



United States Department of the Interior

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IN REPLY REFER TO:

April 2, 1993

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QA: N/A

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

Dear Carl:

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

Sincerely,

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Larry R. Hayes
Technical Project Officer
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Department of the Interior
United States Geological Survey
YUCCA MOUNTAIN PROJECT
Monthly Highlights and Status Report
February 1993

DISCLAIMER

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

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ACRONYM LIST

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

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

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

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

GMP	Geologic Modeling Program
GMS	Geoscience Modeling System
GMT	Greenwich Mean Time
GOCO	government-owned contractor-operated
GOES	Geostatistical Environmental Operational Satellite
GP	Geologic Procedure
GPO	Government Printing Office
GPP	Geophysical Procedure
GPR	ground-penetrating radar
GPS	global positioning satellite
GQA	Graded Quality Assurance
GRESS	Gradient Enhanced Software System
GSA	Geological Society of America
GSA	General Services Administration
GSIS	Geoscientific Information System
GSP	Geologic Studies Program
GTUF	G-Tunnel Underground Facility
GW	ground water
GWE	Gigawatts Electrical
GWTT	ground water travel time
GXP	Geochemical Procedure
HIP	Hydrologic Investigations Program (formerly NHP)
HITF	Hydrology Integration Task Force
HLRW	high-level radioactive waste
HLRWM	High-Level Radioactive Waste Management
HLW	high-level waste
HP	Hewlett Packard
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
ISM	Interactive Surface Modeling
ISO	International Standards Organization
ITR	Information Technology Resources
IVV	Independent Verification and Validation
JGR	<i>Journal of Geologic Research</i>
LA	license application
LACT	laser alignment and centering target
LAN	local area network
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley Laboratories
LCS	Liquid Scintillation Counter
LDRP	litigation discovery request procedure
LDS	lightning detection system
LLNL	Lawrence Livermore National Laboratory
LLP	Lightning Location & Protection, Inc.
LLW	low-level waste
LOE	level of effort
LPRS	large plot rainfall simulation
LRC	Local Records Center
LRE	latest revised estimate
LRGS	Local Read-Out Ground Station
LRP	long-range plan
LRP/IPS	Long Range Plan/Integrated Project Schedule
LRS	Litton Resource System
LSC	liquid scintillation counter
LSP	laser safety plan
LSS	Licensing Support System
LWS	Lathrop Wells aeromagnetic survey
LV	Las Vegas
MAs	Management Agreements
MADS	Meteorological Alert Distribution System
MCL	Maximum Contaminant Level
MEDA	Meteorological Data Acquisition Network
MFC	mass flow controller
MGDS	Mined Geologic Disposal System
MISIS	Micro Integrated Storm Information System
MOA	Memorandum of Agreement
MODFE	Modular Finite Element
MOU	Memorandum of Understanding
MPBH	multipurpose borehole
MPM	Management Procedure Manual
MPU	Manuscript Prep Unit
MRIR	Material Receiving and Inspection Report
MRS	monitored retrievable storage
MSA	major system acquisition
MSHA	Mine Safety and Health Administration

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

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

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

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

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

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

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

1.2.3 SITE

OBJECTIVE

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

WBS 1.2.3.1 Coordination and Planning

Principal Investigator - L. Hayes

OBJECTIVE

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

M&I QA Implementation GSP 0G3193G2

Summary Account Manager - J. Stuckless

ACTIVITIES AND ACCOMPLISHMENTS

Verification Activity Plan USGS-VA 93-02 was prepared for transfer of PI responsibilities in soils and rock investigations from USBR to Sandia National Laboratory.

Monthly reports from 15 investigators in rock characteristics section were compiled.

Monitored and/or provided input to the following open items: YM-CAR-93-015, CAR-91-03, CAR-91-05, CAR-91-07, CAR-91-09, CAR-92-05, CAR-92-07, CAR-92-08, CAR-92-09, CAR-92-10, CAR-92-11, NCR-92-02, NCR-92-26, NCR-92-33, NCR-92-38, NCR-93-01, NCR-93-03, NCR-93-04, NCR-93-07, NCR-93-08, and NCR-93-09.

Continued to investigate and monitor the status of controlled property that has been transferred or must be transferred from the Branch of Geologic Risk Assessment to the YMPB.

Technical, planning, and QA implementation meetings were held with the University of Nevada, Reno, Seismological Laboratory. Orientation, training, technical procedure preparation, procurement, data submittal, and software QA implementation support were provided to the Menlo Park, CA staff. QA requirements overview sessions were provided to organizations bidding on the Seismic Reflection study. A QA review and evaluation of an Accelerator Radiocarbon Dating Laboratory at the NOAA facility in Boulder was conducted. An informal Readiness Review was conducted for activity 8.3.1.17.4.3.4. Support staff attended several planning sessions for the transition to the YMP-USGS QA Program to the QARD, DOE/RW/0333P, R0.

Technical procedures SP-18, R0, "*Application of seismic-refraction techniques to hydrologic studies*", and GCP-25, R0, "*Determination of chemical composition by energy dispersive x-ray fluorescence spectrometry*", have been prepared.

Six MOAs were approved and distributed per QMP-4.02. Several MOAs are currently in Reston, Virginia, for signature. H. Oliver's gravity and magnetic studies MOA is currently in preparation prior to QA review.

Z. Peterman, B. Marshall, S. Mahan, K. Futa, J. Paces and B. Widmann attended a 3 hour IGG meeting devoted to partitioning hours worked into individual SCP activity accounts.

B. Marshall installed hardware and software onto the central IGG PC in order to run the IGG database software over the existing Localtalk network in Building 21B. This will allow access of the data base by project personnel from their own desktop computers.

J. Paces compiled, wrote and distributed January monthly report of work accomplished by the Isotope and Geochemistry Group. (10 hrs)

B. Marshall attended a CCC meetings on software QA on February 4, 1993 and February 18, 1993.

B. Widmann completed AP-5.1Q, R2 and AP-5.1, R2-ICN1 readings. (4 hrs)

S. Mahan accepted position as the YMPB Federal Women's Program Coordinator.

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

ACTIVITIES AND ACCOMPLISHMENTS

All 62 USGS and LBL hydrology summary-account schedules were statused as of the end of January using schedule-status, progress, and variance information provided by each summary-account manager. Four accounts showed relatively small negative schedule variances, none of which have any significant long-term impact on major milestones, and which probably can be made-up by the end of FY93. Nine summary accounts showed cost variances greater than 25 K, most caused by administrative delays in the execution of pending contracts and in the filling of personnel vacancies. The largest cost variance was +118 K in the LOE account for "*Percolation in the UZ, surface-based testing*" resulting from three critical vacancies being filled in the February-March time frame.

M. Umari and R. Luckey met with DOE, M&O, and support contractors to discuss logistics for c-well testing. Critical prerequisites to testing include design and installation of power system, completion of discharge pipeline to Fortymile Wash, and obtaining air-quality permits for generators. It was estimated that all items could be in place to allow testing to begin July 1, 1993. Luckey and Umari attended a meeting on vertical seismic profiling and cross-hole seismic work. While the primary focus of the meeting was planned work in UZ-16, processing of c-well cross-hole seismic data collected by LBL was discussed with Dr. J. Rector of the University of California at Berkeley. Dr. Rector indicated that some interpretation could be completed within the time and cost constraints to be useful for design of hydraulic and tracer tests.

D. Gillies met with CRWMS/M&O and DOE-YMP staff to identify and describe USGS-hydrology-program input to new Level 2 milestones being established in the YMP summary schedule. These milestones represent the compilation of information to support preliminary, interim, and final "models" of the saturated and unsaturated zones at the end of FY94, FY96, and FY98, respectively.

M. Chornack assisted with comment resolutions for revisions to YMP-USGS study plans 8.3.1.2.2.4 (ESF), 8.3.1.2.2.6 (UZ gas phase), 8.3.1.2.2.7 (UZ hydrochemistry), and 8.3.1.2.2.8 (Fluid flow, UZ fractured rock).

M. Chornack participated in the YMP open house and public tour held on February 20.

Final plans for testing of well USW G-2 were completed and a criteria letter requesting the work was forwarded to DOE. Several internal USGS meetings were held to plan the logistics of the testing. J. Czarnecki was designated over-all coordinator, P. Tucci will be responsible for monitoring water levels and discharge, and W. Steinkampf will be responsible for monitoring chemistry and collecting water samples.

B. Dudley, Z. Peterman, and R. Luckey, as the Executive Subcommittee of the Committee for the Advancement of Science at Yucca Mountain (CASYS) met several times to plan a symposium on repository thermal-loading effects, which will be held in Denver, March 24-25, 1993.

M&I QA Implementation, Hydrology 0G3193H2
Summary Account Manager - W. Causseaux

ACTIVITIES AND ACCOMPLISHMENTS

TECHNICAL PROCEDURES

The following preliminary draft technical procedures, scientific notebook plans, and/or modifications were prepared or changed as requested.

- | | |
|-------------|---|
| HP-07, R2 | Use of a trace gas for determining atmospheric contamination in a dry-drilled borehole |
| HP-23, R3 | Collection and field analysis of ground-water samples from saturated zone |
| HP-59, R1 | Method for calibrating digital thermometers |
| HP-60, R3 | Method for monitoring water-level changes using pressure transducers and pressure transmitters |
| HP-160, R2 | Methods for analysis of samples for gas composition by gas chromatography |
| HP-176, R2 | Procedure to collect gas composition samples at selected depth intervals |
| HP-177, R2 | Operation of a barometric pressure transducer |
| HP-192, R2 | Shallow soil gas collection |
| HP-247, R0 | Thermistor calibration procedure for pneumatic testing section of unsaturated zone borehole testing program |
| HP-253T, R0 | Performing various hydrologic tests using prototype pressure transducer and packer assemblies |
| HP-256, R0 | Method for collecting and storing CO ₂ gas samples from borehole atmosphere or from free air by absorption in a KOH solution |
| HP-258, R0 | Method for determining the Ph of a sample |
| HP-259, R0 | Determination of bulk density using an irregular hole bulk density sampler |
| HP-260, R0 | Sampling hydrologic testing, and monitoring perched water zones in the Exploratory Shaft Facility |
| HP-261T, R0 | Collection and processing of rock cutting samples from wells drilled with mud using the rotary hydraulic method |

The Technical Procedure Status List was updated.

S. Frans of HIP is currently processing 40 hydrologic procedures and scientific notebook plans.

The following HIP Technical Procedures were approved:

- HP-253T, R0 Performing various hydrologic tests using prototype pressure transducer and packer assemblies
- HP-256, R0 Method for collecting and storing CO₂ gas samples from borehole atmosphere or from free air by absorption in a KOH solution
- HP-261T, R0 Collection and processing of rock cutting samples from wells drilled with mud using the rotary hydraulic method

Open Items

NCR-92-37 (lack of training) was closed February 19, 1993.

S. Boucher submitted an amended response to NCR-92-39 on February 26, 1993 (failed barometer).

J. Watson prepared the initial response to NCR-93-09 and submitted it for review (reports processing).

J. Woolverton and M. Chornack requested that USGS-NCR-93-06 be voided. The nonconformance report was written to document the failure to compile records packages for two scientific publications supporting activity 8.3.1.2.2.6.1 (Gas-phase circulation). A determination was made that the two publications were not published, therefore finalized records packages are not required to be prepared.

M. Pabst attended the YMP-USGS Open Items meeting on February 24, 1993.

USGS-NCR-92-34 was closed during February. The nonconformance report documented problems with certificates produced by Scott Gases Inc.

Audits

AFR-9203-03 and AFR-9203-04 were closed (borehole sample submittal to the SMF and TDIFs not submitted on an approved schedule) (M. Ciesnik participant).

Data Management

S. Boucher submitted the 1992 continuous and periodic network data to the PDA per the approved schedule.

Software

M. Ciesnik initiated SQA paperwork for NETPATH (which does geophysical modeling), and S. Boucher submitted SQA documentation for Lotus 123.

Sample Management

T. Oliver submitted sample collection forms for samples collected February 2 and 3, 1993.

Meetings and travel

M. Pabst met on February 9, 1993 with the YMP-USGS Management Assessment Committee members to discuss QA concerns.

HIP QA Implementation staff met on February 11, 1993, with YMP-USGS QA staff to discuss ideas and approaches to processing QMPs (new as well as revisions) in the most efficient manner possible.

S. Frans and J. Woolverton travelled to the HRF to provide QA support for A. Flint's staff.

M. Chornack met with J. Woolverton, E. Weeks, D. Thorstenson, and C. Peters, to discuss QA requirements applicable to sampling for chlorofluorocarbons.

D. Appel, M. Chornack, R. Luckey, W. Causseaux, S. Boucher, and J. Woolverton met on February 12, 1993, to discuss concerns over processing and reviewing technical procedures for QA compliance within HIP.

J. Woolverton met with W. Causseaux, L. Anna, E. Kwicklis, and J. Ziemba to discuss the March audit for study 8.3.1.2.2.8 (supporting work by LBL).

Records Management

Three HIP technical procedure packages were submitted to the LRC by S. Frans.

M. Pabst assisted the YMP-USGS LRC staff in finding and submitting missing or incomplete pages for several data packages.

Computer Operation & Data Management, Hydrology 0G3193H3

Summary Account Manager - C. Washington

ACTIVITIES AND ACCOMPLISHMENTS

Novell System

The COU installed the new Novell file server. It has more than adequate storage space for this fiscal year. Because the server is new, a considerable amount of time was spent testing and re-configuring it.

The new DaVinci E-mail upgrade has also been installed and all old E-mail has been converted to the new format. Instructions on the use of this package will be in the COU Newsletter.

Researched and ordered numerous upgrades for the Novell file server.

Unix System

Most of this month was spent on the testing and maintenance of the Ingres data base in preparation for the administrative testing of data transfers from the Prime to the DG.

A backup schedule for the DG and the Ingres data base was created. The current estimate on the number of tapes needed to backup the Unix systems is approximately 100.

Prepared a proposal for the administrative section concerning the type of equipment that is most practical to purchase for their applications.

Researched and ordered additional unix software and hardware.

Hydrologic Research Facility (HRF)

The 56Kb line from the HRF to the Bank of America Center is being upgraded to a 128Kb line.

Field Operations Center (FOC)

C. Washington and R. Hoffman will visit the FOC in March to find out what progress has been made in connecting the USGS portion of the building.

Parfet Bldg

The COU tested and brought up four additional lines in the Parfet building, freeing up four ports for GSP use.

Scientific Reports and Project Documents, Hydrology 0G3193H4

Summary Account Manager - T. Brady

ACTIVITIES AND ACCOMPLISHMENTS

Scientific reports processing

J. LaMonaca, HIP-YMPB, currently is processing 89 YMP-HIP scientific publications, 66 YMP-GSP scientific publications, 8 YMP-LBL scientific publications, and 36 abstracts.

T. Brady completed HIP review of the following reports:

"A reconnaissance study of strike slip faulting near, Yucca Mountain Nevada", by D. O'leary; *"Ground water altitudes and well data, Nye County, Nevada"*. by M. Ciesnik; *"Seismicity and focal mechanisms for the Southern Great Basin of Nevada and California in 1991"*, by S. Harmsen; *"Volumetric analysis of debris eroded off a hillslope near Yucca Mountain, Nevada, during a convective rainstorm"*, by J. Coe, P. Glancy, and J. Whitney; *"Revised preliminary potentiometric surface map, Yucca Mountain and vicinity, Nevada"*, by E. Ervin, R. Luckey, and D. Burkhardt; *"A hydrogeologic analysis of saturated zone ground water system under Yucca Mountain, Nevada"*, by C. Fridrich, W. Dudley Jr., and J. Stuckless; and *"Isotopic studies of cavity filling and fracture coating minerals as an aid to understanding paleohydrology, Yucca Mountain, Nevada, USA"*, by B. Marshall, J. Stuckless, Z. Peterman, and J. Whelan.

T. Brady completed HIP review of the following abstracts:

"Aftershocks of the June 29, 1992 ML 5.6 Little Skull Mountain earthquake", by K. Smith, A. Sheehan, M. Savage, J. Brune, and J. Anderson; *"Intraformational deformation in the Calico Hills formation exposed near Yucca Mountain, Nevada"*; by D. Buesch, and R. Dickerson; *"Does the Walker Lane extend through the Nevada Test Site region?"*, by C. Fridrich, and D. O'Leary; *"The practical utilization of thermocouple psychrometers in the unsaturated zone"*, by J. Rousseau, M. Kurzmack, and C. Loskot; and *"Thermodynamic processes of liquid and vapor movement in the U12g12 drift extension G-tunnel, Nevada Test Site"*, by J. Rousseau, W. Thordarson, and M. Kurzmack.

Study plan status

HIP submitted to the YMPO, the USGS responses to the State of Nevada comments on Study Plan - 8.3.1.2.1.4, R0 - *"Regional hydrologic systems synthesis and modeling"*; and the USGS responses to the YMPO review comments on Study Plan - 8.3.1.2.2.1, R1 - *"Characterization of the unsaturated-zone infiltration"*.

WBS 1.2.3.2 Geology

Principal Investigator - J. Stuckless

OBJECTIVE

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

WBS 1.2.3.2.2 Rock Characteristics

OBJECTIVE

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

WBS 1.2.3.2.2.1 Geologic Framework of the Yucca Mountain Site

OBJECTIVE

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

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

Principal Investigator - R. Spengler

OBJECTIVE

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

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

Summary Account Manager - R. Spengler

ACTIVITIES AND ACCOMPLISHMENTS

Revisions to PACS statements continued in February to clarify and improve narratives. C. Hunter and R. Spengler represented the rock characteristics investigators in milestone meetings with R. St. Clair, M&O, to identify linkages of USGS work to program goals.

C. Hunter developed responses to DOE information requests and assembled requirements for the bidders in support of the seismic reflection contract. The proposal was amended to reflect design changes. Issues included safety, training, access, and explosives handling and storage.

C. Hunter supervised completion of preliminary cross sections constructed by USGS of proposed ramp alignments and underground excavations of the ESF. These sections were delivered to DOE and design groups February 18. Stable-base mylars are being produced to allow appropriate distribution by EG&G. The sections eventually will be released as an open file report.

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

0G32211A93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU11AA Conduct lithologic logging/synthesize borehole data

C. Hunter, R. Dickerson, and F. Singer completed the 1:6000-scale geologic cross sections depicting the north ramp, south ramp, and main Topopah-level drift alignments beneath Yucca Mountain including technical review, revisions, final check, and final production. These cross sections, along with location maps and a description of the stratigraphic units, were delivered to DOE and design engineers. The sections will be published as an open file report.

D. Buesch continued lithologic logging of core from UZ-16. R. Drake compiled partial structure logs for NRG-6 and UZ-16. The contact between nonwelded tuff of the Topopah Spring Member and the tuffaceous rocks of Calico Hills is at approximately 1201 ft. Minimal core was recovered between 1191 and 1201 ft; almost 100 percent was recovered below 1201 ft. The 10-ft-thick interval of nonrecovered core probably represents the lowest part of the nonwelded Topopah Spring Member. The contact is established by the relatively high abundance of quartz as phenocrysts in the rocks of Calico Hills. Rare or trace amounts of quartz phenocrysts occur in the lowest part of the Topopah Spring Member between the depths of 1167 to 1191 ft.

D. Buesch continued work on developing standardized methods of compiling structure logs of core. Most of the parameters, and how these parameters will be represented, have been established. Remaining parameter feedback from PIs will be incorporated. The final format of the structure log will be used on all core holes, including site characterization and engineering holes.

Lithologic logging of core from North Ramp boreholes continued. See description under SCP 8.3.1.14.2.1, "Surface Facilities Exploration Program".

3GGU21AA Conduct isotopic sampling/analysis/evaluation/synthesis

S. Mahan assisted P. Nelson in the selection of core from the waxed section of USW G-1, -2 and -4 stored in IGG facilities. Selected samples will have 1" diameter cores drilled out, and will be used for property testing.

3GGU400 Construct isopach and structural contour maps

J. Nelson and R. Dickerson completed volume modeling of the undivided Topopah Springs Member within the designated study area of the computer-based lithostratigraphic synthesis. This volume modeling effort included a quality check on the volumes modeled for internal consistency and geological soundness. Work has begun on subdividing the Topopah Springs Member into stratigraphic subdivisions similar to those employed in the geologic cross sections for ramp and drift design.

Quality Assurance

Personnel completed all assigned training and reading requirements including GERT for some staff and various training for new staff.

3GGU21AA Conduct isotopic sampling/analysis/evaluation/synthesis

B. Marshall revised technical procedure GCP-25 "*Determination of chemical composition by energy dispersive x-ray fluorescence spectrometry*" in response to comments from the QA group.

Planning and Operations

D. Buesch, Z. Peterman, B. Marshall, and J. Paces met to review calcite-filled breccia core from UZ-16 and UZ-N35. Buesch met with J. Rousseau and B. Thordarson to discuss production of a short paper summarizing the lithology, structure, and fracture coating mineral logs from UZ-16; B. Carlos (LANL) has agreed to participate. Buesch attended the second day of the UZ-16 VSP studies workshop.

SCP 8.3.1.4.2.1.2 Surface-based geophysical surveys 0G32211B93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU265 Analysis of bids for seismic contract

The evaluation of seismic reflection contract costs continued with T. Brocher and staff. C. Hunter, R. Spengler, J. Stuckless, and Brocher (USGS-YMP) and J. Arnold and M. Corbett (USGS Contract Administration Section) met with finalists in the bid selection process. Additional clarifications and requested information postponed bid submittals to February 16, 1993, to allow bidders time to calculate final bid costs and to respond to information requests. Best and final bids were received February 25; evaluation continued by the technical-committee and GSP staff.

Quality Assurance

Work to fully qualify software products was put on hold pending evaluation of software documentation.

T. Brocher continued revision of technical procedure SP-10, R1 *"Deep seismic reflection study of the tectonic environment."*

Planning and Operations

MOA work scope and budget planning continued.

C. Hunter and T. Brocher continued to develop responses to concerns for planning and safety, security and operational issues for the seismic reflection work, including meetings and or discussions with D. Edwards (USGS test coordination), USGS contracts, and with DOE/NTS/FOC staff.

Work Performed but not in Direct Support of the Scheduled Tasks

The following two reports have received USGS and DOE approval and are ready for printing:

"Status of aeromagnetic survey coverage of Yucca Mountain and vicinity to a radius of about 140 kilometers, southwestern Nevada and southeastern California", by R. Sikora, D. Ponce, and H. Oliver (U.S. Geological Survey Open-File Report 93-44).

"Gravity and magnetic data of Fortymile Wash, Nevada Test Site, Nevada", by D. Ponce, S. Kohn, and S. Waddell, (U.S. Geological Survey Open-File Report 92-343).

The paper *"Seismic reflection profiling: essential geophysical data for Yucca Mountain, NV"*, by W. Hunter, R. Spengler and T. Brocher, was reviewed and approved by the DOE-YMP Office. The paper will be presented as part of the American Nuclear Society (ANS) Fourth Annual International High-Level Waste Management Conference in Las Vegas (April 26-30, 1993).

SCP 8.3.1.4.2.1.3 Borehole geophysical surveys 0G32211C93

Summary Account Manager - P. Nelson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU393A Analyze log and core data

P. Nelson talked with two labs regarding dielectric measurements of core. Both labs use the same technique to get data over the 2 to 200 Mhz range. Z. Peterman assisted with core acquisition and plugging; 1-inch plugs were cut from waxed G-1 samples.

Schlumberger presented a first-pass computation on the geochemical logs acquired in USW G-2 in 1991. A few problems with parameters used in the mineralogy computation were discussed. Due to the lack of geochemical data in hole G-2, the mineralogy from XRD was used to guide the computations.

A final proof of the open file report on the G-2 logs was completed.

3GGU395 Maintain and expand existing data base

Large-format plots of the log and core data from the 40 deep boreholes in and around Yucca Mountain were delivered to R. Spengler.

3GGU371 Run magnetometer/magnetic suscept logs UZ/SD

The portable field magnetometer was sent to Geomatrix for calibration; it will be used to reference the 3-component borehole magnetometer. P. Nelson found that the gyro package was damaged by water during the last logging trip and will need to be replaced. UZ-16 can be logged without it, but the directional information will be lost.

During checkout of the magnetic susceptibility tool, a broken potentiometer was located and replaced. Checks on the gain steps, linearity, and radial and vertical characteristics of the tool were completed.

WBS 1.2.3.2.2.1.2 Structural Features within the Site Area

Principal Investigator - R. Spengler

OBJECTIVE

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

SCP 8.3.1.4.2.2 Structural Features within the Site Area LOE Account OG32212Z93

Summary Account Manager - R. Spengler

ACTIVITIES AND ACCOMPLISHMENTS

R. Spengler met with A. Braun, R. Blackburn, L. Martin, and R. Linden in the field to observe and inspect structural analysis and mapping work being done in exposed fault zones.

C. Hunter and R. Spengler represented the rock characteristics section investigators in project meetings held by M. Watson and R. St. Clair to discuss milestones, linkages, impacts and scheduling with relation to upper-level project milestones.

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

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF183A Conduct struct analysis/mapping-exposed fault zones

A. Braun, R. Blackburn, L. Martin, and R. Linden continued detailed geologic and fracture mapping (at a 1:240 scale) of the Ghost Dance Fault in Split Wash. Over 300 fractures have been recorded in this area. Braun indicates that mappers moving northward through the study area have observed subtle changes in the Tiva Canyon Member. Additional efforts focused on these outcrops include sample collection for petrographic analysis. F. Singer began processing thin sections of samples from the Tiva Canyon Member of the Paintbrush Tuff. Singer is examining samples for petrographic differences within the sub-units exposed along the Ghost Dance Fault.

3GGF186A Conduct geologic mapping northeast corner of site area

D. Buesch and R. Dickerson began preparation of maps, cross sections, and illustrations for a summary report and presentation at the 1993 Geological Society of America Cordilleran and Rocky Mountain Section meeting in Reno, Nevada. The abstract "*Intraformational deformation in the Calico Hills Formation near Yucca Mountain, Nevada*" by D. Buesch and B. Dickerson, which summarizes some of the stratigraphic and structural relations in the upper Paintbrush Canyon area, was accepted by the Society.

3GGF200A Conduct mapping of western YM/northern Crater Flats

C. Fridrich spent one day working with D. Sawyer and others of the USGS Weapons Containment group on a new compilation of the Beatty 30 by 60 minute quadrangle, Nevada. New unpublished mapping in the East of Beatty Mountain 7.5 minute quadrangle was used to upgrade the compilation made by Frizzell and Shulters (1991). This work also supports SCP 8.3.1.17.4.5, "Detachment faults".

Quality Assurance

Technical Procedure GP-18, "*Petrographic analysis of volcanic rocks*", is being revised following technical review.

Planning and Operations

C. Fridrich continued preparation for the upcoming field season of mapping in Crater Flat (on the western side of Yucca Mountain). These preparations include hiring a field assistant; ordering field equipment, base maps, and airphotos; and arranging for transportation and housing in the field.

D. Buesch and A. Braun met to discuss quantitative and semiquantitative methods to characterize lithologic contacts in the Tiva Canyon Member of the Paintbrush Tuff. DOE has requested clarification of the field distinction of these contacts.

D. Buesch and R. Dickerson met to discuss compilation of previous mapping and to plan future mapping in the area near upper Paintbrush Canyon. Dickerson met with S. Lundstrom regarding the nature and extent of Quaternary deposits in the Upper Paintbrush Canyon.

Meetings were held to discuss plans for South Ramp geology (SRG) drill holes, position of drill holes, and drilling requirements.

USGS staff participated in a field trip to compare zonal features in the Tiva Canyon Member exposed in Drill Hole Wash and on Antler Ridge, and to observe mapping work in the Ghost Dance Fault.

SCP 8.3.1.4.2.2.2 Surface-fracture network studies 0G32212B93

Summary Account Manager - M. Fahy

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF100 Compile map of Tiva Canyon data area

M. Fahy continued work on the report.

3GGF081 Map and analyze Fran Ridge ESF pits area

M. Fahy created drawings to accommodate the survey data. Fahy gave R. Spengler preliminary-draft graphics showing the current extent of mapping. The memo detailing the work (time and technical details) at P2001 was prepared and will be sent to R. Spengler (USGS) and distributed to other participants.

M. Fahy mapped an additional cell at P2001 while waiting for the construction crews to prepare the Fran Ridge pit area.

Quality Assurance

Paperwork required by USGS QMP-3.03 for DIPS software was submitted to the YMP Software Configuration Manager in February and will be reviewed by USGS software QA staff.

M. Fahy began paperwork on the mapping and analysis of Fran Ridge ESF pits area data submittal. Submittal is controlled by the schedule in the revised PACS and will take place after data acquisition is completed and reviewed.

M. Fahy and others met with software QA staff to establish the process for approval of AUTOCAD and ORACLE. Future meetings were scheduled.

Work Performed but not in Direct Support of the Scheduled Tasks

M. Fahy participated in the DOE/YMP QA surveillance at the North Ramp portal (February 1993). The auditors examined field data books and procedures and made recommendations to the mappers.

M. Fahy spent considerable time supporting Geologic Mapping of the ESF based on priorities set by USGS and construction deadlines.

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

Summary Account Manager - S. Beason

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF006B Map portal/interpret/submit data

S. Beason, M. Fahy, and P. Burger continued geologic mapping of the North Ramp portal for the ESF. The mappers traveled to the NTS on February 8 at the Project's request, but the portal area was not ready for mapping. Six traceline surveys were completed in the second lift of the portal cut: three horizontal and three vertical surveys. Work continued on a plan-view map of the exposed geology. Photogrammetry targets were placed on the exposed rock for the second lift. D. Wehner of Johnson Controls World Services took overlapping stereophotos in support of this activity.

Quality Assurance

S. Beason and P. Burger participated in the DOE/YMP QA surveillance at the North Ramp portal. The auditors examined field data books and procedures and made recommendations to the mappers.

S. Beason met with software QA staff to establish the process for approval of AUTOCAD and ORACLE.

Planning and Operations

S. Beason completed a draft of the criteria letter for the underground mapping of the North Ramp launch chamber.

S. Beason expanded on PACS task descriptions for FY94 and submitted them to the USGS. Beason provided the USGS with a quarter-by-quarter breakdown of proposed FY93 underground mapping expenditures based on projected construction schedules for the North Ramp portal and starter tunnel.

Work Performed but not in Direct Support of Scheduled Tasks

S. Beason edited a job safety analysis for geologic mapping at the North Ramp portal. L. Johnson, USGS assembled the job safety analysis worksheets and submitted them to DOE, Las Vegas.

SCP 8.3.1.4.2.2.5 Seismic tomography/vertical seismic profiling 0G32212E93

Summary Account Manager - E. Majer

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF041 Incorporate/integrate VSP model with rock characteristics

Preparation for field work continued. Software modifications were made to allow longer records and to record lower frequency content. The display software was modified to allow more flexibility in recovering the in-field results.

3GGF045 Develop and validate interpretational code

Work began to complete documentation and improve stability of the inversion routines for VELIN3D. The improvements focused on reducing the probability of the inversion results being caught in local minima.

Planning and Operations

E. Majer and T. Daley attended a meeting involving VSP personnel regarding input to DOE on the expected results of the VSP in UZ-16. Work began on the summary report describing conclusions and recommendations.

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 0G32532E93

Summary Account Manager - C. Fridrich

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

C. Fridrich attended a meeting of the Hydrology Integration Task Force at Lawrence Livermore Labs on February 11, 1993. In addition, Fridrich also participated in a meeting to write a criteria letter for the proposed testing of drill hole G-2, northern Yucca Mountain.

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 0G32552C93

Summary Account Manager - J. Sass

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GAT013 Continue field measurements

No field measurements were carried out this month. No new holes have been made available and none of the WT holes have been reconfigured to accommodate thermal logging equipment.

3GAT016 Maintain laboratory/calibrate equipment

Continued tests of high-temperature thermal conductivity apparatus. The issue of shielding the apparatus against high-pressure failure of the pressure vessel is being researched.

3GAT045 Evaluate drilling plans and recommendations

There has been no activity with regard to drilling plans. YMP management will initiate the participation of the USGS in such activities by notification of impending meetings or workshops.

Quality Assurance

3GAT013 Continue field measurements

Work continues on outstanding software QA issues that preclude obtaining qualified data.

3GAT016 Maintain laboratory/calibrate equipment

A QA review of revised GPP-20 R3 was received and minor comments were resolved. Major comments yet to be resolved center around documentation of software involved in calibration of temperature sondes and calculation of temperatures during logging runs. A meeting was held with QA specialists to determine the strategy for compliance with QA requirements. Dialogue also continues with QA specialists on calibration vendors and on calibration of balances, micrometers and vernier calipers. QA records were maintained and updated and reading assignments were carried out as required.

Variances

3GAT012 Collect core samples/prepare thermal specimens

Activity 3GAT012 did not start on time due to QA problems with the technical procedure (GPP-20 R3) and a lack of communication with the appropriate site testing coordinators. Steps are being taken to improve communication and facilitate sampling. No significant impact to the schedule is anticipated.

WBS 1.2.3.2.6 Surface Characteristics

OBJECTIVE

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

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

OBJECTIVE

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

WBS 1.2.3.2.6.2.1 Surface Facilities Exploration Program

Principal Investigator - M. McKeown

OBJECTIVE

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

SCP 8.3.1.14.2.1 Surface facilities exploration program 0G32621A93

Summary Account Manager - M. McKeown

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

D. Buesch continued compilation of lithologic logs, and structure logging for NRG-2 and NRG-6 continues. Most work on NRG-2 entailed structural logging, with continued evaluation of lithologic contacts. Depths to the lower lithologic contacts in NRG-6 include Tiva Canyon Member - lower lithophysal zone (60 ft), lower nonlithophysal zone (134 ft), and lower nonwelded zone (159 ft); pre-Tiva Canyon bedded tuff (173 ft); Pah Canyon Member (220 ft); Topopah Spring Member - Topopah Spring Member-related bedded tuff (247 ft), nonwelded zone (260 ft), vitrophyre (271 ft), upper nonlithophysal zone (429 ft), and upper lithophysal zone (713 ft). R. Spengler confirmed that the contact between the upper lithophysal and middle nonlithophysal zones equates to the thermal-mechanical unit boundary of Tsw1 and Tsw2. All other depths are tentative and require confirmation by USGS personnel.

Quality Assurance

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

A YMP-USGS-QMP-3.10, R2 Verification Activity (VA), USGS-VA-93-02, meeting to close out and transfer PI responsibilities was held February 22, 1993. Attendees included M. McKeown, USBR (past PI) and D. Kessel, SNL (current PI). A. Boulton began preparing data and records transmittals, records packages, and appropriate documentation. VA close-out is expected to be completed in March 1993.

Planning and Operations

USGS, SNL, and DOE representatives attended various meetings in February to discuss transfer of the soil and rock study, specifically, procedures for sample acquisition, requirements of structure logs, and timing of deliverable milestones.

Representatives from DOE, M&O, RSN, and USGS discussed goals and geometry of a proposed NRG-2a hole (to be used to help constrain the amount of nonlithified tuff along the north ramp grade) and plans for South Ramp geology (SRG) drill holes, including position of drill holes and drilling requirements.

Meetings were held to discuss selection of samples for mechanical and thermal-mechanical testing, and to continue discussions about drilling NRG-6.

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 0G32622A93

Summary Account Manager - M. McKeown

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GSR001 Perform materials testing soil & rock phys/mech-north ramp

R. Nolting (MK M&O) assisted D. Buesch in the selection of samples from NRG-2 and NRG-6 to be used in geomechanical and thermal-mechanical tests, and sample requests were submitted to the Sample Overview Committee (SOC) for approval of release. NRG-6 samples from depths 0 to 330 ft have been approved and sent to the laboratory for testing; samples from the depths 330 to 550 ft will be evaluated at the March SOC meeting. NRG-2 samples are from depths 0 to 215 ft.

Quality Assurance

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

The verification activity meeting to close out and transfer PI responsibilities was held February 22, 1993.

Planning and Operations

D. Buesch attended a Sample Overview Committee meeting to represent the soil and rock study and to discuss NRG-6 sample requests. A phone conference was held to discuss the status of NRG samples for geomechanical and thermal- mechanical tests.

WBS 1.2.3.2.6.2.3

Principal Investigator - M. McKeown

OBJECTIVE

To determine the dynamic properties of the subsurface soil and rock strata. (SCP Study 8.3.1.14.2.3)

SCP 8.3.1.14.2.3 Surface Facilities Field Tests 0G32623A93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Quality Assurance

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

The verification activity meeting to close out and transfer PI responsibilities was held February 22, 1993.

WBS 1.2.3.2.8 Preclosure Tectonics

OBJECTIVE

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

WBS 1.2.3.2.8.3 Vibratory Ground Motion

OBJECTIVE

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

radioactive materials. (SCP Investigation 8.3.1.17.3)

WBS 1.2.3.2.8.3.1 Relevant Earthquake Sources

OBJECTIVE

To identify and characterize those earthquake sources that are relevant to a deterministic seismic hazard analysis of the site and, if active, could cause severe ground shaking at the site.

SCP 8.3.1.17.3.1.2 Characterize the 10,000 year cumulative slip earthquake 0G32831B93

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GSS118A Evaluate and revise deterministic seismic hazard methodology

Preparations were made to bring a full time scientist into the YMPB GSP to oversee this project.

Variances

3GSS119A Contribute to DOE topical report - Seismic hazard approach

Activity 3GSS119A did not begin because the DOE topical report has not yet been initiated by DOE/M&O.

Work Performed but not in Direct Support of Scheduled Tasks

USGS personnel responded to comments by the state of Nevada.

WBS 1.2.3.2.8.3.3 Ground Motion From Regional Earthquakes and Underground Nuclear Explosions

OBJECTIVE

To select or develop ground-motion models that are appropriate for estimating ground motion at the site from earthquakes and UNEs. (SCP Study 8.3.1.17.3.3)

SCP 8.3.1.17.3.3 Ground motion from Regional earthquakes and UNEs 0G32833A93

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GES010 Develop earthquake ground motion methodology

Project planning, and selection of study participants began this month.

Planning and Operations

3GES010 Develop earthquake ground motion methodology

YMPB GSP completed and signed an MOA with the USGS Branch of Seismology and Engineering to do this study. A team of four USGS seismologists was selected to participate in this study.

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

OBJECTIVE

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

SCP 8.3.1.17.3.4.1 Determine Site Effects From Ground Motion Recording 0G32834A93

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Planning and Operations

3GSG250 Conduct seismic field experiment #1

Plans were made to conduct the seismic experiment.

Work Performed but not in Direct Support of Scheduled Tasks

USGS personnel responded to comments by the state of Nevada.

WBS 1.2.3.2.8.4 Preclosure Tectonics Data Collection and Analysis

OBJECTIVE

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

WBS 1.2.3.2.8.4.1 Historical and Current Seismicity

Principal Investigator - J. Brune

OBJECTIVE

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

SCP 8.3.1.17.4.1.1 Compile Historical Earthquake Record 0G32841A93

Summary Account Manager - J. Brune

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GSM100 Develop method - Peak ground acceleration

Field work continued and led to the discovery of additional precarious rocks near Yucca Mountain and near Caliente, Nevada.

3GSM105 Compile historical earthquake records

Extensive comparisons were made between isoseismal maps and historic earthquakes and locations of precarious rocks.

Work Performed but not in Direct Support of Scheduled Tasks

USGS personnel responded to comments by the state of Nevada regarding this study.

SCP 8.3.1.17.4.1.2 Monitor current seismicity 0G32841B93

Summary Account Manager - J. Brune

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GSM134A Monitor FY93 seismicity

Recorded data from SGBSN for all of February. UNR preliminary bulletin is now complete through January 1993. Submitted draft report on comparison of UNR and USGS seismic event bulletins for the month of September 1992 to L. Hayes and M. Sullivan.

3GSM147A Reduce Little Skull Mountain earthquake data

Assembled instrument responses for the portable instruments which recorded the Little Skull Mountain aftershock sequence.

3GSM140A Prepare 1992 earthquake catalog

No activity this month. USGS BGRA is responsible for the first nine months of the catalog and UNR is responsible for the last three months.

3GSM148A Data analysis Little Skull Mountain earthquake

Finished picking Little Skull Mountain events through November. Started assembly of first-motion pick data for Little Skull Mountain aftershocks.

Quality Assurance

3GSM134A Monitor FY93 seismicity

Completed draft of new technical procedure for calibration of seismic instruments of the SGBSN.

3GSM147A Reduce Little Skull Mountain earthquake data

Performed a seismic instrument "cluster test" to verify the responses prior to redeployment.

WBS 1.2.3.2.8.4.2 Location and Recency of Faulting Near Prospective Surface Facilities

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.2.1 Identify appropriate trench locations in Midway Valley 0G32842A93

Summary Account Manager - F. Swan

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFP003 Mapping and soil descriptions in Midway Valley

The inspection of preliminary geologic mapping delineated on aerial photographs was begun during the February reporting period. In addition, selected soil pits were inspected in the field to determine if the deposits are suitable for thermoluminescence dating.

Quality Assurance

3GFP003 Mapping and soil descriptions in Midway Valley

Continued QA training and updates as necessary.

Work Performed but not in Direct Support of Scheduled Tasks

Preparation for an upcoming QA audit was started during the February reporting period. T. Mendez- Vigo and P. Reilly met with Geomatrix personnel to help prepare them for the upcoming audit. Examination of the files continued through the end of the reporting period to ensure readiness.

SCP 8.3.1.17.4.2.2 Conduct exploratory trenching in Midway Valley 0G32842B93

Summary Account Manager - F. Swan

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFP006 Assemble job packages for trenches

Proposed trench locations for 1993 were presented to C. Menges (USGS) who compiled all trenching activities for the field coordinator.

3GFP008 Excavate/log/study trenching near proposed ESF

Data analysis and initial report preparation was started for the trenching investigations near the proposed ESF.

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

Mapping of the north wall and descriptions of geologic units in MWV-T4 was completed during the February reporting period. Data analysis and initial report preparation for MWV-T4 was started during the reporting period.

Quality Assurance

3GFP006 Assemble job packages for trenches

3GFP008 Excavate/log/study trenching near proposed ESF

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

Continued QA training and updates as necessary.

Planning and Operations

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

Sites for soil profile descriptions were selected along the north wall of MWV-T4. These sites will be described during the March reporting period.

Variances

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

Activity 3GFP016 did not start as planned. Time and funding constraints will not allow study of the trench this fiscal year. During October and November of 1992, additional excavations and study of the area near the proposed ESF (activity 3GFP008) were required on the basis of prior work. This added work plus the planned work had to be completed by November 23, 1992, so that construction activities for the ESF could take place as scheduled. More persons were added to completing the fieldwork for activity 3GFP008 by the deadline, resulting in an increased amount and rate of spending that was not anticipated.

In addition, trench priorities have changed. Newly obtained geophysical data indicates that a fault may be present in the middle of Midway Valley. For purposes of Study 8.3.1.17.4.2 a higher priority to the investigation of this possible fault was assigned than to the study of trench A-3. The location of a trench(es) across this possible fault will depend on the final geophysical interpretation and other information such as geologic mapping.

Based on these considerations, the priorities for excavation activities are being reevaluated within the context of this study and within the scope of other trenching activities scheduled by the USGS for FY93. The excavation and study of trench A-3 will depend primarily on trenching priorities still to be assessed and secondarily, on scheduling with REECo, DOE's excavation contractor.

Work Performed but not in Direct Support of Scheduled Tasks

Preparation for an upcoming QA audit was started during the February reporting period. T. Mendez-Vigo and P. Reilly met with Geomatrix personnel to help prepare them for the upcoming audit. Examination of the files continued through the end of the reporting period to ensure readiness.

WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain

Principal Investigator - J. Whitney

OBJECTIVE

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

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

Summary Account Manager - L. Anderson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

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

3GTQ033B Evaluate faults SW of Yucca Mountain

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

Quality Assurance

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

A meeting was held to review status of on-going work for activity 8.3.1.17.4.3.2 and its relationship to study plan approval by NRC (90 day waiting period). A report will be written by QA personnel outlining status and resolution of issues. A technical review of USGS technical procedure for "*Identification of geomorphic features of possible tectonic origin using conventional and low-sun-angle vertical aerial photographs*" was completed and submitted for QA review.

SCP 8.3.1.17.4.3.4 Evaluate Bare Mountain fault zone 0G32843D93

Summary Account Manager - L. Anderson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

Verification of mapped faults and lineaments and their relationship to surficial deposits was conducted. Sites for excavation of soil pits were identified as well as an additional trench site across a suspected fault scarp associated with the Bare Mountain fault.

Quality Assurance

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

A meeting was held to review status of on-going work for activity 8.3.1.17.4.3.2 and its relationship to study plan approval by NRC (90 day waiting period). A report will be written by QA personnel outlining status and resolution of issues.

WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.4.1 Evaluate the Rock Valley fault system 0G32844A93

Summary Account Manager - D. O'Leary

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTN011 Work on study plan/conduct fieldwork Rock Valley fault system

Revised study plan (8.3.1.17.4.4) in response to additional comments from DOE reviewer. Additional two hours spent on this task (phone discussion with reviewer, edit and revision, generation of new copy and response memo to DOE).

Quality Assurance

3GTN011 Work on study plan/conduct fieldwork Rock Valley fault system

Conducted technical review of QMP document on analysis of low-sun-angle aerial photographs. (2 hrs)

Planning and Operations

3GTN011 Work on study plan/conduct fieldwork Rock Valley fault system

Prepared specifications for acquisition of low-sun-angle photography and thermal IR images over east side of Jackass Flats.

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 significance of the Miocene-Paleozoic contact 0G32845B93

Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTD017B Complete map of the Calico Hills / Write report

Spent one week compiling field mapping and conducting photogeologic interpretation using a PG-2 photogrammetric plotter. Mapping in the interior of the Calico Hills was compiled and areas identified for further field work.

3GTD009B Evaluate Miocene-Paleozoic contact

Portions of the Miocene-Paleozoic contact were examined photogrammetrically and areas identified for further field work.

SCP 8.3.1.17.4.5.2 Evaluate postulated detachment faults in the Beatty-Bare Mountain area 0G32845B93

Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

C. Fridrich spent one day working with D. Sawyer and others of the USGS weapons containment group on a new compilation of the Beatty 30 by 60 minute quadrangle, Nevada. New unpublished mapping in the East of Beatty Mountain 7.5 minute quadrangle was used to upgrade the compilation made by Frizzell and Shulters (1991).

Quality Assurance

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

A scientific notebook plan was developed and computer software was documented so that investigators could begin collecting and analyzing data.

Planning and Operations

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

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

Preparations were made for the upcoming field season of mapping along the north and south margins of Crater Flat (at and near the Bare Mountain fault zone). These preparations include hiring a field assistant; ordering field equipment, base maps, and airphotos; and arranging for transportation and housing in the field.

WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.6 Evaluate Quaternary Faulting within the Site Area LOE Account 0G32846Z93

Summary Account Manager - C. Menges

ACTIVITIES AND ACCOMPLISHMENTS

Installed personal computer in office for use in basic word processing and data storage-analysis tasks. Prepared purchase orders for technical field equipment. Contacted EG&G personnel to acquire GIS map products needed to locate new trenches. Conducted technical review of preliminary report on literature survey of Quaternary faults within 100 km of the site (in progress). Coordinated with QA specialists on procedures for submitting TDIFs for completed logs, data reports, and reports from trenches.

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

0G32846A93

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GPF026A Complete field mapping/submit map for review

All the data from previous workers was compiled on the fault map. Bedrock faults were also compiled and new bedrock mapping was incorporated. Areas were identified for further field work and field checking.

Quality Assurance

3GPF026A Complete field mapping/submit map for review

A QA review of field notebooks was started in anticipation of TDIF submittal.

Planning and Operations

3GPF026A Complete field mapping/submit map for review

Plans were made to conduct field work to fill in unmapped areas.

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

0G32846B93

Summary Account Manager - C. Menges

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

Continued cleaning and mapping stratigraphy and faults on Busted Butte exposure #4. Flagged and photographed two buried scarps on upper part of exposure. Identified unit containing basaltic ash. Collected thermoluminescence (TL) dating sample from exposure #4.

3GPF035A Study trenches excavated on Yucca Mtn. faults

Reviewed and revised previously submitted logs from trench T8 on Solitario Canyon fault zone. Reviewed logs in progress for trench SCF-T1 on Solitario Canyon fault. Collected samples for thermoluminescence dating and uranium series dating in trenches 14D, T8 and CF1.

3GPF029A Locate/excavate/log new trenches

Conducted field reconnaissance of several potential sites for new trenches at southern end of Solitario Canyon fault.

Quality Assurance

3GPF19P Study faults on west & east sides of Busted Butte
Reviewed and revised notebook covering field activities.

3GPF035A Study trenches excavated on Yucca Mtn. faults
Continued to review and revise notebooks on field activities related to trench operations.
Initiated development of procedures for entering completed trench logs into GIS data base
by EG&G personnel.

Planning and Operations

3GPF035A Study trenches excavated on Yucca Mtn. faults
Received and reviewed photographs for trenches SCR-T1 and SCR-T3 on Stagecoach Road
fault. Completed initial draft of a general outline for use in preparing trench reports.
Completed paperwork to hire field assistant for trench activities. Continued arrangements
for seismic refraction geophysical surveys on South Windy Wash fault zone.

3GPF029A Locate/excavate/log new trenches
Completed outline of proposed trenching activities on Solitario Canyon fault for FY93.
Developed procedures and approximate scheduling with DOE field coordinators to
implement new trenching program.

3GPF037A Study of scarp morphology on Quaternary faults
Discussed with DOE officials possibilities of using Raytheon to survey fault scarp profiles
prior to excavating new trenches.

Variances

3GPF032A Scarp degradation and evolution Northern Windy Wash
Activity 3GPF032A did not start this month. Principal investigator was required by DOE to
work on the Erosion Topical Report. This may delay completion of this activity but should
not affect the overall program.

Work Performed but not in Direct Support of Scheduled Tasks

Coordinated with L. Wright and M&O staff on status and content of tectonic map of Death Valley
area, (including Yucca Mountain). USGS personnel responded to comments by the state of Nevada.

WBS 1.2.3.2.8.4.10 Geodetic Leveling

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.10.1 Relevel base station network 0G3284AA93

Summary Account Manager - G. Perasso

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTM007J Continue to relevel network and resurvey quadrilaterals

Releveling activities continued this month. Over 110 km of the level line have now been resurveyed. 56% of this task has been completed.

Work Performed but not in Direct Support of Scheduled Tasks

USGS personnel responded to comments by the state of Nevada.

SCP 8.3.1.17.4.10.2 GPS Base - Station Survey 0G3284AB93

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTM020 Resurvey GPS base stations

Work on two technical procedures started this month.

Quality Assurance

3GTM020 Resurvey GPS base stations

Discussions with QA personnel were conducted on QA and technical procedure requirements.

Work Performed but not in Direct Support of Scheduled Tasks

USGS personnel responded to comments by the State of Nevada regarding this study.

WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis

Principal Investigator - J. Whitney

OBJECTIVE

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

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

Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTE074 Prepare study plan

Revision of the study plan was completed and the study plan was submitted for USGS review on February 26, 1993. This completes this task and milestone 3GTE074M.

3GTE072 Compile geologic map of the Death Valley area

Drafting of Death Valley map was completed. A review of the line work was conducted and problems identified; solutions to those problems were explored.

Work Performed but not in Direct Support of Scheduled Tasks

A response to a memo from DOE was written concerning open items from the NRC's Site Characterization Analysis (SCA) comments that relate to study plan 8.3.1.17.4.12. Response included information and explanations requested in order to resolve unanswered questions as to how study 8.3.1.17.4.12 will address procedural concerns.

SCP 8.3.1.17.4.12.2 Evaluate tectonic models 0G3284CB93

Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GTE045 Evaluate Tectonic models

Review of literature continuing along with preparation of bibliography data base of relevant reports and maps.

Work Performed but not in Direct Support of Scheduled Tasks

A response to a memo from DOE was written concerning open items from the NRC's Site Characterization Analysis (SCA) comments that relate to study plan 8.3.1.17.4.12. Response included information and explanations requested in order to resolve unanswered questions as to how study 8.3.1.17.4.12 will address procedural concerns.

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 0G33111A93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

Data collection continued in February. Site data from the five weather stations were downloaded and reviewed each Monday. Satellite and weather chart data were archived on tape backup every three days, if possible. Some problems with satellite terminal resulted in an inability to archive imagery for two weeks. The wet winter continued as several major storms hit the western U.S. during the month. A precipitation record for Las Vegas for the month of February was broken with the total at 2.4 inches. Yucca Mountain received over 3.5 inches. The jet stream meandered well south of its "normal" position. This brought Pacific storms (with heavy rainfall) directly into California and then inland to Nevada and Arizona, while leaving Washington with below normal rainfall. Storms occurred on February 7, 8, 18, 23, and 26-28. The last storm of the month left a 3 to 5-inch snow cover on the crest of Yucca Mountain. *El Nino*, which caused near record precipitation in the southwest last year, still may be controlling weather patterns this winter.

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

Report organization and format was established for each topic. The synoptic report will present the origin and trajectory of synoptic-scale storms that caused precipitation at Yucca Mountain. Also, each storm will be classified according to Elliott's Weather Types of North America (1943), if possible. The anomalies caused by *El Nino* do not match the classic types. The report of regional precipitation will consist of an isohyetal analysis of each major storm event occurring in southern Nevada/southeastern California region surrounding Yucca Mountain. Additionally, a co-kriged geostatistical map of each major precipitation event is planned. A climatological report, using historic site meteorological data from one USGS weather station (from the station's installation to September 30, 1992), will be generated. This report will include historical temperature, relative humidity, wind speed and direction, solar radiation, and precipitation profiles. The information will be presented as monthly and annual means.

Work Performed but not in Direct Support of the Scheduled Tasks

Precipitation collectors (two 18-inch diameter standpipes) were set up to collect rainfall for geochemical analysis. Samples, requested by C. Peters, from the February 26-28 storm were retrieved. (2 hrs)

Additional precipitation samples were collected for other chemical analysis from some of the USGS collection gauges. Some were sent to J. Whelan and others to Z. Peterman. (2 hrs)

Supported tours of the HRF. (8 hrs)

WBS 1.2.3.3.1.1.2 Runoff and Streamflow

Principal Investigator - D. Beck

OBJECTIVE

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

SCP 8.3.1.2.1.2.1 Surface-water runoff monitoring 0G33112A93

Summary Account Manager - T. Kane

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRSO30A Complete FY83-85 data report

The reports section plans on making final adjustments to the report prior to sending it onto HIP data section for final approval, which should occur in mid March.

3GRS031A Complete reduction of FY86-89 data and preparation of report

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

3GRS023A Collect FY93 runoff and streamflow activity

Last months pattern of regional storms moving in off the Pacific continued throughout February. Heavy rain brought several runoff events which were observed and recorded on and off the NTS. In addition to rainfall, an accumulation of snow contributed to potential runoff at higher elevations.

Runoff occurred at Fortymile Wash above the confluence with East Cat Canyon. This site, which experienced an estimated flow of 500 cfs in January, had a flow of less than 10 cfs on February 19. The same scenario of heavy snow pack in the Timber Mountains, which occurred in January has been established again. Additional runoff events may occur at this site if another warm rain occurs.

For the first time, flow was measured at a miscellaneous site which contributed to the Amargosa River. A discharge of 255 cfs was measured on the Carson Slough at Stateline Road in Death Valley, California, on February 9. Further downstream measurements were made at Amargosa River at Eagle Mountain and Tecopa, all of which were higher than previous measured stages. Measurements also were made upstream on the Amargosa River at Highway 95 below Beatty, and near Beatty stations 10251218, and 10251220.

Continuous flow was monitored at Unnamed Tributary to Stockade Wash near Stockade Wash, with measurements being collected weekly. Flow was from a combination of snow melt and regional storms. On February 9, Stockade Wash, above Buckboard Mesa road, saw an event which was later flagged for culvert computation.

Measurements made at the above mentioned sites range from 0.10 to 415 cfs and are undergoing analysis. The data will provide additional information which will be added to those collected this year in developing runoff characteristics in ephemeral channels. Levels for determining peak discharges by the slope conveyance method were run at East Cat Canyon Wash, at Fortymile Wash, Stockade Wash near Fortymile Wash, and Stockade

Wash above Buckboard Mesa road. The levels are being processed in the Subdistrict office.

In addition to surface water measurements, water samples were taken at most of the sites mentioned. Presently they are being analyzed at the Denver lab.

Personnel were confined to the collection of streamflow data for the entire month of February, starting with measurements made in early February to cover the recession of the January storms. Storm events occurred during the following periods: February 7-9, and February 19-20. Subsequent measurements were made through February 11, and again through February 26.

On February 22-26, monthly visits were made to collect streamflow and precipitation data and conduct site maintenance at all network sites.

Quality Assurance

3GRS023A Collect FY93 runoff and streamflow activity

Quality assurance activities conducted by C. Martinez this month include: documentation and tracking of APs, HPs and related reading assignments, and preparation of January's data package.

Planning and Operations

3GRS028A Apply for site prerequisite survey

G. Ryder (DOE) was contacted regarding permits for three sites scheduled to be installed this year. Ryder reported that due to the heavy amount of rainfall in the last two months, survey crews were unable to access site areas. He estimated that crews may be able to go out by mid March.

Variances

3GRS028A Apply for site prerequisite survey

Activity is delayed until March 31, 1993 pending environmental clearances by DOE for the three new sites located on Yucca Mountain to support current studies of the unsaturated zone. This delay will cause activity # 3GRS017A to be pushed back for one month as well.

3GRS030A Complete FY83-85 data report

Activity is delayed until March 31, 1993 due to delays with the drafting of additional figures by the reports section in Carson City.

3GRS031A Complete reduction 86-89 data and prepare report

Activity has a two month delay due to extensive field activities in January and February; estimated time of completion is August 31, 1993.

Work Performed but not in Direct Support of the Scheduled Tasks

Water samples from four sites were collected and prepared for shipment to the Denver lab for analyses. (24 hrs)

WBS 1.2.3.3.1.1.3 Regional Ground-Water Flow System

Principal Investigator - J. Czarnecki

OBJECTIVE

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

SCP 8.3.1.2.1.3 Regional Ground Water Flow System LOE Account 0G33113Z93

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Support project operations

M. Ciesnik reviewed and revised HP-23, R2 "*Saturated zone hydrochemical sampling*" per discussions with project staff. J. Czarnecki performed a technical review of the revisions, and suggested changes to HIP management regarding the preparation and review of technical procedures.

A criteria letter regarding unscheduled hydrologic and hydrochemical testing in drillhole USW G-2 was drafted, reviewed, and forwarded to DOE/LV. The testing was recommended by the Hydrology Integration Task Force. A drill crew may be available to begin this work as early as March 22, 1993.

M. Ciesnik read HP-12, R3 and HP-37, R1 pertaining to borehole drilling and coring, and sample collection. The HPs were reviewed to determine their applicability to planned work on the project.

J. Czarnecki reviewed hydrochemical sampling programs with A. Yang (HIP), T. Kane (USGS/LV), B. Michel (USGS Reston) and W. Steinkampf (HIP). A decision was made to fund hydrochemical sampling and analyses as part of Kane's surface-water studies.

M. Ciesnik prepared and revised SNP HP-261T, R0 "*Collection and processing of rock cutting samples from wells drilled with mud using rotary hydraulic method*". The plan was reviewed by J. Czarnecki.

M. Ciesnik participated in the monthly Open Items meeting conducted by the USGS/YMP QA Office. Ciesnik also discussed several outstanding QA issues related to the closing of AFRs 9203-03 and -04 with J. Ziemia (SAIC).

C. Savard represented the HIP SZ section during the Yucca Mountain Open House Public Tour at the HRF.

Collect FY93 moisture data

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

Project staff collected a bailed sample from UE-29 a#1 and dip samples from Delirium and Pah Canyon Washes, and conducted field analyses of the samples. Samples were submitted to the USGS NWQL for analyses. G. Buchanan was trained in procedures for data collection, data analyses, sample preparation and preservation, and sample documentation. Calibration standards were ordered to maintain an adequate inventory.

Project staff assisted surface water personnel in collecting indirect discharge data from high-water events in upper Fortymile Wash.

SCP 8.3.1.2.1.3.2 Regional potentiometric level distribution and hydrogeologic framework studies

0G33113B93

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRG054 Revise water level data report

M. Ciesnik wrote the abstract and press release for the report entitled "*Ground-water altitudes and well data, Nye and Inyo Counties, Nevada-California*" and returned the report for further processing.

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

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

3RG068 Survey water wells in Amargosa Desert FY93

J. Czarnecki discussed surveying and leveling of wells that are part of the DOE/YMP Environmental Monitoring Plan network. All wells have been surveyed as a part of that program obviating the need to run levels to a number of wells used in the regional hydrology studies.

SCP 8.3.1.2.1.3.3 Fortymile Wash recharge study 0G33113C93

Summary Account Manager - C. Savard

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRG026 Conduct ponding and infiltration tests

Installed software on portable field computer which will be used to download data from data loggers during field test.

Variances

3GRG021B Write/revise Fortymile recharge data report

3GRG023B Evaluate southern Nevada and California streamflow

Reports are behind schedule due to time needed to document ongoing recharge events during FY93. Time has been spent mapping the extent of surface-water runoff flows, collecting and processing water quality samples, measuring water-level responses in wells, measuring changes in unsaturated zone moisture content through neutron logging, and documenting and communicating field results.

WBS 1.2.3.3.1.4 Regional Hydrologic System Synthesis and Modeling

Principal Investigator - J. Czarnecki

OBJECTIVE

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

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

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Staff prepared the monthly PACS report, reviewed FY93 budget figures, assisted with TDIF for Amargosa vegetation mapping, and attended the bimonthly SZ sectional PI meeting.

J. Czarnecki met with K. Kipp (USGS CRR) to discuss characterization of the hydrology of Bonneville Salt Flats in Utah. Discussions included field and modeling studies related to playa environments. Also discussed was the capability of computer code HST3D (Heat and Solute Transport in 3 Dimensions) to automatically change hydraulic conductivity as a function of increased temperature resulting in precipitation and dissolution of various mineral species.

J. Czarnecki attended a meeting of the Hydrology Integration Task Force. The meeting was largely focused on the modeling work being done by T. Buscheck (LLNL) and others related to the extended-dry concept of nuclear-waste disposal and its potential impact on the UZ and SZ flow systems.

SCP 8.3.1.2.1.4.2 Subregional two-dimensional areal hydrologic modeling 0G33114B93

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRM031A Calibrate 2-D FE Model

J. Czarnecki became familiar with the UNIX operating system on the HIP SUN computer. A finite-element computer code was successfully compiled and various simulations related to the large hydraulic gradient were run. Head-dependent sinks were incorporated into these runs using vertical-source/sink functions. Various script files were developed to handle a number of processes analogous to those on the QCO HIP PRIME computer.

Variations

3GRM028A Draft report preliminary simulation of large hydraulic gradient

This activity is delayed until revised simulations can be run incorporating head-dependent sinks. All supporting script files for post-processing simulation results need to be converted from PRIME CPL language to UNIX. All computer files have been moved from the PRIME computer to the HIP Sun computer.

SCP 8.3.1.2.1.4.4 Regional three-dimensional hydrologic modeling 0G33114D93

Summary Account Manager - J. Downey

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFH022C Refine 3D hydrogeologic model

C. Faunt 1) finished correlating faults on 2-D cross-sections, which will be used for attribution in the computer; 2) continued using the recently developed user code in

EP/SECT (cross-section modelling software), is used to attribute both faults and horizons. The horizons are finished and the faults are nearing completion; and 3) began plotting the horizon data in three-dimensions. This data will be examined to find problems in the data before gridding.

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

K. Turner reviewed the draft of regional tectonics and crustal stress analysis report and discussed needed revisions with C. Faunt, the author. Detailed written comments and final analysis of statistics remain to be finished in order to complete this review.

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

C. Faunt, F. D'Agnese and K. Turner developed a poster for presentation at the Waste Management '93 Conference, in Tucson and the International High Level Nuclear Waste Management Conference, in Las Vegas. Preparation included developing transfer standard for conversion of computer graphics files to color photographic prints, developing maps and photographic prints from slides, and coordinating with the Colorado District graphics department to complete the task on time.

K. Turner, F. D'Agnese and C. Faunt contacted Intergraph Corp. and arranged for delivery of the software option required to extract the x-y-z coordinates defining the desired hydrogeologic units from the geologic 3-D cross-section and geologic map files in the MGE system. The extracted x-y-z data can then be evaluated by the CPS-3 software to create the needed subsurface geometry definitions.

3GRM041A Generate model input arrays

F. D'Agnese finalized preliminary vegetation maps and worked on the report for *"Regional vegetation mapping of the Death Valley Region"*. Maps for field checking were printed at 100K. A field trip has been scheduled to field check resulting density and land cover classes.

K. Turner 1) continued to complete the draft report on the Amargosa Desert vegetation mapping originally conducted by L. DeMarco. The report is essentially complete and will be submitted for colleague review next month; and 2) reviewed regional vegetation classification maps developed by F. D'Agnese and worked with E. Gutentag, and C. Faunt to outline the report.

F. D'Agnese 1) continued terrain analysis for surface characterization (recharge, discharge, geomorphic, pedogenic, and hydrologic analysis), which included developing an average annual precipitation map of model area based on Quiring's regression; 2) conducted a recharge estimation for regional model and compared it with estimates made by Waddell (1982), Rice (1984) and Harrill (1988); 3) conducted water balance accounting for Death Valley Region based on earlier investigations (models and water resource studies). Review of the source materials, found that very few of the investigations agree; 4) contacted J. Harrill (Carson City) to discuss pumpage estimation for Amargosa and Pahrump Valleys; 5)

arranged with D. Ambos (HRF) to purchase climate data for Nevada study area; 6) arranged with R. La Camera to acquire estimates of ground-water pumpage for key basins in the study area from the Nevada State Engineer; and 7) continued working with B. Meier (Intergraph) to develop a 2.5 dimensional terrain model of the study area to be used in visualization of the 3-dimensional model, YMP tour demonstrations, and presentations.

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

F. D'Agnese continued to work on the regional potentiometric surface map. Preliminary regional water table maps were developed representing the potentiometric surface as both continuous and discontinuous. Map is being revised to include water table depressions at discharge areas. The map is also being compared to other published maps and topographic data. D'Agnese discovered some software bugs in CPS-3 and arranged to have those bugs rectified with help from Radian Corp. (Austin, Texas).

F. D'Agnese continued developing layers for preliminary model using GIS database.

Methods on distributing hydraulic conductivity were reviewed, including random analysis, stochastic conditional simulation, Bayesian statistics and deterministic methods.

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

F. D'Agnese, E. Gutentag, K. Turner, and C. Faunt began preparing outline of report on Conceptual and Numerical Model of the Death Valley Region.

F. D'Agnese, C. Faunt and K. Turner submitted an abstract to Second International Conference/Workshop on GIS and Environmental Modeling to be held in Breckenridge, Colorado in September. This paper also will be submitted to a journal to fulfill Milestone 3GFH014M.

3GFH009C Continue testing with chemical models

K. Turner and C. Faunt discussed statistical processing strategies on the regional water geochemistry data with D. Perfect. Initial screening statistics were developed using SAS.

K. Turner and C. Faunt reviewed mapping methods to display the results of the geochemical data statistics with D. Perfect. Some initial contour map plots were produced using SURFER, and C. Faunt and D. Perfect began the data transferrals needed to create map displays using Arc/Info.

D. Perfect has been conducting basic statistical analysis of hydrochemical data, sorting and parsing the chemical data; finished chemical balances for the data base, which is now ready for some statistical analyses; and continued working on an open file report of "*Hydrochemical data in Death Valley Region*".

Planning and Operations

3GFH022C Refine 3-D hydrogeologic model

The hard-disk on the Intergraph Workstation at CSM failed mechanically (the drive-motor failed). The fault was diagnosed and the disk was replaced by Intergraph field engineers (without charge). Data on the disk had been backed-up, so no information was lost.

Assistance in reconfiguring the new disk by Intergraph personnel was necessary, however, and this was scheduled for and completed March 3, 1993, and all operations are back to normal. Work on model construction was delayed but not severely.

WBS 1.2.3.3.1.2 Unsaturated Zone Hydrology

OBJECTIVE

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

WBS 1.2.3.3.1.2.1 Unsaturated Zone Infiltration

Principal Investigator - A. Flint

OBJECTIVE

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

SCP 8.3.1.2.2.1 Unsaturated Zone Infiltration LOE Account 0G33121Z93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Support project operations, FY93

Activities for February included preparation of monthly PACS. B. Guertal, L. Hofmann and L. Flint were involved in an all day public tour on February 20, 1993. B. Guertal gave two one-hour small group tours of the HRF. L. Hofmann spent two hours giving technical assistance to the saturated zone Fortymile Wash recharge program.

Technical procedures HP-258 and HP-259 were sent to technical review. Technical procedure on particle size analysis was completed and received a preliminary review.

Work continued on preliminary drafts for title summaries and abstracts for paper presentations at ASA and AGU for 1993.

Neutron moisture monitoring FY93

Neutron holes were not logged in February because they were logged the last week of January and are scheduled again the first week of March.

SCP 8.3.1.2.2.1.1 Characterization of hydrologic properties of surficial materials 0G33121A93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUI012 Collect/analyze consolidated/unconsolidated materials

The sampling program of small grab samples taken near the neutron holes continued. Due to the large amount of precipitation that has occurred during the last few months, standard techniques are being adapted to measure soil water potential in the field. Tensiometers will be placed at five or six selected locations in order to determine the in-situ soil water

potential.

Field bulk density samples were collected for each of the major stratigraphic units at Neutron hole N-85. Bulk density was determined for both the fine (less than 2 mm fraction) and coarse (greater than 2 mm fraction) fractions. A model of infiltration processes at N-85 has been developed and preliminary results are described in the artificial infiltration PACS account.

- 3GUI015A Develop preliminary geohydro/surficial/infil/runoff map
Work related to the preliminary surficial map primarily dealt with software concerns. Additional GIS work is on hold, pending arrival of the Sun Workstation.

SCP 8.3.1.2.2.1.2 Evaluation of natural infiltration 0G33121B93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

- 3GUI305 Conduct water balance studies FY93

Bowen ratio data was collected from Pagany Wash. Tensiometers have been built for placement in the surface soils in Pagany Wash and at the infiltration site at N-85 to evaluate drying trends following saturated conditions, due to recent high rainfall and due to ponding. Some of the tensiometers will be automated for collection with data loggers.

- 3GUI310 Evaluate shallow/deep infiltration process FY93

Additional efforts were made to evaluate the flow codes for investigating steady state conditions in deep boreholes. The dual-spaced neutron logging tool was calibrated in the 3 tanks and will be used to log UZ-16 following the removal of the drill string. The UZ-16 borehole is 12" diameter uncased, but the relative magnitude of the counts can be assessed.

- 3GUI050 Prepare report historical neutron hole data

Additional data organization and editing is ongoing for input into the neutron hole data base prior to preparation of the data for analysis. This data base should be complete within two weeks.

Work Performed but not in Direct Support of the Scheduled Tasks

Several hours were spent evaluating neutron holes in Solitario Canyon to decide which borehole could be used for the University of Nevada, Reno seismic program. They will be installing seismic instruments in three locations, north of the repository boundary, south of the boundary near the Ghost Dance fault, and the one in Solitario Canyon to provide information for triangulation of seismic events. (6 hrs)

SCP 8.3.1.2.2.1.3 Evaluation of artificial infiltration 0G33121C93

Summary Account Manager - A. Flint

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

- 3GUI636 Conduct infiltrometer study/prepare OFR

Two additional water storage tank systems were calibrated. Results of the calibrations were similar to those of the first tank calibration. With the completion of these calibrations, there are now three water storage tank systems.

Fabrication of two additional double ring infiltrometers has been completed. The three double rings have been installed at N-85. These rings will be used in the prototype ponding/infiltration study.

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

Final preparations for the prototype ponding experiment at N-85 have been completed. The infiltration experiment is scheduled to begin on March 9, 1993.

Multiple sets of time domain reflectometry (TDR) probes were installed at various locations at N-85. These probes will be used to determine the rate of water movement away from the infiltration ring. Background sets of measurements were taken every 3 to 4 days, depending upon weather patterns and conditions. Volumetric water content values, as determined by TDR, have been compared to neutron logs and gravimetric/volumetric water contents obtained from grab samples. Slight modifications of the $1/V_p$ values, as determined by TDR, is needed, and work is currently underway on those modifications.

Field bulk density samples were collected for each of the major stratigraphic units at N-85. Samples were collected in triplicate, and bulk density was determined for both the coarse (> 2 mm) and fine (< 2 mm) fractions.

A preliminary 2-D model that contains nine major stratigraphic units has been developed. The model has been run using site characterization data that was collected for each of the 9 units. The infiltration simulations have been run under a variety of differing boundary conditions, and for a range of hydraulic conductivities and porosity values. Model predictions will be compared to actual measured infiltration values.

WBS 1.2.3.3.1.2.3 Percolation in the Unsaturated Zone - Surface Based Study

Principal Investigator - J. Rousseau

OBJECTIVE

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

SCP 8.3.1.2.2.3 Percolation in the Unsaturated Zone, Surface-based Study LOE Account OG33123Z93

Summary Account Manager - M. Chornack

ACTIVITIES AND ACCOMPLISHMENTS

HRF Borehole Monitoring and Sensor Recalibrations

Continued monitoring of HRF boreholes; backup psychrometers activated to confirm arrival time of water precipitation; ordered materials for cable and tubing reel racks for hydro-instrumentation of UZ boreholes; began fabrication of 2nd reel rack unit - expect to complete 16 units by end of April 1993; took delivery of 82 downhole instrument station apparatuses (DISAs) from Faustson Tool Company, Denver; coordinated with K. Lobos (SAIC, Las Vegas) for design and layout of a power distribution grid to the UZ borehole field sites; resolved contract issue with local SBA (Denver Region) on the award of Insulated Instrument Shelter (IIS) contract. Inspected facilities of local manufacturer and prepared technical assessment of their capabilities and qualifications. SBA (Denver) agreed

to award contract to R/P International, Lincoln Heights, Ohio (manufacturer of the first pre-production unit); arranged for the relocation of existing instrument shelter at UZ-1 to Test Cell 'C'; received and installed bell provers (large mass flow calibrators) at the deep UZ calibration laboratory at the HRF; interviewed potential candidate to fill position vacancy with the deep UZ computer programming support group; hired hydrologic technician to fill position vacancy in the deep UZ calibration laboratory; hosted Open House Public Tour at the HRF on Saturday, February 20, 1993; coordinated efforts in the preparation of an Interior report on borehole lithology, fractures, and mineralogy for UZ-16; report will be co-authored by USGS and Los Alamos; purchased and installed RockWare software on PC system; software will be used to prepare detailed borehole instrumentation and stemming plans; completed criteria letter for testing and instrumenting shallow UZ boreholes (UZ-4, -5, -7 and -13); prepared monthly PACs status reports for month of January, 1993; made final presentations (5) on February 9th and 10th to the DOE project office on the Deep UZ VSP program - a follow-up meeting was held on February 26th to resolve remaining grout/borehole sealing issues (USGS, Sandia, M&O, and SAIC were represented at these meetings); coordinated with PBT, Inc. for development of criteria for measurements of P- & S-wave velocities on core samples from UZ-16; completed fabrication of a geophone cable mounting bracket positive; purchase order for fabrication of these units was awarded to Headway Industries, Lakewood; processed request to terminate further development of IDAS software; made recommendations to enhance existing PC data acquisition system to take over functions of the IDAS; moved warehousing, fabrication and assembly operations associated with the Deep UZ calibration laboratory at the HRF to Test Cell 'C'; prepared specification requirements, per request of Central Region procurement division, for advertising the purchase of 100 pressure transducers on open bid - bid closeout is scheduled for March 1st; prepared and submitted two abstracts for presentation at 1) Fourth TIE Workshop, DOE, Oak Ridge, Tennessee, and 2) AGU meeting, Baltimore, Maryland; began preparation of an abstract for the SEG meeting in Washington, D.C., in September, on results of VSP computer and physical simulations of Yucca Mountain, Nevada; prepared attachments 1 and 2 of QMP-3.03 for eleven (11) software programs that will be used in analyzing VSP data for UZ-16 (VSP-2);

Air-K Testing

A manifold system was fabricated for use with the mass flow calibration system. The mass flow calibration system was installed in the HRF calibration laboratory along with a calibration table and work area. The 5 and 20 cubic feet bell provers, which were purchased for use in the expansion of the mass flow calibration system, were installed. The maximum filtered air flow rate available in the HRF calibration laboratory is 5 cubic feet per minute. This is not adequate for the mass flow calibration system, so a new storage tank, which will increase the flow rate to 50 cubic feet per minute, will be installed outside the calibration laboratory. A Sierra Instruments representative visited the calibration laboratory to complete installation of the bell provers, and to update and recalibrate the mass flow calibration bench. However, he was unable to get either the calibration bench hardware or software to operate correctly. After four days of trying to make the system operational, the representative requested that the equipment be shipped back to the factory for a complete inspection.

Work began on the field trailer electrical system and the packer assembly electrical system. Preliminary examination of the USBR trailer electrical system revealed that the only slip ring which was completed is damaged beyond repair, the wire organization for passing through the reel axle is incorrect, and the wire-to-pin connections in the packer assembly wiring do not match the supplied electrical drawings.

A memo was received from the USBR which described welding modifications to the field trailer boom, which must be completed to meet required load capacity.

Continued to inventory equipment and organize new lab and office space at Test Cell 'C'; J. Rousseau's abstract on TCPs was reviewed; two trips were made to NTS during the reporting period to familiarize staff with electrical and pneumatic work which is required to complete field equipment; Sierra Instruments calibration bench was packaged for shipment to the factory for inspection. Payment for bell provers has been delayed until a fully operational mass flow calibration system is supplied by Sierra.

Prepared and submitted purchase requisitions for the following: a trailer axle, a 400 gallon air tank, a field trailer awnings, a bell prover oil, MathCad computer software, BPO to Holmans Computer Center, BPO to Keisub Electrical Parts.

Support Project Operations

Candidates were found to fill three open positions at the HRF: two physical scientists (equivalent to USGS hydro-techs) and one QA-specialist/physical scientist. Arrangements have been made with Foothill to interview the top candidates for the three positions.

Job descriptions were written up for possible summer student help from University of Nevada, Reno (UNR) funded by DOE. The descriptions for three possible positions were forwarded to DOE through R. Craig.

A manuscript was received from P. Nelson in the Geologic Division for technical review prior to publication. It is an overview of the relationships between rock permeability and porosity determined from wireline logs. Technical review was started in late February.

Work on the permeameter procedure is nearly complete. It was revised after initial review and will be submitted to review in March. The technical specifications for a high-speed centrifuge to measure unsaturated hydraulic conductivity were sent to REECo capital equipment purchasing.

Work is continuing in the back labs of the HRF to get processing facilities set up. The environmental chamber is up and running, but will have to wait several months for furniture to be delivered. There were some problems with the building vacuum system, which wouldn't even draw 10 inches of mercury. The problem has been repaired, at least temporarily, and the system now can draw a vacuum of 19 inches. It will improve further with the installation of a new motor. An independent vacuum system is being assembled in the lab for high vacuum applications.

The HP-229 procedure was modified to allow new and better relative humidity/temperature sensors to be used in the RH ovens. The Campbell Scientific 207 probes were replaced with RoTronic sensors after the modification was done on the procedure. The CSI 207 probes have been sent to the HIF for closing calibrations.

Comments were received on the chilled-mirror psychrometer procedure, and it is undergoing revision.

February tours:

Nevada State Assembly Representatives, 2/16/93, 0.5 hr, Soeder

University of Minnesota, 2/18/93, 1 hr. Soeder

Johnson Controls film crew in lab, 2/18/93, 1 hr, Soeder

YMP Open House - Public Tour, 2/20/93, 8 hrs, Hudson

SCP 8.3.1.2.2.3.1 Matrix hydrologic-properties testing 0G33123A93

Summary Account Manager - D. Soeder

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP005A Measure rock properties/state variables FY93

High temperature oven drying at 800°C was finished on all canned samples from N-54.

Physical properties analyses are complete on samples from this borehole, and the cores are in storage in a locked equipment cage. Analyses of the backlog of canned neutron core samples will begin in March.

3GUP025A Determine matrix permeability FY93

Matrix permeability measurements have been completed on 13 runs of samples from the Prow transect. Four runs of fracture-fill samples (fault breccia and calcite-silica mineralization from Trench 14) also were completed as part of a study of the role of fractures as flow pathways for meteoric water on Yucca Mountain.

3GUP031A Determine moisture characteristic curves FY93

Moisture characteristic curve measurements in the chilled-mirror CX-2 psychrometer are continuing on samples of fine soil (<2 mm size fraction) and on larger fragments (2 mm to 9.5 mm size fraction). A paper titled "*Effect of rock fragment size on laboratory determination of water potential*," by M. Nash, L. Flint and A. Flint is being written for the Soil Science Society of America Journal. The study is attempting to define the optimal fragment size for samples of various materials being run in the CX-2. Nine additional cores from the UZ-6 transect were run as part of the INTRAVAL project, and water potential was determined from a soil section adjacent to the N-85 borehole for each of the defined soil layers present.

SCP 8.3.1.2.2.3.2a Surface-based boreholes studies 0G33123B93

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP052A Test and calibrate equipment

Installed Sierra Instruments, high (mass) flow range bell provers in the HRF calibration laboratory. Bell provers will be used to calibrate mass flow meters used in air-permeability testing program. Continued development of technical procedure for calibrating mass flow meters in 0 - 5 slpm range. A defect in the low-flow calibration system purchased from Sierra Instruments was uncovered. Unit is being returned to the manufacturer for repair and/or replacement.

3GUP053A Drill UZ boreholes

Drilling on UZ-16 continued; on February 24, 1993, coring penetrated through the water table at a depth of 1609-1614 feet. Water samples were collected and a verbal operations order was prepared to direct drilling activities on UZ-16 through completion to 80 feet below the water table. Testing guidelines were established to evaluate disturbances to the upper unsaturated zone from drilling in the saturated zone. Borehole should be complete by mid-March.

SCP 8.3.1.2.2.3.2b Vertical seismic profiling 0G33123C93

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP081B Conduct VSP prototype field test and analysis

Present plans are to acquire the first complete crosshole data set at Idaho Springs, CSM Experimental Mine by the end of March. Only one acquisition episode took place in February due to scheduling difficulties. Equipment malfunctions prevented acquisition of any meaningful data. The equipment has been repaired but the Mine cannot schedule more work until after March 12, 1993.

Planning and Operations

3GUP084B Provide velocity measurements UZ-16 core

PBT Laboratory, a potential contractor to perform core velocity measurements, was inspected and found satisfactory. PBT has completed length and time calibration standard measurements. Certification through the QA office must be completed before velocity measurements can be performed on UZ-16 core.

Work Performed but not in Direct Support of the Scheduled Tasks

Completed preparations of VSP presentation and made presentations to the DOE project office.

Prepared expanded abstract of VSP modeling and imaging for technical presentation at the fall SEG meeting.

Completed semi-final draft of H. Jaramillo's thesis on VSP imaging and modeling of Yucca Mountain. Plans are to defend in March.

Additional work on the Yucca Mountain Model data includes resorting the data into "common receiver gathers" to aid in re-imaging with better migration velocities.

SCP 8.3.1.2.2.3.2c Integrated Data Acquisition System 0G33123D93

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP072C Develop, test, review, and integrate software

A recommendation was submitted to the DOE project office to terminate further development of IDAS software. Steps have been taken to begin converting to PCDDAS which will take over the functions of IDAS. Began modifications to the HRFDAS that is used to monitor the HRF borehole. Testing of the modifications is scheduled for mid-March. No impact to program schedules is anticipated as a result of these actions.

3GUP076C Evaluate prototype data from HRF borehole
Evaluation of data from the HRF boreholes continued throughout the reporting period.
Sensors in these boreholes have been operating for over 16 months and continue to provide reliable data.

SCP 8.3.1.2.2.3.2d Air-permeability and gaseous-tracer testing 0G33123E93

Summary Account Manager - G. LeCain

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUP031D Prepare/test/write report for UZ-16 air-k
Staff is presently completing electrical wiring of the air-permeability testing packer assembly and support trailer.

Planning and Operations

3GUP032D Prepare/test/write reports for UZ air-k testing
Staff obtained packers which will be used for testing in 5" boreholes. This is the first step in expanding the operational range of the surface-based, air-permeability, testing program.

3GUP033D Construct and test backup packer assembly
Investigated sources for the purchase of sliding end packers that will work with the already constructed assembly subs. The packers must work with the USGS subs since the cost associated with building new subs for each new packer is prohibitive.

Variances

3GUP031D Prepare/test/write report for UZ-16 air-k
The USGS staff has assumed all USBR responsibilities. Items still to be completed include: pneumatic plumbing, boom reinforcement, checking of and repairing poor welds, installation of third axle, installation of sun awnings, construction of data acquisition and power system in trailer office, performance of safety testing, writing of HP operation manuals, field testing of packers and trailer. Estimated date to begin field testing of the system is June 14, 1993.

WBS 1.2.3.3.1.2.4 Percolation in the Unsaturated Zone - ESF Study

Principal Investigator - M. Chornack

OBJECTIVE

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

SCP 8.3.1.2.2.4 Percolation in the Unsaturated Zone, ESF Study LOE Account 0G33124Z93

ACTIVITIES AND ACCOMPLISHMENTS

Support Project Operations, FY93

Attended Integrated Data System (IDS) information exchange meeting in Las Vegas, Nevada. A progress report from the IDS designers was presented. Presentations were made by the U.S. Bureau of Mines and Sandia National Laboratories, who have built and used similar systems. The SZ modelers meeting was attended. The purpose of the meeting was to integrate modeling approaches and information between modelers and the SZ and

UZ projects; two staff members attended FRHP meetings on February 4 and 18, 1993, and L. Anna attended a one day UNIX training session.

Two staff meetings were held to discuss detailed and routine project operations. In addition, other discussions were held about QA responsibilities, purchasing plans, administrative procedures, and training needs.

Prepared for the upcoming internal audit of activity 8.3.1.2.2.8.1.

Reviewed three technical procedures: "*Collecting gas samples in boreholes*"; "*Collecting soil gas*"; and "*Procedures for collecting temperature, humidity, and pressure data*".

Reviewed QA reading assignment AP-5.1Q, R3.

Prepared January PACS reports, and prepared and processed a number of purchase requests.

Comment resolution of technical review of USGS-HP-250, "*Intact fracture sampling, radial sampling*" was completed. However, still resolving HIP QA review.

Completed interviews and contacted references for the two finalists for the Computer Systems Analyst position vacancy. B. Britain accepted the position on February 11, 1993, and will start work March 1, 1993.

Completed technical review of journal paper, "*An improved method for quantifying soil macroporosity*", by V. Vermeul, and others.

Completed chemical hygiene plan and chemical inventory for 1993 for the FRHL, and submitted it to HIP Chemical Safety Officer, J. Fararese.

The slab saw in the FRHL is being converted from using water as the cutting fluid to air. This change will benefit both the fractured rock group and the hydrochemistry group. As a result, the dust collection process is being revamped. Drawings were submitted to the Branch of Isotope Geology machine shop for five air duct plenums/adapters, which will be installed in March.

S. Anderton continued supporting the percolation test, the block E experiment, and tests on sample 13B. He made the drawings for the dust collection system and helped set up new stations in the lab on the LAN and did troubleshooting associated with these new stations. Anderton also performed maintenance of the pressure transducer calibration system, the pure water system, and the vacuum saturation system.

SCP 8.3.1.2.2.4.1 Intact fractures testing in the ESF 0G33124B93

Summary Account Manager - G. Severson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUS015J Complete journal paper: detailed moire

This paper is planned to be submitted to the HIP reports section for formal technical review in April 1993.

3GUS020J Design and conduct tests

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

3GUS024J Complete OFR on projection moire

Progress toward this "final report" continues. A draft of this OFR should be submitted sometime in May 1993 following completion of activity 3GUS015J.

3GUS028J Design/fabricate vessel

After reviewing the cost estimates obtained from commercial machine shops, the USGS Branch of Isotope Geology machine shop was selected to do the machine work for the pieces for the low-pressure vessel, and to fabricate the LVDT mounting brackets for displacement measurements. The machine shop already has cut and dressed the B-7 rod that will be used to bolt the vessel together.

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

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

SCP 8.3.1.2.2.4.2 Percolation testing in the ESF 0G33124B93

Summary Account Manager - F. Thamir

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUS034B Prepare analytical report on imbibition experiments

An experiment was repeated on one fractured core where the water flow rate through a fracture at different pressures was measured. The repetition was required to verify effects of barometric pressure fluctuations on water flow rate through fractures. These effects were observed in a previously conducted experiment. Results indicate that as the barometric pressure rises, flow rate increases, and vice versa. This effect will be studied and included in the report.

3GUS035B Plan and design ESF percolation test

Work on the new revision to the ESF percolation test study plan, SP-8.3.1.2.2.4.2, continues.

SCP 8.3.1.2.2.4.4 Radial borehole testing 0G33124D93

Summary Account Manager - G. LeCain

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUS0410 Design/construct/test borehole packer system

Work cannot be completed until the required equipment is purchased. The requisition is in Contracts and is expected to be advertised in the CBD during March, 1993.

SCP 8.3.1.2.2.4.7 Perched Water Tests in the ESF 0G33124G93

Summary Account Manager - M. Chornack

ACTIVITIES AND ACCOMPLISHMENTS

Variances

3GUS012G Begin monitoring ESF for perched water

3GUS013G Begin conducting perched water testing in the ESF

The earliest start date to begin monitoring (3GUS012G) and conducting (3GUS013G) perched water tests, if water is encountered, in the ESF is April 1, 1993.

Work Performed but not in Direct Support of the Scheduled Tasks

Prepared HP-260 "Sampling, hydraulic testing, and monitoring perched-water zones in the Exploratory Studies Facility". (20 hrs)

SCP 8.3.1.2.2.4.8 Hydrochemistry tests in the ESF 0G33124H93

Summary Account Manager - A. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUS400 Investigate locations, short hole drilling, ESF

C. Peters updated three documents (TPP, CM-0019, PPL) for LANL ESF test coordinators to be consistent with current version of study plan.

Planning and Operations

3GUS403 Research gas-sampling system

C. Peters talked with USGS contracting office about the progress of the requisition for the Seamist. It will be advertised in Commerce Business Daily in March.

WBS 1.2.3.3.1.2.6 Gaseous-Phase Movement in the Unsaturated Zone

Principal Investigator - M. Chornack

OBJECTIVE

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

SCP 8.3.1.2.2.6.1 Gaseous-phase circulation study 0G33126A93

Summary Account Manager - M. Chornack

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGP06B Plan tracer tests in selected UZ boreholes

Plans for conducting convergent and divergent flow tests were updated, to include conducting divergent tests in September/October 1993 and convergent tests (requiring 6 different tracers) in March 1994. Equipment and supply needs were determined.

Dynacalibrator for calibration was sent. The tracer position paper was prepared, sent to appropriate parties for review and discussion, and revised after additional literature search based on those reviews. The revised paper was then redistributed to include additional DOE management personnel. Subsequently, meetings were held (USGS position paper preparers were not informed of nor invited to this meeting) at which it was determined that

no tracers with known ozone depleting potential would be included in the permit submitted to the State (even at the < 5 gram levels requested in the position paper). Additionally, it was decided that several potential non ozone depleting tracers which were recommended to the State by it's UNLV consultant, would be studied by that consultant for suitability. The length of these studies is as yet undetermined; however, it is likely that the time for study will delay the convergent tracer test plans significantly (as was pointed out in the position paper).

3GGP08B Plan modeling and gas flow interference tests

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

3GGP02B Collect UZ Borehole Data - FY93

Pressure shut-in tests completed at UZ-6s. A solenoid panel was prepared, fifth wheel trailer transported to UZ-6 and shut-in pressure tests begun at UZ-6. BCF concentration profile for determining dilution factors was completed at UZ-6s. Two hot wire anemometers were purchased. Transducers and hot wire anemometers were sent out for calibration. UZ-6s gas sampling tubing bundle and thermocouple bundles were taken apart, lengths remeasured, rebundled, and installed into UZ-6s. Preparations began for March gas sampling trip.

3GGP04B Tabulate and analyze gas samples

Began UZ-6s pressure shut-in test analysis. Continued tabulation and analysis of UZ-6s physical data.

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 26 hours were spent in support of the following tasks:

Management agreements were set up with E. Weeks (NRP), H. Haas (SMU), and N. Plummer (NRP).

The area that had been previously infrared recorded was video recorded to provide a visual location key for the infrared recording.

HPs 176, 177, 178, and 192 were revised.

WBS 1.2.3.3.1.2.7 Unsaturated Zone Hydrochemistry

Principal Investigator - A. Yang

OBJECTIVE

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

SCP 8.3.1.2.2.7 Unsaturated-Zone Hydrochemistry LOE Account 0G33127Z93

Summary Account Manager - A. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Conduct information seminars on model for project staff

D. Thorstenson is conducting informal seminars for project members at the DFC, as time allows, two hours per week on geochemical modeling. This requirement will stimulate project members to attend the seminars so they have a better understanding of what the model can do and what final products may be expected. Three seminars were held in February, devoted primarily to mass-balance modeling.

Procure, test borehole sampling system (12" hole)

A 12-1/2 inch packer system will be needed to collect gas from up to 15 zones in unsaturated zone boreholes. One possibility is a straddle packer system (as tested at UZ16); another possibility is a Seamist system. The 12-inch Seamist system must be procured and tested at a UZ borehole at Yucca Mountain.

C. Peters discussed Seamist procurement with USGS contracting office. It will be advertised in Commerce Business Daily in March.

Prepare hydrologic procedures, FY93

The KOH-collection of CO₂ procedure is now written and fully QA approved.

Technical procedures HP-192, HP-160, HP-178, and HP-260 were written, reviewed and revised.

G. Rattray discussed with QA personnel the proper QA procedures for purchasing Freon-related fluorocarbon calibration standards. He copied, practiced operating, and provided operating assistance to UZ hydrochemistry personnel on the chemical speciation and reaction path programs WATEQ4F and PHREEQE. Rattray also performed the following tasks: a technical review for HP-07; drove the cube van from HRF to Denver (18 hrs); inspected delivery of UZ-16 and N-55 core for delivery of all specified samples; attended a management meeting at FOC regarding procedures to follow for drilling below water table at UZ-16; assisted Caltrol personnel during installation of automated tracer gas injection system; inventoried equipment, located missing equipment, facilitated communications between Caltrol, REECo, and NTS personnel, provided USGS input regarding location of instrument hookup, became familiar with ROC operating software, tested equipment, and modified ROC programming to meet USGS needs (60 hrs); purchased HFC-134a from Scott Specialty Gasses; verified QA requirements, arranged for modifications to Scott BPO, discussed with DuPont the analytical sensitivity of HFC-134a, arranged with Scott to provide this gas for USGS (13 hrs); and tested sorption of CO₂ (50,000 ppm) onto gypsum cement.

J. Higgins completed a reading assignment for AP-5.1Q, R3 *"Control and transfer of technical data on the Yucca Mountain site characterization project"*, and began technical review of HP-259, R0, entitled *"Determination of bulk density using an irregular hole bulk density sampler"*.

M. Beasley completed QA reading assignments HP-234T, R0; HP-257, R0; and AP-5.1Q, R3.

A. Yang, C. Peters, and G. Rattray held a coordination meeting with D. Thorstenson, R. Stingle, and T. McConnoughey of USGS NRP for a mid-March field trip for gas samplings at UZ-6s, UZ-16, and shallow soil gas. Due to limited numbers of gas-chromatography instruments and the many gas components to be analyzed, work schedules needed to be

coordinated.

A. Yang contacted J. Rousseau to obtain compositions of grout mix to be used for borehole stemmings. The chemical recipe for gypsum could affect the carbon dioxide gas adsorption, and the isotopic composition of hydrogen and oxygen in the water vapor needs to be studied to understand the extent of effects.

A. Yang reviewed three technical procedures - (1) "Gas samplings from shallow soil zone", (2) "Analysis of soil CO₂ gas by infra-red gas analyzer", and (3) "Soil samples for water-isotopic analyses", were submitted by J. Whelan.

J. Ferarrese procured safety gloves and chemical reagents for use in the UZ Hydrochem lab.

A service contract was awarded to the Packard company to cover the Packard Liquid Scintillation Center. The service contract was necessary to ensure ongoing, proper performance of the instrument and associated cooling system.

All balances in UZ hydrochemistry lab were calibrated manually. This is done each month in addition to the regular QA calibrations to provide a more immediate means of detecting potential calibration problems.

P. Striffler planned and scheduled REECo support for project operations at NTS, including preparation of work orders for generator support and service at UZ-6S, UZ-16, and a crane at UZ-16.

C. Peters met with the QA staff regarding various QA matters, prepared UZ-16 field work schedule and discussed it with UZ-hydrochemistry project members, and attended the GAC meeting.

All UZ-hydrochemistry project members completed QA reading assignments.

SCP 8.3.1.2.2.7.1 Gaseous-phase chemical investigations 0G33127A93

Summary Account Manager - A. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUH011 Evaluate existing export models gaseous C-14 export

Carbon-14 data from the top four probes at UZ-1 cannot be modeled by a steady-state radioactive decay with diffusive transport model. They can be fit reasonably well with a transient source term diffusion model.

3GUH012 Prepare, analyze and tabulate data

Processed UZ-1 gas samples: (1) Fifteen 300cc stainless steel (ss) storage cylinders were heat evacuated for 14C sample storage; (2) fifteen 2.1 liter aluminum sample cylinders were degassed and 13C/12C samples sent for analysis; (3) fifteen 500cc ss sampling cylinders were degassed and 14C samples stored in the 300cc ss storage cylinders.

Thirty silicargel towers were dewatered and their water contents measured.

3GUH013 Oversee drilling, collect gas and water vapor samples

P. Striffler spent 14 days injecting and monitoring tracer gas at two drill rigs on Yucca Mountain. Borehole UZ-16 reached the water table, and Striffler collected two water samples.

3GUH014 Design, build, and test equipment

An instrument engineer for Dionex Corporation has repaired a faulty valve on the ion chromatograph. Also, J. Fararese is preparing the ion chromatograph, gas chromatograph, and data acquisition system for transport to the NTS for field use.

Leak tested eight sections of packer's bladder system and purchased other packer parts.

3GUH015 Prepare interpretive report/OFR: UZ-1 gas and water vapor

P. Striffler continued to verify and tabulate data and compile narrative sections for open file data report. Additional sections for input were discussed with C. Peters.

Quality Assurance

3GUH012 Prepare, analyze and tabulate data

A memo describing 13/12C samples from UZ-1 and sample IDs has been submitted to the LRC.

Work Performed but not in Direct Support of the Scheduled Tasks

P. Striffler collected borochlorofluoride (BCF) samples in triplicate from 11 zones in borehole UZ-6S. Striffler also set up gas chromatograph and analyzed BCFs. BCF samples were collected in cooperation with gas phase circulation. (6 hrs)

P. Striffler worked with L. Jones (Fisher Controls) setting up and testing the automated tracer injection equipment. (8 hrs)

C. Peters met with USBR representatives to discuss their remaining responsibilities and transfer of information matters to USGS UZ-hydrochemistry. (12 hrs) He reviewed and revised packer installation procedures. (4 hrs)

SCP 8.3.1.2.2.7.2 Aqueous-phase chemical investigations 0G33127B93

Summary Account Manager - A. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUH035A Prepare report on effects of core sealing

Continued preparation of slides for presentation at IHLRWM meeting on "Effects of Core Sealing" study.

3GUH030A Export, prepare, extract, analyze core

Thirty-six pieces of UZ-16 cores in the interval between 1005 feet and 1430 feet were transferred from SMF in Nevada to Denver, Colorado. A. Yang requested and prepared the paperwork and M. Chornack transported the cores from Nevada to Denver with the van according to technical procedure HP-131, R2. The UZ 16 cores were placed in refrigerators in the UZ lab and the UZN 55 core was stored in the Ammonia room in Building 56.

3GUHO36A 3H and ¹⁴C method development report

J. Fararese finished the draft report and sent it to the co-author for input and revision.

Planning and Operations

3GUHO30A Export, prepare, extract, analyze core

Selected seven core intervals from UZN-53, and seven core intervals from UZN-54 for pore water extraction studies.

Work Performed but not in Direct Support of the Scheduled Tasks

P. Striffler collected water samples from the water table during drilling at UZ-16, and analyzed the water for Ph, SC, and alkalinity. The water samples were separated and preserved for different analyses, and sample tracking forms were completed. Results show that the water samples are tainted with salt (NaCl) used by borehole loggers. Samples were collected by UZ hydrochemistry personnel, acting as USGS site representative at UZ-16. (12 hrs)

WBS 1.2.3.3.1.2.8 Fluid Flow in Unsaturated Zone Fractured Rock

Principal Investigator - L. Anna

LBL Principal Investigator - G. Bodvarsson

OBJECTIVE

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

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

Summary Account Manager - L. Anna/E. Kwicklis

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUF026 Model imbibition experiments

The hardware for a new imbibition design is assembled. The experimental setup is complete; the hardware and software data retrieval system is being assembled and adapted to the new experiment.

3GUF020 Conduct scoping and bounding calculations

Continued to develop techniques to calculate fracture porosity from measured total porosity and acoustic properties of rock. Continue to search Yucca Mountain literature for total porosity and acoustic properties of rock data. Liquid water flux rates are being calculated from water saturation and water potential profiles from surface based borehole data. Because the initial phase of this work was successful, it is planned to investigate other surface based boreholes for similar information.

3GUF022 Model large block percolation experiment

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

Variations

3GUF026 Model imbibition experiments

This activity has been delayed because the imbibition experiment has been changed. Changes include: a new non-fractured sample; continuous data collection instead of periodic collection; and the introduction of a psychrometer in the middle of the sample to measure water potential and inflow rates in real time. Inflow rates at a specific water potential will give more meaningful information when comparing numerical simulation.

Work Performed but not in Direct Support of the Scheduled Tasks

Compiled data on fracture orientation, dip, frequency, density, and flow rates in differential stress regimes, and fracture characterization at different scales. L. Anna gave a workshop to the UZ fractured rock hydrology group on fracture characteristics determined from structural and tectonic information. (25 hrs)

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

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUF418L Complete and publish paper in RWMNFC journal

Reviews of the paper "*Accuracy and efficiency of a semi-analytical dual-porosity simulator*" by R. Zimmerman, G. Chen, G. Bodvarsson, and E. Kwicklis were received from the journal. The paper has been modified in accordance with reviewer's suggestions and returned to the editor.

3GUF217L Complete semi-analytical methods report

Analysis of asymptotic solutions for vertical and horizontal infiltration into fractured rock was carried out, and will be included in the report/user's manual as test problems.

WBS 1.2.3.3.1.2.9 Site Unsaturated Zone Modeling and Synthesis

Principal Investigator - E. Kwicklis

LBL Principal Investigator - G. Bodvarsson

OBJECTIVE

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

SCP 8.3.1.2.2.9.1 Conceptualization of the unsaturated-zone hydrogeologic system 0G33129A93

Summary Account Manager - E. Kwicklis

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM015 Complete study plan revision/resolution comments

In November, responses to DOE review comments and the revised study plan were submitted to SAIC and forwarded to the DOE reviewers for their concurrence. All reviewers except those from Weston and LLNL have accepted the USGS responses. The authors are working with the reviewers to resolve the few remaining differences.

3GUM002A Develop conceptual models of UZ - FY93

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

No work was conducted under these activities in February because of unscheduled work related to modeling heat buildup and redistribution of moisture liquid at the proposed repository due to heat generated by radioactive decay (see unscheduled work).

Work Performed but not in Direct Support of the Scheduled Tasks

E. Kwicklis attended a meeting on January 22, 1993 in Las Vegas to discuss results obtained recently by LLNL of the thermal flow and transport modeling. As a result of examining some of the papers published pertaining to those results, numerical modeling has been initiated to investigate to what extent these results are sensitive to the use of the effective continuum approximation to liquid, vapor and heat flow in unsaturated fractured rock. Models are being constructed using both the effective continuum approximation and a true dual porosity approach to see if the high rates of condensate generation and dry-out predicted by the effective continuum approximation are significantly lowered by considering the finite amount of time required for liquid within the matrix blocks of a fractured medium to move to the fracture walls.

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

0B33129B93

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM016L Complete decoupled TOUGH testing

Testing of the decoupled TOUGH code continued with comparisons of cross-sectional models from the 3-dimensional site-scale model.

SCP 8.3.1.2.2.9.3 Simulation of the hydrogeologic system 0B33129C93

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUM25L Complete and publish paper in RWMNFC journal

Responses to the review comments have been incorporated in the paper. This completes the task.

3GUM32L Complete report moisture flow

All of the information used during the development of the site-scale model has been classified and chronologically arranged. Lists of computer files and examples were added in order to better describe the different steps involved in the building of the 3-dimensional grid, the choice of rock properties for the hydrogeological units and the first 2-dimensional simulations. The outline of the report is based on this compilation. The completion of the task will be delayed until the end of March.

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

Further simulations with a fractured, porous medium were performed with the original version of TOUGH2 and a new version including only moisture flow and no gas flow. Tests were run to compare the accuracy and the efficiency of the two codes. An infiltration rate of 1 mm/yr also was used.

Variances

3GUM32L Complete report moisture flow

Time was devoted to arranging project files, in order to leave comprehensible documentation of the work done during the last two years. The writing therefore was slightly delayed and a draft of the report will be completed in March.

3GUM20L Prepare report on grid effects

The completion of the report is delayed until the end of June, due to work performed on more urgent tasks (report of moisture-flow model, RWMNFC review).

WBS 1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization Activities

Principal Investigator - M. Chornack

OBJECTIVE

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

Prototype Cross-Hole Testing 0G3312AC93

Summary Account Manager - G. LeCain

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT004 Prepare open file report on ALTS testing and analysis

Work continued on the Apache Leap Test Site prototype testing report. Statistical analysis of the permeability results suggests some correlation between injection rates and calculated permeabilities for the injection zone, and no correlation between injection rate and calculated permeabilities for the crosshole monitoring zones. The decision to use constant rate transient tests and allow them to run until steady state is proving to be a good one. It is providing estimates of permeability based on transient testing and identifying boundary influences that would adversely impact steady state analysis.

Prototype Tracer Testing 0G3312AD93

Summary Account Manager - A. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT016D Prepare WRI report on gaseous tracer tests

Generated table and graph of data compiled testing sorption of CO₂ onto gypsum cement.

Work Performed but not in Direct Support of the Scheduled Tasks

C. Peters discussed with DOE/YMPO, DOE/ NVO, the M&O contractor, and others concerns about tracer position progress and permit applications. (7 hrs)

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

Computer files of compression test records are up to date. These data will form the basis of the planned OFR and journal papers on pore-water extraction methods. A number of additional analyses and models need to be accomplished. However, progress on this task has been slowed by the lack of personnel and the loss of P. Burger to the project. Burger did compression tests, handled the data base, and ran the pore-water chemical models. M. Beasley has been unable to devote much time to this task because of his work on the packer systems.

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

The writing of the OFR is in process. The report will include the data base of one dimensional pore-water extraction test results from first and second generation cell designs. The data tables for pre-testing information (sample, degree of welding, degree of saturation, water content, etc.), mechanical test data (load and volume of water extracted, strain, etc.), and pore-water chemistry data (ion concentrations, Ph, etc.) have yet to be generated from the computer data files. C. Peters and J. Higgins have designed the tables and identified the appropriate data to be included. Peters is preparing an analysis of measurement precision for the chemistry data to be included in the report, and has met with branch QA personnel to discuss the appropriate methods to use. Higgins is preparing the text to accompany the tables.

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

This paper is based on a combination of a WRIR ("*Pore-water extraction from unsaturated tuff by triaxial and one-dimensional compression methods*" by T. Mower, J. Higgins, A. Yang, and C. Peters), development of the high-pressure one-dimensional compression cell, and pore-water extraction data generated since the writing of the WRIR. The first drafts of the introduction, purpose and scope, and sections on the first and second generation test cell designs were edited and expanded this month.

Variances

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

Due to the loss of P. Burger for data analysis, testing, and computer modeling and a reduced participation by M. Beasley, this task has not been completed. It is anticipated that the appropriate data analyses can be completed by June 30, 1993.

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

Preparation of the OFR is progressing slower than originally anticipated because of the lack of personnel to devote the required time to transfer the data files to the data tables for the report. The USBR person (P. Burger) most familiar with the computer programs is no longer on the project.

Work Performed but not in Direct Support of the Scheduled Tasks

M. Beasley discussed grooving smooth drainage plates for the second high-pressure one-dimensional compression cell with D. Winegarden. It was decided that one set of drainage plates would be grooved by Winegarden by electronic etching rather than by the USBR shops as was previously done. The electronic etching produces a slightly narrower and rectangular shaped groove rather than the half-round shaped grooves machined into drainage plates for the first high-pressure cell. The drainage plates were completed and will be tested with the new cell before a decision is made whether a second set of drainage plates will be completed by this method. If this groove shape performs well with respect to drainage and strength, the second set of drainage plates will be completed by the etching process. (3 hrs)

Because of difficulties with the availability of rock saw equipment in the USBR labs during their building renovations, M. Beasley is converting a USGS rock saw to a dry cut saw to be used for core preparation. Beasley worked on obtaining materials and planning for the modification of the saw and installation of a dust collection system for the room. (8 hrs)

J. Higgins discussed with F. Travers (USBR) repair of the load frame in the USBR Vibration Laboratory. Travers plans to work on the repairs during the end of March and beginning of April. It is estimated that the repair will require a maximum of one week of his time. (2 hrs)

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 1.2.3.3.1.1 Site Saturated Zone Ground-Water Flow System

Principal Investigator - M. Umari

OBJECTIVE

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

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

Summary Account Manager - R. Luckey

ACTIVITIES AND ACCOMPLISHMENTS

Support Project Operations

Site potentiometric-level evaluation (8.3.1.2.3.1.2)

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

M. Boucher gave QA support to various activities, evaluating QA and organizing QA support for other groups of activities.

P. Tucci continued working on a draft criteria letter needed to pump and clean existing WT holes prior to sampling. Tucci attended a SZ Modeling meeting to participate in discussions on integration of regional, subregional, and site scale models.

All personnel working on the site potentiometric levels project met to discuss project goals, changes in procedures, and project plans and priorities for the current year.

P. Tucci attended a Department of Interior training class on team building concepts.

Saturated-zone fractured-rock hydrology (8.3.1.2.3.1.3)

M. Umari discussed scheduling of c-holes testing activities with B. Sublette (SAIC/T&MSS) as part of the preparation of the c-holes testing Test Planning Package, prepared the monthly PACS report for January 1993, tracked spending under accounts 4889-12001, -12002, -12005, and -12006, identified the net available from additional funding under -12006 that was not recognized at the beginning of FY93, and earmarked it for SZFRHP expenditure needs.

Prepare procurement documents

Procurement paperwork was completed for a soldering station (to use in soldering the multi-conductor cable to electric connectors), micro uninterruptable power supply and power conditioner (to provide clean, uninterruptable AC power to the data acquisition system to be used during the c-hole testing), and 21 absolute Druck transducers for use at the Raymond Quarry.

Prepare for and attend technical and administrative meetings

R. Luckey, M. Umari, and G. Patterson attended a c-holes-testing coordination meeting, attended by representatives from USGS, LANL, DOE, RSN, SAIC (T&MSS), REECO, and M&O. The topics of discussion were: discharge pipeline to carry water from the c-holes during testing, use of discharged water for fire protection at the North Portal of the ESF, tagging the discharged water with a tracer so that it can be detected at proposed Fortymile Wash holes, electric power supply to the c-hole pad, Test Planning Package schedules, permit for tracer injection, waiver of permit for water withdrawal during testing, and permit for air emissions from generators. The meeting was fruitful in that it clearly identified all the prerequisite activities that need to be completed before testing can start, established July 1, 1993 as the date to start the tests, and established channels of communication between personnel of various contractors.

Do operational tasks

Work at the Raymond Quarry site, which will be used to prototype the c-holes-bound packer string: members of the SZFRHP assembled two packer strings on the ground, and then used a drill rig (on loan from the USBR) to install the strings in two of the nine Raymond Quarry prototyping holes. After installation, generator power was provided to the transducer and thermistor circuits in the two strings, and it was determined that the circuitry of one of the strings was functioning correctly, while that of the other was not. The cause of this circuitry malfunctioning is being investigated.

Oversee LBL's effort to complete analysis of seismic profile

M. Umari and R. Luckey attended a meeting at which E. Majer, and a U. of California at Berkeley professor, presented the information obtained from seismic tomography between two of the wells (UE-25 c#2, and #3) at the c-well complex. Luckey asked the professor to submit a proposal identifying the cost of completing the analysis of the tomography data and producing a report that presents and explains the results.

Convert scientific notebook to technical procedure

The scientific notebook (SN), for the field simulation of the c-hole testing was approved. The SN will probably be used for the initial stages of the actual testing at the c-holes (tests are planned to start in July 1993), and as such, the conversion to a technical procedure is not imminent.

Develop software QA for analysis programs

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

Develop scientific notebook for (hydraulic and) tracer tests

The SN for the field simulation of the c-hole testing has been approved.

Routine tasks completed in this reporting period

Monitored 20 zones in 20 wells on a monthly basis (approximately 700 ft of steel tape are still stuck in well WT-7, above the water table, making it impossible to measure the water level in the well); monitored 17 zones in 12 wells on an hourly basis (the lower zone in well H-5 is still unmonitored due to a packer jammed in the well; work to free the packer is anticipated to start in March); obtained continuous analog data from three zones in two wells (included in count of hourly sites above) in order to monitor water-level responses to earthquakes and UNE's; obtained real-time data on 17 zones in 12 wells using DCP's (included in count of hourly sites above); evaluated status of network at end of each month; monitored real-time data on a daily basis, looking for water-level excursions.

Special tasks completed in this reporting period

Calibrated transducers at the following wells: G-2, WT-11; replaced transducers at the following wells: WT-11; installed data-collection platform (DCP) and transducer in well G-2, which was added to the continuous water-level network on February 3, 1993; replaced barometer at well WT-11; security locks were placed on all WT wells in periodic network by REECO; approximately 700 ft of steel tape from Chain #1 are still stuck in well USW WT-7; efforts to recover the remainder of the tape continued in February; approximately 400 ft and 500 ft of steel tape from Chain #2 were lost and subsequently recovered, in wells J-11 and UZ-16, respectively.

Winner of the "Steel Tape Fishing Contest" was the team of G. O'Brien and S. Boucher, who recovered all 900 ft of steel tape from wells J-11 and UZ-16. Chain #2 was repaired, although it currently is a length of 2,115 ft, rather than 2,600 ft, until additional lengths of replacement tape can be obtained. Because of recent problems with the steel tapes, and the damage to the multiconductor cable unit during attempts to recover the tape stuck in WT-7, the project is limited in its ability to maintain the current level of monitoring activity. The possibility of purchasing a new steel tape, to replace the aging Chains 1 and 2, is being investigated.

Inclement weather, with extended periods of cloud cover during January and February, resulted in increased maintenance of DCP sites. Batteries were often run down, due to the lack of recharging through the solar panels.

SCP 8.3.1.2.3.1.2 Site potentiometric-level evaluation 0G33131B93

Summary Account Manager - P. Tucci

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF064A Complete 1990-91 water-level report

Transducer data (1990-91) for several wells were converted to water levels for analysis and inclusion in the report. A draft of "Data collection system" section of report is nearly complete; all the tables and figures for "Periodic water-level measurements" section are complete; work on the periodic network data for the report is essentially complete; and editing and revisions to previous drafts of the report continued.

3GWF025A Reduce 1992 water-level data

Work continued on reducing 1992 periodic water-level data.

3GWF002 Review 1992 water-level data and prepare TDIF

TDIF completed and data submitted to LRC on February 12, 1993, completing this activity.

Variances

3GWF064A Complete 1990-91 water-level report

Work on the 1990-91 water-level data report is behind schedule. Factors such as last year's delays in evaluation and reduction of the data (due to addressing effects of earthquakes on water levels and producing associated reports), recent problems of losing steel tapes in wells and jammed packers, writing criteria letters, getting data into ADAPS, and access problems in ADAPS, have all taken time away from work on the report. The report will be lengthy, because it includes two years of data for both the periodic and continuous networks, and colleague review of the report will also be lengthy. It is anticipated that an additional month will be required to complete the report.

Work Performed but not in Direct Support of the Scheduled Tasks

Estimated hours spent : 124 hours

The report, "*Hydrologic responses to earthquakes, June 28-29, 1992, at Yucca Mountain, Nevada*", by G. O'Brien and P. Tucci, received Director's approval and was forwarded to the Waste Management '93 conference organizers. (16 hrs)

Work was done on repairing various water-level measuring equipment at NTS, and resolving computer-link problems between the HRF and Denver. (48 hrs)

G. O'Brien worked on revisions to HP-60 and software QA for Lotus 123 macros. (40 hrs)

G. O'Brien responded to bids for the purchase of new transducers, and reviewed the criteria letter for developing WT wells. (8 hrs)

G. O'Brien worked on programs for strain analysis of water-level data. (4 hrs)

G. O'Brien attended a meeting of site-potentiometric levels project personnel. (8 hrs)

Status of approved reports or reports awaiting approval:

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

The report, *"Water levels in continuously monitored wells in the Yucca Mountain area, Nevada"*, by D. Lobmeyer and R. Luckey was sent to Central Region for approval October 16, 1992. Received DOE concurrence January 13, 1993.

The report, *"Precision and accuracy of water-level measurements taken in the Yucca Mountain area, Nevada, 1988-90"*, by M. Boucher received USGS Director's approval as Water-Resources Investigations report 93-4025 on February 17, 1993. It received DOE concurrence January 13, 1993.

The report, *"Earthquake-induced water-level fluctuations at Yucca Mountain, June, 1992"*, by G. O'Brien has been revised following colleague review and was sent for approval February 2, 1993.

SCP 8.3.1.2.3.1.3 Analysis of single- and multiple-well hydraulic-stress tests 0G33131C93

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF003D Reanalyze past C-Hole data

E. Ervin is developing a fracture network model for the c-holes using the software package Fracman. Ervin continued fracture geometry simulations during February. The conceptual model for flow at the c-holes is based on work done by A. Geldon and outcrop data collected from the Crater Flat Tuff by Ervin and M. Chornack. The model can be used to analyze past preliminary pump tests that were conducted at the c-holes.

A. Geldon, as part of writing the *"Intraborehole flow & stress test"* report, is analyzing past c-hole test data by using manual graphical matching techniques.

3GWF010D Complete intraborehole flow and stress test report

A. Geldon has been working on the report, continuing to make very good progress, and estimates that the report is 70% complete. However, due to the large amount of data being processed and analyzed for this report, the projected completion date of the report is July 1, 1993 (date at which the report, having received colleague review, would be sent simultaneously for WRD Region / Head Quarters review, and for DOE concurrence).

3GWF008D Monitor/analyze strain-related pressure response

It has been determined that, given the complexity of the preparations currently underway to provide all the NTS contractor support in time for the cross-hole testing to start July 1, 1993, it is not desirable to add the additional requirement of placing packers for strain-related pressure monitoring in the c-holes now, so that data would be gathered until July 1. Rather, the decision has been made to wait until the multi-zone packer system is in place, and then conduct strain-related pressure monitoring during down times in the cross-hole

testing.

SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0G33131D93

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF007F Complete design memoranda - 5-zone packer string

The final agreement with the USBR, finalized in the form of a MOA, is that the USBR will document its design of the packer string system by design memoranda, also would include instructions on assembly of the string prior to field deployment. The final review and revision process of these design memoranda are not due to be completed until the end of May 1993.

3GWF030F Expand packer strings to 5-zones

The work under this activity is being carried out jointly by the SZFRHP/ HIP/ USGS-YMP, and the USBR.

The details of what the USBR is doing in procurement and construction to expand the existing two 3-zone packer strings to three 5-zone packer strings, was formalized in the form of a MOA between the USGS and the USBR.

J. Bowen, USBR, reported that all the requisitions for the procurements that the USBR is responsible for have been submitted. The main concern regarding these procurements is the projected delivery date (sometime in June 1993) of the Druck pressure transducers. Because the testing at the c-holes starts in July 1993, the transducers have to be spliced to the multi-conductor cables, the spliced sections tested for electric continuity, and then "potted" for water-proofing, before being shipped to the NTS.

A contractor was identified to do the soldering of wires between water-proof electric connectors and multi-conductor cable segments. Twenty-five (25) cables were delivered to the contractor, out of which nine were soldered and returned. These nine were checked for electric continuity; problems were identified, which will require re-soldering.

J. Bowen, USBR, and J. Earle, USGS, will travel to Houston for the detailed inspection and testing of the packers being fabricated for the USGS by the Tam International Company. If all goes well, the packers will be delivered to the USBR by the end of March 1993.

A meeting was held with D. Banks from the Centerlift Company, provider of the two pumps and the pump shroud to be used during the c-holes testing, to make sure that all the components of the pump/shroud system were there (at the USBR, where all the components of the packer strings are located). All the components were physically located.

3GWF014F Develop techniques for (and begin) analysis of X-hole test results

Using the software package FracMan (by Golder Associates) to develop a 3-dimensional fracture-network model for the c-holes (the model can be used for cross-hole test design, and analysis of the eventual cross-hole test results): E. Ervin continued fracture geometry simulations during February. The conceptual model for flow at the c-holes is based on work done by A. Geldon and outcrop data collected from the Crater Flat Tuff by Ervin and M. Chornack.

Planning and Operations

3GWF007F Complete design memoranda - 5-zone packer string

J. Bowen, USBR, has prepared an outline for the design memoranda package, which he presented to M. Umari and J. Gemmell. He reported that he has started the draft of the memoranda package. Umari and Gemmell elaborated to Bowen their expectations for the content of the memoranda package.

SCP 8.3.1.2.3.1.5 Testing of the C-hole sites with conservative tracers 0G33131E93

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF170A Complete tracer injection system

A tracer mixing tank will be required at the surface during the tracer tests at the c-holes. \$5,000 has been earmarked for this purpose in FY93, and the isotope geology machine shop is the most likely candidate to do the work.

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

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

Because the computer modeling activity serves summary account 8.3.1.2.3.1.4 as well, progress was reported there.

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 0G33132A93

Summary Account Manager - W. Steinkampf

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWH001A Assessment of extant data, phase II

An attempt was made to augment incomplete records having cation-anion balances exceeding 10% using hardness and alkalinity values. The effort was partially successful. Corrections were made to records for which prior incorrect conversions of alkalinity to bicarbonate had been made. Preliminary areal (3"x3") plots of some dissolved constituent concentrations appear to reflect regional-scale geologic structural control.

SCP 8.3.1.2.3.2.2 Hydrochemical characterization of water in the upper part of the saturated zone
0G33132B93

Summary Account Manager - W. Steinkampf

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWH004B - Collect hydrochemical data/samples

W. Steinkampf met with J. Woolverton, J. Rousseau, and C. Peters to identify sample-collection methods to be used, and to coordinate sample needs and priorities to be considered, if sampleable water collects in the borehole during the drilling of USW UZ-16. He also provided some of the equipment and supplies needed for sample and data collection. Guidance was provided regarding the handling of bailer samples that were collected on February 25, 1993.

W. Steinkampf provided information describing a method for the collection and treatment of water samples for the determination of dissolved free aluminum (Al^{3+}) to USGS Office of Water Quality (USGS/OWQ) staff for consideration for inclusion in forthcoming USGS/OWQ protocols and recommended procedures for collection of selected ground-water chemical and isotopic data.

3GWH005B Develop borehole data/sample collection methods

W. Steinkampf met with M. Laaksoharju (GeoPoint AB, Spånga, Sweden) in Lakewood to discuss methods used in the Swedish program for the collection of ground-water samples for colloidal-sized particulates. Laaksoharju offered to provide a copy of a draft report of the results of collaborative efforts with C. DeGueldré (NAGRA)

Quality Assurance

3GWH004B - Collect hydrochemical data/samples

W. Steinkampf met with J. Czarnecki, M. Ciesnik, and D. Thorstenson to discuss an error identified in NWM-USGS-HP-23, R2 "*Collection and field analysis of ground-water samples from saturated zone*". Appropriate corrective measures were agreed upon, which Ciesnik has undertaken to institute.

Work Performed but not in Direct Support of the Scheduled Tasks

Estimated 40 hours worked.

W. Steinkampf participated in a YMP/Geochemical Integration Team workshop to identify post-emplacement geochemical aspects of coupled geochemical/hydrological processes that likely will occur as a result of the perturbation of the thermal and geohydrologic regimes at and in the vicinity of the repository block.

W. Steinkampf attended a meeting with R. Craig (USGS/LV) to discuss programmatic requirements for contractor support of USGS investigations at Yucca Mountain.

SCP 8.3.1.2.3.2.3 Regional hydrochemical characterization 0G33132C93

Summary Account Manager - W. Steinkampf

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWH905A Select sample sites - FY93

W. Steinkampf met with K. Stetzenbach (UNLV) in Las Vegas to identify sites and logistical needs and to coordinate plans for joint sample collection efforts in the Death Valley National Monument (DVNM). Discussions were also held with B. Newman (LANL) to plan his inclusion in the sample collection effort.

3GWH910 Collect/analyze/evaluate regional samples - FY93

W. Steinkampf began preparation of equipment and materials at the NTS for DVNM sample collection; and met with DVNM staff in Death Valley to report work performed in the monument during calendar year 1992, and to apply for a 1993 collection permit. He also acquainted new DVNM staff with YMP plans for work within the monument.

Work Performed but not in Direct Support of the Scheduled Tasks

Estimated 10 hours worked.

W. Steinkampf attended a meeting of the YMP quality integration group in Las Vegas.

W. Steinkampf provided user-survey information for the 1992 YMP site atlas.

WBS 1.2.3.3.1.3.3 Saturated Zone Hydrologic System Synthesis and Modeling

Principal Investigator - E. Ervin

LBL Principal Investigator - K. Karasaki

OBJECTIVE

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

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

Summary Account Manager - E. Ervin

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM010 Develop porous-media flow model and boundaries

E. Ervin organized a modeling coordination meeting for modelers in the SZ section and the principal USGS modelers in the UZ section. Items discussed included development of the regional 3-D model, fracture-network modeling at the UE25c-hole complex, work being done by T. Buschek at LLNL on the impact of a 'hot' repository on the saturated zone, and the status of and plans for the subregional models. Notes from the meeting are available through E. Ervin.

Work Performed but not in Direct Support of the Scheduled Tasks

The report entitled "*Revised potentiometric-surface map for Yucca Mountain and vicinity, Nevada*", by E. Ervin, R. Luckey and D. Burkhardt received approval after a programmatic and policy review from DOE. The report is currently being put in camera-ready format, and the figures are being prepared in the Publications and Graphics Units of the USGS Colorado District. Minor changes were made to the text and tables by the main author, E. Ervin, to correct errors created during the

text translation process.

SCP 8.3.1.2.3.3.2 Development of fracture network model 0G33133B93

Summary Account Manager - E. Ervin

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM013B Complete fracture mapping/prepare report: Crater Flat

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

An HP total station surveying instrument was borrowed from the Geophysics Branch of the Geologic Division in order to accurately locate the sites of fracture mapping east of Little Skull Mountain. The work was performed by M. Chornack and E. Ervin; the fracture mapping sites were located and plotted on the 7 1/2 minute USGS Specter Range NW Quadrangle.

3GWM005B Develop conceptual model fracture network FY93

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

Quality Assurance

3GWM013B Complete fracture mapping/prepare report: Crater Flat

L. Anna continued his independent review of the fracture data collected by E. Ervin and M. Chornack. The data are currently with him.

SCP 8.3.1.2.3.3.2 Development of fracture network model 0B33133B93

Summary Account Manager - K. Karasaki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWM18CA Study outcrop fracture bias and prepare report

Studies on fluid flow in fracture networks based on square lattices continued. Attempts are being made to incorporate a 2-dimensional, co-variance structure of lattice bonds in the model and to evaluate estimates of flow parameters using cross-validation methods.

3GWM21CA Complete TRINET users manual

The cause of the bug in TRINET related to an occasional spike in concentration profile has been found. It is believed to have been caused by the very small inaccuracy in the element length input. A routine is being written to ensure the correct element is read.

3GWM23CA Study prediction error and design test

K. Karasaki attended the UZ-16 VSP meeting. E. Majer presented a preliminary result of high resolution, cross hole, imaging survey at UE25 C-hole complex. The seismic anomalies seem to correspond with the location of inflow zones.

K. Karasaki attended the Hydrology Integration Task Force meeting. In the meeting a long term pump test at the UE25 C-hole complex was discussed. Discussions also were held on the "hot-repository" idea, presented by T. Buscheck.

WBS 1.2.3.6 Climatology and Meteorology

OBJECTIVE

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

WBS 1.2.3.6.2 Climatology

OBJECTIVE

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

WBS 1.2.3.6.2.1 Change in Climatic Conditions

OBJECTIVE

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

WBS 1.2.3.6.2.1.1 Modern Regional Climate

Principal Investigator - B. Parks

OBJECTIVE

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

SCP 8.3.1.5.1.1.1 Synoptic characterization of regional climate 0G36211A93

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCR014 Conduct stable/radiogenic isotope anal of precipitation

J. Whelan developed a network of sources of precipitation samples, at both NTS and regional scales, to implement the study plan; i.e., $d^{18}O$ and dD values of precipitation as a data base for interpreting data collected from a number of other study plans.

Variances

3GCR005B Develop study plan

Completion of the study plan has been delayed due to field work and leave taken by key personnel.

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

Principal Investigator - B. Parks

OBJECTIVE

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

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

Summary Account Manager - B. Parks

ACTIVITIES AND ACCOMPLISHMENTS

Prepared schedules for tasks assigned to this activity. Provided status reports of planned activities and prepared variance analysis reports. Performed administrative and management duties.

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

0G36211B93

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCL013B Collect cores

Plans to collect cores were delayed because of the above normal rainfall in the region, making it impossible to access some of the dry lakes and playas that will be cored. Also, the coring rig, being purchased by the DRI, University of Nevada, Reno, (which will participate with the USGS in this and several other activities) has not been delivered. The major coring activity originally scheduled to begin in February, 1993 tentatively has been rescheduled to begin in late March, 1993.

3GCL016B Paleontological preparation/assessment

Ostracode and chemical data from 50 sites was entered into the modern data base that will serve as the basis for analog reconstruction of climate parameters. Eleven samples collected in southern Nevada in January were prepared for analysis.

3GCL014B Stratigraphic analysis

Summary of findings from field trip taken in January has been completed and is in review in the USGS. This document will satisfy the stratigraphic analysis described in this work element.

3GCL013M TDIF: Cores and samples - lakes/playas/marshes

This milestone will be delayed because the coring expected to be completed in January-February, 1993, will not be completed until late March or April. This is because the extreme amount of precipitation in southern Nevada has precluded getting a coring rig into the lakes and playas to be sampled.

Variations

3GCL013M Cores and samples - lakes/playas/marshes

This will be delayed because the coring expected to be completed in January-February, 1993, will not be completed until late March or April. This is because the extreme amount of precipitation in southern Nevada has precluded getting a coring rig into the lakes and playas to be sampled.

WBS 1.2.3.6.2.1.3 Climatic Implications of Terrestrial Paleoecology

Principal Investigator - B. Parks

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)

WBS 1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain

Principal Investigator - B. Parks

OBJECTIVE

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

SCP 8.3.1.5.1.4.2 Surficial deposits mapping of Yucca Mountain area 0G36214B93

Summary Account Manager - S. Lundstrom

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCH035A Airphoto/fieldcheck/sampling/analysis northern 1/3 Yucca Mountain

Continued airphoto interpretation and field checking of deposits. Analyses are being entered onto map products.

3GCH035M Draft report/TDIF: northern 1/3 Yucca Mountain

PI completed this Milestone, report is in review in USGS.

Variances

3GCH039M Report/TDIF: FY92 Study

Milestone 3GCH039M has been completed by the PI and is in the hands of his supervisor for review.

SCP 8.3.1.5.1.4.3 Eolian history of the Yucca Mountain region 0G36214C93

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCH162C Write report on lead isotopic composition

Completed.

WBS 1.2.3.6.2.2 Effects of Future Climatic Conditions on Hydrologic Characteristics

OBJECTIVE

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

WBS 1.2.3.6.2.2.1 Quaternary Regional Hydrology

Principal Investigator - R. Luckey

OBJECTIVE

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

SCP 8.3.1.5.2.1 Quaternary Regional Hydrology LOE Account 0G36221Z93

Summary Account Manager - R. Luckey

ACTIVITIES AND ACCOMPLISHMENTS

Collect hydrologic data FY93

Continued data collection at the Stewart Creek and Kawich Creek Analog Recharge sites. The data collection system consists of two stream-flow sites, 4 meteorological sites, and 6-8 water quality sites. On a daily basis, T. Oliver checked the NWIS data base for DCP data and performed weekly data pulls from the LRGS to fill missing data. In addition, T. Oliver collected samples from the analog sites during a field trip and entered the data obtained into the NWIS data base.

Support project operations

During this reporting period, the PIs responsible for this study planned, scheduled and monitored routine project operations, prepared routine procurement documents, monitored rate of spending, and held or participated in routine administrative meetings.

During the reporting period, the QA specialists involved in this study monitored all project activities for QA compliance, tracked all open items, and attended bi-weekly USGS-HIP SZ QA meetings. Other special tasks and items included: J. Watson's attendance at a QA Open Items meeting; Watson's preparation of the initial response to NCR 93-09 to address deficiencies in review and approval documentation for a scientific report prepared by GSP and HIP personnel.

T. Oliver submitted three scientific notebooks to R. Luckey for final review: SN-0016, SN-0017, and SN-0022.

The contract with the New Mexico Institute of Mining and Technology (NMIT) for activity 8.3.1.5.2.1.4b is being modified as part of actions to be completed for AFR-92-07. This action is based on changed QA requirements for the activity as reflected in a submitted ACSR.

SCP 8.3.1.5.2.1.1 Regional paleoflood evaluation 0G36221A93

Summary Account Manager - D. Grasso

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH21A Field recon YM and vicinity for paleoflood evidence

Heavy rains continued during the month of February in southern Nevada and southeastern California in response to re-established El Nino conditions. Moderate to heavy runoff continued to fill playa lakes in the region. D. Grasso conducted field reconnaissance investigations of the upper and lower Amargosa River drainage basins, the lower Fortymile Wash drainage, the drainage outlet from Mercury Valley, and the lake that has been

forming in Death Valley. Runoff in late February on the Amargosa River has been substantial. Although large flood peaks have not been observed, sustained lower flow volumes have contributed to the growth of the 1993 Death Valley lake. The water level is presently at the -220 foot contour level. Thus, the 1993 lake is about 62 feet deep at its deepest location in the Badwater Basin (-282 feet). Of particular interest is that from the Amargosa Desert near the confluence of Fortymile Wash, the Amargosa River neither loses nor gains appreciable amounts of water. Flow measurements made at Stateline, Death Valley Junction, Eagle Mountain, south of Eagle Mountain, Shoshone, and at two locations near Shoreline Butte in southern Death Valley have recently revealed that the Amargosa River flows subaerially, not subsurface, throughout much of its course. In response to the latest-February regional precipitation, for example, the Amargosa River has been flowing at a rate of some 220 to 240 cfs (nearly 500 acre-feet per day). These field reconnaissance investigations have therefore shown that the 1993 Death Valley lake is growing in direct response to precipitation-runoff from the Amargosa River drainage basin, and that this system contributes the bulk of the water to the lake. Additionally, local flow from tributary (alluvial fan) channels adjacent to the lake were observed to have little influence on the lake in comparison to the volume of water that is contributed by the Amargosa River.

Work Performed but not in Direct Support of the Scheduled Tasks

D. Grasso prepared an in-house report on the current status of the regional paleoflood evaluation. The report contains statements on (1) the objectives, goals, approaches, and status of all PACS activities for FY92/FY93, (2) recommendations and thoughts on the future direction of the Mission 2001 PACS activities, (3) a summary of the current Amargosa River basin study, and (4) five topics/locations recommended for future site-specific regional paleoflood work to be conducted in the Yucca Mountain area beginning in FY94. (35 hrs)

SCP 8.3.1.5.2.1.3 Evaluation of past discharge areas 0G36221C93

Summary Account Manager - E. Gutentag

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH11 Complete report on methods of channel geometry

Report by W. Osterkamp has gone through colleague review and is being sent to author for final corrections.

3GQH003 Vegetation mapping Phase II

F. D'Agnese finalized preliminary vegetation maps worked on report for "*Regional vegetation mapping Death Valley Region*". Maps for field checking were printed at 100K. A field trip is scheduled for March 6, 1993 to field check resulting density and land cover classes.

K. Turner continued work on the draft report on the Amargosa Desert vegetation mapping originally conducted by L. DeMarco. Report is essentially complete and will be submitted for colleague review next month.

K. Turner reviewed regional vegetation classification maps developed by F. D'Agnese and helped E. Gutentag and C. Faunt outline the report.

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

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

E. Gutentag, C. Faunt, F. D'Agnese with the aid of Z. Peterman GSP, planned an early March sample collection trip to the southern part of the Yucca Mountain flow system.

E. Gutentag, F. D'Agnese, C. Faunt are planning a late April collecting trip to Nellis Air Force Bombing Range. The collection will consist of playas and springs and will be conducted on weekends prior to and after the high level waste meeting. The Air Force will permit collection if the manpower is available.

S. Mahan sent J. Everenden a copy of the $^{87}\text{Sr}/^{86}\text{Sr}$ ratios for all springs, wells and precipitation samples from southern Nevada and California determined by the IGG over the past 5 years. This information will provide Everenden with isotopic data for his hydrochemical modeling efforts.

S. Mahan, with assistance of A. Walker, analyzed unspiked $^{87}\text{Sr}/^{86}\text{Sr}$ compositions of several carbonate samples from localities postulated to be discharge sites by J. Czarnecki. One sample from the Las Vegas Formation carries a Sr isotopic composition very similar to values typical of Paleozoic carbonates ($^{87}\text{Sr}/^{86}\text{Sr} = 0.700903$) whereas the other samples (Horsethief Tufa and two other "discharge sites") contain substantially more-radiogenic Sr ranging in $^{87}\text{Sr}/^{86}\text{Sr}$ from 0.7132 to 0.7172.

S. Mahan submitted two water samples from VH1 and VH2 (Crater Flat) to L. Kwak for Pb isotopic analysis. These two wells are within close proximity to each other, and were thought to be drawing from the same aquifer; however, they are pumping waters that yield vastly different Sr isotopic compositions. Pb isotopic compositions hopefully will provide additional isotopic tracer information to decipher hydrological relationships in Crater Flat.

S. Mahan completed additional Sr isotopic analysis of water from Blue Point and Big Muddy Springs. Although collection of previous and present water samples were separated by several years, isotopic compositions are analytically indistinguishable.

S. Mahan analyzed two water samples collected by J. Czarnecki from well NA-7, one from a shallow depth of 120 feet, and the second from a depth of 1500 feet. Czarnecki reported a difference of 2 Ph units between the two waters. Sr isotopic compositions verify the presence of two distinct components in the well ($^{87}\text{Sr}/^{86}\text{Sr}$ of 0.71328 for the shallow sample and 0.71217 for the deep sample).

K. Futa prepared multiple aliquots of two carbonate samples from fine-grained paludal deposits in the Pahrump Valley. Samples were collected from carefully documented and dated (14C) sections by J. Quade. Existing age control will be used as an empirical test of U-series techniques on spring discharge carbonates in the southern Great Basin.

Staff collected samples of tufa and banded travertine from a mound in Rock Valley. Unlike the fine-grained paludal deposits observed elsewhere (e.g., Site 199, Las Vegas Valley), these deposits appear to be from a distinct, structurally-controlled, calcite-saturated discharge site similar to the mounds along Furnace Creek in Death Valley. However, examination indicates that banded feeder veins document a complex history of precipitation and brecciation, presumably related to abundant Quaternary movement along the Rock Valley Fault System. Samples will be analyzed to obtain U-series geochronology, as well as Sr, O, and C isotopes.

J. Paces prepared four additional samples of discharge carbonate from Site 199 and the Horsetooth locality for U-Th chemistry. These samples will better constrain the poorly-defined results obtained earlier from the deepest analyzed sample at Site 199 (HD659) and the single leach/residue pair used to estimate the age of the Horsetooth deposit.

3GQH037 Determine discharge mechanism in hydrologic units

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

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

A plot of hydrochemical data and flow paths was developed to help with hypothesis testing of ground-water flow system.

3GQH019 Prepare report on origins of surface deposits

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

SCP 8.3.1.5.2.1.4a Analog recharge sites 0G36221D93

Summary Account Manager - R. Lichty

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH14CA Test PRMS model

B. Lichty used the optimization and sensitivity capabilities of PRMS to test various configurations of parameter estimates relating to snowpack energy and water balance computations, and developed error propagation estimates of mean squared runoff prediction error resulting from parameter errors (uncertainty). Two important parameters in this regard are 1) transmission coefficients, and 2) monthly scaling parameters of the Jensen-Haise potential evapotranspiration (PET) algorithm. Transmission coefficients influence the effect of forest canopy cover density on shortwave radiation reaching snowpack surfaces. Jensen-Haise scaling parameters quantify the varying effects of temperature and humidity relations on PET on a monthly basis.

SCP 8.3.1.5.2.1.4b Geochemistry of arid-zone infiltration 0G36221E93

Summary Account Manager - A. Riggs

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH001D Prepare long-term met. data report

Six data storage modules were dumped to disk, and the DECODES program, required to input data to ADAPS, was begun.

3GQH003D Collect watershed inputs and meteorological data

Continued meteorological data collection: watershed instrumentation is not yet installed, so no watershed data was collected; wired new pyranometer and sent it out for calibration, along with 5 data loggers, 3 hygrometer/thermometers, 15 soil thermistors, and a barometer.

3GQH007D Analyze/interpret Cl-36 and precipitation data

Measured stone content of 13 soil samples from terraces, 36 terrace soil leachates on the ion chromatograph, and 11 terrace soil samples were prepared for total Cl measurement. One split was measured with selective ion electrode; the other was saved. Splits of 10 other terrace soil samples were measured with selective ion electrode.

Soil water was extracted from 23 soil samples and the H-2 and O-18 contents were measured.

Ten Cl-36 dates were run. Total Cl content was determined for five calcrete profile samples and four boulder samples.

Twelve boulder samples were prepared and sent out for analysis - six for major elements, two for U-Th content, and four for B-Gd content.

Work Performed but not in Direct Support of the Scheduled Tasks

An estimate of 10 hours were spent in performing the following tasks:

A. Riggs and H. Claassen reevaluated the New Mexico Institute of Mining and Technology contract and wrote a letter to F. Phillips conveying their impressions.

Performed annual update of chemical hygiene plan for lab in Bldg. 56.

Read AP-5.1Q, R3.

SCP 8.3.1.5.2.1.5 Studies of calcite and opaline silica vein deposits 0G36221F93

Summary Account Manager - J. Whelan

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GQH835A Write report on uranium ratios

3GQH836A Write report on evidence for higher water table

3GQH837A Write report on evidence complex ground-water flow

3GQH838A Write report on radiogenic tracer isotopes

3GQH839A Write report on isotopic studies/paleohydrology

Completed.

3GQH816B Collect specimens from cores and field sites

J. Whelan and T. McConnaughey spent two weeks in the lab developing techniques for extracting CO₂ and H₂O from soil and atmospheric gases for stable isotope studies. Different types of cryogenic traps, rates of gas flow, and effects of sample size were tested. Isotopic compositions were determined on twelve extractions. Considerable time was devoted in preparation for the field trip to the NTS in March; where soil gas CO₂ concentrations will be measured, samples of soil gas CO₂ and moisture will be collected, and a means for isolating neo-formed carbonate in the soils will be devised; for comparison with the gas geochemical studies.

3GQH832A Prep mineralogic/petrologic description of specimens

R. Moscati reran 14 samples of carbonate tufa from Grapevine Spring, that had been among the last samples analyzed as the MAT 252 was failing near the end of January.

R. Moscati and J. Whelan performed 63 determinations of the $d^{13}C$ and $d^{18}O$ compositions of samples from drill hole USW G-1. In general, the new data fit the patterns observed in the reconnaissance data set, but are significant in two respects: (1) both the upper and lower lithophysal zones of the Topopah Springs contain calcite mineralizations in which the earlier portion has heavy $d^{13}C$ values (to 3.7‰) whereas the later calcite fits the pattern of light $d^{13}C$ values typical of the UZ; this is similar to the errant values reported from G-4. (2) Some calcite from deep in G-1 has very light $d^{18}O$ values (down to 1.3‰) that strongly suggest either very warm or isotopically light waters, or a combination of the two.

R. Moscati and J. Whelan performed 69 determinations of the $d^{13}C$ and $d^{18}O$ compositions of samples from drill hole USW G-2. Again, these data confirm previously recognized patterns and, again, unusually heavy $d^{13}C$ values occur within the lower lithophysal zone of the Topopah Springs. In this drill hole, however, these heavy values are only ~50 m above the SWL, so it is possible that they represent deposition from some past higher water table.

R. Moscati and J. Whelan performed 49 determinations of the $d^{13}C$ and $d^{18}O$ compositions of samples from drill holes UE 25 A-5, RF-3, RF-9, and USW GU-3. The latter three of these holes were cored from near the surface and, therefore, provide an opportunity to sample calcite from the surficial zone dominated by soil processes into the deeper fractures coated with calcite druses. In general, the data collected shows a smooth isotopic transition from soil calcrete values (i.e. like trench 14) into the compositions typical of the UZ.

J. Whelan requested 21 samples from UZ-16 (904 feet to ~1340 feet) from the SOC.

Work Performed but not in Direct Support of the Scheduled Tasks

The MAT 252 performed well for most of the month. Including standards and testing with tank CO₂, nearly 300 analyses were performed.

T. McConnaughey and J. Whelan analyzed 10 samples of air and/or soil gas collected during a reconnaissance trip in January. These samples were collected in duplicate from the air and differing soil depths at Fran Ridge with excellent replication and a systematic trend of decreasing soil gas $d^{13}C$ with depth as would be predicted from published studies of soil carbonate.

T. McConnaughey prepared a technical procedure entitled "*Carbon dioxide measurement with EGM-1 and WMA-2 portable IRGA*" for field measurement of soil gas CO₂ concentrations; and J. Whelan prepared two scientific notebook plans entitled "*Collection of soil gases and moisture for stable isotope analysis*" and "*Collection of neo-formed carbonate from soils*".

WBS 1.2.3.7.2.1 Natural Resource Assessment

Principal Investigator - C. Hunter

OBJECTIVE

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

SCP 8.3.1.9.2.1.4 Assessment of Hydrocarbon Resources 0G3721D93

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GNR002A Evaluate hydrocarbons in Railroad Valley analog

J. Grow began preparing a report on the sonic velocities of rocks determined from well logs in Railroad Valley, the nearest oil production to Yucca Mountain within the Great Basin.

Grow continued digitizing sonic logs from Railroad Valley which will allow computation of accurate depth vs. time curves for key exploration wells along seismic reflection lines near the prolific Grant Canyon oil field. Work continued on digitizing density, gamma ray, and other logs in order to help identify formations which are seldom identified in other reports.

Planning and Operations

J. Grow and C. Barker submitted a well-core sampling plan covering organic geochemistry, micropaleontology, and fluid inclusion geothermometry to J. Bergquist.

Work Performed but not in Direct Support of the Scheduled Tasks

J. Grow and C. Barker met with consulting geologists in Denver to share knowledge of oil and gas prospects in the Great Basin.

C. Barker met with J. Cole regarding the Eleana Formation (a Mississippian shale) in well ER-12. These data were incorporated into an abstract entitled "*The case for pre-middle Cretaceous extensional faulting in northern Yucca Flat, Southwestern Nevada*" (by Cole and others, 1993) to be presented at the Geological Society of America- Rocky Mountain/Cordilleran section meeting, in Reno, Nevada, May 1993. C. Barke: arranged for ROCK-EVAL analyses of the Eleana Formation in well ER-12.

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 socioeconomics studies to assess the regional socioeconomic action studies; to coordinate Project activities with the community and state and local governments; and to plan and implement a public communication plan.

WBS 1.2.5.2 Licensing

OBJECTIVE

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

WBS 1.2.5.2.2 Site Characterization Program

Principal Investigator - W. Dudley, Jr.

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

A. Yang and C. Peters responded to the DOE/Las Vegas comments on Study Plan 8.3.1.2.2.7, Rev 1, "*Hydrochemical characterization of the unsaturated zone*". (24 hrs)

YMP-USGS SP 8.3.1.2.2.4, R1 "*Characterization of the unsaturated-zone in the ESF*" a draft copy of Section 3.10, "*Major faults*" which was not included in R1, was written.

YMP-USGS SP 8.3.1.2.2.9, R0 "*Unsaturated-zone modeling and synthesis*" DOE reviewers were contacted to obtain author/reviewer concurrence on comment resolution. Two reviewers have not come to concurrence on the author/reviewer comment resolution.

J. Czarnecki prepared responses to comments from the State of Nevada pertaining to SP 8.3.1.2.1.4 "*Regional hydrology system synthesis and modeling*".

D. Hoxie, P. McKinley, and J. Stuckless met on February 1 and, additionally, met with A. Handy, R. Lewis (TRW), and J. Beckett (EG&G) to discuss USGS YMP input to the review and revision of the YMP Technical Data Parameter Dictionary.

D. Hoxie participated in the Technical Data Parameter Dictionary meeting on February 9; attended the AP-6.17Q Assessment Team (AT) meeting to evaluate the results of the AT sponsored Natural Barriers Workshop; participated in the Hydrology Interpretation Task Force (HITF) meeting at LLNL; completed General Employee Radiological Training (GERT); and participated in the Integration Group (IG) meeting on February 23 to review and complete responses to comments on the Early Site Suitability Evaluation report.

NRC Interactions (NRC, NWTRB, ACNW)

Coordinated with DOE personnel on scheduling and content of proposed field trips by NRC to visit trenches in Crater Flat and Stagecoach Road areas.

WBS 1.2.5.3 Technical Data Base Management

OBJECTIVE

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

WBS 1.2.5.3.5 Technical Data Base Input

Principal Investigator - L. Hayes

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

A new system for tracking the TDIFs through the PDA indicates that there are 109 TDIFs within the Data Management office or otherwise placed within the system which require attention for entering into the ATDT. Half of these are complete except for a quality check of the input to the ATDT data base which is expected to be completed by March 5, 1993. All outstanding data items have been identified and placed within the tracking system. A data base has been designed and work has begun to automate this tracking process.

Standard data base maintenance

Routine jobs were performed throughout the month, including the retrieval of the water quality data from the WRD National Water Quality Laboratory (NWQL), entering the data into the Water Quality (QW) subsystem of the WRD/HIP National Water Information System (NWIS) data base. The maintenance and cleanup of the Satellite Transmission (SATIN) and Automated Data Processing System (ADAPS) logs and directories were accomplished on schedule. Both ADAPS and SATIN are also subsystems within the HIP NWIS data base. Backup of the all the NWIS data base subsystem files was performed and the backup tape sent to the LRC for storage in their fire proof vault.

The PRIME computer had a disk crash again this month. Maintenance was done on the data bases before opening the system again for use. Complications from the restore operations caused problems with individual access rights. These had to be corrected before some individuals were able to continue work in their own areas.

Due to the PRIME crash, D. Burkhardt had to maintain the QW laboratory data pulls manually several times. Burkhardt and B. Kerans checked individual incoming satellite data directories and archives to assure that no satellite data was lost due to the disk crash.

The Novell File Server also had problems. B. Oatfield needed files restored on this system, in order to continue work in progress.

Satellite transmissions

D. Burkhardt completed the conversion to water-levels for all years for well WT-16. Wells WT-13 and P-1 were converted through 1991. Well P-1 was also converted through 1992 as requested by G. O'Brien for an earthquake report. The P-1 site was difficult to convert, due to several field problems. Work has begun on the B-1, 1 3/4 tube at this point.

D. Burkhardt is preceding with the conversion to water levels for G-3 and H-1 sites. Frequent program changes in the field are making H-1 conversions more difficult than expected. All incoming satellite readings and conversion work for these wells are being handled within the NWIS "SATIN" and "ADAPS" subsystems.

One of HIP's satellite data collection platforms (DCP) was moved from the B-1 site to the G-2 site. Several problems arose with the set-ups to receive the data, none of them local to HIP. D. Burkhardt, worked with the personnel responsible for the direct readout ground station (DRGS), local readout ground station (LRGS), and WRD Reston Headquarters to track down the formatting problems. The data currently is being received and formatted correctly throughout the systems.

During the conversion to water levels and plotting of the B-1 site for 1990-1991, problems on the site were identified. This type of information was used in making decisions on placement of DCPs.

Data Logger Data

A. Riggs had several years worth of meteorological data collected using CR21X data loggers. D. Burkhardt worked with the device conversion and delivery system (DECODES), programming format statements to properly load CR21X data. These USGS National programs allow entry of DCP and electronic data logger (EDL) data into the NWIS automated data processing (ADAPS) files. Using information organized by B. Oatfield on mandatory site information and possible UZ parameter codes, Burkhardt worked with Riggs to define and enter sites and data descriptors into ADAPS. He then wrote the necessary formats and ran the data entry programs to populate the ADAPS data base. Burkhardt will be working with Riggs on how to enter data and produce ADAPS plots for analysis.

User assistance

D. Burkhardt handled a request from E. Gutentag to locate some early QW data. This process took longer than expected because the data was a special laboratory schedule from 1989. The data was recovered from the HIP NWIS archives, without having to request a "re-pull" from the WRD National Laboratory.

D. Burkhardt also assisted G. O'Brien with sensitivity analysis on calibration regressions. The QA office had asked about the accuracy of the calibration factor. Burkhardt demonstrated how to take output from MINITAB to get a confidence level for the slope, allowing O'Brien to respond technically to the QA request for information.

D. Burkhardt compiled a "key" to his maintained conversion notes, which contains a more extensive explanation of some of the notes made during the conversion processes. The key was created as an aid for P. Tucci and G. O'Brien in understanding the conversion notes, and making selections and analyses for water level reports.

B. Oatfield worked with F. D'Agnese, doing retrievals from the HIP reference data base containing WRD data collected by various districts, to locate any available discharge measurements. Oatfield also worked with D. Perfect, doing multiple NWIS retrievals, to answer questions on sites Perfect was entering into the "historical" AEC/NHP LOTUS file that she is creating for the paleohydrology project.

B. Oatfield is helping C. Savard establish sites for entering surface water samples he is collecting. He is also pulling QW lists of laboratory schedules and laboratory codes for J. Czarnecki to review. These will be used to organize and coordinate the water quality sampling that is occurring due to the current wet conditions in the Yucca Mountain area.

B. Kerans worked with J. Czarnecki in researching data from some USGS Utah District NWIS sites he was interested in. The data also was copied from the Utah NWIS data base into the HIP NWIS reference data base, for further work.

B. Kerans also worked with J. Brooks, from the YMPB Administrative section. She is working with the property section of the USGS Administrative Financial Information Management System (AFIMS), and needed proper access and orientation.

B. Kerans and B. Sockriter, from the Computer Operations Unit (COU), met with J. Henderson and N. Berger of the YMPB Administration Section. Various ways of meeting the computer needs of the Administrative section as they move to a new data base environment were discussed. Following the meeting, a write-up of the discussion points outlining various options was submitted to Henderson by Kerans.

Software installation

B. Oatfield received the X-window emulator package which was ordered to test access from a PC to the UNIX servers, where the data bases reside. Oatfield is working with the COU to determine the necessary conditions needed for the new package (memory management corrections, proper graphics boards, etc.) to operate correctly. This is a test case, to see if the emulator package would be effective for other HIP PC users. After establishing the proper set-up and environment files, Oatfield will test the SURFACE III modeling package that is installed on the DG server. He also will be testing access to the ARC/INFO and Ingres data bases located on the UNIX servers.

B. Oatfield also is working with the COU to establish access to an ARC/INFO training CD he acquired that would be of assistance to new HIP ARC/INFO users.

B. Kerans worked with C. Washington to determine the best way to increase space and memory on the DG server to accomodate the new WRD software applications. After surveying other Survey operations and WRD headquarters personnel, a meeting was held with D. Gillies and a decision was made on how to proceed.

B. Kerans also received an updated tape of the ADAPS programs being ported to the DG environment. This software was installed on the designated DG for testing.

Software quality assurance

B. Kerans attended the CCC meetings on February 4 and February 18. The first meeting included a review of some GSP software that was being debated due to some questions as to how to define a "software product", "software item", or "software system". This has been under consideration for some time. The second meeting, included a review of updated software control forms (SCF) that might alleviate the debates over "system" definitions. This meeting also reviewed a draft of the CCC draft charter. Some official comments on the Charter were submitted for review at this time.

L. Anna was selected as a designated alternate for HIP representative to the CCC. B. Kerans and Anna met in order to review the committee representative duties involved, and cover some of the current CCC issues.

Data administration

B. Oatfield researched a sampling of basic constituents collected by various HIP projects. These were compared with the history of the construction of the DOE "parameter codes dictionary", and the current listing of the DOE parameter codes received by P. McKinley. Oatfield and B. Kerans met with McKinley to discuss ways of handling possible confusion between the constituent values actually collected and handled by HIP, and the more consolidated parameter codes. McKinley was to meet with a DOE committee discussing the DOE Parameter Code Dictionary the following week in Las Vegas.

In response to a memorandum on data quality, B. Oatfield also began research on proper handling of data quality control (QC) within the USGS, according to standard Survey practices, official publications, and Survey memoranda. This information will help verify and guide proper storage of data in the HIP NWIS data base.

B. Oatfield also is continuing a compilation of possible UZ constituents collected by the HIP projects. The first group of requested new constituents for inclusion in the NWIS-I and NWIS-II systems should be offered to WRD National Headquarters in March. Currently, some of these constituents ("parameters", in the current NWIS-I system) are

being handled with designated temporary parameters.

B. Kerans met with P. McKinley and J. Beckett, the DOE technical data base (TDB) manager. Various files and printouts from earlier Yucca Mountain Project investigations were being reviewed for entry into the TDB.

B. Kerans also had a short meeting with J. Schornick, from WRD Reston Headquarters, discussing the current status of the NWIS-II development. An agreement was made for an exchange of information on the current NWIS-II constituent system, and the constituents needed for HIP activities.

Training

B. Oatfield attended Introduction to ARC/INFO training, and B. Kerans attended the Colorado Ingres Users Group meeting.

WBS 1.2.5.4 Performance Assessment

OBJECTIVE

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

WBS 1.2.5.4.4 Site Performance Assessment

Principal Investigator - A. Flint

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

LBL tested the input deck of the 1-D flow code against the decoupled version of TOUGH to determine if the air phase has an effect on the results. In using climate change scenarios the withdrawal of water causes air phase movement but has no apparent effect on the results.

3GPA008 Analyze fracture/fault fill and develop model

Water retention curve data is being collected using the CX-2 on samples from Trench 14. Permeability measurements are finished for the Trench 14 samples. Permeabilities are an order of magnitude higher when flow is in the direction of layering versus across it. Fault samples permeabilities also have been completed. Water retention samples are being prepared and measurements will start in March.

WBS 1.2.5.4.6 Development and Validation of Flow and Transport Models

Principal Investigator - A. Flint

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GVF003 Develop and refine data for INTRAVAL program

The refined INTRAVAL data set was sent to C. Voss, Golder Associates. He has redistributed the data to the INTRAVAL participants using paper copy and diskettes.

3GVF007 Develop and test hydraulic functional relations

As part of the INTRAVAL data set, several samples, which include fractures, are being analyzed to determine which characteristic curves best apply. Some of the data may support the double hump model that currently is in use for fracture and matrix properties. There is an estimated two order of magnitude reduction in saturated flow when the fractures are drained and matrix flow dominates. The water retention data is being fit to a van Genuchten curve to determine if the double hump model may apply.

WBS 1.2.5.4.7 Supporting Calculations for Postclosure Performance Analysis

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

3GPC007 Measure thermal effects on rock properties

A technical paper is being prepared on the preliminary results of the study. A presentation is scheduled for the next CASY meeting. The results were going to be presented at the IHLWC but the paper was withdrawn due to the time constraints in getting USGS director's approval.

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 1.2.9.2 Project Control

OBJECTIVE

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

WBS 1.2.9.2.2 Participant Project Control

Principal Investigator - R. Ritchey

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Meetings were held with DOE, M&O, and USGS personnel to establish the framework for the preliminary, interim, and final models for the Project Summary Schedule. USGS level 3 milestones for FY93/94 were assigned to their respective topic areas for incorporation into the planned "models." Prerequisites were identified for the matriculation of the interim and final "models." This exercise will prove valuable in defending funding considerations and impacts of schedule changes.

Basis of Estimate forms and the USGS Participant Work Breakdown Structure Dictionary were submitted to DOE/YMPO.

Status to the USGS schedules was input, earned value was calculated, and status information was uploaded to Las Vegas.

1.2.11 QUALITY ASSURANCE

OBJECTIVE

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

WBS 1.2.11.1 Quality Assurance Coordination and Planning

Principal Investigator - T. Chaney

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Three ACSRs were prepared for GSP which will go through GAC review in March:

- | | |
|--------------------|--|
| ACS-G1232412-1, R0 | Tectonic models and synthesis |
| ACS-G1232412-2, R0 | Evaluate tectonic models |
| ACS-G1232846-1, R0 | Evaluate age and recurrence of movement on suspected and known Quaternary faults |

A request was made to Document Control to rescind five remaining SIPs and/or QALAs; this was completed in mid-February.

In response to CAR-92-07, a request was made to rescind the following three USBR technical procedures:

EGP-5005-86, R2	Determining unified soil classification (visual method).
EGP-7000-89, R2	Performing disturbed soil sampling in test pits, trenches, accessible borings, and tunnels.
EGP-7221-89, R2	Determining unit weight of soils in-place by the water replacement method in a test pit.

As a result of the CAR Board decision for CAR-92-07 to revise the original commitments of integrating the USBR into the YMP-USGS at the program level, the USBR will work on the YMP via task agreements. Consequently, modifications to USGS QMPs that include USBR responsibilities are being evaluated for rescission or modification. All USBR QA procedures will be rescinded by April 30, 1993.

WBS 1.2.11.2 Quality Assurance Program Development

OBJECTIVE

To establish and maintain the QA program documents.

ACTIVITIES AND ACCOMPLISHMENTS

A Draft Matrix for the DOE QARD was completed indicating which requirements are already met, are not applicable, or will require changes to the program. This process identified 15 currently existing QMPs requiring revision, four new QMPs to be developed, and seven QMPs requiring modification.

The Draft Matrix, Impact Analysis Statement, and Transition Plan were transmitted to the Office of Quality Assurance.

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

QMP-4.01, R4	Procurement document control
QMP-5.04, R4-M1	Preparation and control of the YMP-USGS quality assurance program plan
QMP-5.05, R3	Scientific notebook system
QMP-7.01, R5	Control of purchased items and services
QMP-7.04, R0	Supplier evaluation

The following draft QMPs or modifications received QA and TPO approval and were sent to Reston for signature approval:

QMP-4.01, R4	Procurement document control
QMP-5.05, R3	Scientific notebook system
QMP-7.01, R5	Control of purchased items and services
QMP-7.04, R0	Supplier evaluation

The following draft QMPs or modifications received full signature approval:

QMP-3.03, R3-M3	Software quality assurance
QMP-5.04, R4-M1	Preparation and control of the YMP-USGS quality assurance program plan
QMP-12.01, R5-M3	Instrument calibration

The quality management procedure master list was updated and forwarded to the YMP-USGS QA Office.

1.2.11.3 Quality Assurance Verification

OBJECTIVE

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

WBS 1.2.11.3.1 Quality Assurance Verification - Audits

Principal Investigator - T. Chaney

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Audit Report USGS-93-05, Colorado Department of Agriculture, was submitted.

Audit USGS-93-06, of six technical activities was researched and planned. Included in the planning was the orientation of new QA and technical auditors as well as the conduct of two audit scoping meetings.

Audit USGS-93-07, Campbell Scientific, Inc., was performed in Logan, Utah.

Responses to several audit findings from Audits USGS-93-02 and -92-05 were researched and evaluated. An evaluation of the response to CAR-92-10 was completed.

VISI Metronics response to Audit USGS-93-03 Observation No. 1 was evaluated resulting in a recommendation to include this supplier on the Approved Suppliers List.

Supplier Evaluation Report USGS-93-E06, Yellow Springs Instruments, Inc., was prepared and submitted recommending deletion from the Approved Suppliers List.

Evaluated response from Colorado State University for Supplier Evaluation 93-E03 and submitted letter recommending their inclusion on the Approved Suppliers List.

Verification of several deficiency documents was completed including AFR-9203-03, 9203-04, NCR-90-37, and NCR-92-37. Verifications of AFR-9203-01, 9205-03 and 9205-10 were started, draft reports were written. Several deficiency document records packages were submitted to the LRC.

Evaluated HIP responses to USGS-NCRs -92-34, -93-05, and -93-06, and recommended acceptance.

A special investigative review was performed resulting in the closure of USGS-NCR-93-05.

Responses and/or evaluations were developed and delivered for the following deficiency documents: USGS-NCRs -93-01, -93-05, -93-07, and USGS-CAR-92-09.

USGS-CARs -90-04 and -92-02 were closed and CARs -90-01, R1 and -92-02, R1, were issued with appropriate documentation submitted.

A new corrective actions statement was written for CAR-92-07 related to the USBR QA program not being up to date.

Record packages were submitted to the LRC for the following: Audit USGS-93-05, Surveillance 93-S02, NCR-92-05, CARs -90-04 and -92-02.

WBS 1.2.11.5 Quality Assurance - Quality Engineering
Principal Investigator - L. Hayes

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

A concurrence draft of QMP-5.05 R3 was approved by the YMP-USGS QA manager and the TPO, and forwarded to Reston for approvals.

The log of USBR work requests was updated and distributed to include one work authorization request received during January. The request involved work activities for studying Bare Mountain and other fault zones as described in SCP Study Plan 8.3.1.17.4.3.

The QA Open Items Committee meeting results focused on recurring problems with report processing, which USGS-CAR-92-05 will need to evaluate, deficiency documents identifying implementation problems with QMP-3.03 R3 software requirements, and implementation of data management requirements.

Progress was made with the annual QA management assessment.

Draft modifications were proposed for QMP-1.01 (organization), QMP-2.01 (management assessments), and QMP-5.05 (scientific notebooks) as needed to address actions resulting from internal deficiency documents.

Approximately 32 software documents have been received, reviewed, and/or processed. The configuration status accounting log was updated and software technical contacts were notified of status of their software documents.

A modification of QMP-3.03, R3 was prepared and a guidance memorandum was prepared to accompany distribution of the modification.

D. Ambos served as the technical specialist for the DOE audit of T&MSS during the period February 1-5. The audit team was accompanied by representatives from the NRC and Clark County, Nevada. These observers spent most of their time with the technical specialist. The NRC observers were K. Hooks and D. Chery. Time was spent preparing the technical input to the audit report. (45 hrs)

The YMP-USGS Grading Acceptance Committee (GAC) met on February 1 to complete processing of ACSRs for SCP Activities 8.3.1.2.1.4, 8.3.1.2.2.4.2., and 8.3.1.5.2.2.

1.2.12 INFORMATION MANAGEMENT

OBJECTIVE

Includes work scope related to the project-level establishment of systems to facilitate organization, storage, and retrieval of information/documents.

1.2.12.2 Records Management

OBJECTIVE

To provide a YMP Records Management System that will meet the requirements of: DOE/RW-0214, Quality Assurance Requirements Document for the Civilian Radioactive Waste Management Program; DOE/RW-0194P, Records Management Policies and Requirements; ANSI/ASME NQA-1, Quality Assurance Requirements for Nuclear Facilities (Requirement 17 and 17S-1, Quality Assurance Records), and the Licensing Support System (LSS).

WBS 1.2.12.2.2 Local Records Center Operation

Principal Investigator - L. Hayes

OBJECTIVE

To provide a Yucca Mountain Project Records Management System that will meet the requirements of: DOE-NNWSI, Quality Assurance Plan, DOE-NNWSI/88-9; DOE-OCRWM Records Management Policies and Requirements, DOE/RW-0194; and the Licensing Support System (LSS); and to establish and operate all local records centers.

ACTIVITIES AND ACCOMPLISHMENTS

All records were received by the LRC and transmitted to the CRF within time limits.

Two hundred seventy-six individual records and 38 criteria packages were received into the LRC. One of these packages was submitted late; five packages required dating and initialing errors corrective action; and three records required QA designation changes. Accuracy rates of received records this month is 97 percent.

Fifty-one individual records and 33 criteria packages (1566 pages); five publication packages and 18 data packages (2,940 pages); and no current cited references were transmitted to the CRF from the LRC. One corrective action was requested of the USGS, making accuracy rate 99 percent.

Also five backlog publications and 27 backlog cited references for a total of 2,223 pages were transmitted to the CRF.

WBS 1.2.12.2.5 Document Control

OBJECTIVE

To provide a Yucca Mountain Project Records Management System that will meet the requirements of: DOE/RW-0241, Quality Assurance Requirements Document for the Civilian Radioactive Waste Management Program; DOE/RW-0194P, Records Management and Requirements, ANSI/ASME, NQA-1, Quality Assurance Requirements for Nuclear Facilities (Requirement 17 and 17-S1, Quality Assurance Records), and the Licensing Support System (LSS).

ACTIVITIES AND ACCOMPLISHMENTS

QMP-5.04, R4-M1, Preparation and Control of the YMP-USGS Quality Assurance Program Plan, was distributed:

The following technical procedures were distributed:

- HP-256, R0 Method for collecting and storing CO₂ gas samples from borehole atmosphere or from free air by absorption in a KOH solution.
- HP-253T, R0 Performing various hydraulic tracer tests using prototype pressure transducer and packer assemblies.
- EGP-01, R0 Determining leach field percolation

The following Activity Control Specification Reports were distributed:

- ACS-G1233114-1, R0 Regional hydrologic system synthesis and modeling
- ACS-G1233124-1, R0 Percolation test in the ESF
- ACS-G1236222-1, R0 Characterization of the future regional hydrology due to climate changes

The following USBR Earth Manual procedures were rescinded:

- EGP-5005-86, R2 Determining unified soil classification (visual method)
- EGP-7000-89, R2 Performing disturbed soil sampling in test pits, trenches, accessible borings, and tunnels
- EGP-7221-89, R2 Determining unit weight of soils in-place by the water replacement method in a test pit.

Also rescinded were five scientific investigation plans (SIPs) and 33 QALAS. There are no longer any SIPs or QALAs in effect for the YMP-USGS.

Documents for seven USBR participants no longer active on the Project were decontrolled.

Transfers of controlled documents from J. Brune to D. von Seggern at UNR and from U. Umbenhower to A. George at the DOE Las Vegas Office were completed.

Several special reports were written as requested as well as the routine document control duties which include but are not limited to submitting records to the LRC, issuing replacement documents, handling all requests for documents, updating and keeping the data base current.

Seven DTN record packages were submitted to the LRC including the annual configuration check which involved over 150 people.

1.2.13 ENVIRONMENT, SAFETY, AND HEALTH

OBJECTIVE

Includes work scope related to environmental compliance, monitoring, and safety and health.

WBS 1.2.13.4 Environmental Field Programs

OBJECTIVE

To identify data requirements; to collect required environmental field data; and to prepare topical data reports.

WBS 1.2.13.4.7 Water Resources

Principal Investigator - R. La Camera

OBJECTIVE

To provide water resources environmental field activity planning documents, field data and analyses, and topical reports describing the results of field data analyses.

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWR021 Conduct Ground-Water Monitoring FY93

Ground-water levels were measured at 27 sites. Discharge was measured at one flowing well and five springs. Ground-water data collected during January were checked and filed. Verified reported elevations of land surface, reference points, and measurement points of six wells with surveying equipment. Met with USGS-National Mapping Division personnel to obtain information of bench marks which will allow elevation determinations at two additional wells. Met with personnel of REECO and RSN to obtain written documentation of previous land surveys at or near monitoring sites on the NTS.

3GWR033 Environmental program support, FY93

Prepared and delivered status report for January to DOE and HIP. Capital equipment acquisition plan for FY93-FY99 was forwarded to DOE.

3GWR034 Evaluate ground-water quality monitoring requirements

Reviewed USGS-YMPB memorandum which detailed the rationale for suspension of water-quality monitoring. No further evaluation was initiated or required by USGS-YMPB or DOE.

3GWR035 Prepare Water-Resources Report through FY92

Checked and reviewed electronically collected water-level data. Prepared tabular and graphical summaries using existing data bases and available data.

Variations

3GWR021 Conduct Ground-Water Monitoring FY93

Water-level data were not collected at MV-1 and AD-6. MV-1 was not measured because it does not have an access tube to allow water-level measurements. AD-6 is currently the owner's only pumping well and the owner feels that a water-level measurement may affect operation of the well. Nearby well AD-5 is currently measured and provides monitoring data for the area.

1.2.15 SUPPORT SERVICES

OBJECTIVE

Includes work scope related to project-level general administrative and project support activities.

WBS 1.2.15.3 Yucca Mountain Site Characterization Project Support for the Training Mission

Principal Investigator - L. Hayes

OBJECTIVE

To manage the resources and perform work in support of the YMP training mission developed and implemented by the Yucca Mountain Site Characterization Project Office and YMP participants.

ACTIVITIES AND ACCOMPLISHMENTS

Various training functions were performed including distributing individual reading assignments; scheduling DOE general employee training; administering GET refresher examination for Denver area trainees; distributing reminder notices to participants with overdue reading assignments and second reminder notices to their appropriate managers; processing and filing training records; submitting packages to the LRC; distributing T&MSS and YMP-USGS Calendar of Training Events; and distributing participant instruction assignment status reports biweekly.

A reading assignment for AP-5.1Q, R3 was distributed.

YMP-USGS Orientation was presented in Denver and in Las Vegas. Records Management training was presented in Denver and software QA training was arranged for presentation in Flagstaff.

The training coordinators' meeting in Las Vegas was attended with much of the meeting's focus on the change in emphasis from reading and understanding assignments to performance-based training. A *Performance-Based Training Reference Manual Workshop on Analysis* was also part of this meeting. A training symposia "*Training for quality: the strategic imperative*" sponsored by the *American Society of Training and Development* was attended by the training coordinator.



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Yucca Mountain Site Characterization
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Las Vegas, NV 89193-8608

WBS 1.2.5.2.2
QA: N/A

APR 21 1993

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U.S. DEPARTMENT OF ENERGY (DOE) RESPONSES TO STATE OF NEVADA COMMENTS ON STUDY PLAN 8.3.1.17.3.1 (RELEVANT EARTHQUAKE SOURCES)

Enclosed are responses to 32 comments made by the State of Nevada on the subject study plan in a letter dated January 7, 1993 (enclosure 1). Enclosure 2 contains DOE's responses.

For comments on DOE-approved study plans, the Yucca Mountain Site Characterization Project Office asks the responsible participant organization (in this case, U.S. Geological Survey) and principal investigator to perform a review and assess the impact of the state's comments on the planned study. The assessment includes a determination as to whether or not a revision is warranted. If a revision is warranted, DOE's intention is stated in the responses. If a revision is not warranted, additional information is provided on how the comment is being addressed, why it is inappropriate, or where the concern is being addressed if another study plan is at issue.

The State of Nevada's comments primarily seek additional explanation of the 10,000-year cumulative slip earthquake concept. Other comments show a lack of understanding for the rationale for the study, especially the 100 km radius around the boundary of the proposed site in relation to seismicity. Other state comments desire clarification of points in the study plan. As reported in the response to Comment 23, a superseded technical procedure will be stricken from the study plan in a future revision.

If you have any questions, please contact either Thomas W. Bjerstedt at (702) 794-7590 or Richard C. Quittmeyer at (702) 794-1864.


Carl P. Gertz
Project Manager

RSED:TWB-3767

Enclosures:

1. State Comments on Study Plan 8.3.1.17.3.1
2. DOE Responses to State Comments

Robert R. Loux

-2-

APR 21 1993

cc w/encls:

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January 7, 1993

Dr. John W. Bartlett, Director
Office of Civilian Radioactive
Waste Management, RW-1
U.S. Department of Energy
1000 Independence Ave. S.W.
Washington, DC 20585

Dear Dr. Bartlett:

The State of Nevada has reviewed the DOE Study Plan "Relevant Earthquake Sources" (Study Plan 8.3.1.17.3.1, Revision 0) and is providing its comments in this letter and attachment. The State's comments address the adequacy, completeness, and technical accuracy of the Study Plan to meet the Department's objective in site characterization.

The Study Plan describes activities that will be performed to gather information to identify and characterize those earthquake sources that are relevant to deterministic and probabilistic seismic hazard analyses of the Yucca Mountain site. The first activity will identify potential earthquake sources, and the second activity will characterize the 10,000 - year cumulative slip earthquakes for the earthquake sources.

Four general comments are offered on this Study Plan.

-
- COMMENT 1
1. The Study Plan shows little originality and appears to be basically a cook book outline of procedures that could be followed for data collection at almost any site. Little if any thought appears to have been given to what the information collected will provide in terms of meeting NRC regulatory requirements for this site, what effect the resultant information, positive or negative, could have on the rest of the site characterization program or how such information will be iteratively fed back into the program in a meaningful way. The Study Plan fails to acknowledge nor is consistent with the NRC Staff Technical Position on Investigations to Identify

Fault Displacement Hazards and Seismic Hazards at a Geologic Repository (NUREG-1451). The DOE decision to arbitrarily limit the area of study to a radius of approximately 100 km from the proposed repository is an example of the inconsistency with regulatory positions. The regulatory process calls for defining the geologic setting first followed by an assessment of all of the Quaternary sources within. By definition, any Quaternary source within the geologic setting is relevant. However, not all relevant sources are going to be significant in establishing design and performance parameters. Until the geologic setting is acceptably defined by the DOE, the significance of any source probably cannot realistically be determined.

COMMENT 2

2. The Study Plan abstract states that the purpose is to gather information that will identify and characterize earthquake sources that are relevant to deterministic and probabilistic seismic hazard analyses. The abstract statement is essentially the last discussion of deterministic analyses. Careful reading of the Study Plan reveals that the DOE definition of relevance of any earthquake source will be based on an iterative assessment of each identified source against the so-called 10,000-yr cumulative slip earthquake. Although much of the information that will be collected could be used in performing a deterministic analysis as required by the NRC, it is unlikely to be sufficient given the planned activities. By doing an iterative assessment, there appears to be a high likelihood that significant data will not be collected until late in the program when the realities of the regulatory process become apparent.

COMMENT 3
(PARTIAL)

3. A principal thrust of the Study Plan is to determine or characterize the 10,000 year "cumulative slip earthquake" for seismogenic structures in the vicinity of Yucca Mountain. The cumulative slip earthquake represents the equivalent amount of slip that will accumulate as elastic strain along a fault in 10,000 years. The underlying assumption of the cumulative slip earthquake is that it represents the largest earthquake to be expected during the life of the proposed facility. Unless it can be shown that (1) the last rupture of each active fault in the area was 10,000 years ago and (2) that the average repeat time of rupture on each fault is less than 10,000 years ago, this approach is fundamentally flawed and will likely underestimate the magnitude of an earthquake if it were to occur.

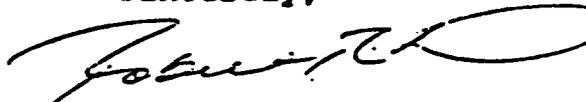
The State's position on the "cumulative slip earthquake" has been articulated in the past and is well-known to the Department. A Summary of the State's position is contained in the attachment to this letter.

COMMENT 4

4. Another major shortcoming of this Study Plan is the failure to recognize that the near-field strong motion effect could extend out to 10 km or more from the source structure depending upon the magnitude. For example, the well-instrumented October 15, 1979 Ms 6.8 earthquake in the Imperial Valley, California showed erratic near-field effects out to about 15 km. Since all of the major source structures at Yucca Mountain are within less than a 10 km radius of the proposed repository and the estimated magnitudes are in the same range, near-field effects should be considered. Although geologic data for the 0-5 km near-field area will reportedly be obtained as part of Study Plan 8.3.1.17.4.6 "Quaternary Faulting in the Site Area", no provisions appear to have been made to provide similar data for those source structures in the 5-10 km range. Adding to the problem is the uncertainty of how to deal realistically with estimating the near-field effect for an earthquake that is based on a 10,000-yr cumulative slip model. At the best, empirical data recorded from the near-field is very sparse for faults with measured offsets. Empirical data recorded from 10,000-yr cumulative slip earthquakes is non-existent.

Should you have questions, this Office is available to meet with the Department to discuss the State's comments at any time.

Sincerely,



Robert R. Loux
Executive Director

RRL:CAJ:jem

Attachment

cc: ✓ Carl Gertz, YMPO
Joe Youngblood, NRC
Dade Moeller, NRC-ACNW
Steve Kraft, EEI
John Cantlon, NWTRB
Dwayne Weigel, GAO

ATTACHMENT

State of Nevada detailed comments. on Study Plan 8.3.1.17.3.1
"Relevant Earthquake Sources".

DISCUSSION OF 10,000-YEAR CUMULATIVE SLIP EARTHQUAKE

COMMENT

3
(PARTIAL)

The second element of the Study Plan is directed toward characterizing the 10,000-year cumulative slip earthquake (CSE), an approach conceptualized by DOE for determining a design basis earthquake in the preclosure period. The CSE is a new methodology based on the linear extrapolation of estimated late Quaternary slip; it is intended to provide a conservative estimate of ground motion with a one-in-ten chance of occurring during the preclosure period. It is a best estimate based on equivalent 10,000-year displacements (p. 2-3). A CSE will be estimated for all identified relevant earthquake sources, with the relevance of the source being assessed iteratively based on the CSE (p. 2-1). The State has previously reviewed this proposed approach, specifically addressing the appropriateness of using the new concept of the CSE. The State's detailed comments were provided in the 1989 report on the Department of Energy's Site Characterization Plan (SCP). It is obvious the authors did not review nor consider those comments in developing this Study Plan. The following discussion summarizes the State's position relative to the CSE.

The concept and use of the 10,000-year cumulative slip earthquake are unacceptable. This type of seismic source characterization is unconventional, unrealistic, misleading, and nonconservative.

As defined, the 10,000-year cumulative slip earthquake is "an earthquake that, occurring every 10,000 years, would produce the observed or estimated average Quaternary slip rate on a fault." This is considered a fundamentally inappropriate approach because it prorates tectonic slip over a 10,000 year period, creating an artificial, "watered-down" earthquake size estimate, and because it is an attempt to incorporate a risk factor into earthquake magnitude estimates. For such a critical facility, the widely used and accepted maximum magnitude or maximum credible earthquake methodology should be used instead of the proposed 10,000-year cumulative slip earthquake.

In supporting the 10,000-year cumulative slip earthquake, the DOE has presented three arguments with which the State takes issue:

First, DOE concludes that the 10,000-year event "can be determined with greater confidence than a true maximum magnitude" (SCP, 1988). This is incorrect, because many more input parameters and uncertainties are involved in the estimation of the 10,000 year event than in the conventional estimation of the maximum magnitude earthquake. There are large uncertainties associated with the

COMMENT
3
(PARTIAL)

estimation of numerical ages, slip rates, recurrence intervals and b-value relationships, all of which should be used to calculate the CSE. The 10,000-year event methodology does not include theoretical or practical concepts of characteristic earthquakes (i.e., future events will be similar to those seen in the geologic record). In total, the uncertainties in a CSE estimate are greater than either the data or the procedures used in conventional deterministic analyses of maximum magnitude earthquakes (such as fault length/magnitude relationships). Conventional methods may involve larger uncertainties in analyzing Basin and Range faults compared to plate margin faults, such as the San Andreas, but this has little bearing on what kind of seismic hazard analysis should be conducted for Yucca Mountain facilities.

Second, DOE contends that "low slip rates suggest that the use of fault length or displacement to develop deterministic estimates of magnitude for a given fault are misleading" (SCP, 1988). As discussed above, the analysis of faults with low slip rates (or long recurrence intervals) may result in comparatively larger uncertainties, but this does not render the analysis meaningless or "misleading". To the contrary, recent studies suggest that faults with lower slip rates may be associated with earthquakes or higher stress drops and moments (Kanamori and Allen, 1986; Cao and Aki, 1986). Thus, prudent, conservative deterministic and probabilistic analyses are even more appropriate for faults in the Yucca Mountain region.

Third, DOE states that "use of slip-rate data (to constrain recurrence times) in conjunction with more conventional fault data provides added assurance that adequately conservative assessments of the local seismogenic potential will be accomplished" (SCP, 1988). This is a somewhat vague statement, but it is inferred to mean that the use of a conventional maximum magnitude earthquake approach is overly conservative. Average long-term slip rate and recurrence data are important elements in defining paleoseismic behavior, but they do not completely characterize fault behavior, particularly with respect to temporal clustering.

The CSE is nonconservative on the basis of evidence for temporal clustering. The 10,000 year event estimation is completely dependent on long-term averages, (i.e., the slip rates which will be utilized are average rates based on measured displacements of dated late Quaternary deposits). Recent work, however, has shown that fault behavior in the Basin and Range province is commonly characterized by spatial and temporal clustering of events (Wallace, 1985; Pearthree and Wallace, 1988). Tectonic strain may be accumulated in a nonlinear fashion (e.g., Thatcher, 1984) with the strain being released spasmodically during short cycles of repeated faulting separated by longer periods of quiescence (Wallace, 1937). The average slip rates and recurrence intervals over the short-term spasmodic, or cluster, periods can therefore be significantly different than the average rates and

COMMENT
3
(PARTIAL)

intervals over the long term. If the tectonic cycle is within a temporal cluster, the slip rates will be greater by a factor of at least 2 to as much as an order of magnitude than the long-term average rate.

Since the CSE is intended to be used iteratively to reassess the relevance of the identified earthquake sources within 100 km of the site, the adequacy of the identification activity is consequently adversely affected. It is highly unlikely that all active faults within the 100 km region can be adequately characterized with respect to slip rates unless detailed Quaternary stratigraphic and fault investigations (such as exploratory trenching) are conducted on each fault. Without such detailed data, large uncertainties will be attached to the estimated cumulative slip.

Since the artificial nature of the 10,000-year CSE will make it impossible to accurately estimate the uncertainty or conservatism of the magnitude estimate, the use of a maximum magnitude earthquake analysis is a more direct and conventional method, and uncertainties can be incorporated into the analysis. Considering different earthquake scenarios, the sensitivities of input parameters can be judged and more meaningful estimates of conservatism can be made. Such an approach has abundant precedent in the nuclear licensing arena.

Multiple estimation methods and corresponding uncertainties should be utilized to understand the sensitivity and conservatism of the estimates. A seismic source analysis of the site should include the estimation of both deterministic and probabilistic maximum magnitude earthquakes for the known and inferred seismic sources. Nevada's historical earthquake record also needs to be considered in the analysis. For example, several similarities have been noted between the Yucca Mountain and the Cedar Mountain areas, suggesting that a 1932 Cedar Mountain type of event should be considered in the seismic analysis (Bell, 1985; Bell and others, 1987). The 1932 Cedar Mountain earthquake was a complicated, multiple fault event, yielding an Ms 7.2.

The Yucca Mountain site lies within a tectonically active area with many potential seismogenic sources lying onsite and immediately adjacent to it. A consequence of such a tectonic setting is that conventional maximum magnitude earthquake analyses will yield high seismic design values for this site. High design values are viewed as appropriately characterizing the site, rather than being overly conservative. The seismic hazards of the site need to be characterized in a manner consistent with analyses for other critical facilities located in areas with numerous local, active faults.

In summary, the 10,000-year cumulative slip earthquake is an artificial design basis earthquake which has little probability of

COMMENT 3 (PARTIAL) actually occurring during the lifetime of the facility; it has no basis in either observed or theoretical Basin and Range tectonics. More likely is the possibility of a larger slip event which would be characteristic of the known style and amounts of displacement at Yucca Mountain.

SPECIFIC COMMENTS

COMMENT 5 1. Section 1.1 (Page 1-1) lists the information items to be synthesized in the study. The difference between the information items to be synthesized in this study (1) maps and cross-sections of earthquake locations determined from historical and instrumental earthquake data; and (2) regional and local seismic data is not obvious and needs to be explained.

COMMENT 6 2. On page 2-1, the Study Plan states that the assessment of the relevance of an identified seismic source requires an assessment of the magnitude of the source. The relevant earthquake sources identified by this study will likely be overwhelmed by the near-field (0-10 km) sources regardless of the magnitude.

COMMENT 7 3. Also on page 2-1, the Study Plan states that activity 8.3.1.17.3.1.2 will assess the magnitude of the sources according to a postulated 10,000-yr cumulative slip earthquake. The 10,000-yr cumulative slip earthquake has been repeatedly rejected by the NRC and the State (see previous discussion) as fulfilling regulatory requirements. A deterministic earthquake approach will be required. If the DOE wishes to pursue the 10,000-yr cumulative slip earthquake in parallel with developing a deterministic basis for the design earthquake, then this Study Plan should be revised to include provisions for both.

COMMENT 8 4. Also on page 2-1, the rationale for selecting the study calls for prediction of potential ground motion in frequency bands of engineering interest (bandwidth 0.5-33 Hz). This bandwidth is considered appropriate for design of the classic free-standing surface structures located in the far-field. What is the frequency bandwidth of interest for subsurface facilities in the near-field? If the DOE has no more than a conceptual idea of the design for the subsurface facilities at this time and has no idea, even conceptual, of what will be required for the repository seals, the appropriate frequency bandwidth will be difficult to establish. An additional complexity is caused by the fact that the potential repository will be located in the near-field. There are little, if any, subsurface or surface strong-motion data in the near-field from strong earthquakes in the Great Basin. There may be some classified data from UNEs but the State is not directly knowledgeable. If such data are available, then provision should be made for its declassification and release.

COMMENT 9 5. Also on page 2-1, element 4 refers to assessing iteratively the relevancy of the compiled earthquake sources based on the

10,000-yr cumulative slip earthquake. As suggested previously, there should be a parallel study to assess the relevancy based on a deterministic analysis, if the intent is to satisfy regulatory requirements. There are two ways of accomplishing these results. One is to look at the known sources only, or two, look at all possible sources. This Study Plan makes it appear that the DOE will be following the first course in deference to the latter. This approach is unlikely to satisfy the NRC requirement for estimating the degree that a natural hazardous condition could be present and still be undetected.

COMMENT 10 6. Also on page 2-1, element 5 states that the DOE will define potentially contributing seismological sources for a probabilistic assessment. Will this effort include all of the potential geophysical sources? What study plan will be used to identify these sources?

COMMENT 11 7. In Section 2.1.2 (page 2-2), the Study Plan refers to Quaternary faults recognized in the site area and in the region by other studies. The region (geologic setting) and the site area have yet to be acceptably defined. In addition, the DOE should not depend solely on other studies, but should verify the work that has been done and independently assess the potential for other sources that may be present as required by NRC regulation.

COMMENT 12 8. On page 2-2, the statement is made that all documented geologic structures potentially relevant to seismic hazards at the site within a 100 km radius will be addressed. How does the DOE plan to handle the other major geologic structures that exist within the geologic setting, but are outside of the arbitrary 100 km radius?

COMMENT 13 9. Also on page 2-2, the Study Plan states that the geographic limits of the area beyond 100 km of the site cannot be set without the results of contributing ground motion attenuation and engineering design criteria studies. This statement is difficult to comprehend. The geographic limits of the geologic setting exist with or without the engineering design criteria studies.

COMMENT 14 10. Component 1 on page 2-3, states that the DOE will determine the dimensions of each Quaternary fault identified as a potentially relevant seismic source using predominately published information. What activities will provide for the information on buried or blind subsurface structures and their earthquake potential? What activity will address potentially relevant seismic sources that have been identified in unpublished sources?

COMMENT 15 11. Relative to Component 3 on page 2-3, there is no regulatory precedent for determining a magnitude representative of the 10,000-yr cumulative slip earthquake.

COMMENT
16

12. On page 2-3, Component 4 refers to the magnitude of earthquakes that control site ground motion at any frequency between 0.5 and 33 Hz. Without even a preliminary design for reference, there is no basis for what frequency range would be appropriate for the subsurface facilities. A more logical approach would be to establish what the range of expected frequencies are in the near-field considering the limited near-field empirical data that has been recorded from earthquakes of the magnitudes expected at Yucca Mountain.

COMMENT
17

13. Component 5 on page 2-3 implies that all sources within a 0-5 km radius (the near-field) will automatically be included, regardless of their individual size. It should also be noted that the near field could extend out to 10 km radius or more if the source magnitude is beyond 6.5.

COMMENT
18

14. Page 2-3 contains a detailed discussion of the 10,000-yr cumulative slip earthquake. As stated in the State's comments on the SCP, the 10,000-yr cumulative slip earthquake appears to have been contrived to specifically fit the limited data that was available for the Paintbrush Canyon fault at the time the SCP was written. Although the concept of a 10,000-yr cumulative slip earthquake could be valuable in determining seismic risk in areas of low seismogenic potential, it hardly seems appropriate for the Great Basin that has experienced six earthquakes in historical times with magnitudes greater than 6.8 and a recent magnitude 5.6 less than 20 km distance from the proposed repository. Disregarding the inherent controversial nature of the 10,000-yr cumulative slip earthquake and the fact that it has already been determined to be unacceptable to the NRC for regulatory requirements, there is a fundamental problem with data availability. Because of the limited extent of Holocene deposits and the shortage of late Quaternary deposits both spatially and temporally, it is doubtful that an acceptable database could be developed that would defend the 10,000-yr cumulative slip earthquake.

COMMENT
19

15. Reference to Section 2.2.2.2 (page 2-4). The location of the study area is dictated not by the need to assess vibratory ground motion, but by the NRC requirements. It is the State's interpretation that 60.122(a)(b)&(c) require that the geologic setting be defined first, followed by an assessment of relevant sources within the setting.

COMMENT
20

16. In Section 3.1.1 (page 3-1), the term "potentially relevant seismic sources" is used incorrectly. Any seismic source that has the potential to effect the repository is by NRC definition relevant. Regulatory definition of relevant information is any information that could influence a staff member in the review, regardless of whether that information is, in fact, used. The key word, according to the NRC, is influence.

COMMENT 21 17. Also in Section 3.1.1 (page 3-1), the Study Plan addresses the necessity of updating the inventory of relevant seismic sources. What process will DOE follow to preclude the inadvertent omission of "material" information on sources within the geologic setting?

COMMENT 22 18. Page 3-1 lists maps which will be used to display information about relevant seismic sources. Item 3 addresses the random earthquake events that have not been associated with known geological structures. If an earthquake cannot be associated with a known geological structure, it does not mean that it is random. An earthquake may need to be confined to a source zone, a source system (e.g. detachment fault) or region for lack of definitive data, or failure of DOE to adequately investigate the possible sources. However, earthquakes are not spatially random.

COMMENT 23 19. Section 3.1.2 on page 3-2 refers to the Seismic Zoning Technical Procedure (SP-03). This procedure has not been included in the references. Has this procedure been developed? If so please provide a copy to the State.

COMMENT 24 20. Under expected accuracy for the design or performance parameter in Section 3.1.4 on page 3-2, it is stated that an inventory of near-field potential earthquake sources will include all identified Quaternary faults within 5 km of FITS (Study Plan 8.3.1.17.4.6). This statement is the only recognition in this Study Plan or in Study Plan 8.3.1.17.4.6 that the repository will have to be designed for near-field strong ground motion. The significance of this issue seems to have been minimized in the rest of the Study Plan. It is suggested that this Study Plan be revised to include a credible discussion of how the DOE intends to acquire the appropriate data for the near-field.

COMMENT 25 21. On page 3-3, it is stated under expected accuracy that the assessment of ground-motion contributions from all identified fault sources will allow the determination of whether the design-basis ground-motion has less than a 1 in 10 chance of being exceeded in 100 years. This value is appropriate only for the surface FITS. DOE has yet to demonstrate that there are underground FITS that should be addressed under this parameter. In addition, since all of the faults within a 0-5 km radius are considered by DOE to be in the near-field, the probability of exceeding the presently proposed (0.4 g) design-basis ground-motion is by definition greater than 1 chance in 10.

COMMENT 26 22. In Section 3.1.5 on page 3-4, it is stated under the range of expected results that potentially relevant sources will include those identified Quaternary fault sources with lengths greater than about 1 km within 10 km of the site. An earthquake occurring on a 1 km or greater fault (e.g. Ghost Dance fault) passing through the repository would definitely contribute to a high frequency ground-motion hazard. Faults of less than 1 km in length would not be as significant unless they are part of a distributed system. A non-

distributed nature of faults at Yucca Mountain would need to be demonstrated by the DOE.

COMMENT
27

23. On page 3-5, the Plan states that information about individual faults with lengths less than a few kilometers at distance beyond 10 km will be compiled if evidence exists or is developed in other activities that such sources are extensions of, or genetically related to, existing potentially relevant sources. What is the plan to demonstrate the opposite, i.e., that such sources are not genetically related as required by NRC regulations?

COMMENT
28

24. Section 3.1.8 (page 3-5) states that information obtained in this activity is expected to be representative of potentially significant seismic sources in the site area and in the region (\leq 100 km). Will the information compiled and synthesized also be developed for the significant sources located beyond the arbitrary 100 km radius that are to be identified in other parts of this study (e.g. Section 2.1.2.2 on page 2-2)?

COMMENT
29

25. On page 3-6 under Section 3.2 Activity 8.3.1.17.3.1.2, there is a need to add a section that explains how DOE intends to use the same data obtained for characterizing the 10,000-yr cumulative slip earthquake to establish a deterministic basis for the design-basis earthquake(s) as required by NRC regulation.

COMMENT
30

26. Reference to Section 3.2.2 on page 3-7, the sample calculation of the 10,000-yr cumulative slip earthquake documented in the SCP, page 8.3.1.17-73 is simple in concept, but will be difficult to achieve in practice. This Study Plan needs to have that sample calculation included, perhaps as an appendix. In addition, the DOE should include a sample calculation of how they expect to deterministically develop the design earthquake for sources in the near-field as required by NRC regulations.

COMMENT
31

27. In Section 3.2.5 (page 3-8), it states that the 10,000-yr cumulative slip earthquake will be constrained on the low end to be greater or equal to the magnitude of the smallest earthquake that would likely cause surface faulting (about Ms 6 to 6.5). It is assumed from this statement that all relevant faults within the near-field (0-5 km) will be considered capable of generating an Ms 6 to 6.5 earthquake. How does the DOE intend to handle the smaller magnitude earthquakes (less than Ms 6) that will occur in the near-field and yet not produce surface rupture? For example, the recent 5.6 magnitude earthquake that occurred at Little Skull Mountain could have done considerable damage if it had occurred on one of the faults that transect and surround Yucca Mountain. The Study Plan needs to be revised to reflect how the DOE will treat this problem.

COMMENT
32

28. The schedule and milestones shown on Figure 5-1 indicate that the results will not be available for five years. Given the critical nature of the results that would come from this study, it

is very likely to receive focused attention. If those results are not available for five plus years, it is unlikely that they could effectively be factored into any iterative site suitability evaluation that the DOE has committed to. The Study Plan needs to be revised to account for the periodic release of results as they become available.

In addition, Figure 5-1 requires input from three other studies, activities, or investigations. What plans are in place to assure that the inputs are available on schedule so the Study Plan milestones are met, and outputs to other studies are accomplished on schedule? Given the amount of information necessary to meet the objectives of this Study Plan and also satisfy NRC regulatory requirements, the schedule is overly optimistic.

References Cited In Comments

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**U.S. DEPARTMENT OF ENERGY (DOE) RESPONSES
TO STATE OF NEVADA COMMENTS ON
STUDY PLAN 8.3.1.17.3.1
(RELEVANT EARTHQUAKE SOURCES)**

Response to Comment 1

The study plan describes an adequate approach to identify relevant seismic sources. Relevant seismic sources are active and could generate ground motion levels of significance to design or performance assessment at the site.

Section 8.3.1.17 of the SCP provides the basis and the regulatory requirements upon which this study plan was prepared. This section also provides information for how the study plan relates to the rest of Section 8.3.1.17 and the rest of the SCP.

With respect to the study plan not acknowledging and not being consistent with NUREG 1451 (U.S. Nuclear Regulatory Commission [NRC] Staff Technical Position on Investigations to Identify Fault Displacement Hazards at a Geologic Repository), the study plan was prepared prior to the release of NUREG 1451 and the earlier preliminary draft versions of the NUREG. The study plan was issued, in December 1991, six months prior to the issuance of NUREG 1451, in May 1992. DOE is currently evaluating NUREG 1451 to determine what effect, if any, it will have on this and other study plans.

DOE disagrees with the State's view that the 100-km radius is arbitrary. The area within a 100-km radius from the potential repository site was chosen for the collection of data on seismic events and Quaternary faults in the SCP, and hence is based upon available knowledge of ground motion attenuation relations. The study plan does state (Section 2.2.2.2, page 2-4) that existing information for seismic sources beyond the 100-km radius that produce ground motions of engineering interest at the site will also be used, depending on attenuation and the response characteristics at the site. Also, historical records of the Southern Great Basin Seismic Network, which will be used in Study 8.3.1.17.3.1, include stations as much as 160 km from the potential repository. (See, also, statements referring to the above, in Section 2.1.2 of Study Plan 8.3.1.17.4.1 [Historical and Current Seismicity].)

With respect to the definition of the geologic setting, DOE's response to the NRC's Site Characterization Analysis comment 75 provided the operative definition for DOE's interpretation of the "geologic setting." The geologic setting of concern to any specific study is defined therein. From a regulatory perspective, geologic setting is defined in 10 CFR Part 60.2 as "the geologic, hydrologic, and geochemical systems of the region in which a geologic repository operations area is or may be located." It basically consists of the universe outside the boundary of the controlled area as well as the geologic environment within the geologic repository operations area (GROA) and interface between the boundary of the GROA and the boundary of the controlled area.

Response to Comment 2

The Department of Energy is currently re-evaluating its use of the 10,000-year cumulative slip earthquake. Changes, if any, in the method used to assess the relevancy of seismic sources would be reflected in a revision to this study plan. As the State points out, "much of the information that will be collected could be used in performing a deterministic analysis...". This is also true for a probabilistic analysis. Hence, the activity to identify relevant earthquake sources can proceed while the re-evaluation is taking place.

Response to Comment 3

The DOE and the State of Nevada have had a long dialog regarding the concept and application of the 10,000-year cumulative slip earthquake (CSE) methodology. This dialog includes the comment response record for the SCP; Consultation Draft (CD); Comments 15, 158, 176, 177, 211, 346H, 381, 417, and 420. It also includes the comment response record for the statutory SCP; Comments 20, 215, 285, 306, 1525, 1534, 1548, 1758, 1775, and 1913. See also the DOE response to NRC's Point Paper Comment 52 on the SCP/CD and DOE's response to NRC's Site Characterization Analysis Comment 66. DOE is well aware of the state's concerns regarding the CSE methodology. The concerns expressed in the state's comments on Study Plan 8.3.1.17.3.1 are similar or identical in intent to the state's prior comments. The application of the 10,000-year CSE methodology for site characterization is under review and it could be superseded. As part of our issue resolution initiative, the DOE is preparing a topical report for the NRC which describes the seismic hazard assessment methodology DOE intends to pursue during site characterization. This reappraisal is considering the developing American Society of Civil Engineers' seismic hazard methodology guidelines and the seismic hazard methodology used by non-OCRWM DOE programs for facilities important to safety. Following completion of this topical report, modification of this and other study plans may be required.

In the case of Study Plan 8.3.1.17.3.5, the words, "and other maximum magnitude events" was inserted after each reference to the "10,000-yr cumulative slip earthquake," and such insertions are equally appropriate for Study Plan 8.3.1.17.3.1, but a revision to this study plan at this time, solely on this basis, is not warranted.

Response to Comment 4

The goal of this study is to identify relevant earthquake sources. Sources in the distance range from 5 to 10 km will be identified on the basis of results from studies 8.3.1.17.4.1 (Historical and Current Seismicity), 8.3.1.17.4.2 (Location and Recency of Faulting near Prospective Surface Facilities), 8.3.1.17.4.3 (Quaternary Faulting within 100 km of Yucca Mountain, including the Walker Lane), 8.3.1.17.4.4 (Quaternary Faulting Proximal to the Site within Northeast Tending Fault Zones), 8.3.1.17.4.5 (Detachment Faults at or Proximal to Yucca Mountain), 8.3.1.17.4.6 (Quaternary Faulting within the Site Area), 8.3.1.17.4.7 (Subsurface Geometry and Concealed Extent of Quaternary Faults at Yucca Mountain), 8.3.1.17.4.8 (Stress Field within and Proximal to the Site Area), 8.3.1.17.4.9 (Tectonic Geomorphology at Yucca Mountain), 8.3.1.17.4.10 (Geodetic Leveling), 8.3.1.17.4.11 (Characteristics of Regional Lateral Crustal Movements), and 8.3.1.17.4.12 (Tectonic Models and Synthesis). The contribution of near-field ground motions to determining the relevancy of seismic sources will be covered in study 8.3.1.17.3.5 (Ground Motion from Regional Earthquakes and UNE).

RESPONSES TO SPECIFIC COMMENTS IN THE ATTACHMENT

Response to Comment 5

"Maps and cross sections" are graphic portrayals of seismic data; "Regional and local seismic" data are tabulations. There may be some redundancy in the different presentations.

Response to Comment 6

A prime responsibility of Study 8.3.1.17.3.1 is to identify relevant earthquake sources, including the magnitude of the source.

Response to Comment 7

See the response to Comment 3.

Response to Comment 8

The range of 0.5-33 Hz is given as a minimum bandwidth (based on SCP Tables 8.3.1.17-a and 8.3.1.17-6a for both surface and underground facilities). This minimum bandwidth does not preclude expansion of these limits if warranted. Study Plan 8.3.1.17.3.1 (next to last sentence, top paragraph, page 2-1) states that "Determination of frequencies of engineering interest will consider parameters and revisions to parameters needed for seismic design and design analysis."

Response to Comment 9

See the response to Comment 3.

Response to Comment 10

Probabilistic seismic hazards analyses will be conducted in Study 8.3.1.17.3.6. Geophysical surveys used to identify faults (hence, potential seismic sources) will be conducted in Studies 8.3.1.4.2.1, 8.3.1.17.4.3, and 8.3.1.17.4.7.

Response to Comment 11

The purpose of this study is to identify earthquake sources that are relevant to design and performance at Yucca Mountain. Determination of the relevance of a potential source depends on the size of the earthquake, its distance from Yucca Mountain, the ground motion-attenuation relation appropriate to the region, and local site effects. A source may be relevant independent of the geologic setting within which it is found. Thus, identification of relevant seismic sources can proceed in parallel with investigations to define geologic setting. See the response to Comment 1 regarding the definition of "geologic setting."

The "other studies" referred to in Section 2.1.2.1 are those studies described in the Site Characterization Plan (SCP) and related study plans as listed in the response to Comment 4. Findings presented by workers outside the Yucca Mountain Project will be considered and used as appropriate.

Response to Comment 12

Seismic sources beyond 100 km from the site will be included to the extent that the ground motion they produce is relevant to design and performance at the site. As the distance from the site increases, the size of the fault (or earthquake) that can produce relevant ground motion at the site also increases. As information on ground motion and site response matures through the execution of other studies, the earthquake magnitude that results in relevant ground motion at the site will become better defined. Potential sources will be assessed iteratively as new information becomes available.

Response to Comment 13

See the response to Comments 11 and 12.

Response to Comment 14

The study plan has been misquoted. Component 1 does not say "using predominantly published sources," but rather says that "information from published sources and other planned activities" will be used. The other planned activities are listed in the response to Comment 4.

Geophysical data and data from boreholes, along with alternative tectonic models, will be used to evaluate buried and blind faults.

If information on potentially relevant seismic sources is unpublished, it will need to be published and available for scrutiny by all parties.

Response to Comment 15

See the response to Comment 3.

Response to Comment 16

See the responses to Comments 1 and 4.

Response to Comment 17

The intent is to identify all seismic sources that produce ground motion that is relevant to design and performance at the site. This is equally true for sources at distances between 0 and 5 km, and between 5 and 10 km.

Response to Comment 18

See the response to Comment 3.

Response to Comment 19

See the response to Comment 1.

Response to Comment 20

"Relevant" is not used in the Site Characterization Plan, nor in this study plan, as a legal term, but rather in its more general usage of "having significant and demonstrable bearing on the matter at hand."

Response to Comment 21

Potentially relevant sources, their analysis and characterization will be clearly described in project reports. External oversight and internal review both act to ensure that "material" information is not omitted.

Response to Comment 22

DOE agrees that earthquakes are neither spatially nor temporally random. Given complete knowledge of the state of the earth, and a complete understanding of how earthquakes occur, it would be possible to predict their occurrence in space and time deterministically. However, given current state-of-the-practice investigation techniques, our knowledge and understanding can never be complete. Thus, in carrying out our analysis, we characterize some of the spatial and temporal aspects of occurrence for certain classes of events as random.

Response to Comment 23

Technical Procedure SP-03, Seismic Zoning, has been withdrawn from use and is no longer available for distribution. The study plan will be revised to delete this procedure before the study begins.

Response to Comment 24

This study plan deals with the identification of relevant seismic sources. Questions concerning the characterization of ground motion, both near- and far-field, as appropriate, are addressed in Study 8.3.1.17.3.3 (Ground Motion from Regional Earthquakes and UNE).

Response to Comment 25

The probability that peak horizontal ground accelerations greater than 0.4 g will occur within 100 years will be evaluated in Study 8.3.1.17.3.6 (Probabilistic Seismic Hazard Analyses) by integrating information on fault locations, rates of different magnitude earthquakes, ground motion / attenuation relations for both the near- and far-field, and local site effects.

Response to Comment 26

The possibility of distributed faulting at and in the vicinity of Yucca Mountain will be considered in characterizing seismic sources and in assessing seismic hazard.

Response to Comment 27

Information derived from fault mapping studies, geophysical surveys, and evaluation and synthesis of tectonic models will be used to assess the potential inter-relationship of faulting. If alternative tectonic models are viable, the consequences of each model will be evaluated.

Response to Comment 28

See the response to Comment 1.

Response to Comment 29

See the response to Comment 3.

Response to Comment 30

The sample calculation already resides in the SCP. An additional example calculation was provided in DOE's response to NRC Point Paper Comment 52 on the SCP/Consultation Draft. The intent is to only provide sample calculations in the yet-to-be-prepared technical procedure for this activity. Sample calculations will be detailed in the procedure written to accompany this study plan. See also the response to Comment 3.

Response to Comment 31

A source zone will be defined to accommodate the possibility that small earthquakes will occur on unidentified faults. The size of earthquakes accommodated in this fashion will depend on the results of site characterization activities, including surface mapping at the site, geologic mapping in the Exploratory Studies Facility, and geophysical investigations.

The potential for damage to engineered structures depends not only on ground motion, but on the structure's design and construction. Damage resulting from the Little Skull Mountain earthquake occurred to structures with no specific seismic design. Structures designed to withstand seismic ground motion typically do not suffer significant damage.

Response to Comment 32

New and more detailed schedules have been prepared for this study since the study plan was approved. The schedule in Section 5.0 depicts important data needs by this study from other studies and feeds from this study to other studies. These linkages also show the relative timing for such constraints and information handoffs. The ongoing integration of this study with other studies (e.g., response to Comment 4), make the collection and sharing of data more efficient.