

*rec'd with letter dtd  
11/26/91*

Department of the Interior  
United States Geological Survey  
YUCCA MOUNTAIN PROJECT  
Monthly Highlights and Status Report  
SEPTEMBER 1991

**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.

*102.8*

9112020277 910126  
PDR WASTE PDR  
WM-11

## TABLE OF CONTENTS

<b>1.2.1 SYSTEMS</b> .....	<b>1</b>
WBS 1.2.1.3 Technical Data Base Management .....	1
WBS 1.2.1.3.5 Technical Data Base Input .....	1
<b>1.2.3 SITE</b> .....	<b>2</b>
WBS 1.2.3.1 Management and Integration .....	2
WBS 1.2.3.2 Geology .....	7
WBS 1.2.3.2.2 Rock Characteristics .....	7
WBS 1.2.3.2.2.1 Geologic Framework of the Yucca Mountain Site .....	7
WBS 1.2.3.2.2.1.1 Vertical and Lateral Distribution of Stratigraphic Units within the Site Area .....	8
WBS 1.2.3.2.2.1.2 Structural Features within the Site Area .....	8
WBS 1.2.3.2.5 Postclosure Tectonics .....	10
WBS 1.2.3.2.5.5 Information Required by the Analysis and Assessment Investigations of the Tectonics Program .....	10
WBS 1.2.3.2.5.5.2 Characterization of Igneous Intrusive Features .....	10
WBS 1.2.3.2.8.4 Preclosure Tectonics Data Collection and Analysis .....	11
WBS 1.2.3.2.8.4.1 Historical and Current Seismicity .....	11
WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain .....	12
WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones .....	14
WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area .....	14
WBS 1.2.3.2.8.4.10 Geodetic Leveling .....	15
WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis .....	16
WBS 1.2.3.3 Hydrology .....	17
WBS 1.2.3.3.1 Geohydrology .....	17
WBS 1.2.3.3.1.1 Description of the Regional Hydrologic System .....	17
WBS 1.2.3.3.1.1.1 Precipitation and Meteorological Monitoring for Regional Hydrology .....	17
WBS 1.2.3.3.1.1.2 Runoff and Streamflow .....	18
WBS 1.2.3.3.1.1.3 Regional Ground-Water Flow System .....	20
WBS 1.2.3.3.1.1.4 Regional Hydrologic System Synthesis and Modeling .....	23
WBS 1.2.3.3.1.2 Unsaturated Zone Hydrology .....	24
WBS 1.2.3.3.1.2.1 Unsaturated Zone Infiltration .....	25
WBS 1.2.3.3.1.2.3 Percolation in the Unsaturated Zone - Surface Based Study .....	27
WBS 1.2.3.3.1.2.4 Percolation in the Unsaturated Zone - ESF Study .....	31
WBS 1.2.3.3.1.2.6 Gaseous-Phase Movement in the Unsaturated Zone .....	34
WBS 1.2.3.3.1.2.7 Unsaturated Zone Hydrochemistry .....	35
WBS 1.2.3.3.1.2.8 Fluid Flow in Unsaturated Zone Fractured Rock .....	38
WBS 1.2.3.3.1.2.9 Site Unsaturated Zone Modeling and Synthesis .....	40
WBS 1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization Activities .....	42
WBS 1.2.3.3.1.3 Saturated Zone Hydrology .....	44
WBS 1.2.3.3.1.3.1 Site Saturated Zone Ground-Water Flow System .....	45
WBS 1.2.3.3.1.3.3 Saturated Zone Hydrologic System Synthesis and Modeling .....	49
WBS 1.2.3.3.2 Preclosure Hydrology .....	51
WBS 1.2.3.3.2.1 Flood Recurrence Intervals and Levels at Potential Locations of Surface Facilities .....	51

WBS 1.2.3.6 Climatology and Meteorology .....	52
WBS 1.2.3.6.2 Climatology .....	53
WBS 1.2.3.6.2.1 Change in Climatic Conditions .....	53
WBS 1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain .....	53
WBS 1.2.3.6.2.2 Effects of Future Climatic Conditions on Hydrologic Characteristics .....	54
WBS 1.2.3.6.2.2.1 Quaternary Regional Hydrology .....	54
WBS 1.2.3.6.2.2.2 Future Regional Hydrology due to Climate Changes .....	59
WBS 1.2.3.7 Resource Potential .....	60
WBS 1.2.3.7.2 Present and Future Value of Resources .....	60
WBS 1.2.3.7.2.1 Natural Resource Assessment .....	60
<b>1.2.5 REGULATORY AND INSTITUTIONAL .....</b>	<b>61</b>
WBS 1.2.5.2 Licensing .....	61
WBS 1.2.5.2.1 NRC Interaction Support .....	61
WBS 1.2.5.2.2 Site Characterization Program .....	62
WBS 1.2.5.2.5 Study Plan Coordination .....	62
WBS 1.2.5.4 Environment .....	63
WBS 1.2.5.4.8 Water Resources .....	63
<b>1.2.9 PROJECT MANAGEMENT .....</b>	<b>64</b>
WBS 1.2.9.1 Management and Integration .....	64
WBS 1.2.9.1.1 Management .....	64
WBS 1.2.9.1.4 Records Management .....	65
WBS 1.2.9.2 Project Control .....	66
WBS 1.2.9.3 Quality Assurance .....	67
WBS 1.2.9.3.1 Quality Assurance Program Development .....	67
WBS 1.2.9.3.2 Quality Assurance - Audits and Surveillances .....	68
WBS 1.2.9.3.3 Quality Assurance - Quality Engineering .....	68
WBS 1.2.9.3.4 Quality Assurance - Quality Overview .....	69

## ACRONYM LIST

A&E	architectural and engineering
ABC	American Borate Corporation
ACD	advanced conceptual design
ACM	alternative conceptual model
ACNW	Advisory Committee on Nuclear Waste
ACP	Area Characterization Plan
ACS	American Chemical Society
ACWP	actual cost of work performed
ADP	automated data processing
ADTS	Automated Data Tracking System
AEC	Atomic Energy Commission
AECB	Atomic Energy Control Board
AECL	Atomic Energy of Canada, Ltd.
AEG	Association of Engineering Geologists
AFOS	Automated Field Operating System
AFR	Audit Finding Report
AGU	American Geophysical Union
AIH	American Institute of Hydrology
ALARA	as low as reasonably possible
ALTS	Apache Leap Tuff Site
AMA	Assistant Manager for Administration
AMFM	alternative means of financing and managing
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
ATC	Asynchronous Terminal Concentrator
ATDT	Automated Technical Data Tracking
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
BBC	British Broadcasting Company
BBS	Bulletin Board System
BCWP	budgeted cost for work performed

BCWS	budgeted cost for work scheduled
BDR	Basic Data Recorder
BFD	Basis for Design
BG&H	Bond Gold and Hydrosearch
BGRA	Branch of Geologic Risk Assessment
BIG	Branch of Isotope Geology
BLM	Bureau of Land Management
BP	before present
BPA	blanket purchase agreement
BPO	blanket purchase order
BQA	Branch of Quality Assurance
BRC	below regulatory concern
BRG	Branch of Central Regional Geology
BSP	balanced cross section modeling program
BSR	Bi-annual Status Report
BWIP	Basalt Waste Isolation Project
C/SCR	Cost and Schedule Change Report
C&C	consultation and cooperation
CA	Construction Authorization
CADD	Computer-Aided Drafting and Design
CAE	Computer-Aided Engineering
CAM	Cost Account Manager
CAP	cost account plan
CAR	Corrective Action Report
CASY	Committee for the Advancement of Science in the YMP
CATS	Corrective Action Tracking System
CBI	Controlled Blasting Investigation
CCB	Change Control Board
CCC	Configuration Control Committee
CD	Consultative Draft
CDP	Career Document Profile
CDR	Conceptual Design for the Repository
CFR	Code of Federal Regulations
CFS	cubic feet per second
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
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
ECR	Engineering Change Report
EDBH	engineered design borehole
EDF	Environmental Defense Fund
EDM	Equivalent Discontinuum Model
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 shaft
ESF .....	Exploratory Shaft Facility
ESF/DRD .....	Exploratory Shaft Facility Design Requirements Document
ESQAT .....	Earth Science Quality Assurance Team
ESR .....	electron spin resonance
ESSE .....	Early Site Suitability Evaluation
ESTC .....	Exploratory Shaft Test Coordination
ESTP .....	Exploratory Shaft Test Plan
ESTP-C .....	Exploratory Shaft Test Plan Committee
ET .....	evapotranspiration
EV .....	earned value
FEHMS .....	Finite Element Heat Mass and Stress
FEIS .....	Final Environmental Impact Statement
FEMA .....	Federal Emergency Management Agency
FFS .....	Federal Financial System
FFS .....	Federal financial system
FID .....	Flame Ionization Detector
FIS .....	Federal interim storage
FITS .....	Facilities Important to Safety
FMMG .....	Fracture Matrix Mesh Generator
FMN .....	Fortymile neutron
FP .....	final procedures
FPC .....	final procurement and construction
FQI .....	Federal Quality Institute
FR .....	Federal Register
FRD .....	Functional Requirement Document
FRHP .....	Fractured Rock Hydrology Program
FSN .....	Fenix and Scisson, Nevada
FSU .....	Florida State University
FTE .....	full-time equivalent
FWP .....	field work proposal
FY .....	fiscal year
G&A .....	Goodson and Associates
GAO .....	Government Accounting Office
GAP .....	Geostatistical Analysis Package
GC .....	gas chromatograph
GCM .....	Global Climate Model
GCP .....	Geochronological Procedure
GD .....	Geologic Division
GEOEAS .....	Geostatistical Environmental Software
GET .....	General Employee Training
GETT .....	grants equal to taxes
GID .....	Ground Water Site Investigation
GIS .....	Geologic Information System
GIS .....	Graphic Information System
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
GOA	Graded Quality Assurance
GRESS	Gradient Enhanced Software System
GSA	Geological Society of America
GSA	General Services Administration
GSIS	Geoscientific Information System
GSP	Geologic Studies Program
GTUF	G-Tunnel Underground Facility
GW	ground water
GWE	Gigawatts Electrical
GWTT	ground water travel time
GXP	Geochemical Procedure
H&N	Holmes and Narver
HIP	Hydrologic Investigations Program (formerly NHP)
HITF	Hydrology Integration Task Force
HLRW	high-level radioactive waste
HLW	high-level waste
HP	Hewlett Packard
HP	Hydrologic Procedure
HQ	Headquarters
HRF	Hydrologic Research Facility
HRMP	Hydrology and Radionuclide Migration Program
HRU	hydrologic-response unit
HSPF	Hydrological Simulation Program
IBM	International Business Machines
IC	ion chromatograph
ICE	Independent Cost Estimate
ICG	International Geologic Congress
ICIAM	International Conference on Industrial and Applied Mathematics
ICN	Interim Change Notice
ICWG	Interface Control Working Group
IDAS	Integrated Data Acquisition System
IDS	Information Data System
IFS	Iterated Function System
IG	Integration Group
IGIS	Interactive Graphics Information System
IGT	Institute of Gas Technology
IHLWM	International High Level Radioactive Waste Management
IMS	Information Management System
INEL	Idaho National Engineering Laboratory
INSTAAR	Institute of Arctic and Alpine Research
INTRAVAL	International Transport Code Validation
IR	infrared
IRG	Interagency Review Group
ISA	Instrument Society of America
ISD	Information Systems Division
ISO	International Standards Organization
IVV	Independent Verification and Validation
JGR	<i>Journal of Geologic Research</i>
LA	license application
LACT	laser alignment and centering target



LAN	local area network
LANL	Los Alamos National Laboratory
LBL	Lawrence Berkeley Laboratories
LCS	Liquid Scintillation Counter
LDRP	litigation discovery request procedure
LDS	lightning detection system
LLNL	Lawrence Livermore National Laboratory
LLP	Lightning Location & Protection, Inc.
LLW	low-level waste
LOE	level of effort
LPRS	large plot rainfall simulator
LRC	Local Records Center
LRE	latest revised estimate
LRGS	Local Read-Out Ground Station
LRP	long-range planning
LRP/IPS	Long Range Plan/Integrated Project Schedule
LRS	Litton Resource System
LSC	liquid scintillation counter
LSP	laser safety plan
LSS	Licensing Support System
LWS	Lathrop Wells aeromagnetic survey
LV	Las Vegas
MADS	Meteorological Alert Distribution System
MCL	Maximum Contaminant Level
MEDA	Meteorological Data Acquisition Network
MFC	mass flow controller
MGDS	Mined Geologic Disposal System
MIC	Management Information Center
MISIS	Micro Integrated Storm Information System
MLT	materials testing laboratory
MMDS	Martin Marietta Data Systems
MODFE	Modular Finite Element
MOT	Management Overview Team
MOU	Memorandum of Understanding
MPBA	multipurpose borehole activity
MPBH	multipurpose borehole
MPM	Management Procedure Manual
MPU	Manuscript Prep Unit
MRIR	Material Receiving and Inspection Report
MRS	monitored retrievable storage
MSA	major system acquisition
MSHA	Mine Safety and Health Administration
MSIS	Management System Information Strategy
MSL	mean sea level
MT	magneto-telluric
M&TE	measuring and test equipment
MTU	metric tons of uranium
MW	mixed waste
NARUC	National Association of Regulatory Utility Commissioners
NBS	National Bureau of Standards (now NIST)
NCAR	National Center for Atmospheric Research
NCR	Nonconformance Report

NEA	Nuclear Energy Agency
NEPA	National Environmental Policy Act
NFS	Nuclear Fuel Services
NHP	Nuclear Hydrology Program (now HIP)
NIST	National Institute of Standards and Technology
NMD	National Mapping Division
NMIMT	New Mexico Institute of Mining and Technology
NNWSI	Nevada Nuclear Waste Storage Investigation
NOAA	National Oceanic and Atmospheric Administration
NOO	Nevada Operations Office
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRP	National Research Program
NSTF	near-surface test facility
NTC	National Training Center
NTS	Nevada Test Site
NTSO	Nevada Test Site Office
NVO	Nevada Operations Office
NWF	Nuclear Waste Fund
NWIS	Nevada Water Information System
NWIS	National Water Information System
NWM	Nuclear Waste Management
NWN	<i>Nuclear Waste News</i>
NWPA	Nuclear Waste Policy Act
NWPO	Nuclear Waste Projects Office
NWQL	National Water Quality Laboratory
NWTRB	Nuclear Waste Technical Review Board
OBS	organization breakdown structure
OCRWM	Office of Civilian Radioactive Waste Management
OF	Open file
OFR	open-file report
OGR	Office of Geologic Repositories
OMB	Office of Management and Budget
OMR	Office of Mineral Resources
OPCNM	Organ Pipe Cactus National Monument
OPFM	Office of Project and Facilities Management
OPIO	Office of Policy, Integration, and Outreach
ORM	Office of Resource Management
ORNL	Oak Ridge National Laboratory
OSTS	Office of Storage and Transportation Systems
OWQSU	Ocala Water Quality Services Unit
P&S	planning and scheduling
PA	performance assessment
PAC	planning and control
PACE	Performance Assessment Calculation Exercise
PACS	Planning and Control System
PAGEOPH	<i>Pure and Applied Geophysics</i>
PAGIS	Performance Assessment of Geological Isolation Systems
PAL	Project Acronym List
PAMP	Performance Assessment Management Plan
PAP	Performance Assessment Plan
PASP	Performance Assessment Strategy Plan

PBEI	prototype blast effects on instrumentation
PBQ&D	Parson, Brinkerhoff, Quade, and Douglas
PBS	pyramid beam splitter
PC	personal computer
PCBI	Prototype Controlled Blasting Investigation
PCCB	Program Change Control Board
PCM	pivoting camera mount
PCSB	Program Cost and Schedule Baseline
PC&TS	Program Coordination and Technical Support
PD	Position Description
PDA	Participant Data Archives
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
PMIS	Program Management Information System
PMP	Program Management Plan
PMR	performance measurement review
PMS	Program Management System
PNL	Pacific Northwest Laboratories
PPWE	prototype pore-water extraction
PQM	Project Quality Management
PRBP	project review briefing package
PRC	Project Records Center
PRDA	Program Research and Development Announcement
PRESS	Project-related Engineering and Scientific Studies
PRMS	Precipitation Runoff Modeling System
PSAR	Preliminary Safety Analysis Report
PSI	pounds per square inch
PTP	Prototype Test Plan
PTS	Petroleum Testing Services
QA/QC	quality assurance/quality control
QA	Quality Assurance
QAG	Quality Assurance Grading
QAGR	Quality Assurance Grading Report
QALA	Quality Assurance Level Assignment
QALAS	Quality Assurance Level Assignment Sheet
QAM	Quality Assurance Manager
QAP	Quality Assurance Program
QAPD	Quality Assurance Program Description
QAPO	Quality Assurance Project Officer
QAPP	Quality Assurance Program Plan
QAR	Quality Assignment Records
QARD	Quality Assurance Requirements Document
QASC	Quality Assurance Support Contractor

QMP .....	Quality Management Procedure
QMPR .....	Quality Management Policies and Requirements
QRA .....	Quality Related Activities
ORB .....	Quality Review Board
QVC .....	Quality Verification Check
QWL .....	quality of work life
R&D .....	research and development
R&H .....	receiving and handling
R&LSD .....	Research and Laboratory Services Division
RALD .....	right angle laser deflectometer
RAM .....	responsibility assignment matrix
RASA .....	Regional Aquifer Study Assessment
RASRA .....	radial arm strike rail assembly
RCR .....	Regional Characterization Report
RCRA .....	Resource Conservation and Recovery Act
REBS .....	Radiation Energy Balance Systems
REEC <sub>o</sub> .....	Reynolds Engineering and Electrical Company
RFP .....	Request for Proposal
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
RWMS .....	Radioactive Waste Management Site
s-p .....	surface-propagated
SA .....	study activities
SAG .....	Software Advisory Group
SAGEEP .....	Symposium on the Application of Geophysics to Engineering and Environmental Problems
SAIC .....	Science Applications International Corporation
SAR .....	Safety Analysis Report
SAS .....	Statistical Analysis System
SBTFRD .....	Surface-Based Test Facility Requirements Document
SBTP .....	Surface-Based Test Prioritization
SCA .....	Site Characterization Analysis
SCC .....	substantially complete containment
SCI .....	Software Configuration Items
SCIF .....	software checklist and indexing form
SCM .....	Software Configuration Management System
SCP .....	Site Characterization Plan
SCPB .....	Site Characterization Program Baseline
SDR .....	Standard Deficiency Report

SDRD	Subsystems Design Requirement Document
SE	Senior Engineer
SE&D	Systems Engineering and Development
SEG	Society of Exploration Geophysicists
SEM	scanning electron microscopy
SEMP	System Engineering Management Plan
SEPDB	Site and Engineering Properties Data Base
SES	Scientific and Engineering Software
SF	spent fuel
SG	Senior Geologist
SGB	Southern Great Basin
SGBSN	Southern Great Basin Seismic Network
SGR	Seismic Group Recorders
SIP	Scientific Investigation Plan
SIR	Scientific Investigations and Research
SIR	Special Investigative Review
SIT	Site Integration Team
SKB	Swedish Nuclear Fuel and Waste Management Company
SMF	Sample Management Facility
SMS	Sample Management System
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SNP	Scientific Notebook Plan
SNSN	Southern Nevada Seismic Network
SOBART	Southern Basin and Range Transects
SOC	Sample Overview Committee
SOIR	status of open items report
SOP	Standard Operating Procedure
SP	Seismic Procedure
SP	Study Plan
SPA	Study Plan Assessment
SPE	Society of Petroleum Engineers
SPOC	submersible pressurized outflow cell
SPR	Semi-annual Progress Report
SPRS	small plot rainfall simulator
SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
SRD	system requirements and description
SRG	strike rail goniometer
SRP	Site Recommendation Report
SSF	software summary forms
SSF	specified software forms
SSR	Site Selection Report
SSSA	Soil Science Society of America
STC	Southern Tracer Complex
SWO	stop-work order
SZ	saturated zone
T&MSS	Technical and Management Support Services
T&MSS SP	T&MSS Standard Practice Procedure
TAR	Technical Assessment Review
TBD	to be determined
TBM	Tunnel Boring Method

TC .....	Technical Contact
TC .....	Training Coordinator
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
TFA .....	Temporary Field Assistant
TIC .....	Technical Information Center
TM .....	thematic mapper
TP .....	Technical Procedure
TPEC .....	Technical Proposal Evaluation Committee
TPO .....	Technical Project Officer
TPT .....	Testing Prioritization Task
TQM .....	Total Quality Management
TRIG .....	Technical Review and Integration Group
TRIMS .....	Technical and Regulatory Information Management System
TRU .....	Transuranic
TVA .....	Tennessee Valley Authority
UNE .....	Underground Nuclear Explosion
UNLV .....	University of Nevada at Las Vegas
UNR .....	University of Nevada, Reno
UPS .....	Uninterrupted Power Supply
URL .....	underground research laboratory
USBLM .....	U.S. Bureau of Land Management
USBR .....	U.S. Department of the Interior Bureau of Reclamation
USDI .....	U.S. Department of the Interior
USFWS .....	U.S. Fish and Wildlife Service
USFS .....	U.S. Forest Service
USGS .....	U.S. Geological Survey
USNSN .....	U.S. National Seismic Network
UTM .....	Universal Trans Mercator
UZ .....	unsaturated zone
UZFRHP .....	Unsaturated Zone Fractured Rock Hydrology Project
UZIG .....	Unsaturated Zone Interest Group
UZSBP .....	Unsaturated Zone Surface-Based Borehole Project
VAR .....	Variance Analysis Report
VARS .....	Video Archival Retrieval System
VLF .....	very low frequency
VOC .....	Validation Oversight Committee
VOG .....	Validation Oversight Group
VSP .....	vertical seismic profiling
WA .....	Western Atlas
WAC .....	Waste Acceptance Criteria
WAS .....	Work Authorization Submission
WAS/FWP .....	Work Authorization System/Field Work Proposal

WBS .....	work breakdown structure
WIPP .....	Waste Isolation Pilot Plant
WIT .....	Working Integration Team
WMNFC .....	Waste Management and Nuclear Fuel Cycle
WMSD .....	Waste Management Systems Description
WNRE .....	Whiteshell Nuclear Research Establishment
WORM .....	Write Once Read Many
WP .....	waste package
WP .....	Weapons Program
WPDRD .....	Waste Package Design Requirements Document
WRD .....	Water Resources Division
WRG .....	Western Region Geology
WRI .....	Water Resources Investigations
WRIR .....	Water Resources Investigations Report
WRR .....	Water Resources Research
WSNSO .....	Weather Service Nuclear Support Office
WSP .....	Water Supply Paper
WT .....	water table
WVDP .....	West Valley Demonstration Project
WY .....	water year
YM .....	Yucca Mountain
YMP .....	Yucca Mountain Project
YMPB .....	Yucca Mountain Project Branch
YMPO .....	Yucca Mountain Project Office

## 12.1 SYSTEMS

### OBJECTIVE

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

### WBS 1.2.1.3 Technical Data Base Management

### OBJECTIVE

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

### WBS 1.2.1.3.5 Technical Data Base Input

Principal Investigator - L. Hayes

### OBJECTIVE

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

### ACTIVITIES AND ACCOMPLISHMENTS

The Participant Data Archives (PDA) accepted eight partial packages and nine Technical Data Information Forms (TDIF).

The final review on the calcite-silica Reference Information Base (RIB) item was completed and returned to Sandia National Laboratories.

The final review and comment on AP-5.1Q Draft R2, Control and Transfer of Technical Data on the YMP, was completed and returned to the author.

The DOE-SAIC T&MSS Automated Technical Data Tracking (ATDT) Manager requested a verification of the data now in the ATDT database from each Participant before the ATDT can issue the first quarterly data catalog. The USGS submitted the largest percentage of the data to this database and the verification has been completed with the results returned to the ATDT Manager.



## 1.2.3 SITE

### OBJECTIVE

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

#### WBS 1.2.3.1 Management and Integration

Principal Investigator - L. Hayes

### OBJECTIVE

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

#### M&I QA Implementation GD 0G31AAAA

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

The draft modifications to three Scientific Notebook Plans were prepared as directed and forwarded to HIP and one Scientific Notebook Plan HP-228T, R0 (Identification, Monitoring, and Sampling of Perched Water Encountered While Drilling Neutron-Access Boreholes) was approved.

Eleven draft technical procedures were changed as requested and returned to the HIP.

QA Implementation Specialists attended the periodic Open Items Committee meetings and assisted the Geologic Division in providing input or actions for YM-CAR-91-50, CAR-91-03, CAR 91-05, CAR-91-10, NCR-90-37, NCR-91-26, NCR-91-31, NCR-91-32, NCR-91-35, NCR-91-36, and NCR-91-39. QA Implementation personnel continued to support the Geologic Division as representatives on the committees to determine how to return to work and how to revise procurement control and control of purchased materials, equipment and services.

The following Verification Activities were conducted by Geologic Division QA Implementation personnel and QA personnel:

USGS-VA-91-02	8.3.1.5.1.4.1	Modeling of Soil Properties
USGS-VA-91-03	8.3.1.17.4.6.1	Quaternary Geology and Potential Quaternary Faults at the Site
USGS-VA-91-04	8.3.1.4.2.2.2	Surface Fracture Network Studies

Informal reviews of the following activities were conducted for the GD by QA Implementation personnel:

8.3.1.4.2.1.1	Surface and Subsurface Stratigraphic Surveys
8.3.1.4.2.2.4	Shaft Wall Mapping
8.3.1.17.4.3.1	Deep Geophysical Surveys
8.3.1.17.4.12.1	Evaluate Tectonic Processes and Stability at the Site

Preliminary drafts were received from the author for further processing of GCP-14, R2 (Extraction and Recovery of H<sub>2</sub>O from Mineral-Hosted Inclusion Fluids) and GCP-17, R3 (Determination of the Isotopic Ratio H/D in H<sub>2</sub>O). The preliminary draft of Determination of the d<sup>18</sup>O Value of H<sub>2</sub>O has been received for typing, but has not been assigned an identifying number. GPP-11, R1 (Magnetic Methods) received signature approval and has been forwarded to document control for further processing. The draft of GP-18, R1 (Volcanic Stratigraphic Studies) has been converted to Scientific Notebook Plan, GP-41T, R0 (Petrographic and Geochemical Analyses of Volcanic Rocks) and is currently with the author for further input. A minor change request was submitted to the QA

Office and approved for GCP-16, R3 (Carbonate Carbon and Oxygen Isotope Analyses).

A training session presented by DOE on the use of Technical Data Information Forms (TDIF) from AP-5.1Q (R2 in draft) was attended on September 18 in Las Vegas. Hands-on instruction was also provided on the use of the Automated Technical Data Tracking system.

Assistance was provided to the LRC in investigating and correcting a technical procedure record submitted to and rejected by the CRF. Assistance was provided to the Geologic Division Coordinator in scheduling Verification Activities for Geologic Division personnel K. Fox, M. Reheis, and C. Throckmorton. Additionally, assistance was provided to Throckmorton in the preparation and submittal of a TDIF for pavement studies.

A memorandum was submitted to the QA Office notifying them that all investigations, remedial actions, and actions to prevent recurrence on USGS-NCR-91-32 were completed. Calibration investigations, involving GCP-23T R0, resulted in the initiation of two new NCRs (91-43 and 91-44) issued to document that HIP activities were accomplished without a management agreement and calibration data was missing from a scientific notebook.

A meeting was held with J. Whitney in order to ascertain the status of his prerequisites for upcoming work to be conducted in Midway Valley.

W. Smith, S. Harmsen, M. Meremonte, and P. Nelson, were assisted with completing software documentation in compliance with QMP-3.03, R2. The software documentation for BINCHAR, SPECTRA, BULLSEYE, RATIO, LTSCAN, PUNT and MAGSTAT was reviewed and submitted to the SCM System.

The report on the status of software in the SCM System with CIRFs from QMP-3.03, R1 that do not have sufficient information for classification was updated at the September 5 CCC Meeting. Further follow-up is needed and will be reported at a future CCC Meeting. At the September 12 CCC Meeting, W. Kohler was assisted with processing 18 CIRFs.

Numerous meetings were held with reviewers to answer review comments for QMP-3.03, R3. The Chairperson of the QMP-3.03, R3 Committee, spearheaded the changes to the draft QMP.

P. Nelson, USGS, was assisted in the disposition response and the required actions for NCR-91-36, concerning Software QA documentation.

A telephone survey is being conducted for Software QA Training to obtain scientists' opinions on previous software training and ideas on how to improve future training.

#### Quality Assurance

J. Barth was active in several USGS/QA functions, map drafts, NCR reports, open items, technical procedures and audits.

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

#### Planning and Operations

M&I - Geologic Division 0G31AAAE

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

F. Singer calculated and compiled the stratigraphic positions of samples collected from the Dung Heap chemostratigraphic reference section.

V. Glanzman transmitted the manuscript record package segment for the following publications to the LRC: (a) "Seasonal Occurrences of Ostracodes in Lakes and Streams of the San Francisco Peninsula, California," by C. Carter, Open-File Report 91-118; (b) "Aerial Photographic Interpretation of Lineaments and Faults in Late Cenozoic Deposits in the Eastern Parts of the Saline Valley 1:100,000 Quadrangle, Nevada and California, and the Darwin Hills 1:100,000 Quadrangle, California," by M. Reheis, Open-File Report 90-500; (c) "Aerial Photographic Interpretation of Lineaments and Faults in Late Cenozoic Deposits in the Eastern Parts of the Benton Range 1:100,000 Quadrangle and the Goldfield, Last Chance Range, Beatty, and Death Valley Junction 1:100,000 Quadrangles, Nevada and California," by M. Reheis and J. Noller, Open-File Report 90-41; (d) "Geological Mapping of Tunnels Using Photogrammetry--Camera and Target Positioning," by J. Coe and K. Ducholm, Open-File Report 90-49; and (e) "Ostracode Assemblages from Springs in the Western United States: Implications for Paleohydrology," by R. Forester, published in "Arthropods of Springs with Particular Reference to Canada" Entomological society of Canada Memoir 155.

Open-File Report 91-34: "Bibliography of Publications Related to the Yucca Mountain Site Characterization Project Prepared by U.S. Geological Survey Personnel through April 1991" by V. Glanzman was submitted to GPO for printing.

A preliminary draft of an I-map, "Geologic Map of Bare Mountain, Nye County, Nevada," by S. Monsen, M. Carr, M. Reheis, and P. Orkild was submitted to the TPO office for preliminary policy and QA review.

Quality Assurance

Planning and Operations

F. Singer assembled the Geologic Division input for the September monthly status report.

F. Singer completed the assembly of the Geologic Division YMP Six-Month Technical Status Report (4/91-9/91) at W. Langer's request.

M&I - Hydrology Program Management and Administration 0G31AAAG

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

Detailed guidance and instructions for implementation of PACS for FY92 and FY93 were prepared and distributed to summary account managers. Intensive efforts began to prepare revised schedules, work scopes, and budgets for about 56 summary accounts in the Hydrology Program.

Instructions and examples were distributed to Hydrology Program technical staff members for preparation of the YMP Site-Characterization Progress Report for April-September 1991.

A property inventory was completed that took approximately 3 months, spanning from Denver to the NTS. This inventory produced 19 recommendations and a report totaling 142 pages. Recommendations and correction of the discrepancies are presently being developed and implemented.

Financial close-out was completed for the entire YMP branch. This close-out included the reconciliation of FFS reports for two cost centers (Hydrology Program and TPO Office), reporting final funding and expenditure levels to Headquarters to effectively close-out the fiscal year and report proper carry-over. All deadlines were met and the error rate for the project in the preparation of the obligation document (9-803) was zero.

Over \$250,000 of obligated money from FY89 was identified that had never been expended nor de-obligated. Many of these obligations were cleaned up by increasing USGS carry-over and allowing for proper accounting of these funds.

All billings to DOE were completed from FY86 to present. FY91 marks the first year that DISCAS and OPAC billings match.

A new cost center for Geologic Studies was set up to include the writing and processing of over 10 new positions as well as assisting in the recommendations and advice in handling a total of 21 individuals to be integrated into the program.

All BPOs, files, travel authorizations, etc. were done and placed in effect prior to the start of FY92.

Routine administrative functions were completed that have not been done for a period of time. This included submitting all cost affecting training on time, having all payroll files prepared on time, receiving off Award checks before the end of the fiscal year, updating of the CDP registered users files to enable all YMP employees to have an updated file, and having all travel vouchers sent to headquarters before the end of close-out.

M&I - Branch, USBR 0G31AAA1

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

R. Craig attended Prototype Management Team meetings on September 6, 13, 20, and 26; attended status meetings on various Test Planning and Job Packages on September 6, 13, 20, and 26; attended ESF Task Force budget meetings on September 12, 19, and 25; attended the Technical Integration Group meetings on September 5 and 26; attended the Sample Overview Committee meeting at the SMF on September 10; provided overviews of Yucca Mountain geology and hydrology programs as part of the public open house tour on September 21; attended YMPB staff meetings in Denver on September 9 and 30; attended NWTRB meetings on ESF design on September 18 and 19; and visited the Natural Infiltration drilling operations on September 23 and 27.

### Quality Assurance

### Planning and Operations

J. Boernge started coordination of hydrologic testing activities and coordinated preparation of the September monthly report of USBR hydrologic activities.

T. Lippert reviewed costs-to-date and current budget estimates for hydrologic testing activities.

Scientific Reports and Project Documents. Hydrology 0G31AAAK

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

HIP is currently processing 81 USGS-YMP scientific publications, 12 LBL-YMP scientific publications, and 20 abstracts.

OFR 91-178, "Water levels in periodically measured wells in the Yucca Mountain area, Nevada, 1989" by G. O'Brien was published and distributed.

WRIR 88-4168, "Geohydrology of rocks penetrated by test well USW H-5, Yucca Mountain, Nye County, Nevada" by J. Robinson and R. Craig was published and distributed.

The HIP review of the following abstracts and reports was completed by T. Brady: "Still no evidence for Chaos in Western U.S. Streamflow" by C. Savard; "Hydrochemical monitoring through a thick unsaturated zone at Yucca Mountain, Nevada, USA" by W. Steinkampf; "Quaternary spring deposits at the Southern end of Crater Flat, Nye Count, Nevada" by E. Taylor; "Preliminary hydrogeologic assessment of test wells UE-25c #1, UE-25c #3, and UE-25c #3, Yucca Mountain, Nye County, Nevada" by A. Geldon; "Projection moire as a tool for the automated determination of surface topography" by J. Cardenas-Garcia, S. Zheng, and F. Shen; "Simulated water-level declines caused by withdrawals from wells J-13 & J-12 near Yucca Mountain, Nevada" by J. Czarnecki; "Permeability of a fracture with cylindrical asperities" by S. Kumar, R. Zimmerman, and G. Bodvarsson; and "Geohydrologic data from shallow neutron-access holes, Yucca Mountain, Nye County, Nevada" by D. Blout, D. Hammermeister, C. Loskot, and M. Chornack.

J. LaMonaca met with W. Dudley, L. Ducret, A. Handy, and T. Brady to discuss scientific reports processing in compliance with QMP-3.04.

M&I OA Implementation. Hydrology 0G31AAAM

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

HIP is currently processing 47 Hydrologic Procedures and six Scientific Notebook Plans.

The following HPs were approved in September: HP-09, R2 (Construction of Piezometers in Unconsolidated Sediments); HP-56, R3 (Gas and Vapor Sampling from UZ Test Holes); HP-86, R2 (Method for Degassing CO<sub>2</sub> and H<sub>2</sub>O Vapor Samples from UZ Test Holes); HP-179, R1 (Field Measurement of Precipitation Using a Tipping Bucket Rain Gage); HP-180, R1 (Field Measurement of Precipitation Using a Propane Heated Tipping Bucket Rain and Snow Gage); and HP-228T, R0 (Identification, Monitoring, and Sampling of Perched Water Encountered in Neutron-Access Boreholes).

J. Woolverton assisted D. Halm in the preparation of HP-213T, R0 (Long-Term Hydrologic Monitoring); assisted the YMP-USGS QA office subcontractor staff in the resolution process for audit findings and observations related to qualifying vendors for calibration services; provided guidance to HIP investigators and QA implementation specialists for modifications of technical procedures and Scientific Notebooks Plans; assisted in the format development for technical review comments of HP-23, R2 (Collection and Field Analysis of Ground-Water Samples from the Saturated Zone); provided input for NCR-90-37, NCR-91-31, CAR-91-03, and CAR-91-07 to the TPO QA representative; and participated in the approval process of HP-179, R1 and Hp-180, R1. The approval of the Tipping Bucket technical procedures was necessary for the resolution process described in ARF-9002-05 and NCR-91-15.

J. Woolverton, B. Kirkland (OWOSU), A. Whiteside, M. Mustard, and A. Lykins prepared a Management Agreement between YMP and OWOSU. The Management Agreement was approved September 21.

J. Woolverton prepared a new Management Agreement between the YMP and the National Water Quality Laboratory. At the end of September, the YMP/NWQL Management Agreement was in the review/signature cycle.

W. Causseaux served at the HIP QA liaison for the NRC Audit of Activity 8.3.1.2.3.1.2 September 16-20.

W. Causseaux, J. Woolverton, J. LaMonaca, and S. Frans attended Root Cause Determination training presented by M. Mustard and J. Ziemba.

Seven published report packages, including raw data and two published abstract packages, were submitted to the LRC.

#### Planning and Operations

#### WBS 1.2.3.2 Geology Principal Investigator - W. Langer

##### OBJECTIVE

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

##### WBS 1.2.3.2.2 Rock Characteristics

##### OBJECTIVE

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

##### WBS 1.2.3.2.2.1 Geologic Framework of the Yucca Mountain Site

##### OBJECTIVE

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

WBS 1.2.3.2.2.1.1 Vertical and Lateral Distribution of Stratigraphic Units within the Site Area  
Principal Investigator - R. Spengler

OBJECTIVE

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

SCP 8.3.1.4.2.1.1 Surface and subsurface stratigraphic studies of the host rock and surrounding units 0G3221A1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

XRF and isotope analysis of selected core exist borehole (3GGU030A)

Selected drill core samples from USW G-1 were analyzed for strontium isotopes and trace elements. Analysis focused on those samples immediately above and below the present-day water table to determine if there had been any isotopic effect resulting from the water table.

R. Snyder responded to Branch review comments on the following reports:

Scope borehole techniques for TV (3GGU008F)

"Evaluation and Comparison of Borehole Fracture Identification Methods Using Television Camera and Acoustic Televiewer Data."

Synthesize borehole data (3GGU011A)

"Evaluation and Comparison by Stratigraphic Units of Borehole Fracture Orientations in 14 Water Holes in the Yucca Mountain Area Using Television Camera Data."

Quality Assurance

Planning and Operations

WBS 1.2.3.2.2.1.2 Structural Features within the Site Area  
Principal Investigator - R. Spengler

OBJECTIVE

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

SCP 8.3.1.4.2.2.1 Geologic mapping of zonal features in the Paintbrush Tuff 0G3221G1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

SEM, XRF, XRD analysis of samples (3GGF181A)

R. Spengler submitted an abstract titled "A low-angle breccia zone of hydrologic significance at Yucca Mountain, Nevada" by Spengler and J. Rosenbaum for acceptance. Abstract was submitted to GSA for presentation at the theme session on geology, hydrogeology, and tectonics of southern Nevada in relation to the potential storage of high-level nuclear waste at the annual meeting in November, 1991.

#### Quality Assurance

R. Spengler attended a verification activity and quality assurance audit for SCP 8.3.1.4.2.2.2 (Surface fracture network studies).

#### Planning and Operations

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

Considerable time was spent in planning, scheduling, and budgeting meetings during the transition from Geologic Division to the Geologic Studies Program.

### SCP 8.3.1.4.2.2.2 Surface-fracture network studies OG3221H1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Conduct field work (I) on uncleared outcrops (3GGF100A)

Field work on this activity was completed on 6/25/91.

Analyze Phase I input (3GGF140A)

C. Throckmorton and E. Verbeek completed the entry of fracture data collected from 41 localities located in the Tiva Canyon and Topopah Spring Members at Yucca Mountain and Fran Ridge. This task involved (a) entering into a computer, measurements and observations noted at each locality; (b) calculating median orientations for fracture sets identified at each locality; (c) transferring locations of field stations from aerial photographs to geologic base maps by means of a PG-2 stereoplotter; and (d) writing preliminary interpretative summaries for each field locality. In accordance with the transition requirements, this material will be submitted to the YMP Data Coordinator by October 1, 1991.

##### Quality Assurance

C. Throckmorton and E. Verbeek participated in a verification of Activity 8.3.1.4.2.2.2, per requirements of YMP-QMP-3.10, R2 (Verification Activity USGS-VA-91-04) on September 24.

##### Planning and Operations

C. Throckmorton, transmitted (per TDIF) data from collected from Pavement 600, collected by C. Throckmorton, to the YMP Data Coordinator on September 16.

C. Barton and W. Page transmitted (per TDIF), data collected by C. Barton and W. Page from six pavements and a washout strip to the YMP Data Coordinator on September 13. By separate TDIF, fracture core data from USW-G4 drillhole, collected by C. Barton, was also submitted on September 13 to the YMP Data Coordinator.

C. Throckmorton and E. Verbeek met with M. Fahy, M. McKeown, and S. Beason (USBR) to discuss methods and techniques utilized for fracture studies on uncleared outcrops.

### SCP 8.3.1.4.2.2.4 Geologic mapping of the exploratory shaft and drifts OG3221J1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

S. Beason and M. McKeown met with D. Williams (RSED/DOE), T. Sullivan (RSED/DOE), and R. Oliver (LANL) regarding re-initiating the effort to deepen the North testpit at Fran Ridge. The



pit will be used for prototyping shaft mapping procedures and the area surrounding the pits cleaned for use in Surface Fracture Network Studies.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

S. Beason spent four days working on Exploratory Shaft Design Requirements and Input to Test Planning Package 91-5.

SCP 8.3.1.4.2.2.5 Seismic tomography/vertical seismic profiling 0B3221A1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Testing and validation of ANRAY90

ANI90 was tested using data from the C-holes and G-4.

NTS VSP data (Area 10 data)

The paper entitled "Resolution of Tomographic Imaging Techniques" by J. Peterson was revised and extended to include more detail on inversion methodology and data analysis.

An extended abstract was submitted for the April 1992 meeting in Las Vegas. The paper is entitled "High Resolution Seismic Imaging for Characterizing Fractures in Potential Sites for Nuclear Waste Disposal" by E. Majer, J. Lee, J. Peterson, and L. Myer.

Quality Assurance

Planning and Operations

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 1.2.3.2.5.5 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 - K. Fox, Jr.

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 0G3255B1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

A draft Memorandum of Agreement between GD and WRD covering heat-flow work at Yucca Mountain for FY92 was prepared. J. Sass traveled to Menlo Park and met with the chiefs of YMPB and TTP to finalize the MOA.

The reconfiguration and testing of the digital temperature-logging system, thermal conductivity laboratory and calibration laboratory continued.

Quality Assurance

The QA manual was updated as necessary.

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

Thermal conductivities were measured on 24 samples of drill cuttings of holes in the Amargosa Desert (cooperative study with J. Czarnecki, WRD). (40 hours)

WBS 1.2.3.2.8 Preclosure Tectonics

OBJECTIVE

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

WBS 1.2.3.2.8.4 Preclosure Tectonics Data Collection and Analysis

OBJECTIVE

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

WBS 1.2.3.2.8.4.1 Historical and Current Seismicity

Principal Investigator - K. Shedlock

OBJECTIVE

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

SCP 8.3.1.17.4.1.2 Monitor current seismicity 0G3284HA

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Catalog of 87-90 seismic events (3GSM115A)

87-89 Catalog (Open-file report) being re-reviewed internally.

Catalog of 1990 seismic events (3GSM116A)

1990 Catalog (Open-file report) in review at the DOE.

Monitor 1991 seismicity (3GSM109A)

Surplus equipment obtained from Hanford being installed as replacements to failing equipment in existing network.

Quality Assurance

Planning and Operations

Test and install network upgrade (3GSM118A)

Still awaiting facilities use and operations permit for USNSN station at Shoshone Peak.

Refraction Technology continues development work for permanent network data acquisition and telemetry node systems. Contract modification being processed in Reston to implement engineering improvements.

Re-routing of existing station signals through node at Yucca Mountain continues.

FY91 capital equipment purchases finalized.

D. Overturf begins installation of first telemetry node at Yucca Mountain; prepares for installation of VSAT.

D. Overturf re-confirms all site selections within 25 km of Yucca Mountain. Permitting process had stalled - is now re-activated.

Work Performed but not in Direct Support of the Scheduled Tasks

University of Nevada, Reno/BGRA Transition Plan completed for FY92/FY93 operations of the SGBSN and submitted to the DOE.

MOA with WRD still being negotiated.

WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain

Principal Investigator - K. Fox, Jr.

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 8.3.1.17.4.3.1 Conduct and evaluate deep geophysical surveys in an east-west transect crossing the Furnace Creek fault zone, Yucca Mountain, and the Walker Lane OG3284J1

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

PI coordinate with labs; complete first draft (3GTQ002J)

A first draft of "Seismic reflection profiling across Tertiary extensional structures in the eastern Amargosa Desert, in Southern Nevada, Basin and Range Province, USA" has been completed. The draft was then submitted to coauthors K. Fox and M. Carr for review.

Requests to complete the MOA, Study Plan, and RFP described in Section B of this report took time available from revision of the manuscript (Task 3GTQ002J).

Two reports were submitted to the Branch for technical review: one by Langenheim and others on "Geophysical characterization of mineral and energy resources at Yucca Mountain", and the other by Oliver and others summarizing the proposed study of deep geophysical surveys at Yucca Mountain, the Walker Lane and the Furnace Creek fault zone. Also, a report by Langenheim and others revising the aeromagnetic survey of the Lathrop Wells area was published.

Work continued on a 200+ page, ten chapter Bulletin summarizing geophysical studies under YMP which will be a follow-up of the Geophysics "White Paper" released last Fall. Work also continued on the Gravity compilations of the Beatty Sheet and a report on five detailed gravity and ground magnetic profiles across Forty-Mile Wash.

**Quality Assurance**

**Planning and Operations**

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

An estimated 120 hours were spent on the following tasks:

At the request of J. Stuckless and R. Spengler, T. Brocher drafted a Memorandum of Agreement for Seismic Reflection Studies at Yucca Mountain and Yucca Wash.

At the request of H. Oliver, T. Brocher helped revise a Study Plan 8.3.1.17.4.3, Quaternary faulting within 100 km of Yucca Mountain, including the Walker Lane, Activity 8.3.1.17.4.3.1.

A Request For Proposals for the seismic reflection profiling across Yucca Mountain, and in Yucca Wash is in preparation.

SCP 8.3.1.17.4.3.2 Evaluate Quaternary faults within 100 km of Yucca Mountain OG3284K1

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

Open File Reports 90-41 and 90-500 on the photogeologic interpretation of Quaternary faults west and south of the NTS were released to Yucca Mountain distribution on August 19 and 29, 1991, respectively.

**Quality Assurance**

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

M. Reheis attended a verification activity and quality assurance audit for the closeout of her participation in this part of the YMP. (6 hours)

WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones

Principal Investigator - K. Fox, Jr.

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 0G3284Q1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

Develop Study Plan (3GTF01A)

Because of pending reorganization of the Tectonics Group, the draft of the study plan will be turned over to J. Whitney for informal review and possible revision.

Because of pending reorganization of the Tectonics group, the deadline for submission of a draft of this report for technical review has been advanced to 12/31/91.

Work Performed but not in Direct Support of the Scheduled Tasks

J. Yount attended a quality assurance audit of this activity. (10 hours)

WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.6.1 Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain 0G3284C1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Prepare Technical Procedures (3GPF12A)

Technical Procedure GP-01, R2 was approved. No technical procedures are currently under revision.

**Collect/correlate volcanic ash deposit (3GPF04A)**

J. Yount collected a sample of volcanic ash, and will forward same to A. Sarna for chemical fingerprinting.

**Prepare Strip Maps of Fault Zones (3GPF03A)**

K. Fox, Jr., J. Yount, M. Carr, J. Whitney, and W. Swadley completed a week-long field review of strip maps of faults at Yucca Mountain and Crater Flat. The review team was accompanied by A. Ramelli (Nevada Bureau of Mines and Geology), L. Anderson (U.S. Bureau of Reclamation), and C. Fridrich (Department of Energy).

**Add field data to digitized fault map (3GPF09A)**

S. Schilling completed compilation of M. Carr's field maps of faults in Crater Flat. Digitization of the map has been suspended for the remainder of this fiscal year.

**Prepare report scarps and lineaments (3GPF05A)**

Technical review of this report (by M. O'Neill, J. Whitney, and M. Hudson) has been completed. The report has been returned to the authors for final revision in response to comments by technical reviewers.

J. Whitney, together with J. O'Neil and M. Hudson, submitted an abstract entitled "Strike slip faulting and oroclinal bending at Yucca Mountain, Nevada: Evidence from photogeologic and kinematic analysis. The abstract was submitted to GSA for presentation at the theme session on geology, hydrology, and tectonics.

**Quality Assurance**

**Planning and Operations**

**Prepare report of field evaluation, scarps and lineaments (3GPF08A)**

An outline of the report is currently being prepared by K. Fox, Jr.

**Prepare report of field evaluation, scarps and lineaments (3GPF08A)**

Because of pending reorganization of the Tectonics group, the deadline for submission of a draft of this report has been advanced to 12/31/91.

**Prepare report scarps/lineaments site area (3GPF07A)**

Because of pending reorganization of the Tectonics group, this report is to be combined with 3GPF08A (Prepare report of field evaluation, scarps and lineaments), discussed above.

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

K. Fox, Jr. attended verification activity and quality assurance audits. Fox also prepared monthly reports and reviewed the six-month technical status report. (6 hours)

**WBS 1.2.3.2.8.4.10 Geodetic Leveling**

Principal Investigator - K. Fox, Jr.

**OBJECTIVE**

To evaluate possible historical and contemporary vertical displacements across potentially significant Quaternary faults within 100 km of Yucca Mountain; to characterize the historical rate of uplift and subsidence in the Yucca Mountain region; and to 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, Yucca Mountain and vicinity 0G3284W1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

The level line sectional data and the GPS data are assembled. A "cover" report needs to be written. These activities will be finished by the end of October 1991.

National Mapping Division (with GD's help) is continuing to redefine its relationship with WRD-YMP. We are planning to establish a series of MOUs that will define our activities, relationship, and cost structures with WRD-YMP.

The National Mapping Division has been contacted by WRD-YMP (J. Stuckless) regarding the proposed FY 92 budgetary activities. After the fiscal year begins, the funds that will be allocated to this activity will be known.

Quality Assurance

Planning and Operations

WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis

Principal Investigator - K. Fox, Jr.

OBJECTIVE

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

SCP 8.3.1.17.4.12.1 Evaluate tectonic processes and tectonic stability at the site 0G3284A1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Tectonics integration (3GTE007J)

In August, K. Fox conferred with L. Wright and M. Carr regarding the status of the Death Valley-Yucca Mountain regional synthesis map. Carr will arrange for preparation of a scale-stable base map, and Wright will revise and forward a current copy of the map for drafting.

Quality Assurance

Planning and Operations

Continued preparation of Study Plan (3GTE00K)

F. Singer and W. Keefer completed Sections 4 and 5 of the study plan in August. These sections were then combined with a draft of sections 1, 2, and 3, previously prepared by K. Fox. Editing and final preparation of the draft study plan was completed by W. Keefer.

Work Performed but not in Direct Support of the Scheduled Tasks

V. Glanzman delivered a mylar base map at 1:250,000 scale. L. Wright delivered a draft of the line work for the map, with faults accentuated in red for clarity, and continues to work on the map explanation.

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 OG3311E1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Monitor stations and tipping-bucket gauges (3GMM01A)  
Continued during September and completed for FY91.

Acquire meteorological data, regional sources (3GMM04A)  
Continued receipt of these data. Lag time in data receipt has been one to five months because of the time required to qualify the data by the National Weather Service.

Monitor rain wedge gauges (3GMM19A)  
The network was monitored for precipitation events on August 31; September 3, 4, 5, and 6; and September 28. The storm of August 31 was the heaviest, dropping well over one inch of precipitation at several gage locations. All told, this series of storms, the last vestige of the summer monsoon, dropped up to 1.5 inches of rain. Runoff was noted to be especially heavy in Abandoned Wash and near USW WT-1.



**Calibrate and install tipping bucket gauges (3GMM21A)**

Calibration continued, no gauges deployed. Deployment is awaiting selection of sites and scheduling of environmental surveys.

**Evaluate tipping bucket data (3GMM22A)**

Data collection and archival continued and data were evaluated for goodness and consistency. No other analyses were conducted.

**Conduct technical procedure training (3GMM26A)**

HP-179, R1, Field Measurement of Precipitation Using a Tipping Bucket Rain Gage, has been assigned for instruction. Instructional reading on the procedures of HP-180, R1 has not been assigned.

**Tabulate data for rain gauges and met stations (3GMM32A)**

September's data were collected and tabulated.

**Prepare report on monitoring activities 1990 (3GMM35A)**

No progress; awaiting removal of QA "Hold Tags" on precipitation and wind data.

**Collect GOES data (3GMM42A)**

Data acquisition and archival continued.

**Quality Assurance**

**Develop technical procedures (3GMM08A)**

HP-180, Calibration of the Qualimetrics heated gage has been approved.

**Grade (QA) monitoring activities (3GMM44A)**

No progress; awaiting guidance from QA office.

**Planning and Operations**

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

Revision of USGS Planning and Control System (PACS) for Precipitation and Meteorological Monitoring. (20 hours)

**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 0G3311F1

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Collect FY91 runoff and streamflow data (3GRS001A)**

The beginning of September saw the continuance of thunder storm activity; the same type of local, sometimes heavy downpours, which developed during the months of July and August. Over Labor Day weekend, one such storm was recorded by area maintenance workers in the region of Yucca Mountain, specifically N.E. Coyote Wash, Ghost Dance Wash, Abandoned Wash and Dune Wash. A measured reading of 1 1/2" was recorded in that area.

An inspection on September 10 by USGS personnel verified flow had occurred, and runoff was confined to the roadway structures, with an estimated discharge of 4.4 cfs bypassing the crest stage gage at Dune Wash. Flow seemed to be spread out having taken the roadcut instead of the natural wash, then breaking out onto the lower reaches of the wash areas, pooling, then going into the ground. Both Ghost Dance Wash and Abandoned Wash seemed to have caused most of the damage to the road structure. What flow managed to continue downstream past the Dune Wash crest stage gage eventually was absorbed and never made it to Fortymile Wash.

This activity was completed September 30.

**Reduce FY83-85 data and prepare report (3GRS004A)**

The report is under review at the subdistrict and is awaiting a QA review by U.S. National Weather Service Nuclear Support Office on precipitation data.

**Quality Assurance**

**Revise technical procedures for streamflow data collection (3GRS009A)**

Technical procedures HP-40, -43, -44, -45, -114, -115, -116, -117, and -169 are presently at SAIC/Golden for retyping.

**Planning and Operations**

**Procure equipment for new gages (3GRS010A)**

Requisitions are under review. Some materials have arrived.

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

A revision of the PACS was performed. An update of activities along with changes in dates and status was completed. (60 hours)

SCP 8.3.1.2.1.2.2 Transport of debris by severe runoff 0G3311G1

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Collect FY91 debris transport data (3GRS001B)**

Minor runoff occurred in the Las Vegas area on September 6, but did not cause hazardous debris movement. Minor runoff also occurred in the Yucca Mountain area on August 31, but was too light for hazardous debris transport.

Preparation of FY92 and FY93 PACS data and two weeks of annual leave by the PI slowed

progress on completion of FY91 and FY90 data collection and processing.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

A meeting was held with Las Vegas staff to plan future study activities and orientation of new staff personnel was completed. (16 hours)

Work was done on the new PACS package for FY92 and FY93. (4 hours)

WBS 1.2.3.3.1.1.3 Regional Ground-Water Flow System

Principal Investigator - J. Czarnecki

OBJECTIVE

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

SCP 8.3.1.2.1.3.2 Regional potentiometric level distribution and hydrogeologic framework studies  
0G3311B1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Reduction of existing regional water level data (3GRG008)

W. Oatfield prepared a page-size illustration of all water-level measuring points for an area extending from Beatty, NV to Mercury, NV and from Death Valley, CA to Pahrump, NV. He also prepared 1:100,000 plots of all of these locations with numbers keyed to tabulated data.

Construction of piezometers in mining company holes (3GRG014A)

S. Keller, J. Czarnecki, and J. Grow (USGS GD) coordinated rig siting assignments for collecting cuttings from three oil wells currently being constructed in the Amargosa Desert.

J. Czarnecki and S. Keller attended a field trip around Bare Mountain, into Crater Flat, and east along U.S. 95 toward the northwest Spring Mountains. The trip was led by M. Carr (GD, Menlo Park) and consisted of fifteen stops designed to familiarize participants with what geologic units might be encountered in oil-test holes to be drilled to 4500 ft in the Amargosa Desert.

M. Ciesnik reviewed several major publications on stratigraphy and structural geology of the Amargosa Desert and the adjacent areas in preparation for the assignment on the drilling sites in Amargosa Desert.

M. Ciesnik collected cutting samples and logged the lithological sequences in the oil well drilled in the Amargosa Desert.

For the Felderhoff Production Co. exploration drilling in the Amargosa Desert (September

and October 1991), S. Keller and C. Wandrey (USGS Branch of Petroleum Geology) scheduled the HIP and Petroleum Branch participants for the sample collection and well-site lithologic logging effort for the three Felderhoff wells. They arranged logistics and materials for the effort, transported a USGS field trailer to the first well site, set up the operation, and began sample collection and logging for the first well (Felderhoff Federal 25-1). They and others participated in a 1-day orientation field trip given by M. Carr, and also collected a set of Paleozoic unit samples for reference during well-site logging. The Felderhoff drilling is expected to continue through late October, with USGS personnel working 12-hour shifts at the logging trailer. On behalf of HIP, Keller arranged for Felderhoff to run its basic suite of borehole geophysical logs in the basin-fill units and is coordinating with Felderhoff, J. Stuckless, and J. Czarnecki to have a sonic log and a dipmeter log run in at least one of the wells. Keller also continued lithologic and geophysical log preparation for the Amargosa Desert mining-company boreholes.

#### Quality Assurance

#### Planning and Operations

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

An estimated 80 hours were spent on the following tasks:

J. Czarnecki prepared input for PACS for FY '92 and FY '93.

M. Ciesnik assisted the PI in preparation of the semiannual progress report.

M. Ciesnik attended the QA workshop on the subject of "Root Cause Determination", organized by the USGS QA Office.

M. Ciesnik updated the file with the "Yucca Mountain Project Administrative Procedures" and checked the file with the QMPs against the most recent list.

M. Ciesnik continued gaining familiarity with the software package QUATTRO PRO 3.0 and its applications.

#### SCP 8.3.1.2.1.3.3 Fortymile Wash recharge study 0G3311C1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### Analyze existing data on Fortymile Wash recharge (3GRG103A)

Began drafting a memo to the record to document the sources of existing data pertinent to Fortymile Wash recharge.

Existing data is still being compiled and analyzed. Other ongoing work is preventing the activity chief from completing this activity. No impact on milestones or deliverables is expected.

##### Write report on channel loss (3GRG105A)

W. Osterkamp continued channel geometry analysis.

##### Coordinate with UZ infiltration tests (3GRG020)

UZ infiltration personnel have been busy preparing for drilling. No impact on milestones or deliverables is expected.

## Quality Assurance

### Planning and Operations

#### Procure equipment for infiltration tests (3GRG108A)

The stock tanks to hold water during the infiltration test were received from the supplier at the Denver office. Transportation is being arranged to have the stock tanks delivered to the Hydrologic Research Facility at NTS.

The major equipment needed has been ordered/received, but minor equipment such as pvc tubing, wood frames, and electrical cable need to be obtained. A method of measuring the water input also needs to be devised to match the delivery system, which has not been decided upon. No impact on milestones or deliverables is expected.

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

An estimated 120 hours were spent on the following tasks:

C. Savard made neutron meter moisture measurements in boreholes UE-29 UZN #91, #92 and #85 in Fortymile Wash to monitor moisture movement after a combined runoff and rainfall event at UZN #91. Preliminary analysis of the neutron logging indicated moisture moved approximately 0.3 meters down into the alluvial sediments.

C. Savard read and changed out rain wedges at the Fortymile Wash location for the Precipitation and Meteorological Monitoring study (8.3.1.2.1.1).

C. Savard submitted the abstract "Still no evidence of chaos in western U.S. streamflow" to colleague review in anticipation of submitting the abstract to the 1991 Fall AGU meeting. The abstract documents some of the scoping work being done to determine if streamflow in the western U.S. (which includes the Yucca Mountain area) can be characterized as chaotic.

C. Savard attended the course "Hydrogeologic Decision Analysis" sponsored by DOE. One of the main thrusts of the course was to let the scientist see how data and analysis can be entered into a cost-benefit model for management decisions.

C. Savard drafted FY92-93 PACS data for submittal to USGS management.

C. Savard represented the Saturated Zone studies during the Public Open House Tour of the Yucca Mountain facilities.

C. Savard collected drill bit cuttings from the oil exploration holes, Felderhoff Federal 25-1, in the Amargosa Desert approximately two miles south of Lathrop Wells. Preliminary analysis in conjunction with USGS Petroleum Branch geologists and the oil field well site geologists indicate approximately 2000 feet of valley fill underlain by Paleozoic dolomite to at least 3360 feet. Basalt flows were encountered in the valley fill and are believed to be the source of magnetic anomalies previously mapped. The hole is programmed to reach 5000 feet.

#### SCP 8.3.1.2.1.3.4 Evapotranspiration studies 0G3311D1

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### Vertical multilevel sampler, Franklin Lake Playa (G2A4)

L. Kroitoru (Weston) revised text on a report describing the deployment of the multilevel

sampler at Franklin Lake Playa, Inyo County California.

**Preparation of paper entitled "Hydrochemistry of Franklin Lake Playa" (G006)**

This activity has been placed on hold until the project chief (J. Czarnecki) can be freed to work on this paper. An abstract and accompanying talk entitled "Hydrochemistry at Franklin Lake playa, Inyo County, California" by J. Czarnecki and W. Oatfield was presented at the American Geophysical Union Fall '86 meeting.

**Analyze Franklin Lake hydrochemical data (3GRG206A)**

This activity has been placed on hold until the project chief (J. Czarnecki) can be freed to work on it. Results from this effort will feed G006.

**Assess old and possible new hydrochemical data and sampling (3GRG040)**

This activity is being work on as part of activity G2A4 (Vertical multilevel sampler, Franklin Lake Playa).

**Quality Assurance**

**Planning and Operations**

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

Principal Investigator - J. Czarnecki

**OBJECTIVE**

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

**SCP 8.3.1.2.1.4.2 Subregional two-dimensional areal hydrologic modeling OG331111**

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Quality Assurance**

**Planning and Operations**

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

J. Czarnecki received USGS Director's and DOE approval for a report entitled "Simulated water-level declines caused by withdrawals from wells J-13 and J-12 near Yucca Mountain, Nevada." Czarnecki revised the report per review comments by J. Harrill (USGS/Carson City), E. Ervin (USGS/HIP), J. Flager (USGS/CR), and C. Puente (USGS/Reston), and also prepared the final layout of the report for copying. Illustrations were taken to SAIC/Golden for final preparation. (80 hours)

SCP 8.3.1.2.1.4.4 Regional three-dimensional hydrologic modeling OG3311K1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Prepare existing data for model input (3GRM11A)

The geological map of Nevada and the data are ready for merging with California geological data sets for use in the 3-D model.

Fault trace data for the Nevada region are being attributed and entered into the 3-D model data base.

SNODIF2 model testing continued with production runs of three weeks duration being made. Publication version 1.0 is currently running on a 386 based computer. Programming design has been frozen so that a paper may be written for publication. The code is being modified to run on the CSM IBM RS-6000 system because of the necessity for long real-time runs.

Develop prototype 3-D model (3GRM12A)

Fairchild Digitizing Services is working on attributed geological separates of the appropriate California Geological Atlas at a 1:250,000 scale.

Fault trace data for the Nevada region have been attributed and plotted using various software packages.

Drainage data for the entire region have been developed, scanned, and plotted.

Well locations have been extracted from the NWIS data base, and plotted using various software packages.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

The review of a technical report on regional hydrologic studies in the Gulf Coast area of the United States for the Texas District continued.

The review of a paper on Groundwater Hydraulics Considerations Regarding Landfills for AWRA Journal began.

Considerable time was spent reviewing publications in order to be prepared for a hearing by the Nevada State Engineer on the DOE water rights request.

WBS 1.2.3.3.1.2 Unsaturated Zone Hydrology

OBJECTIVE

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

WBS 1.2.3.3.1.2.1 Unsaturated Zone Infiltration

Principal Investigator - A. Flint

OBJECTIVE

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

SCP 8.3.1.2.2.1.1 Characterization of hydrologic properties of surficial materials 0G3312Z1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Collect rock outcrop samples & perform lab analysis (3GUI001)

This is an ongoing activity. No new samples were collected. Laboratory analysis continued on previously collected samples. Core samples were collected from USW UZN-55, a neutron-access borehole which is currently being drilled.

Tabulate rock outcrop and soils data (3GUI002)

Data collected under 3GUI001 is being tabulated.

Analyze spatial variability soil physical props (3GUI004)

Continued this activity with new data from 3GUI002.

Evaluate various GIS techniques (3GUI006)

No additional progress. Activity on hold until GIS position can be filled.

Collect samples and lab analysis (3GUI007)

Began drilling of USW UZN-55. Collected core samples from that borehole.

This is an on-going activity. Previously collected samples are being analyzed for bulk density, grain density, porosity, and permeability. Selected samples are being tested in a relative humidity-drying oven. This activity will end 10/2/91 and then be listed under activity 3GUI025A.

Quality Assurance

Develop technical procedures (3GUI008A)

Prototype studies are being conducted to determine what technical procedures will be needed for this activity.

Conduct technical procedure training (3GUI023A)

No technical procedures currently exist for this activity.

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

Revision of USGS Planning and Control System (PACS) for Characterization of Hydrologic Properties of Surficial Materials. (20 hours)



## **ACTIVITIES AND ACCOMPLISHMENTS**

### **Technical Activities**

#### **Log neutron moisture meter (3GUI301)**

Neutron logging was completed as scheduled for September for existing boreholes.

#### **Collect soil samples to support ET studies (3GUI316)**

Delayed due to lack of manpower. No milestones should be effected at this time.

#### **Test shallow borehole instruments Topopah Wash (3GUI320)**

No progress due to lack of manpower.

#### **Evaluate moisture profile spatial variability (3GUI323)**

Moisture profiles for boreholes in Pagany Wash were compared with bulk density profiles obtained using gamma logs in an effort to identify layers and estimate porosity for the alluvium.

#### **Drill and sample neutron holes (3GUI340)**

Drilling of the first new neutron access borehole was initiated and is still in progress. Retrieval, documentation, sampling, and storage of core was also initiated and is continuing. The borehole is logged with the neutron moisture meter during installation.

#### **Tabulate neutron meter moisture data (3GUI350)**

Tabulation of neutron-count data is ongoing for existing boreholes. Tabulation of data for new boreholes in the process of being installed was initiated.

#### **Develop large and small-scale water balance models (3GUI360)**

Inverse modeling of the alluvium profile in Pagany Wash was performed using the neutron log record and a 2-D infiltration model for 5 boreholes (N5 through N9) to investigate material properties and the effect of layering in the alluvium. The results of this preliminary analysis using moisture content profiles will be presented at the ASA convention in Denver on October 30th. The flow model is being developed as part of the Pagany Wash water balance model using daily precipitation and ET data.

#### **Procure/install crosshole gamma equipment (3GUI385)**

Delayed for funding.

#### **Procure/install fast response psychrometer (3GUI388)**

Delayed for lack of manpower.

#### **Analyze 3H of UZP core (3GUI390)**

Tritium samples were collected from new borehole drilled on Yucca Mountain.

#### **Procure weighing lysimeters (3GUI392)**

Delayed for further analysis. Prototype studies are not complete.

### **Quality Assurance**

#### **Develop technical procedures (3GUI381)**

Continued evaluation of the need for technical procedures to support new drilling of neutron calibration holes.

Conduct technical procedure training (3GUI383)

All employees required to implement any technical procedures have been trained.

Planning and Operations

Procure/install soil heat-flux instruments (3GUI380)

No progress. Instruments have not been ordered.

Work Performed but not in Direct Support of the Scheduled Tasks

Revision of USGS Planning and Control System (PACS) for Matrix Hydrologic-Properties Testing.  
(20 hours)

SCP 8.3.1.2.2.1.3 Evaluation of artificial infiltration OG331221

**ACTIVITIES AND ACCOMPLISHMENTS**

Technical Activities

Develop/conduct field test of infiltrometers (3GUI606)

Field test of infiltrometers will be postponed until additional personnel are available.

R&D methods for artificial infiltration (3GUI616)

No progress due to lack of personnel.

Evaluate instru infiltration/ponding experiment at Jackass Flat (3GUI617)

Due to lack of personnel, this activity has been postponed; all associated milestones will be shifted equal to the delay of starting the activity.

Develop technical procedures (3GUI682)

Procedure for sample handling and measurement of physical properties is in technical review and procedure for measurement of water potential is in draft form. Investigation of additional procedures & refining of processing methods is currently underway.

Quality Assurance

Planning and Operations

Procure support equipment for precipitation network (3GUI688)

Received new style storage raingages & prototype development is underway to enhance ease of use and accuracy.

Work Performed but not in Direct Support of the Scheduled Tasks

Revision of USGS Planning and Control System (PACS) for the Evaluation of Artificial Infiltration.  
(20 hours)

WBS 1.2.3.3.1.2.3 Percolation in the Unsaturated Zone - Surface Based Study

Principal Investigator - J. Rousseau

**OBJECTIVE**

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

SCP 8.3.1.2.2.3.1 Matrix hydrologic-properties testing OG3312U1

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Evaluate sample handling process (3GUP001A)**

All laboratory tests completed on sample handling and drying methods. Procedure was written and has been submitted to USGS QA review.

**Prepare report on preliminary k and water retention (3GUP016A)**

Report published as USGS OFR 90-569 in August, 1991.

**Evaluate water retention method to estimate relative permeability (3GUP021A)**

New membrane barrier material appears to be working at pressures up to 10 bars.  
Evaluation of SPOC design continuing.

**Develop core analysis for hydraulic properties (3GUP024A)**

An additional core holder is in the process of being added to the prototype permeameter to double the sample capacity. The permeameter has successfully measured gas and water flow through several dozen core samples.

**Collect outcrop samples and develop borehole sampling techniques (3GUP027A)**

Data analysis is underway for spatial-variability samples collected from Yucca Mountain outcrops.

**Analyze core from NTS prototype drillholes (3GUP028A)**

Water content and physical properties samples are being collected and preserved from the new borehole.

**Evaluate imbibition method to estimate UZ k (3GUP50A)**

New imbibition measurement technique being evaluated.

**Quality Assurance**

**Complete technical procedures (3GUP005A)**

Prototype development still underway on all methods except for physical properties measurements, where procedure has been finalized.

**Planning and Operations**

SCP 8.3.1.2.2.3.2a Surface-based boreholes studies OG3312V1

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Finalize/submit thermocouple psychrometer technical procedure (3GUP007E)**

Draft of TCP technical procedure completed.

**Construct and modify DISA (3GUP080E)**

DISA modifications were identified during assembly of DISA's for instrumenting HRF boreholes #1 & #2. Five additional DISAs will be fabricated incorporating the modifications. Fabrication of these modified DISAs should be completed by Feb. '92.

Order and calibrate TCP-sprt-THM-acpower (3GUP087E)  
Activity completed in June, 1991.

Gas sampling (3GUP083E)  
See 3GUP041E - assembly of first gas sampling system is underway. Software is being written to run this system.

Develop software for gas sampling system (3GUP045E)  
Writing of software for gas sampling system continued during month of September.

Design, build, test water inject apparatus #3, instr (3GUP046E)  
See 3GUP045E (activity is the same).

Drill instrument #3 (3GUP022E)  
See GUP020E, 021E - HRF #3 was drilled during week of 9/16/91. Borehole #3 will be instrumented with modified DISAs in Feb. '92.

#### Quality Assurance

#### Planning and Operations

Order flowmeters/controllers design/build multi-station (3GUP041E)  
All parts, equipment, supplies for multi-station gas sampling system have been delivered. Assembly is under way with fabrication of the manifold components. Unit should be assembled by 12/31/91.

Prepare AC order (3GUP063E)  
The purchase order for a D.C. calibrator (Capital Equipment) was returned to be purchased by the USGS. REEC Co will not procure as originally planned. Capital equipment funds were requested to be reprogrammed for the purchase of this unit by the USGS. All other equipment for electronic diagnostic testing has been received.

Mobilize and drill instrument holes (3GUP084E)  
HRF boreholes #1, #2, and #3 were drilled in September '91. Outer casings were set and grouted into place. Wellhead boxes, conduit, and other ancillary construction activities were completed. Boreholes will be instrumented (#1 & #2 only) during the 2nd week of October. DISA units have been assembled for installation in HRF boreholes #1 and #2.

Purchase and test diagnostic equipment (3GUP082E)  
See 3GUP063E.

Construct 15 DISA units (3GUP031E)  
Ten DISA units have been constructed. These will be used in HRF #1 & #2. Five modified DISAs (ref. 3GUP080E) will be built for instrumenting HRF #3.

Mobilize (3GUP019E)  
Drilling of HRF boreholes commenced on September 9, 1991. Activity is complete.

Drill instrument #1 (3GUP020E)  
HRF Borehole #1 was drilled during week of 9/9/91. Borehole instrumentation will be completed by 10/15/91.

Design, build, test water injection apparatus #3 (3GUP039E)

Request was submitted to the Bureau of Reclamation to design, build, and test a water injection apparatus. Preliminary design meetings were held.

Drill instrument #2 (3GUP021E)

See 3GUP020E - HRF #2 was drilled during week of 9/9/91. Borehole will be instrumented during the 2nd week of October.

SCP 8.3.1.2.2.3.2b Vertical seismic profiling 0G331231

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Acquire/test/procure real earth cross borehole data, Idaho Springs (3GUP041B)

Permission to build access road was obtained and the purchase order was issued. Project has been coordinated with USGS earthquake division. Excavating is scheduled for early October.

Conduct 2-D Yucca Mountain VSP model experiment (3GUP025B)

Velocity analysis for waves in the Yucca Mountain physical model was performed. The migration of the fault model data showed that velocities obtained so far are more accurate than those being used traditionally in the acoustic laboratory.

Acquire 3-D VSP modeling package for IBM RS/6000 (3GUP018B)

Activity suspended - see August report.

Design/build and use absorbing boundary model (3GUP026B)

Activity suspended - see August report.

Quality Assurance

Planning and Operations

Process/image data from simple fault model experiment (3GUP024B)

Work continued in the right hand side of the model. Migrating was performed and we now have the combinations (p-p, p-s, s-p, s-s) after stacking 33 partial images on each combination. Work will continue in this side to get a better image from the model.

Install V-seis software on RS/6000 (3GUP038B)

Activity is canceled - see August report.

Install V-seis on Cray (3GUP039B)

Activity suspended - see August report.

Work Performed but not in Direct Support of the Scheduled Tasks

The migration of PS converted waves was successfully performed on the plexiglas (tunnel) model. Incidence angles for the vertical reflector (right edge of the model) were calculated on three shot positions. Theoretical reflection coefficients were determined by using the incidence angles calculated for every grid point in the medium. Based on the theoretical reflection coefficients, sign corrections were applied to the migrated data obtained from raw data. Application of the method will be tested for other shot locations.

"Separation of P-S Waves on Cross-Borehole, and VSP-Data" - Paper submitted to SEG (Society of

Exploration Geophysicists) Committee for presentation at the annual meeting in November in Houston, TX. The paper was accepted by the SEG Committee and will be presented by C. Erdemir. Slides are being prepared for the presentation.

SCP 8.3.1.2.2.3.2d Air-permeability and gaseous-tracer testing 0G331251

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

QA drawings/assemble/test instruments, packer trailer (3GUP010D)

The USBR continued to work on the QA drawings, assembly instructions and test instructions for the 8" packer assembly and support trailer.

Purchase all measurement and data storage equipment (3GUP020D)

The new data loggers and a selection of thermocouple psychrometers were delivered.

Review/develop cross-hole/single hole air injection (3GUP011D)

The technical staff continued to review and develop air injection test methods. A model for analysis of tests where the dimensionless radius is less than 20.0 was reviewed and applied to several single-hole tests.

Complete construction of first support trailer (3GUP003D)

The final major piece of equipment, a hydraulic cable winch, needed for the support trailer was selected and purchased. The winch will have a 6,000 lb. pull and in addition will contain a hydraulic system capable of operating the support trailer hose reel.

Quality Assurance

Graded QA and other QA requirements (3GUP023D)

The staff continued to satisfy all appropriate QA requirements.

Complete QA for 8" packer assembly and support trailer (3GUP004D)

The USBR continued to work on the QA requirements for the 8" packer assembly and support trailer.

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 40 hours were spent on the following tasks: work plan and PACS; UZ-13 monitoring system; and MFC calibration facility.

WBS 1.2.3.3.1.2.4 Percolation in the Unsaturated Zone - ESF Study

Principal Investigator - B. Lewis

OBJECTIVE

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

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### Continue Moire projection; method development (3GUS005A)

Work continued to progress using image digitization and processing to look at Moire fringes. Drafts of journal papers discussing fast-Fourier transform analysis and stereo viewing of objects are in preparation. The high-resolution imaging equipment is scheduled to be installed and evaluation of the equipment complete by December 1991.

#### Prepare Moire journal paper (3GUS016A)

Dr. J. Cardenas-Garcia submitted a manuscript copy of a paper entitled, "Implementation and Use of an Automated Projection Moire Experimental Set-Up" on April 19 to the HIP reports section. This paper has been reviewed by the section chief, reports section, and one technical reviewer. It still remains in technical review.

#### Complete procedure; radial fracture sampling (3GUS017A)

All reviews have been completed for technical procedure YMP-USBR-HP-02, R0. The procedure is with the co-investigator for final draft preparation.

#### Prepare letter report: Moire bench marking (3GUS003A)

The draft submitted under activity 3GUS016A includes the bench marking and calibration of the projection Moire equipment. The requirements under this activity (3GUS003A) have been met with this manuscript. This paper is still in technical review.

#### Prepare journal paper; equipment benchmark (3GUS023A)

The draft submitted under 3GUS016A (Prepare Moire journal paper) includes the bench marking and calibration of the Projection Moire equipment. The requirements under this activity (3GUS023A) have been met with this manuscript. This paper is still in technical review.

#### Construct equipment; calibrate and test cores (3GUS014A)

No funds were available during the month of September to place orders or fabricate equipment. This is delayed until October 1991.

### Quality Assurance

#### Write technical procedure; Moire calibration (3GUS007A)

This procedure has been started. Little progress was made during September.

### Planning and Operations

#### Prepare budget and work plans (3GUS013A)

A preliminary budget was prepared and a draft of the PACS for FY92 and FY93 was prepared and submitted to USGS management.

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

#### Percolation test support:

Support for the prototype ESF test accounted for approximately 1.0 to 1.25 FTEs for the FY91 year. Work conducted for this test during the month of September included the following: thermocouple psychrometer calibrations and associated data collection; pressure transducer calibrations; installation and wiring of sensors for TDR and electrical resistivity; additional air permeability testing of instrumentation boreholes; and continued work on enclosure for the large block test. (260 hours)

The formal colleague review of the manuscript in activity 3GUS016A was completed. (17 hours)

Two HP3495A scanners were obtained from CASU. (2 hours)

The assessment of DEC computer equipment was completed. Useful items were transferred to the USGS Branch of Geochemistry and another USGS-YMP project. The remaining items were inventoried, itemized, and prepared for transfer to the Central Region Property Control Unit.

Work started on a draft of the six-month, SCP Progress Report to be submitted on October 4, 1991.

SCP 8.3.1.2.2.4.2a Prototype infiltration (percolation) testing 0G331201

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Develop technical procedure, fracture location, air permeability (3GUS008B)**

The fracture location procedure was received back from the QA section review. The suggested changes will be incorporated and the procedure will be sent back to the QA section for final review. Completion of the air permeability procedure will be delayed until the large block test (activity 3GUS001B), where most of the effort is currently needed, is started. This delay is not expected to alter the next stage (activity 3GUS003) since the actual measurements have been finished, and only the formal procedure draft is being delayed.

**Analyze data from large block test (3GUS006B)**

Air permeability measurements of the fracture network in the block were made. Results have not been finalized yet.

**Create pond, large block (3GUS001B)**

The data logging system that will be used to collect the data is complete. Installation of electrical resistance electrodes on the block is complete. Installation of TDR probes is complete. A problem with the thermocouple psychrometer system has caused a delay in the start of the ponding test. The problem was caused by a water bath malfunction where the psychrometers are being checked before their final installation in the large block. The actual start of the test will be delayed until October 1991.

**Develop resistivity procedure (3GUS024B)**

Instrumentation testing continued. Resistivity measurements will be incorporated in the pond test (activity 3GUS001B).

**Initiate contract at core labs (3GUS030B)**

This activity has been delayed pending results from the Hydrologic Research Facility (HRF) laboratory (see activity 3GUS027B).

**Draft resistivity technical procedure (3GUS035B)**

- The activity start will be delayed until the large block test (activity 3GUS001B), where most of the effort is currently needed, is started. This delay is not expected to alter the finish time because more people will be available to work on other activities after the large block test is started.

**Analyze hydro-properties of core (3GUS027B)**

The contract with Core Labs has been delayed. Several welded tuff samples were cored.



The samples were sent to the HRF in Mercury, Nevada, to measure their water permeability using the newly built equipment. The permeability of one core was estimated to be around 3 microdarcies. A second core was tested this month; however no measurable water flow rate with an applied differential pressure of 30 psi was detected through the sample.

**Conduct psychrometry test (3GUS002B)**

This test will be delayed for two more weeks until all the psychrometers are checked (see activity 3GUS001B for cause of delay).

**Explore TDR applications (3GUS015B)**

The application of TDR method to estimate water content in the large block was looked into. To get meaningful TDR readings, the TDR probes need to be approximately 5 cm apart. This condition does not exist in the large block. Therefore, TDR strips were made and fixed on two opposite sides of the block to get qualitative, rather than quantitative water content estimates. This activity is complete.

**Apply TDR on large block (3GUS017B)**

The TDR method to estimate water content in the large block will be used in a qualitative way (see activity 3GUS015B). This activity is complete.

**Quality Assurance**

**Calibrate instrumentation (3GUS011B)**

Equipment was sent to QA approved vendors for calibration as required; other equipment was calibrated in-house.

**Draft fracture location procedure (3GUS009B)**

The procedure was completed and will be sent to the QA section for final approval.

**Planning and Operations**

**WBS 1.2.3.3.1.2.6 Gaseous-Phase Movement in the Unsaturated Zone**

Principal Investigator - E. Weeks

**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 0G3312W1**

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Analyze gas samples UZ boreholes for geochemistry (3GGP03A)**

Analysis of gas samples from UZ boreholes for geochemistry was completed.

**Tabulate/analyze air flow and chemical data (3GGP05A)**

Tabulation and analysis of air flow and chemical data collected under activities 3GGP01A and 3GGP03A was completed.

Progress report air flow and gas chemistry (3GGP16A)

The progress report on air flow and gas chemistry is in preparation.

Collect UZ borehole data (3GGP02A)

The need to collect additional UZ borehole data is currently being evaluated. This decision could significantly impact this activity.

#### Quality Assurance

#### Planning and Operations

### WBS 1.2.3.3.1.2.7 Unsaturated Zone Hydrochemistry

Principal Investigator - I. Yang

#### OBJECTIVE

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

#### SCP 8.3.1.2.2.7.1 Gaseous-phase chemical investigations 0G3312X1

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### Analyze UZ gas (3GUH003B)

Thirteen (13) samples derived from UZ6s core pore-gas and seven (7) gas samples derived from UZ4 core pore-gas were analyzed on the gas chromatograph for CO<sub>2</sub>, CH<sub>4</sub>, and SF<sub>6</sub> content.

##### Tabulate data for gas sampling analysis (3GUH006B)

Final data tabulation for UZ gas sampling analysis cannot be performed until all of the results are in; we are still waiting on results.

Received carbon 13/carbon 12 data for UZ1 and UZP6 gas sampling field trips, FY91.

Fifteen aluminum storage cylinders which are used in the collection of carbon-13/carbon-12 isotopic ratios in CO<sub>2</sub> gas in the field have been evacuated, leak tested, and are ready for use during the next UZ gas sampling field trip.

##### Procure/outfit mobile sampling laboratory (3GUH014B)

Methods development continues on the portable gas chromatograph to be used in the Mobilab. If a viable method is developed, a technical procedure will be written for this instrument and it will be used in analyzing CO<sub>2</sub> and SF<sub>6</sub> samples from UZ boreholes in the field.

##### Develop technical procedures (3GUH009B)

Methods development continued on the portable gas chromatograph. If a viable method is developed, a technical procedure will be written for this instrument and it will be used in analyzing CO<sub>2</sub> and SF<sub>6</sub> samples from UZ boreholes in the field.

Develop method to identify UZ fractures (3GUH008B)

Method was developed. However, test can not be conducted due to need for equipment procurement and environmental permits.

Complete procure laboratory and lab supplies (3GUH013B)

Received VWR orders - samples vials, pipet bulbs, polyseal vial caps, etc.

FY90 gas sample data report (3GUH054B)

Continued to compile UZ-1 gas data from 1884 through 1990.

Procure SF-6 injection system (3GUH024B)

Continued looking into SF<sub>6</sub> injection system by RSN.

Test tracer method for locating fractures (3GUH005B)

Field test can not be conducted due to lack of environmental permits.

Collect gas samples from UZ boreholes (3GUH002B)

Gas-sample collection is scheduled for November of 1991.

#### Quality Assurance

Conduct/complete technical procedure training (3GUH023B)

K. Schofield was trained for laboratory degassing procedures.

#### Planning and Operations

Procure/outfit mobile sampling laboratory (3GUH014B)

Mobilab is in the process of being procured by REECo.

Test straddle packer system for gas samples UZP boreholes (3GUH018B)

Received parts for leakmeter. Talked with company representatives concerning hook-up and operation. Still need 3/16" nylon tubing for external argon supply connection.

Procured all materials for short packer string to be used in UZ13 to monitor UZP6 drilling.

Procure micro-computer (3GUH030B)

Data acquisition system for gas chromatograph was ordered. Waiting for delivery.

Complete software requirements (3GUH011B)

Software requirements for gas chromatograph automation was completed and ordered.

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

An estimated 88 hours were spent on the following tasks:

P. Striffler represented the UZ Hydrochemistry Laboratory at the Nevada Test Site during the Yucca Mountain tours and explained unsaturated zone programs and future plans, and answered questions.

Various staff members prepared the PACS schedules for FY92 and FY93.

## **ACTIVITIES AND ACCOMPLISHMENTS**

### **Technical Activities**

#### **Procure laboratory and field supplies (3GUH007A)**

Received VWR orders - samples vials, pipet bulbs, polyseal vial caps, etc.

#### **Extract/analyze porewater H<sub>2</sub>O samples from boreholes (3GUH110A)**

Completed distillation of eight core samples from UZ4, UZ5, and UZ6s, some previously squeezed.

Delivered 180 samples to laboratory for analysis. Water samples are squeezed for water and known spiked samples.

The cooling unit which is necessary for proper operation of the liquid scintillation counter has become non-functional. The unit was taken out of the instrument and shipped to the manufacturer for repair. With the liquid scintillation counter out of service it has not been possible to analyze any pore-water samples for tritium content.

The ion chromatograph was calibrated for bromide, chloride, nitrate and sulfate analysis. Statistical standard error curves will be derived from the calibration data.

Several tritium samples which were analyzed on the in-house liquid scintillation counter in building 56 laboratory were sent to the Reston Isotope Laboratory in Reston, VA, for a cross-check on the in-house results. The results from Reston concur with results from in-house analysis.

#### **Analyze core and water from UZP boreholes (3GUH021A)**

Apache Leap site cores have been completed.

#### **Train staff in technical procedures (3GUH017A)**

MSDS sheets were obtained for all chemicals used in building 56 UZ Hydrochemistry Laboratory. This is a necessary safety regulation.

#### **Develop collection method H<sub>2</sub>O from fractures (3GUH003A)**

Field test can not be conducted due to lack of environmental permits.

#### **Prep. OFR-sp, dtps, proto and site UZ hydrochem (3GUH012A)**

Due to other urgent work, the report preparation has not been started.

### **Quality Assurance**

#### **Develop technical procedures (3GUH004A)**

HP-204 "Liquid Scintillation Spectrometry Method for Tritium Measurement of Water Samples" was held up in the Quality Assurance review. The QA reviewer proposed a few changes; the author disagrees. The HP then had to go through another technical review - where it is currently being held due to the current technical reviewer not agreeing with the changes proposed by the QA reviewer.

The title of HP-194 was changed to read "Approximation of Relative Humidity using a Silica-Gel Tower within Unsaturated-Zone Test Boreholes as an Aid in Determining

Pumping Efficiency". This became necessary when confusion arose due to the original title.

Revisions to HP-86 "Method for Degassing CO<sub>2</sub> and H<sub>2</sub>O (Vapor) Samples from Unsaturated Zone Test Boreholes" were approved and the new version distributed.

Revisions to HP-56 "Gas and Water Vapor Sampling from Unsaturated-Zone Test Holes" were approved and the new version distributed.

#### Planning and Operations

##### Procure laboratory and field supplies (3GUH007A)

Two anion standards, bromide, and nitrate were procured from NIST. These standards will be used in the calibration of the ion chromatograph.

Silicon tubing and hose connections were procured. These items are necessary in field pumping UZ boreholes.

Various consumable laboratory items such as glass vials and lids for sample water collection, pipette fillers, syringes, etc. were procured.

##### Procure LSC triaxial DAS (3GUH019A)

Data acquisition system for loading frame ordered in August, 1991. Waiting for delivery.

##### Procure hi-resolution liquid chromatograph (3GUH018A)

Received computer for data acquisition system. Computer will be set up at the Denver Federal Center for in-house analysis of anions and cations.

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

An estimated 88 hours were spent on the following tasks:

P. Striffler represented the UZ Hydrochemistry Laboratory at the Nevada Test Site during the Yucca Mountain tours and explained unsaturated zone programs, future plans, and answered questions.

Various staff members prepared the PACS schedules for FY92 and FY93.

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

Principal Investigator - C. Boughton

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 0G3312T1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### Conduct scoping calculations (3GUF005)

Simulations intended to explore the influence of flux and average matric potential on the

channeling behavior, matrix potential variability and bulk properties of a fracture network containing fractures of various hydraulic apertures continued to frustrate investigators with as yet unidentified numerical problems. Additional simulations run during September still suffered from convergence problems and other inconsistencies, with the result that no credible observations have yet been produced from this effort.

**Revise air encapsulation and infiltration papers (3GUF021)**

The report entitled "Numerical simulations done in support of the prototype and Exploratory Shaft Percolation tests at Yucca Mountain, Nevada" returned from technical review. In order to partially satisfy comments made by reviewers, additional simulations were run employing different hydrologic characteristics and boundary conditions. These results will be incorporated in revisions to the report.

**Document code (3GUF015)**

Several sections of the documentation were drafted, including an introduction and sections describing variables used in the code and the functions of various subroutines.

**Calculate geostatic prediction of relative k (3GUF018)**

Progress in this area is reported under activity 3GUF005 (Conduct scoping calculations).

**Modify model (3GUF024)**

The variable aperture code VSFRAC was updated to include a subroutine to calculate the mean and variance in relative permeability and saturation at each prescribed matrix potential for a user-specified number of realizations of the possible aperture field.

**Quality Assurance**

**Planning and Operations**

**Respond to study plan comments (3GUF001)**

To date, six of the eight DOE reviewers have indicated their concurrence with the proposed revisions to the study plan. The remaining reviewers are still considering the revisions and have made a verbal commitment to complete their responses in the first week of October.

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

E. Kwicklis participated in the training course offered by DOE-YMPO entitled "Hydrogeological Decision Analysis" taught by R. Freeze, J. Massman, and L. Smith in Las Vegas, September 9-13. (40 hours)

E. Kwicklis prepared the detailed FY92-93 schedules and work descriptions for the PACS for this SCP activity. (24 hours)

E. Kwicklis continued to learn the basics of UNIX and the VI editor in order to begin performing simulations on the SUN rather than the PRIME. Several programs, including TOUGH, were transferred to the SUN, and successfully modified, compiled and executed. Because the SUN is under-utilized compared to the PRIME, this transition to the SUN should facilitate computations done for this activity in the future. (16 hours)

SCP 8.3.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock 0B3312T1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Prepare/publish final cylinder asperities paper (3GUF009L)

The paper "Permeability of a fracture with cylindrical asperities" by S. Kumar, R. Zimmerman, and G. Bodvarsson was published in the journal *Fluid Dynamics Research*. A hard copy (disk) of the data from the paper was sent to the USGS/QA office, and copies of the cited references have been sent to the USGS LRC.

Valid. size/shape effects, mod. dual porous model (3GUF019L)

R. Zimmerman and A. Flint met to discuss results of USGS imbibition experiments. It was decided that Zimmerman will look into the problem of determining characteristic curves based on measured sorptivity values.

R. Zimmerman prepared and submitted an abstract for a presentation at the Conference on High-Level Nuclear Waste, to be held in April 1992, in Las Vegas.

Complete lubrication theory paper (3GUF017L)

This task is completed and the paper published in the 1991 *Proceedings of the International High-Level Radioactive Waste Management Conference*.

Quality Assurance

Planning and Operations

Prepare budget and work plan (3GUF008L)

On September 19, G. Bodvarsson, R. Zimmerman, and C. Wittwer met with B. Lewis and A. Flint to discuss and finalize work plans for the 1992-3 fiscal years.

WBS 1.2.3.3.1.2.9 Site Unsaturated Zone Modeling and Synthesis

Principal Investigator - B. Lewis

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 0G3312C1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

#### Quality Assurance

Review OMP-3.03, R3 (3GUM06A)

The document is still undergoing comment resolution.

#### Planning and Operations

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

An estimated 17 hours were spent on the following tasks:

M. Whitfield provided copies of 12 USGS publications to the State of Nevada for potential exhibits in the hearing on pumpage from water well J-13.

M. Whitfield submitted 72 copies of WRI 86-4015 (USW G-4) to the LRC for storage and future distributions.

M. Whitfield provided the LRC with state coordinates for the existing 74 neutron boreholes near and on the NTS. The data was needed to complete the TDIF for SCP activity 8.3.1.2.2.1.2 (Natural Infiltration).

#### SCP 8.3.1.2.2.9.2 Selection, development, and testing of hydrologic-modeling computer codes 0B3312D1

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

Test decoupled TOUGH hydrological simulation (3GUM13A)

C. Wittwer participated in the DOE presentation of the Quality Program Hotline on September 6.

A meeting was held in Berkeley on September 13 between R. Spengler, G. Bodvarsson, K. Karasaki, and C. Wittwer to discuss the geological data currently included in the model. Lithologic logs of some of the wells located on the borders of the area of the site-scale model were obtained by Spengler. These unpublished data were needed to design the isopach maps of the hydrogeological units.

An abstract and an extended summary were prepared in response to the call for papers for the *Waste Management and the Nuclear Fuel Cycle* special issue on Yucca Mountain and of the annual meeting of the American Nuclear Society. The papers will describe the development of the 3-D site-scale model. The authors will be C. Wittwer and G. Bodvarsson of LBL, A. Flint, L. Flint, M. Chornack, B. Lewis, and R. Spengler of USGS and C. Rautman of SNL.

A meeting was held in Berkeley on September 19 with B. Lewis and A. Flint to discuss the organization of LBL task orders for the study-plan FY92 and FY93. It was decided to divide the work done on the site-scale model into two tasks according to the study-plan. The task called "Simulation of the natural hydrogeologic system" will cover the development of the site-scale model and subsequent submodels designed to test various hypotheses and refine the main model. The PACS forms for this new defined task were written.

C. Wittwer and G. Bodvarsson prepared and submitted an abstract for presentation at the Conference on High-Level Nuclear Waste, to be held in April 1992 in Las Vegas.

#### Quality Assurance



## Planning and Operations

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

#### Activities

Principal Investigator - B. Lewis

#### OBJECTIVE

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

#### Prototype Cross-Hole Testing OG331211

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Analyze ALTS data by numerous methods/comparisons (3GUT003C)

The March, 1991 ALTS data was analyzed using a solution that quantifies both wellbore storage and skin effects. The solution was partially successful; however the calculated permeabilities showed approximately one order of magnitude higher values than more traditional analysis methods.

Reduce and examine ALTS data (3GUT002C)

ALTS data was used in sensitivity analysis to evaluate the importance of the start time in reducing the raw field data. Sensitivity analysis showed that some early time data plots were very sensitive to very small (less than 5 seconds) changes in data reduction start times.

##### Quality Assurance

##### Planning and Operations

#### Prototype Tracer Testing OG331211

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Develop and complete technical procedures (3GUT005D)

Procedures for aqueous tracer laboratory experiments are complete. No procedures begun for field prototype testing or gas tracer testing.

Procure laboratory and field supplies (3GUT008D)

Sent gas chromatograph TCD detector out for repair.

Design tracer gas sorption experiments (3GUT004D)

Prepared drawing of glass manifold, flasks, and openings for withdrawing gas sample from flask, applying vacuum, etc; this will be custom-made by Ray Allen in October of 1991.

Outlined various combinations of tests to run (i.e. sample/gas ratios, sample/moisture ratios, concentrations of gas tracers, size of sample material, etc.).

Conduct lab tracer-gas adsorption with stemming material (3GUT013D)

Work has just begun on this; Gypsum cement has been placed in 500 ml flasks, with various sample sizes and sample/gas ratios. The gas tracer used in these tests is 1.6ppm SF<sub>6</sub>.

Conduct lab sorption-tracer gas on tuff material (3GUT001D)

These tests have not yet begun due to incomplete testing on Gypsum cement.

Prepare criteria letter (3GUT010D)

No progress due to difficulties in organizing various personnel required to attend necessary meetings.

#### Quality Assurance

Produce WRI report on aqueous tracer tests (3GUT003D)

In review.

#### Planning and Operations

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

Various staff members prepared the PACS schedules for FY92 and FY93. (24 hours)

### Prototype Dry Coring of Rubble 0G3312L1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Test effects of block tech/gas used & coring tec (3GUT001F)

Blocking materials experiment completed. Blocking chemicals cause less than a 15 °C rise in temperature in either welded or nonwelded rubble; thus blocking materials used is not a problem.

Test effects of seal methods (3GUT001E)

A new sealing method using saran wrap will begin to be tested. Graphs of weight loss will be update.

An outline of a report on sealing methods is completed and procedure draft written.

#### Quality Assurance

#### Planning and Operations

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

Various staff members prepared the PACS schedules for FY92 and FY93. (56 hours)

### Prototype Pore-Water Extraction 0G3312M1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Reduce data pore-water chem vs comp & chem anal (3GUT003G)

Plots from 217 water sample analyses for one-dimensional compression tests have been reviewed for accuracy. New plots with error bars and corrections are now being developed.

Write technical procedure for 1-D compression (3GUT005G)

The technical procedure HP-223, "Method for Pore-Water Extraction Using One-Dimensional Compression" is in technical review.

Develop compress method extract uncontaminated pore-water (3GUT004G)

To date, 16 densely welded tuff cores were compressed (eight during September) using the second generation compression cell. Moisture contents of the cores ranged from 4.1 to 15.8 percent and degree of saturation ranged as low as 38 percent. Pore water was recovered from core with moisture contents as low as 4.1 percent and initial saturations of 38 percent with the aid of nitrogen injection. The 16 densely-welded tuff cores compressed to date with the second generation cell show that the new cell's degree of success in extracting pore water from these high strength rocks greatly exceeds that of the first generation cell. The initial degree of saturation required to extract water has been reduced by 60 percent.

Extract & analyze pore water-use high-press cell (3GUT001G)

Compressed seven core samples of densely welded rock from UZ6S and UZ4. Moisture contents varied from 10.4 to 15.9 percent. Water recovered ranged from 15.1 to 22.1ml. All water was recovered by compression; therefore, nitrogen injection was not required to extract adequate water for chemical analyses.

Water extracted from the seven tests conducted on densely- welded tuff was collected and will be sent for analyses of cations and anions soon. The water samples collected from these tests will be analyzed also and will be used to evaluate relationships between change in pressure and water chemistry.

Nine cores from UZ4 were prepared for 1-D compression and will be tested in October.

Prep WRIR pore-water chem vs press f/compression (3GUT015G)

The pore-water chemical data are being studied for interpretations. The WRI report is not started at this time.

WRI Report (T13M)

This report is nearly ready to submit for technical and editorial review. It is expected to be submitted for review before January 1992.

#### Quality Assurance

Conduct technical procedures training (3GUT017G)

Training of employee K. Schofield on the one dimensional compression cell and related procedures continues.

#### Planning and Operations

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

Various staff members prepared the PACS schedules for FY92 and FY93. (16 hours)

### WBS 1.2.3.3.1.3 Saturated Zone Hydrology

#### OBJECTIVE

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

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

Principal Investigator - R. Luckey

#### OBJECTIVE

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

#### SCP 8.3.1.2.3.1.2 Site potentiometric-level evaluation OG3313E1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### **Collect 1990 water-level data (3GWF004B)**

Routine tasks completed this month include: (a) monitored three wells (on a quarterly basis); (b) monitored 15 zones in 15 wells (on a monthly basis); (c) monitored 21 zones in 13 wells (on a hourly basis); (d) obtained continuous analog data on four zones of two wells (included in count of hourly sites); (e) obtained real-time data on nine zones in six wells using satellite data-collection platforms (included in count of hourly sites); (f) evaluated the status of the network at the end of each month and made recommendations for instruments that should be watched, calibrated, or replaced; and (g) monitored real-time data on a daily basis, looking for water-level excursions.

Transducers were replaced and calibrated at well USW H-1, tube 3.

Transducers were calibrated at the following wells: USW WT-2, UE-25p#1, UE-25 WT #16.

The pressure effects of one California earthquake were recorded on a strip chart for the lower zone of USW H-4.

HP-60, R1 (Method for monitoring water-level changes using pressure transducers was revised and is ready for technical review.

Barometer sn 20396 was calibrated by SVERDRUP.

##### **Prepare 1989 water-level data report (3GWF041A)**

The report "Water-levels in periodically measured wells in the Yucca Mountain area, Nevada 1989" by G. O'Brien was approved by the USGS Director on March 20. The report was received from the printer and distributed.

The reviews of the report "Water-levels in continuously measured wells in the Yucca Mountain area, Nevada 1989" by D. Lohmeyer and R. Luckey have been completed and the authors are revising the report.

##### **Reduce 1990 water-level data (3GWF023)**

D. Burkhardt developed a method for using the USGS National Water Information System software to process 1990 transducer output to water levels. The method needs to be tested

to determine if it is acceptable.

**Study accuracy and precision of water-level data (3GWF118A)**

The draft of the report "Precision and accuracy of water-level measurements taken in the Yucca Mountain area, Nevada, 1988-90" by M. Boucher has been returned from three reviewers and the author is revising the report.

**Reduce 1991 water-level data (3GWF024A)**

No work was performed on this task due to lack of manpower and higher priority being placed on 1989 and 1990 data.

**Prepare 1990 water-level data (3GWF042A)**

No work was performed on this task due to lack of manpower and higher priority being placed on 1989 and 1990 data.

**Analysis of water-level trends (3GWF220A)**

This task and milestone G009 is delayed until 9/30/92 in order to concentrate limited resources on 1990 and 1991 water-level data.

**Quality Assurance**

**Convert HP-196T (notebook) (3GWF117A)**

Work has begun and the activity is approximately 20% complete.

**Planning and Operations**

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

R. Luckey attended a hearing on the Water Appropriation Permit of use of J-13 water. (120 hours)

R. Luckey, M. Boucher, and G. O'Brien prepared for and participated in the NRC audit of this activity, including a demonstration of calibration procedures at remote data-collection sites. (88 hours)

G. O'Brien and E. Ervin attended "Hydrogeological Decision Analysis" course sponsored by DOE in Las Vegas. (40 hours - O'Brien's time only)

M. Boucher attended QA training "Root Cause Determination" (4 hours) and a Technical Data Information Form training course (4 hours).

**SCP 8.3.1.2.3.1.3 Analysis of single- and multiple-well hydraulic-stress tests 0G3313F1**

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Prepare C-Holes Hydrogeology Report (3GWF030)**

The Scientific Reports and Project Documents unit, YMP-USGS Hydrologic Investigations Program (HIP), submitted the final report version to the USGS-YMP Branch on September 23 for technical/editorial and QA review. The QA review was completed with no adverse findings.

**Prepare Scientific Notebook(s) for Earth Tide, Barometric, and Seismic (earthquake and UNE) Monitoring (3GWF130A)**

The authors of the draft Scientific Notebook procedures for Seismic monitoring (HP-221T,

and HP-222T), G. Patterson and J. Gemmell, met with G. O'Brien (one of the technical reviewers) to resolve review comments. The agreed-on changes will be incorporated into the text, and the draft submitted to QA review in October.

The barometric-monitoring-related hydrologic procedure, HP-121, for using the Setra barometric pressure transducer, was technically reviewed by G. LeCain. J. Gemmell incorporated the review comments into the text, and forwarded the document for further processing.

**Monitor the C-Holes for Earth Tide, Barometric, and Seismic Effects (3GWF035A)**

Data collection for pneumatic diffusivity calculations (needed for analysis of barometric effects in uncased boreholes) continued in UE-25c#3.

**Monitor Earth Tide, Barometric, Seismic, and UNE Responses at Selected Network Wells (3GWF036A)**

Monitoring of water level fluctuations (used in earth tide and atmospheric loading analyses) continued at USW H-4 and UE-25B#1.

Seismic monitoring continued at USW H-4.

**Prepare Intraborehole Flow and Stress Test Report (3GWF032A)**

G. Patterson continued to work on the report. The report will be completed in the first two months of FY92.

**Quality Assurance**

**Planning and Operations**

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

Updated the PACS (Planning and Control System) schedule for FY92 and FY93.

**SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0G3313G1**

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Begin Procedure to Obtain a) Power, and b) Permits at C-Holes to Conduct Cross-Hole Testing (3GWF142A)**

The process of obtaining power for the C-holes has been slowed down by change of personnel involved in processing the request. Efforts will be resumed in FY92 with the new personnel in charge.

The request for a permit waiver to allow for conducting of the c-hole tests will be initiated in FY92.

**Update New Modules to Well Test Analysis Program (3GWF146A)**

Plans for contracting the process of updating the modules to outside consultants were discussed. The contracting will take place in FY92.

**Log Temperatures in C-Holes (3GWF144A)**

Temperature logging at the C-holes will be combined with the heat-pulse flow meter logging that will be conducted by the Borehole Geophysics Unit of the USGS National Research

Program (NRP) in November 1991.

**Construct and Test Conceptual Models (3GWF147A)**

Evaluation of alternative modeling approaches commenced. This activity will be split into two, starting in FY92, namely: "Preliminary modeling to assist in cross-hole test design", and "Develop techniques to analyze cross-hole test results".

**Construct Two 3-Packer Strings (Prototype String for Laboratory and Field Testing) (3GWF140A)**

J. Gemmell (USGS) and J. Boernge (USBR) visited Tam International in Houston and conducted a partial limit test on the packers that they are manufacturing for us. An unannounced surveillance was also conducted of their manufacturing process. Both limit testing and surveillance activities produced satisfactory results.

J. Gemmell also met in Houston with Multiflex, Inc. representatives to discuss the feasibility of developing an umbilical cord that would combine all our hoses and electrical cables into one or more strings.

Meetings were held with USBR to discuss status of packer string requisitions and fabrication process. Packers are scheduled for delivery from Tam's International by mid October 1991. Fabrication of "test" units has begun. Electrical connectors and compression fittings have been ordered. Tubing and electrical cables have been purchased.

Transducers were delivered September 19. J. Gemmell conducted tests on the transducers and the results are satisfactory. The tests, however, were for the lower end of the pressure range. Further tests will have to be conducted to verify their performance for the higher pressure range.

**Construct Tracer Injection System (3GWF150A)**

The tubing has been purchased. The solenoids have been ordered. The thermistors have not been selected yet.

**Test (Laboratory) Packer String (3GWF148A)**

This task will begin once the USBR finishes constructing the 3-zone packer strings. It is currently planned that this will take place in December 1991, and January 1992.

**Quality Assurance**

**Planning and Operations**

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

Updated the PACS (Planning and Control System) schedule for FY92 and FY93.

**SCP 8.3.1.2.3.1.5 Testing of the C-hole sites with conservative tracers OG3313H1**

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Construct Models to Assist Tracer Selection (3GWF155A)**

Consideration is being given to trying a simple 1-dimensional analytical solution to the advection-dispersion equation for porous media to come up with estimates of tracer volumes and concentrations needed for the planned tracer tests.

**Develop Techniques for Solute Transport at C-Holes (3GWF154A)**

Consideration is being given to using the HST 3-dimensional solute transport code of the USGS to construct a porous-medium-equivalent model of the C-hole area, and compare its performance to a fracture-network model of the area by K. Karasaki of LBL.

**Request Permit for Tracer Injection (3GWF151A)**

Plans for FY92 are to expand the list of permitted tracers from the presently approved list.

**Quality Assurance**

**Planning and Operations**

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

Updated the PACS (Planning and Control System) schedule for FY92 and FY93.

M. Umari and G. Patterson attended a class entitled "Contaminant Hydrogeology: A Decision Analysis Framework" at the DOE-YMPO training facility in Las Vegas September 9-13.

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

Principal Investigator - R. Luckey

LBL Principal Investigator - K. Karasaki

**OBJECTIVE**

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

**SCP 8.3.1.2.3.3.1 Conceptualization of saturated zone flow models within the boundaries of the accessible environment OG3313A1**

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Synthesis of potentiometric surface map (3GWM005A)**

E. Ervin is completing corrections to the average 1988 water levels in wells near Yucca Mountain as a result of the effects of temperature and density variations, by techniques discussed by P. Oberlander, 1989, "Fluid density and gravitational variations in deep boreholes and their effect on fluid potential", Ground Water, Vol. 27, No. 3, pp. 341-350.

**Preliminary hypothesis testing phase I (3GWM009A)**

E. Ervin and A. Geldon continued work on development of a fully 3-dimensional geometric model of the Yucca Mountain area for input to the ground-water flow model to be used for preliminary hypothesis testing phase. Three-dimensional GIS packages for geometric modeling are being examined to determine which would best suit the needs of the project. Some of these packages are Dynamic Graphics, LYNX, and Intergraph.

Work is delayed due to other commitments, such as the technical needs for the J-13 permit application and the GSA field trip.



Synthesize hydraulic data at "H" wells (3GWM006A)

Work is delayed due to other commitments, such as the GSA field trip.

#### Quality Assurance

Graded (QA) model conceptualization activities (3GWM012A)

Revised Grading reports detailing limited applications of Criteria 5 and 6 were resubmitted to the QRB following rejection, by the board, of reports G1233133a and G1233133b. A memo from M. Blanchard details and clarifies guidance for the conduct of YMPO activities of programmatic importance.

#### Planning and Operations

Review (DOE) study plan 8.3.1.2.3.3.1 (3GWM001A)

YMPO review of the study plan was completed August 27 and the document was returned to HIP.

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

The 115 comments on study plan 8.3.1.2.3.3, from seven DOE reviewers, are being examined. There are approximately 44 major comments.

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

An estimated 80 hours were spent on the following:

Final plans were made by E. Ervin and M. Chornack for the 1991 Geological Society of America field trip entitled "Hydrogeologic overview and field trip of the regional ground-water flow system in relation to Yucca Mountain, Nevada" to be held October 25-27.

E. Ervin attended a training class sponsored by DOE called Hydrogeologic Decision Analysis. The course was taught by R. Freeze, J. Massmann and L. Smith September 9-13.

E. Ervin developed PACS for FY92 and FY93 for this summary account.

E. Ervin reviewed a report by J. Czarnecki entitled "Simulated water-level declines caused by withdrawals from wells J-14 and J-12 near Yucca Mountain, Nevada."

#### SCP 8.3.1.2.3.3.2 Development of fracture network model 0G3313B1

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

Supervise preliminary modeling II (3GWM002B)

E. Ervin and M. Chornack submitted their abstract entitled "Fractures in the Bullfrog Member of the Crater Flat Tuff east of Little Skull Mountain, Nye County, Nevada" to the American Geophysical Union for the fall meeting to be held in San Francisco.

A commercial program for generating steronets was purchased from Rockware, Inc, Wheat Ridge, Colorado. E. Ervin loaded and ran the program for some preliminary fracture data from east of Little Skull Mountain.

#### Quality Assurance

Grade (QA) USGS fracture-network model activity (3GWM004B)

Revised Grading reports detailing limited applications of Criteria 5 and 6 were resubmitted to the QRB following rejection, by the board, of reports G1233133a and G1233133b. A memo from M. Blanchard details and clarifies guidance for the conduct of YMPO activities

of programmatic importance.

The TPO made this task a high priority in January; thus, the work is ahead of schedule.

#### Planning and Operations

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

E. Ervin and K. Karasaki developed PACS for FY92 and FY93 for this summary account.

#### SCP 8.3.1.2.3.3.2 Development of fracture network model 0B3313C1

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

Develop preliminary model I (3GWM002C)

Simulations of radially convergent 2-dimensional tracer tests were conducted using TRINET.

K. Karasaki traveled to Denver for joint planning of technical activities for FY92 with the USGS scientists.

Compute 3-D fracture distribution from boreholes (3GWM001C)

Preliminary analysis of the Crater Flat fracture data from an aerial photo was conducted.

An algorithm that generated self-similar fracture patterns was designed for use with outcrop maps from Crater Flats as input.

#### Quality Assurance

#### Planning and Operations

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

E. Majer and associates resumed preparations for seismic field work at the C-Holes. The electronics were mounted and interfaced with the piezoelectric source. The cable was mounted on the wireline truck, the vehicle for carrying the electronics was prepared and the whole system was installed in the field vehicle.

#### WBS 1.2.3.3.2 Preclosure Hydrology

##### OBJECTIVE

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

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

Principal Investigator - P. Glancy

##### OBJECTIVE

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

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**Incorporate FY90 data in data base (3GFR005)**

Some data from the heavy runoff years of 1984 and 1990 still remain to be collected and analyzed when time permits. Most of the data collected and processed thus far have been incorporated into the YMP data base.

**Collect, analyze, evaluate FY91 flood data, ongoing (3GFR001)**

Vigilance in tracking storm events and runoff continued. Minor runoff from thunderstorms occurred in the Yucca Mountain area from thunderstorms on August 31 and in Las Vegas on September 6. Data were collected on these events as part of Activity 8.3.1.2.1.2.1. These data will be incorporated in the data base for site flood and debris hazards.

**Develop analytical schemes for the flooding process (3GFR009)**

Literature scanning and selection of articles useful to this activity were added to the technical library.

**Review of available flood-analysis techniques, ongoing (3GFR010)**

Literature scanning, sorting, and selection of appropriate knowledge continued.

**Compute PMF for Yucca Mountain drainage (3GFR003)**

The report on PMF peaks (clear water) was completed by USBR and should be transmitted for YMP review in the near future. The qualification of PMF software resumed in September; the total task is about 50% complete.

**Map PMF flood-inundation zones at Yucca Mountain (3GFR004)**

Computational work is well underway; progressing as planned.

**Quality Assurance**

**Revise technical procedures for flood data collection (3GFR012)**

About one dozen technical procedures pertaining to streamflow measurements and documentation are in varying states of review and/or revision. The reasons and/or need for those reviews and revisions are unclear. These procedures continue to be used for ongoing monitoring because they were approved several years ago.

**Planning and Operations**

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

Preparation of the FY92 and FY93 PACS package was completed. (24+ hours)

**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 1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain

Principal Investigator - J. Whitney

##### OBJECTIVE

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

#### SCP 8.3.1.5.1.4.1 Modeling of soil properties in the Yucca Mountain region 0G3621H1

##### ACTIVITIES AND ACCOMPLISHMENTS

###### Technical Activities

Synthesis and report writing (3GCH005A)

A final copy (computer and hard copy) of all the dust collected from 1984-1989 is in the process of being transferred to Water Resources Division.

###### Quality Assurance

###### Planning and Operations

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

M. Reheis attended a verification activity and quality assurance audit for the closeout of her participation in this portion of the YMP.

#### SCP 8.3.1.5.1.4.2 Surficial deposits mapping of Yucca Mountain area 0G3621I1

##### ACTIVITIES AND ACCOMPLISHMENTS

###### Technical Activities

Obtain photos (3GCH027B)

1:6,000 orthophoto quadrangles were obtained from DOE in August, 1991, to be used for compilation of the surficial geology map.

###### Quality Assurance

###### Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

J. Whitney attended QA verification activity and quality assurance audits.

Considerable time has been spent in planning, scheduling, and budgeting meetings during the transition from GD to the Geologic Studies Program.

SCP 8.3.1.5.1.4.3 Eolian history of the Yucca Mountain region OG3621J1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

J. Whitney attended verification activity and QA audit.

Considerable time has been spent in planning, scheduling, and budgeting meetings during the transition from GD to the Geologic Studies Program.

WBS 1.2.3.6.2.2 Effects of Future Climatic Conditions on Hydrologic Characteristics

OBJECTIVE

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

WBS 1.2.3.6.2.2.1 Quaternary Regional Hydrology

Principal Investigator - J. Stuckless

OBJECTIVE

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

SCP 8.3.1.5.2.1.1 Regional paleoflood evaluation OG3622A1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Research paleoflood analysis methods (3GQH006A)

Literature scanning continued. Pertinent articles were added to the YMP technical library.

Revise Coyote Wash report (3GQH005A)

Editorial and QA reviews by the YMP office were completed. The manuscript is ready for transmittal to the USGS Director for approval through the Central Region reports section.

Quality Assurance

Develop technical procedures (3GOH007A)

There was no progress this month; work will not begin until resolution of DOE study plan comments are completed.

Planning and Operations

Update/review (DOE) study plan (3GOH001A)

DOE review comments were received on August 23. Comment resolution is about 10% complete.

Work Performed but not in Direct Support of the Scheduled Tasks

Preparation of the FY92 and FY93 PACS package was completed.

SCP 8.3.1.5.2.1.3 Evaluation of past discharge areas 0G3622B1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Reduce vegetation & statistical analyze data (3GOH006)

Due to the unavailability of J. Emerick, K. Turner will statistically check the vegetation map and enter it into GIS in FY92.

Copy/scan geologic maps (3GOH040)

The geological map of Nevada data sets and the California geological data sets are being merged.

This activity has finished the 1:250,000 scale geologic maps.

Geologic maps at 1:62,500 and 1:24,000 showing more detailed geology are being copied and scanned for areas of needed geologic complexity.

Input maps to arc-info/spans (3GOH041)

This activity is continuing, the more complex the geology, the greater the time it takes to attribute the data in the data base.

Fault trace data for the Nevada region have been attributed.

Land use/land cover maps have been entered into the system.

The surface water hydrologic unit map has been input into the system.

Determine discharge mech. in hydrologic units (3GOH034A)

K. Kolm and J. Downey continued working with their report manuscripts.

Plan and conduct field trip wet and dry playas (3GOH014)

A field trip to collect wet and dry playas is planned for October 18-19 and 25-26 (before and after the GSA meeting in San Diego).

Analyze flora and fauna for wet and dry playas (3GOH026)

R. Forester (GSP) reports that this work is on schedule.

Collect and analyze soil samples (3GQH001)

A MOA with the GD Branch of Geochemistry is in place, but not all of the procedures needed for this activity have been QA'd.

Analyze fauna samples modern discharge springs (3GQH022)

R. Forester (GSP) reports that this work is on schedule.

#### Quality Assurance

#### Planning and Operations

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

Time was spent by all project personnel in preparing the new PACS information. (36 hours)

E. Gutentag prepared for ASTM standard testing for specific capacity tests. (10 hours)

#### SCP 8.3.1.5.2.1.4a Analog recharge sites 0G3422C1

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

Collect hydrologic data from remote sites (3GQH011C)

Data collected from the Kawich base, Kawich Peak, Veg Spring and Stewart base and equipment requiring calibration were cycled out of the field. Winter preparations and servicing were completed.

Annual summaries were written for Stewart and Veg Spring for air, soil temperature, solar radiation, and precipitation data.

A new data collection platform was prepared for installation and was installed at Kawich.

Initial evaluation and scoping was done on the development of hydrologic response units (HRU) at Kawich and Stewart. Arcinfo has been used to manipulate the elevation, slope and aspect data stored in INFO files. This data must be reduced from tens of thousands of polygons into several hundred polygons. Each polygon represents an area which responds to precipitation as a homogeneous hydrologic unit. The project personnel are working on developing a proficiency with the software and an understanding of how the physical characteristics of the basins interact so that the HRUs can be developed.

Prototype testing ET equipment (3GQH023C)

This activity was completed.

Prepare technical procedures for ET (3GQH025C)

This activity was completed.

Analyze methods for ET (3GQH024C)

Leaf area analysis has continued and will be proceeding through the fall.

Tens of thousands of leaves have been dried and prepared for determination of leaf area analysis.

Install equipment and collect ET data at remote sites (3GOH022C)

This work has been completed for the 1991 field season.

#### Quality Assurance

#### Planning and Operations

Procure additional ET equipment (3GOH021C)

This activity was completed.

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

Laboratory inventory, description, and CAS number identification of chemicals was completed and reported to the Associate Chief of HIP and the USGS safety officer as requested. (4 hours)

Non-essential equipment was surveyed. (4 hours)

D. Beck reviewed HP-54 modifications. (1 hour)

HP-23 underwent technical review. (16 hours)

Preparation of PACS for FY92 and FY93 was completed. (16 hours)

### SCP 8.3.1.5.2.1.4b Geochemistry of arid-zone infiltration OG3622E1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Analyze chemistry and geochronology (3GOH005C)

<sup>36</sup>Cl dates of rocks from the lowest terraces from the study site are much older than their setting would suggest, indicating heretofore unsuspected features of the transport mechanism. Collection and analysis of soil water and calcareous materials are making good progress.

Design equipment installation (3GOH009C)

The electronic integration of the long term, and eddy flux correlation measuring equipment has finally been achieved, paving the way for installation of the long-term meteorological monitoring instrumentation.

##### Quality Assurance

Design equipment installation (3GOH009C)

Two steel rules have been submitted for calibration so that they will be acceptable for use in the calibration of soil-moisture monitoring equipment.

##### Planning and Operations

### SCP 8.3.1.5.2.1.5 Studies of calcite and opaline silica vein deposits OG3622D1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Calibrate new solid source mass spectrometer (3GOH910)

The instrument, after two years of installations has never met specifications and has been returned to the factory for modification.



Develop X-ray Fluorescence procedure (3GOH002B)

B. Marshall continues to develop technical procedure GP-21, R0.

Conduct Pb isotope experimental work (3GOH125A)

B. Zartman and L. Kwak completed experimental work on leaching techniques to isolate calcite hosted lead from lead held in the insoluble silicate residue.

Map deepen Trench 14 (3GOH420)

Z. Peterman, J. Stuckless, E. Taylor, and S. Levy collected samples from the deepened trench for stable radiogenic isotopes and mineralogic analyses. In addition, mapping of the trench by photogrammetric methods has begun.

Analyze Sr isotopes-deposits at Trench 14 (3GOH422A)

The following abstract was prepared and submitted to the National 1992 GSA meeting in San Diego, California entitled "A Model for the Formation of Pedogenic Carbonate Based on Strontium Isotope Data from Southwest Nevada" by B. Marshall and S. Mahan.

Analyze Pb isotopes-deposits at Trench 14 (3GOH424A)

No new analyses have been obtained. The following abstract was prepared and submitted to the National 1992 GSA meeting in San Diego, California entitled "Lead Isotopes in the Carbonate-Silica Veins of Trench 14, Yucca Mountain, Nevada" by R. Zartman and L. Kwak.

Analyze fossils-deposits at Trench 14 (3GOH425A)

Samples for the original Trench 14 have been analyzed for microfossils. A final report is in preparation.

Analyze stable isotopes-deposits at Trench 14 (3GOH429A)

Analyses for stable isotopes have been analyzed on original Trench-14 samples.

Prepare 2nd position paper on Trench 14 (3GOH810A)

The following abstract was prepared and submitted to the National 1992 GSA meeting in San Diego, California entitled "Isotopic Evidence for a Per Descensum Origin for Hydrogenic Veins in Faults near Yucca Mountain, Nevada" by J. Stuckless, Z. Peterman, J. Whelan, and D. Muhs.

Analyze stable isotopes in deposits of known origin (3GOH004B)

The following abstract was prepared and submitted to the National 1992 GSA meeting in San Diego, California entitled "E  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  Values of Epigenetic Calcite Within Yucca Mountain, Nevada: Paleohydrologic Implications" by J. Whelan and J. Stuckless.

Analyze Sr isotopes-deposits of known origin (3GOH005B)

Strontium isotopic analysis was performed on spring deposits from Death Valley.

Analyze fossils-deposits of known origin (3GOH007B)

Samples are prepared but not studied.

Reanalyze T-14 samples if needed (3GOH126A)

Insoluble residue analyses for Sr have been performed on samples.

Analyze major GW for U, Sr, O, C, and H isotopes (3GOH018B)

The following abstract was prepared and submitted to the National 1992 GSA meeting in

San Diego, California entitled "Strontium Isotope Characterization of Ground-Water Flow Systems in Southern Nevada" by Z. Peterman, J. Stuckless, S. Mahan, E. Gutentag, and J. Downey.

Quality Assurance

Integrate data with QA verification (3GQH019B)

Integration of data with QA verification has not been performed.

Planning and Operations

Calibrate new solid source mass spectrometer (3GQH910)

Procurement of a solid-source, multicollector mass spectrometer continues to move forward. The specifications had to be reviewed by Information Systems Division as part of a new policy to scrutinize any equipment purchase to determine what proportion might be ADP equipment. Z. Peterman met with ISD to discuss and review the various components of the mass spectrometer. Among the \$350K worth of electronics components, only the PC in the digital acquisition system is ADP equipment.

WBS 1.2.3.6.2.2.2 Future Regional Hydrology due to Climate Changes

Principal Investigator - J. Stuckless

OBJECTIVE

To characterize the impacts of potential future climate changes on the regional and site surface-water system, the site unsaturated zone hydrology, and the regional and site saturated zone hydrology. (SCP Study 8.3.1.5.2.2)

SCP 8.3.1.5.2.2.1 Analysis of future surface hydrology due to climate changes 0G3622F1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

Follow up and revise study plan (831522) (3GFH010A)

Revisions to the study plan continued as part of comment resolution.

SCP 8.3.1.5.2.2.3 Synthesis of effects of possible future recharge due to climate changes on hydrologic characteristics of the Yucca Mountain saturated zone 0G3622G1

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

GSIS development maps and data sets II (3GFH002C)

SPANS (Tydac Technology) continued the testing of 1200 x 1058 SVGA board by their software experts in order to develop necessary drivers for it to operate with SPANS.

A major activity during September involved the preparation for the First International Conference/Workshop on Integration Geographic Information Systems and Environmental Modeling in Boulder, Colorado.

K. Turner presented an invited paper on 3-D GIS to the Geotech '91 Conference in Lakewood on September 24.

K. Turner began the process of reviewing the vegetation statistics data originally developed by deMarco in order to complete the map and report on the vegetation studies in the Amargosa Desert.

#### Quality Assurance

#### Planning and Operations

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

On September 30, K. Turner, K. Kolm and J. Downey discussed 3-D GIS Graphic display issues with an IBM internal research group.

Considerable time was spent developing information to present in this PACS report by all members of the staff. Also, time was spent developing work plans for project personnel.

#### WBS 1.2.3.7 Resource Potential

##### OBJECTIVE

To determine present and future resource potentials at the repository site and surrounding area; to determine the likelihood of inadvertent human intrusion into a mined geologic disposal system; and to determine the possible consequences of interference. (SCP Program 8.3.1.9)

##### WBS 1.2.3.7.2 Present and Future Value of Resources

##### OBJECTIVE

To evaluate the natural resource potential and its future economic importance at Yucca Mountain. (SCP Investigation 8.3.1.9.2)

##### WBS 1.2.3.7.2.1 Natural Resource Assessment

Principal Investigator - J. Bergquist

##### OBJECTIVE

To identify and assess the mineral and energy resource potential at the proposed repository site at Yucca Mountain; to conduct a geochemical sampling program for precious, base, strategic metals, energy resources, and industrial minerals; and to assess the potential for geothermal energy and hydrocarbon resources and the potential for undiscovered resources and future exploration. (SCP Study 8.3.1.9.2.1)

SCP 8.3.1.9.2.1.5 Mineral and energy assessment of the site, comparison to known mineralized areas, and the potential for undiscovered resources and future exploration 0G3721E1

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

Prepare report on mineral deposits 100KM Yucca Mountain (3GMR002A)

A 385 page report entitled "Mines, prospects and mineral occurrences in Esmeralda and Nye Counties, Nevada, Near Yucca Mountain" by J. Bergquist and E. McKee was completed on September 28 and transmitted to L. Hayes on September 30.

Prepare report on geophysical (3GNR002C)

USGS OFR "Geophysical characterization of mineral and energy resources at Yucca Mountain and vicinity, Nevada" by V. Langenheim, D. Hoover, and H. Oliver was transmitted to DOE on September 30.

"Petroleum geology scoping activities related to natural resource assessment of Yucca Mountain, Nevada" by J. Roe was transmitted to L. Hayes on September 30.

Prepare report on geochemical (3GNR003B)

Progress was made on analytical capabilities of the USGS analytical laboratories.

#### Quality Assurance

#### Planning and Operations

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

J. Bergquist began drafting the MOA for work in FY92 and attended meetings with program managers from WRD/GSP.

### 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 support DOE by providing Project coordination and support of NRC interactions by providing input related to site aspects of proposed NRC regulation changes, and evaluate the impact of the regulation changes on the site activities, strategies, and plans; to support DOE/HQ in the development of site technical position papers by synthesizing site and site performance assessment technical information into Project positions; to develop draft position papers which support these positions; to perform technical evaluation of site data and related reports, technical reports, and conclusions, and draft position papers; to coordinate study plan review; to support the preparation of the semi-annual progress report for site investigations and assessments; and to coordinate and perform technical reviews of the site characterization program.

#### WBS 1.2.5.2.1 NRC Interaction Support

Principal Investigator - L. Hayes

#### OBJECTIVE

To support DOE interactions on the site program with NRC by providing information, coordination, and support within the Project.

#### ACTIVITIES AND ACCOMPLISHMENTS

D. Hoxie attended the dry run on September 24 and 25 at YMPO in preparation for the NWTRB meeting on the effects of thermal loading on repository design.

D. Hoxie reviewed and commented on the document "Nuclear Regulatory Commission Draft Staff Technical Position on Geologic Repository Operations Area Underground Facility Design -- Thermal Loads."

#### WBS 1.2.5.2.2 Site Characterization Program

Principal Investigator - W. Dudley, Jr.

#### OBJECTIVE

To support the DOE in the completion of the Site Characterization Plan; to provide ongoing technical planning and support of site characterization activities; and to integrate results into site characterization activities and programs as appropriate, monitor each site program, and serve as the interface between the principal investigator and the DOE/HQ.

#### ACTIVITIES AND ACCOMPLISHMENTS

D. Hoxie participated in a field trip on September 18 to acquaint ESSE geohydrology peer-review team member D. Kreamer (UNLV) with the Yucca Mountain site and environs. On September 27, Hoxie met with ESSE peer-review team member, T. Webb (Brown University), to discuss the ESSE results for the future climate guideline.

D. Hoxie attended the training course "Hydrogeologic Decision Analysis" in Las Vegas, September 9-13.

All of the USGS written responses for the State of Nevada comments were completed by the first week in September and submitted to SAIC for preparation of the final DOE document.

#### WBS 1.2.5.2.5 Study Plan Coordination

Principal Investigator - L. Hayes

#### OBJECTIVE

To coordinate the preparation review and revision of SCP Study Plans.

#### ACTIVITIES AND ACCOMPLISHMENTS

S. Keller transmitted the September Hydrologic Investigations Program (HIP) study-plan status report to W. Causseaux September 30. Since the August monthly report, the following has been learned about HIP study plans that are in the DOE approval process or at NRC.

The comment resolution form (CRF) package for YMP-USGS SP 8.3.1.2.3.3 (Site saturated-zone hydrologic system synthesis and modeling) was transmitted to R. Luckey and E. Ervin for the initiation of author response to DOE review.

DOE/YMPO comment resolution was completed for SP 8.3.1.14.2.2 and the study plan was forwarded to DOE/HQ for transmittal to the NRC.

Reviews of the study plan for SCP activity 8.3.1.2.2.9.1 have not been completed.

#### WBS 1.2.5.4 Environment

##### OBJECTIVE

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

##### WBS 1.2.5.4.8 Water Resources

Principal Investigator - R. LaCamera

##### 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

Field collection and analyses of water quality samples for selected wells and springs were completed September 3-6. Water samples were shipped to the USGS Laboratory in Arvada, Colorado for analysis.

On September 9, G. Fasano, K. Grassmeier, and J. Gibson met with REEC Co drilling staff and U. Clanton of the DOE site characterization group for discussions on the proposed well JF-3.

On September 10, D. Beck, D. Bloom, and J. Gibson accompanied Nevada District YMP staff members on a day-long field briefing at Yucca Mountain on regional and local hydrogeology and geomorphology. The briefing was conducted by G. Dixon and P. Glancy and also included discussion of the history of site characterization work at Yucca Mountain.

The recently acquired project field vehicle was delivered to the USGS Las Vegas office on September 16. The vehicle has been modified in Carson City to facilitate collection of water quality samples.

On September 18, K. Grassmeier, G. Fasano, R. LaCamera, and J. Gibson met with REEC Co drilling staff and DOE Site Characterization Branch for further discussions concerning specifications for the proposed well JF-3. A preliminary drilling schedule was presented, and LaCamera outlined the needs and objectives of the USGS for geophysical logging before the new borehole has been cased.

R. Long, G. Fasano, and J. Gibson met with REEC Co staff on September 19 at the site of the proposed well JF-3 to discuss with the archaeologist from DRI a satisfactory site for the borehole which would avoid cultural resources.

G. Fasano and J. Gibson met with B. Thompson, SAIC, on October 3 to work out details for the geophysical logging for proposed well JF-3. It was decided that full profiles of air and water temperature will be needed for the entire depth of the borehole.

J. Harrill and R. LaCamera prepared exhibits for and presented testimony at the hearings before the Nevada State Engineer held in Las Vegas on the water permit application for well JF-3. Their testimony was given on September 30.

In the coming weeks SAIC and USGS will have to work with REEC Co drilling staff to prepare a field operations schedule for drilling and associated activities for development of the proposed well JF-3.

Water level measurements cannot now be taken at well Army-1 because there is no way to access the wellhead with measuring equipment. The pump at this well will have to be serviced in the near

future, and at that time access should be provided at the wellhead for water level measuring equipment.

## **1.2.9 PROJECT MANAGEMENT**

### **OBJECTIVE**

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

### **WBS 1.2.9.1 Management and Integration**

### **OBJECTIVE**

To provide overall management of the Yucca Mountain Project including: technical integration and interaction with other OCRWM Program elements.

### **WBS 1.2.9.1.1 Management**

Principal Investigator - L. Hayes

### **OBJECTIVE**

To provide overall management of the Yucca Mountain Project including budgeting and financial analysis, progress reporting, support to HQ management activities, training, and overall Project integration.

### **ACTIVITIES AND ACCOMPLISHMENTS**

A new training assistant was assigned to provide support in data entry and database maintenance.

Ten record packages were finalized and submitted to the LRC.

Information regarding reading assignment completion status was provided to the TPO QA Advisor for distribution during Open Items meetings. First and Second Reminder Notices were distributed for overdue reading assignments. Individual reading assignments were distributed to personnel per management's request. Participants requiring unescorted access to Yucca Mountain were scheduled for DOE's General Employee Training (GET). GET Refresher Training booklets were distributed to appropriate personnel along with options on how to complete the course.

YMP-USGS Orientation was provided by the Training Coordinator for contract personnel in Denver. The TPO QA Advisor, working with the YMP-USGS QA Manager, traveled to Reno during the week of September 9 to provide orientation and discuss the YMP QA requirements with Dr. Brune, University of Nevada-Reno, and his staff.

Several YMP-USGS personnel attended the DOE Automated Technical Data Tracking (ATDT) System Training held in Las Vegas on September 18 and the DOE Contaminant Hydrogeology class held in Las Vegas from September 9-13. The ATDT training was presented by DOE to explain the changes in data management requirements outlined in Draft AP-5.1Q R2 (Control and Transfer of Technical Data on the Yucca Mountain Project) including revisions to the Technical Data Information Form (TDIF). Participants completing the Contaminant Hydrogeology course were interviewed regarding the effectiveness and relevancy of the course in order to provide feedback to the DOE Training Officer.

Reading assignments were issued for the following modifications or revisions to procedures:

OMP-17.01,R4-M5	YMP-USGS Records Management
HP-09, R2	Construction of Piezometers in Unconsolidated Sediments
HP-56, R3	Gas and Water Vapor Sampling from Unsaturated-Zone Test Holes
HP-86, R2	Method for Degassing CO <sub>2</sub> and H <sub>2</sub> O Vapor Samples from Unsaturated Zone Test Holes
HP-179, R1	Field Measurement of Precipitation Using a Tipping Bucket Rain Gage
HP-180, R1	Field Measurement of Precipitation Using a Propane Heated Tipping Bucket Rain and Snow Gage
HP-228T, R0	Identification, Monitoring, and Sampling of Perched Water Encountered While Drilling Neutron-Access Boreholes

The Training Coordinator and four other YMP Training Representatives attended the American Society of Training and Development Regional Conference in Colorado Springs, CO, September 13-15. Following this conference, the USGS hosted a DOE Training Representatives Meeting September 16 and 17 in Golden. Prior to the beginning of the meeting, a demonstration of the YMP-USGS Instruction Database was provided to interested YMP Training Representatives.

The Training Coordinator met with L. Hayes, L. Ducret, R. Ritchey, D. Porter, and A. Whiteside on September 20 to discuss the implementation of the new WBS No. 1.2.9.1.5 for training. A consensus was reached regarding the specific types of training that would fall under this WBS Element.

#### WBS 1.2.9.1.4 Records Management

Principal Investigator - L. Hayes

#### OBJECTIVE

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

#### ACTIVITIES AND ACCOMPLISHMENTS

The LRC provided one room within the LRC for the storage of data material being received by the YMPB data personnel. The LRC provided for the magnetic tape data stored in the LRC to be rewound, certified and stored at Security Archives.

The YMP-USGS Records Coordinator attended the YMP Records Coordinator's meeting in Las Vegas September 11 and 12.

The Best Available Copy issue will be addressed upon resolution of the YMP CAR-YM-91-065 issued to the CRF for resolution of legibility and completeness issues. The YMP-USGS LRC will hold documents as part of USGS-CAR-91-08 until resolution of CAR-YM-91-065.

The LRC received 391 individual QA documents and 12 record packages. HIP submitted nine manuscript packages and Geologic Division submitted four complete packages and 21 partial packages. Six new lists of Cited References were submitted to the LRC. Six packages containing 1,042 pages of QMP-related documents were sent to the CRF. One package of manuscripts containing 854 pages was also submitted to the CRF.



Coordination, testing, and configuration were performed to place a temporary file server in the LRC. Initial testing has been completed to compare the performance of the file server at the LRC and the file server at HIP in Building 53 in providing file access for the Records Database System. LRC personnel will not use the HIP system and file server until testing has been satisfactorily completed.

Document Control issued Modification QMP-17.01,R4-M5, YMP-USGS Records Management, and the following technical procedures:

GPP-11, R1	Magnetic Methods
HP-09, R2	Construction of Piezometers in Unconsolidated Sediments
HP-56, R3	Gas and Water Vapor Sampling from Unsaturated-Zone Test Holes
HP-86, R2	Method for Degassing CO <sub>2</sub> and H <sub>2</sub> O Vapor Samples from Unsaturated Zone Test Holes
HP-179, R1	Field Measurement of Precipitation Using a Tipping Bucket Rain Gage
HP-180, R1	Field Measurement of Precipitation Using a Propane-Heated Tipping Bucket Rain and Snow Gage
HP-228T, R0	Identification, Monitoring, and Sampling of Perched Water Encountered While Drilling Neutron-Access Boreholes

J. Krulik and G. Harrell (USBR) were provided controlled copies of the YMP-USBR QA Manual. Other routine document control functions were performed including issuing procedures to new copy holders, distributing replacement documents, following up on previous distributions, and transmitting 13 completed record packages to the YMP-USGS Local Records Center.

The USGS was represented at the September 23-25 Controlled Documents Focus Group Meeting in Las Vegas. The draft Controlled Documents Management Plan was reviewed again for additional changes before submittal to the DOE Project Office. A draft revision to AP-1.5Q was reviewed to ensure its compliance with the Controlled Documents Management Plan.

Also, the Focus Group discussed the proposed Project-wide integrated controlled document distribution where Project level documents would be issued to the Participant Document Control Centers and distributed from there to their own personnel (e.g., if the USGS has 30 people on distribution for DOE procedures, USGS Document Control would get one transmittal for the 30 documents and then distribute to those 30 needing the controlled document). Tracking would be done at the Participant level, rather than out of DOE Document Control, Las Vegas.

**WBS 1.2.9.2 Project Control**  
**Principal Investigator - L. Hayes**

**OBJECTIVE**

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

**ACTIVITIES AND ACCOMPLISHMENTS**

The SAIC/Golden actual cost distribution, estimated cost distribution, FTE report, and the USGS cost report for August were compiled. The August actual costs and schedule status for the USGS were sent to Las Vegas for input into the PACS system. The compilation of the USGS monthly status report for August was completed and the report was edited and submitted to DOE.

Graphics capability to print or display the distribution curve was added to the PACS database system. S. Reisler requested other minor changes regarding editing scope of work and report format. All

changes have been made and incorporated in the PACS database system.

The status and updating of all USGS schedules were completed on time and sent to Las Vegas for input into the APECS system. Baseline comparison charts and logic charts were run on all schedules and sent to the Principal Investigators for analogy and use for next month's input.

A special run of logic plots of the saturated and unsaturated zone schedules were run and given to D. Gillies of the Hydrologic Department of the USGS for use in laying out the planned work for the FY92 and FY93 budgets. Also, the same kind of plots were run for the Geology Department and given to R. Ritchey to be distributed in a meeting to explain how to go about incorporating their new logic into the schedules.

Much time and effort has been put into redoing the schedules for FY92 and FY93. At this time approximately 1/3 of the hydrologic program has been revised and returned to the Principal Investigators for their approval and minor corrections.

Some input has been received from Geology and a first run made on it to familiarize the Principal Investigators with the process of applying logic that can be managed and controlled over the year.

S. Barnes coordinated completion of over 25 requisitions between YMP staff and the USBR Acquisition Operations Branch.

#### WBS 1.2.9.3 Quality Assurance

##### OBJECTIVE

To establish and implement a Yucca Mountain quality assurance program.

##### WBS 1.2.9.3.1 Quality Assurance Program Development

Principal Investigator - T. Chaney

##### OBJECTIVE

To establish and maintain the QA program descriptions.

##### ACTIVITIES AND ACCOMPLISHMENTS

Drafts were prepared for the QA Manager for the following documents:

ICN to YMP-USGS-QAPP-01, R5	Quality Assurance Program Plan
QMP-1.01, R4	Organization Procedure
QMP-5.03, R7	Development and Maintenance of Quality Management Procedures
QMP-5.04, R4	Preparation and Control of the YMP-USGS Quality Assurance Program Plan
QMP-2.01, R2-M1	Management Assessment of YMP-USGS Quality Assurance Program
QMP-5.02, R3-M1	Preparation and Control of Drawings

Modification QMP-17.01, R4-M5 (YMP-USGS Records Management) was approved. The concurrence draft of QMP-17.01, R5 (YMP-USGS Records Management) has been prepared and distributed for final concurrence review. Review comments were received and a concurrence draft of QMP-3.03, R3 (Software Quality Assurance) is being prepared by the Software QA Committee.

USBR Quality Assurance Program training sessions were held on September 3, 9, 16, and 23 for

Geologic Branch personnel entering YMP-USBR.

**WBS 1.2.9.3.2 Quality Assurance - Audits and Surveillances**  
Principal Investigator - T. Chaney

**OBJECTIVE**

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

**ACTIVITIES AND ACCOMPLISHMENTS**

Audit USGS-91-21 of Activity 8.3.1.17.4.4.1 "Evaluate Rock Valley Fault System" and Activity 8.3.1.17.4.3.2 "Evaluate Quaternary Faults within 100 Kilometers of Yucca Mountain" was conducted in Reno, NV and Denver, CO. One significant deficiency was noted concerning indeterminate authorization of work activities.

Audit USGS-91-22, LaCoste & Romberg Gravity Meters, Inc., was conducted. No deficiencies were identified and recommendation was made to retain the vendor on the Approved Vendors List.

Audit USGS-91-23, EG&G Geometrics, Inc., was conducted. No deficiencies were identified and the report is being prepared as required by QMP-18.01.

An Audit Team Leader Planning Checklist was prepared in response to USGS-AFR-9110-09.

QA and TPO representatives met to discuss and agree upon actions needed to resolve AFR-USGS-9110-07 concerning records issues.

Vendor Evaluation USGS-91-E13, Druck, Inc. was conducted. No deficiencies were identified and a report recommending retention of the vendor on the Approved Vendors List was submitted.

M. Mustard, J. Ziemba, and D. Porter attended the YMPO training class, Auditor/Lead Auditor Training in Las Vegas September 23-27.

USBR submitted AFR response to USGS-9007-01, R1 on September 27.

**WBS 1.2.9.3.3 Quality Assurance - Quality Engineering**  
Principal Investigator - T. Chaney

**OBJECTIVE**

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

**ACTIVITIES AND ACCOMPLISHMENTS**

Review comments were provided to the QMP coordinator for Modification QMP-17.01, R4-M5 (records). Additionally, the concurrence draft for QMP-17.01, R5 is under evaluation to assure resolution of review comments made in August. QMP-4.03, R0 is being re-drafted to address comments.

The Open Items Committee met during September to review the status of open items and to discuss actions and required resolutions for several key open items. The QA Advisor for the YMP-USGS TPO worked with the following open items during the month: External Item(s) DOE CARs YM-91-50 (technical reviewer qualifications), YM-91-51 (software QA), YM-91-52 (LRC safes), and YM-91-74

through -77 (software QA); Internal Item(s) AUDITS: AFR 9002-05 (calibration), AFR 9007-01 R1 (maintenance of USBR QA Program), AFR 9013-08 (data package submittals), AFR 9105-04 (HIP technical procedures), AFR 9110-02 (qualification records), AFR 9110-07 (record rejections) and AFR 9110-08 (30-day submittals); CAR 90-01 (interface controls), CAR 90-04 (timeliness of corrective actions), CAR 91-03 (unapproved vendors), CAR 91-06 (management assessments), CAR 91-07 (misinterpretation of QMP requirements), CAR 91-08 (transmittals for individual QA records), CAR 91-09 (misinterpretation of software QA requirements) and CAR 91-10 (misinterpretation of exemptions from procurement requirements); NCR 90-37 (calibration requirements), NCR 91-01 (accession numbering on publications), NCR 91-12 and -13 (software QA), NCR 91-14 (qualification records with Study Plans), NCR 91-18 (data submittals), NCR 91-21 (vendor calibrations), NCR 91-31 (calibration), NCR 91-36 (software) and NCR 91-39 (seismic contracts). Other miscellaneous action items included follow-up of instruction assignments, resolving overdue document control notices, coordination of audits/surveillances, discussions regarding management agreements, and trending, especially concerning deficiencies involving calibration, software and procurement.

The QA Advisor for the YMP-USGS TPO worked closely with the YMP-USGS QA Manager to provide management coverage for the NRC audit of SCP Activity 8.3.1.2.3.1.2, an ongoing monitoring activity involving site potentiometric water-level evaluations, PI - R. Luckey, USGS. The audit team members included J. Conway, NRC Audit Team Leader, J. Gilray and N. Coleman, Auditors. The audit began at the Nevada Test Site on Monday, September 16, and moved to the Denver area mid-week with a wrap-up held on Friday, September 20. The NRC acknowledged that the USGS and support personnel were very cooperative and demonstrated a positive attitude regarding the implementation of the QA program. Four potential findings involving QA implementation problems were discussed at the audit exit. There were no significant deficiencies noted with the technical program or its adequacy.

Approximately 45 items have been received, reviewed, and/or processed by the SCM Librarian in accordance with QMP-3.14. This includes updating the Configuration Status Log, the SCM Document Tracking database, and the Directory of Users. Technical Contacts have been notified upon receipt of SQA Documentation and upon SCM Baselineing of Software Products.

An Agenda and Minutes were prepared and distributed for the GCC meetings held on September 5, 12, and 26. A CCC Review Plan and Report was completed for each of the CCC Reviews conducted at those meetings.

The SCM Librarian attended several meetings with the SQA Specialist, providing input regarding the reviews of SQA. Responses to DOE CARs-91-074, -075, -076, and -077 were provided on behalf of the SQA Specialist. Investigative and remedial actions have been initiated for each CAR. Meetings were held with the SQA Specialist and the TPO QA Advisor to coordinate a response for USGS-CAR-91-09, regarding misinterpretation of QMP-3.03.

#### WBS 1.2.9.3.4 Quality Assurance - Quality Overview

Principal Investigator: T. Chaney

#### OBJECTIVE

To provide reviews, analysis, and interpretations of QA requirements and application of QA to technical and scientific disciplines.

#### ACTIVITIES AND ACCOMPLISHMENTS

The QA Advisor for the YMP-USGS TPO worked closely with the TPO and QA management personnel on various management agreements and verification activities involving the transition efforts from the Geologic Division to the USGS Yucca Mountain Project Branch Geologic Studies Program.

The new organization is slated to be in effect as of October 1 for FY92. The QA Advisor will continue to work with the TPO and QA Manager in order to develop a status report depicting the concerns and questions requiring resolution for the activities affected by the transition.