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Monthly Highlights and Status Report  
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ENCLOSURE 3

## TABLE OF CONTENTS

<b>1.2.1 SYSTEMS</b> .....	<b>1</b>
<b>WBS 1.2.1.3 Technical Data Base Management</b> .....	<b>1</b>
<b>WBS 1.2.1.3.5 Technical Data Base Input</b> .....	<b>1</b>
<b>WBS 1.2.1.4 Performance Assessment</b> .....	<b>1</b>
<b>WBS 1.2.1.4.4 Site Performance Assessment</b> .....	<b>1</b>
<b>WBS 1.2.1.4.4.2 Favorable and Adverse Conditions</b> .....	<b>2</b>
<b>WBS 1.2.1.4.6 Development and Validation of Flow and Transport Models</b> .....	<b>2</b>
<b>WBS 1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses</b> .....	<b>3</b>
<b>1.2.3 SITE</b> .....	<b>4</b>
<b>WBS 1.2.3.1 Management and Integration</b> .....	<b>4</b>
<b>WBS 1.2.3.2 Geology</b> .....	<b>11</b>
<b>WBS 1.2.3.2.2 Rock Characteristics</b> .....	<b>11</b>
<b>WBS 1.2.3.2.2.1 Geologic Framework of the Yucca Mountain Site</b> .....	<b>11</b>
<b>WBS 1.2.3.2.2.1.1 Vertical and Lateral Distribution of Stratigraphic Units within the Site Area</b> .....	<b>12</b>
<b>WBS 1.2.3.2.2.1.2 Structural Features within the Site Area</b> .....	<b>15</b>
<b>WBS 1.2.3.2.3 Erosion</b> .....	<b>19</b>
<b>WBS 1.2.3.2.3.1 Present Location and Rates of Surface Erosion</b> .....	<b>19</b>
<b>WBS 1.2.3.2.5 Postclosure Tectonics</b> .....	<b>19</b>
<b>WBS 1.2.3.2.5.3 Changes in Hydrology Due to Tectonic Events</b> .....	<b>19</b>
<b>WBS 1.2.3.2.5.3.2 Effect of Tectonic Processes and Events on Changes in Water-Table Elevation</b> .....	<b>19</b>
<b>WBS 1.2.3.2.5.5 Information Required by the Analysis and Assessment Investigations of the Tectonics Program</b> .....	<b>20</b>
<b>WBS 1.2.3.2.5.5.2 Characterization of Igneous Intrusive Features</b> .....	<b>20</b>
<b>WBS 1.2.3.2.6 Surface Characteristics</b> .....	<b>20</b>
<b>WBS 1.2.3.2.6.2 Soil and Rock Properties of Potential Locations of Surface Facilities</b> .....	<b>21</b>
<b>WBS 1.2.3.2.6.2.2 Surface Facilities Laboratory Tests and Material Property Measurements</b> .....	<b>21</b>
<b>WBS 1.2.3.2.8.4 Preclosure Tectonics Data Collection and Analysis</b> .....	<b>22</b>
<b>WBS 1.2.3.2.8.4.1 Historical and Current Seismicity</b> .....	<b>22</b>
<b>WBS 1.2.3.2.8.4.2 Location and Recency of Faulting Near Prospective Surface Facilities</b> .....	<b>23</b>
<b>WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain</b> .....	<b>24</b>
<b>WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones</b> .....	<b>24</b>
<b>WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area</b> .....	<b>26</b>
<b>WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis</b> .....	<b>26</b>
<b>WBS 1.2.3.3 Hydrology</b> .....	<b>27</b>
<b>WBS 1.2.3.3.1 Geohydrology</b> .....	<b>27</b>
<b>WBS 1.2.3.3.1.1 Description of the Regional Hydrologic System</b> .....	<b>27</b>
<b>WBS 1.2.3.3.1.1.1 Precipitation and Meteorological Monitoring for Regional Hydrology</b> .....	<b>27</b>
<b>WBS 1.2.3.3.1.1.2 Runoff and Streamflow</b> .....	<b>30</b>
<b>WBS 1.2.3.3.1.1.3 Regional Ground-Water Flow System</b> .....	<b>32</b>
<b>WBS 1.2.3.3.1.1.4 Regional Hydrologic System Synthesis and Modeling</b> .....	<b>37</b>
<b>WBS 1.2.3.3.1.2 Unsaturated Zone Hydrology</b> .....	<b>39</b>

WBS 1.2.3.3.1.2.1	Unsaturated Zone Infiltration	40
WBS 1.2.3.3.1.2.3	Percolation in the Unsaturated Zone - Surface Based Study	43
WBS 1.2.3.3.1.2.4	Percolation in the Unsaturated Zone - ESF Study	49
WBS 1.2.3.3.1.2.6	Gaseous-Phase Movement in the Unsaturated Zone	52
WBS 1.2.3.3.1.2.7	Unsaturated Zone Hydrochemistry	54
WBS 1.2.3.3.1.2.8	Fluid Flow in Unsaturated Zone Fractured Rock	57
WBS 1.2.3.3.1.2.9	Site Unsaturated Zone Modeling and Synthesis	58
WBS 1.2.3.3.1.2.10	Prototype Hydrologic Tests that Support Multiple Site Characterization Activities	61
WBS 1.2.3.3.1.3	Saturated Zone Hydrology	65
WBS 1.2.3.3.1.3.1	Site Saturated Zone Ground-Water Flow System	65
WBS 1.2.3.3.1.3.2	Saturated Zone Hydrochemistry	71
WBS 1.2.3.3.1.3.3	Saturated Zone Hydrologic System Synthesis and Modeling	72
WBS 1.2.3.3.2	Preclosure Hydrology	75
WBS 1.2.3.3.2.1	Flood Recurrence Intervals and Levels at Potential Locations of Surface Facilities	75
WBS 1.2.3.6	Climatology and Meteorology	76
WBS 1.2.3.6.2	Climatology	76
WBS 1.2.3.6.2.1	Change in Climatic Conditions	76
WBS 1.2.3.6.2.1.1	Modern Regional Climate	76
WBS 1.2.3.6.2.1.2	Paleoclimate Study of Lake, Playa, and Marsh Deposits	76
WBS 1.2.3.6.2.1.3	Climatic Implications of Terrestrial Paleocology	77
WBS 1.2.3.6.2.1.4	Paleoenvironmental History of Yucca Mountain	77
WBS 1.2.3.6.2.2	Effects of Future Climatic Conditions on Hydrologic Characteristics	78
WBS 1.2.3.6.2.2.1	Quaternary Regional Hydrology	78
WBS 1.2.3.6.2.2.2	Future Regional Hydrology due to Climate Changes	84
<b>1.2.5</b>	<b>REGULATORY AND INSTITUTIONAL</b>	<b>87</b>
WBS 1.2.5.2	Licensing	87
WBS 1.2.5.2.1	NRC Interaction Support	87
WBS 1.2.5.2.5	Study Plan Coordination	87
WBS 1.2.5.4	Environment	88
WBS 1.2.5.4.8	Water Resources	88
<b>1.2.9</b>	<b>PROJECT MANAGEMENT</b>	<b>90</b>
WBS 1.2.9.1	Management and Integration	90
WBS 1.2.9.1.4	Records Management	90
WBS 1.2.9.1.5	Training	91
WBS 1.2.9.2	Project Control	92
WBS 1.2.9.3	Quality Assurance	92
WBS 1.2.9.3.1	Quality Assurance Program Development	92
WBS 1.2.9.3.2	Quality Assurance - Audits and Surveillances	93
WBS 1.2.9.3.3	Quality Assurance - Quality Engineering	94
WBS 1.2.9.3.4	Quality Assurance - Quality Overview	95

## ACRONYM LIST

A&E .....	architectural and engineering
ABC .....	American Borate Corporation
ACD .....	advanced conceptual design
ACM .....	alternative conceptual model
ACNW .....	Advisory Committee on Nuclear Waste
ACP .....	Area Characterization Plan
ACS .....	American Chemical Society
ACWP .....	actual cost of work performed
ADN .....	Affected Document Notice
ADP .....	automated data processing
ADTS .....	Automated Data Tracking System
AEC .....	Atomic Energy Commission
AECB .....	Atomic Energy Control Board
AECL .....	Atomic Energy of Canada, Ltd.
AEG .....	Association of Engineering Geologists
AFOS .....	Automated Field Operating System
AFR .....	Audit Finding Report
AGU .....	American Geophysical Union
AIH .....	American Institute of Hydrology
ALARA .....	as low as reasonably possible
ALTS .....	Apache Leap Tuff Site
AMA .....	Assistant Manager for Administration
AMFM .....	alternative means of financing and managing
AML .....	Arc Macro Language
AMP .....	Administrative Management Procedure
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
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
EDXRF	energy-dispersive x-ray fluorescence
EEI	Edison Electric Institute
EEP	Emergency Evaluation Plan
EFAP	Environmental Field Assessment Plan
EIA	Emergency Information Administration
EIS	Environmental Impact Statement
EKES	Electronic Keyed-Entry System
EM	electromagnetic
EMP	electron-microprobe
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ERC	Engineering Request Change

ERDA	Energy Research and Development Administration
EROS	Earth Resource Observatory System
ERTP	Environment Requirements Training Program
ES	exploratory shaft
ESF	Exploratory Studies Facility
ESF/DRD	Exploratory Shaft Facility Design Requirements Document
ESQAT	Earth Science Quality Assurance Team
ESR	electron spin resonance
ESSE	Early Site Suitability Evaluation
ESTC	Exploratory Shaft Test Coordination
ESTP	Exploratory Shaft Test Plan
ESTP-C	Exploratory Shaft Test Plan Committee
ET	evapotranspiration
EV	earned value
FEHMS	Finite Element Heat Mass and Stress
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FFS	Federal Financial System
FFS	Federal financial system
FFT	Fast-Fourier Transform
FID	Flame Ionization Detector
FIS	Federal interim storage
FITS	Facilities Important to Safety
FMMG	Fracture Matrix Mesh Generator
FMN	Fortymile neutron
FOLD	Federally Owned Landsat Data
FP	final procedures
FPC	final procurement and construction
FQI	Federal Quality Institute
FR	Federal Register
FRD	Functional Requirement Document
FRHP	Fractured Rock Hydrology Program
FSN	Fenix and Scisson, Nevada
FSU	Florida State University
FTE	full-time equivalent
FWP	field work proposal
FY	fiscal year
G&A	Goodson and Associates
GAO	Government Accounting Office
GAP	Geostatistical Analysis Package
GC	gas chromatograph
GCM	Global Climate Model
GCP	Geochronological Procedure
GD	Geologic Division
GEOEAS	Geostatistical Environmental Software
GET	General Employee Training
GETT	grants equal to taxes
GID	Ground Water Site Investigation
GIS	Geologic Information System
GIS	Graphic Information System
GOCO	government-owned contractor-operated
GOES	Geostatistical Environmental Operational Satellite

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

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

M&TE .....	measuring and test equipment
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
NCTM .....	National Computer Technology Meeting
NEA .....	Nuclear Energy Agency
NEPA .....	National Environmental Policy Act
NFS .....	Nuclear Fuel Services
NGS .....	National Geodetic Survey
NHP .....	Nuclear Hydrology Program (now HIP)
NIST .....	National Institute of Standards and Technology
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
PMI	Phase Measuring Interferometry
PMIS	Program Management Information System
PMP	Program Management Plan
PMR	performance measurement review
PMS	Program Management System
PNL	Pacific Northwest Laboratories
PPWE	prototype pore-water extraction
PQM	Project Quality Management
PRBP	project review briefing package
PRC	Project Records Center
PRDA	Program Research and Development Announcement
PRESS	Project-related Engineering and Scientific Studies
PRMS	Precipitation Runoff Modeling System
PSAR	Preliminary Safety Analysis Report
PSI	pounds per square inch
PTP	Prototype Test Plan
PTS	Petroleum Testing Services
QA/QC	quality assurance/quality control
QA	Quality Assurance
QAG	Quality Assurance Grading
QAGR	Quality Assurance Grading Report

QALA	Quality Assurance Level Assignment
QALAS	Quality Assurance Level Assignment Sheet
QAM	Quality Assurance Manager
QAP	Quality Assurance Program
QAPD	Quality Assurance Program Description
QAPO	Quality Assurance Project Officer
QAPP	Quality Assurance Program Plan
QAR	Quality Assignment Records
QARD	Quality Assurance Requirements Document
QASC	Quality Assurance Support Contractor
QMP	Quality Management Procedure
QMPR	Quality Management Policies and Requirements
QRA	Quality Related Activities
QRB	Quality Review Board
QVC	Quality Verification Check
QWL	quality of work life
R&D	research and development
R&H	receiving and handling
R&LSD	Research and Laboratory Services Division
RALD	right angle laser deflectometer
RAM	responsibility assignment matrix
RASA	Regional Aquifer Study Assessment
RASRA	radial arm strike rail assembly
RCR	Regional Characterization Report
RCRA	Resource Conservation and Recovery Act
REBS	Radiation Energy Balance Systems
REECo	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
SOAP	Software Quality Assurance Plan
SRD	system requirements and description
SRG	strike rail goniometer
SRM	standard reference material
SRP	Site Recommendation Report
SSF	software summary forms

SSF	specified software forms
SSR	Site Selection Report
SSSA	Soil Science Society of America
STC	Southern Tracer Complex
SWO	stop-work order
SZ	saturated zone
T&MSS	Technical and Management Support Services
T&MSS SP	T&MSS Standard Practice Procedure
TAR	Technical Assessment Review
TBD	to be determined
TBM	Tunnel Boring Method
TC	Technical Contact
TC	Training Coordinator
TCF	telescoping camera pedestal
TCPAL	Thermocouple Psychrometer Calibration
TDAG	Technical Data Advisory Group
TDB	Technical Data Base
TDD	Test Descriptions Document
TDF	task definition form
TDIF	Technical Data Information Form
TDR	time domain reflectometry
TDS	total dissolved solids
TEF	Test and Evaluation Facility
TESS	TRW Environmental Safety Systems
TFA	Temporary Field Assistant
TIC	Technical Information Center
TM	thematic mapper
TP	Technical Procedure
TPEC	Technical Proposal Evaluation Committee
TPO	Technical Project Officer
TPT	Testing Prioritization Task
TQM	Total Quality Management
TRIG	Technical Review and Integration Group
TRIMS	Technical and Regulatory Information Management System
TRU	Transuranic
TSR	Technical Status Report
TVA	Tennessee Valley Authority
UNE	Underground Nuclear Explosion
UNLV	University of Nevada at Las Vegas
UNR	University of Nevada, Reno
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
WSA	Wilderness Study Area
WSNSO	Weather Service Nuclear Support Office
WSP	Water Supply Paper
WT	water table
WVDP	West Valley Demonstration Project
WY	water year
YM	Yucca Mountain
YMP	Yucca Mountain Project
YMPB	Yucca Mountain Project Branch
YMPO	Yucca Mountain Project Office

## 1.2.1 SYSTEMS

### OBJECTIVE

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

### WBS 1.2.1.3 Technical Data Base Management

### OBJECTIVE

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

### WBS 1.2.1.3.5 Technical Data Base Input

Principal Investigator - L. Hayes

### OBJECTIVE

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

### ACTIVITIES AND ACCOMPLISHMENTS

The Participant Data Archives (PDA) accepted 16 Technical Data Information Forms (TDIFs) covering SCP Activities 8.3.1.2.2.3.1, 8.3.1.4.2.1.3, 8.3.1.5.2.1.4, 8.3.1.5.2.1.5, 8.3.1.17.4.7.1, and 8.3.1.17.4.7.2.

Input of data information into the Automated Technical Data Tracking System (ATDT) has been brought up to date for the issuance of the second quarterly data catalog.

Requests are being processed from the USBR to have the Geologic Division (GD) data transferred to them for those activities assigned to the them.

### WBS 1.2.1.4 Performance Assessment

### OBJECTIVE

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

### WBS 1.2.1.4.4 Site Performance Assessment

### OBJECTIVE

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

WBS 1.2.1.4.4.2 Favorable and Adverse Conditions

Principal Investigator - A. Flint

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GPA001 Develop imbibition system at OSU**

Imbibition set-up has been developed and core tests have been run. A computer program has been written and is currently being assessed to further automate the calculation of sorptivity from imbibition curves.

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

A written plan for this project is currently being written to organize the preliminary modeling efforts and incorporate a preliminary neutron calibration using data from recently drilled boreholes N-54 and N-55.

Quality Assurance

Planning and Operations

WBS 1.2.1.4.6 Development and Validation of Flow and Transport Models

Principal Investigator - A. Flint

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GVF004 Literature review of thermal conductivity and heat capacity**

A literature compilation has been done on thermal conductivity and heat capacity, as well as instrumentation methodology, and has been assessed.

**3GVF013 Analyze horizontal variability from Shardy base transect**

The analysis of the horizontal variability along the Shardy Base transect has been completed and final aspects will be worked out during the finalization of the technical report in 3GVF014 (Prepare technical report, horizontal variability of Shardy base transect).

**3GVF009 Continue development of 3D borehole imbibition model**

Current understanding of particle density/porosity/bulk density relationships is being assessed to set up reasonable input parameters for this model. Materials Testing Lab reports are also being evaluated. G-Tunnel core samples are being organized to run through the gas pycnometer for particle density to support or negate some previous

questionable results. Preliminary runs have been made to assess the development of the mesh.

**3GVF015 Finalize geostatistical software and text**

Finalization of the software is almost complete, along with the final revisions of the text.

**3GVF001 Prepare for core heating experiment**

All samples from Calico Hills and repository block outcrops have been prepared and saturated for initial physical property measurements. A 3-point imbibition method is being evaluated to easily obtain flow parameters on all samples to evaluate effects of heating on flow processes.

**3GVF005 Develop method for thermal conduct & heat capacity**

Heating techniques are being developed and evaluated. Methodology to prepare samples by drilling very small holes has been assessed and appropriate equipment is being procured.

**3GVF014 Prepare technical report, horizontal variability of Shardy base transect**

A first draft of the technical report has been prepared and a compilation of the data analysis is being incorporated into the draft.

Quality Assurance

Planning and Operations

WBS 1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses

Principal Investigator - A. Flint

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GPC001 Develop calibration procedure, test CX-2**

The calibration system developed using saturated salt solutions is being repeated over time to assess instrument stability. A procedure to validate internal instrument temperature (IR sensor is incorporated in the measurement) has been developed and calibrated. The system is currently being tested using rock samples and preliminary procedure outlines have been written.

**3GPC004 Finish measurement on transect core, preliminary data analysis**

Core samples have been organized and all data is being compiled to determine final measurements required to complete transect data set. Preliminary data analysis of physical and hydrologic features is ongoing.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks  
Worked in support of public tours. (5 hours)

### 1.2.3 SITE

#### OBJECTIVE

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

#### WBS 1.2.3.1 Management and Integration

Principal Investigator - L. Hayes

#### OBJECTIVE

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

#### M&I - Branch 0G3192B1

Summary Account Manager - L. Ducret

#### ACTIVITIES AND ACCOMPLISHMENTS

R. Craig attended (a) Prototype Management Team meetings on January 10, 17, and 24; (b) Exploratory Studies Facility (ESF) meetings on January 10, 17, and 24; (c) UZ-16 Task Force meetings on January 9, 16, and 30; (d) the Technical Integration Group meetings on January 9 and 16; (e) a Design Requirements meeting on January 21; (f) a Design Review meeting on January 28 and provided review of UE-25 NRG-1 design material; (g) a YMPB staff meeting in Denver on January 13; (h) a Verification of Comments meeting on January 9; and (i) a Sample Overview meeting at the Sample Management Facility (SMF) January 23.

R. Craig provided overviews of Yucca Mountain geology and hydrology programs as part of the public open house tour on January 22.

#### M&I - Geologic Studies Program 0G3192G1

Summary Account Manager - J. Stuckless

#### ACTIVITIES AND ACCOMPLISHMENTS

Visited Travertine Point to examine a locality described in the Minority Report for the J. Szymanski review. Collected five samples to examine the alleged change in grain size as a function of elevation of exposure. There appears to be no correlation between depth of crystallization and crystal size as claimed in the report.

Prepared reviews of the Minority and Majority Reports on the J. Szymanski reviews.

Continued work on MOAs with the Geologic Division.

Continued work on start up of GSP.

Revised final report on Trench 14 for the Waste Management '92 symposium and submitted it for approvals.

Study plan 8.3.1.4.2.1: Completed final changes following comment resolution.

Study plan 8.3.1.5.1.3: Completed draft responses to comments and resubmitted to DOE for comment verification.

Study plan 8.3.1.9.2.1: Completed comment responses and resubmitted to DOE for comment resolution.

Study plan 8.3.1.17.4.3: Completed first draft of study plan and initiated formal USGS review.

Study plan 8.3.1.17.4.5: Arranged schedule for comment resolution 2/6/92.

Work Performed but not in Direct Support of the Scheduled Tasks  
Assisted in a DOE field trip for a number of congressional aids.

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

#### ACTIVITIES AND ACCOMPLISHMENTS

The YMP-USGS list of configuration control items requiring response to the DOE YMPO was updated. A configuration management change request and change directive were evaluated, and the Affected Document Notice (ADN) CR 92-005 was completed and returned to the YMP Configuration Control Board Secretary.

Twelve hydrologic and one geologic technical procedures and one scientific notebook plan were prepared or changed as requested.

A Change Request (CR) was coordinated to modify the SCPB as the result of a need to move the seismic profiling task from Study 8.3.1.17.4.3 to 8.3.1.4.2.1.

Test Planning Packages were developed for Studies 8.3.1.17.4.2 and 8.3.1.4.2.1.

Preparation began on an IMOU for Study 8.3.1.17.4.2.

Preparation began on a Management Agreement with the Nevada District.

Assistance was given to the GSP in the evaluation and response to the Transition Plan for the Southern Great Basin Seismic Network.

Documentation to delineate the working relationship between the USGS, SNL, and Geomatrix Consultants, Inc. was coordinated for the GSP.

An informal prerequisites review continued for Studies 8.3.1.5.1.2 and 8.3.1.5.1.3 to prepare for work authorization.

The GSP was assisted with responses to and/or remedial/investigative actions for five CARs and NCRs.

PACS reports were investigated and a report prepared covering anticipated GSP FY92 field work.

Lesson plans, view graphs, handouts, and a mock example were prepared and Software Quality Assurance Overview Sessions and Software Quality Assurance Implementation Workshops were conducted in the Denver area to implement training to QMP-3.03, R3, Software Quality Assurance.

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

M&I - Hydrology Program Management and Administration 0G3192H1

Summary Account Manager - D. Gillies

ACTIVITIES AND ACCOMPLISHMENTS

Detailed FY92 budgets were developed for all 60 USGS and LBL PACS Summary Accounts in the hydrology program. Budgets account for all staff hours, travel, contracts, supplies and materials, non-capital equipment, laboratory services, and common services planned for each account.

All 60 USGS and LBL summary-account schedules were stated as of the end of December using schedule status and progress information provided by each summary-account manager as a part of the USGS's routine monthly-reporting process. Minor schedule variances were noted in several accounts.

D. Appel attended a meeting January 16 at the HRF with staff from the Unsaturated-Zone Infiltration and Surface-Water Runoff projects. Discussion focussed on priorities for installation of continuous streamflow stations in washes on Yucca Mountain.

A meeting was held in Denver on January 14 to discuss integration of data being collected by the Water Resources Assessment project with Site Potentiometric-Level data being collected for site characterization. The use of various USGS NWIS data bases for accomplishing data integration also was discussed.

Hydrology Program senior staff met twice during the month to formulate a response to a corrective action report involving untimely closeout of open quality-assurance items.

A Saturated-Zone/Quaternary Hydrology section meeting was held on January 17 to discuss the current study of hydrogenic deposits in the Amargosa Desert, recent deep drilling by a petroleum exploration company, status of monitoring well JF-3, and the use of QA implementation specialists.

The new Hydrology Program contract for technical services (Foothill) was awarded January 17.

M&I OA Implementation, Hydrology 0G3192H2

Summary Account Manager - W. Causseaux

ACTIVITIES AND ACCOMPLISHMENTS

HIP is currently processing 36 Hydrologic Procedures and six Scientific Notebook Plans.

Two approved Hydrologic Procedures and two approved Scientific Notebook Plans were submitted to SAIC by S. Frans.

Corrective actions for NCR 91-06 and 91-38 were completed by J. LaMonaca.

J. Woolverton worked with J. Ferarese to complete Investigative Actions for USGS-NCR-91-31. It was determined that calibration documentation problems associated with QA Balance Services Inc. did not have an adverse impact on quality from the use of analytical balances on work performed for SCP activity 8.3.1.2.2.7.1 - Gaseous-phase UZ hydrochemistry.

W. Causseaux met with A. Lykins of the QA Office and T. Mendez-Vigo of SAIC/Golden on January 29 to finalize proposed draft revisions for QMP-4.01, R4, QMP-7.01, R5, and QMP-7.04, R0. The draft revisions were submitted to the QA Office on January for review and transmittal to

the TPO for technical reviews by GSP and HIP.

D. Appel and W. Causseaux met with M. Mustard on January 30 to discuss the HIP memorandum dated 01/24/92, to the QA Manager, regarding HIP Section Chief opinions on CAR-92-02, untimely HIP actions on QA Corrective Actions during 1991. As a result of this meeting, the HIP will make changes in its draft proposed disposition for CAR-92-02.

J. Ziemba of SAIC/Golden visited W. Causseaux and J. LaMonaca to verify the HIP actions associated with NCR-91-06 regarding incorrect processing of two scientific publications. As a result of the visit, NCR-91-06 was closed.

J. Woolverton served as a principal interface between the YMP-USGS audit team and UZ technical staff during Audit USGS-92-02 which was conducted January 13-24, 1992 for SCP activity 8.3.1.2.2.3.2 - UZ site vertical borehole studies and SCP activity 8.3.1.2.2.6.1 - UZ gaseous-phase circulation study.

D. Appel, W. Causseaux, M. Chornack, and J. Woolverton of HIP met with T. Chaney and M. Mustard on January 24 to discuss USGS Audit 92-02 preliminary findings for SCP Activity 8.3.1.2.2.6.1. As a result of the meeting, Appel noted that HIP needed to clarify the present status of the Activity, with special reference to current funding, assigned personnel, and the status of ongoing work subject to QA controls.

J. Woolverton continued to assist C. Peters in the preparation of a management agreement between the YMPB and the Branch of Petroleum Geology for SCP activity 8.3.1.2.2.7.1 - Gaseous-phase UZ hydrochemistry.

D. Appel met with W. Causseaux on January 9 to discuss proposed changes in the format that will be used for the preparation of management agreements with USGS entities that will be doing work for the HIP, YMPB. Then Causseaux discussed with L. Hayes the HIP opinion that HIP management agreements with such entities as USGS, GD laboratories should not be required to comply with the new format established by the GSP-GD management agreements. Hayes agreed to discuss the matter with GD officials. C. Peters visited Causseaux on January 27 to express his concern about the unfavorable impact on his relationship with the Isotope laboratory, of the continued delays in YMPB completion of the management agreement with the lab.

On January 14, D. Appel and W. Causseaux met with B. Lewis, R. Luckey, D. Gillies, D. Beck, M. Whitfield, M. Boucher, M. Pabst and J. Woolverton to discuss USGS CAR-92-02 -- untimely HIP completion of deficiency reports. The corrective action report subject matter includes continued late response and completion of corrective actions committed in deficiency documents by the Hydrologic Investigation Program.

D. Appel and W. Causseaux met with B. Lewis and J. Woolverton to discuss USGS CAR-92-03; i.e. - Management Agreements needed between HIP and organizations (and individuals) outside the YMPB.

F. Packard, Oregon District Groundwater Specialist, met with J. Woolverton to discuss the YMP-USGS Quality Assurance Program. Packard requested copies of the YMP-USGS QAPP, OMPs, and a list of current approved Technical Procedures.

J. Woolverton traveled to the Hydrologic Research Facility January 6-10 to work with A. Flint's staff on QA related issues for SCP activity 8.3.1.2.1.1.1. - Precipitation and meteorological monitoring.

D. Appel met with W. Causseaux, R. Luckey, M. Boucher and J. Woolverton on January 24 to finalize the HIP proposed disposition for CAR-92-02. As a result of agreements reached at this meeting, the final proposed disposition was submitted by Appel to the QA Office.

D. Appel, R. Luckey, M. Whitfield, W. Causseaux, and M. Boucher represented the HIP staff at a scoping meeting on January 27 with K. McFall of YMPO regarding the upcoming YMPO Audit 92-13, scheduled for Denver on April 6-10, 1992. Causseaux met with McFall of YMPO and T. Chaney on January 27 to finalize a list of HIP funded SCP Activities that might be candidates for technical audit during the April 1992 YMPO Audit of the USGS.

W. Causseaux met with M. Mustard on January 29 to discuss final plans for the USGS Audit 92-03, scheduled for Denver starting February 18, 1992. Selected Activities to be audited are included in SCP Studies 8.3.1.2.1.3, 8.3.1.2.1.4, 8.3.1.2.3.1, 8.3.1.2.3.2, and 8.3.1.5.2.2.

Six published abstract packages, one Geologic Studies Program publication package and two published Lawrence Berkeley Laboratory publication packages were submitted to the LRC.

### Computer Operation & Data Management, Hydrology 0G3192H3

Summary Account Manager - C. Washington

#### ACTIVITIES AND ACCOMPLISHMENTS

##### New NOVELL File Server

The backup software to handle the 1-Gigabyte disk drives has been received, installed and tested.

The users will be switched on February 7, 1992 to the new Novell File Server.

The Local Record Center (LRC) will not be switched until the T-1 link has been installed and tested in the Parfet building.

##### Telecommunication link to Parfet Building

The link to the Parfet building is not adequate for data base access for the LRC.

The T-1 remote bridges, on loan from a vendor, were tested and checked out at T-1 speeds.

The order has been placed to purchase the T-1 bridges. By upgrading existing bridges, problems are being experienced with the USGS Property Unit and the DOE Property Unit. The bridges have USGS property tags and the USGS wants to eliminate the old numbers. DOE has restricted any elimination of property until they develop a procedure.

The T-1 link has been ordered from U.S. West and as of February 3, 1992, a date of completion has not been received.

##### Telecommunication link (56Kbs) to HRF, Area 25, NTS.

The Computer Operations Unit (COU) experienced problems connecting all of the PCs at the HRF due to the WitTel's misunderstanding of when all of the ports were to be wired. WitTel has now wired all ports and the COU is connecting and verifying operations.

The old 19.2 Kbs link is scheduled for discontinuance on or about March 1, 1992.

##### Data General Workstations

The COU, in conjunction with the Data Management Unit (DMU), considered the

requirements of the DMU and the Administrative Section. The Data General hardware proposed for the initial implementation of AIS and NWIS are as follow:

- 1 - Data General Aviiion Server
  - 2 - 1 GB disk drives
  - 1 - 8mm Tape drive
  - 1 - QIC Tape drive
- 3 - Diskless Data General Workstations (Administrative Section)
- 1 - Data General Laser printer (Administrative Section)

The implementation of diskless workstations in the Parfet building is to ensure proper software installation and backup procedures.

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

#### ACTIVITIES AND ACCOMPLISHMENTS

HIP is currently processing 86 YMP-HIP scientific publications, 54 YMP-GSP scientific publications, 10 YMP-LBL scientific publications, and 14 abstracts.

The HIP review of the following reports and abstract were completed by T. Brady: "Design of a three-dimensional site-scale model for the unsaturated zone at YM Nevada", by C.S. Wittwer, G.S. Bodvarsson, M.P. Chornack, A.L. Flint, L.E. Flint, B.D. Lewis, R.W. Spengler, and C.A. Rautman; "Seismic reflection profiling across Tertiary extensional structures in the eastern Amargosa Desert, southern Nevada, Basin and Range province", by T.M. Brocher, M.D. Carr, K.E. Fox, Jr., and P.E. Hart; "Characterization of fault-filling deposits in the vicinity of Yucca Mountain, Nevada", by J.S. Stuckless, Z.E. Peterman, R.L. Forester, J.F. Whelan, D.T. Vaniman, B.D. Marshall, and E.M. Taylor; "Prediction of actual solar radiation using modeled clear sky radiation and air temperature", by A.L. Flint and L.E. Flint; and abstract, "Paleohydrology of lakes as a means for climatic reconstruction--examples of full-glacial records from a midwestern upland pond and slackwater basin", by B. Curry, F.L. Forester, and N.K. Bleur.

W. Causseaux met with D. Porter of SAIC/Golden on January 2 to discuss the fact that the YMPO will be issuing new guidelines for the preparation of QA Grading Reports for SCP Studies. The new guidelines are likely to impact the preparation of HIP's remaining QAGRs and the implementation of QMP-5.15, R0; therefore, processing of HIP QAGRs was temporarily suspended.

W. Causseaux discussed with B. Lewis, on January 17, the status of HIP responses to the State of Nevada comments on Study Plan 8.3.1.2.1.1 - Precipitation and Meteorological monitoring. It was determined that A. Flint would complete his assessment of HIP responses and prepare for submittal to YMPO by February 7, 1992.

W. Causseaux talked to D. Grawley of the YMPO on January 23 about the status of the study plan for SCP-8.3.1.2.2.9. The last remaining YMPO review, by Lawrence Livermore, is now expected at YMPO by the end of January.

J. LaMonaca met with P. Reilly, SAIC/Golden on January 14 to discuss the processing of scientific reports for the Geologic Studies Program. A flow chart will be constructed for a better

understanding of the processing requirements.

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

**ACTIVITIES AND ACCOMPLISHMENTS**

Routine jobs were performed though out the month, including the retrieval of the QW data from the WRD National Water Laboratory, entering these data into the HIP NWIS data base and the cleanup of the Satellite Transmission of data (SATIN) maintenance logs and directories.

Extra maintenance was necessary for the data bases due to a PRIME crash during the month. Such maintenance becomes more necessary as the transition from DIS-I hardware to DIS-II hardware progresses and the PRIMEs are retired.

B. Kerans had several discussions with M. Wallendorf concerning agenda items for the January CCC meeting. The meeting was held January 9. The upcoming QMP-3.03 training was discussed, as well as questions on requirements for purchasing commercial software.

The WRD National Computer Technology Meeting (NCTM) is coming up in May and B. Kerans spent some time this month discussing subject ideas and "peer reviewing" abstracts for presentations that would effect the handling of the new NWIS-II data bases.

All members of the DMU attended the training for QMP-3.03 on Software Quality Assurance, in order to ascertain how to handle the software programs and data bases under their management and be of service to participants. There were still some questions following the training. B. Kerans, as CCC representative, drafted a memorandum to D. Gockel in an attempt to clarify some of the outstanding problems.

B. Kerans has been spending a good portion of her time learning the operation and setup of the Data General computers. This has included the introduction to the window application within the Ingress data base package called Window/4GL.

The Data Management Unit has been working the Computer Operations Unit in defining the needs in term of Data General hardware purchases to satisfy the requirements of DMU and the Administrative Unit. New software is expected by the end of this year in replacing the AFIMS and CDP functions.

Three meetings of the DMU were held this month to discuss the job duties of each person in the group and to go over plans in the assembly of data from the different PIs. This also included an overview done by D. Burkhardt covering specific topics concerning GIS data base operations within the ARC/INFO GIS software. There are now plans to meet with the DOE EG&G people to learn more about the plans for the DOE GIS data base and to add requirements for passing data to the GIS Technical Data Base.

D. Burkhardt has also been working on various continuous water levels records. This includes starting on a check of the values in the 1985-88 report, producing the first copy of the tables for the 1990 report, and computing the corrections needed for the voltages collected in 10 of 14 wells required for the report to DOE on the response of the wells during an earthquake on December 16-18, 1991.

A meeting was held with D. Beck, D. Wood, D. Gillies, R. Luckey, B. Kerans, W. Oatfield and N. Stuthmann to discuss problems that Nevada has in entering data. Most of the discussion concerned

the problems in keeping the DOE data apart from other district data until the data are ready for release.

W. Oatfield reviewed a list of QW records sent by K. Garcia, Nevada District. Oatfield made a copy of the National Archives master accession list and passed to D. Wood the most probable delivery dates that represented HIP record deliveries to the Archives.

W. Oatfield used data from his files and some position calculations from these records and created a reference table of field IDs and NWIS primary keys for the Saturated Zone Regional GW project and S. Keller. Oatfield retrieved GWSI latitude/longitude locations of these sites supplemented with copies of notes on sites not in the data base were sent to Keller.

W. Oatfield polled R. Healy, D. Stannard, E. Weeks, D. Pollack, and J. McLean about typical UZ parameters used in the studies, and about where this type of data might be stored. He has also reviewed the GW Branch numbered technical memos and other reports for authoritative statements of policy about locating wells in the field.

Now that W. Oatfield is trying to clarify some of the specific data problems and needs of YMP participants, the DMU group is trying to locate and review the available NWIS-II design specifications to see if YMP needs may be met. This will be an ongoing project for the DMU, as detailed information is not easily available at the current time.

The Data Management Unit has an ongoing responsibility for user assistance for participants. This month assistance has (a) located data from the NWQL for some new GSP members and helped set them up for future retrievals; (b) assisted participants with information for classes that were being taken at the training center; (c) assisted HIP staff who were new to the HIP LAN and software packages; and (d) set up staff with QVARSA IDs and automatic continuum "pulls" to participate in a statistics course.

WBS 1.2.3.2 Geology  
Principal Investigator - J. Stuckless

OBJECTIVE

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

WBS 1.2.3.2.2 Rock Characteristics

OBJECTIVE

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

WBS 1.2.3.2.2.1 Geologic Framework of the Yucca Mountain Site

OBJECTIVE

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

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

Principal Investigator - R. Spengler

OBJECTIVE

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

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

0G3221A2

Summary Account Manager - Z. Peterman

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGU002A Geochemical isotopic sampling and analysis, phase 1

The staff of the Isotope Geochemistry Support Group of GSP continued work in support of Stratigraphic Studies and Geologic Mapping of Zonal Features.

S. Mahan and Kraft have nearly completed preparation of samples and energy-dispersive X-ray fluorescence (EDXRF) analyses of core samples from the high-silica rhyolite of the Topopah Spring Member of the Paintbrush Tuff. These samples will be used to determine the utility of the systematic variation in Sr-isotope ratios as a potential stratigraphic indicator.

Z. Peterman and J. Paces participated in the Rock Characteristics Workshop held in Las Vegas on January 14. Peterman described some of the isotopic and geochemical work underway by the Isotope Geochemistry Support Group.

B. Marshall reviewed an NRC report on geochemical analogs and provided comments to the Southwest Research Institute for inclusion in a proceedings publication. Marshall completed a comparison of analytical and iterative thermal model solutions. A discrepancy exists due to simplifying assumptions made in the analytical solution. For the Christmas Lake dike, the iterative (finite difference) technique yields more accurate results.

3GGU010A Compilation of existing boreholes, lithologic logs

The start of this activity has been deferred due to the Section Chief's involvement in planning, and while the formal process to fill a vacancy in the Rock Characteristics section continues. There is no milestone impact at this time.

Quality Assurance

3GGU002A Geochemical isotopic sampling and analysis, phase 1

B. Marshall completed calibration of the energy-dispersive X-ray fluorescence unit following replacement of the tube.

Planning and Operations

3GGU002A Geochemical isotopic sampling and analysis, phase 1

Finnigan Mat has delayed delivery of the new automated solid-source mass spectrometer by one month (now due mid-March). This delay will impact the date for bringing this unit on-line, but isotopic work will continue on existing NBS and VG Isomass units.

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

An estimated 120 hours were spent on the following:

Prepared for and attended the Rock Characterization Workshop held for DOE in Las Vegas. R. Spengler chaired the meeting and provided an overview of Rock Characteristics Section accomplishments and plans for future investigations for FY92 and FY93. Z. Peterman provided an update on the isotopic and geochemical work underway for rock characterization projects by the Isotope Geochemistry Support Group. C. Hunter and J. Paces participated in discussions with DOE personnel.

The section chief participated in Drillhole Sequencing meeting sponsored by the Sample Oversight Committee (SOC).

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

Summary Account Manager - C. Hunter

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### **3GTQ005J Write seismic contract**

This task is 85% complete. After completion of the Request for Proposal document in late November 1991, subsequent delays in the procurement process have required some revisions. The necessary new documents have been completed and resubmitted to the contract office. The section chief's office and T. Brocher continue to work with QA and with DOE (including meetings with G. Roberson and D. Williams in Las Vegas) to resolve DOE concerns with respect to Geophysics Peer Review Panel suggestions in regard to the planned seismic lines across Yucca Mountain, and necessary revisions to the SCPB and RFP documents.

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

Approximately 55% of the compilation and technical review of previously acquired gravity and magnetic data from Fortymile Wash is complete. This review will be used to refine the approach to be used for acquisition of new data in the site region, particularly in support of seismic investigations.

##### **3GGU250 Collect and reduce magnetic/gravity in Yucca Wash**

This activity to collect magnetic and gravity data in investigations to support interpretation of the seismic lines to be run in Yucca Wash is awaiting approval of the study plan. This information will be used to target the location for proposed corehole USW G-5. Data from this activity will also provide constraints on the interpretation of regional variation in the stratigraphic relationships at Yucca Mountain. There is no milestone impact at this time.

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

Compilation of previously collected data has begun under this review of regional geophysics. The review will be used to refine the planning and selection of procedures and collection parameters for acquisition of future geophysical data.

H. Oliver completed a new two-dimensional analysis of gravity profiles across Yucca Mountain in terms of deep detachment faults. This work, along with geologic input from K. Fox, has been added to the gravity chapter in the proposed USGS bulletin "Status of Regional Geophysical Studies at Yucca Mountain and Vicinity, Nevada and California." Other chapter authors have been contacted to answer review comments and to submit revised chapters to Oliver.

H. Oliver's group has also done work on another report listed in the MOA and received DOE approval for the USGS Open-file Report 91-620 on geophysical characterization of mineral and energy resources at Yucca Mountain. They are currently taking steps to have 200 copies reproduced for DOE distribution.

Additional work was also performed detailing gravity/magnetic profiles across Midway Valley and Fortymile Wash. H. Oliver expects to have this report into final review next month.

**3GGU201 Collect/reduce gravity/magnetic data along seismic profile**

Activity on this effort to obtain gravity and magnetic data in support of the seismic profiles to be conducted across Yucca Mountain from Crater Flat to Yucca Wash is awaiting final approval of the study plan. Information from this task will support interpretation of the seismic profiles. There is no milestone impact at this time.

**3GTQ006J Oversee field operations**

Field operations to obtain seismic data along profiles crossing Yucca Mountain and along Yucca Wash, using shallow vibration methods and deep shotholes, are not yet underway. These efforts are awaiting approval of the vendor contract which is in the procurement system after submittal of revised documents this month.

Quality Assurance

**3GGU220 QA documentation of software**

This activity to complete documentation of data reduction software for gravity and magnetic studies is approximately 25% complete. Progress has been made in outlining details of gravity and magnetic surveys that are planned along Yucca Wash and along seismic profiles over Yucca Mountain in support of the seismological investigations. The MOAs for formal participation by the investigators have been completed and signed by the Branch Chief for geophysics.

Planning and Operations

**3GGF223 Study plan approval**

The study plan for this activity, included under approval of the 8.3.1.4.2.1 "Vertical and Lateral Distribution of Stratigraphic Units within the Site Area" study plan, has complete resolution of review comments and has been submitted to DOE for verification of revisions and final approval.

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 40 hours were spent on the following:

Prepared for and attended the Rock Characterization Workshop held for DOE in Las Vegas. R. Spengler summarized the progress on seismic efforts, including resolution of DOE concerns with respect to the seismic lines. Spengler and C. Hunter used the travel opportunity to meet directly with DOE representatives.

The manuscript "Seismic Reflection Profiling across Tertiary Extensional Structures in the eastern Amargosa Desert, southern Nevada Basin and Range Province, United States," by T. Brocher et al., has received approval of the Director and has been sent on to DOE and to the Geological Society of America for publication.

The section chief completed the memorandum of agreement for gravity and magnetic investigations in the rock characteristics section.

SCP 8.3.1.4.2.1.3 Borehole geophysical surveys 0G3221C2

Summary Account Manager - P. Nelson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

Efforts have begun to evaluate the commercially available array of downhole electrical logging methods. The first activity in this effort was a comparison test between Dresser-Atlas and Schlumberger to evaluate a variety of logs and different models of tools to facilitate comparisons to logging runs made in Yucca Mountain holes in the early 1980's.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 40 hours were spent on the following:

Prepared for and attended the Rock Characterization Workshop held for DOE in Las Vegas. P. Nelson made a presentation detailing the status of the understanding of appropriate geophysical logging approaches used in previous drilling efforts and planned for future drillholes.

The section chief completed the memorandum of agreement for borehole geophysical work in the rock characteristics program.

WBS 1.2.3.2.2.1.2 Structural Features within the Site Area

Principal Investigator - R. Spengler

OBJECTIVE

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

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

Summary Account Manager - C. Hunter

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GGF184A Structural analysis of exposed fault zone**

A. Braun and assistant located and surveyed a detailed grid for mapping characteristics of the Ghost Dance fault within the proposed repository area. Each segment of the grid will be 200 feet by 200 feet and will allow work to be done at varying scales to the same foundation grid. This field work is the first of numerous site visits. The efforts will characterize a large number of parameters along the fault and will be integrated into the geologic model.

**3GGF182A Analyses of samples TPT, THT, T**

Outcrop samples from reference sections were selected and submitted for Sr isotopic analyses.

Z. Peterman and J. Paces participated in the Rock Characteristics Workshop held in Las Vegas on January 14. Peterman described some of the isotopic and geochemical work underway by the Isotope Geochemistry Support Group.

B. Marshall reviewed an NRC report on geochemical analogs and provided comments to the Southwest Research Institute for inclusion in a proceedings publication. Marshall completed a comparison of analytical and iterative thermal model solutions. A discrepancy exists due to simplifying assumptions made in the analytical solution. For the Christmas Lake dike, the iterative (finite difference) technique yields more accurate results.

The planned starts of tasks 3GGF124 (Reconnaissance of the study area), 3GGF160 (Revise technical procedure on analysis of volcanic rocks), 3GGF131A (Field check southern and western Yucca Mountain mapping), 3GGF101 (Review and revise outcrop sections of TPT), and 3GGF125 (phase 1 geologic map northeast corner of site) were moved out while the formal process continues to fill a vacancy in the Rock Characteristics section.

#### Quality Assurance

3GGF182A Analyses of samples TPT, THT, T

B. Marshall completed calibration of the energy-dispersive X-ray fluorescence unit following replacement of the tube.

#### Planning and Operations

3GGF182A Analyses of samples TPT, THT, T

Finnigan Mat has delayed delivery of the new automated solid-source mass spectrometer by one month (now due mid-March). This delay will impact the date for bringing this unit online, but isotopic work will continue on existing NBS and VG Isomass units.

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

Prepared for and attended the Rock Characterization Workshop held for DOE in Las Vegas. R. Spengler provided an overview of efforts in mapping and integration of these efforts into the overall program. (10 hours)

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

Summary Account Manager - M. Fahy

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GGF160A Revise technical procedures, grid design, RC gage development

The Data Notebook TP is 30% complete.

Revisions for GP-12 are 40% complete.

3GGF159A Design fracture data base; software QA

"CLUSTRAN" software has arrived and will be processed for QA according to USBR QMP-3.03b. SURFER and GRAPHER have also arrived and will be processed.

The basic data base structure is 80% complete. Internal review is complete.

3GGF152A Fracture data login

Morgan's data login (OFR 89-92) is complete.

The pavement data login is 60% complete. Request for the release of the partial pavement data set will be initiated through USBR TPO to USGS TPO, attention A. Handy.

The field records are not available. Implications for the project include the lack of data support for a planned Open-File Report by C. Barton.

#### **3GGF100 Map and analyze fractures in Tiva Canyon member**

A working map (1:2000') showing the azimuths of major clusters with respect to orientation for all Level 1 fracture data stations is complete. This map was used in the DOE presentations in Las Vegas. Separation of fracture data based on interpretation of cooling versus non-cooling is 70% complete. Working maps for cooling and tectonic joints at Fran Ridge are complete and were presented at the DOE meeting in Las Vegas. Results indicate that both cooling and tectonic joints are laterally heterogeneous even at this small scale. Implications for the project include limitations on the grid size for any significant fluid flow modeling in the UZ and SZ portions of the project.

AVTD analyses along Dead Yucca Ridge remain 90% complete. Initial working maps were shown at the DOE Las Vegas meeting.

Preliminary stereoplots are 90% complete for the available data.

Copies of Scott and Bonk's field notebooks have been delivered to USBR. Login is 10% complete.

S. Beason and M. McKeown's (Level 1) profile data for the ramp alignments has been checked and will be submitted to the LRC.

AUTOCAD DXF files for the preliminary contoured stereoplots and pole plots are 10% complete. Priority on Level 1 data. The topographic DXF files are promised by EG&G for the end of January, 1992. The joint diagrams will be merged with the topographic bases. Training continues on AUTOCAD ver11.

#### Quality Assurance

3GGF159A Design fracture data base; software QA.

Initial approval for software QA for "DIPS" is complete. The testing plan is 50% complete. Testing will be done by comparison with Micronet.

#### Planning and Operations

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

M. Fahy attended the YMP Rock Characteristics Workshop held for DOE in Las Vegas and summarized the work underway on the analysis of the surface fracture networks. (20 hours)

#### SCP 8.3.1.4.2.2.3 Borehole evaluation of faults and fractures OG322112

Summary Account Manager - J. Wright

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GGU004F Review vendors techniques; acquisition

A paper by K. Burns entitled "Geological structures for Televiewer Logs of GT-2, Fenton Hill, New Mexico", LA-10619-HDR parts 1 & 2 was reviewed. A meeting was held with

CER Corporation, Las Vegas, Nevada, to determine their capabilities in subsurface fracture characterization. Initial cataloging of fracture data from G-4 and G-2 begun.

Quality Assurance

3GGF03AF Surveillance QA

The Surveillance Report S-91-06 was completed and transmitted to the USBR Quality Assurance Manager on January 15. This task is 100% complete.

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

Preparation for the YMP Rock Characteristics Workshop. (16 hours)

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

Summary Account Manager - S. Beason

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

3GGF006B Excavate test pit

Work has begun on re-writing the criteria letter for deepening of the Fran Ridge Pits.

Planning and Operations

3GGF002B Synthesize data base design

This activity has been rescheduled to better fit with the hiring of a photogrammetrist in late spring 1992.

Work Performed but not in Direct Support of the Scheduled Tasks

S. Beason attended the YMP Rock Characteristics Workshop on January 14 in Las Vegas. (20 hours)

SCP 8.3.1.4.2.2.5 Seismic tomography/vertical seismic profiling 0B3221A2

Summary Account Manager - E. Majer

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGF030B Validate interpretational codes ANI90 and BEAM87

ANI90 and VELIN3D computer processing codes were tested using actual data from NTS Area 2. This testing involved ray tracing on 3-dimensional fold anisotropy and comparing to measured results from the field data. This activity is ongoing and is 20% completed.

Quality Assurance

Planning and Operations

3GGF031B Update ESF planning documents

This effort has been deferred awaiting determination of the ESF configuration with no milestone impact at this time.

### WBS 1.2.3.2.3 Erosion

#### OBJECTIVE

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

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

Principal Investigator - J. Whitney

#### OBJECTIVE

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

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

Summary Account Manager - J. Coe

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

DOE and NRC have selected erosion as the first topic for issue resolution on Yucca Mountain. J. Whitney attended an initial strategy meeting with DOE in Las Vegas to plan the outline of the technical chapters of the DOE staff position paper on erosion.

#### Quality Assurance

#### Planning and Operations

J. Coe's transfer to the project from Geologic Division was delayed until February.

### WBS 1.2.3.2.5 Postclosure Tectonics

#### OBJECTIVE

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

#### WBS 1.2.3.2.5.3 Changes in Hydrology Due to Tectonic Events

#### OBJECTIVE

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

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

Principal Investigator - J. Whitney

#### OBJECTIVE

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

SCP 8.3.1.8.3.2.5 Effects of faulting on water-table elevation 0G3253A2

Summary Account Manager - C. Fridrich

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Summary account manager C. Fridrich moved from Las Vegas to Denver in early January and set up a temporary office in the Parfet building. Work continued on an interpretive report on the large hydraulic gradient. Meetings were held with investigators from HIP to discuss strategies for future investigations on the large hydraulic gradient.

Quality Assurance

Planning and Operations

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

OBJECTIVE

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

WBS 1.2.3.2.5.5.2 Characterization of Igneous Intrusive Features

Principal Investigator - J. Sass

OBJECTIVE

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

SCP 8.3.1.8.5.2.3 Heat flow at Yucca Mountain and evaluation of regional ambient heat flow and local heat flow anomalies 0G3255B2

Summary Account Manager - J. Sass

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Several QA reading assignments were completed and QA documents were updated as additions were received.

Planning and Operations

Several companies were interviewed for calibration services. Project personnel began testing commercial accuracy standards on newly purchased equipment.

WBS 1.2.3.2.6 Surface Characteristics

OBJECTIVE

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

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

OBJECTIVE

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

WBS 1.2.3.2.6.2.2 Surface Facilities Laboratory Tests and Material Property Measurements

Principal Investigator - M. McKeown

OBJECTIVE

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

SCP 8.3.1.14.2.2 Laboratory test and material property measurements 0G3262A2

Summary Account Manager - M. McKeown

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

The schedule assumes field and laboratory testing would begin in mid-November, but the failure to complete the Test Planning Package requires revising the start date to mid-February, 1992. The resultant slippage of dependent activities includes an impact on Title II design.

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

All necessary planning documentation is in place for starting this activity except the Test Planning Package being prepared by others.

**3GSR006 Materials testing: soil/rock-physical/mechanical properties**

This activity cannot start until field exploration starts.

**3GSR007 Design data submittal for North Ramp**

This activity cannot start until field exploration begins.

Quality Assurance

**3GSR002 Prepare QA grading report submit for review**

The QAGR was submitted and approved in November.

Planning and Operations

**3GSR001M Study plan approval NRC**

The study plan for Soil/Rock Investigations was verbally approved; written approval is expected soon.

Work Performed but not in Direct Support of the Scheduled Tasks

A site selection report for six alternative North Portal alignments was completed and is in review. This report presents the important geotechnical considerations for the six potential alignments of the north portal ramp.

### WBS 1.2.3.2.8 Preclosure Tectonics

#### OBJECTIVE

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

### WBS 1.2.3.2.8.4 Preclosure Tectonics Data Collection and Analysis

#### OBJECTIVE

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

### WBS 1.2.3.2.8.4.1 Historical and Current Seismicity

Principal Investigator - K. Shedlock

#### OBJECTIVE

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

### SCP 8.3.1.17.4.1.2 Monitor current seismicity 0G3284HB

Summary Account Manager - K. Shedlock

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GSM160A Monitor 1992 seismicity

Seismic activity was monitored and recorded in January.

The following activities have been delayed because a signed memorandum of agreement is not in place and funds for fieldwork are not available: 3GSM150A Install SGBSN nodes (2); 3GSM156A Continue SGBSN site preparation; 3GSM113A Install USNSN node Gold Mountain; and 3GSM120A Select SGBSN sites. In general all upgrade activities have been suspended temporarily.

#### Quality Assurance

#### Planning and Operations

##### 3GSM114A Complete transition -- sign MOA

USGS-UNR transition plan was sent to DOE, but final approval was not given during January. A memorandum of agreement was written in November based on this transition plan, but is not been signed because of a disagreement on the timing of the transfer of data collection from the USGS to UNR. A new transition plan may be written to reflect schedule changes in the transfer of seismic monitoring responsibilities.

WBS 1.2.3.2.8.4.2 Location and Recency of Faulting Near Prospective Surface Facilities  
Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.2.1 Identify appropriate trench locations in Midway Valley 0G32841B  
Summary Account Manager - F. Swan

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFP001 Excavate and log soil pits

Environmental surveys for the soil test pits are expected to be completed in February. Test plan activities were coordinated between Geomatrix and DOE.

3GFP002 Surficial mapping in Midway Valley

A conference paper was prepared for the March 1992 Waste Management Conference in Tucson, Arizona, entitled "Recent Characterization of Activities of Midway Valley as a Potential Repository Surface Facility Site."

Geomatrix personnel received USGS quality assurance training and technical procedures to read from the USGS QA Office.

Certification for Non-Federal Contractor Personnel Qualification was completed in accordance with OMP-2.08.

Quality Assurance

Planning and Operations

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

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFP012 Complete trench log on trench ABR-B

Final drafting of trench logs for trench ABR-B were completed and work continued on a draft report to accompany the trench log.

F. Swan presented results-to-date of surficial mapping in Midway Valley and the study of trench ABR-3 to the Nuclear Waste Technical Review Board on January 22. Graphics for the presentation were prepared by Geomatrix and approved by DOE.

A draft scientific notebook plan was written for this activity and reviewed in house. The SNP was sent to the USGS for review and approval.

3GFP005 Write criteria and assemble job package for trenches

The project is waiting for environmental surveys of the long trench to be completed.

Quality Assurance

Planning and Operations

WBS 1.2.3.2.8.4.3 Quaternary Faulting within 100 km of Yucca Mountain

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.3.2 Evaluate Quaternary faults within 100 km of Yucca Mountain 0G3284K2

Summary Account Manager - L. Anderson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

The project started compilation of a map of Quaternary faults within 100 km of Yucca Mountain.

Work continues on compiling existing data on faults in the 100 km region. Data is being entered into a reference data base.

A technical procedure on using aerial photos to collect data is being revised after USBR QA comments.

Quality Assurance

Planning and Operations

The study plan was reviewed by the USGS and revised after review. The study plan will be sent to DOE for review in February.

WBS 1.2.3.2.8.4.4 Quaternary Faulting within Northeast-Trending Fault Zones

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.4.1 Evaluate the Rock Valley fault system 0G3284Q2

Summary Account Manager - D. O'Leary

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

D. O'Leary participated in the OCRWM field trip in late January and received a NTS badge and security briefing. He visited Yucca Mountain, met Nevada project staff, and briefly visited his future field areas.

Quality Assurance

Planning and Operations

A memorandum of agreement with the Office of Energy and Marine was written for the half-time participation of D. O'Leary. The MOA has been signed by all but one individual. A revised study plan was completed and submitted to the section chief for review.

WBS 1.2.3.2.8.4.5 Detachment Faults

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.5.1 Evaluate the significance of the Miocene-Paleozoic contact in the Calico Hills area to detachment faulting within the site area 0G3284S2

Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

Comment resolution meeting on the study plan is scheduled with DOE for early February. The transfer of a geologist from the Geologic Division to WRD-YMP-GSP to complete the geologic mapping of Calico Hills is moving through the personnel system.

Work Performed but not in Direct Support of the Scheduled Tasks

At the request of the GSP branch chief, W. Hamilton wrote parts of a guidebook for a OCRWM and participants field trip that took place from January 28-31. Hamilton also served as a field trip facilitator and speaker on the trip.

SCP 8.3.1.17.4.5.2 Evaluate postulated detachment faults in the Beatty-Bare Mountain area 0G3284T2

Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Data collection awaits study plan approval.

Quality Assurance

Planning and Operations

WBS 1.2.3.2.8.4.6 Quaternary Faulting within the Site Area

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.6.1 Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain  
0G3284C2

Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

No work was done on this activity in December. The official transfer of an individual scientist to YMP-GSP to work on this activity has been delayed until February. Hire of new USGS tectonic specialist is now scheduled for mid-March.

SCP 8.3.1.17.4.6.2 Evaluate age and recurrence of movement on suspected and known Quaternary faults  
0G3284D2

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Work was begun on a progress report to characterize the Quaternary faults near Yucca Mountain based on available information (Report 3GPF18M, Interpretive Quaternary Fault YM).

Quality Assurance

Planning and Operations

WBS 1.2.3.2.8.4.12 Tectonic Models and Synthesis

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.17.4.12.1 Evaluate tectonic processes and tectonic stability at the site 0G3284A1  
Summary Account Manager - W. Hamilton

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

3GTE001K Draft study plan and USGS review

Work on Study Plan 8.3.1.17.4.12 was postponed due to W. Hamilton's efforts to prepare the field trip guidebook and participate in a OCRWM field trip this month.

3GTE06JA Order thematic map -- 1:100,00

Ordering of enhanced thematic mapper images at 1:100,000 scale has been delayed until a sole source justification is written.

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)

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GMM10A Analysis of station data-FY91**

Work continued to format the station data.

The planned finish date was delayed because of underestimation of time required to process large amounts of data. Also, work was slowed because of diversion of staff to other high-priority tasks including: 1) intense effort to calibrate neutron-moisture meters; 2) baseline moisture conditions in two newly drilled neutron holes, N54 and N55; 3) calibration of tipping-bucket rain gauges; 4) preparation of snow gauges for winter; and 5) assisting with four public and 11 special tours of YM and the HRF during the first quarter of FY92.

**3GMM034 Analysis of regional data-FY91**

Methods of analysis were discussed, and plans were made to organize regional data into computer spreadsheets.

The planned finish date was delayed because of underestimation of time required to process large amounts of data. Also, work was slowed because of diversion of staff to other high-priority tasks including: 1) intense effort to calibrate neutron-moisture meters; 2) baseline moisture conditions in two newly drilled neutron holes, N54 and N55; 3) calibration of tipping-bucket rain gauges; 4) preparation of snow gauges for winter; and 5) assisting with four public and 11 special tours of YM and the HRF during the first quarter of FY92.

**3GMM080 Analysis of Yucca Mountain precipitation data-FY91**

Collection gage data was organized into a spreadsheet format for comparison and analysis.

The planned finish date was delayed because of underestimation of time required to process large amounts of data. Also, work was slowed because of diversion of staff to other high-priority tasks including: 1) intense effort to calibrate neutron-moisture meters; 2) baseline moisture conditions in two newly drilled neutron holes, N54 and N55; 3) calibration of tipping-bucket rain gauges; 4) preparation of snow gauges for winter; and 5) assisting with four public and 11 special tours of YM and the HRF during the first quarter of FY92.

**3GMM060 Design optical lightning detection network**

To determine the feasibility for an optical lightning detection network, an analysis of the lightning strike data was planned. This study will determine statistically if the available data from the NTS lightning detection system is adequate to successfully correlate total catch versus lightning strike density without adding an optical lightning network.

The planned finish date was delayed because the technology required to establish an automated network is still being worked out by the manufacturer of the optical lightning detector. In addition, the need for additional lightning data is still being evaluated. The activity is "on hold."

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

The ongoing effort to monitor weather station and tipping-bucket data continued. To enhance the consistency of data collection, a schedule for downloading and checking for inconsistencies and errors was established. Data will be downloaded within the first 10 days

of each month for the preceding month's data.

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

Precipitation and evaporation data continued to be collected as available from regional sources.

**3GMM070 Collect GOES data-FY92**

Collection and archiving of GOES satellite data continued.

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

A significant winter storm invaded the Yucca Mountain region on January 3-6. Many gages recorded over 1.5 inches of precipitation. The mean areal catch was over 1 inch. The data were recorded and filed. Maintenance was performed as necessary on the network.

**3GMM100 Monitor daily weather patterns-FY92**

The synoptic weather patterns were monitored and documented during the month. Written procedures were prepared that will permit anyone to obtain the data in the absence of the meteorologist.

**3GMM23A Collect NTS lightning data-FY92**

No lightning activity occurred in the Yucca Mountain region during the month; however, detection equipment was in continual operation.

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

Laboratory calibration of 1.0mm Sierra-Misco raingauges continued. One gauge was completed and swapped with the one at Weather Station 4 (Yucca Mountain crest). Calibration of the second gauge was nearly complete.

**3GMM33A Design tipping-bucket network expansion**

The planned finish date was delayed because in addition to diversion of staff to the high-priority tasks described above, more statistical analyses of FY91 precipitation events needs to be done to better determine where additional rain gauges need to be located.

Quality Assurance

**3GMM066 Graded QA and other QA requirements**

All QA requirements were accomplished.

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

A procedure was drafted regarding the operation of the collection gage network. The network will consist of three types of collection gages--plastic wedges, 4" diameter plastic gages, and 8" diameter metal gages.

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

Worked in support of public tours. (18 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 0G3311F2

Summary Account Manager - T. Kane

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GRS002A Collect FY92 runoff and streamflow data

The average precipitation throughout the network for the period of December 13, 1991 to January 9, 1992, was 1.60 inches. Rainfall ranged from 0.75 inch at Indian Springs to 3.70 inches at Stockade Pass above Area 12.

Stockade Pass above Area 12 had 1.2 feet of snow on the ground, January 8.

Unnamed tributary to Fortymile Wash had snowpack in the channel 0.3 foot to 4 feet deep.

Road runoff at Amargosa River near Beatty at the Crest stage gage was estimated at 0.675 to 0.725 cfs.

Topopah Wash at Little Skull Mountain had an estimated flow of 7.4 cfs. Flow came across Lathrop Wells road and flowed down past the Crest Stage gage.

Amargosa River at Tecopa showed rise of 1.77 feet recorded on the chart for January 5. In addition, two excellent high-water marks were in agreement with stages of 1.68 feet and 1.88 feet. An estimated flow of 30 cfs was applied to the peak stage of 1.88 feet.

Amargosa River tributary No. 2, near Johnnie, Nevada, was estimated to have flowed at 2.0 cfs. Precipitation and runoff was caused by a three-day storm front January 4-6.

The average precipitation throughout the network for the period of January 10-30 was 0.03 inch. No runoff was noted during this period.

The status report of September, 1991, refers to the storm of the Labor Day holiday. This area was revisited due to conversations with USGS meteorologists on the Nevada Test Site. A visual inspection of Yucca Mountain from top to base, along with Ghost-Dance Wash, Abandoned Wash, and Dune Wash, was made on January 29. The results confirmed the status report of September. The flow which was a result of an intense downpour, used the gradient of the road cut to carry both heavy sediment and water back and forth across the road surface and in and out of individual washes. The amount of water was estimated to be under 10 cfs.

Levels were run at the following stations:

Fortymile Wash near Amargosa 10251258  
Fortymile Wash at the Narrows 10251250  
Cane Springs Wash tributary near Cane Springs 10251265

Cross sections were also made to reference present channel conditions and to determine slope. Levels were run to verify data.

**3GRS022A Complete FY 83-35 data and prepare report**

The report is at present in the District Office, Carson City, for retyping. Surface-water records are still under final review by the PI and are scheduled to leave for District level review in the next two weeks.

#### Quality Assurance

**3GRS027A Complete technical procedures for streamflow data collection**

HPs 100, 117, 166, and 219 are at HIP for review and then submittal to QA office. HPs 40, 43, 44, 114, and 169 are with the PI for comment resolution.

#### Planning and Operations

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

On January 27, five springs in Ash Meadows and Death Valley were measured using the current meter. Method measurements are used to verify current ratings for flumes at individual sites. (14 hours)

Three man days of work was applied to developing a new site atlas. This work was performed in cooperation with EG&G. Site IDs for stream gages and precipitation gages were determined. Latitude and longitude coordinates were established. New and old sites for the gages were plotted and information passed on to EG&G.

An inspection was made at new office facilities at HRF. Space is needed for upcoming projects. Coordination of space is now in progress. (4 hours)

#### SCP 83.1.2.1.2.2 Transport of debris by severe runoff 0G3311G2

Summary Account Manager - D. Grasso

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

**3GRS002B Field reconnaissance of severe runoff features**

P. Glancy continued reconnaissance work in the vicinity of the confluence of Fortymile Wash and the Amargosa River seeking evidence of severe historical runoff from the Wash into the Amargosa River drainage. One long-term resident was interviewed regarding his observations of the large flood of 1969; however, no useful information was obtained. Channels comprising the tributary channel system of the Fortymile Wash alluvial fan were examined near their crossing at U.S. Highway 95. Only three of about seven definable channels show evidence of recent runoff. Of these active channels, only one appears to have a capacity to transmit flows on the order of 1,000 cfs, or greater. More interviews and field work are planned for this spring.

D. Grasso and P. Glancy conducted a site visit and field evaluation of the Copper Canyon

mudflow west of Walker Lake, Nevada. This area was subjected to a severe runoff event in August 1990 (Glancy) that resulted in the deposition of an extensive mudflow deposit that spread radially out onto the distal toe slope of the Copper Canyon alluvial fan. Field evidence shows that the mudflow carried only small pebbles to the distal end of the fan, and that at least one and possibly two lower magnitude floods have occurred since August of 1990. While the viscous mudflow of 1990 was a slow-moving, over-bank flood event, the later floods appear to have been less viscous and confined to the channel. The second flood, which was probably generated in the granitic foothills of the drainage, may have partially eroded muds of the earlier event, and has apparently deposited much coarser and angular granitic debris on top of the earlier mudflow deposits within the channel. The reconnaissance efforts also evidence a possible third, and latest event, within the drainage. This flood appears to have partially eroded deposits of both earlier events.

P. Glancy printed additional photographs of the 1990 mudflow at Copper Canyon, west of Walker Lake, Nevada. These photos supplement Scientific Notebook Plan documentation of field work done during the summer of 1991.

D. Grasso continued to investigate the lower and middle reaches of Duck Creek in the southern part of Las Vegas Valley to locate reliable exposures where the fluvial stratigraphy of Duck Creek might best reveal the area's geologic history. It is thought that a comparison between runoff histories of Duck Creek and its trunk channel, Las Vegas Wash, may disclose important evidence of severe runoff events in southern Nevada. Other drainages in southern Nevada also need to be examined for evidence of severe runoff that may be correlative with those of Duck Creek and Las Vegas Wash.

#### Quality Assurance

#### Planning and Operations

3GRS004B Procure and prepare aerial reconnaissance data

A computer search of EROS data files has been ordered to locate aerial photos of Yucca Mountain and vicinity that immediately post-date the 1969 floods.

D. Grasso contacted FOLD (Federally Owned Landsat Data) for a recent listing of all available Landsat Multispectral Scanner (MSS) and Thematic Mapper (TM) data for southern Nevada. These digital satellite data sets, which pre-date 1984, are available at a reduced rate (\$80 per tape).

D. Grasso contacted USGS staff members in Carson City, Nevada, faculty members of UNLV's Department of Engineering, and remote sensing specialists of the Las Vegas Valley Water District regarding the availability of aerial photographs, satellite image data, and/or digital landscape data sets for Yucca Mountain and vicinity. These data are needed for upcoming aerial reconnaissance of landscape features related to debris transport by severe runoff.

#### WBS 1.2.3.3.1.1.3 Regional Ground-Water Flow System

Principal Investigator - J. Czarnecki

#### OBJECTIVE

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

SCP 8.3.1.2.1.3.2 Regional potentiometric level distribution and hydrogeologic framework studies

0G3311B2

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

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

This activity has been delayed because of M. Ciesnik's diversion to meet QA requirements from three projects. The immediate impact is that quarterly water-level monitoring cannot legally proceed in Nevada or California, although the Nevada State office of the BLM has given prior verbal approval to access well sites. Some lands in California that have mining-company constructed drillholes that were converted to piezometers by the project are now part of a Wilderness Study Area (WSA). The WSA also includes Franklin Lake playa.

**3GRG052 Process existing log data Amargosa Desert**

S. Keller (SAIC/Golden) continued to process geophysical and borehole cuttings data from mining company drillholes in the Amargosa Desert. He has enjoined W. Carr (USGS ret.) to help describe the drillhole cuttings because of Carr's familiarity with the local geology. Keller reported on the progress of this activity at the Saturated Zone Section Meeting held on January 17. Because the scope of this effort is substantially larger than originally anticipated, the finish date for this activity has been extended to May 1, 1992.

**3GRG054 Prepare report on existing regional water level data**

W. Oatfield has been reassigned to another completely separate project under the Computer Operations Unit. Although completion of this activity was due prior to Oatfield's transfer, it remains unfinished. Completion of this activity is critical to the assessment of regional potentiometric-levels data and to 2-D and 3-D modeling of the regional ground-water flow system. If this activity is to be achieved, Oatfield's priorities must be re-assessed given his new position.

**3GRG053 Locate additional piezometers in the Amargosa Desert**

This activity is part of the effort to measure water-levels in the Amargosa Desert as part of the scheduled quarterly monitoring program. Lack of field personnel has hampered this activity. J. Czarnecki has suggested having personnel from the Carson City, Nevada USGS office assist in this activity and in monitoring water levels. This suggestion has not been resolved. Failure to close this issue will impact successful completion of several other scheduled activities (assessment of regional water levels and regional modeling particularly).

**3GRG003 Measure water-levels in wells in the Amargosa Desert**

Personnel were diverted to other unscheduled tasks preventing them from going to well sites. See 3GRG053.

**3GRG010 Analyze regional water levels**

Personnel were diverted to other unscheduled tasks preventing this analysis. Further, activity 3GRG054 was scheduled for completion to feed this activity but has been delayed. Until 3GRG054 is completed, no analysis can be effectively performed. See 3GRG054 above.

**3GRG007 Prototype equipment testing of small diameter well pump**

Personnel are being sought to assist in the deployment of a small diameter pump for obtaining water samples from 2" piezometers in the Amargosa Desert. No one has been

identified as able and available. Discharge permits are also required before testing can proceed.

### Quality Assurance

### Planning and Operations

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

M. Ciesnik initiated a review of various aspects of the project in preparation for the QA internal audit scheduled for February of 1992. (16 hours)

J. Czarnecki gave a summary at the Saturated Zone section meeting on January 17 of planned work related to the conversion of oil-test holes constructed in the Amargosa Desert. (4 hours)

J. Czarnecki developed a detailed budget for FY92 for three project accounts. Included in this exercise was the creation of four spreadsheets using QUATTRO PRO. (32 hours)

J. Czarnecki reviewed personal copies of QA controlled documents against a document checklist. (2 hours)

#### SCP 8.3.1.2.1.3.3 Fortymile Wash recharge study 0G3311C2

Summary Account Manager - C. Savard

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### **3GRG004B Develop infiltration test procedure**

Reviewed infiltration testing literature. Tested a proposed water level monitoring system for the infiltration tanks with a float system, ten-turn potentiometer, and CR-21X datalogger in the office using a bucket a water. The system should be able to record water level changes to 0.01 feet.

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

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

Conferred with W. Davies, Unsaturated Zone Section, about necessary equipment needed to record and transfer data from infiltration testing equipment to project PCs for analysis.

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

##### **3GRG010B Continue to site FMN & FM holes**

The resolution of data from SP #11 is being coordinated in USGS files so the data can be entered into the computer data bases. This data is important because it defines the large hydraulic gradient in the Fortymile Canyon area. Siting of additional holes to further refine the water table location requires the SP #11 data be resolved.

A reconnaissance of the Fortymile Wash drainage channels at US 95 was performed with P. Glancy and J. Johnson, Nevada District, to determine what channels appeared to be active and their relative size to upstream cross-sections. Changes in channel geometry are related

to the amount of flowing water and can indicate where potential recharge to the ground-water system is occurring.

**3GRG003B Complete report on channel loss**

Drainage areas and channel lengths were computed for several sites in the Fortymile Wash and Topopah Wash watersheds. Cross-sectional data were processed and estimates of the amount of recharge using an Agricultural Research Service computer runoff model were made.

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

A correlation integral analysis of the rate of change in streamflow from the Merced River streamflow discharge time series began. The analysis may indicate the information about the underlying nonlinear dynamics of runoff. The predictability of streamflow is important in the Yucca Mountain area to define ground-water recharge.

**3GRG106A Analyze imagery of Fortymile Wash**

The GSP personnel who operate the image analyzers were unable to be reached.

**3GRG028 Collect FY-92 moisture data**

Rain wedges were read at UE-25 UZN#85, UE-25 UZN#92, and UE-29 UZN#91. Neutron logged UE-25 UZN#85, UE-25 UZN#92, and UE-29 UZN#91. Surface Water data collection personnel from the Nevada District were notified that no runoff had occurred in the Fortymile Wash drainage basin in the Yucca Mountain area.

**Quality Assurance**

**Planning and Operations**

**3GRG001B Complete criteria letter ponding sites**

Continued to draft criteria letter.

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

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

Continued to draft criteria letters.

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

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

The discharge from JF-3 drilling operations into Fortymile Wash was observed. Future aquifer testing and sampling will also discharge into Fortymile Wash. Siting of FMN and FM holes should avoid sites where natural infiltration and recharge could be affected by additional water introduced by man.

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

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

Foreign travel paperwork was processed for USGS and DOE offices in anticipation of attending and presenting a paper at the special session 'Predictability of Climatic and Hydrologic Systems: Insights from Nonlinear Dynamics' of the American Geophysical Union Spring 1992 meeting in Montreal, Canada.

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

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

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

An estimated 40 hours were spent on the following:

Depth to water was measured in JF-3 to assist Nevada District personnel. A check measurement was made with the Regional Saturated Zone electric tape and compared to the Nevada District electric tape. Depth to water from the measuring point for both tapes was the same.

Represented the Saturated Zone section during the January Public Open-House Tour.

Assisted in trouble shooting communication problems between Hydrologic Research Facility computers and Denver computers.

### **SCP 8.3.1.2.1.3.4 Evapotranspiration studies OG3311D2**

Summary Account Manager - J. Czarnecki

### **ACTIVITIES AND ACCOMPLISHMENTS**

#### **Technical Activities**

#### **3GRG205A Complete Report on vertical multilevel sampler, Franklin Lake Playa**

J. Czarnecki revised a paper entitled "Hydrochemical and hydrologic evidence of localized recharge at a discharge area, Franklin Lake playa, Inyo County, California" according to colleague review comments. The paper will be published in the proceedings of Waste Management '92. See G2A43 below.

#### **G2A43 Vertical Multilevel Sampler, Franklin Lake Playa**

The original report for this milestone was revised by J. Czarnecki according to technical review and resubmitted for technical review causing a 1 month delay in processing. The outlet for this paper is Waste Management '92, the organizers of which have indicated that delivery of the report may occur up to April 1, 1992 for publication. A companion paper for the 7th International Conference on Water-Rock Interactions is still being processed and likely will not be ready in time for the publication deadline.

#### **3GRG209A Obtain permits for piezometer construction**

This activity was delayed. See 8.3.1.2.1.3.2 "Regional potentiometric levels and hydrologic framework."

#### **3GRG201A Perform prototype tests of ET measurement**

This activity has not started. Staff are being sought to assist in this activity, particularly someone with micrometeorological instrumentation experience. Access to sites is also pending permit filing and approval with the BLM.

**3GRG030 Select WT/ET sites**

Until permits from BLM are obtained to visit field sites, this activity cannot proceed. A field trip is tentatively scheduled for mid- to late-March with S. Tyler (DRI) to examine sites and to review the chloride profiling method as an alternative to piezometer construction.

**3GRG031 Purchase materials for piezometer nests**

This activity is pending the outcome of 3GRG030.

**3GRG206A Analyze Franklin Lake hydrochemical data**

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

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

J. Czarnecki and D. Stannard revised text and illustrations to USGS Water-Supply Paper 2377 entitled "Geohydrology and evapotranspiration at Franklin Lake playa, Inyo County, California" according to USGS final editorial review. (8 hours)

M. Ciesnik had extensive discussions with R. Holliday (SAIC/Golden) on closure of the outstanding NCR-91-09. As a result of this discussion, Ciesnik revised the regional hydrology project's sample tracking system to streamline the process of identifying samples in the field (e.g. assigning a field ID number traceable to a site-ID number of the latitude and longitude used at the USGS laboratory). (24 hours)

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 0G3311I2

Summary Account Manager - J. Czarnecki

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GRM017A Hydrology integration task force participation**

J. Czarnecki prepared a meeting agenda and contacted HITF participants for their input to it. Next meeting is scheduled for February 6, 1992 at LANL.

**3GRM022A Publish paper on conceptual model of the Yucca Mountain flow system**

A camera-ready version of a paper entitled "Conceptual Models of Regional Ground-Water Flow and Planned Studies at Yucca Mountain, Nevada" by J. Czarnecki and W. Wilson was finalized and sent to the American Institute of Hydrology for publication in Hydrological Science and Technology. AIH claims to have a major backlog in processing submitted

papers and putting out their journal.

**3GRM10A Prepare software QA for MODFE code**

M. Ciesnik performed comparisons of test cases for transient simulation runs made with MODFE on the PRIME computer and on a 386/20 IBM-PC. These runs are part of a verification exercise to test the software. M. Ciesnik also participated in two workshop sessions on QMP-3.03, R3 (Software Quality Assurance) consisting of an overview of the procedure and an implementation session. J. Czarnecki was scheduled to attend but could not because of other commitments. Both Ciesnik and Czarnecki completed reading assignments of QMP-3.03, R3.

**3GRM019A ACNW Meeting on climate change**

This meeting has been rescheduled by the organizers to March 11, 1992 in Bethesda, Maryland. Notification of this change did not reach J. Czarnecki until two days prior to scheduled departure for the previously scheduled meeting.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

J. Czarnecki and C. Fridrich revised a proposal for performing additional testing in drillhole USW G-2 and other holes. The proposed testing will be discussed at the next meeting of the Hydrology Integration Task Force on February 6, 1992. (8 hours)

M. Ciesnik tested FORTRAN graphic libraries contained in the software package PLOT88 of PLOTWORKS, Inc. in conjunction with the Lahey EM/32-F77L3 compiler. This test was an initial step in compiling graphics routines used in hydrologic model development on IBM-PC compatible computers. Also successfully tested was the compilation and creation of executable load modules of MODT (the transient version of MODFE) using the EM/32-F77L3 compiler and running these modules as .EXE files in protected mode. (40 hours)

J. Czarnecki and M. Ciesnik freed space on their respective computers by transferring files to Bernoulli 20Mb removable disk packs. (12 hours)

J. Czarnecki and J. Whitney arranged a seminar by G. King (Univ. of Strasbourg) entitled "Hydrologic Significances of Earthquake Strain." The seminar was attended by about 70 YMP members. (4 hours)

J. Czarnecki discussed plans with C. Duffy (Pennsylvania State Univ.) for chairing a General Groundwater session at the American Geophysical Union meeting in Montreal, Canada in May, 1992. Czarnecki prepared the preliminary paperwork to gain permission to attend the meeting. (8 hours)

J. Czarnecki and E. Gutentag conferred with W. Osterkamp on his transmission loss calculations for Fortymile Wash, Topapah Wash, and the Amargosa River. The preliminary estimate of transmission loss (or recharge) for Fortymile Wash was about 1/2 the value specified in the model of Czarnecki and Waddell (1984). (4 hours)

J. Czarnecki participated in field trip, for TESS M&O and DOE/HQ personnel, of Death Valley, the Amargosa Desert, Crater Flat and Yucca Mountain. Czarnecki provided a short slide show and a field briefing of uncertainties regarding the ground-water flow system boundary conditions and how

those uncertainties are being resolved through the use of opportune data collection from mining-company supplied boreholes and through various hydrologic investigations. (30 hours)

SCP 8.3.1.2.1.4.4 Regional three-dimensional hydrologic modeling 0G3311K2  
Summary Account Manager - J. Downey

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GRM040 Interface GIS with ground-water models**

C. Faunt, K. Kolm, A. Turner and F. D'Agnese attended a training course by Intergraph Corporation on ERMA (their interface between GIS and statistics and modeling packages). Prototype ERMA software, which supplies an integrated GIS-Modflow capability, was installed on the Intergraph workstation at CSM by Intergraph personnel.

C. Faunt and F. D'Agnese worked with D. Williams on testing ARC/INFO and MODFLOW interface at the Mapping Division's GIS Lab. The work was done in cooperation with M. Tate on the data general.

**Quality Assurance**

**Planning and Operations**

**3GRM040 Interface GIS with ground-water models**

C. Faunt arranged for training by Dynamic Graphics on 3D Modeling Technology in Earth Science Applications.

A. Turner attended briefing session with Intergraph Federal Systems Division in Reston, Virginia. As a result of these discussions, continued Intergraph support for the GIS modeling efforts is assured.

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

J. Downey removed VGA graphics accelerator from the 386 computer as SPANS was unable to provide the proper drivers. Using the board as part of an X windows emulator on the 386 is currently being investigated. (10 hours)

J. Downey undertook preliminary evaluation of the software package TOOLBOOK as a tool to develop a hypertext data base of paleohydrology data for release as a USGS Open File Report. This would be similar to the USGS Arctic data base OFR. (20 hours)

**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 OG3312Z2**

Summary Account Manager - A. Flint

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUI002A Analyze rock outcrop samples**

A compilation of existing data and organization of all transect worksheets has been undertaken. A composite transect has been developed to represent an entire lithologic transect which will receive flow measurements. Assessment of additional locations for transects has been undertaken to provide a complete and representative data set for geostatistical analysis.

**3GUI005 Test borehole logging tools in new neutron hole**

The status of the new logging van has been determined and procurement is progressing. Field plans have been made and coordinated to test van tools in N-54 and undergo training of procedures for several staff members.

**3GUI004A Compile and analyze existing soils data**

There is an ongoing organization to locate all disk and worksheet data in preparation for the arrival of persons filling infiltration vacancies. Evaluation of a possible data base for use in the analysis is ongoing.

**Quality Assurance**

**3GUI023A Graded QA and other QA requirements**

Proceeding as required.

**Planning and Operations**

**3GUI025A Procure SPARC station for GIS program**

Procurement is ongoing and the software requirements and compatibility are being investigated.

**3GUI026A Continue procurement of geophysical logging van**

Paperwork was sent to the company for the procurement of a van the week of January 27.

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

Worked in support of public tours. (9 hours)

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### **3GUI302 Initiate small scale deterministic model**

Modification and testing of the 2-D finite difference algorithm VS2DT (developed by R. Healy, E. Weeks, and E. Lappala, USGS WRIR 83-4099 and 90-4025) was continued in an effort to develop a more accurate upper boundary condition for the Pagany Wash small scale deterministic model for unsaturated flow and transport. The code was modified to allow more efficient development of irregular shaped mesh boundaries and operator selection of moisture characteristic functions. An example using irregular mesh boundaries for an unsaturated transport problem was tested successfully using a 900 node mesh.

#### **3GUI311 Initiate analysis of moisture profiles**

Analysis of moisture profiles was continued using the large amount of data obtained from geophysical logging, video logging, and core sample analysis of neutron access boreholes N-55 and N-54 in WT-2 Wash. Analysis of moisture profiles for the third new neutron access borehole, N-37, was also initiated. Preliminary comparison of the moisture profiles for all three boreholes indicates significant stratigraphic continuity and a direct dependence of the general shape of the vertical profiles on geologic structure and lithology. Specifically, the characteristics of lithologic contacts and the relationship of lithologic textures above and below such contacts may determine the general shape of the vertical moisture profile in a manner predicted by unsaturated flow theory. This information can be extremely important in characterizing the 3-D spatial distribution of moisture content in Yucca Mountain, as well as providing information to the characterization of present day infiltration. Hypothesis developed following a more detailed analysis of the moisture profiles will be tested using the deterministic numerical models.

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

Calibration of the automated supply reservoir and installation of the automated class-A evaporation pan continued. Installation of the automated refill valve and supply line was completed. The line was pressure tested and buried. Installation of datalogger and power supply, and calibration of the automated supply reservoir is continuing.

#### **3GUI385 Drill new neutron access holes**

The drilling of the third new neutron access borehole (N-37) was completed as scheduled. The new hole was logged using CPN neutron moisture meters in an effort to obtain data pertinent to meter calibration and also for investigating the effects of drilling on the hydrologic conditions of the host rock. Drilling of the fourth new borehole, N-11, located above 5,100 ft. on Mile-High Mesa, will begin as scheduled on February 5, 1992.

#### **3GUI381 Log neutron access boreholes FY92**

All existing neutron access boreholes were scheduled for logging during the second week of February, 1992.

#### **3GUI387 Continue locating new neutron holes**

Optimum locations for four new neutron access boreholes (N-36, N-15, N-16, and N-17) were finalized and approved, and job packages for drilling are in the process of approval. All four sites are within the Pagany Wash sub-drainage, and are necessary for expanding the monitoring network within this important sub-drainage in terms of both spatial coverage and

physiographic coverage. Boreholes N-15, N-16, and N-17 were all located at elevations above 5,100 ft. on Mile-High Mesa, a relatively unique area on Yucca Mountain that forms the upper "head-water" portion of Pagany Wash and may have an increased potential for infiltration. Work is continuing on identifying optimum locations for additional boreholes.

**3GUI396 Testing and calibration of prototype TDR**

Testing and calibration of the prototype TDR has been delayed due to lack of manpower.

**3GUI389 Calibration & testing of cross-hole gamma probe**

Parallel access tubes have been installed at a field site in Jackass Flats for field calibration of the cross-hole gamma probe. The access tubes were installed using a newly developed procedure that utilizes a portable pneumatic jack-leg in an effort to achieve a minimum disturbance of surficial materials. Laboratory calibration has been initiated, and a preliminary test of instrument operation and sensitivity has been completed.

**3GUI324 Initiate tritium sampling program**

Selection of core samples from the recently installed neutron-access boreholes has been initiated and is continuing. Specific procedures for this study, such as sample handling and procurement of analysis (isotope concentrations) have been outlined and are in the process of more detailed development.

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

Field calibration of neutron-moisture meters has been initiated using boreholes N-55, N-54, and N-37, which have recently been installed using a continuous coring procedure that will allow a more accurate calibration for these boreholes. These calibrations will also be used to improve the analysis of moisture profiles obtained from existing neutron logs using information on stratigraphy, lithology, and density at the older borehole sites. An attempt to improve the accuracy of the general calibration equation for each neutron meter (converting counts to moisture content) has been initiated using data obtained from borehole N-54.

Quality Assurance

**3GUI409 Graded QA and other QA requirements**

Implementation of all QA requirements were performed as needed.

Planning and Operations

**3GUI405 Procure CSI TDR**

The CSI TDR was been ordered, but procurement has been delayed.

**3GUI368 Procure instrumentation for ET**

Instrumentation for seven additional ET stations have been procured.

Work Performed but not in Direct Support of the Scheduled Tasks

Worked in support of public tours. (9 hours)

SCP 8.3.1.2.2.1.3 Evaluation of artificial infiltration OG331222  
Summary Account Manager - A. Flint

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUI630 Determine field locations infiltration sites**

Ongoing evaluation of conceptual model of infiltration utilizing data from NS4 and NS5, along with uncased boreholes UZ-7, UZ-4 and UZ-5. This is assisting the development of criteria to make siting decisions.

**3GUI606 Prototype infiltrometer field testing**

Preliminary organization of infiltrometer study plan and associated equipment and literature in preparation for arrival of infiltration scientist should begin in March.

**3GUI616A Develop prototype ponding study**

Existing information and preliminary assessment of equipment needs and locations were compiled in anticipation of position vacancy being filled.

**Quality Assurance**

**3GUI695 Graded QA and other QA requirements**

Ongoing as required.

**Planning and Operations**

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

Worked in support of public tours. (2 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 OG3312U2  
Summary Account Manager - A. Flint

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUP26AA Transect sample statistics**

From the 650+ samples obtained on a variety of surface transects over Yucca Mountain, 57 samples have been selected as representative of the various formations, members and microunits which comprise Yucca Mountain. These 1-inch diameter by 2-inch long core plugs will undergo saturated hydraulic conductivity analyses and pycnometry.

**3GUP010A Develop and test imbibition procedure**

A new procedure is under development at Oregon State University which measures directly the weight gain of samples as water is imbibed. Cores are being run to test the technique, and a computer program was developed to automate sorptivity calculations from imbibition.

**3GUP27AA Chilled-mirror psychrometer verification**

No progress was made on this activity in January except to attach a fine wire thermocouple to a disk of rock to check emissivity measurements. The thermocouple-rigged rock will be calibrated by REECo before tests are made in the CX-2 psychrometer.

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

Design plans and parts layout began for this activity in January. Some items are still being procured for the apparatus.

**3GUP27AA Permeability of selected transect samples**

This activity was started in January on samples from 3GUP26AA. Cores were saturated with water using the carbon dioxide purge/vacuum procedure from HP-229, and then saturated hydraulic conductivities were measured using the high-flow permeameter.

**3GUP30AA Neutron core physical property measurements**

Bulk and grain density, water content and porosity measurements were obtained under HP 229 on cores from the N55 borehole in January. Core samples have also been received at the HRF from the N54 borehole.

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

This activity missed early start date of 12/31/91 because the hydro-geologic modeling position has not been filled and other personnel are not available to do the work.

**3GUP028A Imbibition measurements on transect samples**

This work was delayed until the new imbibition procedure is developed at OSU under 3GUP010A.

**3GUP31AA Neutron core gas pycnometry measurements**

This work was unavoidably delayed due to technical problems with the new Micromeritics pycnometer. It will be held up until the pycnometer is repaired and calibrated, and a procedure is approved. A loaner pycnometer will be obtained from Micromeritics while ours is being repaired, and the 57 selected transect samples will be run beginning in February.

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

No personnel were available to work on this activity, and it has been delayed.

Quality Assurance

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

QA procedure development, training and equipment calibrations are continuing as required.

Planning and Operations

**3GUP022A Procure centrifuge**

All procurement paperwork was submitted by January 31, 1992. A quotation was received from Beckman for the special ultracentrifuge unit, and the procurement is being processed as a capital equipment acquisition.

**3GUP044A Procure environmental chamber**

All procurement paperwork was submitted by January 31, 1992, and is being processed as a capital equipment acquisition.

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

Worked in support of public tours. (8 hours)

**SCP 8.3.1.2.3.2a Surface-based boreholes studies 0G3312V2**

Summary Account Manager - J. Rousseau

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

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

Work continued on construction of the first gas sampling apparatus. Three more wet/dry panels remain to be constructed. New staff addition in February will accelerate remaining assembly requirements.

**3GUP003E Instrument and monitor HRF boreholes**

Monitoring of HRF #1 and #2 continued throughout month of January. The second bank of sensors were run to continue primary sensor data. No apparent drift in sensors was noted. HRF #3 is scheduled for instrumentation week of February 24, 1992.

**3GUP023E Develop/test/evaluate in situ pressure transducer recalibration**

This activity has not started. The activity will be conducted in parallel with evaluation of multi-station gas-sampling apparatus (3GUP021E), which is underway. The start of the activity can be delayed until about 4-1-92 without adversely impacting longer-term schedule for instrumentation of deep UZ hydrologic boreholes.

**Quality Assurance**

**3GUP059E Complete processing thermistor, pressure transducer, psychrometer technical procedure**

Reviews of technical procedures continued during the reporting period.

**Planning and Operations**

**3GUP014E Acquire/install humidity generator**

The humidity generator will be delivered to HRF/NTS in March 1992. Training on this equipment will be conducted at the HRF in March.

**3GUP053E Develop elec diag/performance verify SPECS elec equipment**

A DC transfer standard calibrator was delivered to Denver in late January. Work will resume on this activity in March, 1992.

**3GUP040E Acquire, install, evaluate optical disk media**

Market research preparation of sole-source procurement documents continued in January. The purchase order should be in place within the next 60 days.

**3GUP035E Prepare for instrumentation of UZP-6**

This activity has functionally been replaced with preparation for instrumenting UZ-16 (VSP-2) because UZP-6 will not be drilled. Preparations continued for instrumenting UZ-16 (VSP-2) and a first hydro instrumented borehole (UZ-19?), tentatively scheduled for January, 1993. Sensors for hydro instrumentation have been ordered. Engineer drawings of the downhole instrumentation apparatus are being prepared. Market surveys for a sliding

screen assembly are nearing completion. A purchase order for a mockup of the geophone cable assembly for which a mounting bracket will be designed has been placed. The mockup is scheduled for delivery in March, 1992.

**3GUP060E Hire and train new staff**

Position descriptions for three positions have been approved. One hire is scheduled for mid February start. Advertising of other two positions will be done during February/March 1992.

**3GUP020E Acquire/install mass flow**

The purchase requisition for a mass flow calibrator was submitted to the QA office in January. The QA office needs to certify the vendor before the procurement division can place a purchase order. The acquisition of the unit will probably slip an additional two months.

**3GUP045E Order additional microwave telemetry**

An alternative to microwave telemetry communication is being investigated. FCC approval of UHF band at NTS would be required. Costs may/may not be cheaper than the microwave alternatives. Procurement activity has been postponed pending final assessment of the UHF option.

SCP 8.3.1.2.2.3.2b Vertical seismic profiling OG331232

Summary Account Manager - J. Rousseau

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUP017B VSP lab/physical & comp sim: 2-D fault method**

The transport to the FSU Cray has been completed. Partial imaging of the fault model and the imbricate fault model continued. A write-up of the new P-S converted mode imaging procedure is in progress.

**3GUP025B VSP prototype field test and data analysis**

There was no work done on this activity due to the inability to drill holes at Bergen Park in January.

**Quality Assurance**

**3GUP030B Develop/write VSP technical procedure: data acquisition**

The outline is nearing completion. The draft of the text is halfway finished.

**Planning and Operations**

**3GUP050B Procure "X" windows computer terminal for VSP**

The purchase order has been written and the terminal is scheduled for delivery in March, 1992.

**3GUP035B Design/test/evaluate/procure geophone mounts**

The delivery of mockup of mounts is scheduled for March, 1992.

**3GUP047B Prepare ICN for cross-hole tomographic surveys**

This activity has not started; it is expected to start February 19, 1992.

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 70 hours were spent on the following:

H. Jaramillo worked on imaging imbricate fault model.

C. Erdemir worked on imaging converted waves and typing of technical procedure.

A. Balch attended instruction session on QMP-3.03, R3.

SCP 8.3.1.2.2.3.2c Integrated Data Acquisition System 0G331242

Summary Account Manager - J. Rousseau

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GUP025C Integration and test design for software**

M. Neil will visit NTS in late February to evaluate the test program on existing network hardware. This test will be necessary for acceptance testing of proposed microwave data communications equipment.

**3GUP045C Develop criteria optical disk media**

J. Baer continued his investigation into the cost and capability of communications software that will be necessary if one of the Intel/PC-DOS based storage systems is chosen; the PDPs and the existing software do not readily communicate with PC-type machines. A. Greengard assisted Baer and M. Neil in collecting detailed pricing and technical information necessary to develop purchasing criteria for a system that meets immediate IDAS needs and provides a technically feasible path for meeting future needs for data archiving and UZ on-line data storage. The completion of the evaluation is anticipated by mid-February. The start of 3GUP046C will be delayed until approximately 2/20/92. Expected long-term schedule effects are minor.

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

J. Baer has given the complete design for the interactive Subsystem to A. Greengard and R. Getzen for review and to A. Sims for coding. No progress has yet been made in coding. (Illness of several persons in January, coupled with tape-drive failure have caused delay.) Baer continued to work on compatibility problems between RSX-11 and National Instruments' GPIB driver. New releases of DEC's RSX operating system have caused continued problems and delays for Baer and Sims. The delay in completing the design of the Interactive Subsystem will affect the starting date for IDAS Prototype-2 evaluation (3GUP051C) and most subsequent activities. The planned finish for this activity is unknown at this time.

**3GUP032C Construct prototype IDAS instrument shelter (IIS)**

The contract for construction has been delayed by over-committed personnel in the Branch of contracts, but should be in place by middle of February. The vendor indicates that five to six months will be needed for construction and delivery. The delay in construction will certainly delay evaluation of the prototype IIS (3GUP033C).

**3GUP035C Procure/deliver Microwave datacom**

The first attempt at procuring the necessary hardware failed because no vendor was willing to meet the requirements under the conditions specified by the procurement office. C. Brown discovered a vendor with a potential off-the-shelf solution to the communications needs in late January. This equipment operates in the 900-960 MHz bands rather than 23

GHz. The costs and logistics of re-designing the system for operation at the lower frequency are currently being evaluated because this equipment looks so promising. The delay in equipment procurement will certainly delay start of 3GUP036C, but may have little impact on long-term schedules because a significant part of the testing can be eliminated through use of off-the-shelf equipment.

#### Quality Assurance

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

A. Sims continued to work intermittently on a draft of this new procedure (HP-144) until early May, followed by A. Greengard's revision.

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

R. Getzen has outlined a new procedure that combines the planned contents of HP-153, HP-154, and part of HP-157. Work continued on this new procedure.

**3GUP062C** Revise IDAS facility procedures, QA review

As part of the general realignment of IDAS procedures, J. Rousseau and R. Getzen determined that IDAS facilities could be more appropriately documented in a non-procedural format that requires no review and approval. This "equivalent documentation" will be completed soon after the new prototype IIS has been evaluated. Delivery of new prototype IIS has been delayed (see 3GUP032C).

**3GUP067C** Revise IDAS software procedures

A. Greengard continued with the revision of HP-135 and HP-151, procedures that cover the development, installation, testing, and configuration control of IDAS software.

#### Planning and Operations

SCP 8.3.1.2.2.3.2d Air-permeability and gaseous-tracer testing OG331252

Summary Account Manager - G. LeCain

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

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

The USBR continued to construct the support trailer.

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

The USBR continued to develop engineering drawings, assembly and test instructions for all equipment used in air permeability testing.

**3GUP018D** Field test 8" packer system

Field testing of the 8" packer system has been postponed until completion of the first support trailer and will coincide with testing of the first 12" packer system.

#### Quality Assurance

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

The project underwent an internal QA audit. The audit found no major problems.

**3GUP004** Complete QA for 8", 12" packers and trailers

The USBR continued to work with the QA requirements for all equipment for air permeability testing.

### Planning and Operations

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

Paper work for the purchase of the Cal-bench has been forwarded to purchasing and QA. The QA staff has scheduled an evaluation of the suggested vendor (Sierra Instruments) to ensure they meet QA requirements.

Purchase of the bell provers, the second component of the mass flow calibration system, has been approved and price quotes have been solicited.

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

The USBR continued to purchase parts for the first 12" packer system.

#### **3GUP022D Bring on staff and train**

Position descriptions for a hydrologist 11/12 and Hydro Tech 9/10/11 have been prepared.

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

Principal Investigator - B. Lewis

#### OBJECTIVE

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

#### SCP 8.3.1.2.2.4.1a Prototype testing of intact fractures OG3312N2

Summary Account Manager - G. Severson

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### **3GUS005J Complete procedure; radial fracture sampling**

All review comments were addressed and the final document was submitted in January. Final approval and all signatures were obtained on January 28.

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

The technical reviews have been completed and the draft is with Dr. Cardenas. The draft entitled, "Implementation and Use of an Automated Projection Moire Experimental Set-Up" is to be submitted to the HIP Reports Section in February 1992.

##### **3GUS006A Continued moire projection; method development**

Work continued to progress using image digitization and processing to look at moire fringes. Phase measuring interferometry (PMI) and stereoviewing are being investigated on a limited basis. Transform analyses for replicating topographical surfaces, fast-Fourier transform (FFT) analysis and cosine transforms continue to be studied as the methods of choice.

The high-resolution video imaging board has been installed. Work has started using the hardware and software for data collection and presentation.

##### **3GUS012J Complete journal paper-Moire Automation**

The technical reviews are complete and this draft entitled, "Projection Moire as a Tool for the Automated Determinations of Surface Topography" is with Dr. Cardenas. This draft

will be submitted to the HIP Reports Section in February 1992.

3GUS013J Complete journal paper; FFT Moire  
Work on this draft continued.

3GUS014J Complete journal paper; stereo viewing moire  
Work on this draft continued.

3GUS004A Write Open File Report; Intact fracture sampling  
A draft has been started on this report.

3GUS014A Complete design fabricate low-pressure vessel  
This activity has not been started. There has not been enough time available to begin this activity.

3GUS001A Select analog site for fracture sampling  
This activity has not been started. There has not been enough time available to begin this activity.

3GUS010A Continued development; axial fracture  
This activity has not been started. There has not been enough time available to begin this activity.

3GUS016J Complete design, radial fracture test vessel  
This activity has not been started. There has not been enough time available to begin this activity.

#### Quality Assurance

3GUS007A Write technical procedure; moire calibration  
There was no progress in January. A draft was started on this procedure. However, the methods developed since this activity was placed in the FY91 and FY92 PACS, preclude the use of the original calibration during the set up of the equipment. Traceable, calibrated objects for the technical procedure are being investigated.

3GUS004J Document computer software; Moire QA  
This activity was delayed until after classroom training on QMP-3.03, R3 in January 1992.  
Work on this activity will start in February 1992.

#### Planning and Operations

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

The Chemical Hygiene Plan for the Building 20, DFC laboratory was submitted to Chemical Hygiene Officer on January 23. (19 hours)

C. Mallon's files were reviewed before replacement staff was hired. (11 hours)

Mercury-contaminated core disposal. (5 hours)

Classroom training on QMP-3.03, R3. (5 hours)

Started 1992 annual EPA Hazardous Substances Assessment:  
Draft of Assessment. (2 hours)

Chemical inventory for assessment. (4 hours)

SCP 8.3.1.2.2.4.2a Prototype infiltration (percolation) testing 0G3312O2

Summary Account Manager - F. Thamer

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GUS029B Prepare data report of imbibition experiments**

Previously collected data is being archived on optical computer disks. Data from a previously run experiment was processed. The data included water flow rate at different water pressures (positive and negative).

**3GUS101B Conduct imbibition experiments on small samples**

A data collection system was set-up to collect data from an imbibition experiment. The sample will be welded tuff (diam. = 53 mm; length = 127 mm). This test is designed to study the effect of fracture mineral coating on the imbibition process. Testing will start during the first week of February.

**3GUS002B Conduct ponding test on large block first stage**

The ponding test, which was started on October 28, 1991, continued. The water front has moved about 15 to 20 cm in the fractures and less than 5 cm in the matrix. The water movement in the fractures is not as fast as originally expected. Six out of the 18 thermocouple psychrometers are showing an increase in water potential (and saturation). The potential level is still detectable with the psychrometers. Therefore, this stage will continue longer than originally expected.

The water front in the fracture network of the welded tuff block is not moving as fast as originally expected. A tentative finish date is March 31, 1992.

**3GUS026B Prepare data report of large block ponding test**

Data is being collected, backed-up, and archived on computer disks. The data include water potentials, electrical resistance, and Time-Domain Reflectometry (TDR) to estimate water saturation within the block.

**3GUS035B Measure rock sample hydrologic properties**

There was no progress during the month. Although four samples of the large block were analyzed by the HRF Matrix Properties lab during December, six samples still remain to be analyzed. However, remaining analyses have been delayed because the Matrix Properties lab is very busy analyzing samples from the new neutron holes and from UZ Infiltration transects, and preparing the lab to analyze samples that will come from the deep UZ borehole program. The delay in sample analysis is not yet critical because the large-block ponding test also is behind schedule (see 3GUS002B).

**3GUS010B Construct equipment for final stage of pond test**

Since the first stage is taking longer than originally expected (see 3GUS002B above), this activity will be delayed for at least two months.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks  
Worked in support of Neutron hole drilling in Nevada. (62 hours)

SCP 8.3.1.2.2.4.3a Prototype bulk-permeability testing 0G3312P2  
Summary Account Manager - E. Kwicklis

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUS001C Test injection packer string for soundness

Fittings and tubing were purchased and packer string was uncrated and assembled in the laboratory in Building 20 in preparation for testing.

This activity began late due to conflicts in the schedules of the two principal investigators. The immediate impact is that testing will be completed several weeks late. There are no long term impacts because the packer will not be used this fiscal year.

Quality Assurance

Planning and Operations

WBS 1.2.3.3.1.2.6 Gaseous-Phase Movement in the Unsaturated Zone  
Principal Investigator - M. Chornack

OBJECTIVE

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

SCP 8.3.1.2.2.6.1 Gaseous-phase circulation study 0G3312W2  
Summary Account Manager - M. Chornack

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GGP06A Tabulate and analyze data

Data collected during FY91 is being analyzed. When completed, this data will be included in the progress report on air flow and gas chemistry. If additional air-flow and gas-chemistry data are collected during FY92, this data will be tabulated and analyzed accordingly.

3GGP17A Continue progress report on air flow and gas chemistry  
This activity is in progress.

3GGP07A Develop and complete technical procedures

Air-flow measurement and gas-sample collection techniques are being evaluated. Technical procedures will be completed for this activity when the evaluation is finished. Technical procedures that currently exist are being evaluated and will be revised if necessary.

3GGP19A Conduct and complete technical procedure training

Personnel assigned to this project are completing technical procedure training. Additional

personnel assigned to this project will complete the technical procedure training prior to conducting any work related to this project.

**3GGP08A Backlogged data**

Preliminary review and compilation of the air-flow and gaseous-phase chemical data from boreholes UZ-6, UZ-6s, and selected neutron-access boreholes will begin during February 1992.

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

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

**Corrective Action:** In progress: replan schedule and obtain additional staff.

**3GGP002A Collect UZ borehole data**

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

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

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

**Corrective Action:** None anticipated at this time.

**3GGP04A Chemical analysis of gas samples**

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

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

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

**Corrective Action:** None anticipated at this time.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks  
Audit by USGS/SAIC-Golden. (16 hours)

## 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 0G3312X2

Summary Account Manager - I. Yang

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

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

The draft technical procedure for CO<sub>2</sub>-gas analysis using a Summit Interests SIP 1000 portable gas chromatograph is in process.

The SF<sub>6</sub> meter to be used in the field for direct measurement of SF<sub>6</sub> concentration in the drilling air was tested in the laboratory. The meter can only accurately measure SF<sub>6</sub> concentration in the stagnant air instead of the flowing air.

3GUH065B Collect gas samples from UZ1 borehole FY92

UZ1 gas samples were collected from January 21-30, 1992. Sixteen <sup>14</sup>C samples, fifteen <sup>13</sup>C/<sup>12</sup>C samples, fifteen CO<sub>2</sub> samples, fifteen gas-composition samples, and fifteen <sup>3</sup>H samples were collected for analyses.

3GUH066B Prepare UZ1 gas samples for analyses FY92

UZ1 gas samples for C-14 and <sup>13</sup>C/<sup>12</sup>C analyses were degassed in the laboratory, volume measured, and stored in cylinders for analyses.

UZ1 water vapor samples for tritium analysis were analyzed in house using new liquid scintillation counter.

Preparation of gas samples is in process.

Fifteen CO<sub>2</sub> samples in aluminum cylinders collected at borehole UZ1 were separated from air for analysis of <sup>13</sup>C/<sup>12</sup>C and <sup>18</sup>O/<sup>16</sup>O content.

Three CO<sub>2</sub> samples in 3 liter Tedlar bags collected at borehole UZ1 were processed for analysis of <sup>13</sup>C/<sup>12</sup>C and <sup>18</sup>O/<sup>16</sup>O content.

#### Quality Assurance

#### Planning and Operations

3GUH070B Procure lab chemicals, labware, and field apparatus

A glass blowing service was procured to repair high vacuum degassing system. Degassing system is used for gas-sample preparation for C-14 analysis.

One tank of commercial Nitrogen-gas cylinder was procured. Gas-sample-collection

cylinders are filled with Nitrogen-gas to prevent atmospheric contamination.

National Institute of Standards and Technology traceable Class P balance weights have been procured. Those balance weights will be used by UZ Hydrochemistry personnel in monitoring balance calibrations in support of the biannual calibrations performed by Quality Assurance vendors.

CO<sub>2</sub> gas standards and high pressure regulators were procured. The gage will be used in calibration of the gas chromatograph, and micro-carbon-dioxide electrodes will be used in analysis of dissolved CO<sub>2</sub> in water samples.

Various safety items including safety glasses for UZ Hydrochemistry Laboratory personnel have been procured.

**3GUH037B Procure GC and DAS**

Quotes were received from Chrompac, a manufacturer of gas chromatographs, on the cost involved in the procurement of a new gas chromatograph and data acquisition system for use in the Mobile Sampling Laboratory.

**3GUH036B Procure 10 kw generator for gas sampling support**

Generator specifications, sources of availability, and service support information were obtained from several Las Vegas based generator suppliers. Currently preparing necessary documents and Quality Assurance forms for REECO procurement.

**3GUH010 Fabricate UZP6 multi-packer string (USBR):**

Borehole UZ-16 (VSP-2) has replaced UZP-6 as the first deep UZ borehole to be drilled in FY 92 and; therefore, the multi-packer string for gas sampling will be used in UZ-16 instead of UZP-6. Fabrication of the string is ongoing at USBR. The string was redesigned based on tests conducted in UZ-6s and a packer gland was ordered.

**Cause:** Tests of the original packer string at borehole UZ-6s indicated the need for a stronger bladder and possibly a redesigned inflation system.

**Impact:** Because completion of the UZ-16 borehole is scheduled several months later than the original schedule for drilling of UZP-6, there is no negative impact from the delay in fabrication of the packer string.

**Corrective Action:** None required. Packer will be ready for use when UZ-16 becomes available for gas sampling.

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

J. Ferarese, Chemical Safety Officer HIP, received a memorandum from the Environmental Protection Agency requesting that laboratories in the HIP respond to a questionnaire which would determine at what level each of our facilities is generating hazardous waste. Ferarese compiled and disseminated to each laboratory manager the information necessary to complete the questionnaire. (16 hours)

A winch and boom was designed for installation on the UZ Hydrochemistry Project flat bed truck for use in installation of packer system. (20 hours)

Input to UZ16 and UZ14 criteria letters for UZ-hydrochemistry were written and incorporated into J. Rousseau's criteria letter for drilling, testing, and instrumenting UE-25 VSP-2, YMSO, Yucca Mountain, Nevada. The content of the criteria letter include sample collections and contractor's support for field gas sampling. (32 hours)

New packer gland and end caps were ordered. All other parts required are on hand. Engineering drawings for the packer string were started.

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

##### 3GUH018A Procure ion chromatograph and DAS

Quotes were received from Dionex Corporation, a manufacturer of ion chromatographs, on the cost involved in the procurement of a new ion chromatograph and data acquisition system for use in the Mobile Sampling Laboratory.

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

The LKB Quantulus liquid scintillation counter was calibrated for analysis of low level tritium in water samples.

Two pieces of UZ5 core were distilled for stable isotopes  $\delta^{18}\text{O}$ ,  $\delta\text{D}$  and  $^3\text{H}$  analyses.

Water was extracted from three UZ4 and UZ5 cores for chemical analyses.

##### 3GUH012A Prepare OFR-sp, dtps, proto and site UZ hydrochemistry

The text content was organized and an outline of each section was developed.

##### 3GUH07AA Procure lab chem. labware & field apparatus

Quinoline and pH buffers were ordered and received. These items will be used in the analysis of dissolved  $\text{CO}_2$  in water samples.

Disposable pipettes used in pipetting water samples for tritium analysis were ordered.

#### Quality Assurance

#### Planning and Operations

##### 3GUH010A Procure refrigerator for core cold storage

Product information was received and the requisition was prepared for procurement.

Cause: Requisition request was delayed because of drilling schedule delay.

Impact: None.

Corrective Action: DOE drilling schedule was delayed until April, 1992 for UZ16 drilling. Therefore, procurement was also delayed. No corrective action is required.

##### 3GUH14AA Collect core from UZN-27 borehole

Coring of UZN-27 borehole was delayed by DOE and probably will be started in March, 1992.

Request for UZN-27 cores were prepared and sent to the Sample Overview Committee for approval.

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

J. Ferarese, Chemical Safety Officer HIP, received a memorandum from the Environmental Protection Agency requesting that laboratories in the HIP respond to a questionnaire which would determine at what level each of our facilities is generating hazardous waste. Ferarese compiled and disseminated to each laboratory manager the information necessary to complete the questionnaire. (16 hours)

An experiment to determine the lowest possible background count for C14 in Quantulus liquid scintillation counter was started. This experiment will determine best sample vial and sample-

volume conditions. (8 hours)

Core requests for UZ14, UZ16 and NRG1 were prepared and sent to the Sample Overview Committee representative. These include 122 cores from UZ14, 57 cores from UZ16, and 15 cores from NRG1. (20 hours)

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

Principal Investigator - E. Kwicklis

LBL Principal Investigator - G. Bodvarsson

#### OBJECTIVE

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

#### SCP 8.3.1.2.2.8.1 Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock OG3312T2

Summary Account Manager - E. Kwicklis

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### **3GUF0021 Revise scoping calculations of percolation test**

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

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

##### **3GUF015 Document variable aperture model VSFRAC**

No progress for this activity was made in January because the revisions required to the report prepared under activity 3GUF0021 were more extensive than anticipated.

Furthermore, the investigator responsible for this work was called upon to work on activities described under other PACS accounts for approximately two weeks during January.

Completion of documentation of VSFRAC will be delayed by approximately one month.

##### Quality Assurance

##### **3GUF0001 Develop graded QA Package**

This activity did not begin as scheduled because the investigator responsible for this work was called upon to work on activities described under other PACS accounts for approximately two weeks during January. Completion of a graded QA Package will be delayed by approximately one month.

##### Planning and Operations

##### **3GUF001 Resolve study plan comments (DOE and NRC)**

The revised study plan was forwarded to DOE-YMP in December for formal concurrence by the DOE reviewers. No further comments have been received.

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

E. Kwicklis spent approximately 40 hours during January as well-site hydrologist during the drilling of neutron hole N37 at the Nevada Test Site.

An additional 8 hours were spent preparing detailed budgets for this account for the remainder of FY92.

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

Summary Account Manager - G. Bodvarsson

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUF006L Prepare paper for 1992 IHLRWM conference

The paper "Semi-Analytical Treatment of Fracture/Matrix Flow in a Dual-Porosity Simulator for Unsaturated Rock Masses," by R. Zimmerman and G. Bodvarsson has been approved for publication, and the final version was sent to the American Nuclear Society.

3GUF002L Complete dual-porosity code

Work has begun on incorporating the modifications to the TOUGH code into the new version, TOUGH2.

3GUF08L Sorptivity/characteristic curve

Characteristic curves have been developed that yield sorptivities that are in agreement with values measured by A. Flint.

3GUF133L Correlate fractures/determine approach to permeability

A review of relevant technical papers was started.

3GUF005L Prepare a paper for RWMNFC journal

An outline for this paper is being prepared.

3GUF010L Initiate verification of fracture perm, models

The development of an approach to perform the verification has started.

Quality Assurance

3GUF007L Continue software QA and all other QA requirements

Reading assignments were completed by various staff members.

Preparations have been made for software QA training to be held at LBL on February 5.

Planning and Operations

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)

## ACTIVITIES AND ACCOMPLISHMENTS

### Technical Activities

#### **3GUM014A Develop alternative conceptual models of UZ**

USGS investigators are periodically providing UZ data to LBL for the development of alternative conceptual models for UZ matrix and fracture flow.

The planned finish data for this activity was not met due to a modeler not being available to work full-time on this activity.

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

USGS investigators are providing stratigraphic data from neutron boreholes to LBL for the construction of a 2-D cross-section model using TOUGH.

### Quality Assurance

#### **3GUM010A Graded QA and other QA requirements**

A delay of four months or more for the start of this activity is anticipated due to not having a revised study plan.

### Planning and Operations

#### **3GUM06A Study plan revisions and resolution of comments**

The YMPO review of the Study Plan has not been received as of this date.

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

An estimated 100 hours were spent on the following:

M. Whitfield completed proofing the final draft on January 7, 1992, of the approved (Director and YMPO) open-file report entitled "Borehole and Geohydrologic Data for Test Hole USW UZ-6, Yucca Mountain area, Nye County Nevada."

M. Whitfield served as a technical reviewer on January 8, 1992, for the Open-File Report entitled "Geohydrologic Data from Test Hole USW UZ-6s."

M. Whitfield attended a Software Quality Assurance upper management briefing on QMP-3.03, R3 on June 13, 1992.

M. Whitfield attended a general QA meeting on January 14, 1992, to discuss how to handle deficiency documents in a more timely manner.

M. Whitfield attended kickoff meeting on January 22, 1992, in Las Vegas as a Readiness Review Team Member for the Readiness Review for test hole UE-25 VSP-2 (UZ-16). Collected copies of permits and correspondence for supporting documenting that prerequisites for drilling and testing are in place.

M. Whitfield served as Acting Project Chief for "Flow in Unsaturated Fractured Rock" project.

M. Whitfield served as the USGS on-drill site representative for the drilling and coring of neutron hole USW UZ-N37.

M. Whitfield received reading assignment for QMP-3.03, R3 and QMP-17.01, R5.

SCP 8.3.1.2.2.9.2 Selection, development, and testing of hydrologic-modeling computer codes 0B3312D2  
Summary Account Manager - G. Bodvarsson

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUM17A Develop alternative conceptual models of UZ**

The development of contour and isopach maps of the hydrogeological units, which give a spatial representation of the area of the site scale model, is complete.

Although considerable hydrogeologic data have been reviewed and used to develop concepts of fluid flow in the UZ at the site scale, complete consideration of alternative conceptual models cannot be concluded until DOE comments on Study Plan 8.3.1.2.2.9 are evaluated and resolved (see 3GUM14A).

**3GUM010 Review of unsaturated flow codes**

Work was started on the review with the compilation of relevant papers.

**Quality Assurance**

**3GUM18A Grading of QA and other QA requirements**

Reading assignments were completed by various staff members.

Preparations have been made for software QA training to be held at LBL on February 5.

**Planning and Operations**

**3GUM14A Study plan revision and resolution of comments**

This activity has not started because the DOE review of the study plan is not complete.

SCP 8.3.1.2.2.9.3 Simulation of the hydrogeologic system 0B3312E2  
Summary Account Manager - G. Bodvarsson

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GUM02B Development of 3-D grid**

Because of the work performed in preparation of the ANS paper (3GUM11B), the development of the 3-D grid was not completed by the end of 1991. The completion of this task is expected by the end of February. Contour and isopach maps of each hydrogeological unit have been digitized, as well as the ground surface and the water table map, in order to develop surfaces from which the elevation of the hydrogeological boundaries can be calculated. These data also allowed the definition of the elevation of the center of the complete grid for the site-scale model. In order to account for the offset along the major faults, the model area has been divided into four sub-areas limited by the faults.

This task has not been completed as planned because of early completion of the ANS paper and work on the RWMNFC paper. This task will be completed by the end of February.

**3GUM11B Prepare paper for AND conference**

The paper entitled, "Design of a Three-Dimensional Model for the Unsaturated Zone at Yucca Mountain, Nevada," by C. Wittwer, et al. has been revised according to DOE comments and was sent to ANS for publication. The paper will also be published as a LBL report.

**3GUM01B Data compilation and analysis**

A new report including rock properties data for the UE25a and b well series has been

reviewed.

**3GUM04B Integrate UZ properties**

Work is continuing on integrating the UZ properties for the site-scale model. Data on porosities and matrix permeabilities were received from A. Flint. Completion of this task is expected in February, with the delay due to the preparation of the ANS and WMNFC papers.

**3GUM03B Perform preliminary simulations with moisture-flow model**

The input deck for the numerical simulations is being prepared.

**3GUM12B Prepare paper for WMNFC**

The bulk of this paper has been completed.

**3GUM07B Evaluate model grid effects**

A submodel is being developed to evaluate grid effects of the moisture flow model.

This task has not been completed as planned because of early completion of the ANS paper and work on the RWMNFC paper. This task will be completed by the end of February.

Quality Assurance

**3GUM14B Grading of QA and other QA requirements**

Reading assignments were completed by various staff members.

Preparations have been made for software QA training to be held at LBL on February 5.

Planning and Operations

**3GUM13B Study plan revision and resolution of comments**

This activity has not started because DOE review of the study plan is not complete.

WBS 1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization

Activities

Principal Investigator - B. Lewis

OBJECTIVE

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

Prototype Cross-Hole Testing 0G3312I2

Summary Account Manager - G. LeCain

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GUT002 Continue reduction and examination of ALTS Arizona**

A new program for editing and reducing the raw data is being used. This program has eliminated problems with ASCII formatting of the data.

**3GUT003 Continue analysis of ALTS data**

The analysis of the cross-hole ALTS data is going well. Analysis shows that the cross-hole flow tests fit a spherical-constant head boundary model. In addition, preliminary comparisons between injection and recovery tests show good correlation.

Quality Assurance

3GUT007C PC software and data analysis QA documentation

Due to a shortage of staff this activity has not yet been started.

Planning and Operations

Prototype Tracer Testing 0G3312J2

Summary Account Manager - I. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT011D Procure supplies for monitoring gas tracer at NTS

A mass flow controller that can tolerate 1,000 psi on the downstream side must still be ordered. Vendors have been investigated and instrument selections have been made from several vendors. All other supplies are on hand.

Cause: It was determined that downstream pressures could be as high as 1,000 psi, and that our present mass flow controllers could not take the pressure.

Impact: None, if the new mass flow controllers are ordered in February.

Corrective Action: New mass flow controllers will be ordered.

3GUT007D Design method for monitoring gas tracer at NTS

A conceptual design has been given to and discussed with RSN. Various RSN personnel have been assigned to the design and purchasing task. The USGS will continue meeting with RSN to approve their final design.

3GUT009D Procure lab supplies for gas tracer tests

Teflon ferrules and couplers, column adapters, and septum tube were received from Ace Glassware. Rubber septa are on order.

3GUT03DD Prepare WRI report on aqueous tracer tests

Manuscript was sent to author, A. Lewis-Russ who left the Project, for response to comments. Comments were responded and manuscript was retyped. Lewis-Russ is checking on the typed copy.

3GUT13DD Conduct tracer gas sorption test on stem materials

The stemming material undergoing testing is gypsum cement. Three size fractions have been characterized for surface area and mineralogy. The surface area increases as the grain size decreases. Mineral fractionation during sample preparation resulted in quartz minerals concentrated in the coarse fraction.

3GUT01DD Conduct tracer gas sorption tests on tuffs

Surface area analyses have been performed on size fractions from the following volcanic tuffs: Tiva Canyon, Yucca Mountain Member, Pah Canyon Member, Bedded Tuff, and Topopah Spring (welded and non-welded). There is little change in surface area among different grain sizes.

3GUT012D Test on-line gas tracer monitoring equipment

The SF<sub>6</sub> meter to be used in the field for on-line measurement was tested in the laboratory for its performance. Test results indicated that this meter can only accurately measure SF<sub>6</sub> concentration in the stagnant air instead of the flowing air. Therefore, the field-automated on-line measuring system should avoid placing the detector inside the main flow line.

Quality Assurance

Planning and Operations

Prototype Dry Coring of Rubble 0G3312L2

Summary Account Manager - C. Peters

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT03FF Complete preparation of report on G-Tunnel work

The introduction, description of work, and excavation section of the report have been drafted.

3GUT01EE Complete testing effects of core sealing method

Cores were sealed in early October, 1991. Test of sealing method involves continuous weighing of the sealed cores to check the weight loss (or moisture loss). A conclusion will be drawn after a year.

3GUT02EE Reduce data for effects of coring methods

Chemical analyses results are being graphically and statistically interpreted. Physical data is being tabulated.

Four coring tests were run to collect additional information on the effects of dry coring on moisture content, water and gas content.

3GUT13FF Complete reduction of data effect of core sealing

Graphical analysis continued and statistical analysis has begun.

Quality Assurance

3GUT004F Develop technical procedures on core sealing

Review of the first draft of the technical procedure is pending further interpretation of the data.

Planning and Operations

Prototype Pore-Water Extraction 0G3312M2

Summary Account Manager - I. Yang

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GUT026G Complete WRI report

WRI report still undergoing edit, prior to colleague review.

Cause: WRI report delayed one month due to lapse of the Colorado School of Mines contract.

Impact: None.

Corrective Action: Work continues.

3GUT029G Ext/anal pore water-use high press cell, UZ welded

Tests to determine extraction efficiencies of two fabric orientations were conducted. The results were similar for 2 orientations.

Chemistry results for water extracted from cores and chips were inconclusive; additional

tests are planned.

Tests to determine the efficiency of water and gas recovery by squeezing with holding stops versus without holding stops were conducted. The results were inconclusive; tests are ongoing.

**3GUT020G Procure and construct additional high press 1-D cells**

The design has been updated and fabrication process steps have been determined on the basis of the consultant's report. Final drawings are being prepared to send to the manufacturer.

**3GUT034G Complete development compress method extract water**

Pore water chemistry data was placed into a Lotus spreadsheet and statistically analyzed and graphed to determine chemistry changes with increasing pressure and average ionic composition of waters for different rock types and pressure levels. Changes in pH and specific conductance were also analyzed for different rock types and pressure levels to evaluate the theorized mechanisms for chemical change for extraction. Analysis of chemistry data indicated several tests and analysis that need to be developed and performed.

The chemistry data was entered into WATEOF, a specification modeling program, to evaluate changes in water chemistry as a function of the mineral content. These changes were also graphed for each sample and suite, and for an average of all of the data.

**3GUT002G Complete ext/analysis chem of PW, UZ4,5,6 and GT**

Three UZ4 and UZ5 cores were squeezed; all cores yielded water and gas. The degree of success of saturation averaged approximately 25 percent. All the cores had a degree of saturation of approximately 20 percent.

Twenty-five (25) cores were prepared for expression.

Quality Assurance

**3GUT035G Complete technical procedure for 1-D compression**

The procedure is being modified after review and will be ready for branch review by February 7, 1992. It has been delayed while the Colorado School of Mines contract was put into place.

Cause: Technical procedure delayed one week due to lapse of the Colorado School of Mines contract.

Impact: None.

Corrective Action: Work to continue.

Planning and Operations

**3GUT009G Procure 2nd data acquisition system (IBM-386)**

Data acquisition system has been received.

Several problems with system have been temporarily repaired pending further investigation.

**3GUT026G Complete WRI report**

The finish date has been delayed until March 2, 1992 due to lapse of the Colorado School of Mines contract.

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

Software has been received. Installation will proceed once the hardware is repaired.

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

A report entitled "A preliminary investigation of water chemistry change related to pore water extraction from unsaturated zone cores by one-dimensional compression" by C. Peters, J. Higgins, et al, was prepared for inclusion in the proceedings of the 7th International Water Rock Interaction symposium. The report was submitted for review. (230 hours)

Requests for UZ16, UZ14, UZN27, and NRG1 have been prepared. UZ14 and UZ16 cores have been approved. Addendum to UZ14 and UZ16 have been prepared, approvals expected at the March 3, 1992 Sample Overview Committee Meeting. (20 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 OG3313E2

Summary Account Manager - R. Luckey

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

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

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

Transducers were replaced and calibrated at well USW H-4 (lower).

Transducers were calibrated at the following wells: USW H-1 (tube 3), USW H-4 (upper), USW H-4 (lower), USW H-5 (upper interval), USW H-5 (lower interval), USW WT-2, and UE-25 WT #16.

HP-60, R1, Method for monitoring water-level changes using pressure transducers, received technical review this month. G. O'Brien responded to all comments and is in the process of documenting comment resolution.

Data were compiled for personnel involved in environmental monitoring program for all wells where data are shared between the programs.

Well USW VH-1 in Crater Flats was measured this month. It had been missed for several months when it was mistakenly assumed that this well could not be monitored because the pump in the well blocked access. The situation was critical as data from this well is shared with the environmental monitoring personnel. However, the problem has been resolved.

Chain #1 was calibrated against the reference steel tape this month.

A request for water-level data for mid-December was received from the State of Nevada. The request was for data that might show response to a minor earthquake in the area. The request will be fulfilled in February.

**3GWF41AA Continue preparing 1989 water-level data report**

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

This activity is delayed three months because the principal investigator was diverted to the management of saturated-zone section. This delay also will impact 1990 and 1991 data reports.

**3GWF20AA Continue analysis of water-level trends**

G. O'Brien continued to spend a considerable amount of time looking at barometrically induced water-level fluctuations. He again conferred with D. Galloway (USGS, California District) on the methodology and has attempted some preliminary analysis of water-table holes.

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

Work continued on the draft report "Precision and accuracy of water-level measurements taken in the Yucca Mountain area, Nevada, 1988-90" by M. Boucher. Most reviewer comments have been resolved and the test is being revised. Once other high priority items quit taking so much of the author's time, the report can be completed in a few weeks.

This activity is delayed two months because the investigator was diverted to preparing data for environmental monitoring program, responding to data request from State of Nevada, and preparing data packages for participant data archive for 1991 data. There is no impact beyond this activity.

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

M. Boucher completed a first draft of technical procedure HP-196, Use of Data Collection Platforms to Collect Water-Level Data. The draft is with PI for his review. No progress was made on this task this month.

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

Calibration water levels were worked up for about 25 percent of the 1991 data. No other work was performed on this task due to higher priority being placed on 1989 and 1990 data.

**3GWF42AA Complete 1990 water-level data report**

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

G. O'Brien completed Lotus 123 macros for calculating water-level altitudes from manual water-level measurements. These macros significantly reduce the amount of work required and will decrease the number of human errors. However, a rounding problem continues to plague the process and until it is resolved, all measurements must continue to be checked.

This activity is delayed seven months because the principal investigator was diverted to the management of saturated-zone section. This delay also will impact 1991 data report.

**3GWF027 Evaluate quality of 1991 transducer data**

Transducer calibrations were worked up for about 25 percent of the calibrations done during 1991.

**3GWF116A Replace current software with NWIS**

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

Quality Assurance

Planning and Operations

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

The bearing system on the measuring wheel of the multiconductor cable was replaced this month after it was discovered to be sticking. For about a year the calibration of this device has been ongoing because consistent readings could not be obtained. The device will be tested next month to learn if the bearing could have been the cause of the problems.

**3GWF006 Convert six sites to DCPs**

Six satellite data collection platforms were received from the manufacturer along with associated antennae and cables. Procurement of suitable shelters continued with a purchase order for 12 trailers issued this month.

**3GWF129A Develop software QA for data reduction**

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

Work Performed but not in Direct Support of the Scheduled Tasks

M. Boucher gave QA support to various activities, especially Evaluation of Past Discharge Areas, to address and close several outstanding items. She also spent time evaluating QA and organizing QA support for eight other groups of activities. (48 hours)

M. Boucher continued training J. Watson, a quality assurance specialist who will handle QA for several activities. (10 hours)

R. Luckey spent considerable time on tasks related to Saturated Zone and Quaternary/Future Regional Hydrology tasks. (100 hours)

R. Luckey participated in Yucca Mountain tour for congressional staffers and chairman of the NRC. (16 hours)

All project staff worked on compiling data for 1985 through 1991 for environmental monitoring program. Much of this work would have been done anyway, so hours spent are only for additional

tasks required. (24 hours)

G. O'Brien attended the Sample Overview Committee meeting to participate in discussion of priorities in drilling program. (16 hours)

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

Summary Account Manager - M. Umari

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GWF001D Finish intraborehole flow & stress test report**

G. Patterson continued work on the draft of the report. The completion date for the report has been moved to 3/1/92 because Patterson was diverted during January to work on DOE's international program with the Atomic Energy of Canada Limited (AECL). He had to participate in an aquifer test at the AECL project's USA site near Fresno, California, January 21-24. Until an additional Hydrologist and a Hydrologic Technician are hired to help in the AECL project work (which is under way), the USGS-YMP/HIP/Saturated Zone Fractured Rock Hydrology project, in charge of the AECL work, is seriously understaffed. No adverse effects are anticipated as a result of this variance.

**3GWF005D Monitor strain-related pressure response in wells**

Data collection for pneumatic diffusivity calculations (needed for analysis of barometric effects in uncased boreholes) was continued in UE-25c#2.

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

Seismic monitoring at USW H-4 was stopped. Data collected since June 1991 will now be analyzed.

**Quality Assurance**

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

HP-220T, HP-221T, HP-222T are in the comment resolution phase between the authors (G. Patterson and J. Gemmill) and the technical reviewer (G. O'Brien).

**3GWF011D Develop software QA for analysis programs under the 8.3.1.2.3.1.3 Activity**

Project staff attended an overview class to be familiarized with the newly approved Software QA QMP-3.03, R3.

**Planning and Operations**

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

A. Geldon wrote a Criteria Letter for redoing the T.V. log for UE-25c#2, because the previously-completed log had non-readable portions.

SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0G3313G2

Summary Account Manager - M. Umari

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GWF020F Construct two 3-zone packer strings**

The USBR has been assembling the monolithic "test sections", which consist of protective

casing that houses the instruments needed for monitoring pressure and temperature changes and injection of tracers, during hydraulic and tracer testing at the C-holes. The completion of these "test sections" is being done in parallel with preparing for laboratory functional testing. The completion of this activity has been moved to 4/2/92 to coincide with that of activity 3GWF023F, Functional tests of prototype packer string.

**3GWF001F Build discharge pipeline for c-holes tests**

The feasibility of the proposed pipeline and the steps necessary for completing it were studied. Requirements for the criteria letter needed for building the pipeline were discussed by the PI and the Chief, Saturated Zone and Quaternary/ Future Regional Hydrology Section.

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

A criteria letter was written by J. Gemmell and G. Patterson to initiate the process of securing Alternating Current power to the C-holes. The criteria letter was transmitted to YMPO on January 22.

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

The USBR continued to issue requisitions for purchase of the additional components to complete this task.

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

A failed attempt was made to run the program. Project members will correct the problem which is likely a FORTRAN programming problem. After that a review of the contents of the program will be conducted and a decision made as to what kinds of aquifer test analysis modules should be added to it.

**3GWF018F Oversee LBL prepare cross-hole seismic work**

LBL's plans for conducting the seismic work at the C-holes in March 1992 were discussed with LBL staff. Further discussion of the field support that the members of the Saturated Zone Fractured Rock Hydrology Project need to provide will be discussed during the February 1992 visit to Denver of E. Major from LBL.

**3GWF023F Functional tests of prototype packer string**

This task is being done in conjunction with 3GWF003F (Purchase additional packers/materials for third 3-zone packer string). The actual test of one section of the multi-component packer string took place during the week of December 16-20, 1991. The functioning of various parts of the setup was tested. The test was successful in uncovering several minor problems (leak in compression fittings, discontinuity in one conductor in the 16-conductor cable, a leak in a pass-through line in the packer). These components are being individually tested now.

**3GWF140A Construct two 3-zone packer strings**

The completion of this activity has been moved from 1/31/92 to 4/2/92 to coincide with that of activity 3GWF023F, Functional tests of prototype packer string, with which it is being conducted in parallel. No adverse effects are anticipated.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

Results from the heat-pulse flow surveys (intraborehole flow), conducted on C-holes by the USGS/WRD Borehole Geophysics unit in December 1991, were analyzed by A. Geldon. These intraborehole flow values were correlated to lithology and evidence of fracture locations obtained

from TV and acoustic televiewer logs. The results will be used to determine packer locations in the eventual hydraulic and tracer tests. This work has the same objective as activity 3GWF027F, Preliminary Numerical/Analytical Modeling to Assist in Cross-Hole Test Design.

J. Gemmell and G. Patterson participated in a preliminary hydraulic test at the Raymond Quarry near Fresno, California, the tentative U.S. site for the activity "Development of Multiple-Well Hydraulic Test and Field Tracer Methods" under the DOE international agreement with the Atomic Energy of Canada Limited (AECL). Results indicate that further search should be conducted for a more suitable site within the same property.

SCP 8.3.1.2.3.1.4 Multiple-well interference testing 0B3313G2

Summary Account Manager - E. Majer

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GWF02C Prepare for cross-hole seismic work

High voltage slip rings were installed on the transmitter wire line truck to interface with the high voltage system. System testing continued on the field system to be used to power the piezoelectric transducers. Maximum pulse voltage was increased to 20 KV. In swept mode operation, the frequency range was increased to allow 500 to 10,000 Hz operation with sweep times up to 250 m seconds at voltages up to 20 KV.

3GWF03C Develop cross-hole seismic profile

Work has not started because preparations have not been completed.

Quality Assurance

Planning and Operations

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

Summary Account Manager - M. Umari

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

A project meeting (Saturated Zone Fractured Rock Hydrology Project) was held to discuss the design of the tracer injection part of the multiple-zone packer system. It was agreed that a change be made in the design from a separate closed-loop tracer-circulation system to one in which the tracer is injected through the 2 7/8" pipe which will carry the pumped, or injected, water during testing. This design change cannot, however, be finalized without consulting with LANL and LBL first.

Preparations were made for G. Patterson and J. Gemmell to visit the Underground Research Laboratory (URL) of the Atomic Energy of Canada Limited (AECL) in Pinawa, Manitoba during February 1992 to participate in a tracer test. Requests for approval of international travel were submitted to DOE in connection with this proposed trip. Experience obtained from this participation will assist in the planned tracer tests at the C-holes.

WBS 1.2.3.3.1.3.2 Saturated Zone Hydrochemistry  
Principal Investigator - W. Steinkampf

**OBJECTIVE**

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

SCP 8.3.1.2.3.2.1 Assessment of saturated-zone hydrochemical data availability and needs 0G3313J2  
Summary Account Manager - W. Steinkampf

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GWH024A Develop chromatograph methods**

There was no action this month. Because temporary laboratory space is no longer available in Building 56, the ion chromatograph system will be shipped to and re-assembled in project laboratory space at the HRF in area 25. Subsequent development work will be conducted at the NTS.

**Quality Assurance**

**Planning and Operations**

**3GWH022A Complete study plan comment resolution**

Comments regarding a requested change to the SCPB were discussed and resolved.

Project office acknowledgment of satisfactory resolution of review comments have not been received. The cause is unknown; the impact is estimated to be minimal, if any.

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

Met with Data Coordination Unit staff to determine the extent to which Hydrologic Investigations Program electronic data bases contain historic hydrochemical data collected both on and adjacent to the NTS. It appears that the population of analyses largely is not available within the WATSTORE system.

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

An estimated 30 hours were spent on the following:

A draft guidance document (ASME) for low-level radioactive waste disposal was reviewed.

Participated in tele-conference of the Project Geochemistry integration team; reviewed draft and revised recommendations formulated at the winter quarterly meeting.

A task description for geochemical investigations relative to the SKB Hard Rock Laboratory was revised and submitted to the Project office.

SCP 8.3.1.2.3.2.2 Hydrochemical characterization of water in the upper part of the saturated zone  
0G3313K2

Summary Account Manager - W. Steinkampf

**Technical Activities**

**3GWH014A Develop mobile laboratory**

There was no action this month, but the activity is in progress.

3GHW015A Develop downhole data-collection and sample equipment  
*In situ* tool wiring was discussed with AECL investigators; vendor specifications were prepared for transmittal to SKB.

Quality Assurance

Planning and Operations

3GWH008B Examine hydrochemical tool test (lab) and 3GWH009B Examine hydrochemical tool test (field)

Evaluations of the hydrochemical tool in the lab and field have not started because the tool has not been purchased. The purchase is dependent on separately funded AECL-OCRWM International Program schedule.

Work Performed but not in Direct Support of the Scheduled Tasks

Read perched-water sampling scientific notebook procedure, QMP-5.05, and QMP-17.01, and began input to criteria letter for construction of borehole UZ-14. (10 hours)

SCP 8.3.1.2.3.2.3 Regional hydrochemical characterization 0G3313L2

Summary Account Manager - W. Steinkampf

Technical Activities

3GWH905 Select sample sites, phase 1

There was no action this month, but the activity is in progress.

3GHW910A Collect regional samples, phase 1

This activity has not started because the study plan has not yet been approved by YMPO.

Quality Assurance

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 8 hours were spent on the following:

Read USGS HP-200.

To date, unsuccessfully attempted to locate analytical data for Keane Spring, Death Valley National Monument, according to a request from the National Park Service.

WBS 1.2.3.3.1.3.3 Saturated Zone Hydrologic System Synthesis and Modeling

Principal Investigator - R. Luckey

LBL Principal Investigator - K. Karasaki

OBJECTIVE

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

SCP 8.3.1.2.3.3.1 Conceptualization of saturated zone flow models within the boundaries of the accessible environment 0G3313A2

Summary Account Manager - E. Ervin

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GWM005AA Synthesize potentiometric map**

E. Ervin revised the 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 Oberlander, P.L., 1989, 'Fluid density and gravitational variations in deep boreholes and their effect on fluid potential', Ground Water, Vol.27, No. 3, pp. 341-350. Results of the reanalysis proved to fit better with the general potentiometric surface, but water levels from four wells remain lower than anticipated. Ervin and R. Luckey continue to discuss the results but have no solution. Little time was spent on this activity because the Study Plan was given priority this month.

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

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

E. Ervin and A. Geldon continued to discuss suitable GIS software for geologic modeling at the UE25c-hole complex. Little time was spent on this activity because the Study Plan was given priority this month.

A. Geldon examined fracture data, heat pulse survey data, and static tracejector data for the C-holes. He is looking for correlations between the data sets.

Quality Assurance

Planning and Operations

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

Of the 115 comments by seven reviewers of Study Plan 8.3.1.2.3.3, all 71 minor comments have been resolved by E. Ervin. Work is continuing on the 44 major comments and the text is being revised accordingly. This effort is estimated to be 80 percent complete.

This activity is delayed two months because of prolonged illness of the principal investigator. This will also delay 3GWM003A and 3GWM004A, but part of the delay may be made up later. The anticipated delay is approximately one month.

SCP 8.3.1.2.3.3.2 Development of fracture network model 0G3313B2

Summary Account Manager - E. Ervin

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GWM01CB Initial mapping of the Crater Flat Tuff**

E. Ervin continued testing of the most recent PC version of the fracture-network model called FRACMAN (v. 2.293), developed by Golder and Associates, Seattle, Washington. She plans to analyze the preliminary fracture data from the Bullfrog Member of the Crater Flat Tuff, east of Little Skull Mountain using the FRACMAN and MAFIC programs.

E. Ervin continued working with the preliminary fracture data from the Bullfrog Member of

the Crater Flat Tuff east of Little Skull Mountain, including loading the grid data into the Rockware stereonet program and testing the program.

M. Chornack installed permanent markers on outcrops where grid maps of fractures were prepared. The markers will enable future replication of the work.

3GWM015B Revise fracture mapping technical procedure

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

#### Quality Assurance

#### Planning and Operations

3GWM007B Coordinate LBL fracture-network modeling phase I

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

3GWM016B Assist LBL, add outcrop data to fracture model

K. Karasaki at Lawrence Berkeley Laboratory was kept informed of progress on mapping fractures in Crater Flat Tuff.

#### SCP 8.3.1.2.3.3.2 Development of fracture network model 0B3313C2

Summary Account Manager - K. Karasaki

#### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GWM01CA Complete borehole fracture data bias study

Development of the borehole bias correction program has been completed and testing is under way using actual field data, including C-hole fracture data.

3GWM06CA Complete rad-waste conference journal article

A set of post-processing routines to the fracture network flow and transport code TRINET, to calculate the equivalent pulse tracer injection response of a fracture network has been written.

Draft sections of the Rad Waste Journal article have been written.

3GWM005C Assist USGS prototype multiple well test phase 1

No work was performed because no assistance has been requested by the USGS.

3GWM009C Assist USGS/multiple well test design phase 1

K. Karasaki attended the workshop on Mirror Lake fracture hydrology project held in Menlo Park.

K. Karasaki and G. Patterson discussed the design of the data acquisition system and tracer delivery system.

3GWM10CA Assist USGS with first hydraulic test report

No work was performed because no assistance has been requested by the USGS.

#### Quality Assurance

Planning and Operations

3GWM04CA Incorporate outcrop data to network model 1

K. Karasaki and E. Ervin discussed responses to comments on Study Plan 8.3.1.2.3.3.

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)

SCP 8.3.1.16.1.1.1 Site flood and debris hazards studies 0G3321A2

Summary Account Manager - P. Glancy

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GFR016 Analyze/evaluate FY91 flood data

Storms and runoff during FY91 were minimal. Data collected for the few known runoff events are being reduced and compiled. Analyses and evaluation of these data are being conducted on schedule.

3GFR002 Collect, analyze, and evaluate FY92 flood data

Weather conditions were monitored during January. No storms with sufficient strength to cause hazardous runoff at Yucca Mountain, or in the surrounding region, occurred in January 1992; thus, no data have yet been collected for FY92.

Quality Assurance

3GFR007 Incorporate FY91 data in the data base

This activity is completed. FY91 data were transmitted to the LRC in late January of 1992.

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

P. Glancy completed the GET Refresher Training course on January 16.

WBS 1.2.3.6 Climatology and Meteorology

OBJECTIVE

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

WBS 1.2.3.6.2 Climatology

OBJECTIVE

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

WBS 1.2.3.6.2.1 Change in Climatic Conditions

OBJECTIVE

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

WBS 1.2.3.6.2.1.1 Modern Regional Climate

Principal Investigator - R. Forester

OBJECTIVE

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

SCP 8.3.1.5.1.1.1 Synoptic characterization of regional climate 0G3621K2

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

3GCR006 Hire personnel-establish criteria

T. Cerling's IPA contract has been processed.

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

Principal Investigator - R. Forester

OBJECTIVE

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

SCP 8.3.1.5.1.2.2 Analysis of stratigraphy-sedimentology of marsh, lacustrine, and playa deposits 0G3621B2

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

3GCL001B Hire and train staff

T. Cerling's IPA contract has been processed.

WBS 1.2.3.6.2.1.3 Climatic Implications of Terrestrial Paleoecology

Principal Investigator - R. Forester

OBJECTIVE

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

SCP 8.3.1.5.1.3.1 Analysis of pack rat middens 0G3621G2

Summary Account Manager - R. Forester

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

3GCL101 Hire and train staff

T. Cerling's IPA has been processed.

WBS 1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain

Principal Investigator - J. Whitney

OBJECTIVE

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

SCP 8.3.1.5.1.4.2 Surficial deposits mapping of Yucca Mountain area 0G3621I2

Summary Account Manager - E. Taylor

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

Planning and Operations

3GCH001A Complete transition and hire staff

The position description for a person to map the mountain has been completed and is being advertised.

SCP 8.3.1.5.1.4.3 Eolian history of the Yucca Mountain region 0G3621J2  
Summary Account Manager - J. Whitney

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GCH020C Conduct analysis-strontium/oxygen/carbon isotopes  
Samples for isotope analyses have been examined and a preparation plan established.

Quality Assurance

Planning and Operations

WBS 1.2.3.6.2.2 Effects of Future Climatic Conditions on Hydrologic Characteristics

OBJECTIVE

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

WBS 1.2.3.6.2.2.1 Quaternary Regional Hydrology

Principal Investigator - J. Stuckless

OBJECTIVE

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

SCP 8.3.1.5.2.1.1 Regional paleoflood evaluation 0G3622A2

Summary Account Manager - D. Grasso

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

Quality Assurance

3GQH007A Develop technical procedures

D. Grasso and P. Glancy examined the needs for specific technical procedures for current FY92 work associated with this activity. It was agreed that specific technical procedures can not be defined until the regional reconnaissance work is well underway; this is due to the fact that the precise nature of the work to be performed, or the types of data to be collected, are unknown. Once these factors are determined, however, a specific set of methods (technical procedures) can be designed for analysis activities involving regional paleoflood features to be studied. At present, a Scientific Notebook Plan is being prepared that will cover the upcoming reconnaissance endeavors for FY92.

Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

An estimated 36 hours were spent on the following:

D. Grasso met with faculty and staff members of UNLV's Department of Engineering to

determine the availability of aerial photographs, satellite image data, and digital landscape data sets for Yucca Mountain and vicinity. These data are needed for upcoming geomorphometric reconnaissance work associated with this activity.

D. Grasso met with USGS staff members in Carson City to inquire into the availability of aerial photographs, satellite image data, and digital landscape data sets for Yucca Mountain and vicinity. These data are needed for upcoming geomorphometric reconnaissance work associated with this activity.

SCP 8.3.1.5.2.1.3 Evaluation of past discharge areas 0G3622B2  
Summary Account Manager - E. Gutentag

**ACTIVITIES AND ACCOMPLISHMENTS**

**Technical Activities**

**3GQH012 Analyze water by NWQL and GSP Isotope staff FY 92**

All water samples collected on previous collection trips have been analyzed.

**3GQH028 Analyze faunal samples and sample modern springs FY 92**

R. Forester, GSP, reports that all samples collected during past field trips are ready for analysis. About 20 percent of the material which were picked and placed on micropaleontological microscope slides have been identified at this time.

**3GQH004 Study analyze results from wet/dry playas**

The GD Branch of Geochemistry has not submitted any analyses for work completed. R. Forester has started to pick the processed samples for ostracodes.

**3GQH002 Vegetation distribution mapping Amargosa Desert**

A. Turner has started working with the statistics for this activity by comparing the random road samples with the plant transects, which will extend the vegetation coverage for the area.

**3GQH009 Prepare faunal samples for analysis**

R. Forester reports that this activity is on schedule and the slides of last summer's collection are ready to be analyzed.

**Quality Assurance**

**Planning and Operations**

**3GQH007 Vegetation Mapping phase 1**

F. D'Agnesse continued searching for existing Landsat Thematic Mapper data for use in the regional mapping of vegetation. The search included locating images listed in the federally owned Landsat Data Library. Because of the estimated high cost of Landsat Thematic Mapper images which was not budgeted for this activity, the images will be borrowed from the Federal Landsat Data Library. Only five images have been located that are free of cloud cover. These five images will be requested from the Library during February.

**3GQH005 Conduct field trips modern discharge springs**

Preliminary plans were made to conduct a March field trip to the Pahrump Valley to collect water samples from springs and wells. This activity will be coordinated with Z. Peterman (GSP).

**3GQH008 Collect faunal samples from past-discharge sites**

J. Downey and E. Gutentag discussed methods to prioritize sites for collection. Samples collected from such sites will be analyzed for chemistry, faunal content and isotope data. A

meeting will be held with GSP climate personnel to choose sites for study.

Work Performed but not in Direct Support of the Scheduled Tasks

E. Gutentag spent 40 hours at the ASTM meeting concerning writing ASTM standards for determining Aquifer Parameters from conducting aquifer tests. These standards can be used or incorporated in YMP hydrologic procedures.

An estimated 20 hours were spent on the following:

Time was also spent in revising HP-234T for the use of a microorganic collector.

E. Gutentag represented R. Forester (GSP) at the CCC meeting (Scientific Software) where QA was required for software programs used by Forester and by the Past Discharge Activity.

SCP 8.3.1.5.2.1.4a Analog recharge sites 0G3622C2

Summary Account Manager - P. McKinley

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

3GOH012C Collect/reduce hydro data from remote sites FY 92

Preparation for the winter field trip was completed.

The 3" flumes were modified with aprons.

3GOH026C Reduce ET data

T. Oliver input ET data into the computer and plotted field data.

3GOH026D Evaluate ET methods and model

J. Emerick has started to evaluate the 1991 ET data prepared by T. Oliver.

3GOH13CA Conduct chloride leaching test FY 92

Samples from Kawich and Stewart were prepared by USGS GD Branch of Geochemistry and returned.

Laboratory and equipment were checked out in preparation for the beginning of extractions.

P. McKinley made contact with B. Arbogast (GD), W. Ficklin (GD), D. Detri (GD), W. Rodman (YMP), and D. Erdmann (WRD) to assure that ion chromatography chloride analysis by GD Branch of Geochemistry was covered on the AVL.

3GOH15CA Complete data report Kawich FY 85-90

P. McKinley talked to E. Maxwell of SERI about their progress in reviewing solar radiation results from the Bird "Clear Sky Model". Completion of the review is awaiting data verification from Ely, Nevada, which is being used in the Bird model to estimate several parameters.

T. Oliver completed regressions for Stewart soil temperatures for 1987 and 1989, Kawich Peak air temperatures for 1988, and Kawich base soil temperatures for 1991. The relation between the analog sites and established weather stations in central Nevada has provided insight into the relation between air temperature and soil temperature at different locations and elevations.

P. McKinley secured long term weather data from K. Redmond, the Regional Climatologist at the Western Regional Climate Center in Reno, Nevada, for the purposes of determining long term trends and how the sampling period at the Analog Recharge sites compares to

the long term norms.

T. Oliver ran statistics on the long weather data from Austin, Nevada.

3GQH16CA Complete data report Stewart FY 85-90  
See 3GQH15CA.

3GQH21CA Development of HRU analog basins  
P. McKinley completed a seven day class on ARC/INFO for managing GIS data bases in order to start the manipulation, consolidation, and evaluation of the data that will be used to develop the HRUs at the analog basins.

3GQH24CA Analysis methods for ET  
Final purchasing agreements were made with Li-Cor so that a Quantum sensor could be calibration checked for comparison with a ceptometer.

#### Quality Assurance

#### Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks  
Meeting on the use of uranium to augment strontium ratio work. (2 hours)

Technical review of HP-194 (not completed yet). (1 hour)

YMP seminar on the Hydrologic Significants of Earthquake Strain. (1 hour)

Completed reading assignment on QMP-3.03. (1 hour)

Chemical Hygiene Plan was completed. (3 hours)

Chemicals were disposed of according to accepted procedures. (1 hour)

SCP 8.3.1.5.2.1.4b Geochemistry of arid-zone infiltration 0G3622E2  
Summary Account Manager - A. Riggs

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

3GQH006D Install long-term meteorological monitoring instruments  
The electrical connectors needed to connect instruments to the datalogger were collected.

The material required to attach instrumentation to the tower was found and cut into appropriate lengths.

The design on the instrumentation shelter for the tower began.

Began working out electrical hookups to datalogger.

3GQH012D Quarterly bulk precipitation collection  
The quarterly bulk precipitation sampling trip was performed as planned--no problems.

3GQH003C Soil and moisture chemical sampling  
Deuterium and <sup>18</sup>O soil profiles from samples collected in May are now being analyzed by NMIMT contractors.

### Quality Assurance

3GQH006D Install long-term meteorological monitoring instruments  
Read AP5.10Q, QMP 3.03, R3, QMP 4.02, R3.

### Planning and Operations

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

An estimated 28 hours were spent on the following:

The chemical hazard plan for the lab in Building 56 was assembled.

The Preliminary Assessment/Site Investigation questionnaire for the lab in Building 56 was completed.

The hood in the lab in Building 56 was fixed.

The purchase of safety glasses and lab coats for the lab in Building 56 was initiated.

E. Ray checked the velocity into the hood in the lab in 56--it was O.K.

Met with J. Watson regarding data submission for Organ Pipe Cactus National Monument balloon work.

The detailed FY92 project budget was assembled.

Attended Software QA overview Saturated Zone Section meeting.

### SCP 8.3.1.5.2.1.5 Studies of calcite and opaline silica vein deposits 0G3622D2

Summary Account Manager - J. Whelan

### ACTIVITIES AND ACCOMPLISHMENTS

#### Technical Activities

3GQH814A Prepare reports - drill hole calcite/silica

Manuscripts entitled "Paleohydrologic implications of the stable isotopic composition of secondary calcite within the Tertiary volcanic rocks of Yucca Mountain, Nevada" by J. Whelan and J. Stuckless and "Strontium isotope geochemistry of calcite fracture fillings in deep core, Yucca Mountain, Nevada" by Z. Peterman and others were submitted for the proceedings of the annual ANS High-Level Radioactive Waste Management Conference.

3GQH813A Evaluate total carbonate system - Yucca Mountain area

J. Whelan, Z. Peterman, B. Marshall, E. Taylor (HIP), and B. Zartman (BIG-GD) met with J. Evernden (BGS-GD) for a day to provide detailed discussions of the geochemistry of carbonate in the Yucca Mountain area. Evernden is reviewing the Szymanski Peer Review Panel Minority Report at the author's request.

Z. Peterman, J. Paces, and E. Taylor spent two days in the field with J. Evernden. Areas visited included trench 14, Yucca Crest, Site 199, the mammoth tusk deposit, travertine point, Ash Meadows, Devil's Hole, and Peter's Playa. Emphasis was on pedogenic calcite, including comparison of true spring deposits with those alleged spring deposits described in the Minority Report.

J. Whelan prepared 15 samples of vein and fracture coating calcite from drill holes G1-G4 for AMS  $^{14}\text{C}$  dating.

J. Whelan prepared photos and petrographic descriptions of samples of vein and fracture

coating calcite from drill hole G2.

J. Whelan visited LAC Minerals' Bond Gold (active) and the Bullfrog (inactive) mines and collected unlocated scoping samples of the carbonate and quartz gangue.

K. Futa continued Nd isotope analyses of calcite fracture fillings in core samples from USW G-2, -3, and -4. Preliminary results suggest an analytically measurable isotopic difference in  $^{143}\text{Nd}/^{144}\text{Nd}$  between surficial calcites and deep fracture fillings.

S. Mahan completed Sr isotopic analyses of the collection of water samples from J12, J13, and Army #1. These are being analyzed to generate high-quality baseline data for subsequent study of water from JF-3. Slight differences in  $^{87}\text{Sr}/^{86}\text{Sr}$  between these data and analyses of earlier collections suggest that isotopically distinct zones are yielding water in these wells.

B. Marshall worked on the interpretation of Sr, O, and C isotope data for fracture fillings in preparation of a report to be presented at the International Water-Rock Conference this summer.

**3GQH803A Analyze isotopes/fossils - Solitario Canyon and Windy Wash**

J. Paces continued analytical work on calcite samples. Chemistry was completed on three samples from Site 199 and was started on samples from Site 106 along Stagecoach Road.

**3GQH806A Analyze isotopes/fossils - depths known origin**

S. Mahan, K. Futa and Kraft continued Sr isotopic analyses of Paleozoic limestone and calcrete samples from Bare Mountain and from Striped Hills.

**3GQH802A Install/calibrate new mass spectrometers**

Delivery of the new Finnigan mass spectrometers for stable and radiogenic isotope measurements has been delayed to March. This delay will impact all milestones related to Sr, Nd, Pb, and stable isotope analyses.

**3GQH801A Hire and train geologists**

The technician position to support stable isotope studies still has not been advertised. This delay will impact all milestones related to stable isotope analyses.

The Finnigan MAT 251 mass spectrometer was down during the month of January, so no stable isotope measurements were possible.

**Quality Assurance**

**3GQH813A Evaluate total carbonate system - Yucca Mountain area**

J. Whelan initiated process of QA approval of Beta Analytical, Inc. for use as a provider of  $^{14}\text{C}$  ages.

**Planning and Operations**

**3GQH813A Evaluate total carbonate system - Yucca Mountain area**

J. Whelan submitted a specimen removal request for core samples from drill holes UE25-b# 1H, -a4, -a5, -a6, -a7, -RF3, and -RF9 for the next SOC meeting.

K. Ludwig (GD) presented a proposal to do high-precision uranium isotope analyses of ground water samples in the vicinity of Yucca Mountain. A presentation to HIP scientists and managers was made on January 9.

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

J. Whelan attended the SOC meeting and borehole sequencing workshop at the SMF.

J. Paces completed system and spike calibrations per GCP-03. Paces also completed reading assignments for QMP-3.04, 4.02, 3.03, 17.01, and AP 5.10.

B. Marshall completed training in QMP-3.03 and helped evaluate training objectives for SAIC.

B. Marshall recalibrated the energy-dispersive X-ray fluorescence unit following replacement of the X-ray tube.

#### WBS 1.2.3.6.2.2.2 Future Regional Hydrology due to Climate Changes

Principal Investigator - J. Stuckless

##### OBJECTIVE

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

#### SCP 8.3.1.5.2.2.1 Analysis of future surface hydrology due to climate changes 0G3622F2

Summary Account Manager - D. Grasso

#### ACTIVITIES AND ACCOMPLISHMENTS

##### Technical Activities

##### Quality Assurance

##### Planning and Operations

##### 3GFH200A Obtain/install micro computer system

Computer hardware and software evaluations for the computer modeling system needed for this activity are complete. Procurement materials were prepared and submitted to the USGS District Office for review. Three hardware and software vendors for each of the system's components were contacted for price quotes. An itemized list of these price quotes and justification for the system was prepared to accompany the DI-1 purchase request forms. The system purchase is now being processed through the appropriate USGS channels.

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

An estimated 62 hours were spent on the following:

D. Grasso and D. Beck conducted a phone search for a surface-water modeler to fill the GS-9 position for this activity. It is hoped to have someone on staff after the move in March, 1992. Some of the prospective candidates look very promising.

D. Grasso attended a GIS meeting at UNLV (January 7) to tour the Department of Engineering Computer Laboratory facility, meet with staff members, and observe their GIS and modeling research activities.

D. Grasso met with G. Dixon and K. Brothers (Las Vegas Valley Water District) on January 14 to examine their new SUN/ERDAS image processing and analysis computer system. Grasso helped them to use their Landsat Thematic Mapper thermal-infrared band coverage of Railroad Valley in central Nevada to detect hot springs and warm-water runoff from the springs. In addition, late-Quaternary shorelines of a pre-existing lake in Spring Valley, Nevada, which cut into alluvial fans surrounding the valley, were also investigated using their Landsat satellite data coverage.

SCP 8.3.1.5.2.2.3 Synthesis of effects of possible future recharge due to climate changes on hydrologic characteristics of the Yucca Mountain saturated zone 0G3622G2

Summary Account Manager - J. Downey

ACTIVITIES AND ACCOMPLISHMENTS

Technical Activities

**3GFH004H Analyze structural geology**

C. Faunt completed input of data on regional and local stress fields.

Additional training for A. Turner, K. Kolm, C. Faunt, and F. D'Agnese by Intergraph personnel (B. Wales) concerning 3-D modeling of regional study area was conducted at Golden.

**3GFH003C Conduct literature search for GSIS (Future/Quaternary GW)**

C. Faunt continued literature search and review including:

Weaver and Hill (1979), Hamilton and Healy (1969), Hill and Beeby (1977), Haimson (1977), Haimson and others (1975), Kanamori and Fuis (1976), McKenzie (1969), Gumper and Scholz (1971).

**3GFH023C Develop recharge/discharge estimates**

F. D'Agnese and K. Kolm continued development of methodology for regional recharge/discharge modeling. Emphasis was placed on resolving calibration of recharge model.

F. D'Agnese continued search for existing Landsat Thematic Mapper data for use in regional mapping of vegetation. Search included locating images listed in Federally Owned Landsat Data (FOLD) library. Approximately five images have been located that are free of cloud cover. Requesting these images through FOLD will save the estimated \$45,000 discussed last month.

**3GFH028C Gather input data to GSIS**

F. D'Agnese completed scanning/digitizing regional cross-sections to be used for regional 3-D hydrogeologic framework.

F. D'Agnese completed conversion of eighteen (18) 1:100,000 scale Digital Line Graph data files of surface hydrology for regional area. Completed coverages include point location data and arc/line data.

C. Faunt began inputting anomalous drainage patterns into GIS.

Data from L. Demarco's Amargosa Desert vegetation study were located, following a search, and the necessary statistical analyses to complete this project were started. Problems getting in touch with J. Emmerick slowed this study.

**3GFH025C Establish data documentation procedure for GSIS**

F. D'Agnese and C. Faunt attended a training course on QA documentation of software.

F. D'Agnese and C. Faunt attended a meeting with N. Stuthmann, B. Kerans, D. Burkhardt, and W. Oatfield on how to deal with GIS data.

**3GFH021C Construct 3-D hydrogeologic framework model**

C. Faunt finished editing digitized geologic cross-sections for 3-D model. The cross-sections were transferred to the Intergraph system and put into 3-D space.

C. Faunt and F. D'Agnesse continued reclassifying geologic units into hydrogeologic units

Fairfield Digitizing Inc. sent the digital files of Mariposa, Trona, Death Valley, and Kingman quads that were on contract for digitization and labelling. The digitizing appears to be accurate; however, the labelling will have to be redone. This will require approximately 80 hours of time.

**3GFH005C Analyze hydrologic framework**

This activity did not begin until late in the month because of the delayed arrival of the critically needed computer software. See December 1991 status report.

Quality Assurance

**3GFH004H Analyze structural geology**

C. Faunt and E. Gutentag completed paperwork for request of purchase of analytical software.

Planning and Operations

**3GFH004H Analyze structural geology**

Radian Corporation has agreed to supply copies of their advanced contouring package CPS-3, including their fault modeling system FFMS, for use with the Intergraph ERMA software at CSM. Contract letters have been received by CSM, and early acceptance of the software is expected. This software is urgently needed to complete construction of a 3-D geological framework model of the Southern Nevada region.

The task of plotting orientations was started in January. The software necessary to start this study arrived on January 28.

**3GFH025C Establish data documentation procedure for GIS**

F. D'Agnesse and C. Faunt are planning to attend a meeting in March with EG&G on GIS and managing the data.

A. Turner is head of this task. Notification of the approval of his IPA agreement was received in early January. Approval was effective December 26, 1991.

**3GFH005C Analyze hydrogeologic framework**

The software necessary to start this study arrived on January 28. The task was begun at the end of this month due to the late arrival of the software.

**3GFH021C Construct 3-D hydrogeologic framework model**

The cross-section work and building of the 3-D model is on hold until Intergraph can determine what steps should be taken next.

Work Performed but not in Direct Support of the Scheduled Tasks

K. Kolm and J. Downey reviewed Study Plan incorporating suggested changes. (10 hours)

J. Downey evaluated formal reviewers' comments on report on SNODIF simulation model coauthored by H. Claassen. (20 hours)

## 1.2.5 REGULATORY AND INSTITUTIONAL

### OBJECTIVE

To support the Department of Energy (DOE)/HQ in the development of the site-related aspects of compliance with Nuclear Regulatory commission agreements, requirements, and policies, environmental and permitting requirements, and related DOE orders, and the development of site-related regulatory documentation; to plan and conduct environmental field investigations and transportation studies related to environmental compliance, permitting and repository design; to plan and conduct 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

J. Stuckless assisted in a DOE field trip for the Chairman of the NRC.

D. Appel attended the NWTRB meeting on YMP priorities in Arlington, Virginia, January 7 and 8.

At the request of DOE-YMPO, responses were prepared to the NWTRB's "Fourth Report to Congress" recommendations and conclusions. Responses prepared by unsaturated-zone PIs were reviewed by Hydrology Program and USGS TPO Office staff.

J. Whitney participated in a meeting with the Nuclear Waste Technical Review Board January 21-23 in Irvine, California. Whitney participated in the planning of the January 28-31 DOE/M&O field trip to the southern Great Basin. He also contributed abstracts to the guidebook and served as a facilitator and speaker on the field trip.

L. Anderson attended the meeting on seismic vulnerabilities that was held by Nuclear Waste Technical Review Board January 21-23 in Irvine, California.

### WBS 1.2.5.2.5 Study Plan Coordination

Principal Investigator - L. Hayes

### OBJECTIVE

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

## **ACTIVITIES AND ACCOMPLISHMENTS**

The Section Chief's office, in conjunction with the PI, rewrote sections of the SCPB to reflect changes in the study plan (8.3.1.4.2.1.2) to carry out seismic traverses across Yucca Mountain and in Yucca Wash. These changes reflect evolution of this effort to focus on site-specific elements of seismic response.

Study Plan 8.3.1.17.4.3 (Quaternary faulting within the site area) - F. Singer made changes to figures and resubmitted them to R. Keefer.

Study Plan YMP-USGS SP 8.3.1.5.2.1, R2 (Quaternary regional hydrology) - S. Keller received author responses to DOE review comments for the regional paleoflooding activity from P. Glancy and D. Grasso, and began incorporating them in the document.

Study Plan YMP-USGS SP 8.3.1.5.2.2 (Effects of future climate on hydrology) - S. Keller received author responses to DOE review comments on the future surface water activity from D. Grasso, and author responses for the future saturated-zone activity from K. Kolm and J. Downey.

Approximately 40 hours spent on comment resolution on Study Plan 8.3.1.2.3.3, Site Saturated-Zone Hydrologic System Synthesis and Modeling

## **WBS 1.2.5.4 Environment**

### **OBJECTIVE**

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

### **WBS 1.2.5.4.8 Water Resources**

Principal Investigator - R. La Camera

### **OBJECTIVE**

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

## **ACTIVITIES AND ACCOMPLISHMENTS**

### **Technical Activities**

#### **3GWR011 Survey monitoring network sites**

No additional water level network sites were surveyed during the month. A review was made of network sites previously surveyed with changes incorporated into the project data base.

Although verbal approval was received from DOE for land access to unsurveyed network site, these sites will not be surveyed until written approval is received.

#### **3GWR001 Groundwater levels/springflow monitoring**

During the month, water levels were measured at 12 monitoring sites and springflow measurements were made at four network sites. Field sheets were checked and filed into the project data base.

Verbal approval was received from DOE to access previously unapproved network monitoring sites. Collection of data from these sites will commence upon receipt of written approval.

### **3GWR005 Groundwater monitoring quarterly report, first quarter FY92**

Compilation of water levels and springflow data for network sites continued. Historical and current water level data was received on January 29 from site characterization network sites that constitute that portion of the water resources monitoring network. The first draft of the cover memo for the initial draft of the quarterly data report was reviewed and formatted.

Progress in the preparation of the first quarterly report was impacted during the month due to unanticipated delays in the drilling of well JF-3 and delays in obtaining water level data for site characterization network sites. The report is still planned to be delivered to DOE within the established time frame.

### **3GWR010 Aquifer pump test JF-3**

Project staff provided nearly continuous field support for drilling activities for well JF-3. The details of well construction were refined and completion based on geologic and hydrologic information was provided during the drilling and in consultation with RSN, REECO, YMPB, DOE, and SAIC technical staff. Investigation of the possible use of Lithium Bromide as a tracer for the circulation fluid during drilling continued. Modifications were made to a water-quality trailer acquired at the Test Site to accommodate the collection and processing of water samples during the pumping of JF-3. Equipment and supplies needed for monitoring and sampling continued to be obtained. Operation, maintenance, and calibration of the transducer and data logger installed on well JF-3 continued. An electronic flow meter was installed by project staff on January 30 at J-12 and interfaced with the data logger to verify the pumping status.

The planned finish date of this activity has been extended to April 30, 1992. This change is being made due to the unanticipated length of time needed for the drilling. Additional time is also needed to obtain approximately one week of base line water level data prior to and after pumping the well and for checking, reviewing, and evaluating all data collected for this activity.

It should be noted that this planned activity may not result in sufficient data being provided to refine previous aquifer storage estimates. This could be better accomplished by utilizing the high capacity pump available in well J-12 and using well J-13 as an observation well.

### **3GWR013 Instrument JF-3**

A transducer, data logger, and other associated equipment planned for the monitoring of water levels during and after the pumping of JF-3 were obtained. Initial equipment checkout and preliminary calibrations were performed. Coordinated with HRMP staff who will provide assistance and equipment for the installation of the transducer.

The planned finish date of this activity has been extended to March 31, 1992. This change is being made due to the unanticipated length of time needed for the drilling.

### **3GWR004 Groundwater quality data collection**

The planned start and finish dates of this activity have been changed to March 2, 1992 and April 30, 1992, respectively. The change is due to manpower priorities required for accomplishing activities associated with the first quarterly report and the pump test for well JF-3.

### Quality Assurance

### Planning and Operations

Work Performed but not in Direct Support of the Scheduled Tasks

The preparation of a management agreement between HIP and the Nevada District that will describe work to be accomplished and the allocation of resources for the Water Resources Monitoring Program was initiated.

Participated in DOE's organizational meeting on January 28 on overall Environmental Monitoring Program activities.

**1.2.9 PROJECT MANAGEMENT**

OBJECTIVE

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

WBS 1.2.9.1 Management and Integration

OBJECTIVE

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

WBS 1.2.9.1.4 Records Management

Principal Investigator - L. Hayes

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

An amended response to USGS-CAR-91-08 was issued to agree with the required changes resulting from the Central Records Facility's (CRF) CAR-YM-91-065, and the Records Management Plan, Rev. 3. A management concurrence meeting resulted in two approved methods for controlled receipt of records submitted to the Local Records Center (LRC). These include the use of either a submittal sheet or a copy to the LRC noted by "cc:LRC", which will be receipted and returned to the sender.

DOE's CAR-YM-91-065 is being verified for legibility and completeness issues, which were incorporated in QMP-17.01, R5, and will be in the QMP-17.03, R0 modification. The Central Records Facility (CRF) is now accepting records held because of this Corrective Action Report (CAR), and the LRC is processing them on a planned schedule.

QMP-17.01, R5, was approved and an effective date of 02/28/92 was approved. Training instruction was written, approved, and made ready for the pilot class scheduled for Wednesday, 02/05/92.

The collection of all outstanding published reports and associated supporting data was completed for Alan Flint and staff.

Activities in the LRC have increased markedly due to the following projects:

Backlog - The Project office has agreed to allow backlog records to be transmitted to the CRF if they meet today's standards. A plan has been implemented to track the various backlog activities.

Legibility and Completeness Issues - The Project office is now accepting records held because of illegibility or incompleteness that cannot be corrected. The procedures are now approved and submittal of the held material is in progress. This includes a large quantity of procurement records.

The LRC received 406 QA "stand-alone" documents and 70 new record packages. Data entry of 746 documents was completed. Ten packages of "stand-alone" records and record packages containing 2,179 pages (423 documents) were transmitted to the CRF.

This month 24 packages of 1991 procurement documents were received, of which 23 were transmitted to the CRF.

One manuscript package containing two publications consisting of 294 pages and two mag tapes was transmitted to the CRF.

Quality Management Procedure OMP-17.01, R5, YMP-USGS Records Management, was distributed.

The following approved technical procedures were issued:

- |             |                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------|
| HP-204, R0  | Liquid Scintillation Spectrometry Method for Tritium Measurement of Water Samples                                      |
| HP-231T, R0 | Identification, Monitoring, and Sampling of Perched or Ground Water Encountered While Drilling Surface-Based Boreholes |

The 1991 YMP-USGS Controlled Documents Configuration Report is 79 percent complete, lagging the response of last year. Numerous other routine document control functions were performed, including issuing procedures to new copy holders, distributing replacement documents, sending out follow-up Document Transmittal Notices (DTNs), and transmitting eight DTN record packages to the LRC.

#### WBS 1.2.9.1.5 Training

Principal Investigator - L. Hayes

#### ACTIVITIES AND ACCOMPLISHMENTS

Various routine training functions were performed, including distributing individual reading assignments; scheduling DOE's General Employee Training (GET); scheduling and proctoring GET Refresher Training exams for Denver area participants; instructing orientation classroom sessions; providing the status of participants' instruction assignment completions; distributing first and second reminder notices to participants with overdue reading assignments; submitting record packages to the LRC; and providing graphics support to YMP-USGS instructors.

Reading assignments were issued for the following procedures:

- |               |                                                                                                                        |
|---------------|------------------------------------------------------------------------------------------------------------------------|
| OMP-17.01, R5 | YMP-USGS Records Management                                                                                            |
| OMP-3.03, R3  | Software Quality Assurance                                                                                             |
| HP-204, R0    | Liquid Scintillation Spectrometry Method for Tritium Measurement of Water Samples                                      |
| HP-231T, R0   | Identification, Monitoring, and Sampling of Perched or Ground Water Encountered While Drilling Surface-Based Boreholes |

YMP-USGS instructors were assisted in preparations for software quality assurance and records training sessions. Practice sessions for the software quality assurance instructors were held prior to a pilot. Classes were scheduled and announcements were distributed to appropriate individuals.

Facilitation was provided for QMP-3.03, R3 classes on January 28, 30, and 31.

On 01/06/92 the YMP-USGS Training Coordinator met with J. Kinney and B. Scavuzzo, USBR, to discuss the integration of USBR training records into the YMP-USGS database. Subsequently, information from USBR training records dating back to 1987 was entered into the YMP-USGS Training Database and records were prepared for submittal to the LRC.

The YMP-USGS Training Coordinator represented the USGS at the quarterly DOE Training Representatives Meeting held in San Diego. A presentation on the use of humor in training was provided to the other participants.

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 December were compiled. The December 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 October/November was completed and the report was edited and submitted to DOE.

The Project Worker Data forms were submitted for the USGS for the fourth quarter of 1991 with projections for the first and second quarters of 1992.

PACS summary account corrections, including incorporation of carry-over funds, were submitted to Las Vegas.

The December status for the USGS schedules was completed and on time. The status report was not sent to Las Vegas for input to the APECS system because of problems with Las Vegas in having the system baselined and approved by DOE.

Some additional minor corrections and activities have been completed and sent to Las Vegas for input to the APECS system before the network is baselined.

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

Quality Management Procedure QMP-17.01, R5, YMP-USGS Records Management, was approved and will be effective 02/28/92.

The following Quality Management Procedures were distributed for Division Review:

QMP-16.03, R3 Tracking, Trending, and QA Management Information Reporting  
QMP-16.04, R0 Control of Quality Deficiency Reports

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

QMP-3.05, R3 Request to Initiate Job Packages and Work Authorization (Criteria Letter)  
QMP-3.15, R0 Application of Graded Quality Assurance  
QMP-3.16, R0 Q-List and Management Control List Support  
QMP-4.01, R4 Procurement Document Control  
QMP-7.01, R5 Control of Purchased Items and Services  
QMP-7.04, R0 Vendor Evaluation  
QMP-16.03, R3 Trend Analysis  
QMP-16.04, R0 Control of Quality Deficiency Reports  
QMP-17.01, R5 YMP-USGS Records Management  
QMP-18.01, R7 Audits  
QMP-18.02, R3 Surveillances

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

Management reviews of draft Quality Management Procedures (QMPs) were completed in accordance with QMP-3.07 (reviews) for: QMP-5.05 R3 (work authorization/criteria letters), QMP-3.15 R0 (graded quality assurance controls), QMP-3.04 R4 (review of publications) and QMP-17.01 R5 (records management).

Analysis of the Project's QA Grading program development and USGS QA Grading planning continued for YMP-USGS guidance. QMP-3.15, Application of Graded Quality Assurance, is being finalized but further changes may be required to comply with the YMP emerging program.

#### 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-92-03 of 10 USGS-HIP activities was researched and planned. The Audit Plan was written.

Audit USGS-92-02 of five USGS-HIP activities was conducted. This Audit resulted in the initiation of one CAR and one Observation.

Audit Report USGS-92-01 for YSI Incorporated was submitted, recommending retention on the Approved Vendors List (AVL).

The Lead Auditor is working with the Lead-Auditor-in-Training for Audit USGS-90-07 (USBR) to assure that Audit Finding Report (AFR) USGS-9007-01 R1 is scheduled for verification to confirm that the corrective actions taken were adequate and effective.

A report on Surveillance USGS-92-S01 of the USBR soils work was issued. This surveillance resulted in the issuance of a Nonconformance Report on ineffective implementation of Criteria 5.

Surveillance Report USGS-92-S02 for Datron Instruments, Inc. was submitted recommending inclusion on the AVL.

Surveillance Plan USGS-92-S03, for Halkins Services, Inc., a potential vendor for calibration services of vacuum gauges, was submitted.

Vendor Evaluation USGS-92-E05, for Intertyme Metrology, Inc., was submitted, recommending the expansion of their approved calibration services to include balances and scales.

CARs, AFRs, and Nonconformance Reports (NCRs) were verified, including CAR-90-01, NCR-91-13, AFR-9115-03, 9110-07, 9101-02, 91-06, and 92-S01-OBS1.

A Special Investigative Review for USGS-NCR-91-36 was performed and a recommendation for its closure was submitted.

The AVL was updated and submitted on schedule.

A response to a DOE request for information about the type of QA programs and QA manuals used by YMP-USGS vendors was submitted.

A request for YMP-USGS participation in the DOE vendor requalification audit of REECo was submitted.

Investigative Reviews for verification of completed actions are in process for closure of NCRs -91-09, -12, -18, -43, and -44. An Investigative Review was performed as partial closure of NCR-91-26 which is to accommodate the transmittal of Procurement Record Packages to the LRC and partially verify corrective actions required for this NCR.

### WBS 1.2.9.3.3 Quality Assurance - Quality Engineering

Principal Investigator - L. Hayes

#### OBJECTIVE

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

#### ACTIVITIES AND ACCOMPLISHMENTS

The Open Items Committee met once during January. The members of the Open Items Committee continued to provide weekly updates to the QA Open Items Coordinator. The following open items were addressed during the month.

External Item(s): DOE/YMPO CARs YM-91-74 through YM-91-77 (software requirements).

Internal Item(s): AUDITS: AFR 9007-01 R1, 9115-01 and -02 (USER QA Program), AFR 9110-02 (qualification records), AFR 9110-07 (record rejections); 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 requirements), CAR 91-10 (misinterpretation of exemptions from procurement QA requirements), CAR 91-11 (scoping activities without documented authorization), CAR-92-02 (timeliness of HIP open items actions), CAR-92-03 (QMP-4.02 MOAs for HIP); NCR 91-09 (sampling), NCR 91-12 and -13 (software requirements), NCR 91-14 (qualification records with Study Plans), NCR 91-18 (data management), NCR 91-25 and -26 (procurement record packages), NCR 91-31 (QA Balance calibrations), NCR 91-37 and -38 (manuscript processing), NCR 91-39 (seismic group contracts), NCR 92-02 (SGBSN management agreement), NCR 92-06 (seismic publications).

Additional actions involved the follow-up for overdue document control notices and the evaluation of recent QA trending reports.

Meetings continued to discuss approaches and methods for recognizing the USBR as a YMPB program and assuring that applicable YMP-USGS QA program requirements were to be implemented by the USBR. The YMPB status log was updated for the technical activities affected by the GD to GSP transition. Other miscellaneous actions involved coordinating with the QA Office to plan for the upcoming DOE/YMPO Audit 92-13, including the technical auditor's scoping meeting with the USGS during the first week in February.

Approximately 10 items have been received, reviewed, and/or processed by the SCM Librarian in accordance with QMP-3.14. Eight additional software documents have been processed in accordance with QMP-3.03, R3. This includes updating the Configuration Status Log, the SCM Document Tracking database, and the Directory of Users. Technical Contacts have been notified upon the receipt of SQA Documentation and upon SCM Baselineing of Software Products.

Input was provided for the preparation of three training courses for QMP-3.03, R3. Several of these training sessions were attended in support of the SQA Specialist.

A Meeting was held for comment resolution of an ICN in the USGS QAPP that includes the Software Quality Assurance Plan (SQAP). The ICN was revised to incorporate comments to the SQAP/Appendix H of the Quality Assurance Program Plan. The matrix of the SQA requirements was updated. Both documents were provided along with QMP-3.03, R3 for transmittal to DOE subject to DOE CARs YM-91-074, -075, and -076.

An evaluation has been initiated to determine the impact of changes between QMP-3.03, R3 and previous SQA implementation and changes to specific classification and documentation requirements in accordance with the response for USGS-CAR-91-09, regarding misinterpretation of QMP-3.03, R2.

#### 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 December Open Items and Trend Analysis Report and the fourth quarter of 1991 Quarterly Trend Report was issued.

The daily and weekly Status of Open Items and Input to Open Items Database for Trending were prepared. New software is being researched and prepared to more effectively streamline this function.

**YUCCA MOUNTAIN PROJECT  
BIOLOGICAL RESOURCES PROGRAM  
MONTHLY PROGRESS REPORT  
FEBRUARY 1992**

Summary of Work Accomplished During Report Period

EG&G Energy Measurements (EG&G/EM) conducted work for the Biological Resources task (WBS 1.2.5.4.7) for the Project Office. Activities included conducting preactivity surveys; continuing site characterization effects studies, support studies for the radiological monitoring program, desert tortoise studies, and habitat reclamation studies; development of work instructions and study designs for new studies; and responding to requests for biological support by Project Office.

**Monitoring and Mitigation**

- A meeting was held between Project Office, USGS, and EG&G/EM to determine an acceptable location for two proposed neutron boreholes near long-term ecological study plot COL6C.
- EG&G/EM met with the Bureau of Land Management (T. Egan and C. Crosby) to discuss biological assessment requirements for permits for USGS to install stream monitoring gauges.
- Received requests to conduct preactivity surveys for neutron boreholes 15, 16, 17, and 36 (request #91-023b). Field surveys for all four boreholes were completed. EG&G/EM met with Project Office safety personnel in the field to identify an access route to boreholes 15 and 16.
- A cost estimate was prepared and submitted to Project Office for conducting a preactivity survey from the Canyon substation to the North Portal facility area.
- EG&G/EM met with Project Office to discuss the short-range construction schedule for Midway Valley and the Rock and Soil Test Pits.
- A stand-by reclamation ecologist was provided to give on-site consultation for salvaging topsoil during the initial construction work at UZ16.

## **Habitat Reclamation**

- Reclamation trials were started at the Forty-Mile Wash site. A weather station was installed at the site that monitors 24 soil moisture and temperature cells.
- Reclamation and soil stabilization was completed at neutron boreholes 54 and 55.
- The nursery contracted to grow plant material for reclamation trials was visited to inspect plant seedlings.

## **Site Characterization Effects Program**

- Traffic count data were collected weekly at 9 locations. Counters were moved to new locations each week.
- Weather and soil moisture and temperature data were collected twice on 48 ecological study plots (ESP).
- Vegetation density data from FY91 continued to be entered into the computer database.
- Maintenance of the eight small mammal trapping grids was completed. This included remarking trap stations, cleaning traps, and replacing broken traps.
- Locations of soil pits were marked on 14 ESP.
- Eight sampling routes were marked for animal-vehicle collisions.
- Petri dishes with filter paper for monitoring dust deposition were placed on 40 study plots.

## **Radiological Monitoring Program**

- The setup of two small mammal trapping grids for training staff scientists was completed.
- Surveys were conducted to locate quail coveys to help identify potential trapping sites. Construction of quail traps was completed.

### **Desert Tortoise Program**

- ✓ ● Tortoise 423 was relocated from the site of the Midway Valley Rock and Soil Test Pit studies to a site 5 km east near the Calico Hills. The tortoise was monitored continuously during the daylight hours for the first 24 hours and daily since.
- Tortoise 211 moved into the Rock and Soil Test Pit area. Plans were developed for handling this animal. Radiomarked tortoises at Yucca Mountain were located once every other week. Tortoises in the Control Area were located once during the first, third, and fourth weeks because several tortoises moved. During March, all radiomarked tortoises will be located either once or twice each week.
- Information was summarized on the additional four possible relocation areas.
- One tortoise was radiomarked this week. This tortoise had been radiomarked but had lost its transmitter. One hundred-twenty-seven tortoises have been marked for the Yucca Mountain Site Characterization Project. Eighty-eight radiomarked tortoises are being monitored.

### **Support Items**

- Sent the January monthly report of Yucca Mountain Site Characterization Project activities and accomplishments to the Project Office. Weekly reports of activities were submitted to the Project Office.
- A response was prepared and submitted to SAIC (B. Foster) regarding the Technical Review Board comment on the need for an integrated terrestrial ecosystem program.
- EG&G/EM provided support for two tours of the Yucca Mountain Site Characterization Project.
- Provided justification for the FY93-94 statements of work included in the PACS account summaries.
- Received a request from Project Office to address reclamation questions from the Nevada Nuclear Waste Project Office.
- Preparation and review of Instructions continued for FY92 field studies

LAWRENCE LIVERMORE NATIONAL LABORATORY YUCCA MOUNTAIN PROJECT  
FEBRUARY 1992 TECHNICAL HIGHLIGHTS AND STATUS REPORT

TABLE OF CONTENTS

1.2.1 Systems

- WBS 1.2.1.1 Management and Integration
- WBS 1.2.1.2.4 Systems Engineering Implementation (Revelli)
- WBS 1.2.1.2.6 YMP Support to MSIS (Ruffner)
- WBS 1.2.1.3.5 Technical Database Input (Revelli)

Performance Analyses (Halsey)

- WBS 1.2.1.4.2 Waste Package Performance Assessment (Halsey)

Geochemical Modeling

- WBS 1.2.1.4.5 Geochemical Modeling & Database Development (Wolery/Johnson)
- WBS 1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses

1.2.2 Waste Package

- WBS 1.2.2.1 Management and Integration
- Waste Package Environment (Wilder)
  - WBS 1.2.2.2.1 Chemical & Mineralogical Properties of the Waste Package (Glassleyaq)
  - WBS 1.2.2.2.2 Hydrologic Properties of Waste Package Environment (Buscheck)
  - WBS 1.2.2.2.3 Mechanical Attributes of the Waste Package Environment (Blair)
  - WBS 1.2.2.2.4 EBS Field Tests (Lin)

Waste Form & Materials Testing (Stout/Clarke)

- WBS 1.2.2.3.1.1 Waste Form Testing - Spent Fuel (Stout)
- WBS 1.2.2.3.1.2 Waste Form Testing - Glass
- WBS 1.2.2.3.2 Metal Barriers
- WBS 1.2.2.3.4.1 Integrated Radionuclide Release: Tests and Models (Viani)
- WBS 1.2.2.3.4.2 Thermodynamic Data Determination

Engineering & Systems Analyses (Ruffner/Clarke)

- WBS 1.2.2.4.1 Waste Package Design (Ruffner)
- WBS 1.2.2.4.2 Container Fabrication & Closure Development (Clarke)
- WBS 1.2.2.4.3 Container/Waste Package Interface Analysis (Ruffner)

1.2.5 Regulatory and Institutional

- WBS 1.2.5.2.1 NRC Interaction Support (Blink)
- WBS 1.2.5.2.2 Site Characterization Program
- WBS 1.2.5.2.4 Technical Support Documentation
- WBS 1.2.5.2.5 Study Plan Coordination (Blink)
- WBS 1.2.5.2.6 Semi-Annual Progress Reports (Campbell)

1.2.9 Project Management

- WBS 1.2.9.1.1 Management (Clarke)
- WBS 1.2.9.1.4 Records Management (Bryan)
- WBS 1.2.9.2 Project Control (Podobnik)
- WBS 1.2.9.3 Quality Assurance

LAWRENCE LIVERMORE NATIONAL LABORATORY  
(LLNL)  
YUCCA MOUNTAIN PROJECT (YMP) STATUS REPORT

FEBRUARY 1992

EXECUTIVE SUMMARY

(Items Proposed for Reporting in YMPO or OGD Reports)

1) As a result of the analyses of repository-heat-driven hydrothermal calculations, it has been recognized that three critical hypothesis tests can be used to help focus model validation work and related site characterization activities. The three hypothesis are:

1) Does repository heat-driven-hydrothermal flow dominate the ambient hydrological system?

2) Do boiling conditions and rock dry-out effects dominate hydrological performance?

3) Does the dry-out front correspond to the nominal boiling point isotherm and is far field heat flow dominated by heat conduction?

These three hypothesis tests will require large-scale heater tests at multiple hydrostratigraphic horizons within the unsaturated zone at Yucca Mountain or a suitably analogous site, such as Busted Butte. If the answer to each of the three hypothesis tests is yes, then the validation of hydrologic performance models of the site can be greatly focussed, thereby enhancing the probability that adequate validation can be achieved.

2) The flow through spent fuel dissolution testing continued at PNL. Results continued to show that dissolution of unoxidized spent fuel and spent fuel oxidized to  $U_4O_9$  are similar. Similarly, unirradiated  $UO_2$  and unirradiated  $UO_2$  oxidized to  $U_3O_7$  at  $25^\circ C$  in a dilute bicarbonate solution had approximately the same dissolution rates.

3) Samples of PNL-76-68, SRL-131, and SRL-165 glasses reacted in water vapor (100% relative humidity) for three years at  $75^\circ C$  were removed from the reaction chamber and are being investigated using analytical electron microscopy (AEM). These samples are part of a suite of samples that are being tested to evaluate reaction under conditions likely to be present after containment breach. The questions to be answered are how much reaction will take place and what are the reaction products. The results from this suite of tests can be compared with tests performed at higher temperature to evaluate temperature as a parameter to accelerate the reaction. Sections of PNL-76-68 and SRL-131 glass have been examined. The SRL-131 glass has reacted about ten times faster than the PNL-76-68 glass. This result is similar to previous results at higher temperature in which PNL-76-68 glass reaction appeared to be inhibited due to the formation of Al-bearing secondary phases which quench the ion-exchange process. At lower temperatures, the secondary phases are not present in sufficient quantity for analysis, but the similarity of low and high temperature relative reaction rates for these glasses implies that the mechanism might be the same.

4) The contract with J. Leckie (Stanford University) has begun. He is developing a semi-empirical model of uranium-goertite surface speciation at elevated temperatures and at a range of pH values.

## **1.2.1 SYSTEMS**

### **1.2.1.1 Management and Integration**

No significant activities.

### **1.2.1.2.4 Systems Engineering Implementation**

J. Blink worked with the RSED and SAIC staff to arrange a review and CCB submission of LLNL's proposed revision to the SCPB in the areas of Near Field Geochemistry and Man-Made Materials.

### **1.2.1.2.6 YMP Support to Management Systems Improvement Strategy**

No significant activities.

### **1.2.1.3.5 Technical Database Input**

M. Revelli participated in the two technical data meetings in Las Vegas on February 4. The first meeting addressed the development status of the Reference Information Base and the near term engineering/design needs. The second meeting reviewed progress made on the Parameter Normalization task and requested participant comments on the Task Plan, the Parameter Identification listing and the Data Dictionary format.

### **1.2.1.4.2 Waste Package Performance Assessment**

The PANDORA-1.1 code development continued. A prototype version with advancements in the waste form alteration and release models is being merged into the main version. A functional and design description was written and reviewed for the merge, and implementation is in progress. The prototype model uses analytical solutions rather than finite difference solutions and calculates whether to apply the concentration or matrix-limited release control for each radionuclide, as it depends on the inputs and on the time-varying inventories. A draft Individual Software Plan for prototyping the PANDORA-1.1 is being reviewed.

D. Stahl, R. Fish, and T. Doering of the M&O staff visited LLNL February 13-14 for discussions on integrated testing and performance assessment.

### **1.2.1.4.5 Geochemical Modeling and Database Development**

Effort is now focused on review of the four user manuals submitted in December and for the verification/qualification activity for version 7.0 of the EQ3/6 family code. The verification/qualification effort is being conducted as an independent activity, in the sense that the code author is not directing or conducting it. The code author is available for consultation on this activity, as needed.

At the request of the database task, work was completed in checking a tentative set of new data files. Some time was spent addressing the technical issues involved in resumption of code development. Discussions have been held within LLNL to identify these issues and how they might be resolved. There are two immediate technical issues. The first issue is a set of changes that would coordinate with changes to the thermodynamic database including using upper and lower case letters to identify chemical species. The database task would like some of these changes to be implemented in the near future. The second issue concerns the incorporation of an ion exchange submodel into a qualified version of EQ3/6. This submodel has already been developed in a prototype branch version. These issues could be dealt with by extending version 7.0 to version 7.1. However, version 7.0 contains a data structure which dates back to the original version of EQ3/6. A new data structure is required in order to add a number of other code capabilities necessary for some anticipated YMP-related calculations at LLNL and LANL. These capabilities include redox disequilibrium in reaction path models, mineral surface speciation submodels, and solid solution submodels in which important radionuclides are incorporated at trace levels. It is anticipated that this change of data structure would be accomplished in version 8.0, which would also incorporate one or more of the above new capabilities. Another option for dealing with data file changes and the ion exchange submodel would be to work these into version 8.0 directly, bypassing version 7.1. The 7.1 option would give some benefit in the shorter term, the trade-off being that some of the work would have to be redone in version 8.0.

On President's Day weekend, the hard-disk on the Sun server crashed. GEMBOCHS and its associated software were located on that disk. Most of the files were restored from weekly backup tapes, but the database itself could not be restored from normal backup tapes (an unanticipated problem due to the recent INGRES upgrade). A December INGRES backup was used for database restoration. Efforts are focused on restoring the database and its software library to their pre-crash state. Operations are expected to be back to normal by the end of March.

#### **1.2.1.4.7 Supporting Calculations for Postclosure Performance Analyses**

This WBS element has not been funded in FY92.

### **1.2.2 WASTE PACKAGE**

#### **1.2.2.1 Management and Integration**

J. Blink attended a LANL meeting to establish a working group for control of Tracers/Fluids/Materials. The meeting was held in Las Vegas on February 11.

#### **1.2.2.2 Waste Package Environment**

The Preliminary Near Field Environment Report is nearly complete. All review comments have been incorporated, and the report will be sent to the Project Office in March.

The near field technical area staff participated in an internal audit February 11-21.

### 1.2.2.2.1 Chemical and Mineralogical Properties of the Waste Package Environment

B. Viani attended the Geochemistry Integration Team Meeting in Las Vegas February 24-25. J. Blink met with A. Simmons on February 28 to arrange LLNL support of future GIT activities.

### 1.2.2.2.2 Hydrologic Properties of the Waste Package Environment

T. Buscheck continued to analyze repository-scale and drift-scale hydrothermal model calculations of repository-heat-driven hydrothermal flow. For Areal Power Density (APD) > 80 kW/acre and 30- and 60-yr-old fuels, the maximum vertical extent of the dry-out zone below the repository horizon was found to be approximately 166 m, regardless of APD. Above the repository horizon, the maximum vertical extent of dry-out increases with APD.

An important conceptual point is that boiling and rock dry-out occur because the thermal loading conditions and heat conductance of the dry-out zone can drive heat flow to the boiling front faster than the far-field heat conductance can dissipate it. Therefore, an increase in heat convection within the dry-out zone will tend to enhance the rock dry-out rate, while an increase in far field heat convection will tend to retard the dry-out rate. It was found that even when a very large heat-convection-dominated heat-pipe zone existed in the two-phase zone above the boiling zone, boiling and dry-out performance were not significantly reduced by the presence of the heat-pipe zone. However, heat-convection-dominated heat flow in the far field (beyond the two-phase zone) has the potential of reducing boiling and dry-out benefits.

The insensitivity of the vertical extent of the lower dry-out zone was attributed to two effects. First, the water table in the model is represented as a boundary with fixed temperature, saturation, and pressure. Because the water table behaves like a temperature sink, it enhances far field cooling as the dry-out front approaches the water table, thereby reducing boiling and dry-out effects. The second reason for the insensitivity of the vertical extent of the lower dry-out zone is the fixed location of the water table. Because the water table is not de-watered in these calculations, it provides an infinite source of water for capillary-driven flow of water back to the dry-out zone. The Equivalent Continuum Model (ECM) assumes that fracture flow will only occur when the bulk saturation of the equivalent medium,  $S_b$ , is greater than the critical bulk saturation,  $S_{b,crit}$ . For the 100  $\mu\text{m}$  fractures assumed in the ECM,  $S_{b,crit} = 98.4\%$ . The saturation profile below the repository horizon approaches 100 percent in the vicinity of the water table. The critical bulk saturation,  $S_{b,crit}$ , occurs approximately 166 m below the repository horizon. The contribution of fracture flow to capillary driven flow back toward the dry-out zone has the effect of limiting the net dry-out to the region where  $S_b > 98.4\%$ .

As a result of the analyses of repository-heat-driven hydrothermal calculations, it has been recognized that three critical hypothesis tests can be used to help focus model validation work and related site characterization activities. The three hypothesis are:

1) Does repository heat-driven-hydrothermal flow dominate the ambient hydrological system?

2) Do boiling conditions and rock dry-out effects dominate hydrological performance?

3) Does the dry-out front correspond to the nominal boiling point isotherm and is far field heat flow dominated by heat conduction?

These three hypothesis tests will require large-scale heater tests at multiple hydrostratigraphic horizons within the unsaturated zone at Yucca Mountain or a suitably analogous site, such as Busted Butte. If the answer to each of the three hypothesis tests is yes, then the validation of hydrologic performance models of the site can be greatly focussed, thereby enhancing the probability that adequate validation can be achieved.

T. Quinn obtained all comments for the Individual Software Plan (ISP) for the initial qualification of V-TOUGH. She finished implementing the comments and has sent out the ISP for comment resolution verification.

T. Quinn and S. Daveler have established the process for writing the V-TOUGH User Manual. This document will be maintained on S. Daveler's Sun workstation in a Framemaker format. S. Daveler completed a draft of the user input to V-TOUGH which was reviewed and commented on by T. Quinn.

T. Quinn reviewed the software configuration management system with J. Blink. They are verifying compliance with the TIP in preparation for an upcoming DOE audit. Although it is not currently required to perform configuration management in accordance with the TIP, by the end of March, compliance with this TIP will be met.

For the purpose of testing V-TOUGH and the EQ3/6 suites of codes, T. Quinn attended a briefing at the Software Technology Center (STC) on analyzing FORTRAN and C Codes. The STC is a repository for tools that can be used for re-engineering codes and determining testing strategies. T. Quinn discussed testing strategies with T. Wolery for EQ3NR, EQ6 and EQPT.

T. Quinn ported the STARS reservoir engineering code to the NERSC UNICOS Cray computers.

S. Daveler debugged several options of Exttool which had not been running properly on Xview (but had been running properly on Sunview).

#### **1.2.2.2.3 Mechanical Attributes of the Waste Package Environment**

Study Plan 8.3.4.2.4.3 is in comment response verification at YMPO and OCRWM.

S. Daveler has been assisting S. Blair in debugging a prototype geomechanical code. The code was converted from S-plus to C, and the changes were verified. S. Daveler wrote a tool to assist in running S. Blair's code and added post-processing graphics capabilities.

#### **1.2.2.2.4 EBS Field Tests/ESF Test Design**

J. Blink met with H. Kalia (LANL TCO) to discuss options for off-block prototype testing. T. Buscheck will calculate potential thermal-hydrological experiments in the Busted Butte stratigraphy.

#### **1.2.2.2.5 Man-Made Materials**

This WBS element has not been funded in FY92.

### **1.2.2.3 Waste Form and Materials Testing**

#### **1.2.2.3.1.1 Waste Form Testing - Spent Fuel**

A combined meeting was held on February 10-11 with LLNL, PNL and Canadian staff at which the US/Canada collaboration agreement (SA-2) was discussed. R. Stout gave an overview presentations of the spent fuel activities at this meeting and at the NRC Technical Exchange in Pasco on February 25.

#### **Spent Fuel Oxidation**

Oxidation dry bath testing continued at PNL.

Presentations were given by R. Einziger of PNL on oxidation testing at the DOE/AECL meeting held in Pleasanton on February 10-11 and also at the NRC technical exchange at Pasco on February 25.

#### **Spent Fuel Dissolution**

Modifications are being made to the experimental procedure used during dissolution of  $UO_2$  because dissolved oxygen in the leaching solution permeates the tubing walls and escapes into the glove box. This will be corrected by using impermeable metal tubing or by using the same oxygen fugacity outside the system as is present inside. This change will be reflected in an Activity Plan D-20-53a update.

The flow through spent fuel dissolution testing continued at PNL. Results continued to show that dissolution of unoxidized spent fuel and spent fuel oxidized to  $U_4O_9$  are similar. Similarly, unirradiated  $UO_2$  and unirradiated  $UO_2$  oxidized to  $U_3O_7$  at  $25^\circ C$  in a dilute bicarbonate solution had approximately the same dissolution rates.

H. Leider gave a presentation on dissolution testing at the DOE/AECL meeting held in Pleasanton on February 10-11. S. Steward gave a presentation on dissolution testing at the NRC technical exchange at Pasco on February 25.

W. Gray of PNL made presentations on dissolution testing at the DOE/AECL meeting held in Pleasanton on February 10-11 and also at the NRC technical exchange at Pasco on February 25.

A paper is being co-authored by W. Gray (PNL), H. Leider, S. Nguyen, S. Steward, and H. Weed of LLNL on the most recent UO<sub>2</sub> dissolution results (LLNL) and Spent Fuel dissolution results (PNL). This paper will be submitted to the Journal of Nuclear Materials.

### Materials Characterization Center

The following paper has been sent to YMPO for review:

"Microstructural Analyses of LWR Spent Fuel at High Burnup" by L. Thomas, C. Beyer and L. Charlot.

#### 1.2.2.3.1.2 Waste Form Testing - Glass

This WBS element has received limited funding in FY92. These funds are being used to maintain the N2 and N3 tests at ANL.

The N2 tests (SRL actinide-doped glass) continue with no sampling period occurring this month. These tests have been in progress for 312 weeks. The N3 tests (ATM-10, a West Valley actinide-doped glass) continue and have been in progress for 230 weeks.

Samples of PNL-76-68, SRL-131, and SRL-165 glasses reacted in water vapor (100% relative humidity) for three years at 75°C were removed from the reaction chamber and are being investigated using analytical electron microscopy (AEM). These samples are part of a suite of samples that are being tested to evaluate reaction under conditions likely to be present after containment breach. The questions to be answered are how much reaction will take place and what are the reaction products. The results from this suite of tests can be compared with tests performed at higher temperature to evaluate temperature as a parameter to accelerate the reaction. These data are being collected, and a paper entitled "Low-Temperature Vapor Alteration of Glass Under Potential Storage Conditions" is being prepared for inclusion in the Yucca Mountain Project Special Issue of the Journal of Nuclear Materials.

Sections of PNL-76-68 and SRL-131 glass have been examined. The SRL-131 glass has reacted about ten times faster than the PNL-76-68 glass. This result is similar to previous results at higher temperature in which PNL-76-68 glass reaction appeared to be inhibited due to the formation of Al-bearing secondary phases which quench the ion-exchange process. At lower temperatures, the secondary phases are not present in sufficient quantity for analysis, but the similarity of low and high temperature relative reaction rates for these glasses implies that the mechanism might be the same.

The following paper was reviewed and verbally approved by YMPO:

"Colloid Formation During Waste Form Reaction: Implications for Nuclear Waste Disposal" by J. K. Bates, J. P. Bradley, A. Teetsov, C. R. Bradley (all of ANL) and M. Buchholtz ten Brink (LLNL).

### **1.2.2.3.2 Metal Barriers**

J. Blink met with TIMET staff in Henderson, NV on February 12 to discuss advances in titanium alloy design and the potential for single point monitoring of titanium containers to detect the onset of crevice corrosion.

J. Blink met in Las Vegas with D. Jones of the University of Nevada (Reno) on January 29 to discuss potential work by UNR on waste package corrosion using cooperative agreement funding. LLNL can provide QA support and technical direction of the work in FY92 and perhaps augment it with programmatic funds in FY93.

#### **1.2.2.3.4.1 Integrated Radionuclide Release**

##### **G-20-2 Determination of Elemental Profiles in Rocks, Minerals, and Glasses using the Ion Microscope**

The following TIPs were completed and distributed:

- 1) TIP-PA-01, Depth Profiling on the Ion Microscope,
- 2) TIP-PA-02, Data Reduction for Depth Profiles, and
- 3) TIP-YM-9, Dektak IIA, Surface Profiling

##### **G-20-3 Interactions of Actinide-bearing Solutions with Rock Core Samples**

Preliminary Scanning Electron Microscopy (SEM) analysis of the core sample to be used in the initial flow-through experiment was completed. The surface of a fracture was found to be mineralogically similar to a non-fracture surface with the exception that the fracture surface contained an unidentified iron-bearing phase.

##### **G-20-5 Interaction of Materials under Repository Conditions**

A tentative protocol was established for sampling the fluids in the UO<sub>2</sub> flow through experiments.

##### **G-20-6 Source Term Development**

The contract with J. Leckie (Stanford University) has begun. He is developing a semi-empirical model of uranium-goertite surface speciation at elevated temperatures and at a range of pH values.

#### **1.2.2.3.4.2 Thermodynamic Data Determination**

This WBS element has not been funded in FY92.

### **1.2.2.4. Design, Fabrication, and Prototype Testing**

#### **1.2.2.4.1 Waste Package Design**

This WBS element has not been funded in FY92.

## **1.2.2.4.2 Container Fabrication and Closure Development**

This WBS element has not been funded in FY92.

## **1.2.2.4.3 Container/Waste Package Interface Analysis**

CAD waste package drawings were generated for the M&O. Plans to conduct thermal analyses of robust waste package internals were initiated: these analyses will begin in late March.

J. Blink reviewed the draft Waste Package Implementation Plan.

## **1.2.5 REGULATORY AND INSTITUTIONAL**

### **1.2.5.2.1 NRC Interaction Support**

D. Wilder and J. Blink attended a meeting of the NWTRB Engineered Barriers Panel held in Augusta, GA on February 11. D. Wilder participated in the SRL tour the following day. J. Blink attended the dry run for the meeting on February 4 and 7 and provided information to R. Morissette for incorporation into his presentation.

R. Stout, S. Steward and J. Blink participated in the NRC Technical Exchange on Spent Fuel in Pasco, WA on February 25. They also participated in the PNL (Hanford) tour the following day.

J. Blink worked with YMPO staff to establish the agenda for the March 18 NRC Technical Exchange in Albuquerque, NM (Air and Vapor Movement due to Thermal Gradients).

### **1.2.5.2.2 Site Characterization Program**

M. Revelli represented LLNL at the February 14 meeting of the Integrated Test Evaluation (ITE) task.

A copy of the Scientific Notebook maintained by LLNL as part of the ESSE task was forwarded to SAIC in response to their request to complete the ESSE Records Package.

### **1.2.5.2.4 Technical Support Documentation**

No significant activities.

### **1.2.5.2.5 Study Plan Coordination**

D. Chesnut completed the review of the USGS Study Plan 8.3.1.2.2.9, "Site Unsaturated-Zone Modeling and Synthesis" on February 10 and transmitted his comments to YMPO.

S. Blair has started the review of the SNL Study Plan 8.3.1.15.1.4, "Laboratory Determination of the Mechanical Properties of Fractures".

J. Nitao has started the review of the USGS Study Plan 8.3.1.2.2.2, Rev. 1, "Water Movement Test".

#### **1.2.5.2.6 Semi-Annual Progress Reports**

No significant activities.

### **1.2.9 PROJECT MANAGEMENT**

#### **1.2.9.1.1 Management**

R. Godman and H. Benton of the M&O visited LLNL on February 20, 1992 and were briefed by the technical staff.

W. Clarke attended the Engine of Evolution meetings in Las Vegas on February 24, 27 and 28.

J. Blink met with M&O and SAIC staff on January 27 to discuss installation of a spent fuel assembly at the LLNL/B&W exhibit in the FOC.

J. Blink met with H. Kahlia (LANL) to discuss approaches to off-block field testing needed prior to ESF testing, e. g., testing of the extended-dryout repository scenario.

J. Blink met with W. Andrews, D. McNelis, W. Wells, R. Boehm, and other UNLV professors on February 13 to discuss opportunities for LLNL-UNLV collaboration. J. Blink arranged for the V-TOUGH (heat and mass transport), TOPAZ (3-D transient heat transfer), and NIKE/DYNA (stress analysis) codes to be provided by LLNL to UNLV. He also provided information on criticality codes, concluding that MCNP-4.2 and KENO-5A are the best options for UNLV. Those codes are available from the Radiation Shielding Information Center at Oak Ridge. KENO is part of a larger package (SCALE-4.1) that also includes the ORIGEN code that can be used to calculate radionuclide generation and decay.

J. Blink attended an update meeting of the DIGE (QA Grading/Classification) task on February 6 in Las Vegas.

J. Blink served as a moderator for the DOE Science Bowl competition in Las Vegas on February 29.

P. Comstock and E. Campbell participated in a tour of Yucca Mountain and supporting facilities at YMPO on February 3-4.

#### **1.2.9.1.4 Records**

Document Control issued seven Change Notices and two new documents under controlled distribution. Routine follow-up for receipt acknowledgements continues.

A total of 103 items were logged into the LLNL-YMP tracking system. This includes 31 records/records packages that were processed through to the CRF. Five action items were closed.

### **1.2.9.2 Project Control**

The January FTE report was submitted to YMPO. The monthly actual costs for October 1991 through January 1992 for the PACS database were submitted to YMPO.

J. Podobnik attended a meeting with the GAO auditors on February 14 to discuss issues associated with management accounts (WBS element 1.2.9) for FY90 through FY92.

J. Norman was assigned to focus on issues raised in the YMPO-DOE Property Control/Management audit conducted in January. A conference call was held with YMPO-DOE Property Management on February 18 to discuss progress on resolving the findings in the audit. A training program has been developed in association with LLNL Property Management. All LLNL-YMP staff will be required to attend one of three sessions scheduled for March.

J. Podobnik attended an ICE briefing held in Las Vegas on February 20 to discuss the purpose, methods, topics and schedule of reviews which will to be conducted at each participant site. LLNL will be visiting during the week of March 23.

J. Podobnik attended the YMPO project control steering committee meeting in Las Vegas on February 21. Topics discussed included ICE review background and requirements, integration and planning out to 2001, and transition of tasks to the M&O. The M&O presented related guidance they have received from DOE in terms of conducting oversight planning. Level 0 and 1 milestones will be proposed by the M&O and its subcontractors to define and integrate future work. Dates will be set and participants will be offered the opportunity to review. Participants will then be required to cost the plan. Formal kickoff for this effort will take place at the next scheduled TPO meeting. The steering committee also heard a progress report from the procedures subcommittee and took action to submit a revision of the existing Capital Equipment procedure.

J. Podobnik, J. Blink and LLNL-YMP technical managers provided information to the M&O in support of the PACS scrub exercise.

J. Podobnik attended an Assist Training course conducted by LLNL AIS personnel on February 13.

J. Podobnik participated in a tour of Yucca Mountain and supporting facilities on February 19.

### **1.2.9.3 Quality Assurance**

LLNL-YMP Audit Report 92-02, Engineering and Performance Analyses, was completed and distributed. Three Adverse Finding Reports were issued.

Internal Audit 92-03, Near Field Environment Characterization, was conducted on February 13 - 18.

The Trend Analysis Report for calendar year 1991 was completed and distributed on February 27.

Quality Assurance Program Plan Change Notice R 1-1-2, Organization, was completed and submitted to YMPO for review and approval.

Quality Procedure Change Notice 17.0-3-1, Quality Assurance Records, was completed and distributed.

Technical Implementing Procedure TIP-YM-09, Dektak IIA Surface Profiling System, was distributed.

Technical Implementing Procedure TIP-YM-12, Electronic Record Keeping, authored by J. Blink, was distributed internally for review and comment.

Work continues on revisions of Quality Procedures 4.0 and 17.0.

J. Blink met with R. Weeks on January 31 and February 11 in Las Vegas to discuss LLNL-YMP QA grading packages and the scope of LLNL-YMP technical work. R. Weeks will be the lead auditor for the April 21-24 YMPO audit of LLNL-YMP.

R. Monks attended the DIGE (QA Grading/Classification) meeting in Las Vegas on February 6.

# Los Alamos

Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

March 2, 1992

TWS-EES-13-02-92-029

Mr. Carl P. Gertz, Project Manager  
Yucca Mountain Site Characterization Project Office  
US Department of Energy  
P.O. Box 98608  
Las Vegas, NV 89193-8608

Dear Mr. Gertz:

**SUBJECT: LOS ALAMOS MONTHLY ACTIVITY REPORT—JANUARY 1992**

Attached is the Los Alamos Monthly Activity Report for January 1992. This internal document describes our technical work in detail; however, the report has not received formal technical or policy review by Los Alamos or the Yucca Mountain Site Characterization Project. Data presented in this document represent work progress, are not referenceable, and are not intended for release from the US Department of Energy. If you have changes to our distribution list, please call Susan Klein at FTS 843-0916.

Sincerely,



Julie A. Canepa

JAC/SHK/eyr  
Attachment: a/s

Cy w/att.:

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C. Johnson, WWC, Las Vegas, NV  
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TWS-EES-13 File, MS J521

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CRM-4, MS A150

*Blanchard* WBS 1.2.9  
QA N/A  
*Simmons*  
*Petrie*  
*Newbury*  
*Livingston*  
*Dyer*  
*Cooper / Simecka*  
*Cloninger / Brodsky*  
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*Susan Klein*

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WBS 1.2.1	Systems (Canepa) .....	1
WBS 1.2.1.3.5	Technical Data (Lopez) .....	1
WBS 1.2.1.4.6	Caisson Experiment (Springer) .....	1
WBS 1.2.1.4.7	Performance Assessment Computational Support (Valentine) .....	2
WBS 1.2.3.1	Site Management and Integration .....	3
WBS 1.2.3.1.1	Site Management (Canepa) .....	3
	Surface-Based Test Management and Integration (Oliver) .....	3
WBS 1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways (Vaniman) .....	4
WBS 1.2.3.2.1.1.2	Mineralogic and Geochemical Alteration (Levy) .....	6
WBS 1.2.3.2.1.2	Stability of Minerals and Glasses .....	8
WBS 1.2.3.2.5	Postclosure Tectonics (Crowe) .....	9
WBS 1.2.3.3.1.2.2	Water Movement Tracer Tests (Fabryka-Martin) .....	12
WBS 1.2.3.3.1.2.5	Diffusion Tests in the ESF (Triay) .....	13
WBS 1.2.3.3.1.3.1	Site Saturated Zone Ground-Water Flow System (Robinson) .....	14
WBS 1.2.3.4.1.1	Ground-Water Chemistry Model (Ebinger) .....	16
WBS 1.2.3.4.1.2.1 & 3	Batch Sorption Studies and Sorption Models (Meijer) .....	18
WBS 1.2.3.4.1.2.2	Biological Sorption and Transport (Hersman) .....	19
WBS 1.2.3.4.1.3	Radionuclide Retardation by Precipitation Processes (Morris) .....	20
WBS 1.2.3.4.1.4	Radionuclide Retardation by Dispersive, Diffusive, and Advective Process (Triay) .....	23
WBS 1.2.3.4.1.5.1	Retardation Sensitivity Analysis (Eggert) .....	25
WBS 1.2.3.4.1.5.2	Demonstration of Applicability of Laboratory Data (Springer) .....	26
WBS 1.2.5	Regulatory and Institutional (Canepa) .....	28
WBS 1.2.6	Exploratory Studies Facility (Kalia) .....	30
WBS 1.2.6.8.4	Integrated Data System .....	32
WBS 1.2.9.1.2.4	Technical Software Management (Cort) .....	33
WBS 1.2.9.1.4	Records Management (Sanders) .....	35
WBS 1.2.9.3	Quality Assurance (Bolivar) .....	36
APPENDIX	.....	37

# YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

## Monthly Activity Report December 1991

### WBS 1.2.1 SYSTEMS

The objective of this task is to integrate systems with the Geologic Repository Program, to describe the Yucca Mountain Site Characterization Project Mined Geologic Disposal System, and to evaluate the performance of the natural, engineered barrier, and total systems for meeting regulatory standards.

#### TECHNICAL DATA (WBS 1.2.1.3.5)

##### ACTIVITIES AND ACCOMPLISHMENTS

Staff was trained on the Automated Technical Data Tracking (ATDT) System.

Staff met with staff to discuss volcanism data for submittal to the Technical Data Base (TDB) and Reference Information Base (RIB).

Staff was trained by B. Luis of SAIC to the Technical Data Information Form (TDIF).

##### PLANNED ACTIVITIES

Staff will attend RIB and Parameter Normalization Working Group meetings on February 3 in Las Vegas, Nevada.

Staff will meet principal investigators to discuss submittal of milestones to TDB or RIB.

Staff will present information on Technical Data Management to the Los Alamos Technical Associates' QAL.

#### CAISSON EXPERIMENT (WBS 1.2.1.4.6)

##### ACTIVITIES AND ACCOMPLISHMENTS

Ordered limonite and contracted with New Mexico Institute of Mining and Minerals at Socorro to crush it to the desired particle size range. The material should be ready by the end of February.

Began to write standard operating procedure for caisson experiment to satisfy Los Alamos ES&H requirements.

Based on discussions with M. Siegel of Sandia National Laboratory, it was decided that Lithium will not be used as a tracer at the present time as its use would require additional experiments to describe the lithium and lithium-nickel interaction with both silica sand and limonite. Nickel, which has been thoroughly characterized, will be the primary tracer used. Bromide with sodium will be introduced as a nonreactive tracer.

##### PLANNED ACTIVITIES

Order silica sand.

## PUBLICATIONS

E. P. Springer and M. D. Siegel

*An Integrated Intermediate-Scale Caisson Experiment to Validate Models of Fluid Flow and Contaminant Transport in the Unsaturated Zone*

Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle, Special issue on the Yucca Mountain Project*  
In preparation.

## PERFORMANCE ASSESSMENT CALCULATIONAL SUPPORT (WBS 1.2.1.4.7)

G. Valentine submitted Milestone 3331, "Physical processes and effects of magmatism in the Yucca Mountain region," to YMPO. This paper will be published in *Proceedings of the High-Level Radioactive Waste Management Conference, April 1992*. The report describes modeling and field studies geared toward constraining the types of igneous processes that might affect repository performance. The report cover letter describes how modeling is used in site characterization, and a distinction between site modeling and performance assessment is proposed.

## **WBS 1.2.3.1 SITE MANAGEMENT AND INTEGRATION**

### **SITE MANAGEMENT (WBS 1.2.3.1.1)**

#### **ACTIVITIES AND ACCOMPLISHMENTS**

Staff met with A. Simmons of the DOE to discuss prepared charter for radionuclide solubility working groups, which would function as an arm of the Geochemistry Integration Team and interface with the GEMBOCHS database.

A principal investigators meeting was held on 24 January. Highlights are presented in the Appendix.

#### **PUBLICATIONS**

J. A. Canepa

*Strategy for Testing the Applicability and Validity of Radionuclide Transport Models for Yucca Mountain, Nevada*  
Conference Paper, Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991

In revision.

A. M. Simmons and J. A. Canepa

*Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, Nevada*

Conference Paper, Waste Management '92 Symposium

In preparation.

### **SURFACE-BASED TEST MANAGEMENT AND INTEGRATION (WBS 1.2.3.1.1)**

The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

We continue to support of the UZ-16 Water Movement Test. Instructions for sample collection were developed by the R. Oliver and the Sample Management Facility geologist.

The job package (JP 92-04) for UZ-16 pad construction was reviewed and approved. Staff reviewed NRG-1 drawings, specifications, and work program and submitted comments.

Staff met with B. Crowe to discuss design and test-related information for the volcanism drilling program in support of DOE, M&O, and SAIC integration teams.

## **WBS 1.23.21.1.1**

# **MINERALOGY, PETROLOGY, AND ROCK CHEMISTRY OF TRANSPORT PATHWAYS**

The purpose of this activity is to define the important mineralogic and geochemical variables along transport pathways at Yucca Mountain in support of performance assessment and to evaluate the impact of repository construction on natural waste-transport barriers.

### **ACTIVITIES AND ACCOMPLISHMENTS**

Quantitative reduction of x-ray diffraction data was completed for outcrop samples from Calico Hills tuff. These data will be used, along with chemical and petrographic data, to evaluate and compare possible sites for surface experiments in adits (ref. milestone 3137). Quantitative reduction of x-ray diffraction data was also completed on 12 sorption-test experiments for I. Triay.

Fracture mineralogy studies focused on manganese oxide minerals in the Crater Flat tuff from drill cores USW G-1, G-2, GU-3, and UE-25b#1. Results of x-ray diffraction and scanning electron microscope analyses will be included in the journal article in preparation (ref. milestone 3123).

S. Bolivar and D. Broxton attended the January 23-24 Sample Oversight Committee (SOC) meeting at the Sample Management Facility. The SOC discussed various drilling options and budget limitations, and there was some discussion about principal investigator's needs and drilling priorities. Drilling priorities will be resolved at the next SOC meeting.

### **PLANNED ACTIVITIES**

Within the next few months, we plan to

- (1) analyze Mn-oxide fracture fillings in the Crater Flat and Paintbrush tuffs to determine their distribution and factors controlling that distribution;
- (2) complete paper on Mn-oxides for publication in a refereed journal;
- (3) analyze calcites to understand transport and precipitation mechanisms; and
- (4) complete sampling of cuttings from USW H-5.

### **PROBLEM AREAS**

None.

### **MILESTONE PROGRESS**

3120

29 May 1992

*Calcite in the Upper Paintbrush Tuff*

30% complete.

3123

2 March 1992

*Mn Fracture Minerals at Yucca Mountain*

Undergoing extensive revision.

3130

17 August 1992

*Fracture Mineralogy of the Paintbrush Tuff*

3137

30 September 1992

*Mineralogy of Calico Hills for Adit Development*

75% complete

**PUBLICATIONS****D. Bish and S. Chipera***Detection of Trace Clays and Clay Minerals Amounts of Erionite Using X-ray Powder Diffraction: Erionite in Tuffs of Yucca Mountain, Nevada, and Central Turkey*Journal article, *Clay and Clay Minerals*

In press.

**D. E. Broxton***Chemical Changes Associated with Zeolitization on the Tuffaceous Beds of Calico Hills at Yucca Mountain, Nevada*Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992

In preparation.

**B. Carlos, D. Bish, and S. Chipera***Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff*Journal article, *Chemical Geology*

Undergoing extensive revision.

**G. D. Guthrie, D. L. Bish, and B. T. Mossman***Quantitative Analysis of Zeolite-Bearing Dusts Using the Rietveld Method*Journal article, Submitted to *Science***D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy***Mineralogy as a Factor in Radioactive Waste Transport Through Pyroclastic Rocks at Yucca Mountain, Nevada*Journal article, *J. Geophys. Res.*

Draft complete; may be revised for a different journal.

## WBS 1.2.3.2.1.1.2 MINERALOGIC AND GEOCHEMICAL ALTERATION

The objective of this task is to characterize past and present natural alteration processes that have affected the potential geologic repository and to predict future effects of natural and repository-induced alteration.

### ACTIVITIES AND ACCOMPLISHMENTS

#### Kinetics of Analcime Dehydration and Rehydration

Studies of the kinetics of analcime dehydration and rehydration continued. Using moisture evolution analysis, we found that the residual water in partly dehydrated analcime is released at a higher temperature than the bulk of the water in the undehydrated mineral. We are monitoring the state of hydration using structural refinement x-ray diffraction data.

#### Glass Dehydration

The current phase of glass-dehydration studies was completed. A paper presenting the results, "Dehydration and rehydration of a tuff vitrophyre," by D. Vaniman, D. Bish, and S. Chipera, is almost complete.

#### Hydrogenic Deposits

D. Vaniman presented the results of a number of hydrogenic deposits studies and discussed the Szymanski hypothesis at the January principal investigators' meeting. Other activities related to hydrogenic deposit studies included SEM studies of calcite-sepiolite intergrowths from Trench 14 and the preparation of plant root ashes for x-ray diffraction and INAA analysis (to determine if they contribute to authigenic mineral formation). S. Levy prepared samples of brecciated and altered rocks for petrographic and SEM examination.

### PLANNED ACTIVITIES

Two papers will be submitted to the 7<sup>th</sup> *International Symposium on Water-Rock Interaction*. D. Vaniman is first author of a paper that combines petrographic observations and modeling of evaporative precipitation to distinguish between hydrogenic deposits from tuff-source and carbonate-source waters. G. WoldeGabriel is preparing a paper on the preliminary results of his K/Ar dating studies of clinoptilolite.

Zeolite stability studies will continue. A new batch of K/Ar samples will be analyzed.

### PROBLEM AREAS

We have finally located a certifiable thermal calibrator for our ovens; it will be obtained through a vendor certified by Lawrence Livermore National Laboratory.

### MILESTONE PROGRESS

3138

30 October 1992

*Chemical Transport in Zeolitic Alteration*

3141

31 March 1992

*Laminated Zone in Trench 14*

3142

3 April 1992

*K/Ar Dating of Clays and Zeolites*

Research continuing; new draft in preparation.

*Preliminary Data—Do Not Reference*

3143

15 January 1992

*Experimental Dehydration of Volcanic Glasses*

Interim draft complete.

## PUBLICATIONS

G. WoldeGabriel, et. al

*Preliminary Assessment of Clinoptilolite KJARr Results from Yucca Mountain, Nevada: a Potential High-Level Radioactive Waste Repository Site*Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium, July 1992*

S. Levy and C. Naeser

*Bedrock Breccias Along Fault Zones near Yucca Mountain, Nevada*

Chapter in USGS Bulletin on Yucca Mountain studies

In USGS editorial review.

S. Levy

*Natural Gels in the Yucca Mountain Area, Nevada, USA*

Conference paper, European Materials Research Society Symposium

In preparation.

D. Vaniman, D. Bish, and S. Chipera

*Dehydration and Rehydration of a Tuff Vitrophyre*Journal article, *J. Geophys. Res.*

Interim draft complete.

D. Vaniman, et. al

*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium, July 1992*

**WBS 1.2.3.2.1.2**  
**STABILITY OF MINERALS AND GLASSES**

The objective of this activity is to produce a model for past and future mineral alteration in Yucca Mountain. The model is intended to explain the natural mineral evolution resulting from the transformation of metastable mineral assemblages to more stable assemblages and the effects of a repository emplacement.

**ACTIVITIES AND ACCOMPLISHMENTS**

This activity has been deferred.

## WBS 1.2.3.2.5 POSTCLOSURE TECTONICS

The objective of these volcanism studies is to determine the hazards of future volcanic activities with respect to siting a high-level radioactive waste repository at Yucca Mountain.

### ACTIVITIES AND ACCOMPLISHMENTS

A paper, "Recent Progress in Volcanism Studies: Site Characterization Activities for the Yucca Mountain Site Characterization Project," describing our recent volcanism work, was prepared for the *Waste Management '92* symposium in Tucson, Arizona, in March. This paper introduces a new matrix of calculations on the disruption parameter. An important conclusion of this paper is that alternative structural models for the disruption parameter do not differ significantly from the random structural model.

Volcanism staff toured Yucca Mountain with a Congressional staff group and with the Chairman of the Nuclear Regulatory Commission. The staff also presented talks on two fields stops and the DOE/HQ and M&O field trip.

The detailed technical procedure for soils studies was completed and distributed.

Our responses to NWTRB questions on the volcanism studies were completed and submitted to DOE/LV.

### Work In Progress

Samples are being processed for paleomagnetic studies of the Lathrop Wells volcanic center, and results should be available in February.

Separation of samples from Lathrop Wells (Q<sub>1g</sub>), Little Black Peak cone, and Lunar Crater is being conducted using the U-Th disequilibrium method using solid-source mass spectrometry. An olivine separation has been obtained from the Q<sub>1g</sub> sample, and recrushed and magnetic separations are continuing in an attempt to remove magnetite inclusions from the olivines.

Plagioclase mineral separates from the U-Th work have been included in a suite of rocks to submit for 40Ar/39Ar analysis.

The volcanism QAL traveled to Riverside, California, to help coordinate quality assurance requirements with S. Wells.

### PLANNED ACTIVITIES

We plan to begin trenching at the Cima volcanic field (permission has already been obtained from the Bureau of Land Management) and Lathrop Wells volcanic field in March.

### PROBLEM AREAS

None

### MILESTONE PROGRESS

The first draft of the Study Plan 8.3.1.8.1.2, Physical Process of Magmatism and Effects on the Repository, will be completed during February.

3174

8 January 1992

*Effects of Magmatic Disruption on the Repository (study plan, R0)*

3071

September 1992, expected completion April 1992

*Status of Geochronology Studies at the Lathrop Wells Volcanic Center*

3129

10 July 1992, expected completion April 1992

*Geochemistry of Lathrop Wells Eruptive Sequences*

3034

30 September 1992

*Report on Magma System Dynamics*

3035

30 September 1992, expected completion April 1992

*Effects of Strombolian Eruption*

3109

30 September 1992

*Report of Subsurface Effects*

3111

30 September 1992

*Preliminary Geologic Mapping of Volcanic Centers*

3164

30 September 1992

*Progress Report on Thermoluminescence*

## PUBLICATIONS

B. M. Crowe *et al.*

*Lathrop Wells Volcanic Center: Status of Field and Geological Studies*

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992

In preparation.

B. M. Crowe *et al.*

*Recurrence Models of Volcanic Events: Applications to Volcanic Risk Assessment*

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992

In preparation.

F. V. Perry and B. M. Crowe

*Geochemical Evidence for Waning Magnetism and Polycyclic Volcanism at Crater Flat, Nevada*

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992

In preparation.

**G. A. Valentine, B. M. Crowe, and F. V. Perry**

*Physical Processes and Effects of Magnetism in the Yucca Mountain Region*

Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference,  
Las Vegas, NV, April 1992

In preparation.

**S. G. Wells, et al.**

*Multiple Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic  
Fields*

Journal article

In preparation.

## **WBS 1.2.3.3.1.2.2 WATER MOVEMENT TRACER TESTS**

The objective of the water movement tracer tests is to obtain measurements of chlorine isotope distributions to help quantify the percolation of precipitation in the unsaturated zone.

### **ACTIVITIES AND ACCOMPLISHMENTS**

The first 100 QA-traceable ream-bit samples were shipped to Hydro Geo Chem (the subcontractor) from the Sample Management Facility. The samples were collected from the first 2 of 12 neutron-access boreholes and weighed approximately 3 tons. The boreholes are 145 and 200 feet deep. Collection of cutting samples from the third borehole continued.

The subcontractor focussed on defining optimum analytical parameters for determining chloride and bromide and revising the draft detailed technical procedure (DP) for ion chromatographic analysis.

J. Fabryka-Martin reviewed the draft job package and RSN work program for borehole UZ-16 to ensure that cuttings would be collected as needed to meet the objectives of the Water Movement Test task. Comprehensive instructions for geologists who will guide sample collection during drilling of UZ-16 were developed with the assistance of geologists at the Drilling Support Division (DSD) of the SMF facility.

A DP for determining bulk density was written and submitted for technical and QA reviews.

Staff developed plans to collect surface-soil grab samples from the vicinity of Yucca Mountain to establish the meteoric Cl/Br ratio; this ratio is needed to estimate the contribution of rock chloride (and hence rock chlorine-36) to the total chloride leached from the cuttings samples. Staff began to investigate the possibility of collecting soil profiles from trenches planned for FY92 in the vicinity of Yucca Mountain.

The subcontractor submitted its annual report for CY 91.

### **PLANNED ACTIVITIES**

The subcontractor will begin processing the approximately 100 QA-traceable ream-bit cutting samples for chloride, bromide and chlorine isotope. Halide profiles from these holes will be used to

- (1) determine the depth to which bomb-pulse chlorine-36 has moved and correlate these depths to the lithology;
- (2) assess the extent to which the bomb-pulse chlorine-36 signals correlate to those of tritium;
- (3) evaluate the variability in the meteoric chloride-36/chloride ratio; and
- (4) test the proposed approach of using Cl/Br ratios to correct the chlorine-36/chlorine ratios for dilution by rock chloride.

Complete additional DPs; process cuttings samples from neutron-access boreholes; process USGS water samples; and collect surface-soil samples from Yucca Mountain area.

### **MILESTONE PROGRESS**

3191

*Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples*

30 September 1992

**WBS 1.233.1.2.5**  
**DIFFUSION TESTS IN THE ESF**

The objective of this task is to determine *in situ* the extent to which the nonsorbing tracers diffuse into the water-filled pores of the Topopah Spring welded unit.

**ACTIVITIES AND ACCOMPLISHMENTS**

No significant activity in this study.

**MILESTONE PROGRESS**

No level II milestones are planned this fiscal year.

### **WBS 1.2.3.3.1.3.1 SITE SATURATED ZONE GROUND-WATER FLOW SYSTEM (REACTIVE TRACER TESTING)**

Experiments will be conducted at the C-Well complex (holes UE25c#1, UE25c#2, and UE25c#3) and in other wells near Yucca Mountain. Reactive tracers will be used to characterize retardation and transport properties on a scale larger than that currently used in laboratory experiments.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

##### **Software Qualification**

Reviews of three software baselines have been completed, and the following comments are being addressed:

- (1) the software design document for the FRACNET application,
- (2) the software requirements specification for the equation solver GZSOLVE, and
- (3) the software requirements specification of an application to convert ASCII file data to the net CDF format.

The implementation phase (coding, verification, etc.) of the SORBEQ application is currently being reviewed. Review comments on the implementation baseline for the interface table tools are also being addressed.

##### **LiBr Sorption Studies**

The procedure for measuring concentrations of dissolved species using the ion chromatograph is complete; the most important aspect of this procedure is a technique we have developed to measure a suite of cations in a single IC run simultaneously. Previously, samples preserved by acidification were difficult to analyze because of interference between the Li and Na chromatograph peaks. Our new technique has solved this problem.

#### **PLANNED ACTIVITIES**

Continue the effort to bring the computer codes FRACNET, FEHMN, and SORBEQ and other software into compliance with the Los Alamos Software Quality Assurance Plan (SQAP). This consists of compiling existing documentation on these codes and writing any new material required by the SQAP.

Z. Dash and B. Robinson will continue to review each software submittal as necessary.

Continue activities necessary for the batch sorption experiments with lithium bromide, including compilation of error statistics on the measurements and the determination of the cation exchange capacity of the samples. Continue to develop techniques for measuring the concentration of polystyrene microspheres in solution.

#### **PROBLEM AREAS**

None

## **PUBLICATIONS**

**W. L. Polzer, W. L., M. G. Rao, H. R. Fuentes, and R. J. Beckman**

*Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters*

Journal article, *Environmental Science and Technology*

Undergoing revision.

**B. A. Robinson**

*FRACNET-Fracture Network Model for Water Flow and Solute Transport*

LA-series report

In preparation.

**B. A. Robinson**

*SORBEQ-A One-Dimensional Model for Simulating Column Transport Experiments*

LA-series report

In preparation.

## **MILESTONE PROGRESS**

**3193**

30 November 1991

*Batch Sorption Experiments with Boron Using Single Crystals*

Completed.

**3188**

16 January 1992

*Documentation for SORBEQ*

**3194**

1 April 1992

*Batch Sorption Experiments with Lithium*

**T112**

22 June 1992

*Final Documentation for FEHMN*

**3196**

27 July 1992

*FRACNET Documentation*

## WBS 1.2.3.4.1.1 GROUND-WATER CHEMISTRY MODEL

The goal of this investigation is to provide conceptual and mathematical models of the groundwater chemistry at Yucca Mountain. These models will explain the present groundwater composition in relation to interactions of minerals and groundwater and will be used to predict groundwater compositions as a result of anticipated and unanticipated environments.

### ACTIVITIES AND ACCOMPLISHMENTS

#### Study Plan

The Ground-Water Chemistry Model study plan 8.3.1.3.1.1, R0, is currently in project review.

#### Other Activities

A paper, "Water-rock interactions and the pH stability of ground waters from Yucca Mountain, Nevada," was completed and submitted to YMPO for review. This paper describes analyses of water composition of samples from the tuff aquifer at Yucca Mountain and from UE 25p#1, both of which were used in a modeling study of pH stability. In separate simulations, each ground water was titrated with two acidic solutions (acidified water [ $10^{-4}$  M HCl] and uranyl nitrate [ $10^{-4}$  M]), and the pH was monitored. The waters were also titrated in the presence of albite, microcline, and quartz or cristobalite and smectite. We found that water from UE 25p#1 (carbonate water) was well buffered by  $\text{CO}_2$  and  $\text{Ca}^{2+}$ ; however, lower  $\text{Ca}^{2+}$  in tuffaceous water caused large pH changes when  $\text{Ca}^{2+}$  was depleted because of Ca-montmorillonite formation or exchange. In general, we noted larger pH changes when the acidic uranyl solution was titrated into the water of interest than when the HCl solution was titrated. We also found that simulations in which minerals were allowed to dissolve and precipitate tended to produce a smaller change in pH than in simulations those in which no minerals were allowed to form.

Modeling of evaporation of various Yucca Mountain waters and waters from the surrounding area continued. A paper describing this work, "Precipitation of calcite, dolomite, sepiolite, and silica from evaporated carbonate and tuffaceous waters of southern Nevada" by D. Vaniman, M. Ebinger, D. Bish, and S. Chipera, was completed, revised, and is in YMPO review. This paper discusses field data and geochemical modeling of the evaporative concentration of ground waters in relation to the evolution of different assemblages of sepiolite, calcite, dolomite, and opal. In the geochemical modeling section, the authors describe waters in carbonate aquifers that produced dolomite along with sepiolite and calcite. They found that the amount of dolomite began to decrease as Si activity increased, and tuffaceous waters did produce some dolomite, but it dissolved as Si activity increased. No sepiolite formed in either carbonate or tuffaceous waters when opal was present, suggesting that opal formed before or after sepiolite and calcite but not at the same time. The modeling results were consistent with observations of fracture material derived from Yucca Mountain.

#### QA Activities

No additional progress to report on the IMOU between Lawrence Livermore National Laboratory and Los Alamos. IMOU is in review in Las Vegas.

## PLANNED ACTIVITIES

Track Study Plan 8.3.1.3.1.1 during YMPO review.

USGS collaboration will continue. Dissolved gas compositions (e.g., fugacities of CO<sub>2g</sub> and O<sub>2g</sub>) from existing and new water-table wells will be used to determine Eh conditions independently of Pt electrode measurements. The gas composition data will also be used in further pH buffering capacity modeling and for refined models of the overall ground-water chemistry.

Continue support of QA efforts. Continue tracking IMOU mentioned above.

## PROBLEM AREAS

None

## MILESTONE PROGRESS

3006

31 March 1992

*Eh and pH Buffering Capacity*

3415

30 September 1992

*Letter Report: Most Active Groundwater Chemistry*

## PUBLICATIONS

M. Ebinger

*Water-Rock Interactions and the pH Stability of Groundwaters from Yucca Mountain, Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992

D. Vaniman, D. Bish, M. Ebinger, S. Chipera

*Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada*  
Conference paper, *Proceedings of the 7<sup>th</sup> Water-Rock Interactions Symposium*, July 1992

## **WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3 BATCH SORPTION STUDIES AND SORPTION MODELS**

The objective of this task is to provide sorption coefficients for elements of interest to predict radionuclide movements from the repository to the accessible environment.

### **ACTIVITIES AND ACCOMPLISHMENTS**

The experiments to evaluate the effects of crushing on the sorption coefficients obtained by batch techniques have been completed. We are awaiting mineralogic analyses to properly interpret the data. Surface-area determinations have been completed on approximately 3/4 of the samples.

Testing of the atomic-force microscope is continuing. This instrument will ultimately be used to image substrates before and after sorption reactions involving the important radionuclides. It will also be used to characterize the detailed textures of Yucca Mountain tuffs at the nanometer scale.

Experiments in conjunction with the Stanford contract have begun. This work will focus on the dependence of solution composition (i.e., ground waters) on sorption coefficients for U and Np on several pure mineral phases.

### **PLANNED ACTIVITIES**

Continue study of radionuclide sorption on pure mineral phases. Revise paper for sorption workshop proceedings after policy review. Complete Study Plan revisions.

### **MILESTONE PROGRESS**

3009

20 February 1992

*Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff*

3212

30 September 1992

*Progress Report on Single Mineral Experiments*

### **PUBLICATIONS**

A. Meijer,

*A Strategy for the Derivation and Use of Sorption Coefficients in Performance Assessment Calculations for the Yucca Mountain Site*

Conference proceedings, *Proceedings of a Workshop on Sorption*, Los Alamos, New Mexico, 11-12 September 1990. Submitted.

## WBS 1.2.3.4.1.2.2

**BIOLOGICAL SORPTION AND TRANSPORT**

The purpose of this research is to determine whether microbial activity can influence the movement of plutonium in tuff. Because fluids are used extensively in the exploration of locations for a nuclear repository, those microorganisms capable of utilizing drilling fluids as growth substrates are of special interest.

**ACTIVITIES AND ACCOMPLISHMENTS**

The paper, "Preliminary Evidence of Siderophore/Plutonium Complexation," submitted to *Applied and Environmental Microbiology* in May, is being revised for publication.

Work was begun on Milestones 3080, Chelation, and 3092, Colloidal Agglomeration.

**PLANNED ACTIVITIES**

Continue plutonium  $K_d$  experiments.

Continue colloidal agglomeration experiments.

**PROBLEM AREAS**

None

**MILESTONE PROGRESS**

3080

30 September 1992

*Report on Chelation*

In preparation.

3092

30 September 1992

*Report on Colloidal Agglomeration*

In preparation.

3176

30 September 1992

*Procedure for Determination of Formation Constants*

In progress.

3177

30 September 1992

*Procedure for Determination of Effects on Colloidal Agglomeration*

**PUBLICATIONS**

L. R. Hersman, D. E. Hobart, and T. W. Newton

*Preliminary Evidence of Siderophore/Plutonium Complexation*

Journal article, *Journal of Applied and Environmental Microbiology*

Undergoing revision.

### WBS 1.2.3.4.13

## RADIONUCLIDE RETARDATION BY PRECIPITATION PROCESSES

The objective of the solubility determination task is to determine the solubilities and speciation of important waste elements under conditions characteristic of the repository and along flow paths from the repository into the accessible environment.

### ACTIVITIES AND ACCOMPLISHMENTS

#### Speciation Studies

We continue to develop the certified version of the photoacoustic-spectrometer (PAS) software, and we are documenting the development phase of the photoacoustic work.

Experimental work on the PAS system continues to focus on the Pu(IV) carbonate systems. Specifically, we are mapping speciation boundaries as a function of both pH and total carbonate (i.e. combined bicarbonate and carbonate anion) concentrations. The pH values studied range from 8 to over 11; total carbonate concentrations examined were between 0.010 and 1.000 M. Because dilute samples of Pu(IV) are under study (0.98 micromolar), spectra from a complete matrix implied by the two independent variables have not yet been obtained. However, at least two Pu-carbonate species, characterized by peaks at 485 and 493 nm, Pu-colloid and Pu-hydroxide, have been found to co-exist within these experimental conditions. The solubilities and mobilities of these species are quite different, and these results may have important implications for studies on the suitability of a long-term repository.

We began using our new Pu(IV) stock solution to produce single crystals of several Pu(IV)-EDTA complexes that have been shown to exist in the system. Our initial attempts failed because of competition for colloid formation, but we finally determined that an excess of EDTA was competitive with colloid formation, and we observed a color change from red/brown to yellow with increasing pH. This was consistent with our observations from UV-VIS-NIR experiments. We also observed that heating of Pu(IV) in the presence of EDTA results in reduction to Pu(III) under certain conditions. We plan to characterize these species using single-crystal x-ray diffraction.

We continued efforts to produce a stable Np(V) stock solution (10-5 M in Np at pH=8.5) in J-13 water for the Dynamic Transport task (WBS 1.2.3.4.1.4).

Synthesis on model complexes continued, and final data reduction on 13-C NMR on the 242-Pu(VI) carbonate system suggested that additional experiments are warranted. These results will be submitted to the *Journal of the American Chemical Society* and published as a milestone report. The letter report on model complex studies is being rewritten as an LA-series report.

#### Solubility Studies

For the UE25p#1 oversaturation solubility experiments at 60° C, the Np determinations at all three pH values have reached steady-state; these solutions are being examined using UV-visible absorption spectrophotometry to determine the oxidation state(s) of Np. When these studies are complete, we will begin x-ray diffraction studies of the solids by adding fresh CO<sub>2</sub>-equilibrated UE25p#1 water at 60° C and monitoring the concentration of soluble Np until steady-state is reached. These undersaturation solubility results will be compared to the results from the oversaturation solubility experiments.

The solubility experiments for Pu at the three pH values are beginning to approach steady-state. Once steady-state is achieved and maintained for some time, oxidation-state determinations of the soluble Pu will begin. The Am/Nd solubility experiments do not appear to have reached steady-state yet, and we will continue to monitor them until steady-state is achieved.

To ensure complete phase separation and minimal adsorption on the filters during preparation of the solution assays, a series of filtration tests was conducted. (Oxidation states of the radionuclides may change during the course of the solubility experiment; therefore, filtration experiments must be performed over time as well as at the beginning of the experiment. This will ensure that sorption of the radionuclide in different oxidation states onto the filter does not occur.) Centricon-30 centrifugal filters were used to separate the liquid from the solid phase. One filter per solution was used, and consecutive solution portions of 500 microliters were filtered through it. Each filtrate was acidified (to minimize sorption in the filtrate-collection container), and an assay was taken. An additional 500 microliters was filtered through the same filter, collected in a new container and assayed, and this was repeated until the assays showed a constant concentration. (The volume needed to saturate the filter is the cumulative amount of volumes used until the assay concentration remains constant.) For the Np filtration experiments, we found no increase in concentration with increased filtering volume, so very little adsorption, if any, took place. A similar result was obtained for Pu. For both the Np and Pu experiments, the filters continued to be presaturated with 500 microliters of solution before filtering a volume for assay. The filtration results for the Am/Nd experiment are not available at this time because some samples are awaiting analysis.

Work is almost complete on the new draft detailed technical procedure, "Concentration Determination of Soluble Radionuclides from Data Provided by the Low Energy Gamma Counting System," (TWS-LBL-DP-01, R0).

## PLANNED WORK

Efforts in all above mentioned areas will continue.

D. Clark will present a seminar on plutonium carbonate speciation probed by  $^{13}\text{C}$  NMR at Lawrence Berkeley Laboratory on January 30.

## PROBLEM AREAS

Problems with the gamma counters were solved by re-installing the old system until hardware problems can be corrected. The Am/Nd assays have had long counting times because of low solubility of these elements in UE25p#1 water. In the future, we plan to use liquid scintillation counting for the assays, which will reduce assay time for Am/Nd to ten minutes.

## MILESTONE PROGRESS

3031

30 September 1992

*Speciation Measurements*

3329

30 September 1992

*Report on Neptunium, Plutonium, and Americium Solubility Experiments from Oversaturation*

3330

15 January 1993, (anticipated early completion)

*Evaluation of Alternative Distribution Schemes in PAS*

PUBLICATIONS

J. M. Combes, C. J. Chisholm-Brause, G. E. Brown, Jr., G. A. Parks, S. D. Conradson, P. G. Eller, I. R. Triay, D. E. Hobart, and A. Meijer,  
*EXAFS Spectroscopic Study of Neptunium(V) Sorption at the  $\alpha$ -FeOOH/Water Interface*  
Journal article, *Environmental Science and Technology*.  
In press.

L. E. Hersman, P. D. Palmer, and D. E. Hobart, *Preliminary Evidence of a Siderophore/Plutonium Complex*  
Journal article, *Journal of Applied and Environmental Microbiology*  
Undergoing revision.

H. Nitsche, R. C. Gatti, E. M. Standifer, S. C. Lee, A. Miller, T. Prussin, R. S. Deinhammer, H. Maurer, K. Becraft, S. Leung, and S. A. Carpenter  
*Measured Solubilities and Speciations of Neptunium, Plutonium, and Americium in a Typical Groundwater (J-13) from the Yucca Mountain Region*  
LA-series report  
In preparation.

C. D. Tait, D. E. Morris, J. M. Berg and W. H. Woodruff  
*Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy*  
In preparation.

C. D. Tait, D. E. Morris, S. A. Ekberg, P. D. Palmer, and J. M. Berg  
*Plutonium Carbonate Speciation Changes with pH*  
Abstract, American Chemical Society National Meeting, San Francisco, California, April 1992  
Submitted to YMPO on 25 November 1991.

Clark, *et.al*  
*Carbonate Complexation of Pu(IV)*  
LA-series report  
In preparation.

Report  
*Molecular Models for Actinide Speciation*  
Submitted 5/30/91.  
Internal technical review completed.

## WBS 1.23.4.1.4 RADIONUCLIDE RETARDATION BY DISPERSIVE, DIFFUSIVE, AND ADVECTIVE PROCESSES

The objectives of this task are to determine the rate of radionuclide movement along the potential flow paths to the accessible environment and to examine the effect of diffusion, adsorption, dispersion, anion exclusion, sorption kinetics, and colloid movements in the flow geometries and hydrologic conditions expected to exist along the flow path to the accessible environment in the scenarios used for performance assessment.

### ACTIVITIES AND ACCOMPLISHMENTS

We continued to study the transport behavior of radionuclides as a function of mineralogy. (The most probable explanations for the discrepancies between batch sorption coefficients and sorption coefficients obtained via column experiments [reported in May 1991] are pseudocolloid formation, precipitation, slow speciation kinetics, or slow mass-transfer kinetics.) This month, we continued stability experiments with Np solutions of the type used for the column-transport experiments.

Last month, we prepared a solution from a well characterized Np(V) acidic stock in J-13 water. The initial concentration was  $1 \times 10^{-3}$  M, and the pH was adjusted to 8.1. After filtration through a 0.05 micrometers nuclepore filter, 72% of the Np remained in the filtered solution, which remained stable over a 9-day period.

This month, we investigated the source of Np loss during filtration. In order to determine whether the source of Np loss was due to formation of a solid phase as a result of the addition of concentrated NaOH, we prepared a Np solution with an initial concentration of  $1.0 \times 10^{-7}$  M. Following addition of the Np(V) acidic stock to J-13 water, the pH of the solution was 7.7, and the pH was not adjusted with NaOH. This solution was filtered through a 0.05 micrometers nuclepore filter, and 98% of the Np remained in the filtered solution. This indicates that Np precipitation may occur due to formation of a solid phase (which dissolves slowly) upon addition of NaOH.

Last month, we fabricated 6 solid-tuff columns, 3 of tuff G4-271 and 3 of tuff G4-1531. This month, we tested the flow of water through these columns, and the high pressures necessary to establish a reasonable flow rate in the columns of tuff G4-271 caused the encapsulation of the solid rocks to fail.

In order to compare transport through solid tuff with the transport in crushed tuff, 2 crushed-rock columns were fabricated of tuff G4-1530.

M. Ott searched notebooks of task participants for data to include in a report summarizing the findings of the dynamic transport and diffusion studies. This data will be included in submittals to the SEPDP.

A detailed technical procedure (DP) to study radionuclide diffusive behavior using tuff wafers was written and is in internal review. The DP for the study of radionuclide diffusion behavior using diffusion cells was revised.

A. Mitchell briefed the public at the YMP open house on January 22. Staff completed the Yucca Mountain exhibit, which will be placed in the Los Alamos Administration Building.

### PLANNED ACTIVITIES

We will prepare stable Np solutions in J-13 (with and without filtration) and without the addition of NaOH to adjust the pH.

Transport experiments using Np in the crushed and solid tuff columns will be started.

**MILESTONE PROGRESS**

3040

30 September 1992

*Kinetics of Sorption on Columns of Pure Minerals*

3044

31 August 1992

*Letter Report on Assessment of Available Techniques for Unsaturated Column Transport Experiments*

In preparation.

3027

31 March 1992

*Report on Sorption by Batch and Column Techniques*

**PUBLICATIONS**

I. R. Triay

*Radionuclide Migration in Tuff under Diffusive Conditions*

Conference Paper, *Proceedings of the Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991*

In preparation.

I. R. Triay, A. J. Mitchell, and M. A. Ott

*Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future*

Conference paper, *Proceedings of the Radionuclide Adsorption Workshop, Los Alamos, NM, 11-12 September 1990*

Submitted.

## **WBS 1.2.3.4.1.5.1 RETARDATION SENSITIVITY ANALYSIS**

The objectives of this task are to construct a geochemical/geophysical model of Yucca Mountain and to use this model to examine the physical and chemical controls on radionuclide transport along flow paths to the accessible environment.

### **ACTIVITIES AND ACCOMPLISHMENTS**

#### **Analysis of Physical and Chemical Properties**

No significant progress in January.

#### **QA and Programmatic**

Certification of TRACRN continues. Code modifications to incorporate dynamic memory allocation are almost complete, and modifications to incorporate interface table input/output have been deleted because of the uncertain status of the interface table software supported by EES-13 staff.

The Software Requirements Specification has been completed and has been accepted by the CCB.

The Models and Methods summary and the Software Design document are almost complete and will be submitted for formal review in early February.

Several verification examples have been completed and are being documented in the Verification and Validation Plan and Verification and Validation Report. The verification examples have been useful to find small bugs in the code.

Work on the users manual continues.

The Study Plan for the Retardation Sensitivity Analysis Task is being revised; it will be resubmitted soon.

### **PLANNED ACTIVITIES**

None

### **MILESTONE PROGRESS**

3052

30 March 1992

*Baseline Documentation for TRACRN*

## **WBS 1.2.3.4.1.5.2 DEMONSTRATION OF APPLICABILITY OF LABORATORY DATA**

The purpose of this study is to design and conduct experiments to evaluate the applicability of laboratory data and to test models used in the Radionuclide Transport Program to determine far field radionuclide transport. Both intermediate- and field-scale experiments and natural analogs will be assessed for their potential to provide the required data.

### **ACTIVITIES AND ACCOMPLISHMENTS**

Met with Lawrence Berkeley Laboratory (LBL) investigators to discuss experimental design for testing radionuclide transport at Yucca Mountain and to develop a schedule to complete this activity. The proposed upper- and lower-alcove design was used as a base case in our discussions of possible new designs.

Two interesting ideas were introduced at these meetings. The first idea involved interrogating the proposed alcove area with 3 to 6 boreholes to be used for hydrologic and geophysical tests and borehole data obtained from these tests would provide another way to predict the performance of the test block. A comparison of these borehole data with alcove-mining data could result in valuable modelling information for the YMP.

The second idea, posed as an alternative to the alcove design, involved tests conducted at packed-off intervals along an array of boreholes that cross zones where discontinuities are present (e.g. fractured zones or faults). Following the tests, the area would be mined to examine tracer movement from the test zones. Advantages of this approach are ensuring that discontinuities are tested (more discontinuities can be tested because of the longer length scale of the boreholes as opposed to the alcove) and avoiding the null case, which may exist in the alcove tests. (The null case may be present in the alcove design because of low-flux conditions at Yucca Mountain since the alcove might be constructed in a location in which water moves only a few centimeters in a ten-year period, and this rate of movement cannot be detected by current equipment.)

There was no resolution of these questions at the meeting, and it was decided that modeling will be needed to further define conditions for alcove or borehole-array design.

Training was completed on the TDIF for technical data submission.

The SCPB change was submitted to the WBS manager for review. The formal submittal must follow AP-06.1, and the necessary forms are being prepared.

### **PLANNED ACTIVITIES**

Submit proposed revision to SCPB for this study according to AP 06.1.

Continue to develop study plan.

Travel to Lawrence Berkeley Laboratory to discuss field-test design and analysis.

### **PROBLEM AREAS**

None

### **MILESTONE PROGRESS**

No FY91 milestones.

**PUBLICATIONS**

**E. P. Springer**

*The Use of Anthropogenic Analogues in Site Characterization of Low-Level Radioactive Waste Sites*  
Conference Paper, *Proceedings of the 13<sup>th</sup> Annual DOE Low-Level Waste Management Conference, Atlanta, Georgia, 19-21 November 1991*

In preparation.

**C. Woloshun**

*A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada*

La-series report

Received YMPO approval on 29 October 1991.

## **WBS 1.2.5 REGULATORY AND INSTITUTIONAL**

The purpose of this task is to coordinate the regulatory and institutional Project requirements within the Los Alamos programmatic structure. The focus of this coordination effort is on the integration of the technical work within the regulatory and institutional framework.

### **Study Plans**

**Water Movement Test, R3 (8.3.1.2.2.2).** A revision incorporating NRC and State of Nevada comments was submitted on 16 October 1991.

**Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5).** A revision incorporating DOE/HQ and Project Office comments was submitted on 11 June 1991.

**Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7).** Issued by DOE/HQ as a controlled document, and sent to the NRC on 10 April 1990.

**Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1).** Accepted by the NRC on 4 September 1990. Responses to NRC comments were submitted on 19 August 1991.

**History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2).** A revision incorporating SAIC comments was submitted on 13 June 1991.

**Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 14-15 March 1990; revision activity has been deferred.

**Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3).** Comment resolution meeting for DOE/HQ and Project Office comments was held in February 1990; revision is in progress.

**Biological Sorption and Transport, R1 (8.3.1.3.4.2).** Revision, incorporating DOE/HQ and Project Office comments, was submitted to Project Office on 20 May 1991. Additional revised text was submitted to the Project Office on 28 August 1991.

**Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2).** Submitted to Project Office on 17 August 1990.

**Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 28-30 August 1990; revision is in progress.

**Diffusion, R0 (8.3.1.6.2).** Comment resolution meeting for DOE/HQ and Project Office comments was held on 28-30 August 1990.

**Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1).** Revision incorporating DOE/HQ and Project Office comments was submitted on 19 June 1990.

**Effects of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.2).** In preparation.

**Characterization of Volcanic Features, R0 (8.3.1.8.5.1).** Accepted by NRC on 4 September 1990.

**Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1).** A revision incorporating DOE/HQ and Project Office comments was submitted on 18 June 1991. On 17 October additional comments were received from SAIC, P. Cloke.

**Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1).** Submitted to Project Office on 15 March 1991.

## **WBS 1.2.6 EXPLORATORY STUDIES FACILITY**

These exploratory studies (ES) will address the issues and information needs associated with the feasibility of storing high-level nuclear waste in a geologic repository at Yucca Mountain.

### **ACTIVITIES AND ACCOMPLISHMENTS**

Prepared responses to comments about Exploratory Studies Facility (ESF) tests in the Construction Implementation Plan (CIP) for M&O.

Began to develop tracers, fluids, and materials management program consistent with the Project plan (YM 91-23) prepared by Los Alamos.

Supported Test Integration and Sample Management Facility meetings.

Prepared briefings for weekly ESF management meeting.

Reviewed the M&O-developed Construction Management Plan.

Resolved comments on ESFDR Appendix B.

Developed milestones and schedules identifying near-term work in support of the ESF design.

Began to develop ESF-based sample requirements for laboratory tests.

Attended NWTB meeting at Washington, D. C., on January 7 and 8.

### **PLANNED ACTIVITIES**

Continue to support M&O on resolving comments on CIP.

Continue to support water management meetings.

Begin to identify APs to be changed to manage tracers, fluids, and materials during site characterization.

Develop strategy to gather information on tracers, fluids, and materials from participants.

Continue to support ramp location initiative.

Continue to support integration meetings such as ESF design, TIG, SMF and surface based testing and its interface with ESF testing.

Make necessary changes to the TPP 91-5 for release as YMP-controlled document.

Prepare change requests for changes in testing needs to update the ESF requirements document (Project level document).

Update the ESF Test Support Requirements Document.

Develop interfaces for testing and the ESF design.

Prepare Title II test planning packages.

**PROBLEM AREAS**

None

**MILESTONES**

None

#### **WBS 1.2.6.8.4 INTEGRATED DATA SYSTEM**

The integrated data system (IDS) supports the Exploratory Studies Facility (ESF) test program by providing a central facility to automatically measure and control aspects of the ESF tests. The primary purposes of the IDS are to assist the principal investigators (PI's) in acquiring high-quality test data in a uniform, controlled fashion and to transfer those data to the PI's organizations for data management and analysis.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

This activity has been deferred.

## WBS 1.2.9.1.2.4 TECHNICAL SOFTWARE MANAGEMENT

The purpose of this activity is to manage the development, implementation, and use of all software employed on activities that will support a license application; to manage the configurations of all software and computational data; and to provide tools and procedures that support these activities.

### ACTIVITIES AND ACCOMPLISHMENTS

#### Software Configuration Management (SCM)

During January, the Software Quality Assurance (SQA) system processed 2 baseline submissions and stored the submitted material in the certification environment, generated the necessary SCM documentation, performed physical and functional configuration audits on each, and generated software review packets to support Configuration Control Board (CCB) review of each.

The section sanctioned 9 software applications and updated the Computer Program Library for each. Three Software Implementation Notices were issued, and one CCB meeting was held at which four reviews were approved and one SCM Variance Authorization was issued.

#### Software Engineering

The Software engineering reviewed various baseline components of the applications currently under development.

The following support tools are being developed:

**DOCGEN** - (see October 1991) prototype development of the narrative description extraction and updating capabilities for source-code prologues.

**COMMAND-LINE PARSER** - Will enable developers to easily define legal command lines for their applications, and to obtain information from the Unix command line. This design is almost complete. This is our first application to incorporate a full, object-oriented analysis and design. This project has helped those within the software engineering effort to gain a much fuller understanding of object-oriented techniques.

**FILE-LIST UTILITIES** - Prototype development is underway for a set of file list reuse components for the SCM effort. These components will enable the SCM to automate many tasks that are at present human-intensive and error-prone.

**PSEUDOCODE FORMATTER** - owing to loss of personnel, no progress was made on this application.

**CONDITION NOTIFICATION FACILITY** - This application awaits SCM approval.

**EXTENDED STRING UTILITIES** - there is no progress to report.

**EXTENDED COPY UTILITIES** - there is no progress to report.

#### Other Activities

The Software Process Improvement Task Force was established in December; its goal is to improve the overall productivity and effectiveness of software use, development, and management throughout the Project. Two meetings were held at which various process improvement issues were identified.

## PLANNED ACTIVITIES

### Configuration Management

- Continue management of submitted baselines and change orders.
- Development of a Software Requirements Specification for the CSA Database upgrade.
- Development of a Software Requirements Specification for the Computer Program Library upgrade.

### Software Engineering

- Continue work on the object-oriented design of the command line parser.
- Continue work on the design and implementation of the extended string utilities.
- Continue work on the design and implementation of the extended copy utilities.
- Continue support of the schedule update effort for the Project Control section.
- Continue support of the SCM effort.

## PROBLEM AREAS

During January, the SQA system was notified that support from the YMP Office in Las Vegas was being withdrawn and the 1992 budget for the Group had been reduced to zero. A great deal of time was spent negotiating with Project Office representatives to determine whether Los Alamos could adopt another participant's software QA Plan as a replacement for our own, but this was discouraged by the Project Office.

The decision to discontinue the Los Alamos SQA approach is bewildering in light of the following:

- The March 1991 audit of this system by the Project Office, NRC, and State of Nevada was flawless. It generated no findings and resulted in high praise from the auditors.
- The Los Alamos SQA approach is highly regarded by the NRC.
- LANL YMP auditors have credited the system with providing timely, accurate information that has been extremely helpful during local audits and surveillances.
- The Los Alamos SQA system implemented an active process improvement effort (see December 1991) that has resulted in substantial improvements in efficiency and effectiveness.

Despite the uncertainties, this group has continued to perform the QA, configuration management, and engineering tasks required until a replacement program is approved.

The decision to terminate support for the LANL SQA system has negatively impacted LANL YMP because computer system support for all system computers has been terminated. Consequently, operating-system and software updates are not being applied and routine maintenance is not being performed on any of these systems (4 work stations, 1 VAX 4000, and 5 Macintoshes). Computer network support has also been suspended, and the Process Improvement Task Force has been disbanded.

#### **WBS 1.2.9.1.4 RECORDS MANAGEMENT**

The objective of this task is to manage records and documents related to the licensing of a geologic repository for the disposal of high-level radioactive waste by developing, implementing, and maintaining a comprehensive, automated, and integrated information management system.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

The Records Processing Center rejected 9 records and accepted 63 records in January.

### **WBS 1.2.9.3 QUALITY ASSURANCE**

The Quality Assurance (QA) Program supports Los Alamos Yucca Mountain Site Characterization Project participants and ensures that their efforts provide data and evidence admissible for the repository-licensing process.

#### **ACTIVITIES AND ACCOMPLISHMENTS**

##### **Software**

Two software Configuration Control Board (CCB) meetings were held. We have received 115 software change requests, and 50 of these have been approved.

##### **Grading**

Of the 32 grading packages being prepared, 27 have been approved, 6 (including 3 for international studies) are in review at the YMPO.

##### **Document Control**

Seven detailed technical procedures (DP-87, DP-88, DP-89, DP 90, DP-92, DP-95, and DP-97) were issued and distributed.

##### **Program Development**

Twelve quality administrative procedures (QPs) are in various stages of the review cycle. The QP writing and review cycle was examined, and several changes have been made to increase efficiency. A trending report for 1990-1991 was distributed to the TPO and Project Leaders. L. McDonald was hired as quality assurance liaison for EES-5.

S. Bolivar, J. Day, and P. Gillespie attended the PQAC meeting in Las Vegas.

##### **Deficiencies**

The YMPO closed out CAR YMP-92-001.

##### **Audits**

Audit report LANL-AR-91-12 (Lawrence Berkeley Laboratory) was approved and distributed. An audit of criterion 18 was conducted.

#### **PLANNED ACTIVITIES**

Revise grading packages. Complete unfinished survey reports and the criterion-18 audit report. Revise several QPs Close out any open CARs.

QAPL will continue to prepare 1991 progress report.

Newly designed YMP orientation class will be held each month.

EES-1 project participants (AR 92-01) will be audited.

## **PROBLEM AREAS**

The existing software quality assurance plan is under review. See WBS 1.2.9.1.2.4 for additional information.

**APPENDIX**

**ATTACHMENTS AND LEVEL III MILESTONE REPORTS**

# Los Alamos

Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

## memorandum

TO Distribution DATE January 30, 1992

FROM J. A. Canepa, EES-13 *Jc* MAIL STOP/TELEPHONE: J521/7-4109

SYMBOL EES-13-01-92-1188

SUBJECT HIGHLIGHTS OF PI MEETING OF JANUARY 24, 1992

Everett Springer gave a presentation on how our data has been used in Performance Assessment calculations and the construction of CCDFs. He compared CCDFs from Sinnock et al. 1984, the NRC Performance Assessment (1990), and the ESSE Presentation (1991). It was decided by the group to invite Mike Wilson (SNL) to a PI meeting so that we might get a better understanding of how CCDFs are constructed.

Dave Vaniman gave an excellent talk on the issues raised by J. Szymanski (DOE/YMP) and the technical progress in resolving these issues (no handouts).

Dick Herbst reported on the future of the software quality assurance effort. He indicated that DOE was not supportive of the effort through the budget. Steps are being taken at EES-13 to re-evaluate the effort. The details are not yet clear on the direction of software quality assurance (SQA). An SQA program is still required by the DOE/YMP.

Dick also announced his intention to pursue a job change. He will be relocating to Washington, D.C. to support the DOE Hanford Tanks Waste Remediation Program.

JAC/em

Attachment: Handout

### Distribution:

K. H. Birdsell, EES-5, MS F665  
D. E. Broxton, EES-1, MS D462  
B. A. Carlos, EES-1, MS D462  
B. M. Crowe, EES-13/LV, MS J900/527  
M. H. Ebinger, EES-15, MS J495  
K. G. Eggert, EES-5, MS F665  
N. Z. Elkins, EES-13/LV, MS J900/527  
J. T. Fabryka-Martin, INC-7, MS J514  
C. D. Harrington, EES-1, MS D462  
L. E. Hersman, LS-2, MS M880  
S. S. Levy, EES-1, MS D462  
A. Meijer, INC-7, MS J514  
D. E. Morris, INC-11, MS G739  
B. A. Robinson, EES-4, MS D443  
E. P. Springer, EES-13, MS J521  
I. R. Triay, INC-11, MS J514  
G. Valentine, EES-5, MS F665  
D. T. Vaniman, EES-1, MS D462  
G. A. Zyvoloski, EES-5, MS F665

### Information Cy:

S. L. Bolivar, EES-13, MS J521  
J. A. Canepa, EES-13, MS J521  
G. P. Cort, EES-13, MS J521  
D. B. Curtis, INC-7, MS J514  
J. L. Day, LATA, MS M321  
R. J. Herbst, EES-13, MS J521  
H. N. Kalia, EES-13/LV, MS J900/527  
R. A. Morley, EES-13/LV, MS J900/527  
W. A. Morris, EES-1, MS D462  
K. W. Thomas, INC-11, MS J514  
K. A. West, EES-13, MS J521  
EES-13 File, MS J521

## memorandum

**Distribution** DATE January 10, 1992  
**FROM** J. A. Canepa *JAC* EES-13 MAIL STOP TELEPHONE J521/7-4109  
**SYMBOL** EES-13-01-92-1151  
**SUBJECT** PI MEETING JANUARY 24, 1992, INC-DO CONFERENCE ROOM, 9:00-11:00 A.M.

There will be a YMP PI meeting on January 24, 1992 in the INC-DO Conference Room starting at 9:00 a.m. Technical topics to be discussed are:

1. A discussion of how our data was used by PA and a comparison of CCDF's over past 8 years - implications for the transport program. (Everett Springer).
2. Update and evaluation of the 'Szymanski' issue-implications for the water chemistry, mineralogy and modeling efforts. (Dave Vaniman).

Please advise interested colleagues of this meeting.

JAC/em

**Distribution:**

K. H. Birdsall, EES-5, MS F665  
D. E. Broxton, EES-1, MS D462  
B. A. Carlos, EES-1, MS D462  
B. M. Crowe, EES-13/LV, MS J900/527  
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E. P. Springer, EES-13, MS J521  
I. R. Triay, INC-11, MS J514  
G. Valentine, EES-5, MS F665

D. T. Vaniman, EES-1, MS D462  
G. A. Zyvoloski, EES-5, MS F665

**Information Cy:**

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K. W. Thomas, INC-11, MS J514  
K. A. West, EES-13, MS J521  
EES-13 File, MS J521

USE OF SORPTION AND SOLUBILITY DATA IN THE YUCCA MOUNTAIN  
PROJECT

1984 - 1991

## LITERATURE REVIEWED

- SINNOCK ET AL. (1984) ALSO J. GEOPHY. RES. (1987)
- NRC PERFORMANCE ASSESSMENT 1990 (UNPUBLISHED AS OF THIS DATE)
- ESSE PRESENTATION NOVEMBER 1991 - RICKERTSEN (PRELIMINARY)

Table 5 from Sinnock et al. (1984)

Prow Pass Member (partially welded tuff)	Americium	470
	Cesium	190
	Neptunium	6.4
	Plutonium	77
	Strontium	22
	Technetium	0.2
	Uranium	NA
	Barium	182
Bullfrog Member (welded tuff)	Americium	140
	Cesium	180
	Neptunium	NA
	Plutonium	80
	Strontium	62
	Technetium	4.2
	Uranium	1.3
	Barium	400
Tram Member (nonwelded tuff)	Americium	28000
	Cesium	610
	Neptunium	28
	Plutonium	400
	Strontium	290
	Technetium	NA
	Uranium	4.6
	Barium	760

Table 6 from Sinnock et al. (1984)

<u>Element</u>	<u>Kd (cm<sup>3</sup>/g)</u>	<u>Ka(g/cm<sup>2</sup>)</u>	<u>Rd for Matrix</u>		<u>Rd for Fractures</u>	
			<u>Zeolitic</u>	<u>clayitic</u>	<u>Unsat</u>	<u>Sat</u>
Am	180	1.8x10 <sup>-4</sup>	3600	1800	1.4	1.0
C	0	0	1	1	1.0	1.0
Cm	180	1.8x10 <sup>-4</sup>	3600	3600	1.4	1.0
Cs	290	2.9x10 <sup>-4</sup>	5800	2900	1.5	1.0
I	0	0	1	1	1.0	1.0
Ni	100	1.0x10 <sup>-4</sup>	2000	1000	1.2	1.0
Np	7	7.0x10 <sup>-6</sup>	140	71	1.0	1.0
Pa	64	6.4x10 <sup>-5</sup>	1300	640	1.1	1.0
Pb	5	5.0x10 <sup>-6</sup>	100	51	1.0	1.0
Pu	64	6.4x10 <sup>-5</sup>	1300	640	1.1	1.0
Ra	900	9.0x10 <sup>-4</sup>	18000	9000	2.8	1.2
Sn	170	1.7x10 <sup>-4</sup>	3400	1700	1.3	1.0
Sr	53	5.3x10 <sup>-5</sup>	1100	530	1.1	1.0
Tc	0.3	3.0x10 <sup>-7</sup>	7	4	1.0	1.0
Th	580	5.8x10 <sup>-4</sup>	12000	5300	2.2	1.1
U	1.8	1.8x10 <sup>-6</sup>	37	19	1.0	1.0
Zr	500	5.0x10 <sup>-4</sup>	10000	5000	2.0	1.1

Preliminary Data—Do Not Reference

**SINNOCK ET AL. (1984)**

- **ASSUMED SOLUBILITY ONLY FOR URANIUM THEN OTHER RADIONUCLIDES WERE CONGRUENTLY LEACHED BASED UPON MASS IN THE WASTE FORM**
- **SINGLE  $K_d$**
- **FLUX WAS 0.5 MM/YR**

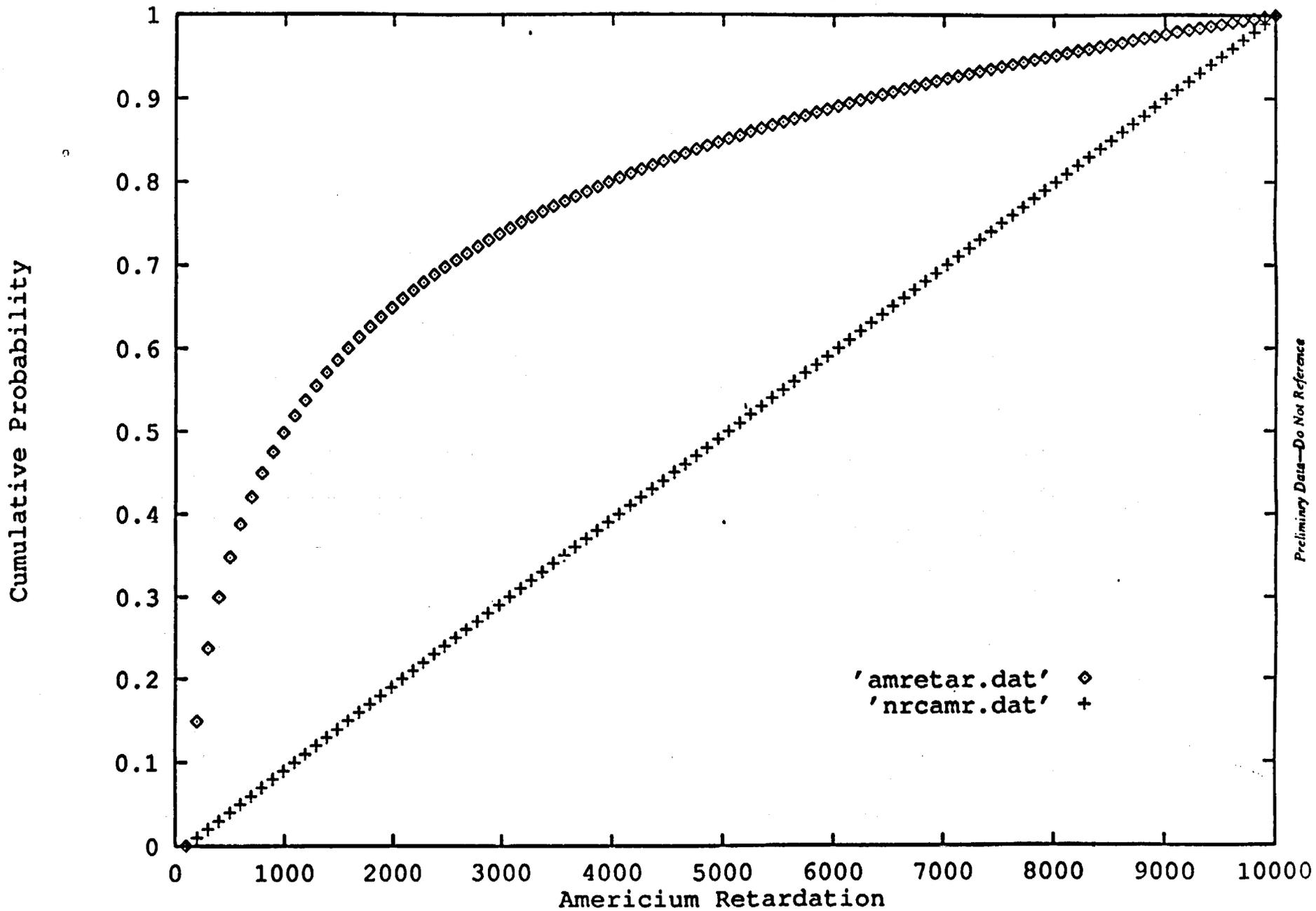
Table 5 from Sinnock et al. (1984)

Tuff Unit	Radionuclide	Sorption Ratio Kd (ml/g)
Topopah Spring Member (welded tuff)	Americium	1200
	Cesium	290
	Neptunium	7
	Plutonium	64
	Strontium	53
	Technetium	0.3
	Uranium	1.8
	Barium	900
Topopah Spring Member (bedded tuff)	Americium	180
	Cesium	16000
	Neptunium	NA
	Plutonium	120
	Strontium	17000
	Technetium	2.5
	Uranium	2.5
	Barium	38000
Calico Hills (bedded tuff)	Americium	4600
	Cesium	7800
	Neptunium	11
	Plutonium	140
	Strontium	3900
	Technetium	NA
	Uranium	5.3
	Barium	94000

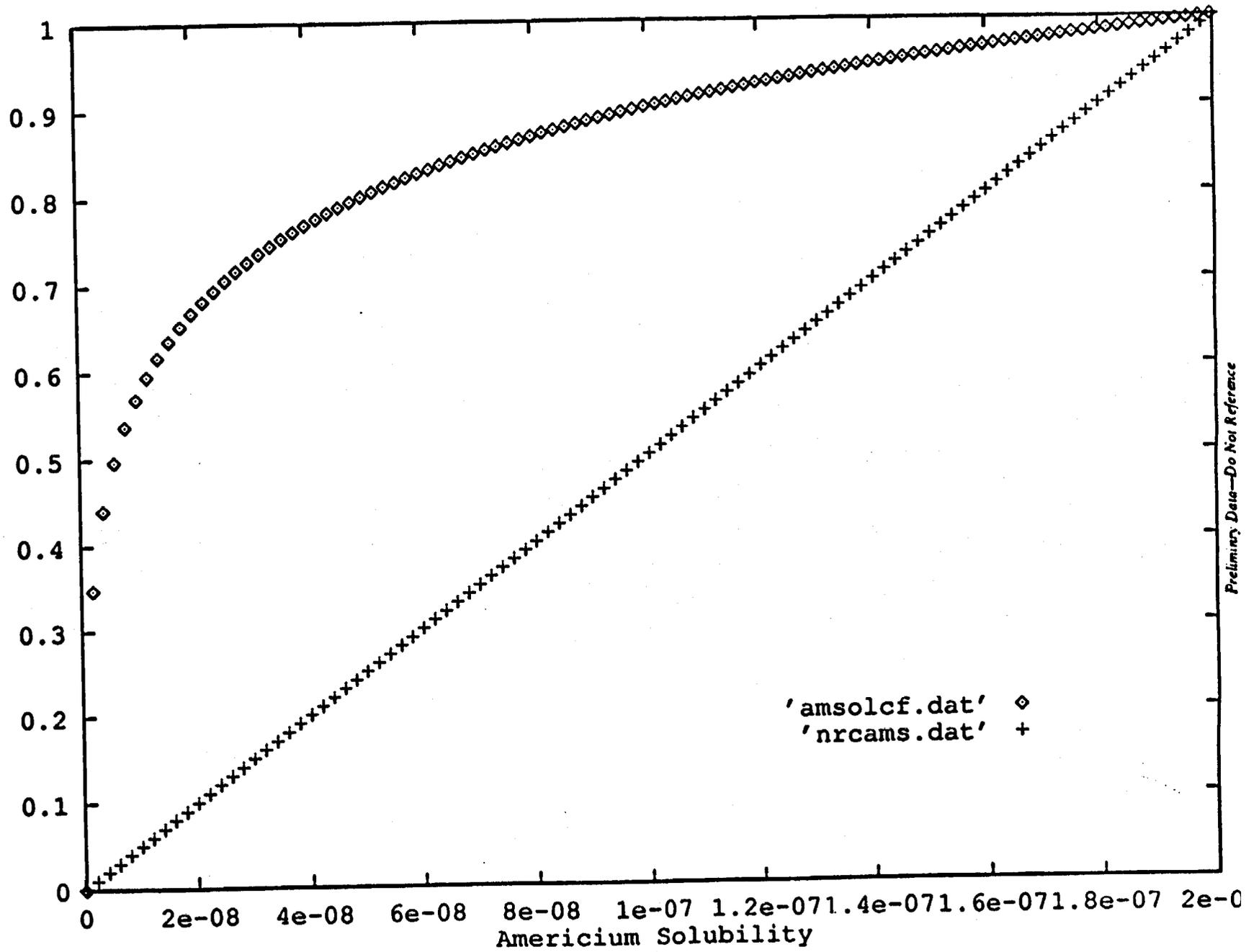
## NRC / ESSE

- SOLUBILITY FOR INDIVIDUAL RADIONUCLIDES WAS USED
- RETARDATION RATHER THAN  $K_d$  WAS USED
- DISTRIBUTIONS RATHER THAN SINGLE VALUES FOR BOTH PARAMETERS

# Americium Retardation

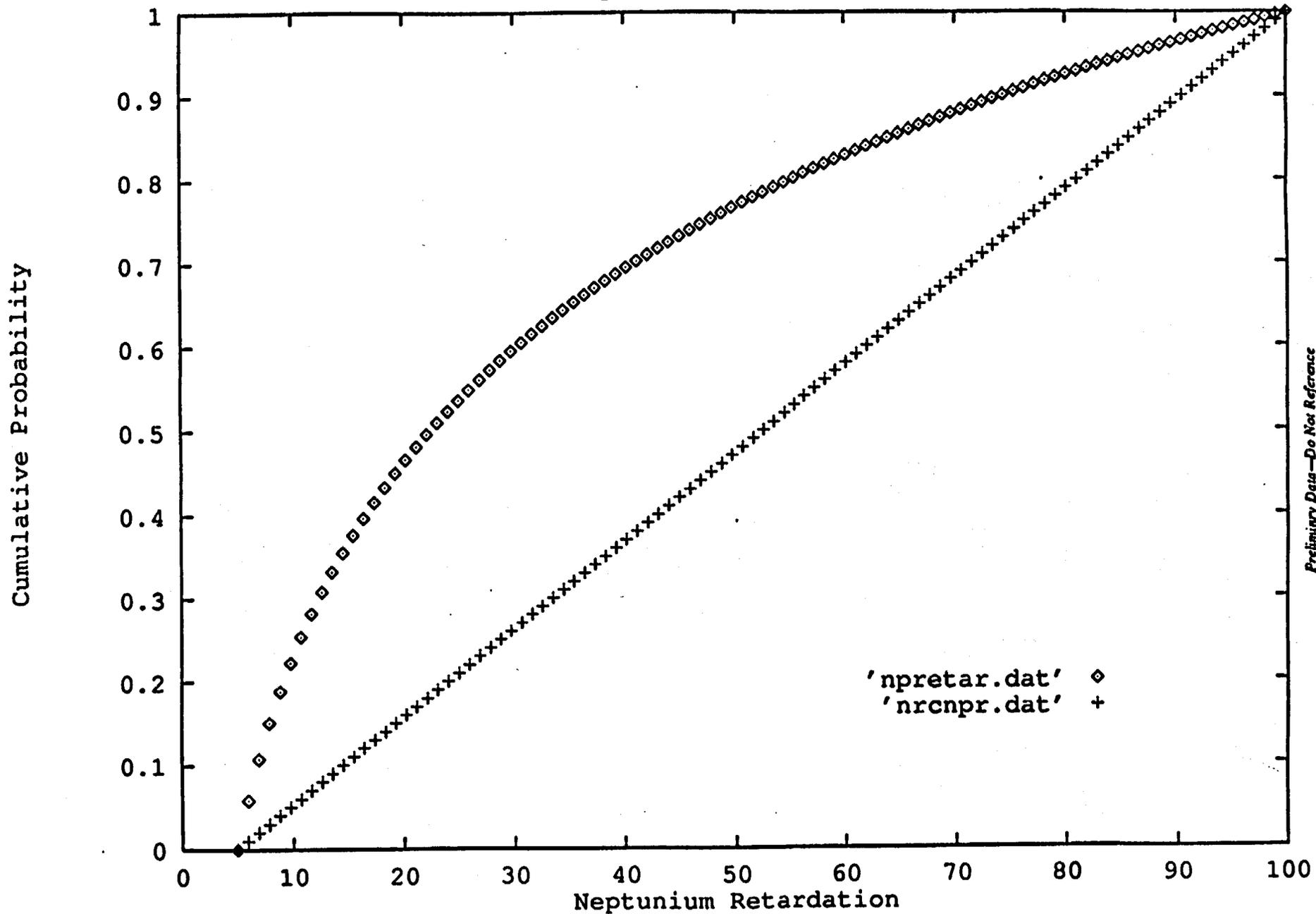


Cumulative Probability



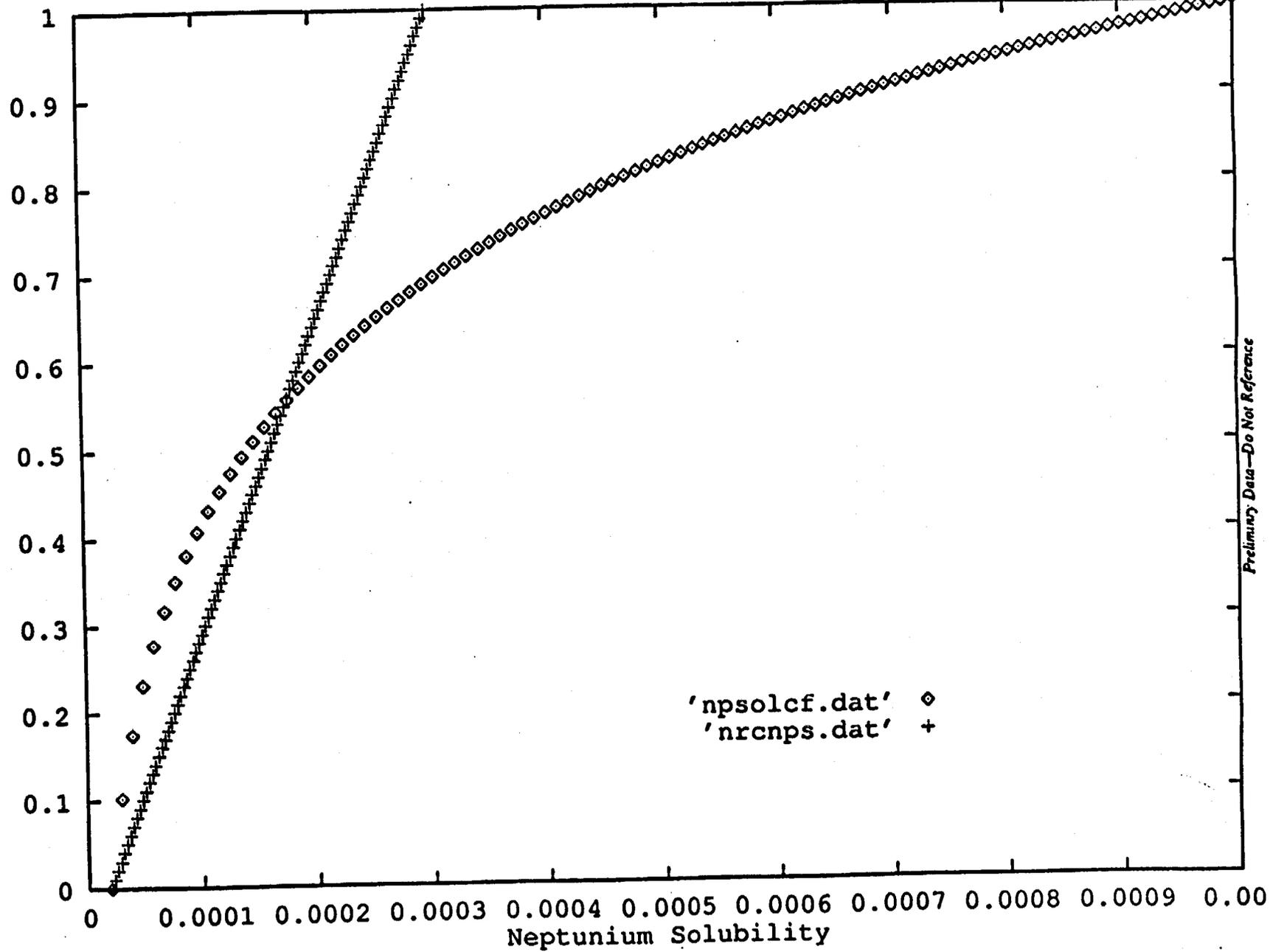
Preliminary Data—Do Not Reference

# Neptunium Retardation



# Neptunium Solubility

Cumulative Probability

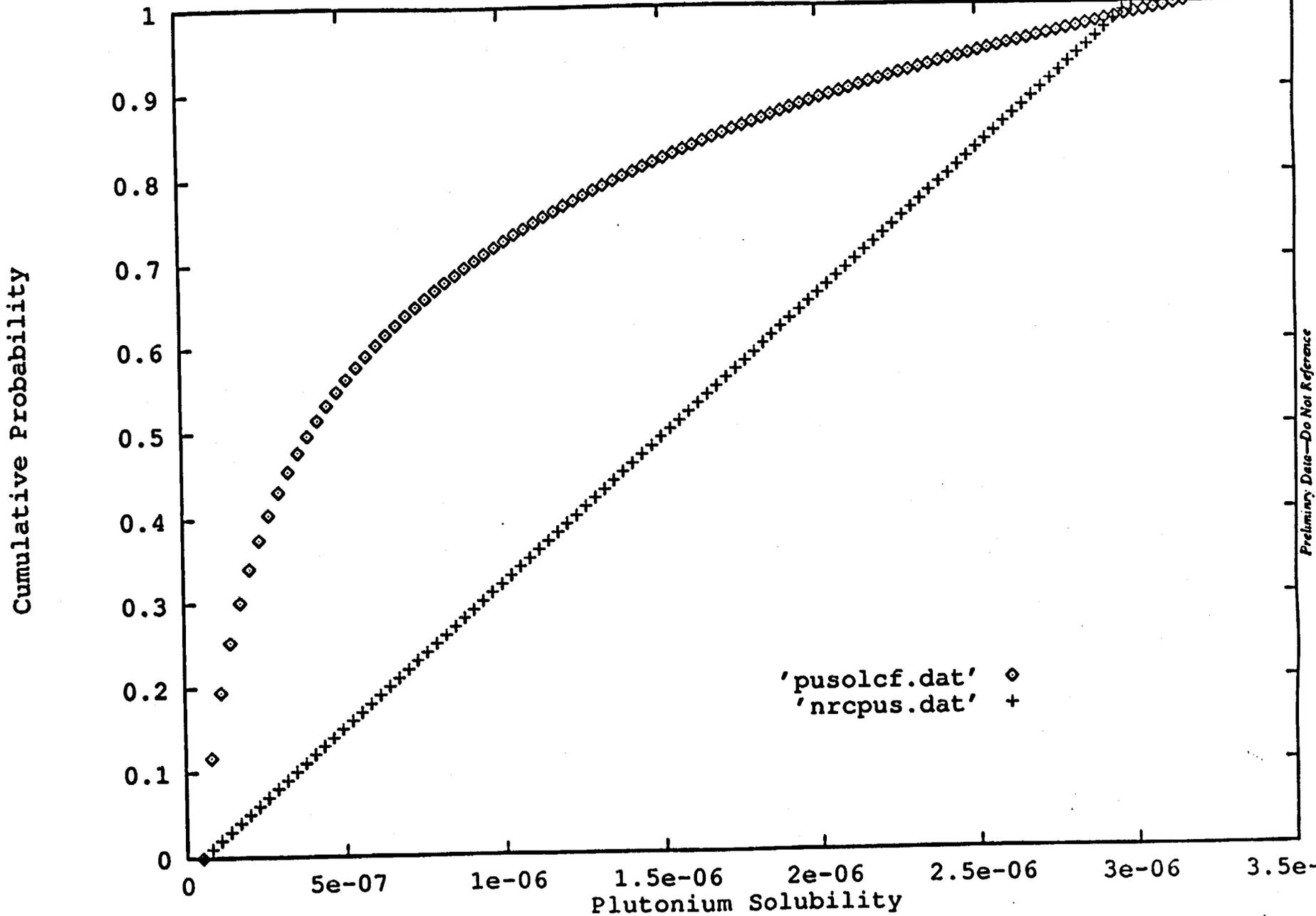


'npsolcf.dat' ◊  
'nrcnps.dat' +

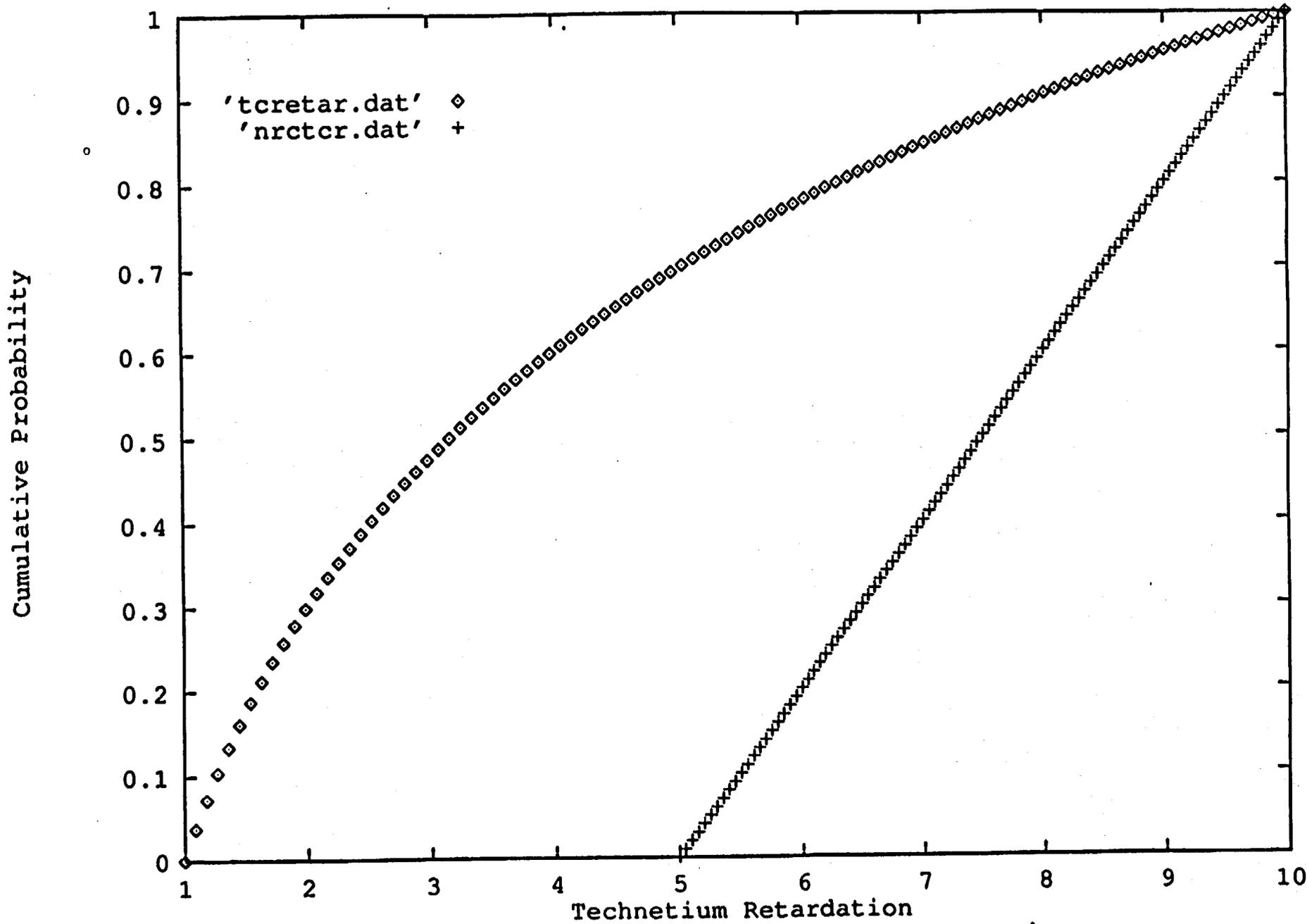
Preliminary Data—Do Not Reference



# Plutonium Solubility

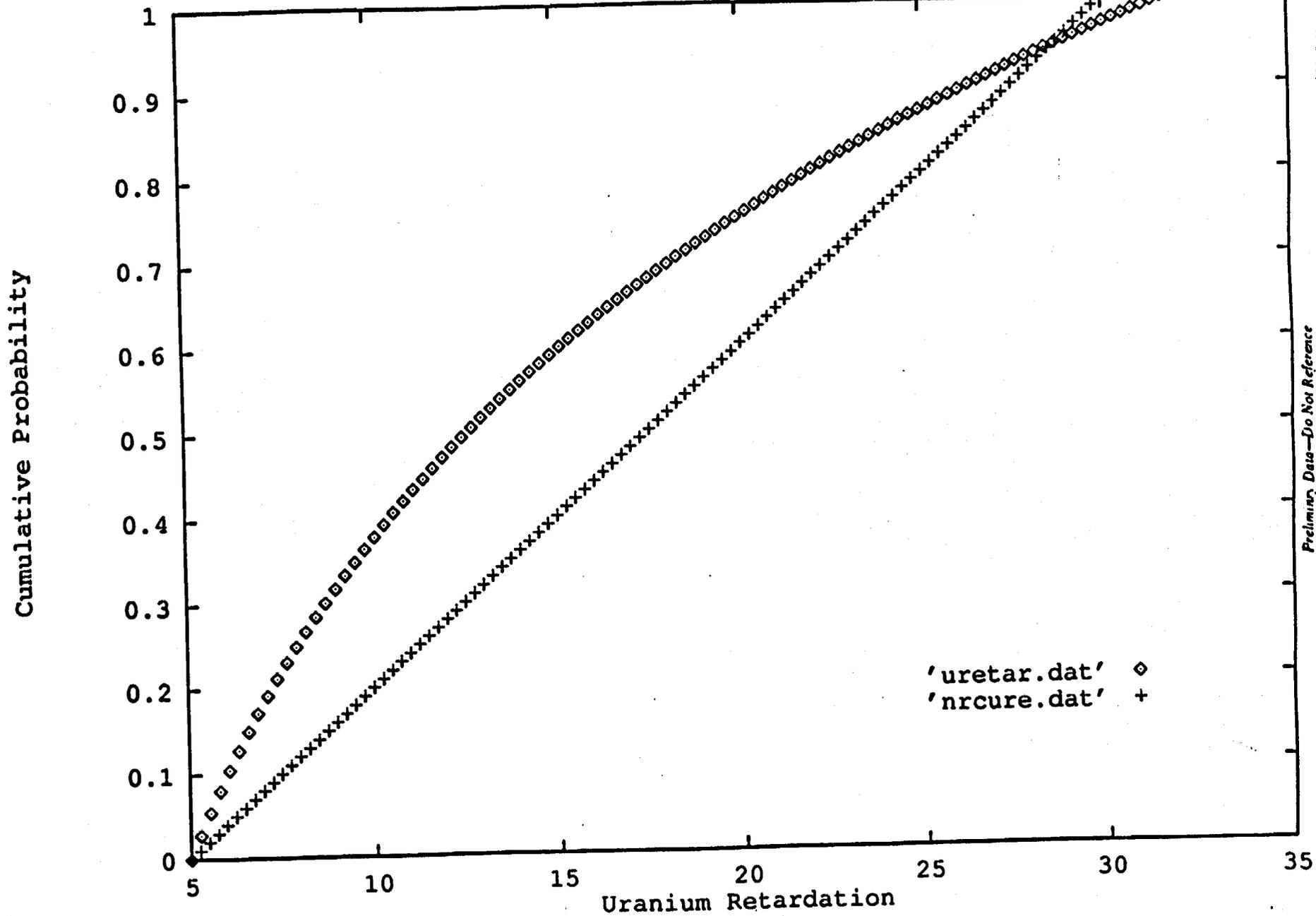


# Technetium Retardation



Preliminary Data—Do Not Reference

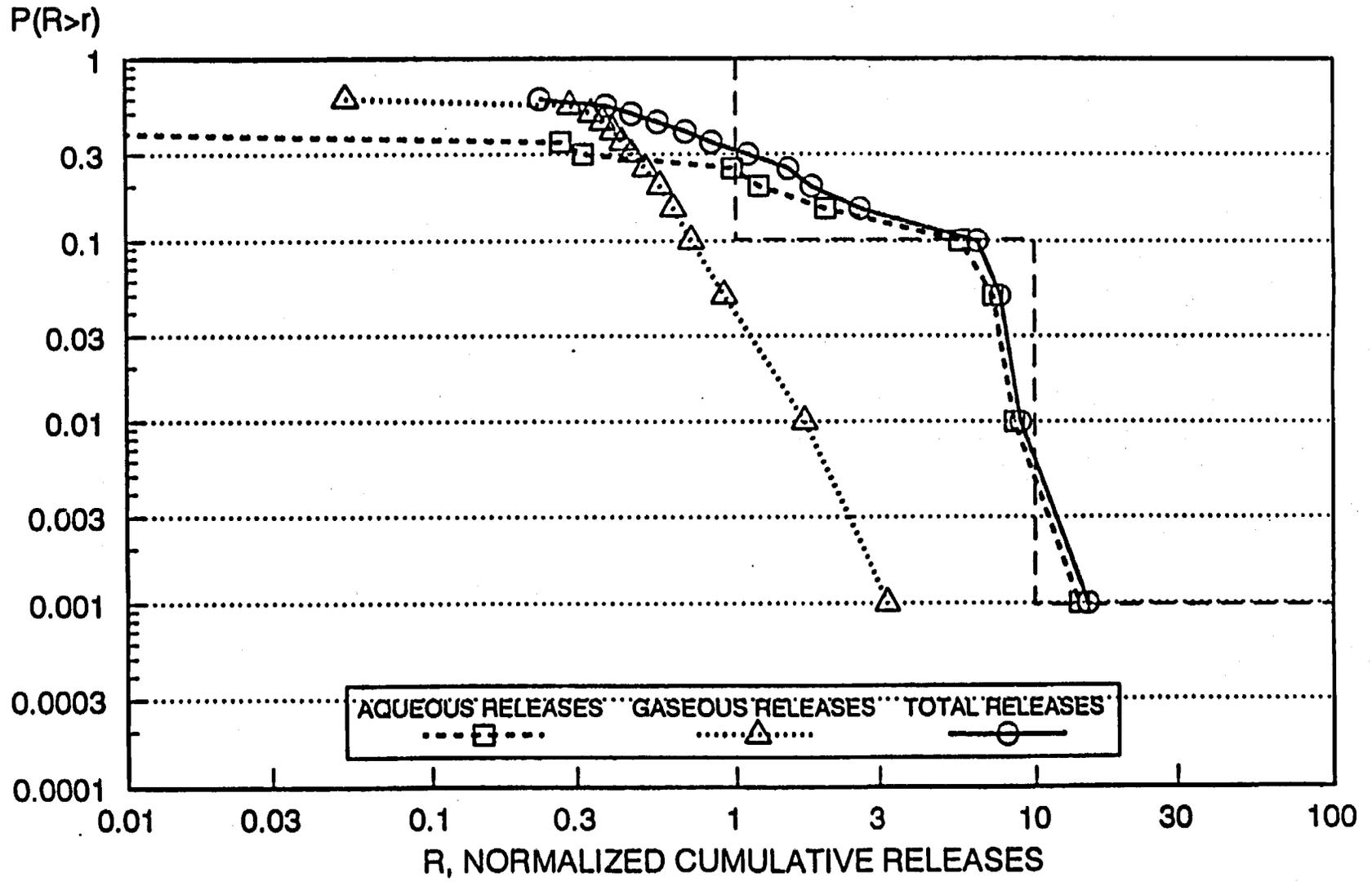
# Uranium Retardation



Preliminary Data—Do Not Reference

# ESSE SYSTEM PERFORMANCE ASSESSMENT

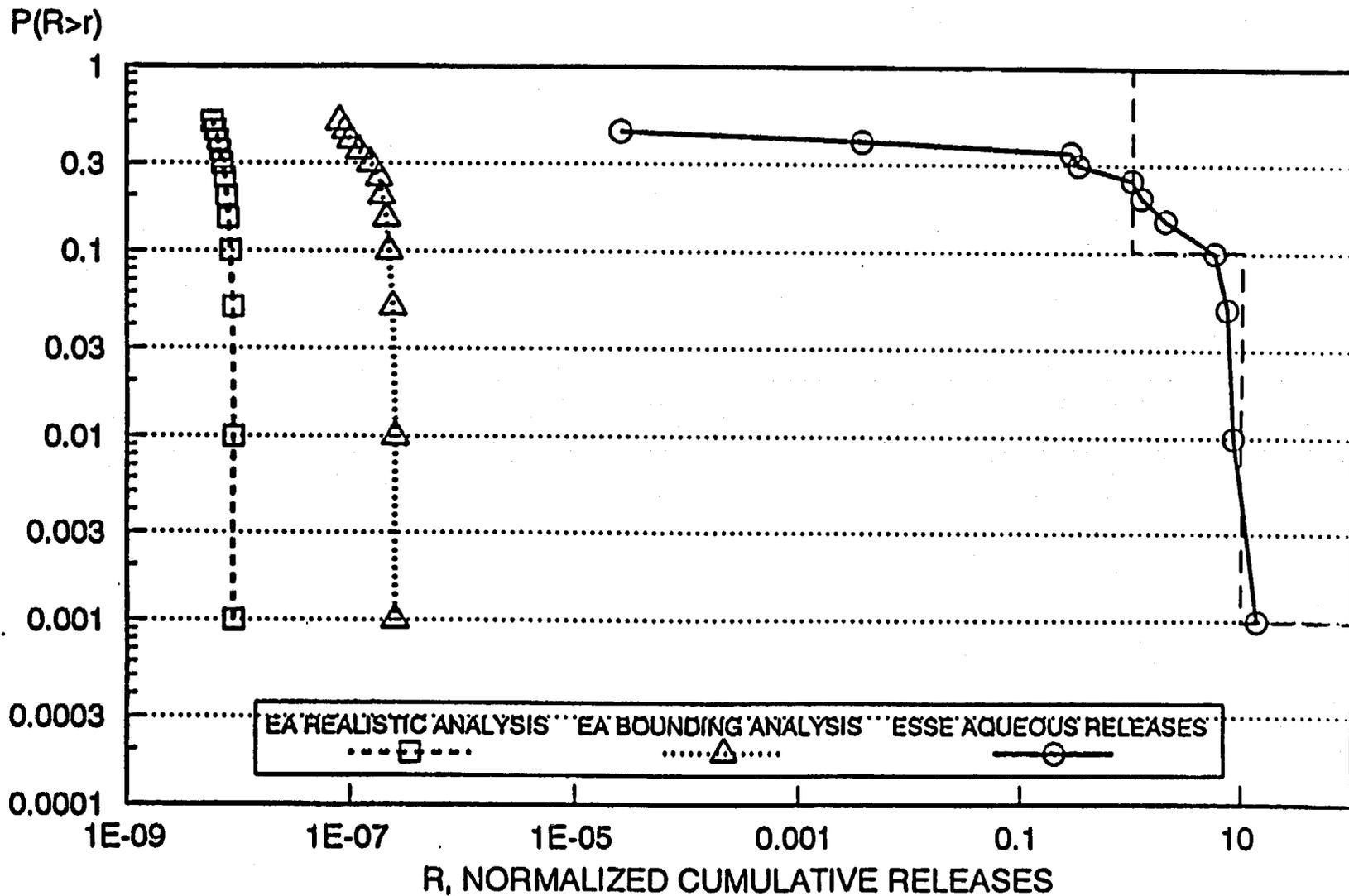
## UNDISTURBED PERFORMANCE



Preliminary Data—Do Not Reference

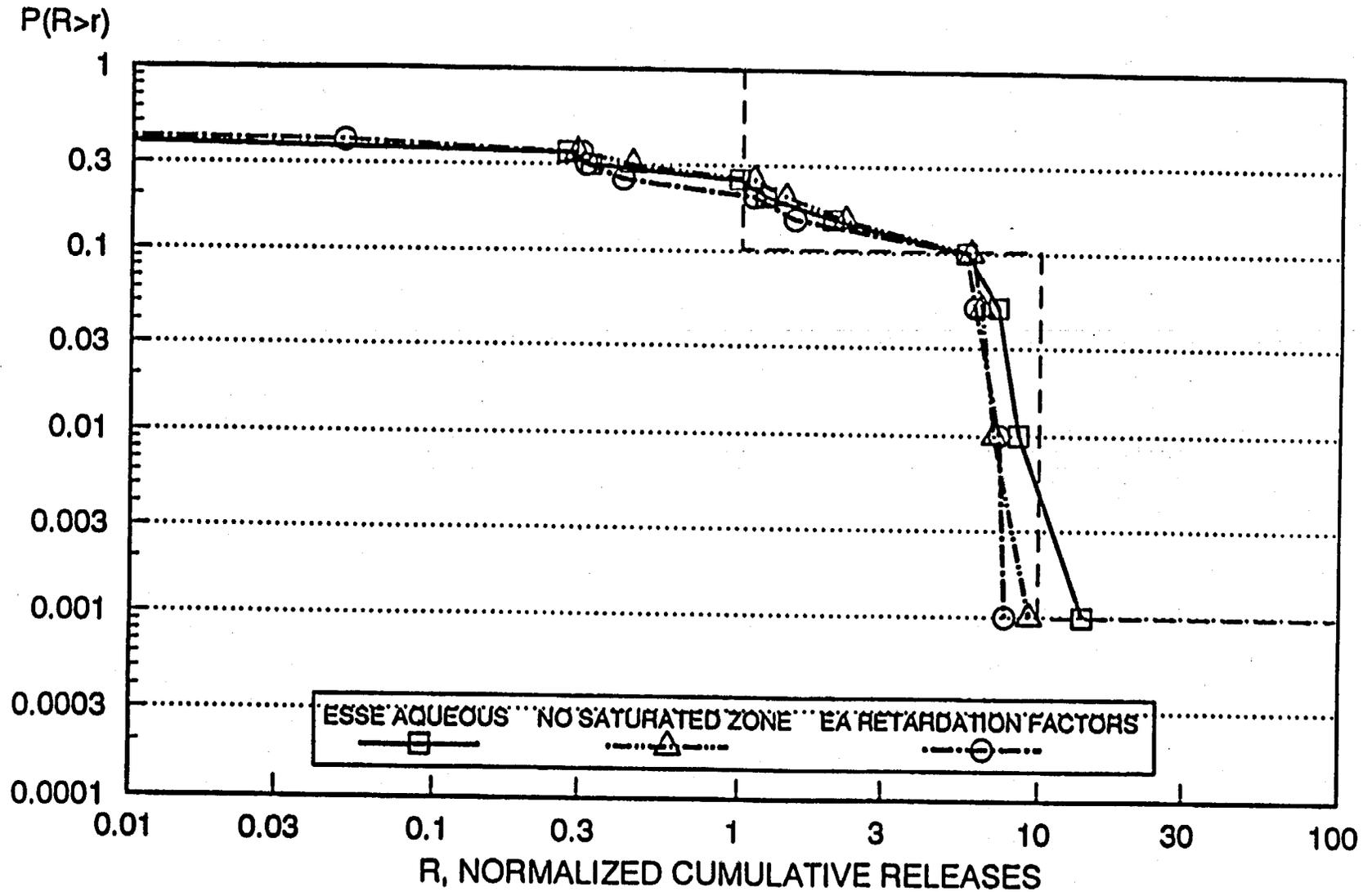
# COMPARISON OF ESSE AND EA ASSESSMENTS

## UNDISTURBED PERFORMANCE



Preliminary Data—Do Not Reference

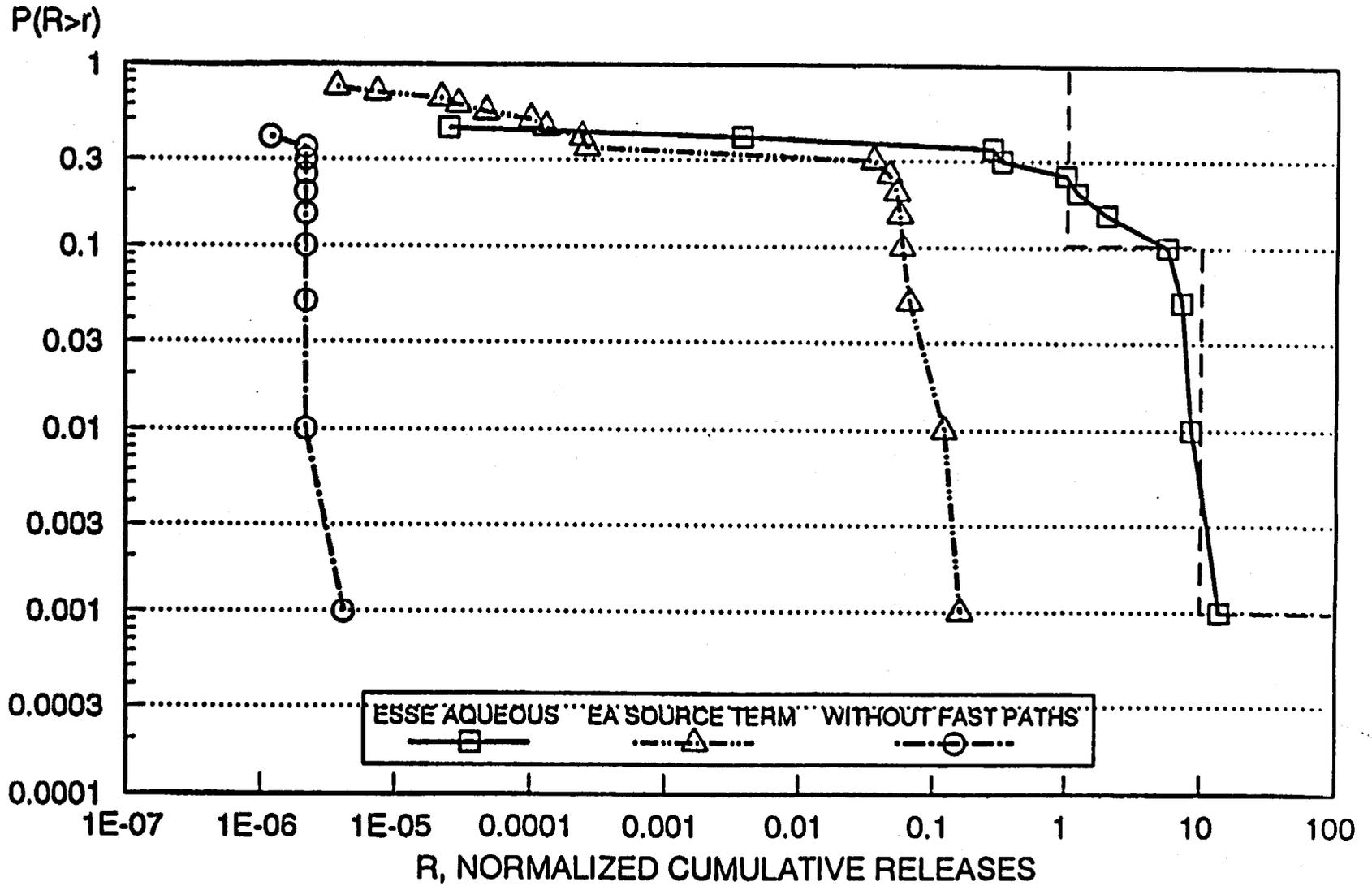
# EFFECTS OF ESSE MODEL FEATURES SATURATED ZONE AND RETARDATION MODELS



Preliminary Data—Do Not Reference

# EFFECTS OF ESSE MODEL FEATURES

## SOURCE TERM AND FAST PATH MODELS



Preliminary Data—Do Not Reference

# ISSUES IDENTIFIED IN TECHNICAL GUIDELINE EVALUATION

## Geohydrology

- Effect of "fast paths" (e.g. heterogeneity; episodic infiltration; topography; perching)
- Modeling uncertainty (e.g. 2D vs 1D modeling)

## Geochemistry

- Colloidal transport of plutonium

## Climate Changes

- Potential water table rise
- Potential increase in flux

## Postclosure tectonics

- Occurrence of faults
- Local concentration of flux due to new paths
- Modification to water table

## Human Interference

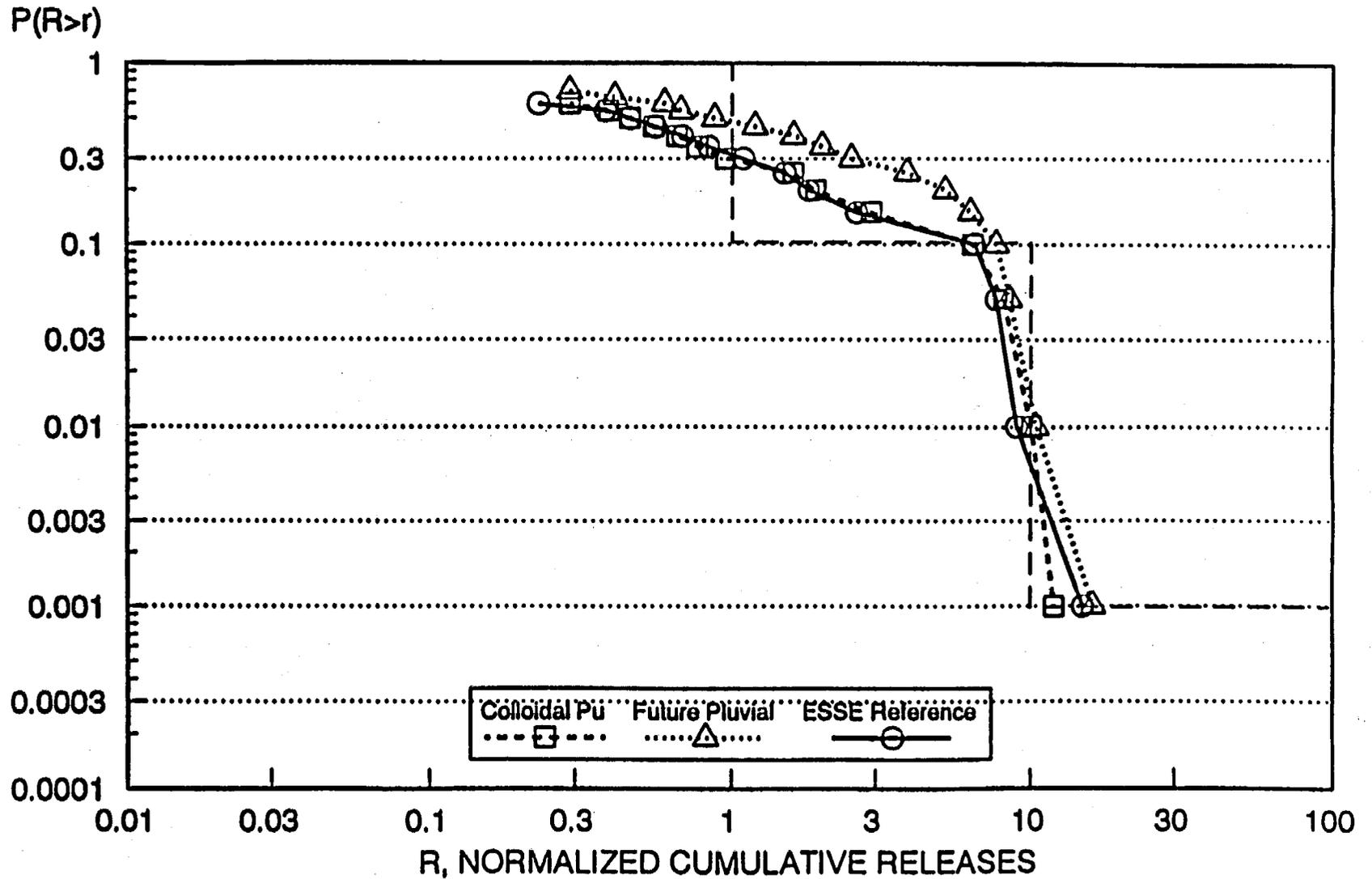
- Potential for future exploration

## Others

- Potential for gaseous release

# EVALUATION OF TECHNICAL GUIDELINE ISSUES

## GEOCHEMISTRY AND CLIMATE CHANGES



Preliminary Data—Do Not Reference

# CONCLUSIONS

- **CURRENT INFORMATION INDICATES NO FEATURES OR CONDITIONS AT YUCCA MOUNTAIN THAT MAKE IT UNSUITABLE**
- **MOST IMPORTANT ISSUE FOR SYSTEM PERFORMANCE IS PRESENCE OF FAST PATHS; EARLY TESTS SHOULD FOCUS ON THESE**
- **GASEOUS RELEASE ALONE CAUSES SITE TO BE marginally LICENSABLE, EVEN IF NO FAST AQUEOUS PATHS**
- **CONCLUSIONS REGARDING SITE SUITABILITY DO NOT DEPEND ON ENGINEERED BARRIERS**

## SUMMARY

- THE LIST OF IMPORTANT RADIONUCLIDES IS CONSISTENT - Tc, I, C, Pu, Am, Np, U
- HOW MUCH CAN THESE DISTRIBUTIONS BE CHANGED? IS THE DISTRIBUTION THE RIGHT APPROACH?
- CAN "OUR" DATA SHIFT THE CCDFs BACK TO THE LEFT?
- IN TERMS OF SENSITIVITY, IS THERE AN OBJECTIVE FUNCTION OTHER THAN A CCDF THAT SHOULD BE USED?