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# United States Department of the Interior

U. S. GEOLOGICAL SURVEY  
Box 25046 M.S. 421  
Denver Federal Center  
Denver, Colorado 80225

INFORMATION ONLY

May 13, 2003

Victor W. Trebules  
Director, Office of Project Control  
Office of Civilian Radioactive Waste Management  
Office of Repository Development  
P.O. Box 364629  
North Las Vegas, Nevada 89036-8629

SUBJECT: Yucca Mountain Project Branch - U.S. Geological Survey (YMPB-USGS)  
Progress Report, April, 2003

Attached is the USGS progress report in the required format for the month of April, 2003.

If you have any questions or need further information, please call Raye Ritchey Arnold at (303)236-5050, ext 296.

Sincerely,

Robert W. Craig  
Technical Project Officer  
Yucca Mountain Project Branch  
U.S. Geological Survey

Enclosure:

cc: J. Bresee, DOE/OCRWM-HQ/Forrestal  
S. Hanauer, DOE/Las Vegas  
W. J. Arthur III, DOE, Las Vegas  
R. Dyer, DOE, Las Vegas  
D. Barr, DOE, Las Vegas  
W. Boyle, DOE, Las Vegas  
D. Coleman, DOE, Las Vegas  
A. Gil, DOE, Las Vegas  
T. Gunter, DOE, Las Vegas

4MSS07  
WM-11

W. Kozai, DOE, Las Vegas  
S. Mellington, DOE, Las Vegas  
E. Smistad, DOE, Las Vegas  
R. Spence, DOE, Las Vegas  
B. Terrell, DOE, Las Vegas  
M. Tynan, DOE, Las Vegas  
R. Latta, NRC, Las Vegas (2 copies)  
R. Andrews, M&O/BSC, Las Vegas  
G. Bodvarsson, M&O/LBNL, Las Vegas  
P. Dixon, M&O/LANL, Las Vegas  
A. Eddebbarh, M&O/LANL, Las Vegas  
E. Hardin, M&O/BSC, Las Vegas  
R. Henning, M&O/BSC, Las Vegas  
J. Houseworth, M&O/LBNL, Las Vegas  
S. Kuzio, M&O/SNL, Albuquerque  
S. Pedersen, M&O/BSC, Las Vegas  
M. Peters, M&O/LANL, Las Vegas  
J. Wang, M&O/LBNL, Berkeley  
W. Alley, USGS, Reston  
D. Duncan, USGS, Reston  
R. Craig, USGS, Las Vegas  
R. Arnold, USGS, Denver  
T. Chaney, USGS, Denver  
M. Chornack, USGS, Denver  
W. Dudley, USGS, Denver  
D. Gillies, USGS, Denver  
C. Hunter, USGS, Denver  
Z. Peterman, USGS, Denver  
W. Scott, USGS, Las Vegas  
J. Stuckless, USGS, Denver  
D. Sinks, BSC, Denver

**U.S. GEOLOGICAL SURVEY**  
**Executive Summary**  
**YUCCA MOUNTAIN PROJECT BRANCH**

April 2003

**GEOLOGICAL STUDIES**

Development of Nye County early-warning drilling program (EWDP) borehole lithostratigraphy continued. Examination and analysis of samples and geophysical logs from drill holes NC-EWDP-27P and NC-EWDP-28P were incorporated into lithostratigraphic logs of those boreholes. Completion of processing of samples from NC-EWDP-16P (by the SMF) is expected by early May 2003, and once processed samples are available, examination of bit-cutting samples from NC-EWDP-16P will begin.

In other lithostratigraphic support to Nye County, all revisions suggested by technical and checker reviews were incorporated into the Phase III cross-section data package, and that completed data package (DTN: GS030408314211.002) was submitted to the USGS Data Manager for final approval and submission to the TDMS/RPC. The data package is presented in "poster" format and consists of two plates, each of which should be printed on 34- by 44-inch sheets for best viewing results. Plate 1 contains four maps which display supporting geologic and geophysical data (at a scale of 1:100,000) used in construction of the geologic cross sections. In summary, figure 1 illustrates the locations of drilled and planned holes of the Nye County early-warning drilling program. Figure 2 shows distribution of faults (both mapped and inferred from geophysical data) in the vicinity of traverses depicted on the cross sections. Figure 3 presents geophysical data used in construction of the cross sections, including aeromagnetic gradients, isostatic gravity data, and inferred depth to basement. Figure 4 displays the exposed stratigraphic units, the potentiometric surface, and seismic refraction lines in the area depicted on the cross sections. Plate 2 of the Phase III cross-section data package presents subsurface interpretations in three cross sections (all at a scale of 1:25,000) named Nye-1, Nye-2, and Nye-3. The digitally assembled cross sections uniquely integrate interpretations of subsurface geophysical information, interpretations derived from drill-hole samples, interpreted surface and subsurface structural geometries, and location of the inferred potentiometric surface. The data package is intended as an aid to resolving specific Key Technical Issues and as an aid for planning future drilling.

With addition of attributes to the digital data set now complete, the completed geologic map of the potential southern expansion of the proposed repository has been submitted to the USGS Central Publications Group for USGS Director's approval. Along with the attributions, final in-house review and editing were performed on that map.

Activity related to characterization of subsurface geology also continued. The underground-mapping team conducted a field trip to examine the Peach Spring Tuff in northwestern Arizona and the Bishop Tuff in east-central California. Mapping-team

members, BSC staff, and USGS personnel used that opportunity to develop a broader understanding of cooling history and textural variations in welded and nonwelded pyroclastic flows. Rock-mechanics testing of materials from Yucca Mountain ECRB excavations continued with long-term creep testing. Direct-shear experiments have been completed, and the assembled data package containing results of that testing entered technical review at the end of the month. Several investigations of fracture patterns and lithophysal characteristics of the repository host horizon (RHH) continued. The mapping team completed the fifth of six planned traverses and began work on the sixth traverse, located in the lower lithophysal zone of the Topopah Spring Tuff (Tptpl). Data collection also began on panels and traverses in excavated exposures of the upper lithophysal zone (Tptpul). Analysis of the fracture network continued, with on-going work to develop representative statistical characterization of the units.

In other geological work, preparation for further opportunity to quantify lithophysal porosity involved planning for data collection in conjunction with two multi-borehole, small-diameter, thermal tests. Discussions examined schedules of tests and types of data which could be collected. Comment resolution from technical reviews of the Deterministic Seismic Hazard Analysis continued. Required revisions have taken longer than anticipated due to on-going schedule conflicts.

## SATURATED-ZONE STUDIES

Monitoring of pressures and temperatures using the MAGI Westbay data logger to collect background pressures and temperatures from transducers installed in borehole NC-EWDP-19IM1 continued through April 15, with that data recording having started in January 2003. Transducers were removed on April 15 and sent for closing calibrations. Interpretation of the pressure data began immediately, with those data providing a means to calculate barometric efficiency. [Please note that any use herein of private brand, trade, or firm names is for identification and explanatory purposes only and does not constitute endorsement by the United States Geological Survey or other agency of the United States government.]

Important progress was made during April on software QA for hydraulic- and tracer-testing software. The USGS software program STRELTSOVA-ADAMS.VI, version 1, submitted in February 2003 to the Independent Verification and Validation (IVV) Group in Las Vegas, was approved on April 2, 2003. The USGS software program INJECTION-PUMPBACK.VI, version 1, also submitted in February to the IVV Group, was approved on April 4. A third program, RECIRC.VI, went to the USGS-YMPB Software Coordinator in March, and it is anticipated that the package will be submitted to the IVV Group in early May. (The RECIRC.VI software does not directly support the SZ In-Situ Testing AMR. It is used only to close a TBV input to the AMR and therefore did not delay progress on the AMR.) In related work, preliminary analyses were re-run using (now-) qualified software, by downloading Q data from the TDMS and re-processing those data. The processed data then were run through the qualified software QA programs, and the

developed results confirmed results presented in the draft copy of the SZ In-Situ Testing AMR. Those developed results will become Technical Product Outputs from the AMR.

Sampling systems for discrete-zone sampling in WT- and H- wells have been designed and are as complete as possible pending final details of well configuration and the final results of BSC re-planning. (Much of the sampling equipment has been purchased, but there will be no attempt to complete that activity until re-planning is final.) One set of samples, however, was collected on April 29.

Modeling of the Death Valley regional flow system (DVRFS) continued with several on-going activities in hydrogeologic data integration, 3-D hydrogeologic model development, and calibration of the flow model. Software utilities were updated to fit with the NWIS data base, and the Death Valley project web site [ <http://sun1daztcn.wr.usgs.gov>] saw continued use in knowledge-exchange and model meetings. Documentation of flow observations in support of the transient version of the DVRFS model also continued, and staff created subsequent model-input files necessary for MODFLOW software. Responses were prepared for USGS Headquarters-review comments regarding the 3-year reVision Inc., contract, and a modified contract package was re-submitted for approval. Other on-going efforts aimed at appraisal of reVision, Inc., software capability and improvements; all contract requirements were deemed functional after that appraisal.

While 3-D hydrogeologic model development continued, staff prepared an abstract concerning uncertainties of geologic models for the MODFLOW—2003 conference to be held in the fall of 2003. In addition, a presentation for the USGS Open House in Henderson, Nevada, was assembled to describe the Yucca Mountain hydrogeologic framework model (HFM). That latter poster presentation also may be shown at the National Nuclear Security Administration (NNSA) Underground Test Area (UGTA) Technical Working Group meeting planned for early May. Thickness distributions were identified using the HFM, and those determinations were being checked for inconsistencies. Additional work was done to update the report on hydraulic properties for volcanic units. On-going review and corrections to the hydrogeologic framework model also continued.

Work continued on calibration of the transient flow model. Hydraulic-conductivity data from the Underground Test Area (UGTA) of the Nevada Test Site were assembled for the UGTA Phase I modeling report. Staff developed appropriate MODFLOW2000 code to enable parallel processing of MODFLOW v.1.10 with the HUF2 (hydrologic unit flow) package. Parallel processing allows multiple computer processors to perform calculations during parameter-estimation and sensitivity simulations, thereby significantly reducing execution times and improving efficiency of the flow-modeling process. MODFLOW2000 parallel processing was tested for steady-state and transient-flow model simulations. Several processors were used successfully for parameter-sensitivity simulations. Execution times were significantly reduced. The current steady-state flow model was compared to results from the 15-layer steady-state model documented in USGS water-resources report WRIR 02-4102 (describing the 3-D numerical DVRFS model), including visualization of flow paths and generation of graphical displays of diagnostic model results. Results were comparable and consistent. With the current

model substantially simplified and inputs improved, overall performance has been improved. Transient simulations were initiated using flow-model simulations for the period from 1913 to 1998. Preparation, testing, and modification of transient input files were underway. Addition of a temporal component adds considerable complexity to input files and to model visualization. MODFLOW2000 packages requiring modification included horizontal flow barrier (HFB), well pumpage (WEL), spring and ET discharge (GHB), water-level observations (HOBS), and hydrogeologic unit flow (HUF). Hydraulic-conductivity depth-decay parameters were removed from the transient flow model due to excessive execution times. That step improved forward simulation times from 50 minutes to 10 minutes, due to decreased computational complexity. (Depth-decay approaches will be used where necessary for accurate representation of the flow system.) Work continued on introductory and hydrologic sections of the transient flow-model report. Additional improvements provided visualization methods for transient flow-model output as well as options to apportion pumpage by model-layer hydraulic conductivity or by opening thickness and model-layer hydraulic conductivity. Improvements have been incorporated successfully into the model-evaluation toolbox. New capabilities were added to the DVRFS post-processor to extract and visualize transient simulated head and drawdown data from MODFLOW2000. Work continued on writing the draft hydrogeologic evaluations section for the final DVRFS model report.

Support of the DVRFS knowledge-exchange protocol continued, with distribution of the summary of the April knowledge-exchange meeting to the USGS Nevada District NNSA program manager and to the YMPB TPO. Staff assisted in the USGS Nevada District program review and presented information on the DVRFS modeling, with emphasis on knowledge-exchange activities. Assembly of text for the HFM chapter of the DVRFS report also continued. In unscheduled but related work, recruitment of speakers for the September Geological Society of America technical sessions (focused on the natural system at Yucca Mountain and the proposed repository) continued.

## UNSATURATED-ZONE STUDIES

Moisture-monitoring work in the ESF and in the ECRB Cross Drift continued during April. Equipment lists required for data packages were updated and cross-referenced to the M&TE data base for calibration information. New data-collection stations (to be deployed during the Alcove #7 re-entry) were planned in coordination with the TCO. Alcove #7 data-logger programs were drafted and tested, and new instrumentation for use in Alcove #7 was obtained and submitted for opening calibrations. New ESF temperature and relative humidity (T/RH) station brackets were designed and coordinated through the TCO. Spreadsheets were updated with monitoring data downloaded from the TCO. Preparation of the ESF moisture-monitoring data package continued, pending results of closing calibrations and final TCO downloads of data.

Routine data collection continued in the Alcove #8/Niche #3 infiltration experiment. Data were received from the TCO and processed. Collected data include T/RH, weight (from the large plot as a proxy for H<sub>2</sub>O volume), heat-dissipation probe (HDP) data,

barometric pressure, and evaporation data. (See previous monthly summaries for additional detail.) Adjustments were made to the array of data collected, including temporary deletion of large-plot stations. Those stations will return to the data set after full ponded conditions are met prior to tracer application.

The tracer part of the experiment has been postponed due to incomplete pre-test modeling. Because that delay may extend many months, the Alcove #8 experiment was reconfigured (on March 24, 2003) to allow qualitative observations regarding fracture connectivity in Niche #3. About 50% of previous water application is being used on two of the large plots. Some degree of dry-out is expected in Niche #3, potentially with indications of fracture connectivity. Those indications will be tested quantitatively during the tracer part of the overall test. Niche #3 observations currently indicate some dry-out, but several Niche #3 permeameters have been turned off and thereby preclude quantitative description. There appears to be less condensation in collection trays, but the observed, wet, rock area in Niche #3 hasn't yet diminished. Mold, although reduced, remains a problem and requires protective equipment for entry behind the bulkhead. Sampling has continued.

Several infiltration test-related data packages are in technical review or in preparation for that review, including "Physical Properties of Borehole Samples from Niche 3 of the ESF Collected from 7/5/00 to 7/13/00;" "Physical Properties of Borehole Samples from Alcove 8 of the ECRB Collected from 7/10/00 to 7/19/00;" "Photographs from Niche 3 of the Alcove 8 / Niche 3 Seepage Experiment During Construction Showing Construction Water in Niche 3, March 6, 2000;" and "Large Plot Ponded Infiltration in Alcove 8 from November 19, 2002 to March 24, 2002."

Bulkhead moisture monitoring continued, with on-going collection of temperature and relative humidity, barometric pressure, and wind-speed data. Routine review and processing of those data continued, but the schedule for opening of bulkheads and retrieval of instruments for closing calibrations (necessary to prepare data packages) remains unknown.

Progress was made in core and lithophysal characterization, including compliance review of the scientific notebook associated with the "Spot and Rim Hydrologic Properties" data package and detail changes specified by the ATDT data base. The data package received internal review by the data-management group, producing requests for clarification of some items in the package and subsequent modification of the data package. The completed "Spot and Rim Hydrologic Properties" data package was submitted on April 30 to the TDMS/RPC in completion of milestone PAGSW937M4 [Spot & Rim Hydrologic Properties DP to TDMS/RPC].

In continued work on characterization of the chemical and isotopic composition of pore water, USGS staff extracted water from three more core samples from the South Ramp, two of which exhibited only low levels of organic acids. Those results do not help to verify the hypothesis that the organic acids likely are produced during storage of the core and are not characteristic of pore water in the natural system, although the hypothesis

remains valid. Extensive examinations using system blanks were conducted to find the source of small amounts of transition metal contamination recently apparent in the ICP-MS analyses. To date, the source of that contamination has not been found, but that situation should not interfere with accurate determination of major elements. Core samples from borehole CHEMSAMP3 were selected for analysis in support of thermal testing on the basis of mapped temperature and moisture distribution provided by E. Sonnenthal (LBNL). The first set of selected samples arrived in Denver on April 23 and extraction of water began on April 30. The second thermal-test workshop has been postponed indefinitely. B. Marshall presented a paper on strontium isotopes in pore water from the Topopah Spring Tuff, Yucca Mountain, Nevada, at the Tenth International High-Level Radioactive Waste Management Conference.

Evaluation of (analytical laboratory) data quality continued, so no direct progress was made to characterization of the hydrochronology of the YM flow system, but work in aspects of Site-scale hydrochemistry did continue. Samples from Bonnie Brae from the Inyo County (California) monitoring program were analyzed for cations and anions. Isotopic and hydrochemical support to the Nye County early-warning drilling program (EWDP) was minor during the reporting period, but sampling in Inyo County travertine well #2 is planned for May. The Nye County sampling trip has been rescheduled for late June or July. No progress has been made in analysis of ECRB water, water vapor, and gas, with activity suspended pending the results of the BSC re-plan. Nothing can be done until the bulkheads are opened and re-instrumented.

In on-going effort to evaluate microclimate records in secondary fracture-filling minerals, petrographic thin sections (optical microscope samples) of secondary mineral deposits from approximately 300 sample locations in the ESF and the ECRB Cross Drift were inspected for the presence of opal in outermost (youngest) depositional layers. About 60 sample locations contained opal with calcite that formed during the latest stage of mineral deposition. Those samples are suitable for  $^{230}\text{Th}/\text{U}$  determination of the timing of the most recent deposition (and, by inference, the most recent fracture percolation at the sampled locality) by microdigestion-sampling of the outer surface of the opal. About 25 of the 60 samples contained evidence of calcite and opal co-genesis in which the calcite and opal displayed correlatable growth banding or were interfingered or interlayered. Those samples may be suitable for determining depositional timing (from the  $^{230}\text{Th}/\text{U}$  ages of correlative opal) and  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values of the calcite and providing a proxy for local climatic conditions at the surface during deposition of the youngest secondary minerals.

Staff of the Environmental Science team reviewed proposals (bids) for a new thermal ionization mass spectrometer. Evaluation factors included assessments of the technical performance capabilities of the proposed instruments, as well as recent installations including time required to attain full performance. To address the latter, a number of laboratories were contacted to solicit comments about installation and performance. These included laboratories in Korea, China, Japan, India, Australia, Great Britain, Russia, and France. Approximately 80 percent of the contacted laboratories replied with comments regarding their experiences with the spectrometer companies.



A USGS-YMPB team, under the leadership of J. Paces, was formed on April 9 to prepare the final chlorine-36 ( $^{36}\text{Cl}$ ) report as an official YMP Technical Report. Virtually all Environmental Science Team personnel are involved at various levels of effort. Preparation of the report requires close coordination with both Los Alamos National Laboratory (R. Roback) and with Lawrence Livermore National Laboratory (G. Nimz). Significant progress has been made in preparation of a first draft and in defining, preparing, reviewing and submitting data packages that will be required for the report. A paper was presented at the 10<sup>th</sup> International High-Level Radioactive Waste Management Conference, entitled *Summary of Chlorine-36 Validation Studies at Yucca Mountain, Nevada*. Authorship included J. Paces, Z. Peterman, L. Neymark, G. Nimz, M. Gascoyne, and B. Marshall.

## WATER-RESOURCES MONITORING

Water-resources monitoring continued during April with routine measurement of ground-water levels at 34 sites and measurement of ground-water discharge at five springs and one flowing well. Ground-water and spring-discharge data collected during March were checked and filed. Data collected and compiled during the period January through March 2003, describing ground-water levels and discharge, were reviewed. A letter report describing results of monitoring of ground-water resources was prepared and delivered to DOE in completion of milestone [PAGSW262M4, Letter Report: 2nd Qtr FY03] on April 30. Preparation of the summary calendar-year monitoring report continued, with recent effort focused on compilation of necessary data packages.

Compilation by W. Clay Hunter, U.S. Geological Survey, Yucca Mountain Project Branch.

# USGS Milestone Report

October 1, 2002 - April 30, 2003

Sorted by Baseline Date

Level: 3

Deliverable	Due Date	Expected Date	Completed Date
<b>PAGSC2040D</b> Training Cost Information Annual Update	12/19/2002	12/12/2002	12/12/2002

**USGS Milestone Report**  
**October 1, 2002 - April 30, 2003**  
Sorted by Baseline Date

**Level: 4**

<b>Deliverable</b>	<b>Due Date</b>	<b>Expected Date</b>	<b>Completed Date</b>
<b>PAGSW932M4</b> Supplemental Fracture Data to TDB/RPC	10/25/2002	11/1/2002	11/1/2002
<b>PAGSW258M4</b> Letter Report: 4th Qtr FY02	10/31/2002	10/31/2002	10/31/2002
<b>PAGSM930M4</b> USGS Dir. Approval of Map of S. Expansion Area	11/8/2002	5/16/2003	
<b>PAGSW930M4</b> Phase II Lithophysal Data to TDMS/RPC	11/15/2002	1/31/2003	1/31/2003
<b>PAGSW931M4</b> Phase I Lithophysal Data to TDB/RPC	11/15/2002	1/31/2003	1/31/2003
<b>PAGSM935M4</b> S. Expansion Area Data to TDMS/RPC	11/26/2002	5/30/2003	
<b>PAGSZ132M4</b> Interpretive Rpt on Opal Geochronology	12/13/2002	12/13/2002	12/13/2002
<b>PAGSZ651M4</b> Interpretive Rpt on Initial U-series Data	12/13/2002	12/13/2002	12/13/2002
<b>PAGSM920M4</b> Phase 3 Lithologies Data Pkg to TDMS/RPC	12/17/2002	2/18/2003	2/18/2003
<b>PAGSZ303M4</b> Final Report to Customer & TDMS	12/27/2002	6/11/2003	
<b>PAGSW530M4</b> Rock Mech (Direct Shear) Data to TDMS/RPC	1/10/2003	5/22/2003	
<b>PAGSW260M4</b> Letter Report: 1st Qtr FY03	1/31/2003	1/31/2003	1/31/2003
<b>PAGSM925M4</b> Phase 3 X-sections DP to TDMS/RPC	2/21/2003	5/29/2003	
<b>PAGSW22M4</b> Fault Infiltration/Tracer Exp Data Pkg--TDMS/RPC	2/28/2003	3/14/2003	3/14/2003
<b>PAGSW937M4</b> Spot & Rim Hydrologic Prop DP - TDMS/RPC	3/31/2003	4/30/2003	4/30/2003
<b>PAGSW262M4</b> Letter Report: 2nd Qtr FY03	4/30/2003	4/30/2003	4/30/2003

**USGS Milestone Report**  
**October 1, 2002 - April 30, 2003**  
Sorted by Baseline Date

**Level: 5**

<b>Deliverable</b>	<b>Due Date</b>	<b>Expected Date</b>	<b>Completed Date</b>
<b>PAGSM37EM5</b> Mtg Summary to TPO	10/31/2002	10/25/2002	10/25/2002
<b>PAGSM37FM5</b> Mtg Summary to TPO	11/29/2002	11/29/2002	11/29/2002
<b>PAGSM30AM5</b> Intro Chap Rpt Contribution to Rpt Editor	12/31/2002	12/20/2002	12/20/2002
<b>PAGSM32CM5</b> Intro Chapters Rpt Contribution to Rpt Editor	12/31/2002	12/20/2002	12/20/2002
<b>PAGSM32EM5</b> Mid-Year Progress HFM Discretization	12/31/2002	12/19/2002	12/19/2002
<b>PAGSM32GM5</b> Prg Rpt - Updates Based on Hydrgeo Parameteriztn	12/31/2002	12/19/2002	12/19/2002
<b>PAGSM34CM5</b> Intro Chapters Rpt Contribution to Rpt Editor	12/31/2002	12/20/2002	12/20/2002
<b>PAGSM373M5</b> Annotated Outline of Report to TPO	12/31/2002	12/18/2002	12/18/2002
<b>PAGSM37GM5</b> Mtg Summary to TPO	12/31/2002	12/20/2002	12/20/2002
<b>PAGSM32AM5</b> Progress HFM Updates - Transient Model	1/31/2003	1/31/2003	1/31/2003
<b>PAGSM37HM5</b> Mtg Summary to TPO	1/31/2003	2/7/2003	2/7/2003
<b>PAGSM30BM5</b> Update Hydrogeologic Data Integration Progress	2/28/2003	2/28/2003	2/28/2003
<b>PAGSM36AM5</b> Update on Predictive Capability Progress	2/28/2003	2/28/2003	2/28/2003
<b>PAGSM37AM5</b> Memo to TPO: Completion - Editing Intro Chapters	2/28/2003	2/28/2003	2/28/2003
<b>PAGSM37IM5</b> Mtg Summary to TPO	2/28/2003	2/28/2003	2/28/2003
<b>PAGSM32DM5</b> Report Contribution to Report Editor	3/31/2003	3/31/2003	3/31/2003
<b>PAGSM34AM5</b> Progress Report Flow Modeling	3/31/2003	3/31/2003	3/31/2003
<b>PAGSM37JM5</b> Mtg Summary to TPO	3/31/2003	3/31/2003	3/31/2003
<b>PAGSM202M5</b> Phase IV Lithostrat Data to USGS DMG	4/1/2003	8/14/2003	

**USGS Milestone Report**  
**October 1, 2002 - April 30, 2003**  
Sorted by Baseline Date

**Level: 5**

Deliverable		Due Date	Expected Date	Completed Date
<b>PAGSM434M5</b>	ATC Barometric Monitoring Data to DMU	4/1/2003	7/30/2003	
<b>PAGSM37KM5</b>	Mtg Summary to TPO	4/30/2003	4/30/2003	4/30/2003

# YMP PLANNING AND CONTROL SYSTEM (PACS)

## MONTHLY COST/FTE REPORT

Participant U.S. Geological Survey  
Date Prepared 5/12/2003 03:29 PM

Fiscal Month/Year April 30, 2003  
Page 1 of 1

### CURRENT MONTH END

### FISCAL YEAR

WBS ELEMENT	ACTUAL COSTS	PARTICIPANT HOURS	SUBCONTRACT HOURS	PURCHASE COMMITMENTS	SUBCONTRACT COMMITMENTS	ACCRUED COSTS	APPROVED BUDGET	APPROVED FUNDS	CUMMULATIVE COSTS
1.5.01.01	146	-1986	225	0	106	0	3444	0	1949
1.5.01.05	54	945	276	0	23	0	543	0	293
1.5.01.06	62	1736	825	0	182	0	748	0	356
1.5.01.07	83	629	4	0	0	0	579	0	272
1.5.01.09	314	2516	1297	0	189	0	2326	0	1205
1.5.03.03	150	3161	1646	0	376	0	2077	0	1173
1.5.03.04	121	2304	537	0	80	0	1975	0	810
1.5.03.07	76	529	248	0	27	0	1430	0	787
1.5.03.13	6	0	166	0	153	0	175	0	16
1.5.03.14	-1	143	0	0	33	0	150	0	46
	1011	9977	5224	0	1169	0	13447	0	6907

**U.S. GEOLOGICAL SURVEY**

**ESTIMATED COSTS FOR October 1, 2002 - April 30, 2003**

5/12/2003 3:29:01 PM

	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
4568-9U001 Science Advisors	41.0	37.7	36.8	42.2	42.0	46.8	39.6	0.0	0.0	0.0	0.0	0.0	286.04
4568-9U010 Publications	19.2	34.2	3.9	8.3	11.4	7.8	3.9	0.0	0.0	0.0	0.0	0.0	88.66
4568-9U040 Tectonics	21.5	10.3	1.7	4.6	6.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	47.40
4568-9U041 Water Levels	3.4	0.0	4.7	0.9	2.8	3.0	6.5	0.0	0.0	0.0	0.0	0.0	21.29
4568-9U042 Geophysics	0.0	0.4	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	5.73
4568-9U060 Mapping Expertise (USBR)	14.6	8.0	4.5	9.2	6.1	5.8	3.7	0.0	0.0	0.0	0.0	0.0	51.79
4568-9U081 Geochemistry	11.7	11.5	11.2	11.4	8.3	729.0	0.1	0.0	0.0	0.0	0.0	0.0	783.32
819Y01 USGS Technical Advisory Capability	111.4	102.2	62.8	76.6	76.6	795.7	59.0	0.0	0.0	0.0	0.0	0.0	1,284.23
4568-9U002 Br Chief, Asst Br Chief, Deputy TPO, Tea	38.5	63.0	53.9	68.1	91.7	91.2	44.2	0.0	0.0	0.0	0.0	0.0	450.57
819Y11 USGS Branch Management	38.5	63.0	53.9	68.1	91.7	91.2	44.2	0.0	0.0	0.0	0.0	0.0	450.57
4568-9U003 Planning & Project Control	27.4	23.4	32.8	33.1	24.0	31.1	42.5	0.0	0.0	0.0	0.0	0.0	214.28
819Y21 USGS Planning & Project Control	27.4	23.4	32.8	33.1	24.0	31.1	42.5	0.0	0.0	0.0	0.0	0.0	214.28
1.5.01.01 Project Support - Project Manageme	177.2	188.6	149.5	177.8	192.3	918.0	145.7	0.0	0.0	0.0	0.0	0.0	1,949.08
4568-9U030 Regulatory Compliance Support	40.8	40.4	30.3	44.8	35.8	47.1	53.6	0.0	0.0	0.0	0.0	0.0	292.70
819Y31 USGS Regulatory Compliance Support	40.8	40.4	30.3	44.8	35.8	47.1	53.6	0.0	0.0	0.0	0.0	0.0	292.70
1.5.01.05 Project Support - Compliance Manag	40.8	40.4	30.3	44.8	35.8	47.1	53.6	0.0	0.0	0.0	0.0	0.0	292.70
4568-9U024 Computer/Network Support	26.4	25.5	23.6	27.2	24.8	19.3	32.2	0.0	0.0	0.0	0.0	0.0	178.99
819Y15 USGS Commputer/Network Support	26.4	25.5	23.6	27.2	24.8	19.3	32.2	0.0	0.0	0.0	0.0	0.0	178.99
4568-9U025 Property Management	24.1	20.5	27.0	23.4	20.2	32.5	29.5	0.0	0.0	0.0	0.0	0.0	177.18
819Y16 USGS Property Management	24.1	20.5	27.0	23.4	20.2	32.5	29.5	0.0	0.0	0.0	0.0	0.0	177.18
1.5.01.06 Project Support - Information Manag	50.6	46.0	50.6	50.6	44.9	51.8	61.7	0.0	0.0	0.0	0.0	0.0	356.17
4568-9U061 Water Resources Monitoring	16.8	32.5	26.7	22.2	31.1	3.6	75.2	0.0	0.0	0.0	0.0	0.0	208.13
819Y41 USGS Water Resources Monitoring	16.8	32.5	26.7	22.2	31.1	3.6	75.2	0.0	0.0	0.0	0.0	0.0	208.13
4568-9U062 Safety	9.1	9.4	9.3	9.3	9.8	8.9	8.3	0.0	0.0	0.0	0.0	0.0	63.93
819Y51 USGS Safety	9.1	9.4	9.3	9.3	9.8	8.9	8.3	0.0	0.0	0.0	0.0	0.0	63.93
1.5.01.07 Project Support - Environmental, Saf	25.9	41.9	35.9	31.5	40.9	12.4	83.5	0.0	0.0	0.0	0.0	0.0	272.06
4568-9U011 Reports Specialists	18.0	18.5	18.5	20.1	17.4	17.3	18.3	0.0	0.0	0.0	0.0	0.0	128.00

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4568-9U012 Data Management	49.3	30.9	31.3	35.4	33.8	33.7	34.5	0.0	0.0	0.0	0.0	0.0	248.95
4568-9U013 Records Support	22.2	2.8	4.5	5.7	21.5	-9.1	6.1	0.0	0.0	0.0	0.0	0.0	53.59
4568-9U014 QAS Support	7.0	6.4	7.3	12.5	29.6	-21.7	6.4	0.0	0.0	0.0	0.0	0.0	47.63
819Y12 USGS Data, Records & Reports	96.5	58.6	61.6	73.6	102.3	20.1	65.4	0.0	0.0	0.0	0.0	0.0	478.17
4568-9U021 Administrative Support & Personnel Servi	33.2	34.8	34.1	67.5	26.0	75.8	15.0	0.0	0.0	0.0	0.0	0.0	286.48
4568-9U022 Facilities Management	0.0	0.0	0.2	10.8	43.0	55.2	218.1	0.0	0.0	0.0	0.0	0.0	327.37
819Y13 USGS Administration & Facilities	33.2	34.8	34.3	78.3	69.0	131.0	233.1	0.0	0.0	0.0	0.0	0.0	613.85
4568-9U023 Training	15.8	17.2	25.4	18.5	6.9	13.7	15.8	0.0	0.0	0.0	0.0	0.0	113.16
819Y14 USGS Training	15.8	17.2	25.4	18.5	6.9	13.7	15.8	0.0	0.0	0.0	0.0	0.0	113.16
1.5.01.09 Project Support - General Project Ser	145.5	110.6	121.2	170.5	178.2	164.8	314.4	0.0	0.0	0.0	0.0	0.0	1,205.17
1.5.01	440.0	427.6	387.5	475.1	492.0	1,194.1	658.8	0.0	0.0	0.0	0.0	0.0	4,075.19
4568-9U050 Alcove 7/X-Drift Instrument Strains	7.8	5.5	3.9	20.4	7.7	0.2	3.8	0.0	0.0	0.0	0.0	0.0	49.31
4568-9U063 Alcove 8/Niche 3 Infiltration	25.9	22.1	29.9	21.4	28.3	22.4	21.5	0.0	0.0	0.0	0.0	0.0	171.57
4568-9U064 Moisture Monitoring ESF & X-Drift	19.2	14.7	13.3	20.8	11.6	23.6	13.6	0.0	0.0	0.0	0.0	0.0	116.96
4568-9U065 Bulkhead Moisture Monitoring	8.2	7.7	21.4	17.6	14.9	32.4	-14.9	0.0	0.0	0.0	0.0	0.0	87.16
4568-9U066 Support to UZ In-Situ Processes AMR	7.3	7.7	2.6	5.0	-0.9	0.2	9.2	0.0	0.0	0.0	0.0	0.0	31.11
AUZG01 USGS UZ Moisture Studies	68.4	57.6	71.2	85.3	61.6	78.8	33.1	0.0	0.0	0.0	0.0	0.0	456.12
4568-9U085 U-Series Delineation of UZ Flow Zones	26.8	5.8	20.1	17.3	9.2	3.7	13.4	0.0	0.0	0.0	0.0	0.0	96.24
4568-9U086 Complete Chlorine 36 Validation	5.0	13.8	11.8	9.9	24.3	10.9	13.0	0.0	0.0	0.0	0.0	0.0	88.66
4568-9U087 Chemical & Isotopic Composition of Pore	30.4	38.0	52.2	32.4	25.3	23.6	36.4	0.0	0.0	0.0	0.0	0.0	238.22
4568-9U088 ECRB H2O, H2O Vapor & Gas Chemistry	0.0	4.6	1.6	0.3	5.2	26.8	9.2	0.0	0.0	0.0	0.0	0.0	47.72
4568-9U089 Microclimate Records in Fracture Mineral	13.9	17.0	13.3	16.6	20.1	41.8	28.2	0.0	0.0	0.0	0.0	0.0	150.71
AUZG02 USGS UZ Isotope Hydrology	75.9	79.2	99.0	76.6	83.9	106.8	100.2	0.0	0.0	0.0	0.0	0.0	621.56
4568-9U090 Isotope Support for Thermal Testing	7.9	12.9	18.7	29.0	-2.5	12.5	16.5	0.0	0.0	0.0	0.0	0.0	95.00
AUZG03 USGS Drift-Scale Test ESF	7.9	12.9	18.7	29.0	-2.5	12.5	16.5	0.0	0.0	0.0	0.0	0.0	95.00
1.5.03.03 Safety Analyses - Unsaturated Zone	152.2	149.7	188.9	190.9	143.1	198.1	149.8	0.0	0.0	0.0	0.0	0.0	1,172.68
4568-9U043 Hydrogeologic Data Integration	13.4	12.2	-2.6	4.0	3.5	114.0	-47.9	0.0	0.0	0.0	0.0	0.0	96.64
4568-9U044 3D Hydrogeologic Model Development	1.2	0.5	0.5	5.4	0.0	0.0	22.0	0.0	0.0	0.0	0.0	0.0	29.53



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4568-9U045 Flow Model Calibration and Evaluation	3.9	8.1	6.6	5.7	8.8	47.8	6.6	0.0	0.0	0.0	0.0	0.0	87.43
4568-9U046 DVRFS Knowledge Exchange Protocol	0.0	0.0	0.0	0.0	0.0	0.0	37.0	0.0	0.0	0.0	0.0	0.0	37.03
4568-9U047 DVRFS Predictive Capability	0.0	0.0	0.0	0.0	0.0	69.6	0.0	0.0	0.0	0.0	0.0	0.0	69.62
<b>819Y61</b> USGS Death Valley Regional Flow Mod	18.5	20.7	4.5	15.0	12.3	231.5	17.7	0.0	0.0	0.0	0.0	0.0	320.24
4568-9U048 Cross-hole Hydraulic & Tracer Testing AT	27.4	27.2	18.7	14.6	17.3	21.7	14.0	0.0	0.0	0.0	0.0	0.0	140.89
4568-9U049 Nye County EWDP Borehole Lithostratigr	12.3	10.2	1.1	17.9	10.0	10.6	16.0	0.0	0.0	0.0	0.0	0.0	78.27
4568-9U051 Deferred - Lithostratigraphic Support to N	0.0	0.0	18.6	4.2	-1.5	0.0	1.3	0.0	0.0	0.0	0.0	0.0	22.63
4568-9U052 Deferred - X-Hole Hydraulic & Tracer Tstg	0.0	0.0	14.6	7.1	13.0	8.8	8.7	0.0	0.0	0.0	0.0	0.0	52.26
4568-9U053 Deferred - Map Proposed Repository Exp	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	8.99
4568-9U072 Support to Proposed Surface Workover T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
<b>ASZG01</b> USGS SZ Investigations	39.8	37.5	53.1	43.7	38.8	41.1	49.0	0.0	0.0	0.0	0.0	0.0	303.04
4568-9U082 Isotopic/Hydrochemical Support to the AT	0.0	4.1	0.0	0.2	0.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	5.98
4568-9U083 Hydrochronology of the Yucca Mountain	0.0	0.0	0.0	0.0	11.8	-1.3	0.6	0.0	0.0	0.0	0.0	0.0	11.15
4568-9U084 Site-Scale Hydrochemistry	19.4	-0.1	15.8	15.0	6.3	13.5	47.1	0.0	0.0	0.0	0.0	0.0	117.08
4568-9U092 Isotope/Hydrochemical Support to Nye C	7.7	23.9	-1.4	6.4	17.1	-7.7	6.2	0.0	0.0	0.0	0.0	0.0	52.28
<b>ASZG02</b> USGS SZ Isotope Hydrology	27.1	28.0	14.4	21.6	35.4	6.1	53.9	0.0	0.0	0.0	0.0	0.0	186.50
<b>1.5.03.04</b> Safety Analyses - Saturated Zone Flo	85.4	86.3	72.0	80.3	86.5	278.7	120.7	0.0	0.0	0.0	0.0	0.0	809.78
4568-9U091 Geochem/Physical Characterization of E	2.1	2.8	1.8	3.8	1.5	38.4	4.1	0.0	0.0	0.0	0.0	0.0	54.63
<b>AEBG01</b> USGS Effects of Water-Rock Interactio	2.1	2.8	1.8	3.8	1.5	38.4	4.1	0.0	0.0	0.0	0.0	0.0	54.63
4568-9U067 Quantify Lithophysal Porosity - In Situ Te	8.1	7.5	5.4	8.2	-0.2	1.2	0.5	0.0	0.0	0.0	0.0	0.0	30.62
4568-9U070 Deferred - Core & Lithophysae Char Tstg	0.0	0.1	0.9	6.1	5.3	27.8	18.7	0.0	0.0	0.0	0.0	0.0	58.94
<b>AEBG02</b> USGS Nevada Operations Support to E	8.1	7.6	6.3	14.3	5.1	29.0	19.2	0.0	0.0	0.0	0.0	0.0	89.56
4568-9U068 Rock Mechanics Testing in the ECRB (U	91.5	53.5	28.2	46.4	35.2	6.1	7.7	0.0	0.0	0.0	0.0	0.0	268.64
4568-9U069 Fracture & Lithophysal Characteristics of	43.7	53.1	48.7	81.5	65.1	31.0	45.3	0.0	0.0	0.0	0.0	0.0	368.35
4568-9U071 Deferred - QAS & Checking Support USB	0.0	0.0	2.1	3.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.94
<b>AEBG03</b> USBR Testing Activities in Support of D	135.2	106.5	79.1	131.5	100.4	37.2	53.0	0.0	0.0	0.0	0.0	0.0	642.93
<b>1.5.03.07</b> Safety Analyses - EBS Performance	145.4	116.9	87.2	149.6	107.0	104.6	76.3	0.0	0.0	0.0	0.0	0.0	787.11
4568-9U015 USGS Data Verification	0.0	0.0	1.0	2.1	1.1	5.8	6.2	0.0	0.0	0.0	0.0	0.0	16.17

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DTAG01 USGS Data Verification	0.0	0.0	1.0	2.1	1.1	5.8	6.2	0.0	0.0	0.0	0.0	0.0	16.17
1.5.03.13 Safety Analyses - Technical Data Ma	0.0	0.0	1.0	2.1	1.1	5.8	6.2	0.0	0.0	0.0	0.0	0.0	16.17
4568-9U004 USGS Support to Site Description	7.3	8.0	17.8	1.1	14.0	-1.9	-0.7	0.0	0.0	0.0	0.0	0.0	45.68
4568-9U006 Support to LANL Ceslum Study	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
ANSG01 USGS Support to Site Description	7.3	8.0	17.8	1.1	14.0	-1.9	-0.7	0.0	0.0	0.0	0.0	0.0	45.68
1.5.03.14 Safety Analyses - Yucca Mountain Si	7.3	8.0	17.8	1.1	14.0	-1.9	-0.7	0.0	0.0	0.0	0.0	0.0	45.68
1.5.03	390.3	360.9	366.9	424.0	351.8	585.3	352.3	0.0	0.0	0.0	0.0	0.0	2,831.43
1.5	830.3	788.5	754.5	899.1	843.8	1,779.4	1,011.1	0.0	0.0	0.0	0.0	0.0	6,906.62
1.5 OPERATING	830.3	788.5	754.5	899.1	843.8	1,779.4	1,011.1	0.0	0.0	0.0	0.0	0.0	6,906.62
CAPITAL EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	830.3	788.5	754.5	899.1	843.8	1,779.4	1,011.1	0.0	0.0	0.0	0.0	0.0	6,906.62
FTEs													
FEDERAL	62.3	75.5	50.2	52.7	54.6	52.2	61.4	0.0	0.0	0.0	0.0	0.0	
CONTRACT	34.7	26.8	27.1	29.2	26.6	29.2	33.5	0.0	0.0	0.0	0.0	0.0	
TOTAL	97.0	102.4	77.3	81.9	81.2	81.5	94.8	0.0	0.0	0.0	0.0	0.0	