Lawrence Livermore National Laboratory

Mark Delligatti from Las Vegas 1/4/95

LLYMP9412076 WBS: 1.2.9
December 15, 1994

L. Dale Foust
Technical Project Officer
CRWMS-M&O
101 Convention Center Drive, M/S 423
Las Vegas, NV 89109

Subject: Lawrence Livermore National Laboratory (LLNL) Monthly Status Report (SCPB:N/A)

Dear Dale:

I am pleased to submit the first LLNL monthly report under our new status as a CRWMS-M&O teammate.

The report has much the same format as previous reports to the Yucca Mountain Site Characterization Office (YMSCO), except that financial information required in Participant Monthly Reports has not been included. The financial data were reported directly to YMSCO this month. As our transition progresses, we expect to send the financial data to your staff, which will consolidate it with other M&O data before submitting it to YMSCO.

This report is intended to be used as a communication tool between LLNL-CRWMS staff and CRWMS-M&O and YMSCO managers. Accordingly, the courtesy copy list is quite extensive and includes YMSCO managers. NRC and NWTRB staff are also on the distribution list (at their request).

If you require further information, please contact James Blink at (702) 794-7157.

Sincerely yours,

for Willis L. Clarke
LLNL-CRWMS Manager

WLC/JAB/mvl
108-94

Enclosure

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LAWRENCE LIVERMORE NATIONAL LABORATORY
(LLNL)
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
(YMP)
STATUS REPORT

November 1994

EXECUTIVE SUMMARY

1) **WBS 1.2, Yucca Mountain Project:** In November, LLNL signed a Memorandum Purchase Order (MPO) formalizing its status as a CRWMS-M&O teammate. The transition from full participant to teammate will take much of this fiscal year. The LLNL Status Report will continue to be published in an abbreviated form as a method of communicating with M&O and YMSCO management. The new report format will include an executive summary, a milestone report, issues and concerns, and technical status of selected WBS elements. It will not include financial data, variance analyses, reports of meetings and interfaces, or reports from support WBS elements.

2) **WBS 1.2.1.5, Special Studies:** LLNL began the analysis of very low thermal loading repositories, including 6.1 and 12.1 MTU/acre, with both 12-yr-old and 41-yr-old Spent Nuclear Fuel. The analyses use both the repository-scale and drift-scale models.

3) **WBS 1.2.2.4.1, Spent Fuel:** Samples from the unsaturated dissolution testing at Argonne National Laboratory, under LLNL sponsorship, were analyzed for pH and carbon content. The two tests which had lost leachate both had higher pHs and higher inorganic carbon contents. An increase in organic content in the low drip rate tests may indicate an increase in formate or oxalate species. The results from the anion analyses will address this.

4) **WBS 1.2.2.4.2, Borosilicate Glass:** The N2 (Savannah River actinide-doped glass) unsaturated dissolution tests continue at Argonne National Laboratory under LLNL sponsorship, with about 106 months of testing. For the tests that were sampled on 6/20/94, all data have been compiled, and previously reported trends are continuing. That is, the major release of transuranic elements from the glass is through spallation of reacted material from the glass with suspension of these materials in solution. The solutions have been filtered and the filters saved to perform future analyses of the colloids. This information, together with a further analysis of the stability of the colloids, will be required to assess the source term that is input to total system performance assessment calculations.

5) **WBS 1.2.2.4.2, Borosilicate Glass:** The N3 unsaturated dissolution tests on West Valley actinide-doped glass continue at Argonne National Laboratory under LLNL sponsorship, with about 88 months of testing. The last sampling occurred in July 1994. The alpha spectroscopy results from the solution and acid wash of that sampling and the acid wash from the January 1994 sampling have been analyzed. There appears to be an unexpected jump in plutonium release for the July samplings; these larger-than-expected values were not observed for the filtered solution or in electroplated samples. A possible cause is that the plutonium was associated with particulate matter that may have been suddenly released due to the samples being disturbed in the January samplings for the first time in nearly four years. It is not clear why a similar jump was not observed for the americium release data. The increase in Pu release will be confirmed with Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) data.

6) **WBS 1.2.3.4.2.1, Geochemical Modeling:** With regard to post-Version 8.0 development of the EQ3/6 code package, the existing Individual Software Plan is being reviewed for possible modification, and a new Software Requirements Specification and Software Design Document for this development are being prepared. Modeling boiling processes requires the inclusion of a submodel for a multicomponent gas phase. In the case of boiling, this consists mainly of steam; however, loss of other volatiles, especially CO_2, has major effects on concomitant processes such as mineral deposition. To complete the gas phase submodel, LLNL is reviewing various published models for calculating fugacity coefficients, looking at their usefulness for application to steam-dominated phases.

7) **WBS 1.2.3.12.2, Hydrologic Properties of the Waste Package Environment:** In past analyses, it has been assumed that the relative humidity *RH* of the atmosphere is 100%. The result of this assumption is to effectively prevent any diffusive loss of moisture out of the top of the mountain. This month, LLNL and its subcontractor UNLV began investigating the impact of an *RH* boundary condition which may be more representative of desert conditions at Yucca Mountain. The preliminary results indicate that the long-term moisture buildup predicted for the condensate zone may be substantially less when a more realistic accounting is made of the atmospheric *RH*.

8) **WBS 1.2.3.12.2, Hydrologic Properties of the Waste Package Environment:** LLNL completed the preparation of additional samples to measure electrical impedance as a function of moisture content at 95°C. Previous impedance data have been reduced using a complex nonlinear least square routine to fit the frequency dependent response. Approximately 90 fits on 60 experiments have been performed. Preliminary results indicate distinct impedance responses depending on saturation level. The response has been tentatively correlated to conduction mechanisms as a function of saturation.

9) **WBS 1.2.3.12.4, Engineered Barrier System (EBS) Field Tests:** X-ray imaging to determine water saturation continues at LLNL. A small block of 2.5 x 10 x 10 cm Topopah Spring tuff from Fran Ridge, with a tensile fracture in the middle, was used to test x-ray scanning capability. Water doped with potassium iodide was added to the top of the sample, and radiographs are being taken as a function of time. Water was observed entering the fracture and the matrix. The images are being processed to determine saturation and the wetting front as functions of time.

10) **WBS 1.2.3.12.4, Engineered Barrier System (EBS) Field Tests:** LLNL's subcontractor, Aircraft Engineering Corporation, has completed welding the load retaining frame dome. The dome and four side sectors will be shipped from Los Angeles to EG&G-Atlas in North Las Vegas during the week of December 5, 1994. LLNL has completed welding two additional sectors; one of the sectors is being repaired for the weld defects, and the other is being cleaned for non-destructive evaluation. Two more sectors will be welded by an outside vendor in the San Francisco area. The final four of twelve sectors will either be fabricated by this outside vendor, or eliminated in favor of a shortened block or a reinforced concrete pedestal. The Engineering Plan for the Large Block Test was also submitted to YMSCO.

DELIVERABLES

LLNL Deliverables Met
(November 1994)

Milestone	WBS 1.2.	Planned Date	Completion Date	Description
MOL80	3.12.2	10-31-94	11-10-94	Report on Hydrological Property Measurements
MOL234	3.12.2	11-17-94	11-30-94	Analysis of the Large Block Test (Status of MOL117)
MOL155	3.12.3	11-29-94	11-30-94	Effects of Radiation on Rock (MOL98 Status)
MOL250	3.12.4	11-30-94	11-30-94	Submittal to YMSCO of Field Operations Plan for Large Block Test.
MOL254	3.12.4	12-01-94	11-14-94	Environmental Protection of Large Block
MOL151	3.12.5	10-27-94	11-18-94	MOL132 Status (Material Identification, Categorizing and Eval.
MOL198	5.3.5	10-31-94	11-16-94	List of expected data submittals to TDB
MOL161	9.2.2	11-30-94	11-30-94	Development of master BOE file for FY95 work scope completed

LLNL Deliverables Not Met
(November 1994)

Milestone	WBS 1.2.	Planned Date	Projected Date	Description	Comment
MOL78	3.10.1	10-31-94	01-95	Report on Code Model Capability Guidelines	See note 1
MOL03	3.10.3.1	10-31-94	12-94	Report on colloid characterization	Completed 12-08-94
MOL152	3.12.1	10-31-94	12-94	Status Report on MOL207	Completed 12-02-94
MOL72	3.4.2.2	10-31-94	12-94	Manuscript describing the DATAO suite & options	
MOL62	3.10.2	11-29-94	01-95	Data report on small block tests to YMSCO.	See note 1
MOL79	3.10.2	11-14-94	12-94	Hydrological properties assoc. w/ recrystallization	See note 1
MOL247	3.12.4	11-15-94	12-94	Rpt verifying 1st sector NDE work is complete	
MOL162	9.2.2	11-30-94	12-94	Milestones Hierarchy	Completed 12-06-94

Note 1: These projected dates were agreed upon by A. Simmons, YMSCO, during a conversation with W. Glassley, LLNL, on 12-05-94.

LLNL Deliverables Scheduled for the Next Reporting Period
(December 1994)

Milestone	WBS 1.2.	Planned Date	Description
MOL112	3.12.2	12-19-94	MOL120 Status (Lab Tests Drying/Rewet of Intact Rock)
MOL176	2.5.1	12-29-94	Activity Plan for 5 Year Comprehensive Corrosion Tests
MOL45	2.5.1	12-29-94	Update Scientific Investigation Plan
MOL94	2.5.1	12-29-94	Submit Preliminary Engineered Materials Characteristics Report
MOL25	3.12.1	12-29-94	Review of Existing Coupled Code Capabilities
MOL04	3.10.3.1	12-29-94	Core Flow Experiment Protocol Documented
MOL238	3.12.4	12-29-94	MOL226 Status (Frame Pre-Assembly Test)
MOL199	3.5.3	12-29-94	Status Report of Data Submittals to TDB

ISSUES AND CONCERNS

None that were not previously reported.

TECHNICAL SUMMARY

1.2.1. SYSTEMS ENGINEERING

1.2.1.5 Special Studies

Modeling Support for theThermal Loading Systems Study

LLNL began the analysis of very low AML repositories, including 6.1 and 12.1 MTU/acre, with both 12-yr-old and 41-yr-old Spent Nuclear Fuel. The analyses use both the repository-scale and drift-scale models.

1.2.2. WASTE PACKAGE

1.2.2.1 Waste Package Coordination and Planning

1.2.2.4 Waste Form

1.2.2.4.1 Spent Fuel

Spent Fuel Dissolution

D-20-43, Unsaturated Dissolution Tests with Spent Fuel

The ultimate objective of this activity is to generate analytical data on the dissolution rate of the UO_2 matrix of spent fuel for use in performance assessment modeling and for direct use in licensing. As part of this task, the flow-through tests on uranium oxides are designed to measure the dissolution rates of the oxides and to determine the rate dependence on several parameters, such as solution pH, temperature, oxygen fugacity, flow rate, and solution anions, particularly carbonate species. These tests are not intended to simulate the repository conditions but rather to provide parametric rate constant information.

Two types of well-characterized irradiated PWR fuels, ATM-103 and ATM-106, are being tested in three types of unsaturated tests at Argonne National Laboratory (ANL). A control test without fuel is also included. The surrogate water used, EJ-13, came from well J-13 and was equilibrated with volcanic tuff for approximately 80 days at 90°C. The seven individual tests have undergone 26 months of testing at 90°C.

Effort in November was devoted to three areas:
- documentation was provided for the three spreadsheets used for gamma, alpha, and anion analyses;
- management visits with LLNL and YMSCO personnel were held at the end of the month; and
- the leachate was removed from the low drip rate and vapor tests, and aliquots were submitted for analysis.

The five low drip rate and vapor tests were interrupted about 200 days after the previous sampling time and then restarted. The leachate was removed and aliquots were submitted for pH, carbon, anion, alpha, and gamma analyses. Additional aliquots of the leachate were sequentially filtered through 1000, 100 and 50 nm filters. The filters were submitted for gamma analysis. The test vessels have been stripped. Aliquots will be submitted for alpha and gamma analysis.

The pH and carbon analyses for these five tests, the two high drip rate tests sampled October 11, and the two batches of EJ-13 used for the low drip rate tests are reported in Table 1. (Only the 6/92 EJ-13 was used for the vapor tests and the high drip rate tests.) The two tests which had lost leachate both had higher pHs and higher inorganic carbon contents. These were S3V1-769 and CC1J1-764 (the control test). The increase in organic content in the low drip rate tests may indicate an increase in formate or oxalate species. The results from the anion analyses will address this.

During examination of the appearance of the spent fuel, the following observations were made. On the surface of both fuels in the low drip rate test, there were several small colored deposits. Because the light source has a red component, true colors can not be specified. However, it appears that both white and/or yellow nucleation sites are forming on the surface of the spent fuel.

Table 1. Carbon Analysis of Spent Fuel Leachate - Unsaturated Conditions After 747-769 Days of Reaction

Test[a]	pH	ppm				
		Organic	Difference[b]	Inorganic	Difference[b]	Total
S62J1-747	6.95	3.73	-2.18	0.07	-21.19	3.80
S32J1-748	7.20	1.86	-4.05	1.49	-19.77	3.35
EJ-13 (6/92)	7.87	5.91	--	21.26	--	27.17
EJ-13(11/93)	7.55	5.24	--	17.67	--	22.91
S31J1-764	6.81	15.50	9.92	3.60	-15.86	19.10
S61J1-766	6.81	10.80	5.22	4.04	-15.42	14.84
CC1J1-764	8.15	10.70	5.12	15.45	-4.02	26.15
S3V1-769	8.81	13.17	7.26	17.54	-3.72	30.71
S6V1-769	7.42	4.63	-1.28	9.82	11.44	14.45

[a] The second character of the test number indicates the ATM number. The third character indicates vapor (V), low drip rate (1) (0.075mL/3.5 day) or high drip rate (2) (0.75 mL/3.5 day).

[b] The difference between the leachate concentration and the initial EJ-13 concentration. For the two low drip rate and the control tests, the initial EJ-13 concentration is a combination of the two EJ-13 values because the water source was changed during the experiment.

1.2.2.4.2 Borosilicate Glass

D-20-27. Unsaturated Testing of WVDP and DWPF Glass

The N2 (DWPF actinide-doped glass) tests continue at ANL as scheduled and have reached 106 months in duration. For the N2 tests that were sampled on 6/20/94, all data have been compiled, and previously reported trends are continuing. That is, the major release of transuranic elements from the glass is through spallation of reacted material from the glass with suspension of these materials in solution. The solutions have been filtered and the filters saved to perform future analyses of the colloids. This information, together with a further analysis of the stability of the colloids, will be required input to assessing the source term that is input to total system performance assessment calculations. Preparations for the next sampling period, which will occur in December, are underway.

The N3 tests on West Valley actinide-doped ATM-10 glass continue at ANL as scheduled. About 88 months of testing have elapsed. The last sampling occurred in July 1994. The alpha spectroscopy results from the solution and acid wash of that sampling and the acid wash from the January 1994 sampling have been reported and analyzed (Figures 1-3). There appears to be an unexpected jump in plutonium release for the July samplings; these larger-than-expected values were not observed for the filtered solution or in electroplated samples. A possible cause is that the plutonium was associated with particulate matter that may have been suddenly released due to the samples being disturbed in the January samplings for the first time in nearly four years. It is not clear why a similar jump was not observed for the americium release data. The increase in Pu release will be confirmed with Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) data, which have just been taken and are being added to the database.

D-20-70, Parametric Studies of WVDP and DWPF Glass

Sixteen tests continue at ANL with some being in progress for up to 8 years. Four of these tests were sampled in November due to the high water level that had accumulated in the test vessels. The tests had not been sampled for four years. These tests are being brought up to Quality Affecting status. To do this, the Activity Plan governing the work will be amended.

Tests on a variety of glasses exposed to 60 and 95% relative humidity (RH) at 70°C continue. No test terminations have been done for several years and none are planned for this year, but the tests will remain ongoing.

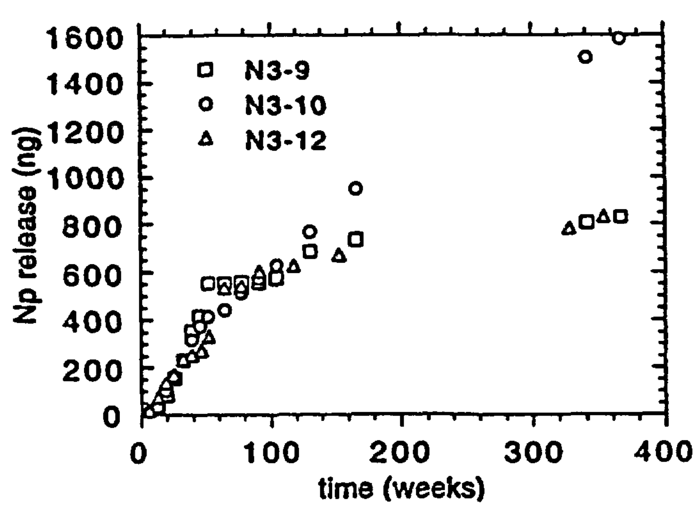

Fig. 1. Neptunium Release from the N3 Tests through 365 Weeks

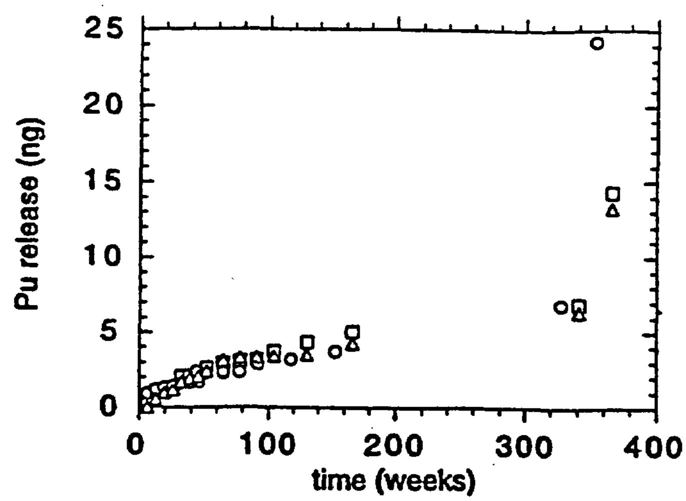

Fig. 2. Plutonium Release from the N3 Series Tests through 365 Weeks. Plot symbols are as for Fig. 1.

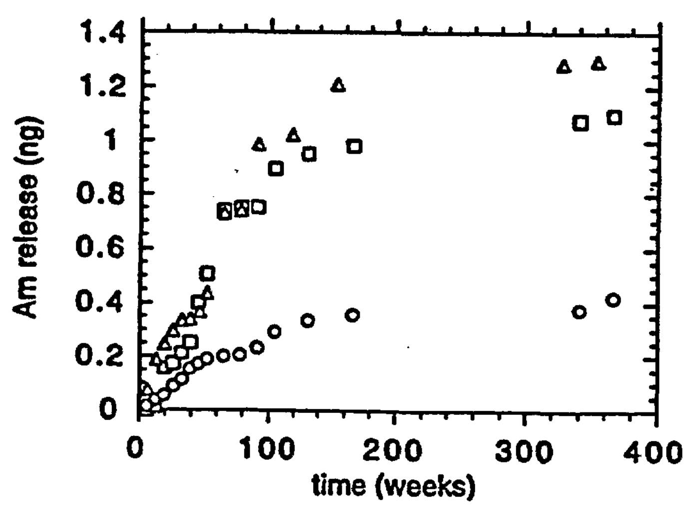

Fig. 3. Americium Release from the N3 Series Tests through 365 Weeks. Plot symbols are as for Fig. 1.

1.2.3 SITE INVESTIGATIONS

1.2.3.4 Geochemistry

1.2.3.4.2 Geochemical Modeling

1.2.3.4.2.1 EQ3/6 Code

This subtask is developing geochemical modeling software (EQ3/6) for analysis and simulation of interactions among water, rock, nuclear waste, and other repository components in the near-field environment, the altered zone, and the far-field environment. In FY94, LLNL maintained the Version 7 series of the software. The independent verification and validation (V&V) activity for Version 7 was completed, and Version 7.2a became the first version of EQ3/6 to be certified for use in quality-affecting work. The development of Version 8.0 continued by adding new capabilities for thermodynamic pressure corrections and ion-exchange modeling (incorporating the Gapon and Vanselow models). In FY95, software maintenance will continue, an independent V&V activity will lead to the certification of Version 8.0, and further development on the software will add capabilities with an emphasis on phenomena related to boiling. These new capabilities will be applied in other WBS elements, principally those dealing with the geochemistry of the altered zone and the near-field zone. In line with this, the software is being extended to deal with a gas (vapor) phase and its interaction with a liquid phase, including boiling and condensation processes. In addition, enthalpy and volume calculations are being included to the software for the first time. Improvements are being made to the software to deal with the possibility of formation of concentrated solutions due to boiling. As time permits, some further additions may be made to the ion-exchange modeling capability, such as the addition of the Gaines-Thomas model and a general site-mixing model.

An Individual Software Plan (ISP) for the independent V&V of Version 8.0 was drafted last month and is still in review. The Software Requirements Specification (SRS) and Software Design Document (SDD) for Version 8.0 are being revised prior to the start of the V&V to eliminate some minor inconsistencies with the software itself and to change the signature approval level to that required by the present software Quality Procedure (QP3.2) Version 8.0 is being set up for in-house beta testing, which may last all or part of the V&V period.

With regard to post-Version 8.0 development, the existing ISP is being reviewed for possible modification, and a new SRS and SDD for this development are being prepared. Modeling boiling processes requires the inclusion of a submodel for a multicomponent gas phase. In the case of boiling, this consists mainly of steam; however, loss of other volatiles, especially CO_2, has major effects on concomitant processes such as mineral deposition. To complete the gas phase submodel, LLNL is reviewing various published models for calculating fugacity coefficients, looking at their usefulness for application to steam-dominated phases.

There was no activity in software maintenance this month. Several maintenance items are pending, however. These deal mainly with non-ideal solid solution modeling. Unresolved maintenance items will be addressed next month (December). Version 7 is still being maintained, and will be until the release of Version 8.0 (Version 7.2a is the most recent version of EQ3/6 that is certified for use in quality-affecting work). In the meantime, the impact of maintenance items for Version 7 is being assessed for possible corresponding action on Version 8.

1.2.3.4.2.2 Geologic and Engineering Materials Bibliography of Chemical Species (GEMBOCHS)

The GEMBOCHS thermodynamic database and software library together provide both standard and custom thermodynamic databases for use with geochemical modeling software such as EQ3/6. The seven standard databases currently available vary considerably in their compositional complexity, comprehensiveness, and level of internal consistency; each database is particularly suited for use with certain geochemical modeling problems.

Work continued on the manuscript "Jewel: A graphical-user interface for generating custom GEMBOCHS-based thermodynamic datafiles for use with EQ3/6 and React", by S. Lundeen and J. Johnson. This manuscript will fulfill milestone MOL63.

LLNL staff worked on the manuscript "GEMBOCHS Thermodynamic Databases for use with the EQ3/6 Geochemical Software Package", by J. Johnson and S. Lundeen. This manuscript will complete MOL72.

Work continued on incorporating into GEMBOCHS the comprehensive NIST database of critical stability constants for metal complexes (over 4000 species).

All comments were resolved on the new GEMBOCHS ISP.

1.2.3.12 Waste Package Environment Testing and Modeling

1.2.3.12.2 Hydrologic Properties of the Waste Package Environment

Modeling

In order to augment the thermo-hydrological calculational support of the thermal loading systems study, LLNL has been conducting the calculations in the near-field/altered zone hydrology task with the same set of thermal loading assumptions. We assume a Youngest Fuel First Spent Nuclear Fuel (SNF) receipt scenario with a 10-yr cut-off for the youngest fuel [referred to as YFF(10)] and account for the emplacement of BWR waste packages (WPs) containing 40 assemblies per WP, and PWR WPs containing 21 assemblies per WP. The waste receipt schedule was supplied by the M&O-Vienna. Areal Mass Loadings (AMLs) of 24.2, 35.9, 55.3, 70, 83.4, 100, 110.5, and 150 MTU/acre have been analyzed assuming the matrix hydrological properties given in the Reference Information Base (RIB) and Klavetter and Peters (1986).

This month, LLNL began investigating the impact of the relative humidity *RH* of the atmosphere overlying the mountain. A new analysis was also begun of LLNL's G-Tunnel heater experiment with emphasis on better understanding of condensate drainage around the boiling zone.

Analysis of the Impact of the Assumed Atmospheric Relative Humidity on Temperature and Relative Humidity Conditions in the Repository

In past analyses, it has been assumed that the *RH* of the atmosphere is effectively 100%. The result of this assumption is to prevent any diffusive loss of moisture out of the top of the mountain. This month, LLNL and its subcontractor UNLV began investigating the impact of using an *RH* boundary condition which may be more representative of desert conditions at Yucca Mountain.

The preliminary results indicate that the long-term moisture buildup predicted for the condensate zone may be substantially less when a more realistic accounting is made of the atmospheric *RH*.

Analysis of LLNL's G-Tunnel Test

This month, J. Nitao began a reinvestigation of LLNL's G-Tunnel heater test using the NUFT hydrothermal code. The model assumes a series of parallel, vertical, uniformly-spaced fractures that are orthogonal to the heater axis. The model utilizes an R-Z-θ coordinate system that provides a fine level of discretization of the fracture-matrix interaction. In future months, we will be performing sensitivity analysis on

- fracture spacing
- fracture aperture
- matrix permeability (including the effect of the pore size distribution)
- initial liquid saturation of the matrix
- characteristic curves for the fractures (does high capillary pressure at low saturations lead to slow imbibition and spreading of saturation in fractures?)
- fracture extent
- heterogeneity in fracture conductivity (does this lead to focusing of condensate flow?)
- thermal buoyancy effects

Software Quality Assurance

C. Wilgus. S. Daveler, and J. Nitao continue to make progress towards the completion of the Individual Software Plan for the V-TOUGH code. In past months, a detailed walk-through of the code identified a list of potential quality issues. As of this month, all but four of those issues have been resolved. The unit and module test suites and the integration test case suite have also been constructed. Walk-throughs of the User Manual and Theoretical Documentation have been conducted.

Laboratory Testing

Electrical Impedance as a Function of Moisture Content

LLNL staff completed the preparation of more samples from the G-4 hole and the LBT cores to complete the measurements at 95°C. Gold electrodes have been deposited on these samples and they are being dried so that the weight of the gold electrodes can be determined. Previous impedance data have been reduced using a complex nonlinear least square (CNLS) routine to fit the frequency dependent response. Approximately 90 fits on 60 experiments have been performed. Analysis of parameters derived from these fits continues. Preliminary results indicate distinct impedance responses depending on saturation level. The response has been tentatively correlated to conduction mechanisms as a function of saturation. Additional work indicates that the Kozeny-Carmen relation predicts reasonable values of permeability of the tuff (at 100% saturation) using mercury injection microstructural data, and that the cation exchange capacity can be estimated by using a form of the Waxman-Smits conduction equation and obtaining fits to the resistivity vs saturation data.

Characteristic Curves of Tuff

For the experiment of determining the moisture retention curve and one-dimensional imbibition using G-4 core, moisture retention experiments at high temperatures continue. Measurements at 95°C were completed. The temperature has been lowered to 80°C. Samples that did not go through the experiments at 95°C were added so that the effect of test history on the test results can be evaluated.

The Effect of Confining Pressure on Fracture Healing

The experiment to determine the effect of confining pressure on fracture healing, as observed previously by Lin and Daily, continues. A fractured Topopah Spring tuff sample from the G-4 hole is being used. The sample has gone through a heating and cooling cycle at an effective pressure of 4.5 MPa (5.0 MPa confining pressure and 0.5 MPa pore pressure). An extended period of flow at this effective pressure and 156°C resulted in only a small change in permeability. The permeability decreased from about 2.6 md to about 2.0 md. The temperature is being decreased to 25°C, and there was an apparent increase in permeability when temperature was dropped. The data are being analyzed.

Resonant Cavity

Some feasibility tests are being designed to evaluate the possibility of using a resonant cavity to measure relative humidity in rock samples in the laboratory. These tests are to determine the effect of rock on the calibration of a resonant cavity.

1.2.3.12.4 Engineered Barrier System (EBS) Field Tests

The author received feedback from two of the reviewers for Study Plan 8.3.4.2.4.4, on the status of resolving their comments. Comment resolution continues.

Large Block Test (LBT)

An Engineering Plan for the Large Block Test has been submitted to YMSCO. A milestone date of November 30, 1994 was established by YMSCO, and that deadline was met.

The large block was protected with insulation material so that the influence of weather on the block is minimized.

Initial Moisture Content

Small samples of the tuff obtained from Fran Ridge, for estimating the initial moisture content, have been saturated with water. Their volume will be determined soon so that the initial moisture content can be determined.

Small Block Tests in the Laboratory

X-ray imaging to determine water saturation continues at LLNL. A small block of 2.5 x 10 x 10 cm Topopah Spring tuff from Fran Ridge, with a tensile fracture in the middle, was used to test the x-ray scanning capability. Water doped with potassium iodide was added to the top of the sample, and radiographs are being taken as a function of time. Water was observed entering the fracture and the matrix. The images are being processed to determine saturation and the wetting front as functions of time.

Sample preparation for the measurement of relative humidity as a function of moisture content is almost complete. The samples will then go through the routine porosity determination procedures.

The samples for the one-dimensional vapor condensation along a fracture test will be prepared soon. Each sample will be a core at least 30 cm in length and about 5 cm in diameter, with a longitudinal saw cut in the middle.

The Load Retaining Frame

LLNL's subcontractor, Aircraft Engineering Corporation, has completed welding the dome of the frame. The dome and four side sectors will be shipped from Los Angeles to EG&G-Atlas in North Las Vegas during the week of December 5, 1994. LLNL has completed welding two additional sectors; one of the sectors is being repaired for the weld defects, and the other is being cleaned for non-destructive evaluation. Two more sectors will be welded by an outside vendor in the San Francisco area. The final four of twelve sectors will either be fabricated by this outside vendor, or eliminated in favor of a shortened block or a reinforced concrete pedestal.

Pre-test Calculations

The progress report, by K. Lee, on the pre-test scoping calculations is complete.

LLNL PROJECT STATUS REPORT EXTERNAL DISTRIBUTION
November 1994

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