

Department of the Interior  
United States Geological Survey  
YUCCA MOUNTAIN PROJECT  
Monthly Highlights and Status Report  
January 1993

DISCLAIMER

Quality Assurance checks on data contained in this report have been performed only to determine that the data have been obtained and documented properly. Any information is preliminary and subject to change as further analyses are performed. This report has not been reviewed for conformity with U.S. Geological Survey technical and editorial standards and stratigraphic nomenclature. Company names are for descriptive purposes only and do not constitute endorsement by the U.S. Geological Survey.

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United States Department of the Interior



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March 4, 1993

WBS: 1.2.9.1.2  
QA: N/A

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SUBJECT: U.S. Geological Survey (USGS) Detailed Monthly Status Report for January, 1993

Dear Carl:

Enclosed is the USGS detailed monthly status report for January, 1993. If you have any questions or comments, please contact Raye Ritchey at 303-236-0517.

Sincerely,

*Raye E. Ritchey*  
for

Larry R. Hayes  
Technical Project Officer  
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Attachment

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BBC	British Broadcasting Company
BBS	Bulletin Board System
BCWP	budgeted cost of work performed
BCWS	budgeted cost of work scheduled
BDR	Basic Data Recorder
BFD	Basis for Design
BG&H	Bond Gold and Hydrosearch
BGRA	Branch of Geologic Risk Assessment
BIG	Branch of Isotope Geology
BLM	Bureau of Land Management
BP	before present
BPA	blanket purchase agreement
BPO	blanket purchase order
BPG	Branch of Petroleum Geology
BQA	Branch of Quality Assurance
BRC	below regulatory concern
BRG	Branch of Central Regional Geology
BSP	balanced cross section modeling program
C/SCR	Cost and Schedule Change Request
C&C	consultation and cooperation
CA	Construction Authorization
CADD	Computer-Aided Drafting and Design
CAE	Computer-Aided Engineering
CAM	Cost Account Manager
CAP	cost account plan
CAR	Corrective Action Report
CASY	Committee for the Advancement of Science in the YMP
CATS	Corrective Action Tracking System
CBI	Controlled Blasting Investigation
CCB	Change Control Board
CCC	Configuration Control Committee
CD	Consultative Draft
CDP	Career Documentation Profile
CDR	Conceptual Design for the Repository
CFR	Code of Federal Regulations
CFS	cubic feet per second
CGC	Center for Geoscience Computing
ChemTrec	Chemical Transportation Emergency Center
CHLW	commercial high-level waste
CIRF	Configuration Identification Request Form
CMR	Branch of Central Mineral Resources
COB	close of business
COCORP	Consortium for Continental Reflection Profiling
CODMU	Computer Operations and Data Management Unit
COGS	Computer-Oriented Geological Society
COSIM	conditional simulation
CPR	Cost Performance Report
CR	Central Region
CRF	Central Records Facility
CRF	Comment Response Form
CRG	Central Regional Geology
CRGB	Central Regional Geology Branch

CRW ..... comment resolution workshop  
 CSCS ..... Cost Schedule Control System  
 CSI ..... Campbell Scientific, Inc.  
 CSM ..... Colorado School of Mines  
 CVO ..... Cascade Volcanoes Observatory  
 CWP ..... Center for Wave Phenomena  
 CY ..... calendar year  
 D&E ..... development and evaluation  
 DAA ..... Design Acceptability Analysis  
 DAS ..... data acquisition system  
 DCP ..... data collection platform  
 DDP ..... Director's Decision Plan  
 DEC ..... Digital Equipment Corporation  
 DECUS ..... Digital Equipment Corp Users Group  
 DEIS ..... Draft Environmental Impact Statement  
 DFC ..... Denver Federal Center  
 DHLW ..... defense high-level waste  
 DISA ..... Downhole Instrument Station Apparatus  
 DMS ..... Desktop Mapping System  
 DOE ..... Department of Energy  
 DOE/HQ ..... Department of Energy Headquarters  
 DOE/NV ..... Department of Energy/Nevada Operations Office  
 DOE/NVO ..... Department of Energy/Nevada Operations Office  
 DOP ..... Department Operating Procedures  
 DOT ..... Department of Transportation  
 DR3M ..... Distributed Routing Rainfall-Runoff Model  
 DRC ..... Document and Records Center  
 DRI ..... Desert Research Institute  
 DRMS ..... Data Records Management System  
 DRS ..... document review sheet  
 DTN ..... document transmittal notice  
 DTP ..... Detailed Test Plan  
 DWMD ..... Defense Waste Management Department (REECo)  
 DWPF ..... Defense Waste Processing Facility  
 DVNM ..... Death Valley National Monument  
 EA ..... Environmental Assessment  
 EAC ..... estimate at completion  
 EAEG ..... European Association of Exploration Geophysicists  
 EBS ..... engineered barrier system  
 ECD ..... electron capture detector  
 ECR ..... Engineering Change Report  
 EDBH ..... engineered design borehole  
 EDF ..... Environmental Defense Fund  
 EDM ..... Equivalent Discontinuum Model  
 EDXRF ..... energy-dispersive x-ray fluorescence  
 EEI ..... Edison Electric Institute  
 EEP ..... Emergency Evaluation Plan  
 EFAP ..... Environmental Field Assessment Plan  
 EIA ..... Emergency Information Administration  
 EIS ..... Environmental Impact Statement  
 EKES ..... Electronic Keyed-Entry System  
 EM ..... electromagnetic

## ACRONYM LIST

A&E	architectural and engineering
ABC	American Borate Corporation
ACD	advanced conceptual design
ACM	alternative conceptual model
ACNW	Advisory Committee on Nuclear Waste
ACP	Area Characterization Plan
ACSR	Activity Control Specification Report
ACS	American Chemical Society
ACWP	actual cost of work performed
ADN	Affected Document Notice
ADP	automated data processing
ADTS	Automated Data Tracking System
AEC	Atomic Energy Commission
AECB	Atomic Energy Control Board
AECL	Atomic Energy of Canada, Ltd.
AEG	Association of Engineering Geologists
AFOS	Automated Field Operating System
AFR	Audit Finding Report
AGU	American Geophysical Union
AIH	American Institute of Hydrology
ALARP	as low as reasonably possible
ALTS	Apache Leap Tuff Site
AMA	Assistant Manager for Administration
AMFM	alternative means of financing and managing
AML	Arc Macro Language
AMP	Administrative Management Procedure
ANS	American Nuclear Society
ANSI	American National Standards Institute
ANSTO	Australian Nuclear Science and Technical Organization
AO	Administrative Officer
AP	Administrative Procedure
APQ	Administrative Procedure Quality
ARR	Area Recommendation Report
ARS	Automated Records System
ASA	American Statistical Association
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASR	Annual Status Report
ASTM	American Society for Testing and Materials
AT	acoustic televiewer
ATC	Asynchronous Terminal Concentrator
ATLAS	Alternatives to License Application Strategies
ATS	Activity Tracking System
AVL	Approved Vendors List
AVS	Application Visual System
BA	Biological Assessment
BAC	budgets at completion
BAMG	Branch of Atlantic Marine Geology

EMP	electron-microprobe
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ERC	Engineering Request Change
ERDA	Energy Research and Development Administration
EROS	Earth Resource Observatory System
ERTP	Environment Requirements Training Program
ES	exploratory studies
ESF	Exploratory Studies Facility
ESF/DRD	Exploratory Studies Facility Design Requirements Document
ESR	electron spin resonance
ESSE	Early Site Suitability Evaluation
ESTC	Exploratory Studies Test Coordination
ESTP	Exploratory Studies Test Plan
ESTP-C	Exploratory Studies Test Plan Committee
ET	evapotranspiration
EV	earned value
FEHMS	Finite Element Heat Mass and Stress
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FFS	Federal Financial System
FFT	Fast-Fourier Transform
FID	Flame Ionization Detector
FIS	Federal interim storage
FITS	Facilities Important to Safety
FMMG	Fracture Matrix Mesh Generator
FMN	Fortymile neutron
FOLD	Federally Owned Landsat Data
FP	final procedures
FPC	final procurement and construction
FQI	Federal Quality Institute
FR	Federal Register
FRD	Functional Requirements Document
FRHP	Fractured Rock Hydrology Program
FSU	Florida State University
FTE	full-time equivalent
FWP	field work proposal
FY	fiscal year
GAO	Government Accounting Office
GAP	Geostatistical Analysis Package
GC	gas chromatograph
GCM	Global Climate Model
GCP	Geochronological Procedure
GD	Geologic Division
GEMLink	General Electric Microwave (communications) Link
GEOEAS	Geostatistical Environmental Software
GET	General Employee Training
GETT	grants equal to taxes
GID	Ground Water Site Investigation
GIS	Graphic Information System
GIT	Geochemistry Integration Team
GMP	Geologic Modeling Program

GMS	Geoscience Modeling System
GMT	Greenwich Mean Time
GOCO	government-owned contractor-operated
GOES	Geostatistical Environmental Operational Satellite
GP	Geologic Procedure
GPO	Government Printing Office
GPP	Geophysical Procedure
GPR	ground-penetrating radar
GPS	global positioning satellite
GQA	Graded Quality Assurance
GRESS	Gradient Enhanced Software System
GSA	Geological Society of America
GSA	General Services Administration
GSIS	Geoscientific Information System
GSP	Geologic Studies Program
GTUF	G-Tunnel Underground Facility
GW	ground water
GWE	Gigawatts Electrical
GWTT	ground water travel time
GXP	Geochemical Procedure
HIP	Hydrologic Investigations Program (formerly NHP)
HITF	Hydrology Integration Task Force
HLRW	high-level radioactive waste
HLRWM	High-Level Radioactive Waste Management
HLW	high-level waste
HP	Hewlett Packard
HF	Hydrologic Procedure
HQ	Headquarters
HRF	Hydrologic Research Facility
HRMP	Hydrology and Radionuclide Migration Program
HRU	hydrologic-response unit
HSPF	Hydrological Simulation Program
IBM	International Business Machines
IC	ion chromatograph
ICE	Independent Cost Estimate
ICG	International Geologic Congress
ICIAM	International Conference on Industrial and Applied Mathematics
ICN	Interim Change Notice
ICWG	Interface Control Working Group
IDAS	Integrated Data Acquisition System
IDS	Information Data System
IFS	Iterated Function System
IG	Integration Group
IGIS	Interactive Graphics Information System
IGT	Institute of Gas Technology
IHLWM	International High Level Radioactive Waste Management
IMS	Information Management System
INEL	Idaho National Engineering Laboratory
INSTAAR	Institute of Arctic and Alpine Research
INTRAVAL	International Transport Code Validation
IPA	Intergovernmental Personnel Act

IR	infrared
IRG	Interagency Review Group
ISA	Instrument Society of America
ISD	Information Systems Division
ISM	Interactive Surface Modeling
ISO	International Standards Organization
ITR	Information Technology Resources
IVV	Independent Verification and Validation
JGR	<i>Journal of Geologic Research</i>
LA	license application
LACT	laser alignment and centering target
LAN	local area network
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley Laboratories
LCS	Liquid Scintillation Counter
LDRP	litigation discovery request procedure
LDS	lightning detection system
LLNL	Lawrence Livermore National Laboratory
LLP	Lightning Location & Protection, Inc.
LLW	low-level waste
LOE	level of effort
LPRS	large plot rainfall simulation
LRC	Local Records Center
LRE	latest revised estimate
LRGS	Local Read-Out Ground Station
LRP	long-range plan
LRP/IPS	Long Range Plan/Integrated Project Schedule
LRS	Litton Resource System
LSC	liquid scintillation counter
LSP	laser safety plan
LSS	Licensing Support System
LWS	Lathrop Wells aeromagnetic survey
LV	Las Vegas
MAs	Management Agreements
MADS	Meteorological Alert Distribution System
MCL	Maximum Contaminant Level
MEDA	Meteorological Data Acquisition Network
MFC	mass flow controller
MGDS	Mined Geologic Disposal System
MISIS	Micro Integrated Storm Information System
MOA	Memorandum of Agreement
MODFE	Modular Finite Element
MOU	Memorandum of Understanding
MPBH	multipurpose borehole
MPM	Management Procedure Manual
MPU	Manuscript Prep Unit
MRIR	Material Receiving and Inspection Report
MRS	monitored retrievable storage
MSA	major system acquisition
MSHA	Mine Safety and Health Administration
MSIS	Management System Information Strategy

MSL	mean sea level
MSS	Multispectral Scanner
MT	magneto-telluric
M&TE	measuring and test equipment
MTL	materials testing laboratory
mtl	main test level
MTU	metric tons of uranium
MW	mixed waste
NARUC	National Association of Regulatory Utility Commissioners
NBMG	Nevada Bureau of Mines and Geology
NBS	National Bureau of Standards (now NIST)
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NCR	Nonconformance Report
NCTM	National Computer Technology Meeting
NEA	Nuclear Energy Agency
NEPA	National Environmental Policy Act
NFS	Nuclear Fuel Services
NGS	National Geodetic Survey
NIST	National Institute of Standards and Technology
NLT	no later than
NMD	National Mapping Division
NMIMT	New Mexico Institute of Mining and Technology
NNWSI	Nevada Nuclear Waste Storage Investigation
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRP	National Research Program
NSTF	near-surface test facility
NTC	National Training Center
NTS	Nevada Test Site
NTSO	Nevada Test Site Office
NVO	Nevada Operations Office
NWF	Nuclear Waste Fund
NWIS	Nevada Water Information System
NWIS	National Water Information System
NWM	Nuclear Waste Management
NWN	<i>Nuclear Waste News</i>
NWPA	Nuclear Waste Policy Act
NWPO	Nuclear Waste Projects Office
NWQL	National Water Quality Laboratory
NWTRB	Nuclear Waste Technical Review Board
OBS	organizational breakdown structure
OCRWM	Office of Civilian Radioactive Waste Management
OEVE	Office of Earthquakes, Volcanoes and Engineering
OFR	open-file report
OGR	Office of Geologic Repositories
OMB	Office of Management and Budget
OMR	Office of Mineral Resources
OPCNM	Organ Pipe Cactus National Monument
OPFM	Office of Project and Facilities Management

OPIO	Office of Policy, Integration, and Outreach
ORM	Office of Resource Management
ORNL	Oak Ridge National Laboratory
OSTS	Office of Storage and Transportation Systems
OWQSU	Ocala Water Quality Services Unit
P&S	planning and scheduling
PA	performance assessment
PACE	Performance Assessment Calculation Exercise
PACS	Planning and Control System
PAGEOPH	<i>Pure and Applied Geophysics</i>
PAGIS	Performance Assessment of Geological Isolation Systems
PAL	Project Acronym List
PAMP	Performance Assessment Management Plan
PAP	Performance Assessment Plan
PASP	Performance Assessment Strategy Plan
PBEI	prototype blast effects on instrumentation
PBS	pyramid beam splitter
PC	personal computer
PCBI	Prototype Controlled Blasting Investigation
PCCB	Program Change Control Board/Project Change Control Board
PCM	pivoting camera mount
PCSB	Program Cost and Schedule Baseline/Project Cost and Schedule Baseline
PC&TS	Program Coordination and Technical Support
PD	Position Description
PDA	Participant Data Archives
PDCR	prototype dry coring of rubble
PDHI	prototype drill hole instrumentation
PDM	Problem Definition Memorandum
PDS	Project Decisions Schedule
PEET	prototype excavation effects test
PI	Principal Investigator
PIP	Prototype Investigation Plan
PIR	Precision Infrared Radiometer
PL	Public Law
PMB	Performance Measurement Baseline
PMF	probable maximum flood
PMI	Phase Measuring Interferometry
PMIS	Program Management Information System
PMP	Program Management Plan/Project Management Plan
PMR	performance measurement review
PMS	Program Management System
PNL	Pacific Northwest Laboratories
PPWE	prototype pore-water extraction
PQM	Project Quality Management
PRBP	project review briefing package
PRDA	Program Research and Development Announcement
PRESS	Project-related Engineering and Scientific Studies
PRMS	Precipitation Runoff Modeling System
PSAR	Preliminary Safety Analysis Report
PSI	pounds per square inch

PTP	Prototype Test Plan
PTS	Petroleum Testing Services
QA/QC	quality assurance/quality control
QA	Quality Assurance
QAG	Quality Assurance Grading
QAGR	Quality Assurance Grading Report
QALA	Quality Assurance Level Assignment
QALAS	Quality Assurance Level Assignment Sheet
QAM	Quality Assurance Manager
QAP	Quality Assurance Program
QAPD	Quality Assurance Program Description
QAPO	Quality Assurance Project Officer
QAPP	Quality Assurance Program Plan
QAR	Quality Assignment Records
QARD	Quality Assurance Requirements Document
QASC	Quality Assurance Support Contractor
QMP	Quality Management Procedure
QMPR	Quality Management Policies and Requirements
QRA	Quality Related Activities
QRB	Quality Review Board
QVC	Quality Verification Check
R&D	research and development
R&H	receiving and handling
R&LSD	Research and Laboratory Services Division
RALD	right angle laser deflectometer
RAM	responsibility assignment matrix
RASA	Regional Aquifer Study Assessment
RASRA	radial arm strike rail assembly
RCR	Regional Characterization Report
RCRA	Resource Conservation and Recovery Act
REBS	Radiation Energy Balance Systems
REECo	Reynolds Engineering and Electrical Company
RFP	Request for Proposal
RGEG	Research Grade Evaluation Guide
RIB	Reference Information Base
RIDS	Record and Information Disposition Schedule
RIS	Records Information System
RMF	Records Management Facility
RMNMD	Rocky Mountain National Mapping Division
RMP	Records Management Plan
RMS	Records Management System
ROD	Record of Decision
RPC	Report Package Collection
RQPG	right angle prism goniometer
RRL	reference repository location
RSED	Regulatory and Site Evaluation Division
RSN	Raytheon Services Nevada
RTISA	request to initiate site activity
RW	radioactive waste
RWMNFC	Radioactive Waste Management and the Nuclear Fuel Cycle
RWMS	Radioactive Waste Management Site
s-p	surface-propagated

SA	summary account
SAG	Software Advisory Group
SAGEEP	Symposium on the Application of Geophysics to Engineering and Environmental Problems
SAIC	Science Applications International Corporation
SAR	Safety Analysis Report
SAS	Statistical Analysis System
SBTFRD	Surface-Based Test Facility Requirements Document
SBTP	Surface-Based Test Prioritization
SCA	Site Characterization Analysis
SCC	substantially complete containment
SCI	Software Configuration Items
SCIF	software checklist and indexing form
SCMS	Software Configuration Management System
SCP	Site Characterization Plan
SCPB	Site Characterization Program Baseline
SDR	Standard Deficiency Report
SDRD	Subsystems Design Requirement Document
SE	Senior Engineer
SE&D	Systems Engineering and Development
SEG	Society of Exploration Geophysicists
SEM	scanning electron microscopy
SEMP	System Engineering Management Plan
SEPDB	Site and Engineering Properties Data Base
SES	Scientific and Engineering Software
SF	spent fuel
SG	Senior Geologist
SGB	Southern Great Basin
SGBSN	Southern Great Basin Seismic Network
SGR	Seismic Group Recorders
SIP	Scientific Investigation Plan
SIR	Scientific Investigations and Research
SIR	Special Investigative Review
SIT	Site Integration Team
SKB	Swedish Nuclear Fuel and Waste Management Company
SMF	Sample Management Facility
SMS	Sample Management System
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SNP	Scientific Notebook Plan
SNSN	Southern Nevada Seismic Network
SOBART	Southern Basin and Range Transects
SOC	Sample Overview Committee
SOIR	status of open items report
SOP	Standard Operating Procedure
SP	Seismic Procedure
SP	Study Plan
SPA	Study Plan Assessment
SPE	Society of Petroleum Engineers
SPOC	submersible pressurized outflow cell
SPR	Semi-annual Progress Report
SPR	Software Problem Report

SPRS	small plot rainfall simulation
SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
SRD	system requirements and description
SRG	strike rail goniometer
SRM	standard reference material
SRR	Site Recommendation Report
SSF	software summary forms
SSF	specified software forms
SSR	Site Selection Report
SSSA	Soil Science Society of America
STC	Southern Tracer Complex
SWO	stop-work order
SZ	saturated zone
T&MSS	Technical and Management Support Services
T&MSS SP	T&MSS Standard Practice Procedure
TAR	Technical Assessment Review
TBD	to be determined
TBM	Tunnel Boring Method
TC	Technical Contact
TC	Training Coordinator
TCD	thermal conductivity detector
TCP	telescoping camera pedestal
TCPAL	Thermocouple Psychrometer Calibration
TDAG	Technical Data Advisory Group
TDB	Technical Data Base
TDD	Test Descriptions Document
TDF	task definition form
TDIF	Technical Data Information Form
TDR	time domain reflectometry
TDS	total dissolved solids
TEF	Test and Evaluation Facility
TESS	TRW Environmental Safety Systems
TFA	Temporary Field Assistant
TIC	Technical Information Center
TM	thematic mapper
TP	Technical Procedure
TPEC	Technical Proposal Evaluation Committee
TPO	Technical Project Officer
TPP/JPP	Test Planning Package Job Planning Package
TPT	Testing Prioritization Task
TQM	Total Quality Management
TRIG	Technical Review and Integration Group
TRIMS	Technical and Regulatory Information Management System
TRU	Transuranic
TSR	Technical Status Report
TVA	Tennessee Valley Authority
UARW	Upper Amargosa River Watershed
UNE	Underground Nuclear Explosion
UNLV	University of Nevada, Las Vegas
UNR	University of Nevada, Reno

UNRSL	University of Nevada, Reno Seismic Laboratory
UPS	Uninterrupted Power Supply
URL	underground research laboratory
USBLM	U.S. Bureau of Land Management
USBR	U.S. Bureau of Reclamation
USDI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USNSN	U.S. National Seismic Network
UTM	Universal Trans Mercator
UZ	unsaturated zone
UZFRHP	Unsaturated Zone Fractured Rock Hydrology Project
UZIG	Unsaturated Zone Interest Group
UZN	unsaturated zone neutron
UZSBP	Unsaturated Zone Surface-Based Borehole Project
VAR	Variance Analysis Report
VARS	Video Archival Retrieval System
VLF	very low frequency
VOC	Validation Oversight Committee
VOG	Validation Oversight Group
VSP	vertical seismic profiling
WA	Western Atlas
WAC	Waste Acceptance Criteria
WAS	Work Authorization Submission
WAS/FWP	Work Authorization System/Field Work Proposal
WBS	work breakdown structure
WIPP	Waste Isolation Pilot Plant
WMNFC	Waste Management and Nuclear Fuel Cycle
WMSD	Waste Management Systems Description
WNRE	Whiteshell Nuclear Research Establishment
WORM	Write Once Read Many
WP	waste package
WP	Weapons Program
WPDRD	Waste Package Design Requirements Document
WRCC	Western Region Climate Center
WRD	Water Resources Division
WRG	Western Region Geology
WRI	Water Resources Investigations
WRIR	Water Resources Investigations Report
WRR	Water Resources Research
WSA	Wilderness Study Area
WSNSO	Weather Service Nuclear Support Office
WSP	Water Supply Paper
WT	water table
WVDP	West Valley Demonstration Project
WY	water year
XRD	x-ray defraction
XRF	x-ray fluorescence
YM	Yucca Mountain
YMP	Yucca Mountain Project
YMPB	Yucca Mountain Project Branch

YMPO ..... Yucca Mountain Project Office

## 1.2.3 SITE

### OBJECTIVE

To characterize Yucca Mountain and vicinity to identify and technically qualify a possible site for the construction and operation of a mined geologic repository for high-level radioactive waste.

#### WBS 1.2.3.1 Coordination and Planning

Principal Investigator - L. Hayes

### OBJECTIVE

To coordinate and plan the work performed within the site WBS elements.

#### M&I - Geologic Studies Program 0G3193G1

Summary Account Manager - J. Stuckless

#### ACTIVITIES AND ACCOMPLISHMENTS

J. Stuckless worked on a sole source justification for a contract with UNRSL to run the seismic net at NTS and a sole source justification for work with DRI. Stuckless attended a meeting on cost reduction in the testing program with other participants and the M&O in Las Vegas. Stuckless also completed drafts of three task agreements with the USBR, and eleven MOAs with Geologic Division Branches and submitted them to Headquarters for approval.

J. Stuckless completed his section of two papers for the High Level Nuclear Waste Conference, and began work on reviewing the Parameter Dictionary.

#### M&I OA Implementation GSP 0G3193G2

Summary Account Manager - J. Stuckless

#### ACTIVITIES AND ACCOMPLISHMENTS

Coordination continued for orientation, training, calibration tracking, document control, and personnel qualifications for new GSP personnel; follow-up and tracking of overdue DTNs and instruction assignments. Management review of QMPs and QMP Modifications was conducted, TDIFs and data records package segments were prepared and reports reviewed, and review of SP 8.3.1.15.1.8 was completed.

A Management Agreement with the USGS Carson City District was drafted for conducting a shallow refraction profile.

Investigation and monitoring continued of the status of controlled property that has been transferred or must be transferred from the Branch of Earthquake and Landslide Hazards (BELH), formerly the Branch of Geologic Risk Assessment, to the YMPB.

Technical procedure GPP-20, R3, *Measurement of subsurface temperature*, is currently in technical review. Preparation of GP-50, R0, *Subsurface mapping, oil-industry style*, has been cancelled and the number has been reassigned to USBR technical procedure, *Photogeologic evaluation of faults using conventional and low-sun-angle vertical aerial photographs*, and is being prepared for review and approval. The following technical procedures are being prepared per the author's instructions:

SP-18, R0	The application of seismic-refraction techniques to hydrologic studies
GCP-25, R0	Determination of chemical composition by energy dispersive x-ray fluorescence spectrometry

Twelve MOAs are currently being tracked from QA review to signature approval. Pending records packages consisting of the QA review documentation have been prepared and submitted to the LRC.

A supplemental response indicating investigative and remedial actions has been completed for USGS-NCR-92-38 (procurements made without MOA approval) and submitted to the QA Office for approval. Two records packages covering the involved procurements were compiled and submitted to the LRC.

M&I - Hydrology Program Management and Administration 0G3193H1  
Summary Account Manager - D. Gillies

ACTIVITIES AND ACCOMPLISHMENTS

All 62 USGS and LBL hydrology summary-account schedules were statused as of the end of December using schedule-status, progress, and variance information provided by each summary-account manager. Three accounts showed relatively small negative schedule variances, none of which have any significant long-term impact on major milestones. Several accounts showed relatively small cost variances caused by administrative delays in the execution of pending contracts and in the filling of personnel vacancies.

Detailed spending plans for all hydrology summary accounts were reviewed and summarized for the USGS TPO. Activities that were short of funds were identified and a plan of action for each was developed.

A joint meeting of hydrologic and geologic investigators working on the Quaternary regional hydrology study was held to coordinate activities. Potential drill sites for the DRI in lake and marsh deposits were a primary topic of discussion.

A symposium on the Little Skull Mountain Earthquake was held January 13, 1993 under sponsorship of the Committee for the Advancement of Science at Yucca Mountain (CASY). D. Luckey prepared a detailed report of the meeting for L. Hayes, USGS TPO.

On January 14, 1993, D. Appel and D. Luckey met with E. Price (Geotrans, Inc.) and G. Juniel (Raytheon) to discuss coordination between the Yucca Mountain Project (YMP) and the DOE-Weapons Environmental Restoration Program (ERP). It was agreed that there is a fair amount of overlap at the regional level with YMP being considerably ahead of ERP.

Hydrology-program management met with the USGS TPO and Data Coordinator on January 14, 1993 to discuss various data issues. A strategy to implement DOE and NRC data submittal requirements was discussed at length. Ways to speed release of USGS data also was a major topic of discussion.

A FY93 schedule for the submittal of TDIFs for hydrologic data was reviewed by hydrology-program management staff in cooperation with the USGS Data Coordinator.

D. Gillies reviewed and edited criteria sheets for hydrology-program level 3 and 4 PACS milestones. These criteria sheets were requested by the M&O.

D. Appel and D. Gillies visited the Nevada Subdistrict Office in Las Vegas January 20, 1993 to discuss the recent USGS technical review of the Yucca Mountain runoff and streamflow project. It was agreed that YMP surface-water records will be processed on a current basis and be published in the Nevada annual water-data report. Plans for the paleoflood activity also were discussed.

B. Dudley, Z. Peterman, and D. Luckey, as the Executive Subcommittee of the Committee for the Advancement of Science at Yucca Mountain (CASY) met on January 26, 1993 to complete revision of the CASY charter. The next day they met with L. Hayes, USGS TPO, who accepted the revised charter after discussing minor changes.

Task agreements with the USBR for support of two hydrology activities (C-holes testing equipment and UZ hydrochemistry gas sampler) were finalized and transmitted to USBR for signature on January 27, 1993.

Hydrology-program management staff reviewed the status of first- and second-quarter FY93 milestones for all hydrology summary accounts. Status information was provided to the USGS TPO on January 29.

D. Gillies prepared a memorandum outlining concerns regarding the collection of ground-water quality data by the YMP Environmental Program's Water Resources Monitoring Project.

M&I QA Implementation, Hydrology 0G3193H2

Summary Account Manager - W. Causseaux

ACTIVITIES AND ACCOMPLISHMENTS

Technical Procedure:

S. Frans of HIP is currently processing 34 hydrologic procedures and scientific notebook plans.

HIP Technical Procedures - 254, R0 and 256, R0 were approved.

The following preliminary draft technical procedures, scientific notebook plans, and/or modifications were prepared or changed as requested and returned to HIP:

- HP-07,R1-M1 Use of a trace gas for determining atmospheric contamination in a dry-drilled borehole
- HP-07, R2 Use of a trace gas for determining atmospheric contamination in a dry-drilled borehole
- HP-60, R3 Method for monitoring water-level changes using pressure transducers and pressure transmitters
- HP-160,R1-M1 Methods for analysis of samples for gas composition by gas chromatography
- HP-160, R2 Methods for analysis of samples for gas composition by gas chromatography
- HP-176, R2 Procedure to collect gas composition samples at selected depth intervals
- HP-177, R2 Operation of a barometric pressure transducer
- HP-192,R1-M1 Shallow soil gas collection
- HP-192, R2 Shallow soil gas collection
- HP-247, R0 Thermistor calibration procedure for pneumatic testing section of unsaturated zone borehole testing program
- HP-248T, R0 Extraction of pore-water from welded and non-welded tuff chips using one-dimensional compression methods
- HP-251, R0 Pressure transducer calibration procedure for pneumatic testing section of unsaturated zone borehole testing program
- HP-253T, R0 Performing various hydrologic tests using prototype pressure transducer and packer assemblies
- HP-255, R0 Determination of water potential using the Decagon Cx-2 water activity

HP-256, R0                    system  
Method for collecting and storing CO<sub>2</sub> gas samples from borehole  
atmosphere or from free air by absorption in a KOH solution

The Technical Procedure Status List was updated and forwarded to the YMP-USGS QA Office.

**Quality Management Procedures:**

S. Boucher, S. Frans, and W. Causseaux reviewed the draft of QMP-6.01, R6.

**Open Items:**

M. Pabst worked with the UZ hydrochemistry staff in preparing and submitting a proposed disposition for USGS-NCR-93-05. The deficiency document stated that an analytical balance was found out of calibration. Pabst conducted investigative actions related to CAR-YM-93-026 (Failure to monitor SF<sub>6</sub> outflow at NRG-6).

USGS CAR-92-04 was closed during January. The CAR documented numerous deficiencies related to Activity 8.3.1.2.2.6.1 (Gaseous Phase Circulation).

SDR-018 was closed during January. The SDR documented a calibration traceability problem with hand-held neutron moisture meter standards.

The HIP Corrective Action for NCR-91-25 regarding incomplete procurement records package was completed by W. Causseaux on January 29, 1993.

**Audits:**

M. Ciesnik prepared the final supplemental response to AFR-92-07-01, pertinent to the contract with the New Mexico Institute of Mining and Technology.

DOE conducted a surveillance on January 13-15, 1993, to assess the closure of USGS-CAR-92-04 on the Gaseous Phase Circulation activity 8.3.1.2.2.6.1.

**Management Agreements:**

S. Boucher renewed the management agreement between HIP-YMPB and H. Claassen via an addendum to the original agreement.

**Data Management:**

S. Boucher transferred a data package containing 4th quarter 1992 water-level data for select wells to C. Westenburg of the environmental program.

**QA Training:**

The HIP QA staff attended training on NQA-1.

S. Frans issued a training matrix for AP-5.1Q.

**Meetings and Travel:**

M. Pabst attended a seminar "Elements of an effective QA Program" and Open Items meetings.

M. Chornack and J. Woolverton traveled to the HRF to assess QA action items pending or in process for activities under the jurisdiction of A. Flint. The QA specialist assigned responsibilities under Flint has vacated the position.

Records Management:

Two HIP Technical Procedure packages were submitted to the LRC by S. Frans, and three HIP abstract and one GSP report packages were submitted to the LRC by J. LaMonaca.

M. Pabst prepared and submitted TDIFs and LRC records (data) packages supporting seven publications generated under activity 8.3.1.2.2.3.2b (vertical seismic profiling).

Computer Operation & Data Management, Hydrology 0G3193H3

Summary Account Manager - C. Washington

ACTIVITIES AND ACCOMPLISHMENTS

I. Novell System

The Computer Operations Unit (COU) is in the process of installing dual ethernet cards in the new file server. The file server will be able to serve as a bridge between the TCP/IP and Novell hubs, eliminating additional hardware and the maintenance associated with it.

The E-mail software upgrade did not allow for unlimited users; therefore, implementation of the new server was delayed until a license was acquired to handle all users.

II. Unix System

Ingres has been successfully installed and tested on the DG file server. After the software was extensively tested, AIS was installed. The Admin section is responsible for testing of this package. As of this date, there has been no response from the Admin section concerning the testing.

Because of the constantly changing hardware requirements of DIS-II for the support of AIS and NWIS-II software, the COU is in the process of upgrading all DG workstation memory and the memory and available disk storage on the DG file server. The upgrade is only what is needed to support AIS and the initial testing of NWIS-II.

III. Hydrologic Research Facility (HRF)

The HRF had numerous problems connecting and transferring data to the HIP LAN. New cables were installed, the hub replaced, and different software installed on all PCs. The HRF is now fully operational and every PC was tested individually.

The COU purchased an extremely fast modem for the transfer of monthly reports, but could not install it because the requested telephone line was not installed.

IV. Field Operations Center (FOC)

Per W. Wilson, the FOC will have a wiring closet installed by March 1, 1993, in order for the building to be networked. If funds permit, all USGS staff can be connected by May 1, 1993.

V. USGS-Branch, Las Vegas

The COU purchased and installed a modem to facilitate faster file transfers between the Las Vegas and Denver offices. The modem was tested and proved to be 4 times faster than the previous one.

C. Washington hand delivered a draft of the ITR Long Range Plan to M. Jones of the YMP IRM. The requirements of USGS and the networking of the USGS-Branch office in Las Vegas was discussed. Jones expressed concerns about the viruses introduced by USGS (Branch) staff to the DOE YMP network. Jones was reassured that the COU was also concerned and had taken steps to eliminate the shipping of the floppy disks to Las Vegas.

Scientific Reports and Project Documents, Hydrology 0G3193H4  
Summary Account Manager - T. Brady

ACTIVITIES AND ACCOMPLISHMENTS

Scientific Reports Processing:

J. LaMonaca, HIP-YMPB, is currently processing 93 YMP-HIP scientific publications, 67 YMP-GSP scientific publications, 8 YMP-LBL scientific publications, and 35 abstracts.

T. Brady completed the HIP review of reports, "*The evaluation of measurement scale using imbibition experiments in volcanic tuff*", by A. Flint, et al.; "*Estimation of water-filled and air-filled porosity in the unsaturated zone, YM, Nevada*", by P. Nelson; "*An inverse procedure for estimating the unsaturated hydraulic conductivities of volcanic tuffs*", by R. Zimmermann, et al.; "*Strontium isotopic evidence for a higher water table at Yucca Mountain*", by B. Marshall, et al.; "*Geophysical investigations of concealed faults near Yucca Mountain, southwest Nevada*", by D. Ponce; "*Isotopic evidence of complex ground-water flow at Yucca Mountain, Nevada*", by Z. Peterman, et al.; "*Structure of Crater Flat and Yucca Mountain, southeast Nevada, as inferred from gravity data*", by H. Oliver, et al.; "*Lead isotopic composition of Paleozoic and late Proterozoic carbonate rocks in the vicinity of YM, Nevada*", by R. Zartman, et al.; "*Isotopic and trace element variability in altered and unaltered tuffs at Yucca Mountain*", by Z. Peterman, et al.; "*The influence of long-term climatic change on net infiltration and recharge at Yucca Mountain, Nevada*", by A. Flint, et al.; "*Seismic reflection profiling, essential geophysical data for Yucca Mountain, Nevada*", by W. Hunter, et al.; "*Earthquake induced water-level fluctuations at Yucca Mountain, Nevada, June 1992*", by G. O'Brien; "*The influence of seasonal climatic variability on shallow infiltration at Yucca Mountain*", by J. Hevesi, et al.; "*Hydrologic responses to earthquakes, June 28-29, 1992, at Yucca Mountain, Nevada*", by G. O'Brien, et al.; "*Structural character of the Ghost Dance Fault, Yucca Mountain, Nevada*", by R. Spengler, et al.; and "*Geoscientific information systems and 3-d hydrogeologic framework models for the Yucca Mountain area, southern Nevada and California, USA*", by C. Faunt, et al.

T. Brady completed the HIP review of abstracts, "*Paleoseismic history of the Paintbrush Canyon Fault in southern Midway Valley, Yucca Mountain, Nevada*", by F. Swan, et al.; "*Photogrammetric analysis of Quaternary hillslope erosion at Yucca Mountain, Nevada*", by J. Coe, et al.; "*Quaternary allostratigraphy of surficial deposit map units at Yucca Mountain, Nevada: A progress report*", by S. Lundstrom, et al.; "*Stratigraphic evidence for multiple small Quaternary displacements on the Bow Ridge Fault at northeast Yucca Mountain, Nye County, Nevada*", by C. Menges, et al.; and "*The development, effect, and record of debris cover on glaciers: implications for paleoclimatic interpretation of glaciated mountain landscapes*", by S. Lundstrom.

Study Plan Status:

The USGS responses to the State of Nevada comments on Study Plan 8.3.1.2.2.7 - Unsaturated Hydrochemistry, were submitted to the YMPO on January 21, 1993.

WBS 1.2.3.2 Geology  
Principal Investigator - J. Stuckless

OBJECTIVE

To conduct geologic investigations to evaluate the suitability of the surface and subsurface environment for siting a nuclear waste repository.

WBS 1.2.3.2.2 Rock Characteristics

OBJECTIVE

To describe present and expected rock characteristics of the Yucca Mountain site and to develop a three-dimensional model of rock characteristics. (SCP Section 8.3.1.4)

WBS 1.2.3.2.2.1 Geologic Framework of the Yucca Mountain Site

OBJECTIVE

To conduct field studies, including surface and subsurface geophysical surveys and geologic mapping on the surface and in the exploratory shaft facility to characterize the geologic framework of the Yucca Mountain site. (SCP Investigation 8.3.1.4.2)

WBS 1.2.3.2.2.1.1 Vertical and Lateral Distribution of Stratigraphic Units within the Site Area

Principal Investigator - R. Spengler

OBJECTIVE

To determine the vertical and lateral variability and emplacement history of stratigraphic units and lithostratigraphic subunits within the Yucca Mountain site area. (SCP Study 8.3.1.4.2.1)

SCP 8.3.1.4.2.1 Vertical & lateral distribution of stratigraphic units LOE Account 0G32211Z93

Summary Account Manager - R. Spengler

ACTIVITIES AND ACCOMPLISHMENTS

Revisions/corrections to PACS work statements continued.

Contract negotiations were conducted with potential vendors on the seismic reflection study at Yucca Mountain. Discussions continued with DOE and NTS staff to clarify safety, security and training requirements.

MOA negotiations continued through the first part of January with all but one MOA completed and awaiting Reston approval.

SCP 8.3.1.4.2.1.1 Surface and subsurface stratigraphic studies of the host rock and surrounding units

0G32211A93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GGU11AA Conduct lithologic logging/synthesize borehole data

D. Buesch and F. Singer completed technical reviews of the 1:6000-scale geologic compiled cross sections depicting the north ramp, south ramp, and the main Topopah-level drift alignments beneath Yucca Mountain. This review included development of detailed structure contours of unit contacts in the Tiva Canyon Member of the Paintbrush Tuff. This method delineates map-scale structure and is used to fill in information from areas where strike and dip measurements are widely separated. In several locations, the strike and dip measured on foliation in the field differ from those determined from the structure contour maps. Differences of orientation emphasize that foliation and unit contacts are not always parallel; the specific reasons for the nonparallelism are under investigation.

A presentation of all efforts toward an integrated computer-interactive lithostratigraphic synthesis of surface and subsurface information was given to DOE, the M&O, EG&G, and other interested parties. This two-day demonstration included an overview of all software tested to date, addressed the advantages and disadvantages of each, presented a synopsis of the data compiled to date from a digitized data base, and reviewed the technical problems involved in such an effort.

J. Nelson and R. Dickerson completed quality assurance checks in January of more data (secondary cross sections and "virtual drill holes") to be incorporated into the computer-based lithostratigraphic study. Quality checks for internal consistency of all structural volumes compiled to date are in progress. Work on new volumes, based on updated data, continues. These constructed structural volumes, bounded by contacts and faults, are the basis for the stratigraphic synthesis.

The preliminary core log from UZ-16 was extended to a depth of 1260 ft in January 1993 with logging of 90 additional feet of core by D. Buesch. The contact between the vitrophyre and lower partially welded tuff in the Topopah Spring Member is at 1165 ft. The contact between nonwelded tuff of the Topopah Spring Member and the tuffaceous rocks of Calico Hills is at 1182 ft. This contact is indicated by the occurrence of quartz as phenocrysts in the rocks of Calico Hills. Textural variations in the tuffaceous rocks of Calico Hills suggest the rocks formed from two or three pyroclastic flow deposits. Zeolitization has altered the glass in the partially welded and nonwelded tuff of the Topopah Spring Member and the tuffaceous rocks of the Calico Hills.

#### 3GGU21AA Conduct isotopic sampling/ analysis/ evaluation/ synthesis

Z. Peterman completed a manuscript entitled "*Isotopic and trace element variability in altered and unaltered tuffs at Yucca Mountain, Nevada*" by Z. Peterman, R. Spengler, F. Singer, and R. Dickerson for submission to the American Nuclear Society's 1993 International High-Level Radioactive Waste Management meeting in Las Vegas.

Z. Peterman met with Harry Reid Center for Environmental Studies Staff (UNLV) including D. Baipier, B. Andrews, K. Stetzenbach, along with M. Powell (DOE) to discuss areas of possible collaboration and potential interest in co-sponsoring a visiting Russian Scientist (Leonid Neymark, Institute for Precambrian Geology and Geochronology). Costs would be shared by the USGS YMPB and UNLV. The discussions were encouraging and negotiations will continue.

Z. Peterman attended a demonstration of the 3-D geologic model, and will attend a subsequent discussion of the project and its milestones on March 12, 1993. Peterman met with A. Simmons (DOE) to discuss a perceived problem of representation of the USGS YMPB Isotope and Geochemistry Support Group.

A. Walker carefully prepared aliquots of 78 outcrop samples of volcanic rocks from the geochemical reference sections at Yucca Mountain for geochemical analysis by K. Stetzenbach (UNLV). Analyses will be extended to a larger number of trace elements which will broaden the baseline data used to evaluate element mobility in YM tuffs. Data obtained by Stetzenbach will also be invaluable in assessing the origin of metal enrichments that occur locally in some of the units.

K. Futa completed measuring unspiked Nd isotopic compositions on HCl-leached Topopah Springs samples from JF-3 drill core and the Highway 95 reference section. Four samples from JF-3 yielded uniform  $^{143}\text{Nd}/^{144}\text{Nd}$  ratios averaging  $0.512058 \pm 0.000012$ . Of the six samples analyzed from the Highway 95 section, three yielded a similar  $^{143}\text{Nd}/^{144}\text{Nd}$  ( $0.523065 \pm 0.000005$ ), while three contain significantly higher ratios ( $0.512113 \pm 0.000014$ ). Results are being evaluated for their implication on stratigraphic variability as well as secondary mobility in the saturated environment. Tuff samples from JF-3 core were leached in dilute acid and prepared for Sr isotopic analysis.

B. Marshall revised the technical procedure GCP-25 *Determination of chemical composition by energy dispersive X-ray fluorescence spectrometry*. The revised procedure was passed on to the QA group for retyping and further comments.

B. Widmann and A. Walker updated and verified XRF geochemical data in the IGG data base including cross-checking with original sample sheets and XRF run sheets.

Quality Assurance

Quality assurance checks for internal consistency and geologic soundness were completed for the basic data (original cross sections, drill hole data, and map data) and the secondary data (secondary cross sections and "virtual drill holes") utilized in the computer-based lithostratigraphic synthesis.

Meetings were held to discuss methods of collecting information for the required measurements for fracture logs from core samples.

Work Performed but not in Direct Support of the Scheduled Tasks

The manuscript entitled "Development of a 3-D lithostratigraphic and confidence model for Yucca Mountain, Nevada," (by D. Buesch, J. Nelson, R. Dickerson, and R. Spengler) to be presented at the American Nuclear Society (ANS) Fourth Annual International High-Level Waste Management Conference in Las Vegas (April 26 to 30, 1993) received final USGS and DOE approval, and is in press.

D. Buesch presented an overview of the lithostratigraphic and confidence activity to date at an unsaturated zone modeling meeting.

D. Buesch and R. Drake attended a one-day workshop led by LANL discussing the new stratigraphic nomenclature and reviewing the characteristics of rocks in the southwest Nevada volcanic field. Buesch and Drake attended a one-day field trip through the eruptive sequence of the rhyolite of Delirium Canyon (also led by personnel from LANL).

D. Buesch, R. Spengler and C. Hunter reviewed a flier written by SAIC Institutional and External Affairs about the Ghost Dance Fault for distribution to the public during tours and general meetings. D. Buesch revised and returned the document to SAIC.

SCP 8.3.1.4.2.1.2 Surface-based geophysical surveys 0G32211B93  
Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU265 Analysis of bids for seismic contract

The evaluation of seismic reflection contract costs continued. Additional requirements and requested information postponed bid submittals to February 16, 1993 to allow bidders time to calculate final bid costs and to respond to information requests.

Quality Assurance

Thirteen key software products of the 38 products to be used by this activity to reduce and interpret potential field data for the YMP were submitted for software QA processing. Four have been approved, GVDAYRED and GVHANDTC (essential for processing gravity data to the point of calculating a Bouguer gravity anomaly) and GVMGREFORM, and GVMGPROFILE (peripheral products). The remaining 25 operational products that will be utilized at other stages of data display and interpretation were introduced into the software QA process.

Planning and Operations

MOA work scope and budget planning continued through January 1993. The MOA covering seismic reflection work has been completed and is awaiting final approval in Reston, VA.

Shot-point staking efforts continued; T. Brocher began work in January with personnel in the field to finalize locations. M. Moses staked locations for off-road shots and clarified adjusted locations for DOE/NTS staff in preparation for pre-activity surveys.

C. Hunter and T. Brocher responded to requests for information for planning and safety, security and operational issues for the reflection work, including meetings and or discussions with D. Edwards (USGS test coordination), M. Corbett and J. Arnold and with DOE/NTS/FOC staff.

Work Performed but not in Direct Support of the Scheduled Tasks

The manuscripts entitled "*Geophysical investigations of concealed faults near Yucca Mountain, southwest Nevada*," (by D. Ponce); "*Structure of Crater Flat and Yucca Mountain, southeastern Nevada, as inferred from gravity data*" (by H. Oliver and K. Fox); and "*Seismic reflection profiling: essential geophysical data for Yucca Mountain, Nevada*," (by W. Hunter, R. Spengler, and T. Brocher) to be presented at the American Nuclear Society (ANS) Fourth Annual International High-Level Waste Management Conference in Las Vegas (April 26 to 30, 1993) received final USGS approval. "*Geophysical investigations of buried volcanic centers near Yucca Mountain, southwest Nevada*," (by V. Langenheim, K. Kirchoff-Stein, and H. Oliver) received final USGS and DOE approval.

T. Brocher's paper ("*Seismic reflection profiling across Tertiary extensional structures in the eastern Amargosa Desert, southern Nevada, Basin and Range Province, United States*"), authored by T. Brocher, M. Carr, K. Fox Jr. and P. Hart) was published in the Geological Society of America Bulletin in January 1993.

SCP 8.3.1.4.2.1.3 Borehole geophysical surveys OG32211C93

Summary Account Manager - P. Nelson

ACTIVITIES AND ACCOMPLISHMENTS

Planning and Operations

The revised MOA for borehole logging activity was completed.

Work Performed but not in Direct Support of the Scheduled Tasks

The paper entitled "Estimation of water-filled and air-filled porosity in the unsaturated zone, Yucca Mountain, Nevada", by P. Nelson, to be presented at the American Nuclear Society (ANS) Fourth Annual International High-Level Waste Management Conference in Las Vegas (April 26 to 30, 1993) received final USGS and DOE approval.

WBS 1.2.3.2.2.1.2 Structural Features within the Site Area

Principal Investigator - R. Spengler

OBJECTIVE

To determine the frequency, distribution, characteristics, and relative chronology of structural features within the Yucca Mountain site area. (SCP Study 8.3.1.4.2.2)

SCP 8.3.1.4.2.2 Structural Features within the Site Area LOE Account OG32212Z93

Summary Account Manager - R. Spengler

ACTIVITIES AND ACCOMPLISHMENTS

Revisions to Task Agreements with USBR were completed and resulted in signed agreements covering technical work in the Surface-Fracture Network Studies (SCP 8.3.1.4.2.2.2) and Geologic Mapping of the Exploratory Studies Facility (SCP 8.3.1.4.2.2.4).

Errors in PACS work statements are being corrected.

R. Spengler participated as a committee member in the DOE workshop on Natural Barriers. Results of the workshop will be used to advise the assessment team as to natural barriers which should be included on the Q list.

SCP 8.3.1.4.2.2.1 Geologic mapping of zonal features in the Paintbrush Tuff OG32212A93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF183A Conduct struct analyses/mapping of fault zones

A. Braun and R. Blackburn set grid points in Split Wash in January; L. Martin and R. Linden began mapping. Eighteen areas were located and six were mapped in Split Wash at a scale 1:240. Increased geologic complexities and unusual inclement weather conditions during November, December, and January have decreased productivity by a little over a third based on the original goal. To date, 24 areas in Split Wash have been mapped.

### 3GGF186A Conduct geologic mapping northeast corner of site area

No field work was performed during January. D. Buesch and R. Dickerson wrote an abstract, "*Intraformation deformation in the Calico Hills Formation exposed near Yucca Mountain, Nevada*" for submittal to the Geological Society of America western regional meeting in Reno, Nevada. This paper summarizes some of the stratigraphic and structural relations in the upper Paintbrush Canyon area. The abstract has been submitted for director's and DOE approval.

### Quality Assurance

Technical review was completed on the technical procedure GP-18, Petrographic Analysis of Volcanic Rocks.

### Planning and Operations

C. Fridrich began preparations for the upcoming field mapping season scheduled for the western side of Yucca Mountain and along the north and south margins of Crater Flat. Preparations included conducting interviews for a student geologic field assistant position and initiating the paperwork for hiring a qualified person on a temporary basis.

R. Dickerson has completed detailed planning for the FY93 geologic mapping activities. R. Drake has been hired to assist Dickerson in mapping the northeast quadrant of the site area.

A. Braun and R. Blackburn met with representatives from DOE and RSN to discuss requirements concerning geologic mapping grids. They concluded that RSN will begin locating area corners in the northeast wing; mapping will continue for several months until entire area is complete.

R. Spengler, A. Braun, D. Buesch, L. Martin, R. Linden and representatives from DOE and the M&O attended a one-day field trip to present current work completed on the Ghost Dance Fault. The report entitled "*Structural characteristics of the Ghost Dance Fault, Yucca Mountain, Nevada*" by R. Spengler, A. Braun, R. Linden, L. Martin, D. Ross-Brown, and R. Blackburn received final Director's approval and was accepted for presentation at the American Nuclear Society Fourth Annual International High-Level Waste Management Conference in Las Vegas (April 26 to 30, 1993).

### Work Performed but not in Direct Support of the Scheduled Tasks

C. Fridrich performed a technical review of the "*Preliminary Map of the Pahute Mesa 30x60 minute quadrangle, Nevada*" by S. Minor and others of the USGS group that contributes to the weapons containment activity. Fridrich was chosen to undertake this review in part to ensure that mapping being done for the Yucca Mountain project in Crater Flat is well integrated with current ongoing mapping efforts in areas immediately to the north on the NTS, Nellis Bombing Range, and adjacent areas.

### SCP 8.3.1.4.2.2.2 Surface-fracture network studies 0G32212B93

Summary Account Manager - M. Fahy

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GGF100 Compile map of Tiva Canyon data area

Three preliminary drawings summarizing existing Tiva Canyon Formation fracture data were prepared and submitted for informal review. M. Fahy continued working on the report; other technical drawings are 10% complete. The outline for "Flow of Data for Analysis" has been submitted to USBR line management for review and comments.

### 3GGF081 Map and analyze Fran Ridge ESF pits area

USBR received survey data (January 1993) acquired by RSN for completion of the clearing of the Pavement 2001. These data provide the topographic base map required by the GP-12 procedure and will be used in subsequent mapping of the pavement. Work to incorporate these data into the P2001 mapping has begun.

#### Quality Assurance

Survey data acquired by RSN for completion of the clearing of the Pavement 2001 will be submitted to USGS PDA and LRC (Denver) as a records requirement after completion of reviews. Data submittal is controlled by schedule in revised PACS.

Paperwork required by USGS QMP 3.03 for DIPS software was submitted to USBR QA Implementation Specialist for transmittal to the YMP Software Configuration Manager. This software will be used in analyses of data for the Tiva Canyon Formation report.

#### Planning and Operations

In support of Geologic Mapping of the ESF, USBR visited the Fran Ridge Pavement 2001 to examine any possible wash overs due to heavy rains occurring at NTS. No damage or wash over of the cleared pavement was evident.

The interagency agreement (MOA/Task Agreement) for surface-fracture network studies received final approval the last week in January 1993.

#### Variations

#### Work Performed but not in Direct Support of the Scheduled Tasks

M. Fahy participated in the DOE/YMP quality assurance surveillance at the North Ramp portal on January 19, 1993.

### SCP 8.3.1.4.2.2.4 Geologic mapping of the exploratory shaft and drifts 0G32212D93

Summary Account Manager - S. Beason

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### Quality Assurance

S. Beason participated in the DOE/YMP quality assurance surveillance at the North Ramp portal on January 19, 1993. The auditors were not able to complete the surveillance since actual mapping did not start until January 20. The surveillance is expected to be completed during the next round of mapping.

#### Planning and Operations

S. Beason, M. Fahy, and P. Burger began geologic mapping of the North Ramp portal for the ESF on January 20, 1993. Four traceline surveys were completed in the portal cut: one horizontal survey and three vertical. Work began on a plan-view map of the exposed geology. Photogrammetry targets were placed on the exposed rock, and overlapping stereophotos were taken by personnel from Johnson-Controls World Services in support of this activity. Mapping of the first round was completed on January 22.

S. Beason attended a meeting in Las Vegas to discuss the basics of a consolidated sampling program for the starter tunnel of the ESF, to minimize the number of personnel required underground and to maximize the results of regular underground schedules. There was discussion of which samples might be taken by the underground mapping team and which samples must be taken by individual PIs. LANL and USGS may utilize the underground mapping team to take general samples and/or alert their PIs when a particular area or zone appears so that sampling can take place.

The interagency agreement (MOA/Task Agreement) for geologic mapping of the Exploratory Studies Facility received final approval in January 1993.

SCP 8.3.1.4.2.2.5 Seismic tomography/vertical seismic profiling OG32212E93

Summary Account Manager - E. Majer

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF041 Incorporate/integrate VSP model with Rock Characteristics

E. Majer, D. Bensch, C. Hunter, design engineers from the M&O, and representatives from DOE and RSN attended a meeting to discuss interfacing work in the NRG holes with the upcoming VSP work. If the work can be done on a "non-interference" basis by both LBL and the others involved with the NRG holes, a VSP will be carried out in NRG-6 to examine the utility of check-shot data for tunnel design criteria. Anticipated results would include internal Poisson ratio and a volumetric estimation of elastic properties.

3GGF045 Develop and validate interpretational code

Work continued on documenting and validating the computer codes ANI90 and BEAM87.

Quality Assurance

All reading and training assignments were completed.

WBS 1.2.3.2.5 Postclosure Tectonics

OBJECTIVE

To supply data on the probability and effects of tectonic initiating events that may alter existing conditions at Yucca Mountain and adversely affect repository performance. (SCP Section 8.3.1.8)

WBS 1.2.3.2.5.3 Changes in Hydrology Due to Tectonic Events

OBJECTIVE

To assess or analyze the possibility that tectonic events could cause changes in existing hydrologic conditions at the Yucca Mountain site. (SCP Investigation 8.3.1.8.3)

WBS 1.2.3.2.5.3.2 Effect of Tectonic Processes and Events on Changes in Water-Table Elevation

Principal Investigator - J. Whitney

OBJECTIVE

To analyze and assess the probability that tectonic initiating events could result in significant changes in the elevation of the water table or potentiometric surface, changes in the hydraulic gradient, the creation of discharge points in the controlled area, or the creation of perched aquifers in the controlled area. (SCP Study 8.3.1.8.3.2)

SCP 8.3.1.8.3.2.5 Effects of faulting on water-table elevation OG32532E93

Summary Account Manager - C. Fridrich

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GAT016 Maintain laboratory/Calibrate equipment

Continued efforts to improve medium term (1-2 hr) temperature stability of temperature calibration baths. Some improvements were noted. Continued tests of high temperature thermal conductivity apparatus. A comparison with the conventional room-temperature apparatus using samples of pure minerals yielded results well within specifications.

Quality Assurance

3GAT013 Continue field measurements

Maintained and updated QA records and completed reading assignments as required.

3GAT016 Maintain laboratory/Calibrate equipment

Removed digital multimeter G-386646 from current YMP equipment list. It was due for recalibration, but not scheduled for use. It will be submitted for recalibration before its next YMP use. Requisitions for required quarterly calibrations were prepared prior to sending the equipment to Intertyme. Continued dialogue with QA specialists on calibration vendors and on calibration of balances, micrometers and vernier calipers.

Planning and Operations

3GAT013 Continue field measurements

Technical review of revised GPP-20 R3 was completed, minor comments resolved, and the procedure sent for QA review.

Variances

3GAT012 Collect core samples/prepare thermal specimens

Work on activity 3GAT012 is pending identification of wells that need additional thermal data. Analysis of existing data is underway but not complete. Collection of samples from new wells is tied to the drilling schedule.

WBS 1.2.3.2.5.5 Information Required by the Analysis and Assessment Investigations of the Tectonics Program

OBJECTIVE

To collect field data called for by analysis and assessment activities in other tectonics investigations to support analyses of volcanic, igneous intrusion, and folding processes. (SCP Investigation 8.3.1.8.5)

WBS 1.2.3.2.5.5.2 Characterization of Igneous Intrusive Features

Principal Investigator - J. Sass

OBJECTIVE

To gather data concerning the presence of thermal anomalies in the area and data on the geochemical and physical effects of intrusions on the surrounding rock. (SCP Study 8.3.1.8.5.2)

SCP 8.3.1.8.5.2.3 Heat flow at Yucca Mountain and evaluation of regional ambient heat flow and local heat flow anomalies OG32552C93

Summary Account Manager - J. Sass

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GTW009 Integrate studies / effects of tectonic processes on water table elevation:

Worked on a draft of the combined study plan for investigations 8.3.1.8.2, 8.3.1.8.3, and 8.3.1.8.4 of the SCP. When complete, this study plan will complete milestone 3GTW009M.

### WBS 1.2.3.2.6 Surface Characteristics

#### OBJECTIVE

To collect information on surface characteristics to determine location and design of repository surface facilities. (SCP Section 8.3.1.14)

### WBS 1.2.3.2.6.2 Soil and Rock Properties of Potential Locations of Surface Facilities

#### OBJECTIVE

To characterize the soil and rock at and near the surface to provide design issues with the necessary geotechnical information to help locate the surface facilities, conduct foundation design analyses, evaluate soil-structure interactions, and evaluate potentially unstable slopes; and provide design issues with hydraulic-related soil information for evaluating erosion potential and infiltration-runoff characteristics. (SCP Investigation 8.3.1.14.2)

### WBS 1.2.3.2.6.2.1 Surface Facilities Exploration Program

Principal Investigator - M. McKeown

#### OBJECTIVE

To conduct an exploration program for characterization of the soil and rock conditions that will influence or be influenced by the construction of the surface facilities. (SCP Study 8.3.1.14.2.1)

### SCP 8.3.1.14.2.1 Surface facilities exploration program OG32621A93

Summary Account Manager - M. McKeown

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GSR005 Conduct field exploration, mapping, drilling, excavation -north ramp

NRG-2, the 60° from horizontal inclined drill hole located on the west side of Exile Hill, reached total depth at 215 ft on January 26, 1993. Compilation of the preliminary core log has begun; depths have not been converted to elevations. The core to a depth of 45 ft is partially welded Rainier Mesa Tuff. From 45 ft to 115 ft there was  $\leq 5\%$  recovery, but ream and core cuttings indicated that this interval is nonwelded Rainier Mesa Tuff. Core recovery was intermittent from 115 ft to 164.6 ft but variations in texture suggest these rocks are part of the pre-Rainier Mesa Tuff sequence of bedded tuffs. Core was not recovered for most of the interval from 164.6 ft to 168.6 ft. Rubble of the Tiva Canyon Member is present in the bottom of this interval. Tiva Canyon Member rocks comprise the core from 168.6 ft to total depth at 215 ft. The contact between the lower lithophysal and lower nonlithophysal zones in the Tiva Canyon Member occurs in this interval; determination of the depth of this contact is in progress.

### Planning and Operations

D. Buesch met with design engineers from the M&O and representatives from DOE and RSN to discuss realignment of the North Ramp, relocation of NRG holes, sample requirements, and geophysical logging. C. Hunter and D. Buesch reviewed the drilling work program for the UE-25 NRG-3 North Ramp borehole and provided comments to RSN. Buesch represented Hunter at the resolution meeting on January 15 in Las Vegas. The USGS corrected the planned rig alignment as the work program was based on an incorrect attitude of the Bow Ridge Fault.

D. Buesch presented an overview of drilling operations and results from NRG-2 and a summary of possible structural geometry of the valley west of the Bow Ridge Fault, with implications for what rocks might be encountered at ramp grade along the north ramp. Buesch illustrated geometric constructions to assist the design and drilling groups in interpretation of geologic constraints impacting drilling difficulties in NRG-2. He presented suggestions for additional drilling at the NRG-2 site to aid in describing subsurface geology along the ramp alignment and to explain lithostratigraphic controls on apparent poor ground penetrated by the NRG-2 hole. A. Girdley (DOE) was assigned to investigate possible modifications to drilling plans to allow additional drilling at NRG-2. Attendees included R. Spengler, D. Ross-Brown, A. Braun, L. Martin, R. Linden and representatives from DOE, RSN, and the M&O.

D. Buesch and C. Hunter continued interaction with L. Thompson (SAIC) concerning choice of geophysical logs and logging protocols for north ramp holes.

R. Spengler, C. Hunter, and D. Buesch met with the M&O ramp design group to discuss details of the transition of responsibility in the Soil and Rock investigations and in responsibility for ramp design. Further teleconference interactions resulted in preliminary choice of rock mechanical testing facilities to support these studies.

### WBS 1.2.3.2.6.2.2 Surface Facilities Laboratory Tests and Material Property Measurements

Principal Investigator - M. McKeown

#### OBJECTIVE

To conduct laboratory tests and material property measurements on representative samples of soil and rock. (SCP Study 8.3.1.14.2.2)

#### SCP 8.3.1.14.2.2 Laboratory test and material property measurements OG32622A93

Summary Account Manager - M. McKeown

### ACTIVITIES AND ACCOMPLISHMENTS

#### Quality Assurance

Work continues on compiling all acquired and developed data information for the TDIF requirements.

#### Planning and Operations

D. Buesch and K. Bhattacharyya discussed special handling of the core from NRG drillholes to preserve in-situ moisture content, and the size and number of samples required for geotechnical testing.

D. Buesch, C. Hunter, conferred with representatives from the M&O, SNL, and DOE regarding physical property testing to be used in NRG holes. Buesch reviewed drilling progress at NRG-2 and presented several possible geologic explanations to interpret the results of the drilling.

D. Buesch submitted a letter to the Sample Overview Committee (SOC) through the USGS SOC representative describing the types of samples needed for geotechnical testing in NRG holes. This letter summarized the final decision of the M&O engineers and representatives from SN', noting that samples for geotechnical tests do not need preservation at moisture conditions, and therefore rescinds a previous request to preserve samples at moisture conditions.

#### WBS 1.2.3.2.8 Preclosure Tectonics

##### OBJECTIVE

To develop an understanding of and to characterize the tectonic events and processes that could impact proposed repository structures, systems, or components considered to be important to safety through the operational phase and that could affect the design and operation of certain structures, systems, and components required for exercising the retrieval option. (SCP Section 8.3.1.17)

#### WBS 1.2.3.2.8.3 Vibratory Ground Motion

##### OBJECTIVE

To develop a seismic-design basis for repository facilities that are important to safety. Provide other information that will facilitate the assessment of the adequacy of the seismic-design basis and the identification of credible accidents that might be initiated by seismic events and lead to the release of radioactive materials. (SCP Investigation 8.3.1.17.3)

#### WBS 1.2.3.2.8.3.4 Effects of Local Site Geology on Surface and Subsurface Motions

##### OBJECTIVE

Determine and model site and systematic effects on surface and subsurface ground motions resulting from the local site geology. (SCP Study 8.3.1.17.3.4)

#### SCP 8.3.1.17.3.4.1 Determine Site Effects From Ground Motion Recording 0G32834A93

Summary Account Manager - J. Whitney

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GSG250 Conduct seismic field experiment #1

12 sites were selected at Yucca Mountain for portable stations. Portable stations were removed from Little Skull Mountain region and readied for redeployment.

##### Quality Assurance

##### 3GSG250 Conduct seismic field experiment #1

Personnel were trained in operating and calibrating REFTEK and EDA portable seismic instruments.

##### Planning and Operations

##### 3GSG101A Gather seismograms from prior studies

##### 3GSG103A Develop initial standard ground motion model

The scope of work was outlined and assigned to a research assistant.

#### WBS 1.2.3.2.8.4 Preclosure Tectonics Data Collection and Analysis

## OBJECTIVE

To provide data and analyses required by other investigations including the assessments of fault displacement and vibratory ground motion that could affect repository design or performance. (SCP Investigation 8.3.1.17.4)

### WBS 1.2.3.2.8.4.1 Historical and Current Seismicity

Principal Investigator - J. Brune

## OBJECTIVE

To compile information on reported and instrumentally recorded earthquakes that characterize the earthquake potential near Yucca Mountain and to attempt to purge explosion and triggered earthquakes related to weapons testing from existing catalogs of instrumentally determined earthquakes. (SCP Study 8.3.1.17.4.1)

### SCP 8.3.1.17.4.1.1 Compile Historical Earthquake Record OG32841A93

Summary Account Manager - J. Brune

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GSM100 Develop method - Peak ground acceleration

Discovered additional very precarious rocks in Solitario Canyon, Yucca Mountain, and Yerington, Nevada, and in Baja California just south of the U.S. border. Made further correlations of precarious rocks with maps of historical seismicity in the west. Removed portable seismic instruments near Little Skull Mountain and transported to Test Cell C for redeployment.

#### 3GSM105 Compile historical earthquake records

Compiled earthquake records and made correlations of precarious rocks with maps of historical seismicity in the west.

### Quality Assurance

#### 3GSM100 Develop method - Peak ground acceleration

Trained personnel in calibration of portable REFTEK instrumentation.

### Planning and Operations

#### 3GSM100 Develop method - Peak ground acceleration

Planned the redeployment of portable instruments around Yucca Mountain for site effect study.

### SCP 8.3.1.17.4.1.2 Monitor current seismicity OG32841B93

Summary Account Manager - J. Brune

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GSM134A Monitor FY93 seismicity

Recorded data from SGBSN for all of January except for a 4-day outage due to triggering software not working on January 21 - 25, 1993. Reviewed TIMIT and HYPOINVERSE programs for use in new VAX recording and analysis system. Installed and formatted two disks for the new VAX system. Reduced the backlog of unpicked events to approximately 20 days. Completed a preliminary comparison of UNR and USGS seismic events bulletins for the month of September 1992. Prepared procedure for and trained seismic analysts developer in reading.

3GSM147A Reduce Little Skull Mtn. Earthquake data

Worked on retrieving data from portable REFTEK instruments and portable EDA instruments.

3GSM140A Prepare 1992 Earthquake catalog

Because of the transfer of the SGBSN, responsibility for this task has been divided. The catalog for the first 9 months of 1992 will be prepared by USGS, BGRA. The remaining 3 months will be prepared by UNRSL. Work commenced on compilation of earthquake data for the first 9 months of 1992.

Quality Assurance

3GSM134A Monitor FY93 seismicity

Installed new "subnet" explicitly for triggered calibration signals. Wrote program to analyze and record station calibration information.

3GSM147A Reduce Little Skull Mtn. Earthquake data

Reviewed Scientific Notebook with QA representative and planned for closeout of notebook.

Planning and Operations

3GSM134A Monitor FY93 seismicity

Reviewed current Yucca Mountain seismic node configuration and planned for UNR use of the data from there. Developed schedule for emergency pager system and wrote the procedures for diagnosing on line recording problems and crashes.

WBS 1.2.3.2.8.4.2 Location and Recency of Faulting Near Prospective Surface Facilities

Principal Investigator - J. Whitney

OBJECTIVE

To identify appropriate trench locations to investigate the possible occurrence of late Quaternary surface faulting in the vicinity of planned critical surface facilities; and using surface and trench mapping, locate sites without evidence of significant late Quaternary faulting. (SCP Study 8.3.1.17.4.2)

SCP 8.3.1.17.4.2.1 Identify appropriate trench locations in Midway Valley 0G32842A93

Summary Account Manager - F. Swan

ACTIVITIES AND ACCOMPLISHMENTS

Variances

3GFP003 Mapping and soil descriptions in Midway Valley

Work on activity 3GFP003 has been delayed so that personnel could complete tasks under 8.3.1.17.4.2.2. Field work on this activity is not expected to be completed until the end of March 1993. No delays in meeting this schedule are anticipated.

SCP 8.3.1.17.4.2.2 Conduct exploratory trenching in Midway Valley 0G32842B93

Summary Account Manager - F. Swan

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFP008 Excavate/log/study trenching near proposed ESF

The field mapping and descriptions of the existing trenches was completed for activity 3GFP008 during this reporting period. Fieldwork included description of soil profiles and review of trench map for the eastern 70 m of TWV-T5.

Quality Assurance

3GFP006 Assemble job packages for trenches

Continued QA training and updates as necessary.

3GFP008 Excavate/log study trenching near proposed ESF

Continued QA training and updates as necessary. There are no known nonconformances or deviations with established QA procedures during this report period.

3GFP021 Clean/modify/relog/study new logs from trench 17

Continued QA training and updates as necessary.

3GFP016 Excavate/log study extensions of trench A-3

Continued QA training and updates as necessary.

Planning and Operations

3GFP006 Assemble job packages for trenches

Work on this activity is not expected to be completed until the end of May 1993. No delays in meeting this schedule are anticipated.

3GFP008 Excavate/log/study trenching near proposed ESF

Planned activities for the February 1993 reporting period include data analysis and initial report preparation. Work on this activity is not expected to be completed until the end of August 1993. No delays in meeting this schedule are anticipated.

3GFP021 Clean/modify/relog/study new logs from trench 17

Fieldwork on this activity will continue into the February 1993 reporting period. Trench mapping should be finished by the end of the reporting period. Work on this activity is not expected to be completed until the beginning of April 1993. No delays in meeting this schedule are anticipated.

3GFP016 Excavate/log/study extensions of trench A-3

Sites for trench locations were submitted to DOE field coordinators for scheduling. Trench excavations will then be scheduled on a priority basis.

Variations

3GFP016 Excavate/log study extensions of trench A-3

No work was done for activity 3GFP016 during the reporting period. The start date for this activity may have to be delayed until trenches are excavated; project personnel were assigned to complete, higher priority, ESF studies in Midway Valley.

WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain

Principal Investigator - J. Whitney

## OBJECTIVE

To identify Quaternary faults within 100 km of Yucca Mountain and to characterize those faults capable of future earthquakes with magnitude such that associated ground shaking could impact design or affect performance of the waste facility. (SCP Study 8.3.1.17.4.3)

### SCP 8.3.1.17.4.3.2 Evaluate Quaternary faults within 100 km of Yucca Mountain 0G32843B93

Summary Account Manager - L. Anderson

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GTQ007B Compile map of Quaternary faults within 100 km/study Beatty scarp

Work continued this month on map compilation. Field verification of the Beatty scarp was begun in conjunction with investigations of the Bare Mountain fault (activity 3GTQ065) and faults SW of Yucca Mountain (activity 3GTQ033B).

#### 3GTQ033B Evaluate faults SW of Yucca Mountain

Field verification of fault scarps and lineaments was conducted in conjunction with verification studies of the Bare Mountain fault (activity 3GTQ065).

### Quality Assurance

#### 3GTQ007B Compile map of Quaternary faults within 100 km/study Beatty scarp

Request was made for YMP-USGS Corrective Action Report (CAR) Board authorization to: 1) conduct surficial geologic mapping of the Bare Mountain fault zone; and 2) conduct reconnaissance verification of existing fault scarps and lineaments of the Death Valley-Furnace Creek and Pahrump-Ash Meadows fault zones. Authorization was received for field verification (reconnaissance) of existing maps or photos at sites including the Death Valley-Furnace Creek and Pahrump-Ash Meadows fault zones. No quality-affecting work can be done until Study Plan 8.3.1.17.4.3 is approved.

#### 3GTQ033B Evaluate faults SW of Yucca Mountain

Received authorization for field verification. See discussion of 3GTQ007B.

### Planning and Operations

#### 3GTQ007B Compile map of Quaternary faults within 100 km/study Beatty scarp

The Task Agreement for USBR to provide technical assistance for Activity 8.3.1.17.4.3.2 was sent on January 21, 1993 to GSP and the YMP-USGS QA office for review, approval, and further processing.

#### 3GTQ033B Evaluate faults SW of Yucca Mountain

Low-sun-angle aerial photographs were received for study of the Pahrump-Ash meadows and Bare Mountain fault zones.

### SCP 8.3.1.17.4.3.4 Evaluate Bare Mountain fault zone 0G32843D93

Summary Account Manager - L. Anderson

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GTQ065 Conduct detailed Quaternary surficial geologic mapping on the east side of Bare Mountain

Verification of faults, lineaments, and surficial deposits was begun this month.

#### Quality Assurance

3GTQ065 Conduct detailed Quaternary surficial geologic mapping on the east side of Bare Mountain  
Request was made for YMP-USGS CAR Board authorization to: 1) conduct surficial geologic mapping of the Bare Mountain fault zone; and 2) conduct reconnaissance verification of existing fault scarps and lineaments of the Death Valley-Furnace Creek and Pahrump-Ash Meadows fault zones. Authorization was received for field verification (reconnaissance) of existing maps or photos at sites including the Death Valley-Furnace Creek and Pahrump-Ash Meadows fault zones. No quality-affecting work can be done until Study Plan 8.3.1.17.4.3 is approved.

#### Planning and Operations

3GTQ065 Conduct detailed Quaternary surficial geologic mapping on the east side of Bare Mountain  
The Task Agreement for USBR to provide technical assistance for Activity 8.3.1.17.4.3.2 was sent on January 21, 1993 to GSP and the YMP-USGS QA office for review, approval, and further processing.

#### WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones

Principal Investigator - J. Whitney

#### OBJECTIVE

To evaluate the potential for ground motion resulting from future movement on Quaternary left-lateral strike-slip faults located east and south of the site area. (SCP Study 8.3.1.17.4.4)

#### SCP 8.3.1.17.4.4.1 Evaluate the Rock Valley fault system 0G32844A93

Summary Account Manager - D. O'Leary

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GTN011 Work on study plan/Conduct fieldwork Rock Valley fault  
Revised interim report: "*Reconnaissance study of strike slip faulting near Yucca Mountain, Nevada*". Submitted revised manuscript to USGS for compliance with editorial standards and for release as an open file report. Continued preparation of data for photo analysis of the Rock Valley fault zone. (Obtained specifications for low-sun angle photography and thermal IR scanning).

##### Planning and Operations

3GTN011 Work on study plan/Conduct fieldwork Rock Valley fault  
Planned acquisition of additional data to analyze possible effects of the June 29, 1992 Little Skull Mountain earthquake. Data include: 1) before and after low-sun-angle photography, and 2) thermal IR imaging, and 3) digital SLAR (radar) images.

##### Work Performed but not in Direct Support of the Scheduled Tasks

Reviewed two manuscripts: 1) "*Preliminary results of fault studies in the Midway Valley area that are relevant to prospective surface facilities of the potential Yucca Mountain repository*", by J. Westling, C. Menges, J. Whitney, F. Swan, M. Angell, and A. Thomas (interim report) 2) "*Rates of Quaternary weathering of colluvium at Yucca Mountain*", by J. Coe, and Whitney (GSA abstract). Approximately four hours were spent per review. Coauthored GSA abstract with C. Fridrich: "*Does the Walker Lane extend through the Nevada Test Site region?*".

Revised study plans for DOE/YMPO/HQ comment resolution. Responded to comments from N. Biggar, M&O/WCFS; approximately two hours spent.

#### WBS 1.2.3.2.8.4.5 Detachment Faults

Principal Investigator - J. Whitney

#### OBJECTIVE

To provide information pertaining to the distribution, displacement rate, and age of detachment faults proximal to Yucca Mountain; and determine whether they represent a significant earthquake source or conceal a significant earthquake source at depth. (SCP Study 8.3.1.17.4.5)

#### SCP 8.3.1.17.4.5.2 Evaluate postulated detachment faults in the Beatty-Bare Mountain area OG32845B93

Summary Account Manager - W. Hamilton

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GTD004B Collect field and lab data - Bare Mountain and Yucca Mountain

3GTD012B Evaluate and conduct mapping, Bare Mountain and Crater Flat

3GTD005B Evaluate extension in Miocene rocks - Bare Mountain and Crater Flat

Field work for these activities will commence in early spring. Preparations were begun for the upcoming field season on mapping along the north and south margins of Crater Flat (at and near the Bare Mountain fault zone). These preparations include interviewing candidates and initiating the paperwork for hiring a field assistant.

##### Work Performed but not in Direct Support of the Scheduled Tasks

C. Fridrich spent two days doing a technical review of the "Preliminary Map of the Pahute Mesa 30 by 60 minute quadrangle, Nevada" by S. Minor and others of the USGS weapons containment group. Fridrich was chosen to undertake this review in part to ensure that mapping being done for the Yucca Mountain project in Crater Flat is well integrated with current mapping efforts that are ongoing in areas immediately to the north on the NTS, Nellis bombing range, and adjacent areas.

#### WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area

Principal Investigator - J. Whitney

#### OBJECTIVE

To evaluate the age and recurrence interval of Quaternary faulting and to analyze the probability of future faulting; to determine which faults moved during the Quaternary; and to assess fault probability on the basis of rates of faulting during the Quaternary. (SCP Study 8.3.1.17.4.6)

#### SCP 8.3.1.17.4.6 Evaluate Quaternary Faulting within the Site Area LOE Account OG32846Z93

Summary Account Manager - C. Menges

#### ACTIVITIES AND ACCOMPLISHMENTS

Completed technical review of HIP journal manuscript on Electromagnetic surveys in Amargosa Valley. Completed reviews of several abstracts (3) on fault studies and surficial mapping in Midway Valley area performed by GSP and Geomatrix staff. Attended CASY symposium on Little Skull Mountain Earthquake in Denver. Prepared Interpersonal Agreement (IPA) for funding work by A. Ramelli of the Nevada Bureau of Mines and Geology for FY93. Prepared employee work plans for

temporary field assistants. Completed table summarizing status of work on existing trenches for the M&O. Coordinated with DOE personnel on scheduling NRC field visit to review trenches in Crater Flat and Stagecoach Road areas (for late March).

SCP 8.3.1.17.4.6.1 Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain

OG32846A93

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GPF026A Complete field mapping/Submit map for review

Copies of the 1:12,000 scale orthophoto overlays were made and transmitted to USGS Las Vegas for informal peer review.

SCP 8.3.1.17.4.6.2 Evaluate age and recurrence of movement on suspected and known Quaternary faults

OG32846B93

Summary Account Manager - C. Menges

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GPF19P Study faults on west & east sides of Busted Butte

Continued to clean exposures and identify and flag contacts and structures on exposures 1,2, and 4 on the west side of Busted Butte.

3GPF035A Study trenches excavated on Yucca Mtn. faults

Conducted field review of completed logs in Trench 14 D (inner wall, north branch and outer wall, southwest branch) with E. Taylor and Geomatrix personnel. Prepared, revised and submitted GSA abstract on completed mapping in Trench 14 D. Worked with Geomatrix personnel in preparing interim report on fault trench studies in Midway Valley. Coordinated with A. Ramelli (co-investigator) in submitting TDIFs, logs and preliminary report on Trench 18 on Solitario Canyon Fault.

Quality Assurance

3GPF035A Study trenches excavated on Yucca Mtn. faults

Worked on submitting TDIFs for completed trench logs. Reviewed and revised field notebooks recording basic field activities related to fault trenches.

Planning and Operations

3GPF035A Study trenches excavated on Yucca Mtn. faults

Scheduled photography and resurveying of vandalized trenches in Crater Flat (T8 and CF-1).

3GPF029A Locate/excavate/log new trenches

Completed detailed list for DOE and M&O personnel of probable and possible trench sites scheduled for FY93. Plotted sites on 1:100,000 scale maps. Project personnel attended field trip on the Ghost Dance fault, conducted field reconnaissance with USGS, DOE, and SAIC personnel on potential trench sites on the Ghost dance Fault.

WBS 1.2.3.2.8.4.10 Geodetic Leveling

Principal Investigator - J. Whitney

**OBJECTIVE**

Evaluate possible historical and contemporary vertical displacements across potentially significant Quaternary faults within 100 km of Yucca Mountain. Characterize the historical rate of uplift and subsidence in the Yucca Mountain region, and evaluate the possible existence of tectonic boundaries that separate domains with differing rates of uplift and subsidence. (SCP Study 8.3.1.17.4.10).

**SCP 8.3.1.17.4.10.1 Relevel base station network 0G3284AA93**

Summary Account Manager - G. Perasso

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

3GTM007J Continue to relevel network and resurvey quadrilaterals

Resurveying of the level-line network continued this month. The distance leveled during this reporting period was 69.2 kilometers, completing 35% of the total level line survey.

**SCP 8.3.1.17.4.10.2 GPS Base - Station Survey 0G3284AB93**

Summary Account Manager - J. Whitney

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

3GTM020 Resurvey GPS base stations

A MOA between USGS, Branch of Tectonophysics in Menlo Park and YMPB was written and signed allowing for the participation of GD personnel in Yucca Mountain activities. Field work for the GPS survey will commence in the spring.

**WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis**

Principal Investigator - J. Whitney

**OBJECTIVE**

To synthesize data relevant to tectonics; and to develop a model or range of models that establishes the causal relationship between application of tectonic forces and formation of structures observed at Yucca Mountain and vicinity; link observed rates of formation of those structures with regional rates of crustal strain; forecast changes in tectonic setting and the manner in which those changes will affect both the regional crustal strain rate and tectonic stability in the Yucca Mountain region; and estimate the effect of those changes on rate and nature of crustal strain at Yucca Mountain and vicinity and the future rate of tectonic processes at Yucca Mountain. (SCP Study 8.3.1.17.4.12)

**SCP 8.3.1.17.4.12.1 Evaluate tectonic processes and tectonic stability at the site 0G3284CA93**

Summary Account Manager - W. Hamilton

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

3GTE074 Prepare study plan

Continued revision of study plan for study 8.3.1.17.4.12, in cooperation with W. Hamilton, USGS, and in preparation for USGS review. Continued creation of bibliography of documents and data sources relevant to synthesis and evaluation of tectonic models.

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GTE045 Evaluate Tectonic models

Two strike-slip fault models have been singled out for consideration, the transfer fault model and the through going, deep-seated, strike-slip fault model. One example of a through going, deep-seated, strike-slip fault was examined in the field. W. Hamilton spent three days evaluating geologic mapping in the "Noble Hills" along the Southern Death Valley fault zone.

WBS 1.2.3.3 Hydrology

Principal Investigator - D. Appel

OBJECTIVE

To conduct hydrologic investigations to evaluate the suitability of the surface and subsurface environment for siting a nuclear waste repository.

WBS 1.2.3.3.1 Geohydrology

OBJECTIVE

To provide information about geohydrologic characteristics, processes, and conditions, both favorable and potentially adverse, to support resolution of the performance and design issues through the development of a credible geohydrologic model of Yucca Mountain and vicinity. (SCP Section 8.3.1.2)

WBS 1.2.3.3.1.1 Description of the Regional Hydrologic System

OBJECTIVE

To develop a conceptual model of the regional hydrologic system to assist in assessing the site's suitability to contain and isolate waste. (SCP Investigation 8.3.1.2.1)

WBS 1.2.3.3.1.1.1 Precipitation and Meteorological Monitoring for Regional Hydrology

Principal Investigator - A. Flint

OBJECTIVE

To characterize the area surrounding Yucca Mountain in terms of precipitation and other meteorological data and their relationship to surface runoff and infiltration; and to provide input into rainfall-runoff model development for the Fortymile Wash drainage basin. (SCP Study 8.3.1.2.1.1)

SCP 8.3.1.2.1.1.1 Precipitation and meteorological monitoring OG33111A93

Summary Account Manager - A. Flint

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GMM035 Collect/analyze synoptic weather/reg/site met data

Data collection continued in January. Site data from the five weather stations were downloaded and reviewed each Monday. Satellite and weather chart data were archived on tape backup every three days. The wet winter continued as several major storms hit the western U.S. during the month. A rather stable low pressure center meandered in the vicinity

of the Washington coast for several weeks early in January. This, coupled with an intrusion of the subtropical jet into southern California, caused heavy precipitation all along the west coast. Much of the precipitation advanced over the Sierra-Nevada and fell at Yucca Mountain and vicinity. Storms occurred on January 2, 6-7, 10, 12-14, and 17-18. Rain gauges at Yucca Mountain recorded from about 2 inches to over 3 inches at some locations from these storms. Most of the precipitation fell as snow at elevations above 4000 feet.

**3GMM038 Prepare technical report FY92 synoptic/reg/site met data**

Work began to reduce the FY92 site data from raw datalogger format to columnar readable format which can be refined into the final report format. Regional and synoptic data were reviewed to determine the best format in which to produce a final report.

WBS 1.2.3.3.1.1.2 Runoff and Streamflow

Principal Investigator - D. Beck

OBJECTIVE

To collect basic data on surface-water runoff at, and peripheral to, Yucca Mountain and its hydrologic flow system; to use the streamflow data to describe the runoff characteristics of the area and assess the response of runoff to precipitation; to assess the potential for flood hazards and related fluvial-debris hazards to the Yucca Mountain Project; and to provide basic data and interpretations of surface-water runoff to investigations that evaluate the amounts and processes of infiltration and ground-water recharge at Yucca Mountain and surrounding areas. (SCP Study 8.3.1.2.1.2)

SCP 8.3.1.2.1.2.1 Surface-water runoff monitoring 0G33112A93

Summary Account Manager - T. Kane

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GRSO28A Apply for site prerequisite survey**

The proposed locations of three planned continuous-recording gages in Upper Fortymile Wash have been relocated to selected sites on Yucca Mountain. Installation of these gages at Yucca Mountain will provide surface-water data in support of current ground-water studies in the unsaturated zone. T. Kane, A. Flint and L. Flint (USGS-HIP), and G. Ryder (DOE) visited Yucca Mountain to locate and inspect potential stream gage sites. Three sites in selected washes were examined and flagged. A memo requesting prerequisite environmental surveillance and permits for the three flagged sites was forwarded to DOE.

**3GRSO30A Complete FY83-85 data report**

Final editing and typing of the FY83-85 draft report was completed by the Nevada District Reports Section. The reports section continued to make some progress on the drafting of additional figures which are planned for inclusion into the report. Final review by the District Chief is tentatively scheduled for the week of February 14, 1993.

**3GRSO31A Complete reduction of FY86-89 data and preparation of report**

Progress has been delayed in the reduction of FY86-89 surface-water data due to extensive field activities associated with runoff within the regional network caused by numerous storms during the month.

### 3GRSO23A Collect FY93 runoff and streamflow activity

A series of large, regional storms from the Pacific Coast passed through southern Nevada during the month. Cumulative precipitation associated with this storm activity ranged from about three to six inches as measured from network precipitation gages. Runoff was observed and documented at the following sites: Fortymile Wash above the confluence with East Cat Canyon, Stockade Wash near Fortymile Wash, Unnamed Tributary to Stockade Wash near Rattlesnake Ridge, Cane Springs Wash, Fortymile Wash at the Narrows, Yucca Wash, Pagany Wash, Topopah Wash, Amargosa River near Beatty, Amargosa River below Beatty at highway 95, Amargosa River at Eagle Mountain, and Amargosa River at Tecopa, California.

Standard and Pygmy meter measurements of discharge were made at Amargosa River at Tecopa and Eagle Mountain, Amargosa River below Beatty, Amargosa River near Beatty, Pagany Wash, Yucca Wash, Cane Springs Wash, and Unnamed Tributary to Stockade Wash near Rattlesnake Ridge. Discharges computed from these meter measurements range from less than 0.10 to about 150 cubic feet per second. These measurements constitute some of the first current meter measurements made on ephemeral washes within the regional network. The data collected as a result of these measurements will provide valuable information on the hydraulic characteristics of runoff in ephemeral channels within a semi-arid environment.

Levels for determining peak discharges by the slope conveyance method were run at Fortymile Wash above the Confluence with East Cat Canyon, Yucca Wash, Cane Springs Wash, Topopah Wash, and Fortymile Wash at the Narrows. Field data collected during these surveys have been compiled and are being processed in the Subdistrict office to determine peak discharge values.

T. Kane presented preliminary results of his recent current meter measurements made at network gaging stations during the month to a gathering of USGS surface-water specialists meeting in the Las Vegas Subdistrict office. Kane's results appear to corroborate other work being investigated within the region and may provide a better understanding of the hydraulic characteristics of runoff in ephemeral channels within the Yucca Mountain streamflow network.

Monthly visits were made to collect streamflow and precipitation data and conduct site maintenance at all network sites. Precipitation gages were zeroed out and current meter measurements were made at Amargosa River at Tecopa and Eagle Mountain, and Unnamed Tributary to Stockade Wash near Rattlesnake Ridge.

### Quality Assurance

#### 3GRSO23A Collect FY93 runoff and streamflow activity

Quality assurance activities conducted by P. Cooley this month include: documentation and tracking of APs, HPs, FOIs, QMPs, and related reading assignments (approx 15 hrs); attendance at QA training for QMP 3.03 and QMP 17.01 (approx 12 hrs); preparation of Quarterly report and TDIF for the environmental monitoring project (approx 8 hrs); preparation of procurement documentation for nonexempt capital equipment for the new gaging sites (approx 20 hrs); and preparation of December's data package for dual storage in the Denver PDA (approx 12 hrs).

### Variations

#### 3GRSO28A Apply for Site Prerequisite Survey

Activity delayed until February 28, 1993 pending environmental clearances by DOE for the three new sites located on Yucca Mountain to support current studies of Unsaturated Zone. This delay will cause activity 3GRSO17A to be pushed back for one month as well.

3GRS030A Complete FY83-85 data report

Activity delayed until February 28, 1993 due to delays with the drafting of additional figures by the reports section in Carson City.

Work Performed but not in Direct Support of the Scheduled Tasks

Water samples from four sites were collected and prepared for shipment to the Denver lab for analyses. (12 hrs)

WBS 1.2.3.3.1.1.3 Regional Ground-Water Flow System

Principal Investigator - J. Czarnecki

OBJECTIVE

To define the potentiometric distribution hydraulic properties, and recharge and discharge for the regional ground-water flow system to determine the magnitude and direction of ground-water flow. (SCP Study 8.3.1.2.1.3)

SCP 8.3.1.2.1.3 Regional Ground Water Flow System LOE Account 0G33113Z93

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Support Project Operations:

J. Czarnecki prepared a spreadsheet to calculate alkalinities from acid-titration data. The spreadsheet automatically plots the volume of titrant against resultant pH and the change in pH per change in volume of titrant, making it easier to pick the endpoints.

M. Ciesnik prepared a requisition request for software and hardware items for the Fortymile Wash study (SCP 8.3.1.2.1.3.3), initiated preparation of the Scientific Notebook for rock samples collected from boreholes, worked on revisions to HP-23, R2 as related to preparation of water samples for tritium analyses and field alkalinity analyses, and participated in the monthly QA open-items meeting and a one-day course on NQA-1.

J. Czarnecki processed and delivered hydrochemical samples to the USGS Water Quality Laboratory obtained from wells in the Amargosa Desert. He also ordered reagents and supplies from USGS Ocala laboratory-supplies warehouse.

J. Czarnecki prepared a letter to California State Lands Commission describing activities at and reclamation of an observation well on the western edge of Franklin Lake playa, Inyo County, California.

Project staff read requisite QA training assignments and documents.

J. Czarnecki prepared a letter to the US Bureau of Land Management outlining the USGS' plans for testing at three mining company boreholes in the Amargosa Desert.

J. Czarnecki performed a technical review of a paper entitled "*Ground-water recharge estimates using a geomorphic-distributed parameter simulation model approach, Amargosa River Basin, Nevada and California*" by W. Osterkamp, L. Lane, and C. Savard.

J. Czarnecki, D. Luckey, C. Fridrich, A. Geldon, and S. Boucher drafted a criteria letter for hydraulic testing of USW-G2 based on recommendations from the Hydrology Integration Task Force.

J. Czarnecki and W. Steinkampf prepared an example of the times needed to clog various pore volumes with CaCO<sub>3</sub> precipitated from tuff water in the saturated zone for elevated temperature regimes.

**Collect FY93 Moisture Data:**

Project staff collect ground-water levels in UE-29 a#1, UE-29 a#2, and UE-29 UZN #91; took readings from rain wedges at UE-29 UZN #91 and #92; and collected neutron moisture logs from UE-29 UZN #91 and #92. Data collection frequency was increased to document ongoing ground-water recharge from rainfall/runoff events in Fortymile Wash. Project staff also assisted meteorology personnel in collecting rainfall readings from nonrecording gages.

SCP 8.3.1.2.1.3.2 Regional potentiometric level distribution and hydrogeologic framework studies

OG33113B93

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRG054 Revise water level data report

M. Ciesnik incorporated final corrections in the report entitled, "*Ground-water altitudes and well data, Nye and Inyo Counties, Nevada-California*", and returned the report for further processing. A TDIF for the report also was prepared.

3GRG011A Test small diameter wells

J. Czarnecki and G. Buchanan prepared plans for testing several small diameter wells in the Amargosa Desert. Czarnecki also checked the status of obtaining permits from the Barstow, California office of the BLM.

3GRG062 Continue preparation of report: Hydrostratigraphy of the Amargosa Desert

J. Czarnecki reviewed borehole locations plotted on a 1:100,000 scale map and discovered discrepancies between actual and plotted locations. No activity has occurred regarding an inquiry made for geophysical and lithologic logs from a mining company for 31 drillholes constructed in the Amargosa Desert. A contract to digitize any forthcoming logs was established. Any logs that are obtained will be evaluated and added to those contained in a draft report entitled "*Lithologic and geophysical logs from U.S. Borax & Chemical Corporation exploration boreholes, Amargosa Desert, Nevada-California*".

SCP 8.3.1.2.1.3.3 Fortymile Wash recharge study OG33113C93

Summary Account Manager - C. Savard

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRG021B Write/revise Fortymile recharge data report

Continued to draft the report. Reviewed ground-water data for completeness and continued preparing TDIF.

**3GRG023B Evaluate southern Nevada & California streamflow**

Graphed annual and monthly streamflow discharge for Arroyo Seco in California. Will use this to determine if El Nino effects are visible in the streamflow record.

**3GRG026 Conduct ponding and infiltration tests**

Received portable field computer and configured it. Installed software allowing the field computer and data logger to communicate. Successfully ran a bench test with real time graphing of data from a ten-turn potentiometer to simulate water level in an infiltration tank.

**WBS 1.2.3.3.1.1.4 Regional Hydrologic System Synthesis and Modeling**

Principal Investigator - J. Czarnecki

**OBJECTIVE**

To synthesize hydrologic, geologic, hydrochemical, and geophysical data into a model and make a qualitative analysis of how the system is functioning; and to represent quantitative observations of hydrologic data pertaining to the ground-water flow system in a comprehensive flow model. (SCP Study 8.3.1.2.1.4)

**SCP 8.3.1.2.1.4 Regional Hydrologic System Synthesis and Modeling LOE Account 0G33114Z93**

Summary Account Manager - J. Czarnecki

**ACTIVITIES AND ACCOMPLISHMENTS**

J. Czarnecki ran computer simulations of the potential effect of pumping one of the C-holes at 200 gpm for a period of one year to examine the potential drawdown at nearby wells using a 2-D finite element model. A letter report summarizing the results was written and supplied to M. Umari.

J. Czarnecki met with W. Nelson (INTERA) to discuss current modeling efforts of the subregional ground-water flow system.

F. D'Agnese, C. Faunt and J. Czarnecki prepared monthly PACS report.

F. D'Agnese, C. Faunt, and K. Turner reviewed FY93 budget figures.

F. D'Agnese and C. Faunt prepared and presented overview of 3-D modeling efforts to L. Anna and other UZ staff and attended a meeting with the SZ Section Chief to discuss progress of 3D modeling efforts.

**SCP 8.3.1.2.1.4.2 Subregional two-dimensional areal hydrologic modeling 0G33114B93**

Summary Account Manager - J. Czarnecki

**ACTIVITIES AND ACCOMPLISHMENTS**

**Variances**

3GRM028A Draft report on preliminary simulation of large hydraulic gradient

3GRM031A Calibrate 2-D FE Model

Both activities were delayed resulting from Project Chief being diverted to work on unscheduled activities. See LOE accounts for 8.3.1.2.1.3 and 8.3.1.2.1.4.

**SCP 8.3.1.2.1.4.4 Regional three-dimensional hydrologic modeling 0G33114D93**

Summary Account Manager - J. Downey

**ACTIVITIES AND ACCOMPLISHMENTS**

### Technical Activities

#### 3GFH022C Refine 3D Hydrogeologic Model

C. Faunt finished correlating faults on 2D cross-sections. These correlations will be used for attribution in the computer. Faunt also continued using the recently developed user code in EP/SECT (cross-section modelling software). This code is used to attribute both faults and horizons. The horizons are finished and the faults are nearing completion.

C. Faunt began plotting the horizon data in three-dimensions. This data will be examined to find problems in the data before gridding.

The paper on structural analysis is completed. Final maps and figures are being prepared. A rough draft is being reviewed by F. D'Agnese, J. Downey and K. Turner. These comments are being incorporated into the manuscript. The report is being updated by incorporating earthquake epicenter data.

J. Downey continued development of Transmissivity data sets for 3-D model from published information.

C. Faunt and F. D'Agnese continued work on paper describing the development of the Hydrogeologic Map of the Death Valley Region. Correlation charts were drafted and the text is being completed.

#### 3GRM041A Generate model input arrays

F. D'Agnese continued regional vegetation mapping. Supervised training and classification will continue through January. Vegetation density maps and land use maps were produced. These are being compared to existing maps. A field trip has been scheduled for March 6, 1993 to field check resulting density and land cover classes.

F. D'Agnese met with R. Anderson and D. Hester (GIS Lab) to discuss latest methodology for developing 100K map of roads in study area for use as base map.

K. Turner continued work on vegetation analysis in the Amargosa which is being conducted in conjunction with Past Discharge (to complete work begun by DeMarco).

F. D'Agnese continued Terrain Analysis for surface characterization (recharge, discharge, geomorphic, pedogenic, and hydrologic analysis). Work included developing Average Annual precipitation map of model area based on Quiring's regression.

F. D'Agnese continued working with B. Meier (Intergraph) to develop a 2.5 dimensional terrain model of the study area to be used in visualization of the 3-dimensional model, YMP tour demonstrations, and presentations.

C. Faunt and F. D'Agnese began preparation of Poster Presentations for the Waste Management '93 Conference, Tucson and the International High Level Nuclear Waste Management Conference, Las Vegas. Preparation included developing transfer standard for conversion of computer graphics files to color photographic prints.

C. Faunt continued preliminary development of code to translate ARC data into an ASCII format that would be readable by Intergraph's ASCII Loader software.

F. D'Agnese continued work on regional potentiometric surface map. Preliminary regional water table maps were developed representing the potentiometric surface as both continuous

and discontinuous. Map is being revised to include water table depressions at discharge areas. The map is also being compared to other published maps and topographic data.

F. D'Agnese and J. Downey developed layers for preliminary model that were generated in GIS.

F. D'Agnese and B. Oatfield retrieved data from NWIS on ground-water well yield in study area to be used as well array in regional model. Reports on ground-water use in Pahrump and the Amargosa Valley were reviewed.

F. D'Agnese and B. Oatfield retrieved data from NWIS on spring discharge rates for use in regional model.

Methods on distributing hydraulic conductivity were reviewed including random analysis stochastic conditional simulation and deterministic methods. F. D'Agnese corresponded with I. Nixon (Intergraph, Huntsville) to discuss the capabilities of Intergraphs 3D Visualizer Voxel Analyst in this regard.

F. D'Agnese worked with E. Swibas (Colorado District, Graphics) to develop means of generating photographic prints of image and map products from 3D modeling.

F. D'Agnese began article on Ground-water Modeling of the Death Valley Region. D'Agnese, E. Gutentag, K. Turner, and C. Faunt began preparing outline of report on conceptual and numerical model of the Death Valley region.

#### 3GFH009C Continue testing with chemical models

D. Perfect finished sorting and parsing the chemical data, and finished chemical balances for the data base. The data base is now ready for some statistical analyses. Perfect continued working on an open file report of Hydrochemical Data in Death Valley Region.

#### Planning and Operations

##### 3GFH022C Refine 3D Hydrogeologic Model

C. Faunt, F. D'Agnese, J. Downey, and K. Turner finished a paper for Waste Management '93 at Tucson "Geoscientific information systems and 3D hydrogeologic models for the Yucca Mountain area, southern Nevada-California, USA". The paper has been processed through peer review and is in Reston.

C. Faunt, F. D'Agnese, J. Downey, and K. Turner prepared paper for IHLRWMC 1993 proceedings entitled, "Characterizing the hydrogeologic framework of the Death Valley region, southern Nevada-California, USA". The paper has been through review and was submitted.

##### 3GRM041A Generate model input arrays

C. Faunt, F. D'Agnese and K. Turner worked extensively on coordinating with DOE YMP to organize a USGS 3-D Modeling booth for the Las Vegas IHLRWC.

#### WBS 1.2.3.3.1.2 Unsaturated Zone Hydrology

##### OBJECTIVE

To develop a model of the unsaturated zone hydrologic system at Yucca Mountain that will assist in assessing the suitability of the site to contain and isolate waste. (SCP Investigation 8.3.1.2.2)

WBS 1.2.3.3.1.2.1 Unsaturated Zone Infiltration

Principal Investigator - A. Flint

OBJECTIVE

To determine the effective hydraulic conductivity, storage properties, and transport properties pertinent to unsaturated zone infiltration as functions of moisture content or potential; and to determine the present and to estimate the future spatial distribution of infiltration rate over the repository block at Yucca Mountain. (SCP Study 8.3.1.2.2.1)

SCP 8.3.1.2.2.1. Unsaturated Zone Infiltration LOE Account 0G33121Z93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Support Project Operations, FY93:

Activities for January included preparation of monthly PACS. A. Flint, L. Flint and D. Hudson spent four days in Tucson at the U. of Ariz./NRC workshop on flow and transport through unsaturated fractured rock. The week prior to this, included time for preparation of presentations on using borehole core measurements to investigate infiltration through the unsaturated zone, and measurement techniques to provide accurate parameters for infiltration models which were presented at the workshop. This was an extremely successful interaction of researchers from various YMP groups and incited several cooperative activities.

Implementation of all QA requirements and other project operations were performed as needed. L. Hofmann, B. Guertal, and M. Nash attended training sessions on QMP 3.0, and QMP 17.01, R5. Two technical procedures were submitted to Denver.

A meeting was held to coordinate priorities and authors for presentations at FY93 professional meetings and to plan out dates for abstract submittals to the review process to meet conference deadlines.

A paper was reviewed for the Soil Physics Division of the Soil Science Society of America Journal by B. Guertal.

Two 1-1/2 hour small group tours were given of the HRF.

Neutron Moisture Monitoring FY93:

All neutron holes were logged in January. The neutron probe field calibration procedure is still being developed and is now incorporating the density logs that were recently run in N54 using the large gamma-gamma tools with the logging van.

SCP 8.3.1.2.2.1.1 Characterization of hydrologic properties of surficial materials 0G33121A93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUI012 Collect/analyze consolidated/unconsolidated materials

Small grab samples were collected from the surface soils near all of the neutron holes. As before, these grab samples were analyzed for water potential and gravimetric water content. In addition, the grab samples were separated into two sizes (less-than and more-than 2-mm).

Water release curves, for the < 2mm size fractions, of each of the major stratigraphic units at neutron hole N 85 have been developed. These curves were produced by uniformly wetting each stratigraphic sample. The samples were then allowed to dry for varying lengths of time. At selected intervals, selected samples were placed in sealed containers. Following a 48 hour equilibration period, soil water potential was determined on each sample using the CX2.

3GUI015A Develop preliminary geohydro/surficial/infil/runoff map

An irregular hole bulk density sampler was tested in the field. Bulk density values obtained were similar to those measured by other techniques. This unit will be used for future bulk density measurements. The advantage of this method is that it is designed for use in gravelly and rocky soils. The unit is also designed to work on sloping terrains where the hill slope morphology has a major influence on such measurements.

A preliminary surficial map for the area located between Northing 754750 to 767500 and Easting 559000 to 569000 was mapped on scale 1:6000. This map was transferred to a GIS system using ARC-INFO. The preliminary results showed this technique will be useful,; however, further work with the software is needed.

SCP 8.3.1.2.2.1.2 Evaluation of natural infiltration 0G33121B93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUI305 Conduct water balance studies FY93

Preliminary plans were made to conduct a detailed TDR study near N13 and N14 by the Bowen ratio station in Pagany Wash. A regular grid will be laid out covering the terrace and channel with 36 probes. This study will provide field calibration data for the artificial infiltration project along with providing surface water content changes and heterogeneity for the upper boundary conditions in our small water shed models.

3GUI307 Develop small scale watershed model

The Highway Ridge/Antler Ridge drainage system was mapped and digitized, including preliminary surface infiltration units corresponding to ridge tops, sideslopes and alluvium/channels. Plans are in progress to develop a sampling scheme involving ridge to ridge transects to provide physical properties for model input, ground proof the preliminary map, as well as providing data for the surficial materials and artificial infiltration projects. The application of the N7 1-D model to other boreholes is awaiting the finalization of the neutron hole data base.

3GUI310 Evaluate shallow/deep infiltration process FY93

Additional neutron logs have been taken in Fortymile Canyon to monitor runoff events due to the large amounts of rainfall this winter. Several runoff events have resulted in downward infiltration in obvious pulses to below 18 feet in N91. Plans have been discussed with the saturated zone researchers to do some time series analyses to estimate infiltration rates in the alluvium.

Efforts were made to compare flow codes (TOUGH, a REECo 1D flow code, and a steady state 1D code A. Flint wrote). This was done using the output from the model using transect and borehole data to predict UZ16 saturation profiles under various climatic scenarios. This investigation will help to work out any errors in using TOUGH prior to applying fractures to the UZ16 model.

3GUI050 Prepare report historical neutron hole data

The neutron hole data compilation for input into the Paradox data base is close to being complete. Programs are being used to debug raw neutron logs and borehole locations, drilling information and lithology are being compiled into worksheets.

SCP 8.3.1.2.2.1.3 Evaluation of artificial infiltration 0G33121C93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUI636 Conduct infiltrometer study/prepare OFR

An experiment was carried out to determine the effect of temperature changes on the pressure transducers. It was determined that temperature changes up to 15 degrees C have no significant effect on the transducers. The water storage tank system is now fully operational.

All the parts for the prototype infiltrometer finally arrived. The full double ring system was assembled and tested at two field locations. The system was allowed to run for two hours at each field location. The float system maintained water head heights  $\pm 1$  mm. The pressure transducers detected changes in head height in the water storage system of 1 mm. Following each infiltration trail, cumulative infiltration and infiltration rates were determined. Based on the success of this prototype system, fabrication of a second double ring system has begun.

3GUI640 Conduct prototype ponding/SPRS/LPRS study-finalize methods

A pulse flow meter, shut off valve, and diversion valve assembly was tested and calibrated for a large (1850 gal.) water storage tank. The pulse flow meter was calibrated by removing measured quantities of water from a water tank and comparing the measured values to the pulse meters estimated values. Two hundred measured liters of water were removed from the storage tank. The pulse meter estimate the volume as 201 liters. Because the purpose of the meter is to give a gross estimate of the total amount of water removed from the large storage tank, this difference is not considered significant.

Various techniques for obtaining bulk density samples from the exposed cliff face were evaluated. It was determined the best method would be small excavations of exposed or created benches. The volume of these holes will be determined by lining them with plastic and filling the holes with known quantities of water.

WBS 1.2.3.3.1.2.3 Percolation in the Unsaturated Zone - Surface Based Study

Principal Investigator - J. Rousseau

## OBJECTIVE

To determine the present *in situ* hydrologic properties of the unsaturated zone hydrogeologic units and structural features; to determine the present vertical and lateral variation of percolation flux through the hydrogeologic units and structural features; to investigate the relationships between present flux and past climatic conditions; and to determine the effective hydraulic conductivity, storage properties, and transport properties as functions of moisture content or potential. (SCP Study 8.3.1.2.2.3)

### SCP 8.3.1.2.2.3 Percolation in the Unsaturated Zone, Surface-based Study LOE Account 0G33123Z93

Summary Account Manager - M. Chornack

## ACTIVITIES AND ACCOMPLISHMENTS

### HRF Borehole Monitoring and Sensor Recalibrations:

Completed process to hire a calibration laboratory manager at the HRF; continued monitoring of the HRF boreholes; completed monthly PACS reports; completed preparation of procurement documents and submitted DI-1 Requisition for two to three additional insulated instrument shelters (IIS), to be delivered in late FY93; continued working on the modification of the Baker Oil Tools' design of the sliding screen apparatus to be used in the deep UZ hydro-instrumentation program; coordinated with Baker Oil Tools to reduce weight of the device; completed fabrication of the first electrical cable and teflon tubing reel racks that will be used during hydro-instrumentation of the UZ boreholes; presented two papers at Workshop VI on Flow and Transport through Unsaturated Fracture as Related to High-Level Radioactive Waste Disposal which was sponsored by NRC, University of Arizona and the Center for Nuclear Waste Regulatory Analyses; completed preparation of technical presentations on the UZ-16 VSP program which will be given on February 9th and 10th in Las Vegas; continued monitoring and inspecting fabrication of the downhole instrument station apparatuses (DISAs) which will be used in the hydro-instrumentation of UZ boreholes. Fabrication is nearing completion, and delivery of the first 82 units is expected during the month of February; prepared request to begin process of hiring a calibration laboratory technician for the HRF deep UZ calibration laboratory; draft of a criteria letter for hydro-instrumentation of existing UZ boreholes was prepared and is currently in review. Letter should be ready to transmit to YMPO in mid to late February; designed and fabricated a DISA, electrical cable, and tubing mounting assembly for use in instrumenting the existing shallow, small diameter UZ boreholes; mock-up of mounting assembly is being evaluated; and submitted TDIFs to LRC for the following: a) GS930108312232.002 - "*Multi-mode seismic cross-borehole imaging of a producing horizon using physical elastic modeling*", by M. Karazincir, b) GS930108312232.003 - "*Wave mode separation of multi-component, multiple-offset VSP data acquired from a complex physical earth model*" by K. Ranzinger, c) GS930108312232.004 - "*Multi-mode crosshole reflection imaging of multi-component physical model data*", by H. Chang, d) GS930108312232.005 - "*Computer and physical VSP modeling of Yucca Mountain, Nevada*", by D. Cunningham, e) GS930108312232.006 - "*Multi-mode, multiple offset VSP reverse time migration (imaging) of a complex, physical earth model*", by G. Hofland, and f) GS930108312232.007 - "*Illumination angle determination and its application to prestack migration of P/S converted waves on physical elastic model data*", by C. Erdemir.

NTS REECo Communications is in the process of ordering three complete electronic keyed entry systems (EKES) for the insulated instrument shelters (IIS), and is in the process of conducting a technical review for the purchase of two radio frequency modems, antennae, and rack mounting kits for IDAS communication field sites.

#### Air-K Testing

G. LeCain attended a GIS presentation at the Colorado School of Mines. The presentation was given by USGS/HIP personnel and covered the different data bases and associated operating software now used throughout the industry.

All field testing equipment that was being constructed by the USBR - support trailer, packers, monitoring instruments - was packaged and shipped to the NTS. The field trailer was shipped on a low-boy and all other items by step-van. All items were delivered to Test Cell C where a construction and repair facility has been set up. All unfinished work will be completed by USGS staff. The PI estimates that the field equipment will be ready for testing in UZ-16 on June 14, 1993.

G. LeCain prepared two detailed memos for D. Appel; the first detailed the amount of construction work remaining to be completed on the air-permeability testing equipment and the second detailed the delayed schedules and of USBR.

#### Support Project Operations:

G. LeCain was the technical reviewer for a New York District report on pressure transducer calibration and use in low permeability glacial tills.

Updated and revised handout for public tours to reflect changes in layout of the HRF (environmental chamber, sample processing lab, etc.).

Set up room 308 in the HRF as the new sample processing lab; moved equipment; set up saturation chambers, etc.

Wrote a memorandum to REECo, regarding the damage to the environmental chamber found by Site Maintenance during assembly, so REECo could make a claim under the manufacturer's warranty.

Conducted several tours of the lab.

#### SCP 8.3.1.2.2.3.1 Matrix hydrologic-properties testing 0G33123A93

Summary Account Manager - D. Soeder

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GUP005A Measure rock properties/state variables FY93

Physical property measurements on the USW-UZN-54 canned core samples continued under procedure HP-229. The last remaining core samples are undergoing high temperature drying to 800°C in steps of 200°C, with a gravimetric water content measurement being taken at each step. The cores can be dried only in batches of two, and the processing is taking longer than anticipated. Data from this analysis is expected to indicate the dehydration sensitivity of various clay and zeolite minerals in the rocks, as well as showing the temperatures at which non-refractory minerals, such as carbonates, dissociate and cause abrupt changes in rock weight.

##### 3GUP025A Determine matrix permeability FY93

Saturated hydraulic conductivity (water permeability) measurements continued on samples collected last spring from the transect up the prow of Yucca Mountain. Saturated hydraulic conductivities were also run on approximately 24 cores from the Yucca Mountain C-Hole

complex, on samples of non-zeolitic Calico Hills tuff. The C-hole core data was then interpreted and analyzed, and placed in a Lotus spreadsheet for delivery to A. Geldon. Analysis of the data collected several months ago from 15 prow sample permeability runs (about 60 samples) was completed in January, after which three more runs of prow transect core were analyzed. Data interpretation on these samples was finished at the end of January.

#### 3GUP031A Determine moisture characteristic curves FY93

The Decagon CX-2 chilled mirror psychrometer is continuing to be used for the measurement of moisture characteristic curves. Experiments were run in January using batch samples of soil to try to get water potential measurements across a variety of saturations in the same material. This was done by saturating and homogenizing the soil, then placing it on a tray in discrete lumps like cookie dough to dry. A fresh, wet sample was selected for the first analysis, and subsequent analyses were performed on samples that had progressively lower water saturations, since they sat on the tray for increasingly longer periods of time. This technique appeared to work quite well, as long as it could be validly assumed that the pore structure and texture of the soil was homogenous among the samples. The CX-2 has proven to be quite versatile for a wide variety of moisture characteristic curve measurements, and will continue to see use in the future.

#### Planning and Operations

##### 3GUP005A Measure rock properties/state variables FY93

Preserved (canned) core samples were delivered to the HRF from the SMF on January 4, 1993, from borehole USW-UZN-38 for analysis of physical properties and state variables under procedure HP-229.

#### SCP 8.3.1 2.2.3.2a Surface-based boreholes studies 0G33123B93

Summary Account Manager - J. Rousseau

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GUP052A Test and calibrate equipment

Conducted a gas sampling experiment to debug problem with solenoid control switching system in the multi-station gas sampling apparatus. Detected fault with purge control solenoid relay wiring. Analyzed results of gas sampling experiment conducted on December, 1992, to verify performance of psychrometers in Station "A" HRF borehole #1. Analysis indicated system is capable of resolving 0.005 to 0.010 grams of H<sub>2</sub>O vapor per 1000 grams of dry air. Net results suggest independent verification of psychrometer readings to within  $\pm 0.5$  to 1.0 bars is feasible. Conducted pressure flow tests to determine pressure head losses in the chilled mirror hygrometer. Tests were conducted at dry air inflow rates varying from 0.5 to 2.0 slpm in 0.5 slpm increments with total mixed gas flows ranging from 0.5 to 5.0 slpm.

##### 3GUP054A Calibrate sensors

Calibration testing of short wire psychrometers which will be for use in measuring core water-potential began in mid-January. Tested operation of psychrometer calibration benches #3 and #4.

#### Planning and Operations

##### 3GUP053A Drill UZ boreholes

Continued monitoring drilling activity at UZ-16. As of January 31, 1993, borehole was at 1350 feet (cored and reamed). Drilling has penetrated throughout the Topopah Spring member and is now in the Calico Hills unit. Penetration rates have increased dramatically. Special

instructions were given to RSN to adjust the mode of operations from 1400 feet to total depth. Instructions require setting a bailer at the bottom of the hole at the end of each shift; retrieving the bailer at the beginning of the next shift. Purpose is to sample water that may drain from the Calico Hills as the borehole approaches the water table. Free gravity drainage should occur prior to reaching 100% saturation.

SCP 8.3.1.2.2.3.2b Vertical seismic profiling OG33123C93

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP081B Conduct VSP prototype field test and analysis

Current plans are to acquire a complete cross-hole data set at Idaho Springs, CSM Experimental Mine by mid-February. Currently awaiting the following: 1) a break in the weather to gain access to the field site, and 2) return of the OYO recording equipment that is being loaned to CSM for these experiments. It is believed that all field problems associated with triggering and zero time control of the downhole seismic source have been solved. Software to analyze the data in the field is being adapted to a portable IBM RISC 6000 workstation.

Planning and Operations

3GUP084B Provide velocity measurements UZ-16 core

Contacted a private company that specializes in core velocity measurements under confined stresses that will approximate the *in-situ* stress environment. Next step is to certify company through QA office to perform velocity measurements on UZ-16 core. Approximately 30 core specimens have been tagged for these measurements. Estimate a total of 50 core specimens will be run to establish velocities for the different rock types encountered during drilling of UZ-16.

Variations

3GUP081B Conduct VSP prototype field test and analysis

Access to the field site and availability of OYO recording equipment continue to delay data acquisition at the CSM experimental mine borehole site.

Delays have no impact on project schedules. It will be several years before cross-hole testing at the UZ-16 (UZ-9, -9a, -9b) borehole cluster site takes place.

SCP 8.3.1.2.2.3.2c Integrated Data Acquisition System OG33123D93

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP072C Develop, test, review, and integrate software

Modifications to SNSRDR, MNTSNR, MNTDPT, and LOAEXT programs were made to accommodate changes to the structure of the IDAS data base as dictated by the inclusion of a tree switch in the sensor to instrument connection scheme. One week was spent trying to get IDAS running on the new wiring configuration. The system ran except for two items: 1) routine monitoring aborted at the end of each scan, and 2) psychrometer excitation was conducted with the wiring polarity reversed. Problem #2 was solved; problem #1 is still not

resolved. Efforts to reproduce the shutdown problem in Denver have not succeeded. Efforts to test this have been somewhat hampered by the misbehavior of DECNET, which may be the result of not having installed the latest software patches from DEC. Patches were installed and testing is continuing. Lack of DECNET patches may not have any connection with stoppage of the routine monitoring software.

**3GUP076C Evaluate prototype data from HRF borehole**

Examination of the IDAS HRF data collected in mid-January indicates that the measurements do not follow the trends observed in the PC-collected data. This was investigated to determine whether the cause can be traced to the PDP software. Data in the IDAS files faithfully represented the voltage measurements taken by the meters. Observation on the front panels of the current generator and multimeters indicated that the IDAS is properly setting and controlling the excitation current. Conclusion is that there is a source of noise present only when the PDP is in operation. Speculation is that the problem may be associated with shielding at the point where the DB25 connectors are employed. Problem is being looked into to resolve spurious noise features which are present only when the PDP-based data collection system is operating; and not present when sensors are controlled by the PC-based DAS.

SCP 8.3.1.2.2.3.2d Air-permeability and gaseous-tracer testing OG33123E93

Summary Account Manager - G. LeCain

**ACTIVITIES AND ACCOMPLISHMENTS**

**Planning and Operations**

**3GUP030D Setup instr. store and repair at NTS**

All field testing equipment that was being constructed by the USBR, support trailer, packers, and monitoring instruments, was packaged and shipped to Test Cell C where a construction and repair facility has been set up. With the delivery of all the field equipment and storage at Test Cell C, this activity is completed.

WBS 1.2.3.3.1.2.4 Percolation in the Unsaturated Zone - ESF Study

Principal Investigator - M. Chornack

**OBJECTIVE**

To conduct hydrologic tests in the ESF to supplement and complement the surface-based hydrologic information needed to characterize the Yucca Mountain site; to provide phenomenological information for analyzing fluid flow and the potential for radionuclide transport through unsaturated fractured tuff; and to provide information about water flow through unsaturated fractured tuffs. (SCP Study 8.3.1.2.2.4)

SCP 8.3.1.2.2.4 Percolation in the Unsaturated Zone, ESF Study LOE Account OG33124Z93

**ACTIVITIES AND ACCOMPLISHMENTS**

Completed the ACSR for the prototype percolation test.

Completed the technical review of HP-250, R0 entitled, "*Intact fracture sampling, radial sampling*".

SCP 8.3.1.2.2.4.1 Intact fractures testing in the ESF OG33124B93

Summary Account Manager - G. Severson

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GUS015J Complete journal paper: detailed moire

Sections have been completed which are found in previously published papers, or papers currently in review, or are included in two papers that are in draft form (one on FFT approach and one overview paper) but have not been submitted to the HIP Reports Section for formal technical review.

3GUS020J Design and conduct tests - gaseous phase

Consideration was given to the design of the tests to be conducted under this activity. The actual start of testing under this activity is dependent on the completion of activity 3GUS028J.

3GUS024J Complete OFR on projection moire

Progress toward this "final report" continues with sections that have been completed which are found in previously published papers or papers currently in review. A draft of this OFR will be submitted for review after activity 3GUS015J is completed.

3GUS028J Design/fabricate vessel

Revisions to the sketches for the low-pressure vessel were completed and put into a package (85 pages) for preliminary cost estimates from several machine shops. These bids will be used to determine the correct approach for procuring the required machine work. In addition, a small package of the drawings for the four different types of LVDT mounting brackets for displacement measurements was put together and submitted for cost estimates.

3GUS022J Select analog site-fracture sampling-evaluate/develop axial fractures

The "north test pit" (test pit #1) at Fran Ridge, Yucca Mountain, NV has been inspected and could be used as a possible sampling site. However, discussions concerning the mapping work (USBR) to be done in this pit indicated that this work will probably not be completed during FY93 due to funding constraints.

Laboratory or field work in FY93 will depend on funding and available staff. Based on the detailed budgets for the USGS activities that were submitted to USGS management in December 1992, the funds and staff will not be available during FY93 to continue any significant efforts on this work

SCP 8.3.1.2.2.4.2 Percolation testing in the ESF OG33124B93

Summary Account Manager - F. Thimir

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUS032B Continue Final Phase of Large Block Test

Test terminated. During the last phase water pressure was maintained at +14 cm of water at the top of the block. Water flow fluctuated between 100 and 0 cubic cm per day. Steady state was not achieved. Data was collected, indexed, backed-up, processed, and archived on computer disks.

3GUS033B Prepare prototype percolation test report

The paper entitled "*Laboratory study of water infiltration into a block of welded tuff*" was completed and submitted to the American Nuclear Society for the 1993 International High-Level Radioactive Waste Management Conference in Las Vegas, Nevada between April 26-30, 1993. The authors are F. Thamir, E. Kwicklis, and S. Anderton. The paper describes the large block test setup and some results that will affect the design of the ESF test.

3GUS035B Plan and design ESF percolation test

Revision to the ESF percolation test study plan, SP-8.3.1.2.2.4.2, was started.

SCP 8.3.1.2.2.4.7 Perched Water Tests in the ESF 0G33124G93

Summary Account Manager - M. Chornack

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GUS010G Evaluate/prepare report on borehole instrumentation

Preliminary contacts were made with Science & Engineering Associates, Inc. concerning the SEA dry hole fluid sampler (Seamist System). This system is a candidate for use in boreholes drilled in the ESF to monitor perched water. Began writing technical procedures to be used in sampling, testing, and monitoring of perched-water zones encountered in the ESF.

WBS 1.2.3.3.1.2.6 Gaseous-Phase Movement in the Unsaturated Zone

Principal Investigator - M. Chornack

**OBJECTIVE**

To describe the pre-waste-emplacement gas-flow field; to identify structural controls on fluid flow; to determine conductive and dispersive properties of the unsaturated zone for gas flow; and to model the transport of water and tracers in the gas phase. (SCP Study 8.3.1.2.2.6)

SCP 8.3.1.2.2.6.1 Gaseous-phase circulation study 0G33126A93

Summary Account Manager - M. Chornack

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

3GGP06B Plan tracer tests in selected UZ boreholes

Plans for conducting convergent-flow tests in borehole USW UZ-6s were formulated. Preparations for conducting these tests are currently underway. The necessary procedures and equipment are being assembled. Fourteen shallow (approximately 1.2 ft. deep) 1-inch diameter sampling boreholes were drilled in the vicinity of boreholes USW UZ-6 and USW UZ-6s. These sampling holes will be used during the tracer tests. The results obtained from these tests will be used to model  $^{14}\text{CO}_2$  and other gaseous radionuclide emanations from the repository to the atmosphere.

3GGP08B Plan modeling and gas flow interference tests

Gas-flow data collected from borehole USW UZ-6s are being prepared (tabulated and analyzed) for utilization in the 3-D gas-flow and -transport model. Began to examine data collected from the pressure shut-in test at USW UZ-6s.

3GGP02B Collect UZ borehole data-FY93

Project scientists are conducting a pressure shut-in test at borehole USW UZ-6 (2 zones being monitored). Continuing to conduct pressure shut-in test in borehole USW UZ-6s. Began monitoring temperature profile in borehole USW UZ-6s.

3GGP04B Tabulate and analyze gas samples

Began preliminary analysis of data collected in conjunction with the shut-in pressure response test at USW UZ-6s.

WBS 1.2.3.3.1.2.7 Unsaturated Zone Hydrochemistry

Principal Investigator - I. Yang

OBJECTIVE

To understand the gas transport mechanism, direction, flux, and travel time within the unsaturated zone; to design and implement methods for extracting pore fluids from the tuff; to provide independent evidence of flow direction, flux, and travel time of water in the unsaturated zone; to determine the extent of the water-rock interaction; and to model geochemical evolution of ground-water in the unsaturated zone. (SCP Study 8.3.1.2.2.7)

SCP 8.3.1.2.2.7 Unsaturated-Zone Hydrochemistry LOE Account OG33127Z93

Summary Account Manager - A. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Conduct Information Seminars on Model for project staff:

D. Thorstenson conducted geochemical modeling seminar twice this month (6 hrs) on WATEQ4F, a USGS developed geochemical model used to analyze chemical speciations in the ground water. Most of the UZ-hydrochemistry project members attended the seminars.

Procure Test Borehole Sampling System (12" hole):

A 12 1/2 inch packer system will be needed to collect gas from up to 15 zones in unsaturated zone boreholes. One possibility is a straddle packer system (as tested at UZ16); another possibility is a Seamist system. The 12-inch Seamist system must be procured and tested at a UZ borehole at Yucca Mountain. Procurement of "SEAMIST" sampling system was authorized by management. The straddle packer to be used at UZ-16 borehole is under construction by USBR.

Prepare Hydrologic Procedures, FY93:

HP-249, "*Method for pore-water extraction using high-pressure one-dimensional compression*", the primary procedure being used for pore-water extraction, was issued.

HP-256 covering the KOM collection of CO<sub>2</sub> has been finalized.

G. Rattray reviewed and modified the HP-07.

Support Project Operations, FY93:

UZ-hydrochemistry project members discussed tracer injection program and responsibilities with QA personnel. All project members attended technical sessions on geochemical modeling of WATEQ4F, the program being used to analyze chemical speciations in pore water. J. Fararese worked with the QA office to update and consolidate all UZ Hydrochemistry calibration forms, certificates, requirements etc.

J. Fararese is re-submitting the TDIF package from May 89 - Dec 91 for UZ1. The LRC asked that TDIFs be separated to reflect pre and post-May 89 data.

Acting as chemical safety officer, J. Fararese met with G. Severson and USBR safety personnel concerning a safety incident in the fractured rock hydrology lab, and had discussions with the regional safety officer concerning the requirements to complete annual chemical inventories and updating chemical hygiene plans. A memo has been drafted to remind the lab managers of this.

Three instruments malfunctioned this month--two liquid scintillation counters and the ion chromatograph. The problems with the liquid scintillation counters have been solved but the ion chromatograph will require a technical engineer.

The windows in the UZ Hydrochemistry laboratory were renovated. This took construction workers three days and severely limited lab operations.

Various operational laboratory tasks were conducted this month (e.g. manually calibrating balances, changing water filters, etc.).

A. Yang presented the results of titanium analyses on UZN-55 cores at the Unsaturated Zone modeler's meeting held in Las Vegas, Nevada, on January 20, 1993.

A. Yang conversed with T. Bjerstedt over the phone on several questions regarding "responses to State of Nevada comments on Study Plan 8.3.1.2.2.7". Information was needed in order to write a cover letter to attach to the responses to the State of Nevada's comments.

A. Yang and D. Thorstenson attended and presented core-analysis data of Yucca Mountain Project at the Workshop VI, "*Flow and transport through unsaturated fractured rock*" at Tucson, Arizona. The workshop was sponsored by the University of Arizona, NRC and Center for Nuclear Waste Regulatory Agency, January 25-28, 1993.

C. Peters had a discussion with USGS management concerning funding for "Seamist" and USBR packer system, and met with QA personnel concerning TDIF schedules and preparation of a general TDIF schedule for UZ Hydrochemistry project. Peters also met with USGS and REECo personnel concerning transferring custody of property to the USGS. Peters met with computer personnel to transfer files from the Prime to the SUN system.

C. Peters prepared a memo and collected information relevant to an overdue paper to be published in the USGS Bulletin report.

All UZ-hydrochemistry personnel completed the QA reading assignments.

**Procure Mobile lab and set up GC & IC in the Mobile lab:**

The UZ-hydrochemistry project mobile lab was procured and delivered to Mercury, Nevada, in December, 1992. However, gas chromatograph and ion chromatograph need to be procured and housed inside the mobile lab.

The revised requisition for the new gas chromatograph and ion chromatograph is in USGS procurement. Procurement personnel processed the paperwork without delay.

Summary Account Manager - I. Yang

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GUH010 Conduct tracer gas sorption test - stemming material/tuff

Batch-type experiments were conducted to test the adsorption and desorption of CO<sub>2</sub> on crushed gypsum cement. Prototype experiments on stemming material and volcanic tuff are complete.

#### 3GUH011 Evaluate existing export models gaseous C-14 export

Preliminary evaluation, using diffusion-model calculation, fit well with the UZ-1 <sup>14</sup>C field data below 50m depth. However, the top 50m data from UZ-1 deviate significantly from model calculation.

#### 3GUH012 Prepare, analyze and tabulate data

UZ16 is still being drilled.

UZ1 sampling complete; expect to receive molecular sieves, silica gel towers, 13/12C aluminum samplers, cold trap samples etc. directly, at which time processing will begin.

#### 3GUH013 Oversee drilling, collect gas and water vapor samples

Monitored the injection of SF<sub>6</sub> at UZ16 throughout the month. Analyzed drilling air samples for tracer-gas concentration from UZ16, NRG2, and NRG6. Identified and corrected flaws with tracer equipment which was set-up at NRG2. Initiated procurement of flow controllers and power supplies to be dedicated to tracer injection project.

Prepared equipment for UZ1 gas and water vapor sampling. Procured supplies. UZ-1 gas sampling was conducted from January 20-29, 1993. Analyzed SF<sub>6</sub> concentration at various collection depths at UZ1. Returned all equipment to Denver labs for processing. Kept sampling records and tracking forms updated.

#### 3GUH015 Prepare interpretive report/OFR: UZ1 gas and water vapor

P. Striffler and C. Peters continued to verify and tabulate UZ-1 gas data, which will be published in USGS Open File Report. A. Yang and D. Thorstenson are working on the expanded version of the UZ-1 data interpretation report. Diffusion mechanism of CO<sub>2</sub> gas transport seems to fit the field data.

### Quality Assurance

#### 3GUH018 Review data and prepare TDIF for UZ-1 data

Prepared general TDIF schedule for UZ-hydrochemistry project.

### Planning and Operations

#### 3GUH014 Design, build, and test equipment

Continued design meetings with USBR. All purchasing orders were prepared and sent out. No packer construction work this month.

### Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 72 hours were spent in support of the following:

Tested analytical response of BCF with electron capture detector and analyzed 30 samples for E. Weeks. (4 hrs)

Reviewed hydrochemistry abstracts in EOS and review of hydrochemical computer modeling. (5 hrs)

Support for tracer injection program: Set up leakmeter at NTS - hooked up argon gas, checked operation, performed heater boost to improve detector sensitivity. Checked with REECo and Caltrol personnel about time frame for setting up automated injection system. (8 hrs)

Set up gas chromatograph at mobile lab for FID analyses - attached O<sub>2</sub> and H<sub>2</sub> gas, repaired leaks in lines, adjusted gas flows, troubleshot problems causing high signals, burned contaminants from column and detector, troubleshot problems with mobile lab generator. (16 hrs)

A. Yang, C. Peters and D. Thorstenson responded to 23 comments raised by the State of Nevada on Study Plan 8.3.1.2.2.7 - *Hydrochemical characterization of the unsaturated zone*. (40 hrs)

Planned for initial UZ-16 (per-packer) sampling, supplies/equipment, and personnel QA training. (2 hrs)

#### SCP 8.3.1.2.2.7.2 Aqueous-phase chemical investigations OG33127B93

Summary Account Manager - I. Yang

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUH035A Prepare report on effects of core sealing

This report was approved by the USGS Director, formatted according to guidelines set by ANS for publication in IHLRWM conference proceedings, and submitted to ANS.

3GUHO30A Export, prepare, extract, analyze core

Distilled several cores from UZN-55 for tritium,  $\delta^{18}\text{O}$  and  $\delta\text{H}$  analyses.

3GUHO36A  $3\text{H}$  and  $^{14}\text{C}$  method development report

The report is written with the exception of the conclusion and a few final touches to the figures and graphs. The report will be given to the co-author for input.

3GUH037A Prepare report, rubble collection and coring

C. Peters is writing the paper and preparing tables for the report.

#### Planning and Operations

3GUHO30A Export, prepare, extract, analyze core

UZN-53 and -54 cores preserved at the SMF at Mercury, Nevada, were planned to be shipped to Denver for hydrochemistry tests. UZN-55 and UZ-16 cores will be shipped to Denver in February.

#### Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 24 hours were spent by K. Scofield calibrating the Orion Microelectrodes for analysis of dissolved CO<sub>2</sub>, chloride, potassium, and Eh. These microelectrodes will be used to test the pore-water chemistry changes as a function of time, storage, and pressure effects during compression.

#### WBS 1.2.3.3.1.2.8 Fluid Flow in Unsaturated Zone Fractured Rock

Principal Investigator - L. Anna

LBL Principal Investigator - G. Bodvarsson

## OBJECTIVE

To develop and validate conceptual and numerical models describing gas flow and liquid water and solute movement in unsaturated, fractured rock at the laboratory and sub-REV scales. (SCP Study 8.3.1.2.2.8)

### SCP 8.3.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock 0G33128A93

Summary Account Manager - L. Anna/E. Kwicklis

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GUF026 Model imbibition experiments

This activity has been delayed because the imbibition experiment has been revised. Changes include: a new non-fractured sample; continuous data collection instead of periodic collection; and the introduction of a psychrometer in the middle of the sample to measure water potential and inflow rates in real time. The hardware for the new design is now being assembled.

##### 3GUF020 Conduct scoping and bounding calculations

Continued to develop techniques to calculate fracture porosity from measured total porosity and acoustic properties of rock. Continued to search Yucca Mountain literature for total porosity and acoustic properties of rock data. Liquid water flux rates are being calculated from water saturation and water potential profiles from surface based borehole data.

##### 3GUF022 Model large block percolation experiment

Data collection for the large block percolation experiment was terminated in January. Transformation of the large volume of data as input into the numerical model has begun. Formulation of the modeling strategy has begun.

##### Work Performed but not in Direct Support of the Scheduled Tasks

Compiled data on fracture orientation, dip, frequency, density, orientation and flow rates in differential stress regimes, and fracture characterization at different scales. 16 hrs

Attended one day modelers meeting in Las Vegas. As part of the program L. Anna presented a talk on "Determination of fracture porosity from sonic velocity", while E. Kwicklis presented a talk on "A preliminary analysis of data from boreholes UZ #4, 5, 7, and 13".

### SCP 8.3.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock 0B33128A93

Summary Account Manager - G. Bodvarsson

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GUF217L Complete semi-analytical methods report

R. Zimmerman and G. Bodvarsson attended the unsaturated zone modeling meeting at USGS offices in Las Vegas.

##### Variations

##### 3GUF418L Complete and publish paper in RWMNFC journal

Work will proceed when reviews of paper are received from journal.

Work Performed but not in Direct Support of the Scheduled Tasks

3GUF08L Prepare journal article on sorptivity analysis

The paper *An inverse procedure for estimating the unsaturated hydraulic conductivity of volcanic tuff* by R. Zimmerman, G. Bodvarsson, A. Flint, and L. Flint, was completed, and sent to the ANS for inclusion in the International High-Level Radioactive Waste Management Conference.

Software QA

T. Hadgu completed a software QA class taught by D. Gockel of USGS on January 11-12, 1993 at LBL.

WBS 1.2.3.3.1.2.9 Site Unsaturated Zone Modeling and Synthesis

Principal Investigator - E. Kwicklis

LBL Principal Investigator - G. Bodvarsson

OBJECTIVE

To develop conceptual and numerical models for the site unsaturated zone hydrogeologic system; to apply the models to predict the system response to changing external and internal conditions; to evaluate the accuracy of the models using stochastic modeling, conventional statistical analyses, and sensitivity analyses; and to integrate data and analyses to synthesize a comprehensive qualitative and quantitative description of the site unsaturated-zone hydrogeologic system under present as well as probable, or possible, future conditions. (SCP Study 8.3.1.2.2.9)

SCP 8.3.1.2.2.9.1 Conceptualization of the unsaturated-zone hydrogeologic system OG33129A93

Summary Account Manager - E. Kwicklis

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM002A Develop conceptual models of UZ - FY93

In November, an investigation was made into possible statistical correlations between saturated hydraulic conductivity, porosity and unsaturated hydraulic parameters used to characterize the moisture retention properties using the van Genuchten (1980) functions. The study examined data collected from boreholes USW G-4 and USW GU3 as reported by Peters and others (1984). In December, the results of these statistical analyses were used to estimate water potential, effective hydraulic conductivity, and liquid flux profiles at four UZ boreholes: UZ #4, UZ #5, UZ #7 and UZ #13. Data from a variety of sources was also compared to assess the consistency of existing data. The draft of the paper summarizing the results of the statistical analyses (reported last month) was incorporated in the draft of a second, longer paper, summarizing not only the regression analyses but also the application of these results to the four UZ boreholes.

The paper entitled "*Estimates of unsaturated zone liquid water flux at boreholes UZ #4, UZ #5, UZ #7 and UZ #13, Yucca Mountain, Nevada, from saturation and water potential profiles*" by E. Kwicklis, A. Flint and R. Healey will be ready for technical review sometime in February.

A meeting of the UZ section was convened January 20 in Las Vegas to present recent modeling work by various USGS participants. Representatives from LANL and Woodward Clyde were also in attendance.

3GUM028A Conduct hypothesis tests/2-D cross-sectional models

In preparation for construction of a numerical model, a survey was made of existing data for flow parameters. Hypotheses concerning the natural flow system in the upper part of the unsaturated zone were constructed based on analyses of water potential, effective hydraulic conductivity and liquid flux profiles calculated for four UZ boreholes (see above activity).

Work Performed but not in Direct Support of the Scheduled Tasks

E. Kwicklis attended a meeting on January 22, 1993, in Las Vegas to discuss results of the thermal flow and transport modeling obtained recently by Lawrence Livermore National Laboratory. As a result of examining some of the papers published pertaining to those results, an effort was initiated to investigate to what extent these results are sensitive to certain approximations employed in LLNL's conceptual model.

SCP 8.3.1.2.2.9.2 Selection, development, and testing of hydrologic-modeling computer codes

0B33129B93

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM016L Complete decoupled TOUGH testing

The decoupled version of TOUGH is being tested against the fully coupled version for various one-dimensional problems with different infiltration rates. Comparisons are being made on the accuracy of the new code, as well as time step size and computational efficiency.

Work Performed but not in Direct Support of the Scheduled Tasks

C. Lai completed a software QA class taught by D. Gockel of USGS on January 11-12, 1993 at LBL.

SCP 8.3.1.2.2.9.3 Simulation of the hydrogeologic system 0B33129C93

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM32L Complete moisture flow report

Various two-dimensional cross sections were run to steady state using different assumptions regarding infiltration rates and fault properties.

G. Bodvarsson participated in a meeting on unsaturated zone modeling held in Las Vegas on January 20, 1993.

3GUM20L Prepare report on grid effects

Simulation studies investigating the effects of the numerical grid on the results have started.

3GUM26L Prepare paper for HLRWM conference, FY93

The paper titled *Studies of the role of fault zones on fluid flow using the site-scale model of Yucca Mountain*, by C. Wittwer, G. Chen, and G. Bodvarsson was finished and sent to ANS to be included in the Proceedings of the 1993 IHLRWM Conference. A copy also was sent to USGS. This concludes this task.

3GUM15L Collect/incorporate new data into moisture-flow model

Fracture flow in the welded units Tiva Canyon and Topopah Spring was included in the simulations. A set of simulations was performed with the new matrix rock properties chosen out of A. Flint's INTRAVAL data set, and using different assumptions regarding properties of fault zones (high and low permeability zones), and three uniform infiltration rates (0.001, 0.01, and 0.1 mm/yr). The results were analyzed in terms of preferential pathways, vertical and lateral flow, and the influence of the characteristic curves. This work is described in the HLRWM paper.

Variances

3GUM25L Complete and publish paper in RWMNFC journal

The task could not be completed because no comments were received. The actual finish is tentatively planned for the end of February.

3GUM35L Evaluate gas-flow data/develop gas component in model

The beginning of the task will be delayed until March due to the completion of other tasks and reports (HLRWM paper, moisture flow- and grid effects- reports).

3GUM26L Prepare paper for HLRWM conference, FY93

This task was completed in advance because of deadlines for paper.

Work Performed but not in Direct Support of the Scheduled Tasks

At the request of USGS, G. Bodvarsson participated in a performance assessment meeting in Las Vegas on January 22, 1993.

G. Chen completed a software QA class taught by D. Gockel of USGS on January 11-12, 1993 at LBL.

WBS 1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization Activities

Principal Investigator - M. Chornack

OBJECTIVE

To perform prototype hydrologic tests to minimize costly stand-by times; to develop QA procedures; to determine feasibility of the proposed tests; to train new personnel; to help increase likelihood of success of the tests; and to test new instruments, equipment, and procedures.

Prototype Cross-Hole Testing 0G3312AC93

Summary Account Manager - G. LeCain

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT004 Prep open file report on ALTS testing & analysis

G. LeCain completed the first draft of the results section on the Thermocouple Psychrometer prototype testing at the Apache Leap Tuff Site. The TCPs showed the boreholes were at saturation and that water vapor was condensing in the test intervals during the entire testing period. LeCain is presently writing the results section on air-permeability testing.

Prototype Tracer Testing 0G3312AD93

Summary Account Manager - I. Yang

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GUT016D Prepare WRI report on gaseous tracer tests

Tabulated experimental data of CO<sub>2</sub> adsorption and desorption on crushed gypsum cement. Gypsum is a proposed borehole grout. If adsorption or desorption occur, it will affect the in-situ CO<sub>2</sub> concentrations, consequently gas-phase investigations. Also, gypsum contains hydration water. Their effects on oxygen and hydrogen isotopic data are being studied.

### Work Performed but not in Direct Support of the Scheduled Tasks

Discussed with R. Dietz of Brookhaven National Laboratory and reviewed literature on methods of dispersing, collecting, and analyzing perfluorocycloalkene tracer gases in order to evaluate their acceptability for use at Yucca Mountain. Rewrote USGS position paper on tracer-gas needs at Yucca Mountain. (12 hrs)

## Prototype Pore-Water Extraction 0G3312AG93

Summary Account Manager - I. Yang

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GUT050G Evaluate and analyze pore-water chemistry and compression techniques

M. Beasley updated the computer data base of compression test records, and pertinent geotechnical test parameters such as porosity, degree of saturation, degree of success, water content, etc. were calculated on a spreadsheet program.

J. Higgins and C. Peters met to discuss possible additional analyses, modelling, and specific tests required to complete this task and contribute to the planned technical papers on pore-water extraction development. They will be consulting with D. Thorstenson concerning geochemical issues before a final decision is made on what will be done.

3GUT052G Prepare OFR on pore-water chemistry vs pressure data

The development of the data base referred to under 3GUT050G above is the first step in developing the planned OFR. Presently, J. Higgins and C. Peters are selecting appropriate tables and graphs for inclusion in the OFR. It is anticipated that the OFR will include three sets of data tables consisting of pre-testing information (sample, degree of welding, degree of saturation, water content, etc.), mechanical test data (load and volume water extracted, strain, etc.), and pore-water chemistry data (ion concentrations, pH, etc.).

3GUT053G Prepare journal paper on development of 1-D compression

This paper will be based on a combination of a WRIR report, development of the high pressure one-dimensional compression cell, and data generated since the writing of the WRIR. A draft introduction, purpose and scope, and a section on both the first and second generation cell designs have been prepared

### Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 8 hours were spent in the support of the following:

Because of difficulties with the availability of rock saw equipment in the USBR labs, M. Beasley is converting a USGS rock saw to a dry cut saw to be used for core preparation. Beasley ordered and received parts to convert the wet rock saw to a dry cutting saw. The vent and collection system must still be modified. (4 hours)

M. Beasley picked up the second high-pressure one-dimensional compression cell from the contract machine shop. He also obtained a cost estimate from grooving the plates. Grooving of the plates will be the final machining required for this second cell. (4 hours)

### WBS 1.2.3.3.1.3 Saturated Zone Hydrology

#### OBJECTIVE

To develop a model of the saturated zone hydrologic system of Yucca Mountain that will assist in assessing the suitability of the site to contain and isolate waste. (SCP Investigation 8.3.1.2.3)

#### WBS 1.2.3.3.1.3.1 Site Saturated Zone Ground-Water Flow System

Principal Investigator - M. Umari

#### OBJECTIVE

To determine the hydrogeologic nature of the Solitario Canyon fault in the saturated zone; to determine the time and spatial variation of the potentiometric surface; to determine the character, magnitude, and causes of water-level fluctuations; to estimate elastic and hydraulic properties; to determine transport properties of the saturated zone; to evaluate the relation between hydraulic properties and fracture characteristics; to characterize chemical and physical properties of the saturated zone that affect radionuclide retardation; and to conduct single-and-multiple well tracer tests using conservative and reactive tracers to determine hydrologic, chemical, and physical properties in the saturated zone. (SCP Study 8.3.1.2.3.1)

#### SCP 8.3.1.2.3.1 Site Saturated-Zone Ground-Water Flow System LOE Account 0G33131Z93

Summary Account Manager - R. Lucky

#### ACTIVITIES AND ACCOMPLISHMENTS

Support Project Operations:

(A) Site Potentiometric-level evaluation (8.3.1.2.3.1.2):

P. Tucci performed routine project operational tasks, including scheduling and coordinating field operations to maintain the water-level monitoring network, overseeing project budget items and spending, preparing personnel actions, attending section meetings, meeting with project personnel, and other miscellaneous administrative and operational tasks (not specified below) for the Site Potentiometric Levels project.

M. Boucher lent QA support to various activities, evaluating QA and organizing QA support for other groups of activities. Boucher attended the NQA-1 training class.

A draft criteria letter to free the packer that is jammed in well H-5 received QA approval and was submitted to DOE.

P. Tucci continued working on a draft criteria letter needed to pump and clean existing WT holes prior to sampling. Tucci attended a CASY Symposium, and answered questions concerning the poster "*Earthquake-induced water-level fluctuations at Yucca Mountain*", by O'Brien and Tucci.

(B) Saturated-zone Fractured-Rock Hydrology (8.3.1.2.3.1.3):

Prepare Personnel Actions:

M. Umari drafted a new position description for J. Gemmill reflecting enhanced duties, and submitted it for reclassification.

**Prepare Procurement Documents:**

Procurement documents were prepared for various equipment, supplies and services for activities of the SZFRHP.

**Prepare and Review Technical Procedures:**

M.J. Umari reviewed a change in the calibration requirements of HP-60, "*Method for monitoring water level changes using pressure transducers and pressure transmitters*".

**Do Operational Tasks:**

Arrangements were made with Bannon Drilling, of Oakhurst, Ca., to ream two of the holes at the Raymond Quarry site that will be used to prototype the c-holes-bound packer string. This was necessary because obstructions were encountered in the hole when a packer simulator was lowered into the holes. Members of the SZFRH project went to the site and were able to lower a single packer down the two holes, and then bring it back to the surface successfully.

**Oversee LBL's Effort to Complete Analysis of Seismic Profile:**

E. Majer collected raw data (seismic wave arrival times) during a cross-hole seismic tomographic survey between wells c-2 and c-3 in June and July of 1992. However, no processing of these seismic wave arrival times to produce a "velocity map", which would indicate fracture intensity distribution on the plane of the cross-section between c2 and c3, has been done. Majer had requested funding to accomplish this task in FY93, and because the funds were not made available, this task has remained unaccomplished.

M. Umari, G. Patterson, and D. Luckey are planning to attend a meeting on February 10, 1993 in Las Vegas where E. Majer will be presenting "*The information obtained from seismic tomography at the C-Well Complex*" to DOE.

**Convert Scientific Notebook to Technical Procedure:**

The SN for the field simulation of the c-hole testing has undergone technical and QA review, and is close to being approved. Questions resulting from the QA review concerning the specific tracers that will be used, and the laboratory and field analyses for the concentrations of these tracers in the effluent from the tracer tests, were responded to. The Scientific Notebook will probably be used for the initial stages of the actual testing at the c-holes (tests are planned to start in 6/93), and as such, the conversion to a technical procedure is not imminent.

**Develop Software QA for Analysis Programs:**

All software applications are in the developmental stages in the SZFRH project, and are exempt from full software QA stipulations according to the ACSR YMP-USGS-ACS-G1233131-1, R0.

**Develop Scientific Notebook for (Hydraulic and) Tracer Tests:**

The SN for the field simulation of the c-hole testing has undergone technical and QA review, and is close to being approved.

**Routine tasks completed in this reporting period:**

Monitored 21 zones in 21 wells on a monthly basis; monitored 17 zones in 12 wells on an hourly basis; the lower zone in well H-5 is still unmonitored due to a packer jammed in the well; continuous analog data obtained from three zones in two wells (included in count of hourly sites above) in order to monitor water-level responses to earthquakes and UNEs; obtained real-time data on 17 zones in 12 wells using DCPs (included in count of hourly sites

above); evaluated status of network at end of each month; monitored real-time data on a daily basis, looking for water-level excursions.

Special tasks completed in this reporting period:

Calibrated transducers at the following wells: WT-3, G-3, b#1, H-5 (upper zone), H-3, and H-1 (tubes 2,3,4); replaced transducers at the following wells: H-4; investigation of the water-level and fluid-pressure responses in wells at Yucca Mountain to earthquakes is continuing; G. O'Brien investigated possible causes of transducer failures; antennae for data transmissions to satellites were realigned at all DCP sites; repaired steel tape (chain #2); calibrated chain #2; removed DCP at well UE-25 b#1; well will be measured monthly as part of the periodic network; DCP will be moved to well USW G-2, which will be incorporated into the continuous network; security locks were placed on wells in periodic network in Crater Flats by REECO; approximately 900 ft of steel tape from Chain #1 were lost down well USW WT-7 on Jan. 25, 1993; efforts will be made to recover the tape in February.

Reduce 1992 Transducer Calibrations:

Transducer data from several wells were reduced on an as-needed basis for inclusion in various reports or for data requests; data were reduced for seven wells for inclusion in the USGS Nevada District's environmental monitoring program quarterly report.

SCP 8.3.1.2.3.1.2 Site potentiometric-level evaluation 0G33131B93

Summary Account Manager - P. Tucci

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF064A Complete 1990-91 water-level report

Transducer data (1990-91) for several wells were converted to water levels for analysis and inclusion in the report. All transducer data for 90-91 put into ADAPS for conversion to water levels. Draft of "Data Collection System" section of report is nearly complete. All tables and figures for "Periodic Water-Level Measurements" section are complete. Work on the periodic network data for the report is essentially complete.

3GWF025A Reduce 1992 water-level data

Data were reduced for wells J-11, J-12, J-13, USW VH-1, UE-25 WT#13, UE-25 WT #15, and UE-25 p#1 for inclusion into USGS Nevada District's environmental monitoring program quarterly report.

3GWF002 Review 1992 water-level data and prepare TDIF

Work was begun on this task and continues.

Work Performed but not in Direct Support of the Scheduled Tasks

G. O'Brien attended the training class, Design of Interpretive Studies, at the National Training Center in Denver, Jan. 25-29. (40 hrs)

P. Tucci and G. O'Brien revised the paper, "*Hydrologic responses to earthquakes, June 28-29, 1992, at Yucca Mountain, Nevada*", to be presented at the '93 WM Symposium in Tucson, following colleague review and submitted it for approval. Submitted for DOE concurrence and USGS Director's approval on January 20, 1993. Discussed preparation of final illustrations with Colorado District personnel. (40 hrs)

G. O'Brien performed a technical review of a paper by C. Faunt and others to be presented at WM '93. (24 hrs)

Work was done on repairing various water-level measuring equipment at NTS, and resolving computer-link problems between the HRF and Denver. (40 hrs)

Status of approved reports or reports awaiting approval:

The text of the approved report "*Water levels in continuously monitored wells in the Yucca Mountain area, Nevada, 1985-88*" was submitted to the Colorado District for final formatting and processing. Work has begun on preparation of camera-ready copies of illustrations by the Colorado District.

The report, "*Precision and accuracy of water-level measurements taken in the Yucca Mountain area, Nevada, 1988-90*", by M. Boucher was sent to Reston for USGS approval in late December.

The report, "*Earthquake-induced water-level fluctuations at Yucca Mountain, June, 1992*", by G. O'Brien has been revised following colleague review and has been sent for approval.

SCP 8.3.1.2.3.3 Analysis of single- and multiple-well hydraulic-stress tests OG33131C93

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF003D Reanalyze Past C-Hole Data

E. Ervin is developing a fracture network model for the c-holes using the software package Fracman. The model can be used to analyze past preliminary pump tests that were conducted at the c-holes.

A. Geldon, as part of writing the intraborehole flow & stress test report, is using a PC-based software package by W. Walton to analyze past c-hole test data. (This is a developmental activity exempt from the software QA program by an approved ACSR).

3GWF010D Complete intraborehole flow & stress test report

A. Geldon has been working on the report, and has made significant progress. Completion of the report is on schedule.

3GWF008D Monitor/analyze strain-related pressure response

This activity was initially focused on ways to resume monitoring the c-holes for strain-related pressure changes, from now until the commencement of cross-hole hydraulic testing at the holes, July 1, 1993. The effort requires placing a packer in one of the c-holes, and measuring the "confined", or "undrained" pressure below it, and the "unconfined", or "drained" pressure above it, by two transducers. This would, in turn, require a work-over rig to be provided by NTS contractors. It has been determined that, given the complexity of the preparations currently under way to provide all the NTS contractor support in time for the cross-hole testing to start July 1, 1993, it is not desirable to add the additional requirement of placing packers for strain-related pressure monitoring in the c-holes now, so that data could be gathered until July 1. Rather, the decision has been to wait until the multi-zone packer system is in place, and then conduct strain-related pressure monitoring during down times in the cross-hole testing.

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GWF007F Complete Design Memoranda - 5-zone Packer String

The final agreement with the USBR on QA matters, finalized in the form of a MOA, is that the USBR will document its design of the packer string system by Design Memoranda according to one of its QMPs. These Design Memoranda may also include instructions on assembly of the string prior to field deployment. The final review and revision process of these Design Memoranda, however, are not due to be completed until end of May 1993.

J. Bowen, USBR, has prepared an outline for the Design Memoranda package, and has started the draft of the memoranda package.

#### 3GWF030F Expand Packer Strings to 5-Zones

The work under this activity is being carried out jointly by the SZFRHP/HIP/USGS-YMP, and the USBR. The details of what the USBR will do in procurement and construction to expand the existing two 3-zone packer strings to three 5-zone packer strings, was formalized in the form of a MOA between the USGS and the USBR.

J. Bowen, USBR, submitted requisitions for purchasing compression fittings (to allow for the water-tight, and water-proof, passage of downhole electric cables through the packer electric cable pass-through's), sliding sleeves (to allow for selecting which of the five packed-off zones to be in hydraulic communication with), and pressure transducers.

A contractor was identified to do the soldering of wires between water-proof electric connectors and multi-conductor cable segments. This is work that the USBR was initially slated to do, but due to budget problems, was removed from their scope of work.

The week of March 15, 1993 has been tentatively chosen for J. Bowen, USBR, and J. Earle, USGS, to travel to Houston for the detailed inspection of the packers being fabricated for the USGS by the Tam International Company.

#### 3GWF014F Develop Techniques for (and Begin) Analysis of X-Hole Test Results

Using the software package FracMan, to develop a 3-dimensional fracture-network model for the c-holes (the model can be used for cross-hole test design, and analysis of the eventual cross-hole test results): E. Ervin is working in cooperation with the SZFRH. The SZFRHP provided Ervin with data and other information related to the c-holes to assist her in her modeling role.

### Work Performed but not in Direct Support of the Scheduled Tasks

On January 29, 1993, M. Umari and G. Patterson visited a small company in Boulder for discussions on possibly contracting out the task of programming the software package Labwindows, which is part of the data acquisition (DAQ) system purchased from National Instruments Inc.

Work was done on designing a reeling system to lower and raise the multi-conductor cables, packer inflation hoses, and transducer reference lines into and out of the c-holes when conducting the cross-hole testing. This reeling system will be operating in synch with the work-over rig to perform its function.

A requisition request was prepared for an uninterruptable power supply (UPS) and a power line conditioner to provide "clean power" from the generators to the DAQ system.

SCP 8.3.1.2.3.1.5 Testing of the C-hole sites with conservative tracers OG33131E93

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF170A Complete tracer injection system

S. Williamson from the Baker Tools Co. delivered components of the down-hole tracer injection system that the SZFRHP purchased from Baker.

The downhole tracer injection system requires, in addition to the components purchased from Baker, a 1.66" O.D. pipe to deliver the tracer from land surface to the downhole system. This pipe will be requested from NTS contractors through a criteria letter.

3GWF169A Continue development of techniques for analysis of tracer test results

The following bullet is a repeat of a previous bullet presented under the monthly report for Summary Account number 8.3.1.2.3.1.4, because the activity discussed under 8.3.1.2.3.1.4 serves activities under the 8.3.1.2.3.1.5 account.

Using the software package FracMan, to develop a 3-dimensional fracture-network model for the c-holes (the model can be used for tracer test design and for analysis of the eventual tracer test results): E. Ervin is working in cooperation with the SZFRH. The SZFRHP provided Ervin with data and other information related to the c-holes to assist her in her modeling role.

WBS 1.2.3.3.1.3.2 Saturated Zone Hydrochemistry

Principal Investigator - W. Steinkampf

OBJECTIVE

To describe spatial variations in chemical composition of ground-water; to identify chemical and physical processes that influence ground-water chemistry; to use hydrochemical data to aid in the identification and/or quantification of ground-water travel times; flow paths; fluxes to, from, and within the saturated zone; and climatic conditions during past periods of recharge. (SCP Study 8.3.1.2.3.2)

SCP 8.3.1.2.3.2.1 Assessment of saturated-zone hydrochemical data availability and needs OG33132A93

Summary Account Manager - W. Steinkampf

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWH001A Assessment of extant data, phase II

The data base currently comprises two major files, one containing all entries (about 4700 analyses), the other sorted to reduce redundancies, as appropriate, remove typographical errors, etc. Final site locations, to be used in areal data treatment, have been assigned where needed using various USGS information sources. This second file contains about 3700 analyses. Of these, nearly 2000 have cation-anion balances of less than 10%. The remainder either contain no major cation and/or anion data, or have balances greater than 10%. Several approximations will be tested in an attempt to reduce the population of analyses with balances greater than 10%.

SCP 8.3.1.2.3.2.2 Hydrochemical characterization of water in the upper part of the saturated zone

OG33132B93

Summary Account Manager - W. Steinkampf

Technical Activities

3GWH004B - Collect hydrochemical data/samples

Met with J. Czarnecki to discuss possible sample collection from boreholes in Forty-mile Wash.

Quality Assurance

Planning and Operations

Variations

Work Performed but not in Direct Support of the Scheduled Tasks

Prepared for and participated in the monthly teleconference of the YMP Geochemistry Integration Team. Discussed GIT plans and current efforts with TPO and selected USGS GSP and HIP investigators for participation.

Prepared for workshop on the impact of thermal loading on coupled geochemical-hydrological processes to be held February 1-3.

Met with USGS unsaturated-zone investigators to discuss the possibility of collecting ground-water samples in the course of UZ-16 drilling. Provided a list of potential sample needs with associated priorities.

Prepared the January status report for 8.3.1.2.3.2.

Continued review of a set of data compiled by the analog studies activity.

SCP 8.3.1.2.3.2.3 Regional hydrochemical characterization OG33132C93

Summary Account Manager - W. Steinkampf

Technical Activities

3GWH910 Collect/analyze/evaluate regional samples - FY93

Received on January 25, 1993 the remainder of field equipment ordered in November. Sample collection in Death Valley National Monument likely to be conducted during the first 3 weeks of March.

Work Performed but not in Direct Support of the Scheduled Tasks

Contacted sources of accelerator mass spectrometric (AMS) analyses of <sup>14</sup>C at LLNL and Woods Hole to determine the probability of sample acceptance and analysis. Discussed with USGS Branch of QA staff the need for these services prior to Branch contact of the agencies to plan assessment trips.

WBS 1.2.3.3.1.3.3 Saturated Zone Hydrologic System Synthesis and Modeling

Principal Investigator - E. Ervin

LBL Principal Investigator - K. Karasaki

## OBJECTIVE

To synthesize available data to develop a conceptual model; to make a qualitative analysis of how the system is functioning; to develop and evaluate porous-media and fracture-network methods for simulating ground-water flow and solute transport; and to estimate ground-water flow direction and magnitude for input to ground-water travel time calculations. (SCP Study 8.3.1.2.3.3)

### SCP 8.3.1.2.3.3.1 Conceptualization of saturated zone flow models within the boundaries of the accessible environment 0G33133A93

Summary Account Manager - E. Ervin

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GWM010 Develop porous-media flow model and boundaries

Discussions continued between modeling members of the Saturated Zone on coordination of the site scale ground-water flow model (10's of km) at Yucca Mountain and the regional ground-water flow model (100's of km). The regional model will provide input to the site scale model in the form of boundaries and recharge and discharge information and has approximately 300 node cells (of the thousands in the model) planned in the area around Yucca Mountain. The cells are 1.5 km<sup>2</sup> in size.

### Work Performed but not in Direct Support of the Scheduled Tasks

The paper entitled "*Summary of revised potentiometric-surface map for Yucca Mountain and vicinity*", by E. Ervin, R. Luckey and D. Burkhardt received approval from USGS Headquarters and was submitted for the 1993 International High-Level Nuclear Waste Conference sponsored by the American Nuclear Society for publication.

E. Ervin attended the Unsaturated Zone Modeling meeting in Las Vegas to represent the saturated zone and to hear plans of the UZ modeling groups.

### SCP 8.3.1.2.3.3.2 Development of fracture network model 0G33133B93

Summary Account Manager - E. Ervin

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GWM013B Complete fracture mapping/prepare report: Crater Flat

E. Ervin began to input and format the fracture outcrop data from the Bullfrog Member of the Crater Flat Tuff in digital format in preparation for a report (Milestone 3GWM013M). In addition, the report outline and introductory sections have been completed.

Arrangements to borrow a surveying instrument from Geologic Division to survey in the sites of fracture mapping east of Little Skull Mountain were completed. The trip to perform the surveying is planned in about one month.

#### 3GWM005B Develop conceptual model fracture network FY93

E. Ervin continued fracture geometry simulations at the UE-25c-hole complex using FRACMAN. The conceptual model for flow at the multiple-well complex is based on work done by A. Geldon and outcrop data collected from the Crater Flat Tuff. The purpose of this work is to assist in the placement of the packers during C-hole cross-hole testing.

Quality Assurance

3GWM013B Complete fracture mapping/prepare report: Crater Flat

L. Anna of the unsaturated section, fractured rock hydrology project, agreed to perform an independent review of the fracture data collected by E. Ervin and M. Chornack.

SCP 8.3.1.2.3.3.2 Development of fracture network model 0B33133B93

Summary Account Manager - K. Karasaki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM18CA Study outcrop fracture bias and prepare report

Further investigation using visual/graphical methods of estimating fracture density in boreholes to examine correlation between changes in fracture characteristics (density, strike, and dip) form C-holes was conducted. Development of a regular square lattice model for statistical representation of fluid flow in fracture networks continues.

3GWM21CA Complete TRINET users manual

The bug in TRINET related to an occasional spike in concentration profile is still being investigated. An innovative way to present temporal and spatial solute concentration has been developed.

3GWM23CA Study prediction error and design test

A numerical inversion scheme for cross-hole tracer tests in fractured rocks was designed.

K. Karasaki attended the Flow and Transport through Unsaturated Fractured Rock workshop held in Tucson, from January 25 - 28, 1993. The workshop focused on the use of borehole measurements and core analysis data, which are relevant to the saturated zone studies.

Work Performed but not in Direct Support of the Scheduled Tasks

J. Najita and S. Segan completed a software QA class taught by D. Gockel, USGS, on January 11-12, 1993, at LBL.

WBS 1.2.3.6 Climatology and Meteorology

OBJECTIVE

To collect and analyze climatic, paleoclimatic, future climatic, and Quaternary hydrologic data to evaluate the suitability of the site.

WBS 1.2.3.6.2 Climatology

OBJECTIVE

To characterize the present, paleo-regional, local climate, and hydrologic conditions at Yucca Mountain, and to determine the magnitude and likely effects that future changes in climate will have on repository performance.

WBS 1.2.3.6.2.1 Change in Climatic Conditions

OBJECTIVE

To provide a baseline for determining the changes in climate that potentially affect the waste isolation capabilities of the site. (SCP Investigation 8.3.1.5.1)

WBS 1.2.3.6.2.1.1 Modern Regional Climate

Principal Investigator - R. Forester

OBJECTIVE

To develop a synoptic characterization of the modern regional climate to provide a baseline and a background for the interpretation of climatic variation. (SCP Study 8.3.1.5.1.1)

SCP 8.3.1.5.1.1.1 Synoptic characterization of regional climate 0G36211A93

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCR014 Conduct stable/radiogenic isotope anal of precipitation

S. Mahan analyzed a precipitation sample for Sr isotopes collected between October 27-30, 1992 from Yucca Crest. The  $^{87}\text{Sr}/^{86}\text{Sr}$  composition for this sample is higher ( $0.71162 \pm 0.00001$ ) than the average precipitation composition (0.71108). In the future, UNLV will provide additional precipitation samples for Sr isotopic analysis from their network of collectors.

Variations

Completion of Study Plan has been delayed due to field work and leave taken by key personnel.

WBS 1.2.3.6.2.1.2 Paleoclimate Study of Lake, Playa, and Marsh Deposits

Principal Investigator - R. Forester

OBJECTIVE

To establish the nature, timing duration, and amplitude of paleoclimate changes based on paleontologic, stratigraphic-sedimentologic, chemical, and mineralogic analyses of lacustrine sediments in or near southern Nevada; and provide a chronologic frame work for this paleoclimatic information. (SCP Study 8.3.1.5.1.2)

SCP 8.3.1.5.1.2 Paleoclimate Study of Lakes, Playas, and Marshes LOE Account 0G36212Z93

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Prepared schedules for tasks assigned to this activity. Provided status reports of planned activities and prepared variance analysis reports. Performed administrative duties and managed personnel. Reviewed QA procedures of potential vendor.

SCP 8.3.1.5.1.2.2 Analysis of stratigraphy-sedimentology of marsh, lacustrine, and playa deposits

0G36211B93

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCL012B Write report

Received both USGS and DOE approval for the manuscript "*Microfossils as indicators of paleohydrology and paleoclimate*" written by R. Forester and A. Smith. Made final corrections and mailed to N. Patera OECD/NEA.

### 3GCL013B Collect cores

J. Paces spent two and a half days in the field with R. Forester and others examining late Pleistocene paludal deposits in Yucca Mountain vicinity. Carbonate-rich samples were collected from several well-dated (11 to 8.6 ka by  $^{14}\text{C}$ , J. Quade, personal communication) sections to provide an empirical calibration for  $^{234}\text{U}$ - $^{230}\text{Th}$  dating techniques.

Coordinated field trip with J. Quade to a number of field sites in southern Nevada to collect fossil and chemical sedimentary material and to identify sites that can be cored. Material from the cores will provide the paleontological and isotopic basis for reconstructing past regional climate and hydrology from the late Pleistocene and Holocene. A number of sites in the Las Vegas, Indian Spring, Cactus Spring, Pahrump Valleys and the Ash Meadows area were visited. Core sites were selected in all of those places. Participants on the field trip included: R. Forester, B. Parks, K. Conrad, J. Paces, E. Taylor, and S. Lundstrom from the USGS; J. Quade, University of Arizona; P. Wigand, S. Livingston, S. Sharp, and F. Nials of the DRI, UNR; and D. Crawley and A. Gil from DOE.

### 3GCLO14B Stratigraphic analysis

Summary of field trip with J. Quade drafted to describe the stratigraphic sequences of late Pleistocene and Holocene sediments in the Las Vegas and Pahrump Valleys. The units described contain fossil and isotopic evidence that indicates elevated levels of past discharge from the sediments during the late Pleistocene and early Holocene.

## WBS 1.2.3.6.2.1.3 Climatic Implications of Terrestrial Paleoecology

Principal Investigator - R. Forester

### OBJECTIVE

To determine aspects of past vegetation change; and use vegetation records to provide quantitative estimates of changes in climatic variables for the southern Great Basin. (SCP Study 8.3.1.5.1.3)

### SCP 8.3.1.5.1.3.1 Analysis of pack rat middens OG36213A93

Summary Account Manager - R. Forester

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

#### 3GCL104 QA evaluation

B. Parks, A. Handy, T. Mendez-Vigo, and R. Forester conducted a QA review of the DRI, UNR. P. Wigand, S. Livingston, S. Sharp, F. Nials, and D. Ritter represented DRI.

#### 3GCL110 Management oversight/scientific coordination

B. Parks, R. Forester, and K. Conrad accompanied P. Wigand on a field trip to southern Nevada. A number of pack rat middens were found, and Wigand discussed DRI's procedures for sampling and analyzing the middens.

#### 3GCL109 Provide c-14 analysis

Samples were collected from selected middens on field trip to southern Nevada

## WBS 1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain

Principal Investigator - J. Whitney

## OBJECTIVE

To evaluate the paleoenvironmental record at Yucca Mountain and surroundings in light of inferred paleoclimate history of the southern Great Basin; to model soil properties in the Yucca Mountain region; to map surficial deposits; and to reconstruct the eolian history of the region. (SCP Study 8.3.1.5.1.4)

### SCP 8.3.1.5.1.4.2 Surficial deposits mapping of Yucca Mountain area 0G36214B93

Summary Account Manager - E. Taylor

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GCH039A Prepare report/on FY92 study

Drafted report of FY92 findings including preliminary description of map units.

3GCH035A Airphoto/fieldcheck/sampling/analysis n. 1/3 YM

Continued airphoto interpretation and field checking of deposits in Quads 20 and 27.

3GCH040A Isotopic analysis

J. Paces organized samples for and transcribed field notes from November 1992 sample collection trip to Yucca Mountain.

### SCP 8.3.1.5.1.4.3 Eolian history of the Yucca Mountain region 0G36214C93

Summary Account Manager - J. Whitney

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GCH163C Collect samples for isotope analyses

D. Craft wet sieved 16 eolian samples from Av soil horizons in Crater Flat for further isotopic and chemical characterization of the eolian components in pedogenic samples from the Yucca Mountain region.

### WBS 1.2.3.6.2.2 Effects of Future Climatic Conditions on Hydrologic Characteristics

## OBJECTIVE

To determine the relations between climatic conditions and hydrologic characteristics in the vicinity of Yucca Mountain during and since the Quaternary; and to predict future hydrologic response to possible future climatic conditions. (SCP Investigation 8.3.1.5.2)

#### WBS 1.2.3.6.2.2.1 Quaternary Regional Hydrology

Principal Investigator - R. Luckey

## OBJECTIVE

To investigate the hydraulic characteristics of paleoflood events and to compare them with modern flooding and related geomorphic processes; to determine past infiltration and percolation history at Yucca Mountain through isotopic and chemical analysis of water from the unsaturated zone; to determine past hydrologic conditions in the regional discharge area; to estimate the conditions and rates of infiltration and ground-water recharge during the Quaternary; and to determine the ages, distribution, origin, and paleohydrologic significance of calcite and opaline silica deposits along faults and fractures. (SCP Study 8.3.1.5.2.1)

SCP 8.3.1.5.2.1 Quaternary Regional Hydrology LOE Account OG36221Z93

Summary Account Manager - R. Luckey

ACTIVITIES AND ACCOMPLISHMENTS

Collect Hydrologic Data FY93:

Continued data collection at the Stewart Creek and Kawich Creek analog recharge sites. The data collection system consists of two streamflow sites, four meteorological sites, and six to eight water quality sites. On a daily basis, T. Oliver checked the NWIS data base for DCP data and performed weekly data pulls from the LRGS to fill missing data. In addition, Oliver prepared for a winter sampling trip to the analog sites to be conducted the week of February 1. Also, Oliver edited the table headers for P. McKinley's data report on Kawich and Stewart basin data and printed the tables for peer review.

Support Project Operations FY93:

The PI planned, scheduled, and monitored routine project operations, prepared routine procurement documents, monitored rate of spending, and held or participated in routine administrative meetings.

The QA specialists monitored all project activities for QA compliance, tracked all open items, and attended biweekly USGS-HIP SZ QA meetings. M. Ciesnik prepared and submitted a supplemental response to the QA office for USGS-AFR 92-07-01 pertinent to the contract with New Mexico Institute of Mining and Technology (NMIMT) for activity 8.3.1.5.2.1.4b. The response was accepted on January 26. Ciesnik and J. Watson participated in NQA1 training. T. Oliver wrote a statement to close out the Analog's project's scientific notebooks and submitted it to P. McKinley for editing.

SCP 8.3.1.5.2.1.1 Regional paleoflood evaluation OG36221A93

Summary Account Manager - D. Grasso

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH20A Geomorphometric analysis of YM and vicinity

The preparation and analysis of geomorphometric, climatic, and hydrologic data pertaining to modern and past regional flooding in the Yucca Mountain area is complete. Further data evaluations will undoubtedly be required, however, during the report preparation stage of this investigation to be started on March 1, 1993. Additional field reconnaissance work also will be required to validate data analysis. Thus far, the physical, surface water conditions for modern-day flooding in the Amargosa River and Fortymile Wash drainages have been established. These estimated precipitation-runoff values will ultimately enable development of regional paleoflood models depicting past runoff conditions and the probable magnitudes and frequencies of past floods. Maps, tables, and figures showing the results of this phase of the regional paleoflood evaluation will be published as part of the summary reconnaissance report.

3GQH21A Field reconnaissance of YM and vicinity for paleoflood evidence

Heavy rains occurred during the month of January throughout southern Nevada and southeastern California in response to re-established El Nino conditions. Moderate to heavy runoff resulted in shallow lakes filling otherwise dry playa lake basins. Field reconnaissance investigations were conducted to evaluate the magnitude of this runoff and to determine whether lake level rises were caused by local or regional runoff. On the Mojave River, for example, flooding from late January storms in the mountains of southern California resulted in a peak discharge of 8,000 cfs during the third week of January, 1993, upstream of Afton

Canyon. We were able to ascertain that the Mojave River flowed to its terminal playa, Silver Lake, where it inundated the playa surface to a depth of from 4 to 6 inches. Estimates of the volume of standing water were made and compared with runoff estimates for the Mojave River at Baker. Local residents there noted that this usually-dry river ran for 7-10 days, which compared well with our estimates of the amount of water needed to fill the Silver Lake playa.

T. Kane and C. Martinez found that considerable runoff also occurred in the Fortymile Wash and middle reaches of the Amargosa River. Flow volumes along the Amargosa were relatively constant between Eagle Mountain and Tecopa. At this same time, P. Glancy noted that the Death Valley playa was inundated with standing water, which he believed to have come from both the Amargosa River and Salt Creek (north). A field reconnaissance trip to Death Valley is planned for mid-February to more accurately determine the surface area of the lake, its volume, and the actual source(s) of water. These data will help to substantiate estimates based on recorded precipitation-runoff data.

SCP 8.3.1.5.2.1.3 Evaluation of past discharge areas OG36221C93

Summary Account Manager - E. Gutentag

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH11 Complete report on methods of channel geometry

Report by W. Osterkamp is in HIP review and one reviewer has responded with minimal comments. The other has not yet responded.

3GQH003 Vegetation mapping Phase II

Supervised training and classification of image will continue through February. Vegetation density maps and land use maps were produced. These are being compared to existing maps. A field trip is scheduled for March 6, 1993, to check resulting density and land cover classes.

K. Turner continued work on vegetation analysis in the Amargosa which is to complete work begun by L. DeMarco in vegetation mapping Phase I.

3GQH025 Analyze water and lithologic samples NWQL/GSP/GD

Of the four samples collected in November by E. Gutentag and J. Watson two were not completely analyzed by the NWQL because QA analytical problems exist with analyses of dissolved sulfate and dissolved fluoride.

GSP has analyzed all samples for strontium ratios collected on prior trips.

3GQH037 Determine discharge mechanism in hydrologic units

C. Faunt and F. D'Agnesse completed correlation charts for a future report on regional hydrogeologic units.

A data set with transmissivity data from published reports is being developed for the regional 3-D model.

Report outline on present regional discharge was developed by E. Gutentag, C. Faunt, and F. D'Agnesse.

3GQH019 Prepare report on origins of surface deposits

First preliminary report for this study, on the distribution of pedogenic carbonates, has gone to technical review. The result from this study will be compared with results from vegetation and chemistry studies. Results from this analysis will be incorporated into report to be completed at end of fiscal year.

SCP 8.3.1.5.2.1.4a Analog recharge sites 0G36221D93

Summary Account Manager - R. Lichty

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH12CA Prepare data reports FY92

T. Oliver continued editing and tabling of hydrologic data.

3GQH19CA Test chloride ion balance model

B. Lichty reviewed J. Downey's FORTRAN program (CLR020.FOR) and modified the code to make it more applicable to the Nevada analog recharge sites as regards to 1) the availability of vegetation data (crown cover density as opposed to basal area), and 2) the algorithm for computing precipitation adjustment factors. Precipitation adjustment factors are intended to account for local trends in observed precipitation amounts as a function of elevation. J. Emerick, CSM, furnished vegetation transect data for Stewart Creek Watershed. The data was used to characterize the various cell configurations required for application of the chloride ion balance method. Results of the chloride ion balance method are inconsistent. Estimates of effective moisture are too low for Stewart Creek and too high for Kawich Creek as judged by comparison with observed streamflow.

SCP 8.3.1.5.2.1.4b Geochemistry of arid-zone infiltration 0G36221E93

Summary Account Manager - A. Riggs

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH001D Prepare long-term met. data report

Recovered the October - December data storage modules.

3GQH003D Collect watershed inputs and meteorological data

Installed the following: five V-notch weirs on the microwatersheds at OPCNM; two bulk precipitation collector housings on sites at OPCNM; and four tipping bucket rain gage foundations at OPCNM.

Met with NPS archaeologist and received approval for all future ground disturbing activities on this project

Performed the quarterly bulk precipitation collection without incident; and sent in 3 cup anemometers and three wind vanes for calibration.

3GQH007D Analyze/interpret Cl-36 and precipitation data

Collected the following: a sample of the top and bottom of a boulder at the head of a debris flow channel on the mountain front; boulder samples from two fan surfaces, one from a terrace surface, and one from a microwatershed; collected 12 soil samples from terrace surfaces and 11 soil samples from fan surfaces.

The stone content of 11 terrace soil samples was measured and the samples were prepared for total Cl measurement, then split and one set measured with a selective ion electrode, the other split saved for ion chromatography.

Seven calcrete samples were measured for total Cl content three times, and the CaCO<sub>3</sub> content was also measured. 16 boulder samples were measured for total Cl content.

#### Quality Assurance

3GQH003D Collect watershed inputs and meteorological data

Answered the AFR from the last QA audit; response was accepted and changes initiated in the NMIMT contract to bring it in line with the new graded QA status of field work.

#### Variations

3GQH001D Long-term met. data report

This may slip by up to three months because the PI didn't recognize the amount of time required to complete this first-time effort and because of time competition with other duties. This should not repeat itself in the future, once the report protocol is worked out.

#### Work Performed but not in Direct Support of the Scheduled Tasks

Ten hours were spent preparing response to Audit Finding Report.

### SCP 8.3.1.5.2.1.5 Studies of calcite and opaline silica vein deposits OG36221F93

Summary Account Manager - J. Whelan

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GQH836A Write report on evidence for higher water table

B. Marshall formatted and printed a final version of the paper *Strontium isotopic evidence for a higher water table at Yucca Mountain*, authored by B. Marshall, Z. Peterman, and J. Stuckless for submission to the ANS 1993 International High-Level Radioactive Waste Management meeting in Las Vegas. In addition, he met with P. Reilly to determine TDIF requirements, and prepared a table of analyses for inclusion in the TDIF for this publication.

3GQH816A Collect specimens from cores and field sites

J. Paces initiated construction of a detailed (1:60 scale) geologic map of altered tuff and carbonate deposits underlying basalt flows capping a low hill west of the FOC.

3GQH833A Prep isotope composition/fluid inclusion history

S. Mahan sampled several more drill-core veins and fracture coatings from USW G-2, USW G-4 and USW G-3 for Pb isotopic analysis. R. Zartman, and L. Kwak have analyzed several of these samples and found that three contained very little carbonate (only 3 to 13% calcite). Mineralogical studies have not yet been conducted, but these fracture coatings are suspected to be predominantly zeolites.

S. Mahan compiled the statistical results duplicate Sr runs from the Isotopic and Geochemistry Group data base. The data base presently contains 842 records with <sup>87</sup>Sr/<sup>86</sup>Sr uncertainties of 0.0009 or smaller. Of the 53 "duplicate" analysis, thirteen represent the same sample collected at the same time analyzed under identical conditions simultaneously. The two sigma standard deviation for this group of samples is  $\pm 0.00074$  or about 1.01%. Other groups of "duplicates" (same collection, different dates of analysis, or different collection, different dates

of analysis) yield similar results. The high values of reported variance relative to analytical uncertainty (closer to  $\pm 0.00002$ ) includes several anomalous analyses in each group that typically vary within 0.00003 of the other.

K. Futa analyzed several carbonate samples from the Amargosa Desert UZ 55 drill core veins for Sr isotopic compositions. He also initiated a literature search on Sr concentrations in soils around the NTS as a possible monitor of Sr mobility in the modern pedogenic environment.

D. Craft organized HD samples collected over the last five years for U-series analyses, and moved all samples to the IGG YM sample room in Building 21A.

3GQH816B Collect specimens from cores and field sites

J. Whelan, with the help of P. Reilly, continued preparation of four TDIFs for publication of the CASY paper "*Stable isotope geochemistry of fault- and fracture- hosted calcite and ground-water carbonate, Yucca Mountain area*".

3GQH832A Prep mineralogic/petrologic description of specimens

J. Whelan spent three days in the field with T. McConnaughey developing techniques for sampling of soil gas CO<sub>2</sub> and H<sub>2</sub>O for soil gas geochemical and stable isotope studies. Different types of gas-sampling probes, field CO<sub>2</sub> measurement equipment, and temperature probes were tested; and samples of soil gas were collected from four different depths in the soil developed on a sand ramp on the west side of Fran Ridge and from a permanent caisson buried in Jackass flats. Calcrete from trench 14D and from Busted Butte was also collected for petrographic and stable isotope studies.

J. Whelan examined core from drill holes UE25 B#1H, and the C-hole complex and requested 20 samples from the SMF.

R. Moscati analyzed the d<sup>13</sup>C and d<sup>18</sup>O compositions of 26 samples from drill holes USW G-1 and G-4, but the data are in question due to poor mass spectrometer performance and will have to be verified.

R. Moscati cataloged and photographed 33 core samples from UE25 UZ-16.

R. Moscati described and sampled for stable isotope work 39 core samples from UE25 RF-3 and A-5.

J. Whelan unofficially examined the core from NRG-2 and -6 available at the SMF the week of January 29 in search of samples critical or useful for future paleoclimate and calcite/opaline silica studies.

J. Whelan spent a day with Roedder and D. Vaniman at LANL evaluating and preparing samples of drill hole calcite from the UZ for further fluid inclusion studies. The samples transferred to LANL were from USW G-2, GU-3, G-3, and G-4; and from UE25 UZ-16, A-4, A-5, and A-7. The initial results from these studies show that in USW G-1 temperatures of calcite deposition determined from by crushing of vapor-rich UZ inclusions range from 60 to 100°C; homogenization temperatures determined from SZ inclusions ranged from 74 to 114°C. Samples from USW G-2 yielded temperatures ranging from 51 to 104°C in the UZ and from 78 to 260°C in the SZ. The higher temperature calcite from deep in G-2 reflects (probably) the high-temperature diagenetic event at ~10.5 Ma.

Scoping studies of the  $^{14}\text{C}$  ages of UZ drill hole calcites are a bit discouraging with respect to paleoclimate studies. With the exception of one sample from USW G-1 with an age of  $20.9 \pm .09$  ka, the other 13 samples had very old ages ranging from 33.3 to  $>54$  ka. The calcite analyzed came from the surfaces of free-growing crystals and should have represented the latest precipitation in these samples. The very old ages probably represent incorporation of "dead" carbon, perhaps provided by local dissolution of older calcite or from equilibration of infiltrating waters with soil zone calcrete, into the precipitating fluids. Another set of samples will be submitted to verify these somewhat negative results, but it now looks like paleoclimate studies based on deep calcite will have to depend on U-series dating which requires  $\sim 20\text{X}$  more sample.

R. Zartman and L. Kwak determined the Pb isotopic composition and U, Th, and Pb contents of six samples of fracture filling calcite from drill holes USW G-1, G-2, and G-4. This data, combined with earlier results, further confirms the thesis of descending soil zone waters transporting and precipitating the calcite found in the UZ. Calcite deposited above the water table shows a Pb isotopic signature indicating derivation from the soil zone environment, whereas SZ calcites appears to have derived its Pb from the host volcanic rocks.

#### Work Performed but not in Direct Support of the Scheduled Tasks

J. Whelan struggled with the MAT 252 which has developed a background of hydrocarbon contamination, possibly from pump oil or from grease used in the assembly of the high-vacuum pneumatic valves. The problem results in poor precision. Twice the machine was baked out, which temporarily resulted in good data but performance quickly deteriorated.

R. Moscati recorded transfer of 45 samples from drill holes USW G-2, GU-3, G-3, and G-4 and UE25 A-4, A-5.

Z. Peterman was appointed to the CASY Executive Subcommittee and met with co-members D. Luckey and B. Dudley on January 26, 1993, to revise the CASY Charter and to determine the status of the CASY Death Valley volume.

Z. Peterman, S. Mahan, B. Marshall, B. Widmann, J. Paces, and K. Futa attended the CASY symposium technical sessions discussing results and ongoing research on southern Great Basin seismicity focussing on the Little Skull Mountain Earthquake. (4 hrs)

J. Paces completed a technical review of a manuscript  $^{234}\text{U}/^{238}\text{U}$  as a ground-water tracer, SW Nevada - SE California, by K. Ludwig, Z. Peterman, K. Simmons, and E. Gutentag. (7 hrs)

J. Paces compiled, wrote and distributed December monthly report of work accomplished by the IGG. (10 hrs)

S. Mahan analyzed five water samples for Sr isotopic analysis from the Paradox Basin analog study collected by L. Spangler. Resulting  $^{87}\text{Sr}/^{86}\text{Sr}$  values ranged from 0.70845 to 0.70946. (12 hrs)

S. Mahan continued to analyze calcites from Swedish boreholes for Sr isotopic compositions. (8 hrs)

B. Marshall attended a CCC meeting (software QA).

D. Craft began learning IDRISI software (GIS package) in preparation for manipulating Yucca Mountain data files in the future.

WBS 1.2.3.7.2.1 Natural Resource Assessment

Principal Investigator - C. Hunter

OBJECTIVE

To identify and assess the natural resource potential at the proposed repository site at Yucca Mountain. (SCP Study 8.3.1.9.1)

SCP 8.3.1.9.2.1.1 Geochemistry Assess of Yucca Mountain OG3721A93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Planning and Operations

The MOA controlling activity in Natural Resource Assessment investigations was completed in January.

SCP 8.3.1.9.2.1.4 Assessment of Hydrocarbon Resources OG3721D93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GNR002A Evaluate hydrocarbons in Railroad Valley analog

J. Grow began digitizing sonic logs from a well in Railroad Valley. This will allow computation of accurate depth vs. time curves for key exploration wells along seismic reflection lines near the prolific Grant Canyon oil field. Preliminary analysis of sonic velocities indicates that the Late Cenozoic valley-fill values can vary from below 7,000 ft/sec to almost 15,000 ft/sec and that every well should be digitized (if the logs were run) rather than depend on a single or a few generalized depth vs. time curves for this valley. We presently have about 20 sonic well logs digitized and will try to double that over the next five months. Density, gamma ray, and other logs are also being selectively digitized in order to help identify formations which are seldom identified in other reports. Very high velocities are found near the Grant Canyon field, and they appear to be associated with high bottom hole temperatures which are indicative of a strong hydrothermal or convective flow system.

Cuttings from several exploration wells in southern Nevada were submitted to the organic geochemistry lab and are currently being cycled through ROCKEVAL analysis.

Planning and Operations

The MOA for this activity was completed in January.

## 1.2.5 REGULATORY AND INSTITUTIONAL

### OBJECTIVE

To support the Department of Energy (DOE)/HQ in the development of the site-related aspects of compliance with Nuclear Regulatory commission agreements, requirements, and policies, environmental and permitting requirements, and related DOE orders, and the development of site-related regulatory documentation; to plan and conduct environmental field investigations and transportation studies related to environmental compliance, permitting and repository design; to plan and conduct socioeconomic studies to assess the regional socioeconomic action studies; to coordinate Project activities with the community and state and local governments; and to plan and implement a public communication plan.

### WBS 1.2.5.2 Licensing

### OBJECTIVE

To review, analyze and interpret regulatory requirements to provide licensing guidance to the Project; to integrate licensing concerns and the needs of the Project; and to define licensing strategies.

### WBS 1.2.5.2.2 Site Characterization Program

Principal Investigator - W. Dudley, Jr.

### OBJECTIVE

To provide ongoing regulatory planning and evaluation of the site characterization program; and integrate regulatory evaluations into the site program.

### ACTIVITIES AND ACCOMPLISHMENTS

NRC Interactions (NRC, NWTRB, ACNW):

D. Ambos was selected to serve as the technical auditor for the DOE audit of T&MSS scheduled for February 1-5. Three days were spent in preparing for the audit in terms of reviewing the T&MSS study plan and work instructions and preparing a checklist. The NRC has received a copy of the checklist and will observe the audit. The State of Nevada also received a copy of the checklist and may also observe the audit.

C. Menges coordinated with DOE personnel on scheduling NRC field visit to review trenches in Crater Flat and Stagecoach Road areas for (late March).

Study Plan Comment Resolution:

YMP-USGS SP 8.3.1.2.2.7, R1 (*Unsaturated-zone hydrochemistry*) - Proposed responses were drafted to three State of Nevada comments on the study plan.

YMP-USGS SP 8.3.1.2.2.9, R0 (*Unsaturated-zone modeling and synthesis*) - DOE reviewers were contracted to track the progress of author/reviewer concurrence with the author's responses to DOE review comments. Three reviewers have completed their concurrences.

### WBS 1.2.5.3 Technical Data Base Management

### OBJECTIVE

To manage, maintain, and accumulate technical data and information produced by site characterization, design development, and performance assessment activities for the Project.

#### WBS 1.2.5.3.5 Technical Data Base Input

Principal Investigator - L. Hayes

#### OBJECTIVE

To provide the hardware, software, personnel, and procedures needed to provide data to the technical data base and to report the acquisition and development of data to the ATDT.

#### ACTIVITIES AND ACCOMPLISHMENTS

Routine jobs were performed throughout the month, including the retrieval of the QW data from the WRD National Water Laboratory, entering the data into the HIP NWIS data base and the cleanup of the Satellite Transmission of data (SATIN) maintenance logs and directories. Backup of the NWIS data base was performed and the backup tape sent to the LRC for storage in their fire proof vault.

Due to a PRIME system crash and further problems with the NWIS disk partition, B. Oatfield and D. Burkhardt both had to perform preventive maintenance procedures on the NWIS system and satellite data files several times during the month in order to verify the data base and insure proper functioning.

Fifty-two data submittals were received in the Participant Data Archives.

The inventory of all data submitted prior to November 1, 1992, was completed and delivered. The inventory was required as part of a response to CAR-92-08. All data submitted from that date forward is also being tracked and both listings are continuously updated as status of data changes.

#### Satellite Transmissions:

The Colorado District notified its satellite data sites that there were problems with incoming satellite data transmissions over the Christmas holiday. D. Burkhardt ran checks on the various satellite data files to insure that HIP data was not affected. Problems were reported to the Colorado District and corrected.

D. Burkhardt continued to work with the device conversion and delivery system (DECODES), programming format statements to properly load CR21X data. These USGS National Programs allow entry of DCP and electronic data logger (EDL) data into the NWIS ADPS files. There were several problems discovered in the process of loading data for wells H-6 and H-4, due to changes in the procedures while the data was being collected and tagged. These problems were resolved in communication with the field personnel involved in the original collection, and through the DECODES formatting flexibility. Both wells now have complete data sets. This completes this step in the process for all wells. Once this process is complete, Burkhardt will begin the steps necessary to convert the data sets from millivolt readings to water levels.

D. Burkhardt has completed the conversion to water levels for data from WT-2 and WT-6 this month. This data is converted using the NWIS ADAPS processing capabilities. Burkhardt is also putting together a summary of conversion notes. These notes aid in checking the data, and will be used by the hydrologists in selection of the data from the NWIS data base to use in upcoming reports.

#### User Assistance:

D. Burkhardt assisted several participants by performing calibration regressions for their data transmittals and field work.

D. Burkhardt also assisted several HIP and YMPB staff members who were experiencing problems with computer access and/or software packages, such as LOTUS, either on the LAN or on individual PCs.

J. Czarnecki discussed the calculation of total alkalinity with B. Oatfield. Oatfield researched the issues involved, including review of written WRD procedures, and communicated his findings to J. Czarnecki and C. Peters. The issues were discussed at an informal technical seminar for chemists held by D. Thorstenson. B. Oatfield is currently assisting M. Ciesnik in resolving the problems that were defined at that meeting.

In addition, B. Oatfield is currently assisting J. Czarnecki in establishing proper identification in the NWIS data base for receipt of some incoming water quality data from the WRD National Water Quality Laboratory (NWQL). Czarnecki also needs access to some WRD data held in the Utah District NWIS data base. Oatfield is gathering the information necessary to perform a data base pull of that data from Utah into the HIP NWIS Reference data base.

B. Oatfield also worked with T. Oliver in reviewing the various formats available from within the NWIS QW (Water Quality) system, to select the proper report tabling format; made several ground water (GW) retrievals from the NWIS data base for the Paleohydrology projects; received a summary of an EPA modeling program that may have use within the projects, distributing the information to HIP modelers; assisted A. Geldon and J. Gemmel in reconstructing some of the history of the C-Wells investigations. Some data tapes were discovered in the process.

#### Software Installation:

G. Rogers Alpha version of the port of ADAPS software from the Prime computer to the Data General environment was updated on the HIP Data General computer. This update corrects some problems found in earlier testing, and allows further use of the ISAM (Indexed Sequential Access Method) file software. D. Burkhardt will begin further testing of the package.

The data management unit received updated information from WRD National Headquarters on hardware needs for new national software. Discussions were held on upgrades to the present HIP Data General equipment that would be necessary for proper performance of the new software, including the new AIS. Outlines for further DIS-II purchases were prepared.

D. Burkhardt and B. Sockriter worked on the WRD survey involving a survey wide SAS (statistical analysis system) procurement. HIP already has several participants using SAS and interested in SAS. Taking this software off the SUN and using a USGS DIS-II procurement would save the YMP approximately \$9,000.

#### V. Software Quality Assurance:

D. Burkhardt worked with T. Oliver, performing verification and validation testing and paperwork, for a millequivalence conversion program used by that project.

B. Kerans worked with M. Wallendorf, who is reviewing the paperwork for software Quality Assurance acceptance of the NWIS (Rev91.1) data base. Information is currently being generated for the quality assurance process for the next version of NWIS (Rev91.2 A).

B. Kerans, HIP representative on the CCC, attended an all day meeting of the CCC on January 15, 1993. This meeting attempted to deal with various NCRs of committee concern, and the review of a potential CCC charter.

#### Data Administration:

A meeting of the data management unit was held to clarify the mission and responsibilities of the unit during a transition period. The transition comes as the chief of the computer operations and data management unit assumes a new position in WRD, leaving the Yucca Mountain Project.

In response to various questions regarding USGS WRD policies on data management and water quality procedures, B. Oatfield gained access to the MEMOS programs on the National Headquarter's PRIME and reviewed pertinent memorandums. Memorandums concerning data collection procedures and original data were located and distributed to affected participants for their review.

**Training:**

B. Kerans attended Ingres data base management training in preparation for the installation of Ingres data bases for National WRD software.

WBS 1.2.5.4 Performance Assessment

OBJECTIVE

To conduct investigations and develop mathematical models examining the performance of the MGDS in the preclosure and postclosure phases; to verify, validate, benchmark, and document codes for assessing the performance of the overall waste isolation system; and to analyze the performance of the total system and subsystems.

WBS 1.2.5.4.4 Site Performance Assessment

Principal Investigator - A. Flint

OBJECTIVE

To integrate physical process submodels and data into computational models for prediction of performance of the site (including uncertainties); and assess whether the site will meet requirements for ground-water travel time in 10 CFR 60.113(a) (2). (SCP Sections 8.2.2 and 8.3.5)

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GPA004 Develop 1-D and 2-D matrix models

The 1-D matrix model developed for both USW UZN-55 and UE25 UZ-16 as part of the INTRAVAL test case was presented at an NRC/Univ. of Arizona workshop on flow and transport in fractured porous media. In addition, another 1-D model was developed to determine steady state conditions with a specified lower water potential boundary. The model quickly provides the initial conditions that are being used in TOUGH for the long term climate change analysis.

3GPA008 Analyze fracture/fault fill and develop model

Preliminary laboratory measurements are continuing. Bulk density, porosity and grain density have been measured.

WBS 1.2.5.4.6 Development and Validation of Flow and Transport Models

Principal Investigator - A. Flint

OBJECTIVE

To develop and validate the calculational models that (1) are used primarily in assessments of performance for the resolution of Issues 1.1, 1.2, 1.3, 1.6, 1.8, and 1.9; (2) describe fluid flow or the transport of energy/or radionuclides; and (3) are not used exclusively in the resolution of a single issue; and to follow applicable quality-assurance procedures.

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GVF003 Develop and refine data for INTRAVAL program

Additional data was added to the INTRAVAL test case. The data will be transmitted to C. Voss, Golder and Assoc. to be retransmitted to the INTRAVAL participants, in early February. The data consists of improved water characteristic curves developed using the Decagon CX-2.

#### 3GVF007 Develop and test hydraulic functional relations

Further fitting of van Genuchten functions has been done on the new CX-2 data. No work on testing the hydraulic functional relations can be done until a larger data set is established.

## 1.2.9 PROJECT MANAGEMENT

### OBJECTIVE

To provide overall management of the Yucca Mountain Project including: project control, quality assurance, technical integration, and interaction with other OCRWM Program demands on Project management activities.

#### WBS 1.2.9.1 Management and Integration

### OBJECTIVE

To provide overall management for contract activities; and to perform project-level coordination of project management activities.

#### WBS 1.2.9.1.2 Technical Project Office Management

Principal Investigator - L. Hayes

### OBJECTIVE

To provide overall technical project office management activities for the Yucca Mountain Site Characterization Project Office.

## ACTIVITIES AND ACCOMPLISHMENTS

The USGS Committee for the Advancement of Science in the Yucca Mountain Project (CASYS) convened a symposium to discuss USGS and UNRSL data and interpretations regarding the June 29, 1992 Little Skull Mountain earthquake.

#### WBS 1.2.9.2 Project Control

### OBJECTIVE

To provide Project and participant management support in the areas of budgeting, cost and schedule planning and control; develop and maintain an integrated project management system; to implement performance measurement; to support the change control system; and to establish WBS and support project control processes.

#### WBS 1.2.9.2.2 Participant Project Control

Principal Investigator - R. Ritchey

### OBJECTIVE

To develop, maintain, integrate, control and report the participant cost and schedule plans, and to participate in change control.

#### ACTIVITIES AND ACCOMPLISHMENTS

A composite list of all Level 3 milestones/deliverables (FY93/94) was submitted to the M&O contractor with criteria statements.

Cost/Schedule Status Reports were updated for analysis of project performance and variance analysis.

Validation of data submission items in the schedules are being analyzed and verified.

### 1.2.11 QUALITY ASSURANCE

#### OBJECTIVE

Includes work scope related to the development and maintenance of project participants assurance programs, consisting of all those planned and systematic actions, necessary to provide adequate confidence that the information to obtain a license for siting, constructing and operating a geologic repository and monitored retrievable storage facility will be met and complies with Federal regulations.

#### WBS 1.2.11.1 Quality Assurance Coordination and Planning

Principal Investigator - T. Chaney

#### OBJECTIVE

To coordinate and support the activities that are performed within the Quality Assurance WBS element.

#### ACTIVITIES AND ACCOMPLISHMENTS

Three Activity Controls Specification Reports (ACSRs) were prepared for HIP and submitted to the Grading Acceptance Committee (GAC):

YMP-USGS-ACS-G1233124-1,R0	Percolation Test in the ESF
YMP-USGS-ACS-G1233114-1,R0	Regional Hydrologic System Synthesis and Modeling
YMP-USGS-ACS-G1236222-1,R0	Characterization of the Future Regional Hydrology Due to Climate Changes

The GAC meeting minutes were prepared for the December 1992 meeting and forwarded to the Committee members, the QA Manager, and the Chief, YMPB, for review. The GAC Status Log was updated.

The five remaining SIPS and QALAs are being evaluated for deletion from the controlled distribution system.

#### WBS 1.2.11.2 Quality Assurance Program Development

#### OBJECTIVE

To establish and maintain the QA program documents.

## ACTIVITIES AND ACCOMPLISHMENTS

Preparations for transmitting the Quality Assurance Requirements Document (QARD) Matrix, Impact Analysis Statement, and Transition Plan are being prepared to go to the Office of Quality Assurance (OQA) per DOE request.

A comparison of the USGS Quality Management Procedures's against the QARD is currently being done to see which requirements are met and which QARD requirements need to be addressed.

Training was received on the Requirements Traceability Network (RTN) in Las Vegas on January 19 and 20 for the Database Administrator and one data entry person.

The following QMPs or modifications were drafted or changed as requested and returned to their respective authors:

QMP-4.01, R4	Procurement Document Control
QMP-5.04,R4-M1	Preparation and Control of the YMP-USGS Quality Assurance Program Plan
QMP-7.01, R5	Control of Purchased Items and Services
QMP-7.04, R0	Supplier Evaluation
QMP-5.05, R3	Scientific Notebook System

Input of data, tracking dates of assignment, and other details necessary to keep the open items data base current were handled. Daily and weekly Status of Open Items were prepared and input to the Open Items data base for trending.

The November, December, and fourth quarter FY92 Open Items and Trend Analysis Reports were written and issued. The report format was revised and a new executive summary was included.

### 1.2.11.3 Quality Assurance Verification

#### OBJECTIVE

To verify the QA program through periodic audits and surveillances of Project activities.

#### WBS 1.2.11.3.1 Quality Assurance Verification - Audits

Principal Investigator - T. Chaney

#### OBJECTIVE

To verify the QA program through periodic audits of Project activities.

#### ACTIVITIES AND ACCOMPLISHMENTS

Responses to several Audit Findings from Audits USGS-92-05 and -92-07 were researched and evaluated.

The Audit Report, USGS-93-02, of criterion 5 was written resulting in two Audit Findings and four Audit Observations.

An audit of the Colorado Department of Agriculture was performed with satisfactory results. The report is pending.

Completed a successful annual Supplier Evaluation of Wavetek-Datron Instruments, (USGS-93-E05).

Vendor Evaluation USGS-93-E07, Li-Cor, Inc. was completed recommending retention on the Approved Suppliers List.

An evaluation of vendor Halkin was performed and documented.

A Special Investigative Review for NCR-92-34 was performed and a recommendation for closure was submitted.

The response to USGS-NCR-93-05 was evaluated and a letter was submitted indicating acceptance.

Developed evaluation responses for NCRs -93-01, and -93-03

Verification of several deficiency documents was started. Draft reports were written for a few of these verifications.

A detailed schedule of upcoming audits, surveillances and vendor evaluations was developed and distributed.

Planning, training, and other preparations were conducted on new responsibilities for tracking and evaluation of deficiency document responses.

Provided a list to A. Lykins, of actual suppliers addresses vs P.O. box addresses listed on the Approved Suppliers List (a DOE request).

#### WBS 1.2.11.3.2 Quality Assurance Verification - Surveillances

##### OBJECTIVE

To verify the YMP USGS QA program through periodic audits and surveillances of Project activities.

##### ACTIVITIES AND ACCOMPLISHMENTS

Surveillance Report USGS-93-S01 was finalized and issued resulting in the closure of CAR-92-04 and the issuance of one Nonconformance Report, USGS-NCR-93-06.

Completed and submitted the Surveillance Report regarding USGS-93-S02, which included the reissuance of CARs -90-04, and -92-02.

#### WBS 1.2.11.5 Quality Assurance - Quality Engineering

Principal Investigator - L. Hayes

##### OBJECTIVE

To provide quality engineering support to the project through reviews of documentation and assistance with QA training.

##### ACTIVITIES AND ACCOMPLISHMENTS

Reviewer responses to resolution of comments were received and finalized for the 12/21/92 concurrence draft of QMP-5.05 R3, Scientific Notebook.

The log of USBR work requests was updated and distributed. Two work authorization requests were received during January. One of the requests involved geologic mapping activities at the North Ramp Portal and starter tunnel at the ESF; the other request involved field verification of existing maps/photos/satellite images for fault zones within 100 km radius of Yucca Mountain. Prerequisite reviews were completed and recommendations and requirements for proceeding with the work were forwarded to the Chief, Geologic Studies Program; the Chief, YMPB; and the YMP-USGS QA Manager for approvals.

The Open Items Committee met to focus on the trending process and deficiency documents generated as a result of the monthly trend analysis.

The selection of FY92 Management Assessment Committee members was finalized.

Configuration management actions for YMPO Affected Document Notices (ADNs) are being coordinated with YMP-USGS Project Control. Two ADNs were received and processed. In addition, a review of Document Action Request #711 was completed and prepared for approval by the Chief, YMPB.

Approximately 40 Software Documents were received, reviewed, and/or processed by the SCM Coordinator in accordance with QMP-3.03, R3. The Configuration Status Log was updated and Technical Contacts have been notified of status of their software documents.

The CSA Quarterly Update for the fourth quarter was provided by the SCM Coordinator.

A report of YMP-USGS Classified Software Products was provided by the SCM Coordinator to D. Von Seggern of the University of Nevada, Reno Seismological Laboratory.

A revised Corrective Action Response for DOE CAR YM-93-014 was completed.

Corrective action by the SCM Coordinator for USGS CAR 91-09 has continued. These actions include tracking and follow up for 310+ software classification and control recommendations. Various USGS technical personnel have been advised by the SCM Coordinator regarding the completion of their actions for this CAR. A supplemental response was completed.

Additional maintenance of the CSA Log software has been provided. Planning for needed revision of the CSA Log data base has continued.

## 1.2.12 INFORMATION MANAGEMENT

### OBJECTIVE

Includes work scope related to the project-level establishment of systems to facilitate organization, storage, and retrieval of information/documents.

### 1.2.12.2 Records Management

#### OBJECTIVE

To provide a YMP Records Management System that will meet the requirements of: DOE/RW-0214, Quality Assurance Requirements Document for the Civilian Radioactive Waste Management Program; DOE/RW-0194P, Records Management Policies and Requirements; ANSI/ASME NQA-1, Quality Assurance Requirements for Nuclear Facilities (Requirement 17 and 17S-1, Quality Assurance Records), and the Licensing Support System (LSS).

#### WBS 1.2.12.2.2 Local Records Center Operation

Principal Investigator - L. Hayes

**OBJECTIVE**

To provide a Yucca Mountain Project Records Management System that will meet the requirements of: DOE-NNWSI, Quality Assurance Plan, DOE-NNWSI/88-9; DOE-OCRWM Records Management Policies and Requirements, DOE/RW-0194; and the Licensing Support System (LSS); and to establish and operate all local records centers.

**ACTIVITIES AND ACCOMPLISHMENTS**

All pending records packages in the Local Records Center (LRC) have now been reviewed to ensure that documents are being held appropriately.

The first batch of backlog individual records are ready for transmittal to the Central Records Facility (CRF). About 90% of the material being reviewed has already been processed into the system.

Records received into the LRC and those transmitted to the CRF were completed within the required time. Accuracy rate of completeness, correctness and legibility for records received into the LRC was 98%, and 100% for records transmitted onto the CRF from the LRC.

The LRC transmitted a total of 4,791 pages to the CRF. This included 90 individual records and 28 criteria records packages (1,215 pages), six current and five backlog publication packages (359 pages), six data packages (2,524 pages), and 18 cited references (693 pages).

A QMP-17.01, R5, YMP-USGS Records Management, training session was held for records sources at the site, with seven attendees.

**WBS 1.2.12.2.5 Document Control**

**OBJECTIVE**

To provide a Yucca Mountain Project Records Management System that will meet the requirements of: DOE/RW-0241, Quality Assurance Requirements Document for the Civilian Radioactive Waste Management Program; DOE/RW-0194P, Records Management and Requirements, ANSI/ASME, NQA-1, Quality Assurance Requirements for Nuclear Facilities (Requirement 17 and 17-S1, Quality Assurance Records), and the Licensing Support System (LSS).

**ACTIVITIES AND ACCOMPLISHMENTS**

The following controlled documents were distributed:

- ACS-G1233121-2,R0    Characteristics of Natural Infiltration
- HP-07,R1-M1        Use of a Trace Gas for Determining Atmospheric Contamination in a Dry-Drilled Borehole
- HP-160,R1-M1       Methods for Analysis of Samples for Gas Composition by Gas Chromatography

Four record packages were submitted to the Local Records Center.

**1.2.13 ENVIRONMENT, SAFETY, AND HEALTH**

**OBJECTIVE**

Includes work scope related to environmental compliance, monitoring, and safety and health.

#### WBS 1.2.13.4 Environmental Field Programs

##### OBJECTIVE

To identify data requirements; to collect required environmental field data; and to prepare topical data reports.

##### WBS 1.2.13.4.7 Water Resources

Principal Investigator - R. La Camera

##### OBJECTIVE

To provide water resources environmental field activity planning documents, field data and analyses, and topical reports describing the results of field data analyses.

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GWR021 Conduct Ground-Water Monitoring FY93

Ground-water levels were measured at 26 sites. Discharge was measured at one flowing well. Ground-water data collected during December were checked and filed.

##### 3GWR033 Environmental Program Support, FY93

Participated in workshop for developing workplan of the Environmental Restoration Program with respect to refining estimates of total ground-water discharge at Ash Meadows. Investigated and developed conceptual report products for the Water Resources Monitoring Program and discussed potential data-reporting plans with USGS-Nevada District and SAIC personnel. Discussed plans for revising EFAP with SAIC personnel. SAIC will develop a plan to produce a revised EFAP by mid-April, and initiate contact with USGS NV-District personnel for input as warranted.

##### 3GWR034 Evaluate Ground-Water Quality Monitoring Requirements

Met with SAIC personnel on January 25 to discuss DOE's plans for monitoring ground-water quality and the potential need for UNLV/USGS interactions. Meeting results were summarized for USGS-Nevada District and USGS-HIP management.

##### 3GWR025 Prepare GW Monitoring Report 1st Quarter FY93

Prepared quarterly monitoring report and delivered report to DOE on January 25, 1993.

##### Quality Assurance

##### Planning and Operations

##### 3GWR021 Conduct Ground-Water Monitoring FY93

Measure ground-water levels at all accessible sites in the monitoring network, and check and file data collected. Measure discharge at five springs and one flowing well.

##### 3GWR033 Environmental Program Support, FY93

Prepare and deliver February status report to DOE.

##### 3GWR034 Evaluate Ground-Water Quality Monitoring Requirements

Discuss DOE's ground-water quality monitoring plans with DOE, USGS-HIP, or UNLV as requested. Continue to compile and check existing water-quality data.

##### 3GWR035 Prepare Water-Resources Report Through FY92

Develop outline for water-resources report and consult with DOE to define report format. Compile and evaluate data to be included in the report.

Variations

3GWR021 Conduct Ground-Water Monitoring FY93

Water-level data were not collected at MV-1 or AD-6. MV-1 was not measured because it does not have an access tube to allow water-level measurements. AD-6 is currently the owner's only pumping well and the owner feels that a water-level measurement may affect operation of the well. Nearby well AD-5 is currently measured and provides monitoring data for the area.

1.2.15 SUPPORT SERVICES

OBJECTIVE

Includes work scope related to project-level general administrative and project support activities.

WBS 1.2.15.3 Yucca Mountain Site Characterization Project Support for the Training Mission  
Principal Investigator - L. Hayes

OBJECTIVE

To manage the resources and perform work in support of the YMP training mission developed and implemented by the Yucca Mountain Site Characterization Project Office and YMP participants.

ACTIVITIES AND ACCOMPLISHMENTS

Various routine training functions were performed including distributing individual reading assignments; scheduling DOE General Employee Training (GET) and distributing USGS User's Guide for the Nevada Test Site to trainees; administering GET Refresher Examination for Denver area trainees; providing information regarding participants' instruction assignment completion statuses and YMP-USGS active/inactive statuses; distributing first reminder notices to participants with overdue reading assignments and second reminder notices to their appropriate managers; processing and filing training records; submitting records packages to Local Records Center; distributing T&MSS and YMP-USGS Calendar of Training Events; preparing YMP-USGS Instruction Assessment forms; and submitting YMP-USGS Training Statistics to DOE Training Officer.

Instructors were assisted in their preparations to instruct a Software Quality Assurance Overview Session and a Software Quality Assurance Workshop Session in Las Vegas and Berkeley, and YMP-USGS Records Management Session in Las Vegas. Assistance was also given in coordinating arrangements for a NQA-1 classroom session in Denver January 28, 1993 and in determining YMP-USGS management interest regarding a three day Software Quality Assurance workshop by an outside vendor.



# United States Department of the Interior



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

IN REPLY REFER TO:

WBS: 1.2.9.2  
QA: N/A

March 10, 1993

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

SUBJECT: U.S. Geological Survey Yucca Mountain Project Monthly Summary for  
February 1993

Dear Carl:

In compliance with Yucca Mountain Project monthly reporting procedures, following is the YMP USGS input for February 1993. If you have any questions, please contact Raye Ritchey at (303)236-0517.

## WBS 1.2.3 - SITE INVESTIGATIONS

Staff from the isotope and geochemistry group contributed to the tectonics and paleodischarge programs. Work in support of tectonic studies continued to focus on dating of pedogenic deposits offset by Quaternary fault movement. Thermoluminescence (TL) dating procedures were continued on samples collected previously from Midway Valley and Stagecoach Road. Additional samples for TL dating were collected from several sites along the Bow Ridge, Paintbrush Canyon, Solitario Canyon and Windy Wash faults, as well as from natural terraces along Fortymile Wash. A suite of soil carbonate samples associated with the Solitario Canyon fault were collected for U-series disequilibrium dating, and should provide age limits on the seismic event that produced the prominent surface rupture preserved in Trench 8. Work in support of paleoclimate studies included preparation and analyses for a wide range of soils, rocks, minerals, and water. Chemical and Sr isotopic analyses were performed on precipitation water collected at Yucca Mountain, carbonate samples from postulated paleodischarge sites, waters from springs (Blue Point and Big Muddy) and wells (NA-7), and Paleozoic carbonates from inaccessible portions of Nellis Air Force Base. In particular, large differences in  $^{87}\text{Sr}/^{86}\text{Sr}$  between shallow (120 feet) and deep (1500 feet) water from well NA-7 confirmed the presence of two geochemically distinct waters within the well. Several samples from relatively young paludal spring discharge deposits were also the focus of  $^{234}\text{U}$ - $^{230}\text{Th}$  dating efforts. Additional samples from deposits near the southern end of Crater Flat are being analyzed to better constrain previously reported ages, and two samples from well documented and dated ( $^{14}\text{C}$ ) late Pleistocene are being analyzed as an empirical test of U-series systematics in spring discharge carbonates from the southern Great Basin. New samples of alluvial fan soils, Precambrian rocks, tufas, and waters were collected on a four day field trip to the Yucca Mountain vicinity, to provide further data on the chemical compositions of components in soil carbonates, as well as the effects of water-rock interactions between isotopically distinct

end-members.

The precipitation and meteorological monitoring project reports that the precipitation record for the month of February was broken, with a total of 2.4 inches. Rainfall at Yucca Mountain was measured at over 3.5 inches. The last storm of the month left a 3 to 5 inch snow cover on the crest of Yucca Mountain.

Staff from the surface water runoff monitoring project report that the heavy rain brought several runoff events which were observed and recorded. Accumulation of snow provides potential runoff at higher elevations. Measurements made ranged from 0.10 to 415 cfs, and are undergoing analysis. The data will provide additional information which will be added to data collected in developing runoff characteristics in ephemeral channels.

In support of regional ground water flow system studies, a criteria letter for unscheduled hydrologic and hydrochemical testing, recommended by the Hydrology Integration Task Force, in drillhole USW G-2 was sent to DOE. A drill crew may be available to begin this work as early as March 22.

Staff supporting surficial materials studies continued the sampling of small grab samples taken near the neutron holes. Due to the large amounts of precipitation during the past few months, standard techniques are being adapted to measure soil water potential in the field. Tensiometers will be placed at 5 or 6 selected locations in order to determine the in-situ soil water potential.

The natural infiltration project reports that Bowen ratio data was collected from Pagany Wash. Tensiometers were built for placement in the surface soils in Pagany Wash and at the infiltration site at N-85 to evaluate drying trends following saturated conditions due to recent high rainfall and due to ponding. Some of the tensiometers will be automated for collection with dataloggers. Additional efforts were made to evaluate the flow codes for investigating steady state conditions in deep boreholes. The dual-spaced neutron logging tool was calibrated in the 3 tanks and will be used to log UZ-16 following the removal of the drill string. The UZ-16 borehole is 12" diameter uncased, but the relative magnitude of the counts can be assessed.

In support of artificial infiltration studies, multiple sets of time-domain reflectometry (TDR) probes were installed at various locations at N-85. These probes will be used to determine the rate of water movement away from the infiltration ring. Background sets of measurements were taken every 3 to 4 days, depending upon weather patterns and conditions. Volumetric water content values, determined by TDR, were compared to neutron logs and gravimetric/volumetric water contents obtained from grab samples. A preliminary 2-D model, containing 9 major stratigraphic units has been developed. The model was run using site characterization data that was collected for each of the 9 units. The infiltration simulations were run under a variety of differing boundary conditions, and for a range of hydraulic conductivities and porosity values. Model predictions will be compared to actual measured infiltration values.

The surface based boreholes project reports that drilling continued on UZ-16. On February 24, coring penetrated through the water table at a depth of 1609-1614 feet. Water samples were collected and a verbal operations order was prepared to direct drilling activities on UZ-16 through completion to 80 feet below the water table. Testing guidelines were established to evaluate disturbances to the upper unsaturated zone from drilling in the saturated zone.

The IDAS project reports that a recommendation was submitted to DOE/YMPO to terminate further development of IDAS software. Steps have been taken to begin converting to PCIDAS, which will take over the functions of IDAS. Modifications began to the HRFDAS, used to monitor the HRF borehole. Testing of the modifications is scheduled for mid-March. No impact to program

schedules is anticipated as a result of these actions.

In support of percolation testing in the ESF, an experiment was repeated on one fractured core where the water flow rate through a fracture at different pressures was measured. The repetition was required to verify effects of barometric pressure fluctuations on water flow rate through fractures. These effects were observed in a previously conducted experiment. Results indicate that, as the barometric pressure rises, flow rate increases, and vice versa. This effect will be studied further. The block "E" percolation test was finished. Drawings were prepared to revamp the dust collection system in the laboratory so that the 26" slab saw can be converted from wet to dry cutting. Drawings for the acrylic vessel were completed.

Staff from the aqueous phase chemical investigations project collected water samples from the water table during drilling at UZ-16. Samples were analyzed for Ph, SC, and alkalinity. The samples were separated and preserved for other analysis. Sample tracking forms were completed. Water samples are tainted with salt (NaCl) used by borehole loggers.

The imbibition experiment, in support of the development of conceptual and numerical models of flow in unsaturated zone fractured rock, has been modified. Modifications include a new non-fracture sample, continuous data collection rather than periodic collection, and the introduction of a psychrometer in the middle of the sample to measure water potential and inflow rates in real time. Inflow rates at a specific water potential will give more meaningful information when comparing numerical simulations.

Staff supporting the conceptualization of the unsaturated zone hydrogeologic system attended a meeting in January to discuss results of the thermal flow and transport modeling recently obtained by LLNL. After examining some of the papers published pertaining to those results, numerical modeling has been initiated to investigate to what extent these results are sensitive to the use of the effective continuum approximate to liquid, vapor and heat flow in unsaturated fractured rock. Models are being constructed using both the effective continuum approximation and a true dual porosity approach to see if the high rates of condensate generation and dryout predicted by the effective continuum approximation are significantly lowered by considering the finite amount of time required for liquid within the matrix blocks of a fractured medium to move to the fracture walls.

In support of prototype crosshole testing, work continued on the Apache Leap Test Site prototype testing report. Statistical analysis of the permeability results suggests some correlation between injection rates and calculated permeabilities for the crosshole monitoring zones. The decision to use constant rate transient tests and allow them to run until steady state is proving to be a good one. It is providing estimates of permeability based on transient testing and identifying boundary influences that would adversely impact steady state analysis.

Staff from the site saturated zone groundwater flow system project calibrated transducers at wells G-2 and WT-11; replaced transducers and barometer at WT-11; installed data collection platform (DCP) and transducer in well G-2; continued efforts to recover 700 feet of steel tape from chain #1 in well USW WT-7; recovered a total of 900 feet of steel tape from chain # 2 in wells J-11 and UZ-16. Inclement weather, with extended periods of cloud cover, resulted in increased maintenance of DCP sites; batteries often were run down due to the lack of recharging through the solar panels.

Staff supporting the assessment of saturated zone hydrochemical data availability and needs attempted to augment incomplete records having cation-anion balances exceeding 10% using hardness and alkalinity values. This effort was partially successful. Corrections were made to records for which prior incorrect conversions of alkalinity to bicarbonate had been made. Preliminary areal plots of some dissolved constituent concentrations appear to

reflect regional-scale geologic structural control.

USGS staff participated in a YMP/Geochemical Integration Team workshop to identify post-emplacement geochemical aspects of coupled geochemical/hydrological processes that likely will occur as a result of the perturbation of the thermal and geohydrologic regimes at and in the vicinity of the repository block.

Staff supporting regional hydrochemical characterization met with representatives from UNLV and Los Alamos National Laboratory to identify sites and logistical needs, and to coordinate plans for joint sample collection efforts in the Death Valley National Monument (DVNM). Preparation began of equipment and materials at the NTS for DVNM sample collection. USGS staff met with DVNM staff to report work performed in the monument during calendar year 1992, and to apply for a 1993 collection permit.

In support of studies of vertical and lateral distribution of stratigraphic units, responses were developed to DOE information requests and requirements were assembled for bidders in support of the seismic reflection contract. The RFP was amended to reflect design changes. Issues included safety, training, access, and explosives handling and storage. Best and final bids were received February 25, 1993; evaluation continues. Preliminary cross sections were completed of proposed ramp alignments and underground excavations of the ESF, and delivered to DOE and the design groups. These cross sections eventually will be released as an Open-File Report.

Staff supporting surface and subsurface stratigraphic studies continued lithologic logging of core from UZ-16. Partial structure logs were compiled for NRG-6 and UZ-16. The contact between nonwelded tuff of the Topopah Spring Member and the tuffaceous rocks of Calico Hills is at approximately 1201 ft. Minimal core was recovered between 1191 and 1201 ft; almost 100 percent was recovered below 1201 ft. The 10-ft-thick interval of nonrecovered core probably represents the lowest part of the nonwelded Topopah Spring Member. The contact is established by the relatively high abundance of quartz as phenocrysts in the rocks of Calico Hills. Rare or trace amounts of quartz phenocrysts occur in the lowest part of the Topopah Spring Member between the depths of 1167 to 1191 ft.

In support of the geologic mapping of zonal features, detailed geologic and fracture mapping (at a 1:240 scale) continued of the Ghost Dance Fault in Split Wash. Over 300 fractures have been recorded in this area. As mappers move northward through the study area, subtle lithologic changes are observed in the Tiva Canyon Member. Additional efforts focused on these outcrops include sample collection for petrographic analysis.

Staff supporting geologic mapping of the exploratory studies facility continued geologic mapping of the North Ramp portal. Mappers traveled to the NTS on February 8 at the Project's request, but the portal area was not ready for mapping. Six traceline surveys were completed in the second lift of the portal cut: three horizontal and three vertical surveys. Work continued on a plan-view map of the exposed geology. Photogrammetry targets were placed on the exposed rock for the second lift. Overlapping stereophotos in support of this activity were taken by Johnson Controls.

Staff supporting the analysis of stratigraphy-sedimentology of marsh, lacustrine and playa deposits report that plans to collect cores were delayed because of the above normal rainfall in the region, making it impossible to access some of the dry lakes and playas that will be cored. Also, the coring rig, being purchased by DRI, has not been delivered. The major coring activity, scheduled to begin in February, has been tentatively rescheduled to late March. Ostracode and chemical data from 50 sites was entered into the modern data base that will serve as the basis for analog reconstruction of climate parameters. Eleven samples collected in southern Nevada in January were prepared for analysis.

The regional paleoflood evaluation project reports that heavy rains continued during February in southern Nevada and southeastern California. Moderate to heavy runoff continued to fill playa lakes in the region. Field reconnaissance investigations of the upper and lower Amargosa River drainage basins, the lower Fortymile Wash drainage, the drainage outlet from Mercury Valley, and the lake that has been forming in Death Valley. Runoff in late February on the Amargosa River was substantial. Although large flood peaks have not been observed, sustained lower flow volumes have contributed to the growth of the 1993 Death Valley lake. The water level is presently at the -220 foot contour level. Thus, the 1993 lake is about 62 feet deep at its deepest location. Of particular interest is that from the Amargosa Desert near the confluence of Fortymile Wash, the Amargosa River neither loses nor gains appreciable amounts of water. Flow measurements have recently revealed that the Amargosa River flows subaerially, not subsurface, throughout much of its course. In response to the latest February regional precipitation, for example, the Amargosa River has been flowing at a rate of some 200 to 240 cfs (nearly 500 acre feet per day). These field reconnaissance investigations therefore have shown that the 1993 Death Valley lake is growing in direct response to precipitation-runoff from the Amargosa River drainage basin, and that this system contributes the bulk of water to the lake. Additionally, local flow from tributary (alluvial fan) channels adjacent to the lake were observed to have little influence on the lake in comparison to the volume of water that is contributed by the Amargosa River.

In support of calcite silica studies, staff spent two weeks in the lab developing techniques for extracting  $\text{CO}_2$  and  $\text{H}_2\text{O}$  from soil and atmospheric gases for stable isotope studies. Different types of cryogenic traps, rates of gas flow, and effects of sample size were tested. Isotopic compositions were determined on twelve extractions. Sixty three determinations were performed of the  $\text{d}^{13}\text{C}$  and  $\text{d}^{18}\text{O}$  compositions of samples from drillhole USW G-1. In general, the new data fit the patterns observed in the reconnaissance data set, but are significant in two respects: (1) both the upper and lower lithophysal zones of the Topopah Springs contain calcite mineralizations in which the earlier portion has heavy  $\text{d}^{13}\text{C}$  values (to 3.7%) whereas the later calcite fits the pattern of light  $\text{d}^{13}\text{C}$  values typical of the unsaturated zone; this is similar to the errant values reported from G-4. (2) some calcite from deep in G-1 has very light  $\text{d}^{18}\text{O}$  values (down to 1.3%) that strongly suggest either very warm or isotopically light waters, or a combination of the two. Sixty nine determinations were performed of the  $\text{d}^{13}\text{C}$  and  $\text{d}^{18}\text{O}$  compositions of samples from drill hole USW G-2, again confirming previously recognized patterns, and again with unusually heavy  $\text{d}^{13}\text{C}$  values occurring within the lower lithophysal zone of the Topopah Springs. In this drill hole, however, these heavy values are only about 50m above the SWL, so it is possible that they represent deposition from some past higher water table. Forty nine determinations of the  $\text{d}^{13}\text{C}$  and  $\text{d}^{18}\text{O}$  compositions of samples from drill holes UE-25 A-5, RF-3, and USW GU-3. The latter three of these holes were cored from near the surface and, therefore, provide an opportunity to sample calcite from the surficial zone dominated by soil processes into the deeper fractures coated with calcite druses. In general, the data collected shows a smooth isotopic transition from soil calcrete values (like trench 14) into the compositions typical of the unsaturated zone. Ten samples of air and/or soil gas were analyzed. These samples were collected in duplicate from the air and differing soil depths at Fran Ridge with excellent replication and a systematic trend of decreasing soil gas  $\text{d}^{13}\text{C}$  with depth as would be predicted from published studies of soil carbonate.

Staff supporting the assessment of hydrocarbon resources began preparing a report on the sonic velocities of rocks determined from well logs in Railroad Valley, the nearest oil production to Yucca Mountain within the Great Basin. Digitizing of sonic logs from Railroad Valley continued, which will allow computation of accurate depth vs time curves for key exploration wells along seismic reflection lines near the prolific Grant Canyon oil field. Work continued on digitizing density, gamma ray, and other logs in order to help identify formations which are seldom identified in other reports.

In support of the surface facilities exploration program, staff continued compilation of lithologic logs, and structure logging for NRG-2 and NRG-6. Most work on NRG-2 entailed structural logging, with continued evaluation of lithologic contacts.

In support of seismic studies, field work continued and led to the discovery of additional precarious rocks near Yucca Mountain and near Caliente, Nevada. Extensive comparisons were made between isoseismal maps and historic earthquakes and locations of precarious rocks. Staff finished picking Little Skull Mountain events through November and started assembly of first-motion pick data for Little Skull Mountain aftershocks.

Staff supporting Midway Valley studies completed mapping of the north wall and descriptions of geologic units in MWV-T4. Data analysis and initial report preparation for MWV-T4 was begun. Sites for soil profile descriptions were selected along the north wall of MWV-T4. Trench priorities have changed; newly obtained geophysical data indicates that a fault may be present in the middle of Midway Valley. For purposes of this study, a higher priority has been assigned to investigation of this possible fault than to the study of trench A-3. The location of a trench(es) across this possible fault will depend on the final geophysical interpretations and other information such as geologic mapping. Based on the preceding, priorities for excavation activities are being reevaluated within the context of this study and within the scope of other trenching activities scheduled by the USGS for FY 1993.

In support of the evaluation of the Bare Mountain Fault zone, verification of mapped faults and lineaments and their relationship to surficial deposits was conducted. Sites for excavation of soil pits were identified, as well as an additional trench site across a suspected fault scarp associated with the Bare Mountain Fault.

Staff evaluating the significance of the Miocene-Paleozoic contact at Calico Hills spent one week compiling field mapping and conducting photogeologic interpretation using a PG-2 photogrammetric plotter. Mapping in the interior of the Calico Hills was compiled and areas identified for further field work. Portions of the Miocene-Paleozoic contact were examined photogrammetrically.

Staff evaluating Quaternary geology and potential faults at Yucca Mountain compiled all data from previous works on the fault map. Bedrock faults also were compiled and new bedrock mapping was incorporated. Plans were made to conduct field work to fill in unmapped areas.

In support of the evaluation of the age and recurrence of movement on Quaternary Faults at Yucca Mountain, cleaning and mapping stratigraphy and faults on Busted Butte exposure #4. Two buried scarps on Butte exposure #4 were flagged and photographed and a unit containing basaltic ash was identified. Thermoluminescence (TL) dating samples were obtained from exposure #4.

Staff supporting releveling of the base-station network report that over 110 km of the level line have now been resurveyed; this task is 56% complete.

#### **WBS 1.2.5 - REGULATORY**

USGS responses to State of Nevada comments on Study Plan 8.3.1.2.1.4, R0, Regional Hydrologic Systems Synthesis and Modeling, and responses to YMPO comments on Study Plan 8.3.1.2.2.1, R1, Characterization of Unsaturated Zone Infiltration, were submitted to YMPO.

There are 109 TDIFs within the data management office, or otherwise placed within the system, which require attention for entering into the ATDT. Half of these are complete except for a quality check of the input to the ATDT data base, which is expected to be completed by March 5. All outstanding data items have been identified and placed within the tracking system.

In support of site performance assessment modeling, water retention curve data is being collected using the CX-2 on samples from Trench 14. Permeability measurements are complete for the Trench 14 samples. Permeabilities are an order of magnitude higher when flow is in the direction of layering versus across it. Fault samples permeabilities are complete.

In support of the development and validation of flow and transport models, as part of the INTRAVAL data set, several samples which include fractures are being analyzed to determine which characteristic curves best apply. Some of the data may support the double hump model that is currently in use for fracture and matrix properties. There is an estimated two order of magnitude reduction in saturated flow when the fractures are drained and matrix flow dominates. The water retention data is being fit to a van Genuchten curve to determine if the double hump model may apply.

#### **WBS 1.2.9 - PROJECT MANAGEMENT**

Meetings were held with representatives from DOE, the M&O and USGS to establish the framework for preliminary, interim, and final models for the site characterization portion of the Project Summary Schedule. USGS level 3 milestones for FY 1993/1994 were assigned to their respective topic areas for incorporation into the planned "models". Prerequisites were identified for the matriculation of the interim and final "models".

The USGS Basis of Estimate forms and Participant Work Breakdown Structure Dictionary were completed and submitted to DOE/YMPO.

#### **WBS 1.2.11 - QUALITY ASSURANCE**

As a result of the CAR Board decision for CAR-92-07 to revise the original commitments of integrating the USBR into the YMP-USGS at the program level, the USBR will work on the YMP via task agreements. Consequently, modifications to USGS QMPs that include USBR responsibilities are being evaluated for rescission or modification. All USBR QA procedures will be rescinded by April 30, 1993.

A draft Matrix for the DOE QARD was developed indicating which requirements are already met, are not applicable, or will require changes to the USGS program. This process identified 15 existing QMPs requiring revision, 4 new QMPs to be developed, and 7 QMPs requiring modification. The draft Matrix, Impact Analysis Statement, and Transition Plan were transmitted to the Office of Quality Assurance.

VISI Metronics response to Audit USGS-93-03 Observation No. 1 was evaluated, resulting in a recommendation to include this supplier on the Approved Suppliers List. Supplier Evaluation Report USGS-93-E06, Yellow Springs Instruments, Inc., was prepared and submitted recommending deletion from the Approved Suppliers List. Response from Colorado State University for Supplier Evaluation 93-E03 was evaluated and a letter was submitted recommending their inclusion on the Approved Suppliers List.

The monthly QA Open Items Committee meeting focused on recurring problems with report processing, which USGS-CAR-92-05 will need to evaluate, deficiency documents identifying implementation problems with QMP-3.03, R3 software requirements, and implementation of data management requirements.

#### **WBS 1.2.12 - INFORMATION SYSTEMS**

All records were received by the LRC and transmitted to the CRF within time limits. Two hundred seventy-six individual records and 38 criteria packages were received into the LRC with an accuracy rate of 97 percent. Fifty-one individual records and 33 criteria packages (1566 pages), and five publication packages and 18 data packages (2,940 pages) were transmitted to the CRF. Five backlog publications and 27 backlog cited references, for a total of 2,223

pages were transmitted to the CRF.

Eight controlled documents were distributed. Three USBR Earth Manual procedures, five Scientific Investigation Plans (SIPs), and 33 Quality Assurance Level Assignment Sheets (QALAS) were rescinded. There are no longer any SIPs or QALAS in effect for the YMP-USGS.

**WBS 1.2.13 - ENVIRONMENTAL**

In support of water resources monitoring, groundwater levels were measured at 27 sites; discharge data were collected at one flowing well and five springs. Groundwater data collected in January were checked and filed. Reported elevations of land surface, reference points, and measurement points of six wells were verified with surveying equipment. Staff met with USGS National Mapping Division personnel to obtain information on bench marks which will allow elevation determinations at two additional wells.

**WBS 1.2.15 - TRAINING**

YMP-USGS Orientation was presented in Denver and Las Vegas. Records Management training was held in Denver and Software Quality Assurance training was arranged for Flagstaff.

Sincerely,

*Larry R. Hayes*

*for* Larry R. Hayes  
Technical Project Officer  
Yucca Mountain Project  
U.S. Geological Survey