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YUCCA MOUNTAIN PROJECT  
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DISCLAIMER

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## 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
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
ALARA .....	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
AMD .....	Administrative Management Section
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
BBC	British Broadcasting Company
BBS	Bulletin Board System
BCWP	budgeted cost for work performed
BCWS	budgeted cost for 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
BQA	Branch of Quality Assurance
BRC	below regulatory concern
BRG	Branch of Central Regional Geology
BSP	balanced cross section modeling program
BSR	Bi-annual Status Report
BWIP	Basalt Waste Isolation Project
C/SCR	Cost and Schedule Change Report
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 Document 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
EEl	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
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 shaft
ESF	Exploratory Studies Facility
ESF/DRD	Exploratory Shaft Facility Design Requirements Document
ESQAT	Earth Science Quality Assurance Team
ESR	electron spin resonance
ESSE	Early Site Suitability Evaluation
ESTC	Exploratory Shaft Test Coordination
ESTP	Exploratory Shaft Test Plan
ESTP-C	Exploratory Shaft 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
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 Requirement Document
FRHP	Fractured Rock Hydrology Program
FSN	Fenix and Scisson, Nevada
FSU	Florida State University
FTE	full-time equivalent
FWP	field work proposal
FY	fiscal year
G&A	Goodson and Associates
GAO	Government Accounting Office
GAP	Geostatistical Analysis Package
GC	gas chromatograph
GCM	Global Climate Model
GCP	Geochronological Procedure
GD	Geologic Division
GEOEAS	Geostatistical Environmental Software
GET	General Employee Training

GETT	grants equal to taxes
GID	Ground Water Site Investigation
GIS	Geologic Information System
GIS	Graphic Information System
GIT	Geochemistry Integration Team
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
H&N	Holmes and Narver
HIP	Hydrologic Investigations Program (formerly NHP)
HITF	Hydrology Integration Task Force
HLRW	high-level radioactive waste
HLW	high-level waste
HP	Hewlett Packard
HP	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
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 simulator
LRC	Local Records Center
LRE	latest revised estimate
LRGS	Local Read-Out Ground Station
LRP	long-range planning
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
MADS	Meteorological Alert Distribution System
MCL	Maximum Contaminant Level
MEDA	Meteorological Data Acquisition Network
MFC	mass flow controller
MGDS	Mined Geologic Disposal System
MIC	Management Information Center
MISIS	Micro Integrated Storm Information System
MLT	materials testing laboratory
MMDS	Martin Marietta Data Systems
MODFE	Modular Finite Element
MOT	Management Overview Team
MOU	Memorandum of Understanding
MPBA	multipurpose borehole activity
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	main testing 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
NHP	Nuclear Hydrology Program (now HIP)
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
NOO	Nevada Operations Office
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	organization breakdown structure
OCRWM	Office of Civilian Radioactive Waste Management
OF	Open file
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
PAC	planning and control
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
PBQ&D	Parson, Brinkerhoff, Quade, and Douglas
PBS	pyramid beam splitter
PC	personal computer
PCBI	Prototype Controlled Blasting Investigation
PCCB	Program Change Control Board
PCM	pivoting camera mount
PCSB	Program Cost and Schedule Baseline
PC&TS	Program Coordination and Technical Support
PD	Position Description
PDA	Participant Data Archives
PDCCR	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
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
PRC	Project Records Center

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
QWL	quality of work life
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
REEC <sub>o</sub>	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	study activities
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
SCM	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 simulator
SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
SRD	system requirements and description
SRG	strike rail goniometer
SRM	standard reference material
SRP	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
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
UNE	Underground Nuclear Explosion
UNLV	University of Nevada at 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. Department of the Interior 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
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
WIT	Working Integration Team
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
YM	Yucca Mountain

YMP ..... Yucca Mountain Project  
YMPB ..... Yucca Mountain Project Branch  
YMPO ..... Yucca Mountain Project Office

## 1.2.1 SYSTEMS

### OBJECTIVE

To integrate systems with the Geologic Repository Program and to describe the YMP Mined Geologic Disposal System (MGDS); and to evaluate the performance of the natural, engineered barrier, and total systems for meeting regulatory standards.

#### WBS 1.2.1.3 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 1.2.1.3.5 Technical Data Base Input

Principal Investigator - L. Hayes

### OBJECTIVE

To provide the hardware, software, personnel, and procedures needed to provide data to the technical base.

#### ACTIVITIES AND ACCOMPLISHMENTS

The Participant Data Archives (PDA) accepted 22 technical data information forms covering SCP activities 8.3.1.2.2.3.1, 8.3.1.5.2.1.3, 8.3.1.5.2.1.5, 8.3.1.17.4.7.2, and one for WBS 1.2.5.4.8 under the Environmental Monitoring Plan.

The PDA has acquired all missing develocorder films from the earthquake center. An audit and inventory was conducted at the Security Archives storage facility to complete the revamping of the develocorder data base.

#### WBS 1.2.1.4 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 1.2.1.4.4 Site Performance Assessment

### 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)

#### WBS 1.2.1.4.4.2 Favorable and Adverse Conditions

Principal Investigator - A. Flint

### OBJECTIVE

To assess site performance characteristics under the favorable and adverse conditions listed in 10 CFR 60.122; and assess engineered barrier system (EBS) performance characteristics under the potentially adverse conditions in 10 CFR 60.122, which refers to impacts on EBS performance. (SCP Section 8.3.5.17)

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GPA006 Test new neutron calibration in 1-D model

Moisture retention curves are currently being developed on many samples representing all of the lithologic units present in USW UZN-55. The data will be used for input into the 1-D model. Additional rock properties are still underway. Several of the N-55 core are being oven dried at temperatures ranging from 200° C - 800° C to determine the appropriate temperature to remove all hydrogen from the rock matrix. Preliminary results suggest that this will improve the neutron probe calibration. All core from N-55 will be dried at high temperature to determine the final calibration to use for the model.

#### 3GPA002 Develop analytical solution to model imbibition

The computer program using the analytical solution for determining sorptivity via inverse modeling was run utilizing the measured sorptivity on the Shardy Base horizontal transect samples and the composite transect samples. Some success was achieved, but it was apparent that additional work is necessary to predict the high and the low permeabilities. Moisture retention curves were run on Shardy Base and composite samples, and will be used for model validation of Brooks and Corey functions.

#### 3GPA007 Sensitivity analysis model mesh size to 1-D infiltration

This activity has begun by considering appropriate mesh sizes according to model specifications, along with the finalization of the neutron calibration for validation input.

### Quality Assurance

### Planning and Operations

### Variances

## WBS 1.2.1.4.6 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

#### 3GVF001 Prepare for core heating experiment

Particle density measurements using the pycnometer and imbibition measurements have been completed on all samples. An additional high temperature oven was obtained and calibrated for use with these samples. Statistical analyses have been run to divide the samples into groups for processing at different temperatures. All preparations for the experiment are complete.

#### 3GVF002 Heating experiment lab analyses

Preparation of core and initial measurements are complete and the necessary equipment has

been obtained and calibrated to begin the heating experiment.

3GVF005 Develop method for thermal conduct and heat capacity

The thermal probe design has been completed and tested in prototype experiments. An experimental protocol has been developed and tested for determining thermal conductivity and heat capacity of rock cores as a function of water content. Data logger programs and wiring panels have been constructed for a system to measure properties on six rock cores simultaneously. Construction and calibration of a set of thermal probes is in progress. A computer program for reading data logger files and computing thermal properties was completed. The program permits interactive data interpretation and analysis.

3GVF009 Continue development of 3-D borehole imbibition model

A 3-D mesh has been constructed and coded for use with TOUGH. Preliminary simulations are unable to reproduce neutron readings; simulated imbibition rates are much smaller than observed in the experimental data. Further model development is awaiting the analysis of laboratory sorptivity data which has just been completed. The MTL core data has not yet been received for model input, and the imbibition data will be used as data for analysis in 3GVF010 (Analysis of MTL core data for model input) for the time being.

3GVF014 Prepare technical report, horizontal variability of Shardy Base transect

Analysis of data from the Shardy Base horizontal transect has been completed. Measured properties include: bulk density, porosity, saturated hydraulic conductivity, and sorptivity. Water characteristic curves have also been measured. This activity has been expanded to include an intensive 2-D sampling grid which is being used to investigate vertical and horizontal trends in bulk and hydraulic properties. Approximately 300 1-inch core specimens were collected in a series of 26 vertical transects arranged across a horizontal transect approximately 3500 ft. long. The determination of properties is in progress. The results of this investigation will be presented at the Fourth International Geostatistics Congress in September, 1992. This information will be used to supplement and finalize the draft of the technical report, and is not expected to create any delays at this time.

3GVF015 Finalize geostatistical software and text

Chapter 3 of the textbook has been completed and work on chapter 4 is in progress. The geostatistics package has been completed. A computer programmer has been hired to perform diagnostic tests and to prepare a version of the software for user testing. The user's manual is being written now. Test copies of the software will be distributed in May. Delays in the actual finish of this activity will not impact any other activities, because the computer package is finished and currently being used for prototype analysis.

Quality Assurance

Planning and Operations

Variances

3GVF015 Finalize geostatistical software and text

Delays in this activity will not impact any other activities. The actual finish date will probably be delayed until mid-summer.

WBS 1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses  
Principal Investigator - A. Flint

OBJECTIVE

To provide documentation and results of calculations used in analyses of postclosure performance that support design efforts, contribute to the resolution of Issue 1.3, and indirectly support activities carried out under other performance assessment WBS elements.

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GPC002 Develop method to determine moisture retention-CX-2

A welded core sample, 1.5 inches in diameter, was initially saturated and then evaporated to attain various water contents. Water potential was determined using the CX-2 at each water content to develop a moisture retention curve. A Brooks and Corey model was successfully fit to the data. A sample cup was fabricated that has a smaller inside diameter enabling the utilization of the many 1-inch core plugs collected from transects. The cup also has an O-ring to see if there is any reduction in water loss from the instrument that may improve the accuracy. Additional core samples are being prepared for moisture retention and an experimental procedure is being developed to see if the particle size of rock chunks has an influence on the measured water potential.

3GPC004 Finish measurement on transect core, preliminary data analysis

Imbibition and moisture retention were completed on the composite transect samples. All remaining core from the UZ-6 transect are undergoing imbibition experiments. Data has been organized into a dataset for submittal to the LRC.

Quality Assurance

3GPC001 Develop calibration procedure, test CX-2

Development of the calibration procedure is being revised based on new information on the CX-2.

Planning and Operations

Variances

## 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 Management and Integration Principal Investigator - L. Hayes

### OBJECTIVE

To manage and integrate the work performed within the site WBS elements.

#### M&I - Branch 0G3192B1 Summary Account Manager - L. Ducret

##### ACTIVITIES AND ACCOMPLISHMENTS

R. Craig attended Prototype Management Team meetings on March 6, 13, 20, and 27; Exploratory Studies Facility (ESF) meetings on March 6 and 20; UZ-16 Task Force meetings on March 5 and 19; the YMPB staff meeting in Denver on March 16; a SOC meeting at the SMF March 3; a Tracer Injection System meeting March 17; and a meeting at the FOC with USBR personnel regarding soils, on March 4.

R. Craig provided overviews of Yucca Mountain geology and hydrology programs as part of the public open house tour on March 28.

R. Craig reviewed the 50% Phase 1A ESF design as part of the Management Review on March 2.

#### M&I - Geologic Studies Program 0G3192G1 Summary Account Manager - J. Stuckless

##### ACTIVITIES AND ACCOMPLISHMENTS

J. Stuckless continued work on MOAs with the Geologic Division with most time being spent on transfer of seismic network from GD to the University of Nevada, Reno.

J. Stuckless continued work on the start up of GSP. C. Menges and W. Simonds were added to the staff.

J. Stuckless presented a report on Trench 14 at the Waste Management '92 symposium poster session.

#### M&I OA Implementation GSP 0G3192G2 Summary Account Manager - J. Stuckless

##### ACTIVITIES AND ACCOMPLISHMENTS

The following preliminary draft technical procedures were prepared or changed as requested:

GCP-14, R2	Extraction and Recovery of H <sub>2</sub> O From Calcite-Hosted Inclusion Fluids
GP-39, R0	Geophotogrammetric Mapping of Trench Walls - Field Work
HP-114, R1	Estimating Streamflow Discharge
HP-126, R1	Extraction of Residual Water from Tuff Samples by Vacuum Distillation
HP-169, R1	Determination of Peak Discharge by the Slope-Area Method
HP-221T, R0	Monitoring the Well Water Level or Fluid Pressure Response to

- HP-222T, R0      Underground Nuclear Explosions or Earthquakes  
Using a Small Draft Packer and Transducer to Measure Field Pressure in Wells
- HP-229, R1      Determination of Water Content and Physical Properties for Laboratory Rock Samples
- HP-236T, R0      Installation and Operation of PVC Straddle Packer String in Unsaturated Zone Boreholes for Gas and Water Vapor Sampling
- HP-237T, R0      Methods for Sealing Unsaturated Zone Borehole Core Samples to Preserve Moisture Content

Final drafts of the following technical procedures were prepared and returned to the HIP for signatures:

- HP-221T, R0      Monitoring the Well Water Level or Fluid Pressure Response to Underground Nuclear Explosions or Earthquakes
- HP-222T, R0      Using a Small Draft Packer and Transducer to Measure Fluid Pressure in Wells
- HP-169, R1      Determination of Peak Discharge by the Slope-Area Method

Within a two week period GP-39, R0, Geophotogrammetric Mapping for Trench Walls-Field Work, was prepared, processed through QA and technical reviews and submitted for controlled distribution in time for investigator J. Coe (GSP) to meet his field work deadline.

A change request to modify the SCPB as a result of a need to move the seismic profiling task from Study 8.3.1.17.4.3 to 8.3.1.4.2.1 was completed.

A job package for SCP activity 8.3.1.5.2.1.5 was revised and approval was coordinated with the chief of the Nevada operation program and the YMPO.

The GSP was assisted with responses to and/or remedial/investigative actions for CAR-91-03, CAR 91-05, CAR-91-07, CAR-92-05, NCR-90-37, NCR-91-26, NCR-91-31, NCR-91-36, NCR-91-44, NCR-92-02, NCR-92-17, AND NCR-92-19. The GSP was also assisted in following up on overdue reading assignments and document transmittal notices (DTNs), in gathering raw data for manuscript record packages, as well as completing TDIFs. A QA records package for Study Plan 8.3.1.17.4.3 was transmitted to the LRC.

The GSP continued to be represented on a committee to revise procurement control and control of purchased materials, equipment and services. Data bases utilized by the GSP were reviewed and suggestions made to create a single relational data base.

Several meetings and planning sessions to transfer the operation of the Southern Great Basin Seismic Network from the Branch of Geologic Risk Assessment to the University of Nevada, Reno were attended.

Eleven technical data information forms were prepared for SCP activity 8.3.1.5.2.1.5 and submitted to the technical data coordinator. Seven of the TDIFs were for data acquisition, two were for selected data, and two were for developed data.

Records packages were prepared and submitted to the LRC for two approved Memoranda of Agreements, "Borehole Geophysical Surveys at Yucca Mountain" and "Facilities and Services, Branch of Isotope Geology". Distribution was provided for the Isotope Geology memorandum.

J. Whitney was assisted with the preparation of viewgraphs for his presentation at the EPRI Workshop on Earthquakes and Tectonics held March 4-6 in Washington, D.C.

The TPO office was assisted with the investigative and remedial actions for USGS-NCR-91-14 on missing qualification documents for study plans. Fifteen GSP study plan files were examined for records compliance. A study plan records package checklist was prepared and submitted to the TPO QA advisor to assist in planning further actions.

Configuration Control Committee (CCC) meetings were attended in Denver (March 5 and 17). Assistance was provided to numerous technical contacts for software in Menlo Park on March 25-27. P. Nelson was assisted with completing the QMP-3.03 attachments for software.

The technical procedure status list was updated and forwarded to the YMP-USGS QA office.

A review of configuration management change request and change directive for eight affected document notices (ADNs) was made. Final responses for the ADNs were returned to DOE/YMP.

M&I - Hydrology Program Management and Administration 0G3192H1  
Summary Account Manager - D. Gillies

ACTIVITIES AND ACCOMPLISHMENTS

All 60 USGS and LBL summary account schedules were statused as of the end of February using schedule-status and progress information provided by each summary account manager.

A draft USGS management agreement for conduct of the YMP environmental program water-resources monitoring project was reviewed by all parties concerned. Minor revisions to the agreement resulted from the review.

D. Appel and D. Gillies met with staff of the USGS Nevada District on March 20 to discuss management of the water resources monitoring project and future plans for expansion of the Yucca Mountain surface-water gaging network. Nevada District staff presented a first-cut budget for FY 93 that would allow for significant expansion of the network.

D. Gillies participated in the March 23 DOE-Environmental Program mid-year financial/progress review for the water resources monitoring project being conducted by the USGS Nevada District.

D. Gillies synthesized historical cost information for selected hydrology program planning and scheduling accounts (SCP studies) in preparation for a meeting with the DOE-HQ Independent Cost Estimating team. At the meeting on March 31, Gillies traced the evolution of Hydrology Program multi-year cost estimates from the 1989 "bottoms-up" exercise conducted for the FY 1991 WAS, to the FY 1992 PACS.

M&I QA Implementation, Hydrology 0G3192H2  
Summary Account Manager - W. Causseaux

ACTIVITIES AND ACCOMPLISHMENTS

S. Frans is currently processing 45 hydrologic procedures and scientific notebook plans.

Seven approved technical procedure packages and five approved scientific notebook plan packages were submitted to SAIC by S. Frans.

W. Causseaux met with G. Patterson, S. Boucher, and W. Rodman to discuss final changes in HP-

222T and HP-222 prior to submittal for review and approval.

W. Causseaux and J. Woolverton met with A. Flint and J. Ziemba to discuss the adequacy of YMP-USGS interfaces with REECo in using QA controls for the sample collection that is acceptable to HIP.

J. LaMonaca submitted the draft of QMP-3.04, R4 to the QA office on March 26 for retyping and preparation for QMP-5.03 Management review.

The HIP reviews of QMP-3.15, R0 were completed by W. Causseaux, R. Luckey, J. Woolverton and G. Severson and submitted to the YMPB on March 17.

W. Causseaux met with T. Chaney to discuss proposed changes in the draft revision of QMP-4.01, with specific reference to include management controls in the management procedure for procurement. The need for comment resolution for the draft of QMP-3.15, R0 was also discussed.

N. Karas (SAIC/Golden) met with W. Causseaux to discuss the status of YMP-USGS QMPs and TPs that are in process or review by the HIP. Of particular interest was the continuing improvement in timeliness and adequacy of technical review and comment resolution records packages.

W. Causseaux met with D. Porter (SAIC/Golden) to finalize comment resolution for the HIP reviews of QMP-3.15, R0. Issuance of this management procedure is important to the YMPB technical staffs to facilitate implementation of the YMPO QA grading process within the USGS-YMP.

J. LaMonaca initiated NCRs 92-13 and 92-14 pertaining to YMPB publications not complying with various requirements of QMP-3.04.

D. Appel met with W. Causseaux and J. Woolverton to finalize the HIP proposed disposition for USGS-CAR-92-04 regarding QA deficiencies for Study Plan Activity 8.3.1.2.2.6.1 Gaseous Phase Circulation.

W. Causseaux met with A. Whiteside to review the final YMPB proposed disposition for NCR-91-31 regarding deficiencies in instrument calibration services provided by approved vendors.

W. Causseaux and S. Frans met with J. Millsap of the YMPB administrative staff to review procurement document records packages prior to submittal to the LRC. Causseaux also talked with T. Mendez-Vigo about strategy previously used to complete the records packages.

D. Appel, W. Causseaux, and other HIP and YMPB personnel attended a meeting on March 3 to discuss the YMPO Audit-92-13 scheduled for six HIP study plan activities during the period April 1-10. The purpose of the meeting was to finalize operational strategy and evaluate readiness for the audit.

W. Causseaux visited the Las Vegas subdistrict office to discuss preparations for YMPO audit-92-13 with M. Pabst and the technical staff of the surface-water runoff study.

W. Causseaux visited the HIP Hydrologic Research Facility at the NTS to participate in USGS Audit-92-04 and to serve as HIP liaison for QA and management.

W. Causseaux met with L. Hayes in Las Vegas to apprise him of the status of USGS Audit-92-04

that was in progress at the Hydrologic Research Facility at the NTS. Hayes and Causseaux met with J. Ziembra and M. Mustard at the YMPB office in Las Vegas to receive a progress report on USGS Audit-92-02.

HIP QA, management, and technical personnel attended the "How To Be Audited" session presented by the YMP-USGS QA office on March 24 as part of the YMP-USGS preparations for the YMPO Audit 92-13.

W. Causseaux and J. Woolverton met with T. Chaney to discuss strategy for the YMPO Audit-92-13 of HIP activities and the Hydrologic Research Facility at the NTS.

D. Appel met with W. Causseaux and J. Woolverton to finalize the HIP proposed disposition for USGS-CAR-92-03 regarding the need for management agreements between HIP and non-USGS organizations.

J. LaMonaca met with L. Ducret and T. Chaney to discuss the proposed changes by the Branch to QMP-3.04, R4.

J. LaMonaca and S. Frans attended classroom training on "How to be Audited", instructed by W. Rodman.

S. Frans and J. LaMonaca attended a meeting concerning QMP-3.07, R4 held by W. Rodman.

J. LaMonaca met with M. Murray (SAIC/Golden) to discuss new QMP-17.01 requirements on record package submittal.

Seven published GSP abstract packages, three published HIP abstract packages, and three complete HIP publication packages were submitted to the LRC by J. LaMonaca.

Computer Operation & Data Management, Hydrology 0G3192H3  
Summary Account Manager - C. Washington

ACTIVITIES AND ACCOMPLISHMENTS

NOVELL File Server

An SMTP Gateway has been installed to address the need of a centralized E-mail delivery point. Most of HIP personnel receives E-mail on three different computers. Beginning April 6, 1992, E-mail from all of HIP's computer systems will be routed to the Novell E-mail Package. Mail will be received and can be sent from only one attach point.

Telecommunication link to Parfet Building

The T-1 link, to speed up transmission from the Parfet Building to Building 53, was installed on March 27.

The T-1 Remote Bridges, according to purchasing, will be ordered on April 6, 1992. The delivery date will be approximately May 1, 1992. When the bridges are received, the Parfet LAN will be taken down for approximately four hours for installation and testing. All concerned will be notified through Novell's E-mail.

Telecommunication link (56Kbs), Area 25, NTS

The computer operations unit installed Ethernet cards and attached all of the PCs at the HRF to the LAN. All of the staff present were instructed in the use of same.

SAIC/Las Vegas has not installed the Class 'C' address; therefore, no more PCs can be added to the HRFs LAN.

The FOC will be networked by SAIC/Las Vegas. At the present, a date has not been set.

Scientific Reports and Project Documents, Hydrology 0G3192H4  
Summary Account Manager - T. Brady

#### ACTIVITIES AND ACCOMPLISHMENTS

HIP is currently processing 83 YMP-HIP scientific publications, 57 YMP-GSP scientific publications, eight YMP-LBL scientific publications, and 15 abstracts.

The HIP review of the following reports and abstracts was completed by T. Brady: "Seismic reflection profiling across Tertiary extensional structures in the eastern Amargosa Desert, southern Nevada, basin and range province, USA", by T. Brocher and M. Carr; "Does localized recharge occur within the ground water flow system of Yucca Mountain, Nevada?", by J. Czarnecki; "A hint of recharge at Franklin Lake playa, Inyo County, California", by J. Czarnecki, D. Ronen, M. Margaritz, and L. Kroitoru; "Application of imbibition experiments to the evaluation of measurement scale in welded and nonwelded tuff", by A. Flint, L. Flint and K. Richards; "Isotopic studies of fracture coatings at Yucca Mountain", by B. Marshall, J. Whelan, Z. Peterman, K. Futa, S. Mahan, and J. Stuckless; "Strontium isotopic composition of the Ash Meadows ground-water systems, southern Nevada", by Z. Peterman, J. Stuckless, S. Mahan, B. Marshall, E. Gutentag, and J. Downey; abstract, "Results from 1991 wildcat wells near Yucca Mountain, Nevada", by A. Harris, J. Repetski, J. Clayton, J. Grow, M. Carr, and T. Daws; abstract, "Soil water transport in the unsaturated zone at Organ Pipe Cactus National Monument, southern Arizona; chloride, bome 36Cl, and stable isotope approaches", by B. Liu, S. Hoines, and F. Phillips; and abstract, "Constraints on extensional fault geometries in eastern Railroad Valley, Nevada, based on seismic reflection and gravity data", by J. Grow, H. Blank, Jr., C. Potter, and J. Miller.

The HIP review of study plan 8.3.1.5.2.1, R2 - Characterization of the Yucca Mountain Quaternary Regional Hydrology, was completed by T. Brady and the final HIP version was transmitted to YMPO on March 31.

Study Plan 8.3.1.2.3.2 - Saturated-zone hydrochemistry, by W. Steinkampf was approved by DOE on March 11.

A change request to the SCPB was completed by HIP for SP-8.3.1.2.3.1 - Site Saturated-Zone Ground-Water Flow for the addition of a new well in the c-hole complex, and transmitted to YMPO March 31.

The HIP review of other participant study plan 8.3.1.2.2.2, was completed and forwarded to the Project Office on March 18.

The HIP review of other participant study plan 8.3.1.15.1.4, was completed and forwarded to the Project Office on March 20.

The HIP author responses to YMPO review comments on draft SP-8.3.1.2.3.3 - Site Saturated-Zone Hydrologic System Synthesis and Modeling were completed by E. Ervin and the proposed revised text was transmitted to YMPO reviewers by S. Keller (SAIC/Golden) on March 31.

The HIP author responses to YMPO review comments of draft SP-8.3.1.5.2.2- Effects of Future

Climate on Hydrology were completed by J. Downey and K. Kolm and the proposed revised text was transmitted to YMPO reviewers by S. Keller on March 16.

Technical Data Base Management, Hydrology 0G3192H5  
Summary Account Manager - N. Stuthmann

ACTIVITIES AND ACCOMPLISHMENTS

Routine jobs were performed throughout the month, including the retrieval of the QW data from the WRD National Water Laboratory, entering these 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 Local Records Center for storage in their fire proof vault.

N. Stuthmann, B. Kerans and D. Burkhardt attended a meeting with EG&G concerning their progress in the development of a GIS data base. Kerans and Stuthmann also had a meeting with A. Flint to learn more about the various type of data he is collecting. Flint gave a very good review of his activities. Now the data management unit must see that the necessary data can be stored either in the present NWIS-I data base or the new version presently being written.

Much of B. Kerans time this month has been spent in setting up and learning about the operation of the data general workstation. This also includes the use of the Ingress data package.

W. Oatfield has completed a memo to be sent to Nevada concerning the question Nevada had on past data in the Amdahl WATSTORE system. He has also prepared a first draft on establishing unique identification of field sites.

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 8.3.1.4.2.1.1 Surface and subsurface stratigraphic studies of the host rock and surrounding units  
0G3221A2

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU002A Geochemical isotopic sampling and analysis, phase 1

Z. Peterman spent two days in the YMP core library in Nevada with R. Spengler sampling cuttings from JF-3 and core from J-13. Samples will be used to further establish the isotope data base on different stratigraphic units and to compare 87/76 Sr ratios obtained from the rocks with 87/86 ratios obtained from waters collected within the same stratigraphic units.

3GGU010A Compilation of existing boreholes, lithologic logs (WT)

The start on this activity has been deferred again due to the section chief's involvement in detailed budget planning and in responding to DOE and M&O concerns on the Independent Cost Estimate (ICE). While the formal process to fill a vacancy in the rock characteristics section continues, a new subcontractor employee has been added and dedicated to rock characteristics activities. Orientation and training activities have begun. There is no milestone impact at this time.

Quality Assurance

3GGU002A Geochemical isotopic sampling and analysis, phase 1

B. Marshall attended two software configuration control committee meetings and completed document review of QMP-3.07.

J. Paces continued calibration of a spike according to GCP-22, starting a second set of calibration standards. Status is still pending.

J. Paces initiated software review (as per QMP-3.03, R3) of a critical program used in U-series data collection by alpha-spectrometry (program name is UTH.FOR, CID #GDD0020.02). The program had to be transferred from the old Nuclear Data Systems operating platform to the new PC-based system following catastrophic failure of the old computer. Alpha-spectrometric data collection has been suspended until all control configuration documentation has been submitted to the software control coordinator.

S. Mahan met Sr isotopic calibration date of SRM 987 on March 4.

Planning and Operations

3GGU002A Geochemical isotopic sampling and analysis, phase 1

B. Marshall recalibrated the pulse processor on the energy-dispersive XRF instrument in order to fix a minor problem which became apparent when analyzing low-Rb samples.

J. Paces continued review of an outside manuscript (submitted to *Geochimica et Cosmochimica Acta*) on actinide element mobility in fractures at the Canadian radioactive

waste repository site.

#### Variances

##### 3GGU12AA Write criteria letters G-5

The criteria package has not been started.

Cause: Scheduling of drillhole G-5 has slipped to FY93.

Impact: There may be indeterminate impact, but the slippage of the drilling schedule should provide necessary flexibility.

Corrective action: the criteria letter will be written when schedule specifics are available.

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

C. Hunter attended the Water Resources Division short course "Isotope Hydrology" at the National Training Center in Denver. Purpose of the training was to enhance interaction of the petrographic group in rock characteristics with the isotope support group, with particular attention to the possible use of Sr stratigraphy in description of variation of rock units at Yucca Mountain. B. Marshall, K. Futa, and S. Mahan from the isotope support group also attended the week-long course, which included reading assignments, homework problems and a course critique. (160 hours)

#### SCP 8.3.1.4.2.1.2 Surface-based geophysical surveys 0G3221B2

Summary Account Manager - C. Hunter

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GGU221 Complete report gravity/magnetics Fortymile Wash

Compilation and technical review of previously acquired gravity and magnetic data from Fortymile Wash is complete. A report providing these detailed data along five profiles across Fortymile Wash just east of Yucca Mountain has been submitted for technical review. (See Ponce and others, 1992.) The report is primarily a data release, but concludes that no significant vertical offset of geologic units occurs directly under the Wash. A gravity anomaly of approximately 2 Mgal, however, is associated with the Paintbrush Fault just west of Fortymile Wash, suggesting that the gravity method could provide an effective means to better define the location of known or suspected faults and to locate completely unknown faults, especially those concealed by alluvium.

Manuscript submitted for technical review:

Ponce, D.A., Kohn, S.B., and Waddell, S., 1992, Gravity and magnetic data of Fortymile Wash, Nevada Test Site, Nevada: U.S. Geological Survey Open-File Report 92-xxx, 36p. [DOE]

##### 3GTQ005J Write seismic contract

This task is 90% complete. The Request for Proposal documents have been revised in response to the contract section concerns, but delays in contract administration continue. The announcement of the forthcoming request for proposals has been published, but vendor response is still stymied by incomplete processing in the contract section office. The rock characteristics section office continues to work with the contract administrator to complete the RFP work. Concerns relative to the RFP from DOE resulting in 66 comments on the original proposal have been answered, with responses approved by L. Hayes (Chief, YMPB) and submitted to DOE.

##### 3GGU222 Submit status of regional geophysical for review

Compilation of previously collected data continues under this review of regional geophysics.

The review will be used to refine the planning and selection of procedures and collection parameters for acquisition of future geophysical data.

Chapter authors of the proposed USGS bulletin "Status of regional geophysical studies at Yucca Mountain and vicinity, Nevada and California" have been contacted to answer review comments and to submit revised chapters to H. Oliver, with a May 1, 1992, deadline.

3GGU250 Collect and reduce magnetics/gravity in Yucca Wash  
This activity to collect magnetic and gravity data in investigations to support interpretation of the seismic lines to be run in Yucca Wash is awaiting approval of the study plan by the NRC. Planning for fieldwork has begun, but there is no allowable start for fieldwork until the MOA is approved. The signed MOA has now received Reston approval. Data from this activity will be used to target the location for proposed corehole USW G-5 and will also provide constraints on the interpretation of regional variation in the stratigraphic relationships at Yucca Mountain. There is no milestone impact at this time.

#### Quality Assurance

3GGU220 QA Documentation of software  
Activity to complete QA documentation of data reduction software for gravity and magnetic studies continues, with nine programs earmarked for QA appraisal. These nine programs have been evaluated by the CCC, which determined the necessary documentation required. Documents for two of these programs have been submitted.

#### Planning and Operations

3GGF223 Study plan approval  
The study plan for this activity, included under approval of the 8.3.1.4.2.1 "Vertical and Lateral Distribution of Stratigraphic Units within the Site Area" study plan, has complete resolution of review comments and was submitted to DOE for verification of revisions and final approval in February 1992. The verification review is awaiting final signature, record center submission, and release to the NRC.

#### Variances

Several of the activities in this account are behind schedule, largely due to delay in approval of the governing study plan.

3GGU220 QA documentation  
QA activities for software are underway. There should be no impact, and corrective action will involve completion of documents required by the configuration committee.

3GTQ005J Write seismic contract

The contract for seismic lines is incomplete.

**Cause:** Delay in the seismic contract stems from DOE and support contractor technical concerns, delays in the contract office, and lag in approval of the SCP baseline rewrites, which influence approval of the study plan.

**Impact:** Failure to run seismic lines will interfere with the process to locate proposed drillhole G-5.

**Corrective action:** SCPB rewrites have been submitted to DOE. Delays in the contract administration group have been addressed, and the progress of the contract documents continues to be monitored and assisted. Responses to the DOE technical concerns have been completed, approved by the TPO, and submitted. The responses will be included in the revised request for proposals.

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

The Memoranda of Agreement for seismic reflection studies and for gravity and magnetic work were completed by the section chief and principal investigators. The seismic reflection MOA has been signed and funds approved. During this reporting period, the MOA for gravity and magnetic studies was signed in Reston.

The manuscript "Seismic reflection profiling across Tertiary extensional structures in the eastern Amargosa Desert, southern Nevada Basin and Range Province, United States," by T. Brocher et al., has received approval of the Director and was sent to DOE approximately March 15 and to the Geological Society of America for publication. The QA data record packages have been submitted to the local record center. Reviews of the paper have been received with very favorable comments; significant time has been spent on revision of the paper.

### SCP 8.3.1.4.2.1.3 Borehole geophysical surveys 0G3221C2

Summary Account Manager - P. Nelson

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

#### 3GGU332 Evaluate logs from G-2

The evaluation of commercially available downhole electrical logging methods in comparison tests between Dresser-Atlas and Schlumberger in logging runs in USW G-2 continues as the main focus of effort during the reporting period. This evaluation and formulation of recommendations is 80% complete and will include consideration of a variety of logs and different models of logging tools for acquisition of each log type, including older model tools to facilitate comparisons to logging runs made in Yucca Mountain holes in the early 1980s. This evaluation and the resulting recommendations for choice of borehole geophysical logging methods will be released as an Open-File Report (P. Nelson, co-authored with R. Schimschal) tentatively entitled "Assessment of geophysical logs from borehole USW G-2, with recommendations for future logging at Yucca Mountain, Nevada." Anticipated date of submission of the report for review is next month.

P. Nelson met with R. Olson (RSN) to review assessment of the Dresser/Schlumberger procedures and to discuss related geophysical logging QA topics.

#### 3GGU393 Compute algorithms to density and resistivity logs

There was no activity during the reporting period. Per the recently completed Memorandum of Agreement, this activity has been deferred to the third quarter. There is no milestone impact at this time.

#### 3GGU364 Write procedure for magnetometer logging

There was no activity during the reporting period. Per the recently completed Memorandum of Agreement, this activity has been deferred to the third quarter. There is no milestone impact at this time.

#### Quality Assurance

#### 3GGU332 Evaluate logs from G-2

P. Nelson attended software QA training.

#### Planning and Operations

#### Variations

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

The Memorandum of Agreement for borehole geophysical studies was completed during the last reporting period by the section chief and principal investigator. The MOA has now been approved by Reston and returned with all necessary signatures.

Discussions with C. Wittwer (LBL) arising from the February unsaturated zone modeling workshop concern preparation of geophysical data for inclusion in the 3-D unsaturated zone/geologic model. Although this work is scheduled by the MOA for later in the year, it has begun at the request of the modeling group. Efforts by P. Nelson include replay of existing data to display at a scale of 1" = 100'.

A paper entitled "Physical properties of ash-flow tuff from Yucca Mountain, Nevada" by P. Nelson and L. Anderson has been accepted for publication by the *Journal of Geophysical Research*. This work is a culmination of FY91 efforts. During this reporting period, the galley proofs were received, corrected and resubmitted to the journal.

### 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 8.3.1.4.2.2.1 Geologic mapping of zonal features in the Paintbrush Tuff 0G3221G2

Summary Account Manager - C. Hunter

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GGF182A Analysis of samples

K. Futa continued high-precision Sr isotopic analyses of outcrop samples (from the volcanic section in the southern portion of Yucca Mountain) which are assumed never to have been positioned below the water table. These analyses are being compared to completed 87/86 Sr ratios from core samples collected below the Topopah Spring member to assess the amount of Sr modification caused by hydrothermal alteration.

##### 3GGF184A Structural analysis of exposed fault zones

A. Braun and assistant R. Linden continued mapping and measurement of fault characterization parameters along and within the Ghost Dance Fault on Yucca Mountain. Work in this period took place in the area south of Whale Back Ridge. The work utilizes the rectilinear grid laid out and reported earlier, which will allow collection of numerous types of information on a consistent foundation grid. These efforts will characterize a large number of parameters along the fault which will be integrated into the geologic model. On this trip, twelve 200' x 200' "areas" from the foundation grid were mapped and fracture data recorded, giving a total of 22 mapped "areas" that have been completed in the field to date.

F. Singer continued preparation of preliminary illustrations using SURFER software to create two- and three-dimensional views of specific lithologic intervals. J. Nelson has had greater involvement with this effort and will continue to support these graphical presentation and modeling activities.

F. Singer continued compilation of a data base comprised of stratigraphic information for incorporation into Sandia National Laboratory's LYNX geotechnical modeling system. To this end, collaborative efforts are underway with workers at Sandia and at the Colorado School of Mines to develop appropriate modeling capabilities, with regard to facilities available elsewhere in the program.

#### 3GGF124 Reconnaissance of study area

This work will conduct detailed investigations of stratigraphically and structurally complex terrains at a scale of 1:12,000. Preparation for detailed mapping in the area north and west of Prow Pass is underway, and field operations will begin shortly. Some of this effort will be carried out in conjunction with the tectonics section.

R. Spengler and C. Hunter visited outcrops in the basal Tiva Canyon/uppermost Topopah Springs in northeastern Crater Flat where a well-exposed roll-over flexure was discovered.

#### 3GGF160 Revise technical procedure on analysis of volcanic rocks

The planned start of this task was delayed while the formal process continues to fill a vacancy in the rock characteristics section. A subcontractor employee (R. Dickerson) who will be dedicated to the mapping effort has been brought on board; training and orientation are partially completed, and initial site visits will occur next month.

#### Quality Assurance

##### 3GGF182A Analysis of samples

B. Marshall attended two software CCC meetings.

B. Marshall completed document review of QMP-3.07.

J. Paces continued calibration of a spike according to GCP-22, starting a second set of calibration standards. Status is still pending.

J. Paces initiated software review (as per QMP-3.03, R3) of a critical program used in U-series data collection by alpha-spectrometry (program name is UTH.FOR, CID #GDD0020.02). The program had to be transferred from the old Nuclear Data Systems operating platform to the new PC-based system following catastrophic failure of the old computer. Alpha-spectrometric data collection has been suspended until all control configuration documentation has been submitted to the software control coordinator.

S. Mahan met Sr isotopic calibration date of SRM 987 on March 4.

#### Planning and Operations

##### 3GGF182A Analysis of samples

B. Marshall recalibrated the pulse processor on the energy-dispersive XRF instrument in order to fix a minor problem which became apparent when analyzing low-Rb samples.

B. Marshall, K. Futa, and S. Mahan completed a week-long short course on Isotope Hydrology. Training included reading assignments, homework problems and a course critique.

J. Paces continued review of an outside manuscript (submitted to *Geochimica et Cosmochimica Acta*) on actinide element mobility in fractures at the Canadian radioactive waste repository site.

### Variations

3GGF160 Revise technical procedure on analysis of volcanic rocks

Delay in this activity is described above. There should be no impact, and corrective action is in place.

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

R. Spengler devoted 36 hours to preparation of detailed budget summaries and administrative planning in response to requests for further details on out-year budgets and to preparation for the Independent Cost Estimate (ICE) interactions.

C. Hunter received two hours of audit training.

### SCP 8.3.1.4.2.2.2 Surface-fracture network studies 0G3221H2

Summary Account Manager - M. Fahy

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GGF160A Revise TPs, grid design, RC gauge development

Revision of the data notebook technical procedure is 85% complete.

3GGF159A Design fracture data base; software QA

The ORACLE data base management software has arrived. Training has begun on use of this program, which is a sophisticated relational data base manager able to accept a full range of data files, from flat files through DXF AUTOCAD files.

The basic geotechnical data base structure is complete. This data base design reflects evaluation of appropriate and useful parameters for inclusion in the data base following coordination of needs from the surface fracture network, underground mapping, and surface soil and rock characterization activities. Many data base formats were used previously. All of these geotechnical activities (managed under USBR as part of the rock characteristics section) will now be able to use a single consistent data base. ORACLE and AUTOCAD links will be possible.

3GGF100 Map and analyze fractures in Tiva Canyon Member

AUTOCAD DXF files for faults, breccias and other structural features were obtained from EG&G. Generation of preliminary contoured stereoplots and pole plots are 15% complete. This work generates lower-hemisphere stereonet projections from the structural data, which are then converted to the DXF format. The priority is on quality-affecting data. The topographic DXF files can be read in but they currently lack elevations. Training continues on AUTOCAD ver11.

3GGF152A Fracture data login

A field meeting with C. Throckmorton was held to review selected outcrops for the uncleared outcrop study and the acquisition of quality-affecting data. (Other site names include "photogeologic" and cleared "pavement".) This review accommodates suggestions derived from the verification activity. The field meeting and further review addresses issues of data and technique verification, confirming early preexisting measurements at these sites. Some sites will have replication of previous data collecting work, meeting an obligation written in the SCP for verification.

### Quality Assurance

Planning and Operations

3GGF160A Revise TPs, grid design, RC gauge development

A meeting with PI and USGS QA staff resulted in the decision to proceed with a USBR TP for data collection and analysis in lieu of revision to GP-12.

Variances

3GGF160A Revise TPs, grid design, RC gauge development

The completed revision was submitted to the USBR QA group, but necessary changes have not been determined. No impact is anticipated.

SCP 8.3.1.4.2.2.3 Borehole evaluation of faults and fractures 0G3221I2

Summary Account Manager - J. Wright

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU006F Edit, review existing data; data log-in

C. Barton's G-4 data have been obtained. Assembly of file compilation has begun on G-4 and G-2, with current emphasis on G-2.

Borehole fracture data files have been acquired from P. Nelson for 57 boreholes at Yucca Mountain. These files are in LOTUS format and are being converted to dBASE files as ASCII flat files.

3GGU07AF Preparation of specifications for data collection

The specification document for collection of fracture data is in preparation. These specifications will describe appropriate techniques for collection of fracture data using borehole television and the televiewer method.

Quality Assurance

Planning and Operations

Variances

3GGU07AF Preparation of specifications for data collection

Specifications are incomplete.

Impact: there should be no significant impact due to rescheduling of the G-5 drillhole.

Corrective action: work is underway to complete these specifications. Technical procedures used at Savannah River have been obtained as model specifications.

SCP 8.3.1.4.2.2.4 Geologic mapping of the exploratory shaft and drifts 0G3221J2

Summary Account Manager - S. Beason

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF022B Upgrade computer equipment

S. Beason and J. Coe met with representatives of DEC/VAX about upgrades to the MicroVax II which presently drives the Kern DSR-11 analytical plotter.

Quality Assurance

Planning and Operations

3GGF006B Excavate test pit

A draft of the criteria letter for deepening of the Fran Ridge Pits has been completed. S. Beason met with R. Oliver and N. Elkins (LANL) regarding opening of the job package and test planning package for pit deepening and pavement clearing around the pits.

Variances

Work Performed but not in Direct Support of the Scheduled Tasks

S. Beason continued preparation of job description and RPA for hiring an analytical photogrammetrist.

S. Beason and others (see listing under Study 8.3.1.14.2.2) participated in a field workshop sponsored by the rock characteristics section to discuss the effectiveness and positioning of drillholes along the proposed alignments of the north and south ramp declines.

SCP 8.3.1.4.2.2.5 Seismic tomography/vertical seismic profiling 0B3221A2

Summary Account Manager - E. Majer

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF030B Validate interpretational codes ANI90 and BEAM87

The ANI90 program was modified and enhanced to include a more flexible user interface to allow a visual representation of the input model. Further enhancements were installed to allow cross section display of any arbitrary alignment through the model volume.

3GGF035M Report: progress VSP

Discussions continued with T. Brocher and with on-site workers at Yucca Mountain regarding cooperative arrangements to perform VSP in conjunction with the seismic line planned for mid-1992. These discussions focused on selection of a possible site (or sites) at which to carry out VSP to interpret and validate the seismic reflection to be done at Yucca Mountain. Candidate holes included H-3, P-1, or one of the C-complex holes. Consultation with J. McDaniels (REECo) during this reporting period suggests that one of the C-complex holes will be most suitable for shooting VSP. Both the H-3 and P-1 wells are instrumented for hydrologic studies.

Quality Assurance

Planning and Operations

Variances

WBS 1.2.3.2.3 Erosion

OBJECTIVE

To identify the site-specific geomorphic parameters and data that are needed to satisfy the design and performance issues and to ensure that the 200-meter disqualifying condition is not exceeded. (SCP Section 8.3.1.6)

### WBS 1.2.3.2.3.1 Present Location and Rates of Surface Erosion

Principal Investigator - J. Whitney

#### OBJECTIVE

To identify the erosional processes in the Yucca Mountain area during the Quaternary; quantify the rates of the different processes and assess their relative importance; and identify the specific locations of past erosion. (SCP Investigation 8.3.1.6.1)

#### SCP 8.3.1.6.1.1.1 Development of geomorphic map of Yucca Mountain 0G3231A2

Summary Account Manager - J. Coe

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GER001A Scoping study -- photogrammetric analysis

J. Coe, J. Whitney, and P. Glancy field checked the photogrammetric map of erosion and deposition on Jake's Point and determined that the photogrammetrically measured volumes are correct within machine measurement error. The first phase of the scoping study is considered successful. Glancy believes that the method will also be useful for SCP activity 8.3.1.2.1.2.2 (debris flow hazards).

##### 3GER002A Write report on erosion rate for existing data

J. Whitney and C. Harrington prepared a revised annotated outline for the DOE topical report on erosion. Data from this report will be used for the report in this activity.

#### Quality Assurance

J. Whitney prepared data and procedures for a DOE/M&O meeting to qualify old data collected before the present QA program was implemented. Whitney spent one day with the SAIC/M&O team to discuss the procedures to be used to qualify "old" data.

#### Planning and Operations

#### Variances

### 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 0G3253A2

Summary Account Manager - C. Fridrich

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

C. Fridrich completed the following report (milestone 3GTW021M, Report: large hydraulic gradient) and submitted it for USGS review: "A geologic hypothesis for the large hydraulic gradient under Yucca Mountain, Nevada" by C. Fridrich, W. Dudley, Jr., and J. Stuckless.

Quality Assurance

Planning and Operations

Variances

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 0G3255B2

Summary Account Manager - J. Sass

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Work was performed to select contractors for calibration of fragile equipment. Ongoing calibration of laboratory and field equipment was also accomplished.

Quality Assurance

Planning and Operations

Variances

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 1.2.3.2.6.2.2 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

Summary Account Manager - M. McKeown

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GSR006 Materials testing

Laboratory investigations under this activity will test a range of soil and rock properties. These parameters will be used in the design of foundations for surface facilities.

3GSR007 Design data submittal of north ramp

The first design data submittal to RSN was made March 16. QA Level 1 soil and rock properties (engineering data) are reviewed as acquired and submitted to RSN for use in the design process for surface facilities.

3GSR016 Draft report on engineering geophysics

Planning is underway in preparation for USBR doing the borehole engineering geophysics specifically required for the soil/rock investigations. These include density and caliper logs of drillholes and a check shot of NRG-1. Planning is also underway for a grounding-mat design survey.

Quality Assurance

### Planning and Operations

#### 3GSR005 Field exploration-mapping, drilling, excavation

All necessary planning documentation was completed this month. Soils investigations began on March 2. Approximately 50 percent of the excavation of planned test pits and in-place testing is complete. This activity provides samples for laboratory testing. Reconnaissance of areas to be mapped is also underway.

### Variances

The organizations responsible for design of the test planning package did not finalize the design. The failure to complete the test planning package on schedule required revising the start date of field exploration to March 1992. The resultant slippage of dependent activities includes an indeterminate impact on Title II design. Specific impacts and corrective action can not be determined due to uncertainty in the TPP status.

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

The final report on site selection for six alternative North Portal alignments was reviewed and transmitted.

M. McKeown attended a part of the rock characteristics workshop held to examine effectiveness of planned drill holes along proposed ramp alignments.

A valuable result of the meeting was realization that the design process for the tunnel boring machine (TBM) requires description of the range of geologic ground conditions likely to be encountered but did not require description of the extent of (bad) ground conditions. On this basis, tentative drill site locations were negotiated with respect to position relative to inferred or known structures, to rig access, and to location relative to the still undetermined final location of the ramp alignment.

Participants at the drillhole effectiveness workshop, held March 4, at the Yucca Mountain site, included S. Beason (USBR), D. Campbell (USBR), R. Craig (USGS), M. Fahy (USBR), C. Fridrich (USGS), C. Hunter (USGS), R. Linden (SAIC), M. McKeown (USBR), R. Spengler (USGS), J. Wesling (Geomatrix), and D. Williams (DOE).

### 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 1.2.3.2.8.4 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 - K. Shedlock

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 8.3.1.17.4.1.2 Monitor current seismicity 0G3284HB  
Summary Account Manager - K. Shedlock

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

The installation of the seismic network upgrade has been put on hold until the seismic network has been completely transferred to the University of Nevada seismology lab (UNRSL).

3GSM114A Complete transition--sign MOA

A meeting was held on March 13 and final terms of the transition plan to transfer the seismic network to UNRSL were agreed upon by UNR and the USGS. On the basis of this revised transition plan and revised budget allocations, a new MOA for USGS participation was halted.

K. Shedlock attended meetings to finalize the BGRA-UNRSL transition plan and BGRA-YMPB MOA. D. Overturf and J. Gomberg prepared informational documents.

D. Overturf and J. Gomberg met with J. Brune and W. Nicks to discuss the technical aspects of the SGBSN transfer to UNRSL.

3GSM157A Continue testing lab/field equipment

Testing telemetry nodes with multiple data acquisition systems continue; data generated in Dallas is sent to Golden via satellite. Remote command and control (from Golden to Dallas) capabilities are being developed and tested.

3GSM160A Monitor 1992 seismicity

Seismic monitoring of the SGBSN continued uninterrupted in March.

The seismic network's computer captured 64 local earthquakes for the month of March, 1992, down from 99 for February. All but one had  $M_L < 3.0$ . Nineteen (19) chemical explosions, and one probable blast, all in the Bullfrog Hills of southwestern Nevada, and two probable blasts in the Dry Lakes area NE of Las Vegas were located from SGBSN digital data in March. There was one NTS nuclear detonation, at Silent Canyon Caldera, March 26, 1992, 16:30 UTC. Low-coda-frequency aftershocks were plentiful for this test, and are continuing at a very diminished rate to this time (4/02/92). No Yucca Mountain, Nevada, earthquakes were detected in March. For a five-day period, approximately March 18-23, one of the two A-to-D converters on the seismic computer was malfunctioning (amplitude of all output channels was about 10% of correct level); this may have reduced the triggering sensitivity, although small chemical explosions at the Bond gold mine were detected throughout that period.

March's seismicity includes a concentration of earthquakes at a point in the Las Vegas

valley, scattered activity in southern NTS, possibly associated with the Rock Valley left-lateral fault system, the tail end of a particularly intense (for the region) swarm at Suncline Ridge in central NTS, isolated earthquakes at Timber Mountain, at central and northern Sarcobatus Flat, at southern Bare Mountain, several earthquakes at southeast Pahrnagat Shear Zone south and southwest of Alamo, Nevada, a few at Grapevine Mountains, Nevada and California, one in the Seaman Range, one in the Hiko Range (southeast of Hiko, Nevada), one in the Amargosa Desert, Nevada-California border area, one in northern Death Valley, California, and a few earthquakes elsewhere in the SGB. The largest SGB earthquake for March,  $M_L$  3.0, occurred in the Reveille Range, Nevada, on March 1, 1992, 05:54:10 UTC. Its first-motion data are consistent with oblique reverse slip-strike on northwest trending nodal planes (mechanisms not shown, constrain is not good).

3GSM154A Test communications - receiving nodes/field  
Processing software development continues.

The first draft of refraction technology equipment documentation was reviewed by SGBSN staff and returned for revision.

3GSM022A Prepare FY91 earthquake catalog  
The 1987-89 Seismicity Catalog is being reviewed at DOE; the 1990 Seismicity Catalog is at the printers; and the 1991 Seismicity Catalog is in internal USGS review.

#### Quality Assurance

#### Planning and Operations

#### Variations

### 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 0G3284IB Summary Account Manager - F. Swan

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GFP001 Excavate and log soil pits

Excavations of soil pits were completed during the week of March 16. The study and logging of the soil pits began on March 23 and will continue into April. A conference poster entitled, "Recent characterization activities of Midway Valley as a potential surface facility site" was presented in early March at "Waste Management '92" in Tucson, Arizona.

#### Quality Assurance

#### Planning and Operations

Variances

SCP 8.3.1.17.4.2.2 Conduct exploratory trenching in Midway Valley 0G3284JB  
Summary Account Manager - F. Swan

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFP013 Write report on trench ABR-B

The report on Trench ABR-B is being revised after Geomatrix and Sandia technical reviews.

Quality Assurance

Planning and Operations

Variances

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 0G3284K2  
Summary Account Manager - L. Anderson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTQ008B Review and synthesize existing work

Work continues on compiling existing work. Development and input into Quaternary fault and reference data base continues.

3GTQ001B Draft technical procedure - aerial photo

Technical review is being conducted.

Quality Assurance

Planning and Operations

3GTQ006B Complete study plan 8.3.1.17.4.3

Study Plan 8.3.1.17.4.3.2 was completed and forwarded to DOE for review and approval.

Variances

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 0G3284O2  
Summary Account Manager - D. O'Leary

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Available air photographs, base maps, satellite imagery were examined and selected for ordering. D. O'Leary began to acquire relevant published information on tectonics of the Southern Great Basin that will be used in this activity.

Quality Assurance

D. O'Leary received QA indoctrination and training in Denver during mid-March.

Planning and Operations

Variances

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 8.3.1.17.4.5.1 Evaluate the significance of the Miocene-Paleozoic contact in the Calico Hills area to detachment faulting within the site area 0G3284S2  
Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTD007B Complete geologic map of Calico Hills

Delay of completion of geologic map of Calico Hills is anticipated because the scientist for this project did not report for duty until March 8. Also, final approval of the study plan is not anticipated until May.

Quality Assurance

Planning and Operations

Final revisions to Study Plan 8.3.1.17.4.5 were made based on the comment resolution meeting in February. The revised study plan has been sent back to DOE for final approval and submittal to DOE. J. Hoisch (Northern Arizona University) completed QA training and indoctrination in March.

Variances

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 8.3.1.17.4.6.1 Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain

0G3284C2

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GPF08A Complete field mapping -- strip map Yucca Mountain fault zone

Field mapping and data collection on the Pagany and Sever Wash faults was initiated in March.

Quality Assurance

Planning and Operations

3GPF07A Hire project staff

The hiring of project staff is complete.

Variances

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

0G3284D2

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GPF11A Complete report -- trench logs Windy Wash

Work was not begun on the Windy Wash trench report because the principal author has been asked to write the technical section of the DOE topical report on erosion.

Quality Assurance

Planning and Operations

3GPF30A Hire project staff

The hiring of project staff is complete. Plans also include hiring a summer field assistant in May. Contract arrangements also completed with the Nevada Bureau of Mines and

Geology for activity 3GPF17A, the relogging of Trench 8 on the Solitario Canyon fault.

NBMG geologist began QA training and indoctrination in March.

Variances

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 0G3284A1  
Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTE07JA Integration of tectonic data  
A contract for the revision of a 1:250,000 scale map of the geology of the Death Valley region was written.

Quality Assurance

Planning and Operations

3GTE06JA Order thematic map -- 1:100,000  
A draft contract and sole source justification was written for thematic mapper imagery. The contract is now being reviewed.

3GTE001K Draft study plan and USGS review  
The study plan for this activity will be delayed until later this fiscal year because the MOA for this work states that the study plan will be completed in the fourth quarter of this fiscal year.

Variances

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 0G3311E2

Summary Account Manager - A. Flint

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GMM02A Monitor stations and tipping-bucket gauges FY92

Work continued to maintain and retrieve data from each weather station and each tipping bucket rain gauge. Data from the stations with radio telemetry are downloaded daily during precipitation events.

##### 3GMM03A Calibrate tipping-bucket rain gauges

The sixth and last Sierra-Misco 1mm rain gauge was calibrated using the laboratory procedure HP-179, R1. Work began to calibrate Qualimetrics 0.1mm snow gauges. These will be sequentially brought in from the field locations and recalibrated using HP-180 laboratory calibration procedures.

##### 3GMM05A Acquire regional meteorological data-FY92

Regional precipitation and evaporation data for southern Nevada and southern California were acquired from various sources. Historical files for all reporting stations in Nevada and California were requested and received from the Western Region Climate Center (WRCC) station. The establishment of a BPO with the WRCC has been requested in order to obtain complete historical precipitation records for regional locations. To date, only current data for most locations of interest have been received. Pea-sized hail was observed near Yucca Mountain while golf ball-sized hail fell in Las Vegas. Also, a tornado was filmed as it touched down in SW Las Vegas. Little damage was done, however.

##### 3GMM07A Monitor collection gauge network-FY92

March was an extremely wet month, one of the wettest on record in southern Nevada. Five major storm systems moved through the region. The rainfall amounts were variable around Yucca Mountain depending on location and elevation. All five appeared to be the result of a split in the jet stream causing low pressure centers to develop off the coast of southern California. This type of storm track is the most likely to produce the heaviest precipitation in the southern Nevada region. Preliminary analysis showed that nearly 3 inches fell over portions of Yucca Mountain. According to the Elliott Storm Types of North America, these are known as "Type C" storms. The storm of March 30 was the most significant in terms of severe weather.

3GMM10A Analysis of station data-FY91

Although no progress has been made this month, no impacts should occur.

3GMM15A Prepare criteria letter

A criteria letter may not be required if the USGS does not need NTS support to accomplish the installation of the raingages. The installation method is currently being developed and should be complete in a few weeks. Environmental surveys still need to be completed for the proposed site. A letter will be drafted which will provide a map with the locations of the rain gages marked.

3GMM23A Collect NTS lightning data-FY92

The storm of March 30 produced widespread lightning throughout southern Nevada. The data were collected and archived for future study in relation to precipitation patterns. Lightning was observed near Yucca Mountain and in Jackass Flats.

3GMM034 Analysis of regional data-FY91

Although no progress has been made this month, no impacts should occur as a result.

3GMM060 Design optical lightning detection network

This program is currently on hold while the manufacturer continues developmental work on the instrument. No impacts should result from this delay.

3GMM070 Collect GOES data-FY92

Collection and archiving of 3-hourly GOES satellite data continued. These images contributed significantly to the tracking of the synoptic-scale storm systems which affected Yucca Mountain during the month.

3GMM080 Analysis of Yucca Mountain precipitation data-FY91

Although no progress has been made this month, no impacts should occur as a result.

3GMM100 Monitor daily weather patterns-FY92

Daily synoptic-scale weather patterns were archived and studied. Each day's patterns were typed according to Elliott's Weather Types of North America. There are six specific types.

Quality Assurance

3GMM066 Graded QA and other QA requirements

An internal audit of the meteorology program was conducted. No major findings were documented. All records were in order and well organized.

Planning and Operations

Variances

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated seven hours were spent on the following:

D. Ambos prepared a position description for a meteorological instrumentation and data manager.

D. Ambos supported other projects as follows: sat on the drill rig at N-17; retrieved precipitation samples for the geochemical program from N-2 and N-46; and logged N-36 as part of the neutron meter calibration scheme.

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 0G3311F2

Summary Account Manager - T. Kane

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRS002A Collect FY92 runoff and streamflow data

The month of March saw a continuation of storm fronts moving across Nevada. They increased the yearly rainfall total at the Nevada Test Site, to well above normal. March turned out to be the wettest on record.

Accumulation of rainfall data was collected after each event. The data were compared with surface-water data and provided runoff characteristics for storms which occurred both on and off the Test Site.

Three separate measurements were made on the Amargosa River at Tecopa station 10251300. These measurements range in discharge from 150 to 170 cfs and occurred on March 27 off the Test Site.

The measurements made on the Test Site include a series of four, made at the Unnamed Tributary to Fortymile Wash near Rattlesnake Ridge, Station 10251248. Discharges range between 1.5 to 2.5 cfs. Water samples were taken and a schedule, 1904 and 39A, is presently being processed at the USGS Denver lab. Local runoff from Jackass Flats, Area 25, was measured at Topopah wash at little Skull Mountain, Station 10251260. The measurement was made 30 miles upstream of the gage. A discharge of 1.5 cfs was obtained on March 30, 1992.

3GRS022A Complete FY 83-85 data and prepare report

Records are undergoing review at Carson City. The data report is at Carson City for retyping.

Quality Assurance

3GRS027A Complete technical process for streamflow data collection

HPs 100, 117, 166, and 219 are at HIP for review and then submittal to QA office. HP-40, R2; HP-43, R2, and HP-169, R1 were approved March 23. HP-44, R2, and HP-114, R1 are in the signature process.

Planning and Operations

3GRS016A Complete installation of two Amargosa gages

The work package with designs and environmental statements is to be resubmitted to the BLM by request. Eagle Mountain is the one remaining site to be constructed under this

heading.

#### Variations

3GRS022A Complete FY 83-85 data and prepare report

The records and report are on hold due to the office relocation at Carson City, Nevada.  
Impact: Schedule delayed possibly one month.

3GRS016A Complete installation of two Amargosa gages

Eagle Mountain construction is on hold due to inability to receive permits from the BLM (California). This is the final site to be completed under this activity. Contact with the BLM at present is being handled by DOE.  
Impact: Schedule delayed; no current estimate of restart.

3GRS027A Complete technical procedures for streamflow data collection

All procedures reside at HIP QA.

Impact: Schedule delayed; estimate additional month to complete.

SCP 8.3.1.2.1.2.2 Transport of debris by severe runoff 0G3311G2

Summary Account Manager - D. Grasso

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GRS002B Field reconnaissance of severe runoff features

D. Grasso and P. Glancy conducted reconnaissance in southern Nevada to determine if any debris had moved as a result of severe storms on February 12-13 and most recently on March 26-27 and 30-31. The March storms were especially heavy and produced intense precipitation, hail, and flooding. On March 30 a funnel cloud touched south of Las Vegas and golf ball-size hail pelted the area. Intense precipitation, measured as 2.0 to 2.5 inches in the southern and southwestern Las Vegas valley near Duck Creek and Blue Diamond, occurred during the March 26-27 storm. This heavy rain resulted in severe runoff and flooding in these parts of the valley where the brunt of the storm system was positioned. Streamflow and erosion was particularly heavy along Las Vegas Wash to the east along its major tributaries (e.g. Flamingo Wash, Duck Creek, and others), as well as in places where city streets act as conduits that drain flood waters from the large alluvial fans surrounding the valley. Duck Creek, at Spencer Road, for example, flowed at bank-full capacity and flooded the streets near-by most of the day of March 27 and again following the severe thunderstorm of March 30.

P. Glancy reconnoitered areas of highest runoff following the storms of March 7-8 and 26-27 to look for evidence of heavy debris transport. Along the Amargosa River, he recorded only minor streamflow and no evidence of intense debris transport from the March 26-27 storm.

D. Grasso investigated the middle reaches of Duck Creek in the southern Las Vegas valley to locate evidence of historic flow events. It is thought that such evidence may reveal important information regarding the frequency and magnitude of severe runoff events in southern Nevada.

P. Glancy revisited Copper Canyon mudflow of 1990 with R. Carmen and J. Yount (USGS-GD). They attempted to reach the source of the mudflow, but were unable to because of the long hike and shortness of daylight. They were, however, able to isolate the source area of a specific tributary and discovered ample evidence of a long and complex debris-flow

history in this drainage. This basin would be exceptionally attractive for paleoflood analysis because of the prevalence of datable stratigraphic horizons of tephra and vegetal (organic) materials. The basin will probably be selected as a candidate site for detailed study of debris-flow and transport processes for this activity, as well as for its long paleoflood history for the paleoflood evaluation activity.

P. Glancy visited Jake's Point, an area west of Fortymile Wash and north of Yucca Wash, with J. Whitney and J. Coe. Coe analyzed the volumes of sediment eroded and deposited by severe floods and ensuing debris flows during July 1984. This group presented a poster session at the AGU meeting in San Francisco in December, 1991, regarding the scoping results of this photogrammetric analysis. Prior to the March 21 field visit to Jake's Point, Glancy and Grasso reviewed Coe's analytical techniques in Denver on March 18-19. The field visit verified the quantitative resemblance of Coe's analyses by field checking the dimensions of the erosional and depositional areas against the numerical results obtained by Coe. The preliminary results of this technique are promising. The technique does, however, require large-scale, high-resolution aerial photography before and after a debris-flow event occurs in order to achieve an acceptable degree of quality and accuracy.

3GRS004B Procure and prepare aerial reconnaissance data

D. Grasso contacted FOLD (Federally Owned Landsat Data) distributors regarding the availability and cost of Landsat digital data for geomorphometric activities. Three of the needed data sets (Landsat TM scenes, all dated 3/23/84) are available. Two have been ordered. The third one will be ordered during the first week in April.

#### Quality Assurance

#### Planning and Operations

#### Variances

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

P. Glancy and D. Grasso spent time preparing for an upcoming QA audit (April 1, 1992) for this activity. The timing of this audit impacted field investigations of a recent runoff event in March, and time needed for the monthly PACS and the six-month status report. (24 hours)

### 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 8.3.1.2.1.3.2 Regional potentiometric level distribution and hydrogeologic framework studies

0G3311B2

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRG052 Process existing log data Amargosa Desert

S. Keller continued to assemble and process existing log data from mining-company drillholes constructed in the Amargosa Desert.

3GRG054 Prepare report on existing regional water level data

R. Luckey, W. Oatfield, J. Czarnecki, and N. Stuthmann met to discuss Oatfield's potential involvement in finishing this assignment. Per that meeting, Oatfield provided M. Ciesnik with a draft version of a water-level data report with approximately 540 water-level measurements. Ciesnik modified the format of the report text and plates for compatibility with USGS review requirements.

3GRG053 Locate additional piezometers in the Amargosa

J. Czarnecki and C. Savard performed field reconnaissance for additional mining company drillholes constructed in the Funeral Mountains and Greenwater Range. A new access road in the Greenwater Range was visited which provided access to a previously inaccessible drillhole (VC-1). This hole (as well as another nearby hole) had collapsed. An additional drillhole site located on a fan south of Pyramid Peak in the Funeral Mountains was visited, but the drillholes there were either too shallow or collapsed.

3GRG003 Measure water levels in Amargosa Desert

J. Czarnecki and C. Savard measured water levels in nine observation wells in the southern half of the subregional ground-water flow system.

3GRG007 Conduct prototype equipment testing in small diameter wells

C. Savard and J. Czarnecki installed and tested a 1-11/16" diameter jack pump (similar to a windmill-style pump) in a 1,100'-deep piezometer located west of Stateline, Nevada, in the Amargosa Desert. The tripod that had been constructed to lower the 1"-diameter pipe and rod downhole was insufficiently tall to handle the pipe, and was taken to a welding shop in Las Vegas for modification. For the test, 30 ft. of 1"-galvanized pipe and rod were lowered down the piezometer by hand, providing a water column of only 20 ft. above the pump intake. This water column was drained in less than 2 minutes at a pumping rate of about 2 gallons per minute. No drawdown was observed in a shallow piezometer constructed in the same borehole, indicating hydraulic isolation. The well was allowed to recover over night and was repumped with similar results. Future testing will be done with the pump intake placed at least 200 ft below the static water level in the well. The above-ground pumping apparatus (pump jack and motor) was assembled in less than one hour.

Quality Assurance

Planning and Operations

3GRG003A Access permits to measure water-levels in Amargosa Wells

Letters requesting access to well sites in the Amargosa Desert were sent to BLM offices in Las Vegas and Barstow, California. Included were maps showing the sites to be visited.

### 3GRG007 Prototype equipment testing for small diameter wells

Plans were discussed by J. Czarnecki with personnel from USGS Las Vegas subdistrict office regarding upcoming planned testing of a jack-pump in 2" diameter wells in the Amargosa Desert. Testing is on hold until appropriate permits are in place from the BLM.

### 3GRG003A Access permits for Amargosa wells

Permit application forms were received from the BLM for access to well sites throughout the Amargosa Desert, but specifically at deep observation wells constructed in mining-company exploration holes. Forms are in the process of being completed for access to these sites and testing the wells located there.

## Variances

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

An estimated 100 hours were spent on the following:

J. Czarnecki submitted a report entitled "Ground-Water Conditions in Amargosa Desert, Nevada-California, 1952-87" (USGS Water Resources Investigations Report 89-4101) to W. Causseaux for qualification of all data contained therein. The report has water-level data that will be needed for regional modeling efforts.

M. Ciesnik participated in a series of pre-audit meetings in preparation for an upcoming DOE audit.

J. Czarnecki prepared a request for personnel action to obtain a contract hydrologic technician to assist the Fortymile Wash study and regional potentiometric levels activity.

M. Ciesnik submitted a technical data information form to the QA office for water levels measured in selected wells in the Amargosa Desert during field trips in 1991.

J. Czarnecki and M. Ciesnik performed routine checks of their QA documents (HPs and QMPs).

J. Czarnecki reviewed a proposed revision to the SCPB for adding drillhole UE-25 c#4 to the c-hole complex.

J. Czarnecki purchased and acquired various equipment for testing a small diameter pump including a shaft pulley, pipe elevators, pipe clamp, and a winch.

M. Ciesnik completed reading assignments pertaining to AP-5.28Q, QMP-3.03, R3, and QMP-3.07, R4.

M. Ciesnik and J. Czarnecki reviewed plans to perform validation of the computer program PLANE-PC, required by QMP-3.03, R2.

M. Ciesnik performed a technical review of modifications made to HP-96, R0 (Measurement of wind speed using a Met-One Inc. Model 014A Wind Speed Sensor).

J. Czarnecki gave presentations on characterization of the regional ground-water flow system to seven busloads of citizens visiting the Hydrologic Research Facility in area 25 on the Nevada Test Site.

M. Ciesnik and J. Czarnecki attended a QA training course entitled "How to Be Audited"

presented by W. Rodman.

SCP 8.3.1.2.1.3.3 Fortymile Wash recharge study 0G3311C2  
Summary Account Manager - C. Savard

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GRG003B Complete report on channel loss

Continued to draft report. Preliminary runs with the Agricultural Research Service model were completed to define the relationship between mean annual streamflow and recharge.

3GRG004B Develop infiltration test procedure

Assisted Nevada District personnel measuring pump discharge during the JF-3 water sampling. Similar techniques with a ten-turn potentiometer will be used to monitor water levels in infiltration tanks. Held brief discussions with L. Hoffman about his future work with artificial recharge studies.

3GRG012B Non-linear analysis of regional streamflow

Prepared supporting material for presentation of a poster supporting the abstract titled 'Looking for chaos in streamflow with discharge-derivative data' which was accepted by the American Geophysical Union for presentation at the Spring 1992 meeting special session 'Predictability of Climatic and Hydrologic Systems: Insights from Nonlinear Dynamics'. The poster will provide information about the underlying nonlinear dynamics of streamflow. Continued correlation integral analysis of Merced River streamflow data for a more complete analysis. The predictability of streamflow is important in the Yucca Mountain area to define ground-water recharge.

3GRG028 Collect FY-92 moisture data

Read rain wedges at UE-25 UZN#85, UE-25 UZN#92, and UE-29 UZN#91. Neutron logged UE-25 UZN#85, UE-25 UZN #92, and UE-29 UZN #91. Made depth to water measurements in UE-29 UZN #91, UE-29 a#1, and UE-29 a#2. The data collection frequency was increased to document an ongoing recharge event.

#### Quality Assurance

#### Planning and Operations

3GRG001B Complete criteria letter ponding sites

Continued to draft criteria letter.

3GRG006B Complete criteria letter FM and FMN holes

Continued to draft criteria letters.

3GRG010B Continue to site FMN and FM holes

Continued to site possible locations for the FMN and FM holes. Observed discharge from JF-3 water sampling pump operation in Fortymile Wash. Future hole locations can not be located where man has influenced the natural movement of water through the unsaturated zone.

#### Variations

3GRG001B Complete criteria letter ponding sites

Ponding sites are not finally located. The infiltration test procedure has not been finalized

and the extent of other DOE contractors involvement is not decided. Infiltration tests at the ponding sites will not be run until neutron logging holes are completed. Additional time is required to complete the draft criteria letters. No impact on major deliverables is expected.

**3GRG003B Complete report on channel loss**

Due to other work commitments and relocation, personnel assigned to complete the report have been unable to finish the report by the scheduled time. Additional time is required to complete the report which is being targeted for a journal.

**3GRG004B Develop infiltration test procedure**

Additional time is needed to develop a workable infiltration test procedure using the large tanks and to define a system to record all the necessary physical parameters for later analysis. No impacts on major deliverables is expected.

**3GRG005B Complete procurement of infiltration test equipment**

When the infiltration test procedure is developed all the equipment necessary can be procured. No impacts on major deliverables is expected.

**3GRG006B Complete criteria letter FM and FMN holes**

Additional time is needed to complete the draft criteria letters. Hole locations need to be sited. The sampling schedule during drilling needs to be defined. No impact on major deliverables is expected.

**3GRG010B Continue to site FMN and FM holes**

FMN locations need to be finalized. A balance between holes used to monitor natural conditions and infiltration experiments needs to be defined. No impacts on major deliverables is expected.

**3GRG012B Non-linear analysis of regional streamflow**

Additional time is required to finish the poster, which is scheduled to be presented on May 14, 1992, at the AGU meeting.

**3GRG109A Procure equipment for air-k tests**

Air permeability tests need to be reevaluated for their help in determining recharge from Fortymile Wash. Experts in the field will be consulted to determine if the costs and effort to obtain air-k data will be useful for Fortymile Wash recharge objectives. Any delay will not impact major deliverables.

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

An estimated 40 hours were spent on the following:

Collected depth to water measurements in the Amargosa Desert for the regional potentiometric level network.

Assisted in testing equipment to be used for ground-water sampling in the regional potentiometric level network.

Participated in the USGS audit of the activity.

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRG205A Complete report on vertical multilevel sampler, Franklin Lake Playa

Two reports entitled "Does localized recharge occur at a discharge area within the ground-water flow system of Yucca Mountain, Nevada?" and "A Hint of Recharge at Franklin Lake Playa, Inyo County, California" were sent to USGS Headquarters for final approval following D. Appel's review.

3GRG030 Select WT/ET sites

This activity has not started. See 3GRG215A below.

Quality Assurance

Planning and Operations

Variances

3GRG201A Perform prototype tests of ET measurement

No prototype testing was performed. Meetings were held with D. Stannard (USGS/NRP) and R. Luckey to discuss the scope of work and available personnel.

3GRG208A Purchase materials for piezometer nests

A determination of type and quantity of materials to purchase for piezometer nests cannot be made until an evaluation of the number of sites is made. This will be delayed until the chloride profiling method can be evaluated and tested, which may greatly minimize the need for piezometer nests. J. Czarnecki discussed chloride profiling with S. Tyler (DRI, Reno) who provided several papers on the subject.

3GRG030 Select WT/ET sites

See 3GRG208A variance.

3GRG206A Analyze Franklin Lake hydrochemical data

No activity. This activity has been placed on hold until the project chief can be freed to work on it. Results from this effort will feed G006 (Hydrochemistry of Franklin Lake playa).

Work Performed but not in Direct Support of the Scheduled Tasks

J. Czarnecki presented a poster entitled "Localized recharge at a discharge area within the ground-water flow system of Yucca Mountain, Nevada" at Waste Management '92 in Tucson, Arizona. Czarnecki sent papers on the regional ground-water flow system and Franklin Lake playa to about 12 persons who stopped by the poster.

J. Czarnecki sent a formal request to the U.S. Board of Geographic Names to officially name the unnamed alkali flat located north of Eagle Mountain as Franklin Lake playa. The request was received and a decision is expected in four months.

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 8.3.1.2.1.4.2 Subregional two-dimensional areal hydrologic modeling 0G331112

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

3GRM017A Hydrology integration task force participation

J. Czarnecki participated in a meeting of a subset of the Hydrology Integration Task Force and the Geochemistry Integration Task Force to set the agenda for a joint meeting on hydrology and hydrochemistry scheduled for May 27 and 28, 1992.

Variances

3GRM014A Verification problems, MODFE computer program  
There was no further activity; staff have been diverted.

3GRM015A Test finite-element mesh generator

This activity has not started; neither J. Czarnecki or M. Ciesnik have been free to start this activity because of other project commitments.

Work Performed but not in Direct Support of the Scheduled Tasks

J. Czarnecki prepared a Research Grade Evaluation Guide (RGEG) package for peer panel review.

J. Czarnecki attended a seminar by C. Voss (USGS/Hawaii) entitled "Parsimony in modeling."

SCP 8.3.1.2.1.4.4 Regional three-dimensional hydrologic modeling 0G3311K2

Summary Account Manager - J. Downey

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRM040 Interface GIS with ground-water models

C. Faunt and F. D'Agnesse continued working with D. Williams on testing ARC/INFO and MODFLOW interfaces at CSM's Center for Geoscience Computing. Williams is finalizing efforts on the evaluation of MODFLOW and ARC/INFO interfaces.

Quality Assurance

Planning and Operations

3GRM13A Develop visualization software

C. Faunt discussed a user interface for the Intergraph system with B. Wales (Intergraph)

Corporation) that would expedite input and visualization of cross-sectional data in the Intergraph system.

K. Turner requested purchase of IDRISI GIS software which is a PC-based raster software package available for only \$400.00 and can be used as a quick visualization tool.

#### Variances

##### 3GRM08A Calibration of 3-D ground-water flow model

This activity has been temporarily delayed until the study plan for future climate changes is approved. A prototype model will be constructed by J. Downey to test memory requirements and/or code constraints.

#### 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 8.3.1.2.2.1.1 Characterization of hydrologic properties of surficial materials 0G3312Z2

Summary Account Manager - A. Flint

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GUI002A Analyze rock outcrop samples

This activity will be extended to June 29, 1992, to incorporate at least two more transects. Along with the Prow transect described in the February report, an additional transect was conducted this month. This transect collected over 300 samples in the Shardy Base of Tiva Canyon along the west side of Yucca Ridge in Solitario Canyon. To investigate the relationship between vertical and horizontal variability in this seemingly very deterministic lithologic unit, 26 vertical transects of 10-15 samples over the 35 foot thick unit were collected over a 4000 foot distance along the unit to create a 2-D dataset. Core plugs are being prepared on the collected field samples. Laboratory measurements are progressing well on the rest of the transect samples. Moisture retention data on the horizontal transect of the Shardy Base indicate a fairly uniform air entry potential of about 0.5 bars which will be used for modeling purposes. Imbibition experiments on that dataset indicate quite a lot of variability, which corresponds with the variation in porosity shown vertically in the unit. Datasets of all measurements done on samples from six transects have been organized into ASCII files for submission into the LRC and TDIFs have been begun. The extension of this activity will not impact the preparation of the OFR due September 30, 1992.

3GUI004A Compile and analyze existing soils data

This activity is progressing now with the arrival of new personnel. Familiarization of new personnel with existing surficial materials data and field testing equipment has begun, along with introduction of field topographic locations that correspond with infiltration-runoff surficial units and associated soils.

3GUI005 Test borehole logging tools in new neutron hole

This activity will be extended to July 1, 1992, to coincide with 3GUI005A, install and check geophysical instruments. The new van has not been received yet.

Quality Assurance

3GUI023A Graded QA and other QA requirements

Implementation of all QA requirements was performed as needed.

Planning and Operations

3GUI025A Procure SPARC station for GIS program

The SPARC station has not been processed through purchasing yet because of delays in the allocation of capital equipment funds.

3GUI026A Continue procurement of geophysical logging van

The geophysical logging van is still expected to arrive soon. The extension of this activity will not impact programmatic schedules. The geophysical logging of all neutron logs is scheduled to take six months after which there is a nine month lag to prepare technical procedures before site characterization borehole logging begins.

Variances

3GUI002A Analyze existing outcrop samples

As explained in the technical activity discussion, this activity has been expanded to include additional transects which will extend the planned finish date to June 29, 1992. This will not impact the planned finish date of 3GUI020A, preparation of OFR for outcrop samples.

3GUI005 Test borehole logging tools in new neutron hole

This activity has been extended to coincide with 3GUI005A, install and check geophysical instruments. Rather than check the old geophysical tools in the new boreholes, then recheck the new tools, the two activities will be concurrent to install the new tools as soon as the new logging van arrives and then check the new tools in the field. The van is expected within four weeks and thus the planned finish of these two activities should not be impacted.

3GUI025A Procure SPARC station for GIS program

This activity has been unavoidably delayed due to the procurement and budgeting process. The actual finish date is currently unknown. There is a three month lag for set up of this system before the next activity to utilize the system begins (3GUI007A, analyze the spatial variability of soil physical properties, six months). This suggests that there will be no impact on programmatic scheduling.

3GUI026A Continue procurement of geophysical logging van

The arrival of the geophysical logging van is imminent, and the delay of this activity should not impact 3GUI005A which allows for three months to install the instruments and field test them in the new boreholes.

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GUI302 Initiate small scale deterministic model

A preliminary analysis of 1-D and 2-D simulation of transient unsaturated flow using the modified version of the VS2DT finite difference algorithm was completed by J. Hevesi, and a comparison of simulation results using VS2DT with results obtained using the TOUGH finite difference algorithm was initiated. The comparison is being made to investigate the importance of including transpiration as a boundary condition and as a sink term in the governing equation for internal nodes within the root zone. Initial results have indicated that including transpiration for an overall ET boundary condition may provide improvements for unsaturated flow simulation and an application of the inverse solution method for investigating material properties and structure within alluvial deposits. Efforts are continuing to more accurately define the ET boundary condition in terms of rooting depth as a function of time and space, root density as a function of depth, time, and space, limiting pressure potentials, and surface resistance factors. The ET subroutine is also being modified to include potential evapotranspiration as a function of meteorological parameters and a solar radiation model in order to account for both seasonal and diurnal effects on the upper boundary condition. For the initial simulations, total daily potential ET was estimated according to evaporation data available from the class A evaporation pan in Jackass Flats. The 90 day flow simulation for the 954 node finite difference mesh required approximately 4 minutes of run-time on a 386/33 machine when using a time step of one day. This is 50 to 100 times faster than flow simulations for the same model using the TOUGH code on the PRIME. A reduction in run-time will be an important advantage in the continuing effort of inverse modeling and also for Monte Carlo simulations.

#### 3GUI311 Initiate analysis of moisture profiles

Analysis of moisture profiles for selected boreholes in Pagany Wash and Fortymile Wash, and also for the newly installed boreholes, was continued by L. Flint, A. Flint, C. Savard, and J. Hevesi as additional data were collected. The boreholes were logged at an increased frequency because of the much higher than average magnitude and frequency of precipitation that occurred for January, February and March. The series of moisture profiles obtained indicated the downward movement of a well defined wetting front to a depth of approximately 2 meters for the newly installed boreholes and for the boreholes in Pagany wash, while the two boreholes in Fortymile Wash, N-92 and N-91, indicated a greater volume of infiltrated water to a depth of 4 to 5 meters. These profiles will be useful as a means of model validation for the small scale deterministic modeling activity, as well as for inverse modeling, specifically in terms of the upper surface layer and the ET boundary condition, because relatively accurate measurements of precipitation depths were made at each borehole site using a storage gage. Logging of the selected boreholes at weekly intervals will continue in order to measure changes in moisture profiles due to evapotranspiration. This work will be valuable in understanding both hydrologic processes and material properties within the upper 2 meters of surficial materials.

#### 3GUI315 Prepare technical paper small scale model

An outline and abstract have been completed for the first report in a series of technical papers describing the analysis of flow simulation results for an application of the inverse solution method. These predict natural infiltration based on possible future climatic conditions, evaluate net infiltration at specific sites using mass balance calculations, perform

sensitivity analyses to evaluate the relative influence of various meteorological, hydrological, and geological parameters, and validate various conceptual models of natural infiltration. The first report will specifically describe the results of the inverse solution method for estimating the field-scale hydrologic and material properties of alluvium deposits in Pagany Wash.

**3GUI321 Install and calibrate automated evaporation pan**

Installation of an automated class A evaporation pan at a field site in Jackass Flats was completed. Modifications made by J. Klenke to the refill reservoir, delivery line, float valve, stilling well, and data collection system will improve the accuracy of measurements. Modifications made by Klenke and J. Gonzales to the instrument shelter, delivery line system, and protective fencing have improved the quality and reliability of the automated system. The instrument station includes a tipping bucket rain gage, totalizing anemometer, and thermistors for measuring water and air temperature. Additional meteorological data, including relative humidity, wind speed, and wind direction, can be obtained from a nearby weather station.

**3GUI324 Initiate tritium sampling program**

Samples were selected from USW-UZN-55 LEXAN samples for tritium analyses. It was agreed to send these samples to USGS Geochemistry in Denver as soon as they are packaged at the Sample Management Facility.

**3GUI368 Procure instrumentation for ET**

No progress was made on this activity during March due to a lack of manpower. This delay does not result in a variance at this time.

**3GUI377 Field calibration of neutron-moisture meters**

Field calibration of the neutron-moisture meters using core samples available from the newly installed neutron access boreholes continued as additional data was collected. A preliminary calibration equation developed by A. Flint and J. Klenke indicated an improvement in calibration accuracy relative to previous calibrations. The improved calibration is possible because of the continuous coring procedure that was implemented for the installation of the new boreholes. N-55 samples are currently being dried at temperature ranges of 200-800° C. Some locations in the borehole indicate a large storage of water at 105° C compared to higher temperatures. Preliminary data suggests that removing all the water from the samples will improve the calibration equation.

**3GUI381 Log neutron access boreholes FY92**

Selected boreholes were logged with increased frequency during March because of the increase in precipitation that occurred during this period. Regular logging of all neutron boreholes was scheduled for the first week of April.

**3GUI385 Drill new neutron access holes**

Installation of boreholes N-17, N-15, and N-16 in Pagany Wash was completed despite a significant amount of down-time due to adverse weather conditions. Installation of boreholes N-27, N-64, and N-38 should proceed on schedule.

**3GUI387 Continue locating new neutron holes**

A total of eight new neutron access boreholes have been successfully installed during FY92. The locations for the final three boreholes to be installed in FY92 have been finalized and approved. The installation of these boreholes should proceed on schedule. Locations of 12 additional boreholes were requested by DOE for FY92 budgeting purposes.

3GUI388 Procure and calibrate sensors for borehole monitoring

No progress was made on this activity during March due to a lack of manpower. This delay does not result in a variance at this time.

3GUI389 Calibration and testing of cross-hole gamma probe

No progress was made on this activity during March due to a lack of manpower. This delay does not result in a variance at this time.

3GUI396 Testing and calibration of prototype TDR

Laboratory testing and calibration of the prototype TDR was completed. Field site testing and calibration is continuing at a location in Jackass Flats. Modifications to the data logger program are also in progress.

3GUI404 Installation of TDR network

Potential field locations for the TDR network have been selected. Installation of the network has been delayed pending procurement of instrumentation (see activity 3GUI409, Graded QA and other QA requirements). This delay does not result in a variance at this time.

#### Quality Assurance

3GUI409 Graded QA and other QA requirements

Implementation of all QA requirements were performed as needed.

#### Planning and Operations

3GUI405 Procure CSI TDR

The problem causing a delay in procurement was identified and corrected. Partial procurement has been completed, and procurement of the remaining materials should now proceed on schedule. The delay does not result in a variance at this time.

#### Variances

### SCP 8.3.1.2.2.1.3 Evaluation of artificial infiltration 0G331222

Summary Account Manager - A. Flint

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GUI606 Prototype infiltrometer field testing

L. Hoffman, a new Foothill Engineering contract employee, began work March 17 and has since made some progress on this activity. Background information has been assimilated and studied and he has become familiarized with the equipment and various field sites. New information regarding calculated solutions for well permeameters has recently been acquired, has been read and will be assessed as to its applicability. A GUELPH Permeameter was loaned to B. Glass with Sandia National Laboratory. Glass is running a comparison of two field infiltrometers.

3GUI616A Develop prototype ponding study

The arrival of only one of the two anticipated personnel has resulted in no further progress on this activity for this month. So far there is no indication, due to the float in this activity, that this will result in programmatic delays.

### 3GUI630 Determine field locations infiltration sites

Field locations for ponding, LPRS and SPRS sites, were chosen this month and sent to DOE for FY93 budgeting purposes. Numbers of sites were reduced to 12 ponding sites, and six each of the rainfall simulation sites. This should represent the various infiltration-runoff units over the mountain. The locations indicated to DOE were not specific and with the assistance of the new employee, work in the artificial infiltration activity this coming month will involve flagging the sites in order to begin the job package for drilling at these plots.

### Quality Assurance

#### 3GUI695 Graded QA and other QA requirements

Implementation of all QA requirements was performed as needed.

### Planning and Operations

### Variances

## 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 8.3.1.2.2.3.1 Matrix hydrologic-properties testing 0G3312U2

Summary Account Manager - A. Flint

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GUP009A Construct and test low-flow permeameter

The design and engineering of this device has been completed. Components that have been requisitioned, but not yet received, include a precision-rate controlled, high pressure syringe pump and a high-resolution pressure transducer with a range of several thousand psi. Construction will begin when all components are received.

#### 3GUP010A Develop and test imbibition procedure

This task was completed as scheduled. Two new imbibition procedures were developed and tested - one at the HRF and the other at Oregon State University (OSU). The HRF procedure utilized a saturated capillary matting in a plexiglas box kept wet by a constant head water supply system. Dry cores were weighed and then placed with the flat face down on the capillary matting. The cores were allowed to freely imbibe water, and the rate of imbibition was measured by reweighing the cores periodically. The OSU system works by suspending the samples from small load cells to obtain a continuous weight as water was imbibed from below. The OSU method allows for continuous collection of datapoints which gives information on filling of secondary pores and will provide datasets for verification of moisture retention methodology and modeling of functional relationships. The HRF system only provides enough data to calculate sorptivity but can run more than 50 samples

simultaneously.

**3GUP013A Model imbibition to verify lab measurements**

Additional samples have been used to collect imbibition data for inverse modeling to estimate saturated conductivity and functional relationships from sorptivity. Some preliminary attempts were made to evaluate the inverse modeling computer program, but with inconclusive results. This study is still underway. The imbibition method described in 3GUP010A (Develop and test imbibition procedure) is currently being tested using core samples and will provide data to be used in modeling imbibition curves for methodology verification and estimation of functional relationships.

**3GUP16AA Matric potential from tensiometer/transducer**

No progress was made on this activity in March. Additional personnel have recently been hired and additional personnel are expected in May, at which time this activity will be resumed. It is not expected that delays in this activity will impact other activities at this time.

**3GUP17AA Water retention from SPOC analyses**

This activity was scheduled for completion at the end of March. Additional development to determine the feasibility of incorporating simultaneous measurement of multi-step outflow along with hysteretic moisture retention is being conducted with the aid of personnel at OSU. In addition, it is desirable to automate the system for more accuracy and quantity which requires some development at this point. This activity will be extended to be concurrent with 3GUP019A (Water retention pressure plate tests) and will feed directly into the preparation of the OFR 3GUP020A and therefore will not impact any milestone activities.

**3GUP25AA Chilled-mirror psychrometer verification**

This activity was scheduled for completion at the end of March. However, additional verification tests are required due to inconsistencies in the data collected on the supersaturated solutions of various salts. This problem appears to be solved. An additional problem related to the way in which the sample cup sits against the mirror may allow some external leakage of air into the chamber. A redesigned sample cup with an O-ring seal is currently being tested.

**3GUP26AA Transect sample statistics**

Statistical and geostatistical analysis of the physical and hydrologic data collected from the transect samples is continuing. M. McGraw (LBL) and C. Rautman (SNL) are contributing to this activity as part of their respective numerical modeling efforts, in addition to J. Istok (OSU).

**3GUP27AA Permeability of selected transect samples**

Saturated hydraulic conductivities were measured on approximately 70 samples from the composite transect. These samples were assembled to provide representative core plugs from all of the lithologic units in the unsaturated zone at Yucca Mountain. Permeabilities are currently being run on deeper Calico Hills core samples from the GU-3 borehole.

**3GUP028A Imbibition measurements on transect samples**

These measurements are being run on the newly-developed HRF imbibition apparatus described in 3GUP010A (Develop and test imbibition procedure). This activity is proceeding as scheduled.

### 3GUP30AA Neutron core physical property measurements

Additional samples have been selected for intersampling from the LEXAN liners to make additional measurements supplementing the dataset from the can samples. As the neutron probe calibration equation efforts have progressed, it was seen as necessary to remove all of the water from the rock samples by heating to very high temperatures. Experiments have been done on several of the N-55 samples to determine the appropriate temperatures to accomplish this and it was shown that some of the units do maintain quite a bit of stored water when only dried at 105° C. Additional equipment was obtained and calibrated in order to dry all of the N-55 samples at high temperature.

### 3GUP31AA Neutron core gas pycnometry measurements

The gas pycnometer has been used to test the repeatability of measurement made on nonwelded tuff. The systems appears stable and a draft technical procedure has been written. Once the procedure is in place samples will be processed.

### Quality Assurance

#### 3GUP02AA QA procedure, training and calibration FY92

QA training and equipment calibrations were carried out as required. A procedure is in preparation for the gas pycnometer and the chilled-mirror psychrometer procedure is currently being revised based on new information obtained from the CX-2.

### Planning and Operations

### Variances

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

Public tour, March 28. (4 hours)

Tour for visitors from Russia, March 24. (2 hours)

Attended AGU Hydrology Days, Ft. Collins, Colorado, March 31. (8 hours)

### SCP 8.3.1.2.2.3.2a Surface-based boreholes studies 0G3312V2

Summary Account Manager - J. Rousseau

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

#### 3GUP053E Develop electronic diagnostic procedure for verification SPECS of electric equipment

Work on this activity was restarted in late March. Approximately four months will be needed to prepare a first draft of the technical procedure for this method. All equipment to continue with development of this procedure is on hand.

#### 3GUP046E Complete development/design of Denver data base

Work on this activity was restarted in March, in conjunction with the planned conversion of the HRF borehole data acquisition system to IDAS in May.

#### 3GUP003E Instrument and monitor HRF boreholes

Monitoring of HRF boreholes continued throughout the month of March.

#### 3GUP021E Construct/test/evaluate multi-station gas sampling apparatus

Construction of the multi-station gas sampling apparatus is essentially complete.

Preliminary testing of the apparatus and supporting software will take place in April.

3GUP059E Complete processing thermistor, pressure transducer, psychrometer technical procedure  
An in-project technical review of the pressure transducer calibration procedure was completed. This technical procedure will be forwarded for QA review and approval during the month of April.

3GUP023E Develop/test/evaluate in-situ pressure transducer recalibration  
No work was done on this activity during the reporting period due to other higher priority commitments.

#### Quality Assurance

3GUP020E Acquire/install mass flow

A QA certification inspection of the vendor/manufacturer of the mass flow calibrator was conducted. Minor deficiencies were noted and are in the process of being corrected. Exact delivery date of the equipment is still unknown at this time. However, delivery is anticipated in early June.

#### Planning and Operations

3GUP014E Acquire/install humidity generator

A two pressure humidity generator has been shipped to the NTS. The unit will be installed in April. Training classes will be given by the product manufacturer on May 21 and 22 at NTS, HRF calibration laboratory.

3GUP040E Acquire, install, evaluate optical disk media

Procurement documents for the optical disk storage media units (WORM drives) were forwarded in February. The delivery date is unknown.

3GUP035E Prepare for instrumentation of UZP-6

Preparations for instrumenting UZ-16 (VSP borehole) [not UZP-6] continued throughout the month of March. A comment resolution meeting to resolve work package issues was held on March 25. A prototype geophone cable mount is being manufactured. The geophone cable mock-up unit was delivered to RSN to support their mount design efforts. Five potential USGS detailees were identified to assist with drilling operations during the months of May, June, July, and August.

3GUP060E Hire and train new staff

All staff actions requiring input at the project level have been completed. Awaiting personnel division action to process hiring requests, PDs, announcements, etc. Two new staff, hired in December, 1991 and February, 1992, have been scheduled for a special training course at Ruska Instruments in Houston, Texas in April. These new-hires have completed GET and QA indoctrination training.

3GUP045E Order additional microwave telemetry

This activity is on hold pending approval of an FCC license application to operate a 10 MHz wide-band transmitter at the NTS. The 10 MHz system is being investigated as an alternative to the 23 GHz microwave telemetry system. License has been applied for.

#### Variances

SCP 8.3.1.2.2.3.2b Vertical seismic profiling 0G331232  
Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP017B VSP lab/physical and computer simulation: 2-D fault method  
H. Jaramillo has produced several excellent fault images. Stacking and compositing continues.

The processing of Yucca Mountain physical-model data continues.

Quality Assurance

3GUP030B Develop/write VSP technical procedure: data acquisition  
There was no activity during this reporting period due to lack of time and illness.

Planning and Operations

3GUP050B Procure "X" windows computer terminal for VSP  
The "X" windows computer terminal was delivered March 6.

3GUP035B Design/test/evaluate/procure geophone mounts  
Evaluation of prototype mounting brackets continues. Current design is considered adequate, but a new, better design is being sought.

Variances

3GUP047B Prepare ICN for cross-hole tomographic surveys  
This activity has not started due to both illness and unavailability of time. Will try to begin this activity during the month of April.

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 40 hours were spent on the following:

C. Erdemir's thesis is nearing completion.

A. Balch attended Midwestern A&S meeting, Dallas, and presented a paper; attended "Underground Sound" symposium (Golden) and presented a paper.

H. Jaramillo gave a paper at graduate seminar.

SCP 8.3.1.2.2.3.2c Integrated Data Acquisition System 0G331242  
Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP045C Develop criteria optical disk media  
Final comparison of suitable alternatives led to a committee decision (J. Baer, R. Getzen, A. Greengard, M. Kurzmack, M. Neil, and J. Rousseau) for a procurement recommendation for a 5-1/4" optical WORM, controller, and communications software. Kurzmack began work on requisition and supporting documents February 14. A requisition for DEC Pathworks, software for communications between ARC-2 and optical disk controller, had not been submitted as of March 23.

### 3GUP025C Integration and test design for software

M. Neil has nearly completed test designs for all phase 1 and phase 2 IDAS software (software completed in task 3GUP013C, Development and module testing software-2, but not 3GUP020C, Development and module testing software-3, or 3GUP023C, Development and module testing software-4). He will be debugging his testing program and associated hardware throughout most of April. A. Greengard and R. Getzen will review his test plan before May 10, will evaluate its performance through early June. A test plan for phase 3 and phase 4 software should be complete by late June. See variances.

### 3GUP013C Development and module testing software-2

Final two modules (Engineering Conversion Subsystem, Interactive Subsystem) in phase 2 software are currently being coded (J. Baer and A. Sims). These subsystems should undergo preliminary debugging and testing about the end of April. Bugs in SNSRDR, MNTSUB, and GPIB driver were corrected in March. Work is currently underway (Baer) to modify MNTTIP and SNSRDR to permit utilization of the new model 182 Keithly Nanovoltmeter. A potential design glitch has been discovered in the way IDAS software tracks the sequence of electronic and mathematical operations associated with each measurement. This glitch can, under rare circumstances, allow inconsistencies between sensor operation and sensor interpretation, as well as QA difficulties in establishing traceability of data. The physical problem can be circumvented procedurally (with some inconvenience and insignificant disruption of data collection). A better solution, which eliminates QA problems, will be designed and tested as part of work elements 3GUP020C and 3GUP051C. See variances.

### Quality Assurance

#### 3GUP049C Write, review, revise IDAS computer procedures

A. Greengard has been making consistent progress in revising these procedures as software/user interface is being changed. At the same time, procedures are being physically combined and realigned to create more useful documents. (See December and January monthly reports.) Working versions of most of the new documents will be available about the end of April.

#### 3GUP060C Write review, revise IDAS instrument procedures

R. Getzen has outlined the new procedures and made some progress in their writing. They should be complete in mid-June; see variances.

#### 3GUP062C Revise IDAS facility procedures, QA reviews

The need for procedures HP-134 and HP-137 has been eliminated by circumstances and realignment of IDAS procedures in December.

#### 3GUP063C Write/review/revise IDAS maintenance procedures

R. Getzen has outlined the new procedures and made some progress in their writing, but many details depend upon field evaluations of IIS and shelter systems (element 3GUP033C) and of IDAS prototype-2 (element 3GUP051C), which will not begin until mid-May. They should be complete in late December, if the shelter is delivered in mid-August.

#### 3GUP067C Revise IDAS software procedures

A. Greengard made considerable progress in revising these procedures in January and February, but needs further input from software engineers, which probably will not be available until June. Estimated completion is June 10, 1992; see variances.

### Planning and Operations

3GUP032C Construct prototype IDAS instrument shelter (IIS)

R/P International Technologies began ordering materials for IIS about March 20 and expects to have the outer shell ready for the first inspection April 22 ± 6 days.

3GUP046C Procure/delivery microwave datacom

The requisition was forwarded to procurement in late February; no problems are expected from ISD or the procurement office. Delivery is expected mid-May.

3GUP035C Procure/deliver microwave datacom

As described in December-January reports, a change from microwave to UHF carrier promises to save money, installation, testing and operational effort, as well as reduce procurement difficulties. This change is only possible because of recent FCC changes in use of 932-941 MHz band, and cannot proceed without FCC approval. Application to FCC, including request for waiver to use point-to-point channel for multi-point communications, were forwarded to FCC on March 3. Prognosis uncertain; see variances.

### Variations

3GUP025C Integration and test design for software

M. Neil was unable to devote the time planned to this activity. Problems causing delay have been mostly eliminated, and he is now making good logical and physical progress, although documentation is behind schedule. This will delay activities 3GUP026C (Integration and test review for software) and 3GUP027C (Integration and test revision of software) and three subsequent activities, probably by three to six weeks. If R. Getzen or A. Greengard can assist him with documentation, some lost time may be recovered.

3GUP013C Development and module testing software-2

The start of activity 3GUP051C (Evaluation of IDAS prototype-2) has been delayed until May 11, and several subsequent activities will be delayed by two to seven weeks.

3GUP060C Write, review revise IDAS procedures

Although work has started on this activity, its completion will be delayed until about June 20, primarily because completion depends upon partial completion of 3GUP051C, which will not begin until mid-May.

3GUP063C Write/review/revise IDAS maintenance procedures

Completion of this activity depends upon evaluation of microwave datacom and IIS systems (3GUP036C and 3GUP033C), which are both significantly behind schedule. The five-month delays in procurement of these major systems were not anticipated. These procedures will probably not reach QA for review until November, so there probably will be significant delays in some FY93 activities.

3GUP067C Revise IDAS software procedures

Because activities 3GUP013C (Development and module testing software-2) and 3GUP025C (Integration and test design for software) are behind schedule, software engineers have been unable to provide A. Greengard with necessary input. Situation should be corrected in May.

3GUP035C Procure/deliver microwave datacom

Last year's attempt at procuring an integrated microwave-modern system, which is not normally available for multi-point configurations like exist here, resulted in a procurement dead-end. The procurement process necessary to obtain a guaranteed system seemed to be a difficult five-to-eight month process (restarting in January). The FCC recently announced

availability of a 932-941MHz band for shared government and commercial data communications, and off-the-shelf equipment for this frequency band seems well-suited, without modification, to the needs of this project. If frequency assignments can be obtained in this band, both time (months) and funds for procurement and intermediate testing, (\$30K - \$60K in communications equipment, and \$60K - \$120K in installation and operating costs) can be saved, but will experience unknown delays in obtaining frequency assignments. Both the NTS frequency coordinator and DOI frequency coordinator are pressing the FCC on behalf of this project. One or two field sites can be operated with the existing equipment, so the major concern is not physical communications with the prototype field sites in early FY93. Delays in developing appropriate procedures for installation, testing, and maintaining communications equipment cause concern.

3GUP061C Review QA, rewrite IDAS instrument procedures  
Start of this activity delayed by delays in completion of 3GUP060C, Write, review revise IDAS procedures (see above). Anticipated long-term impacts are negligible.

SCP 8.3.1.2.2.3.2d Air-permeability and gaseous-tracer testing 0G331252  
Summary Account Manager - G. LeCain

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUP003 Complete construction of first support trailer

The USBR has begun construction of the pneumatic control system for the support trailer. The boom system has been redesigned due to problems in supporting the packer system. The USBR has begun final design of the mass flow controllers housing and control panel that will be installed in the support trailer office.

3GUP005D Purchase parts/assembly of 12" packer system #1

The packers for use in the 12.25-inch packer assembly were received. The USBR can now begin manufacturing the interval pipe and also begin assembly work on the packer assembly.

3GUP010 Complete engineering drawings/assembly/test instr, packer

A USBR drafting technician has been assigned to work on the engineering drawings. Drawings for the 8-inch packer assembly are mostly complete and work has begun on the 12.25-inch system.

3GUP014D Expand hydrologic research facility calibration lab

The thermistor calibration system at the HRF was used successfully to calibrate the air permeability testing 10K ohm thermistors. The pressure transducers are presently being tested to determine if they should be operated in current mode or voltage mode. This must be determined before any adaptations to the present system are considered.

3GUP015D Technical procedure/pressure transducer calibration

The pressure transducers are being tested to determine if they are to be operated in current mode or voltage mode.

#### Quality Assurance

#### Planning and Operations

3GUP001 Purchase mass-flow control calibration system

Sierra Instruments was selected to provide a mass flow calibration system to be installed at

the HRF. Purchase of the first of two parts of the system is awaiting QA approval. Paper work for the second part (two bell provers) will be submitted upon QA approval of Sierra Instruments.

**3GUP011 Review/develop crosshole, single hole air injection**

A meeting between the PI and management to discuss the possibility of bringing on additional staff to adapt 3-D hydraulic methods to pneumatic testing was held. The general opinion, supported by all, was that a request for support should be made to the USGS research program to determine if the expertise is available.

**3GUP020 Purchase all measurement and DAS equipment**

A pressure transducer order was received. These pressure transducers will be used in monitoring intervals. Two lap-top computers for use in field testing were ordered.

**Variances**

**3GUP001 Purchase mass-flow control calibration system**

This purchase was delayed by uncertainties in funding and QA certification of the selected supplier. All obstacles have been dealt with and the planned finish is April 30, 1992.

**3GUP003 Complete construction of first support trailer**

Due to staff shortages the USBR is behind schedule. Additional staff has been made available and the new planned finish is June 30, 1992.

**3GUP005D Purchase parts/assembly of 12" packer system #1**

The USBR Purchasing department required considerably longer than anticipated to purchase the 12.25-inch packers. The packers have been received and the new planned finish is June 30, 1992.

**3GUP023 Graded QA and other QA requirements**

This activity is on hold until policy regarding the graded QA system is implemented. The new planned finish date is September 30, 1992.

**WBS 1.2.3.3.1.2.4 Percolation in the Unsaturated Zone - ESF Study**

Principal Investigator - B. Lewis

**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 8.3.1.2.2.4.1a Prototype testing of intact fractures 0G3312N2**

Summary Account Manager - G. Severson

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUS023J Journal paper, moire bench-mark and calibration**

The technical reviews of the draft entitled, "Implementation and Use of an Automated Projection Moire Experimental Set-Up" have been completed. Comment resolution remains to be addressed.

3GUS006A Continued moire projection; method development

Work continues to progress using image digitization and processing to look at moire fringes. Work with phase measuring interferometry (PMI), stereoviewing, and the transform analyses for replicating topographical surfaces (fast-Fourier transform (FFT) analysis and cosine transforms) continue to be studied.

The high-resolution video imaging board has been installed. Work has started using the hardware and software for data collection and presentation. The monitor for viewing real-time data does not have enough resolution to fully display the data collected. Several monitors are still being investigated for this use.

3GUS012J Complete journal paper-Moire automation

The technical reviews are complete and this draft entitled, "Projection Moire as a Tool for the Automated Determinations of Surface Topography" was returned to the HIP reports section and will be sent to Dr. Cardenas for comment resolution.

3GUS013J Complete journal paper; FFT Moire

Work on this draft continues.

3GUS014J Complete journal paper; Stereo viewing moire

Work on this draft continues.

3GUS004A Write open file report; intact fracture sampling

A draft has been started on this report.

3GUS014A Complete design fabricate low-pressure vessel

Previous drawings and notes regarding the vessel are being reviewed. Possible ways of funding the materials necessary are being considered.

Quality Assurance

Planning and Operations

Variances

3GUS007A Write technical procedure; moire calibration

There was no progress in March. A draft was started on this procedure. However, the methods developed since this activity was placed in the FY91 and FY92 PACS preclude the use of the original calibration during the set up of the equipment. Traceable, calibrated objects for the technical procedure are being investigated.

3GUS016J Complete design, radial fracture test vessel

This activity has not been started. This activity will be started when more details of the low-pressure vessel are complete.

3GUS001A Select analog site for fracture sampling

This activity has not been started. No funds for continuing and completing the fracture sampling aspects of the intact fracture test during FY92 are available. Approaches to completing this activity will be considered during the fourth quarter of FY92 with the proposed laboratory and field experiments and the funding necessary to complete this activity.

3GUS010A Continued development; axial fracture

This activity has not been started. See comments under activity 3GUS001A.

Work Performed but not in Direct Support of the Scheduled Tasks

Technical review of QMP-3.15, R0 and comment resolution. (8 hours)

Minor maintenance/repairs and clean up of Satec load frame. (3 hours)

SCP 8.3.1.2.2.4.2a Prototype infiltration (percolation) testing 0G3312O2

Summary Account Manager - F. Thimir

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUS101B Conduct imbibition experiments on small samples

Finished one imbibition experiment on a core sample. The test started on February 5 and ended on March 9. The sample was welded tuff (diam. = 53 mm; length = 127 mm). This test was designed to study the effect of fracture mineral coating on the water imbibition process. Approximately 10 cubic cm of water were imbibed into the sample through an area of 22 squared cm during 30 days. No other tests were made during this month because three computers, which are used to collect data in the laboratory, malfunctioned during this period.

3GUS002B Conduct ponding test on large block first stage

The ponding test, which was started on October 28, 1991, continues. The water front has moved about 40 to 45 cm in the fractures and 5 to 10 cm in the matrix surrounding the fracture. The water movement in the fractures is not as fast as originally expected. Eight out of the 18 thermocouple psychrometers are showing an increase in water potential (and saturation). The potential level is still detectable with the psychrometers. Therefore, this stage will continue longer than originally expected.

3GUS026B Prepare data report of large block ponding test

Data is being collected, indexed, backed-up, and archived on computer disks. The data include water potentials, electrical resistance, and time-domain reflectometry to estimate water saturation within the block.

3GUS010B Construct equipment for final stage of pond test

Construction on this stage started. A water spraying system is being constructed and tested. The system will allow controlling water pressure and flow rates which will be used to apply constant water pressure or constant flow rates on the large block.

Quality Assurance

Planning and Operations

Variances

3GUS002B Conduct ponding test on large block first stage

The water front in the fracture network of the welded tuff block is not moving as fast as originally expected. The tentative finish date is revised from March 31 to May 31, 1992. It is also anticipated that the second stage of the ponding test (activity 3GUS007) will not last as long as originally expected, which was three months. The second stage may be bypassed and only data from the fractures and the matrix immediately surrounding the fractures will

be collected. A tentative duration of the second stage will be reported next month.

#### 3GUS035B Measure rock sample hydrologic properties

Originally this set of measurements was scheduled to be made at the matrix hydrologic properties laboratory in Nevada. However, the laboratory staff were not able to make the measurements because they were busy conducting other similar tests. This delay will not affect the final finish date since the completion of this activity is linked with the large block ponding experiment which is delayed as described in activity 3GUS002B (Conduct ponding test on large block first stage).

#### 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-emplacment 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 0G3312W2 Summary Account Manager - M. Chornack

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GGP06A Tabulate and analyze data

Deficiencies in the gaseous-phase circulation study were discovered during an internal USGS audit. As a result of the audit, YMP-USGS-CAR-92-04 was issued on this study. All data collection and analysis activities are suspended pending resolution of the items listed in the corrective action report.

##### 3GGP17A Continue progress report air flow and gas chemistry

Due to the corrective action report, work on this activity is temporarily suspended.

##### 3GGP07A Develop and complete technical procedures

Existing air-flow measurement and gas-sample collection techniques are being evaluated. If needed, additional technical procedures will be completed for this activity when the evaluation is finished. Revisions will be made to existing technical procedures, if necessary.

##### 3GGP19A Conduct and complete technical procedure training

When new personnel are assigned to the gaseous-phase circulation study, technical procedure training will be conducted prior to their performing any work related to this project.

#### Quality Assurance

#### Planning and Operations

#### Variances

##### 3GGP06A Tabulate and analyze data

Temporary suspension of work on this activity.

Cause: USGS audit resulted in corrective action report, YMP-USGS-CAR-92-04, being

issued.

Impact: Level 3 milestones are negatively impacted by this departure from the original schedule.

Corrective Action: Issues raised in the corrective action report are being resolved. Some items listed in the corrective action report have been resolved.

#### 3GGP08A Backlogged data

Preliminary review and compilation of the air-flow data and gaseous-phase chemical data from boreholes UZ-6, UZ-6s, and selected neutron-access boreholes will begin during March.

Cause: Compilation, checking, and submittal of backlogged air-flow and gas-phase chemical data from UZ-6, UZ-6s, and selected neutron-access boreholes has been delayed because of lack of staff.

Impact: Qualification of data and outyear level 3 milestones are negatively impacted, but workarounds are still possible.

Corrective Action: replan schedule and obtain additional staff; in progress.

#### 3GGP002A Collect UZ borehole data

Periodic gas sampling and/or air-flow measuring may be conducted at selected UZ boreholes.

Cause: The need to collect additional UZ borehole data during FY92 is being evaluated.

Impact: Level 3 milestones are negatively impacted by this departure from the original schedule.

Corrective Action: None anticipated at this time.

#### 3GGP04A Chemical analysis of gas samples

Future chemical analysis of gas samples collected from UZ boreholes is dependent upon whether or not additional gas samples are collected.

Cause: The need to collect additional UZ borehole data during FY92 is being evaluated.

Impact: Level 3 milestones are negatively impacted by this departure from the original schedule.

Corrective Action: None anticipated at this time.

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

Participated in USGS audit and resolution of deficiencies reported in YMP-USGS-CAR-92-04.

#### 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)

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

3GUH066B Prepare UZ1 gas samples for analyses FY92

All UZ1 gas samples collected during the FY92 field trip in January have been processed.

3GUH012 Perform leak and pressure tests on UZP6 packers

The prototype packer was inflated in 12-1/8" steel pipe in the laboratory. This was tested for water and gas leaks at various pressures. 20 psi was found sufficient to stop water movement past the packer bladder element. 35 psi bladder pressure was sufficient to stop tracer gas movement between the packer-bladder element and the steel pipe wall. This was accomplished by injecting the tracer gas, 1 ppm SF<sub>6</sub>, at the top of the packer at 15 psi. The leakmeter was placed at the other end of the packer for leak detection.

3GUH044B Prepare WRI/OFR, on UZ1 data 1984-1991

I. Yang is writing this report. The report consists of an introduction, description of the test hole, method of sampling and analysis, data and interpretations, and conclusions. The introduction section was completed.

3GUH067B Analyze UZ1 gas samples 1992

Fifteen (15) condensed water vapor samples collected during the FY92 gas sampling field trip are being analyzed in the LKB Quantulus low level liquid scintillation counter in the UZ hydrochemistry laboratory.

No results have yet been received for C<sup>14</sup> or C<sup>13</sup>/12C analyses.

### Quality Assurance

3GUH019B Develop technical procedures, portable GC, SF<sub>6</sub> meter

A technical procedure entitled, "Method for Analysis of a CO<sub>2</sub> Gas Sample Using a Summit Interest SIP 1000 Gas Chromatograph" has been written by J. Ferarese and submitted to the QA office for technical and QA review.

A technical procedure entitled "Method for Analyzing the Concentration of Gasses with an Ion Track Instrument, Leakmeter 120" was written and submitted for review.

### Planning and Operations

3GUH070B Procure lab chem, labware, and field apparatus

Three CO<sub>2</sub> gas standards and two high pressure regulators have been received. These gas standards will be used to calibrate micro-carbon-dioxide electrodes used in analysis of dissolved CO<sub>2</sub> in water samples.

3GUH037B Procure GC and DAS

A Chrompac model CP-9000 gas chromatograph and data acquisition system to include thermal conductivity detector, flame ionization detector and electron capture detector has been ordered through REECo.

3GUH036B Procure 10 kw generator for gas sampling support

A capital equipment procurement request was submitted but was returned with instructions to procure through USGS requisition instead of through REECo. A requisition was retyped

into USGS format and submitted for procurement.

3GUH010 Fabricate UZP6 multi packer string (USBR)

One segment of a prototype packer has been completed and tested. The packer is for use in UZ-16 gas sampling. A string of eight packers for the system will be constructed by June 1, 1992.

3GUH025B Outfit mobile lab with GC, IC, degassing rack  
The mobile lab is still involved in REECo purchasing.

The degassing rack to be mounted inside the mobile lab is under fabrication.

Variances

Work Performed but not in Direct Support of the Scheduled Tasks

P. Striffler traveled to NTS to work as USGS site representative on drilling of neutron access test hole N-17. (40 hours)

Prepared scientific notebook plan for packer use at UZ-16. (16 hours)

Prepared scientific notebook plan for sealing core recovered during UZ-16 drilling. (16 hours)

SCP 8.3.1.2.2.7.2 Aqueous-phase chemical investigations 0G3312Y2  
Summary Account Manager - I. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUH009A Analyze/extract core and water, UZ4, 5, 6s boreholes

The gas chromatograph was used to determine percent CO<sub>2</sub> concentration, part per million CH<sub>4</sub> (Methane) and part per million SF<sub>6</sub> (Sulfur Hexafluoride) of pore gas from squeeze samples:

From Core UZ4 - 48 samples.

From Core UZ5 - 33 samples.

3GUH01AA Compile raw data UZ4,5,6s, and UZP through May 1991

A Lotus file has been set up and input of chemical analysis results to the file has begun.

Quality Assurance

3GUH17A Train staff on analysis technical procedures

J. Ferarese trained G. Rattray and P. Striffler on the operation of the in-house gas chromatograph in the UZ hydrochemistry laboratory.

Planning and Operations

3GUH010A Procure refrigerator for core cold storage

A core storage refrigerator was received.

3GUH018A Procure ion chromatograph and DAS

A Dionex Corporation Model DX-100 ion chromatograph and data acquisition system to include anion and select cation analysis capabilities has been ordered through REECo.

3GUH015A Procure "Seamist" fracture-water collector

A meeting has been held with Seamist personnel. Requirements for the collection of fracture water in surface-based boreholes were discussed, and they are preparing a proposal.

#### Variances

3GUH14AA Collect core from UZN-27

Cause: Hole has not yet been started.

Impact: None.

Corrective Action: None.

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

Technical procedure HP-194, R0 was revised and updated in September 1991 by author J. Ferarese. This month the author addressed the technical review comments and submitted the HP to the QA office for further processing. (4 hours)

J. Ferarese is conducting an experiment which will examine the use of teflon vials for liquid scintillation counting of carbon-14 samples in the Quantulus LKB liquid scintillation counter. Counting performance will be determined and compared to that of other counters. A first experiment was completed but yielded results which were not expected. A similar study using a different size vial will be conducted and results compared to the initial results. (24 hours)

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

Principal Investigator - E. Kwicklis

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 0G3312T2

Summary Account Manager - E. Kwicklis

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GUF0021 Revise scoping calculations of percolation test

Major revisions in the organization and technical content have been made in this report as a result of USGS technical review. Major portions of the report have been rewritten, additional figures drafted and additional simulations performed.

3GUF015 Document variable aperture model VSFRAC

Several major sections in the documentation for VSFRAC were completed including those dealing with the governing equations, particle tracking methods and review of important previous work.

3GUF0051 Scoping and bounding calculations-FY92

Steady flow within a network of five 125 micron and four 25 micron fractures was simulated for constant head boundary conditions ranging from 0.0 to -0.25 m of water in order to examine the dependence of pressure head variation and flux distribution within the network to the assigned boundary conditions. It was observed that variance in pressure head within the network increased and flow became more concentrated along specific pathways as

pressure heads imposed at the boundaries deviated from the pressure heads at which the transmissivities for the two fracture sizes were equal. Continuum properties such as permeability were calculated for the network. Future simulations will consider the effects of various matrix materials on the observations made to date.

#### Quality Assurance

##### Planning and Operations

3GUF001 Resolve study plan comments (DOE and NRC)

All comments by DOE and its contractors have been resolved to the satisfaction of the reviewers except those made by K. Kersch (SAIC/LV). A meeting will be held with Kersch in early April to discuss his two unresolved comments.

##### Variances

3GUF0021 Revise scoping calculations of percolation test

This activity is behind schedule because revisions are incorporating new work that represents a far more sophisticated understanding and modeling approach than was described in the original report. The revisions thus attempt to reflect advances that have been made in modeling since the report was submitted for review.

3GUF0001 Develop graded QA package

This activity did not begin as scheduled because the investigator responsible for this work is a new hire and has not yet reported for duty.

#### SCP 8.3.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock 0B3312T2

Summary Account Manager - G. Bodvarsson

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUF002L Complete dual porosity code

The semi-analytical dual-porosity simulator has been used to study vertical infiltration into fractured tuff formations, using characteristic curves for the fractures derived by Pruess et al. (LBL Report 20778, 1988).

3GUF08L Sorptivity/character curve analysis

The new analysis method is being written up in a technical report.

3GUF005L Prepare paper for RWMNFC journal

A draft of a paper entitled "Accuracy and Efficiency of a New Dual-Porosity Simulator for Flow in Unsaturated, Fracture Rock Masses", by R. Zimmerman, G. Bodvarsson and E. Kwicklis has been completed for eventual submission to the journal *Radioactive Waste Management and the Nuclear Fuel Cycle* (Special Issue on Yucca Mountain).

#### Quality Assurance

3GUF006L Prepare paper for 1992 IRLRMN conference

QA materials for the paper entitled "Semi-Analytical Treatment of Fracture/Matrix Flow in a Dual-Porosity Simulator for Unsaturated Fractured Rock Masses", by R. Zimmerman and G. Bodvarsson have been prepared for transmittal to the USGS after publication in the conference proceedings in April.

3GUF007L Continue software QA and all other QA requirements

G. Bodvarsson, E. Klahn, L. Tsao and R. Zimmerman attended a class in records management (QMP-17.01, R5) given on March 25 at LBL by L. Watt (SAIC/Golden), with L. Ducret of the USGS as an observer.

Reading assignments were completed by various staff members.

#### Planning and Operations

#### Variances

### WBS 1.2.3.3.1.2.9 Site Unsaturated Zone Modeling and Synthesis

Principal Investigator - M. Whitfield

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 0G3312C2

Summary Account Manager - B. Lewis

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GUM05A Construct 2-D cross-section model using TOUGH

LBL modelers are utilizing current USGS geologic and hydrologic data from neutron boreholes in the construction of a 2-D cross-section model using TOUGH. When the model has been completed, it will be used to conduct sensitivity analyses to identify important hydrologic parameters and to begin to investigate grid effects on moisture flow.

3GUM014A Develop alternative conceptual models of UZ

A working set of alternative conceptual models for the UZ hydrogeological system have been identified.

##### Quality Assurance

##### Planning and Operations

3GUM06A Study plan revision and resolution of comments

LBL modelers are responding to the technical review comments for Study Plan 8.3.1.2.2.9. E. Kwicklis will provide the review of the response prior to transmittal to YMPO for DOE verification.

##### Variances

SCP 8.3.1.2.2.9.2 Selection, development, and testing of hydrologic-modeling computer codes 0B3312D2

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM17A Develop alternative conceptual models of UZ

Data on porosity and permeability measurements on small plug samples by A. Flint and others were reviewed.

Quality Assurance

3GUM18A Grading of QA and other QA requirements

G. Bodvarsson and L. Tsao attended a class in records management (QMP-17.01, R5) given on March 25 at LBL by L. Watt (SAIC/Golden), with L. Ducret of the USGS as an observer.

Reading assignments were completed by various staff members.

Planning and Operations

3GUM14A Study plan revision and resolution of comments

Responses to the study plan comments are being prepared.

Variations

SCP 8.3.1.2.2.9.3 Simulation of the hydrogeologic system 0B3312E2

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM11B Preparation of paper for ANS conference

Some of the figures included in the ANS paper were designed in color for presentation at the April conference.

3GUM01B Data compilation and analysis

A meeting between R. Spengler and his staff has been scheduled in April in order to use the logging data to refine the current subdivision of the hydrogeological units into sublayers. The main compilation and analysis of the data for the design of the site-scale model has been completed. This completes this task.

3GUM03B Perform preliminary simulation of moisture-flow model

In order to facilitate the check of the 3-dimensional grid, the surface of the site-scale model has been divided into three zones, depending on the types of horizontal connections between the elements. These are (1) regular elements without any contact with fault elements, (2) fault elements connected to another element that may or may not contain a fault, and (3) elements without fault, but connected to a fault element. The connections between the group 1 elements have been checked and the connections between groups 2 and 3 are being verified. Simulations with a 2-D cross section have started in order to assess the effect of the numerical grid by the Ghost Dance Fault.

3GUM07B Evaluate model grid effects

A new regular grid has been developed and is being used to test the feasibility of using the

TOUGH2 simulator and the IBM 6000 RISC machine to solve an unsaturated flow problem with a large number of elements (8000).

3GUM12B Preparation of paper for WMNFC  
Work related to the resolution of the structural discontinuities is being included in the paper.

#### Quality Assurance

3GUM14B Grading of QA and other QA requirements  
G. Bodvarsson and L. Tsao attended a class in records management (QMP-17.01, R5) given on March 25 at LBL by L. Watt (SAIC/Golden), with L. Ducret of the USGS as an observer.

Reading assignments were completed by various staff members.

#### Planning and Operations

3GUM13B Study plan comment resolution and revision  
The responses to the DOE comments are being prepared.

#### Variations

### WBS 1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization

#### Activities

Principal Investigator - B. Lewis

#### 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 0G3312I2

Summary Account Manager - G. LeCain

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUT002 Continue reduction and examination of ALTS Arizona

All ALTS data have been reduced to engineering units. The data are presently being examined to evaluate equipment performance and stability. A possible problem identified from the data is the variability in the pressure transducers. The atmospheric pressure readings show more range than expected.

3GUT003 Continue analysis of ALTS data

The ALTS data are 60% through the final analysis. Analysis shows that the geometry of the tests changes with time and distance. The earlier data show pure radial flow, while the later data show leaky-radial flow and the later data from the monitoring zones show spherical flow.

#### Quality Assurance

#### Planning and Operations

## Variances

Prototype Tracer Testing OG3312J2  
Summary Account Manager - I. Yang

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GUT011D Procure supplies for monitoring gas tracer at NTS

Two meetings were held in Las Vegas with representatives from USGS, RSN, and REECo, and a final design for the gas tracer monitoring system was approved. The monitoring system will be provided by a contractor selected through competitive bid; REECo will purchase the system from the approved contractor. All supplies to be provided by USGS are on hand.

3GUT009D Procure lab supplies for gas tracer tests

Improvement to the system design was accomplished by redesigning the connections between the glass column and manifold. The modified column and manifold design were received on March 24. All lab supplies for the gas tracer tests are on hand.

3GUT03DD Prepare WRI report on aqueous tracer tests

The manuscript was sent to the author, A. Lewis-Russ, for checking retyped copy.

3GUT13DD Conduct tracer gas sorption test on stem materials

Work on the tracer gas sorption tests was temporarily delayed while the final design, acquisition, and installation of the gas tracer monitoring system was coordinated and approved by representatives from USGS, RSN, and REECo. Priority was given to completing the details of the monitoring system since its operation will be required at least six months prior to the use of the stemming material.

3GUT01DD Conduct tracer gas sorption tests on tuffs

See "Conduct tracer gas sorption test on stem materials" (3GUT13DD) above.

3GUT012D Test on-line gas tracer monitoring equipment

Testing cannot start until the equipment has been procured and installed. See "Design method for monitoring tracer gas at NTS" (3GUT011D) above. A scientific study plan, entitled "Injection of a Tracer Gas Used for Determining Atmospheric Contamination in a Dry-Drilled Borehole," and a technical procedure, entitled "Method for analyzing the concentration of gasses with an Ion Track Instrument Leakmeter 120," were written in support of this activity.

#### Quality Assurance

#### Planning and Operations

#### Variances

3GUT13DD Conduct tracer gas sorption test on stem materials

**Cause:** Priority was given to coordinating the final design, acquisition, and installation of the gas tracer monitoring system at NTS. Drilling is scheduled to begin in April; the monitoring system is needed during drilling while the stemming material will not be used until November at the earliest.

**Impact:** None, since the tests will be completed months before the stemming material is

used in the borehole.

Corrective Action: None; testing will proceed in April and be completed months before the stemming material is used in the boreholes.

Work Performed but not in Direct Support of the Scheduled Tasks

Attended WRD class "Isotope Hydrology". (40 hours)

Prepared graphs and slides for a presentation by I. Yang at the High-Level Waste Management Conference meeting in Las Vegas, April 12-16. (8 hours)

Prototype Dry Coring of Rubble 0G3312L2

Summary Account Manager - C. Peters

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT03FF Complete preparation of report on G-Tunnel work

Sections on lab work, chemistry results, introduction, and description of work have been completed. Sections on excavation and effects of blasting are being written. First draft completion expected by mid-May.

3GUT01EE Complete testing effects of core sealing method

All core weights (86 cores) were measured.

A control piece of Lexan was placed in a cooler to determine if condensation is caused by moist atmospheric air in the liner or the core moisture. This test is ongoing.

3GUT02EE Reduce data for effects of coring methods

Tabulation of chemical results from the cores progressed.

3GUT004F Develop technical procedures on core sealing

A scientific notebook plan has been prepared to utilize information gleaned from UZ-16, UZN-27, and NRG-1 to update the draft copy of the technical procedure.

3GUT016F Conduct technical procedures training on core sealing

Core sealing procedures have been discussed with SMF staff. UZ-16, NRG-1 and UZN-27 will be used as SMF staff training holes.

3GUT03FF Prepare report for effects of core sealing

An annotated outline was prepared.

3GUT07FF Develop technical procedure on rubble coring

Prepared outlines for the technical procedures.

Quality Assurance

Planning and Operations

Variations

3GUT03FF Complete preparation of report on G-Tunnel work

Cause: Report not completed. Report draft should be completed by mid-May.

Impact: None.

Corrective Action: None.

Prototype Pore-Water Extraction 0G3312M2  
Summary Account Manager - I. Yang

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GUT026G Complete WRI report

Editing of the text of the report is complete for colleague review. Presently, the figures are being modified for review. It is planned to submit the report for colleague review during the month of April 1992.

The finish has been delayed due to the lapse of, and problems with renewal of, the IPA with the Colorado School of Mines.

##### 3GUT029G Ext/analyze pore water-use high pressure cell, UZ welded

Eight tests were conducted on welded and partially welded tuffs with moisture contents ranging from 5 to 22 percent. The loading method was continuous for some samples and staged for some. Staged versus continuous compression give similar results in strain and water obtained for nonwelded tuffs, but data is incomplete for welded. Additional tests are required.

##### 3GUT020G Procure and construct additional high pressure 1-D cell

Heat treatment of the components caused the material to become too hard to machine to finished specifications. The material has been sent back for solution annealing. The parts will then be finished and heat treated. This additional procedure has delayed the completion of the test cell.

##### 3GUT034G Complete development of compress method extract water

Two comparison tests were run between nonwelded core samples and nonwelded rock chips from nearly the same interval. The chips had an average moisture content of 9.7 percent and produced an average of 15.8 ml of water and 125.5 ml of gas. The similar core averaged a moisture content of 8.6 percent and produced an average of 1.8 ml of water and 90.1 ml of gas.

##### 3GUT018G Procure/develop data acquisition software

Labtech Control displays are being configured and set up to acquire data from the load frame. The data acquisition board requires additional programming before system is operational.

##### 3GUT002G Complete ext/analysis chemistry of pore water, UZ4, 5, 6 and GT

Distillation and oven dried volume of water extracted were added to the data base. Moisture contents and saturation/success values were corrected, using calculated moisture contents based on total volume of water extracted.

Water was extracted from seven UZ cores (6 nonwelded, 1 partially welded) with moisture contents from 4.6 to 14.2 percent using the second generation cell. Results obtained 0-18.3 ml of water per sample (success of 0-44.9 percent) and 58.2-112.8 ml of gas per sample.

##### 3GUT031G Prepare journal paper on 1-D compression

A paper entitled "A Preliminary Study of the Chemistry of Pore Water Extracted from Tuff

by One-dimensional Compression" by C. Peters, J. Higgins, P. Burger and I. Yang was submitted for publication.

3GUT006G Modify high-press cell tech procedure  
Information that varies between the high pressure cell and 1-D compression procedures has been collected from two major cell users.

3GUT027G Submit WRIR triaxial and 1-D methods review and approval  
This report will be submitted for review in mid-April, 1992.

#### Quality Assurance

#### Planning and Operations

#### Variances

3GUT029G Ext/analyze pore water-use high pressure cell, UZ welded  
Cause: One month delay due to the results being inconclusive, additional testing is required.

Impact: None.

Corrective Action: None.

3GUT020G Procure and construct additional high pressure 1-D cell  
Cause: Heat treating of material is delayed one month.  
Impact: Although the specifications for the heat treatment were identical to the treatment done on the original second generation cell, the material became too hard to machine.  
Corrective Action: The material is to be solution annealed, machined to unfinished specifications, heat treated again, and finished to specifications. Assurances were made that no changes to the physical properties would result from this process.

3GUT026G Complete WRI report  
Cause: One month delay due to the lapse of the Colorado School of Mines contract from October 1991 to February 26, 1992.

Impact: None.

Corrective Action: None.

3GUT037G Compression of UZP-6 core pore water extraction  
Cause: Three month's delay from original schedule caused by the change in the drilling schedule.

Impact: No UZP-6 core; replace activity with UZ-16 core.

Corrective Action: None.

3GUT034G Complete development of pressure method to extract water  
Cause: One month delay due to inconclusive results.  
Impact: None, the UZ-16 drilling is not likely to start until June, 1992, due to the lack of a tracer permit.

Corrective Action: For the squeezing of rock chips, if technical procedures are not ready, scientific notebook procedures will be used.

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

A second load frame (in Bldg. 56) and its testing room are being cleaned up for use as soon as the second data acquisition system and second high press cell are completed. (24 hours)

Laboratory supplies for one-dimensional tests were ordered including: pH sampling sheets, conductivity calibration set, syringe filters, Nalgene sample bottles, nylon ferrules, tube unions, male connectors, tube adapters, and 3-way stopcocks. Tube adapters and conductivity calibration set have yet to arrive. (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 - R. Luckey

#### 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 8.3.1.2.3.1.2 Site potentiometric-level evaluation 0G3313E2

Summary Account Manager - R. Luckey

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### 3GWF005A Begin 1992 water-level data collection

Three wells are being monitored on a quarterly basis; 15 zones in 15 wells are being monitored on a monthly basis; 21 zones in 13 wells are being monitored on an hourly basis; continuous analog data is being obtained on four zones of two wells (included in count on hourly sites); real-time data is being obtained on nine zones in six wells using satellite data-collection platforms (included in count of hourly sites); the status of the network is being evaluated at the end of each month and recommendations are being made for instruments that should be watched, calibrated, or replaced; and real-time data is being monitored on a daily basis looking for water-level excursions.

Replaced and calibrated transducers at the following wells: UE-25b #1 (lower), USW H-1 (tube 1), and UE-25 WT #13.

Calibrated transducers at the following wells: USW WT-2, USW G-3, USW H-5 (lower) and USW H-6 (lower).

Removed barometer S/N 19236 from well USW H-5 for calibration.

Well UE-25 WT #13 was converted to real-time system.

HP-60, R1, Method for monitoring water-level changes using pressure transducers, was transmitted to the QA office for review on March 24.

Backlog of data from data-collection platforms, dumped onto diskettes, was prepared for transmittal to Denver.

Packers were placed in the lower zones of USW H-5 and USW H-6 to allow monitoring of formation pressure, as opposed to water level.

C. Savard made a number of water-level measurements in wells UE-29a #1, UE-29a #2 (part of quarterly network) and UE-29 UZN #91 to look for possible effects of recent rainfall and runoff events in the Fortymile Wash area.

3GWF41AA Continue preparing 1989 water-level data report

The report "Water levels in continuously measured wells in the Yucca Mountain area, Nevada, 1989" by D. Lobmeyer and R. Luckey has been written and reviewed. No progress was made on this task this month because of one remaining author to other tasks.

3GWF20AA Continue analysis of water-level trends

G. O'Brien continues to spend time looking at barometric, earth-tides, and seismically induced water-level fluctuations. He continues to confer with D. Galloway (USGS/California District) on the methodology.

E. Ervin began investigation of long-term water-level trends. If this analysis does not warrant a report of its own, the results will be reported in the revised potentiometric-surface map.

R. Luckey presented response of water-level network to December seismic events at TPO meeting in Las Vegas on March 6.

3GWF18AA Continue study of accuracy and precision of water-level data

Work continued on draft report "Precision and accuracy of water-level measurements taken in the Yucca Mountain area, Nevada, 1988-90" by S. Boucher. Most reviewer comments have been resolved and the text is being revised. Little progress was made on this task this month as the author spent most of her time this month participating in or preparing for audits.

3GWF117A Convert HP-196T (notebook)

S. Boucher completed a first draft of technical procedure HP-196, "Use of Data Collection Platforms to Collect Water-Level Data" and PI reviewed it and made some suggestions for revision. G. O'Brien completed task of preparing model logbook entries as an attachment to the procedure. Such models should avoid past problems that occurred because of incomplete entries. Little progress was made on this task this month as the author spent most of her time this month participating in or preparing for audits.

3GWF024A Reduce 1991 periodic water-level measurements

Manual measurements were worked up for about one-half of the wells.

3GWF42AA Complete 1990 water-level data report

Regression analyses were done for all transducer calibrations for 1990 and results were compiled into tables suitable for inclusion in the report. Compilation of transducer histories was nearly completed.

3GWF006 Convert six sites to DCPs

Well UE-25 WT #13 was converted to a data collection platform and went online on March

19 with minimal problems.

Well USW WT-2 was in the process of being converted to a data collection platform on March 31. Indications are that it will be online in early April.

3GWF027 Evaluate quality of 1991 transducer data

Data has been continuously evaluated through 1991 and plots are available for a more formal evaluation. No other work has been performed on this task.

3GWF026 Reduce 1991 transducer calibrations

Transducer calibrations were worked up for about 75 percent of the calibrations done during 1991.

3GWF116A Replace current software with NWIS

All continuous water-level monitoring sites will be converted to data collection platforms by late spring. This conversion will make use of National Water Information System (NWIS) software easier. For efficiency, current software will be used on non-DCP sites until they are converted. NWIS software is currently being used to edit data coming from DCP sites.

#### Quality Assurance

##### Planning and Operations

3GWF006 Convert six sites to DCPs

Twelve trailers, to be used as data collection platform shelters were received from the manufacturer.

3GWF129A Develop software QA for data reduction

The technical contact for this software retired in September. G. O'Brien has been designated as the new technical contact for this software but was instructed not to spend time on this activity until the outcome of 3GWF037, Research NWIS software, is known. It is strongly suspected that this task can be better accomplished in the future using NWIS software.

##### Variances

3GWF117A Convert HP-196 for satellite platforms

This is delayed one month because the process is taking much longer than expected. There is no impact, because HP-196T is adequate until HP-196 is approved.

3GWF006 Convert six sites to DCPs

This is delayed an additional two months because of the late delivery of trailers and delays in installation. No impact as data is being collected by data loggers during conversion process.

3GWF18AA Continue study, accuracy/precision, water levels

This is delayed one month (has been delayed previously). This study, while important, is conducted as time permits and the amount of time available has been seriously underestimated as person working on this study has had to spend much time working with other projects. There is no impact because nothing in the foreseeable future depends on this study. The delay is limited because study is near completion, but further delay is possible.

3GWF20AA Continue analysis of water level trends

This is delayed six months, partially as a result of decision to report this analysis when revised potentiometric map is produced. There is no impact because this analysis is only needed to complete this map.

Work Performed but not in Direct Support of the Scheduled Tasks

S. Boucher gave QA support to various activities preparing for and during audits to address and remedy several potential problems. She also spent time evaluating QA and organizing QA support for eight other groups of activities. She issued, worked on, closed, or helped verify a number of NCRs for other projects. (45 hours)

R. Luckey spent considerable time on tasks related to saturated zone and Quaternary/future regional hydrology tasks. (120 hours)

R. Luckey delivered files and graphs so that the manuscript preparation unit could prepare camera-ready copy for the 1985-88 continuous water-level report. PACS activity for that report was stashed as complete several months ago with delivery of the report to DOE for their concurrence. (30 hours)

SCP 8.3.1.2.3.1.3 Analysis of single- and multiple-well hydraulic-stress tests 0G3313F2

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF005D Monitor strain-related pressure response in wells

The six month (October 1991 to March 1992) activity of strain-related monitoring (monitoring for the hydraulic effects of atmospheric loading, earth tides, earthquakes, and UNEs) was 100% completed. (The data will now be analyzed to obtain aquifer characteristics).

3GWF010D Develop scientific notebooks/hydrologic procedures for monitoring hydraulic changes from seismic stress

HP-221T and HP-222T were approved on March 13. This activity is now 100% complete.

3GWF001D Finish intraborehole flow and stress test report

Starting on March 1, G. Patterson's time has been dedicated, almost 100%, to the task of completing the draft of the report. The planned completion date of the report has been moved to July 1, 1992. The completion date is assumed here to be the date of approval by the TPO, preceded by colleague and supervisory reviews, and followed by the simultaneous submittal of the report to the YMPO for concurrence, and to the USGS/WRD regional/headquarters review process for Director's approval.

3GWF002D Reanalyze past c-hole aquifer tests with advanced techniques

A. Geldon has applied a dual-porosity technique to analyze some previously-completed aquifer tests at the c-holes. He has written up his analysis in the form of an internal report. He is considering eventually converting this internal report into a journal article.

Quality Assurance

3GWF011D Develop software QA for analysis programs under the 8.3.1.2.3.1.3 activity

The main code that needs software QA is the well test analysis program. This program is needed to analyze previously completed hydraulic tests at the c-holes. It was determined

that G. LeCain of the HIP is also using the program and will be the person primarily responsible for entering it into the software QA system. This activity should be considered 100% completed by the end of March, because it feeds into the successor activity 3GWF012D, "Continue development of software QA for account 8.3.1.2.3.1.3 programs".

### Planning and Operations

#### Variations

##### 3GWF001D Finish intraborehole flow and stress test report

The author of the report, G. Patterson, had been, until the beginning of March, working on a variety of project tasks, while also trying to finish the report. As a result, completion of the report has been delayed several times. Starting with March 1, the PI has dedicated Patterson's time 100% to finishing the report. There is no anticipated negative impact on other activities as a result of the delay in completion of this report.

#### SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0G3313G2

Summary Account Manager - M. Umari

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GWF002F Run power and obtain permits for hydraulic tests at the c-holes

A criteria letter has already been written and forwarded to the YMPO to initiate the job package needed to construct the power line. This is all the work that was intended to be accomplished under this activity. The activity now should be considered 100% complete. (Permits needed are to be secured by the YMPO's Project and Operations Control Division).

##### 3GWF003F Purchase additional packers/materials for third 3-zone packer string

The USBR issued all the requisitions for purchase of the additional components to complete this task. This activity now should be considered 100% complete.

##### 3GWF106F Refine and add modules to aquifer test analysis program

The program in its present form is adequate for reanalyzing past c-hole aquifer tests, which is successor activity 3GWF003F. The program is going to be entered into the software QA process (which is part of successor activity 3GWF017F) in its present form. This activity, therefore, now should be considered 100% complete.

##### 3GWF018F Oversee LBL preparation for cross-hole seismic work

A. Geldon had given E. Majer copies of recently prepared hydrogeologic sections for the c-holes (see February 1992 status report) to aid him in the upcoming cross-hole seismic surveying.

USGS completed its part in the preparations to initiate the cross-hole seismic surveys. These included design and construction (the latter through the USBR) of two tripods needed to hoist the seismic tool cables with, arranging for diesel fuel to be delivered to LBL's logging truck during the seismic surveys at the c-holes, and coordinating with LBL on the rental of a generator to be used while conducting the surveys. What is left is to actually conduct the surveys, which is LBL's activity 3GWF03C, "Develop cross-hole seismic profile". The present USGS activity, 3GWF018F, should be considered 100% complete.

3GWF027F Preliminary numerical/analytical modeling to assist in cross-hole test design

During the week of March 2-6, M. Umari, A. Geldon, and G. Patterson attended the class "Fluid Flow and Solute Transport in Fractured Rocks", coordinated by P. Hsich. The appropriate techniques to be used to interpret results from the upcoming tests, and to do pre-test design simulations, were discussed in the class.

Related activities that had been described under previous monthly reports are: A. Geldon's synthesis of various borehole logs to obtain a composite picture of hydraulically-conductive fracture locations in the c-holes (this indicates locations to place the packers during the cross-hole tests), and Geldon's analysis of previously-completed aquifer tests at the c-holes using dual-porosity techniques (monthly report for activity 8.3.1.2.3.1.3).

This activity will be continued through the successor activity 3GWF028F, "Continue preliminary numerical/analytical modeling to assist in cross-hole test design". The present activity, therefore, now should be considered 100% complete.

3GWF020F Construct two 3-zone packer strings

The USBR has completed all major work items for the construction of the two 3-zone packer strings. (The final assembly awaits the return of the 12 packers from Tam International after repairs are completed on them to ensure that they deflate properly). This task now should be considered 100% complete. It leads to activity 3GWF004F, "Complete construction of third 3-zone packer string", starting April 1, 1992.

3GWF021F Oversee field simulation of cross-hole tests

This activity encompasses all work related to the U.S. site (Raymond Quarry, near Fresno, California) of the DOE/AECL international project. It is intended that the planned hydraulic and tracer tests planned for the c-holes be prototyped at the Raymond site.

During the week of March 9, three 250-ft. deep boreholes were drilled at the Raymond site. The boreholes were configured in a triangle similar to the c-holes, with a distance of 25 feet between each pair of wells. M. Umari from the USGS was present during the drilling.

During the week of March 30, preliminary hydraulic testing was conducted at the Raymond site using the newly drilled holes. Well (O-O) was pumped, under open-hole conditions, while the pressure drawdown was monitored in two, packer-isolated, zones of each of the other two wells (SE-1, and SW-1). The process was repeated by pumping well SW-1, while observing the pressure drawdown in wells (O-O), and SE-1. The results have not been analyzed yet, but indicate a very good hydraulic connection between the wells. Present from the USGS during the testing were M. Umari and J. Gemmell.

3GWF024F Develop scientific notebook for cross-hole tests with prototype string

Discussions were initiated with the QA office on what is needed for initiating this scientific notebook plan.

Quality Assurance

3GWF001F Build discharge pipeline for c-holes tests

A criteria letter was written by the PI and submitted to the TPO to be forwarded to the YMPO to initiate the job package needed for building the pipeline. This was all the work intended to be accomplished under this activity. This activity, therefore, now should be considered 100% complete.

Planning and Operations

Variances

Work Performed but not in Direct Support of the Scheduled Tasks

A QA grading report had to be written for activities of the DOE/AECL project. M. Umari prepared the report in cooperation of YMPO's Office of International Programs. It was requested that all activities be exempt from the USGS QA program because the activity does not involve site characterization.

The change request to drill a fourth, inclined, borehole at the c-hole complex was resubmitted. M. Umari worked on this in cooperation with S. Keller (SAJC/Golden).

SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0B3313G2

Summary Account Manager - E. Majer

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF02C Prepare for cross-hole seismic work

Preparation for the seismic field work at the c-holes continued. In order to increase bandwidth, a new module that matches output impedance has been built. It will match the dynamic load (piezoelectric crystal) to the electronics that drive the cable and crystal.

Quality Assurance

Planning and Operations

Variances

SCP 8.3.1.2.3.1.5 Testing of the C-hole sites with conservative tracers 0G3313H2

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF161A Preliminary modeling for tracer tests

Work on this activity will continue under the successor activity 3GWF167A, "Continue preliminary modeling for tracer tests". Application of analytical solute transport equation for estimation of tracer volumes will continue under 3GWF167A. The present activity now should be considered 100% complete.

3GWF160A Expand injection permit to full suite of tracers

Indications are that the YMPO's Project and Operations Control Division is in the process of obtaining a class of umbrella permits that can then be used by YMP participants for the various site characterization activities.

Quality Assurance

Planning and Operations

Variances

## 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 0G3313J2

Summary Account Manager - W. Steinkampf

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GWH004 Assess data (extant), phase 1

Located field notebook used to record sample and field data collection at and in the vicinity of the site from late 1980 through mid 1984. The records indicate that most of the samples collected contained drilling fluid and/or other contaminants. Examination of the resultant analytical data confirms this.

USGS Weapons Program geohydrologic support staff in Las Vegas report that checking and site verification of historic USGS hydrochemical data for the NTS and vicinity was started this month. Following checking, entry into a USGS electronic data base will begin.

##### 3GWH024A Develop ion chromatograph methods

There was no action. The chromatograph system was disassembled, packed, and shipped, with attendant reagents, supplies, and supporting equipment, to laboratory space in building 4215 in area 25 of the NTS. The equipment will be installed and performance verified in mid-April. Methods development will begin again in Nevada after installation.

#### Quality Assurance

##### 3GWH022A Complete study plan comment resolution

Received YMP notification that review-comment resolution has been accepted, and that the verification draft of the study plan (8.3.1.3.2.3) has been approved by all mandatory reviewers at the project level. Formal YMPO approval will be followed by transmittal to the OCRWM for approval and transmittal to the NRC.

#### Planning and Operations

#### Variances

##### 3GWH001 Grade QA for SZ hydrochemical study

The study was graded in a general fashion in May 1991. A revised package, which will address individual activities and work efforts, has not been started because USGS guidance for such grading has not been available. Grading package preparation can/will begin after a guidance or implementation document has been issued. No impact.

##### G022 Work authorization (non-surface-disturbing)

The early finish date has changed to the end of July 1992 to reflect estimated date of NRC acceptance of Study Plan 8.3.1.2.3.2, R0. This will perhaps delay a sample and data collection effort in the Death Valley region planned for mid to late summer 1992. An additional problem perhaps arises because the M&O contractor is scheduled to assume

responsibility for study-plan handling on April 15. Prior to that date there will be a hiatus in processing. This likely will deleteriously impact the forecast NRC approval date. The possibility of expediting YMP handling of the study plan to enable YMP approval and transmittal before the hiatus is being explored.

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

An estimated 12 hours were spent on the following:

Participated in a meeting of the Work Group for High-level Waste (Sub-committee for Nuclear Waste Management) at the spring meeting of the American Society of Mechanical Engineers in Denver.

Began informal survey within the USGS YMP programs as part of the FY92 management assessment. A summary of QIG efforts for the past year and a brief question list regarding quality assurance were sent to each principal investigator.

Prepared monthly status report.

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

OG3313K2

Summary Account Manager - W. Steinkampf

#### Technical Activities

3GWH014A Develop mobile laboratory

Met with D. Nordstrom (USGS) to discuss his group's experiences in designing and constructing a mobile laboratory. Will examine the lab and discuss subsequent modifications and interactions with suppliers during a visit to Boulder, Colorado, in April.

3GWH008B Examine hydrochemical tool test (lab)

No action. Testing has not taken place.

3GWH008B Examine hydrochemical tool test (field)

No action. Testing has not taken place.

#### Quality Assurance

#### Planning and Operations

3GHW015A Develop downhole data-collection and sample equipment

Cable length needs and anticipated pump usage information transmitted to SKB. Agreed to send specifications and drawings of hydraulic shifting tool planned for incorporation in the system.

#### Variances

3GWH014A Develop mobile laboratory

Lack of study personnel has resulted in this task receiving low priority; impact is minimal. Purchase of this equipment is planned in FY93. Purchase will be either from SKB or an as-yet-unidentified US contractor. This study will draw on the experience of study 8.3.1.2.2.7 in designing a mobile laboratory and selecting a builder/supplier. Additional information will be obtained from USGS National Research Program staff in Boulder, Colorado.

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

An estimated 50 hours were spent on the following:

Collected water samples for selected stable and radioisotope determinations. Samples were

collected near the end of pumping of borehole JF-3, under the aegis of the environmental monitoring program; and from borehole UE-25UZN#91. Samples were processed, as appropriate, at the Hydrologic Research Facility in area 25 for future analyses, then shipped to Lakewood, Colorado.

Contacted J. Gordon (USGS Branch of Quality Assurance) to obtain, for examination, copies of the forms recombined for use in collecting ground-water hydrochemical data and samples. Reviewed the forms for possible inclusion/adaptation in planned sample-collection activities. An electronic version would be most useful for study efforts. It appears that such a version, that is/will be compatible with work stations and to-be-used INGRES, will be available within a year. Contact will be maintained with the Branch for updates in this matter.

Participated in a teleconference/meeting of representatives of the Geochemistry and Hydrology Integration Task Forces. The objective of the joint meeting was to formulate an agenda for the upcoming joint workshop (May 27-29).

Met with L. Hayes, W. Dudley, D. Appel, and R. Luckey on several occasions to discuss perceived coordination problems within the HIP. It was resolved with agreement to produce a summary statement addressing concerns regarding plans for the utilization of extant hydrochemical data.

Participated in the monthly teleconference of the Geochemistry Integration Task Force.

Participated in a meeting of RSN, REECo, and USGS personnel to resolve comments on RSN specifications for drilling of UZ-16. Spoke with D. Wonderly (REECo) to preliminarily apprise him of study plans for sampling of extant WT holes, and construction and sampling of planned WT holes.

SCP 8.3.1.2.3.2.3 Regional hydrochemical characterization 0G3313L2  
Summary Account Manager - W. Steinkampf

Technical Activities

3GWH905 Select sample sites, phase 1

Discussed basis for consideration of sample collection of Death Valley springs with W. Werrell of the National Park Service. Will meet with Werrell in early April to plan preliminary reconnaissance trip through the monument to examine and discuss the general geologic settings, and to visit some of the sites he will propose. Follow-up visits to all sites for detailed reconnaissance will follow.

3GHW910A Collect regional samples, phase 1

Samples for  $^3\text{H}$ ,  $\delta^{13}\text{C}$ ,  $^{14}\text{C}$ , and  $^{36}\text{Cl}$  determinations were collected from boreholes UE25-JF#3 and UE25-UZN#91. The JF#3 samples were collected attendant to work done under the aegis of DOE's environmental monitoring program.

Quality Assurance

Planning and Operations

Variations

### WBS 1.2.3.3.1.3.3 Saturated Zone Hydrologic System Synthesis and Modeling

Principal Investigator - R. Luckey

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 0G3313A2

Summary Account Manager - E. Ervin

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### 3GWM005AA Synthesize potentiometric map

Discussion of the results of the water-level corrections for temperature and density effects continued between E. Ervin and R. Luckey. Little time spent on this activity as the study plan was given priority this month.

##### 3GWM007AA Develop geologic model of C-holes and site

A. Geldon has completed analysis of existing data at the UE25c-well complex comprising television and acoustic televiwer logs, in addition to caliper logs, core analyses, tracejector surveys, temperature logs, static tracer tests and heat-pulse surveys into a conceptual geologic model. This conceptual model is ready to be input to a GIS, probably the LYNX system, however; further work is on hold pending purchase, lease or loan of the GIS software. E. Ervin met with K. Turner of the Colorado School of Mines to discuss her testing the LYNX software at the School of Mines GIS facility. She plans to begin trial use of the LYNX software in mid April using the conceptual geologic model developed by Geldon.

##### Quality Assurance

##### Planning and Operations

##### 3GWM002A Revise and resolve (USGS) study plan comments

E. Ervin has responded to the 115 DOE comments by seven reviewers of Study Plan 8.3.1.2.3.3, Site Saturated Zone Synthesis and Modeling--consisting of 71 minor comments and 44 major comments. The draft recompilation was sent to the reviewers for their concurrence on March 31.

##### Variances

##### 3GWM05AA Synthesize potentiometric map

This activity is delayed two months because of prolonged illness of the principal investigator and unexpected difficulty in interpreting corrected water levels. It will delay milestone 3GW06M by at least two months, possibly more as review process of that milestone will be more difficult than originally anticipated.

##### 3GWM007AA Develop geologic model of C-holes and site

The geologic model of the C-holes for the available data is complete, however; development of the site geologic model is on indefinite hold until it is decided which group is performing

the work and more data are available.

Work Performed but not in Direct Support of the Scheduled Tasks

E. Ervin attended a saturated-zone meeting to discuss SZ modeling activities and presented a short overview of how goals of the modeling and how the modeling is structured between the different projects. The meeting was arranged for J. Bredehoeft--who provided a short discussion of his work examining the effect of seismic activity on water levels at Yucca Mountain. (4 hours)

SCP 8.3.1.2.3.3.2 Development of fracture network model 0G3313B2

Summary Account Manager - E. Ervin

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM01CB Initial mapping of the Crater Flat Tuff

E. Ervin and M. Chornack finished initial fracture mapping in the Crater Flat Tuff, east of Little Skull Mountain and have emplaced permanent markers in all of the fracture-mapping locations.

3GWM015B Revise fracture mapping technical procedure

Technical procedure GP-12, R1--Mapping Fractures on Pavements, Outcrops and Along Traverses, is in the final stages of revision to include more information on the areal fracture-set surveys and the 2 x 2 m grid surveys being done by E. Ervin and M. Chornack. The revised procedure also will include new versions of field forms.

3GWM016B Assist LBL, add outcrop data to fracture model

E. Ervin and K. Karasaki (LBL) are writing a journal outlining current fracture-collection efforts, use of the data in fracture modeling at the UE25c-Hole complex and the status of current fracture modeling at that multiple-well complex.

Quality Assurance

Planning and Operations

3GWM007B Coordinate LBL fracture-network modeling phase I

Ongoing discussions by E. Ervin with M. Umari and A. Geldon about work occurring at the UE25c-hole complex continued. Ervin still plans to see a portion of the cross-hole tomography to be done by E. Major at the multiple-well complex.

Variances

3GWM015B Revise fracture mapping technical procedure

This is delayed two months because of prolonged illness of the principal investigator.

SCP 8.3.1.2.3.3.2 Development of fracture network model 0B3313C2

Summary Account Manager - K. Karasaki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM04CA Incorporate outcrop data to network model 1

Writing of a report on estimation of the prediction error using spatially correlated data has been initiated. The report will extend and apply a recently developed theory for general stationary random variables to the special case of spatially correlated data.

3GWM06CA Complete rad-waste conference journal article  
More draft sections of the Rad Waste Journal article entitled "Fracture Flow Model in the Saturated Zone at Yucca Mountain," by K. Karasaki and E. Ervin have been written.

3GWM009C Assist USGS/multiple well test design phase 1  
No work was done because the USGS did not request assistance.

3GWM005C Assist USGS prototype multiple well test phase 1  
No work was done because the USGS did not request assistance.

3GWM10CA Assist USGS with first hydraulic test report  
No work was done because the USGS did not request assistance.

3GWM02CA Write report on borehole fracture data bias  
S. Martel has begun writing a journal article on the borehole fracture data bias studies. The article will describe a new approach to interpreting fracture orientation and density data derived from boreholes so that "true" in-situ distributions of such parameters can be estimated with less error.

#### Quality Assurance

3GWM04CA Incorporate outcrop data to network model 1  
K. Karasaki attended a class in records management (QMP-17.01, R5) on March 25 at LBL given by L. Watt (SAIC/Golden) and observed by L. Ducret.

#### Planning and Operations

3GWM04CA Incorporate outcrop data to network model 1  
K. Karasaki gave E. Ervin responses to the review comments on Study Plan 8.3.1.2.3.3. The reviewers needed some clarification on the inversion algorithm and double porosity model. As a result, modifications were made to the study plan.

#### Variations

3GWM06CA Complete rad-waste conference journal article  
This activity has not been completed this month as planned; work is continuing. The new estimated date of completion is April 30, 1992.

### WBS 1.2.3.3.2 Preclosure Hydrology

#### OBJECTIVE

To examine hydrologic conditions, including flooding, availability of water supply, and characteristics within and above the repository horizon; and to determine whether engineering measures that require excessive cost, or technology beyond that which is reasonably available, will be needed during construction or operation of the repository. (SCP Section 8.3.1.16)

#### WBS 1.2.3.3.2.1 Flood Recurrence Intervals and Levels at Potential Locations of Surface Facilities

Principal Investigator - P. Glancy

#### OBJECTIVE

To assess the flood and debris hazards at and near the potential repository surface facilities locations to allow adequate design of facilities to prevent or reduce hazards to an acceptable level. (SCP Study 8.3.1.16.1.1)

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFR016 Analyze/evaluate FY91 flood data

There was no progress; continued rain in southern Nevada preempted work on this element. Most of the month was spent field checking and measuring runoff caused by these storms.

3GFR002 Collect, analyze, evaluate FY92 flood data

The wet weather of February in southern Nevada continued throughout March. A significant storm on March 7-8 caused renewed runoff in the Las Vegas area and along the lower Amargosa River near Tecopa. Reconnaissance of the basin to Death Valley Junction has occurred. Again some light runoff from the Carson Slough area flowed through Franklin Plaza and downstream past Eagle Mountain. That flow, combined with more local runoff downstream, caused more flow to Death Valley. The magnitude of flow to Death Valley seemed similar to that of February 12-15, 1992. Peak flows were documented. Flooding of the Salt Pan, near Badwater in Death Valley, expanded as a result of the freshwater input. No intense flooding in Death Valley was noted.

An intense storm moved through Las Vegas on March 23-24 and 27. Although flooding occurred in the Las Vegas valley, the storm did not cause flooding or surface streamflow at Yucca Mountain. Similarly, flooding did not occur in Death Valley and runoff in the lower Amargosa River was mild due to the fact that the storms were located in the southwestern part of the Las Vegas valley.

The storms of February and early March caused moderate runoff in the Overton area northeast of Las Vegas. This runoff was documented by P. Glancy and found not to have been of a severe nature.

3GFR018 Reconnaissance of Yucca Mountain to assess debris hazards

P. Glancy visited the Coyote Wash area and other parts of Yucca Mountain with J. Coe and J. Whitney to explore the use of Coe's photogrammetric skills to analyze the characteristics and quantities of debris on the upstream slopes of small drainages that might be mobilized by intensive runoff. Coe believes that these photo-analysis techniques can be used to derive estimates of the magnitude of potential debris hazards (erosion and deposition) if suitable high-resolution, large-scale air photography is available. This strategy will be pursued further.

3GFR004 Map PMF flood-inundation zones at Yucca Mountain

The USBR is continuing work on the delineation of PMF zones. P. Glancy organized a meeting between RSN, DOE, USBR, and USGS staff concerned with PMF flood prediction products. This meeting will take place in Las Vegas in early April to review the status and completeness of the PMF study.

Quality Assurance

Planning and Operations

Variances

## 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 1.2.3.6.2.1.2 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 8.3.1.5.1.2.2 Analysis of stratigraphy-sedimentology of marsh, lacustrine, and playa deposits

0G3621B2

Summary Account Manager - R. Forester

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GCL004B Sample outcrop sites

Sediment samples taken by J. Quade during his study of the wetland deposits from the Las Vegas Valley will be made available for study by R. Forester. Those samples, when QA'd, will be processed for calcareous microfossils and resulting material used to make preliminary reconstructions of past limnology and climate. The fossil content of those samples should also provide important information on sites for future outcrop sampling or coring.

##### 3GCL002B Conduct reconnaissance - Las Vegas valley

Availability of samples noted above (3GCL004B) will partially fulfill this activity and of more importance will serve to guide the reconnaissance of the valley deposits.

#### Quality Assurance

##### Planning and Operations

Participants in the YMP climate program together with personnel from SAIC organized a climate workshop to be held on April 1.

Variances

3GCL002B Conduct reconnaissance - Las Vegas valley and 3GCL001B Hire and train staff  
The final hiring of mapping personnel has been delayed, but is anticipated in the near future. Reconnaissance of the Mountain and of the Valley deposits awaits this personnel action.

WBS 1.2.3.6.2.1.3 Climatic Implications of Terrestrial Paleocology

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 0G3621G2

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCT315M Work Authorization 1.2.3.6.2.1.3

It is believed that the study plan has been signed by DOE, but it is not known if a work authorization is in place.

Quality Assurance

Planning and Operations

Variances

3GCL101 Hire and train staff

P. Wigand has not been hired yet, but the USGS and DRI have initiated the necessary paper work to complete that task in the near future.

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 8.3.1.5.1.4.2 Surficial deposits mapping of Yucca Mountain area 0G3621I2

Summary Account Manager - E. Taylor

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

Variances

3GCH001A Complete transition and hire staff

The position description is complete, justifications are being completed and position should be advertized and filled by the end of March.

SCP 8.3.1.5.1.4.3 Eolian history of the Yucca Mountain region 0G3621J2

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCH158C Conduct field trip - sand ramps

The need for thermoluminescence dating of material from eolian and hill slope materials has been identified and necessary work to obtain these dates have been initiated.

Quality Assurance

Planning and Operations

Variances

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 - J. Stuckless

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 8.3.1.5.2.1.1 Regional paleoflood evaluation 0G3622A2

Summary Account Manager - D. Grasso

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH007A Develop technical procedures

A scientific notebook plan is being prepared to document paleoflood investigations and research techniques. Only minor amounts of work were accomplished in March because of unusually heavy rainfall in southern Nevada. The unplanned arrival of several serious storms required immediate field attention on other Yucca Mountain SCP projects, namely the site flood and debris hazards activity and the transport of debris by severe runoff

activity. Severe flooding was mostly restricted to the Las Vegas valley and did not affect the immediate area of Yucca Mountain.

### 3GQH008A Geomorphometric analysis of Yucca Mountain and vicinity

D. Grasso worked on technical strategies for conducting geomorphometric analyses of the drainages and alluvial fan systems surrounding Yucca Mountain.

D. Grasso and P. Glancy met with J. Whitney and J. Coe on March 18 and 19 to discuss the use of photogrammetric equipment for geomorphometric analysis activities. This equipment, operated by Coe, is capable of deriving high-resolution, digital landscape data from stereo aerial photographs. Because these high-quality data are lacking for large segments of the study area, this technique may be particularly valuable for geomorphometric analysis of paleoflood sites around Yucca Mountain.

D. Grasso explored the availability of digital terrain data sets, Landsat TM imagery, and aerial photography needed for this phase of the investigation. Two of three preliminary Landsat TM scenes, in digital format, were ordered.

D. Grasso worked on a longitudinal stream profile of the modern-day Amargosa River from upper Fortymile Wash to Badwater in Death Valley, California. The profile, when complete, will show the slope of different reaches of the river system and any breaks in slope that might be related to bedrock barriers or channel adjustments due to changes in past flow regimes. Additional longitudinal profiles will be drawn, of river terraces parallel to the channel, to show the geometry of the river's paleo-floodplain.

### 3GQH003A Reconnoiter Yucca Mountain and vicinity for paleoflood evidence

A visit to the Yucca Mountain area by P. Glancy, J. Coe, and J. Whitney provided a good verbal exchange of ideas on ages of alluvial deposits and the lack of extensive erosion of the area during late-Quaternary time. Whitney showed evidence of long-term landscape stability, but conceded that storm debris transport could have resulted from paleofloods of local severity during the period of landscape stability.

D. Grasso conducted a field reconnaissance of alluvial fans along the west margin of the Las Vegas valley to determine whether these landforms were remnants of past environmental conditions, or if they were still active today. Although flooding in the valley (March 26-27, 30) has shown that the fans are currently active, the presence of very well developed soils, especially in the upper fan (apex) areas, indicate surface stability. Thus, it appears that while the upper parts of the fans may be quite stable, lower (toe) areas may still be developing.

P. Glancy's visit with R. Carmen and J. Yount (USGS-GD) to the source area of the 1990 Copper Canyon mudflow disclosed some valuable evidence of paleofloods and paleo-debris-flow in that drainage. Stratigraphic exposures were discovered that include volcanic-ash deposits, organic debris, and charcoal lens within various stratigraphic units. This should allow the best opportunity discovered thus far for dating these types of deposits. One of the major objectives of this dating will be to see how important the Holocene is in terms of its debris-flow history. Copper Canyon now appears to be a very important site with good potential for development of a debris-flow history based on absolute dates.

### Quality Assurance

### Planning and Operations

3GQH004A Final DOE review and approval of study plan

Following author and reviewer concurrences, the study plan for this SCP activity was sent to DOE for verification and approval.

### Variances

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

An estimated 32 hours were spent on the following:

D. Grasso contacted FOLD distributors regarding the availability and cost of Landsat digital data for geomorphometric activities. Three of the needed data sets (Landsat TM scenes, all dated 3/23/84) are available. Two have been ordered. The third one will be ordered during the first week in April.

D. Grasso and P. Glancy met with J. Whitney and J. Coe to discuss a digital photogrammetric technique for deriving high-resolution digital elevation data from stereo aerial photographs. This technique may be useful for geomorphometric analysis of paleoflood sites in the Yucca Mountain area.

#### SCP 8.3.1.5.2.1.3 Evaluation of past discharge areas 0G3622B2

Summary Account Manager - E. Gutentag

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GQH012 Analyze water by NWQL and GSP isotope staff

All samples collected prior to March 1992 have been analyzed for Sr 87/86 isotopes. The playa samples collected in the Fall of 1991 are in the queue for soil chemistry analysis by the Geologic Division, Branch of Geochemistry.

During late March 1992, samples collected California and Nevada will be submitted in early April to NWQL and the GSP isotope lab.

3GQH028 Analyze faunal samples modern springs FY92

R. Forester reports no new work on this activity during March 1992.

3GQH004 Study/analyze results from wet/dry playas

R. Forester reports no new work on the ostracode study of this activity. The Branch of Geochemistry has not sent any results of the playa samples still in their work queue for analysis.

3GQH007 Vegetation mapping phase 1

F. D'Agnese began testing of remote sensing techniques using the Landsat Thematic Mapper for regional mapping of vegetation. Methods involved red/infrared ratios, to obtain normalized difference vegetation indices, soil-adjusted vegetation indices, and perpendicular vegetation indices. The most suitable methods will be used for vegetation mapping in the regional (3 by 3 degree) area.

3GQH008 Collect faunal samples from past discharge site FY92

On a late March field trip this activity was attended with poor results. A sample collected from Mound Spring in the Pahrump Valley will be analyzed for Sr 87/86 ratio. No faunal material was found at Mound Spring.

**3GQH002 Vegetation distribution mapping Amargosa Desert**

K. Turner reports that he needs to correlate transects with road surveys for the Amargosa Desert. He and C. Faunt would like to sample the vegetation when the plants are in full bloom, most likely the second or third week of April. This activity needs to be extended into the growing season.

**3GQH009 Prepare faunal samples for analysis**

This activity has been part of the work R. Forester is to perform. He reports that no new work has been performed during March 1992.

**3GQH300 Collect/sample ostracodes--surface sediments**

This activity combined with 3GQH305 (Collect/sample ostracodes--Playas in New Mexico and Texas) was to collect and subsample surface sediments for ostracode and other calcareous microfossils from playas in eastern New Mexico and western Texas. This activity was not conducted because of extreme moisture conditions in the area.

**3GQH305 Collect/sample ostracodes--Playas in New Mexico and Texas**

This activity has not started because of extreme moisture conditions in the study area.

**3GQH306 Conduct analyses--water quality, paleontology, isotopes--New Mexico and Texas**

This activity was to be conducted with 3GQH300 (Collect/sample ostracodes--surface sediments), 3GQH305 (Collect/sample ostracodes--Playas in New Mexico and Texas), and all three activities will be conducted together when climatic conditions permit.

**3GQH005 Conduct field trips modern discharge springs FY92**

This activity was expanded to test whether ostracodes and other aquatic microorganisms are found living in the aquifer. In early March 1992, the aquatic microorganism collector was tested at well JF-3 which is 0.5 mile south of J-12 in Area 25, NTS. This well was pumping 234 gallons per minute for 36 hours. For 22 hours, 20 gallons per minute was diverted through the aquatic microorganism collector during the time of collection. Although JF-3 was pumping about 10 percent air, which was probably introduced into the aquifer during well development with high pressure compressed air, the undisturbed aquifer may not have been oxygenated. Preliminary analyses of the collection nets in the field indicated that no organisms were present and final analysis of the net contents will be completed in April 1992.

During late March, three springs and one flowing well were collected in the Amargosa Desert area in California and Nevada. These samples will be processed during April.

Quality Assurance

Planning and Operations

Variations

**3GQH002 Vegetation distribution mapping Amargosa Desert**

This activity will need to be field checked during the time the desert plants bloom, so that more accurate interpretations can be made. Then the road surveys can be checked against plant transect data. This activity needs to be extended through May.

3GQH300 Collect/sample ostracodes--surface sediments; 3GQH305 Collect/sample ostracodes--Playas in New Mexico and Texas; and 3GQH306 Conduct analyses--water quality, paleontology, isotopes--New Mexico and Texas

These activities are to be conducted in west Texas and eastern New Mexico playas. It is estimated that these activities will be conducted when weather conditions change. During the winter and spring, most playas in the study area have standing water and thus will not yield meaningful data.

Work Performed but not in Direct Support of the Scheduled Tasks

J. Watson, E. Gutentag spent a total of 120 hours in preparing for QA audit YMP-92-13 and in closing NCRs from prior work.

SCP 8.3.1.5.2.1.4a Analog recharge sites 0G3622C2

Summary Account Manager - P. McKinley

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH13CA Conduct chloride leaching test FY92

The USGS Branch of Geochemistry, who is performing the chemical analysis for the chloride leaching experiment, has completed the first two sets of analysis.

T. Oliver has finished the first and second leach of Stewart tuff. The chloride concentrations decreased with the second leach.

T. Oliver started the first leach of Kawich Creek tuff.

3GQH15CA Complete data report Kawich FY 85-90

P. McKinley talked to E. Maxwell of SERI about their progress in reviewing solar radiation results from the Bird "Clear Sky Model". The National Climatic Data Center (NCDC) has updated data from Ely, Nevada which is being used in the Bird model to estimate several parameters. SERI has the data from NCDC and is verifying the updates. The current estimate from SERI is mid-April before they can provide the information.

P. McKinley completed Kawich Creek at base surface water record for the water year 1989 and 1990.

T. Oliver has completed the software testing for Minitab step-forward regression. D. Burkhardt has agreed to do the verification and validation of Oliver's testing.

3GQH16CA Complete data report Stewart FY 85-90

P. McKinley talked to E. Maxwell of SERI about their progress in reviewing solar radiation results from the Bird "Clear Sky Model". The National Climatic Data Center has updated data from Ely, Nevada which is being used in the Bird model to estimate several parameters. SERI has the data from NCDC and is verifying the updates. The current estimate from SERI is mid-April before they can provide the information.

T. Oliver has completed the software testing for Minitab step-forward regression. D. Burkhardt has agreed to do the verification and validation of Oliver's testing.

3GQH018C Prepare data report on Kawich: FY 91

T. Oliver and P. McKinley completed the final review and entry of the data for Kawich base

soil and air temperatures for 1991.

**3GQH21CA Development of HRU analog basins**

P. McKinley and F. D'Agnese completed the transfer of basin slope, aspect and elevation data to the Sun.

P. McKinley transferred vegetation units and basin reference points to mylar for scanning into an Arc data base.

P. McKinley and F. D'Agnese scanned the Kawich and Stewart vegetation maps into the Sun for future HRU development.

P. McKinley made contact with C. Rich of National Mapping who has agreed to help in the final Arc/Info design of the HRUs. A meeting is scheduled for early April to collate the elevation, slope, aspect and vegetation units.

Quality Assurance

**3GQH012C Collect/reduce hydro data from remote sites FY92**

K. Burgess-Kohn, YMP-USGS training coordinator, worked with P. McKinley to insure that relevant QMPs were satisfied for the April field trip.

Planning and Operations

**3GQH012C Collect/reduce hydro data from remote sites FY92**

Preparation for the quarterly April field trip for sampling and equipment maintenance was completed. In addition to the regular field work, precipitation distribution in the basins will be investigated in April. This will involve additional sets of snow surveys at various vegetation groups and representative slopes and aspects.

Variances

**3GQH014C Test PRMS model**

The activity leader is moving to another job which will impact the start of this activity indefinitely.

Work Performed but not in Direct Support of the Scheduled Tasks

Software quality assurance training. (2 hours)

Two reading assignments. (1 hour)

Reviewed an extended abstract for G. Leavesley and L. Stannard. (2 hours)

Monthly and semiannual reports. (4 hours)

Preparation and discussions on future climate meeting with DOE. (2 hours)

SCP 8.3.1.5.2.1.4b Geochemistry of arid-zone infiltration 0G3622E2

Summary Account Manager - A. Riggs

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GQH006D Install long-term meteorological monitoring equipment**

Worked with Applied Technologies personnel to clear up bugs in their sonic anemometer

software. They eventually fixed the problems.

Completed the electronic integration of the eddy flux and long-term meteorological monitoring equipment. The system will collect and integrate 25 data streams into one file at 10 hertz now.

Finished the design of the long-term meteorology instrumentation shelter and submitted it to Quality Metal Products for construction.

#### 3GQH003C Soil moisture and chemical sampling

Staff met with the New Mexico Institute of Mining and Technology contractor at Organ Pipe Cactus National Monument and discussed the status of the project to date and the future direction. The meeting proved particularly useful by being able to review the geologic development of the deposits in the area. After returning, H. Claassen, E. Taylor, and A. Riggs spent a full day discussing what had been learned and how it could best be applied to further project goals.

Ten samples from Terrace 2 were analyzed for the volume of stones per sample, dry bulk density, the Cl concentration, and gravimetric water content.

A carbonate experiment was initiated to verify that Cl can be measured in carbonate material.

#### 3GQH016D Selection and preliminary mapping of microwatersheds

A number of potential sites were visited and two stream terraces were chosen and their bounds were determined by simple visual techniques.

#### Quality Assurance

##### 3GQH006D Install long-term meteorological monitoring equipment

Sent cup anemometers, hygrometer/thermometers, and barometer to HIF for calibration; initiated requisition for calibration of pyranometer.

Read QMP-3.07, R4 and QMP-17.01, R5.

#### Planning and Operations

#### Variances

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

Attended the paleoclimate workshop. (12 hours)

#### SCP 8.3.1.5.2.1.5 Studies of calcite and opaline silica vein deposits OG3622D2

Summary Account Manager - J. Whelan

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GQH814A Prepare reports -- drill hole calcite silica

J. Whelan continued efforts to involve E. Roedder in fluid inclusion studies. Arrangements were made for Roedder to tutor myself and D. Vaniman (LANL) in proper sampling and sample preparation, and the measurement of fluid inclusion properties. Whelan prepared a draft of a technical procedure for fluid inclusion studies for comment by Roedder.

Hopefully this work will get underway in April. Whelan initiated the process of vendor QA approval for contracting d18O measurements of opaline silica with the isotope geochemistry lab of P. Knauth at Arizona State University.

J. Whelan and B. Marshall presented "The isotope geochemistry of secondary and pedogenic carbonate from Yucca Mountain" for the Geology Department at the University of Colorado. Whelan continued work on describing fracture mineralogy and petrography of drill core samples from G-4. K. Futa continued evaluation of Sr-Sm-Nd systematics in vein and surficial carbonates. Data indicates that REE content varies considerably in the carbonates. S. Mahan completed Sr analysis of fracture fill samples HD-328, -331, -348, -344, -350, and -322. Mahan continued processing water samples from well JF-3, and samples obtained from C. Peters. Z. Peterman prepared a manuscript for the Water-Rock Interaction Conference entitled "Strontium isotope characterization of the Ash Meadows ground-water system, southern Nevada". Mahan spent one week in southern Nevada collecting soil and water samples for Sr analysis. Whelan made arrangements for a sampling trip to the Bond Gold mine near Beatty.

3GQH803A Analyze isotopes/fossils, Solitario Canyon and Windy Wash

J. Paces continued analysis of the site 199 paleolacustrine spring deposits. Additional data continues to suggest that the deposits formed  $\approx 42$  Ka. Paces initiated analysis of samples of pedogenic carbonate from site 106.

3GQH809A Analyze samples trench 14 original exposures

J. Paces initiated analysis of dissolution residues from trench 14.

#### Quality Assurance

B. Marshall attended two software configuration control committee meetings.

B. Marshall completed document review of QMP-3.07.

J. Paces continued calibration of spike according to GCP-22 starting a second set of calibration standards. The status is still pending. Paces initiated software review (per QMP 3.03, R3) of a critical code used in U-series data collection by alpha-spectrometry (UTH.FOR, CID# GDD0020.02). The program had to be transferred from the old Nuclear Data Systems operating platform to the new PC-based system following catastrophic failure of the old computer. Alpha-spectrometric data collection has been suspended until all configuration control documentation has been submitted to the SCC. S. Mahan met Sr isotopic calibration date of SRM 987 on March 4.

S. Mahan completed QA records management for two manuscripts for the Water-Rock Interaction Conference currently in the system.

#### Planning and Operations

3GQH814A Prepare reports -- drill hole calcite silica

J. Whelan continued efforts to involve E. Roedder in fluid inclusion studies. Arrangements were made for Roedder to tutor myself and D. Vaniman (LANL) in proper sampling and sample preparation, and the measurement of fluid inclusion properties. Whelan prepared a draft of a technical procedure for fluid inclusion studies for comment by Roedder. Hopefully this work will get underway in April. Whelan initiated the process of vendor QA approval for contracting d18O measurements of opaline silica with the isotope geochemistry lab of P. Knauth at Arizona State University.

### Variances

#### 3GQH802A Install/calibrate new mass spectrometers

Delivery of the new Finnigan mass spectrometers for stable and radiogenic isotope measurements has been delayed to April. This delay will impact all milestones related to Sr, Nd, Pb, and stable isotope analyses.

#### 3GQH801A Hiring and training of geologists

The technician position to support stable isotope studies still has not been advertised. This delay will impact all milestones related to stable isotope analyses.

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

J. Whelan attended an SOC meeting at which specimen removal requests for himself and A. Geldon were approved.

B. Marshall recalibrated the pulse-processor on the energy-dispersive XRF instrument in order to fix minor problem which became apparent when analyzing low Rb samples.

B. Marshall, S. Mahan, and K. Futa spent one week in the Isotope Hydrology short course.

J. Paces reviewed a manuscript of B. Marshall et al. for the Water-Rock Interaction Conference.

### WBS 1.2.3.6.2.2.2 Future Regional Hydrology due to Climate Changes

Principal Investigator - J. Stuckless

#### OBJECTIVE

To characterize the impacts of potential future climate changes on the regional and site surface-water system, the site unsaturated zone hydrology, and the regional and site saturated zone hydrology. (SCP Study 8.3.1.5.2.2)

#### SCP 8.3.1.5.2.2.1 Analysis of future surface hydrology due to climate changes 0G3622F2

Summary Account Manager - D. Grasso

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

#### Quality Assurance

#### Planning and Operations

##### 3GFH200A Obtain/install micro computer system

Procurement documentation for hardware and software needed for the modeling system was submitted to the USGS district office in Carson City, Nevada, for review and processing in February. At last notice (March 30), J. Lansen, computer section chief in Carson City, noted that the review was complete and that the materials will be forwarded to the regional office in Menlo Park for processing/purchase.

##### 3GFH100A DOE approval of study plan

S. Keller (SAIC/Golden) finalized the draft recompilation of the study plan and forwarded copies to the authors (D. Grasso, J. Downey, and K. Kolm) and DOE reviewers on March 16. At this time, Keller noted that, "when concurrences have been reached with all reviewers, a new recompilation incorporating any necessary changes will be transmitted to

the Project Office for DOE verification review."

### Variations

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

An estimated 58 hours were spent on the following:

D. Grasso conducted interviews of prospective employees to fill the surface-water modeler position (GS-9/11) open for this activity. Someone is lined up for the position and hopefully will be brought on board soon. D. Beck and Grasso met with D. Gillies and D. Appel to discuss this action.

D. Grasso met with J. Coe to discuss the possibility of using photogrammetric equipment currently operated by Coe and J. Whitney to develop high-resolution landscape data sets for surface water modeling at Yucca Mountain. The use of this equipment and techniques developed by Coe could improve delineation of HRUs needed to perform surface-water runoff modeling via the PRMS software supported by the USGS.

D. Grasso attended the annual ASPRS/ACSM national meeting in Albuquerque, New Mexico, to learn more about the various remote sensing, surveying, and mapping techniques used today to classify and derive landscape and watershed parameters. During the meeting, Grasso met with R. Welch and associates (Center for Remote Sensing and Mapping Science) to discuss their digital, automated, photogrammetric techniques for deriving such information as elevation, slope, and aspect from stereo aerial photographs. Their software package, DMS (Desktop Mapping System) is a low cost software package that enables image processing for photogrammetric, remote sensing, and GIS applications using personal computers. Their automated method for deriving digital elevation data from aerial photographs may be especially useful for this activity. Other remote sensing and mapping packages, including PCI, ER Mapper, and ERDAS for Unix workstations, were also evaluated for their possible use in this activity.

SCP 8.3.1.5.2.2.3 Synthesis of effects of possible future recharge due to climate changes on hydrologic characteristics of the Yucca Mountain saturated zone 0G3622G2  
Summary Account Manager - J. Downey

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GFH004H Analyze structural geology

Radian Corp. has supplied copies of their advanced contouring package CPS-3, including their fault modeling system FFMS, for use with the Intergraph ERMA software at CSM. This software is urgently needed to complete construction of the 3-D geological framework model of the southern Nevada region.

3GFH003C Conduct literature search for GSIS (Future/Quaternary GW)

C. Faunt continued literature search and review including:  
Smith and Lindh (1978), Mckinley and others (1990), Ball and Nordstrom (1987), Claassen (1985), White (1979).

3GFH023C Develop recharge/discharge estimates

F. D'Agness began converting digital soil surveys received from SCS into ARC/INFO coverages which will be used for recharge estimation.

F. D'Agnese began preliminary testing of remote sensing techniques used for regional mapping of vegetation using Landsat Thematic Mapper data. Methods involved red/infrared ratios, Normalized Difference Vegetation Indices, Soil-Adjusted Vegetation Indices, and Perpendicular Vegetation Indices. The most suitable methods will be used for vegetation mapping in the regional (3 degree by 3 degree) area.

3GFH028C Gather input data to GIS

C. Faunt began compiling a water chemistry coverage of the regional area from existing USGS files and reports.

3GFH005C Analyze hydrogeologic framework

C. Faunt examined rose diagrams of faults that were made to show the distribution of fault orientations.

C. Faunt did some preliminary analysis of the stress data compiled from the literature. Faunt and K. Turner constructed a trend surface for the stress data. This gridded surface can now be input into the GIS to help analyze the faults as to their stress/strain relationships.

Quality Assurance

Planning and Operations

3GFH004H Analyze structural geology

B. Wales (Intergraph Corp) is writing software to automate the process of "attributing" cross-section units.

3GFH025C Establish data documentation procedure for GIS

F. D'Agnese and C. Faunt attended a meeting with E. Ezra and J. Beckett (EG&G Nevada-Yucca Mountain Project) in Las Vegas to discuss EG&G's methods for development of the YMP GIS technical data base and data documentation conducted by EG&G.

Variances

3GFH021C Construct 3-D hydrogeologic framework model

This activity was not worked on during the month of March. Work on this activity is temporarily delayed until a user defined software code is supplied to the project by B. Wales (Intergraph).

Work Performed but not in Direct Support of the Scheduled Tasks

C. Faunt and F. D'Agnese prepared for and conducted field work with past discharge (E. Gutentag) in the Pahrump/Amargosa Valley area. Field work involved playa, spring and water-well sampling for strontium-ratio, ostracode, and chemical analysis. (Approx. 2 weeks)

C. Faunt, F. D'Agnese, K. Kolm and K. Turner attended a meeting organized by EOSAT on GIS and remote sensing. (4 hours)

C. Faunt, F. D'Agnese, K. Turner, and J. Downey attended an informational meeting with J. Bredehoeft to discuss the modeling efforts of the Yucca Mountain Project. (4 hours)

In response to review comments, J. Downey reformulated software code for SNODIF in order to accommodate snow permeability more accurately. (120 hours)

C. Faunt finished editing the Carbonate paper and gave it to K. Kolm and E. Gutentag to review so

that it could be resubmitted to formal review. (10 hours)

## 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 support DOE by providing Project coordination and support of NRC interactions by providing input related to site aspects of proposed NRC regulation changes, and evaluate the impact of the regulation changes on the site activities, strategies, and plans; to support DOE/HQ in the development of site technical position papers by synthesizing site and site performance assessment technical information into Project positions; to develop draft position papers which support these positions; to perform technical evaluation of site data and related reports, technical reports, and conclusions, and draft position papers; to coordinate study plan review; to support the preparation of the semi-annual progress report for site investigations and assessments; and to coordinate and perform technical reviews of the site characterization program.

### WBS 1.2.5.2.5 Study Plan Coordination

Principal Investigator - L. Hayes

### OBJECTIVE

To coordinate the preparation review and revision of SCP Study Plans.

### ACTIVITIES AND ACCOMPLISHMENTS

The section chief's office completed rewriting of sections of the SCPB to reflect changes in Study Plan 8.3.1.4.2.1.2 to acquire seismic traverses across Yucca Mountain and in Yucca Wash. The suggested rewrites and supporting documents were submitted to DOE on March 23. Also included were responses to DOE and T&MSS concerns on the request for contract proposals. The contract administration office has been advised of appropriate changes to the RFP. The section chief's office also continued efforts with the contract division to ensure timely progress of the proposal.

R. Spengler and C. Hunter met with R. Keefer, R. Craig, D. Williams, R. Crawley, and T. Sullivan on the rewrite of SCPB sections.

Approximately 80 hours were spent on comment resolution on Study Plan 8.3.1.2.3.3, Site Saturated-Zone Hydrologic System Synthesis and Modeling.

D. Grasso approved changes made by S. Keller to the study plan, tables, and figures for 8.3.1.5.2.2.1, and discussed final revision procedures before the recompiled study plan could be submitted for final review. Only minor changes were needed.

D. Grasso approved changes made by S. Keller to the final, recompiled draft of the study plan for

8.3.1.5.2.1.1. Changes made to the tables and figures were also reviewed and approved. Following author and review concurrences, the study plan was submitted to DOE for verification.

The monthly HIP study plan status report was transmitted to W. Causseaux in HIP management.

Study Plan 8.3.1.2.3.1 (Site saturated-zone ground-water flow) - M. Umari and S. Keller finalized the change request to the SCPB for the new C-holes complex well, and transmitted it to the Project Office on March 31 under a TPO letter.

Study Plan 8.3.1.2.3.2 (Saturated-zone hydrochemistry) - A TPO letter notifying the Project Office that the verified study plan of November 27, 1991, can serve as the approval version, was transmitted on March 20.

Study Plan 8.3.1.2.3.3 (Site saturated-zone synthesis and modeling) - The author responses to DOE review comments were completed. A draft study plan and comment tracking table were transmitted to each reviewer and the author for author/reviewer concurrence.

Study Plan 8.3.1.5.2.1, R2 (Quaternary regional hydrology) - Author/reviewer concurrences were concluded on March 19, and HIP review by T. Brady was completed on March 26. The study plan was finalized after final author approval from D. Grasso for Sec. 3.1 (Regional paleoflood evaluation), and was transmitted to the Project Office under a TPO letter.

Study Plan 8.3.1.5.2.2 (Effects of future climate on hydrology) - S. Keller incorporated the completed author responses for Section 3.3 (Future saturated-zone hydrology) from J. Downey and K. Kolm, and transmitted a draft study plan and comment tracking table to each DOE reviewer and the authors for author/reviewer concurrence.

#### WBS 1.2.5.2.6 Semi-Annual Progress Reports

Principal Investigator - L. Hayes

#### OBJECTIVE

To provide support to DOE/HQ for the development and preparation of the Site Characterization Semiannual Progress Reports.

#### ACTIVITIES AND ACCOMPLISHMENTS

D. Appel revised and distributed instructions for preparation of technical investigator input to the semi-annual Site Characterization Progress Report No. 6 for the period October 1991 through March 1992.

Technical Status Reports for site performance assessment, development and validation of flow and transport models, and supporting calculations for postclosure performance analysis covering the period October 1991 through March 1992 were written.

The TSRs for precipitation and meteorological monitoring, hydrologic properties of surficial materials, natural infiltration, artificial infiltration, and matrix hydrologic-properties testing covering the period October 91 - March 92 have been completed and submitted to the USGS for collation.

R. Luckey prepared the six-month technical update report for the site potentiometric-level evaluation project.

The six-month progress reports for conceptualization of SZ flow models and development of

fracture-network model were compiled by E. Ervin for the period of October 1, 1991 to March 31, 1992.

SCP Progress Report 6 for prototype testing of intact fractures was compiled for the period of October 1, 1991 to March 31, 1992.

#### WBS 1.2.5.4 Environment

##### OBJECTIVE

To identify data requirements; to collect required environmental field data; and to prepare topical data reports.

##### WBS 1.2.5.4.8 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

##### 3GWR011 Survey monitoring network sites

There was no progress during March. The pumping of well JF-3, water quality sampling, and springflow and water level measurement precluded any additional surveying.

##### 3GWR001 Groundwater levels, springflow monitoring, FY92

Water level measurements were made at 27 network sites and springflow was measured at five network sites. Field sheets were checked and filed into the project data base.

##### 3GWR010 Aquifer Pump Test JF-3

Well JF-3 pumping took place on March 4 and 5. Well JF-3 and well J-12 water levels were continuously monitored and recorded from February 26 to March 12. Pumping discharge of well JF-3 was continuously monitored and recorded during pumping. Some water quality parameters were monitored continuously and periodically recorded manually. Manual water level measurements with an electric tape were made at varying intervals prior to, during, and after pumping. Observations of flow meter and flume gage-height were made and recorded. Four complete water quality samples were collected at 11 hours, 22 hours, and 34 hours after pumping started. Duplicate samples were collected at the 34-hour sampling. The total pumping period was 36 hours. Preliminary test results indicate that the drawdown in well JF-3 was about 1-1/2 feet. No drawdown was detected in well J-12.

##### 3GWR013 Instrument JF-3

The continual water level monitoring system was removed on March 12. The system was removed in anticipation of pump removal on March 16 and 17. Pump removal has been delayed until further notice. A permanent continual monitoring system will be installed once the pump has been removed and permanent tubing installed.

##### 3GWR004 Groundwater quality data collection

Water quality samples were collected at four selected network sites (excluding well JF-3)

from March 24-26. Samples were shipped to the USGS Central Lab in Denver for analysis.

3GWR006 Groundwater monitoring report, second quarter FY92  
Report data that are stored in a data base were reviewed.

#### Quality Assurance

#### Planning and Operations

3GWR014 Capital equipment procurement  
Purchase orders were completed for permanent monitoring equipment for well JF-3.

#### Variations

3GWR011 Survey monitoring network sites  
This activity is delayed due to priority of other activities. The impact on the project is minimal because water levels are measured as depth below measuring point and actual altitudes of water levels can be recalculated after surveying is completed.

3GWR013 Instrument JF-3  
Monitoring equipment has been temporarily removed so that the pump can be removed and permanent monitoring tubing can be installed. Pump removal by DOE contractor has been delayed until further notice. In the interim, well J-12 is still in non-pumping status and water levels are being continuously monitored. Problems will occur if well J-12 needs to be pumped before well JF-3 has a permanent monitoring system installed.

3GWR004 Groundwater quality data collection  
Although water-quality sample collection was delayed from January, the activity is now underway and biannual sampling in FY92 still will be achieved.

3GWR006 Groundwater monitoring report, second quarter FY92  
The progress on this activity is limited due to extended duration of work related to JF-3. Data compilation will intensify in April. The report is still anticipated to be completed, however, by the planned milestone date.

3GWR014 Capital equipment procurement  
There is a possibility that a government I-vehicle purchased for water-quality purposes may not arrive by the end of the fiscal year in time to be adequately modified. Short-term impact is minimal as other vehicles can be utilized during the remainder of the year.

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

Reviewed and provided input to HIP on the final draft of a management agreement between USGS-YMP and USGS Nevada District for the water resources monitoring program.

Participated in YMP environmental program mid-year financial review.

Submitted a memo to DOE with recommendations for handling access problems with certain network site, such as wells VH-1 and Army 1.

Provided input to DOE environmental monitoring staff for inclusion into the Annual Site Environmental Report.

## 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 of the Yucca Mountain Project including: technical integration and interaction with other OCRWM Program elements.

### WBS 1.2.9.1.4 Records Management

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

QMP-17.01, R5, YMP-USGS Records Management training, was completed for all required personnel. This included seven attendees in Menlo Park and six attendees at Lawrence Berkeley Laboratories. Two new records management training modules were written for the new employee orientation class (75- and 20-minute presentations).

With training complete, all records received are being reviewed for proper use of the QA designation. L. Watt and M. Murray are calling each record source to review the proper QA designation for all questionable designations. Agreement is being reached before any change is made. This has resulted in future records for the record sources being received properly rather than having repeats of the same offense.

Tracking of the various LRC records activities is developed and in process. Reports should be ready by April 30.

L. Watt is reviewing each record received into the LRC which requires correction of any kind before submittal to the CRF. This helps in identifying what type of activities should be tracked. In many instances, a cause has been identified and remedied to prevent repeated problems. With these items submitted properly now, it requires less LRC employee time. This direct work with the record sources and their delegates is beginning to pay off in less follow-up work required of the LRC staff.

Two hundred sixty-three criteria-related "stand-alone" documents and 18 packages were received into the LRC and date stamped. The stand-alone records were quality verification checked and 25 "correction requests" were issued. Nine packages received a "correction request."

Fifteen publication packages were received from J. LaMonaca. Four publication packages were transmitted to the CRF containing one OFR, one WRIR, three LBL reports, two journal articles, and six abstracts, with a total page count of 907. Three cited reference packages containing 40 cited references with a total page count of 907 were also transmitted to the CRF.

The following approved QMP and modifications were distributed:

QMP-3.07, R4	YMP-USGS Review Procedure
QMP-2.02,R5-M2	USGS Personnel Qualification
QMP-2.08,R1-M3	Non-Federal Contractor Personnel Qualification
QMP-3.03,R3-M1	Software Quality Assurance
QMP-4.02,R3-M1	Control of Management Agreements

The following approved technical procedures were issued:

GP-39, R0	Geophotogrammetric Mapping of Trench Walls - Field Work
HP-40, R2	Estimation of Peak-Streamflow Discharge by the Slope-Conveyance Method
HP-43, R2	Installation, Operation, and Examination of Two Types of Non-Recording Rain Gages
HP-169, R1	Determination of Peak-Streamflow Discharge by the Slope-Area Method
HP-220T, R0	Air Flow Monitoring in Deep Saturated Zone Boreholes and in Partially Cased Boreholes
HP-221T, R0	Monitoring the Well Water Level or Fluid Pressure Response to Underground Nuclear Explosions or Earthquakes
HP-222T, R0	Installation of a Small Diameter Packer and Transducer to Measure Fluid Pressure in Wells

ICN-8 to the YMP-USGS Quality Assurance Program Plan was distributed to controlled copy holders.

A rescission notice for the YMP-USGS Software Quality Assurance Plan was issued.

A rescission notice was issued for HP-136, R0 Methods for Handling and Storage of Drill Cuttings and Core from Unsaturated Zone Boreholes at the Unsaturated Zone Testing Laboratory (Test Cell C).

A controlled set of YMP-USGS QMPs, TPs, and the QAPP was issued to the YMPO Document and Records Center.

The 1991 YMP-USGS Controlled Documents Configuration Report has been completed. 112 participants responded. As a result of the configuration report, 20 participants were sent replacement documents and four participants were decontrolled.

Work is continuing on the indexing of and organization of YMP-USBR DTNs into records packages.

Numerous routine document control functions were performed including issuing procedures to new copy holders, distributing replacement documents, sending out follow-up DTNs, transferring controlled documents to new copy holders, sending information copies to various persons/agencies, and transmitting eight DTN record packages to the LRC.

WBS 1.2.9.1.5 Training

Principal Investigator - L. Hayes

ACTIVITIES AND ACCOMPLISHMENTS

Various routine training functions were performed including distributing individual reading assignments and YMP-USGS orientation video tape assignments; scheduling DOE's general employee training; scheduling GET refresher training exams for Denver area participants; providing management with information regarding the status of participants' instruction assignment completions; distributing first, second, and third reminder notices to participants with overdue reading assignments; supporting instructors providing make-up sessions for software quality assurance and records management training; and submitting record packages to the LRC.

Reading assignments and highlight sheets were prepared and issued for the following procedures:

QMP-3.03, R3	Software Quality Assurance
QMP-3.07, R4	YMP-USGS Review Procedure
QMP-3.07, R4	Highlight Sheet
QAPP-01, R5	ICN No. 8      Quality Assurance Program Plan
AP-5.19Q, R2	ICN No. 1      Interface Control
AP-5.19Q, R2	ICN No. 1      Highlight Sheet
AP-6.3Q, R0	ICN No. 2      Interaction of Participants and Outside Interests with Yucca Mountain Project Sample Management
AP-6.4Q, R1	Procedure for the Submittal, Review, and Approval of Requests for Yucca Mountain Project Geologic Specimens
HP-40, R2	Estimation of Peak-Streamflow Discharge by the Slope-Conveyance Method
HP-43, R2	Installation, Operation, and Examination of Two Types of Non-Recording Rain Gages
HP-169, R1	Determination of Peak Discharge by the Slope-Area Method

Software training was conducted in Denver on March 3, 16 and 24, with P. Covington as trainer. Completed the writing of lesson plans, view graphs, and worksheets for the software unit for YMP-USGS orientation.

The following assistance was provided to GSP management: J. Stuckless, announcing and scheduling participants for an April 16 and 17 Wilderness First Aid Course; R. Forester, preparing for a YMP-USGS Climate Workshop April 1; J. Whitney, providing YMP-USGS orientation, software quality assurance, and records management training for new employees; R. Spengler, requesting GET training for Menlo Park area; Z. Peterman, preparing QMP-2.07, R1, attachment 1 forms for new employees and planning the documentation of vendor training for the new mass spectrometer.

The following assistance was provided to HIP management: D. Appel, preparing an internal memorandum regarding YMP-USGS personnel qualification; M. Whitfield, assisting with training portion of UZ 16/VSP 2 borehole readiness review; P. McKinley, initiating process to modify QMPs 2.02 and 2.08 to allow for wavering of current qualifications requirements for temporary personnel and subsequently prepared waiver letter for personnel involved in implementing HP-165, Method for Measuring Snow Water Content.

Two parts of a major revision of the YMP-USGS orientation were prepared in addition to preparation of text on the technical role, records management, and software quality assurance that was incorporated for a special session.

Reviewed and commented on training portion of draft copy "Working at the Nevada Test Site" for R. Craig. Included information about working at the NTS in March 25 orientation which Craig attended to critique before submittal of final lesson plan for approval of T. Chaney.

WBS 1.2.9.2 Project Control  
Principal Investigator - L. Hayes

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

The SAIC/Golden actual cost distribution, estimated cost distribution, FTE report, and the USGS cost report for February were compiled. The February actual costs and schedule status for the USGS were sent to Las Vegas for input into the PACS system.

S. Reisler chaired the Project Control Procedures Standing Committee meeting.

February status for the USGS schedules was completed and sent to Las Vegas for input into the APECS system. Reports and plots were distributed to the PIs in preparation for next month's statusing.

Minor changes were made to the hydrologic file due to a hold up of some work which was to be accomplished.

Summary plots and milestone listings have been generated for the TPO to be used for meetings in Las Vegas.

Additional schedules and data print outs were sent out for the ICE team to conduct an independent cost analysis for the upcoming years.

A booklet containing geological plots and reports was created for R. Spengler to adjust milestones for DOE requirements.

An existing program was altered to provide technical assistance with variance data retrieval for PACS reporting.

Archived data were retrieved to produce reports needed by R. Ritchey for the ICE review.

WBS 1.2.9.3 Quality Assurance

OBJECTIVE

To establish and implement a Yucca Mountain quality assurance program.

WBS 1.2.9.3.1 Quality Assurance Program Development

Principal Investigator - T. Chaney

OBJECTIVE

To establish and maintain the QA program descriptions.

ACTIVITIES AND ACCOMPLISHMENTS

QMP-17.01, R5, YMP-USGS Records Management, was approved. QMP-3.15, R0, Application of Graded Quality Assurance, was completed and approved. This procedure will be issued and reviewed by the DOE audit early next month and will be implemented in the near future.

The following QMPs were distributed for division review:

- QMP-3.08, R0 Submittal of Prerequisites and Test Information (Prerequisites Review)
- QMP-2.05, R4 Qualification of Audit Personnel
- QMP-18.01, R7 Audits
- QMP-18.02, R3 Surveillances

The following modifications were prepared and approved:

- QMP-4.02,R3-M1 Control of Management Agreements
- QMP-3.03,R3-M1 Software Quality Assurance
- QMP-2.02,R5-M2 USGS Personnel Qualification
- QMP-2.08,R1-M3 Non-Federal Contractor Personnel Qualification

The following draft QMPs were changed as requested and returned to their respective authors:

- QMP-3.04, R4 Technical Review, Approval, and Distribution of YMP-USGS Publications
- QMP-3.07, R4 YMP-USGS Review Procedure
- QMP-3.08, R0 Submittal of Prerequisites and Test Information (Prerequisite Review)
- QMP-3.15, R0 Application of Graded Quality Assurance
- QMP-4.01, R4 Procurement Document Control
- QMP-7.01, R5 Control of Purchased Items and Services
- QMP-7.04, R0 Vendor Evaluation
- QMP-16.03, R3 Trend Analysis
- QMP-18.01, R7 Audits
- QMP-18.02, R3 Surveillances

The QMP master list was updated and forwarded to the YMP-USGS QA office.

The USBR amended their response to Surveillance USGS-92-S01; NCR-92-05 was submitted to the USGS QA office for review and approval.

The USBR QA manager took a trip to the Yucca Mountain site to ensure proper training of USBR personnel performing in-place density testing in support of SCP 8.3.1.14.2.2 on March 3-5. He made a follow-up trip March 15-18 to ensure the effectiveness of USBR-7221 training of USBR personnel.

CAR No. USBR-91-01 was submitted to the USGS QA office in accordance with USBR-QMP-

16.01.

Response to Surveillance Observation USGS-92-S01-OBS1 from Surveillance USGS-92-S01 was accepted by the USGS QA office on March 12.

USBR submitted QA Balance calibration information to the USGS QA office in support of USGS-NCR-91-31.

Surveillance No. USGS-91-S08 was performed by the USGS and facilitated by the USBR QA office on March 20-30.

#### WBS 1.2.9.3.2 Quality Assurance - Audits and Surveillances

Principal Investigator - T. Chaney

#### OBJECTIVE

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

#### ACTIVITIES AND ACCOMPLISHMENTS

Audit Report USGS-92-02 of five USGS-HIP activities was written. The Audit resulted in the initiation of one Corrective Action Report and one Observation.

Audit Report USGS-92-03 of ten USGS-HIP activities was written. The Audit resulted in the issuance of four Audit Finding Reports.

Audit USGS-92-04 of six USGS-HIP activities was researched, planned, and conducted resulting in four Audit Finding Reports. Verification of several NCRs and Audit Findings also were conducted during the Audit.

Vendor Evaluation 92-E07, for Hewlett Packard, was submitted recommending retention on the Approved Vendors List.

Vendor Evaluation 92-E10, for Reynolds Electrical and Engineering Co. was performed in conjunction with OCRWM vendor requalification audit YMP-92-10. A report indicating favorable results will be prepared and submitted.

Surveillance Package 92-S01 was closed and transmitted to the Local Records Center. Surveillance Report 92-S04, for Sierra Instruments, Inc. was submitted. QA concerns were listed on two Observations which require a response. Surveillance Report 92-S05, MKS Instruments, Inc. was submitted recommending inclusion on the Approved Vendors List. Surveillance Plan 92-S06, Ruska Instruments, Inc. was submitted and the surveillance performed with favorable results. Surveillance Plan 92-S08, for the U.S. Bureau of Reclamation, was submitted and the surveillance performed to verify corrective actions for USGS-AFR-9007-01, Rev. 1. A report will be submitted.

Investigative reviews for verification of completed actions were completed for closure of NCRs -91-09, -91-43, 91-44, 92-07, and USGS AFR-9112-04.

### WBS 1.2.9.3.3 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

Management reviews were performed in accordance with QMP-3.07, R3 (reviews) for draft OMPs: QMP-3.08, R0 (Submittal of Prerequisites and Test Information) and QMP-3.15, R0 (Application of Graded QA); and Modifications for QMP-2.05, R4 (Qualification of Audit Personnel), QMP-18.01, R7 (Audits), and QMP-18.02, R3 (Surveillances). In addition, meetings were held with the QA office and the Chief, YMPB, to discuss the pertinent QA and management requirements for the next draft of QMP-5.05, R3 (scientific notebooks).

Members of the Open Items Committee continued to provide weekly updates to the QA open items coordinator. The Open Items Committee met once during March to discuss the status of various open items. The following open items were addressed during the month:

External Item(s): DOE/YMPO CARs YM-91-74 through YM-91-77 (software requirements); and NRC DNs 1 through 4 (site potentiometric water level evaluations).

Internal Item(s): Audits: AFR 9007-01 R1, 9110-02 (YMP-USGS qualification records), 9112-02 (management agreements), 9115-01 and -02 (USBR procurements and technical procedures); CAR 90-04 (timeliness of corrective actions), CAR 91-03 (unapproved vendors), CAR-91-05 (procurement record packages), CAR 91-06 (management assessments), CAR 91-07 (misinterpretation of QMP requirements), CAR 91-08 (transmittals for individual QA records), CAR 91-09 (misinterpretation of software requirements), CAR 91-10 (misinterpretation of exemptions from procurement QA requirements), CAR 91-11 (scoping activities without documented authorization), CAR 92-03 (management agreements), CAR 92-04 (work authorization for SCP Activity 8.3.1.2.2.6.1), CAR 92-05 (problems with manuscript processing); NCR 90-37 (calibration standards), NCR 91-09 (sampling), NCR 91-14 (qualification records with Study Plans), NCR 91-31 (QA Balance calibrations), NCR 91-37 and 91-38 (report processing problems), NCR 92-02 (SGBSN management agreement), NCR 92-05 (USBR Earth Manual procedures), NCR 92-06 (seismic publications), NCR 92-08 (report processing problem), NCR 92-10 (review of data), NCR 92-13 and 92-14 (report processing problems).

Other miscellaneous actions involved coordinating with YMPB and QA personnel during internal Audit 92-04; coordinating with the Open Items Committee members on planning details for the upcoming DOE/YMPO Audit 92-13; monitoring the status of open and/or overdue training assignments and document transmittal notices; and continuing to update the tracking logs for statusing GSP technical activities and TPO action items.

Several CAR Board meetings addressed associated actions that were discussed involving CAR-90-04 (timeliness of actions), CAR-92-06 (management assessments), CAR-92-03 (management agreements), CAR-91-10 (processing exempt procurements), CAR-91-11 (work authorization) and CAR 92-05 (report processing problems). Also NCR-91-10 (technical procedure boilerplate requirements) was discussed and elevated to CAR-92-06.

Re-evaluation of previous QMP-3.03 classification and documentation requirements was completed on behalf of the Configuration Control Committee (CCC) for software covered by USGS-NCR-92-

02 (Southern Great Basin Seismic Network). The results of this evaluation have been prepared for presentation on April 2, 1992, to the CCC and the technical contact for their concurrence.

Approximately 45 items have been received, reviewed, and/or processed by the SCM coordinator in accordance with QMP-3.03, R3. The Configuration Status Log has been updated and technical contacts have been notified of status of SQA documentation.

An agenda and minutes were prepared for the CCC meetings held on March 5 and 19. CCC Review documentation was completed for each of the CCC reviews conducted at those meetings.

A memorandum and enclosures were prepared for the Chief, YMPB, to transmit the CCC's recommended classification and documentation requirements for QMP-3.03, R2 software to the appropriate technical contacts. Actions related to the issuance of ICN 8 to QAPP-01, R5 were completed. A modification to QMP-3.03, R3 was drafted to conclude resolution of independent verification and validation issues which were remaining from the November 12, 1991 comment resolution of QMP-3.03, R3. Support was provided to the SQA specialist in the production and distribution of two memoranda regarding implementation of QMP-3.03, R3. Notifications have been prepared on behalf of the SQA Specialist to transmit the results of his re-evaluation of certain user manuals. Actions have been initiated to identify data identification requirements for previously released software. All of these actions are pursuant to USGS-CAR-91-09 and are summarized in a supplemental response which was provided on March 27.

A supplemental response was provided to document completion of corrective action associated with DOE CAR YM-91-077.

Two Quality Assurance Grading Reports for the International Program, G1233132aI, Hydrochemical Characterization of the Upper Part of the Saturated Zone (Steinkampf), and G1233131aI, Development of Multiple-Well Hydraulic Test and Field Tracer Test Methods (Umari), were reviewed, approved and submitted to the YMP Quality Review Board for acceptance.

#### WBS 1.2.9.3.4 Quality Assurance - Quality Overview

Principal Investigator - T. Chaney

#### OBJECTIVE

To provide reviews, analysis, and interpretations of QA requirements and application of QA to technical and scientific disciplines.

#### ACTIVITIES AND ACCOMPLISHMENTS

Prepared daily and weekly status of open items and input to open items data base for trending.

The February Open Items and Trend Analysis Report was written and issued.

Several trend analysis problems were addressed including YMPB report processing problems and untimely open items responses and/or actions. In addition, the chairman of the YMP-USGS 1991 Management Assessment Committee continued with preparation of its report. Draft input was forwarded to the chairman for incorporation into the draft report. Interviews with select management and technical personnel, QA implementation support personnel, and QA personnel will take place in April.



I-326386 *djc*

# United States Department of the Interior



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

IN REPLY REFER TO:

April 15, 1992

Carl P. Gertz, Project Manager  
Yucca Mountain Project Office  
U.S. Department of Energy  
P.O. Box 98608  
Las Vegas, Nevada 89193-8608

*Sari*  
*Umeka*  
*Wyer*  
*Gym / Simms*  
*Bradsky*  
*Jones, S*  
*Sticker* } rw-22  
*Wallace*  
*Gertz*  
*Japon*  
*Blanchard* } w/b  
*4/20/92*

WBS: 1.2.9.2  
QA: N/A

APR 20 2 32 PM '92

SUBJECT: U.S. Geological Survey Yucca Mountain Project Monthly Summary for March 1992.

Dear Carl:

In compliance with the revised Yucca Mountain Project monthly reporting procedures, following is the YMP USGS input for March, 1992. If you have any questions, please contact Raye Ritchey at FTS 776-0517.

### WBS 1.2.1 - SYSTEMS ENGINEERING

The performance assessment modeling project reports that moisture retention curves are being developed on many samples representing all of the lithologic units present in USW UZN-55. The data will be used for input to the 1-D model. Several of the N-55 core are being oven dried at temperatures ranging from 200 C - 800 C to determine the appropriate temperature to remove all hydrogen from the rock matrix. Preliminary results indicate that this will improve the neutron probe calibration. All core from N-55 will be dried at high temperature to determine the final calibration to use for the model.

In support of the development and validation of flow and transport models, thermal probe design has been completed and tested in prototype experiments. An experimental protocol has been developed and tested for determining thermal conductivity and heat capacity of rock cores as a function of water content. Data logger programs and wiring panels have been constructed for a system to measure properties on six rock cores simultaneously. Construction and calibration of a set of thermal probes is in progress. A computer program for reading datalogger files and computing thermal

properties, which permits interactive data interpretation and analysis, was completed. Analysis of data from the Shardy Base horizontal transect has been completed. Measured properties include: bulk density, porosity, saturated hydraulic conductivity, and sorptivity. Water characteristic curves have also been measured. This activity has been expanded to include an intensive 2-D sampling grid which is being used to investigate vertical and horizontal trends in bulk and hydraulic properties. Approximately 300 1" core specimens were collected in a series of 26 vertical transects arranged across a horizontal transect approximately 3500 ft. long.

In support of supporting calculations for postclosure performance analysis, a welded core sample, 1.5 inches in diameter, was initially saturated and then evaporated to attain various water contents. Water potential was determined using the CX-2 at each water content to develop a moisture retention curve. A Brooks and Corey model was successfully fit to the data. Additional core samples are being prepared for moisture retention and an experimental procedure is being developed to see if the particle size of rock chunks has an influence on the measured water potential. Imbibition and moisture retention were completed on the composite transect samples. All remaining core from the UZ-6 transect are undergoing imbibition experiments.

### WBS 1.2.3 - SITE INVESTIGATIONS

The precipitation and meteorological monitoring project reports that March was one of the wettest months on record in southern Nevada, increasing the yearly rainfall total at the Nevada Test Site to well above normal. Five major storm systems moved through the region. Rainfall amounts were variable around Yucca Mountain depending on location and elevation. All five systems appeared to be the result of a split in the jet stream causing low pressure centers to develop off the coast of southern California. This type of storm track is the most likely to produce heavy precipitation in the southern Nevada region. Preliminary analysis shows that nearly 3 inches fell over portions of Yucca Mountain. The storm of March 30 produced widespread lightning throughout southern Nevada. The data were collected and archived for future study in relation to precipitation patterns. Lightning was observed near Yucca Mountain and in Jackass Flats. Accumulation of rainfall data was collected after each event. The data were compared with surface-water data and provided runoff characteristics for storms which occurred both on and off the Test Site. Three separate measurements were made on the Amargosa River at Tecopa station 10251300, ranging in discharge from 150 to 170 cfs. Measurements made on the Test Site include a series of four, made at the Unnamed Tributary to Fortymile Wash near Rattlesnake Ridge, Station 10251248. Discharges range from 1.5 to 2.5 cfs. Water samples were taken and a schedule, 1904 and 39A, is being processed at the USGS Denver lab. Local runoff from Jackass Flats, Area 25, was measured at Topopah Wash at Little Skull Mountain, Station 10251260. The measurement was made 30 miles upstream of the gage. A discharge of 1.5 cfs was obtained on

March 30.

Staff from the transport of debris by severe runoff studies conducted reconnaissance in southern Nevada to determine if any debris had moved as a result of severe storms in February and March. March storms were particularly heavy and produced intense precipitation, hail, and flooding. On March 30th a funnel cloud touched south of Las Vegas and golf-ball size hail pelted the area. Heavy rain during the March 26-27 storm resulted in severe runoff and flooding in those parts of the valley where the brunt of the storm system was positioned. Streamflow and erosion was particularly heavy along Las Vegas Wash to the east and along its major tributaries, as well as in places where city streets act as conduits that drain flood waters from the large alluvial fans surrounding the valley. Areas of highest runoff were reconnoitered to look for evidence of heavy debris transport. Along the Amargosa River, only minor streamflow and no evidence of intense debris transport were recorded.

In support of studies on regional potentiometric levels and hydrologic properties, field reconnaissance was performed for additional mining company drillholes constructed in the Funeral Mountains and Greenwater Range. Water levels were measured in nine observation wells in the southern half of the subregional groundwater flow system.

Analysis of rock outcrop samples in support of the characterization of hydrologic properties of surficial materials has been extended to incorporate at least two more transects. Along with the Prow transect, an additional transect, collecting over 300 samples in the Shardy Base of Tiva Canyon along the west side of Yucca Ridge in Solitario Canyon, was conducted this month. To investigate the relationship between vertical and horizontal variability in this seemingly very deterministic lithologic unit, 26 vertical transects of 10-15 samples over the 35 foot thick unit were collected over a 4000 foot distance along the unit to create a 2-D dataset. Moisture retention data on the horizontal transect of the Shardy Base indicate a fairly uniform air entry potential of about 0.5 bars which will be used for modeling purposes. Imbibition experiments on that dataset indicate quite a lot of variability, which corresponds with the variation in porosity shown vertically in the unit.

The natural infiltration project reports that the analysis of moisture profiles for selected boreholes in Pagany Wash and 40-Mile Wash, and also for the newly installed boreholes, continued as additional data were collected. The boreholes were logged at an increased frequency because of the much higher than average magnitude and frequency of precipitation that occurred for January, February and March. The series of moisture profiles obtained indicated that the downward movement of a well defined wetting front to a depth of approximately 2 meters for the newly installed

boreholes and for the boreholes in Pagany Wash, while the two boreholes in 40-Mile Wash, N-92 and N-91, indicated a greater volume of infiltrated water to a depth of 4 to 5 meters. These profiles will be useful as a means of model validation for the small scale deterministic modeling activity, as well as for inverse modeling, specifically in terms of the upper surface layer and the ET boundary condition, because relatively accurate measurements of precipitation depths were made at each borehole site using a storage gage. Logging of the selected boreholes at weekly intervals will continue in order to measure changes in moisture profiles due to evapotranspiration. This work will be valuable in understanding both hydrologic processes and material properties within the upper 2 meters of surficial materials. Installation of boreholes N-17, N-15 and N-16 in Pagany Wash was completed despite a significant amount of downtime due to adverse weather conditions.

In support of matrix hydrologic properties testing, saturated hydraulic conductivities were measured on approximately 70 samples from the composite transect. These samples were assembled to provide representative core plugs from all of the lithologic units in the unsaturated zone at Yucca Mountain. Permeabilities are being run on deeper Calico Hills core samples from the GU-3 borehole. Additional samples have been selected for intersampling from the LEXAN liners to make additional measurements supplementing the dataset from the can samples. As the neutron probe calibration equation efforts have progressed, it was seen as necessary to remove all of the water from the rock samples by heating to very high temperatures and it was shown that some of the units do maintain quite a bit of stored water when dried at only 105 C.

In support of prototype infiltration testing, an imbibition experiment on a welded tuff (diam. = 53mm; length = 127mm) core sample was begun on February 5 and ended on March 9. This test was designed to study the effect of fracture mineral coating on the water imbibition process. Approximately 10 cubic cm of water were imbibed into the sample through an area of 22 squared cm. The ponding test, begun on October 28, 1991, continued. The water front has moved about 40 to 45 cm in the fractures and 5 to 10 cm in the matrix surrounding the fracture. The water movement in the fractures is not as fast as originally expected. Eight out of the eighteen thermocouple psychrometers are showing an increase in water potential (and saturation). The potential level is still detectable with the psychrometers; therefore, this stage will continue longer than originally expected.

To determine scoping and bounding calculations for use in the development of conceptual and numerical models of flow in unsaturated zone fractured rocks, steady flow within a network of five 125 micron and four 25 micron fractures was simulated for constant head boundary conditions ranging from 0.0 to -0.25 m of water in order to examine the dependence of pressure head variation and flux distribution within the network to the assigned boundary

conditions. It was observed that variance in pressure heads within the network increased and flow became more concentrated along specific pathways as pressure heads imposed at the boundaries deviated from the pressure heads at which the transmissivities for the two fracture sizes were equal. Continuum properties such as permeability were calculated for the network. Future simulations will consider the effects of various matrix materials on the observations made to date.

To conceptualize the unsaturated zone hydrogeologic system, LBL modelers are utilizing current USGS geologic and hydrologic data from neutron boreholes in the construction of a 2-D cross section model using TOUGH. When the model is completed, it will be used to conduct sensitivity analyses to identify important hydrologic parameters and to begin to investigate grid effects on moisture flow.

In support of the simulation of the natural hydrologic system, in order to facilitate the check of the 3-dimensional grid, the surface of the site-scale model has been divided into 3 zones, depending on the types of horizontal connections between the elements. These are: 1) regular elements without any contact with fault elements, 2) fault elements connected to another element that may or may not contain a fault, and 3) elements without fault but connected to a fault element. The connections between the group 1 elements have been checked; the connections between group 2 and 3 elements are being verified. Simulations with a 2-D cross section have begun in order to assess the effect of the numerical grid by the Ghost Dance Fault.

Staff from the prototype tracer testing project gave priority to coordinating the final design, acquisition, and installation of the gas tracer monitoring system at the Nevada Test Site. This monitoring system is needed for drilling which is currently scheduled to begin in April.

The prototype pore water extraction project reports that eight tests were conducted on welded and partially welded tuffs with moisture contents ranging from 5 to 22 percent. The loading method was continuous for some samples and staged for some. Staged versus continuous compression gives similar results in strain and water obtained for nonwelded tuffs, but data is incomplete for welded tuff. Comparison tests were run between nonwelded core samples and nonwelded rock chips from nearly the same interval. The chips had an average moisture content of 9.7 percent and produced an average of 15.8 ml of water and 125.5 ml of gas. The similar core averaged a moisture content of 8.6 percent and produced an average of 1.8 ml of water and 90.1 ml of gas.

In support of multiple-well interference testing, it is intended that planned hydraulic and tracer tests planned for the c-holes be prototyped at the Raymond site (Raymond Quarry near Fresno, CA).

Three 250-foot deep boreholes were drilled at the Raymond site. The boreholes were configured in a triangle similar to the c-holes, with a distance of 25 feet between each pair of wells. Preliminary hydraulic testing was conducted using the newly drilled holes. Well (0-0) was pumped, under open-hole conditions, while the pressure drawdown was monitored in two packer-isolated zones of each of the other two wells (SE-1 and SW-1). The process was repeated by pumping well SW-1, while observing the pressure drawdown in wells (0-0) and SE-1. Results have not been analyzed yet, but indicate a very good hydraulic connection between the wells.

To support the hydrochemical characterization of water in the upper saturated zone and regional hydrochemical characterization studies, water samples were collected for stable and radioisotope determinations. Samples were collected near the end of pumping of borehole JF-3, under the aegis of the environmental monitoring program; and from borehole UE-25 UZN #91.

In support of the conceptualization of saturated zone flow modeling activities, analysis was completed of existing data at the UE-25 c-well complex, compiling television and acoustic televiwer logs, caliper logs, core analyses, tracejector surveys, temperature logs, static tracer tests and heat-pulse surveys into a conceptual geologic model. This conceptual model is ready to be input to a GIS, probably the LYNX system; however, further work is on hold pending purchase, lease, or loan of the GIS software.

Staff of the isotope geochemistry support group continued work in support of stratigraphic studies, sampling cuttings from JF-3 and core from J-13, at the YMP core library. Samples will be used to further establish the isotope data base on different stratigraphic units and to compare 87/76 Sr ratios obtained from the rocks with 87/86 Sr ratios obtained from waters collected within the same stratigraphic units.

The surface-based geophysics project reports that compilation and technical review of previously acquired gravity and magnetic data from Fortymile Wash is complete. A report providing these detailed data along five profiles across Fortymile Wash just east of Yucca Mountain has been submitted for technical review. The report is primarily a data release but concludes that no significant vertical offset of geologic units occurs directly under the Wash. A gravity anomaly of approximately 2 Mgal, however, is associated with the Paintbrush Fault just west of Fortymile Wash, suggesting that the gravity method could provide an effective means to better define the location of known or suspected faults and to locate completely unknown faults, especially those concealed by alluvium.

In support of borehole geophysical surveys, the evaluation of commercially available downhole electrical logging methods in comparison tests between Dresser-Atlas and Schlumberger in logging

runs in USW G-2 continued. This evaluation and formulation of recommendations is 80 percent complete and will include consideration of a variety of logs and different models of logging tools for acquisition of each log type, including older model tools to facilitate comparisons to logging runs made in Yucca Mountain holes in the early 1980's.

Staff from the geologic mapping of zonal features project continued high-precision Sr isotopic analyses of outcrop samples (from the volcanic section in the southern portion of Yucca Mountain) which are assumed to never have been positioned below the water table. These analyses are being compared to completed 87/86 Sr ratios from core samples collected below the Topopah Spring member to assess the amount of Sr modification caused by hydrothermal alteration. Mapping and measurement continued of fault characterization parameters along and within the Ghost Dance Fault on Yucca Mountain. Work during this period took place in the area south of Whale Back Ridge. This work utilizes the rectilinear grid laid out and reported earlier, which will allow collection of numerous types of information on a consistent foundation grid. These efforts will characterize a large number of parameters along the fault which will be integrated into the geologic model. Outcrops were visited in the basal Tiva Canyon/uppermost Topopah Springs in northeastern Crater Flat where a well exposed rollover flexure was discovered.

In support of regional paleoflood evaluation studies, staff worked on a longitudinal stream profile of the modern-day Amargosa River from upper Fortymile Wash to Bad Water in Death Valley, California. The profile, when complete, will show the slope of different reaches of the river system and any breaks in slope that might be related to bedrock barriers or channel adjustments due to changes in past flow regimes. Additional longitudinal profiles will be drawn on river terraces parallel to the channel to show the geometry of the river's paleofloodplain. Field reconnaissance was conducted of alluvial fans along the west margin of the Las Vegas valley to determine whether these landforms were remnants of past environmental conditions, or if they are still active today. Although flooding in the valley (March 26-27 and 30) has shown that the fans are currently active, the presence of very well developed soils, especially in the upper fan (apex) areas, indicates surface stability. Thus, it appears that while the upper parts of the fans may be quite stable, the lower (toe) areas may still be developing. A visit to the source area of the 1990 Copper Canyon mudflow disclosed some valuable evidence of paleofloods and paleo-debris-flows in that drainage. Stratigraphic exposures were discovered that include volcanic-ash deposits, organic debris, and charcoal within various stratigraphic units. This should allow the best opportunity discovered thus far for dating these types of deposits. One of the major objectives of this dating will be to see how important the Holocene is in terms of its debris-flow history. Copper Canyon now appears to be a very important site with good

potential for development of a debris-flow history based on absolute dates.

The past discharge project reports that field trips to modern discharge springs have been expanded to test whether ostracodes and other aquatic microorganisms are found living in the aquifer. In early March, the aquatic microorganism collector was tested at well JF-3 which is 0.5 miles south of J-12 in Area 25. This well was pumping 234 gallons per minute for 36 hours. For 22 hours, 20 gallons per minute was diverted through the aquatic microorganism collector during the time of collection. Although JF-3 was pumping about 10 percent air, which was probably introduced into the aquifer during well development with high pressure compressed air, the undisturbed aquifer may not have been oxygenated. Preliminary analyses of the collection nets in the field indicated that no organisms were present and final analysis of the net contents will be completed in April.

To assist in the evaluation of possible future changes in climate, preliminary testing was begun of remote sensing techniques used for regional mapping of vegetation using Landsat Thematic Mapper data. Methods involved red/infrared ratios, normalized difference vegetation indices, soil-adjusted vegetation indices, and perpendicular vegetation indices. The most suitable methods will be used for vegetation mapping in the region (3 degree by 3 degree) area.

The soil and rock properties project reports that the USGS schedule assumed that field and laboratory testing would begin in mid-November, but failure to complete the Test Planning Package and begin North Ramp soils investigations until March may result in slippage of dependent activities including an impact on Title II design. Soils investigations began on March 2. Approximately 50 percent of the excavation of planned test pits and in-place testing is complete. Reconnaissance of areas to be mapped is also underway. The first design data submittal to Raytheon Services Nevada was made March 16. QA/Level 1 soil and rock properties (engineering data) are reviewed as acquired and submitted to RSN for use in the design process for surface facilities.

Staff from the site flood and debris hazards studies report that a significant storm March 7-8 caused renewed runoff in the Las Vegas area and along the lower Amargosa River near Tecopa. Reconnaissances of the Amargosa River in February showed that no flow from the upper basin to Death Valley Junction had occurred. Again, some light runoff from the Carson Slough area flowed through Franklin Plaza and downstream past Eagle Mountain. That flow, combined with more local runoff downstream, caused more flow to Death Valley. The magnitude of flow to Death Valley seemed similar to that of February 12-15. Peak flows were documented. Flooding of the Salt Pan, near Badwater in Death Valley, expanded as a result of the fresh water input. No intense flooding in Death

Valley was noted. An intense storm in Las Vegas on March 23-24 caused flooding in the Las Vegas valley, but did not cause flooding or surface streamflow at Yucca Mountain. Similarly, flooding did not occur in Death Valley and runoff in the lower Amargosa River was mild.

**WBS 1.2.5 - REGULATORY & INSTITUTIONAL**

In support of water resources assessment studies, well JF-3 pumping took place on March 4-5. Pumping discharge of well JF-3 was continuously monitored and recorded during pumping. Some water quality parameters were continuously monitored and periodically recorded manually. Manual water level measurements were made with an electric tape at varying intervals prior to, during, and after pumping. Observations of flow meter and flume gage-height were made and recorded. Four complete water quality samples were collected at 11 hours, 22 hours, and 34 hours after pumping started. Duplicate samples were collected at the 34-hour sampling. Total pumping period was 36 hours. Preliminary test results indicate that the drawdown in well JF-3 was about 1 1/2 feet. No drawdown was detected in well J-12.

Sincerely,

*Larry R. Hayes*

*for* Larry R. Hayes  
Technical Project Officer  
Yucca Mountain Project  
U.S. Geological Survey

cc: D. Appel, USGS/Denver  
J. Blakey, USGS/CR  
T. Blejwas, SNL/Albuquerque  
M. Brodeur, SAIC/Las Vegas  
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L. Ducret, USGS/Denver  
W. Dudley, USGS/Denver  
D. Gillies, USGS/Denver  
R. Hirsch, USGS/Reston  
V. Iorii, DOE/YMPO/Las Vegas  
C. Johnson, TESS/Las Vegas  
K. Krupka/PNL  
R. Lowder, MACTEC/Las Vegas  
R. Pritchett, REECO/Las Vegas  
R. Ritchey, USGS/Denver  
E. Roseboom, USGS/Reston  
D. Russ, USGS/  
J. Sauer, USGS/NR  
V. Schneider, USGS/Reston  
J. Shaler, SAIC/Golden  
M. Siegel, SNL, Albuquerque  
A. Simmons, DOE/YMPO/Las Vegas  
R. St. Clair, TESS, Las Vegas  
N. Trask, USGS/Reston  
B. Viani, LLNL/  
J. Weeks, USGS/Denver  
R. Wesson, USGS/  
YMP-USGS Local Records Center File 1.1.02



neutron logging of drillhole N-91 in upper Fortymile Wash were discussed. Water levels in N-91 (detected with a well sounder) rose following two precipitation/flood events; however, soil moisture increased in N-91 in only the top 5 meters of the unsaturated zone, well above the saturated zone. This suggests possible movement of water through fractures (or some other mechanism) that could not be detected using neutron logging in N-91.

Staff from the Fortymile Wash recharge study read rain wedges at and neutron logged UE-25 UZN#85, UE-25 UZN#92, and UE-29 UZN#91. Depth to water measurements were made in UE-29 UZN#91, UE-29 a#1 and UE-29 a#2. The data collection frequency was increased to document an ongoing recharge event. While measuring depth to water in UE-29 a#1, water was heard dripping in the casing indicating further support for groundwater recharge from the recent rain and runoff. Runoff observations, precipitation data, neutron logging results, and depth-to-water measurements were discussed with several staff members.

The surface based borehole studies project reports that preparations for instrumenting UZ-16 (VSP borehole) continued. A geophone cable mounting bracket was designed and a prototype built. RSN has been tasked to develop its own version. A meeting was held to discuss requirements and costs for conducting a zero effort, VSP survey of UZ-16 as part of the standard borehole logging program. The start date for drilling UZ-16 is still unknown. Temporary (summer) staff have been hired to assist with well sitting duties. Sensors for the first hydrologic instrumented borehole, probably UZ-14, have been ordered, with delivery scheduled for May. An inventory of bulk materials and supplies for instrumenting USGS and SNL boreholes was forwarded to REECO. Inventory includes pricing information and should be adequate to support REECO budgeting needs. A meeting was held with REECO to assess their interest in fabricating the Downhole Instrument Station Apparatuses (DISAs) and in constructing a cable-spooling rack to support the UZ borehole instrumentation program. Several machine shops in the Denver area were visited to evaluate capabilities and interest in fabricating the DISAs. Mass production of the DISAs needs to get underway within the next few months.

In support of vertical seismic profiling activities, all Yucca Mountain model data has been wave mode separated and deconvolved using both one signature (extracted from the zero offset data) for the whole data and 24 different signatures (one for each shot gather). All the P-mode data were migrated several times (using different parameters) in order to improve the quality of the stacked image. The P-P migration procedure was run for the 24 offsets in the following ways: 1) after deconvolving the whole set of data using one different signature for different offsets; 2) after deconvolving the whole set of data using a single signature coming from the zero offset data; 3) without any deconvolution; 4)

processing flow, as well as the best parameters, for good image achievement. Preliminary results indicate that a good image of the Yucca Mountain Model is able to be generated.

In support of the development of conceptual and numerical models of flow in unsaturated zone fractured rocks, fracture network simulations were completed that examined the variability in pressure head and flux distribution in a network of variably saturated fractures as a function of the boundary pressure head. The most general conclusions to be drawn from the study are that pressure head variability increases as the boundary pressure head deviates from the pressure head at which the permeability-thickness products of the individual fractures are equal (the cross-over pressure head) implying that, in general, pressure head will vary considerably in unsaturated fractured rock, even under steady flow conditions. Furthermore, the locations of specific pathways along which liquid flow is concentrated depends on the boundary pressure head in the rock. In general, flow becomes more concentrated along specific pathways as boundary pressure head deviates more from the cross-over pressure head. Much of the month was spent in analyzing these fracture network simulations and summarizing the work and results in a draft report, "Numerical Investigation of Steady Liquid Water Flow in a Variably Saturated Fracture Network". This report was not planned at the beginning of the year, but the work and results are thought to be significant enough to take precedence over other planned activities.

The prototype tracer testing project reports that the location of equipment and sampling points for injection and monitoring of SF<sub>6</sub> were determined. This temporary injection and monitoring system is similar to the methods employed at Apache Leap.

In support of prototype pore water extraction testing, four UZ core were cut and prepared for compression. Four core (2 welded, 2 nonwelded) with moisture contents ranging from 4.17 to 6.11 percent were compressed using the high pressure one-D compression cell. Water obtained from the tests ranged from 0 to 5.1 ml and the degree of success ranged from 0 to 36.7 percent. This phase of testing using the high pressure cell was completed on April 27. To develop the compression method for extracting pore-water, tests were performed on chips and cores of the same composition and water content. Nitrogen gas was used to purge the cell of atmospheric gas contained in the voids between chips so that CO<sub>2</sub> gas collected during squeezing is known to be from pore gas. This testing was completed April 30.

In support of site potentiometric level evaluations, the effect on the water level of the April 22 earthquake in southern California was investigated. The water level in the upper zone fluctuated less than a foot. Pressure changes were recorded in the lower interval, but the total range could not be determined.

Staff from the multiple-well interference testing project wrote a contract to drill six more wells at the Raymond Quarry site, near Oakhurst, California. It is intended that the hydraulic and tracer tests planned for the c-holes be prototyped at the Raymond site. The six wells are laid out to allow for the study of the dependence of the hydraulic parameters (obtained from the cross-hole testing) on "scale", or the distance between pumped and observed wells.

Staff from the stratigraphic studies project analyzed a suite of samples from G-4 drill core for Sr initial isotopic ratios in order to substantiate the isotope composition vs. depth variations observed previously in samples from UE-25a drill core. Data have not yet received final reduction and interpretation; however, the large range of present-day Sr isotopic ratios offers encouragement for use of this technique as a stratigraphic tool in the Topopah Springs welded and lithophysal units (cooperative study of the potential repository horizon with LANL).

In support of surface based geophysics activities, compilation and technical review of previously acquired gravity and magnetic data is complete. A manuscript, "Gravity and magnetic data of Fortymile Wash, Nevada Test Site, Nevada", was submitted for USGS Director's approval. This report shows a shallow-source magnetic anomaly directly over the Wash which does not appear to be related to topographic or magnetic terrain effects. The cause of the anomaly may be fluvial basalt debris carried downstream from the basalt flows at Dome Mountain.

In support of borehole geophysical surveys, an open-file report is in USGS review, which assesses logging results by Atlas Wireline and Schlumberger from borehole G-2. This report provides recommendations for use of specific logging tools in applications at Yucca Mountain. No appreciable differences were found between density and dielectric logs from the two suppliers. Induction logs continue to be difficult to obtain in the high-resistivity welded tuff, but Schlumberger's 40kHz tool offers a higher signal/noise ratio that should provide an operational advantage. Schlumberger's sidewall epithermal neutron technique provided good porosity estimates in both water and air-filled boreholes, with no offset as the tool moved through the water/air interface. This is a real advantage, as neither the Atlas nor Birdwell tools are calibrated to provide porosity estimates in air-filled boreholes. Neither supplier provided K, U, and Th estimates from spectral gamma-ray logging that agreed satisfactorily with core analyses.

Staff from the geologic mapping of zonal features project completed Sr isotopic analysis of five HCl-leaches from playa samples collected in November, 1991.  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios ranged widely. Analysis of residues from these same samples is still pending. These samples also were resubmitted for acetic acid leach/residue chemistry to compare the effects of weak acid attack. This study is intended to investigate the links between Sr isotopic

compositions of rock units and the eolian component in soils. Mapping and measurement continued of fault characterization parameters along, and within, the Ghost Dance fault. More than 50 percent of the mapped area has some rock exposure, allowing very detailed mapping. Data acquired so far describe north-trending fractures associated with the Ghost Dance fault in a zone up to 200 m wide. A second set of fractures oriented 20 to 40 degrees west is present in some locations. The exposures have required differentiation of Quaternary colluvium into two subdivisions to better communicate the geological information being mapped. Field mapping is underway in Crater Flat, west of Yucca Mountain. Initial results suggest structure similar to Yucca Mountain, with northward-decreasing offsets on north-trending normal faults and northward increase in left-lateral oblique slip. Exposures of the wall of the Claim Canyon caldera segment have been located. A well-defined arch, separating the structural domains of the Bullfrog Hills and northern Crater Flat was identified.

In support of past discharge studies, ostracodes were picked from four sites in the Oasis Valley: Coffey Ranch, near house; Coffey Ranch picnic area; Goss Spring; and Bailey's Hot Springs (Burro Springs). Ostracodes were also present in samples from Red Rocks Park area from Whiterock Spring and Willow Spring. Ostracodes were collected from three springs in the Spring Mountains: Cave Spring, Grapevine Spring, and Deer Creek Spring. Ostracodes were present at the spring pond at Indian Springs, Nevada. Samples of material collected from JF-3 in the microorganism collector in early March were examined under the microscope. Sand grains, paint chips, and nylon rope slivers were found in the material. Unfortunately, no remains of living organisms were found in this sample, although 26,400 gallons of water passed through the microorganism collector. Small, dark, round, glassy, ball-like material, perhaps "tekites", were in the sample.

In support of regional paleoflood evaluation studies, work progressed on longitudinal stream profiles of the modern-day Amargosa River from upper Fortymile Wash to Bad Water in Death Valley, and on drainages in the Goodsprings, Nevada (Potosi Mountain) area that are sites of recent (1990) debris flows. When complete, these profiles will show the slope of different reaches of the drainages and any breaks in slope that might be related to changes in flow regime or climatic conditions. In the Potosi Mountain area, four debris flows that occurred along ephemeral streams may provide evidence of the influential effects of channel slope and surface geology. Each of the debris flows appears to have been generated along steep tributary streams, and to have flowed out onto older gentle sloping fans before coming to a stop. The relationship between debris flow processes and landscape characteristics are important to our understanding of regional paleoflooding and the development of alluvial surfaces. Reconnaissance continued of alluvial fans along the west margin of Las Vegas valley to determine if these landforms are remnants of

past environmental conditions, or if they are currently active. Initial analysis indicates that 1) recent floods have stripped parts of the older fan surface and soil prior to burial, and 2) fan building is an active and ongoing process in the Las Vegas valley today - hypotheses supported by observations of flooding, channel erosion, and debris transport and deposition that occurred along modern drainages during the heavy rains of March, 1992.

Staff working on the development of a geomorphic map of Yucca Mountain started an erosion rate study of dated colluvial boulder fields. An analytical stereoplotter is being used to calculate a planar surface on the boulder fields and to collect a digital terrain model from the channels that cut the fields. The difference between these two surfaces, along with dates for the rock varnish from the surface of the fields, will be used to calculate a long-term erosion rate for the mountain.

The site flood and debris hazards project reports runoff continued into the first week in April from the wet weather pattern in southern Nevada that began in mid-February and continued throughout March. The final storm of this wet weather episode occurred on March 30 in the Las Vegas valley and moderate flooding resulted. The southern part of the valley was hardest hit, as in previous storms. Serious environmental damage to the lower Las Vegas Wash occurred during this final phase of storms and runoff. The lake that had been forming in Death Valley as a result of Amargosa River flows during February and March had totally evaporated by April 28. This evaporation was documented by photographs taken from Dante's View. None of the accumulation of water in Death Valley was contributed from Yucca Mountain or Fortymile Wash. No runoff occurred in the Yucca Mountain area that was able to reach the Amargosa River drainage.

Staff from the current seismicity project report that the seismic network's computer detected 45 local earthquakes for the month of April, down from 64 for March, and 99 in February. April's seismicity includes diffusely distributed earthquakes in the southern Nevada Test Site area, some of which are associated with the Rock Valley left-lateral fault system; a few earthquakes in the Pahranaagat Shear Zone south-southwest of Alamo, Nevada; a few at Grapevine Mountains, Nevada and California; one southwest of Hiko, Nevada; two in the Amargosa Desert; several in the eastern part of the Panamint Range, California; and a few elsewhere in the southern great basin (SGB). The largest SGB earthquake occurred in the Reville Range, Nevada, on April 17. Few areas that had been previously aseismic exhibited seismicity in April. No SGB earthquake in April was large enough to provide good constraint of P-wave polarities for attempting focal mechanism solutions.

In support of Midway Valley studies, approximately 17 soil pits were excavated; soil horizon logs have been completed in 9 of the pits. An appendix was written to the Midway Valley criteria letter

requesting support for cleaning and logging Trench 17, excavating Trench A-3, and excavating a box trench on the Bow Ridge fault at Trench 14d.

Staff working on the evaluation of Quaternary geology and potential faults at Yucca mountain obtained previous mapping along the Solitario Canyon fault, the Fatigue Wash fault, and northern Windy Wash fault for compilation. A structure map of southern Yucca Mountain was prepared from unpublished geologic mapping. Data from these sources will be compiled on the final fault map.

Staff evaluating the age and recurrence of movement prepared a criteria letter requesting three new trenches on the Stagecoach Road fault and one new trench on the Solitario Canyon fault. Also requested were extensive cleaning of natural outcrops on Busted Butte and cleaning of Trench CF-1 on the Fatigue Wash fault. Trench localities were selected and flagged in the field.

#### WBS 1.2.5 - REGULATORY & INSTITUTIONAL

In support of water resource monitoring, ground water levels were measured at 27 sites, with ground water discharge measured at one flowing well. Conversion of well JF-3 to the final monitoring configuration was initiated on April 15 and monitoring strings were installed on April 20. Preliminary evaluation of data on ground water quality collected to date (with respect to constituent concentrations, variability of parameters, and areal coverage) began.

Sincerely,



*for* Larry R. Hayes  
Technical Project Officer  
Yucca Mountain Project  
U.S. Geological Survey

cc: D. Appel, USGS/Denver  
J. Blakey, USGS/CR  
T. Blejwas, SNL/Albuquerque  
M. Brodeur, SAIC/Las Vegas  
R. Bullock, RSN/Las Vegas  
D. Campbell, USBR/Denver  
J. Canepa, LANL/Los Alamos  
T. Chaney, USGS/Denver  
T. Conomos, USGS/WR  
J. Cook, USGS/SR  
R. Craig, USGS/Las Vegas  
J. Docka, Weston/Washington D.C.  
✓ R. Dyer, DOE/YMPO/Las Vegas  
L. Ducret, USGS/Denver  
W. Dudley, USGS/Denver  
D. Faust, TESS, Las Vegas  
D/ Gillies, USGS/Denver  
✓ R. Hirsch, USGS/Reston  
✓ V. Iorii, DOE/YMPO/Las Vegas  
C. Johnson, TESS/Las Vegas  
K. Krupka/PNL  
R. Lowder, MACTEC/Las Vegas  
R. Pritchett, REECO/Las Vegas  
R. Ritchey, USGS/Denver  
E. Roseboom, USGS/Reston  
D. Russ, USGS/  
J. Sauer, USGS/NR  
V. Schneider, USGS/Reston  
M. Siegel, SNL, Albuquerque  
✓ A. Simmons, DOE/YMPO/Las Vegas  
R. St. Clair, TESS, Las Vegas  
T. Statton, TESS, Las Vegas  
N. Trask, USGS/Reston  
B. Viani, LLNL/  
J. Weeks, USGS/Denver  
R. Wesson, USGS/  
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I-327029 *up*

United States Department of the Interior



GEOLOGICAL SURVEY

MAY 8 2 20 PM '00

WATER RESOURCES DIVISION

333 West Nye Lane

Room # 203

Carson City, NV 89706

May 5, 1992

Mr. Carl P. Gertz, Project Manager  
Attn: Ms. Wendy Dixon  
U. S. Department of Energy  
Yucca Mountain Project Office  
P.O. Box 98608  
Las Vegas, NV 89193-8608

Dear Ms. Dixon:

Enclosed is the monthly status report for the Water-Resources Monitoring Program. This report is for the period April 1 - April 30, 1992.

If any clarification or additional information is needed, please don't hesitate to call me (at 702-887-7600).

Sincerely,

*Richard J. La Camera*

Richard J. La Camera  
Hydrologist

Enclosure

cc/w enc:

- Kathleen Grassmeier, DOE/YMPO, Las Vegas, NV
- Gregg Fasano, SAIC, Las Vegas, NV
- Raye Ritchey, WRD, Denver, CO
- Dan Gillies, HIP, Denver, CO
- Dave Beck, WRD, Las Vegas, NV
- Craig Westenburg, WRD, Las Vegas, NV

DIVISION Dixon  
 CC: Grassmeier  
 CC: Wilson  
 CC: Dyer  
 CC: Schrecka  
 CC: R. White  
 CC: Orest up  
 CC: Jones  
 CC: \_\_\_\_\_

REC'D IN YMP  
5/8/92

ENCLOSURE 141

**Yucca Mountain Project  
USGS Monthly Status Report  
March 1992**

**Project Title:** Water-Resources Monitoring

**WBS Number:** 1.2.5.4.8. G

**Summary Account #:** OG54892B

**Project Chief:** Richard J. La Camera, U.S. Geological Survey (USGS), Water Resources Division, Nevada District

**Reporting Period:** April 1-30, 1992

**Section I. LATEST REVISED FUNDING ESTIMATE FOR FY 92:** Not Revised.

Operating: \$ 529,000  
Capital Equipment: \$ 27,000

**Section II. PROGRESS AGAINST PLANS/SCHEDULE:**

**A. Schedule Status:** See attachment 1.

**B. Narrative of Progress and Work Performed:**

**1. 3GWR011 Survey Monitoring Sites**

Land surveys of reference points at two monitoring sites were conducted to permit the calculation of water-surface altitudes. Surveys have now been conducted for twenty two of twenty four sites at which the need for surveys have been identified.

**2. 3GWR0001 Ground-Water Level/Springflow Monitoring FY-92**

Ground-water levels were measured at twenty seven sites. Ground-water discharge was measured at one flowing well. Water level and discharge data were checked and filed, and data entry into computerized USGS databases was initiated. Responses to technical-review comments on the procedure for measurement of discharge using flumes, weirs, and barrels (HP-54) were prepared as per QA requirements.

**3. 3GWR010 Aquifer Pump Test JF-3**

Checking, reviewing, and entering of data into computerized USGS databases was initiated. The data includes continuous water-level, periodic water-level, pump discharge, and water-quality data collected at wells J-12 and JF-3 before, during, and after drilling and pumping of well JF-3.

**4. 3GWR013 Instrument JF-3**

Conversion of well JF-3 to the final monitoring configuration was initiated by the DOE contractor on April 15. USGS personnel were onsite to observe pump removal on April 15 and 16, and monitoring strings were installed on April 20. Placement of a cement pad around the well by the DOE contractor and subsequent calibration and installation of water-level monitoring equipment by USGS are scheduled for early May.

**5. 3GWR006 Ground-Water Monitoring Report, 2nd Quarter FY-92**

Water level and discharge data collected during the second quarter of FY 92 were reviewed and compiled, and report preparation was begun.

**6. 3GWR014 Capital Equipment Procurement**

Monitoring equipment for well JF-3 was received. Development of specifications and selection of an appropriate mobile water-quality lab began.

**7. 3GWR004 Ground-Water Quality Data Collection**

Water-quality measurements and samples were collected at three wells. Samples were shipped to the USGS National Water-Quality Laboratory. The scientific notebook for water-quality monitoring (HP 225T) was closed, as per QA requirements, following approval and implementation of HP 225 for water-quality measurements. The measurements and samples collected complete this activity, which entailed the first, semi-annual measurement of water quality at ten sites.

**8. 3GWR016 Water-Quality Network Revision**

Preliminary evaluations of data on ground-water quality collected to date (with respect to constituent concentrations, variability of parameters, and areal coverage) began. Documentation of the network, and any revisions, will be based on such analyses and was not warranted at this time.

**9. 3GWR017 Water-Level Monitoring Network Revision**

DOE is considering USGS recommendations to improve data-collection capabilities at several network sites. A revision of the water-level and springflow monitoring network was not warranted at this time.

**10. 3GWR018 Consult on Revision to EFAP**

Based on discussions with SAIC personnel, there is a need for revision of the EFAP in FY 92. Also as per those discussions, USGS consultation regarding content of the EFAP will begin upon initiation of revisions by SAIC.

**11. 3GWR015 Calibrate Water-Level Equipment**

Electric tapes were checked for accuracy against a reference steel tape tape utilized by site-characterization investigations in December 1991. Calibration checks of continuous water-level monitoring equipment installed in wells J-12 and JF-3 were conducted in December 1991 and February 1992.

**C. Variances/Problems/Notes:**

**1. 3GWR011 Survey Monitoring Sites**

Activity has been limited due to priority of water-level and water-quality monitoring. Impact on project is minimal since water-level data are measured as depths below a specific measuring point (and can be converted to water-surface altitude after surveying is completed).

**2. 3GWR0001 Ground-Water Level/Springflow Monitoring FY-92**

Water-level data were not collected at Army Well 1 due to a lack of access to the water surface.

**3. 3GWR010 Aquifer Pump Test JF-3**

The actual pump-testing of well JF-3 is complete. This activity, however, will not be listed as completed until water level and well-discharge data have been checked, reviewed, and processed into computerized USGS databases. Completion of data processing is planned in July. Although relocation of USGS offices, priority data-collection activities, and complications related to data processing (such as reformatting of data and proper identification of data in the database) have delayed entry of the data collected into computerized databases, the delay will not impact monitoring activities.

**4. 3GWR013 Instrument JF-3**

Installation of an instrument shelter and calibration and installation of water-level monitoring equipment will occur after the placement of a cement pad around the well by the DOE contractor. Construction of the pad, installation of the shelter, and calibration and installation of water-level monitoring equipment are currently scheduled for completion by mid-May. In the interim, continual monitoring of water levels in well J-12 (which the NTS has cooperatively kept in a non-pumping status) has been maintained, and that well will provide for monitoring of water levels between pumping well J-13 and Amargosa Valley.

**5. 3GWR006 Ground-Water Monitoring Report, 2nd Quarter FY-92**

None.

**6. 3GWR014 Capital Equipment Procurement**

Selection and receipt of an Interior vehicle may not occur by the end of the fiscal year. Receipt of such a vehicle is a prerequisite to the design, selection, and procurement of modifications to provide for a mobile water-quality lab. Should delays in obtaining a vehicle which preclude procurement of the mobile lab before the end of the fiscal year occur, other USGS vehicles will be utilized to accomplish the collection of water-quality data and capital equipment funds will be reprogrammed to FY 93.

**7. 3GWR004 Ground-Water Quality Data Collection**

None.

**8. 3GWR016 Water-Quality Network Revision**

None.

**9. 3GWR017 Water-Level Monitoring Network Revision**

None.

**10. 3GWR018 Consult on Revision to EFAP**

Limited activity. Impact on the program is minimal, since the EFAP serves primarily to document plans and technical activities for the program. In the interim, plans and technical activities of the program will continue under the direction of the existing

EFAP, the ground-water level and springflow monitoring plan developed to address concerns of the NPS, and consultations with DOE. At this time, no delay in the scheduled completion date for this activity is anticipated.

**11. 3GWR015 Calibrate Water-Level Equipment**

Activity was initiated ahead of schedule to improve the accuracy of water-level measurements during testing of well JF-3 and routine monitoring. Subsequent calibration checks will occur periodically, as warranted by changes in equipment utilized and indicators of equipment performance.

**D. Plans For Next Month:**

**1. 3GWR011 Survey Monitoring Sites**

Complete the activity by conducting surveys of reference points at two remaining sites in the monitoring network for ground-water levels.

**2. 3GWR001 Ground-Water Level/Springflow Monitoring FY-92**

Measure ground-water levels and springflows at all accessible sites in the monitoring network, and check and file the data collected.

**3. 3GWR010 Aquifer Pump Test JF-3**

Limited progress in data processing is anticipated due to priority of ground-water level monitoring, springflow monitoring, instrumenting of well JF-3, and preparation of the quarterly data report. Checking and reviewing of data collected will continue as time permits.

**4. 3GWR013 Instrument JF-3**

Complete the activity by installing a cement pad, instrument shelter, and calibrated water-level monitoring equipment.

**5. 3GWR006 Ground-Water Monitoring Report, 2nd Quarter FY-92**

Complete the activity by reviewing and compiling data, and delivering the data report to DOE..

**6. 3GWR014 Capital Equipment Procurement**

Select and initiate procurement of an Interior vehicle. Plan, design, and initiate procurement (to the extent possible) of modifications to the vehicle for water-quality monitoring.

**7. 3GWR004 Ground-Water Quality Data Collection**

None scheduled or planned.

**8. 3GWR016 Water-Quality Network Revision**

Limited progress is anticipated due to priority of ground-water level monitoring, springflow monitoring, instrumenting of well JF-3, and preparation of the quarterly data report. Evaluation of data on ground-water quality collected to date will continue as time permits.

**9. 3GWR017 Water-Level Monitoring Network Revision**

None scheduled or planned.

10. 3GWR018 Consult on Revision to EFAP

None scheduled or planned.

III. WORK PERFORMED WHICH WAS NOT DESCRIBED IN ORIGINAL SCHEDULE:

1. Changes to water applications for the support of site-characterization activities were discussed with DOE, NPS, USFWS, and USGS personnel. Preliminary data from the testing of well JF-3, and potential effects of increased withdrawals on Death Valley National Monument (DVNM) resources were evaluated.
2. As per a meeting in DVNM, the NPS will obtain and operate the redundant monitoring system, but would like USGS input and/or assistance on installation. Potential configurations for the installation of a redundant, water-level monitoring system at Devils Hole were evaluated.

USGS Monthly Status Report  
April, 1992

A # 0G54892B

SA Manager: LACAMERA

SA Title: 1.2.5.4.8 Water Resources Assessment (Ground Water)

P&S #: 0G548

Type of Account: Discrete

(Please read and follow instructions for each item below)

I. Latest revised estimate (\$000.0) \_\_\_\_\_ hours \_\_\_\_\_

II. Progress Against Plans/Schedule

A. Schedule Status: Enter Actual Start, Planned Finish, and Actual Finish dates, as appropriate.

ACTIVITY ID	CODE	ACTIVITY TITLE	EARLY START	EARLY FINISH	ACTUAL START	PLANNED FINISH	ACTUAL FINISH
3GWR006M	0G54892B	GROUNDWATER REPORT SECOND QUARTER-FY92	/ /	05/15/92	/ /	/ /	/ /
3GWR007M	0G54892B	GROUND WATER REPORT THIRD QUARTER-FY92	/ /	08/14/92	/ /	/ /	/ /
3GWR009	0G54892B	locate design Well JF-3	/ /	/ /	10/01/91	/ /	11/20/91
3GWR011	0G54892B	survey monitoring network sites	/ /	/ /	10/01/91	<del>04/30/92</del> 05/31/92	/ /
3GWR001	0G54892B	ground water levels springflow monitoring FY-92	/ /	/ /	10/01/91	09/30/92	/ /
3GWR005	0G54892B	G-W monitoring report first quarter report FY92	/ /	/ /	11/15/91	/ /	02/13/92
3GWR010	0G54892B	aquifer pump test JF-3	/ /	/ /	11/16/91	<del>04/30/92</del> 07/31/92	/ /
3GWR013	0G54892B	Instrument JF-3	/ /	/ /	12/16/91	<del>04/30/92</del> 05/31/92	/ /
3GWR005M	0G54892B	GROUNDWATER REPORT FIRST QUARTER-FY92	/ /	/ /	02/13/92	/ /	02/13/92
3GWR006	0G54892B	G-W monitoring report second quarter-FY92	/ /	/ /	03/02/92	05/15/92	/ /
3GWR014	0G54892B	capital equipment procurement	/ /	/ /	03/02/92	06/30/92	/ /
3GWR004	0G54892B	ground water quality data collection	/ /	/ /	03/23/92	<del>04/27/92</del> 4/30/92	/ /

3GWR016	06548928 water quality network revision	<del>04/01/92</del> 07/30/92	04/01/92	1	1	1
3GWR017	06548928 water level monitoring network revision	<del>04/01/92</del> 07/30/92	04/01/92	1	1	1
3GWR018	06548928 consult on revision to environmental field plan	<del>04/01/92</del> 09/01/92	04/01/92	1	1	1
3GWR019	06548928 compile regional water resources data	05/15/92 09/01/92		1	1	1
3GWR007	06548928 G-W monitoring report third quarter-FY92	05/18/92 08/14/92		1	1	1
3GWR020	06548928 compile water-use data FY 91	06/15/92 09/30/92		1	1	1
3GWR012	06548928 instrument tracer well	07/01/92 09/14/92		1	1	1
3GWR015	06548928 calibrate water level equipment	<del>07/16/92</del> 09/14/92	12/15/91	1	1	1
3GWR004A	06548928 ground water quality data collection	08/03/92 09/30/92		1	1	1

B. Narrative of Work Performed (What, When, Where, How, Why)  
Reference activity ID and activity title; code each narrative bullet.  
Ex: 3GSS111A Conduct Scoping Study for Mag. Est.:  
^ narrative bullet (T) - Technical Work  
^ narrative bullet (Q) - Quality Assurance  
^ narrative bullet (P) - Planning, Operations, Logistics

C. Variances: Describe any departures from original schedules. Address cause, impact (short- and long-term), and any planned or possible corrective action. Reference activity ID number and title.