



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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TO: David Brooks, Acting Director, HLPD, M/S 4 H 3

FROM: Paul T. Prestholt and John W. Gilray
Sr. On-Site Licensing Representatives

DATE: March 17, 1992

SUBJECT: OFFICE OF GEOLOGIC DISPOSAL (OGD) WEEKLY HIGHLIGHTS FOR
THE WEEK ENDING MARCH 6, 1992.

Please find enclosed the above-referenced OGD report
for the week ending March 6, 1992.

There is nothing requiring specific management
attention in the reports.

nan

cc w/encs.: Charlotte Abrams, M/S 4 H 3
Rosetta Virgilio, M/S 3 D 23
Dean Kunihiro, Region 5

NOTE TO CHARLOTTE: Also enclosed is the LLNL YMP Status Report,
February, 1992, and a copy of the Preliminary Field Composite
Borehole Log

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PDR WASTE PDR
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CJUT

ADD: Charlotte Abrams Ltr. Encl.
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Department of Energy
Yucca Mountain Site Characterization
Project Office
P. O. Box 98608
Las Vegas, NV 89193-8608

WBS 1.2.9.2
QA: N/A

MAR 11 1992

John W. Bartlett, Director, Civilian Radioactive Waste Management,
HQ (FW-1) FORS

OFFICE OF GEOLOGIC DISPOSAL (OGD) WEEKLY HIGHLIGHTS FOR THE WEEK ENDING
MARCH 6, 1992

I. CRITICAL ITEM STATUS - YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
(YMP)

A. Site Characterization Planning

Regulatory Interactions

The Regulatory Interactions Branch staff attended the Waste Management '92 Conference during the week of March 2, 1992. They presented a poster session on geochemistry and staffed the YMP exhibit.

A Technical Direction Letter to the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) on the Peer Review of Technical Basis for Erosion Topical Report was transmitted February 24, 1992. A letter was transmitted to the U.S. Geological Survey (USGS) on February 27, 1992, on Directions for Assistance in Preparing the U.S. Department of Energy (DOE) Topical Reports on Erosion and Calcite-Silica Deposits.

Exploratory Studies Facility (ESF) Task Force Activities

The ESF Title II 50 percent Design Review has commenced and is comprised of 25 drawings, 12 analyses, and 74 specifications. This review, consisting of technical and management portions, is expected to be completed by mid-April 1992. The status is as follows:

<u>Drawings</u>	<u>Analysis</u>	<u>Specifications</u>
Through Engineering (25) Through Computer-aided Draft Design (CADD)(25) Through Review (25)	Initial Draft (12) Final Draft (12) Review (12)	Initial Draft (74) Final Draft (74) Review (74)

MAR 11 1992

The following organizations are participating in this 50 percent review: DOE, M&O, USGS, Sandia National Laboratories (SNL), Los Alamos National Laboratory (Los Alamos), Lawrence Livermore National Laboratory (LLNL), Technical and Management Support Services (T&MSS), Reynolds Electrical and Engineering Co., Inc. (REECo), and Raytheon Services Nevada (RSN).

<u>Drawings</u>	<u>Analysis</u>	<u>Specifications</u>
Through Engineering (11)	Initial Draft (07)	Initial Draft (02)
Through CADD (02)	Final Draft (00)	Final Draft (00)
Through Review (01)	Review (00)	Review (00)

Site Characterization Plan (SCP) Progress Report (PR)

PR 5 is still in concurrence at DOE Headquarters (HQ). The guidance letter for PR 6 was sent to all the participants, the Yucca Mountain Site Characterization Project Office (YMPO) and DOE/HQ on March 4, 1992.

SCP Study Plan (SP) Status

No SPs were approved by YMP during this week.

SP BREAKDOWN

In Screening Review	0
In YMP and HQ Review	4
Awaiting Comment Resolution Meeting	6
Awaiting Author Revision	11
In YMP/HQ Verification Audit	7
Preparing to Submit or Awaiting YMP Approval	2
U.S. Nuclear Regulatory Commission (NRC) Phase 1 Review	17
NRC Acceptance	19
Total	66

SCP SP Status:

Total SPs Assigned to Cover 106 Studies	103
Total SPs Submitted for Review	
Including Revision to SPs	66
Total SPs Not Yet Submitted for Review	44

MAR 11 1992

Received Comments from the State of Nevada	8
Responses Transmitted to the State of Nevada	5

Received Comments from NRC	9
Responses Transmitted from OGD to DOE/HQ	5
Responses Transmitted from DOE/HQ to NRC	4

B. Environmental Programs

Environmental Compliance and Permitting

The Water Appropriations Permit for Well J-13 was received from the Nevada State Engineer on March 2, 1992. The permit approves the withdrawal of .2 cubic feet per second up to 94.83 acre feet per year for ten years. Permit conditions include implementation of the groundwater monitoring plan developed with the National Park Service and further regulation should monitoring identify unmitigable impacts on existing water rights.

C. Field Operations

The Site Manager and Field Operations Center staff participated in, and provided support to, four tours during the past week.

The fourth neutron access borehole, UZN-11, was completed. It was bored to a depth of 84.4 feet. REECO rigged up and began work on the fifth borehole, UZN-36, on February 28, 1992. It is presently bored to a depth of 26 feet.

The YMP Safety & Health Plan, Revision 1, has been submitted to the Office of Civilian Radioactive Waste Management for the signatures of the Director, and the Secretary of Environmental Safety & Health.

The Site Manager initiated job package (JP) authorization for two new site activities. The first is JP 92-4, UZ-16 Drill Pad and Access Road. REECO commenced site preparation on February 28, 1992. The second activity is JP 92-5, Midway Valley Excavations. Work will commence next week.

The Site Manager and staff are assisting in accomplishing the YMP 50% Design Review for ESF, North Portal Title II Design. Comments are due to RSN by close of business March 6, 1992.

MAR 11 1992

Sample Management Facility (SMF)

The core plugger set up was completed and it is now operational. The Information Systems Division began upgrading the SMF network to Ethernet.

D. Project Planning and Control

Completed the schedule for installation of Participant Planning and Control System (PACS) Work Stations. Schedule is for March and April 1992, with all installations to be completed by the end of April 1992.

Received M&O integrator updates to participant PACS databases, coordinated updates with the participants, and completed input of data.

E. Quality Assurance Implementation

No significant new items to report this week.

Determination of Importance and Grading Enhancement (DIGE)Continuation of Existing Process

The Quality Review Board and associated Assessment Team continue to provide support to YMPO while the DIGE effort develops a modified process.

Quality (Q)-List and Q-List Procedure Development

RSN has completed the updates to the various portions of the design. This will allow initiation of revision to the repository, ESF, surface facility and SCP baselines. SNL continues to make scheduled progress in the development of the process to apply to the alluvium. A March 24, 1992, review meeting is scheduled. Documentation to initiate the Quality Management Procedure (QMP) 06-04 review of SAND 89-7024 was received by M&O. Assessment of potential impact caused by delays in this logic are being conducted. Discussions between the DIGE staff, YMPO, and HQ have resolved comments on the draft Administrative Procedure (AP) 6.17Q. Comments from the QMP 06-04 review of the draft Q-Grading procedure are being resolved. These efforts are behind schedule and rescheduling is being evaluated.

Management Control (MC) List and Procedure Development

Comments have been received from the QMP-06-04 review of the draft MC List Procedure (AP 5.40). The results of the requirements identification, extraction, and verification exercise are being evaluated to determine if sufficient information exists as a basis for the MC Requirements Plan being developed. A team has been established to complete development of this plan. A draft is targeted for March 10, 1992, to be used in review with YMPO. The Requirements Traceability Network enhancements, including reports, have been developed, but have not been checked out fully due to the emphasis on the above plan. The draft MC System Grading Procedure remains on hold.

Implementation

Initiation by the participants to develop their procedures and lists continues to be delayed, driven by delays in completion of AP 6.17Q approval. In addition, the need for participant procedures as a specific output of this effort is being evaluated.

Task Management

Revision 0 of the DIGE Management Plan has been approved. Limited distribution will occur during the week of March 9, 1992. Recently identified changes to the DIGE effort are being incorporated in Revision 1 of the Management Plan.

F. Public Outreach and Institutional Activities

On March 3, 1992, Jeanne Cooper, Richard Morissette, Tom Doering, Diane Harrison-Giesler, and Paul Fransioli participated in a Science Fair at O'Callaghan Junior High School as judges for various student science projects.

Various YMP presentations were given at the Waste Management '92 Conference in Tucson, Arizona, this week, including presentations by Carl Gertz and Beatrice Reilly. A. C. Robison attended the conference and met with Nevada Legislature's Committee on High-Level Radioactive Waste and with various representatives of affected units of local government who were also in attendance. Carl Gertz also gave a presentation to the International Public Communications Forum on March 1, 1992. The YMP exhibit also was set up and staffed for Waste Management '92.

A presentation on the Yucca Mountain Cultural Resources Program was given by Richard Arnold at W. E. Ferron Elementary School on March 6, 1992, and Paul Standish spoke to the Mineral County

F. Public Outreach and Institutional Activities (Continued)

Commission in Hawthorne, Nevada, on March 5, 1992. Richard Lowder and James Bresee gave a presentation in Washington, D.C., on March 5, 1992, to discuss Total Quality Management at the Federal Quality Institute's one-day seminar.

Thirty-five junior and senior high school students from the Chamber of Commerce Leadership Program visited the Yucca Mountain Information Office (YMIO) on March 4, 1992. They toured YMIO and received presentations by April Gil on geology and Gregory Fasano on environmental programs.

An Open House/Tour to Yucca Mountain, Nevada, was conducted on February 29, 1992, with approximately 200 visitors. Tours were also conducted for KLVX Channel 10 on March 4, 1992, and for Waste Management '92 on March 6, 1992 (in conjunction with the DOE Nevada Field Office).

Because of the overwhelming response to the prior Waste Isolation Pilot Plant tours in Carlsbad, New Mexico, two additional tours are scheduled for March 19, 1992, and March 26, 1992.

On February 29, 1992, and March 1, 1992, William Macnabb, James Blink, Effie Harle, and Mindy Wadkins participated in DOE's Regional High School Science Bowl at the University of Nevada, Las Vegas.

The Eureka County Commission has recently opened their YMIO. They have been added to the YMPO mailing list.

G. Systems Management and Integration

Geochemistry

No significant new items to report this week.

II. ANALYSIS & VERIFICATION DIVISION

Participated in Management Review of the Title II Design of Design Package 1A, North Portal Area on March 2-3, 1992, in Las Vegas, Nevada.

Attended Workshop on Earthquakes and Tectonics, Electric Power Research Institute High-Level Waste Performance Assessment for the Proposed Repository, March 4, 1992, and March 6, 1992, in Arlington, Virginia.

Provided and consolidated DOE comments on the draft General Accounting Office report entitled "Nuclear Waste: DOE's Repository Site Investigations, a Long and Difficult Task."

MAR 11 1992

Attended Waste Management '92 Conference on March 2-5, 1992, in Tucson, Arizona.

Initiated a review of Mined Geologic Disposal System (MGDS) Annotated Outline Skeleton Text package. Review comments are due March 10, 1992.

Initiated technical review under AP 1.10Q for SPs:

8.3.1.2.2.2 R1 Water Movement Tests (Review comments due March 15, 1992)

8.3.1.15.1.4 Laboratory Determination of the Mechanical Properties of Fractures (Review comments due March 15, 1992)

Completed verification review under Implementing Line Procedure 22.3.1 for SP:

8.3.1.2.3.2 Characterization of Yucca Mountain Saturated-Zone Hydrochemistry

III. GENERAL INFORMATION ITEMS

M&O

Efforts have been initiated to define the detailed 2001 plan by June 2, 1992.

Several meetings held between MGDS Site Integration and the M&O Systems Analysis Group have resulted in a refined set of MGDS tasks to support the thermal loading system study, Phase I. The primary focus of the MGDS Phase I support is in the area of relocation feasibility/concept development for in-drift emplacement. The subsurface and waste package tasks comprise a majority of the MGDS effort related to the study.

T&MSS

The ESF Design Plan (overall considerations) and ESF Plan (specific considerations) are in verification review by the Change Control Board and for division director approvals prior to their issue.

LOS ALAMOS

Recent briefings were given to YMPO regarding the use of tracers. As follow-up to these, a letter was sent to the technical project officers requesting their designation of point of contact in their organizations.

LOS ALAMOS (Continued)

These contacts will facilitate information exchange and allow Performance Assessment to track tracer use and evaluate possible impacts to waste isolation integrity, health and safety considerations, and other testing activities.

IV. UPCOMING EVENTS CALENDAR

Please note that the usage of "(P)" in the calendar indicates that the event is open to the public. Educational presentations and State and public interactions are handled by the Speakers Bureau; contact Linda Artis at (702) 794-7896 or FTS 544-7896 for additional information. Exhibits are handled by Kevin Rohrer at (702) 794-7769 or FTS 544-7769, and tours are handled by Mindy Wadkins at (702) 794-7374 or FTS 544-7374.

<u>Date</u>	<u>Event</u>	<u>Location</u>	<u>YMFO Contact</u>
A. <u>DOE/EQ Meetings</u>			
Wednesday, March 25	Program Management Meeting	Washington, DC	C. Gertz
B. <u>Internal and DOE/NV Meetings</u>			
No significant new items to report.			
C. <u>NRC Interactions</u>			
Tuesday, March 17	Thermal Loads	Albuquerque, NM	T. Bjerstedt
Wednesday, March 18	Air, Vapor Movements Due to Thermal Gradients	Albuquerque, NM	T. Bjerstedt
Tuesday- Wednesday, April 28-29	Complimentary Cumulative Distribution Function	Albuquerque, NM	T. Bjerstedt
Tuesday, May 19	Interactions Schedulings	Rockville, MD	T. Bjerstedt
Wednesday, May 27	DOE Licensing Topical Report on Erosion	Rockville, MD	T. Bjerstedt

MAR 11 1992

<u>Date</u>	<u>Event</u>	<u>Location</u>	<u>YMPO Contact</u>
C. <u>NRC Interactions (Continued)</u>			
Wednesday, June 3	Drafts on License Application	Rockville, MD	T. Bjerstedt
(TBD) July 1992	Topical Report Calcite-Silica	TBD	T. Bjerstedt
(TBD) August 1992	WIPP - Briefing and Tour	Carlsbad, NM	T. Bjerstedt
(TBD) September 1992	Total System Performance Assessment	TBD	T. Bjerstedt

<u>Date</u>	<u>Event</u>	<u>Location</u>	<u>YMPO Contact</u>
D. <u>Nuclear Waste Technical Review Board (NWTB) Interactions (P)</u>			
Tuesday- Wednesday, March 10-11	NWTB T&S Panel	Arlington, VA	A. Simmons
Monday- Wednesday, April 6-8	NWTB Full Board Meeting	Dallas, TX	A. Simmons
Monday, May 11	NWTB Panel on EBS	Hanford, WA	A. Simmons
Wednesday, May 13	NWTB Panel on EBS	Idaho Falls, ID	A. Simmons
Tuesday- Friday, July 7-10	NWTB Full Board Meeting	Denver, CO	A. Simmons
Thursday- Friday, August 13-14	NWTB Full Board Meeting	Las Vegas, NV	A. Simmons
Saturday- Sunday, August 15-16	NWTB Panel on SG&G	Las Vegas, NV	A. Simmons

<u>Date</u>	<u>Event</u>	<u>Location</u>	<u>Speaker</u>
E. <u>State and Public Interactions</u>			
Saturday, March 7	Boy Scouts Atomic Energy Merit Badge Workshop	Las Vegas, NV	E. Harle
Monday, March 9	Nevada Nuclear Waste Task Force	Reno, NV	C. Gertz
Tuesday, March 10	LLNL/DOE Pressure Safety Conference	Las Vegas, NV	C. Gertz
Tuesday, March 10	Green Valley Library	Henderson, NV	R. Arnold
Monday, March 16	University of Nevada, Electrical Engineering Honor Society	Reno, NV	C. Gertz
Wednesday, March 18	Southern Nevada Floor Covering Association	Las Vegas, NV	C. Gertz
Tuesday, March 24	USCEA Fuel Cycle '92 Conference	Charleston, SC	J. Younker
Thursday, March 26	Family Home Hospice	Las Vegas, NV	R. Arnold
Thursday, March 26	Yucca Mountain Lecture Series	YMIO, Beatty, NV	R. Arnold
Saturday, March 28	Boy Scouts Geology Merit Badge Workshop	Las Vegas, NV	E. Harle
Tuesday, March 31	Yucca Mountain Lecture Series	YMIO, Las Vegas, NV	R. Arnold
Saturday, April 4	Girl Scouts Merit Badge Workshop	Las Vegas, NV	E. Harle
Friday, April 10	American Power Dispatchers Association	Las Vegas, NV	C. Gertz

MAR 11 1992

<u>Date</u>	<u>Event</u>	<u>Location</u>	<u>Speaker</u>
E. <u>State and Public Interactions</u> (Continued)			
Monday, May 4	ASQC Third International Waste Management Conference	Las Vegas, NV	C. Gertz
Thursday, May 7	Nevada Water Savers	Las Vegas, NV	R. Arnold

<u>Date</u>	<u>Event</u>	<u>Location</u>
F. <u>Exhibits Scheduled</u>		
Saturday, March 28	Public Open House (P)	Las Vegas, NV
Saturday, April 25	Public Open House (P)	Las Vegas, NV
Thursday, May 28	Public Open House (P)	Las Vegas, NV
Saturday, June 27	Public Open House (P)	Las Vegas, NV

<u>Date</u>	<u>Event</u>	<u>Escorts</u>
G. <u>Tours Scheduled</u>		
Tuesday, March 10	Monmouth College	S. Jones
Friday, March 13	Booker 6th Grade Center	J. Cooper V. Best
Tuesday, March 17	DOE Office of Hearings and Appeals	TBD
Wednesday, March 18	Las Vegas Chamber of Commerce	TBD
Friday, March 20	Chaparral High School	L. Thompson T. Pysto
Wednesday, March 25	Energy Fuels Nuclear	M. Voegele

MAR 11 1992

<u>Date</u>	<u>Event</u>	<u>Escorts</u>
G. <u>Tours Scheduled</u> (Continued)		
Saturday, March 28	Public Open House (P)	Various Escorts
Thursday, April 2	DOE Office of Hearings and Appeals	TBD
Friday, April 17	International High-Level Waste Management Conference	K. Beall
Wednesday, April 22	Chaparral High School	TBD
Saturday, April 25	Public Open House (P)	Various Escorts
Monday May 11	Institute of Shaft Drilling Technology	TBD
Thursday, May 28	Public Open House (P)	Various Escorts
Saturday, June 27	Public Open House (P)	Various Escorts

YMP:DLH-2310


Carl P. Gertz
Project Manager

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°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°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 Leckie (Stanford University) has begun. He is developing a semi-empirical model of uranium-goethite 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 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 μ 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 Test /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°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. Leir, S. Nguyen, S. Steward, and H. Weed of LLNL on the most recent UO₂ 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 UO₂ 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 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 165 items were logged into the LLNL-YMP tracking system. This includes 31 records/records pages that were processed through 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 92-02 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.



Department of Energy
Yucca Mountain Site Characterization
Project Office
P. O. Box 98608
Las Vegas, NV 89193-8608

WBS 1.2.3.5
QA: N/A

MAR 11 1992

Carl H. Johnson, State of Nevada, Carson City, NV
Phillip Niedzielski-Eichner, Nye County, Chantilly, VA
Dennis A. Bechtel, Clark County, Las Vegas, NV
Albert C. Douglas, City of Las Vegas, Las Vegas, NV
Paul T. Prestholt, NRC, Las Vegas, NV

PRELIMINARY FIELD COMPOSITE BOREHOLE LOG

For your information, enclosed is a copy of the Preliminary Field Composite Borehole Log for borehole USW UZN-11 which was developed by the Drilling Support and Sample Management Department of Technical and Management Support Services. Borehole geophysical logging of this hole was performed on February 25, 1992. Geophysical logging information produced was utilized in conjunction with core and sample cuttings information to develop this preliminary field composite borehole log.

If you need additional information regarding the log, please contact Uel S. Clanton at (702) 794-7943.


Carl P. Gertz
Project Manager

RSER:USC-2227

Enclosure:
Composite Borehole Log

cc w/o encl:
J. H. Peck, SAIC, Las Vegas, NV
C. L. Lugo, SAIC, Las Vegas, NV
P. E. Seidler, SAIC, Las Vegas, NV
R. L. Bullock, RSN, Las Vegas, NV
J. R. Dyer, YMP, NV
A. C. Robison, YMP, NV

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT PRELIMINARY FIELD COMPOSITE BOREHOLE LOG

BORE HOLE ID: USW UZN-11

STUDY PLAN NO.: 8.3.1.2.2.1

CORE SIZE: HQ/2.25"

DRILL DATES: 2/5/92 - 2/25/92

GROUND ELEVATION: 5220 ft MSL (est.)

GROUND COORDINATES: N 780,600 E 559,000 (est.)

TOTAL DEPTH: 84.4

ANGLE FROM VERT.: NA

BEARING: NA

LOG VERSION DATE
2/25/92



ALLUVIUM



NON-WELDED



PARTIALLY WELDED



DENSELY WELDED



BEDDED TUFF



VITROPHYRE

AW: Airways

SPC: Stones per Carat

SS: Surface Set

geology by Drilling Support Division, Drilling Support and Sample Management Dept., T&MSS

RUNS/DATES/ RECOVERY	CORE LOSS	DRILLING RATE (ft/hr) BIT RECORD			FRAC FREQ (X/5 FT)	DEPTH STRAT COL	LITHOLOGY/REMARKS
		0	10	20			
		20	70	120	50	100	
DC-1 2/5/92		START CORE @ 1.7					0.0 - 1.7 Alluvium; unconsolidated material from drive cores
1		8.5	Chrisset SN 6S 4711, 9AW, 6 SPC		100		Top TIVA CANYON mbr @ 1.7
2			10.8			5	1.7 - 10.0 Tuff, ashflow; pale red, moderately to densely welded, devitrified; 5% phenocrysts of sanidine with scattered plagioclase and some black mafics; scattered glassy shards, some as remnant vesicle walls; pumice dark brown to black, devitrified, flattening ratio 5:1, some to 2 cm; fractures common, coated with dull orange clay and minor calcite
3			12.0				
4		22.0			100		
5	10.0/10.0 100%	12.4				10	from 5.0-6.9, increasing glassy shards from 6.9-10.0, pyrolusite blooms common
2/20/92		22.7			58		NOTE: No drilling 2/6/92 - 2/19/92 due to fishing operations and rain
6						15	10.0 - 13.4 Tuff, ashflow; very pale orange to yellowish gray, moderately welded; 1% pumice fragments with Fe stained alteration halos; minor blotite; dark yellow-orange clay on fractures
7		61.2			82		
8		106.0			100	20	13.4 - 18.5 Tuff, ashflow; light brown-gray, moderately to densely welded; < 1% pumice; manganese dendrite coatings; dark yellow-orange clay on fractures
9		29.4				25	18.5 - 25.2 Tuff, ashflow; light brown-gray, moderately welded; minor lithophysae; sanidine common; gray-orange clay on fractures
20.8/19.0 91.3%					22		25.2 - 27.3 Tuff, ashflow; gray-red, nonwelded
10		15.0				30	Top BEDDED TUFFS @ 27.3

ENCLOSURE

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
PRELIMINARY FIELD COMPOSITE BOREHOLE LOG (cont.) USW UZN-11

pg. 2 of 3

geology by Drilling Support Division, Drilling Support and Sample Management Dept., T&MSS

11	9.4			3 0	
2/21/92					27.3 - 30.8 Tuff, ashfall; bedded, moderate red brown, nonwelded; < 5% pumice
12	150.0	2		3 5	30.8 - 32.0 Tuff, ashfall; light yellow to white, nonwelded; 10% light pink devitrified pumice; 35% black vitric fragments
13	150.0	5		4 0	32.0 - 36.4 Tuff, ashfall; dark grey brown, nonwelded; 15% subangular to angular lithics; scattered black glassy blebs
14	Drag bit 151.5	23		4 5	36.4 - 46.0 Tuff, ashfall; dark grey brown, nonwelded, vitric; sparse phenocrysts of sanidine; 35% light pink woody vitric pumice; scattered angular lithics; very abundant black glass as blebs, shards, and remnant vesicles; matrix contains abundant subrounded milky white reworked? material
15	271.0	9		5 0	46.0 - 50.5 Tuff, ashfall; buff to light brown, nonwelded, vitric?; interval composed of well sorted, subrounded, opaque, slightly argillaceous material - resembles sandstone; abundant white woody vitric pumice; interval soft and crumbly; scattered light yellow smears or blebs - possibly zeolite?
19.7/13.9 71%					
2/24/92					
16	312.0	12		5 5	50.5 - 60.6 Tuff, ashfall; white, non-welded, vitric; 15% potassium feldspar phenocrysts; up to 80% white vitric pumice lapilli; up to 5% rhyolite lithic fragments, subangular and red to gray in color; lapilli size increases downhole; high angle (approx 60 degrees) fault contact at 60.6, Yucca Mountain mbr. on downhole side.
17	307.0	7		6 0	Top YUCCA MOUNTAIN mbr @ 60.6
18	156.0	48		6 5	60.6 - 68.7 Tuff, ashflow; light gray to dark gray, partially devitrified, non to moderately welded; < 5% potassium feldspar phenocrysts, 2% pumice lapilli, 1- 2% lithic fragments; increasing amount of very small lithophysae and vesicles downhole.
19	99.6	56		7 0	68.7 - 71.5 Tuff, ashflow; moderately to densely welded; abundant very small void spaces and lithophysae.

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
PRELIMINARY FIELD COMPOSITE BOREHOLE LOG (cont.) USW UZN-11

pg. 3 of 3

geology by Drilling Support Division, Drilling Support and Sample Management Dept., T&MSS

20	60.0			70	71.5 - 84.4 Tuff, ashflow; densely welded, vitric from 71.5-75.2, devitrified from 75.2-84.4; some axiolitic pumice fragments.
21	75.0		49		
22	Christensen #IS 17965 10.8		64	75	
23	11.4		62	80	
27.5/33.9 81.1%					TOTAL DEPTH @ 84.4