-4
USWG-4
USWH-4
USWH-4
NRG-6
UZ-16
NRG-4
NRG-2B
UE25WT-6
E:570000
WT-16
RF-3
UE25WT-5
UE25WT-5



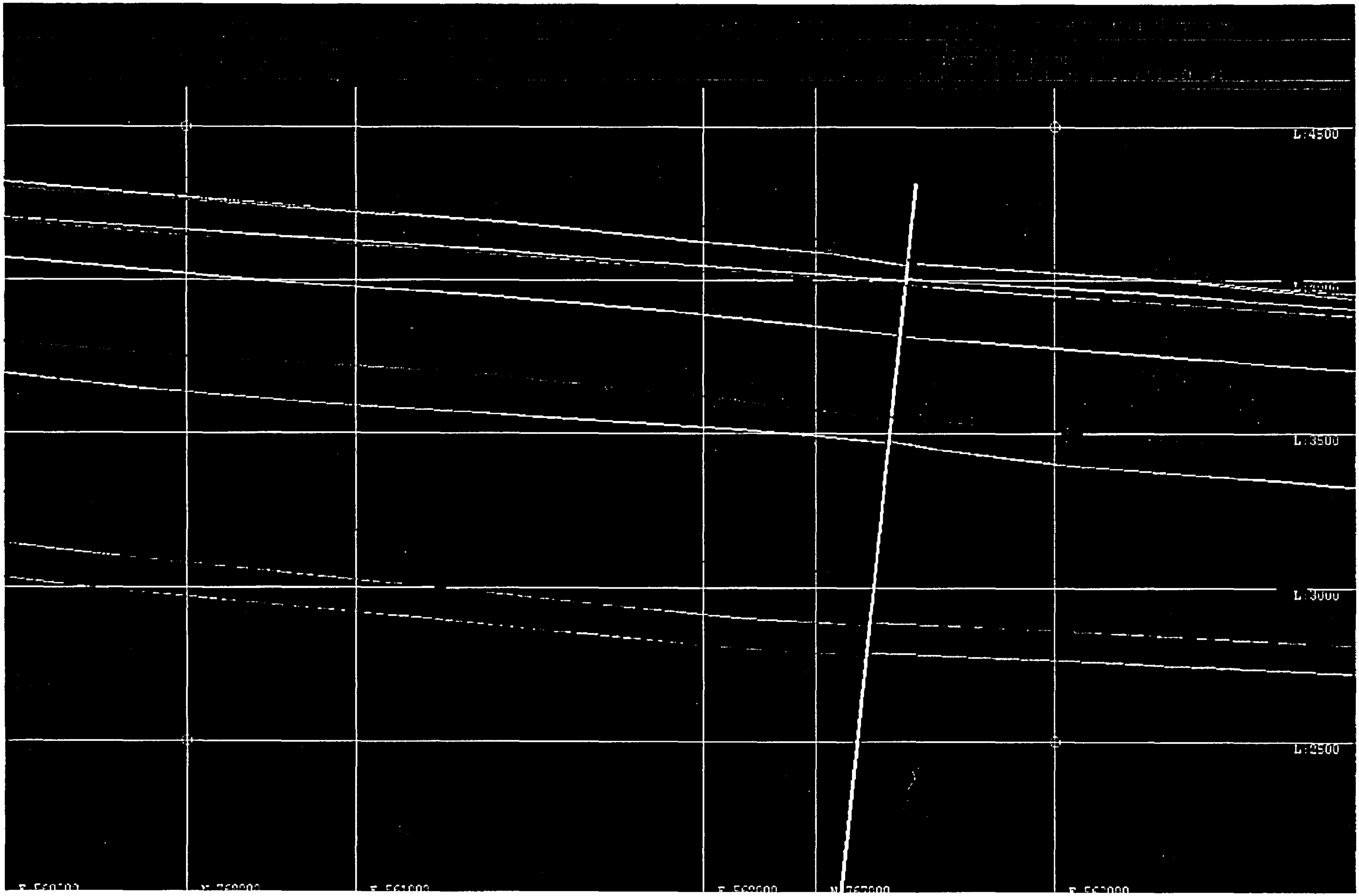
LOCATION MAP FOR CROSS SECTIONS CUT FROM USGS YMP.R1.0 MODEL
db7.dxf
db6.dxf
db1.dxf
PRO
ESF OPTION 30
CROSS SECTION LOCATIONS ARE APPROXIMATE
db2.dxf
db5.dxf
db8.dxf
db9.dxf
YMP-94-232.0


LYNX SYSTEM Thu Jul 14 16:40:33 1994 PROJECT : YUCCA MOUNTAIN, NV (USER : bric_dv) STUDY : CONSTRUCT A 3-D LITHOSTRATIGRAPHIC MODEL OF YUCCA MTN.
MAP :
NORTH : 757343 EAST : 560000 ELEVATION : 2000
SCALE Y 1: 4000 SCALE X : 4000
MAP VIEWPLANE -
AZIMUTH: 90.79 INCLIN. : 0
Curve Cross-Section between ESF South Ramp & Drift. #2
L:4500
L:4000
L:3500
L:3000
L:2500

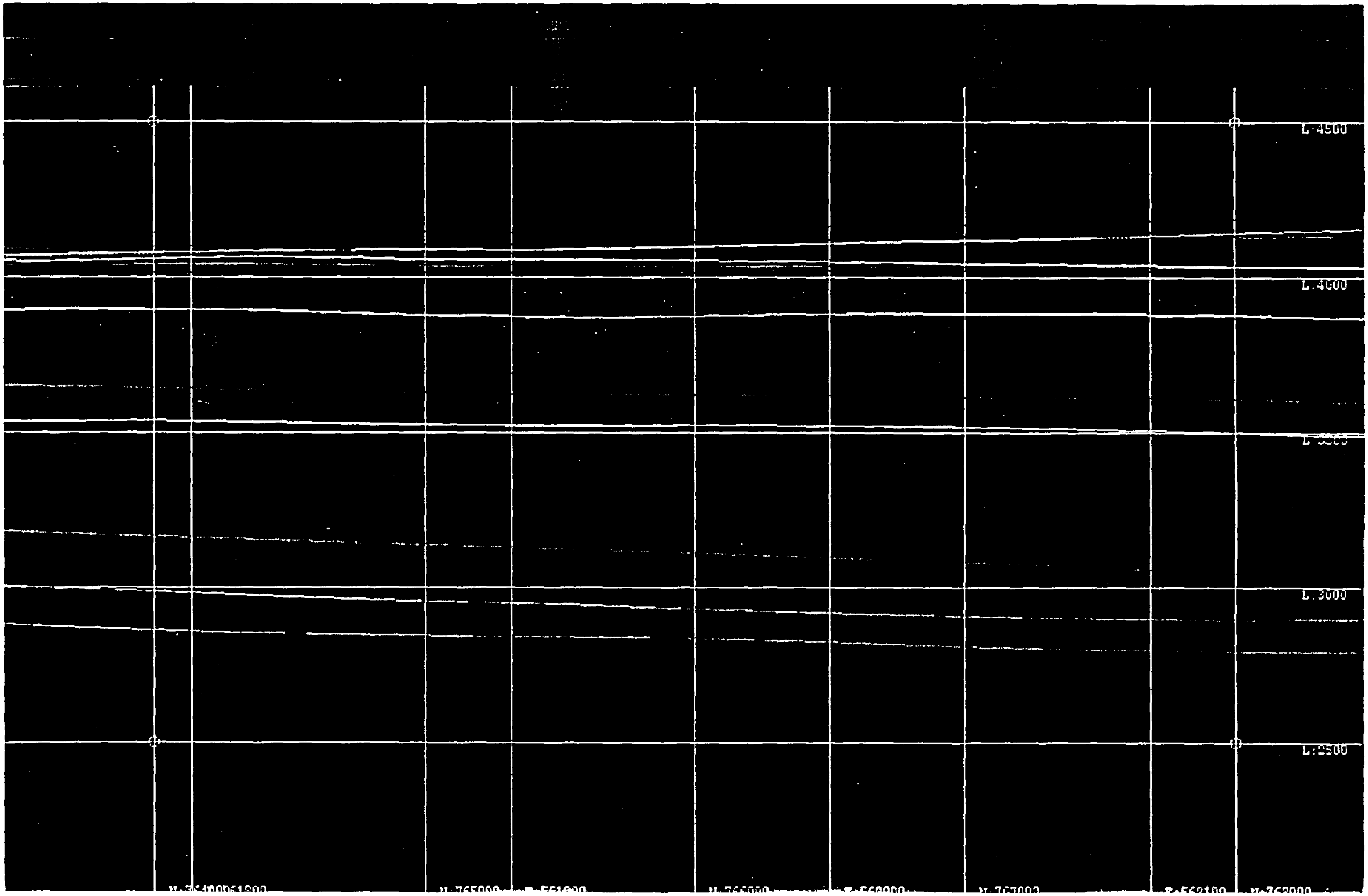
YMP-94-226.0
db2.dxf



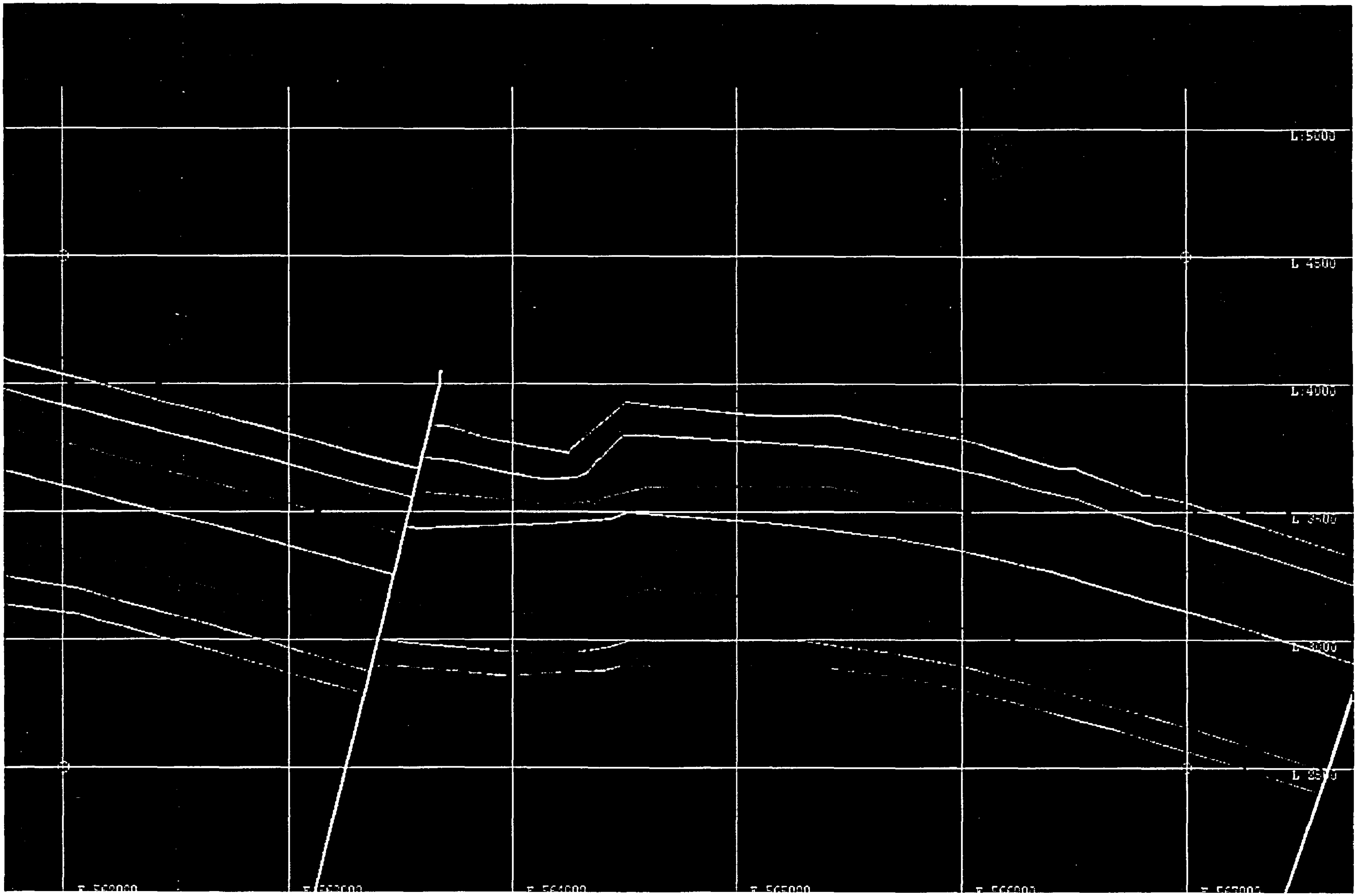
YMP-94-227.Ø
dbs.dxf



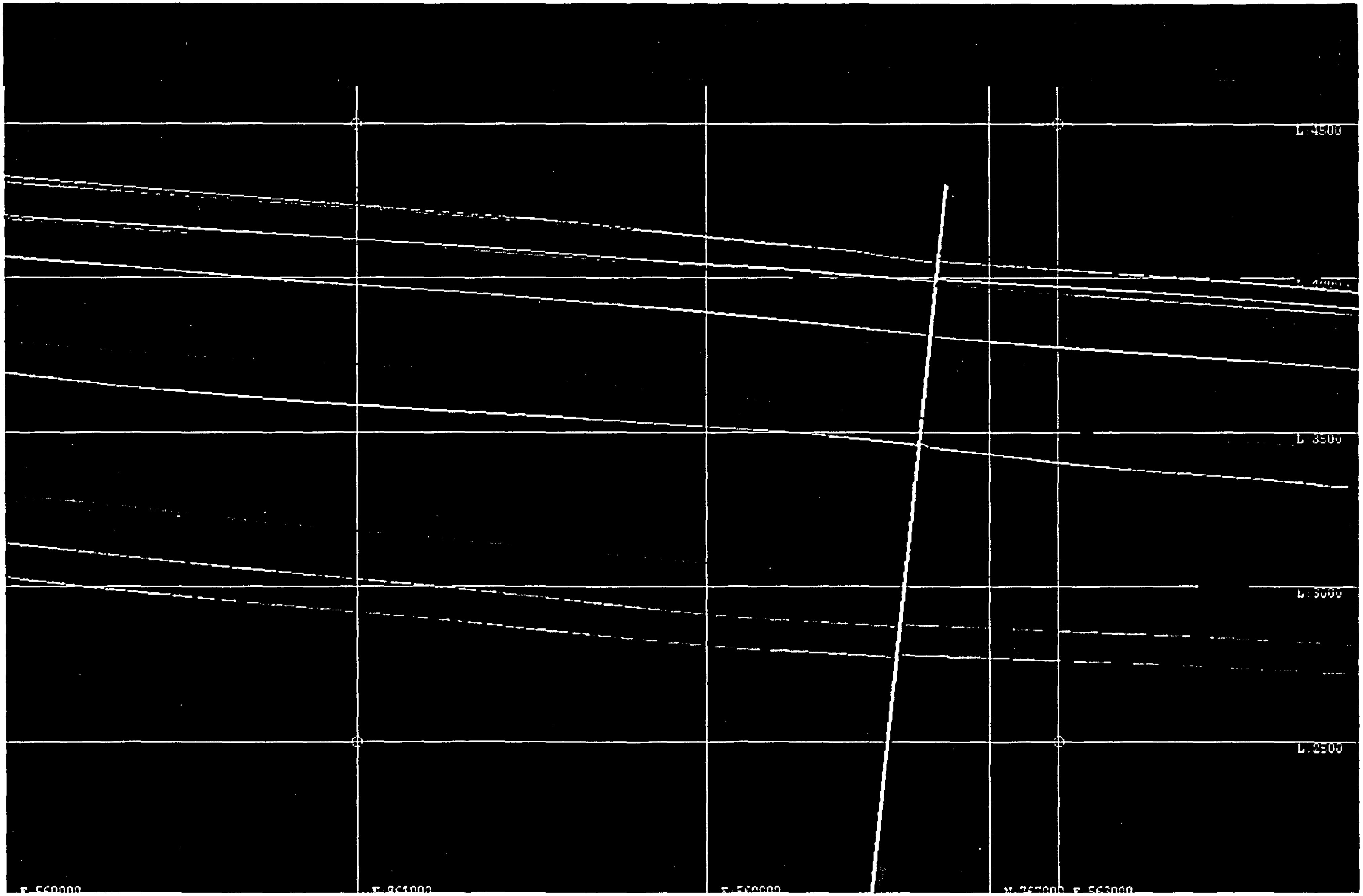
YMP-94-225.Ø
db1.dxF

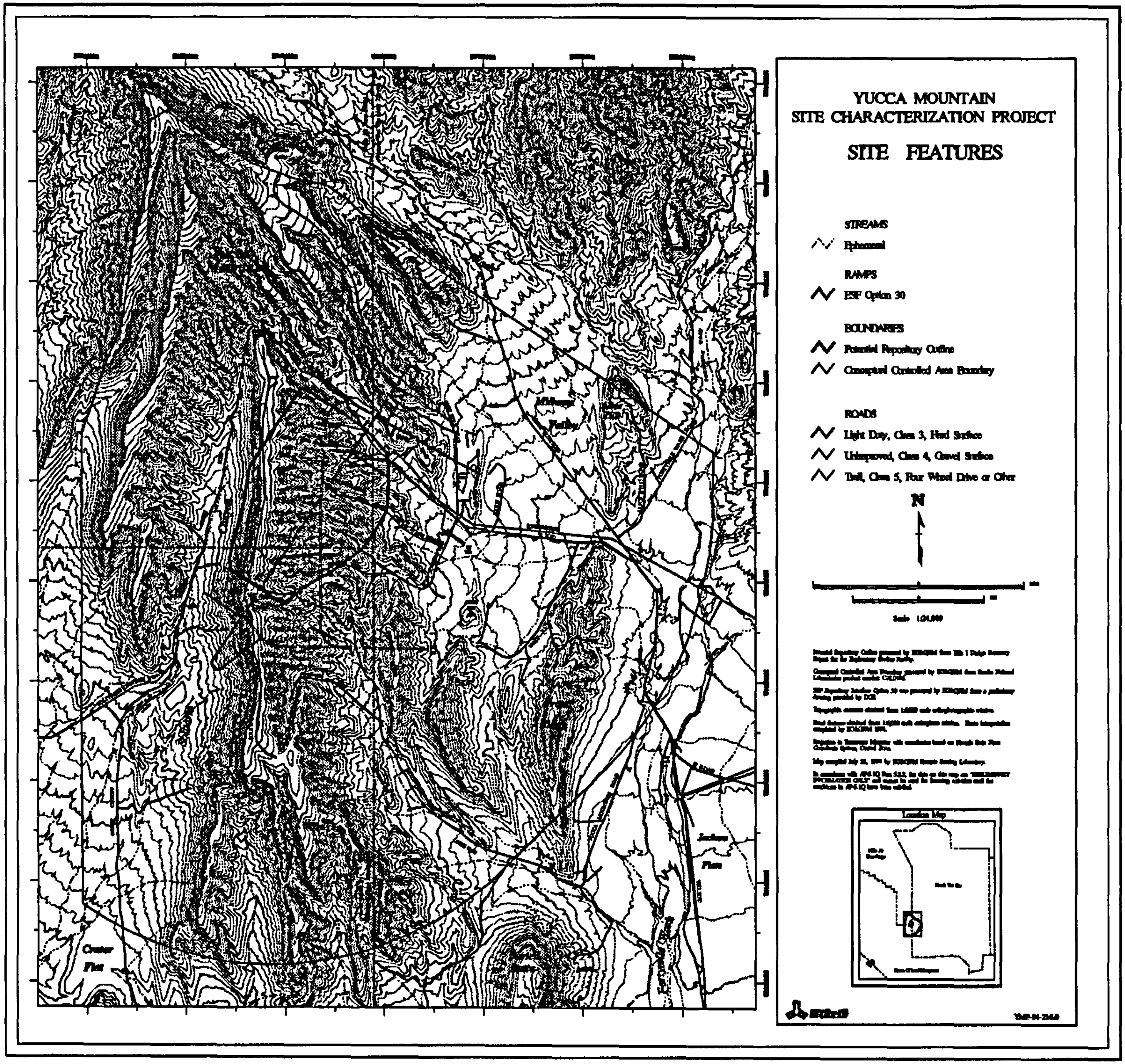


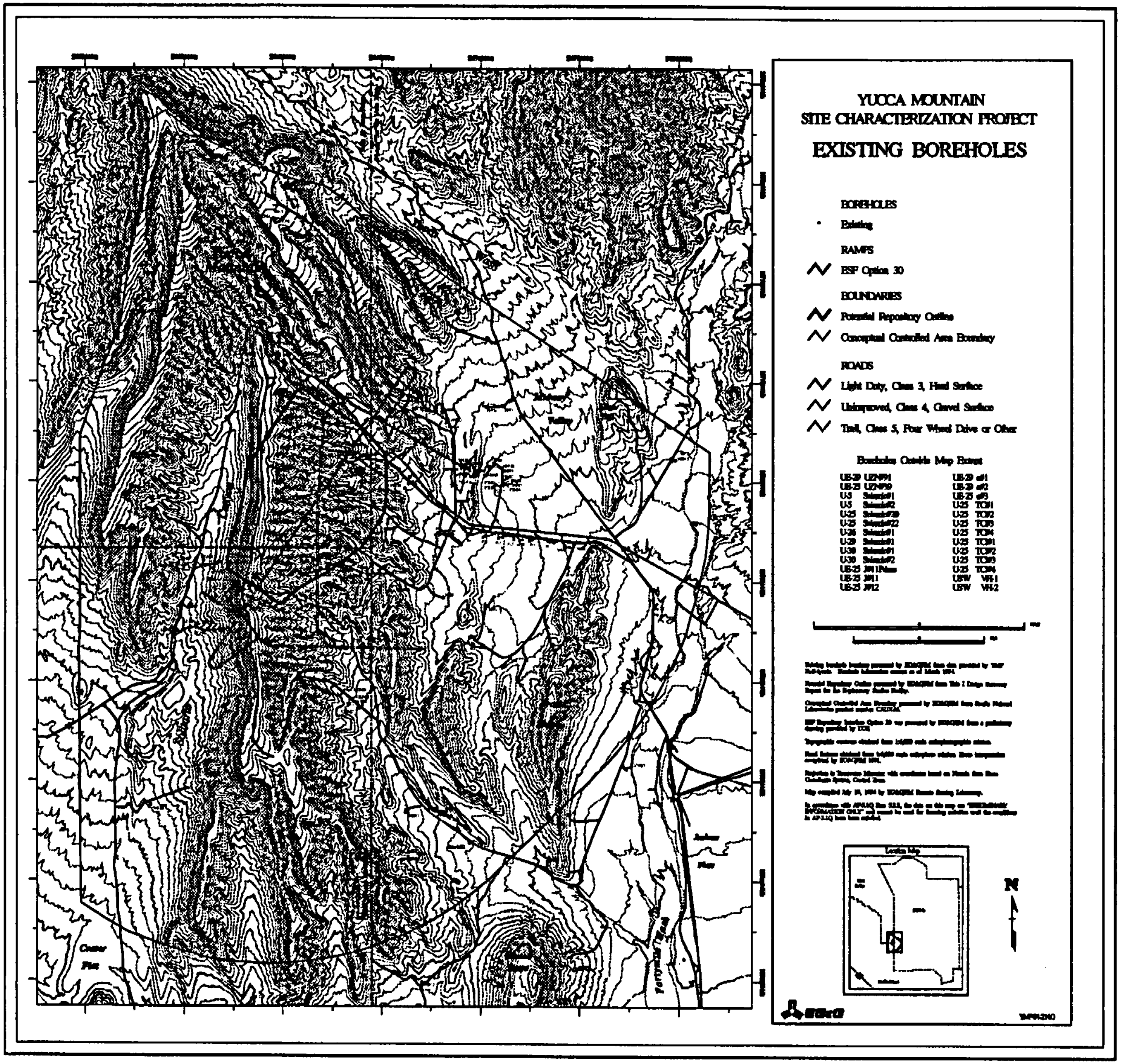
YMP-94-229.0
dt7.dxf

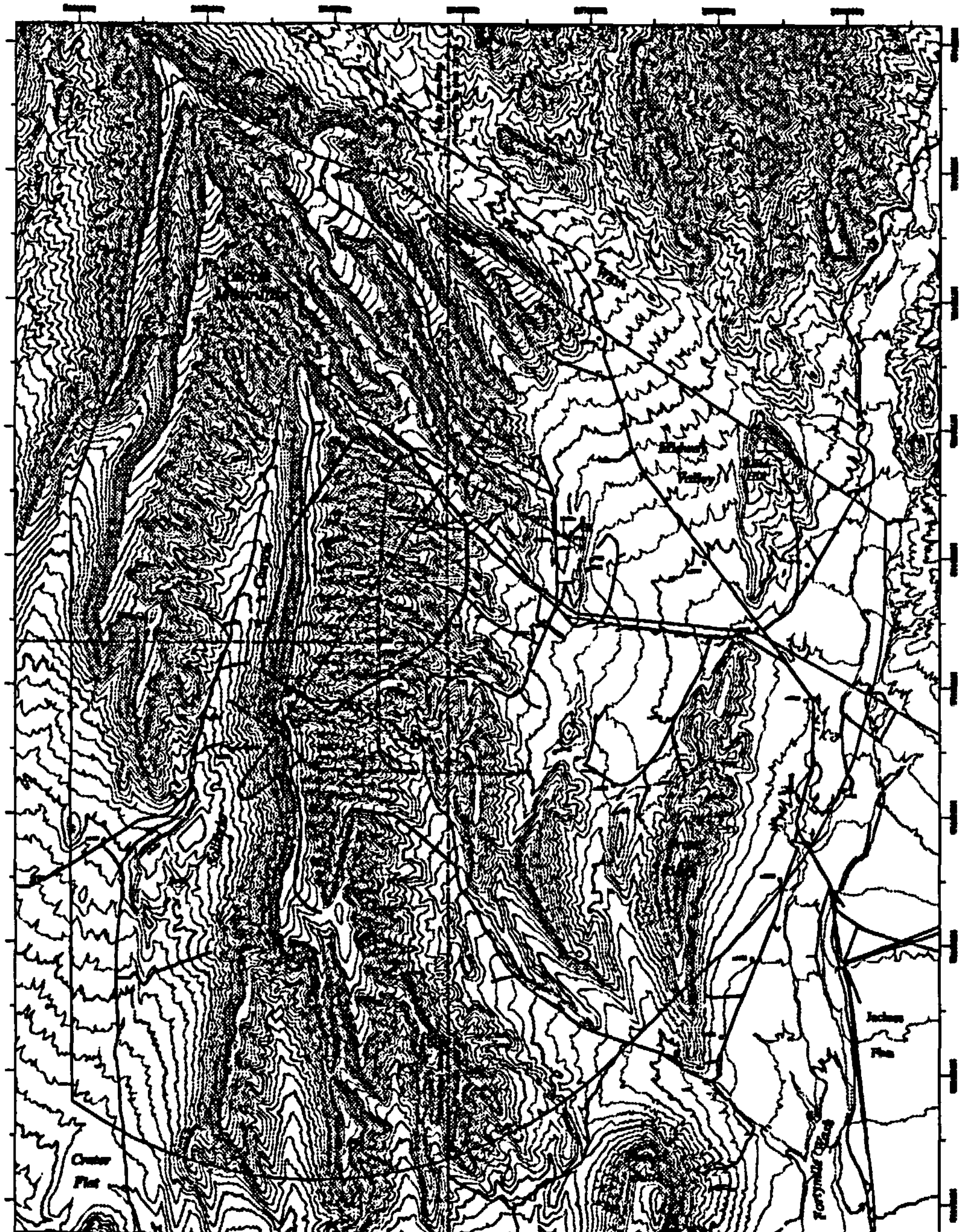


YMY-44-228.Φ
d66.dxf




YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
SITE FEATURES
STREAMS
Ephemeral
RAMPS
ESF Option 30
BOUNDARIES
Potential Repository Outline
Conceptual Controlled Area Boundary
ROADS
Light Duty, Class 3, Hard Surface
Unimproved, Class 4, Gravel Surface
Trail, Class 5, Four Wheel Drive or Other
N
Location Map
Midway Valley
Crater Flat
Jackass Flats


YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
EXISTING BOREHOLES
BOREHOLES
Existing
RAMPS
ESF Option 30
BOUNDARIES
Potential Repository Outline
Conceptual Controlled Area Boundary
ROADS
Light Duty, Class 3, Hard Surface
Unimproved, Class 4, Gravel Surface
Trail, Class 5, Four Wheel Drive or Other
Boreholes Outside Map Extent
Location Map
N



YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

PLANNED BOREHOLES

BOREHOLES
- Planned

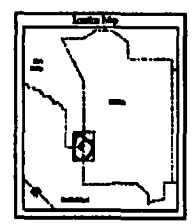
RAMPS
ESF Option 30

BOUNDARIES
Potential Repository Outline
Conceptual Controlled Area Boundary

ROADS
Light Duty, Class 3, Hard Surface
Unimproved, Class 4, Gravel Surface
Trail, Class 5, Four Wheel Drive or Other

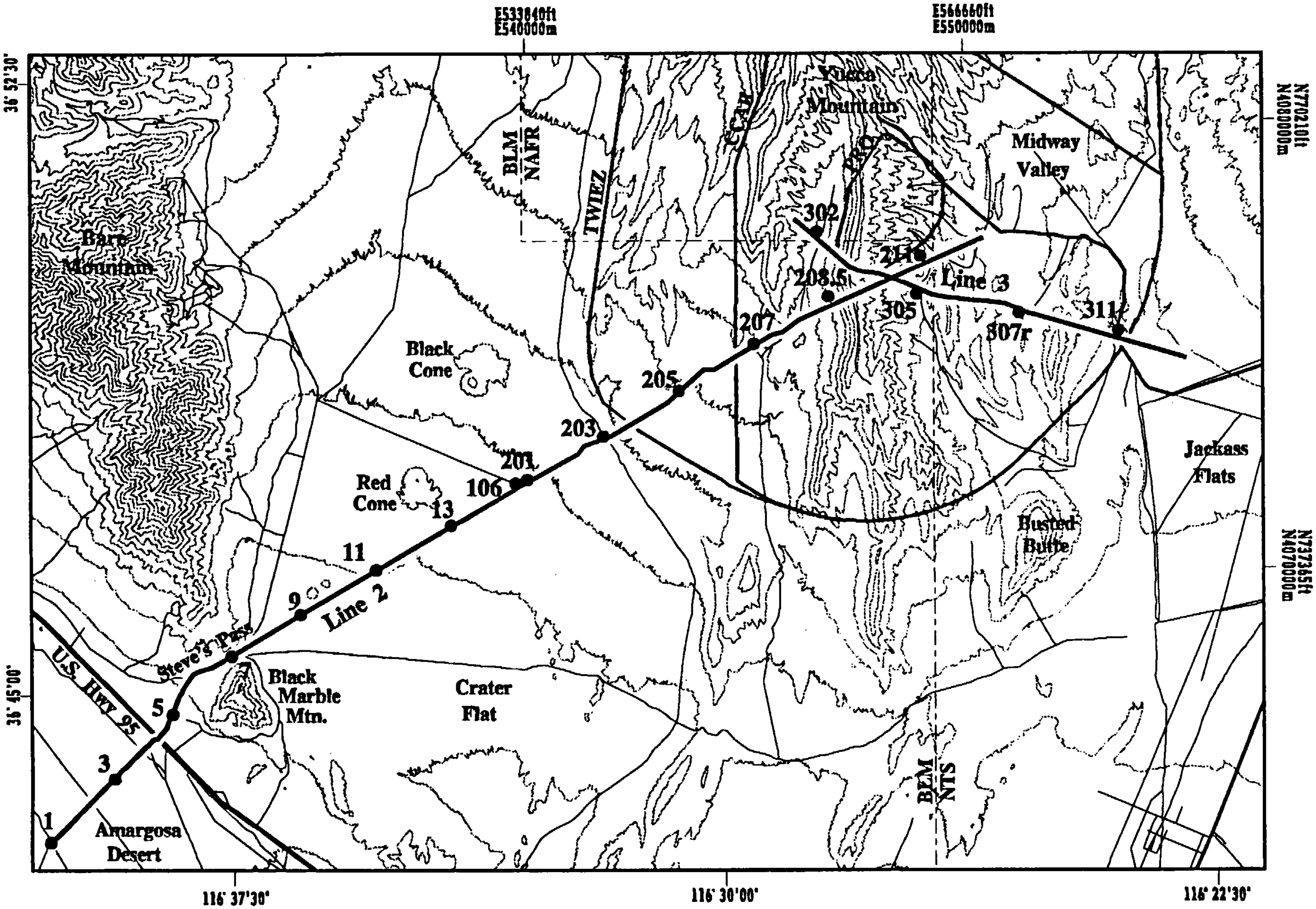
Boreholes Outside Map Extent

USW [illegible]-101	USW V-1
USW [illegible]-102	USW V-2
USW [illegible]-103	USW V-3
USW [illegible]-104	USW V-4
USW [illegible]-105	USW WT-22
USW [illegible]-106	USW WT-25
USW [illegible]-201	USW WT-27
USW [illegible]-202	UE-25 C#7
USW [illegible]-203	UE-25 FM#5
USW [illegible]-204	UE-25 WW19
USW [illegible]-205	UE-25 WW20
USW [illegible]-302	UE-25 UZN#2
USW [illegible]-516	



N

YMP-94-215.0



LEGEND

● Proposed Shothole

Proposed Seismic Reflection Line

N

2 1 0 1 2 Mi

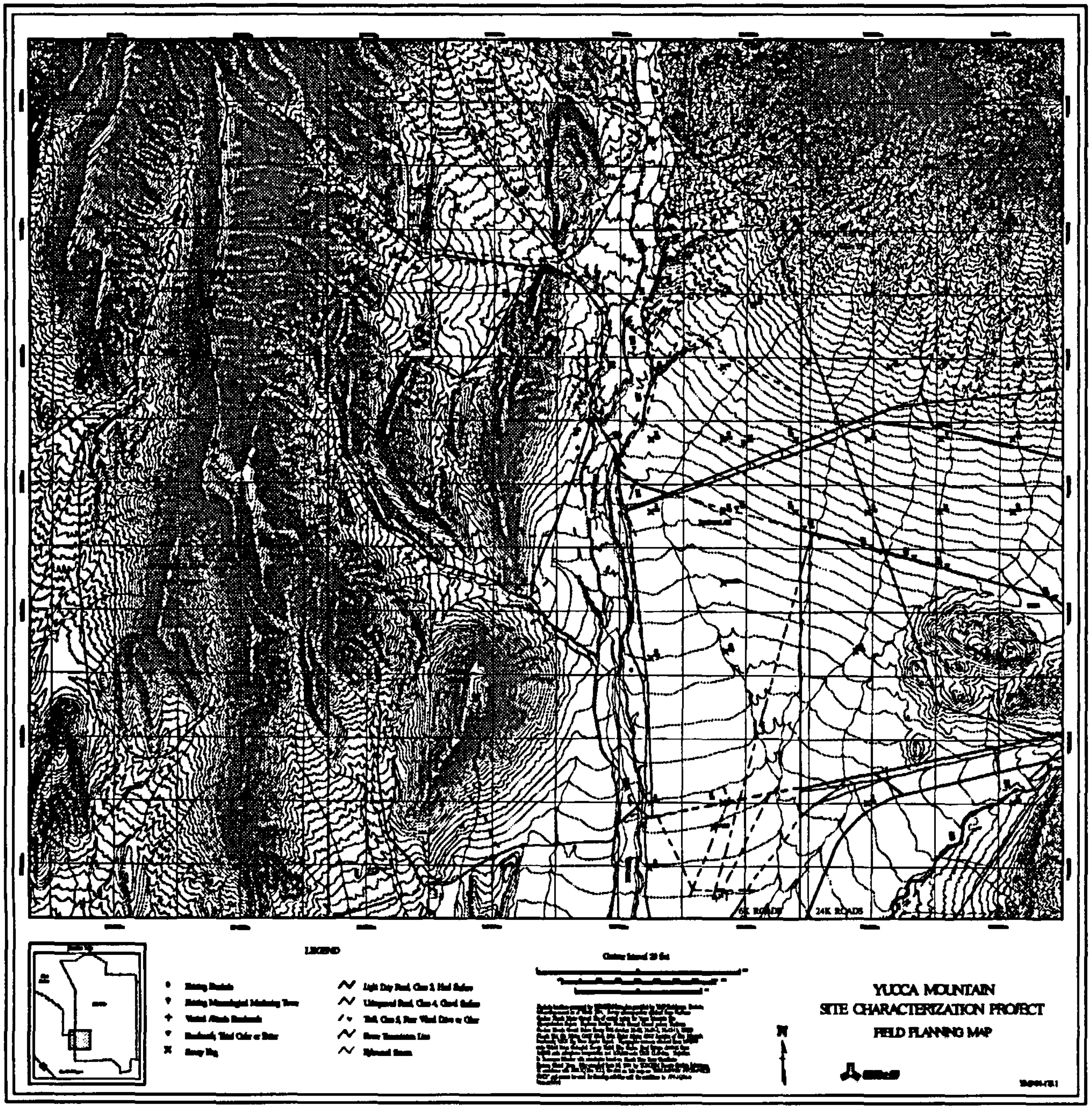
2 1 0 1 2 Km

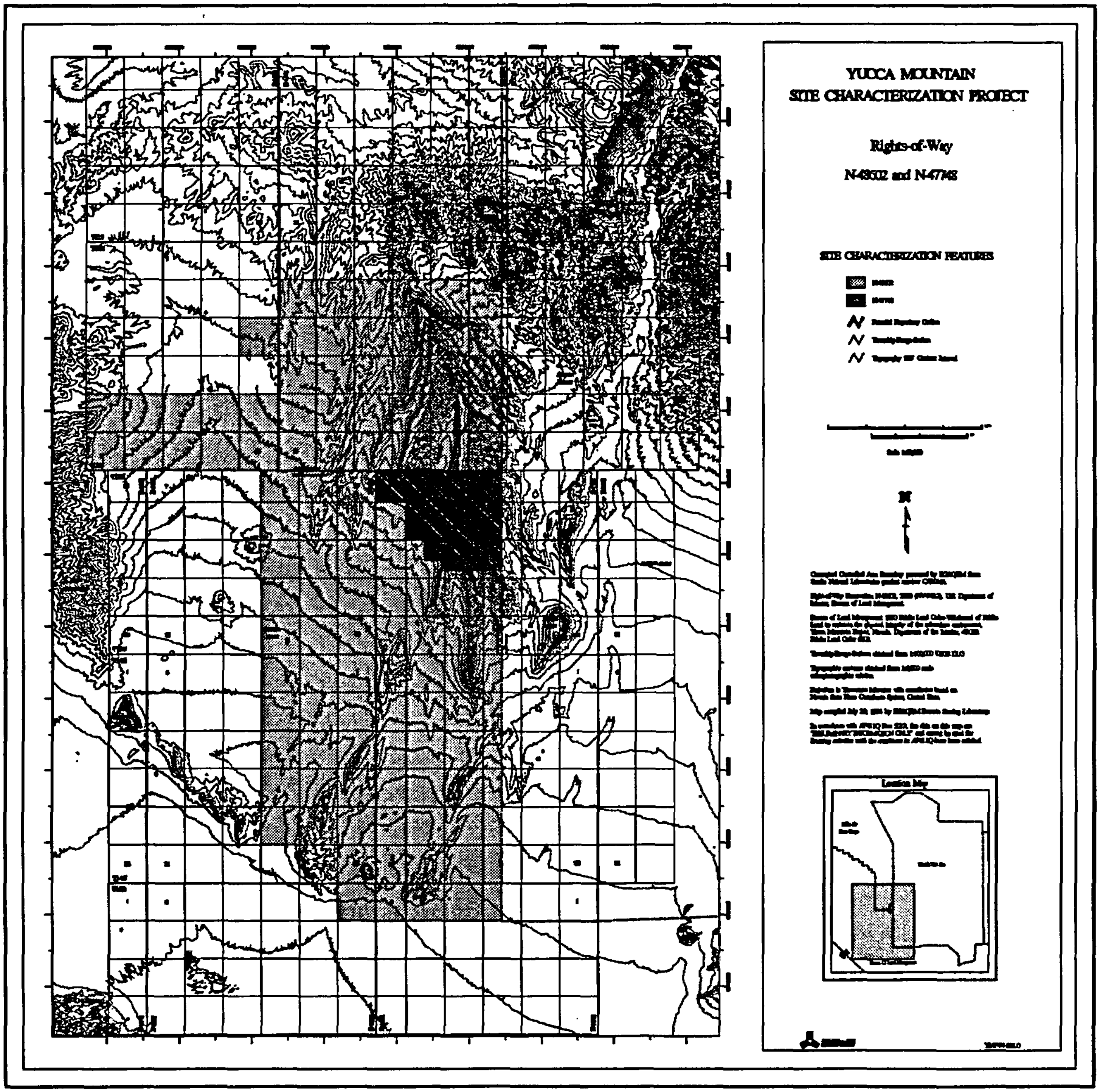
Contour Interval 200 ft

YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
PROPOSED SEISMIC REFLECTION LINES

EG&G

YMP-94-210.0


24K ROADS
LEGEND
YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT
FIELD PLANNING MAP



ymp94221pg26093148_1.rgc Date: Tue Jul 27 09:35:33 1994

Lawrence Livermore National Laboratory

LLYMP9407081
July 25, 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 - June 1994 (SCP: N/A)

Attached is the June Project Status Report for LLNL's participation in the Yucca Mountain Site Characterization 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.

ENCLOSURE 3

Recycled

LAWRENCE LIVERMORE NATIONAL LABORATORY YUCCA MOUNTAIN PROJECT
JUNE 1994 TECHNICAL HIGHLIGHTS AND STATUS REPORT
TABLE OF CONTENTS

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

June 1994

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

1) **WBS 1.2.1.5, Special Studies:** A repository scale thermal-hydrological model was used to investigate the sensitivity of the relative humidity and temperature at various locations in the repository to the gas-phase diffusion efficiency. In general, for the factor of 10 range of diffusion investigated, the effect on temperature and relative humidity behavior is relatively minor. Re-wetting the reduced-relative humidity zone (also called the dry-out zone) back to humid conditions is affected by gas-phase re-wetting driven primarily by the binary diffusion of air and water vapor, and by liquid-phase re-wetting driven primarily by gravity drainage in fractures and matrix imbibition. Gas-phase re-wetting is likely to be the dominant re-wetting mechanism as the reduced-relative humidity zone re-wets to a value of about 70 to 80%. Subsequent re-wetting back to ambient relative humidity conditions (98.4%) is dominated by liquid-phase re-wetting.

2) **WBS 1.2.1.5, Special Studies:** Repository-scale thermal-hydrological calculations were conducted for six sets of matrix properties: those of the Reference Information Base and for the five sets of Topopah Spring welded tuff properties listed in Pruess and Tsang (1994) and based on Flint et al. (1993). The duration of the boiling period was found to be insensitive to the range of matrix properties considered. Five of the six property sets produced similar relative humidity conditions at the end of the boiling period for three Areal Mass Loadings (55.3, 110.5, and 150 metric tonnes uranium per acre). The sixth property set results in a substantially faster liquid-phase re-wetting rate and more humid conditions by the end of the boiling period, particularly for the low thermal load and for the outer 25% of the two higher thermal load repositories.

3) **WBS 1.2.2.3.1.1, Waste Form Testing - Spent Fuel:** Unsaturated dissolution tests at 90°C are in progress at Argonne National Laboratory to evaluate the long-term performance of spent fuel in the potential Yucca Mountain repository. These tests examine the leach/dissolution behavior of two types of well-characterized irradiated PWR fuels in three types of tests: saturated water vapor atmosphere, low drip rate of J-13 water equilibrated with tuff (0.075 mL/3.5 d), and a ten-fold higher drip rate. The ongoing tests have completed 21 months. As expected, the greatest mass of material is transported in the high-drip rate tests. The cesium transported was 1 µg for the high-drip rate tests, 0.3-0.7 ng for the low-drip rate tests, and 0.1-0.3 ng for the vapor tests; for comparison, the control test in the hot cell (with no spent fuel) measured less than a picogram of cesium.

4) **WBS 1.2.2.3.1.1, Waste Form Testing - Spent Fuel:** Parametric tests of unsaturated dissolution of UO_2 pellets exposed to dripping J-13 water at 90°C have been ongoing for 9 years at Argonne National Laboratory. These tests are designed to examine the dissolution behavior of UO_2, formation of alteration phases, release

rates, and mechanisms of uranium release, and serve as a pilot study for similar tests with spent nuclear fuel. Surface area normalized uranium release values have been measured for all Teflon-supported samples. Most tests are characterized by a period of rapid uranium release between one and two years of reaction. Uranium release rates during this interval were up to 14 mg•m^{-2}•d^{-1}, with most of this release being attributed to the spallation of UO_2 granules from the sample surface. Subsequent to the one-to-two year rapid release period, release rates for most tests decreased to an average of approximately 0.10 to 0.30 mg•m^{-2}•d^{-1} throughout the duration of the tests.

5) **WBS 1.2.2.3.1.2, Waste Form Testing - Glass:** The N2 (Defense Waste Production Facility actinide-doped glass) unsaturated dissolution tests continue at Argonne National Laboratory. A scheduled solution sampling at 101 months was completed. In order to perform the sampling and retain the correct interchange of vessels, the stored liquid from the previous sampling period that was being saved for additional studies has been transferred to a glass storage vial. No problems were encountered, and the tests continue.

6) **WBS 1.2.2.3.2, Metal Barriers:** As a consequence of the Container Materials Workshop held in May, four bounding environments were identified that encompass the extremes that a metal barrier container could experience in the potential repository.

- A dilute groundwater, like that of Well J-13.
- A concentrated groundwater that would simulate a dry-out condition followed by resaturation with concentration of the ionic salts. Concentrations would be on the order of 20-100x those in the dilute groundwater.
- An acidified concentrated groundwater with pH as low as 2 that would simulate reactions between certain man-made materials and the water.
- An alkalized concentrated groundwater with pH as high as 12 that would simulate reactions between man-made materials, such as concrete, and the aqueous environment.

Long-term testing (on the order of five years or longer) in these four bounding environments will be useful in selecting materials for the container. The tests will be conducted at 60 and 90°C in the water, in the vapor phase above the water, and in some instances at the water line. Three groups of metals were also selected for testing:

- Corrosion allowance,
- Moderately corrosion resistant (e.g., 70/30 copper-nickel and Monel 400), and
- Highly corrosion resistant (e.g., Incoloy 825, Hastelloy C-22, Hastelloy C-4, Titanium Grade 12, and Titanium Grade 16).

7) **WBS 1.2.2.3.2, Metal Barriers:** In conjunction with the International Program, LLNL transported an array of metal barrier specimens for exposure in the New Zealand geothermal fields. Three sets of specimens were prepared from samples that were "on hand". These include flat coupons for weight loss, sandwich coupons for crevice observation, and stressed C-ring specimens for stress corrosion evaluation. Materials included two carbon steels, 316L stainless steel, Alloy 825, high purity copper, aluminum bronze, and 70-30 copper-nickel. On June 13, the first set of corrosion specimens was placed in Paraiki Hot Springs, where the environmental conditions are 89°C, pH 2, around 450 ppm chloride ion, and 1150

ppm sulfate ion. These are quite aggressive conditions which approximate one of the "bounding" environments planned for the long-term testing. The other sets of specimens will be placed in other locations in the New Zealand geothermal field so that a range of exposure conditions will be obtained

8) **WBS 1.2.2.3.5, Non-Metallic Barrier Concepts:** A preliminary study of the feasibility of fabrication of non-metallic barriers is nearly complete. General conclusions of this study are:

- Sufficiently large ceramic and ceramic coated vessels can be fabricated using currently available materials and techniques.
- Current industrial capacity is insufficient to handle the fabrication of large numbers of such vessels.
- Alumina based ceramics are probably the most suitable materials for non-metallic barriers.
- Experimental confirmation of the suitability of available materials is required.
- Final closure remains the weakest link in the use of non-metallic barriers due to average temperature limitations imposed by the zircalloy cladding.
- Thermal spray techniques are most promising both as fabrication and closure methods.

9) **WBS 1.2.3.12.1, Chemical and Mineralogical Properties of the Waste Package Environment:** Field-based experiments in New Zealand on dissolution and precipitation kinetics continue. Materials for sample holders have been emplaced in Paraiki Stream, in a pool at 89.1°C, pH 3.0, to evaluate the material durability. To data, all sample holder materials, except certain Fe- metals, have survived well. Mineral samples for kinetics measurements are ready for emplacement, once complete evaluation of sample holders is finished.

10) **WBS 1.2.3.12.2, Hydrologic Properties of the Waste Package Environment:** A series of thermo-hydrological calculations were carried out for six sets of matrix properties of the TSw1 and TSw2 units; the properties were obtained from the Reference Information Base and from a recent Lawrence Berkeley Laboratory publication. These properties were shown to have a strong influence on both the time for return to a relative humidity that could accelerate corrosion and on the temperature at which the humidity returns. Since corrosion will be accelerated when both temperature and humidity are high, it is important to be able to accurately calculate these parameters.

11) **WBS 1.2.3.12.3, Mechanical Attributes of the Waste Package Environment:** Development of a Multipoint Borehole Laser EXtensometer (MBLEX) design continued in support of the Large Block Test, and several component parts for this system were ordered. This system was discussed with representatives of AECL, USBM, Bechtel Corp., and other interested parties to evaluate potential collaborations in its development.

12) **WBS 1.2.3.12.4, Engineered Barrier System (EBS) Field Tests (Large Block Test):** Engineering analysis of the capability of the load retaining frame, as designed, was completed. The load retaining frame design is not structurally adequate to contain the desired pressure of 600 psi. Modifications were proposed to retrofit the frame.

13) **WBS 1.2.5.3.4, Geologic and Engineering Materials Bibliography of Chemical Species (GEMBOCHS):** A revised set of element catalogs has been generated. The catalogs contain all thermodynamic data available in GEMBOCHS for compounds of the elements Tc, Th, U, Np, Pu, and Am. The catalogs are now available for remote electronic access via the anonymous GEMBOCHS ftp account.

14) **WBS 1.2.5.3.4, Geologic and Engineering Materials Bibliography of Chemical Species (GEMBOCHS):** The first edition of the new, stand-alone GEMBOCHS Data Catalog for the YMP-TDB was generated. This quarterly catalog, which covers the second quarter of 1994, includes an overview of the GEMBOCHS system, a discussion of recent accomplishments, and tables summarizing

- The types of thermodynamic data contained in GEMBOCHS,
- The specific chemical species and data contained in each of the seven thermodynamic data files currently provided for use with EQ3/6, and
- The literature sources for these data.

LLNL Deliverables Met
(June 1994)

None

LLNL Deliverables Not Met
(June 1994)

Milestone	WBS	Planned Date	Projected Date	Description	Comment
MOL45	1.2.2.3.2	01-31-94	07-29-94	Submit updated Metal Barriers SIP	Delayed by TPR & NWTRB preparation
MOL04	1.2.3.10.3.1	01-12-94	08-15-94	Document core flow experiment protocol	Delayed by equip.malfunction
MOL03	1.2.3.10.3.1	03-31-94	07-29-94	Report on colloid characterization	Delayed by equip.malfunction related to MOL04
MOL26	1.2.3.12.1	03-31-94	07-29-94	*Topical Report on Near Field* Geochemistry	Delayed by TPR & NWTRB preparation
MOL15	1.2.3.12.4	03-31-94	07-29-94	Large Block Excavated and Small Blocks Delivered to LLNL	Delayed by construction planning
MOL34	1.2.3.12.4	06-30-94	07-29-94	Pre-Test Calculations on Large Block Test	Will not impact LBT schedule
MOL73	1.2.3.12.5	05-31-94	07-29-94	Stability of Organic Compounds	Delayed by new ESF work
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
MOL89	1.2.5.4.2	06-30-94	08-31-94	YMIM Release, including User Manual	In final review

LLNL Deliverables Scheduled for the Next Reporting Period
(July 1994)

Milestone	WBS	Planned Date	Projected Date	Description	Comment
MOL94	1.2.2.3.2	07-29-94	07-29-94	Eng. Materials Characterization Report	
MOL24	1.2.3.12.1	07-29-94	07-29-94	Manuscript and Field Data of Preliminary Results of New Zealand Field Studies and Simulation	
MOL31	1.2.3.12.2	07-29-94	07-29-94	Impact of Heterogeneity on Heat Pipes and Buoyant Vapor Flow	

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 30-JUN-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
1334	1369	1199	45	2.6	102.6	170	12.4	114.2	1785	1780	5	0.3	1563	71.6

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 50.

Cumulative Schedule Variance:
Same as above. The correct schedule variance is -85.

Variance At Complete:

Ray B. Stout, July 15, '94
P&S ACCOUNT MANAGER DATE

W. L. Clarke 7/15/94
TPO DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 30-JUN-94

PARTICIPANT: LLNL PEM: TYNAN WBS: 1.2.3.11.3

WBS TITLE: GEOPHYSICS-ESF SUPPORT SUBSURFACE GEOPHYSICAL TSTG

P&S ACCOUNT: 0L3B3

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	ICPI
128	128	77	0	0.0	100.0	51	39.8	338.1	180	129	51	28.3	108	100.0

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:

Variance At Complete:
$20k has been taken via CCB action. However, some of the funds will be used to offset a shortfall in WBS 1.2.3.5.2.2 which was only allocated $25k. The proper accounts will be charged; 1.2.3.11.3 will underrun and 1.2.3.5.2.2 will overrun; the total costs will be $205k, but with a different distribution than anticipated by YMSCO. These actions are by direction of the YMSCO Asst. Manager for Sci. Programs.

W. L. Clarke 7/15/94
P&S ACCOUNT MANAGER DATE

W. L. Clarke 7/15/94
TPO DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 30-JUN-94

PARTICIPANT: LLNL PEM: SIMMONS WBS: 1.2.3.12.1

WBS TITLE: CHEMICAL AND MINERALOGIC. PROP. OF WASTE PACKAGE

P&S ACCOUNT: 0L3C1

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
508	514	595	6	1.2	101.2	-81	-15.8	86.4	610	722	-112	-18.4	706	75.6

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:

Variance At Complete:
The variance at complete is due to unanticipated costs for Program Review meetings, unmatched expenses for field studies in which equipment had to be fabricated, rather than purchased, and the transfer of funds to accomodate external collaborations, as per Project Office changes. Cost/Schedule Change Request is being prepared to reallocate budget from other WBS element to cover expanded workscope.

P&S ACCOUNT MANAGER DATE TPO 7/15/94 DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 30-JUN-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
1985	1798	1786	-187	-9.4	90.6	12	0.7	100.7	2530	3019	-489	-19.3	2512	59.4

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:
Excavation delays and frame delivery postponement 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 procurement of 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, arising 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 are requiring addition of an LLNL 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.

W. L. Delorme 7/15/94 — P&S ACCOUNT MANAGER, DATE

W. L. Delorme 7/15/94 — TPO, DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 30-JUN-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	TCPI
197	166	265	-31	-15.7	84.3	-99	-59.6	62.6	248	385	-137	-55.2	396	68.3

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:

Variance At Complete:
Workscope was added for studies of diesel fuel impacts on the ESF. Additional funding of $160k has been approved for transfer from headquarters but has not yet been applied at LLNL. LLNL cannot change BCWS until documentation is received.

W. L. Clarke 7/15/94
P&S ACCOUNT MANAGER DATE

W. L. Clarke 7/15/94
TPO DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 30-JUN-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
179	179	264	0	0.0	100.0	-85	-47.5	67.8	240	325	-85	-35.4	354	100.0

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). Two requests for additional funding (92.5k) were processed through Change Control in July, coordinated with Element PEM.

7/15/94 W. L. LeClare 7/15/94
P&S ACCOUNT MANAGER DATE TPO DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: 30-JUN-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
451	451	524	0	0.0	100.0	-73	-16.2	86.1	601	674	-73	-12.1	698	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.

[signature] 7/14/94 [signature] 7/15/94
P&S ACCOUNT MANAGER DATE TPO DATE

Participant LLNL | Yucca Mtn. Site Char. Project-Planning & Control System | 01-Jun-94 to 30-Jun-94
PACS Participant Work Station (PPWS) | Page - 1
Prepared - 07/14/94:11:43:58 | WBS Status Sheet (WBS02) | 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	13	13	13	0	0	120	120	106	0	14	160	156	4
1.2.2	WASTE PACKAGE	302	270	290	-32	-20	2558	2630	2495	72	135	3445	3480	-35
1.2.3	SITE INVESTIGATIONS	520	479	575	-41	-96	4946	4681	4757	-265	-76	6348	7156	-808
1.2.5	REGULATORY	124	129	139	5	-10	1096	1051	1092	-45	-41	1462	1530	-68
1.2.9	PROJECT MANAGEMENT	102	102	121	0	-19	917	917	991	0	-74	1222	1292	-70
1.2.11	QUALITY ASSURANCE	53	53	47	0	6	486	486	394	0	92	650	634	16
1.2.12	INFORMATION MANAGEMENT	21	21	27	0	-6	187	187	181	0	6	250	252	-2
1.2.13	ENVIRONMENT, SAFETY, & HEA	2	2	4	0	-2	19	19	12	0	7	25	25	0
1.2.15	SUPPORT SERVICES	32	32	45	0	-13	286	286	245	0	41	382	380	2
Total		1169	1101	1261	-68	-160	10615	10377	10273	-238	104	13944	14905	-961

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
LBRHRS	8281	7278	7559	7901	7764	7742	7988	7922	7912	7794	7746	7454	93341
LABOR	762	654	658	749	711	720	725	743	722	730	709	708	8591
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	214	217	221	233	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	1169	1147	1072	1110	13944

Participant LLNL
Prepared - 07/14/94:11:43:58

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

01-Jun-94 to 30-Jun-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	8036	0	0	0	62436
LABOR	762	413	383	497	513	552	513	558	594	0	0	0	4785
SUBS	114	303	254	233	315	246	218	101	135	0	0	0	1919
TRAVEL	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER	152	385	243	355	388	452	388	456	532	0	0	0	3351
CAPITAL	0	0	11	21	138	33	15	0	0	0	0	0	218
Total ACWP	1028	1101	891	1106	1354	1283	1134	1115	1261	0	0	0	10273

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	1169	1147	1072	1110	13944
BCWP	1188	1062	944	1048	1810	1177	1036	1011	1101	0	0	0	10377
ACWP	1028	1101	891	1106	1354	1283	1134	1115	1261	0	0	0	10273
ETC	0	0	0	0	0	0	0	0	0	1516	1606	1510	4632

Fiscal Year Distribution

	Prior	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	Future	At Complete
BCWS	11048	13944	43192	46455	35899	25532	17825	12021	8684	3594	823	705	219722
BCWP	10882	10377	0	0	0	0	0	0	0	0	0	0	
ACWP	10846	10273	0	0	0	0	0	0	0	0	0	0	
ETC	0	4632	42662	45613	34901	25892	18815	12262	9167	3624	823	7574	227084

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

PARTICIPANT: LLNL

DATE PREPAREC 7/11/94

FISCAL MONTH/YEAR: JUNE,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	12,600	0.70	104		0	0			160,000		104,800
SUBT 1.2.1	12,600	0.70	104	0	0	0	0	0	160,000	122,061	104,800
1.2.2.1	19,500	1.00	160		78	0	0		400,000		316,800
1.2.2.3.1.1	350,799	0.90	150	483	119	163,429	587,413		1,785,000		761,999
1.2.2.3.1.2	101,294	0.20	32		364	6,043	68,762		280,000		221,294
1.2.2.3.2	125,400	3.90	615		16,386	25,182	0		880,000		640,100
1.2.2.3.5	10,500	0.70	108		0	0	0		100,000		61,000
CAPITAL EQUIP.	0				9,366	0	0	0	****	91,000	133,823
SUBT 1.2.2	607,493	6.70	1,065	483	26,313	194,654	656,175	0	3,445,000	7664034*	2,155,016
1.2.3.12.1	164,800	2.40	377		4,788	77,263			610,000		577,800
1.2.3.12.2	66,800	2.90	467		2,327	0	0		861,000		590,900
1.2.3.12.3	28,900	1.40	213		4,335	0	1,600		230,000		153,500
1.2.3.12.4	187,400	9.30	1,668		7,108	353,102	35,979		2,530,000		1,335,000
1.2.3.12.5	37,400	1.60	257		85	0	28,732		248,000		214,800
1.2.3.10.3.1	26,800	1.50	239		6,698	0	4,607		392,000		201,100
1.2.3.10.3.2	28,100	0.70	175		2	0	0		301,000		140,500
1st SUBT 1.2.3*	540,200	20.30	3,396	0	25,343	430,365	71,318	0	5,172,000	*	3,213,600
1.2.3.1	23,300	1.20	156		188	0	0		245,000		207,100
1.2.3.4.2	27,600	1.00	160		103	0	0		381,000		247,600
1.2.3.5.2.2	1,700	0.00	5		0	0	0		25,000		58,700
1.2.3.10.1	200	0.00	0		0	0	0		75,000		91,500
1.2.3.10.2	11,700	0.60	100		0	0	0		175,000		173,400
1.2.3.11.3	1,400	0.10	10		36,525	0	0		80,000		24,000
CAPITAL EQUIP.	0	0.00	0		16,650	0	0		***	15,000	0
2nd SUBT 1.2.3	65,900	2.90	431	0	53,466	0	0	0	1,081,000	1,116,109	802,300
1.2.5.1	7,300	0.30	52		0	0	0		150,000		95,500
1.2.5.2.2	22,600	1.10	182		0	0	0		240,000		262,900
1.2.5.3.4	23,300	1.50	236		4,687	0	0		342,000		203,600
1.2.5.3.5	6,300	0.40	72		0	0	0		50,000		35,900
1.2.5.4.2	104,400	5.20	823		1,490	0	0		660,000		509,100
1.2.5.5.2	-100	0.00	0		0	0	0		20,000		6,800
CAPITAL EQUIP.	0				0	0		0	**	34,000	0
SUBT 1.2.5	163,800	8.50	1,365	0	6,177	0	0	0	1,462,000	1,294,237	1,113,600

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

PARTICIPANT: LLNL

DATE PREPAREC 7/11/94

FISCAL MONTH/YEAR: JUNE,1994

WBS ELEMENT	CURRENT MONTH END								FISCAL YEAR		
	ACTUAL COSTS	PARTICIPANT FTES	HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS#	CAP EQPT ACCURAL	APPROVED BUDGET	CURRENT FY94 AFP	CUMULATIVE COSTS
1.2.9.1.2	58,800	1.90	296		11	0	0		621,000		465,700
1.2.9.2.2	61,500	4.90	787		1,366	0	49		601,000		523,200
SUBT 1.2.9	120,300	6.80	1,083	0	1,377	0	49	0	1,222,000	1,057,812	988,900
1.2.11.1	46,200	1.70	281		11,200	0	0		650,000		392,500
SUBT 1.2.11	46,200	1.70	281	0	11,200	0	0	0	650,000	609,812	392,500
										(FUNDED UNDER 1.2.16)	
1.2.12.2.2	15,500	0.80	127		0	0	0		116,000		81,800
1.2.12.2.3	10,400	0.30	48		0	0	0		134,000		98,400
SUBT 1.2.12	25,900	1.10	175	0	0	0	0		250,000	215,606	180,200
										(FUNDED UNDER 1.2.17)	
1.2.13.2.5	2,500	0.10	20		0	0	0		25,000		10,900
SUBT 1.2.13	2,500	0.10	20	0	0	0	0	0	25,000	18,750	10,900
1.2.15.2	38,200	3.00	749		99	0	0		290,000		184,800
1.2.15.3	7,900	0.10	24		0	0	0		92,000		59,100
SUBT 1.2.15	46,100	3.10	773	0	99	0	0	0	382,000	300,010	243,900
TOTAL LLNL	1,630,993	52	8,691	483	123,975	625,019	727,542	0	13,849,000	4,734,397	9,205,916

* 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

Work conducted by the Spent Fuel Oxidation and Spent Fuel Dissolution tasks has been affected by a suspension of radiological work in Bldg. 325 at Pacific Northwest Laboratories (PNL). Work conducted by the YMP was not a contributory element in the closure of the facility; however, this action has had a significant impact on our work schedule. The program manager has requested formal documentation of the justification for the building closure. This justification will be provided to LLNL and placed in the project records. PNL Line Management has taken an action item to provide this documentation. At this time, it is anticipated that the facility will reopen in August. PNL staff have placed a priority on restart of YMP work when the building reopens.

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

In order to augment the thermo-hydrological calculation support of the thermal loading systems study, we have also been conducting the calculations in the near-field/altered zone hydrology WBS (1.2.3.12.2) with the same set of thermal loading assumptions. 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 (WPs) containing 40 assemblies per WP, and PWR WPs containing 21 assemblies per WP. The waste receipt schedule was supplied by John King of M&O. Areal Mass Loadings (AMLs) of 24.2, 35.9, 55.3, 70, 83.4, 100, 110.5, and 150 MTU/acre have been analyzed assuming the matrix hydrological properties given in the Reference Information Base (RIB) and Klavetter and Peters (1986). This month we investigated the impact of (1) enhanced gas-phase diffusion (this WBS element), and (2) more recent matrix hydrological property data given in a recent draft report (Pruess and Tsang, 1994), and which are based on measurements by Flint and others (1983) (WBS 1.2.3.12.2).

<u>The Impact of Enhanced Gas-Phase Diffusion</u>

Tables 1 and 2 list the time required to attain the indicated values of relative humidity, *RH*, and the temperatures at which those values of *RH* are attained, for three values of the binary, gas-phase diffusion tortuosity factor, τ_{eff}, (0.2, 1, and 2), and for AMLs of 110.5 and 150 MTU/acre. In general, for this range of τ_{eff}, the dependence of temperature and relative humidity behavior on τ_{eff} is seen to be relatively minor.

Re-wetting the reduced-*RH* zone (also called the dry-out zone) back to humid conditions is affected by:

- gas-phase re-wetting driven primarily by the binary diffusion of air and water vapor, and
- liquid-phase re-wetting driven primarily by gravity drainage in fractures and matrix imbibition.

Modeling and laboratory studies conducted by LLNL have demonstrated that gas-phase re-wetting is likely to be the dominant re-wetting mechanism as the reduced-*RH* zone re-wets from low *RH* to an *RH* of about 70 to 80%. Subsequent re-wetting back to ambient *RH* conditions (98.4%) is dominated by liquid-phase re-wetting. Enhanced gas-phase diffusion has two general effects on dry-out and re-wetting behavior. First, it enhances the magnitude of dry-out during the boiling period, particularly at the outer edge of the repository. Second, it enhances the gas-phase re-wetting rate for *RH* up to about 70 to 80%. This second effect primarily pertains to the post-boiling period.

For the 110.5-MTU/acre case (Table 1), enhanced gas-phase diffusion tends to:

- modestly affect the time required to re-wet to RH = 70 and 80% for the inner 75% of the repository,
- modestly increase the time required to re-wet to RH = 95% for the inner 75% of the repository,
- modestly increase the time required to re-wet to RH = 70, 80, and 90% for the outer 10% of the repository, and
- substantially increase the time required to re-wet to RH = 95% for the outer 50% of the repository

The relationship between temperature and RH is relatively insensitive to the magnitude of gas-phase diffusion over this range of τ_{eff} for the inner 75% of the repository. For a given value of RH, enhanced gas-phase diffusion results in lower temperatures for the outer 25% of the repository.

Table 1: AML = 110.5 MTU/acre

Time required to attain the indicated relative humidity at various repository locations and the temperature at which that value of relative humidity is attained for 22.5-yr-old SNF, k_b = 280 millidarcy, and three gas-phase diffusion tortuosity factors, t_{eff}.
The locations are identified as the fraction of the repository area enclosed, with 0 percent corresponding to the repository center, and 100 percent corresponding to the outer perimeter.

Table 1a: t_{eff} = 0.2

Fraction of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	15,960	27,910	40,990	49,980	68	54	45	42
75	9540	15,520	24,950	32,590	76	64	53	48
90	3190	4890	7460	9890	93	82	73	68
97	1410	1810	2360	2890	106	101	93	88

Table 1b: t_{eff} = 1.0

Fraction of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	13,490	22,790	39,960	54,040	72	58	46	40
75	9160	15,570	27,210	37,890	76	63	51	45
90	3480	6170	11,400	16,740	90	77	64	57
97	1410	1970	3170	4760	106	98	85	76

Table 1c: t_{eff} = 2.0

Fraction of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	14,260	23,850	42,270	59,750	70	57	44	38
75	10,180	17,870	33,350	47,150	72	59	46	41
90	3920	7730	16,040	26,640	85	71	57	48
97	1490	2240	4490	8130	104	93	76	65

The temperature and RH behavior for the 150-MTU/acre repository (Table 2) shows similar sensitivity to the magnitude of gas-phase diffusion over this range of τ_{eff}. Enhanced gas-phase diffusion tends to:

- modestly affect the time required to re-wet to RH = 70 and 80% for the inner 75% of the repository,
- modestly increase the time required to re-wet to RH = 70, 80, and 90% for the outer 10% of the repository, and

- substantially increase the time required to re-wet to RH = 95% for the outer 10% of the repository.

The relationship between temperature and RH is relatively insensitive to the magnitude of gas-phase diffusion over this range of τ_{eff} for the inner 75% of the repository. For a given value of RH, enhanced gas-phase diffusion results in lower temperatures for the outer 10% of the repository.

Table 2: AML = 150 MTU/acre

Time required to attain the indicated relative humidity at various repository locations and the temperature at which that value of relative humidity is attained for 22.5-yr-old SNF, k_b = 280 millidarcy, and three gas-phase diffusion tortuosity factors, t_{eff}.
The locations are identified as the fraction of the repository area enclosed, with 0 percent corresponding to the repository center, and 100 percent corresponding to the outer perimeter.

Table 2a: t_{eff} = 0.2

Fraction of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	20,630	34,850	50,920	64,120	68	52	45	41
75	16,400	24,520	32,700	43,360	70	59	51	46
90	8660	12,090	16,520	19,780	81	72	64	59
97	4330	6020	8180	10,060	93	84	77	72

Table 2b: t_{eff} = 1.0

Fraction of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	18,860	29,280	47,690	61,630	70	57	45	41
75	14,670	22,760	34,660	42,180	73	60	50	45
90	8790	13,210	19,810	27,190	79	69	59	52
97	4650	7050	10,970	14,340	88	78	69	63

Table 2c: t_{eff} = 2.0

Fraction of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	19,470	29,380	48,260	64,180	69	56	45	41
75	15,390	23,380	36,100	45,900	71	59	48	44
90	9610	14,520	23,170	29,140	76	66	55	50
97	5310	8420	13,500	18,330	84	74	64	57

Sensitivity of Relative Humidity Conditions at the End of the Boiling Period to Matrix Properties

This month's near-field/altered zone hydrology report discusses the sensitivity of temperature and relative humidity behavior to the matrix hydrological properties assumed for the TSw1 and TSw2. Repository-scale calculations were repeated for the five sets of matrix properties for the Topopah Spring welded tuff (Table 7 in Section 1.2.3.12.2) that are listed in Pruess and Tsang (1994) and based on Flint et al. (1993). Rather than repeat the details of that section, we focus here on the relative humidity conditions at the end of the boiling period.

Table 3 summarizes the duration of the boiling period at various repository locations and the RH attained at the end of the boiling period for the "reference" case based on the matrix hydrological properties obtained from the RIB and Klavetter and Peters (1986)] for AMLs of 55.3, 110.5, and 150 MTU/acre. The bulk permeability, k_b, is

280 millidarcy for all of these calculations. Table 4 summarizes the same information for the five sets of more recent matrix property data listed in Pruess and Tsang (1994) and based on Flint et al. (1993).

Table 3

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 SNF, various Areal Mass Loadings, k_b = 280 millidarcy, and assuming the matrix properties from Klavetter and Peters (1986) for the TSw1 and TSw2 units. The locations are identified as the fraction of the repository area enclosed, with 0 percent corresponding to the repository center, and 100 percent corresponding to the outer perimeter

Fraction of repository area enclosed (%)	Duration of the boiling period (yr) and the relative humidity (%) at the end of the boiling period for indicated AMLs		
	55.3 MTU/acre	110.5 MTU/acre	150 MTU/acre
50	1760 yr 81%	6130 yr 44%	9590 yr 47%
75	1160 yr 84%	4290 yr 51%	7210 yr 45%
90	440 yr 93%	2870 yr 68%	5010 yr 54%
97	80 yr 98.5%	2150 yr 87%	3960 yr 67%

Table 4

Duration of the boiling period at various repository locations and relative humidity attained at the end of the boiling period for 22.5-yr-old SNF, k_b = 280 millidarcy, and matrix properties for the TSw1 and TSw2 units obtained from the indicated sources. The locations are identified as the fraction of the repository area enclosed, with 0 percent corresponding to the repository center, and 100 percent corresponding to the outer perimeter

Table 4a: AML = 55.3 MTU/acre

Fraction of repository area enclosed (%)	Duration of the boiling period (yr) and the relative humidity (%) at the end of the boiling period for the indicated sources of TSw1 and TSw2 matrix properties				
	LBL-USGS-3.2	LBL-USGS-3.5	LBL-USGS-3.1/3.6	LBL-USGS-3.4	LBL-USGS-3.3
50	1660 yr 97.5%	1730 yr 82%	1770 yr 78%	1760 yr 77%	1780 yr 76%
75	1100 yr 98.2%	1140 yr 85%	1190 yr 79%	1180 yr 79%	1180 yr 76%
90	430 yr 98.8%	420 yr 95.8%	430 yr 89%	440 yr 86%	440 yr 83%
97	90 yr 98.9%	80 yr 98.8%	80 yr 98.7%	90 yr 97.6%	90 yr 95.7%

Table 4b: AML = 110.5 MTU/acre

Fraction of repository area enclosed (%)	Duration of the boiling period (yr) and the relative humidity (%) at the end of the boiling period for the indicated sources of TSw1 and TSw2 matrix properties				
	LBL-USGS-3.2	LBL-USGS-3.5	LBL-USGS-3.1/3.6	LBL-USGS-3.4	LBL-USGS-3.3
50	5850 yr 68%	6110 yr 36%	6050 yr 38%	5930 yr 35%	6130 yr 36%
75	4020 yr 86%	4250 yr 48%	4200 yr 49%	4200 yr 46%	4280 yr 46%
90	2690 yr 95.3%	2800 yr 71%	2810 yr 67%	2850 yr 65%	2870 yr 63%
97	2070 yr 98.0%	2080 yr 93%	2110 yr 88%	2140 yr 85%	2170 yr 81%

Table 4c: AML = 150 MTU/acre

Fraction of repository area enclosed (%)	Duration of the boiling period (yr) and the relative humidity (%) at the end of the boiling period for the indicated sources of TSw1 and TSw2 matrix properties				
	LBL-USGS-3.2	LBL-USGS-3.5	LBL-USGS-3.1/3.6	LBL-USGS-3.4	LBL-USGS-3.3
50	9320 yr 76%	9520 yr 36%	9370 yr 38%	9380 yr 37%	9360 yr 36%
75	6720 yr 89%	7030 yr 38%	6970 yr 39%	6980 yr 37%	7020 yr 36%
90	4420 yr 95.1%	4820 yr 55%	4860 yr 52%	4880 yr 50%	4920 yr 49%
97	3290 yr 96.5%	3720 yr 73%	3780 yr 66%	3810 yr 64%	3840 yr 62%

A comparison of Tables 3 and 4 indicates that the duration of the boiling period is insensitive to the range of matrix properties considered. A comparison of Tables 3 and 4 also indicates that with the exception of LBL-USGS-3.2, the remaining 4 LBL-USGS cases and the reference case result in very similar *RH* conditions at the end of the boiling period. Both of these observations apply to all three AMLs. Because

LBL-USGS-3.2 results in a substantially faster liquid-phase re-wetting rate, it results in relatively humid conditions by the end of the boiling period. This observation is particularly applicable to the entire 55.3-MTU/acre repository and to the outer 25% of the 110.5- and 150-MTU/acre repositories. Relative to the reference matrix hydrological property case, the following observations apply to the end of the boiling period for the 55.3-MTU/acre repository:

- LBL-USGS-3.2 results in more humid conditions,
- LBL-USGS-3.5 results in nearly the same *RH* conditions, and
- LBL-USGS-3.1/3.6, LBL-USGS-3.4, and LBL-USGS-3.3 result in slightly less humid conditions.

Relative to the reference matrix hydrological property case, the following observations apply to the end of the boiling period for the inner 75% of the repository for 110.5 and 150 MTU/acre repositories:

- LBL-USGS-3.2 results in more humid conditions and
- LBL-USGS-3.5, LBL-USGS-3.1/3.6, LBL-USGS-3.4, and LBL-USGS-3.3 result in less humid conditions.

In general, we observe that relative humidity behavior during the above-boiling period is much less sensitive to the matrix property data than during the post-boiling period.

It should be emphasized that Tables 1 through 4 are based on the smeared-heat-source, repository-scale model. Consequently, the listed value of *RH* is applicable to average liquid saturation conditions. 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. It should also be noted that thermo-hydrological heterogeneity and variability in the heat output among the WPs will cause local behavior to deviate from average behavior.

1.2.1.6 Configuration Management

No significant activity.

1.2.2. WASTE PACKAGE

1.2.2.1 Waste Package Coordination and Planning

Several LLNL staff members attended the fifth Design Integration Workshop held on June 29 in Pleasanton, CA. On the previous afternoon, a laboratory tour was conducted for some of the workshop participants and included stops to view the corrosion sensor laboratory, the slow crack growth test apparatus, and the thermogravimetric analysis unit. Several LLNL presentations were made during the tour and the workshop.

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

Work conducted by the Spent Fuel Oxidation and Spent Fuel Dissolution tasks has been affected by a suspension of radiological work in Bldg. 325 at Pacific Northwest Laboratories (PNL). Work conducted by the YMP was not a contributory element in the closure of the facility; however, this action has had a significant impact on our work schedule. The program manager has requested formal documentation of the justification for the building closure. This justification will be provided to LLNL and placed in the project records. PNL Line Management has taken an action item to provide this documentation. At this time, it is anticipated that the facility will reopen in August. PNL staff have placed a priority on restart of YMP work when the building reopens.

Spent Fuel Dissolution

No PNL activities are being reported this month due to a total shutdown of all radiological work in PNL Bldg. 325 for safety assessment. This will also further delay installation of the new liquid radioactive waste disposal holding tank for the analytical hot cells.

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

Tests under unsaturated conditions at 90°C are in progress at Argonne National Laboratory (ANL) to evaluate the long-term performance of spent fuel in the potential Yucca Mountain repository. These tests examine the leach/dissolution behavior of two types of well-characterized irradiated PWR fuels, ATM-103 and ATM-106, in three types of tests: two with a saturated water vapor atmosphere, two with a drip rate of 0.075 mL/3.5 d, and two with a drip rate of 0.75 mL/3.5 d. A control test without fuel but with a 0.075 mL/3.5 d drip rate is also included. EJ-13 water for the tests came from well J-13 and was equilibrated with volcanic tuff for approximately 80 days at 90°C. The seven tests have undergone 21 months of testing at 90°C by the end of June.

The pH and carbon contents of the fluids for the tests (both the fluid supply and the leachate) are shown in Table 5. The pH for the drip tests, with the exception of the control test (CC1J1) which does not contain spent fuel, are 6.9 and 7.1. Since January 1994, a new batch of EJ-13 water has been used, and the pH of the EJ-13 introduced has ranged between 7.3 and 8.4. The two vapor tests (S6V1 and S3V1) have the lowest pH of the spent fuel tests, 6.1 and 6.7. Radiolysis appears to be the simplest explanation of the change in pH in the tests.

The organic carbon content (5 to 7 ppm) is relatively unchanged for the new EJ-13 water for the period January through April 1994. However, for the old EJ-13, the organic content has increased significantly, 128 ppm versus 5 to 7 ppm. For the high drip rate tests (S32J1 and S62J1), the organic and inorganic carbon content have decreased. For the two vapor tests, the organic carbon has increased, and the inorganic carbon has decreased. The behavior of the carbon in the two low-drip tests (S31J1 and S61J1) appears similar to that in the vapor tests. Hypotheses have been proposed to explain the above results; these will be tested when analysis of the solid phases are conducted. The one result which is unexpected is the control tests which has a large increase in organic carbon and only a slight decrease in the inorganic carbon.

Table 5
Carbon and pH Results for Spent Fuel Leachate

Test	pH	Organic Carbon, ppm	Inorganic Carbon, ppm	Total Carbon, ppm	Carbon Anion, ppm
EJ-13-old[a]	3.2	128	15.2	143	NA
EJ-13-1/94[b]	8.4	5.1	20.2	25.7	NA
EJ-13-4/94[b]	7.3	7.0	51.5	28.5	8.2
CC1J1-589[c]	3.2	38.9	12.8	51.7	56.7
S3V1-580[c]	6.1	11.1	3.7	14.8	12.5
S6V1-574[c]	6.7	26.4	3.2	29.6	18.3
S31J1-568[c]	7.1	11.8	3.8	15.8	9.4
S61J1-559[c]	7.1	10.8	2.0	12.9	8.4
S32J1-581[d]	6.9	3.4	3.2	6.6	6.5
S62J1-581[d]	6.9	3.1	2.4	5.5	6.5

[a] Results from aliquots from the previous EJ-13 bottle which was in the hot cell from 9/92 until 1/94.

[b] Results from aliquots from the new EJ-13 bottle at successive dates of 1/94 and 4/94.

[c] Results from leachate that was produced from both EJ-13 bottles.

[d] Results from the removed 1/20/94 leachate. The new EJ-13 bottle was used after restart.

The anion composition of the spent fuel leachate as well as that of the EJ-13 water has been measured. The control test showed an increase in fluoride, chloride, nitrite, sulfate and formate from the EJ-13. Large increases in nitrite content are also seen in the two vapor tests, and the two low-drip tests. Smaller increases in nitrite are seen in the high-drip tests. The other differences may only denote variabilities inherent in the analyses. Measurements at three successive times did not reveal any trends. The up to a factor of two difference between the organic carbon content and the carbon anion content is attributed to the difference in detectability and accuracy of both techniques.

Gamma analysis of the leachates provides more definitive information. With only a few exceptions, the leachate quantities are one to seven orders of magnitude greater than that in the EJ-13 or in the control. As expected, the greatest mass of material is transported in the high-drip rate tests. The cesium transported was 1 µg for the high-drip rate tests, 0.3-0.7 ng for the low-drip rate tests, and 0.1-0.3 ng for the vapor tests. The americium, europium and cerium content in the base of the ATM-103 vapor test (S3V1) was one to two magnitudes greater than that found in the other vapor tests and in both of the low-drip rate tests. The reason for the difference from the low-drip rate test with ATM-103 (S31J1) is unknown. The results from the alpha and gamma analyses for the acid strip of the test vessels and the alpha results for the leachate should be available in the near future. At that time, the discrepancy may be resolved.

D-20-49.1, Unsaturated Dissolution Tests with Spent Fuel and UO_2

The objective of this Task 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 serve as a pilot study for similar tests with spent nuclear fuel.

Surface area normalized uranium release values have been measured for all Teflon-supported samples up to the present 9-year (108 month) results. These data are being compiled for individual sampling periods and to track cumulative release trends. Most tests are characterized by a period of rapid uranium release between one and two years of reaction. Uranium release rates during this interval were up to 14 $mg \bullet m^{-2} \bullet d^{-1}$, with most of this release being attributed to the spallation of UO_2 granules from the sample surface. A single sample (PMP8U-8) displayed a normalized release of 56 $mg \bullet m^{-2} \bullet d^{-1}$, but this high value is believed to have arisen from the dissolution of secondary uranyl minerals during the final overnight acid strip of the test vessel components. Subsequent to the one-to-two year rapid release period, release rates for most tests decreased to an average of approximately 0.10 to 0.30 $mg \bullet m^{-2} \bullet d^{-1}$ throughout the duration of the tests.

Spent Fuel Oxidation

Dry Bath Testing

A new fuel sample weighing balance, to replace the balance at PNL that has been used since testing began, was purchased and installed. The new balance has features which allow for faster weighings and automatic calibrations.

Purchase orders were placed to acquire parts for a new data acquisition system at PNL. The original acquisition system is much behind current technology and has several shortcomings. The new system will be installed during the interim shutdown which is scheduled for August.

Last year, a complete history of each test sample in the main part of the tests at PNL was entered into a computer spreadsheet. We are currently working on a similar history for the samples which make up the "special tests", i.e. drybaths 1, 8, and 9.

All drybaths at PNL are scheduled to be shut down on August 1 for an interim weighing of samples.

Thermogravimetric Apparatus (TGA)

The PNL Test Plan for Thermogravimetric Analyses of Spent Fuel Oxidation has been completed, reviewed internally, and sent to LLNL for approval. Revision of the PNL Technical Procedure is underway.

With the current hold on radiological work in PNL Bldg. 325, it has not been possible to complete the series of X-ray diffraction (XRD) analyses intended to determine if the observed loss of the $UO_{2.4}$ phase in spent fuel oxidized beyond an oxygen-to-metal ratio (O/M) of 2.4 is due to formation of an amorphous product or to a decrease in $UO_{2.4}$ crystallite size. The focus of this effort has shifted to transmission electron microscopy (TEM). An intensive effort is being made to produce suitable specimens of the highly friable oxidized fuel at $O/M > 2.4$ for TEM examination.

Materials Characterization Center (MCC) Hot Cell Activities

Planning for a fuel shipment to Argonne National Laboratory has been initiated. There is concern that this work may not be able to be accomplished during FY94 because of the time involved to obtain the needed shipping approvals and documentation. Preparations have begun at ANL to receive the spent fuel from the MCC. The MCC has asked for specifications; how much fuel, and in what form (rodlets or pellets). LLNL will respond with specifications in July.

1.2.2.3.1.2 Waste Form Testing - Glass

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

The N2 (DWPF actinide-doped glass) tests continue. A scheduled solution sampling at 101 months was completed. Samples were taken for alpha spectroscopy, cation analysis using Inductively Coupled Plasma Mass Spectroscopy (ICP/MS), anions, carbon, and filtering to detect colloidal material. In order to perform the sampling and retain the correct interchange of vessels, the stored liquid from the 12/21/93 sampling period that was being saved for additional studies has been transferred to a glass storage vial. No problems were encountered, and the tests continue. Additional data from earlier test periods are being compiled.

The N3 (West Valley ATM-10 glass) tests continue as scheduled. A total of 79 months of testing have been completed. The cation release data for these tests have been compiled. Inclusion of the total contribution from the EJ-13 solution that was added during testing must be done to determine the final release values. This work plus the compilation of the actinide release data are now in progress.

Preparation for the next 6 month sampling period for these tests has been initiated, and the sampling is scheduled for July. 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.

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

Sixteen tests continue with some in progress for up to 8 years. Two of these tests were sampled in June to prevent the water that has been collecting in the test vessels from contacting the glass. The sampling occurred without incident.

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

1.2.2.3.2 Metal Barriers

The purpose of the metallic barrier task is to characterize their behavior and determine corrosion rates and corrosion mechanisms, including the interaction between the metal containment barriers and the surrounding environment. Tests, modeling, and investigations are performed to determine this behavior. Conceptual models of corrosion processes are developed for use in evaluating waste package performance. This task provides considerable input on materials properties to the waste package and repository design teams, as well as to performance assessment.

Task Management and Quality Assurance (PACS OL232JCD)

A workshop was held May 10-12 in Pleasanton, CA to discuss plans for testing of container materials during the Advanced Conceptual Design (ACD) phase of the project. The workshop was attended by about 40 people, representing OCRWM, YMSCO, the M&O, LLNL, and various sub-contractors. An observer from the NWTRB attended also. The purpose of the workshop was to discuss what materials may be used for the multiple barrier concept that is the focused ACD approach, what environments are meaningful for testing, and what kinds of tests should be performed. Much of the emphasis was on "long term" testing (meaning up to 5 years of exposure) since recent project impetus is on substantially complete containment and on making an application for the construction authorization phase of licensing in 2001. Several informal talks were presented during the first two days of the workshop; then, on the morning of the third day, the participants were split into three groups:

- candidate materials,
- test environments, and
- test methods.

Each group made recommendations, which were reported back to the entire workshop body on the last afternoon. A summary of the workshop is being prepared, and the recommendations are being incorporated into the revised Metal Barrier Scientific Investigation Plan (SIP) and into the Engineering Materials Characterization Report.

In conjunction with the International Program, W. Bourcier transported an array of metal barrier specimens for exposure in the New Zealand geothermal fields. Three sets of specimens were prepared from samples that were "on hand". These include flat coupons for weight loss, sandwich coupons for crevice observation, and stressed C-ring specimens for stress corrosion evaluation. Materials included two-grades of carbon steel, 316L stainless steel, Alloy 825, high purity copper, aluminum bronze, and 70-30 copper-nickel. On June 13, the first set of corrosion specimens was placed in Paraiki Hot Springs, where the environmental conditions are 89°C, pH 2, around 450 ppm chloride ion, and 1150 ppm sulfate ion. These are quite aggressive conditions which approximate one of the "bounding" environments planned for the long-term testing. The other sets of specimens will be placed in other locations in the New Zealand geothermal field so that a range of exposure conditions will be obtained. Because we did not have on hand specimens of some of the corrosion resistant metals, such as Hastelloy C-4, Hastelloy C-22, Titanium Grade 12 and Titanium Grade 16, we expect to obtain specimens of these materials for emplacement at a future date.

D. McCright and J. Farmer visited R. Russo at Lawrence Berkeley Lab on May 31 to discuss advanced techniques for sensitively measuring film growth on metals and alloys exposed to humid environments.

D. McCright attended the High Level Waste Conference May 23-26 in Las Vegas. He co-authored a paper with A. Roy and R. Fish (both of the M&O) on the container material selection process. R. Van Konynenburg presented a paper on the limitations of scientific prediction and participated in a panel discussion.

A QA grading package for Activity E-20-18F was completed, approved, and a copy forwarded to Argonne National Laboratory asking them to complete an ANL "preparedness review". The grading package covers the LLNL portion of the work, and the preparedness review is to show coordination of effort.

P. Fojas, a graduate student from the University of Nevada, Reno, began his summer assignment on May 25. He will work with G. Henshall, D. McCright, and others on development of experiments to provide parameters for the pitting corrosion model under development. D. Jones, a professor of metallurgical engineering at UNR, is working on a summer assignment to assist in preparation of the Engineering Materials Characterization Report.

A. Roy (M&O) visited with D. McCright and R. Van Konynenburg on June 13-14 to gather information on the physical and mechanical properties of the container candidate materials.

D. Stahl (M&O) visited with the Metal Barrier Principal Investigators on June 13-14 to discuss the workscope and budgets for the coming fiscal year. There were also a number of follow-up items from the May materials testing workshop that were discussed. These included the bounding environments, some specific corrosion tests, the proposed long-term comprehensive corrosion test, and milestones for FY95.

On a related project, D. McCright attended the Waste Acceptance Technical Review Group (TRG) meeting in Las Vegas on June 21-22. On June 22, the TRG took the public tour of Yucca Mountain to observe progress made on excavating the Exploratory Studies Facility and other related facilities. M. Voegle, SAIC, guided the TRG tour.

<u>Prepare Planning Documents (PACS OL232LFF)</u>

The purpose of this activity is to update the planning documents for the Metal Barriers Task, particularly the Scientific Investigation Plan (SIP) and any subordinate activity plans, to account for changes in the multi-purpose container, waste package, and repository designs. The current SIP was written for the Conceptual

Design phase, but the candidate materials and configuration of barriers proposed for ACD are significantly different, necessitating an extensive revision of the SIP.

Work continues on a re-write of the 1989 Metal Barrier SIP to include the materials and test plans specific to ACD. Recommendations resulting from the May Container Materials Workshop are being incorporated into the SIP, which is expected to be complete by late July. In addition to discussion of long-term corrosion tests, shorter term corrosion tests and other physical and mechanical evaluations are discussed, along with plans for modeling activities, degradation mode surveys, and inputs to selection criteria and material recommendations.

Because initiation of long-term tests is receiving a high priority in the planning process and will receive a great deal of attention if adequate funding is obtained to begin these tests in the early part of FY95, aspects of the planning for the long-term tests are discussed below. The revised SIP, as well as other planning documents, will reflect the level of attention that has been given to planning for the long-term comprehensive corrosion tests.

As a consequence of the May Container Materials Workshop, meetings of the staff continued with emphasis on test environments and test methods. In support of the long-term testing plan, J. Estill prepared a cost estimate of test specimen procurement and test vessel fabrication. Some 10,000 test specimens will be required for testing different corrosion specimen types in several test environments that bound the expected envelope of relevant Yucca Mountain repository conditions. Four bounding environments were identified that encompass the extremes that a metal barrier container could experience and reflect conditions that will cause high corrosion rates for some of the materials. About 24 test vessels will be required if two temperatures are used for four bounding environments, and each candidate alloy family is tested in a separate vessel. The numbers of test specimens and test vessels, and consequently the costs of the testing program, will be the subject of continuing dialogues between the principal investigators and LLNL project management. As a preliminary estimate, J. Estill prepared a cost analysis of specimen procurement from Metal Samples of Munford, Alabama, including estimates for glass vessels, thermocouples, heaters, and control/data acquisition equipment. The cost will range from $100k to $300k depending on specimen selection, e.g., U-bend vs. wedge open loaded (WOL) specimens for stress induced corrosion testing.

The four bounding environments are:

- A dilute groundwater, like that of Well J-13, which represents undisturbed aqueous conditions existing at Yucca Mountain.
- A concentrated groundwater that would simulate a dry-out condition followed by resaturation with concentration of the ionic salts. Concentrations would be on the order of 20-100x those in the dilute groundwater, and this would require continuing dialogue with PIs in the near-field environment on a detailed composition and the process for preparing this kind of environment. From a metallurgical performance point of view, it is important to retain the ratio of the various ionic species present in the dilute groundwater while recognizing the limitations on solubility of the various chemical species as the species are concentrated.

- An acidified concentrated groundwater that would simulate reactions between certain man-made materials and the water. The "man-made" materials are those that would be introduced into the repository during construction and operation and which would not be removed or inadvertently left behind when operations cease. Hydrocarbons, such as fuels, oils, hydraulic fluid, brake fluid, and many other compounds may react with water and steam at somewhat elevated temperatures to form organic acids. This environment would further simulate the acid producing metabolism products of certain kinds of microbiological organisms. Values of pH as low as 2 may occur under certain bounding conditions, and these would be aggressive to several of the metallic candidate materials.
- An alkalized concentrated groundwater that would simulate reactions between man-made materials, such as concrete, and the aqueous environment. Values of pH as high as 12 could occur. In general, these high pH values would be beneficial to preventing high rates of corrosion, even for carbon steel.

It is felt that long-term testing (on the order of five years or longer) in these four bounding environments will be useful in selecting materials for the container. It is planned to conduct the tests at 60 and 90°C in the water, in the vapor phase above the water, and in some instances at the water line.

During the May Container Materials Workshop, candidate materials for multiple barrier waste package containers were categorized into three groups:

- Corrosion allowance,
- Corrosion resistant, and
- An "intermediate" group or materials having properties in between those of the first two groups.

In later discussions between Metal Barriers Principal Investigators and M&O design staff, the suggestion was made to rename the "intermediate" group as "moderately corrosion resistant". This includes such materials as 70/30 copper-nickel and Monel 400. As a further distinction the corrosion resistant group, including materials such as Incoloy 825, Hastelloy C-22, Hastelloy C-4, Titanium Grade 12, and Titanium Grade 16 should henceforth be termed "highly corrosion resistant" Thus, the three groups are:

- Corrosion allowance,
- Moderately corrosion resistant, and
- Highly corrosion resistant.

E. Dalder clarified some nomenclature about candidate corrosion allowance materials that were discussed and recommended at the May Container Materials Workshop. The correct designations are: UNS G10200 cross-referenced to ASTM A516 Grade 55 for the wrought carbon steel, UNS J02501 cross-referenced to ASTM A27 Grade 70-40 for the centrifugal cast carbon steel, and UNS K21590 cross-referenced to ASTM A 387 Grade 22 for the nominal 2 1/4 Cr - 1 Mo alloy steel.

E. Dalder obtained technical performance information about the recently developed Grade 16 titanium, which is a Ti-base "lean" alloy, containing around 0.05% Pd. Ti Grade 16 was identified as a candidate material for a highly corrosion resistant metal barrier at the May Container Materials Workshop. The very small palladium addition increases the resistance to crevice corrosion, while maintaining a fully alpha phase microstructure which promotes greater resistance to embrittlement due to hydride formation. Thus, the two potentially damaging corrosion related problems in using titanium are greatly reduced. As with other Ti-base materials, Grade 16 is exceptionally resistant to corrosion in saline environments and in acid environments. This material, like other grades of titanium, is also apparently immune to microbiologically influenced corrosion. The Canadian AECL program on spent fuel containers is considering Grade 16 Ti as a candidate material. The Grade 16 Ti material was developed by the titanium industry as a lower cost alternative to previous grades that contained significantly higher palladium levels.

Degradation Mode Surveys (PACS OL232LFA, Activity E-20-13)

The purpose of a degradation mode survey is to amass previously published information about a candidate material and its performance in a number of environments and applications, and to interpret this body of information in the context of a potential repository in Yucca Mountain. In many cases, the degradation mode survey indicates the ways in which a material can degrade and serves to indicate the rate and kind of degradation in environments that have some similarity to what a metal barrier may experience in the Yucca Mountain setting. Lack of information in many cases suggests what work will be required to determine the behavior of the candidate material in Yucca Mountain environments.

Currently, D. Bullen at Iowa State University is compiling a degradation mode survey on carbon steel and alloy steels, cast irons and alloy cast irons. Revision 1 of the draft degradation mode survey was received on May 20 and a copy was sent to YMSCO on May 31. The draft is undergoing review at LLNL and at YMSCO. E. Dalder is coordinating the reviews. Completion of this survey constituted completion of Milestone MOL46.

E. Dalder visited Iowa State University on June 9 and discussed with D. Bullen and associates the status of the current degradation mode survey on iron-base materials and what future surveys might be needed on other materials. One such material is Ni-base Alloy 400 (Monel 400). Previous degradation mode surveys have focused on copper-nickels (such as CDA 715: 70 Cu-30 Ni) and on the Ni-Cr-Fe-Mo alloys, including the commercial Hastelloys, Incoloys, and Inconels. A specific survey on Alloy 400 would close the information gap.

Performance Tests and Model Development (PACS OL232LFB, Activity E-20-16)

The purpose of model development is to develop a predictive tool that will enable use of experimental data and analyses to draw long-term assessment of the performance of candidate container materials under Yucca Mountain conditions. This work will ultimately describe the performance of the multiple barrier waste package container. As a first step in that direction, the modeling work has focused on pitting of a highly corrosion resistant barrier, such as one of the nickel-base or titanium-base candidate materials. While pitting corrosion is usually governed by electrochemical, chemical, and occasionally metallurgical parameters, an important aspect of pitting is "stochastic". Much of the modeling work is aimed at developing the stochastic aspect of pitting within the electrochemical and chemical parameters. G. Henshall is the Principal Investigator for the model development.

G. Henshall has prepared an article for the Materials Research Society Meeting on Nuclear Waste Disposal to be held in Kyoto, Japan in October of 1994. This article is entitled, "Stochastic Modeling of the Influence of Environment on Pitting Corrosion Damage of Radioactive Waste Containers", and has been submitted to YMSCO and LLNL for review and approval to publish.

Details of the Modeling: Exponential Birth Probability

G. Henshall has performed calculations over the past few months regarding the effects of wait time on pitting potential. These calculations have assumed that the birth probability, λ, depends upon the applied potential, E_{app}, according to the phenomenological expression:

$$\lambda \sim A\,(E_{app} - B) \qquad (1)$$

where A and B are constants. As discussed elsewhere (Ref. 1), this is one of two expressions that have been used to model the electrochemical potential dependence of the birth probability. The other expression, which was the focus of more recent modeling effort, has the form

$$\lambda \sim C\,\exp(D\,E_{app}) \qquad (2)$$

The values of A and B in equation (2) were selected based on two constraints: First, for the largest E_{app} used in the simulations, 0.02151 (arbitrary units), the value of λ must be the same as that for previous calculations using equation (1), i.e. $\lambda = 0.002151$. Second, the value of λ must decrease by a factor of 50 when E_{app} decreases by an order of magnitude from 0.002151. Using these computed values of C and D, simulations of the effect of wait time on pitting potential were performed as in previous months using 20 runs per simulation. No decay in λ with time was used (see the April 1994 report).

The pitting potential vs. wait time curves all had the same general shape, with variations only in the absolute values and the amount of scatter. Examples are shown in Figure 1 for the minimum wait time, t_{min}, and the median wait time, $<t_p>$. Note how the pitting potential, E_p ($= E_{app}$), decreases as the wait time increases until the wait time reaches an asymptotic limit. At this point, wide variations in E_p result from the same wait time. Physically, these results do not appear to be plausible. They suggest that pitting would occur within a constant, finite wait time at arbitrarily low potentials.

The reason for the unusual behavior show in Figure 1 is evident by plotting the birth probability as a function of E_{app}. The upper graph of Figure 2a shows that for E_{app} values below about 4×10^{-4} (arbitrary units), the birth probability reaches a limiting value. Therefore, in this regime, pits initiate after essentially the same wait time regardless of the applied potential. The reason for the behavior shown in this plot stems directly from equation (2). As shown in the semi-log plot on the lower half of Figure 2b, λ is clearly an exponential function of the applied potential (linear on the semi-log plot).

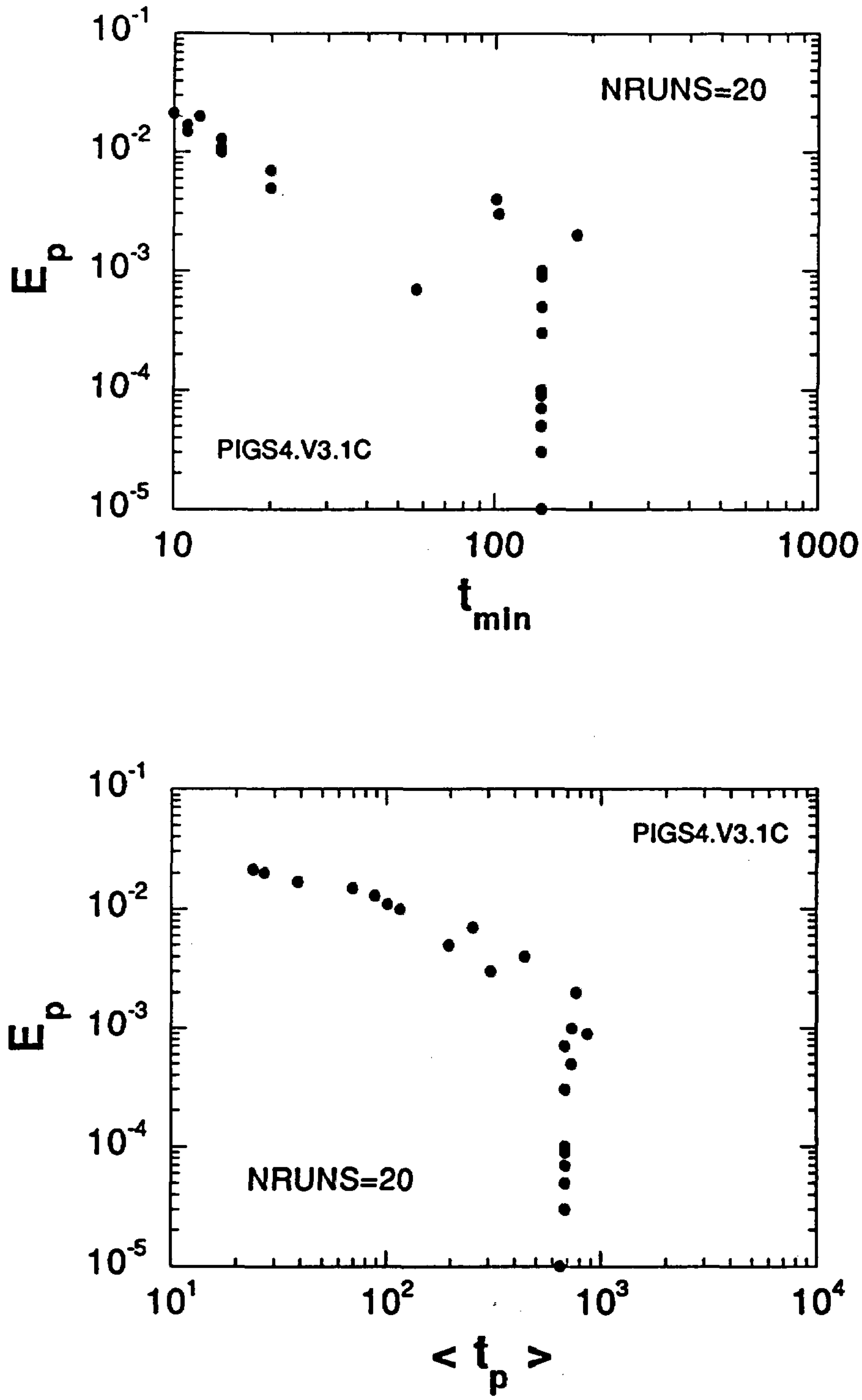
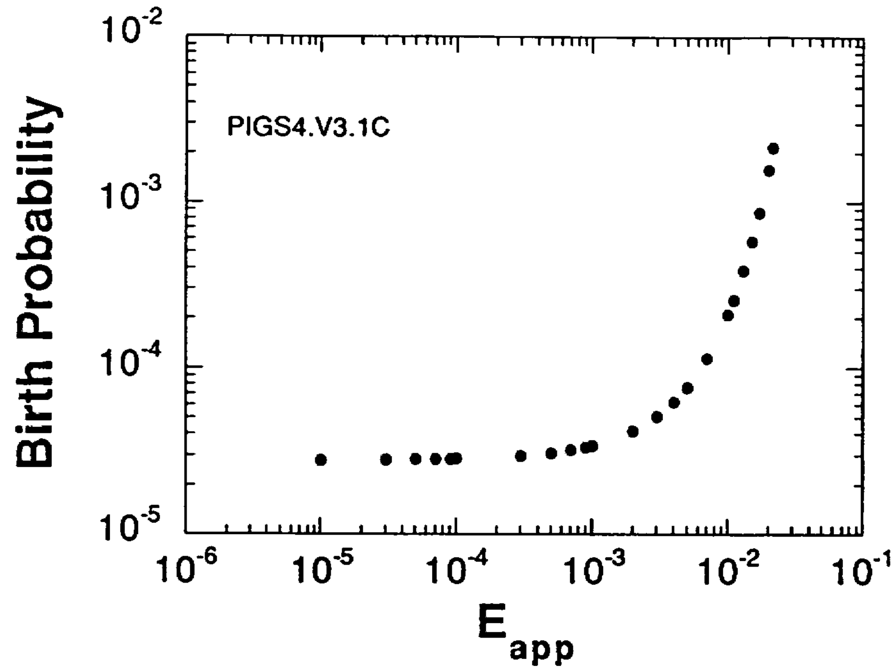


Figure 1. The variation in the pitting potential, E_p, as a function of t_{min} and $<t_p>$ for the case in which the birth probability is given by the exponential expression of equation (2). The units for potential and time are arbitrary.



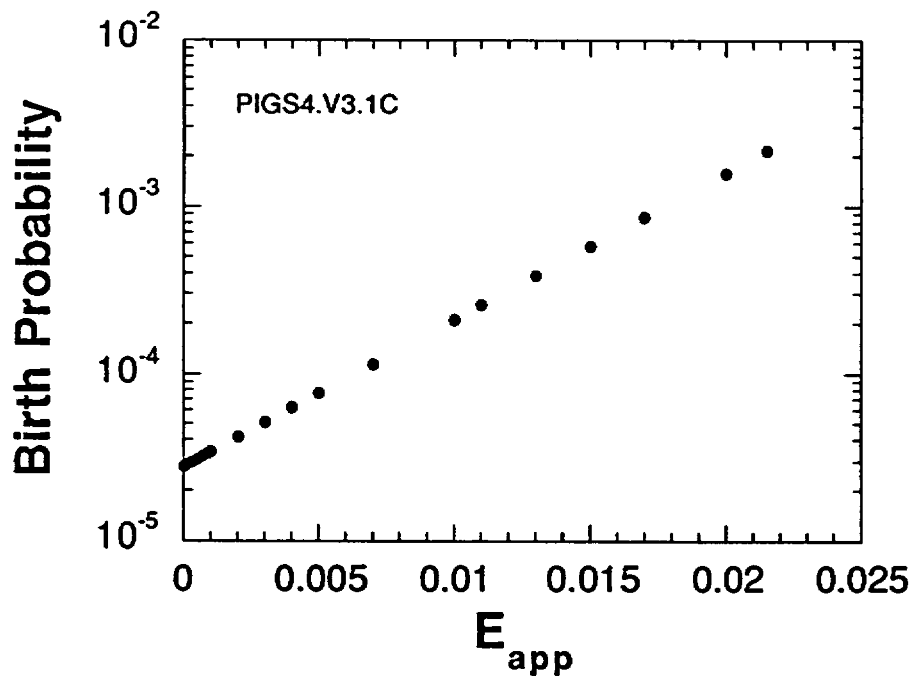


Figure 2. The variation in the birth probability as a function of the applied potential corresponding to the simulations depicted in Figure 1. The results are shown on log-log and semi-log coordinates axes. The units for potential are arbitrary.

Details of the Modeling: Potentiodynamic Pitting Experiment Simulation

Measurements of the pitting potential are often made using a potentiodynamic technique, rather than the potentiostatic one that has been simulated in previous months. Simulation of potentiodynamic experiments required the development of a new version of the Pitting Initiation and Growth Studies (PIGs) computer program and a program to construct histograms from an array of real numbers. Details of the new model and what its usefulness may be are given below.

In a typical potentiodynamic experiment, the applied potential, E_{app}, is swept from a low value, E_o, toward higher values at a constant velocity, v:

$$E_{app} = E_o + vt \qquad (3)$$

where t is time. The potential at the time the first pit is detected is designated as the pitting potential, E_p. As discussed by Shibata and Takeyama (Refs. 2-4), the stochastic theory of pitting predicts that E_p is actually a distributed quantity for any given sweep velocity. From a simple algebraic stochastic theory based on birth processes only, Shibata and Takeyama (Refs. 2,4) deduced the most probable value of the pitting potential, $\underline{E}_p$, as a function of sweep velocity. The form of this relationship depends on the equation relating the birth probability, λ, and E_{app}. Both linear and exponential relationships between λ and E_{app} were observed (Refs. 2-4):

$$\lambda \sim \alpha\ (E_{app} - E_c) \qquad (4a)$$

where α is a constant and E_c is the critical potential below which pit initiation cannot occur, or

$$\lambda \sim \gamma\ \exp\ (\beta\ E_{app}) \qquad (4b)$$

where γ and β are constants. Using eqn. (4a) leads to (Refs. 2,4)

$$\underline{E}_p = (v/\alpha)^{1/2} + E_c \qquad (5a)$$

while eqn. (4b) leads to

$$\underline{E}_p = [1/(\gamma\ \beta)]\ \ln(v/\gamma) \qquad (5b)$$

Thus, a plot of $\underline{E}_p$ vs. $v^{1/2}$ will yield a straight line if eqns. (4a) and (5a) are correct, or a plot of $\underline{E}_p$ vs. log (v) will yield a straight line if eqns. (4b) and (4b) are correct.

Since the Monte Carlo model (PIGS) computes the generation of a stable pit using the concepts of embryo death and a critical embryo age in addition to embryo birth, the relationships between $\underline{E}_p$ and the embryo birth probability, λ, are more complex than that assumed for deriving equations (5). Thus, it is necessary to determine if the $v^{1/2}$ and ln(v) relationships will be predicted by the more complex Monte Carlo model. If so, then the decision of which form of eqn. (4) to use within PIGS for a particular material-environment system can be made from plots of standard potentiodynamic experimental data.

To test this hypothesis, a series of simulations were performed in which the applied potential was swept according to eqn. (3). A particular sweep velocity was chosen, and a simulation was performed until the first stable pit was generated. The value of E_{app} at this time step, eqn. (3), was designated as E_p. This process was repeated with different random number "seeds" (Ref. 5) to produce one hundred separate E_p values for that particular sweep velocity. A histogram of these E_p values was generated, a smooth curve approximation was made, and the E_p value corresponding to the peak in this curve was designated as $\underline{E}_p$. Following Shibata (Ref. 2), the median pitting potential $<E_p>$, was also calculated from the one hundred E_p values. This process was repeated for different values of sweep velocity, all other input parameters remaining constant, so that plots of $\underline{E}_p$ and $<E_p>$ vs. $v^{1/2}$ and log (v) could be constructed.

The results of such a numerical "experiment" are given in Fig. 3 for the case in which eqn. (4a) was used with E_c = 0.0. The initial potential, E_o, in eqn. (1) was also set to 0.0. Both the median and the most probable pitting potentials clearly exhibit the $v^{1/2}$ dependence predicted by eqn. (5a) for the simple birth-only model. The $\underline{E}_p$ results show somewhat more scatter than those for $<E_p>$, perhaps due to the uncertainty in defining the smooth curve approximation to the histogram of E_p values. As predicted by eqn. (5a), the intercept at zero velocity is essentially zero. Also in agreement with the simple algebraic theory of Eqns. (5), plots (not shown here) of $<E_p>$ and $\underline{E}_p$ vs. log (v) were not linear.

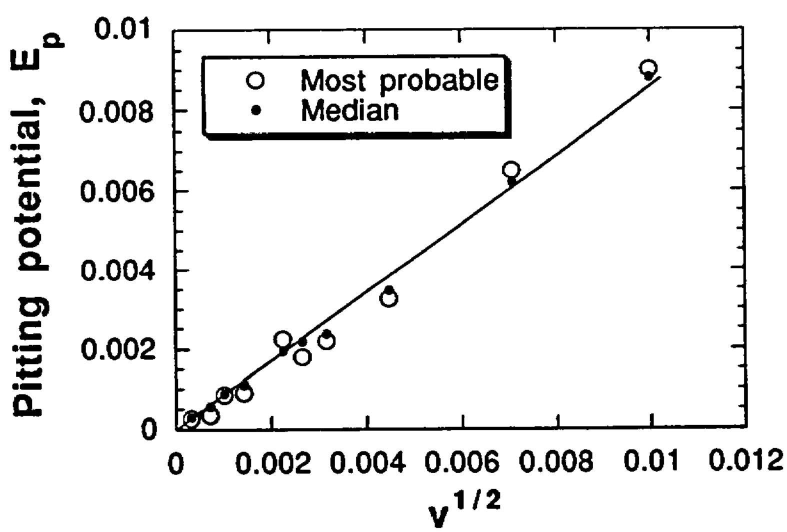


Figure 3. PIGS predictions of the most probable pitting potential, $\underline{E}_p$, and the median pitting potential, $<E_p>$, as a function of the square root of the potentiodynamic sweep velocity for E_c = 0.

The results of a similar set of simulations are given in Fig. 4 for the case in which eqn. (4a) was used with E_c = 0.002. The initial potential; E_o in Eqn. (1), was set equal to 0.003. The median pitting potential clearly exhibits the $v^{1/2}$ dependence predicted by Eqn. (5a) for the simple birth-only model. The $\underline{E}_p$ results again show somewhat more scatter but also exhibit the linear dependence on $v^{1/2}$. Using linear regression analysis, a straight line was fit to the $\underline{E}_p$ data, and the intercept at zero sweep velocity was calculated to be 0.00208. The intercept predicted by Eqn. (5a) is E_c = 0.002; only 4% lower than that predicted by PIGS. Finally, neither the median nor the most probable values exhibit linear behavior on a plot (not shown here) of pitting potential vs. log(v).

Further simulations of this kind are planned in which Eqn. (4b) will be used. In this case, it is expected that Eqn. (5b) will better describe the results than Eqn. (5a). If so, then empirical potentiodynamic data could be used to determine whether Eqn. (4a) or (4b) should be used within the PIGS model (Ref. 1) to simulate pitting in any particular material-environment system.

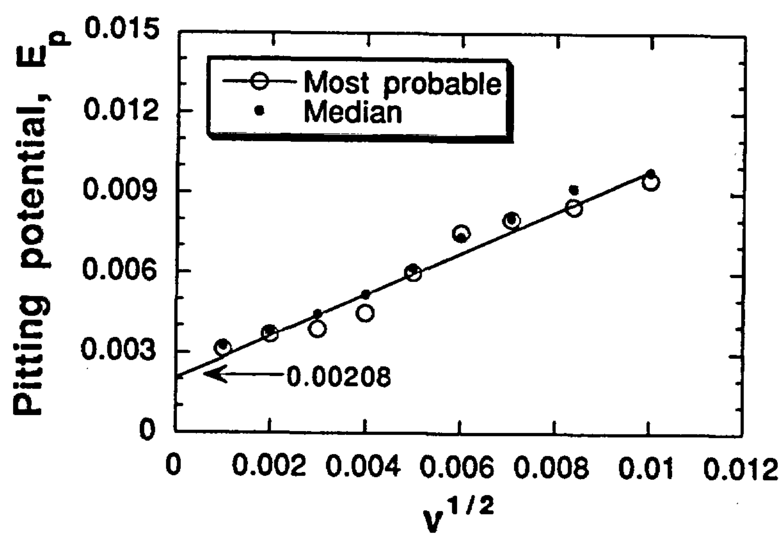


Figure 4. PIGS predictions of the most probable pitting potential, $\underline{E}_p$, and the median pitting potential, $\langle E_p \rangle$, as a function of the square root of the potentiodynamic sweep velocity for E_c = 0.002.

Parameter Tests and Metal Degradation (PACS OL232LFC, Activity E-20-17)

There are currently two active parametric studies, one on thermogravimetric analysis and the other on corrosion sensor development, including support to the Large Block Test.

Thermogravimetric Analysis

The purpose of this work is to determine the limits where aqueous corrosion processes occur after emplacement of the waste package. The key parameters appear to be humidity, temperature, and surface conditions. The experimental work discussed in this section will indicate the inter-relationship between these parameters. Thermogravimetric analysis is a sensitive experimental method to discern the discontinuity in reaction rate corresponding to the transition from oxidation to corrosion.

In May, G. Gdowski and J. Estill performed several successful exploratory tests with the thermogravimetric analyzer. The previously mentioned problem of condensing water in the upper part of the apparatus was eliminated by modifying the heating of the exit port from the reactor and adjusting the flow rates of the reaction gas and the purge gas. In addition the width of the specimen was narrowed to eliminate possible interactions with sides of the reaction zone.

The exploratory tests were performed with commercially pure copper (CDA 102), the temperature range was 60 to 90°C, and the calculated relative humidities were 70 to 80%. The test times varied between 24 and 96 hrs. The tests consisted of holding the specimen at a constant temperature in a constant humidity environment. The flat plate specimen was suspended by a wire (platinum or high nickel alloy) attached to a hole that was drilled in one end of the plate. The specimen was thus oriented vertically.

It was found in every test that the most severe corrosion occurred at the bottom of the specimen. Depending on reaction conditions, the corrosion product varied between slight orange-brown discoloration to exfoliating black corrosion product. More severe corrosion occurred at longer test times and higher temperatures. Interestingly, under all test conditions, there were significant regions of the test specimen where visual inspection indicated very little oxidation.

It appears that the enhanced corrosion at the bottom of the specimen is due to water accumulation there. Unfortunately, real time visual monitoring of the specimen is not possible with the present test apparatus.

Exploratory testing of specimens with the thermogravimetric analyzer continued in June. These tests were performed with commercially pure copper (CDA 102; UNS# C10200), a carbon steel alloy (1020; UNS# G10200), and a Ni-Fe-Cr-Mo alloy (Incoloy 825, UNS# N08825).

A comparison of the three alloys tested under the same conditions (70°C, air with 60% relative humidity, 90-130 hrs.) showed that, as expected, the carbon steel was the most severely degraded, pure copper was less degraded, and Incoloy 825 showed no visible degradation. The carbon steel specimen was attacked over the whole specimen; however, there were regions of severe corrosion where the corroded material was exfoliated. The copper specimen had regions of very little attack and a smaller region of exfoliated black corrosion product. Optical inspection of the Incoloy 825 specimen indicated no corrosion. These tests also showed that materials which were more aggressively attacked also absorbed the most water from the high humidity air.

A carbon steel specimen was also tested under lower humidity conditions (30% relative humidity) at 70°C for 90 hrs. Under these conditions, the weight gain was less than the detection limit of the instrument. Only a very small amount of oxidized material was optically visible. These tests showed the enhanced aggressiveness of the high humidity environment relative to the low humidity environment for carbon steel.

In July, a humidity sensor will be incorporated in the apparatus. Accurate humidity measurements in the reaction zone are necessary for an understanding of the interaction of water vapor with the test specimens. At present, the humidity in the reaction zone is obtained by calculation of test parameters.

Corrosion Sensor Development - Support to Large Block Test

The purpose of this activity is to develop sensors and methods to monitor atmospheric corrosion phenomena for prospective container materials, and also to investigate the rates and mechanisms of microbiologically-induced corrosion (MIC). Past work has centered on measurements in the liquid phase. Relatively little work has been done, relevant to the Yucca Mountain Site Characterization Project, on the application of electrochemical methods (and other sensors) in the gas phase, which is a more realistic corrosion environment for the repository. Our current efforts center around the development of microelectrode arrays for corrosion potential/rate measurements in the gas phase, initially to be used in the Large Block Test, and the use of the quartz crystal microbalance for studying MIC processes.

Metal Barrier personnel are developing sensors to support the Large Block Test (LBT). Principal Investigators M. Whitbeck and R. Glass are evaluating solid state iridium (IV) oxide pH sensors. Iridium wire coated with iridium (IV) oxide has been prepared by electrolysis and will be used in evaluating polymeric coatings for ion-exchange and protection.

Preliminary tests are underway to address the sensing of corrosion as either a rate or as corrosion potential. Initial tests used iron and stainless steel (304) wire (0.05 - 0.125 mm dia) free standing, mounted in epoxy or in epon. A silver wire serves as a reference electrode when coated with silver chloride. Both potentiodynamic and simple potential measurements are being evaluated. Typical preliminary results indicate that corrosion measurements are feasible when there is an adequate amount of. Problems encountered include fragility of the connections; future designs will include electrical connectors epoxied directly to the probe.

During June, the humidity chamber in LLNL Bldg. 241/high bay was made operational, and the corrosion microsensor work was begun in humid environments. Our initial emphasis is to develop integrated sensors which can detect changes in the "corrosivity" of an environment (e.g., pH changes; increases in the chloride ion concentration, etc.) and also monitor the environmental (corrosion) response of the container materials of interest. Ultimately, these sensors will be manufactured using state-of-the-art microfabrication methods developed in the electronics industry. Currently, bundles of microwires are sealed in epoxy, with only the ends of the wires being exposed (disc sensors of micron dimensions). The initial work is being done with iron and AISI 316 stainless steel. We believe that we are getting reasonable responses (corrosion potentials) at high humidities for these materials. Humidities above 90% RH are being used because this is what is expected to be encountered in the geochemical holes of the Large Block Test and in unventilated drifts in Yucca Mountain. A computer, display, and data logger have been interfaced to the experimental apparatus for long-term measurement and real-time display of results. Sensors for atmospheric pH and chloride will be tested in July. The initial application for these sensors is the Large Block Test, which will be monitored for long-term geochemical changes which may influence corrosion (e.g., as a result of evaporation, percolation, and condensation). The LBT will also include monitoring the response of Monel 400, 70/30 alloy, and carbon steel.

The quartz crystal microbalance (QCM) arrived during June. This system consists of the AC-cut quartz crystals, the crystal interface, and the analyzer module. Electrodes are plated on both sides of the crystal (they come with platinum, but any other material can be plated on). When an ac voltage is applied the electrodes, a shear wave is set up in the quartz (piezoelectric effect). The frequency of crystal vibration is inversely proportional to the mass of the crystal. Corrosion processes can be monitored if the container material of interest is used for the electrodes. The material either gains or loses weight as it corrodes, causing a frequency change, and the corrosion rate can be directly determined. Sensitivities of ng/cm^2 are possible. Both atmospheric and liquid phase corrosion can be investigated. During June, this system was set up and interfaced to a computer. We have done a library search of microbes present at the Yucca Mountain site, and have begun efforts to obtain some of these microbes. We will use the QCM to evaluate the rates of microbiologically-induced corrosion in both the liquid and gas phase.

Crack Growth Tests (PACS OL232LFD, Activity E-20-18F)

The purpose of this work is to determine the stress corrosion susceptibility of candidate container materials under a variety of environmental, metallurgical, and mechanical stress conditions relevant to the repository. Stress corrosion is an important degradation mode that can affect both corrosion allowance and corrosion resistant materials. Work to date has focused on the corrosion resistant materials. A sensitive crack growth measurement apparatus, which operates under the principle of measuring minute changes in the electrical resistance of the test specimen as a crack propagates, is in use at Argonne National Laboratory (ANL) to measure crack growth on pre-cracked compact tension specimens.

ANL Principal Investigators D. Diercks and J. Park have renewed YMP-sponsored research activity on the determination of crack growth rates in candidate metal barrier waste container materials. Research activities under this renewed phase deal with fracture mechanics crack-growth-rate determinations on Types 304L and 316L stainless steels and Incoloy 825 under high stress ratios. In addition, tests will be conducted under low stress ratio conditions on Ti Grade 12, Hastelloy C-4, and the new heat of Incoloy 825. The Incoloy 825, Type 304L SS, and Type 316L SS are from different heats of material than those tested in the previous phase of this program, and the Titanium Grade 12, Hastelloy C-4, and Hastelloy C-22 are new materials for the program. As stated in previous reports, all six of the alloys to be tested have been purchased. The alloys are in the form of plate, and it was confirmed that the chemical compositions of the alloys meet specifications.

Cross-sections of the Type 304L SS, Type 316L SS and Incoloy 825 plates were metallographically examined in May to determine grain or rolling direction because this information was not available through the vendor. The grains are equiaxed and no preferred rolling is apparent. The Type 304L SS material showed larger grains than the Type 316L SS, and sensitization is not observed in either material. Metallographic examinations of the Hastelloy C-4 and C-22 material were presented in earlier reports. The grain direction for Ti Grade 12 was provided by the vendor. Four 1T-compact tension specimens were machined from each of the six materials. The design of the specimens is in accordance with the ASTM E399 Standard, except for 1.27-mm deep side grooves at both sides and a small threaded hole on the front face for instrumentation.

Before SCC tests begin, the specimens are being fatigue cracked in air at room temperature to introduce a sharp starter crack for a length of 1.91 mm. In June, the specimens were fatigue pre-cracked for Titanium Grade 12, Hastelloy C-4, and Hastelloy C-22 materials. The fatigue-cracking was performed in air at room temperature under a cyclic load with a triangular load shape, load ratio of $R = 0.1$-0.25 and 1 Hz.

The Preparedness Review was performed this month, and the task at ANL is approved to initiate quality affecting (ANL QA level 1) activities.

Engineered Materials Characterization Report - EMCR (PACS OL232LFE)

The purpose of preparing the materials characterization report is to compile and synthesize information on the cogent properties of the candidate materials for the Waste Package and other Engineered Barrier System components. This report is planned to incorporate information on the important physical, mechanical, and chemical properties of the candidate materials, plus an outline of the long range and short range testing planned during ACD. Much of the long range testing plans were discussed in the Planning Documents Section above. The Engineered Materials Characterization Report (EMCR) will serve as input to the Basis For Design document for Waste Package design.

D. Jones (UNR) and R. Van Konynenburg are tasked to be co-authors of the Engineered Materials Characterization Report. The first draft of the report has a due date of the end of July.

References for WBS 1.2.2.3.2

1. G. Henshall, W. Halsey, W. Clarke, and R. McCright, University of California Lawrence Livermore Laboratory Report No. UCRL-ID-111624 (1993).
2. T. Shibata and T. Takeyama, *Corr.* **33**, p. 243 (1977).
3. T. Shibata, *Corr. Sci.* **31**, p. 413 (1990).
4. T. Shibata and T. Takeyama, in Proc. Second Japan-U.S.S.R. Corrosion Seminar, JSCE (1980) pp. 178.

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.

1.2.2.3.5 Non-Metallic Barrier Concepts

(PACS OL235JGD and OL235KKA)

The purpose of the non-metallic barriers task is to characterize the behavior of non-metallic materials, such as ceramics, and to determine degradation rates and mechanisms, including the interaction between the barrier and the surrounding environment. The work in the non-metallic barriers task parallels that in the metallic barriers task. One of the multiple barriers of the waste package container may be fabricated from a non-metallic material. A primary objective of this task is determination of the feasibility of making a non-metallic barrier as part of a waste package.

K. Wilfinger has begun to collate data gathered over the past 6 months in preparation for writing a final report on large scale non-metallic barriers and sealing with a projected completion date of August 1. He continues to seek published data and the confirmation of manufacturer claims. He attended the manufacturer's exposition at the ASM Thermal Spray Conference in Boston MA on June 21.

Current industry claims are that certain thermal spray techniques and materials can offer relatively thick, impervious coatings at up to 98% of theoretical density. High Velocity Oxy-Fuel (HVOF) sprayers produce the densest materials in most applications. Coatings are considered "thick" when they exceed 1 millimeter; however free standing structures up to 80 millimeters thick have been made successfully. Some coatings can be pre-stressed thermally to make them more resistant to inadvertent damage. Robotic systems can be constructed to apply coatings to the interior or exterior of large vessels. Sealing of an interior lining remains an issue, while an exterior coating on a metal vessel could be made to provided a "seamless" closure. A relative few manufacturers claim to be able to lay down coatings of alpha alumina rather than the gamma phase normally resulting from thermal spray techniques. Product samples have been requested for confirmation by x-ray diffraction.

Manufacturers of monolithic, castable, refractory liners fabricate parts up to 2.5x2.5x6.7 m (8'x8'x22') and several inches thick. This technology could be used to fabricate movable containers, but the materials used are hydrated calcium aluminate cements with about 15% of connected porosity. As such, they are unlikely to be of use in preventing transport of water and radionuclides. A substantial development effort would likely be required to overcome this.

General conclusions of this study are:

- Sufficiently large ceramic and ceramic coated vessels can be fabricated using currently available materials and techniques.
- Current industrial capacity is insufficient to handle the fabrication of large numbers of such vessels.
- Alumina based ceramics are probably the most suitable materials for non-metallic barriers.
- Experimental confirmation of the suitability of available materials is required.
- Final closure remains the weakest link in the use of non-metallic barriers due to average temperature limitations imposed by the zircalloy cladding.
- Thermal spray techniques are most promising both as fabrication and closure methods.

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

No significant activity.

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

The Independent Software Validation activity for EQ3/6 Version 7 is in the final stages. Work is now focused on writing the final report, which is close to completion.

Work is progressing on incorporating thermodynamic pressure corrections and a generic ion exchange model into EQ3/6 Version 8.0. The test case library is being enlarged to represent these new capabilities, as well as the new redox disequilibrium capability. A preliminary round of regression testing comparing version 8.0 with version 7.2a was conducted.. A convergence problem exists in high concentration solutions and is still being diagnosed. Some new options have been added to EQ6 to make it more convenient for the user to remove minerals present in equilibrium with the aqueous solution. Also, the code will now automatically generate (if necessary) a chemical reaction for a user-defined reactant species, based on its specified chemical composition. Reactions are required because of the way the code now tracks mass balances (in terms of chemical species as opposed to chemical elements). In addition, the major option switches in EQ3NR and EQ6 have been made common between the two codes, in order to make them easier to use. Previously, some switches had one meaning in EQ3NR and another in EQ6.

T. Wolery's work on QP 3.2 (the software quality procedure) was completed last month and the procedure has been issued. This task had caused a minor delay in progress on EQ3/6 Version 8.0.

1.2.3.5 Drilling

1.2.3.5.2.2 Engineering, Design, and Drilling Support

One logging session was conducted at USW SD9 on June 28. A downhole run performed a photographic inspection of the drill hole.

1.2.3.10 Altered Zone Characterization

1.2.3.10.1 Characterization Techniques for the Altered Zone

No significant activity.

1.2.3.10.2 Characterization of Thermal Effects on the Altered Zone Performance

Experiments to examine rock-water interaction in relevant lithologic units continue. The run products from the earlier completed experiment are being analyzed.

Bounding analyses for identifying the range of responses that may result from hydrothermal processes were conducted using the FEHM code. Specific attention has been paid to reaction product volumes, and assuming specific changes in porosity and permeability due to these interactions. The results of those simulations are being analyzed. They will be used to determine, for preliminary scenarios and reconnaissance studies, the degree to which changes in permeability during rock-water interaction might influence thermal evolution of the repository block.

The study plan for this WBS is being written and is expected to be ready for internal LLNL review in August 1994.

1.2.3.10.3 Integrated Testing

1.2.3.10.3.1 Integrated Radionuclide Release: Tests and Models

June activities will be reported in a later monthly progress report.

1.2.3.10.3.2 Thermodynamic Data Determination

June activities will be reported in a later monthly progress report.

1.2.3.11 Integrated Geophysical Testing for Site Characterization

1.2.3.11.3 Geophysics - ESF Support, Subsurface Geophysical Testing

No significant activity. The work will resume when the capital and non-capital procurements have been received.

1.2.3.12 Waste Package Environment Testing

This WBS element was created from WBS element 1.2.2.2. Reporting and PACS have been converted to the new system, but funds still reside within WBS 1.2.2.

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. It will be submitted to YMSCO in July.

Work at the New Zealand natural process analog site is emphasizing evaluation of the way in which model validation activities can be conducted in the field. Data have been collected and compared against simulations which demonstrate that very good agreement can be achieved between the two. However, perfect matches are impossible due to inherent uncertainties in data values, thermodynamic property measurements, and limitations of conceptual models. As a result, attention is being focused on developing strategies that allow a more flexible approach to validation efforts. This will be important when validation efforts address characterization of processes and properties of the site.

Field-based experiments in New Zealand on dissolution and precipitation kinetics continue. Materials for sample holders have been emplaced in Paraiki Stream, in a pool at 89.1°C, pH 3.0, to evaluate the material durability. To data, all sample holder materials, except certain Fe- metals, have survived well. Mineral samples for kinetics measurements are ready for emplacement, once complete evaluation of sample holders is finished.

Collaborations continue with the University of Chicago and the University of Illinois, in areas of thermodynamic database review and development, and nuclear magnetic resonance (NMR) studies of cation exchange and sorption in minerals. A list of minerals for review has been developed and will be evaluated for consistency with other data bases.

1.2.3.12.2 Hydrologic Properties of the Waste Package Environment

Thermo-hydrological Calculations

In order to augment the thermo-hydrological calculation support of the thermal loading systems study, we have been conducting calculations in the near-field/altered zone hydrology task with the same set of thermal loading assumptions.

See WBS 1.2.1.5 for a description of the waste receipt scenario. In that section, we report on the impact of enhanced gas-phase diffusion on humidity and temperature and on the sensitivity of humidity at the end of boiling to matrix hydrological property data. In this section, we continue the sensitivity study to include temporal and spatial distributions of temperature and humidity.

Areal Mass Loadings (AMLs) of 24.2, 35.9, 55.3, 70, 83.4, 100, 110.5, and 150 MTU/acre were analyzed assuming the matrix hydrological properties given in the Reference Information Base (RIB) and Klavetter and Peters (1986), and in a recent draft report (Pruess and Tsang, 1994) which is based on measurements by Flint and others (1983).

Table 6 summarizes the time required to attain the indicated relative humidity, *RH*, at various repository locations and the temperature at which that value of *RH* is attained for the "reference" case based on the RIB and Klavetter and Peters data for AMLs of 55.3, 110.5, and 150.0 MTU/acre. It should be emphasized that the relative humidity calculations are based on the smeared-heat-source, disk-shaped model of the repository. Therefore, the relative humidity is based on average liquid saturation. It should also be noted that thermo-hydrological heterogeneity and variability in the heat output among the WPs will cause local behavior to deviate from average behavior.

Table 6

Time required to attain the indicated relative humidity at various repository locations and the temperature at which that value of relative humidity is attained for 22.5-yr-old SNF, k_b = 280 millidarcy, and assuming the matrix properties from Klavetter and Peters (1986) for the TSw1 and TSw2 units.

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

Table 6a: AML = 55.3 MTU/acre

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	670	1660	3330	4630	107	97	80	72
75	410	940	1610	2280	107	99	89	81
90	NA	200	380	490	NA	103	97	94
97	NA	NA	NA	NA	NA	NA	NA	NA

Table 6b: AML = 110.5 MTU/acre

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	15,960	27,910	40,990	49,980	68	54	45	42
75	9540	15,520	24,950	32,590	76	64	53	48
90	3190	4890	7460	9890	93	82	73	68
97	1410	1810	2360	2890	106	101	93	88

Table 6c: AML = 150 MTU/acre

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	20,630	34,850	50,920	64,150	68	52	45	41
75	16,400	24,520	32,700	43,360	70	59	51	46
90	8660	12,090	16,520	19,780	81	72	64	59
97	4330	6020	8180	10,060	93	84	77	72

We repeated the repository-scale calculations for the five sets of matrix properties for the Topopah Spring welded tuff (Table 7) that are listed in Pruess and Tsang (1994) and based on Flint et al. (1993). For zero net recharge flux, the initial liquid saturation at the repository horizon is calculated to be 68, 76, 78, 74, 66, and 64% for the six cases in the table, respectively. In order to result in nearly the same initial liquid water content in the TSw1 and TSw2, a porosity (ϕ_m) of 0.11 was assumed for the three cases that yielded lower initial liquid saturation (reference case, LBL-USGS-3.4, and -3.3) and ϕ_m = 0.10 for the three cases that yielded higher initial liquid saturations (LBL-USGS-3.5, -3.2, and -3.1/3.6).

Table 7
Matrix hydrological property data for the TSw1 and TSw2 units

Sample Name	S_r	ϕ_m	$k_{m,sat}$ (m^2)	α (10^{-5} Pa^{-1})	m
Reference Case	0.08	0.11	1.9×10^{-18}	0.058	0.4438
LBL-USGS-3.2	0.0	0.10	4.0×10^{-16}	0.125	0.18
LBL-USGS-3.5	0.0	0.10	5.0×10^{-18}	0.133	0.25
LBL-USGS-3.1/3.6	0.0	0.10	1.0×10^{-18}	0.067	0.29
LBL-USGS-3.4	0.0	0.11	5.0×10^{-18}	0.067	0.25
LBL-USGS-3.3	0.0	0.11	4.0×10^{-18}	0.2	0.22

The properties listed are S_r, α, and m (the three van Genuchten characteristic curve fitting parameters), the matrix porosity (ϕ_m), and the saturated matrix permeability ($k_{m,sat}$).

For AMLs of 55.3, 110.5, and 150 MTU/acre, and for the five sets of LBL-USGS property measurements, Tables 8 through 10 summarize the relative humidity and temperature information given in Table 6 for the reference properties. Although these cases have different values of saturated matrix permeability, k_m, they all share the same bulk permeability, k_b, of 280 millidarcy. For an AML of 55.3 MTU/acre, relative to the case with the reference matrix properties (called the reference case), one of the LBL-USGS matrix property cases results in substantially faster re-wetting, one case results in nearly the same re-wetting rate, and three cases result in slower re-wetting back to ambient humidity conditions (98.4%) in the repository. A comparison of Tables 6a and 8a shows that LBL-USGS-3.2 results in substantially faster re-wetting back to humid conditions, resulting in relatively hot conditions as high relative humidity is attained. A comparison of Tables 6a and 8b shows that LBL-USGS-3.5 results in a similar re-wetting rate to the reference case. A comparison of Tables 8c-e with Table 6a shows that data from LBL-USGS-3.1/3.6 and -3.4 result in somewhat slower re-wetting, and that LBL-USGS-3.3 results in much slower re-wetting back to humid conditions. Regardless of the re-wetting rate, relatively hot conditions prevail for the 55.3-MTU/acre cases, (105 to 107°C) at the time that *RH* returns to 70%. In general, with the exception of LBL-USGS-3.2, there is not a great degree of variability in the relationship between temperature and *RH.*

Relative to the reference 110.5-MTU/acre case, one case results in substantially faster re-wetting, one case results nearly the same re-wetting rate, and three cases result in slower re-wetting back to ambient humidity conditions at the repository

Table 8: AML = 55.3 MTU/acre

Time required to attain the indicated relative humidity at various repository locations and the temperature at which that value of relative humidity is attained for 22.5-yr-old SNF and k_b = 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.

Table 8a: Matrix properties for LBL-USGS sample 3.2 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	NA	750	1240	1480	NA	103	99	97
75	NA	280	700	870	NA	103	100	98
90	NA	NA	160	210	NA	NA	100	98
97	NA	NA	NA	NA	NA	NA	NA	NA

Table 8b: Matrix properties for LBL-USGS sample 3.5 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	490	1570	2520	3490	107	98	87	79
75	290	900	1350	1700	107	100	93	87
90	NA	190	330	400	NA	103	98	96
97	NA	NA	NA	NA	NA	NA	NA	NA

Table 8c: Matrix properties for LBL-USGS samples 3.1 and 3.6 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	690	2240	7170	12,050	107	90	65	57
75	430	1270	3340	5930	107	95	72	63
90	NA	220	450	640	NA	102	95	91
97	NA	NA	NA	NA	NA	NA	NA	NA

Table 8d: Matrix properties for LBL-USGS sample 3.4 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	870	2390	6660	10,600	106	89	67	59
75	510	1330	3210	5300	106	94	73	65
90	130	270	580	880	107	101	93	87
97	NA	NA	NA	NA	NA	NA	NA	NA

Table 8e: Matrix properties for LBL-USGS sample 3.3 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	960	3180	14,200	29,100	105	81	54	43
75	580	1790	7430	15,050	106	87	60	50
90	140	320	910	1910	107	99	86	72
97	NA	NA	NA	NA	NA	NA	NA	NA

horizon. A comparison of Tables 6b and 9a shows that LBL-USGS-3.2 results in much faster re-wetting back to ambient humidity conditions. Consequently, temperatures are significantly greater with respect to *RH*. For example, the center of the repository has a temperature of 96°C when *RH* returns to 70% as compared with 68°C in the reference case. A comparison of Tables 6b and 9b shows that LBL-USGS-3.5 results in nearly the same re-wetting rate as the reference case. Consequently, there is a similar relationship between temperature and *RH*. An

Table 9: AML = 110.5 MTU/acre

Time required to attain the indicated relative humidity at various repository locations and the temperature at which that value of relative humidity is attained for 22.5-yr-old SNF and k_b = 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.

Table 9a: Matrix properties for LBL-USGS sample 3.2 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	5970	6410	7060	8740	96	93	90	85
75	3480	3830	4170	4800	100	98	95	91
90	1760	2070	2440	2640	106	102	99	97
97	840	1120	1450	1720	107	103	100	98

Table 9b: Matrix properties for LBL-USGS sample 3.5 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	22,280	28,530	34,780	42,390	59	54	48	45
75	9580	12,710	17,200	23,350	75	68	61	55
90	2720	3680	4920	6760	97	89	82	75
97	1160	1530	1920	2290	107	103	98	93

Table 9c: Matrix properties for LBL-USGS samples 3.1 and 3.6 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	31,570	48,790	72,310	94,690	51	42	37	34
75	16,160	30,080	45,930	58,990	63	49	41	38
90	3450	6560	12,010	18,980	91	76	64	54
97	1130	1620	2260	2820	107	102	94	88

Table 9d: Matrix properties for LBL-USGS sample 3.4 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	31,290	47,260	71,840	93,860	51	43	37	34
75	16,470	29,220	44,140	57,350	62	50	42	38
90	3940	7260	12,780	19,080	87	74	62	54
97	1330	1830	2510	3490	107	100	91	83

Table 9e: Matrix properties for LBL-USGS sample 3.3 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	33,940	61,360	119,890	185,850	49	38	32	31
75	19,730	39,340	78,500	112,770	57	44	35	33
90	4770	11,340	26,180	39,140	83	65	49	42
97	1350	1990	3410	5360	107	98	84	74

examination of Tables 6b and 9c-d shows that LBL-USGS-3.1/3.6 and -3.4 result in very similar re-wetting rates that are substantially slower than the reference case in the inner 75% of the repository. For the outer 10% of the repository, these three cases have very similar re-wetting rates. Table 9e indicates that LBL-USGS-3.3 has a much slower re-wetting rate than all of the other cases, except at the outer 3% of the repository where re-wetting is modestly slower. For the inner 75% of the repository, LBL-USGS-3.1/3.6, -3.4, and -3.3 all have similar relationships between temperature and *RH*. For all six matrix property cases, the outer 3% of the repository has a similar temperature versus *RH* relationship. Regardless of case, the outer 3% of the 110.5-MTU/acre repository is relatively hot (~106°C) at the time that *RH* returns to 70%. Except for LBL-USGS-3.2, the inner 75% of the repository has cooled to relatively cool temperatures (49 to 76°C at the time that *RH* returns to 70%.

Table 10: AML = 150 MTU/acre

Time required to attain the indicated relative humidity at various repository locations and the temperature at which that value of relative humidity is attained for 22.5-yr-old SNF and k_b = 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.

Table 10a: Matrix properties for LBL-USGS sample 3.2 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	8960	9600	10,840	12,030	97	95	91	87
75	5690	6180	6830	8170	101	98	96	91
90	2980	3510	4060	4400	105	102	98	96
97	2020	2300	2650	2940	107	103	100	98

Table 10b: Matrix properties for LBL-USGS sample 3.5 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	31,240	38,690	46,850	54,100	54	49	45	43
75	18,750	23,780	28,990	35,380	66	59	54	49
90	7740	9930	12,830	17,520	83	77	70	62
97	3480	4420	5820	8020	98	91	84	77

Table 10c: Matrix properties for LBL-USGS samples 3.1 and 3.6 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	36,740	54,710	76,450	103,600	50	42	38	35
75	29,790	46,930	67,180	81,860	52	43	38	36
90	13,140	23,350	36,290	47,780	70	55	45	41
97	4630	7810	13,500	21,390	90	77	65	55

Table 10d: Matrix properties for LBL-USGS sample 3.4 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	36,240	53,670	77,150	106,290	51	43	38	35
75	28,920	44,800	65,090	79,720	53	44	39	36
90	13,070	22,110	34,020	44,680	70	57	47	42
97	4970	7960	12,920	19,230	88	77	66	57

Table 10e: Matrix properties for LBL-USGS sample 3.3 in the TSw1 and TSw2 units

Percentage of repository area enclosed (%)	Time required to attain the indicated relative humidity (yr)				Temperature at which the indicated relative humidity is attained (°C)			
	70%	80%	90%	95%	70%	80%	90%	95%
50	38,530	67,740	136,540	224,430	49	40	34	32
75	31,910	56,830	111,490	171,140	51	40	34	33
90	16,730	32,050	60,180	86,980	63	48	38	35
97	6120	11,790	23,940	36,410	83	68	52	44

Relative to the reference property 150-MTU/acre case, one of the LBL-USGS matrix property cases results in substantially faster re-wetting, one case results in nearly the same re-wetting rate, and three cases result in slower re-wetting back to ambient humidity conditions at the repository horizon. A comparison of Tables 6c and 10a shows that LBL-USGS-3.2 results in much faster re-wetting back to ambient humidity conditions. Consequently, temperatures are significantly greater with respect to *RH*. For example, the center of the repository has a temperature of 97°C when *RH* returns to 70% as compared with 68°C in the reference case. A comparison of Tables 6c and 10b shows that LBL-USGS-3.5 results in nearly the same re-wetting rate as the reference case. Consequently, there is a similar relationship between temperature and *RH*. An examination of Tables 6c and 10c-d shows that LBL-USGS-3.1/3.6 and -3.4 result in very similar re-wetting rates that are substantially slower than the reference case in the inner 75% of the repository. For the outer 10% of the repository, these three cases have similar re-wetting rates. Table 10e indicates that LBL-USGS-3.3 has a much slower re-wetting rate than all of the other cases throughout the entire repository. Re-wetting back to *RH* = 90 and 95% is particular slow for these property data. Unlike the 55.3- and 110.5-MTU/acre cases, the slower re-wetting rates for LBL-USGS-3.1/3.6, -3.4, and -3.3 for the 150 MTU/acre AML allow the outer 3% to cool to somewhat cooler temperatures (83 to 90°C) when *RH* returns to 70%. With the exception of LBL-USGS-3.2, the inner 75% of the repository has cooled to relatively cool temperatures (51 to 70°C) at the time that *RH* returns to 70%, and to 40-59°C at the time that *RH* returns to 80%.

Two critical questions for waste package (WP) integrity are:

- For humid conditions, what temperature is sufficiently cool to result in a substantial reduction in WP degradation rates?
- For hot conditions, what relative humidity is sufficiently dry to result in a substantial reduction in WP degradation rates?

The answer to these questions will be addressed by the WP material characterization studies that will determine the range of temperature and relative humidity conditions that are sufficiently cool and/or dry to result in significantly reduced degradation rates for the WP materials under consideration.

Some of the properties listed in Table 7 have stronger influence on the results than other listed properties. In general, liquid phase re-wetting increases with increasing $k_{m,sat}$ and m, and with decreasing α. Gas phase re-wetting is primarily affected by τ_{eff} (see Section 1.2.1.5). Tables 6, 8, 9 and 10 show that the re-wetting was almost identical for the LBL-USGS-3.1/3.6 and -3.4 property sets, and it should be noted that a five fold increase in saturated matrix permeability was offset by a small decrease in the fitting factor, m, from 0.29 to 0.25.

The calculations reported here assume a binary gas-phase diffusion tortuosity factor, τ_{eff}, of 0.2. Next month, we will report on repeating much of the above suite of cases for the situation of enhanced gas-phase diffusion where it is assumed that τ_{eff}, = 2. Section 1.2.1.5 of this month's report discusses recent results in an ongoing study of the impact of gas-phase diffusion using the reference matrix properties.

Laboratory Experiments

Electrical Impedance as a Function of Moisture Content

During June, we continued the preparation of more samples from the G-4 hole and the Large Block Test cores 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. These mechanisms are being studied.

Characteristic Curves of Tuff

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 were completed. The samples are being saturated to 100%, and the measurements in the drying phase will start soon.

The Effect of Confining Pressure on Fracture Healing

We 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 the G-4 hole is used. 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 up to 150°C and back down to 25°C. After heating, the water permeability at 25°C is about 50% lower than that measured at the same temperature before heating. No drastic fracture healing has been observed. Steam flow was performed at 125°C; and no significant effect on the permeability was observed. All the chemical data measured on water samples after flow through the rock have been entered into a database. Some water samples were examined for the existence of bacteria, and no evidence of bacteria colonies was observed.

Water permeability was measured at an effective pressure of 1.5 MPa (2.0 MPa confining pressure and 0.5 MPa pore pressure) with 25, 50, and 80°C temperatures. The measurements will be continued up to 150°C.

1.2.3.12.3 Mechanical Attributes of the Waste Package Environment

Management and Integration

S. Blair attended the IHLRWM conference in Las Vegas (May 24-26) and the 1st North American Rock Mechanics Symposium in Austin, TX (June 3-5). P. Berge attended the Spring AGU meeting (May 23 - 27). The purpose of attending these meetings was to participate in geomechanics sessions on deformation and fluid flow behavior of rock at repository conditions.

Budget plans for the remainder of year were developed.

Planning documents

Activity Plan AP-GM-01/GM-03/GM-05 for the Geomechanical Attributes of the Waste Package Environment was completed and issued as a controlled document.

S. Blair assisted the P.I. in review and resolving geomechanics-related comments on Study Plan 8.3.4.2.4.4 (Engineered Barrier System Field Tests).

Laboratory

The Waste Package Design Integration Team toured the laboratory facilities.

Preparation of test specimens from core samples taken from the Large Block Test was initiated. Equipment such as thermocouples, electrical conditioning boxes, etc. for laboratory tests on small blocks was ordered.

Support of the Large Block Test (LBT)

Development of a Multipoint Borehole Laser EXtensometer (MBLEX) design continued, and several component parts for this system were ordered. This system was discussed with representatives of AECL, USBM, Bechtel Corp., and other interested parties to evaluate potential collaborations in its development.

Preliminary arrangements were made with SAIC regarding use of their seismic source for elastic wave velocity measurements on the LBT.

Modeling

The FRACROCK code was used to assess the stability of the rock bolting system to be used at the LBT. Analysis shows the stresses in the rock to be quite low, indicating that the bolting system should be stable.

A preliminary map of fractures in the horizontal plane of the block was digitized for input into the DDA discrete analysis code. Digitizing the fracture map that represents the top surface of the block was initiated.

1.2.3.12.4 Engineered Barrier System (EBS) Field Tests

Revisions to the Engineered Barrier System Field Tests (EBSFT) Study Plan are in progress based on the comment resolution meeting.

Large Block Test (LBT)

Matrix Bulk Porosity

A total of 19 Hg-porosimetry measurements have been completed using the core sections from the vertical instrument holes. The average bulk porosity is about 11.24%, with a minimum value of 8.23% and a maximum value of 16.17%.

Fracture Mapping

The fractures at the top of the block were mapped and described in detail. We are evaluating Earth Vision as a tool to display the data in 3-D.

Excavation

The excavation work continued. The area 1 m away from the block was excavated to about 3 m below the top of the block. Some small samples were collected for testing of moisture content.

Small Block Tests in the Laboratory

Tests continued 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), the potential insulation materials, and the thermal control for the guard heaters, under a 5 MPa stress. Copper plates may be used to distribute heat from the guard heaters. Tests continued to evaluate the lateral temperature distribution on the surface of a copper plate, opposite to the heater. Thermal conduction model calculations continued to help design the guard heaters.

Preparation of small blocks, obtained from Fran Ridge, for scoping experiments continued. X-ray imaging to determine water saturation began.

The Load Retaining Frame

Engineering analysis of the capability of the load retaining frame, as designed, was completed. The load retaining frame design is not structurally adequate to contain the desired pressure of 600 psi. The predicted stress levels in gussets of the frame exceed the yield and ultimate strengths of the frame material. The axial loads in the bolts have small margins as compared to the yield and ultimate strengths of the bolt material. Finally, there is a significant vertical displacement between the bottom and top of the frame. Modifications were proposed to retrofit the frame. Those modifications include:

- decreasing the distance from the cylinder walls to the bolts by drilling new holes in the flanges nearer the walls and increase number of bolts for those new holes,
- adding a c-shape collar assembly to the hoop direction vertical flanges,
- stiffening the gussets,
- adding a stiffening collar around the bottom flange to reduce loads on the anchor bolts, and
- to connect the load retaining frame to the bladder support structures inside the frame.

The effectiveness and associated cost of these modifications are being evaluated.

Aircraft Engineering Corporation, the fabricator of the frame, reported that they are having difficulty in completing the frame construction within the price and time allocated under the contract. Negotiation with Aircraft Engineering is underway to resolve the problem.

Loading Devices

A meeting with the potential manufacturer for the bladders was held to discuss detailed design criteria of the bladders. The engineering design of the bladder support/housing devices continued.

Other Items

Procurement of instruments continued.

SNL continued mapping the fracture flow visualization test area along with the excavation.

A poster paper entitled "A Medium Scale Test of the Thermal Effect on Hydrological-Chemical-Mechanical Processes in a Rock Mass", by W. Lin, et al., was presented at the First North American Rock Mechanics Symposium.

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

June activities will be reported in a later monthly progress report.

1.2.5 REGULATORY

1.2.5.1 Regulatory Coordination and Planning

J. Johnson attended the YMP-Radionuclide Solubility Working Group (SOLWOG) meeting in Las Vegas on June 2. He described the means by which SOLWOG members could access GEMBOCHS databases and software tools via remote access. LLNL staff are currently in the process of establishing these remote-access links.

1.2.5.2 Licensing

1.2.5.2.2 Site Characterization Program

R. Van Konynenburg attended a "dry run" on June 28 in Las Vegas in preparation for a talk he is scheduled to deliver to the NWTRB in July. The subject is "Potential Effects of Engineered Barriers on Radionuclide Migration". His talk will focus on identification and discussion of the corrosion products that would be produced on the various metal barrier materials (and other components in the waste package, such as the pour canister, multi-purpose container for spent fuel and the basket material) and how these corrosion products will interact with the various radionuclides that will be present. Certain metals and corrosion products will sorb some radionuclides, and the beneficial interaction will be discussed in addressing controlled release issues R. Van Konynenburg also assisted LANL personnel in preparing their talk on the release of Carbon-14.

1.2.5.3 Technical Data Management

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

The first edition of the new, stand-alone GEMBOCHS Data Catalog for the YMP-TDB was generated. This quarterly catalog, which covers the second quarter of 1994, includes an overview of the GEMBOCHS system, a discussion of recent accomplishments, and tables summarizing

- The types of thermodynamic data contained in GEMBOCHS,
- the specific chemical species and data contained in each of the seven thermodynamic data files currently provided for use with EQ3/6, and
- the literature sources for these data.

The R24 suite of thermodynamic data files for use with EQ3/6 has been completed. This suite incorporates improved thermodynamic data for several key aluminum aqueous species and aluminosilicates.

A revised set of element catalogs has been generated. The catalogs contain all thermodynamic data available in GEMBOCHS for compounds of the elements Tc, Th, U, Np, Pu, and Am. The catalogs are now available for remote electronic access via the anonymous GEMBOCHS ftp account.

Jewel code development: Several minor computational bugs associated with generation of thermodynamic data files for use with the geochemical modeling code *React* were resolved.

1.2.5.3.5 Technical Data Base Input

No significant activities.

1.2.5.4 Performance Assessment

1.2.5.4.2 Waste Package Performance Assessment

June activities will be reported in a later monthly progress report.

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

No significant activity.

1.2.9 PROJECT MANAGEMENT

1.2.9.1 Management and Coordination

1.2.9.1.2 Technical Project Office Management

W. Clarke, C.K. Chou, and J. Savy met with L. Hayes, J. Whitney (USGS) and staff on July 6 in Denver. The purpose of the meeting was to discuss the future involvement of LLNL in YMP seismic hazard assessment work.

A. Simmons (YMSCO), visited LLNL-YMP on July 7 to work on program planning.

W. Clarke and J. Blink attended the TAG meeting in Las Vegas on June 24.

J. Blink participated in the 50% design review of the Integrated Data and Control System on June 7.

J. Blink taught the physics module for the Nye County LESSON (science workshop for teachers) at NTS on June 1. He also taught the electromagnetism module and assisted A. Gil (YMSCO) in teaching the earth science modules on June 2-3. On June 8, he and J. Calovini (RSN) served as tour guides for both the Weapon and Yucca Mountain sides of NTS for the Nye County teachers. On June 13-14, J. Blink taught the physics module for the Clark County LESSON workshop. He served as tour guide on June 17. He also taught the electromagnetism module and worked with E. Harle (SAIC) to teach the earth science module on June 22-23.

On June 15, J. Blink presented hands-on science classes to 40 eighth grade students attending the Math, Science, & Engineering Academy for predominantly black school. The summer course is co-sponsored by DOE-NV and by Ft Valley State College in Georgia.

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 LLNL-YMP Quality Procedures (QPs) are being reviewed and edited to incorporate text and procedural changes required by the YMSCO review of the QARD requirements matrix. Royce Monks traveled to Las Vegas during the week of June 6 to discuss changes made thus far with YMSCO personnel.

Quality Assurance Program Development

The YMP Quality Procedures are being revised to comply with QARD review. Changes are made to the RTN matrix during the process to maintain consistency.

Quality Assurance Verification

Quality Assurance Verification - Audits

Notification of Audit 94-06 was distributed on June 17, and an entrance meeting was conducted on June 29. This audit will concentrate on LLNL-YMP Performance Analysis and include the following procedures/requirements:

- 033-YMP-QP 2.4, Technical Reviews
- 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 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

Corrective action for CAR LLNL-032 was completed and verified, and the CAR was closed on June 13.

Quality Assurance Verification - Surveillance

No significant activity.

Field Quality Assurance/Quality Control

No significant activity.

Quality Assurance - Quality Engineering

No significant activity.

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 seven revisions and one change notice. Follow up continues on previously distributed documents.

1.2.12.2.3 Participant Records Management

A total of 147 items were logged into the LLNL-YMP tracking system. This includes twenty-five records/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.

1.2.13.2 SAFETY AND OCCUPATIONAL HEALTH

1.2.13.2.5 Occupational Safety and Health

J. Blink performed two ES&H inspections at the Fran Ridge site of the Large Block Test. Documentation was delivered to the Safety Office in the FOC.

1.2.15 SUPPORT SERVICES

1.2.15.2 Administrative Support

No significant activity.

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

Currently there are 102 participants on the project who are to be trained and/or tracked. Three new staff members and three summer hires were oriented in June.

Creation of a new training database program is in progress. Programming has been completed; however, the database needs to be tested and implemented. The projected completion date is now August.

LLNL PROJECT STATUS REPORT EXTERNAL DISTRIBUTION
June 1994

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WBS: 1.2.9.1
QA: N/A

L-36007

Los Alamos

NATIONAL LABORATORY
Earth and Environmental Sciences Division

EES-13 Nuclear Waste Management R&D
Mail Stop J521, Los Alamos, NM 87545
Phone (505) 667-9768, Fax (505) 667-1934

July 18, 1994

LA-EES-13-07-94-003

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

Dear Mr. Nelson:

Los Alamos Monthly Activity Report for June 1994; Highlights of Activity, Variance Analysis Report, and PACS Monthly Cost/FTE Report (SCPB: N/A)

Attached is the Los Alamos monthly activity report for June 1994, which includes the Highlights of the Monthly Activity Report, Variance Analysis Report, and PACS Monthly Cost/FTE Report.

The Highlights of the Monthly Activity Report is an internal document describing our technical work; however, it has not received formal technical or policy review by Los Alamos or the YMP. Data presented in this document constitute predecisional information, should not be referenced, and are not intended for release from the U.S. Department of Energy as referenceable information.

The Variance Analysis Report identifies cost and/or schedule variances, analyzes those variances as to cause, and establishes any corrective action necessary.

The PACS Monthly Cost/FTE Report presents a monthly summary of Los Alamos' effort on the YMP. This report provides monthly totals of cost, labor person-hours, subcontractor person-hours, outstanding commitments, and accruals, all at the third level of the WBS. In addition, updated annual budget, approved funds, and annual cost values are provided.

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

Sincerely,

Julie A. Canepa

Julie A. Canepa

SHK/afa

Attachment: a/s

317
Asst Mgrs (6)
Dyer W
Horton
Clark W

CC:
CC:
CC:
CC:

REC'D IN YMP 7/28/94

ENCLOSURE 4

Cy w/att:
W.L. Clarke, LLNL, Livermore, CA
W.R. Dixon, YMSCO, Las Vegas, NV
J.R. Dyer, YMSCO, Las Vegas, NV
N Z. Elkins, EES-13/LV, MS J900/527
L.D. Foust, M&O/TRW, Las Vegas, NV
L.R. Hayes, USGS, Denver, CO
V.F. Iorii, YMSCO, Las Vegas, NV
S.H. Klein, EES-13, MS J521
M.M. Martin, M&O/TRW, Las Vegas, NV
A. R. Pratt, EES-13, MS J521
L. E. Shephard, SNL, Albuquerque, NM
W.B. Simecka, YMSCO, Las Vegas, NV
J.A. Mercer-Smith, EES-13, MS J521
M.D. Voegele, SAIC, Las Vegas, NV
RPC File (2), MS M321
LA-EES-13 File, MS J521

Los Alamos Highlights for June 1994

WBS 1.2.3.1.1 Site Management. To support the Scenario A planning for a 2001 license application, management staff revised criteria statements for Level 2 milestones and submitted them to YMSCO. They also worked with principal investigators to develop workscopes and major milestones to meet the 2001 license application date, which is a follow-up to the recently completed planning for a 1998 site suitability report.

Management staff continued to prepare for the NWTRB full board meeting in July; they traveled to Las Vegas for a presentation dry run.

Management staff attended a meeting on gaseous tracers in Las Vegas on 17 June.

Management staff forwarded Geochemistry input for Scenario A to the DOE to be used as an example for other YMP participants.

WBS 1.2.3.2.1.1.1 Transport Pathways. YMP researchers from the Earth and Environmental Sciences and the Chemical Sciences Divisions at Los Alamos collaborated on the petrographic characterization of microautoradiography samples. The samples under study were used in plutonium microautoradiography experiments.

Dust samples were submitted for size separations and X-ray diffraction analysis. These samples, taken from sites at and near Yucca Mountain, will be used to evaluate the potential impact of operations on the mineral content of eolian dusts. These dusts will also be used to monitor Fe, Sc, and rare-earth element input into near-surface environments from eolian sources. The chemical data will be used to constrain the rates and mechanisms of processes involved in the formation of calcite-silica deposits.

R. Raymond acquired the remaining SEM photomicrographs needed to complete Milestone 4031, "Silica Mobility in Devitrified Paintbrush Tuff, Yucca Mountain, Nevada." Raymond concluded that fractures formed during the late stages of devitrification and cooling are intimately associated with 1) the removal of cristobalite and 2) porosity enhancement, as great as 20 percent absolute. He also found that the late-stage alteration of the tuff appeared to be a site-specific analog to possible future alteration in unsaturated, densely-welded tuff. This milestone will be published in the June 1994 Los Alamos Monthly Activity Report.

WBS 1.2.3.2.1.1.2 Alteration History. G. WoldeGabriel presented a paper titled "The mineralogy and temporal relations of authigenic minerals in altered tuffs and the utility of alkali zeolites as potential low-temperature dateable minerals" at the Eighth International Conference on Geochronology, Cosmochronology, and Isotope Geology in Berkeley, California, 5-11 June.

D. Broxton traveled to the Nevada Test Site and examined the vitric zeolitic transition in several of the drill core suites from older, deeper holes. He reported that the core from USW GU-3 looked especially promising as a source of samples for detailed study and that the transition interval is an important hydrologic boundary.

WBS 1.2.3.2.1.2 Stability of Minerals and Glasses. Staff continued setting up the flow-through apparatus that will be used when measuring the rates of clinoptilolite dissolution and precipitation. For example, quantities of boehmite and quartz are prepared for use in controlling the Al and Si concentrations, respectively, for input into the reaction vessel. Boehmite is obtained by thermally treating gibbsite (Baker-analyzed reagent aluminum hydroxide) at 250°C with distilled, deionized water for 24 hours. For quartz, they are using clear Brazilian quartz crushed and sieved to a size fraction of 0.1 - 0.3 mm.

WBS 1.2.3.2.8.4.6 Fault Scarp Study. Work continued along the trace of the Ghost Dance fault across Antler and Whale Back ridges to identify locations for samples for cosmogenic dating of fault activity. Sample sites were identified, and samples were subsequently collected along a topographic traverse, from a bedrock outcrop on the eastern ridge crest and then from seven to eight sites that extend across the fault trace. The sample sites were closely spaced where they are in proximity of the fault trace. The samples were delivered to the University of Arizona AMS facility for processing of quartz separates and the cosmogenic beryllium analyses.

WBS 1.2.3.3.1.2.2 Water Movement Test. Chlorine-36 analyses were received from Purdue University for one UZ-16 alluvial sample and fourteen groundwater samples. The UZ-16 sample, from a depth of 20 ft, was at meteoric background and showed no indication of bomb-pulse chlorine-36. The groundwater samples were collected from springs and shallow wells in the Amargosa Valley by USGS principal investigators (J. Czarnecki and W. Steinkampf) as part of their study plan activities relating to characterization of saturated-zone chemistry and flow paths. All samples had chlorine-36 concentrations that were at or below meteoric background.

J. Fabryka-Martin and two graduate research assistants collected several vertical profiles from the soil and fractured rock face exposed at the NRG-5 drill pad. Sampling activities were coordinated with those of USGS investigators, primarily A. Flint, W. Guertal, D. Hudson, and J. Paces. The purpose of this sampling activity was to apply various hydrologic, geochemical, and isotopic techniques to evaluate the role of the soil cover and of fractures in transmitting infiltrating water into the Tiva Canyon welded unit. Laboratory processing began on the 14 soil profile samples in order to analyze them for chloride and chlorine-36.

J. Fabryka-Martin presented a paper at the Eighth International Conference on Geochronology, Cosmochronology, and Isotope Geology, 5- 11 June in Berkeley, California. A paper titled "Distribution of chlorine-36 in the unsaturated zone at Yucca Mountain: an indicator of fast transport paths" was published as an abstract in the conference proceedings.

WBS 1.2.3.2.5 Volcanism. ***Field Work.*** Volcanism staff, G. Thompson (Stanford University), and participants in the USGS geophysical program conducted field work in the Yucca Mountain area. They made ground magnetic traverses at five sites across the Solitario Canyon fault near and across exposures of a 10 Ma basaltic dike that intrudes the fault. Other sites for ground magnetic traverses were examined northwest of the intersection of the Solitario Canyon fault with Drillhole Wash. Unfortunately, the staff was unable to locate outcrops of the basalt (only float in colluvium) and therefore did not conduct additional ground magnetic traverses. They conducted multiple north-south and east-west round magnetic traverses across the south aeromagnetic anomaly of Crater Flat (about 1 km south of Little cones) and were able to identify the surface coordinates of the anomaly. These coordinates will be used to site exploratory drilling of the anomaly.

Staff continued mapping the 3.7 Ma basalt centers of Crater Flat; the mapping is now about 70% complete. Compilation of the mapping on orthophotographic base maps was started.

Volcanism. ***Geochemistry Studies.*** An abstract titled "Field, Geochemical, and Geochronologic Evidence for Polycyclic Volcanism at the Lathrop Wells Volcanic Center, Southwestern Nevada" by F. Perry,

B. Crowe, S. Wells, and L. McFadden was presented at the Eighth International Conference on Geochronology, Cosmochronology and Isotope Geology, Berkeley, California.

Compositions of olivine and plagioclase phenocrysts from samples of Chronostratigraphic Units I, II, and III at the Lathrop Wells center were determined using an electron microprobe. Petrographic analysis and volumetric determination of mineral phases by point counting were determined for eight samples from the Lathrop Wells center. Thin sections were completed and examined from three possible ash horizons identified in borehole USW-VH-2.

Volcanism. ***Chronology Studies,*** Three new ^{3}He exposure ages were determined from Chronostratigraphic Unit III at the Lathrop Wells center.

Publications

F. Perry et al., "Field, Geochemical, and Geochronologic Evidence for Polycyclic Volcanism at the Lathrop Wells Volcanic Center, Southwestern Nevada," U.S. Geological Survey Circular 1107

G. WoldeGabriel et al., "The mineralogy and temporal relations of authigenic minerals in altered tuffs and the utility of alkali zeolites as potential low-temperature dateable minerals," U.S. Geological Survey Circular 1107

J. Fabryka-Martin et al., "Distribution of chlorine-36 in the unsaturated zone at Yucca Mountain: an indicator of fast transport paths," U.S. Geological Survey Circular 1107

YMP PLANNING AND CONTROL SYSTEM (PACS)

Participant:	LANL		MONTHLY COST/FTE REPORT					Fiscal Month/Year June FY1994	
Date Prepared:	18-Jul-94							Page 1	
								Fiscal Year 1994	
WBS Element	Actual Costs	Participant Hours	Subcon Hours	Purchase Commitments	Subcon Commitments	Accrued Costs*	Approved Budget	Approved Funds	Cumulative Costs
1.2.1	29.5	313.3	0.0		0.0		40.0	36.0	31.1
1.2.3	840.3	4,218.7	2,684.1		696.2		9,353.0	8,239.3	6,510.5
1.2.5	72.7	350.2	346.4		50.5		725.0	660.4	505.3
1.2.6	98.9	992.6	103.9		96.2		2,120.0	1,908.0	1,354.6
1.2.9	133.0	697.0	659.3		44.2		1,220.0	1,098.0	870.5
1.2.11	85.8	177.8	659.5		92.0		1,200.0	1,080.0	903.5
1.2.12	52.3	17.6	321.8		133.0		500.0	450.0	351.9
1.2.13	5.1	309.8	44.9		44.2		100.0	90.0	41.9
1.2.15	78.8	283.4	388.5		49.9		538.0	484.2	445.3
Totals	1,396.4	7,360.3	5,208.4		1,206.2	0.0	15,796.0	14,045.9	11,014.6

Robert Spiro
8-702-794-1983

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: June 30, 1994

PARTICIPANT: LANL **PEM:** D. Williams **WBS:** 1.2.3.1

WBS TITLE: Site Investigations, Coordination & Planning

P&S ACCOUNT: 0A31

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
568	568	714	0	0.0	100.0	-146	-25.7	79.6	806	921	-115	-14.3	1013	115.0

Analysis

Cumulative Cost Variance:

Los Alamos is still awaiting the correction of certain erroneous charges (in the amount of $96k) made against this account; it is anticipated that the LANL groups responsible for those charges will rectify this condition during the coming reporting period.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

As discussed above, anticipated corrections to erroneous costs made against this account will alleviate this variance, reducing it to within threshold levels.

PARTICIPANT: LANL PEM: Ardyth Simmons WBS: 1.2.3.2.1.2.2

WBS TITLE: Kinetics and Thermodynamics of Mineral Evolution

P&S ACCOUNT: 0A32122

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
139	141	28	2	1.4	101.4	113	80.1	503.6	186	154	32	17.2	37	35.7

Analysis

Cumulative Cost Variance:

The work in this account (a Yale University subcontract) has been performed; however, this effort has not yet been charged to Los Alamos. The ETC's have, however, been adjusted to reflect the work that has been completed.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

(Not reportable.)

PARTICIPANT: LANL PEM: Ardyth Simmons WBS: 1.2.3.4.1.4.1

WBS TITLE: Dynamic Transport Column Experiments

P&S ACCOUNT: 0A34141

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
605	607	780	2	0.3	100.3	-173	-28.5	77.8	834	949	-115	-13.8	1072	134.3

Analysis

Cumulative Cost Variance:

The variance shown this month for this P&S account is due to the continuing presence of a component summary account (Liquid Scintillation Counter), showing cost with no budget (as previously discussed, this item was budgeted in FY 93, and apparently cannot be removed from PACS even though it was costed in FY 94); the variance is also due to greater than anticipated spending in another component summary account, during the first seven months of the fiscal year (Los Alamos Project Control staff are working with the principal investigator in question to control the overrun.) Additionally Los Alamos Project Control Staff are currently adjusting ETC's to reflect a more realistic distribution of budget.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

As noted under "Cumulative Cost Variance" above, the presence of cost for the FY93 purchase of a Liquid Scintillation Counter is artificially inflating this variance; rectification of this problem in PACS would reduce this VAC to within threshold limits.

PARTICIPANT: LANL PEM: Ardyth Simmons WBS: 1.2.3.9.7

WBS TITLE: Special Studies: ESF Test Coordination

P&S ACCOUNT: 0A397

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
701	701	533	0	0.0	100.0	168	24.0	131.5	886	847	39	4.4	674	58.9

Analysis

Cumulative Cost Variance:

Anticipated costs from newly hired staff (discussed in the May, 1994 VAR for this account) have yet to be fully realized against this P&S account; once this is accomplished, the cumulative variance should be rectified. The ETC's have, however, been adjusted to reflect this delay in costing of effort.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

(Not reportable.)

PARTICIPANT: LANL PEM: M. Brodsky WBS: 1.2.6.1.1

WBS TITLE: ESF Management, Planning and Tech. Assess.

P&S ACCOUNT: 0A611

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
517	517	412	0	0.0	100.0	105	20.3	125.5	700	666	32	4.8	558	93.4

Analysis

Cumulative Cost Variance:

Anticipated charges from newly hired staff in this area have not yet been fully realized, resulting in the displayed positive, cumulative cost variance. The ETC's have been adjusted to account for that delayed costing of effort.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

(Not reportable.)

PARTICIPANT: LANL PEM: M. Brodsky WBS: 1.2.6.1.6

WBS TITLE: Explor. Stud. Faci. (ESF) Test Management

P&S ACCOUNT: 0A616

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
750	750	522	0	0.0	100.0	228	30.4	143.7	1000	918	82	8.2	696	63.1

Analysis

Cumulative Cost Variance:

Internal Laboratory cost-correction procedures, initiated last reporting period to correctly attribute cost against this effort, were incorrectly applied, and will be rectified this month. This action is expected to contribute to reduction of the variance to within threshold levels.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

(Not reportable.)

Julie A. Canepa 7/18/94 Julie A. Canepa 7/18/94

P&S ACCOUNT MANAGER DATE TPO DATE

WBS: 1.2.9.1
QA: N/A

Los Alamos
NATIONAL LABORATORY

Earth and Environmental Sciences Division
EES-13 — Nuclear Waste Management R&D
Phone (505) 667-9768, Fax (505) 667-1934
Mail Stop J521, Los Alamos, New Mexico 87545

317
Asst Mgrs (6)
Dyer
Holton
Lorell
cc:
cc:
cc:
cc:
REC'D IN YMP
8/19/94

I-3609480

BUD 18 8/11/94

August 11, 1994

LA-EES-13-08-94-002

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

Dear Mr. Nelson:

Los Alamos Monthly Activity Report for July 1994: Highlights of Activity, Variance Analysis Report, and PACS Monthly Cost/FTE Report (SCPB: N/A)

Attached is the Los Alamos monthly activity report for July 1994, which includes the Highlights of the Monthly Activity Report, Variance Analysis Report, and PACS Monthly Cost/FTE Report.

The Highlights of the Monthly Activity Report is an internal document describing our technical work; however, it has not received formal technical or policy review by Los Alamos or the YMP. Data presented in this document constitute predecisional information, should not be referenced, and are not intended for release from the U.S. Department of Energy as referenceable information.

The Variance Analysis Report identifies cost and/or schedule variances, analyzes those variances as to cause, and establishes any corrective action necessary.

The PACS Monthly Cost/FTE Report presents a monthly summary of Los Alamos' effort on the YMP. This report provides monthly totals of cost, labor person-hours, subcontractor person-hours, outstanding commitments, and accruals, all at the third level of the WBS. In addition, updated annual budget, approved funds, and annual cost values are provided.

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

Sincerely,

Julie A. Canepa

Julie A. Canepa

SHK/afa

Attachment: a/s

ENCLOSURE 5

Cy w/att:
W.L. Clarke, LLNL, Livermore, CA
W.R. Dixon, YMSCO, Las Vegas, NV
J.R. Dyer, YMSCO, Las Vegas, NV
N Z. Elkins, EES-13/LV, MS J900/527
L.D. Foust, M&O/TRW, Las Vegas, NV
L.R. Hayes, USGS, Denver, CO
V.F. Iorii, YMSCO, Las Vegas, NV
S.H. Klein, EES-13, MS J521
M.M. Martin, M&O/TRW, Las Vegas, NV
A.R. Pratt, EES-13, MS J521
L.E. Shephard, SNL, Albuquerque, NM
W.B. Simecka, YMSCO, Las Vegas, NV
J.A. Mercer-Smith, EES-13, MS J521
M.D. Voegele, SAIC, Las Vegas, NV
RPC File (2), MS M321
LA-EES-13 File, MS J521

Los Alamos Highlights for July 1994

WBS 1.2.3.1 Test Management and Integration D. Vaniman represented the principal investigators at the SOC meeting on 13 July.

WBS 1.2.3.1.1 Site Management. Study Plan 8.3.1.3.4.1/3," Batch Sorption Studies and the Development of Sorption Models," which incorporated comments resolved at the 2 February comment resolution meeting, was submitted to YMSCO.

Los Alamos staff prepared for the FY 1996 OMB Submission Proposal Kick Off Meeting, which will be held on 1 August. They also were preparing for the upload of PPA FY 1995 to PACS, which will be done on 11 August.

Meetings. Staff hosted the WBS Hydrology Manager, J. D'lugosz, and R. Keeler (also from YMSCO) for discussions of ongoing work (Water Movement Tracer Tests and Site Saturated Zone Ground-Water Flow System) and planned work (Diffusion in the ESF and LIDAR Studies).

Los Alamos staff (J. Canepa, J. Mercer-Smith, B. Robinson, I. Triay, G. Zyvoloski, S. Levy, D. Tait, and A. Meijer) attended a meeting of the NWTRB in Denver on 12 July. The following presentations were made: S. Levy and I. Triay, "Colloid Formation, Stability, and Transport, Review of Existing Information." A. Meijer, "Retardation of Gas-Phase Radionuclides." G. Zyvoloski, "Unsaturated-zone Flow and Transport at Yucca Mountain." D. Tait, "Status and Priorities re: Solubility/Speciation of Long-Lived Radionulcides." I. Triay, "Status and Priorities Regarding Sorption of Long-Lived Radionuclides."

J. Canepa, W. Carey, D. Curtis, B. Robinson, A. Meijer, and E. Springer attended the Geochemistry Integration Team meeting on Model Validation in Denver, CO.

J. Mercer-Smith hosted a meeting on Hydrology planning and guidance for FY 1995. R. Patterson (YMSCO Hydrology team leader) and J. Farley (M&O) presented guidance for Hydrology tasks in FY95 as part of the Proposed Program Approach. The following presentations were made: P. Reimus, "Site Saturated Zone Groundwater Flow System"; J. Fabryka-Martin, "Water Movement Tracer Tests"; I. Triay, "Diffusion Tests in the ESF"; and D. Cooper, "Gaseous Phase Movement in the Unsaturated Zone."

WBS 1.2.3.2.1.1.1 Transport Pathways. Five serial thin sections were prepared of a single sample of fracture-filling calcite from the unsaturated zone at Yucca Mountain. These thin sections will be used in microautoradiography and trace mineral studies, but they were studied optically before transmittal to A. Filano for exposure to radionuclide-bearing solutions. This particular sample, from 425.5-425.7 ft depth in core USW G-1, has a variety of opaline intergrowths within the calcite; this will allow comparison of the response to microautoradiography of both of these minerals. The calcite/opal sections will be used in microautoradiography experiments to determine the importance of calcite, compared with other trace minerals, in retardation of radionuclide migration.

Optical analysis also began on five microautoradiographs of tuff samples for the trace minerals study. These microautoradiographs should clarify the sites of Pu sorption on samples of devitrified tuff from the Topopah Spring Member, vitric Calico Hills Formation, zeolitized Calico Hills Formation, zeolitized Prow Pass Member of the Crater Flat Tuff, and devitrified Prow Pass Member.

Min-Pet staff spent two weeks preparing the FY95 milestone, budget, and manpower projections in preparation for loading this information into the PACS. The preliminary Scenario A milestone projections were used as a basis for this planning. Planning included a detailed breakdown of costs for each summary account and a justification of the costs. It also included a list of all proposed milestones for each summary account.

WBS 1.2.3.2.1.1.2 Alteration History. S. Levy attended the summer meeting of the NWTRB in Denver on 12 July. She made a presentation titled "Colloid Formation, Stability, and Transport," which covered information from natural analog work in progress at Yucca Mountain. She discussed vertical fracture networks that have served as pathways for colloid transport, some of which are as much as 90 m long. Silica deposits formed along the transport pathways fluoresce green in short-wave ultraviolet light, which is an indication of significant uranium content. Colloidal silica formed during the lifetime of a waste repository could also retard actinides by the mechanism of coprecipitation if the silica still exists in dispersed colloidal form when radionuclides are released into the groundwater.

Staff began characterizing the changes from the long-term steam-heating experiments. (The experiments have been in progress for about 1.5 years.) Starting materials included powdered samples of Yucca Mountain devitrified tuff, vitric nonwelded tuff, vitrophyre, smectite-rich altered tuff, zeolitic altered nonwelded tuff, Na-bentonite, Ca-smectite, opal-CT, and two standard clinoptilolites. All samples are run at a 2:1 water-rock ratio. The reaction vessels are maintained in ovens at 100 and 200°C.

S. Levy prepared draft responses to technical review comments on the geochemistry sections of the FY93 Thermal Loading Systems Study Final Report. This report was prepared by TRW Environmental Safety Systems Inc., with input from Mineralogy-Petrology personnel and other YMP participants.

WBS 1.2.3.2.1.2 Stability of Minerals and Glasses. *Clinoptilolite solubility.* Measurements of the reversible solubility of Na-exchanged Castle Creek clinoptilolite are currently being conducted at Penn State in order to evaluate the free energy of the Na end-member. They have completed runs at 125, 175, 225, and 265°C, and runs to 350°C are underway. However, the results are incomplete at present because the necessary large number of analyses of Si, Al, Na, and K are still in progress. Consequently, evaluation of the solubility products must wait until the next monthly report. The evaluation is straightforward because the experimental pH of the solutions (quenched and measured at 25°C) that were equilibrated with the clinoptilolite ranges from 7.8 (125°C) to 8.8 (265°C); therefore, the solute Al must be present predominantly as $Al(OH)_4^-$ in all of the experiments, which is an ionic state that simplifies and makes more accurate the calculation of the solubility product.

Preparation for rate measurements. Penn State researchers have also continued work on setting up the flow-through apparatus that will be used in the next stage of this project when measuring the rates of clinoptilolite dissolution and precipitation.

The flow-through experiments to determine the rates of reaction of clinoptilolite will begin initially without any zeolite in the reaction vessel so that flow rates and input concentrations of Al and Si from the nutrient vessels can be calibrated. Following these steps, the rest of the contract year will be devoted to determining the dissolution and precipitation rates of clinoptilolite at temperatures from about 100 to 350RC in solutions with silica concentrations up to amorphous silica saturation and aluminum concentrations up to boehmite saturation.

At Yale University, twelve experiments were running, of which nine were conducted under QA. Twenty-five analcime dissolution experiments at various pHs and temperatures as well as of clinoptilolite dissolution experiments at various pHs and temperatures were also running.

WBS 1.2.3.2.5 Volcanism. A letter was submitted to the DOE summarizing responses to comments and questions by the NRC on Study Plan 8.3.1.8.5.1, "Characterization of Volcanic Features."

Field Studies. Trenching was completed at the Little Cones volcanic center on the Cind-R-Lite property. Staff identified three satellitic scoria mounds southeast of the southern Little Cone, one of which erupted two small lobes of lava. Higher-standing topography directly south of the cone breech of the southern Little Cone is upheld by partly indurated fanglomerate, and not a buried lava flow as inferred originally.

A revised geologic map of the Lathrop Wells volcanic center was compiled on black-and-white orthophotographs. This map will be used to fulfill a Los Alamos milestone and will be submitted to EG&G, who will digitize the map and combine it with digital topography as the first step of revised volume calculations for probability studies.

Sampling was completed for K-Ar age determinations and geochemistry studies at Makani Cone, Black Cone, and the newly identified lava lobes from the scoria mounds south of the Little Cones.

Probability Studies. A meeting was held with Geomatrix Inc. in San Francisco to coordinate plans for implementation of an expert judgment elicitation of the probability of magmatic disruption of the repository and waste isolation system. A rough draft of the expert judgment appendix for Study Plan 8.3.1.8.1.1 was completed and was in final revision. The strategic plan for the expert judgment study is about 70 percent complete.

WBS 1.2.3.4.1.1 Groundwater Chemistry Model. Staff prepared a briefing titled "Retardation of Gas-Phase Radionuclides" and presented it at the NWTRB meeting in Denver, Colorado. Staff also participated in a YMP Model Validation meeting in Denver.

Staff continued to evaluate the controls on adsorption behavior of the important radionuclides.

Staff completed a preliminary report that reviewed the controls on the Solubility and Sorption behavior of samarium and other rare earth elements in natural groundwater systems.

Problem Areas. New data on groundwater chemistry collected by the U.S. Geological Survey would be very useful in formulating conceptual models of the reactions that control groundwater chemistry in Yucca Mountain. However, these data are not readily available. Facilitation of the transfer of these data would be much appreciated.

WBS 1.2.3.4.1.2.1 Batch Sorption. Staff completed U isotherms on Yucca Mountain tuffs. Preliminary information indicated that zeolitic tuff has a batch sorption coefficient on the order of 10 to 20 ml/g. No appreciable sorption has been measured for vitric and devitrified tuffs.

WBS 1.2.3.4.1.5.1 Retardation Sensitivity Analysis. Staff produced two-dimensional cross-section runs for Np with both equivalent-continuum and double-permeability fracture models, and they believe it was the first simulation of its kind. The results indicated that it is extremely important to account for diffusion if fracture flow is important. Results showed tentatively that nominal diffusion values could retard the flow by a factor of 10.

Staff produced two-dimensional cross section runs for Cl-36. They explored continuum and double-permeability fracture models. Initial results show strong lateral flow effects when higher infiltration rates are used, and they are attempting to compare this with the field data; qualitatively, the field data are similar. Staff produced two-dimensional coupled-flow and geochemistry runs and used coupled dissolution/precipitation reactions to change permeability and porosity. The results of these runs indicated that the modeled effects can be important in the altered zone.

Staff received isopac data for four major units from the LBL/USGS model. After considerable effort, this data was loaded into the Stratmodel three-dimensional framework model. The staff compared this newer model with the previous one they had been using from the SNL database and found considerable differences (up to 150 meters) to be evident from the topography.

No hydrological information or layering information was available from LBL. Because of this lack of data, staff will not be able to begin the modeling work on this data this year.

WBS 1.2.3.4.1.5.2 Applicability of Laboratory Data to Repository Transport Calculations. Staff participated in the workshop on model validation held 19-21 July in Denver. A presentation was made on proposed field tests in the Calico Hills.

Publications

Submitted to YMSCO for approval

Selection of a Preferred Initial Access for the Exploratory Studies Facility by Diedre Boak et al.

The Nature of Interlayer water in Smectite by Steve Chipera et al.

Milestone 3372, Mineralogic Variation in Drill Core UE-25 UZ-16, Yucca Mountain, NV by Steve Chipera et al.

Implications of Surface-Exposure Dating of Scarps along the Solitario Canyon and Windy Wash Faults, Yucca Mountain, Nevada, by in situ produced cosmogenic C-14 by Charles Harrington

Approved by YMSCO

Milestone 3429, Multi-reflection RIR and Intensity Normalizations for Quantitative Analysis: applications to Feldspars and Zeolites by Steve Chipera and David Bish

Milestone 3345, Uranyl Interactions in the Goethite/Solution Interphase Region: Formation of Binary and Ternary Surface Complexes

Milestone 3424, Neptunium(V) Sorption on Hemitite in Aqueous Suspension: Effects of Carbonate and EDTA by M. Kohler et al.

Milestone 3379, Mineralogy and Temporal Relations of coexisting authigenic minerals in altered tuffs and the utility of alkali zeolites as potential low-temperature dateable minerals

Milestone 3430, Complexation of Carbonate Species at the Goethite Surface: Implications for Adsorption of Metal Ions in Natural Waters by A. vanGeen et al.

Dikes v. Sills at the Paiute Ridge Intrusive Complex, Southern Nevada by Greg Valentine

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: July 31, 1994

PARTICIPANT: LANL PEM: D. Williams WBS: 1.2.3.1

WBS TITLE: Site Investigations, Coordination & Planning

P&S ACCOUNT: 0A31

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
636	636	741	0	0.0	100.0	-73	-16.5	85.8	806	921	-74	-9.2	939	122.3

Analysis

Cumulative Cost Variance:

(Not reportable).

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

As of this status period, Los Alamos is still awaiting the correction of erroneous charges made against this account, which is expected to reduce the VAC to within threshold levels (this was discussed in the June, 1994 VAR for 0A310).

PARTICIPANT: LANL   PEM: Ardyth Simmons   WBS: 1.2.3.2.1.1.1

WBS TITLE: Min., Petrol., and Rock Chem. of Trnsp. Pathways

P&S ACCOUNT: 0A32111

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
608	567	580	-41	-6.7	93.3	-13	-2.3	97.8	725	644	81	11.2	741	246.9

Analysis

Cumulative Cost Variance:

(Not reportable.)

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

The at-completion variance shown for this account is attributed to subcontract costs in one of the component summary accounts which have not yet been posted to that account. This is expected to be corrected within the next reporting period; no impact is foreseen upon schedule, as the work under this technical subcontract has already been performed.

PARTICIPANT: LANL   PEM: Ardyth Simmons   WBS: 1.2.3.2.1.2.2

WBS TITLE: Kinetics and Thermodynamics of Mineral Evolution

P&S ACCOUNT: 0A32122

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
195	154	41	-41	-21.0	79.0	113	73.41	375.6	234	187	47	17.2	62	69.0

Analysis

Cumulative Cost Variance:

The work in this account (a Yale University subcontract) has been performed, as described in the June, 1994 VAR for this account; however, this effort has still not been properly charged to Los Alamos. The ETC's will be further adjusted to reflect the work that has been completed.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

(Not reportable.)

PARTICIPANT: LANL   PEM: Ardyth Simmons   WBS: 1.2.3.4.1.3.1

WBS TITLE: Dissolved Species Concentration Limits

P&S ACCOUNT: 0A34131

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
886	892	992	6	0.7	100.7	-100	-11.2	89.9	1068	1195	-127	-11.9	1188	86.7

Analysis

Cumulative Cost Variance:

The variance shown this month for this P&S account has been linked to greater than anticipated spending in a component summary account (0A34131GB4) during the first ten months of the fiscal year; Los Alamos Project Control staff are working with the principal investigator in question to control the overrun. Moreover, Los Alamos Project Control Staff will scrutinize and adjust ETC's to reflect a more realistic distribution of budget.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

(The at-completion variance shown this month for 0A34131 is attributable to the same, greater-than-anticipated costs discussed under "Cumulative Cost Variance" above.)

PARTICIPANT: LANL   PEM: Ardyth Simmons   WBS: 1.2.3.4.1.4.1

WBS TITLE: Dynamic Transport Column Experiments

P&S ACCOUNT: 0A34141

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
681	663	889	-18	-2.6	97.4	-226	-34.1	74.6	834	944	-110	-13.8	1118	310.9

Analysis

Cumulative Cost Variance:

The variance shown this month for this P&S account continues, due to the presence of a component summary account (Liquid Scintillation Counter), showing cost with no budget (as previously discussed, this item was budgeted in FY 93, and apparently cannot be removed from PACS even though it was costed in FY 94); the variance is also due to greater than anticipated spending in another component summary account, during the first nine months of the fiscal year. Los Alamos Project Control staff are continuing to work with the principal investigator in question to control this overrun, and are adjusting ETC's to reflect a more realistic distribution of budget.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

As noted under "Cumulative Cost Variance" above, the presence of cost for the FY93 purchase of a Liquid Scintillation Counter is artificially inflating this variance; rectification of this problem in PACS would reduce this VAC to within threshold limits.

PARTICIPANT: LANL   PEM: Ardyth Simmons   WBS: 1.2.3.9.7

WBS TITLE: Special Studies: ESF Test Coordination

P&S ACCOUNT: 0A397

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
765	765	562	0	0.0	100.0	203	26.5	136.1	886	772	114	12.9	651	57.6

Analysis

Cumulative Cost Variance:

The ETC's for this account will be adjusted to accomodate further delays in full costing against the account by newly hired staff (first discussed in the May, 1994 VAR for 0A397). It is expected that this corrective action will mitigate this variance.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

As discussed above under "Cumulative Cost Variance", full costing of newly-hired staff will rectify variances shown for this account.

PARTICIPANT: LANL PEM: M. Brodsky WBS: 1.2.6.1.6

WBS TITLE: Explor. Stud. Faci. (ESF) Test Management

P&S ACCOUNT: 0A616

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
840	840	624	0	0.0	100.0	216	25.7	134.6	1000	889	111	11.1	743	60.4

Analysis

Cumulative Cost Variance:

Internal Laboratory cost-correction procedures, initiated during the May, 1994 reporting period to correctly attribute cost against this effort, were incorrectly applied, as mentioned in last month's VAR for 0A616. Correction of this problem is ongoing, and is expected to be completed this month. This action is expected to help reduce the variance to within threshold levels.

Cumulative Schedule Variance:

(Not reportable.)

Variance At Complete:

(Not reportable.)

Julie A. Canepa 8/15/94

P&S ACCOUNT MANAGER DATE

Julie A. Canepa 8/15/94

TPO DATE

Raytheon Services Nevada
P O Box 95487
Las Vegas NV 89193-5487

Raytheon

ADDRESS REPLY TO:
Raytheon Services Nevada
Yucca Mountain Project
101 Convention Center Drive, Suite P-230
Las Vegas, Nevada 89109

YMP:448:94

WBS 1.2.9
QA: N/A

I-360685 RV

RPTS 1.1 8-18-94

August 12, 1994

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

Attention: V. F. Iorii

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT (YMP) EXECUTIVE STATUS REPORT (ESR)

Attached is the input to the above subject report for the month of July, 1994, from Raytheon Services Nevada (RSN).

If there are any questions, please contact me at 794-7014.

WC Kopatich

William C. Kopatich
Technical Project Officer

WCK:jmf
Attachment:
As Stated
cc: J. R. Dyer, YMSCO, M/S 523
J. M. Replogle, YMSCO, M/S 523
W. B. Simecka, YMSCO, M/S 523
R. E. Spence, YMSCO, M/S 523
T. M. Rodriguez, TRW, M/S 423
Executive Office, RSN, M/S 580
J. M. Fleetwood, RSN, M/S 403
R. G. Musick, Jr., RSN, M/S 403
R. L. Schreiner, RSN, M/S 403
L. E. Shaw, RSN, M/S 403
D. J. Tunney, RSN, M/S 403
L. E. Watson, RSN, M/S 726
E. L. Wright, RSN, M/S 403
YMP File
RMC

DIVISION IORII
CC: Dyer
CC: Replogle
CC: Simecka
CC: Spence
CC: Nelson
CC: Richardson-23%
CC:
CC:

8/15/94

ENCLOSURE 6

Raytheon Services Nevada
July 1994 Monthly Input
Yucca Mountain Site Characterization Project (YMP)
Executive Status Report (ESR)

EXECUTIVE SUMMARY

Facilities Engineering:

Completed General Support Facilities Complex (GSFC) 50% Design Review.

Prepared sketches, estimate and schedule for UZ-7a, Borehole Drill Pad and Access Road.

Systems Engineering:

As-built drawings for NRG 7/NRG 7A Boreholes Pad, Ghost Dance Pavement, SD-12 Borehole Pad, Alice Ridge Trench, and NRG-2 Series Borehole Pad were approved and submitted to the DRC. RSN has submitted as-built drawings for all required job packages.

RSN personnel participated in the Technical Database Workshop conducted in Denver.

Surface-Based Testing

Completed Work Programs for USW SD-9, Rev. 1; USW NRG-7/7a and USW NRG-6 Grout Pump Study At UE-25 UZ-16, Rev. 0A; USW NRG-6 North Ramp Borehole Enlargement, Rev. 0; USW NRG-7/7a North Ramp Borehole Enlargement, Rev. 0; USW SR-1 AND USW SR-2 Stagecoach Road Boreholes, Rev. 0; USGS Seismic Reflection Profile Program, Rev. 0; USW SD-7 Systematic Drillhole, Rev. 0A. Prepared Summary Cost Estimates for USW SD-9, Rev. 1; USW NRG-6 North Ramp Borehole Enlargement, Rev. 0; USW NRG-7/7a North Ramp Borehole Enlargement, Rev. 0; USGS Seismic Reflection Profile Program, Rev. 0; and USW SR-1 & SR-2 Stagecoach Road Boreholes, Rev. 0.

Supported field operations for (1) drilling at USW SD-12, USW SD-9 (double shifts), USW SR-1, USW SR-2, and USW NRG-6 (casing removal); (2) geophysical logging at USW SD-9 (RUN #1), USW SD-12 (RUN #1), UE-25 NRG-2, and UE-25 NRG-2b.

Reviewing proposals for standard suite borehole logging services at USW UZ-14 and borehole directional survey services at USW SD-9 and USW SD-12. Preparing procurement documents for RFP for Vertical Seismic Profiling services at UE-25 UZ-16.

Interfaced with SAIC on implementing transition of subcontracts and procurements for geophysical logging and wireline surveying services.

Revised RSN YMP Project Procedures PP-10-01 and PP-03-20.

Field Operations

Completed the field work for as-builts for the shallow boreholes designated SR-1 and SR-2 located south of Stagecoach Road adjacent to Stagecoach Road Trench SCRT-1.

Established and prominently flagged the centerline coordinate point for SRG-1.

Staked intermediate points along the proposed South Ramp Tunnel Alignment.

Produced a final location map and provided survey support for field verification of the Ghost Dance Fault Trenches.

Field located and established coordinates for an existing borehole approximately 200' ± South and East of UZ-7A pad area. Also provided coordinates for UZ-8, N-48, and N-49.

Quality Assurance

Quality Control verified the following: (1) drilling activities at SD-9 and SD-12, and (2) activities at C-well Complex and SD-7.

Reviewed/approved/commented on the following: (1) two Procedure Interim Changes, (2) four Work Programs, (3) two Field Verification Plans, and (4) one Transition Plan.

DELIVERABLES

Letters and memorandums regarding Surface Based Testing Operations for the month of June.	Continuous
Submitted the third phase of the construction monitoring survey data of the box cut around the North Portal to the M&O.	7/20/94

ISSUES AND CONCERNS

The following NCRs are open: (1) NCR No. YMP-94-03, boreholes not secured in accordance with the borehole security program. Awaiting completion of disposition by REECo.
(2) NCR No. YMP-94-0040 was issued due to cave-in during surface drilling at Borehole SD-9. A disposition of repair has been specified by RSN Surface Based Testing and the NCR has been transmitted to REECo for disposition action. (3) NCR No. YMPO-94-0056, Compaction of Drill Pad for Borehole SD-7, was issued and dispositioned use-as-is.

The following RSN deficiency report is open: DR-93-O-009, job package records not submitted in required time frame. The corrective action completion date for this has been extended to August 31, 1994.

Closed Deficiency Report No. DR-94-O-001, gauges at SD-12 not calibrated.

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

PARTICIPANT RSN | FISCAL MONTH/YEAR Jul-94

DATE PREPARED 15-Jun-94 | PAGE 1 of 1

	CURRENT MONTH END						FISCAL YEAR		
	ACTUAL COSTS (K)	PARTICIPANT HOURS	SUBCON. HOURS	PURCHASE COMMITMENTS	SUBCON. COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET (K)	APPROVED FUNDS (K)	CUMULATIVE COSTS (K)
1.2.1	$4	40.0					$80	$80	$77
1.2.2	$0	0.0					$0	$0	$0
1.2.3	$230	2766.0			$705,000.00	$273,000	$3,546	$3,546	$2,549
1.2.5	$0	0.0					$30	$30	$31
1.2.6	$137	1486.0					$1,899	$1,899	$1,083
1.2.7	$65	890.0					$1,422	$1,422	$1,242
1.2.9	$46	455.0					$550	$550	$458
1.2.11	$46	638.0					$650	$650	$502
1.2.12	$7	81.0					$100	$100	$69
1.2.14	$5	14.0					$33	$33	$29
1.2.15	$19	507.0					$457	$457	$285
TOTALS	$559	6877			$705,000	$273,000	$8,767	$8,767	$6,325

Note: 1.2.2 budget and actuals transferred to 1.2.3

COSTFTE.XLS

Participent RSN	Yucca Mtn. Site Char. Project-Planning & Control System PACS Participent Work Station (PPWS) WBS Status Sheet (WBS02)	01-Jul-94 to 31-Jul-94 Page - 1 Inc. Dollars in Thousands
Prepared - 08/10/94:10:10:19		

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	6	6	4	0	2	68	68	77	0	-9	80	80	0
1.2.3	SITE INVESTIGATIONS	278	3	228	-275	-225	2785	2683	2548	-102	135	3546	3550	-4
1.2.5	REGULATORY	0	0	0	0	0	31	31	31	0	0	31	31	0
1.2.6	EXPLORATORY STUDIES FACILI	134	134	137	0	-3	929	929	1083	0	-154	1899	1951	-52
1.2.7	TEST FACILITIES	141	77	65	-64	12	1296	1193	1242	-103	-49	1422	1422	0
1.2.9	PROJECT MANAGEMENT	46	46	46	0	0	458	458	458	0	0	550	550	0
1.2.11	QUALITY ASSURANCE	54	54	46	0	8	542	542	502	0	40	650	650	0
1.2.12	INFORMATION MANAGEMENT	8	8	8	0	0	83	83	69	0	14	100	100	0
1.2.15	SUPPORT SERVICES	49	49	24	0	25	402	402	314	0	88	480	480	0
Total		716	377	558	-339	-181	6594	6389	6324	-205	65	8758	8814	-56

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
LBRHRS	6271	8794	8256	8646	9582	6549	6413	11932	9773	9233	7392	7163	100004
LABOR	419	618	590	605	686	481	557	648	748	714	771	701	7538
SUBS	5	53	0	45	120	157	0	0	120	0	17	670	1187
OTHER	2	2	2	2	2	2	2	2	10	2	2	3	33
Total BCWS	426	673	592	652	808	640	559	650	878	716	790	1374	8758

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	6283	8714	7162	7235	8049	9640	7926	10840	7125	6465	0	0	79439
LABOR	435	627	505	545	588	791	712	755	551	504	0	0	6013
SUBS	0	53	0	48	29	0	1	26	75	50	0	0	282
OTHER	2	1	5	1	0	0	0	10	6	4	0	0	29
Total ACWP	437	681	510	594	617	791	713	791	632	558	0	0	6324

Resource Distributions

Fiscal Year 1994	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
BCWS	426	673	592	652	808	640	559	650	878	716	790	1374	8758
BCWP	479	648	613	653	823	647	561	713	875	377	0	0	6389
ACWP	437	681	510	594	617	791	713	791	632	558	0	0	6324
ETC	0	0	0	0	0	0	0	0	0	40	1193	1257	2490

Fiscal Year Distribution

	Prior	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	Future	At Complete
BCWS	10852	8758	15056	13909	11406	8584	6341	6077	4958	5	0	0	85946
BCWP	10852	6389	0	0	0	0	0	0	0	0	0	0	
ACWP	11324	6324	0	0	0	0	0	0	0	0	0	0	
ETC	0	2490	16275	13265	11291	8469	6226	5962	4843	5	0	0	86474

None

United States Department of the Interior

TAKE PRIDE IN AMERICA

GEOLOGICAL SURVEY
BOX 25046 M.S. 425
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

I-360965

INFORMATION ONLY

August 15, 1994

Vince Iorii
Yucca Mountain Site Characterization
Project Office
U. S. Department of Energy
P.O. Box 98608
Las Vegas, Nevada 89193-8608

RL RPTS 1.8 8/15/94

SUBJECT: Yucca Mountain Project Branch - U.S. Geological Survey (YMPB-USGS) Progress Report, July 1994

Dear Vince:

Attached is the USGS progress report in the required format for the month of July, 1994.

If you have any questions or need further information, please call me or Raye Ritchey at (303)236-0516.

Sincerely,

for Raye E. Ritchey
Larry R. Hayes
Technical Project Officer
Yucca Mountain Project Branch
U.S. Geological Survey

Enclosure:
cc: R. Crawley, DOE/Las Vegas
J. Dlugosz, DOE/Las Vegas
R. Dyer, DOE/Las Vegas
S. Jones, DOE/Las Vegas
W. Kozai, DOE/Las Vegas
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A. Simmons, DOE/Las Vegas
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T. Sullivan, DOE/Las Vegas
M. Tynan, DOE/Las Vegas
D. Williams, DOE/Las Vegas
P. Justus, NRC/Las Vegas (2 copies)
P. Burke, M&O/Las Vegas
R. St. Clair, M&O/Las Vegas
D. Appel, USGS/Denver
G. Bodvarsson, LBL/Berkeley
M. Chornak, USGS/Denver
R. Craig, USGS/Las Vegas
L. Ducret, USGS/Denver
D. Gillies, USGS/Denver
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R. Spengler, USGS/Denver
J. Stuckless, USGS/Denver
J. Whitney, USGS/Denver

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ENCLOSURE 7

U.S. Geological Survey
EXECUTIVE SUMMARY
July 1994

WBS 1.2.3.1 - Coordination and Planning

United States Geological Survey-Yucca Mountain Project Branch (USGS-YMPB) is currently processing 74 hydrologic-related scientific publications, 59 geologic and climate-related scientific publications, 12 USGS-LBL hydrologic-related scientific publications, and 88 abstracts.

WBS 1.2.3.2 - Geology

Work on the 3-D site-scale model, Topopah surface, continued with the creation of three more isopach maps and a structure contour map of the base of the Tiva Canyon Tuff for the entire fault block that contains Isolation Ridge; this will assist modeling efforts in the northernmost part of the site-scale model. Flow diagrams, maps, and tables to accompany the 3-D site-scale model analysis paper were pepared. Seven of the completed isopach maps were digitized using AutoCAD; final revisions to the surfaces were incorporated.

In stratigraphic studies, core from USW UZ-14 between about 512 and 672.6 m (total depth) was examined, and unit and subunit contacts within the Prow Pass tuff were selected; the underlying Bullfrog Tuff was briefly examined. Contacts within the lower portion of the Calico Hills Formation (pyroclastic units 1 and 2, the bedded tuff unit, and the basal sandstone unit) were selected. Lithologic logging of borehole USW SD-9 and USW SD-12 was begun including selection of lithologic contacts from the surface to 453 and 354 m, respectively; detailed logging was completed from the surface to 453 and 290 m, respectively.

Surface-based geophysics staff completed collating the physical property data for nearly all of the rock units involved in the modeling. Well-log information has been collated and preliminary geologic/geophysical cross-sections, to be imported into HYPERMAG were developed for several lines, and preliminary gravity and magnetic models were generated for five points.

Thin-section examination of the Solitario Canyon measured section was begun as part of the geologic mapping of zonal features studies. The thin-section suite comprises subunit lithologies within the Tiva Canyon Tuff. Attention is being given in the thin-section examination to identifying those characteristic petrographic features above and below lithologic contacts. At present, the non- to partially-welded base, the basal vitrophyre, and the columnar zones have been examined in detail. Opaque mineral phases appear to be diagnostic in delineating these contacts. The primary iron oxide phenocryst magnetite ($FeO.Fe_2O_3$) is unoxidized in the vitrophyre but is almost completely oxidized to hematite (Fe_2O_3) in the overlying devitrified zone and underlying non- to partially-welded base.

At the Exploratory Studies Facility (ESF), five samples from the North Ramp Box Cut were obtained and submitted for trace-element analysis. Analysis of fracture data from the detailed line surveys for the ESF North Ramp starter tunnel continued.

WBS 1.2.3.3 - Hydrology

Collection of synoptic weather data continued in the form of weather charts and weather satellite images. Lightening data also are being collected during storms. One significant storm was recorded at Yucca Mountain in July; a maximum of 0.18 cm was measured in Drill Hole Wash. The non-recording gage network captured this small storm with many gages located on the perimeter reading zero.

Analysis of water-level measurements made in drillhole USW G-2 indicated a substantial drop since monitoring began.

Ponding and infiltration experiments continued in the Fortymile Wash recharge study. Additional data collected included: precipitation data from gages in Fortymile Canyon; neutron logs from UE-29 UZN #91 and #92; water-level measurements in UE-29a #1, #2, and UE-29 UZN #91.

In unsaturated zone infiltration studies, two soil samples for Pagany Wash near UE-25 UZN #7 and nine soil samples from Castle Point near USW UZ-N15, N17, and N36 were collected to characterize the physical properties of the unconsolidated surficial material. On-site measurements were made of bulk density, sieved rock and sand fraction, particle-size analysis, $CaCO_3$ analysis, and porosity and particle-density measurements of the various size fractions for samples from WT-2 Wash, Yucca Crest, and Pit 10 in Midway valley.

Artificial infiltration studies continued with a double-ring infiltrometer experiment completed at two locations near borehole UE-25 UZN #7; surface infiltration rates and sorptivity values were determined for each of the infiltration runs. Bulk density samples and sidewall samples were collected at each locations and will be characterized to determine several physical and hydrologic characteristics.

Regular monthly neutron logs were obtained in 97 holes in the natural-infiltration monitoring network. Preliminary processing of the count data was completed, and the count data were entered into the historical neutron hole count database.

Air-permeability testing was begun in USW NRG-7/7A. Air-injection testing was conducted on over 20 test intervals in the Topopah Spring upper lithophysal zone and five tests were conducted in the middle nonlithophysal zone. A zone of decreased permeability created during the drilling was observed in the immediate area of the borehole; this "well bore skin" can cause some problems in testing and in test analysis. The lower permeability will necessitate using higher gas pressures for the tests, and they will have to be conducted for longer time periods, which will limit the number of tests for a given time interval. Effects of the wellbore skin will have to be determined before results from the tests can be analyzed.

In USW UZ-14 studies, one PQ-size, crushed core sample was compressed by high-pressure, one-dimensional compression for testing. Nearly 27 ml of pore water was extracted from the sample. Twenty core samples from USW UZ-14 were distilled and prepared for analysis of tritium, $^{18}O/^{16}O$, and D/H. Fifty samples of pore water were sent to the U of C Stable Isotope Laboratory for analysis of $^{18}O/^{16}O$ and D/H.

The large-block, prototype ESF percolation experiment was restarted in July. Currently, water is flowing continuously through the block fractures at a rate less than 1 cm^3/hr. Average water pressure along the block top is between -24 and -19 cm of water. Measurements of water pressure in the block matrix and fracture are being made with tensiometers. Pressures along the top will be decreased until water flow stops, then increased until flow begins again to determine any hysteretic behavior that may affect water flow in fractures.

Monitoring of perched water in the ESF by other investigators was continued. To date, the starter tunnel has been drill and blasted to about 61 m. Alcove #1 has been excavated to final depth. Drilling of the three radial boreholes has been completed. No natural water flows have been encountered.

Gaseous-phase chemical investigations in the unsaturated zone continued. Fifteen gas samples were obtained from borehole USW UZ-1 and were analyzed for concentrations of oxygen and nitrogen using the gas chromatograph.

As part of the aqueous-phase chemical investigations, three core samples from USW NRG-6 and 7/7A and one from USW UZ-14 were compressed by high-pressure, one-dimensional methods. All yielded pore water for chemical analyses. Pore-water extraction by distillation methods was completed on 28 other core samples. Twenty-one samples from USW UZ-14, two from USW NRG-6, and three from USW NRG-7/7A were distilled; the extracted pore water will be analyzed for selected chemical constituents and ^{14}C.

Precision of analysis of several duplicate samples from USW UZ-1 and UZ-14 were checked for consistency and found that there is a consistent lowering of counting rate after the sample vials were allowed to sit for more than a month. This could be due to phase separation between the water sample and the organic scintillation cocktail. Some of the samples will be rerun with counting continuing for at least one month.

As part of the evaluation of site potentiometric levels, 19 water-level zones were monitored in 17 wells on a monthly basis (manually) and 17 zones in 12 wells on an hourly basis (transducers). Continuous analog water-level data were obtained in four zones in two wells in order to monitor water-level responses to seismic events. Real-time data were obtained from 17 zones in 12 wells using DCP's. Four manual water-level measurements were made at USW UUZ-14 and one measurement at UE-25 SD#9.

WBS 1.2.3.6 - Climatology

As part of Paleoclimate studies of lake, playa, and marsh deposits, analysis (counting) of ostracode data was completed of the late Holocene core taken from the southern Pahranagat Lake. Graphs showing stratigraphic distribution of key ostracode species and other material of interest were created; preliminary results show most of the record as being deposited in an environment that was different from that of the modern world.

Residues from forty processed samples from Pahrump Playa, Nevada cores were examined and residual sand fraction weights and ostracode occurrences recorded. Thirteen isotope and 14 gastropod subsamples from Lower Pahranagat Lake, Nevada cores and 82 isotope subsamples from southern ancestral Great Salt Lake Basin were prepared.

Processing was continued for additional strata from a pack rat midden covering the last 34,000 years; middens have been sorted and analyzed. Collection and analysis of pollen samples from Summer Lake, Oregon and Fish Lake Valley in the central Great Basin was continued.

In support of unsaturated-zone hydrochemistry studies, 36 samples of rock gas CO_2 were analyzed for isotopic compositions of C and O.

WBS 1.2.12.2 - Information Management

Records received by the LRC were better than 99 percent accurate; the records accuracy by the Project records office also was 99 percent. A total of 10,973 pages were transmitted with 87 percent being data-related records.

USGS LEVEL 3 MILESTONE REPORT
OCTOBER 1, 1993 - JULY 31, 1994
Sorted by Baseline Date

Deliverable	Due Date	Expected Date	Completed Date	Comments
G300: FINAL RPT, CROSS-HOLE PROTOTYPE TESTING Milestone Number: 3GUT004M	03/31/93	08/31/94		
PUBLICATION: RAILROAD VALLEY ANALOG Milestone Number: 3GNR02AM	09/30/93	09/30/94		
PUBLICATION: DEVELOPMENT OF 1-D COMPRESSION Milestone Number: 3GUH045M	01/31/94	08/31/94		
ANALYSIS PAPER: UZ-16 COMPLETION REPORT (P013) Milestone Number: 3GUP066M	02/01/94	09/30/94		
ANLYS PAPER: LAB MEASUREMENT OF UNSATURATED FLOW Milestone Number: 3GUS034M	02/04/94	08/31/94		
ANALYSIS PPR: DATA-STARTER TUNNEL & NORTH PORTAL Milestone Number: 3GGF012M	02/28/94	08/31/94		
CRITERIA LETTER: TECH SUPPORT FOR X-HOLE TESTING Milestone Number: 3GWF086M	02/28/94	09/30/94		
ANLYS PPR: MAG/GRAV INTERP YUC WASH/MDWAY VALLEY Milestone Number: 3GGU463M	03/31/94	09/30/94		
ANLYS PPR: MAPS SOUTH-CNTRL GHOST DANCE FAULT Milestone Number: 3GGF122M	03/31/94	09/30/94		
PUB: STRUCTURAL FLOW-PATH ANLYS W/TRANSPT & CHEM Milestone Number: 3GFH009M	03/31/94	09/30/94		
PUBLICATN: RESULTS - ZERO OFFSET & WALKAWAY DATA Milestone Number: 3GUP086M	03/31/94	08/31/94		
PUBLICATION: GEOPHYSICAL STUDY/WINDY WASH FAULT Milestone Number: 3GPF039M	04/15/94	11/30/94		

Deliverable	Due Date	Expected Date	Completed Date	Comments
ANALYSIS PPR: MAG/GRAV ACROSS GHOST DANCE FAULT Milestone Number: 3GGU440M	04/29/94	08/31/94		
PUBLICATION: ASSESS LITTLE SKULL MTN EQ Milestone Number: 3GSM149M	04/29/94	08/31/94		
PUBLICATION: INFILT STUDY; DEVELOPMENT/TESTING Milestone Number: 3GUI636M	04/29/94	09/30/94		
PUBLICATION: 1-D AND 2-D MATRIX MODELS Milestone Number: 3GPA006M	04/29/94	08/31/94		
ANLYS PPR: ISOTOPIC PARAMETERS- DRILLCORE SECTNS Milestone Number: 3GGU22BM	05/31/94	09/30/94		
ANLYS PPR: MAP-GHOST DANCE FAULT PAVEMENT Milestone Number: 3GGF202M	05/31/94	08/31/94		
PUBLICATION: FINAL SUMMARY RPT - MIDWAY VALLEY Milestone Number: 3GFP029M	05/31/94	09/30/94		
PUBLICATION: MAP - CALICO HILLS Milestone Number: 3GTD018M	05/31/94	12/30/94		
PUBLICATION: MAP- EAST OF BEATTY QUADRANGLE Milestone Number: 3GTD028M	05/31/94	08/31/94		
ANLYS PPR: SCARP DEGRADATION/EVOL N. WINDY WASH Milestone Number: 3GPF034M	05/31/94	08/31/94		
PUBLICATION: STAGE COACH RD FAULT Milestone Number: 3GPF118M	05/31/94	09/30/94		
PUBLICATION: STREAMFLOW CHAOS JOURNAL ARTICLE Milestone Number: 3GRG023M	06/30/94	03/31/95		
PUBLICATION: HISTORICAL NEUTRON HOLE DATA Milestone Number: 3GUI050M	06/30/94	09/30/94		

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Deliverable	Due Date	Expected Date	Completed Date	Comments
PUB: PROJECTION MOIRE METHOD - FRACT-SURF CHAR Milestone Number: 3GUS024M	06/30/94	08/31/94		
PUBLICATION: ORIGIN OF SURFACE DEPOSITS Milestone Number: 3GQH019M	06/30/94	08/31/94		
ANLYS PPR:ALTERATIONS IN CORE FROM UZ-14 & UZ-16 Milestone Number: 3GNR020M	06/30/94	12/30/94		
PUBLICATION: LITHOSTRATIGRAPHIC CRITERIA Milestone Number: 3GGU130M	07/15/94	07/28/94	07/28/94	
ANALYSIS PAPER: LITHOLOGIC LOGGING - PHASE 2 Milestone Number: 3GGU31AM	07/15/94	07/15/94	07/15/94	
ANLYS PPR: 3-D SITE-SCALE MODEL/TOPOPAH-SURFACE Milestone Number: 3GGU135M	07/29/94	09/30/94		
ANALYSIS PAPER: SEISMIC REFLECTION PROFILE EVAL Milestone Number: 3GGU256M	07/29/94	12/28/94		
ANALYSIS PAPER: PRELIMINARY WT/UZ-14 MAG RESULTS Milestone Number: 3GGU399M	07/29/94	07/28/94	07/28/94	
ANALYSIS PPR: PROGRESS GEOCHEM REFERENCE SECTION Milestone Number: 3GGF206M	07/29/94	08/31/94		
ANLYS PPR:LITH\CHEM PROP WELD/BEDDED PBRUSH\TUFF Milestone Number: 3GGF207M	07/29/94	08/31/94		
PUBLICATION: CATALOG OF SEISMIC EVENTS -CY 1993 Milestone Number: 3GSM025M	07/29/94	09/29/94		
ANLYS PPR: BASALTIC VOLC. BARE MTN-CRATER FLAT Milestone Number: 3GTD025M	07/29/94	08/31/94		
PUBLICATION: FY92 SYNOPTIC/REG/SITE MET DATA Milestone Number: 3GMM038M	07/29/94	09/30/94		

Deliverable	Due Date	Expected Date	Completed Date	Comments
PUBLICATION: FY93 SYNOPTIC/REG/SITE MET DATA Milestone Number: 3GMM041M	07/29/94	09/30/94		
PUBLICATION: CRATER FLAT TUFF FRACTURE MAPPING Milestone Number: 3GWM013M	07/29/94	09/30/94		
ANLYS PPR: MAP-REGIONAL VARIATION-TIVA CYN TUFFS Milestone Number: 3GNR032M	07/29/94	08/31/94		
LETTER REPORT: GROUND-WATER DATA 3RD QTR FY94 Milestone Number: 3GWR042M	07/29/94	07/27/94	07/27/94	
ANALYSIS PAPER: BOREHOLE COMPLETION DATA REPORT Milestone Number: 3GUP302M	07/30/94	09/30/94		
PUBLICATION: BOW RIDGE FAULT Milestone Number: 3GPF120M	08/31/94	09/30/94		
PUBLICATION: MAP OF DEATH VALLEY AREA Milestone Number: 3GTE072M	08/31/94	09/30/94		
ANALYSIS PAPER: PERCHED WATER Milestone Number: 3GUS021M	08/31/94	08/31/94		
PUB: SECTION OF PERC & IMBIBITION TEST RESULTS Milestone Number: 3GUF022M	08/31/94	08/31/94		
ANALYSIS PAPER: GEOCHRONOLOGICAL STUDIES Milestone Number: 3GQH023M	08/31/94	08/31/94		
DATA TO TDB: GEOCHEMICAL & ISOTOPIC DATA Milestone Number: 3GQH024M	08/31/94	08/31/94		
PUB: METEOROLOGICAL DATA FY92-94, ARID-ZONE INFL Milestone Number: 3GQH001M	08/31/94	08/31/94		
ANLYS PPR: RADIOGENIC/STABLE ISOTOPE STUDIES Milestone Number: 3GNR034M	08/31/94	09/30/94		

Deliverable	Due Date	Expected Date	Completed Date	Comments
PUBLICATION: HYDROGEOLOGY OF WELL JF-3 Milestone Number: 3GWR032M	08/31/94	01/17/95		

USGS LEVEL 4 MILESTONE REPORT
OCTOBER 1, 1993 - JULY 31, 1994
Sorted by Baseline Date

Deliverable	Due Date	Expected Date	Completed Date	Comments
PROV. RESULTS:ISOTOPE DATING/EOLIAN SANDS/SOIL Milestone Number: 3GCH161M	08/31/93	08/31/94		
PRELIMINARY SUMMARY PALEOFLOOD STUDIES Milestone Number: 3GQH010M	09/30/93	09/30/94		
REVIEW DRAFT: SUMMARY REPORT - MIDWAY VALLEY Milestone Number: 3GFP028M	01/20/94	08/31/94		
DATA TO LRC: TRENCH LOGS Milestone Number: 3GFP017M	02/21/94	08/31/94		
REVIEW DRAFT: TRENCHES STAGE COACH RD FLT Milestone Number: 3GPF117M	03/15/94	08/15/94		
REVIEW DRAFT: CATALOG OF EVENTS CAL YEAR 1993 Milestone Number: 3GSM024M	03/31/94	08/31/94		
DATA TO LRC: SEISMIC DATA Milestone Number: 3GSM24AM	03/31/94	08/31/94		
DATA TO LRC: UE-25 UZ#16 AIR-K DATA Milestone Number: 3GUP039M	03/31/94	07/14/94	07/14/94	
DATA TO LRC: FRACTURE LOGS DATA Milestone Number: 3GUP305M	03/31/94	11/30/94		
DATA TO LRC: GAS/H20 VAPOR DATA-UZ#16/NRG-6/UZ-1 Milestone Number: 3GUH022M	03/31/94	09/30/94		
SELECT SEISMIC CONTRACTOR(S) Milestone Number: 3GGU265M	04/29/94	10/31/94		
DATA TO LRC:FY93 SYNOPTIC/REGIONAL/SITE MET DATA Milestone Number: 3GMM039M	04/29/94	09/30/94		

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Deliverable	Due Date	Expected Date	Completed Date	Comments
DATA TO LRC: FY93 MATRIX PROPERTIES DATA Milestone Number: 3GUP034M	04/29/94	08/31/94		
TECHNICAL MEMO: APR-1 FRACTURE DATA Milestone Number: 3GGF120M	05/23/94	08/12/94		
REVIEW DRAFT: MAP- BIG DUNE QUADRANGLE Milestone Number: 3GTD029M	05/31/94	08/31/94		
DATA TO LRC: QUADRILATERAL SURVEY Milestone Number: 3GTL009M	06/30/94	11/30/94		
MEMO TO TPO: INSTUMENTATION CERTIF FOR NRG-6 Milestone Number: 3GUP072M	06/30/94	12/15/94		
DATA TO LRC: AXIAL FRACTURE BLANK TEST RESULTS Milestone Number: 3GUS032M	06/30/94	08/31/94		
DATA TO LRC: 1ST & 2ND QTR FY94 GAS FLOW DATA Milestone Number: 3GGP03M	06/30/94	08/31/94		
DATA TO LRC: 1ST & 2ND QTR FY94 GAS SAMPLE DATA Milestone Number: 3GGP05M	06/30/94	08/31/94		
DATA TO LRC: 1ST & 2ND QTR FY94 TRACER TEST DATA Milestone Number: 3GGP07M	06/30/94	08/15/94		
DATA TO LRC: HYDRAULIC DATA Milestone Number: 3GWF020M	06/30/94	08/31/94		
DATA TO LRC: LIMITED SITE HYDROCHEMISTRY DATA Milestone Number: 3GWH008M	06/30/94	07/27/94	07/27/94	
ABSTRACT: ORIGIN OF SECONDARY CALCITE IN UZ -YM Milestone Number: 3GQH866M	06/30/94	07/06/94	07/06/94	
PREP: TBM MAPPING PREPARATION (LEVEL 4) Milestone Number: 3GGF50BM	07/29/94	08/31/94		

Deliverable	Due Date	Expected Date	Completed Date	Comments
REVIEW DRAFT: STRUCT CONTROLS/BASALTIC VOLCANISM Milestone Number: 3GTW015M	07/29/94	08/31/94		
DATA TO LRC:PRELIM TBL FLT PARAMS REL EQs-V. IV Milestone Number: 3GSS114M	07/29/94	08/31/94		
PROV RESULTS: CONFERENCE ON GROUND MOTION Milestone Number: 3GES006M	07/29/94	08/31/94		
DATA TO LRC: ROCK VALLEY TRENCH LOGS Milestone Number: 3GTN016M	07/29/94	09/27/94		
PROV RESULTS: HISTORY OF FATIGUE WASH FAULT Milestone Number: 3GPF105M	07/29/94	08/31/94		
PROVISIONAL RESULTS: COSMOGENIC DATING RESULTS Milestone Number: 3GPF116M	07/29/94	08/31/94		
STREAM-GAGE INSTALLATION MEMO Milestone Number: 3GRS018M	07/29/94	08/31/94		
DRAFT REPORT: HYDROGEOLOGIC MAP OF DEATH VALLEY Milestone Number: 3GRM043M	07/29/94	09/30/94		
REVIEW DRAFT: TUFF MATRIX PROPERTIES Milestone Number: 3GUP035M	07/29/94	07/18/94	07/18/94	
MEMO TO TPO: INSTALLATION/INITIAL TEST OF INSTRU Milestone Number: 3GUP096M	07/29/94	11/15/94		
MEMO TO TPO:GAS SAMPLING SOFTWARE COMPLETION RPT Milestone Number: 3GUP102M	07/29/94	07/06/94	07/06/94	
AXIAL INTACT FRACTURE SAMPLING METHODS (TP) Milestone Number: 3GUS029M	07/29/94	08/31/94		
DATA TO LRC: SINGLE-HOLE REDUCED DATA Milestone Number: 3GUS422M	07/29/94	09/30/94		

Deliverable	Due Date	Expected Date	Completed Date	Comments
MEMO TO TPO:STATUS OF BUILD/CALIBRATE/TEST EQUIP Milestone Number: 3GUS009M	07/29/94	07/29/94	07/29/94	
REVIEW DRAFT: TRACER-GAS SORPTION ON STEM/TUFF Milestone Number: 3GUH027M	07/29/94	09/30/94		
DATA TO LRC: SECOND QUARTER WATER-LEVEL DATA Milestone Number: 3GWF052M	07/29/94	07/25/94	07/25/94	
PROV RLTS: HYDRAULIC X-HOLE TEST PROGRAM TO DATE Milestone Number: 3GWF012M	07/29/94	11/08/94		
DATA TO LRC: FRACTURE FILLING DATA Milestone Number: 3GWM010M	07/29/94	09/30/94		
PROVISIONAL RESULTS: DUPLICATE ANALYSIS COMPARSN Milestone Number: 3GCL120M	07/29/94	08/31/94		
PROVISIONAL RESULTS: RADIOCARBON DATING RESULTS Milestone Number: 3GCL130M	07/31/94	08/31/94		
REVIEW DRAFT: SURFICIAL DEPOSITS MAP C. 1/3 YM Milestone Number: 3GCH055M	07/31/94	07/28/94	07/28/94	
PROV RESULTS: SAMPLES-TRENCHES & DRILL HOLES Milestone Number: 3GQH026M	07/31/94	09/30/94		
PROVISIONAL RESULTS: PHYS/MINERAL/PETRO DESCRIPT Milestone Number: 3GQH18M	07/31/94	07/29/94	07/29/94	
PROVISIONAL RESULTS: ISOTOP COMP/FLUID INCLUSION Milestone Number: 3GQH852M	07/31/94	07/29/94	07/29/94	
REVIEW DRAFT: EFFECTS OF SITE GEOL ON GRND MOTN Milestone Number: 3GSG002M	08/15/94	08/12/94		
DATA TO LRC: THERMOLUMINESCENCE DATA Milestone Number: 3GSE002M	08/21/94	08/31/94		

Deliverable	Due Date	Expected Date	Completed Date	Comments
TECH PROC: MOD GCP-3 FOR URAINIUM SERIESM DATING Milestone Number: 3GQH870M	08/26/94	09/26/94		
REVIEW DRAFT: THERMOBAROMETRY/LOWER PLATE Milestone Number: 3GTD021M	08/29/94	09/30/94		
REVIEW DRAFT: GAS PHASE TRACER TEST Milestone Number: 3GGP007M	08/30/94	09/30/94		
PROV. RESULTS: SCENARIOS-TECTONICS EFFECTS- HYDR Milestone Number: 3GTW016M	08/31/94	08/31/94		
MEMO TO TPO: PROGRESS OF FIELD MEASUREMENTS Milestone Number: 3GAT046M	08/31/94	08/31/94		
REVIEW DRAFT: HISTORICAL & CURRENT SEISMICITY Milestone Number: P107	08/31/94	09/01/94		
REVIEW DRAFT: SEIS-TECT DEATH VALLEY-FURNACE CRK Milestone Number: 3GTQ012M	08/31/94	08/31/94		
REVIEW DRAFT: AGE AND ACTIVITY BARE MTN FAULT Milestone Number: 3GTQ061M	08/31/94	08/31/94		
PROV RESULTS:STRUCT. HISTORY- MINE MTN FAULT SYS Milestone Number: 3GTN010M	08/31/94	08/31/94		
PROV RESULTS: EVAL OF POSS DETACHMENT FAULTS Milestone Number: 3GTD014M	08/31/94	08/31/94		
DATA TO LRC: NUMERICAL AGE DETERMINATIONS DATA Milestone Number: 3GTD027M	08/31/94	08/03/94		
PROV RESULTS: HISTORY OF GHOST DANCE FAULT Milestone Number: 3GPF104M	08/31/94	08/31/94		
PROVISIONAL RESULTS: ALICE RIDGE TRENCH STUDY Milestone Number: 3GPF109M	08/31/94	09/30/94		

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Deliverable	Due Date	Expected Date	Completed Date	Comments
PROVISIONAL RESULTS: HISTORY SOLITARIO CYN FLT Milestone Number: 3GPF113M	08/31/94	09/30/94		
DATA TO LRC: NRG-7a AIR-K DATA Milestone Number: 3GUP041M	08/31/94	09/30/94		
DATA TO LRC: GAS/WATER VAPOR DATA FROM USW UZ-14 Milestone Number: 3GUP312M	08/31/94	07/03/95		
MEMO TO TPO: DRAWINGS FOR HIGH PRESSURE VESSEL Milestone Number: 3GUS035M	08/31/94	08/31/94		
MEMO TO TPO: COMPLETE BH MONITOR ANISOTROPY SYS Milestone Number: 3GUS410M	08/31/94	08/31/94		
TECH PROC: BOREHOLE PRESSURE CELL & EXTENSOMETER Milestone Number: 3GUS008M	08/31/94	08/31/94		
DATA TO LRC: 1ST-3RD QTR FY94 ESF PERCHED WATER Milestone Number: 3GUS014M	08/31/94	08/31/94		
DATA TO LRC: 1ST-3RD QTR FY94 ESF HYDROCHEMISTRY Milestone Number: 3GUS401M	08/31/94	08/31/94		
MEMO TO TPO: ESF HYDROCHEM SAMPLING METHODOLOGY Milestone Number: 3GUS404M	08/31/94	08/31/94		
DATA TO LRC: AQUEOUS-PHASE DATA Milestone Number: 3GUH031M	08/31/94	08/31/94		
REVIEW DRAFT: PARTICLE TRACKING ALGORITHM Milestone Number: 3GUM016M	08/31/94	08/31/94		
CRITERIA LET: REHABILITATING WELLS H-4/H-6/b#1 Milestone Number: 3GWF076M	08/31/94	08/31/94		
PROVISIONAL RESULTS: TRACER INJECTION SYS STATUS Milestone Number: 3GWF085M	08/31/94	08/31/94		

Deliverable	Due Date	Expected Date	Completed Date	Comments
MEMO TO TPO: STATUS OF HYDROCHEM DATA REPORT Milestone Number: 3GWH003M	08/31/94	08/31/94		
PROVISIONAL RESULTS: PALEONTOLOGIC/ISOTOPE DATA Milestone Number: 3GCL118M	08/31/94	08/31/94		
REV DRAFT: MAP OF SURF DEPOSITS, S CRATER FLAT Milestone Number: 3GQH020M	08/31/94	08/31/94		
REV DRAFT: SUMMARY -GROUND WATER TRACER STUDIES Milestone Number: 3GQH028M	08/31/94	09/30/94		
PROV RESULTS: SR,PB,& S ISO ANLYS YM GRND WATER Milestone Number: 3GNR036M	08/31/94	08/31/94		

Participant USGS | Yucca Mtn. Site Char. Project-Planning & Control System | 01-Jul-94 to 31-Jul-94
PACS Participant Work Station (PPWS) | Page - 1
Prepared - 08/15/94:09:22:11 | WBS Status Sheet (WBS02) | 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	5	5	6	0	-1	51	51	55	0	-4	62	64	-2
1.2.3	SITE INVESTIGATIONS	1829	1535	1957	-294	-422	16469	15210	16070	-1259	-860	21331	21752	-421
1.2.5	REGULATORY	98	79	97	-19	-18	992	976	921	-16	55	1206	1186	20
1.2.9	PROJECT MANAGEMENT	121	121	52	0	69	983	983	859	0	124	1225	1125	100
1.2.11	QUALITY ASSURANCE	159	159	145	0	14	1582	1582	1619	0	-37	1900	1923	-23
1.2.12	INFORMATION MANAGEMENT	41	41	36	0	5	416	416	414	0	2	530	530	0
1.2.13	ENVIRONMENT, SAFETY, & HEA	53	53	60	0	-7	377	377	394	0	-17	483	479	4
1.2.15	SUPPORT SERVICES	24	24	47	0	-23	239	239	238	0	1	287	287	0
Total		2330	2017	2400	-313	-383	21109	19834	20570	-1275	-736	27024	27346	-322

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
LBRHRS	17618	18011	18747	20608	20170	21181	25516	29668	29646	28025	26464	26355	282009
LABOR	971	1037	1207	1272	1273	1368	1634	1648	1613	1530	1578	1575	16706
SUBS	588	624	696	790	758	667	770	746	733	710	991	694	8767
CAPITAL	0	0	197	41	0	0	0	49	97	90	500	577	1551
Total BCWS	1559	1661	2100	2103	2031	2035	2404	2443	2443	2330	3069	2846	27024

Actual Cost of Work Performed

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	11856	12411	12139	14734	18465	18096	16085	15265	16439	13920	0	0	149410
LABOR	713	832	1588	1272	1102	1284	1597	1240	1561	1613	0	0	12802
SUBS	583	652	685	782	664	809	755	799	833	789	0	0	7351
CAPITAL	4	0	185	29	23	0	1	32	145	-2	0	0	417
Total ACWP	1300	1484	2458	2083	1789	2093	2353	2071	2539	2400	0	0	20570

Participant USGS	Yucca Mtn. Site Char. Project-Planning & Control System	01-Jul-94 to 31-Jul-94
	PACS Participant Work Station (PPWS)	Page - 2
Prepared - 08/15/94:09:22:11	WBS Status Sheet (WBS02)	Inc. Dollars in Thousands

WBS No. - 1.2 -YUCCA MOUNTAIN PROJECT

Resource Distributions

Fiscal Year 1994	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
BCWS	1559	1661	2100	2103	2031	2035	2404	2443	2443	2330	3069	2846	27024
BCWP	1532	1647	1943	2116	1764	2134	2209	2230	2242	2017	0	0	19834
ACWP	1300	1484	2458	2083	1789	2093	2353	2071	2539	2400	0	0	20570
ETC	0	0	0	0	0	0	0	0	0	0	3876	2900	6776

Fiscal Year Distribution

	Prior	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	Future	At Complete
BCWS	24644	27024	16516	2801	58	0	0	0	0	0	0	0	71043
BCWP	23158	19834	0	0	0	0	0	0	0	0	0	0	
ACWP	23430	20570	0	0	0	0	0	0	0	0	0	0	
ETC	0	6776	17002	2801	58	0	0	0	0	0	0	0	70637

YMP PLANNING AND CONTROL SYSTEM (PACS)

Participant U.S. Geological Survey

Date Prepared 08/15/94 09:26

MONTHLY COST/FTE REPORT

Fical Month/Year JULY 1994

	CURRENT MONTH END						FISCAL YEAR		
WBS ELEMENT	ACTUAL COSTS	PARTICIPANT HOURS	SUBCON HOURS	PURCHASE COMMITMENTS	SUBCON COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1.2.1	6	64	0		0		62		55
1.2.3	1954	11302	10369	196	1478		20635		15669
1.2.5	98	1178	566		52		1175		900
1.2.9	53	792	612		77		1225		860
1.2.11	145	588	1366		122		1900		1619
1.2.12	36	0	1173		96		530		414
1.2.13	60	40	0		0		483		394
1.2.15	47	0	374		26		287		238
TOTALS	2399	13964	14460	196	1851		26297	0	20149

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR 10/1/93 - 07/31/94

		OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
0G1194B	Q-List Development and Maintenance	0.6	1.5	9.2	1.3	7.0	5.1	7.2	6.0	11.2	5.5	0.0	0.0	54.6
1.2.1.10		0.6	1.5	9.2	1.3	7.0	5.1	7.2	6.0	11.2	5.5	0.0	0.0	54.6
*1.2.1.1		0.6	1.5	9.2	1.3	7.0	5.1	7.2	6.0	11.2	5.5	0.0	0.0	54.6
**1.2.1		0.6	1.5	9.2	1.3	7.0	5.1	7.2	6.0	11.2	5.5	0.0	0.0	54.6
0G3194B1	Branch Coordination and Planning	31.0	41.7	59.2	29.3	44.0	36.5	85.4	-30.8	37.2	62.9	0.0	0.0	396.4
0G3194B2	M&I - Branch Administrative Services	28.7	14.7	81.4	12.5	18.8	56.2	48.1	36.2	45.2	14.7	0.0	0.0	356.5
0G3194G1	Geologic Studies Program Management	22.9	27.8	38.5	58.0	58.3	5.4	19.3	26.6	35.3	23.3	0.0	0.0	315.4
0G3194G2	QA Implementation GSP	20.5	21.3	16.2	20.9	16.1	23.1	20.4	22.5	19.3	17.9	0.0	0.0	198.2
0G3194H1	Hydrology Program Management	35.2	33.3	88.0	40.2	36.3	-4.5	54.3	103.5	57.0	42.8	0.0	0.0	486.1
0G3194H2	QA Implementation, HHydrology	13.0	13.5	20.5	8.6	10.8	17.4	15.2	9.6	31.7	13.5	0.0	0.0	153.8
0G3194H3	Computer Operation & Data Mgmt Hydrology	26.3	28.0	53.7	31.8	28.8	35.7	35.5	43.7	34.7	43.2	0.0	0.0	361.4
0G3194H4	Scientific Rpts/Proj Documents Hydrology	7.1	8.4	11.6	6.1	7.1	7.1	6.5	6.9	9.3	8.4	0.0	0.0	78.5
1.2.3.1		184.7	188.7	369.1	207.4	220.2	176.9	284.7	218.2	269.7	226.7	0.0	0.0	2346.3
*1.2.3.1		184.7	188.7	369.1	207.4	220.2	176.9	284.7	218.2	269.7	226.7	0.0	0.0	2346.3
0G32211A94	Surface/Subsurface Stratigraphic Studies	52.3	61.2	82.3	77.7	75.0	128.0	87.3	49.2	136.8	135.4	0.0	0.0	885.2
0G32211B94	Surface-Based Geophysical Surveys	0.0	0.9	1.5	53.9	26.6	23.4	15.9	0.6	9.7	13.7	0.0	0.0	146.2
0G32211C94	Borehole Geophysical Surveys	0.0	0.0	6.4	58.9	21.4	16.8	-29.4	-2.0	38.0	-24.2	0.0	0.0	85.9
1.2.3.2.2.1.1		52.3	62.1	90.2	190.5	123.0	168.2	73.8	47.8	184.5	124.9	0.0	0.0	1117.3
0G32212A94	Geologic Mapping of Zonal Features	61.7	83.1	80.1	77.8	64.3	79.5	54.3	87.2	73.0	55.7	0.0	0.0	716.7
0G32212B94	Surface-fracture Network Studies	0.0	0.0	13.9	0.6	21.7	1.1	6.5	6.3	4.5	6.2	0.0	0.0	60.8
0G32212D94	Geologic Mapping of the ES and Drifts	31.5	30.6	65.4	44.9	49.7	60.5	56.5	57.2	58.7	63.4	0.0	0.0	518.4
1.2.3.2.2.1.2		93.2	113.7	159.4	123.3	135.7	141.1	117.3	150.7	136.2	125.3	0.0	0.0	1295.9
0G32531A94	Tectonic Effects	4.0	2.0	7.4	-3.3	0.6	3.8	-0.2	0.3	5.1	3.0	0.0	0.0	22.7
1.2.3.2.5.3.1		4.0	2.0	7.4	-3.3	0.6	3.8	-0.2	0.3	5.1	3.0	0.0	0.0	22.7
0G32552C94	Heat Flow at Yucca Mountain	0.0	0.0	0.0	21.9	0.0	0.0	26.1	0.0	0.4	32.8	0.0	0.0	81.2
1.2.3.2.5.5.2		0.0	0.0	0.0	21.9	0.0	0.0	26.1	0.0	0.4	32.8	0.0	0.0	81.2
0G32621A94	Surface Facilities Exploration Program	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	-3.1	0.0	0.0	1.5
1.2.3.2.6.2.1		0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	-3.1	0.0	0.0	1.5
0G32831A94	Identify Relevant Earthquake Sources	4.6	9.0	10.4	-5.0	4.1	14.6	6.5	15.8	10.1	11.2	0.0	0.0	81.3
0G32831B94	Characterize 10,000-yr Slip Earthquakes	0.0	0.0	0.0	32.7	-3.5	18.7	-14.5	1.0	23.8	10.1	0.0	0.0	68.3
1.2.3.2.8.3.1		4.6	9.0	10.4	27.7	0.6	33.3	-8.0	16.8	33.9	21.3	0.0	0.0	149.6
0G32833A94	Empirical Earthquake Model	0.6	0.2	-0.8	20.0	0.0	8.7	2.5	0.0	8.0	0.0	0.0	0.0	39.2
1.2.3.2.8.3.3		0.6	0.2	-0.8	20.0	0.0	8.7	2.5	0.0	8.0	0.0	0.0	0.0	39.2
0G32834A94	Site Effects from Ground-Motion	0.0	0.0	14.5	6.2	-18.4	17.7	5.0	1.5	11.7	8.9	0.0	0.0	47.1
1.2.3.2.8.3.4		0.0	0.0	14.5	6.2	-18.4	17.7	5.0	1.5	11.7	8.9	0.0	0.0	47.1
0G32841A94	Compile Historical Earthquake Record	0.8	0.0	1.0	2.6	1.0	28.6	15.0	2.4	28.7	17.3	0.0	0.0	97.4
0G32841B94	Monitor Current Seismicity	80.0	109.8	102.8	115.5	121.3	67.2	117.6	90.8	87.1	143.2	0.0	0.0	1035.3

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR 10/1/93 - 07/31/94

	OCT EST	NOV EST	DEC EST	JAN EST	FEB EST	MAR EST	APR EST	MAY EST	JUN EST	JUL EST	AUG EST	SEP EST	TOTAL
1.2.3.2.8.4.1	80.8	109.8	103.8	118.1	122.3	95.8	132.6	93.2	115.8	160.5	0.0	0.0	1132.7
0G32842B94 Conduct Expl. Trenching in Midway Valley	0.0	0.0	0.0	105.0	15.9	5.5	11.9	1.4	-19.7	0.0	0.0	0.0	120.0
1.2.3.2.8.4.2	0.0	0.0	0.0	105.0	15.9	5.5	11.9	1.4	-19.7	0.0	0.0	0.0	120.0
0G32843B94 Eval Quaternary faults w/i 100 km of YM	13.2	26.4	14.6	6.0	37.7	22.6	10.8	26.7	13.5	9.7	0.0	0.0	181.2
0G32843D94 Evaluate Bare Mountain Fault Zone	21.6	26.3	25.5	13.1	8.7	16.0	2.6	10.2	3.4	0.7	0.0	0.0	128.1
1.2.3.2.8.4.3	34.8	52.7	40.1	19.1	46.4	38.6	13.4	36.9	16.9	10.4	0.0	0.0	309.3
0G32844A94 Evaluate the Rock Valley Fault System	6.9	19.4	9.8	17.5	-0.4	-0.9	5.1	7.1	29.6	8.9	0.0	0.0	103.0
0G32844B94 Evaluate the Mine Mountain Fault System	0.0	6.8	-6.8	1.0	0.0	-1.0	4.3	1.9	2.6	3.5	0.0	0.0	12.3
1.2.3.2.8.4.4	6.9	26.2	3.0	18.5	-0.4	-1.9	9.4	9.0	32.2	12.4	0.0	0.0	115.3
0G32845B94 Evaluate Postulated Detachment Faults	3.4	2.2	13.1	30.9	-12.8	12.2	9.5	12.7	14.5	43.8	0.0	0.0	129.5
0G32845C94 Evaluate Potential Relationship of Brecc	0.0	0.0	2.6	0.8	5.7	1.3	0.8	0.1	0.0	0.1	0.0	0.0	11.4
0G32845D94 Evaluate Postulated Detachment Faults	0.0	0.0	0.0	0.0	0.0	0.2	0.3	1.1	4.4	0.2	0.0	0.0	6.2
0G32845E94 Eval Age of Detachment Faults - Radiomet	0.0	0.0	0.0	0.0	0.0	0.0	3.6	6.7	14.0	-2.2	0.0	0.0	22.1
1.2.3.2.8.4.5	3.4	2.2	15.7	31.7	-7.1	13.7	14.2	20.6	32.9	41.9	0.0	0.0	169.2
0G32846B94 Evaluate Age and Recurrence of Movement	21.1	3.2	47.9	26.9	49.5	40.5	26.9	101.9	31.6	27.6	0.0	0.0	377.1
1.2.3.2.8.4.6	21.1	3.2	47.9	26.9	49.5	40.5	26.9	101.9	31.6	27.6	0.0	0.0	377.1
0G3284AA94 Relevel Base-Station Network, YM	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.0	15.0	13.0	0.0	0.0	33.0
1.2.3.2.8.4.10	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.0	15.0	13.0	0.0	0.0	33.0
0G3284CA94 Eval Tectonic Process/Stability at Site	0.0	0.0	2.2	10.1	15.6	6.4	-14.7	-7.7	2.0	0.5	0.0	0.0	14.4
0G3284CB94 Evaluate Tectonic Models	0.0	0.6	1.7	-1.3	5.8	29.2	24.2	26.3	17.6	17.6	0.0	0.0	121.7
1.2.3.2.8.4.12	0.0	0.6	3.9	8.8	21.4	35.6	9.5	18.6	19.6	18.1	0.0	0.0	136.1
*1.2.3.2	301.7	381.7	495.5	714.4	489.5	600.6	442.0	500.7	624.1	597.0	0.0	0.0	5147.2
0G33111A94 Precipitation/Meteorological Monitoring	10.7	12.7	24.7	12.7	7.0	18.7	23.5	36.5	11.6	38.5	0.0	0.0	196.6
1.2.3.3.1.1.1	10.7	12.7	24.7	12.7	7.0	18.7	23.5	36.5	11.6	38.5	0.0	0.0	196.6
0G33112A94 Surface-Water Runoff Monitoring	25.3	33.2	37.2	33.8	32.0	24.6	21.8	20.7	103.7	-33.5	0.0	0.0	298.8
1.2.3.3.1.1.2	25.3	33.2	37.2	33.8	32.0	24.6	21.8	20.7	103.7	-33.5	0.0	0.0	298.8
0G33113B94 Regional Potentiometric Level Distributi	5.4	6.7	4.1	7.9	4.0	3.0	3.9	4.2	8.9	2.2	0.0	0.0	50.3
0G33113C94 Fortymile Wash Recharge Study	5.6	5.2	8.7	3.4	5.7	6.0	5.6	5.7	5.8	6.7	0.0	0.0	58.4
1.2.3.3.1.1.3	11.0	11.9	12.8	11.3	9.7	9.0	9.5	9.9	14.7	8.9	0.0	0.0	108.7
0G33114B94 Subregional Two-Dimensional Areal Hydrol	0.0	0.0	0.0	1.8	1.5	6.0	5.6	3.4	-0.4	5.1	0.0	0.0	23.0
0G33114D94 Regional 3-D Hydrology Modeling	3.9	5.3	10.6	7.3	6.5	6.4	8.1	9.3	30.1	27.3	0.0	0.0	114.8
1.2.3.3.1.1.4	3.9	5.3	10.6	9.1	8.0	12.4	13.7	12.7	29.7	32.4	0.0	0.0	137.8
0G33121A94 Char Hydr Prop of Surficial Material	25.7	28.0	20.0	20.5	9.7	21.4	24.5	10.6	36.4	39.9	0.0	0.0	236.7
0G33121B94 Evaluation of Natural Infiltration	5.1	49.7	52.5	19.2	26.3	51.5	40.6	28.6	27.0	60.8	0.0	0.0	361.3
0G33121C94 Evaluation of Artificial Infiltration	0.0	0.0	12.0	13.3	12.9	10.0	42.7	17.7	10.7	69.4	0.0	0.0	188.7
1.2.3.3.1.2.1	30.8	77.7	84.5	53.0	48.9	82.9	107.8	56.9	74.1	170.1	0.0	0.0	786.7
0G33123A94 Matrix Hydrologic-Properties Testing	13.1	29.9	38.7	59.0	-29.3	41.3	43.4	23.0	17.5	42.7	0.0	0.0	279.3

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0G33123B94	Surface-Based Borehole Studies	57.7	59.1	101.8	143.7	78.0	152.1	223.2	201.0	198.5	94.6	0.0	0.0	1309.7
0G33123C94	Vertical Seismic Profiling	5.7	12.9	38.6	-1.5	11.7	20.8	27.0	17.9	32.8	44.9	0.0	0.0	210.8
0G33123D94	Integrated Data Acquisition System	24.3	26.8	27.1	19.7	38.3	24.3	28.4	35.8	13.1	24.6	0.0	0.0	262.4
0G33123E94	Air-Permeability/Gaseous-Tracer Testing	16.8	19.7	22.4	28.9	60.0	27.1	52.0	9.8	29.6	28.3	0.0	0.0	294.6
0G33123F94	USW UZ-14 Support	33.8	12.6	20.7	4.6	13.3	27.2	37.1	37.7	27.6	23.0	0.0	0.0	237.6
1.2.3.3.1.2.3		151.4	161.0	249.3	254.4	172.0	292.8	411.1	325.2	319.1	258.1	0.0	0.0	2594.4
0G33124A94	Prototype Testing of Intact Fractures	22.0	32.4	36.7	37.3	27.8	37.8	45.5	40.5	31.3	73.3	0.0	0.0	384.6
0G33124B94	Prototype Infiltration Testing	9.3	14.6	19.8	12.2	8.7	10.1	12.4	7.1	12.5	18.3	0.0	0.0	125.0
0G33124D94	Radial Borehole Testing	0.0	0.0	8.6	32.0	40.6	23.0	114.1	46.6	26.9	92.6	0.0	0.0	384.4
0G33124E94	Prototype Excavation Effects Testing	7.8	10.4	13.3	3.9	4.0	13.0	24.9	23.3	26.5	23.1	0.0	0.0	150.2
0G33124G94	Prototype Perched-Water Testing	0.0	0.0	4.0	1.3	1.1	5.3	2.6	5.4	1.3	2.7	0.0	0.0	23.7
0G33124H94	Hydrochemistry tests in the ESF	6.0	7.7	8.7	5.7	0.5	16.5	9.9	14.4	7.6	20.5	0.0	0.0	97.5
0G33124J94	Major Faults in the ESF	9.8	7.4	17.7	-3.0	-1.6	4.7	-2.4	0.0	0.0	2.9	0.0	0.0	35.5
1.2.3.3.1.2.4		54.9	72.5	108.8	89.4	81.1	110.4	207.0	137.3	106.1	233.4	0.0	0.0	1200.9
0G33126A94	Gaseous-Phase Circulation Study	7.8	10.5	32.4	40.7	7.1	25.5	57.0	-23.3	23.9	31.3	0.0	0.0	212.9
1.2.3.3.1.2.6		7.8	10.5	32.4	40.7	7.1	25.5	57.0	-23.3	23.9	31.3	0.0	0.0	212.9
0G33127A94	Gaseous-Phase Chemical Investigations	12.5	13.7	16.3	8.4	21.8	5.5	17.4	14.6	18.3	38.0	0.0	0.0	166.5
0G33127B94	Aqueous-Phase Chemical Investigations	9.8	7.3	16.0	15.9	11.4	27.9	12.2	20.3	16.3	13.0	0.0	0.0	150.1
1.2.3.3.1.2.7		22.3	21.0	32.3	24.3	33.2	33.4	29.6	34.9	34.6	51.0	0.0	0.0	316.6
0G33128A94	Development of Conceptual and Numerical	0.0	0.0	0.0	14.6	11.9	10.6	10.5	12.2	8.4	13.7	0.0	0.0	81.9
1.2.3.3.1.2.8		0.0	0.0	0.0	14.6	11.9	10.6	10.5	12.2	8.4	13.7	0.0	0.0	81.9
0G33129A94	Conceptualization of UZ Hydrogeologic Sy	0.0	0.0	0.0	14.3	15.5	29.4	21.3	17.4	23.4	28.1	0.0	0.0	149.4
1.2.3.3.1.2.9		0.0	0.0	0.0	14.3	15.5	29.4	21.3	17.4	23.4	28.1	0.0	0.0	149.4
0G33131B94	Site Potentiometric-Level Evaluation	30.9	31.1	56.4	46.5	33.9	38.4	72.9	42.6	109.9	49.8	0.0	0.0	512.4
0G33131C94	Anal Single/Mult-Well Hydraulic-Stress	5.2	2.8	6.3	1.5	2.1	4.7	-0.2	0.4	15.1	7.9	0.0	0.0	45.8
0G33131D94	Multiple-Well Interference Testing	11.7	26.2	38.1	38.1	20.5	1.1	11.7	-4.3	8.8	31.8	0.0	0.0	183.7
0G33131E94	Testing C-Hole Sites w/ Conserv Tracers	5.0	8.1	13.1	8.5	16.7	9.6	8.8	3.8	9.1	7.5	0.0	0.0	90.2
1.2.3.3.1.3.1		52.8	68.2	113.9	94.6	73.2	53.8	93.2	42.5	142.9	97.0	0.0	0.0	832.1
0G33132B94	Hydrochem Char of Water - Upper Part SZ	4.4	9.8	14.6	8.5	10.1	19.4	6.7	3.9	-4.9	11.2	0.0	0.0	83.7
1.2.3.3.1.3.2		4.4	9.8	14.6	8.5	10.1	19.4	6.7	3.9	-4.9	11.2	0.0	0.0	83.7
0G33133A94	Conceptualization of SZ Flow Models	3.8	3.9	15.3	4.8	6.1	8.3	4.1	2.9	3.1	5.7	0.0	0.0	58.0
0G33133B94	Development of Fracture-Network Model	5.3	5.8	-0.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6
1.2.3.3.1.3.3		9.1	9.7	15.2	4.4	6.1	8.3	4.1	2.9	3.1	5.7	0.0	0.0	68.6
*1.2.3.3		384.4	493.5	736.3	665.1	515.8	731.2	1016.8	689.7	890.4	945.9	0.0	0.0	7069.1
0G36212B94	Analysis of Stratigraphy - Sedimentology	11.3	12.3	21.9	13.4	15.2	16.5	13.0	26.6	16.2	74.9	0.0	0.0	221.3
1.2.3.6.2.1.2		11.3	12.3	21.9	13.4	15.2	16.5	13.0	26.6	16.2	74.9	0.0	0.0	221.3
0G36213A94	Analysis of Pack Rat Middens	0.0	0.0	36.3	1.4	4.5	-3.0	0.1	2.2	4.2	30.4	0.0	0.0	76.1

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1.2.3.6.2.1.3		0.0	0.0	36.3	1.4	4.5	-3.0	0.1	2.2	4.2	30.4	0.0	0.0	76.1
0G36214B94		0.0	0.0	14.9	6.7	3.3	6.4	8.7	8.4	6.9	1.3	0.0	0.0	56.6
1.2.3.6.2.1.4		0.0	0.0	14.9	6.7	3.3	6.4	8.7	8.4	6.9	1.3	0.0	0.0	56.6
0G36221C94	Evaluation of Past Discharge Areas	0.0	0.0	19.0	16.4	32.2	23.4	20.4	32.8	19.2	19.4	0.0	0.0	182.8
0G36221D94	Analog Recharge Sites	7.6	4.4	6.8	3.6	7.9	6.2	7.2	0.0	0.0	0.4	0.0	0.0	44.1
0G36221E94	Analog Recharge Sites	0.0	0.0	7.5	-0.2	6.4	1.1	1.6	4.9	1.7	4.8	0.0	0.0	27.8
0G36221F94	Calcite and Opaline Silica Vein Deposits	15.6	26.6	35.6	28.7	29.0	24.3	27.0	56.8	4.5	35.4	0.0	0.0	283.5
1.2.3.6.2.2.1		23.2	31.0	68.9	48.5	75.5	55.0	56.2	94.5	25.4	60.0	0.0	0.0	538.2
*1.2.3.6		34.5	43.3	142.0	70.0	98.5	74.9	78.0	131.7	52.7	166.6	0.0	0.0	892.2
0G3721A94	Geochemical Assessment of YM in Relation	2.3	7.7	8.1	33.6	40.3	26.3	23.3	15.0	39.8	17.8	0.0	0.0	214.2
1.2.3.7.2.1		2.3	7.7	8.1	33.6	40.3	26.3	23.3	15.0	39.8	17.8	0.0	0.0	214.2
*1.2.3.7		2.3	7.7	8.1	33.6	40.3	26.3	23.3	15.0	39.8	17.8	0.0	0.0	214.2
**1.2.3		907.6	1114.9	1751.0	1690.5	1364.3	1609.9	1844.8	1555.3	1876.7	1954.0	0.0	0.0	15669.0
0G52294B1	NRC Interaction Support	1.8	8.5	7.1	3.6	3.1	22.3	37.4	7.8	3.0	2.0	0.0	0.0	96.6
0G52294B2	Site Characterization Program	22.6	5.1	23.8	18.4	15.1	34.3	11.1	33.6	22.4	28.4	0.0	0.0	214.8
0G52294B3	Study Plan Coordination	1.0	19.7	-17.1	0.1	1.0	5.9	2.0	1.5	3.3	1.4	0.0	0.0	18.8
0G52294B4	Technical Status Report	2.7	0.0	0.0	0.0	0.0	9.7	1.6	-1.7	3.4	0.0	0.0	0.0	15.7
0G52294B5	Issue Resolution	0.0	0.0	0.0	0.0	1.7	0.0	-1.7	1.7	0.3	0.4	0.0	0.0	2.4
1.2.5.2.2		28.1	33.3	13.8	22.1	20.9	72.2	50.4	42.9	32.4	32.2	0.0	0.0	348.3
*1.2.5.2		28.1	33.3	13.8	22.1	20.9	72.2	50.4	42.9	32.4	32.2	0.0	0.0	348.3
0G53594B	Technical Data Base Input	24.2	32.2	28.8	26.1	24.3	31.0	30.1	37.0	31.2	28.8	0.0	0.0	293.7
0G53594H	Technical Data Base Control and Input	11.1	11.9	17.3	6.0	10.0	11.4	11.9	12.8	11.8	12.1	0.0	0.0	116.3
1.2.5.3.5		35.3	44.1	46.1	32.1	34.3	42.4	42.0	49.8	43.0	40.9	0.0	0.0	410.0
*1.2.5.3		35.3	44.1	46.1	32.1	34.3	42.4	42.0	49.8	43.0	40.9	0.0	0.0	410.0
0G54494H	Site Performance Assessment	10.1	11.7	25.5	10.7	11.7	8.3	8.8	13.9	15.8	24.9	0.0	0.0	141.4
1.2.5.4.4		10.1	11.7	25.5	10.7	11.7	8.3	8.8	13.9	15.8	24.9	0.0	0.0	141.4
*1.2.5.4		10.1	11.7	25.5	10.7	11.7	8.3	8.8	13.9	15.8	24.9	0.0	0.0	141.4
**1.2.5		73.5	89.1	85.4	64.9	66.9	122.9	101.2	106.6	91.2	98.0	0.0	0.0	899.7
0G91294B	Management and Integration (TPO)	21.5	21.2	55.3	20.1	30.7	43.1	101.6	29.7	45.1	-3.0	0.0	0.0	365.3
1.2.9.1.2		21.5	21.2	55.3	20.1	30.7	43.1	101.6	29.7	45.1	-3.0	0.0	0.0	365.3
*1.2.9.1		21.5	21.2	55.3	20.1	30.7	43.1	101.6	29.7	45.1	-3.0	0.0	0.0	365.3
0G92294B	Project Control	52.9	-7.4	114.1	37.5	45.4	45.0	41.3	64.1	46.4	55.8	0.0	0.0	495.1
1.2.9.2.2		52.9	-7.4	114.1	37.5	45.4	45.0	41.3	64.1	46.4	55.8	0.0	0.0	495.1
*1.2.9.2		52.9	-7.4	114.1	37.5	45.4	45.0	41.3	64.1	46.4	55.8	0.0	0.0	495.1
**1.2.9		74.4	13.8	169.4	57.6	76.1	88.1	142.9	93.8	91.5	52.8	0.0	0.0	860.4
0GB194Q	QA-Coordination & Planning	23.4	25.3	30.9	18.9	24.6	29.0	18.9	32.1	27.4	27.5	0.0	0.0	258.0
1.2.11.1		23.4	25.3	30.9	18.9	24.6	29.0	18.9	32.1	27.4	27.5	0.0	0.0	258.0

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*1.2.11.1	23.4	25.3	30.9	18.9	24.6	29.0	18.9	32.1	27.4	27.5	0.0	0.0	258.0
0GB294Q QA-Program Development	33.4	31.3	46.5	29.9	52.8	46.4	39.3	37.8	33.1	39.8	0.0	0.0	390.3
1.2.11.2	33.4	31.3	46.5	29.9	52.8	46.4	39.3	37.8	33.1	39.8	0.0	0.0	390.3
*1.2.11.2	33.4	31.3	46.5	29.9	52.8	46.4	39.3	37.8	33.1	39.8	0.0	0.0	390.3
0GB3194Q QA Verification-Audits	60.3	50.9	60.7	48.3	48.1	68.1	61.3	55.7	73.2	64.1	0.0	0.0	590.7
1.2.11.3.1	60.3	50.9	60.7	48.3	48.1	68.1	61.3	55.7	73.2	64.1	0.0	0.0	590.7
0GB3294Q Quality Assurance Verification - Surveil	9.1	28.9	15.2	21.5	23.7	22.1	18.7	17.7	11.4	-1.7	0.0	0.0	166.6
1.2.11.3.2	9.1	28.9	15.2	21.5	23.7	22.1	18.7	17.7	11.4	-1.7	0.0	0.0	166.6
*1.2.11.3	69.4	79.8	75.9	69.8	71.8	90.2	80.0	73.4	84.6	62.4	0.0	0.0	757.3
0GB594B QA-Quality Engineering	22.2	29.5	14.8	22.2	10.5	22.1	23.1	25.2	29.0	15.1	0.0	0.0	213.7
1.2.11.5	22.2	29.5	14.8	22.2	10.5	22.1	23.1	25.2	29.0	15.1	0.0	0.0	213.7
*1.2.11.5	22.2	29.5	14.8	22.2	10.5	22.1	23.1	25.2	29.0	15.1	0.0	0.0	213.7
**1.2.11	148.4	165.9	168.1	140.8	159.7	187.7	161.3	168.5	174.1	144.8	0.0	0.0	1619.3
0GC2294B Local Records Center Operations	32.8	38.3	29.5	35.5	26.7	29.3	29.9	29.3	29.7	29.1	0.0	0.0	310.1
1.2.12.2.2	32.8	38.3	29.5	35.5	26.7	29.3	29.9	29.3	29.7	29.1	0.0	0.0	310.1
0GC2394B Participant Records Management	3.6	8.7	6.6	7.2	8.1	7.3	7.1	6.7	41.8	7.0	0.0	0.0	104.1
1.2.12.2.3	3.6	8.7	6.6	7.2	8.1	7.3	7.1	6.7	41.8	7.0	0.0	0.0	104.1
*1.2.12.2	36.4	47.0	36.1	42.7	34.8	36.6	37.0	36.0	71.5	36.1	0.0	0.0	414.2
**1.2.12	36.4	47.0	36.1	42.7	34.8	36.6	37.0	36.0	71.5	36.1	0.0	0.0	414.2
0GD2594B Occupational Safety and Health	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	6.6	6.8	0.0	0.0	26.8
1.2.13.2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	6.6	6.8	0.0	0.0	26.8
*1.2.13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	6.6	6.8	0.0	0.0	26.8
0GD4794H Water Resources	32.9	27.8	32.9	29.7	32.4	32.7	27.8	32.1	65.5	53.1	0.0	0.0	366.9
1.2.13.4.7	32.9	27.8	32.9	29.7	32.4	32.7	27.8	32.1	65.5	53.1	0.0	0.0	366.9
*1.2.13.4	32.9	27.8	32.9	29.7	32.4	32.7	27.8	32.1	65.5	53.1	0.0	0.0	366.9
**1.2.13	32.9	27.8	32.9	29.7	32.4	32.7	27.8	45.5	72.1	59.9	0.0	0.0	393.7
0GF394B Training	19.6	22.3	13.9	20.9	21.2	23.5	23.4	22.2	24.1	46.6	0.0	0.0	237.7
1.2.15.3	19.6	22.3	13.9	20.9	21.2	23.5	23.4	22.2	24.1	46.6	0.0	0.0	237.7
*1.2.15.3	19.6	22.3	13.9	20.9	21.2	23.5	23.4	22.2	24.1	46.6	0.0	0.0	237.7
**1.2.15	19.6	22.3	13.9	20.9	21.2	23.5	23.4	22.2	24.1	46.6	0.0	0.0	237.7
1.2 OPERATING	1293.4	1482.3	2266.0	2048.4	1762.4	2106.5	2345.6	2033.9	2412.4	2397.7	0.0	0.0	20148.6
CAPITAL EQUIPMENT	0.0	0.0	0.0	31.7	22.6	0.0	0.5	32.2	143.4	-1.2	0.0	0.0	229.2
GRAND TOTAL	1293.4	1482.3	2266.0	2080.1	1785.0	2106.5	2346.1	2066.1	2555.8	2396.5	0.0	0.0	20377.8
FTEs													
FEDERAL	87.2	91.5	89.4	108.4	135.5	134.3	118.2	111.5	120.2	101.8	0.0	0.0	
CONTRACT	55.4	89.0	82.4	97.7	89.3	101.1	100.6	107.0	105.5	99.4	0.0	0.0	
TOTAL	142.6	180.5	171.8	206.1	224.8	235.4	218.8	218.5	225.7	201.2	0.0	0.0	

- * Fourth level WBS roll-up
- ** Third level WBS roll-up

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: July 31, 1994

PARTICIPANT: USGS PEM: TYNAN WBS: 1.2.3.2.2.1.1

WBS TITLE: Vertical and Lateral Distribution of Stratigraphic Units in the Site Area

P&S ACCOUNT: OG32211

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
974	959	1119	-15	-1.5	98.5	-160	-16.7	85.7	1420	2179	-759	-53.5	1657	43.5

Analysis

Cumulative Cost Variance:

Cause:
Much of the negative cost variance is due to not correctly identifying and planning necessary resources to complete the work. This has required some redirection of staff in order to meet planned milestones by the end of the fiscal year. Extensive travel and field excursions have been required for data collection and analysis. The remainder of the variance results from 1) reporting of costs for space & facilities earlier than planned.

Impact:
No impact. The account is expected to close out at or near the planned budget.

Corrective Action:
None Required. P&S account is not expected to overrun the budget at completion, with the exception of unfunded costs addressed in the variance at completion.

Cumulative Schedule Variance:

Not Applicable

Variance At Complete:

Cause:
The variance is due to the estimate to complete being modified to reflect additional scope/budget associated with running the seismic line. This EAC represents the estimated funds required to complete the work related to the seismic line planned for this fiscal year. The original budget was not

adequate to cover all scope addressed in PACS. If the decision is made not to award this contract this fiscal year, the EAC for this fiscal year will be modified, and the corresponding budget moved to fiscal year 1994.

Impact:
None. Funds will be made available if a decision is made to proceed with award of the seismic line contract.

Corrective Action:
None required at this time.

P&S ACCOUNT MANAGER	**DATE**	**TPO**	**DATE**

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: July 31, 1994

PARTICIPANT: USGS **PEM: PATTERSON** **WBS: 1.2.3.3.1.2.3**

WBS TITLE: Percolation in the Unsaturated Zone - Surface-Based Study

P&S ACCOUNT: OG33123

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
2488	1651	2615	-837	-33.6	66.4	-964.0	-58.4	63.1	3164	3087	77	2.4	5014	320.6

Analysis

Cumulative Cost Variance:

Cause:

Most of the negative cost variance (indicating an overspent condition) is due to the behind-schedule condition. However, some of the cost variance is due to 1) ahead-of-schedule acquisition and calibration of equipment needed for instrumentation of UZ boreholes, 2) redirection of some resources within the UZ-14 account to analyze samples of the perched water encountered in UZ-14, and 3) redirection of some resources to support DOE's initiative to acquire pre-ESF construction pneumatic and hydrologic data.

Impact:

Overall, this P&S account will not be overspent at the end of the FY 94, despite the redirection of resources as indicated above. However, unless the UZ-14 summary account is replanned to reflect current delays in drilling and testing, this summary account will be significantly underspent by the end of the year. However, because the resources allocated to this summary account are primarily salaries of permanent full-time staff, other closely related summary accounts in WBS 1233123 and 1233127 may be overspent because of the redirection of staff to tasks within those summary accounts.

Corrective Action:

A C/SCR could be prepared for the UZ-14 summary account as described in the "schedule variance" section. A portion of the current funding could be reprogrammed to other affected summary accounts in WBS 1233123 and WBS 1233127 to avoid the predicted overspent condition in these accounts.

Cumulative Schedule Variance:

Cause:

Several tasks involving testing, hydrologic instrumentation, and monitoring in recently drilled boreholes have been delayed by two to five months. These delays are all related to unexpected conditions encountered in the boreholes and are beyond the control of the USGS as described below.

1) Both air-permeability testing and instrumentation of NRG-6 have been delayed because a 50-foot section of casing is still lodged in this borehole.

2) Geophone instrumentation of UZ-16 and the vertical seismic profiling production survey have been delayed about 2 months due to the unavailability of a drilling/support crew. Time required for RSN to award a VSP data-acquisition contract has the potential to delay the production survey by another 3 months.

3) Tasks scheduled for UZ-14 are behind schedule by up to 6 months because of the delay in completion of drilling of USW UZ-14 because of the perched water encountered therein. UZ-14 tasks behind schedule include geophysical logging, gas sampling, preparation of data report, gas-phase testing, review of gas and water-vapor data, and air-permeability testing.

Impact:

1) The delay in instrumentation of NRG-6 will reduce the pre-TBM-excavation monitoring period for this borehole by about 5 months.

2) Delay of VSP survey of UZ-16 is acceptable because no near-term, high-priority YMP initiatives are impacted.

3) Although the overall YMP site-characterization schedule is impacted by delays at UZ-14, the delays are acceptable because no near-term, high-priority YMP initiatives are impacted.

Corrective Action:

1) USGS and DOE staff are working hard to maximize the scope and duration of pneumatic-pathways monitoring prior to excavation of the ESF north ramp by the TBM. To support this effort, USGS has agreed to change the priority order of borehole instrumentation so that two other boreholes can be instrumented in the near term in addition to NRG-6. Accordingly, NRG-7a will be instrumented instead of UZ-7, and SD-9 will be instrumented instead of SD-12. Individual task titles and work scopes have been revised in PACS to reflect these critical shifts in borehole-instrumentation priorities.

In addition, because of continuing access problems in hole NRG-6, air-permeability testing of NRG-7a will be performed first, and was started during July.

2) USGS will continue to work closely with RSN staff to minimize the delay in award of the VSP data-acquisition contract.

3) Most remaining work in UZ-14 has been put on hold until FY 95 in order to support DOE's initiative to obtain pre-ESF-north-ramp-construction data from NRG and SD boreholes. Because UZ-14 tasks comprise a dedicated summary account, some consideration should be given to a C/SCR to reschedule this account when enough is known about the sequence and duration of tasks still to be completed. Alternatively, the variance in this summary account could be allowed to grow through the end of FY 94 and then the UZ-14 summary account could be rebaselined or eliminated for FY 95.

Variance At Complete:

Not Applicable

P&S ACCOUNT MANAGER	**DATE**	**TPO**	**DATE**

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: July 31, 1994

PARTICIPANT: USGS PEM: PATTERSON WBS: 1.2.3.3.1.2.4

WBS TITLE: Percolation in the Unsaturated Zone - ESF Study

P&S ACCOUNT: OG33124

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
1526	1231	1217	-295	-19.3	80.7	14.0	1.1	101.2	2328	1935	393	16.9	2300	152.8

Analysis

Cumulative Cost Variance:

Not Applicable

Cumulative Schedule Variance:

Cause:

Schedule variance is due to 1) 2-month delay in the conduct of single-hole air-permeability tests in the first Radial Boreholes alcove because of a drill rig blocking access to the boreholes, unavailability of required power and compressed air, lack of access to the alcove because of TBM construction, and temporary disconnection of the alcove ventilation system; 2) 6-month delay in extraction of pore water from ESF drill cores for the Hydrochemistry test because of delay in drilling of the radial boreholes and unavailability of equipment to squeeze cores; and 3) delay in procurement of capital equipment (high-pressure cell) for the prototype Intact Fracture test.

Impact:

ESF Radial Boreholes and Hydrochemistry tests are running behind schedule, but the delays are consistent with overall delays in the ESF schedule. The delays described are not controllable by the USGS.

Corrective Action:

Communicate problems to the ESF Testing Coordinator and request assistance with resolution.

Variance at Complete:

Cause:

Variance results from projection to the end of FY 94 of the individual cost variances described above.

Impact:

This P&S account probably will be underspent by about $500 K at the end of FY 94. Major sources of the underrun include 1) delay to FY 95 of the award of a contract ($165 K) to the U.S. Bureau of Mines for installation of pressure cells for the Excavation Effects test and 2) unspent funds budgeted for equipment and chemical analysis of samples for the Perched Water and Hydrochemistry tests ($120 K).

Corrective Action:

USGS already has identified potential FY 94 underrun to the YMSCO. Some funds already have been reprogrammed to other high-priority needs per direction from YMSCO.

P&S ACCOUNT MANAGER	DATE	TPO	DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: July 31, 1994

PARTICIPANT: USGS PEM: PATTERSON WBS: 1.2.3.3.1.3.3

WBS TITLE: Saturated Zone Hydro. Sys. Synthesis and Modeling

P&S ACCOUNT: OG33133

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
174	205	69	31	17.8	117.8	136	66.3	297.1	225	136	89	39.6	76	29.9

Analysis

Cumulative Cost Variance:

Cause:
The positive cost variance (indicating an underspent condition) is because the work for the Fracture-Network Modeling summary account is being accomplished by a former USGS employee on disability retirement who is continuing to work part time as a volunteer. This is why the summary account has accrued no costs since November 1993 and yet remains on schedule.

Impact:
Budgeted funds are not being spent at the rate originally anticipated.

Corrective Action:
See "variance at completion."

Cumulative Schedule Variance:

Not Applicable.

Variance At Complete:

Cause:
See "cumulative cost variance."

Impact:
The P&S account probably will underrun by about $120 K by the end of FY 94 because no additional staff will be brought on board until FY 95. There are no programmatic impacts because work is still on schedule.

Corrective Action:

Some of the unspent funds are being reserved to support analytical-element modeling analysis of boundary conditions for a site-scale saturated-zone flow model. The remaining unspent funds will be made available for reprogramming to other high-priority YMP work.

P&S ACCOUNT MANAGER	DATE	TPO	DATE

Yucca Mountain Site Characterization Project
Variance Analysis Report
Status Thru: July 31, 1994

PARTICIPANT: USGS　　**PEM: Iorii**　　**WBS: 1.2.9.1.2**

WBS TITLE: Technical Project Office Management

P&S ACCOUNT: 0G912

FY 1994 Cumulative to Date									FY 1994 at Completion					
BCWS	BCWP	ACWP	SV	SV%	SPI	CV	CV%	CPI	BAC	EAC	VAC	VAC%	IEAC	TCPI
416	416	365	0	0.0	100.0	51.0	12.3	114.0	500	425	75	15.0	439.0	140.0

Analysis

Cumulative Cost Variance:

Cumulative Schedule Variance:

Variance At Complete:

Cause:
This account is projecting a variance at completion due to funds being budgeted for the mandatory relocation of USGS office space not planned to be costed this fiscal year.

Impact:
There is no impact. Funds are committed and will be costed either late this fiscal year or early next fiscal year. At this point, it appears that it will be early next fiscal year, resulting in the lower fiscal year estimate at completion.

Corrective Action:
None required.

P&S ACCOUNT MANAGER　　DATE　　TPO　　DATE

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