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

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M E M O R A N D U M

DATE: September 15, 1990

FOR: John J. Linehan, Director, HLPD, Division of High-Level Waste Management, M/S 4 H 3

FROM: John W. Gilray, Sr. OR - YMP

SUBJECT: YMP Site Report for the months of August and September, 1990

I. QUALITY ASSURANCE

A. Forthcoming Audit of YMP Activities

The YMP organization has devoted the majority of their time and efforts the last two months in preparing for the October 22 audit of the YMP and in developing the necessary plans, procedures and requirement documents for site characterization work pertaining to Midway Valley trenching and calcite silica investigation.

In preparing for the audit the YMP has reviewed and revised their existing QA related procedure to meet current QA Program requirements and has conducted training of personnel to these revised procedures. The majority of these revisions are an enhancement and consolidation of previous QA procedural control and therefore are not a reduction of previous QA controls. The YMP has developed and issued the "Technical Requirements Baseline Document for the Midway Valley Trenching and Calcite/Silica Activities", YMP/CM-0007. In addition the YMP with support from the participants have been involved in conducting functional analyses and developing grading packages and conceptional designs. A readiness review of the Midway Valley final design package is expected to be performed in mid-December with NRC overview.

102.7
WM-11
NH03

The results of the YMP audit of the above activities plays an important role as to the acceptability of QA program implementation and in turn the design activities.

This office has also devoted a considerable amount of time in the last two months in monitoring the YMP development of program procedures and technical documents in preparation for this audit, and in keeping the appropriate NRC/HLW staff members informed of the status of these activities and in preparing for the possible on-site involvement in the conduct of the audit both at Hqts and at project.

B. Second YMP QA Workshop

DOE held a QA workshop at Las Vegas from October 10, 1990, through October 12, 1990. Participating in the workshop were the TPOs, scientists and QA personnel from the National Labs and USGS which support the YMP. The two NRC On-Site Representatives (P. Prestholt and J. Gilray) attended this workshop as observers.

The goals for this workshop were:

1. To identify specific issues associated with any real life problems experienced by the scientific community in implementing the QA Program; reach a consensus of the issues.

2, To propose resolutions to those issues that can be solved at the workshop.

3. To develop recommendations for actions by upper management and others to resolve any remaining issues.

The workshop was successful in that major issues were identified and recommended solutions were proposed. Time did not allow the the participants to formulate and consolidate these issues and recommendations into a workshop report and recommended action plan. The workshop will reconvene on October 25 to complete these activities. Workshop attendees believe this workshop was very productive and worthwhile.

In general the major recommendations will probably be keyed to:

Simplifying the complex hierarchy of requirement documents that are imposed on the participants particularly in the scientific research field.

Involving the scientist in the preparation and concurrence of implementing procedures.

Providing an educational seminar to the participants regarding the NRC licensing process and the rationale for the need for the Appendix B requirements for scientific and research activities.

C. Raytheon

The YMP has developed a transition plan which outlines the necessary actions that need to be accomplished in order that Raytheon can be qualified to take over the previous responsibilities of Holmes & Narver and Fenix & Scisson. Raytheon is expected to take over these responsibilities in November and presently plans to adopt the previously approved QA program of Fenix and Scisson.

D. Singer Allegations

The YMP has some technical concerns with the conclusion reached in the investigation of the Singer allegation. As a consequence, additional technical and QA reviews are being conducted on this investigation. The YMP expects that NRC will receive a formal response of this investigation by the end of the year.

II. WASTE PACKAGE

The LLNL monthly status reports for the month of August and September are enclosed for your information. It is encouraged that comments and/or questions regarding the contents of these reports be directed through this office for action and resolution in order to minimize the impact on the YMP.

III. LOW LEVEL WASTE ACTIVITIES

I participated in an audit of activities pertaining to excavation and preparation of the uranium tailing site at Durango, Colorado, the week of September 17 and provided input to the audit report to Larry Pittigilo of LLWM.

There are no new issues that this office has identified that have not been brought to management's attention.

cc: w/encs: K. Hooks, M/S 4H3; J. Bunting, M/S 4H3; J. Latz

wo/encs: D. Shelor, C.P. Gertz, R.E. Loux, M. Glora, G. Cook, D.M. Kunihiro, D. Weigel, R.E. Browning, M/S 4H3; H. Denton, M/S 17F2; R. Bernero, M/S 7A4; H. Thompson, M/S 17G21; S. Gagner, M/S 2G5; L. Kovach, M/S NLS260

Lawrence Livermore National Laboratory

LLYMP9009007
September 5, 1990

WBS 1.2.9
QA: N/A

Carl Gertz, Project Manager
Department of Energy
Nevada Operations Office
Yucca Mountain Project Office
P.O. Box 98608
Las Vegas, Nevada 89193-8608

SUBJECT: Yucca Mountain Project Status Report - August 1990

Attached is the August Project Status Report for LLNL's participation in the Yucca Mountain Project.

If further information is required, please contact Deborah A. Kiraly of my staff at FTS 543-4571.

Sincerely,

Leslie Jardine
LLNL Technical Project Officer
for YMP

LJJ/DK/dk

cc:
Distribution

DISCLAIMER

The LLNL Yucca Mountain Project cautions that any information is preliminary and subject to change as further analyses are performed or as an enlarged and perhaps more representative data base is accumulated. These data and interpretations should be used accordingly.

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

AUGUST 1990

1.2.1 SYSTEMS

1.2.1.1 Management and Integration

Four summaries were submitted to the American Nuclear Society for the 1991 International High Level Radioactive Waste Management Conference to be held in Las Vegas, April 28-May 2, 1991.

Staff hosted an all day visit by M. Blanchard of YMPO on August 22. Comprehensive briefings on Performance Assessment, geochemistry, and hydrology were presented.

Staff attended the Sample Overview Committee meeting in Las Vegas on August 14.

1.2.1.2.4 Systems Engineering Implementation

Reviewed and accepted Interface Identification/Memorandum of Understanding - Control #630004.

1.2.1.4.2 Waste Package Performance Assessment

Staff participated in the PA Working Groups meeting at YMPO on August 1-3 and made presentations on recent work.

Staff attended the PACE 90 Perturbed Configuration meeting held in Las Vegas on August 1-3.

LLNL staff in conjunction with SNL staff attended a Performance Assessment planning meeting with M. Blanchard of YMPO in Las Vegas on August 21.

1.2.1.4.5 Geochemical Modeling and Data Base Development

Work has continued on the "code" side for the upcoming EQ3/6 Code and Database release. This work has consisted of resolving a number of maintenance issues and known errors, and testing of the codes and new data files using a large set of standard input sets, which is being augmented as part of this work.

The priority put on getting the code ready for the Code and Database release has pushed back the start of final revisions of the EQ6 User's Guide. The necessary revisions are primarily responses to reviewers' comments. Computations Department support for code maintenance, documentation, and release has been

largely pulled off to support the Database Task and project level software quality assurance activities.

Immediately after the EQ3/6 Code/Database release, effort on the code side will shift toward revision and completion of outstanding code documentation, chiefly the EQ6 User's Guide and the revision of the EQ3NR User's Guide.

1.2.2 WASTE PACKAGE

1.2.2.1 Management and Integration

Seventeen summaries were submitted to the American Nuclear Society for the 1991 International High Level Radioactive Waste Management Conference to be held in Las Vegas, April 28-May 2, 1991.

1.2.2.2 Near-Field Environment Characterization

Geochemistry

Work continued on the first draft of the Preliminary Waste Package Environment Report.

Yale University submitted its quarterly report to LLNL on the Single Phase Dissolution of Minerals activity. Work continues on kaolinite, gibbsite, and cristobalite kinetics.

Hydrology

The review comments were completed for the paper by D. G. Wilder entitled "Engineered Barrier Systems and Canister Orientation Studies for the Yucca Mountain Project, Nevada." The comments were submitted to YMPO.

Wunan Lin presented a poster paper entitled "Laboratory Investigations on Fracture Healing" at the SEG Workshop in Denver on August 6-8, 1990.

A proposal was received from Pierre Mousset-Jones of the University of Nevada-Reno for our review and possible funding. The proposal is entitled "Characterization of Thermally Induced Water/Vapor/Gas Transport in the Rock Mass." A response was sent to C. Gertz of YMPO for his comment.

Dr. George Danko of the University of Nevada-Reno suggested a proposal for work on a Heat-Pipe Concept. This request was passed on to C. Gertz of YMPO.

Geomechanics

Dale Wilder met with Les Shepherd and Larry Costin in Las Vegas on August 2 to discuss coordination of SNL/LLNL field and laboratory studies. A joint meeting was proposed to be held on September 12-13 at LLNL to expand the discussions to include additional technical staff members of both laboratories.

Man-Made Materials

No significant activities.

Field Tests

The Prototype Engineered Barrier System Field Test - Final Report has been sent to the technical reviewers.

The review comments for the SIP for Engineered Barrier System Field Tests were completed and sent to YMPO.

Comments were submitted to SNL on the draft ESF Test Descriptions Document.

Dale Wilder gave a briefing at the TPO meeting on August 3 on the objectives and results of G-Tunnel Prototype tests.

Memos were sent to C. Gertz in response to his request for Field Operations Support Group Preparation for the Midway Valley Event. The memos addressed hard hat and safety requirements.

1.2.2.3 Waste Form Characterization

Spent Fuel

The Activity Plan for flow-through dissolution of Spent Fuel and UO_2 (D-20-53) was completed.

Glass

The Test Plan for YMP Static Leach Tests has been submitted by Argonne National Laboratory (ANL) to LLNL. Three test matrices are identified:

simple tests to aid in model development
simple site-relevant tests for model development
complete site-relevant tests for model development

An ANL report on the parametric studies of WVDP and DWPF glasses based on the unsaturated test is being reviewed.

Analyses of reacted glass samples are being performed using analytic electron microscopy (AEM). Sections have been prepared of the reacted top, bottom, and side surfaces of the glass from an experiment in which the glass sample was exposed to one drop of EJ-13 water every 3.5 days for one year. The reacted layer consists of a complex structure of overlapping clay layers interspersed between iron-rich backbone structures. The structure is similar to that observed on SRL-165 glass reacted for 280 days in static MCC-1 leach tests.

A test matrix was performed to establish the surface area to volume ratios that can best be used in performing static leach tests. The resulting samples are undergoing analysis to describe the effect of the SA/V ratio on secondary phase formation during water/glass reactions. Preliminary AEM analyses indicate that the altered layer has a structure more complex than indicated by the scanning electron microscope (SEM). These analyses are continuing.

A critical evaluation of all current glass performance tests being carried out at ANL, LLNL, SRL, PNL, and Catholic University was made. The tests were ranked according to their perceived merit for use in developing a glass dissolution model. The evaluation was requested at the Technical Exchange Meeting in June at ANL where representatives of both the glass producers and YMP discussed the problem of relating short-term glass performance tests to repository performance. The evaluation was forwarded to ANL to be included in the meeting summary.

David Short was nominated as a reviewer for the Waste Acceptance Preliminary Specifications (WAPS) Technical Assessment Review (TAR).

Integrated Radionuclide Release

Development of the ability to analyze lanthanide (rare earth) elements at low concentrations in glasses and glassy rocks continued. Seven sets of ion implants, including ^{238}U in Topopah Spring tuff, were made in support of the effort to establish standards for analysis of YMP samples. A peak-stripping program is being written for the ion microscope to correct for interferences in the lanthanide region. Analysis was completed of lanthanide standards with inductively coupled plasma-mass spectrometry (ICP-MS).

Interpretation of core flow-through and tuff wafer experiments continued. Information on the fracture and pore structure is required to adequately model and predict the actinide transport. Application of fracture-matrix hydrological transport models to the experimental data began. Techniques to determine the 3-D pore structure of the tuff samples were identified, and evaluation of their usefulness began.

Design and acquisition of equipment to do more sophisticated actinide transport experiments commenced. Both chemical and hydrological transport will be studied simultaneously with this system. The design of the second-generation core-flow-through system incorporates the following features:

confining and pore pressure typical of the repository
sensors for impedance tomography
pressure differential monitoring
adjustable core size
computer control

Thermodynamic Data Determination

All requirements from the Readiness Review were completed, and QA Level I work began.

Container Materials Modeling and Testing

Continued laboratory testing to measure fracture toughness properties and propensity to pitting in simulated J-13 well water for the six reference path container materials.

Metallographic and microscopic characterization began on the 18 inch diameter inertial weld specimens obtained from the B&W contract. Samples of three candidate materials for the waste package container are being studied.

Four responses have been received from the April material survey sent to professional organizations and industry.

The Container Material Selection Criteria report completed its LLNL reviews/approvals and was submitted to YMPO for acceptance.

Comments were resolved for the B&W report by E. Robitz, et al., "Closure Development for High-Level Nuclear Waste Containers for the Tuff Repository Phase 1 Final Report." Response to SAIC reviewer comments will be submitted to YMPO on September 5. YMPO acceptance of this report will be needed as soon as possible in order close out the contract in FY90.

D. McCright attended the Technical Review Group working session for the Defense Waste Report draft in Buffalo, NY on August 8-9.

1.2.2.4 Waste Package Design

The Engineered Barrier System design including the Waste Package design is being re-examined using a structured Systems Engineering approach. The services of systems engineers from Synergistics, Inc. have been engaged to assist in this effort. Using the regulations and the current OCRWM reference documents, the upper level mission requirements were defined for the Waste Management System and then functional analysis proceeded through each level of the system down to allocating those functions that are satisfied by the EBS. This activity has established a foundation for defining the mission requirement of the EBS for follow-on efforts of evaluating alternate design concepts for the Waste Package.

Container Fabrication and Closure Development

Coordination continued with Babcock & Wilcox to transfer records packages and close out the contract.

1.2.5 REGULATORY AND INSTITUTIONAL

1.2.5 Regulatory and Institutional

NRC Interaction Support

LLNL and its subcontractors made 14 presentations to the NWTRB Engineered Barrier System Panel in Pleasanton, CA on August 28-29, 1990. The presentations concentrated on the alternate container design using a systems engineering process and on spent fuel and glass waste form characterization studies.

Site Characterization Program

Responses to comments on the Site Characterization Plan are being prepared for the September 11-12 meeting in Las Vegas.

Regulatory Review
No significant activities.

Study Plan Coordination
Staff reviewed the USGS Study Plan "Effects of Local Site Geology on Surface and Subsurface Motions."

Semiannual Progress Reports
No significant activities.

1.2.9 PROJECT MANAGEMENT

1.2.9.1 Management

Staff prepared a baseline plan for the FY91 budget and milestones.

An internal QA grading procedure was drafted and reviewed by LLNL staff members.

A schedule for technical data submission (AP-5.1Q) was submitted to YMPO.

Lee Carpenter of YMPO spent the day with LLNL-YMP LRC staff members on August 14. Discussions included privacy of qualification records, training of LRC staff, and LRC budget planning.

1.2.9.2 Project Control

Screened several internal candidates for the Resource Manager position recently vacated by Suzanne Bradley. Perpetua Comstock was selected; her effective date of transfer is September 1, 1990.

In conjunction with project management, prepared the first version of the FY91 budget by prime account. Included the first version of the Schedule 1 manpower requirements.

Provided an estimate to YMPO of the FY90 total cost.

Formulated an internal schedule for FY90 closing and FY91 opening.

Completed and transmitted the interim LLNL Long Range Plan to YMPO.

Submitted P&S accounts to YMPO for Hydrologic Properties of Waste Package Environment and Waste Package Design. PACS data for LLNL is now complete.

Provided actual costs and estimate at completion by P&S account cost elements to YMPO.

Began PACS network verification to permit progress reporting through the LLNL-YMP PACS system.

1.2.9.3 Quality Assurance

An improved QA action item list was completed. The LLNL-YMP data base is used to select QA actions from the total LLNL-YMP correspondence list.

Notified YMPO that all follow-up actions identified during the Readiness Review of the "Actinide and Technetium Thermodynamic Measurements" activity were completed and the start of work was approved.

Transmitted to YMPO on August 16 the signed Interface Identification/Memorandum of Understanding document pertaining to Tracer Selection, Use, and Detection Plan.

Conducted Audit 90-15 of Argonne National Laboratory subcontractor activities on August 23-24.

Transmitted to YMPO on August 22 Audit Report LLNL-90-18 resulting from the external audit of subcontractor Tektronix, Inc., Beaverton, Oregon.

Transmitted Nonconformance Report NCR-041 to YMPO as a result of Audit 90-12.

Transmitted Nonconformance Report NCR-048 to YMPO as a result of Audit 90-03.

Transmitted Nonconformance Report NCR-050 to YMPO as a result of Audit 90-02.

Corrective actions were completed to close Standard Deficiency Report (SDR) 537. YMPO approval was requested on August 22.

Transmitted Readiness Review Record Memoranda to YMPO staff members for signatures on August 3. These signatures are required to close SDR 536.

Conducted Surveillance S90-06, encompassing the review of quality related activities associated with the Procurement of Items and Services, Document Control, and Quality Assurance Records, on August 6-9.

Conducted Surveillance S90-07 of Florida State University (FSU) Calorimeter subcontract work on August 9. Transmitted Surveillance Report No. S90-07 to YMPO on August 21.

Transmitted LLNL-YMP Quality Assurance Program Plan Change Notice 1.0-0-3 to YMPO on August 20.

Transmitted to YMPO on August 17 the LLNL-YMP FY 1990 Quality Assurance Audit Schedule, Rev. 7, and LLNL-YMP FY90 Quality Assurance Surveillance Schedule, Rev. 4.

Distributed draft Technical Implementing Procedure, TIP-YM-01, "Documentation and Coding Standards for FORTRAN Programs" on August 27 for internal review.

Staff provided formal internal review of a draft revised LLNL QP 2.8, "Quality Assurance Grading". The comments are currently being resolved by the author.

QA, technical, and management staff members attended a YMPO QA Workshop in Denver, CO on August 7-8. The relationship between QA requirements and project productivity was discussed at length. Specific actions are to be assigned to the participant QA Managers.

Lawrence Livermore National Laboratory

LLYMP9009136
October 4, 1990

WBS 1.2.9
"QA: N/A"

Carl Gertz, Project Manager
Department of Energy
Yucca Mountain Project Office
P.O. Box 98518
Las Vegas, Nevada 89193-8518

SUBJECT: Yucca Mountain Project Status Report - September 1990

Attached is the September Project Status Report for LLNL's participation in the Yucca Mountain Project.

If further information is required, please contact Elizabeth Campbell of my staff at FTS 532-7854.

Sincerely,

Leslie Jardine
LLNL Technical Project Officer
for YMP

LJJ/EC/ec

cc:
Distribution

DISCLAIMER

The LLNL Yucca Mountain Project cautions that any information is preliminary and subject to change as further analyses are performed or as an enlarged and perhaps more representative data base is accumulated. These data and interpretations should be used accordingly.

LAWRENCE LIVERMORE NATIONAL LABORATORY YUCCA MOUNTAIN PROJECT
MONTHLY TECHNICAL HIGHLIGHTS AND STATUS REPORT
SEPTEMBER 1990
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LAWRENCE LIVERMORE NATIONAL LABORATORY
(LLNL)
YUCCA MOUNTAIN PROJECT (YMP) STATUS REPORT

SEPTEMBER 1990

1.2.1 SYSTEMS

1.2.1.1 Management and Integration

Staff attended the Site Suitability meeting in Las Vegas on September 20-21.

1.2.1.2.4 Systems Engineering Implementation

AP-5.1Q, AP-5.2Q, and AP-5.3Q are in the process of being implemented. Internal procedures will be completed in October 1990. A schedule of technical data submission has been submitted to YMPO for approval.

Three staff members attended the OCRWM Systems Engineering course in Las Vegas on September 18-21.

1.2.1.4.2 Waste Package Performance Assessment

The simplified one-layer model for diffusion from a waste package through a rubble zone was solved exactly as a series from the Laplace transform method. A test computer implementation was done. Results were generally consistent with the final results from the YMP PACE-90 calculation done by PNL using a more detailed UC-Berkeley diffusion model.

The Controlled Sampling Test System (CSTS) computer program was completed, verified and entered. All major features run in an apparently reasonable way; verification of correctness is in progress. After finding and correcting an implementation error, the controlled sample selection function was verified to give correct controlled samples and to select subcells in an unbiased way.

Set up and ran a second workshop on the Human Intrusion Drilling Scenario. The workshop was held at LBL and attended by staff from LLNL, SNL, LBL, PNL, YMPO and SAIC. Franz Lauffer (SNL) and Tom Buscheck (LLNL) made presentations. This second workshop focussed on hydrology issues. In a previous meeting (late August), SNL had made some changes to its proposed hydrologic problems or at least the modelling of those problems. Rather intense discussions followed and it was agreed some changes were needed for the quick drain problem. SNL was assuming, in essence, a bathtub with an open drain. Even assuming drift seals hold, LLNL and others believe a fracture/matrix flow model to be more appropriate and representative. The drain could be modelled as a large fracture. During this discussion, it became obvious that the source term input had been misunderstood. SNL agreed to take the LLNL (Buscheck) proposed modelling solution under consideration, and LLNL (MacIntyre) agreed to coordinate source term statements of work (LLNL, PNL and LBL).

Work on the MOU and draft Scenario Methods Report is continuing. Meetings and low funding have seriously restricted work on the report.

Three staff members attended the meeting held at Golder Associates in Seattle September 18-21 which focussed on the collection of knowledge on site suitability in relation to Performance Assessment. They will be distributing their report in the near future. LLNL presented the engineered barrier problems. Golder is working on models for sub components within the larger MDGS PA model.

Staff participated in a joint meeting on September 12-13 to discuss coordination of SNL/LLNL field and laboratory studies for mechanical attributes.

Staff participated in an American Society of Civil Engineers (ASCE) Nuclear Structures and Materials Committee administrative meeting on September 21 in Palo Alto, CA.

1.2.1.4.5 Geochemical Modeling and Data Base Development

Completed the update of MDAin data for uranium compounds. This update is required by the extensive changes, additions, and deletions present in the March 1990 final draft NEA compilation relative to its August 1989 predecessor.

Completed the verification activity designed to ensure accurate correspondence between thermodynamic data for uranium compounds in MDAin and the final draft NEA compilation.

Completed development of DBERROR, an automated INGRES-EMAIL-INTERLEAF system for submitting, processing, and filing database Change Requests. Copies of the DBERROR User's Guide were distributed to local users of the database, and full scale testing of the system was initiated.

Generated data[0,1].[SUP,HMW,COD,NEA,PIT,COM].R[4,5,6], the updated suites of thermodynamic data files suitable as input for the EQ3/6 package. It is anticipated that the R6 suite will be that which accompanies the revised EQ3/6 package to be released in the next two weeks.

Completed the document by J. Johnson, S. Lundeen, J. Delany, and S. Chamberlain entitled "Thermodynamic Databases for EQ3/6.3245.0990" which describes the contents and application utility of the database suite distributed with EQ3/6.3245.0990.

Completed the document by J. Delany and S. Lundeen entitled "The LLNL Thermochemical Database and Revised Data and File Format for the EQ3/6 Package", which is intended to provide a comprehensive overview of MDAin, its access and modification using DBAPP, and its application to EQ3/6 via the d0out interface.

1.2.2 WASTE PACKAGE

1.2.2.1 Management and Integration

Staff attended the meeting of the National Research Council (NRsrchC) in Washington, D.C. on September 17-18. The purpose of the meeting was to propose changes to the EPA regulation for the MGDS. The NRsrchC report, "Re-Thinking High Level Radioactive Waste Disposal" was reviewed. There were participants from all levels and areas of the national and international high level waste disposal programs.

Staff reviewed the August 90 revision of the Waste Acceptance Preliminary Specification for High-Level Waste Glass and transmitted the review documentation to YMPO.

1.2.2.2 Near-Field Environment Characterization

Staff participated in the joint meeting held in Sunol on September 12-13 with SNL to discuss coordination of field and laboratory studies for thermomechanical interactions. Staff presented information on long-term hydrothermal calculations.

An internal Audit of the Near-Field Environment Characterization Technical Area was held September 19-25.

Chemical and Mineralogical Properties of the Waste Package Environment
Continued work on the Preliminary Waste Package Environment Report.

Bill Glassley went to Los Alamos on September 17 to coordinate geochemical activities with LANL.

Hydrologic Properties of the Waste Package Environment
Work continued on the Fracture Healing experiment. Steam was sent through a fractured Topopah Spring Tuff sample to see if steam can cause fracture healing as was observed when water flowed through the tuff samples at high temperature.

Repaired the constant humidity chamber. It is now being tested.

Continued the study of imbibition of water in G-Tunnel tuff samples.

Work began on analyzing the radionuclide diffusion experiments conducted by M. ten Brink using analytical double porosity models developed by A. Rasmussen and I. Neretnieks.

In the code development area, work continues in debugging and enhancing pre- and post-processors for the V-TOUGH code. Work includes finding an alternative to the SAC graphics software, due to some deficiencies in that software. Initial tests on using the PVWAVE graphics package look promising. The mesh generator that will be used to generate the three-dimensional mesh for the vertical emplacement case is being ported to run on the SUN workstation. Some basic meshes were generated,

and a program is being developed which will convert the 3-D mesh data to a format compatible with the V-TOUGH code.

Development was initiated of a dual porosity fracture-matrix model.

The staff worked on incorporating the changes to the Hydrology Study Plan.

Staff attended the Symposium on "Fractures, Hydrology and Yucca Mountain" sponsored by the USGS in Golden, Colorado on Sept. 13-14.

Staff made presentations for the V-TOUGH User's Workshop held at the LBL on September 13-14. John Nitao and Tom Buscheck submitted a paper entitled "Modeling Hydrothermal Flow in Variably Saturated, Fractured, Welded Tuff During the Prototype Engineered Barrier System Field Test of the Yucca Mountain Project". John Nitao submitted a paper entitled "Increasing the Efficiency of the TOUGH code for Running Large-Scale Problems in Nuclear Waste Isolation".

Mechanical Attributes of the Waste Package Environment
Continuing to incorporate review comments on the Study Plan.

Man-Made Materials
Review of the proposed new Study Plan is in progress.

EBS Field Tests/ESF Test Design
Work continues on the technical review of the Final Report on the Horizontal Prototype Test.

Staff attended an ESF Alternatives Study meeting on September 17 in Las Vegas.

1.2.2.3 Waste Form Characterization

Waste Form Testing - Spent Fuel
Work continued at LLNL to initiate dissolution testing of UO_2. Characterization of test samples was completed. Planning documents are near completion.

The final report (PNL-7169) containing detailed results of the Series 2 bare spent fuel dissolution tests was sent to print. Printing and distribution were completed on the detailed report (PNL-7170) of results from the Series 3 spent fuel dissolution tests. The Series 2 tests were conducted at 25°C in unsealed silica vessels, and the Series 3 tests were conducted at 85°C and 25°C in sealed stainless steel vessels. Both test series used J-13 well water. Publication of the Series 3 report completes Milestone R205 of WBS element 1.2.2.3.1.1.L (Activity D-20-42).

Pressurized tube scoping tests with unirradiated cladding were completed at PNL. End caps were welded on six sections of cladding (3 PWR, 3 BWR). These cladding sections were heat treated in air to produce an oxide film on the outer surface. Three different oxide film thicknesses were produced on two types of cladding; one type had a thicker tube wall than the other. These results showed that the technique can be used to monitor the initiation and growth of cracks in the oxide layer, but that the results are sensitive to the method of pre-test preparation of the welded

can be used to monitor the initiation and growth of cracks in the oxide layer, but that the results are sensitive to the method of pre-test preparation of the welded portion of the specimen. The weld affected regions should be coated with an elastic insulator to prevent premature cracking of the oxide in those areas (which are not the region being studied).

Dry Bath ceramography of five oxidized fuel samples from the PNL dry bath experiments was completed. There were three powder and two fragment samples. The growth rate of U_4O_9 along grain boundaries in spent fuel was determined by computer-assisted image measurement of ATM-103 fuel oxidized at 195°C. Comparison of the transformed volume fractions with the oxidation weight gains confirmed that the grain-boundary U_4O_9 in samples with average O/M ratios up to 2.16 is close to stoichiometric $UO_{2.25}$. The computer-assisted image measurements were also used to determine the shapes of spent fuel fragments in order to derive two pyramidal parameters for oxidation model development. Additional measurements of fuel grain structures are in progress.

Preparation of the draft report on the representativeness of spent fuel ATMs to the total spent fuel inventory was completed at the MCC. The report recommends that at least one (and possibly two) additional fuels should be acquired if the suite of spent fuel testing materials available to the repository project is to be considered representative of the spent fuel inventory. These fuels are a modern high-burnup PWR fuel and a modern high-burnup BWR fuel.

A draft of ORNL/TM-11670, "Distribution of Characteristics of LWR Spent Fuel", which was prepared under a subcontract at ORNL, was received at the MCC and is being reviewed. The report gives background information on the Characteristics Database (CDB) data that were used by the MCC. It also includes additional information on the types and relative quantities of defective and burnable absorber fuel in the spent fuel population.

LLNL and PNL staff attended a workshop in Gull Harbour, Manitoba, Canada on September 3-5. The Canadians have emphasized oxidation work. They are not as far along as we are in the dissolution studies that use flow-through techniques. LLNL presented results from its fragment dissolution modeling effort which considers the exposed grain boundary and grain interior areas. PNL made three presentations :

1) "Long-Term Dissolution Tests with Oxidized Spent Fuel";

2) "Indications for the formation of Pu, Am and Cm Colloids in Static Dissolution Tests"; and

3) "Effects of Water Composition and Temperature Variables on the Dissolution Rate of UO_2.

A paper entitled "Results from Long-Term Dissolution Tests Using Oxidized Spent Fuel" was written for the Materials Research Society Meeting, November 26-28 in Boston, MA.

Waste Form Testing - Glass

The ANL N3 tests on ATM-10, a West Valley actinide-doped glass, were sampled this month after 166 weeks. The solution was filtered to detect particulate materials released and suspended in solution. Analysis of the filters will begin next month.

A topical report discussing all the unsaturated test parametric experiments performed at ANL on WVDP and DWPF glasses has been sent to LLNL for review. Additionally, all of the parametric experiments were sampled. In the P-VII series (tests conducted with varying degrees of sensitized 304L type stainless steel), aliquots of the leachate were evaporated on Transmission Electron Microscope (TEM) carbon-coated Cu grids to evaluate particulate distribution. Initial examination of the grids indicates many small particles exist that may be amenable to further analysis.

The SVT matrix was performed to establish the SA/V ratios that can be used in performing tests as part of activity D-20-28 (Static Leach Testing of WVDP and DWPF Glass). The samples from these tests are undergoing detailed characterization, the results of which will be presented in a manuscript tentatively entitled "The Effect of SA/V Ratio on the Formation of Secondary Phases during Glass/Water Reactions." This report will convey the finding that the alteration phases formed on the surfaces of glasses reacted at identical (SA/V)•t values (in a distilled water leachant) are different. When these analyses of the secondary phases are considered in conjunction with the analyses of the concentrations of species in solution, it is clear that (SA/V)•t scaling is not as simple as has been previously assumed. The preliminary conclusion is that researchers should be wary of using (SA/V)•t scaling to accelerate leach tests. Variations in the observed alteration phase assemblages, probably the result of precipitation kinetics, indicate that different reaction mechanisms can control glass/water reactions over time.

Samples of SRL 165U glass reacted by LLNL at 150°C for short periods of time were successfully prepared for AEM examination. Initial examination of the sections indicates a complex layer structure with varying degrees and possibly types of crystallinity. Portions of the layer have been successfully separated for analysis, and sections containing the intact layer structure are available. No sections were obtained with the glass/layer interface intact because the layer had spalled from the glass surface immediately after leaching. However, sections of the glass surface will be made, and they should provide evidence as to the structure of the glass/layer interface.

Analyses of the solutions formed on vapor-hydrated glass have continued. Effort is being made to incorporate the data into the upcoming MRS paper "The Importance of Secondary Phases in Glass Corrosion."

Staff reviewed the PNL document by McGrail et. al. entitled "Preliminary Assessment of the Controlled Release of Radionuclides From Waste Packages Containing Borosilicate Waste Glass."

Work began on the invited paper "Overview of Chemical Modeling of Nuclear Waste Glass Dissolution" for presentation at the Materials Research Society Meeting.

The reaction path computer code GT from the University of Illinois is being purchased in order to supplement the capabilities of EQ3/6, the LLNL-generated reaction path code. The acquisition of GT will allow rock-centered (transport described relative to the motion of rock) flow-through modeling, which is currently not available in EQ3/6. Because of FY91 budget limitations, no further code development work is being planned on EQ3/6. This stoppage would limit the glass modeling efforts to current types of modeling efforts. EQ3/6 improvements taking into account surface chemistry, ion exchange, and site-mixing models for clays and zeolites are being deferred.

Integrated Radionuclide Release

Compilation and documentation of existing data from tuff wafer and tuff cup experiments moved into a new phase. Approximately 2/3 of the existing data and analysis parameters were entered into a format that allows both easier interpretation of the data and generation of data records appropriate for YMP archives. In addition, specifications are being written for software that will automate the data acquisition and feed results into a user-friendly database.

Scoping studies were initiated to study colloids generated in uranium and actinide glass leach experiments. The first goal is to determine methods best suited to identify

1) the location of actinide isotopes in the colloids; and
2) the mineralogy and sizes of the particles containing the actinides.

Fresh and archived samples were obtained from long-term dissolution experiments at Argonne National Lab.

Evaluation continued on techniques to determine the three dimensional pore structure of the tuff samples. An epoxy impregnation method seems promising, as does a technique that combines Nuclear Magnetic Resonance (NMR) and Computerized Axial Tomography (CAT) scanning. The new Tracor automation available on the electron microprobe was used to do image analysis of the two-dimensional pore-size distribution on a sample of Topopah Spring tuff. Pores as small as 0.3 μm were clearly identified in photomicrographs. Preliminary results showed a bimodal pore distribution with no preferred orientation of maximum pore dimension.

As part of efforts to identify and segregate fracture transport from matrix transport of uranium in the tuff samples, materials are being assembled to do autoradiography of existing samples. With this technique, the location of the radioisotope tracer (e.g. uranium) can be identified on scales from mm to cm and correlated with physical and mineralogical features of the tuff. Information about the actinide distribution on this scale is needed to complement information gathered with the Scanning Ion Mass Spectroscopy (SIMS) on scales from 0.1 μm to mm.

Plans were drawn up and purchase of components initiated for the second-generation core-flow-through system that will measure both chemical and hydrological transport. Comparison of sources was completed and purchase initiated of the MALVERN 4700PS/MW photon correlation spectroscopy system. This will be used to determine particle sizes in spent-fuel and glass waste solutions. Purchase

of a critical point dryer was also initiated. This equipment will allow glass and rock samples to be dryed without mobilization of constituents during the drying process and will maintain the integrity of the surfaces.

Staff attended a workshop on sorption held at LANL Sept 11-12, followed by a discussion with NRC on Sept 13. Work in progress within this task related to sorption and its effect of radioisotope mobility was presented in a talk entitled "Sorption and porosity heterogeneity: effects on radionuclide migration". Discussions among LANL, LLNL, and contract investigators helped to define areas needing additional work and to establish priorities.

Thermodynamic Data Determination

Approval to start QA-1 work has been received from LLNL-YMP.

Calibration of the titrant pump was completed using the new weights calibrated by ME. This completes the variable temperature calorimeter calibration, and it is now on the M&TE QA-1 list for YMP. The pH monitoring system was recalibrated on schedule. QA Level I measurements may now begin for the high temperature calorimetry activity.

Final values of stepwise stability constants for three Pr-diglycolate complexes at five temperatures were obtained. Agreement with prior literature values, where possible, was excellent and served as a validation of the HiT-SPEC technique. In addition, calculations were made to report values of molar absorptivities of Pr^{3+} as functions of wavelength and temperature, as well as van't Hoff computations of reaction enthalpies and entropies for Pr(diglycolate) complexation.

The flow through cell system for the reduction of U(VI) to U(IV) and subsequent absorption measurements using photoacoustic spectroscopy was successfully put into operation. Measurements of the third and fourth carbonate complexation constants were started.

1.2.2.3.2 Container Materials Modeling and Testing

Two papers were submitted to YMPO for review. The paper by G. Gdowski and R. McCright entitled "Corrosion Considerations of High-Nickel Alloys and Titanium Alloys for High Level Radioactive Waste Disposal Containers" is to be presented at the NACE Corrosion 91 Conference. The second paper by G. Gdowski and R. McCright entitled "Degradation Mode Surveys of High Performance Candidate Container Materials" is to be presented at the HLRWM meeting in Las Vegas in April 1991.

Draft reports for the degradation mode surveys of high-nickel alloys and titanium alloys were also prepared and are undergoing internal review.

Jang-Yul Park, the Principal Investigator from Argonne National Laboratory (LLNL YMP subcontractor), visited LLNL and presented the results of his study on the stress corrosion behavior of austenitic alloys. Crack growth tests conducted on Alloy 825, 304L and 316L stainless steels for greater than 10,000 hours in simulated J-13 well water at 93°C indicate predicted failure times much greater than 10,000 years

under these conditions. A draft final report has been prepared by Park and will be submitted to LLNL shortly for review.

Conrad Kundig and Dale Peters from the Copper Development Association visited LLNL to discuss the status of the container materials program. They promised to send us copies of papers from other countries where copper or copper alloys are being considered for waste disposal containers.

Laboratory studies continued on the austenitic Alloy 825. Pitting potential tests reveal that a chloride concentration of greater than 10,000 ppm is required to initiate pitting at 23 and 50° C at neutral pH; the ongoing tests also reveal a strong dependency on temperature and pH.

1.2.2.4 Waste Package Design

A list of selection criteria for design was assembled. This list is being distributed to the Technical Area Leaders and other staff members for their comments and input.

An abstract by L. Jardine entitled "The Use of a Systems Engineering Process to Develop Engineered Barrier System Design Concepts" was submitted for the Panel II Session (Yucca Mountain Overview) of the Waste Management '91 Conference.

Container Fabrication and Closure Development

The friction-welded specimens and all stock materials of the six candidate container materials were shipped by Babcock and Wilcox (B&W) to LLNL. B&W also submitted a draft final report to LLNL for review, which summarized the Phase 2 fabrication and closure development studies. The shipment of all documentation and QA records (scheduled for September 29), will close the present contract with B&W.

1.2.5 REGULATORY AND INSTITUTIONAL

1.2.5 Regulatory and Institutional

NRC Interaction Support

Staff participated in the DOE-NRC Technical Exchange on Radionuclide Sorption, September 12 at Los Alamos, NM and in the Technical Exchange on Unsaturated Zone Hydrologic Characterization, September 26-27, at Denver, CO.

Site Characterization Program

Staff completed the LLNL input and review of the NRC, Site Characterization Analysis (SCA) and SCP comments from the State of Nevada (Preliminary Comments), Edison Electric Institute, the California Energy Commission, Lincoln County, Nevada, and the U.S. Department of the Interior.

Regulator Review

No significant activities.

Study Plan Coordination

Technical reviews were completed for the following Study Plans:

1) SNL Study Plan 8.3.1.17.33 "Development of Empirical Models for Underground Nuclear Explosions"; and

2) USGS Study Plan 8.3.1.9.2.1 "Natural Resource Assessment of Yucca Mountain, Nye County, Nevada".

Semiannual Progress Reports

Preparation of the LLNL portion of the Third Technical Status Report (TSR) is in progress.

1.2.9 PROJECT MANAGEMENT

1.2.9.1 Management

L. Jardine, C. Gertz, and other OCRWM/YMPO staff met with D. Deere, E. Verink and other staff members of the NWTRB in Gainesville, FL. The purpose was to review TRB recommendations on engineered barrier system and waste package technical activities in order to consider those recommendations in the FY91 technical work planning effort.

A second draft of the internal procedure for QA grading was issued for review. Grading under the new system will begin in mid-October.

Staff hosted German visitors from Julich and the Lower Saxony government on September 24. Briefings on the Climax test, near-field environment issues, and waste package selection criteria were presented.

1.2.9.2 Project Control

Generated and distributed Summary account worksheets for the next 18 month period to the Technical Area Leaders for verification. The objective is to determine the accuracy of the existing database for statusing and collecting costs for performance measurement reporting for the period beginning October 1, 1990.

Identified the critical path in the LLNL PACS/LRP database for the Waste Package, with and without Performance Assessment.

Updating the PACS Summary Account data for Hydrologic Properties of Waste Package Environment and for Design and Analysis.

A separate account was set up to track expenditures in support of the OCRWM-Golder contract. An estimate of costs was provided to YMPO.

Completed the year-end estimate for FY90. Screened outstanding liens and pre-liens to determine validity and costing schedule.

Renewed SANLs that will be in effect for FY91. Closed SANLs for which work has been completed in FY90.

Processed capital equipment requisitions for FY90 and 91.

Completed the August FTE and Milestone reports and submitted them to YMPO.

Refined the FY91 detailed budget and revised the FY91 Schedule 1 data.

Completed and submitted the initial FY91 Operating Plan to the LLNL Budget Office.

Provided an 8 week cost projection for FY91 to YMPO. Also provided the September costs by third level WBS.

1.2.9.3 Quality Assurance

Conducted LLNL-YMP Audit 90-07 of Near Field Environment Modeling and Testing and Audit 90-087 of Geochemical Modeling.

Transmitted to YMPO the Audit Report 90-15 resulting from the LLNL-YMP external audit of Argonne National Laboratory's Chemical Technology Division.

Closed Nonconformance Report LLNL-059, Acknowledgement of Receipts.

Transmitted to YMPO Nonconformance Report LLNL-060 which identifies a potentiostat as being out-of-tolerance when received for calibration.

Completed corrective actions needed to close Standard Deficiency Reports 536 and 544.

Transmitted to YMPO the response to Standard Deficiency Report SDR 567.

Attended QA meetings in Las Alamos on September 7 and in Las Vegas on September 27.