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

AUG 28 1996

OVERNIGHT MAIL

Michael J. Bell
Engineering and Geosciences Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission
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Rockville, MD 20852

SUBMITTAL OF PARTICIPANTS' MONTHLY STATUS REPORTS

As you have requested, the U.S. Nuclear Regulatory Commission is on distribution to receive a copy of the Yucca Mountain Site Characterization Project participants' monthly status reports on a regular basis. Enclosed is the U.S. Geological Survey Monthly Status Report for July, 1996.

If you have any questions, please call April V. Gil at (702) 794-5578.

For Robert W Barlow
Stephan J. Brocoum
Assistant Manager for
Suitability and Licensing

AMSL:AVG-2513

Enclosure: (NOT RECORD MATERIAL)
U.S. Geological Survey Monthly
Status Report for July, 1996

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IN REPLY REFER TO:

INFORMATION ONLY

August 13, 1996

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

SUBJECT: Yucca Mountain Project Branch - U.S. Geological Survey (YMPB-USGS) Progress Report, July, 1996

Attached is the USGS progress report in the required format for the month of July, 1996.

If you have any questions or need further information, please call Raye Ritchey Arnold at (303)236-0516, ext. 282.

Sincerely,

Raye Ritchey Arnold
for Robert W. Craig
Technical Project Officer
Yucca Mountain Project Branch
U.S. Geological Survey

Enclosure:

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U. S. GEOLOGICAL SURVEY

EXECUTIVE SUMMARY
July 1996

WBS 1.2.3.1 Coordination and Planning

U. S. Geological Survey - Yucca Mountain Project Branch is currently processing 191 scientific papers prepared by USGS authors. Of these, 63 are related to hydrologic studies and 128 to geologic studies. In addition, 48 abstracts by USGS authors are being processed, as well as 17 reports from LBL.

WBS 1.2.3.2 Geology

Geologic Framework

Personnel involved in site stratigraphic studies completed their reexamination of cores, cuttings and geophysical logs for a more precise delineation of ten principal lithostratigraphic contacts in boreholes G-2, GU-3, SD-7, SD-12, ONC#1, WT-2, WT-10, UZ-7a, and UA-14. Lithostratigraphic contacts were correlated with borehole geophysical logs, including calculated porosity and water-saturation profiles.

Stratigraphic contacts, fractures, and faults were examined in the ESF, including the Thermal Test Facility (Alcove 5) and the Upper Paintbrush Tuff Contact Alcove (Alcove 6). Studies of the aeromagnetic anomalies produced by the Topopah Spring Tuff suggest that such data offer a means for calculating attitudes of buried faults.

Efforts continued in the interpretation of the regional seismic reflection profile across Crater Flat and Yucca Mountain, and in the integration of the reflection data with the models being developed from gravity and magnetic surveys. Emphasis is on the resolution of seismic reflection horizons and fault geometry. Digital magnetic data sets were provided to LBL and such data were also prepared for submittal to the USGS technical data base, thus completing these work elements in the geophysical studies program. Additional funding was acquired for continued vertical seismic profiling in support of LBL's synthesis of shear-wave velocity data and for additional processing and imaging of central block structure and interpreting high-resolution seismic reflection data by LBL staff.

The 1:6000-scale geologic map of the central block of Yucca Mountain and accompanying text and cross sections are being reviewed and processed for eventual release as a USGS Open-File Report. The report contains detailed lithologic descriptions of the many units within the Timber Mountain and Paintbrush Groups being mapped, together with descriptions of all the main faults that transect the area and a synopsis of the structural development of the central block. The fault data provided valuable input to the synthesis report on the seismotectonic framework of Yucca Mountain (discussed below).

Project personnel discussed critical structural issues related to the development of the 3-D framework geologic model with the M&O modeling team, and began final interpretations of the ground-based geophysical data from the Midway Valley area to decipher the location of buried faults.

Geologic mapping of the ESF was accomplished as follows: (1) full periphery geologic mapping was completed to station 59+68; (2) detailed line survey was completed to station 59+68; and (3) stereophotography was completed to station 59+64.40.

Seismotectonic Studies

The synthesis report, "Seismotectonic framework and characterization of faulting at Yucca Mountain, Nevada", was completed on July 31. In addition to an introductory chapter that summarizes the history of seismotectonic studies in the Yucca Mountain area and the regulatory and design requirements and technical issues involved in site characterization, the report contains eleven chapters that discuss the results of the several major areas of investigation that were pursued to obtain essential information on tectonism and seismicity that may affect repository performance. Chapter headings are:

1. Geologic Setting of Yucca Mountain
2. Neogene Tectonic Evolution of Yucca Mountain
3. Quaternary Faults in the Yucca Mountain Region
4. Quaternary Paleoseismology and Stratigraphy of the Yucca Mountain Site area
5. Models of Earthquake Recurrence and Preliminary Paleoearthquake Magnitudes at Yucca Mountain
6. Geodesy and Contemporary Strain in the Yucca Mountain Region
7. Historical Seismicity in the Yucca Mountain Region
8. Synthesis of Tectonic Models for the Yucca Mountain Area
9. Fault Displacement Hazard: A Summary of Issues and Information
10. Estimation of Vibratory Ground Motion at Yucca Mountain
11. Relevant Earthquake Sources

Combined, the topics listed above lead to (1) identifying and characterizing faults, both at Yucca Mountain and in the surrounding areas, with emphasis on faults with demonstrable Quaternary activity; (2) determining the distribution and geochronology of Quaternary deposits; (3) calculating amounts, rates, and recurrence intervals of Quaternary fault displacements; (4) estimating earthquake magnitudes and recurrence rates at Yucca Mountain; (5) locating and characterizing relevant earthquake sources; and (6) developing tectonic models. These are all items of primary importance to comprehensive site characterization, and the results and interpretations provide critical data for probabilistic seismic hazard analysis.

WBS 1.2.3.3 Hydrology

Regional Hydrology

Processing of QA records for meteorological instrument calibrations was continued. Work on the preparation of the data package for submittal was continued. The data from the weather stations is in technical review. The data from the expanded network of tipping bucket precipitation gages was prepared and is being technically reviewed.

Data was collected from the tipping bucket precipitation network. Analysis of precipitation amounts and intensities measured using the tipping bucket network was continued.

Routine maintenance was made on the three streamflow-gaging stations located along Fortymile Wash. Project staff kept vigilance for potential precipitation and runoff associated with several storms that tracked through the southern Nevada area. Runoff was neither observed nor reported during the reporting period for the three gages or for the Yucca Mountain area.

Records for the continuous-recording streamflow gaging stations planned for publication were given final review by the Nevada District Data Section. Camera-ready copies of all surface-water and precipitation data tables have been prepared and are being transmitted to the Principal Investigator. The report on FY 1995 streamflow and precipitation data and the associated data records package are delayed because the Nevada District Data Section has just completed reviewing records for the continuous-recording streamflow gaging stations. Camera-ready copies of all surface-water and precipitation data tables have been prepared and are being transmitted to the Principal Investigator. The delays have resulted from reassignment of project personnel, electronic data processing problems, and backlogs associated with District staff review of the continuous and peak-discharge surface-water data. The completion dates for these activities have been rescheduled for the end of August, which should allow for sufficient time to check the tables, complete the text, prepare the data records package, and submit them for further USGS processing.

Because of operational delays in the drilling and rig support, USW G-2 tests were not completed on time. The report has not been drafted, but the draft milestone has been completed by notifying DOE of the test/report delay. Management discussions are under way concerning the future of the report.

Recovery data are still being collected from well USW G-2. Residual drawdown on July 29, 1996, 95 days following completion of the single-well pumping test, was 3.24 feet. Adjustments were made to the G-2 data files for the two June calibration checks when the transducer was moved from its set point.

A data package containing temperature log data collected in USW G-2 and another containing geophysical log data and computations were reviewed and submitted to the USGS Data Management Coordinator.

The water quality segment of the FY95 Fortymile Wash data package was submitted to the USGS Data Management Coordinator.

Project staff completed work on the delayed draft of the regional saturated-zone modeling report, and submitted the report for colleague review. Both reviewers agreed to begin work on the report immediately, and to complete the review as expeditiously as possible. The authors and all members of the modeling unit will make responses to colleague review comments and post-review revisions to the report their top priority. No delay in completion of the related Level 3 Milestone (3GRM600M) is anticipated.

Regional SZ modeling staff continued to work on software QA for 3 post-processor programs for MODFLOWP. The records package for the MODFLOWP Software QA documentation was submitted to the USGS Records Coordinator.

Members of the saturated-zone modeling unit met on July 11 with Ike Winograd (USGS, Reston, VA) and Alan Burns (USGS, Denver, CO) to discuss regional modeling results and conceptual models of the ground-water flow system of the Death Valley Region.

Unsaturated Zone

The completed infiltration-properties data packages and map were submitted to the Project Technical Database Administrator on July 25, 1996, completing milestone 3GUI600M. Milestones 3GUI240M and 3GUI241M were also completed by submittal of the U.S. Geological Survey Water-Resources Investigations Report entitled "Estimation of shallow infiltration and presence of potential fast pathways for shallow infiltration in the Yucca Mountain area, Nevada".

To support development of the stochastic infiltration flux map, annual rainfall distribution maps for a dry year (1989) and a wet year (1993) were developed into GIS coverages. These will be used to estimate shallow infiltration and develop GIS coverages of shallow infiltration with different rainfall scenarios.

Unsaturated-zone prototype holes at the HRF continued to be monitored on an on-going basis for the 57th month. Borehole data from these holes as well as NRG-7a, NRG-6, UZ#4, UZ#5, UZ-7a, and SD-12 were transferred to Denver, converted to engineering units, and archived to optical disk on a routine basis throughout the month. Daily EKES files were checked for any shelter activity. Sensor readings were checked daily as well for unusual occurrences, and any statistical outlyers were flagged as such. Staff supported the monitoring activity with numerous calibrations, systems repairs and adjustments, and maintenance/repair visits to the field sites.

The stemming plan for SD-7 was completed and reviewed for accuracy. A copy of the plan was forwarded to DOE for their review and approval on July 31, 1996, completing activity 3GUP631.

Fabricating the instrumentation for SD-7 is on hold pending approval of the stemming plan by DOE and assignment of a date to begin instrumentation of this borehole. Figures for UZ-7a have

been compiled for the borehole monitoring data report, and compilation of those for SD-12 will begin in early August.

The first draft of the report on borehole completion of USW UZ-14 was completed and submitted for data and technical reviews in June. Reviews are not yet finished. Expected completion date for reviews is August 31, 1996. Staff completed and submitted the final draft of the completion report for UZ-16. The data package and information for the technical data base also were submitted.

Spectral analyses of the UZ-7a and SD-12 pneumatic pressure data were completed in conjunction with the preparation of the pneumatic synthesis report, "Interpretation of Pneumatic and Chemical Data for the Unsaturated Zone, Yucca Mountain, Nevada."

The unusual responses from instrument station 'D', at NRG-7a, located in the PTn (base of the Yucca Mountain Tuff) at NRG-7a, continue to be observed. Since the last monthly status report, water potentials have been slowly recovering to their pre-disturbance state (i.e. pre-May 9, 1996). No correlation of the anomalous behavior of this instrument station with respect to construction activities in the ESF has yet been found. Instrument malfunction has been ruled out as a possible explanation. Data indicate that the disturbance must have originated and propagated from above the instrument station, via enhanced communication with the outside atmosphere. Apparently the disturbance has abated, at least temporarily. Data from this station will continue to be closely monitored to try to establish a cause for the unusual responses.

A draft outline for the report on the hydrology of the ESF main drift has been prepared and is currently being reviewed for compliance with the criteria statement for the associated milestone (3GUP665A). A second revised draft of the North Ramp Hydrology report, along with responses to the colleague review comments, were forwarded to the four reviewers of this report during the second week of July. Acceptance/rejection responses from two of the reviewers have been returned; two are still outstanding. Report is in the final stage of preparation for submittal to the USGS editorial review staff. A concurrent QA review will be conducted while this report is in editorial review.

A data package containing temperature log data collected in Exploratory Shaft Facility Alcoves in 1995 and 1996 was reviewed and submitted to the USGS Data Management Coordinator.

Staff forwarded 445 pneumatic data files on 24 microdiskettes to LBL during the third week of July. These files contained pneumatic pressure, dry-bulb temperature, thermistor temperature, and water potential data through July 15, 1996 for NRG-6, NRG-7a, UZ#4, UZ#5, SD-12, and SD-7, completing activity 3GUP665NM.

A draft report on UZ hydrogeologic units and matrix properties was completed and submitted for technical review. Prototype development for the preparation of a technical procedure to operate the ultracentrifuge continues. A proposal was completed to evaluate thermal effects on unsaturated hydraulic conductivity. Samples are being tested on the high pressure permeameter to finalize the technical procedure.

In the Bow Ridge Fault Alcove, the USGS field staff continued cross-hole pneumatic and tracer testing in the Bow Ridge Fault and Tiva Canyon lower lithophysal zone. The boreholes are horizontal, parallel, 3 meters apart, and both penetrate the Bow Ridge Fault at a depth of approximately 51 feet. The cross-hole tests indicate fault breccia permeability values of 20 darcies. This agrees with the single-hole pneumatic test results of 10 darcies. The cross-hole pneumatic tests also indicate fault breccia porosity values of 29%. Tracer tests between the boreholes had travel time that vary from 30 to 90 minutes.

The boreholes for testing in the Upper and Lower Paintbrush Nonwelded Contact Alcoves have been sealed off from the alcoves and are not scheduled for additional testing until FY 1997. All instruments requiring calibration (pressure transducers, thermistors, mass flow controllers, power supplies, and data loggers) used in alcoves 2 and 3 have been sent for close-out calibrations.

Interpretation of the occurrence of perched water and the magnitude of perched water bodies continues. Perched water chemistry data are currently being synthesized for inclusion in the milestone memo to the TPO due later in FY 96. The report on results of perched water testing is currently undergoing colleague review.

In support of the ESF Moisture Dryout study, calibration of the heat dissipation probes is being continued. Field data loggers in the main tunnel and alcoves have been checked and downloaded. Data are being compiled and submitted to LBL for incorporation into an analysis report.

In preparation for the section on gas circulation and pneumatic pathways in the UZ synthesis report, detailed frequency analyses are being conducted on pressure data from several boreholes in order to determine the phase lag and amplitude of barometric pressure induced changes, both before and after the effects of the ESF were noticed. These analyses have quantified some of the ESF effects that have been identified only through graphical comparison. Comparative analysis of pneumatic data from NRG-6, NRG-5, NRG-7a, SD-9 SD-7, UZ-7a, and SD-12 is ongoing to chart the effects of the TBM as it moves along the Ghost Dance Fault. A small-scale 3-dimensional model of the North Ramp and part of the Main Drift is being refined to analyze the horizontal permeability of the rocks affected by the ESF excavation. The model simulates the progress of the TBM by applying barometric stresses at the ESF horizon and will be calibrated against both pressure changes within each geologic unit and the time at which the borehole first began to be affected by the ESF. Pneumatic diffusivity modeling is being conducted on data from borehole SD-7 and UZ-7a for inclusion in the milestone Gas Phase Circulation report. The completion of this report has been delayed to allow for further analysis of important data being collected from borehole SD-7, and to allow for further development of a model being constructed to assess the horizontal permeability of zones affected by TBM excavation.

Gas sample collection from fifteen stations was completed at SD-12. CO2, CH4 and SF6 concentrations were measured with the gas chromatograph on-site. C-13/C-12 gas samples were collected in mylar balloons and C-14 gas samples were collected on molecular sieves in stainless steel cylinders. The C-13/C-12 gas samples were transported to the USGS Denver laboratory for

analysis. The C-14 gas samples were transported to Denver where the molecular sieves will be degassed.

Ten UZ water samples (2 NRG-6, 2 NRG-7A, 3 SD-12, and 3 ESF) were prepared for tritium analysis, and twenty UZ water samples (2 NRG-6, 2 NRG-7A, 11 SD-12, and 5 ESF) have been counted for tritium concentration and the data reduced. Three SD-12, two SD-7, one SD-9, and two NRG-7A core samples were distilled for tritium and deuterium and oxygen-18 analyses, and nine SD-9 core samples were compressed for chemical composition and C-14 analyses.

The analysis paper entitled "Preliminary 3-Dimensional Discrete Fracture Model, Tiva Canyon Tuff, Yucca Mountain Area, Nye County, Nevada", by Lawrence O. Anna, (3GUF105M) has been completed and transmitted to YMPO.

Preliminary three-dimensional discrete fracture networks of the upper part of the Topopah Spring Tuff have been successfully simulated. Fracture orientation and spacing were "bootstrapped" directly from ESF fracture mapping. Twenty realizations were run (Monte Carlo simulations) for each of 4 different scaled cubes, at 50 m, 100 m, 150 m, 200 m on a side. Mapped intensities were matched with simulated intensities. Conductive intensities have been calculated from air-permeability data. The model will include stratigraphic units from the top of the Topopah Spring to the bottom of the middle non-lithophysal unit (tptpmn). Network and pathway analysis are nearly complete. Some preliminary flow simulations have begun.

The preliminary outline for the report on the Topopah Spring Tuff model has been completed and submitted as a Level 4 milestone to the USGS TPO. Preparation of the report itself has been initiated in parallel with the model development in order to minimize the delay resulting principally from the unanticipated large amount of data from the ESF.

A letter that includes tables of limited simulated outcome of the number of fracture connections, connection probabilities, directional permeability and permeability tensor calculations has been submitted to LBL.

The USGS and LBL authors (E. Kwicklis, G.S. Bodvarsson and A. Flint) of the report on the conceptual model of UZ hydrologic system met in Berkeley on July 17-19 to discuss topics central to the report. The authors reached a consensus on several issues, including (1) likely entry points of water from the unsaturated zone to the saturated zone, (2) uses and limitations of chloride accumulation data for estimating percolation flux, (3) use of temperature data for estimating percolation flux, (4) relative importance of vapor diffusion under ambient conditions, and (5) the possible lack of correspondence between "high-flux" areas and areas where environmental isotopes with "post-bomb" concentrations have been found. The conclusions of this meeting were recorded in a meeting summary sent to the participants. The draft report has not been completed due to the principal author's unanticipated involvement in the North Ramp Hydrogeology Report and in preparing a presentation to the NWTRB (July 9-10, Denver) on the findings of this report.

Analysis of the pneumatic pressure data collected from the upper 9 monitoring stations at borehole UZ#1 was completed. This analysis resulted in estimates of effective permeability to air in the stratigraphic intervals bounded by the monitoring stations. All intervals were estimated to have effective permeabilities to air greater than 10^{-12} m^2, except for the intervals defined by stations 5 and 6, which included the Tptrv2, Tptrv3, Tpbt2 and lowermost Tpp units (3.8×10^{-14} m^2), and the interval defined by stations 6 and 7, which included the Tptrv2, Tptrv1 and Tptrn units (9.0×10^{-14} m^2). The low effective permeability to air of the interval defined by stations 5 and 6 may have resulted from high water saturations rather than a small intrinsic permeability, because the drained porosity which provided the best fit of the model to the data was only 0.01.

Saturated Zone

The main part of the 3GWF650M (January - June 1996) data milestone submittal will be for data from a short pump test in the Lower-Bullfrog / Tram in January that will be analyzed as an aquifer test, and from the February-March combined hydraulic/tracer test in the same unit. The latter test was a convergent, conservative tracer test using iodide (in the form of NaI) as tracer, with UE-25 c#3 as the pumping well and UE-25 c#2 as the injection well.

During July, several sections of the draft letter report on the results of the hydraulic and conservative tracer tests at the C-wells were written, including introductory material on the February-March tests in Bullfrog/Tram interval and details of the equipment used during the tests. The data package consolidating all the January-June data from the raw-data files collected by the Labview data-acquisition program, and from sample concentrations digital files obtained from UNLV, was finalized and prepared to be submitted for review.

The c-holes conservative tracer testing program of the USGS has been suspended temporarily while LANL conducts reactive tracer tests in the Lower-Bullfrog interval. The LANL NaI two-well partial-recirculation test, with UE-25 c#1 as the injection well and UE-25 c#3 as the pumping well, has not been successful, indicating that such a test with the reactive tracers lithium bromide and microspheres would not be successful either. Therefore, a request has been submitted to the State of Nevada for the use of lithium bromide and microspheres in a two-well partial-recirculation test, with UE-25 c#2 as the injection well and UE-25 c#3 as the pumping well, because tracer connectivity has already been established between UE-25c #3 and UE-25c #2. This test was planned to start on July 17, but the State of Nevada has not acted on the request yet. Further delays in the State's action on the request may develop because the use of liquid tracers at the C-hole complex and gaseous tracers in the ESF are governed by the same permit.

A letter report was prepared and submitted to the USGS-YMPB TPO on July 31 to meet the level-4 milestone, 3GWF733M, Process FY 1995 tests at the C-well complex.

The 1996 routine water-level data network includes 28 zones in 22 wells to be measured manually on a quarterly schedule (manual measurements) and 3 zones in 2 wells to be measured hourly (transducer measurements). During July, 27 manual measurements were completed, and 8 zones in 6 wells were monitored hourly with transducer measurements. The hourly monitoring

included: wells UE-25p #1 and USW H-5 upper and lower zones, the two wells and 3 zones of the 1996 network; well USW G-2, which has been monitored since January 1996 in support of hydraulic testing of the well; wells UE-25 WT #3, UE-25 WT #14, and USW H-4 upper and lower zones, which were instrumented during May 1996 in support of the testing at the C-hole complex. Continuous analog data were collected from two zones in one well (USW H-5 upper and lower zones) in order to monitor water-level responses to seismic events.

The 1995 hourly data have been reviewed and will be included in the 1985 - 1995 water-level synthesis report and in the 1995 water-level data report.

A modification to HP-60, R4, "Method for Monitoring Water Level Changes Using Pressure Transducers and Pressure Transmitters," was reviewed and processed. The change eliminates the option of documenting transducer failures in ways other than writing a Nonconformance Report.

Work has continued on calibration of the site saturated-zone flow model, using simplified boundaries and hydraulic properties (without the parameter-estimation module). Recharge and discharge areas have been added to the model. Questions remain as to model run times using the original large model area and using the parameter-estimation module. However, significant progress has been made in speeding up model-run times. Some time has been spent in getting visualization software, obtained from LANL, running on USGS computers. Staff worked on revising the software QA documentation for the parameter-estimation software (PEST).

The report on the preliminary site flow model could not be completed because of delays in obtaining the grid necessary to run the model. A considerable amount of work is completed on the report, and once the preliminary simulations are done, those parts of the report can be written. Completion of a draft of the letter report to submit for review (Level 4 Milestone 3GWM610M) has been made a top priority for the Site SZ Modeling group, so that this milestone and activity can be completed early in August. No delay in the Level 3 Milestone, 3GWM611M, is anticipated. That milestone will meet all required criteria, but will be in the form of a letter report to DOE rather than a USGS-series report.

WBS 1.2.3.6 Climatology and Paleohydrology

Data on modern diatoms from Oregon and British Columbia reveal that the major freshwater diatom assemblage in the Owens Lake records is characteristic of lakes that are located at latitudes at least 6 degrees farther north than the present site of Owens Lake. Some of the diatoms living in Owens Lake during past glacial times now live in areas with two to three times the mean annual precipitation and about 1,000 m higher in elevation (as compared to present-day Owens Lake). Diatom counts from the most complete Owens Lake cores are providing a stratigraphically complete record back to 500 ka. Unique assemblages in overlapping parts of all cores provide unambiguous correlations between cores.

Diatoms, ostracodes, and samples for water chemical analyses (major ions and isotopes) are being collected from springs, rivers, lakes, and reservoirs in the Owens Lake Basin to provide

analog data that help to interpret the paleoclimate records for both Owens Lake and the Lathrop Wells deposits.

A draft of the Paleoclimate Synthesis Report is nearing completion.

U-series analyses of 7 samples of boulder rinds from surficial unit 4f, which represents an intermediate stage of incision of Fortymile Wash between the time of initial downcutting and the present, show that the innermost rinds span a narrow age range from 21 to 31 ka. All samples have elevated initial $^{234}U/^{238}U$ rations relative to all other alluvial and colluvial samples outside of the incised Fortymile Wash channel. These ages correspond to a time when paleodischarge sites were active, indicating increased effective moisture availability throughout the region.

Initial uranium and thorium analyses of samples from trenches CFF-T1a, CFF-T2a, and RV-T3 are encouraging with respect to data quality, consistency of resulting ages, and uniformity of initial ratios. The resulting data underscore the viability of the present method of microsampling the silica-rich inner rind layers for dating the times of deposition.

A determination of whether the last event recorded by secondary mineral occurrences within the Yucca Mountain tuffs was precipitation or dissolution of calcite or opal is important for interpreting the ages of the latest mineral surfaces. To address this question, calcite surfaces were experimentally corroded by prolonged ultrasonic attack in deionized water. These experiments produced extreme corrosion, and studies are currently being conducted with the use of the scanning electron microscope to determine the effect of corrosion and the textures that might result from the calcite being corroded by unsaturated-zone water.

Deionized water leaches of four samples of cuttings from borehole UZ-14 were analyzed for strontium isotope compositions; the resulting isotopic ratios are very close to the values obtained on perched water from UZ-14. Additional samples are being prepared in the effort to isotopically characterize pore water in the unsaturated zone and to compare it with fracture water.

Raw data from line surveys between stations 22 and 30 in the ESF were compiled and converted to estimates of the abundance of calcite and opal in fractures and lithophysal cavities. The results clearly display the heterogeneous occurrence of these secondary minerals. One sample (at station 26+88) provides the youngest U-series age yet obtained: 28.3 ka with an initial ratio $^{234}U/^{238}U$ ratio of 6.4. This and other samples collected from outermost growth surfaces in areas where bomb-pulse Cl-36 values have been obtained are normal in both ages (28 to 380 ka) and initial U rations (typically between 4 and 9). Younger ages with low initial ratios (1.4 to 1.8) would have been expected had the calcite and opal been deposited from waters moving downward along fast pathways.

WBS 1.2.13.4.7 Water-Resources Monitoring

Staff measured ground-water levels at 27 sites and measured discharge at one flowing well. Staff also checked and filed ground-water data collected during June. Water-level data were not

collected at site MV-1 because the well does not have an access tube to allow water-level measurements. Water levels will be obtained at that location only when project staff are notified that the pump installed in the well has been removed. Site CF-1 has been eliminated from the monitoring network. An obstruction, which has prevented access to the water surface since March 1996, resulted from a new owner's testing of the pump in the well. No data could be collected at site CF-1 this month, and no future water-level measurements will be made by USGS unless the obstruction in the well is removed. Monitoring may resume in the area following drilling and completion of an observation well; the new owners intend to construct the observation well downgradient from planned withdrawals to support mining operations.

Monthly measurements of water levels in wells CF-2 (VH-1), J-13, J-12, JF-1 (WT-15), JF-2 (WT-13), and J-11 are planned by USGS-SCP personnel during the remainder of FY96. Measurements by EMP personnel at sites CF-2 and J-12 provided supplemental data at those locations during July. Supplemental monitoring of water levels at sites J-13, JF-1 (WT-15), JF-2 (WT-13), and J-11 by EMP personnel will occur following preparation of a draft report on data collected and compiled for calendar year 1995 and testing and calibration of recently obtained equipment.

USGS Nevada District participation in SAIC's planned radiological-monitoring program was discussed with DOE and SAIC personnel. Discussions also addressed changes in criteria for milestone completion.

After resolving comments associated with YMP data reviews, staff began preparation of the data-records package for the summary monitoring report through CY95 for submittal to the USGS Records Coordinator. The draft base map was forwarded to USGS-Nevada District reports section on July 2, and staff began preparation of the draft report.

In support of the FY 1996 third-quarter monitoring report, periodic measurements and information on pressure-sensor calibrations were obtained from site-characterization personnel. Data on ground-water levels were compiled for 7 sites, and staff reviewed data on ground-water levels and discharge collected and compiled for monitoring sites during April through June, 1996. Staff prepared and delivered courtesy copies of the report to DOE and SAIC on July 26.

USGS Level 3 Milestone Report

October 1, 1995 - July 31, 1996

Sorted by Baseline Date

Deliverable	Due Date	Expected Date	Completed Date	Comments
SYNTHESIS OF HYDROGEOLOGIC UNIT/MATRIX PROPERTIE Milestone Number: 3GUP603M	5/30/96	9/10/96		
SURFICIAL DEPOSITS MAP SHEETS 14-17, 23-24 29-30 Milestone Number: 3GCH201M	6/28/96	8/30/96		
LETTER REPORT Milestone Number: 3GWR626M	7/30/96	7/30/96	7/30/96	
Compl Seismotectonic Synthesis Report Milestone Number: 3GSH100M	8/1/96	8/1/96		
MOD FLOW IN UNSAT FRAC NET TOPOPAH SPRG UNIT ES Milestone Number: 3GUF604M	8/16/96	9/30/96		
SYSTHESIS GAS PHASE CIRCULATION IN THE ESF Milestone Number: 3GGP605M	8/28/96	9/27/96		
Characteristics of Fractures at Yucca Mtn, NV Milestone Number: 3GGF205M	8/30/96	8/30/96		
LETR RPT: REGIONAL GROUND-WATER FLOW MODELING Milestone Number: 3GRM600M	8/30/96	8/30/96		
SYSTHSIS OF UNSAT ZONE INFILTRATION YUCCA MTN AR Milestone Number: 3GUI623M	8/30/96	8/30/96		

Deliverable	Due Date	Expected Date	Completed Date	Comments
GEOLOGIC MAP OF YUCCA MOUNTAIN, NEVADA Milestone Number: 3GGF204M	8/30/96	8/30/96		
SYNTHESIS INTERMED UNSAT-ZONE HYDRCHEMSTRY AT YM Milestone Number: 3GUH607M	8/30/96	10/31/96		
TR: RSLTS HYDRA/CONSERVATIVE TRACER TST C-WELLS Milestone Number: 3GWF660M	8/30/96	8/30/96		
RELIMIN SITE SATURATED-ZONE GRND-WTR FLOW MOD Milestone Number: 3GWM611M	8/30/96	8/30/96		
YNTH QUAT RSP YM UNSAT & SAT HYDROL CLMT CHNG Milestone Number: 3GCA102M	8/30/96	8/30/96		
YNTHESIS OF SELECTED PALEODISCHARGE SITES Milestone Number: 3GQH671M	8/30/96	8/30/96		
PT: RESULTS OF AGE SAMPLING DETERMAINATION Milestone Number: 3GQH450M	8/30/96	9/30/96		
TR RPT: AIR PERMEABILITY & HYDROCHEMISTY IN ESF Milestone Number: 3GUS619M	8/30/96	8/30/96		

USGS Level 4 Milestone Report

October 1, 1995 - July 31, 1996

Sorted by Baseline Date

Deliverable	Due Date	Expected Date	Completed Date	Comments
REVIEW DRAFT: IN-SITU MONITORING DATA PACKAGE Milestone Number: 3GUP661M	2/28/96	8/30/96		
REVIEW DRAFT: HYDROGEOLOGIC UNITS & MATRIX PROP Milestone Number: 3GUP602M	2/29/96	7/29/96	7/29/96	
DATA TO TDB/CRF:IN-SITU Bh MONITORING, 9/95-2/96 Milestone Number: 3GUP660M	3/28/96	9/30/96		
DATA TO CRF: FY95 FORTYMILE WASH Milestone Number: 3GRG624M	3/29/96	8/16/96		
LTR RPT: SYSTHESIS OF TECTONICS MDLS FOR YM AREA Milestone Number: 3GTE610M	3/29/96	8/30/96		
ADMIN RPT: AIR-K TESTING IN SB Bh THRU FY95 Milestone Number: 3GUP610M	3/29/96	8/30/96		
MEMO: SUMM OF FY1995 DATA Milestone Number: 3GWH608M	3/29/96	8/30/96		
ADMIN RPT: DEATH VALLEY HYDROCHEMISTRY Milestone Number: 3GWH609M	3/29/96	8/30/96		
Compl Report: Surf Faulting in Basin/Range Milestone Number: 3GSS105M	4/29/96	8/1/96		
REVIEW DRAFT: CONCEPTUAL MODEL OF UZ HYDRO SYS Milestone Number: 3GUM603M	4/30/96	8/30/96		
REVIEW DRAFT:GAS PHASE CIRCULATION IN VIC OF ESF Milestone Number: 3GGP604M	5/1/96	8/9/96		
ADMIN REPORT: NORTH RAMP HYDROLOGY Milestone Number: 3GUP667M	5/13/96	8/30/96		

·liverable	Due Date	Expected Date	Completed Date	Comments
\TA TO CRF: FY95 SITE METEOROLOGY ilestone Number: 3GMM600M	5/31/96	8/30/96		
:VIEW DRAFT: REGIONAL GROUND WATER FLOW ilestone Number: 3GRM601M	5/31/96	7/22/96	7/22/96	
)MIN RPT: STREAMFLOW & PRECIPITATION DATA, FY95 ilestone Number: 3GRS600M	5/31/96	8/30/96		
\TA TO CRF: FY95 STREAMFLOW DATA ilestone Number: 3GRS602M	5/31/96	8/30/96		
:VIEW DRAFT: PRELIM SITE SZ 3-D GW FLOW MODEL ilestone Number: 3GWM610M	5/31/96	8/16/96		
:VIEW DRAFT: PALEOCLIMATE SYNTHESIS REPORT ilestone Number: 3GCA101M	6/28/96	8/16/96		
:V DRAFT:MDLNG FLOW UZ FRAC NTWRKS TSw UNIT ESF ilestone Number: 3GUF603M	6/28/96	8/30/96		
/W DRAFT: INTERMEDIATE UZ HYDROCHEMISTRY AT YM ilestone Number: 3GUH606M	6/28/96	8/30/96		
STRUMENTATION PLAN FOR BOREHOLE USW SD-7 ilestone Number: 3GUP631M	6/28/96	7/30/96	7/30/96	
ınsmittal of Results TSw Fract Model to LBL ilestone Number: 3GUF604NM	7/30/96	7/29/96	7/29/96	
)vide UZ Pneumatic Data fm Boreholes to LBL ilestone Number: 3GUP665NM	7/30/96	7/30/96	7/30/96	
\TA TO TDB/CRF: PRELIM. SURF PROPERTIES MAP ilestone Number: 3GUI600M	7/31/96	7/25/96	7/25/96	
:MO TO TPO: CONCEPTUAL MODEL OF UZ HYDRO SYSTEM ilestone Number: 3GUM612M	7/31/96	9/12/96		
EMO: TESTS RESULTS THROUGH DEC 1995 ilestone Number: 3GWF733M	7/31/96	7/30/96	7/30/96	

Deliverable	Due Date	Expected Date	Completed Date	Comments
LETTER REPORT: PNEUMATIC DATA FROM SD-7 **Milestone Number:** 3GUP671M	8/1/96	8/15/96		
DATA TO CRF: ESF MAPS AND DATA **Milestone Number:** 3GGF600M	8/15/96	8/15/96		
LTR DESCRIBING HYDRAULIC PROP WT-SERIES WELLS **Milestone Number:** 3GWF625M	8/29/96	8/29/96		
LTR RPT: PALEO HYDR/CLIM SIGNIF OF SURF DEPOSITS **Milestone Number:** 3GCH103M	8/30/96	8/30/96		
LETTER REPORT: USW G-2 **Milestone Number:** 3GRG604M	8/30/96	9/30/96		
Compl Rpt: Charact Fault Displ for PSHA **Milestone Number:** 3GSS100M	8/30/96	8/1/96		
REVIEW DRAFT: IN-SITU MONITORING DATA PACKAGE **Milestone Number:** 3GUP662M	8/30/96	8/30/96		
MEMO TO TPO: RSLTS OF PERCHED-WATER TESTING **Milestone Number:** 3GUS600M	8/30/96	8/30/96		

Yucca Mountain Project
Variance Analysis Report

Entered on: 08/13/96 07:40 AM **Entered by:** Raye Arnold
WBS: 1.2.3.1.2
WBS Title: Participant Management and Integration
AM: JONES S. **OM:** STATTON T.
Subject: Cost/Schedule Variance Analysis

YMP Participant: USGS
Submitted by: Raye Arnold
Reporting Period: 07/96

Data:

Cumulative Cost Variance: ($-99K / -13.9%)
Cause:
The negative cost variance is due largely to the budget and funding being at below the minimum level to manage the USGS site program. Initial budgets indicated that a potential overrun of $426K was possible. This account was not funded at level adequate even for basic staffing requirements, leaving no funding for supplies & materials, office machine maintenance, secretarial support, publications, vehicle support, etc.

Impact:
There is a projected cost overrun in this P&S account of approximately $116K at this time. Cost underruns have been identified in P&S account 0G33131 to help offset this cost overrun.

Corrective Action:
All unbudgeted costs to this P&S account require TPO approval. Account is being closely monitored to minimize overruns. Staff time is being rebudgeted and charged to other WBS elements, as appropriate.

Cumulative Schedule Variance: ($0K / 0%)
Variances are within tolerance.

Variance at Complete: ($-116K / -13.6%)
See "Cumulative Cost Variance"

Approved:
- ○ No
- ○ Tech. Mgr
- ● TPO
- ○ Yes

Yucca Mountain Project
Variance Analysis Report

Entered on: 08/14/96 09:38 AM **Entered by:** Raye Arnold
WBS: 1.2.3.2.8.3.6
WBS Title: Probabilistic Seismic Hazards Analyses
AM: JONES S. **OM:** STATTON T.
Subject: Cost/Schedule Variance Analysis

YMP Participant: USGS
Submitted by: Raye Arnold
Reporting Period: 07/96

Data:

Cumulative Cost Variance: ($-22K / -17.6%)
Variances are within tolerance.

Cumulative Schedule Variance: ($0K / 0%)
Variances are within tolerance.

Variance at Complete: ($-73K / -23.3%)
Cause:
The negative variance at complete is due to the need to hire additional staff in order to complete the seismotectonic synthesis report level 3 milestone.

Impact:
There will be a cost overrun in P&S account; however, there are adequate projected cost underruns within the USGS 1.2.3 WBS element to offset these cost overruns. There will be no schedule variance; the milestone was completed by the due date of August 1, 1996.

Corrective Action:
Ensure adequate cost underruns within the third level WBS to cover this cost overrun.

Approved:
- ○ No
- ○ Tech. Mgr
- ● TPO
- ○ Yes

Yucca Mountain Project
Variance Analysis Report

Entered on: 08/14/96 09:37 AM **Entered by:** Raye Arnold
WBS: 1.2.3.2.8.4.6
WBS Title: Quaternary Faulting within the Site Area
AM: JONES S. **OM:** STATTON T.
Subject: Cost/Schedule Variance Analysis

YMP Participant: USGS
Submitted by: Raye Arnold
Reporting Period: 07/96

Data:

Cumulative Cost Variance: ($-26K / -10.7%)
Variances are within tolerance.

Cumulative Schedule Variance: ($0K / 0%)
Variances are within tolerance.

Variance at Complete: ($-70K / -23.3%)
Cause:
This negative variance at complete is projected due to significantly more field work was required than had been planned or funded this fiscal year. Additionally, $15K from this account was transferred to USBR to complete an FY1995 milestone report, 3GTQ530M, which was submitted on July 22, 1996. This was not part of the planned budget.

Impact:
There will be a cost overrun in P&S account; however, there are adequate projected cost underruns within the USGS 1.2.3 WBS element to offset these cost overruns.

Corrective Action:
Ensure adequate cost underruns within the third level WBS to cover this cost overrun.

Approved:
- ○ No
- ○ Tech. Mgr
- ● TPO
- ○ Yes

Yucca Mountain Project
Variance Analysis Report

Entered on: 08/13/96 07:50 AM **Entered by:** Raye Arnold
WBS: 1.2.3.3.1.3.1
WBS Title: Site Saturated Zone Ground-Water Flow System
AM: JONES S. **OM:** STATTON T.
Subject: Cost/Schedule Variance Analysis

YMP Participant: USGS
Submitted by: Raye Arnold
Reporting Period: 07/96

Data:

Cumulative Cost Variance: ($108K / 11.4%)
Cause:
This positive cost variance is due primarily to the cleanout of WT-12 requiring less time and resources than was budgeted for the effort.

Impact:
There is no schedule impact to this cost variance. Work was completed with less time and resources than budgeted. There is a projected cost underrun in this P&S account of approximately $64K at this time. These funds have been identified to help offset the projected overrun in P&S account OG312.

Corrective Action:
No corrective action required. Projected underrun will be used to help offset projected overrun.

Cumulative Schedule Variance: ($3K / 0.3%)
Variances are within tolerance.

Variance at Complete: ($64K / 5.6%)
Variances are within tolerance.

Approved:
- ○ No
- ○ Tech. Mgr
- ● TPO
- ○ Yes

Yucca Mountain Project
Variance Analysis Report

Entered on: 08/13/96 07:54 AM **Entered by:** Raye Arnold
WBS: 1.2.3.6.2.2.1
WBS Title: Quaternary Regional Hydrology
AM: JONES S. **OM:** STATTON T.
Subject: Cost/Schedule Variance Analysis

YMP Participant: USGS
Submitted by: Raye Arnold
Reporting Period: 07/96

Data:

Cumulative Cost Variance: ($120K / 12.5%)
Cause:
This positive cost variances results from new, unplanned work being added to the scope of this P&S account. Time-phasing of other budgets within this P&S account was not adjusted resulting in an artificially high spend rate in the earlier months of the fiscal year. This results in an apparent, but not real, underrun condition. Further, invoices which have been received from DRI for costs incurred are in dispute and therefore, not paid or costed. Also, expenditures for laboratory analysis are planned to be very high in the fourth quarter of the fiscal year. There is also an unplanned vacancy resulting from the departure of a subcontract employee.

Impact:
There is some expected underrun in this account (approximately 47K at this time). It is not likely that the unplanned vacancy will be filled this fiscal year.

Corrective Action:
Contact DRI to resolve invoicing problems.

Cumulative Schedule Variance: ($2K / 0.2%)
Variances are within tolerance.

Variance at Complete: ($47K / 4.3%)
Variances are within tolerance.

Approved:
- ○ No
- ○ Tech. Mgr
- ● TPO
- ○ Yes

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

Inc. Dollars in Thousands

WBS No. - 1.2

WBS Title - Yucca Mountain Project

Parent WBS No. - 1.0

Parent WBS Title - Mined Geologic Disposal System

Element ID - 12

Statement of Work:

See the current WBS Dictionary

Cost/Schedule Performance

		Current Period					FY1996 Cumulative to Date					FY1996 at Completion		
Id	Description	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	CV	BAC	EAC	VAC
1.2.3	Site Investigations	1094	1053	1117	-41	-64	10343	10238	9816	-105	422	12394	12508	-114
1.2.5	Regulatory	32	32	41	0	-9	307	307	260	0	47	365	363	2
1.2.8	Environment, Safety, and H	42	42	50	0	-8	431	432	411	1	21	515	515	0
1.2.9	Project Management	56	56	89	0	-33	554	554	508	0	46	664	664	0
1.2.12	Information Management	8	8	2	0	6	68	68	63	0	5	80	80	0
1.2.15	Support Services	156	156	147	0	9	1560	1560	1602	0	-42	1871	1888	-17
Total		1388	1347	1446	-41	-99	13263	13159	12660	-104	499	15889	16018	-129

Resource Distributions by Element of Cost

Fiscal Year 1996
Budgeted Cost of Work Scheduled

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	23259	23807	23340	23449	24069	25071	23358	27690	24694	23874	23805	23543	289959
LABOR	954	972	944	959	980	1021	955	1177	1032	1009	1006	1003	12012
SUBS	34	41	39	46	75	109	106	117	139	133	126	120	1085
TRAVEL	30	41	38	38	43	46	42	40	35	37	25	22	437
PM&E	25	18	23	37	35	29	27	35	30	19	15	4	297
OTHER	157	159	155	165	165	214	180	181	171	190	151	154	2042
CAPITAL	0	0	0	0	0	0	16	0	0	0	0	0	16
Total BCWS	1200	1231	1199	1245	1298	1419	1326	1550	1407	1388	1323	1303	15889

Actual Cost of Work Performed

LBRHRS	21987	21558	21063	22761	20217	20627	19331	21820	20636	22047	0	0	212047
LABOR	825	785	801	909	860	867	816	977	883	963	0	0	8686
SUBS	56	72	97	111	118	170	188	220	170	195	0	0	1397
TRAVEL	8	43	29	26	40	60	25	52	56	33	0	0	372
PM&E	0	0	0	44	151	-20	48	66	39	83	0	0	411
OTHER	129	152	170	182	277	150	167	193	186	172	0	0	1778
CAPITAL	0	0	0	0	0	0	16	0	0	0	0	0	16
Total ACWP	1018	1052	1097	1272	1446	1227	1260	1508	1334	1446	0	0	12660

WBS No. - 1.2 -Yucca Mountain Project

Resource Distributions by Element of Cost

Fiscal Year 1996
Estimate to Complete

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
LBRHRS	0	0	0	0	0	0	0	0	0	0	25187	24307	49494
LABOR	0	0	0	0	0	0	0	0	0	0	1112	1075	2187
SUBS	0	0	0	0	0	0	0	0	0	0	219	220	439
TRAVEL	0	0	0	0	0	0	0	0	0	0	55	45	100
PM&E	0	0	0	0	0	0	0	0	0	0	39	18	57
OTHER	0	0	0	0	0	0	0	0	0	0	289	286	575
CAPITAL	0	0	0	0	0	0	0	0	0	0	0	0	0
Total ETC	0	0	0	0	0	0	0	0	0	0	1714	1644	3358

Resource Distributions

Fiscal Year 1996	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
BCWS	1200	1231	1199	1245	1298	1419	1326	1550	1407	1388	1323	1303	15889
BCWP	1193	1238	1175	1189	1360	1402	1319	1518	1418	1347	0	0	13159
ACWP	1018	1052	1097	1272	1446	1227	1260	1508	1334	1446	0	0	12660
ETC	0	0	0	0	0	0	0	0	0	0	1714	1644	3358

Fiscal Year Distribution

	Prior	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	Future	At Complete
BCWS	0	15889	0	0	0	0	0	0	0	0	0	0	15889
BCWP	0	13159	0	0	0	0	0	0	0	0	0	0	
ACWP	0	12660	0	0	0	0	0	0	0	0	0	0	
ETC	0	3358	0	0	0	0	0	0	0	0	0	0	16018

YMP PLANNING AND CONTROL SYSTEM (PACS)

Participant U.S. Geological Survey

Date Prepared 08/14/96 11:13

MONTHLY COST/FTE REPORT

Fiscal Month/Year JULY 1996

	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
1.2.3	1115	17563	3496	0	456	283	12588	0	9776
1.2.5	40	512	368	0	36	0	365	0	259
1.2.8	49	724	0	0	0	0	515	0	410
1.2.9	89	1362	368	0	30	3	664	0	505
1.2.12	2	184	0	0	0	0	80	0	63
1.2.15	147	1702	368	0	21	25	1871	0	1598
TOTALS	1442	22047	4600	0	543	311	16083	0	12611

U.S. GEOLOGICAL SURVEY
ESTIMATED COSTS FOR 10/1/95 - 07/31/96

		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
0G311968	Scientific Programs Management and Integ	13.9	15.6	15.2	17.0	29.6	30.6	29.7	30.7	19.4	18.5	0.0	0.0	220.2
1.2.3.1.1		13.9	15.6	15.2	17.0	29.6	30.6	29.7	30.7	19.4	18.5	0.0	0.0	220.2
0G312968Z	U.S. Geological Survey Support	79.6	93.3	92.1	107.4	174.8	34.2	66.3	78.7	24.1	60.1	0.0	0.0	810.6
1.2.3.1.2		79.6	93.3	92.1	107.4	174.8	34.2	66.3	78.7	24.1	60.1	0.0	0.0	810.6
*1.2.3.1		93.5	108.9	107.3	124.4	204.4	64.8	96.0	109.4	43.5	78.6	0.0	0.0	1030.8
0G32211D96	Compilation and Synthesis of Existing St	11.4	14.1	11.9	37.6	24.4	32.7	10.7	33.3	22.2	19.8	0.0	0.0	218.1
0G32211H96	Geophysical Investigations	3.5	0.1	0.0	0.0	0.8	-3.6	0.0	51.5	6.0	25.7	0.0	0.0	84.0
0G32211K96	Analysis of Pre 1985 Geophysical Logs	0.0	0.0	0.0	0.0	0.0	0.6	0.0	60.8	3.0	4.2	0.0	0.0	68.6
1.2.3.2.2.1.1		14.9	14.2	11.9	37.6	25.2	29.7	10.7	145.6	31.2	49.7	0.0	0.0	370.7
0G32212H96	Geologic Map of the Central Block of the	34.1	33.4	34.0	31.8	35.2	55.4	60.5	39.7	47.3	43.1	0.0	0.0	414.5
0G32212J96	Exploratory Studies Facility Mapping (US	111.3	100.7	135.7	183.3	192.8	244.4	157.1	165.7	253.0	266.9	0.0	0.0	1810.9
1.2.3.2.2.1.2		145.4	134.1	169.7	215.1	228.0	299.8	217.6	205.4	300.3	310.0	0.0	0.0	2225.4
0G32831A96	Summary of Geologic, Geophysical, and Se	5.9	6.3	5.9	6.5	6.9	5.9	6.8	40.6	12.5	17.1	0.0	0.0	114.4
1.2.3.2.8.3.1		5.9	6.3	5.9	6.5	6.9	5.9	6.8	40.6	12.5	17.1	0.0	0.0	114.4
0G32833A96	Coordination and Review of Ground Motion	0.0	11.5	24.0	14.0	24.1	-10.8	0.0	0.0	0.0	0.0	0.0	0.0	62.8
1.2.3.2.8.3.3		0.0	11.5	24.0	14.0	24.1	-10.8	0.0	0.0	0.0	0.0	0.0	0.0	62.8
0G32836A96	Seismotectonics Summary and Synthesis	7.8	16.6	14.2	16.7	16.9	12.4	10.7	17.8	14.2	19.7	0.0	0.0	147.0
1.2.3.2.8.3.6		7.8	16.6	14.2	16.7	16.9	12.4	10.7	17.8	14.2	19.7	0.0	0.0	147.0
0G32846A96	Quaternary Faulting at the Site	14.7	21.7	17.7	21.9	25.1	35.8	42.8	-0.2	28.0	30.6	0.0	0.0	238.1
0G32846K96	Trench Samp Dates Quat. Flts Hist GD, RV	0.0	0.0	0.0	0.0	3.8	0.0	0.7	10.1	8.2	7.8	0.0	0.0	30.6
1.2.3.2.8.4.6		14.7	21.7	17.7	21.9	28.9	35.8	43.5	9.9	36.2	38.4	0.0	0.0	268.7
0G3284CC96	Prepare Final Report on Tectonic Models	18.2	5.8	10.3	7.0	7.9	7.7	6.4	14.1	14.5	15.7	0.0	0.0	107.6
1.2.3.2.8.4.12		18.2	5.8	10.3	7.0	7.9	7.7	6.4	14.1	14.5	15.7	0.0	0.0	107.6
*1.2.3.2		206.9	210.2	253.7	318.8	337.9	380.5	295.7	433.4	408.9	450.6	0.0	0.0	3296.6
0G33111B96	Collection of Site Meteorological Data f	6.2	7.3	5.9	6.7	6.9	7.9	8.4	7.3	9.4	11.2	0.0	0.0	77.2
1.2.3.3.1.1.1		6.2	7.3	5.9	6.7	6.9	7.9	8.4	7.3	9.4	11.2	0.0	0.0	77.2
0G33112C96	Collection of Site Streamflow Data	7.0	19.4	9.6	10.2	8.3	4.4	1.1	3.3	5.1	4.9	0.0	0.0	73.3
1.2.3.3.1.1.2		7.0	19.4	9.6	10.2	8.3	4.4	1.1	3.3	5.1	4.9	0.0	0.0	73.3
0G33113A96	Assessment of Key Data/Modeling Problems	0.1	5.2	8.8	1.1	1.9	1.1	2.6	4.5	13.2	5.7	0.0	0.0	44.2
0G33113C96	Fortymile Wash Recharge	5.8	4.9	4.0	2.5	6.2	5.8	5.0	6.7	2.2	4.4	0.0	0.0	47.5
1.2.3.3.1.1.3		5.9	10.1	12.8	3.6	8.1	6.9	7.6	11.2	15.4	10.1	0.0	0.0	91.7
0G33114D96	Regional Saturated- Zone Numerical Model	7.1	6.2	1.5	2.7	10.4	24.6	6.0	28.9	32.0	20.0	0.0	0.0	139.4
0G33114E96	Regional Saturated- Zone Boundary Condit	5.0	12.5	12.2	15.5	4.3	3.4	-0.2	0.0	0.0	0.0	0.0	0.0	52.7
0G33114F96	Regional Saturated- Zone Framework Model	0.0	0.0	12.3	22.8	16.0	10.2	5.8	14.1	9.1	1.3	0.0	0.0	91.6
1.2.3.3.1.1.4		12.1	18.7	26.0	41.0	30.7	38.2	11.6	43.0	41.1	21.3	0.0	0.0	283.7
0G33121C96	Infiltration Distribution	7.8	9.5	9.0	11.3	11.2	8.2	9.7	5.7	4.6	0.5	0.0	0.0	77.5
0G33121D96	Infiltration Properties	5.7	6.7	5.7	9.9	11.0	5.8	6.2	10.0	6.8	10.1	0.0	0.0	77.9

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0G33121E96	Infiltration Processes	15.4	18.1	16.9	20.3	23.7	20.0	16.2	19.2	16.1	20.8	0.0	0.0	186.7
1.2.3.3.1.2.1		28.9	34.3	31.6	41.5	45.9	34.0	32.1	34.9	27.5	31.4	0.0	0.0	342.1
0G33123C96	Vertical Seismic Profiling: Borehole UE-	17.5	20.0	13.2	32.7	21.1	10.1	9.5	19.9	18.4	-9.5	0.0	0.0	152.9
0G33123D96	Unsaturated Zone Borehole Instrumentatio	74.8	82.1	66.5	38.2	57.3	41.1	49.5	55.1	45.8	71.3	0.0	0.0	581.7
0G33123G96	Integrated Analysis and Interpretation	0.0	0.0	12.4	12.9	15.3	16.7	17.1	16.1	13.9	10.9	0.0	0.0	115.3
0G33123H96	Matrix Properties of Hydrologic Units	12.2	9.3	9.4	7.2	7.7	7.2	6.1	14.4	11.3	13.4	0.0	0.0	98.2
0G33123K96	Temporary Instrumentation of SD-7	0.0	0.0	0.0	4.6	6.6	5.8	7.5	10.2	6.3	-2.7	0.0	0.0	38.3
1.2.3.3.1.2.3		104.5	111.4	101.5	95.6	108.0	80.9	89.7	115.7	95.7	83.4	0.0	0.0	986.4
0G33124E96	Air-Permeability and Hydrochemistry Test	29.5	33.8	37.6	42.4	56.3	24.9	41.2	29.1	49.6	43.4	0.0	0.0	387[illegible]
0G33124F96	Perched Water Testing in the Exploratory	0.9	0.0	2.8	4.3	3.0	1.0	12.4	22.0	-12.8	4.4	0.0	0.0	38.0
0G33124K96	ESF Moisture/Dryout	0.0	0.0	0.0	0.0	7.0	7.5	12.9	18.3	12.6	21.4	0.0	0.0	79.7
1.2.3.3.1.2.4		30.4	33.8	40.4	46.7	66.3	33.4	66.5	69.4	49.4	69.2	0.0	0.0	505.5
0G33126B96	Gas Circulation and Pneumatic Pathways	9.6	11.5	9.0	13.7	9.6	8.9	8.7	10.3	11.7	8.0	0.0	0.0	101.0
1.2.3.3.1.2.6		9.6	11.5	9.0	13.7	9.6	8.9	8.7	10.3	11.7	8.0	0.0	0.0	101.0
0G33127B96	Unsturated-Zone Hydrochemistry	26.2	26.4	32.2	23.4	53.2	18.3	46.8	28.9	28.7	30.4	0.0	0.0	314.5
1.2.3.3.1.2.7		26.2	26.4	32.2	23.4	53.2	18.3	46.8	28.9	28.7	30.4	0.0	0.0	314.5
0G33128A96	Fluid Flow in Unsaturated-Zone Fractured	6.9	6.9	6.6	7.2	8.4	8.8	9.3	15.3	9.3	10.3	0.0	0.0	89.0
1.2.3.3.1.2.8		6.9	6.9	6.6	7.2	8.4	8.8	9.3	15.3	9.3	10.3	0.0	0.0	89.0
0G33129B96	Intermediate Site Unsaturated-Zone FlowM	7.3	8.6	15.2	30.5	6.3	16.6	17.7	23.0	1.8	7.8	0.0	0.0	134.8
1.2.3.3.1.2.9		7.3	8.6	15.2	30.5	6.3	16.6	17.7	23.0	1.8	7.8	0.0	0.0	134.8
0G33131A96	Conduct Hydraulic/Tracer Tests, C-Wells	39.6	40.5	40.7	49.0	57.6	7.2	10.1	8.6	0.9	23.2	0.0	0.0	277.4
0G33131F96	Site Potentiometric Levels Monitoring	11.7	17.5	17.2	0.4	3.7	10.3	10.8	16.8	3.5	14.1	0.0	0.0	106.0
0G33131G96	Pumping and Testing Existing Monitoring	11.8	14.0	5.4	20.7	20.8	21.4	31.8	17.6	43.7	27.3	0.0	0.0	214.5
0G33131K96	Enhanced C-Wells Hydraulic and Conservat	0.0	0.0	0.0	0.0	0.0	51.2	42.1	52.1	45.6	50.5	0.0	0.0	241.5
1.2.3.3.1.3.1		63.1	72.0	63.3	70.1	82.1	90.1	94.8	95.1	93.7	115.1	0.0	0.0	8[illegible]
0G33132D96	Saturated-Zone Hydrochemical Sample and	6.7	6.9	6.3	8.7	6.9	6.9	7.4	7.0	0.6	0.0	0.0	0.0	5[illegible]
1.2.3.3.1.3.2		6.7	6.9	6.3	8.7	6.9	6.9	7.4	7.0	0.6	0.0	0.0	0.0	57.4
0G33133D96	Site Saturated Zone Framework Model	14.9	10.2	4.6	0.1	0.1	0.7	11.2	16.7	10.1	10.4	0.0	0.0	79.0
0G33133E96	Site Saturated Zone Numerical Model	11.5	10.1	3.3	13.4	17.4	21.1	15.2	22.0	14.8	14.3	0.0	0.0	143.1
1.2.3.3.1.3.3		26.4	20.3	7.9	13.5	17.5	21.8	26.4	38.7	24.9	24.7	0.0	0.0	222.1
*1.2.3.3		341.2	387.6	368.3	412.4	458.2	377.1	428.1	503.1	414.3	427.8	0.0	0.0	4118.1
0G3521968	Tracer Gas Support	5.2	5.2	5.1	5.4	5.4	5.5	5.3	5.9	5.0	5.7	0.0	0.0	53.7
1.2.3.5.2.1		5.2	5.2	5.1	5.4	5.4	5.5	5.3	5.9	5.0	5.7	0.0	0.0	53.7
*1.2.3.5		5.2	5.2	5.1	5.4	5.4	5.5	5.3	5.9	5.0	5.7	0.0	0.0	53.7
0G36212B96	Paleoclimate Study of Lake, Playa and Ma	21.0	18.3	14.8	25.4	23.3	29.2	16.0	-29.7	5.1	9.7	0.0	0.0	133.1
1.2.3.6.2.1.2		21.0	18.3	14.8	25.4	23.3	29.2	16.0	-29.7	5.1	9.7	0.0	0.0	133.1
0G36214A96	Geochronological Studies of Surface Desp	22.4	16.3	17.1	3.4	0.9	-10.3	11.2	9.5	8.4	12.3	0.0	0.0	91.2

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0G36214B96	Surface Deposits Mapping	5.9	5.9	6.2	7.2	8.0	7.2	10.1	12.3	6.2	7.3	0.0	0.0	76.3
1.2.3.6.2.1.4		28.3	22.2	23.3	10.6	8.9	-3.1	21.3	21.8	14.6	19.6	0.0	0.0	167.5
0G36215A96	Paleoclimate/Paleoenvironmental Synthesi	9.1	9.1	15.4	3.3	13.8	8.9	13.5	33.0	11.5	21.8	0.0	0.0	139.4
1.2.3.6.2.1.5		9.1	9.1	15.4	3.3	13.8	8.9	13.5	33.0	11.5	21.8	0.0	0.0	139.4
0G36221E96	Subsurface Mineral Record of Past Hydrol	16.9	36.8	25.6	27.0	18.8	28.2	21.4	-3.4	6.8	-5.2	0.0	0.0	172.9
0G36221F96		0.0	0.2	4.5	12.2	16.5	8.1	8.4	35.7	17.1	24.8	0.0	0.0	127.5
0G36221G96	Evaluation of Paleo Ground-Water Dischar	9.5	4.1	-0.7	0.0	1.7	4.2	14.9	60.2	30.6	20.6	0.0	0.0	145.1
0G36221K96	Dating of Fracture Coatings in ESF	0.0	0.0	24.3	50.5	86.9	53.0	31.3	34.4	50.0	60.9	0.0	0.0	391.3
1.2.3.6.2.2.1		26.4	41.1	53.7	89.7	123.9	93.5	76.0	126.9	104.5	101.1	0.0	0.0	836.8
*1.2.3.6		84.8	90.7	107.2	129.0	169.9	128.5	126.8	152.0	135.7	152.2	0.0	0.0	1276.8
**1.2.3		731.6	802.6	841.6	990.0	1175.8	956.4	951.9	1203.8	1007.4	1114.9	0.0	0.0	9776.0
0G52496B2	Regulatory Documentation	5.7	5.9	0.0	8.9	0.9	0.0	0.0	-5.0	11.2	0.3	0.0	0.0	27.9
1.2.5.2.4		5.7	5.9	0.0	8.9	0.9	0.0	0.0	-5.0	11.2	0.3	0.0	0.0	27.9
*1.2.5.2		5.7	5.9	0.0	8.9	0.9	0.0	0.0	-5.0	11.2	0.3	0.0	0.0	27.9
0G53596B	Technical Data Base Input	7.2	10.3	12.5	14.1	11.8	13.1	20.8	21.4	17.5	19.9	0.0	0.0	148.6
1.2.5.3.5		7.2	10.3	12.5	14.1	11.8	13.1	20.8	21.4	17.5	19.9	0.0	0.0	148.6
*1.2.5.3		7.2	10.3	12.5	14.1	11.8	13.1	20.8	21.4	17.5	19.9	0.0	0.0	148.6
0G54196B	Interact with Site Characterization and	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	3.5	0.0	0.0	14.6
1.2.5.4.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	3.5	0.0	0.0	14.6
0G54696B	Planning and Coordination of Flow- and-T	0.0	0.0	0.4	10.2	-3.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	7.8
1.2.5.4.6		0.0	0.0	0.4	10.2	-3.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	7.8
*1.2.5.4		0.0	0.0	0.4	10.2	-3.1	0.3	0.0	0.0	11.1	3.5	0.0	0.0	22.4
0G55396B		0.0	0.0	0.0	0.1	-0.1	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.5
1.2.5.5.3		0.0	0.0	0.0	0.1	-0.1	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.5
*1.2.5.5		0.0	0.0	0.0	0.1	-0.1	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.5
0G5796B	Technical Evaluation	0.9	0.0	0.0	0.9	0.5	-0.2	0.0	15.9	25.3	16.1	0.0	0.0	59.4
1.2.5.7		0.9	0.0	0.0	0.9	0.5	-0.2	0.0	15.9	25.3	16.1	0.0	0.0	59.4
*1.2.5.7		0.9	0.0	0.0	0.9	0.5	-0.2	0.0	15.9	25.3	16.1	0.0	0.0	59.4
**1.2.5		13.8	16.2	12.9	34.2	10.0	13.5	20.8	32.5	65.1	39.8	0.0	0.0	258.8
0G82596B	Occupational Safety and Health	7.3	7.4	7.0	7.7	7.8	7.5	7.5	10.8	10.1	11.8	0.0	0.0	84.9
1.2.8.2.5		7.3	7.4	7.0	7.7	7.8	7.5	7.5	10.8	10.1	11.8	0.0	0.0	84.9
*1.2.8.2		7.3	7.4	7.0	7.7	7.8	7.5	7.5	10.8	10.1	11.8	0.0	0.0	84.9
0G84596B	Radiological Studies	0.0	0.0	0.0	0.1	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-0.3
1.2.8.4.5		0.0	0.0	0.0	0.1	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-0.3
0G84796H	Water Resources Monitoring	33.3	26.9	27.4	27.8	31.9	31.6	39.8	32.8	36.4	37.3	0.0	0.0	325.2
1.2.8.4.7		33.3	26.9	27.4	27.8	31.9	31.6	39.8	32.8	36.4	37.3	0.0	0.0	325.2
*1.2.8.4		33.3	26.9	27.4	27.9	31.9	31.2	39.8	32.8	36.4	37.3	0.0	0.0	324.9

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**1.2.8		40.6	34.3	34.4	35.6	39.7	38.7	47.3	43.6	46.5	49.1	0.0	0.0	409.8
0G9121968	Participant Technical Project Office	27.1	29.1	29.7	25.2	24.4	22.6	15.8	34.4	23.4	44.6	0.0	0.0	276.3
1.2.9.1.2.1		27.1	29.1	29.7	25.2	24.4	22.6	15.8	34.4	23.4	44.6	0.0	0.0	276.3
*1.2.9.1		27.1	29.1	29.7	25.2	24.4	22.6	15.8	34.4	23.4	44.6	0.0	0.0	276.3
0G92296B	Participant Project Control - USGS	19.9	20.9	19.7	20.5	27.0	18.8	18.1	22.0	17.9	44.3	0.0	0.0	229.1
1.2.9.2.2		19.9	20.9	19.7	20.5	27.0	18.8	18.1	22.0	17.9	44.3	0.0	0.0	229.1
*1.2.9.2		19.9	20.9	19.7	20.5	27.0	18.8	18.1	22.0	17.9	44.3	0.0	0.0	229.1
**1.2.9		47.0	50.0	49.4	45.7	51.4	41.4	33.9	56.4	41.3	88.9	0.0	0.0	505.[illegible]
0GC52196B	Records Operation (USGS)	5.4	3.5	3.3	4.8	4.9	6.7	15.3	8.8	8.0	2.3	0.0	0.0	63.[illegible]
1.2.12.5.2.1		5.4	3.5	3.3	4.8	4.9	6.7	15.3	8.8	8.0	2.3	0.0	0.0	63.0
*1.2.12.5		5.4	3.5	3.3	4.8	4.9	6.7	15.3	8.8	8.0	2.3	0.0	0.0	63.0
**1.2.12		5.4	3.5	3.3	4.8	4.9	6.7	15.3	8.8	8.0	2.3	0.0	0.0	63.0
0GF2396B1	Support/Personnel Services	49.0	42.6	37.2	41.8	39.7	52.0	43.6	29.5	38.0	30.0	0.0	0.0	403.4
0GF2396B2	Facilities Management - Space	85.4	57.6	71.0	71.3	71.3	71.3	71.3	71.3	71.3	71.3	0.0	0.0	713.1
0GF2396B3	Facilities Management - Computers/Phones	24.9	17.1	20.4	20.8	20.8	20.8	20.8	20.8	20.8	20.8	0.0	0.0	208.0
0GF2396B4	Facilities Management - Other	13.3	8.7	11.2	11.1	11.1	11.1	11.1	11.1	11.1	11.1	0.0	0.0	110.9
0GF2396B5	Procurement/Property Management - USGS	2.2	12.4	7.9	8.6	7.8	8.5	8.8	9.8	7.9	7.8	0.0	0.0	81.7
1.2.15.2.3		174.8	138.4	147.7	153.6	150.7	163.7	155.6	142.5	149.1	141.0	0.0	0.0	1517.1
*1.2.15.2		174.8	138.4	147.7	153.6	150.7	163.7	155.6	142.5	149.1	141.0	0.0	0.0	1517.1
0GF396B	YMP Support For The Training Mission (US	5.6	5.0	4.0	3.6	7.7	4.3	14.2	15.1	15.4	5.9	0.0	0.0	80.8
1.2.15.3		5.6	5.0	4.0	3.6	7.7	4.3	14.2	15.1	15.4	5.9	0.0	0.0	80.8
*1.2.15.3		5.6	5.0	4.0	3.6	7.7	4.3	14.2	15.1	15.4	5.9	0.0	0.0	80.8
**1.2.15		180.4	143.4	151.7	157.2	158.4	168.0	169.8	157.6	164.5	146.9	0.0	0.0	1597.9
1.2 OPERATING		1018.8	1050.0	1093.3	1267.5	1440.2	1224.7	1239.0	1502.7	1332.8	1441.9	0.0	0.0	126[illegible]
CAPITAL EQUIPMENT		0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	16.0
GRAND TOTAL		1018.8	1050.0	1093.3	1267.5	1440.2	1224.7	1255.0	1502.7	1332.8	1441.9	0.0	0.0	12626.9
FTEs														
FEDERAL		118.1	125.4	123.4	133.7	118.8	121.9	112.7	127.9	121.1	129.6	0.0	0.0	
CONTRACT		7.9	8.6	11.1	15.4	17.4	21.5	22.7	28.0	27.1	26.9	0.0	0.0	
TOTAL		126.0	134.0	134.5	149.1	136.2	143.4	135.4	155.9	148.2	156.5	0.0	0.0	

* Fourth level WBS roll-up

** Third level WBS roll-up

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AUG 23 1996