



United States Department of the Interior

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

IN REPLY REFER TO:

INFORMATION ONLY

December 11, 2003

Victor W. Trebules
Director, Office of Project Control
U.S. Department of Energy
Office of Repository Development
1551 Hillshire Drive
Las Vegas, NV 89134-6321

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

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

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

Sincerely,

Raye Ritchey Arnold

for 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
W. Kozai, DOE, Las Vegas
S. Mellington, DOE, Las Vegas
S. Petersen, 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. Eddebarh, 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
M. Mustard, USGS, Denver
T. Chaney, USGS, Denver
M. Chornack, 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
YUCCA MOUNTAIN PROJECT BRANCH
Executive Summary

November 2003

GEOLOGICAL STUDIES

Several elements of geological investigations in support of Nye County efforts continued during November, with accomplishment of several important goals. A data package describing lithostratigraphic results from examination of Nye County early-warning drilling program (EWDP) Phase IV-A boreholes was revised after USGS data-management review and submitted to the TDMS and the RPC. That package was sent to the TDMS/RPC on November 28 in completion of **milestone PAGSM203M4 [Phase IV Lithostratigraphic Data to TDMS/RPC]**. Selected samples from EWDP boreholes NC-EWDP-24P and NC-EWDP-29P were examined and submitted for trace-element analysis. Geophysical logs from those drill holes (-24P and -29P) currently are being compiled for future correlation with existing lithostratigraphic data. In substantial unscheduled work in support of DOE KTI (key technical issue) interactions, editorial revisions to an existing data package were prepared, the related package was corrected and enhanced, and the revised package was submitted to supersede the original material per procedure AP-SIII.3Q, with a submittal date of November 26 for completion of **milestone PAGSM202M5 [Interpretation of the Lithostratigraphy of Deep Boreholes NC-EWDP-16P, NC-EWDP-27P, and NC-EWDP-28P, Nye County Early Warning Drilling Program Phase IV A]**.

Other geological efforts also continued, involving a map of potential expansion areas (nearly complete), technical reviews of underground mapping and video imagery, and on-going collection of data from lithophysal rock units. Final editing of the geologic map of the potential repository expansion area has been completed. The USGS data-management review is in progress. Evaluation of fracture and lithophysal character of the repository host horizon (RHH) continued during November. Technical review of lithophysal panel mapping, surveying of large lithophysal cavities, and small-scale fracture traverses were performed. Staff are developing responses to review comments, and the revised package is being prepared. On-going analysis of borehole video imagery concentrated on development of lithophysal percentages and fracture frequencies. Other on-going work involved development (calculation) of discrete fracture networks for the RHH. Quantification of lithophysal porosity with in situ testing continued during the month. On-going lithophysal data collection from Slot Test #3 continued, making use of detailed logging.

SATURATED-ZONE STUDIES

Multiple areas of focus continued for the Death Valley regional flow-system (DVRFS) modeling, including on-going work in integration of data and data bases, calibration of flow models, and comprehensive exchange of knowledge, particularly with regard to issues requiring exactly consistent data use in several areas of effort. Staff from the USGS worked with contractors and vendors to deploy GEOPRO, v. 2.21, on the data-base server and client workstation in Tucson and to USGS offices. Draft documentation developed by contractor reVision, Inc., including release notes, installation guidelines and training manuals, was reviewed and currently is being revised to incorporate USGS comments. Deployment and installation of GEOPRO, v. 2.21, through remote connections (using NetMeeting) was successfully field-tested at the Tucson and Denver USGS offices. Network-performance testing related to accessing the primary server in Tucson was completed, and minor issues were documented. GEOPRO, v. 2.22, which addresses future-version compatibility issues, is planned for release to all DVRFS team members in December. Performance of file downloading using GEOPRO was tested against FTP and network-drive approaches and was found to be significantly better and more appropriate for production use. Additional development is needed to make GEOPRO more robust, but the full DVRFS GIS data base was loaded on the SQL Server. Additional on-going development was directed to the SQL Server data-base server, with access successfully tested from the Denver office. Implementation of the GEOPRO interface for all project members was underway. Staff also continued maintenance of the project web site.

Staff worked extensively to develop a long-term strategy for optimization of design, analysis, and integration of the technical and project data bases to better support the model-calibration process. A debriefing on work-flow processes related to water-level and water-use information stored in the technical and project data bases was conducted to guide planning efforts for long-term use and release of such information. Staff documented the work-flow process used (1) to develop the technical data base to store information from the USGS Ground Water Site Inventory (GWSI), (2) to develop the DVRFS project data base through analysis and integration of the GWSI information, and (3) to develop head-observation targets and requisite input files for the DVRFS flow model to support steady-state and transient-model calibration. Documentation of data bases and work-flow processes is being used to plan and optimize organization of the data bases, to enhance integration of the data bases with other project components, and to develop interfaces to streamline the analytical process. Also documented was the work-flow sequence describing how water-use and pumpage data were analyzed and migrated to the DVRFS project data base and flow model to support transient-model calibration. Team members developed a plan to address potential changes to the GIS data base that might result from peer review of the DVRFS transient-model report. Phased integration of changes will occur as reviews of individual report chapters are completed, and again when reviews of the entire report are complete. Scoping exercises examined development of a laptop-based demonstration of the GEOPRO project for USGS and DOE managers. Staff also developed an initial strategy to evaluate, organize, and develop required documentation (including supporting metadata descriptions) necessary to submit the DVRFS GIS data base(s) to the USGS review process.

Numerous meetings with reVision staff and DVRFS team members explored concepts for releasing the DVRFS GIS data base supporting the transient model in a comprehensive, efficient manner. In the concept explored, a spatial GIS data base would be directly linked to the transient-model report, thus allowing direct end-user access to underlying data sets. The proposed process would build on the GEOPRO platform and would emphasize achievement of ease-of-use and maximum transfer of information to a non-scientific end-user. At present, the concept is called the "dynamic report." Technical feasibility of and USGS guidance for the proposed dynamic report were further explored with project members, USGS publications staff, and contractors. Technology options that might dovetail a product of the proposed nature with the current USGS publications system were examined. The USGS publications staff also confirmed that the innovative approach addressed key issues of releasing complex models and data bases. The concept of the dynamic report was also introduced to Chip Groat, director of the USGS, and to Karen Siderelis, director of the Geographic Information Office (GIO), at the USGS Publications Conference in Denver on November 18. Both directors were receptive to the concept and were interested in the development of a prototype to demonstrate proof-of-concept.

In work on flow-model calibration and evaluation, the recharge array was modified to more directly reflect net infiltration estimates. In September, the first flow-model layer was made thicker, allowing for direct use of net-infiltration data without using a low-pass filter (as required previously to prevent ponding of recharge in flow model layer 1). Additional efforts addressed improvements necessary for sensitivity analyses. Targeted runs were made to identify correlated parameters, such as runs examining effects of estimating hydraulic properties in concert with storage values. Flow-model runs were made to address composite scaled sensitivities for two storage parameters several orders of magnitude too large. By making several sensitivity runs, the values of the parameters were increased by about 1 order of magnitude and the composite scaled sensitivities were reduced by several orders of magnitude, making them compatible with the composite scaled sensitivity values for all other storage parameter values assigned in the flow model. Model correlations were tested by running correlation-matrix calculations. Regular re-running of correlation-matrix calculations is essential as parameter values change during calibration, but determination of a correlation matrix for all flow-model parameters is a markedly time-intensive process.

Various improvements to calibration were developed, including automated relocation of observations from inactive cells to the appropriate active cell and methods of hydrograph visualization to interface with the double-precision code necessary to derive the balanced water budget. Toward calibration of the regional transient-flow model, testing continued of the latest version of the MODFLOW double-precision code [mf2k-1.12dp.exe] to ensure compatibility with MODFLOW post-processing software such as HYDFMT.exe, necessary for examining drawdown at wells. HYDFMT.exe is essential for post-processing developed in GIS from which model results are analyzed and report figures are created. Modeling files and directories were reorganized to streamline future modeling runs, and appropriate smoothing and storage values were examined. (The most-sensitive parameters are storage values, and the top three most sensitive have extremely large composite scaled sensitivities.) Along similar lines, recharge, storage, and alluvial hydraulic conductivity were re-estimated (together) to provide a better fit to the hydraulic-head and flow data.

Work with knowledge exchange (KE) also continued, including planning for on-going monthly knowledge-exchange meetings. An array of issues were addressed in agenda items, with attention paid to milestones, consistency updates, GEOPRO and modeling-consistency updates, data-base release, and discussions of future scientific direction for the DVRFS project. A KE meeting was attended by numerous USGS staffers, contractors, and National Park Service consultants. A written summary of the meeting was prepared and distributed; the summary also was posted to the DVRFS web site at <http://sun1daztcn.wr.usgs.gov>. That summary represented completion on November 30 of milestone **PAGSM38FM5 [November 2003 Knowledge Exchange Meeting Summary]**.

UNSATURATED-ZONE STUDIES

The water-infiltration experiment in Alcove #8/Niche #3 continued during the reporting period. Permeameters still are settling into routine operation; one-way valves between tension and supply towers were replaced, improving steady flow. Clogged supply tubes in the permeameters decreased water levels in individual plots, causing upward adjustment of experimental tension levels in Alcove #8 and subsequent re-adjustment by operators to approach planned experimental conditions. All plots (except plot #5) are putting on less water than was applied in last year's large-plot experiment. Some of the observed behavior may arise from constraints on boundary conditions "perceived" by the centrally located plots (the large plot behaved essentially as a double-ring infiltrometer), as well as from implications of earlier experimental controls. (With that protection from boundary effects, the central plots took on water immediately due to preservation of the "priming" in flow paths.) Compilation of routinely collected and assembled data was received from the TCO and checked. That data set included temperature, relative humidity, barometric pressure, water volume, and background evaporation. Heat-dissipation probes (HDPs) collected data around the large plot and from the trench. Background efforts also are underway in Alcove #8 to prepare for application of tracers (planned to occur in the new year).

Work in moisture monitoring in the ESF and in the ECRB Cross Drift focused on removal of instruments and deactivation of stations, as well as shipment of instruments for closing calibrations. Instruments were replaced in TRH04, TRH07, TRH10, XTRH02, and XTRH05, and the extracted instruments likewise were sent for closing calculations. Station TRH09 remained active as tunnel control for the Alcove #7 experiments. Stations XTRH01 and XTRH06 remained active as tunnel control for the ECRB bulkhead experiments.

Alcove #7 moisture monitoring also continued, with on-going collection of data. Operational experiments were conducted in attempts to isolate thermocouple-station transformers to investigate possible grounding-loop effects. Spreadsheets were updated with the latest downloaded data. Those data indicate the Alcove #7 environment is not completely isolated from outside environmental influence. Natural or man-made pathways apparently exist which allow for changes in the temperature, humidity, and pressure.

Bulkhead moisture monitoring continued as well. On-going data collection utilized 34 recording stations. Monitoring equipment was replaced as necessary. Maintenance operations were carried out as necessary on the equipment. Bulkhead moisture-monitoring data were received from the TCO and processed. Additional work focused on compilation of several moisture-monitoring data packages, including effort on the data summary for RTD/HDP (resistance temperature device and heat-dissipation probe) data acquired in the bulkheaded ECRB Cross Drift from November 2001 to May 2003. Work also began on thermocouple data from behind the bulkhead. Data checking and technical review for pressure data are tentatively anticipated for January.

In culmination of planned analysis of chemical and isotopic composition of pore water, a pore-water data package (DTN: GS031008312272.008) was submitted to the TDMS and to the RPC, in completion on November 25 of **milestone PAGESZ604M4 [Pore Water Data Package to TDMS/RPC]**. Two presentations arising from determinations of chemical and isotopic composition of pore water were given at the annual Geological Society of America meeting in Seattle on November 4 (citations listed below). Staff also participated in a field trip to the Hanford reservation in south-central Washington to obtain an overview of the geology and hydrology of a site with a fairly deep unsaturated zone.

Scofield, Kevin M., and Oliver, Thomas A., 2003, *Geochemistry of pore water from the unsaturated zone at Yucca Mountain, Nevada*: Geological Society of America Abstracts with Programs, v. 35, n. 6, p. 355.

Marshall, Brian D., and Futa, Kiyoto, 2003, *Strontium isotopes in pore water and travel time in the unsaturated zone, Yucca Mountain, Nevada*: Geological Society of America Abstracts with Programs, v. 35, n. 6, p. 355.

Isotope-group support for Thermal Testing continued during the month. Although no water samples were collected during the month, ten centrifuge tests were performed on five individual core samples from borehole ESF-HD-CHEMSAMP3. A small volume of pore water (0.25 ml, filtered) was extracted from one of the sampled intervals; that sample now has been analyzed for major cations and anions. Moisture-content measurements continued on all samples concurrent to testing.

Isotopic and hydrochemical support to the Nye County early-warning drilling program continued. The 6-week (first quarter of the fiscal year) Nye County sampling effort was completed in mid November. Samples from that Nye County sampling effort have been analyzed for cations and anions, but other analyses are not yet complete. Interpretation of those analyses is underway but also is not complete. On-going effort in interpretation of the hydrochronology of the Yucca Mountain flow system continued, with focus on preparation of a synthesis report and the associated data package. That data package was nearly ready for review at this reporting.

Significant effort continued in geochemical testing of UZ flow, although no new technical work was completed during the reporting period. The last batch of whole-rock samples from borehole USW SD-9 was analyzed, in the on-going analysis of U-series isotopes in UZ rocks. Resulting data, along with analyses (of whole-rock powders) run in FY2003, will be reduced (processed) and included in current data-package preparation. The transformer

required for operation of the new Triton mass spectrometer on building electrical power was installed in early November. The necessary laboratory space and power requirements now are ready for the mass-spectrometer installation engineer, and it remains expected that the instrument will be brought on line by the end of the calendar year. In other preparations for analytical work, potential contractors involved with providing acoustic tomography (seismic) imaging of lithophysal cavities in the ESF were interviewed.

Other work also focused on data matters. A data package containing data and supporting information for analyses of three saturated-zone ground-water samples was compiled and submitted to the EST (Environmental Science Team) QA specialist. The requested data packaging was in support of the SZ geochemistry AMR (ANL-NBS-HS-000021). The preliminary package currently is undergoing additional QA processing. Technical review comments (following AP-2.14Q procedures) were provided by USGS EST staff on the SZ geochemistry AMR (ANL-NBS-HS-000021, rev 01D), entitled *Geochemical and isotopic constraints on groundwater flow directions, mixing, and recharge at Yucca Mountain, Nevada*. Staff also worked on compilation of technical comments to Chapter 5 of the Yucca Mountain Site Description (TDR-CRW-GS-000001, Rev 02A), with that review expected to be completed in early December. A short manuscript describing U-series systematics of Yucca Mountain whole-rock and water samples was completed and submitted for technical and editorial review. The tentative title of the manuscript is "*U-series isotopes as indicators of water-rock interaction in the unsaturated zone at Yucca Mountain, Nevada, USA*" by J. Paces and L. Neymark, and the paper is intended for submission to the 11th Water-Rock Interaction meeting in Saratoga Springs, New York, to be held in June 2004. That editorial review is complete, and the manuscript awaits revision by the authors.

In work related to investigation of mineral records of UZ flow, staff initiated work evaluating a new piece of equipment delivered to USGS colleagues at the Denver Federal Center. The newly arrived micromill will be capable of both sampling and measurement of secondary minerals, including providing surface profiles of opal used for microdigestion analysis. Additional experimentation and evaluation are required before Yucca Mountain samples may be analyzed with that equipment.

Much effort during this reporting period was devoted to development of presentations and manuscripts documenting secondary mineral-growth and fluid-inclusion data and consequent interpretation of the thermal history of Yucca Mountain. Logistics and necessary training upgrades, however, were discussed in preparation for a December sampling trip to the Yucca Mountain ESF. A manuscript intended for publication as a USGS water-resources investigations report (WRIR), tentatively entitled "Secondary mineral records of past seismicity and heating of the proposed repository horizon at Yucca Mountain, Nevada," discusses an apparent record of past seismic activity contained within secondary deposits of calcite and silica in the unsaturated zone. That record may be an analog for effects of waste-induced heating on the wall rocks of emplacement drifts. Revision began of a manuscript (tentatively entitled "*Thermal history of the unsaturated zone at Yucca Mountain, Nevada*," by J. Whelan, L. Neymark, and others), with changes based on technical review. Lastly, a paper was presented to the Geological Society of America meeting in Seattle:

Whelan, J.F., Neymark, L.A., and Moscati, R.J., 2003, *Evidence from secondary calcite $\delta^{13}C$ values of unsaturated-zone depositional conditions and past climate at Yucca Mountain, Nevada*: Geological Society of America Abstracts with Programs, v. 35, n. 6, p. 354-355.

Significant additional activities of the USGS Environmental Science Team (isotope group) involved unscheduled work. Staff conducted an AP-2.14Q review of document ANL-EBS-MD-000033, rev 2 (*Engineered Barrier System: Physical and Chemical Environment*). That report relies heavily on chemical analyses of dust and pore water generated by the USGS Environmental Science Team. A separate AP-2.14Q review of a report largely based on USGS data was carried out on document ANL-NBS-HS-000021, rev 01D (*Geochemical and Isotopic Constraints on Groundwater Flow Directions, Mixing, and Recharge at Yucca Mountain, Nevada*). Several staff members attended a planning meeting for the UNLV ^{36}Cl validation project on November 18 (held at UNLV). On November 19, staff participated in an ESF trip to examine LANL and USGS sample sites in Alcove #6 and along the Main Drift. Special attention was given to features that were targeted by LANL in their early sampling. The UNLV sampling, under the guidance of Jean Kline, will focus on re-sampling many of those [LANL] sites after excavation an additional one meter into the rock mass. In addition, UNLV will analyze subsamples of USGS ^{36}Cl validation core and LANL samples if such samples can be found. In other work, six samples of dust were collected from various locations in the ECRB Cross Drift using the Typhoon vacuum interfaced with the stainless-steel cyclone, with analytical work to start following approval of planning documents. Finally, Z. Peterman presented a paper at the national meeting of the Geological Society of America in Seattle on November 4:

Peterman, Zell E., and Paces, James B., 2003, *Geochemistry of the Paintbrush Group, Yucca Mountain, southern Nevada*: Geological Society of America Abstracts with Programs, v. 35, n. 6, p. 355.

Additional papers were presented by USGS scientists to the 2003 Geological Society of America special session on Yucca Mountain sponsored by the U.S. Department of Energy. Papers described the history of the Yucca Mountain investigation, described the geologic setting of the site on the basis of extensive mapping, and detailed the tectonic evolution of Yucca Mountain. Citations for those additional papers are listed:

Stuckless, John S., and Roseboom, E.H., Jr., 2003, *The Road to Yucca Mountain: A Brief History*: Geological Society of America Abstracts with Programs, v. 35, n. 6, p. 353.

Potter, Christopher J., Day, Warren C., and Sweetkind, Donald S., 2003, *Geologic Setting of the Proposed High-Level Radioactive Waste Repository, Yucca Mountain, Nevada*: Geological Society of America Abstracts with Programs, v. 35, n. 6, p. 353.

O'Leary, Dennis W., 2003, *Understanding the Tectonic Evolution of Yucca Mountain*: Geological Society of America Abstracts with Programs, v. 35, n. 6, p. 353-354.

(And yes, that small range of page numbers is correct!)

WATER-RESOURCES MONITORING

Water-resources monitoring continued during November. Ground-water levels were measured at 34 sites, and ground-water discharge was measured at one flowing well. Ground-water and spring-discharge data collected during October were checked and filed for later compilation. In related work, Department of Energy approval was received on November 24 for the water-resources Summary Monitoring Report for Calendar Years 2000—2002.

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

USGS Milestone Report
October 1, 2003 November 30, 2003
Sorted by Baseline Date

Level: 4

Deliverable	Due Date	Expected Date	Completed Date
PAGSW266M4 Letter Report: 4th Qtr FY03	10/31/2003	10/31/2003	10/31/2003

USGS Milestone Report
October 1, 2003 November 30, 2003
Sorted by Baseline Date

Level: 5

Deliverable	Due Date	Expected Date	Completed Date
PAGSM38EM5 Mtg Summary to TPO: Oct03	10/31/2003	10/31/2003	10/31/2003
PAGSM38FM5 Mtg Summary to TPO: Nov03	11/28/2003	11/30/2003	11/30/2003

YMP PLANNING AND CONTROL SYSTEM (PACS)

MONTHLY COST/FTE REPORT

Participant U.S. Geological Survey
 Date Prepared 12/11/2003 07:54 AM

Fiscal Month/Year November 30, 2002
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	121	1705	492	0	365	0	2813	0	303
1.5.01.05	27	389	252	0	162	0	444	0	68
1.5.01.06	21	266	301	0	148	0	291	0	51
1.5.01.07	21	532	0	0	0	0	579	0	50
1.5.01.09	188	667	1289	0	683	0	2499	0	327
1.5.03.01	8	175	0	0	0	0	575	0	18
1.5.03.03	92	1189	651	0	455	0	1241	0	195
1.5.03.04	34	559	163	0	78	0	1230	0	81
1.5.03.07	38	580	1	0	0	0	400	0	115
1.5.03.12	8	167	0	0	0	0	250	0	22
1.5.03.13	30	48	735	0	461	0	675	0	79
1.5.03.14	8	182	38	0	13	0	146	0	14
	596	6459	3922	0	2365	0	11143	0	1323

U.S. GEOLOGICAL SURVEY

ESTIMATED COSTS FOR October 1, 2003 - November 30, 2002

12/11/2003 7:54:20 AM

	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	22.1	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.12
4568-9U010 Publications	13.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.26
4568-9U035 Chemical Thermodynamic Data Review o	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
4568-9U040 Tectonics	8.1	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.36
4568-9U041 Water Levels	5.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.41
4568-9U042 Geophysics	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.50
4568-9U060 Mapping Expertise (USBR)	4.5	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.05
4568-9U081 Geochemistry	67.7	47.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.90
819Y01 USGS Technical Advisory Capability	120.5	80.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.60
4568-9U002 Br Chief, Asst Br Chief, Deputy TPO, Tea	32.0	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.82
819Y11 USGS Branch Management	32.0	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.82
4568-9U003 Planning & Project Control	29.7	24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.38
819Y21 USGS Planning & Project Control	29.7	24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.38
1.5.01.01 Project Support - Project Manageme	182.3	120.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	302.79
4568-9U030 Regulatory Compliance Support	41.0	27.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.37
819Y31 USGS Regulatory Compliance Support	41.0	27.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.37
1.5.01.05 Project Support - Compliance Manag	41.0	27.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.37
4568-9U024 Computer/Network Support	30.0	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.39
819Y15 USGS Commputer/Network Support	30.0	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.39
1.5.01.06 Project Support - Information Manag	30.0	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.39
4568-9U061 Water Resources Monitoring	20.3	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.26
819Y41 USGS Water Resources Monitoring	20.3	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.26
4568-9U062 Safety	9.1	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.75
819Y51 USGS Safety	9.1	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.75
1.5.01.07 Project Support - Environmental, Saf	29.4	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.01
4568-9U011 Reports Specialists	13.3	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.45
4568-9U012 Data Management	36.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.48

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	EST	EST	EST	EST	EST	EST	EST	EST	EST	EST	EST	EST	
4568-9U013 Records Support	7.6	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.72
4568-9U014 QAS Support	22.5	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.55
819Y12 USGS Data, Records & Reports	79.4	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	126.20
4568-9U021 Administrative Support & Personnel Servi	29.7	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.59
4568-9U022 Facilities Management	0.0	114.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.38
4568-9U026 Facilities Other	1.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.68
819Y13 USGS Administration & Facilities	31.3	123.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	154.65
4568-9U023 Training	19.9	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.78
819Y14 USGS Training	19.9	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.78
4568-9U025 Property Management	7.9	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.98
819Y16 USGS Property Management	7.9	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.98
1.5.01.09 Project Support - General Project Ser	138.6	188.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	326.60
1.5.01	421.2	377.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	799.17
4568-9U017 Legacy Software Support	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
APAG01 USGS Legacy Software Support	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
4568-9U008 LA Chapter Preparation	10.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.59
APAG03 USGS LA Chapter Preparation Support	10.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.59
4568-9U007 KTI Support	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.86
APAG04 USGS KTI Support	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.86
1.5.03.01 Integration	10.3	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.45
4568-9U063 Alcove 8/Niche 3 Infiltration	16.6	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.88
4568-9U064 Moisture Monitoring ESF/X-Drift Closeout	8.2	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.83
4568-9U065 Bulkhead Moisture Monitoring	34.5	14.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.90
4568-9U073 Alcove 7 Moisture Monitoring	3.2	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.82
AUZG01 USGS UZ Moisture Studies	62.4	37.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99.43
4568-9U085 Geochemical Testing of UZ Flow	15.8	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.62
4568-9U086 Complete Chlorine 36 Validation	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.23

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4568-9U087 Chemical & Isotopic Composition of Pore	9.7	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.63
4568-9U089 Mineral Records of UZ Flow	8.8	18.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.25
4568-9U094 Thermal History of Yucca Mountain	2.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.60
AUZG02 USGS UZ Isotope Hydrology	36.6	43.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.34
4568-9U090 Isotope Support for Thermal Testing	4.0	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.43
AUZG03 USGS Drift-Scale Test ESF	4.0	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.43
1.5.03.03 Safety Analyses - Unsaturated Zone	103.1	92.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	195.20
4568-9U043 Hydrogeologic Data Integration	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.70
4568-9U044 3D Hydrogeologic Model Development	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
4568-9U045 Flow Model Calibration and Evaluation	5.2	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.22
4568-9U046 DVRFS Knowledge Exchange Protocol	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
4568-9U047 DVRFS Predictive Capability	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.58
819Y61 USGS Death Valley Regional Flow Mod	5.2	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.50
4568-9U049 Nye County EWDP Borehole Lithostratigr	8.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.03
ASZG01 USGS SZ Investigations	8.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.03
4568-9U055 Site HFM - AMR	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
4568-9U092 Hydrochemistry/Support to Nye Co. EWD	33.4	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.36
ASZG02 USGS SZ Isotope Hydrology	33.4	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.36
1.5.03.04 Safety Analyses - Saturated Zone Flo	46.6	34.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.89
4568-9U069 Fracture & Lithophysal Characteristics of	77.0	38.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.12
AEBG03 USBR Testing Activities in Support of D	77.0	38.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.12
1.5.03.07 Safety Analyses - EBS Performance	77.0	38.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.12
4568-9U005 YMP Performance Confirmation	13.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.51
APAG02 USGS Performance Confirmation Supp	13.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.51
1.5.03.12 Performance Confirmation Support	13.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.51
4568-9U016 USGS Data Verification	49.7	29.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.46
APAGD5 USGS Data Verification	49.7	29.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.46

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1.5.03.13 Safety Analyses - Technical Data Ma	49.7	29.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.46
4568-9U004 USGS Support to Site Description	6.2	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.90
ANSG01 USGS Support to Site Description	6.2	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.90
1.5.03.14 Safety Analyses - Yucca Mountain Si	6.2	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.90
1.5.03	305.9	218.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	524.53
1.5	727.2	596.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,323.70
1.5 OPERATING	727.2	596.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,323.70
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	727.2	596.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,323.70
FTEs													
FEDERAL	48.6	43.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CONTRACT	31.9	25.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	80.6	68.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0