



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

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MEMORANDUM

DATE: July 15, 1991
FOR: Joseph Holonich, Acting Director, HLPD,
Division of High-Level Waste Management, M/S 4 H 3
FROM: *John W. Gilray*
John W. Gilray, Sr. OR - YMP
SUBJECT: YMP Site Report for the months of May and June, 1991

I. QUALITY ASSURANCE

A. Audit of USGS QA Program

The YMP conducted an audit of USGS QA program from May 20 through 24, 1991 at Denver Colorado. The audit team evaluated the effectiveness of USGS QA Program requirements and implementing procedures. In addition, implementation of corrective action(s) as provided in the response(s) to open Project Office Standard Deficiency Reports were evaluated to determine if they were satisfactorily closed. The technical specialist of the audit team audited activities associated with (1) Unsaturated Zone Hydrochemistry, (2) Site Saturated Zone Ground-water Flow System, (3) Quaternary Regional Hydrology, and (4) Historical and Current Seismicity.

The evaluation of these above activities included a determination of adequacy of technical qualifications of scientific personnel, the understanding of procedural requirements as they pertain to scientific investigation activities, the adequacy of technical procedures, the development of study plans, and work supporting the Site Characterization Plan.

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Overall the auditors concluded that the USGS is satisfactorily implementing an effective QA program in accordance with their QA Program and QA and technical implementing procedures.

I assisted Teek Verma as an NRC observer of this audit which resulted in general agreement with the auditors preliminary conclusions. A report of the results of my observation of this audit has been prepared and submitted to Teek Verma for inclusion in the NRC observation report.

B. YMP Surveillance of Ratheon Services Nevada (RSN)

On June 24 and 25, 1991, YMPD conducted a quality assurance (QA) surveillance of the RSN YMP QA Program.

The DOE/YMPD Auditors selected Criteria I, "Organization"; V, "Instructions Procedures and Drawings"; XVI, "Corrective Action"; and XVIII, "Audits" from the RSN QA Program Plan for review and assessment of adequacy of procedural controls and procedural implementation.

The auditors concluded that the procedural controls under Criteria I, V, XVI, and XVIII are generally adequate and their procedural implementation is satisfactory. No adverse findings were identified.

I participated as the NRC observer of this surveillance and am in general agreement with the auditor's preliminary conclusions. In addition I have prepared and submitted an observation report of this surveillance to Ken Hooks of NRC.

C. YMP Surveillance of USGS Controls of Measurement and Test Equipment used at the Yucca Mountain Site

On June 12 and 13, 1991, the YMPD conducted a quality assurance surveillance (YMP-SR-020) of the USGS YMP QA program at the Yucca Mountain Site.

This surveillance evaluated the adequacy of procedural controls and their implementation of Criterion 12, "Control of Measuring and Test Equipment" from the USGS QA Program Plan. The specific area reviewed was the control and use of measurement and test equipment used at the Yucca Mountain Site. The auditors concluded that the procedural controls and the implementation of these controls were acceptable and no adverse findings were identified.

I participated as the NRC observer of this surveillance and am in general agreement with the auditors preliminary conclusions. In addition I have prepared and submitted an observation report of this surveillance to Ken Hooks of NRC.

D. YMP ESF North Area Design Studies Review--(ESF Design Study)

The YMP conducted a Management Review of the ESF Design Study the week of June 3, 1991. Thirteen reviewers participated in this review generating 496 comments which have been resolved and dispositioned.

The week of June 17, 1991, the YMP conducted an independent design review of the ESF Design Study which resulted in 275 resolved comments. The NRC staff (M. Delligati, D. Gupta, P. Prestholt and J. Gilray) participated as observers of this design review. The ESF Design is in a preliminary design phase which will require substantial design work before the design package is finalized and independently verified. The purpose of the review was to provide assurance that to the level of detail presented in the design, that the Design Study for the North Area is technically correct and in compliance with

the requirements of the upper-tier document and applicable codes and standards.

The disciplines involved in the independent review were civil, electrical, mechanical, mining, structural, testing support, performance assessment, QA, repository interface, maintain ability /operability, environmental, regulatory and safety.

The overall independent review process was conducted under the controls described in the Independent Technical Review Plan for the North Area Design Study. As a result of reviewing this plan I pointed out that since this is a controlled document the plan should have a unique procedural control number and a notation on each page which would convey the revision status of each page. The YMP agreed to make these corrections.

The YMP gave a detailed presentation of the overall design control process to the NRC observers which was similar to the presentation given to the Nuclear Waste Technical Review Board in March of 1991. The results of this presentation allowed the NRC staff to gain a clearer understanding of the improved design controls instituted by the YMP from previous design control activities.

It is my understanding that the NRC observers are in general agreement that the ESF Design Studies are continuing in a satisfactory manner.

E. Miscellaneous

- ◆ The appointment for the YMP QA Division Director is still delayed. It appears that OCRWM personnel office is moving slow on the selecting committee's paper work.
- ◆ This office (P. Prestholt and J. Gilray) reviewed the DOE investigation report and supporting documents concerning the resolution of allegations of Sam Singer. We concluded that

the investigation report is reasonable and that there are no unresolved QA or nuclear safety issues. The results of our review have been reported to Ken Hooks of NRC who is preparing a memorandum of the overall results of the NRC review of this investigation.

- ◆ I am continuing my efforts in developing QA/Administrative procedures for the LLWM. At present I have developed 6 of 14 procedures.

- ◆ Software QA Workshop

The Software Advisory Group (SAG) continues to work on revising and improving the software QA controls in Section 19 of the Quality Assurance Requirements Document (QAR). The YMPD is presently recommending to incorporate Section 19 into the first 18 criteria of the QAR. However, the Software Advisory Group strongly recommends that Section 19 remain separate.

- ◆ I plan on attending the Quality Integration Group meeting in San Diego July 23, 24, and 25. The purpose of this meeting is to review NQA-3 controls and the possible benefits of incorporating these controls in the YMP QA program. Also the meeting will discuss the follow-up activities associated with previous QA workshop action items.

II. WASTE PACKAGE

The LLNL May monthly status report is enclosed (Enclosure 1). The June report has not been issued as yet. 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.

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

cc w/enc: K. Hooks, M/S 4H3; R. Ballard, M/S 4H3; J. Latz
wo/enc: D. Shelor, C.P. Gertz, R.E. Loux, M. Glora, G. Cook,
D.M. Kunihiro, D. Weigel, B. Youngblood, J. Linehan, M/S 4H3;
H. Denton, M/S 17F2, R. Bernero, M/S 6A4; H. Thompson,
M/S 17G21; S. Gagner, M/S 2G5; E. O'Donnell, M/S NLS260



Lawrence Livermore National Laboratory

LLYMP9106
July 3, 1991

WBS 1.2.9
"QA: N/A"

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

SUBJECT: May 1991 Technical Highlights and Status Report

Attached is LLNL's Technical Highlights and Status Report for the month of May 1991. A Status Report has been completed for each WBS. A summary of this work was previously submitted to YMPO on June 14 as the "Yucca Mountain Project Status Report - May 1991." This report is not required by YMPO, but is an LLNL internal requirement.

If you have any questions or need additional information, please contact Elizabeth Campbell of my staff at FTS 532-7854 or (415) 422-7854.

Sincerely,

A handwritten signature in cursive script that reads "Leslie J. Jardine".

Leslie J. Jardine
LLNL Technical Project Officer
for YMP

LJJ/EC/ec

cc:
Distribution

Attached

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
MAY 1991 TECHNICAL HIGHLIGHTS AND STATUS REPORT
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1.2.1 SYSTEMS

WBS 1.2.1.1 MANAGEMENT AND INTEGRATION

L. Ballou, Associate Project Leader

OBJECTIVE

Manage and integrate work performed within the systems WBS elements.

ACTIVITIES AND ACCOMPLISHMENTS

Technical and management staff prepared for the June 1991 YMPO audit of LLNL-YMP.

WBS 1.2.1.2.4 SYSTEMS ENGINEERING IMPLEMENTATION

M. Revelli, Task Leader

OBJECTIVE

Provide for the integration of Project technical activities in order to move toward an efficient Mined Geologic Disposal System for the Yucca Mountain site that meets DOE and regulatory requirements.

ACTIVITIES AND ACCOMPLISHMENTS

The draft technical Database Handbook outline was reviewed and the GEMBOCHS (Thermodynamic Database) section was revised. A summary of the parameter categories and parameters in GEMBOCHS was also prepared. This information was forwarded to YMPO/SAIC through the Technical Data Advisory Group.

IMOU 660025 "Title I Design Summary Report - Revision I" was revised to include LLNL as a signator and to identify LLNL's supporting role in Sections 3.7.2.2, 3 & 4 of the report. LLNL will sign the IMOU following its review and acceptance by YMPO.

WBS 1.2.1.2.6 YMP SUPPORT TO MANAGEMENT SYSTEMS IMPROVEMENT STRATEGY

D. Ruffner, Technical Area Leader

OBJECTIVE

Manage the YMP resources and perform work in support of the MSIS being conducted by the Office of Civilian Radioactive Waste Management (OCWRM).

ACTIVITIES AND ACCOMPLISHMENTS

D. Ruffner attended MSIS meetings in Las Vegas on May 2 and May 28-29.

WBS 1.2.1.4.2 WASTE PACKAGE PERFORMANCE ASSESSMENT

W. Halsey, Technical Area Leader

OBJECTIVE

Integrate physical process submodels and data into computational models for prediction of long-term waste package performance including single-package performance under local conditions, the net performance of the set of all waste packages in the repository, and probabilistic distributions of net performance and characterization of uncertainties. Assess whether the waste package subsystem will meet the performance objectives for the waste packages and engineered barrier system specified in 10 CFR 60.113. Provide feedback to design optimization studies. Provide a source term for the total system performance assessment.

ACTIVITIES AND ACCOMPLISHMENTS

W. Halsey has accepted the position of Technical Area Leader for the Performance Analyses group. He is replacing D. Chesnut who has accepted a position supporting the SRP (Savannah River Project) under the Earth Sciences Department at LLNL. D. Chesnut will continue part-time on the YMP as a hydrologist.

The IMOU between LLNL and SNL on scenario development was completed on May 24 and forwarded to YMPO for processing.

An internal QA grading package was completed for Activity I-20-20a, Scenario Identification.

W. Halsey attended the OCRWM Graduate Fellowship meeting in Las Vegas on May 29.

The abstract by T. Ueng and W. O'Connell entitled "Diffusive Barrier Simplified Analysis - Design and Sensitivity Applications" was accepted for the Focus '91 meeting to be held in Las Vegas, September 29-October 2.

An internal audit was completed for the PA Technical Area on May 8.

WBS 1.2.1.4.5 GEOCHEMICAL MODELING AND DATA BASE DEVELOPMENT

T. Wolery/J. Johnson, Task Leaders

OBJECTIVE

Develop and verify computer codes and data bases used in assessment of performance, following applicable quality assurance procedures. The geochemical modeling task involves activities in code development and data base development. The objective of this task is to develop tools necessary for predicting behavior of the waste package environment, site geochemistry, and for waste package performance assessment. The existing EQ3/6 code is being expanded to provide capabilities to handle nuclear waste applications and a data base is being developed to support these applications.

ACTIVITIES AND ACCOMPLISHMENTS

Code Maintenance, Documentation, and Release

Continued restructuring of GEMBOCHS and D0OUT that will facilitate generation of composite databases for the EQ3/6 package based on alternate suites of basis and auxiliary basis aqueous species.

Continued development of a software interface between GEMBOCHS and the GT geochemical modeling code.

Continued revision of the DBERROR User Guide to incorporate modifications discussed in the past few monthly reports.

Continued modification of the filing system for controlling and tracking the evolution of database software products to achieve conformance with procedures described in the TIP-YM-11, "Software Configuration Management System", which was approved during March 1991.

Generated three large YMP record segments and transferred these to the LRC:

- 1) EQ3/6 Database Software Configuration Management;
- 2) Information on database change requests collected from November 14, 1989 to June 9, 1990;
- 3) Database references (1960-1991).

J. Johnson attended the 10th Annual North American INGRES User Convention, May 19-23 in San Jose, CA.

WBS 1.2.1.4.7 SUPPORTING CALCULATIONS FOR POSTCLOSURE PERFORMANCE ANALYSES

C. Carrigan, Principal Investigator

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

A paper by C. Carrigan entitled "Models of Water Table Excursions Induced by Seismic and Volcanic Events at Yucca Mountain, Nevada" was presented at the Spring American Geophysical Union Meeting on May 29 in Baltimore, MD. Also presented at a special session was the paper entitled "The Potential of Tectonism and Volcanism for Producing Significant Excursions of the Water Table". Afterwards, a press conference was held on this topic.

G. C. P. King, from the Institut de Physique du Globe in Strasbourg, France visited LLNL on May 10 to discuss seismic induced movement of the water table.

Internal QA grading was completed for this activity.

1.2.2 WASTE PACKAGE

WBS 1.2.2.1 MANAGEMENT AND INTEGRATION

L. Ballou, Associate Project Leader

OBJECTIVE

Manage and integrate work performed within the waste package WBS.

ACTIVITIES AND ACCOMPLISHMENTS

W. Clarke worked with D. Harrison-Giesler and D. Morissette on May 22-23 on the agenda and organization of the DOE EBS Workshop to be held in Denver in June.

D. Wilder and B. Viani attended the International meeting with Swedish representatives in Las Vegas on May 28-30 discussing a joint venture on geochemistry and hydrology tasks.

An internal audit was completed on the Near Field Environment Technical Area.

WBS 1.2.2.2.1 CHEMICAL AND MINERALOGICAL PROPERTIES OF THE WASTE PACKAGE

D. Wilder, Acting Task Leader

OBJECTIVE

Determine the mineralogical and chemical variability of the Topopah Spring tuff in the vicinity of waste packages, and evaluate the mineralogical and chemical response of the waste package environment to emplacement of waste. Design, execute, and interpret laboratory and field-based experiments, tests, and studies to provide data for numerical analysis. Develop and evaluate computational and conceptual models to support long-term predictions of the behavior of the waste package environment.

ACTIVITIES AND ACCOMPLISHMENTS

Work continued on determining the impact of hydration water and temperature on clinoptilolite stability and cation exchange properties.

Installation of the HPLC (liquid chromatograph) was finished. A calibration method was developed for organic acid anions which are potential complexing agents for metals in the vicinity of the repository.

High pressure safety tests were run on all pressure vessels as required by the LLNL Hazards Control Dept.

The Adsorption Workshop was held at LLNL on May 10.

Study plan 8.3.1.3.1.1 "Groundwater chemistry model of Yucca Mountain" was reviewed.

Staff members discussed topics in geochemistry in a meeting with A. Simmons (YMP) and P. Cloke (SAIC).

The paper by K. Nagy and T. Lasaga entitled "Dissolution and Precipitation Kinetics of Gibbsite at 80°C and pH 3: The Dependence on Solution Saturation State" was reviewed.

Internal QA grading was completed for:

- 1) GC-01.1, Scoping, Geochemistry, Property Measurements, and
- 2) GC-05.1, Scoping/Test Design and Prototype Applications.

Quality Procedures manuals were updated, and "read and sign" QA paperwork was completed.

WBS 1.2.2.2.1 EFFECT OF MAN-MADE MATERIALS

D. Wilder, Acting Task Leader

ACTIVITIES AND ACCOMPLISHMENTS

The literature search is continuing.

WBS 1.2.2.2.2 HYDROLOGIC PROPERTIES OF WASTE PACKAGE ENVIRONMENT

T. Buscheck, Task Leader

OBJECTIVE

Provide a detailed conceptual and quantitative understanding of the flow and transport processes active in the near-field waste package environment. Provide a basis for the near-field flow and transport submodel to be included in the waste package performance assessment.

ACTIVITIES AND ACCOMPLISHMENTS

Work continued on the fracture healing experiment. Another blind test using an aluminum sample was done. The blind test confirmed that the high silica concentration in the water condensed from the steam that flowed through the tuff sample, as reported previously, was due to the rock sample. Scanning Electron Microscope (SEM) photos of the fracture surfaces of the tuff sample were taken. The post-experiment surface contains micron-size particles of silica minerals. The pre-

experiment surface lacks such small particles. The post-experiment surface is smoother than the pre-experiment surface.

The constant humidity chamber has been successfully tested.

S. Daveler has continued the development and testing of a post-processing package for V-TOUGH and LLNL's flow and transport simulator, Extool (extractor tool). This tool was originally developed in parallel with enhancements to V-TOUGH which write time history files of primary and secondary output variables based on user-selected options. Extool has been enhanced to extract one-dimensional slices of data. A library has also been written of subroutines (to write Extool formatted files) which can be called by other hydrological simulation codes besides V-TOUGH. A first draft has been completed of the User's Manual for Extool.

The first draft of the Individual Software Plan (ISP) for the V-TOUGH code was completed by T. Quinn.

Work continued on the development of a modeling and site characterization strategy which will be presented to the M&O Contractor in the near future.

A request was received from Linda Lehman of Lehman and Associates, Las Vegas, for a copy of V-TOUGH. The collaboration agreement was signed and a copy was transmitted.

The abstract for the paper by T. Buscheck, J. Nitao and D. Chesnut entitled "The Impact of Episodic Nonequilibrium Fracture-Matrix Flow on Geologic Repository Performance" has been accepted for the System Performance Modeling session of the Nuclear Waste Packaging Focus '91 Conference to be held in Las Vegas on September 29-October 2.

The abstract for the paper by T. Buscheck, J. Nitao and D. Chesnut entitled "The Impact of Episodic Nonequilibrium Fracture-Matrix Flow on Repository Performance at the Potential Yucca Mountain Site" was submitted for the MRS/EMRS symposium on the Scientific Basis for Nuclear Waste Management to be held in Strasbourg in November.

W. Lin attended the AGU meeting in Baltimore on May 30 where he presented a poster paper entitled "Role of Steam in Fracture Healing of Topopah Spring Tuff Samples".

W. Lin attended the Sample Overview Committee (SOC) meeting at on May 7-8 at NTS.

D. Chesnut, D. Wilder and T. Buscheck attended the second meeting of the Hydrology Integration Task Force held at LLNL on May 9.

Internal QA grading was completed for:

- 1) GH-01.1, Scoping Hydrologic Properties Measurements,
- 2) GH-5.1, Geohydrology Model Applications/Analyses: Scoping/Test Design,
- 3) GH-5.2, Geohydrology Model Applications/Analyses-Prototype Applications.

Work continued in preparation for the YMP QA audit. An internal audit was also held for the Near Field Environment.

WBS 1.2.2.2.3 MECHANICAL ATTRIBUTES OF THE WASTE PACKAGE ENVIRONMENT

S. Blair, Task Leader

OBJECTIVE

Determine the mechanical properties and behavior of Topopah Spring tuff in the vicinity of waste packages. Evaluate the mechanical response of the waste package environment to emplacement of waste. Design, execute, and interpret laboratory and field-based experiments, tests, and studies to provide data for numerical analysis. Develop and evaluate computational and conceptual models to support long-term predictions of the mechanical behavior of the waste package environment.

ACTIVITIES AND ACCOMPLISHMENTS

A Comment Resolution Meeting for the Study Plan for Characterization of Mechanical Attributes of the Waste Package Environment (Study Plan 8.3.4.2.4.3) is scheduled to be held on July 8-9 at LLNL.

Began an evaluation of the Postclosure Rock Characteristics Guidelines in 10 CFR 960 for the Early Site Suitability Evaluation (ESSE) study.

Internal QA grading was completed for:

- 1) GM-01.1, Scoping Geomechanics Properties Measurements,
- 2) GM-03.1, Scoping Geomechanic Code and Model Development, and
- 3) GM-05.1, Scoping/Prototype Model Applications for Geomechanical Analysis.

WBS 1.2.2.2.4 ENGINEERED BARRIER SYSTEM (EBS) FIELD TESTS

W. Lin, Task Leader

OBJECTIVE

Conduct and evaluate exploratory shaft tests and experiments to help characterize the site's suitability for the development of a repository. Conduct prototype testing to prepare for EBS field test.

ACTIVITIES AND ACCOMPLISHMENTS

Internal QA grading was completed for:

- 1) EB-01.1, Samples Analyses for Engineered Barrier System Field Prototype Test
- 2) EB-02.1, Engineered Barrier System Field Prototype Test, and
- 3) EB-05.1, Scoping Calculations for Engineered Barrier System Field Prototype Test.

WBS 1.2.2.3.1.1 WASTE FORM TESTING - SPENT FUEL

R. Stout, Technical Area Leader

OBJECTIVE

Characterize the behavior of and determine the radionuclide release rates from the spent fuel waste form under tuff repository conditions in order to establish a data base and conceptual models to support predictions of the engineered barrier system performance necessary for license application in accord with the requirements of 10 CFR Part 60 and 40 CFR Part 191.

ACTIVITIES AND ACCOMPLISHMENTS

A meeting was held on the Waste Form Characterization Report with YMPO personnel at LLNL on May 7.

Spent Fuel Leaching/Dissolution Tests (H. Leider, Task Leader)

Flow-through dissolution tests were carried out on UO_2 and schoepite ($\text{UO}_3 \cdot 2\text{H}_2\text{O}$) at 25°C . Four carbonate/bicarbonate solutions were used, with initial pH ranging from 8 to 10; however, it was observed that with time, all pH's approached a value of ~ 9.65 . This was also seen in initial tests with spent fuel at PNL. The pH behavior is due to loss of CO_2 from solution as argon containing various amounts of oxygen is bubbled through the leaching solutions. Such an effect is predictable because carbonate/bicarbonate solutions have a finite equilibrium fugacity of CO_2 in the gas phase, but it was expected that the changes would be much slower than was actually seen. The solution absorbs CO_2 from or evolves CO_2 to the atmosphere, depending

on the particular solution involved. This problem is being corrected by slowly sparging the solutions with air containing appropriate concentrations of CO_2 . The limited experience at LLNL and PNL with this approach to date indicates that it will be an effective method for stabilizing the pH.

Early interpretation of the experiments shows:

- 1) the dissolution rate of UO_2 increases with increasing carbonate/bicarbonate concentration,
- 2) dissolution rate depends on O_2 fugacity at high (0.2M) carbonate/bicarbonate concentration but not at low concentration (0.002M)
- 3) tests on schoepite and dehydrated schoepite also show that dissolution rate increases with increasing carbonate/bicarbonate concentration and is unaffected by O_2 fugacity, as expected since uranium in schoepite is fully oxidized.

Pacific Northwest Laboratory

Spent Fuel Leaching/Dissolution Tests

Stabilization of the 2×10^{-4} M Na_2CO_3 solution at pH = 10 requires the CO_2 concentration in the cover gas to be about 1 ppm. Rather than purchasing a pre-mixed gas, the carbonate solution was sparged with atmospheric air after passing it through Ascarite absorbent to remove the CO_2 . During testing that was conducted to determine the suitability of the Ascarite method, the water supply bottle was switched from polyethylene to glass. Following this change, the uranium concentration in the column effluent dropped immediately by a factor of about 10 and continued to drop over the next 10 days by another factor of about 10. Silicon dissolved from the glass bottle was apparently responsible for the decreased dissolution rate. Inductively Coupled Plasma Mass Spectrometry (ICP-MF) of the solution indicated the Si concentration to be about 1.5 ppm. The supply bottle was switched back to polyethylene and the test was restarted using a fresh sample of fuel.

One additional flow-through column was started during May. It was loaded with spent fuel fragments that were archived from one of the Series 3 tests previously terminated. Water from the J-13 well at Yucca Mountain, which is the same water used in the semi-static Series 3 test, is being pumped through this column. Preliminary evaluation of the early results from this test indicates that the dissolution rates in the flow-through test are approximately equal to those observed for the soluble radionuclides in the last cycle of the Series 3 test.

Hot Cell Operations

This activity is now reported under "Spent Fuel Oxidation" (MCC-PNL).

Argonne National Laboratory

YMP Series 5 Spent Fuel Leach (SFL) Tests

No significant activities.

Saturated Tests with Unirradiated UO_2

No significant activities.

Unsaturated Tests with Unirradiated UO_2

No significant activities.

Lawrence Berkeley Laboratory

Electrochemistry of UO_2 Dissolution

No significant activities.

Spent Fuel Oxidation (R. Stout, Task Leader)

Lawrence Livermore National Laboratory

Oxidation Model Development

No significant activities.

Pacific Northwest Laboratory

Thermogravimetric Apparatus (TGA) Tests

No significant activities.

Dry Bath Test

The drybath tests to determine oxidation front penetration rates continue as planned. Characterization samples of ~100 mg each are being removed for the tests. Leaching samples of ~3 g have been removed from each two crucibles at 195°C. Over 20 characterization samples have been sent to the hot cells. SEM examination of some of the samples at high $\Delta(O/M)$ indicate no contamination with fluorine as found in the commercial spent fuel (CSFM) tests. X-ray diffraction (XRD) is continuing on two series of fuels that show promise for the most complete results this year. Ceramography, the primary source of information from these tests, will start shortly when the new examination facility is finished. A total interim examination on all drybath samples was completed in May. The next full interim weighing is scheduled in August.

R. Einziger of PNL met with R. Stout in Las Vegas to discuss the progress of the test and the technical interpretation of the data. A draft of the paper, "Grain Boundary Oxidation of PWR Spent Fuel in Air", was transmitted to LLNL for approval. Work continues on a draft of the paper for the Focus '91 meeting, although no word of acceptance/rejection has yet been obtained.

MCC - Pacific Northwest Laboratory

Spent Fuel Characterization

This activity will include the additional workscope funded by LLNL and the activities previously reported as "Hot Cell Operations" under "Spent Fuel Leaching/Dissolution Tests" (PNL). There is nothing significant to report this month as funding has not been received by PNL for the increase in workscope for this activity.

Zircaloy Cladding Corrosion (R. Stout, Task Leader)

Lawrence Livermore National Laboratory

Stress Analysis of an Oxide Film on a Zircaloy Cladding

No significant activities.

Zircaloy Hydride Modeling

No significant activities.

Pacific Northwest Laboratory

C-Ring Experiments

No significant activities.

Pressurized Cladding Stress Corrosion Cracking Test

No significant activities.

Fluoride/Cladding Interaction Test Development

No significant activities.

Carbon-14 Release and Concentration Profiling for Spent Fuel Cladding

No significant activities.

WBS 1.2.2.3.1.2 WASTE FORM TESTING - GLASS

W. Bourcier, Task Leader

OBJECTIVE

Characterize the behavior of and determine the radionuclide release rates for glass waste forms under tuff repository conditions in order to establish a data base and conceptual models supporting predictions of engineered barrier system performance necessary for license application in accord with the requirements of 10 Part CFR 60 and 40 CFR Part 191.

ACTIVITIES AND ACCOMPLISHMENTS

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

The N2 tests (SRL actinide-doped glass) continued as scheduled with no sampling period occurring this month; these tests have been in progress for 276 weeks. The N3 tests (ATM-10, a West Valley actinide-doped glass) continued as scheduled; these tests have been in progress for 194 weeks.

D-20-28: Static Leach Testing of WVDP and DWPF Glass

No significant activities.

D-20-29: Parametric Studies of WVDP and DWPF Glasses Based on the Unsaturated Test

Review comments on the ANL Topical Report by A. Woodland, J. Bates and T. Gerding entitled "Parametric Effects on Glass Reaction in the Unsaturated Test Method" were addressed, and the report was returned to LLNL.

D-20-30: Parametric Studies of WVDP and DWPF Glass

The paper "Mechanistic Interpretation of Glass Reaction: Input to Kinetic Model Development" was presented by W. Ebert of ANL at the ANS meeting on May 2 in Las Vegas.

D-20-31: Studies of Glass Surface Layers and Precipitation

An abstract by J. Mazer entitled "AEM Analysis of SRL 131 Glass Altered as a Function of SA/V" was submitted for project review and presentation at the Symposium for the Scientific Basis for Nuclear Waste Management XV, November 1991. All Analytic Electron Microscope (AEM) samples have now been prepared, and detailed analysis of the reacted layers is in progress.

The manuscript by W. Ebert, J. Bates, and W. Bourcier entitled "The Hydration of Borosilicate Waste Glass in Liquid Water and Steam at 200°C" was revised and

resubmitted for consideration based on reviewer comments received from the journal and from LLNL staff.

D-20-32: Geochemical Interactions

The fabrication of flow-through cells for the dissolution work is complete. The plumbing design sketch for the first test series was drafted and the tubing connections and fittings have been assembled. The final buffer compositions have been selected. Approximately 16 cells will be used in the first series, with 13 powders and 3 monoliths. Glass powders and monoliths have been prepared and are ready for use.

Because of a recent tritium release, another Environmental Safety and Health (ES&H) inspection is being performed of all buildings at LLNL operated by the Nuclear Chemistry Division. As a consequence, laboratory work in these buildings is on hold pending completion of the inspection. Work should resume by May 24.

All precursor QA planning documents have been completed and FY91 flow-through tests for glass tasks are ready to begin but will not be performed due to lack of funds. These experiments are being placed on hold pending determination of FY92 funds.

D-20-34: Development of Licensing Database for Glass Waste Form Materials Interactions

R. Stout and B. Bourcier attended a meeting on May 7 at LLNL to evaluate the status of the draft Waste Form Characterization Report with DOE-YMP and SAIC staff.

D-20-37: Generate Models for Release From Glass

An abstract entitled "Toward a Consistent Model for Glass Dissolution" by D. Strachan, W. Bourcier, and B. McGrail was submitted for publication in the Radioactive Waste Management Journal. This paper will be a joint product of modeling work at PNL and LLNL with the purpose of providing a focus for future model development and experimental efforts.

B. Bourcier attended the Nuclear Waste Technical Review Board Meeting in Reno on April 16 and presented a talk on the use of natural analogs in validating a glass performance model.

B. Bourcier met with R. Atabek and M. Jorda from CEA, Fontenay-aux-Roses, France on May 7, to discuss current developments in glass modeling in the French and U.S. nuclear waste programs.

The problem in the GT code that caused the code to crash for some input problems was fixed. The cause had to do with mineral phases that contain trace amounts of some constituents. These types of phases are specific to the most recent LLNL database that was recently modified to be used by the GT code. The author of the GT code provided the fix.

The Scientific Investigation Plan (SIP) WF-02 was revised and submitted for approval. The revisions were made to re-organize the activities to better reflect current and planned work. The revisions also removed references to the old QA level assignments and replaced them with the new QA grading process.

The Activity Plan D-20-66 "Glass Dissolution Tests to Provide Fundamental Kinetic Data on Glass Dissolution Rates and Mechanisms" (which governs the flow-through tests at LLNL) and QA grading sheets were submitted for approval. The Test Plan for the flow-through tests was completed and is also waiting for approval.

WBS 1.2.2.3.2 METAL BARRIERS

D. McCright, Task Leader

OBJECTIVE

Select a metallic material of construction for the waste package container, and then characterize the behavior of the metal barrier and determine corrosion rates and mechanisms, characteristics of other degradation modes, and mechanical and microstructural properties.

ACTIVITIES AND ACCOMPLISHMENTS

Task Management

On May 10, R. Staehle, University of Minnesota, met in a technical exchange with W. Clarke's technical staff to discuss cumulative damage functions. Staehle is funded by DOE/HQ as part of the PASS program. The topic of this seminar was "Four Step Approach to Predicting the Performance of Radioactive Waste Containers".

G. Gdowski is working with L. Jardine to document the history of the decision to use the radioactive waste decay heat to keep water away from the waste packages. This assignment also involves documenting the advantages and disadvantages of maintaining the temperature above the boiling point.

W. Clarke attended Advisory Board meeting of the University of Nevada, Reno on May 3.

Task Quality Assurance

An internal audit of the Container Materials Technical Area was held May 14-15. There was one finding from the audit - lack of timely completion of internal QA grading. The initial part of the grading process is complete and a formal meeting to review is scheduled for June 14.

Scientific notebooks used by the staff were surveilled and technically reviewed.

E-20-13: Degradation Mode Surveys

Work continues on the degradation mode surveys for additional alloy systems. The report on the nickel-chromium-molybdenum alloys has received approval by the Project Office, and the report is being processed through TID.

E-20-14: Co-ordination with Design, Fabrication, and Prototype Testing

No significant activities.

E-20-15: Selection Criteria

No significant activities.

E-20-16: Model Development

G. Henshall's modeling effort currently consists of exploring the effects of environmental variables on the pitting response, using the approach discussed in last month's report. This approach simulates the effects of environment on the stochastic parameters:

- 1) birth probability
- 2) death probability, and
- 3) the critical embryo age required to produce a stable pit.

The environmental variables considered are:

- 1) applied potential
- 2) chloride ion concentration, and
- 3) temperature.

Empirical equations have been developed for these parameters in terms of the environmental variables.

An interesting question to explore with the model is whether a threshold exists in the potential (the so-called critical potential) at which pitting occurs or whether the pit initiation rate just becomes very slow as the potential is reduced. The question is particularly relevant for nuclear waste containment because of the extremely long times involved. The stochastic model has been used to explore the effect of the applied potential on the median induction time required to initiate a pit. Two forms of pitting equations have been used in the model - incubation time is inversely proportional to (potential minus critical potential) and incubation time is inversely proportional to the exponential of the potential. The first form would produce no pits, even over geologic time spans, if the potential is subcritical. The second form would produce pits at very long times, even at low potential.

The effects of chloride on the pit initiation behavior were also explored using the stochastic model. An increase in the slope of the survival probability plot with increasing chloride concentration was produced by the model, as expected. More quantitatively, the relationship between the induction time and chloride was examined. From the literature, this relationship is suggested as an inverse function, and the simulation indicates that this is a reasonable, though not perfect, description.

Finally, the influence of temperature on pit initiation was explored with the stochastic model. Data in the literature show that the effect of temperature on pitting behavior is complex, and the pitting induction time may increase or decrease with increasing temperature. The reason that the model is able to simulate this type of behavior is that temperature affects the stochastic parameters in different ways, such that their effect on the induction time is different. Specifically, an increase in temperature increases the pit birth rate and death rates while decreasing the time required to produce a stable pit. However, the increase in the pit death rate increases the induction time, thereby providing the model with a means to simulate complex temperature dependencies.

E-20-17: Technique Development

The Metal Barrier Task group met on May 21 and discussed electrochemical testing/modeling plans (Activity E-20-18) for the remainder of FY91. The group decided to:

- 1) re-examine the critical potential data already obtained for Alloy 825 over a range of temperature, pH, and chloride concentration,
- 2) determine where additional data points are needed to fit a three-variable factorial design experiment,
- 3) obtain the needed data,
- 4) perform the analysis.

The goal is to derive a parametric equation expressing the critical potential as a function of the above three environmental variables. This work will be the focus of a presentation planned for the Focus '91 Conference to be held in Las Vegas in September and for the NACE Corrosion '92 Conference to be held in Nashville, TN in April 1992. This work will also provide information for the Model Development Activity (E-20-16).

E-20-18: Parametric Studies

The work conducted under E-20-17 (Technique Development) will eventually be incorporated into this activity. The reason why this could not be done earlier relates to calibration of the potentiostats used for determining the critical potentials. D. Fleming is now working on a way to perform user-calibration (or rather user-confirmation) of the instruments using an ASTM G-5 procedure. Materials for conducting the user-confirmation have been received.

E-20-19: Container Material Selection

A summer student, D. Lathi, from MIT arrived on May 15. He is working on a compilation of various mechanical properties of an expanded list of candidate materials (from Activity E-20-13, Degradation Mode Surveys). This work will be used in the materials selection for the preliminary candidate materials for the metallic barrier.

WBS 1.2.2.3.4.1 INTEGRATED RADIONUCLIDE RELEASE: TESTS AND MODELS

M. ten Brink, Task Leader

OBJECTIVE

Characterize and model the integrated behavior of the waste forms, barrier materials, and surrounding environment.

ACTIVITIES AND ACCOMPLISHMENTS

The core flow-through apparatus pump line was tested to reduce pulsation and volume. Test specimens were prepared, and calibration was arranged. An Operational Safety Procedure was submitted to LLNL management.

Instrument maintenance efforts involved changing ion sources, re-aligning and adjusting the primary-beam rastering electronics and changing the oil in the turbomolecular pumps. An EGA card, an optical disk drive and an x-y display unit

were installed in the instrument-controlling IBM PC. Also, data were generated for uranium sensitivities and useful yields in silicon.

Tuff samples were inspected and prepared for fracture characterization.

Additional training was received on photon correlation spectroscopy (PCS).

The laboratory was cleaned up in preparation for the DOE Health and Safety inspection.

Staff participated in three integration meetings with the Geochemistry Task:

LLNL staff,
YMPO (A. Simmons and P. Cloke), and
I. Triay of LANL.

Task personnel prepared for the Software QA audit by:

- 1) completing annual review of Scientific Notebooks,
- 2) verifying that all paperwork was up-to-date,
- 3) organizing data files, and
- 4) following up on calibration for thickness standards

Continued working on TIPs.

Reviewed budget and planning charts.

WBS 1.2.2.3.4.2 THERMODYNAMIC DATA DETERMINATION

R. Silva, Task Leader

OBJECTIVE

Obtain thermodynamic data that has been identified as needed by the Integrated Testing, Spent Fuel Testing, Glass Waste Form Testing, and Package Environment tasks, but which may be unavailable or in question. Thermodynamic data on the formation constants of solid phases and solution species identified as important for modeling solubilities and speciation of major components likely to form under the repository conditions will be obtained. This will include data to model changes due to elevated temperature (e.g., up to 125°C), anticipated variations in Eh and pH, and changes in solution compositions. Data is passed through to the data base development task in WBS 1.2.1.4.5 for incorporation in the geochemical modeling data base.

ACTIVITIES AND ACCOMPLISHMENTS

Spectroscopy (High-Temperature, Photoacoustic, and Photothermal Deflection)

Last month, measurement was reported of a series of spectra using the Guided Wave Spectrometer. The analysis of these spectra will provide the formation constants for americium hydrolysis at 23, 50, 75, and 95°C. The evaluation of these spectra is proceeding and the analysis will be ready for the next reporting period.

High-Temperature Calorimetry

This project is not funded in FY91.

Solubility Studies

This project is not funded in FY91.

Quality Assurance Status

The Guided Wave spectrometer and the IBM UV-visible spectrometer have been calibrated in accordance with LLNL TIP's.

The Task Leader has conducted an annual review of the scientific notebooks, comments have been addressed, and copies of all the pages have been submitted to the Local Records Center.

The Nuclear Chemistry Division was recently audited by the DOE for compliance with Environmental Safety and Health standards. Industrial Safety, Industrial Hygiene, Radiation Containment and Fire Protection disciplines were evaluated.

WBS 1.2.2.4.1 WASTE PACKAGE DESIGN

D. Ruffner, Technical Area Leader

OBJECTIVE

Execute the waste package design concepts. The activity will produce plans and specifications for the waste package concepts for Advanced Conceptual Design (ACD) and License Application Design (LAD). Analyses to support the container designs and performance assessments will be conducted.

ACTIVITIES AND ACCOMPLISHMENTS

No significant activities.

WBS 1.2.2.4.2 CONTAINER FABRICATION AND CLOSURE DEVELOPMENT

W. Clarke, Technical Area Leader

OBJECTIVE

Develop processes for fabrication, closure, and inspection of the waste package; to provide input to the metal barrier selection process; and to fabricate and test prototype units from the resultant drawings and specifications. The task involves four activities: fabrication and closure process development, inspection process development, prototype fabrication and testing, and materials acquisition.

ACTIVITIES AND ACCOMPLISHMENTS

No significant activities.

WBS 1.2.2.4.3 CONTAINER/WASTE PACKAGE INTERFACE ANALYSIS

D. Ruffner, Technical Area Leader

OBJECTIVE

Develop waste packages concepts consistent with qualified materials and processes and that are fully compatible with the repository design.

ACTIVITIES AND ACCOMPLISHMENTS

Preparation continues for the June DOE-EBS Workshop in Denver.

1.2.5 REGULATORY AND INSTITUTIONAL

WBS 1.2.5.2.1 NRC INTERACTION SUPPORT

J. Blink, Assistant Project Leader

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

L. Jardine, W. Halsey and W. O'Connell attended the NWTRB Panel on Risk and Performance Analyses held in Washington, D.C., May 20-22. L. Jardine presented a paper entitled "Preclosure Performance Assessment", and W. O'Connell gave a presentation entitled "Source Term Development".

B. Bourcier attended the Nuclear Waste Technical Review Board Meeting in Reno on April 16 and presented a talk on the use of natural analogs in validating a glass performance model.

WBS 1.2.5.2.2 SITE CHARACTERIZATION PROGRAM

L. Ballou, Associate Project Leader

OBJECTIVE

Support the DOE in the completion of the Site Characterization Plan. Provide ongoing technical planning and support of site characterization activities. Integrate results into site characterization activities and program as appropriate, monitor each site program, serve as the interface between the principal investigator and the DOE/HQ.

ACTIVITIES AND ACCOMPLISHMENTS

A revision to the SCPB to incorporate Man-Made Materials activities into the Waste Package Environment Testing area was sent to the Change Request office on May 28.

LLNL staff attended the Core Group review of the Early Site Suitability Evaluation (ESSE) methodology briefing in Las Vegas on May 1. In addition, LLNL staff participated in the May 14 and 23 ESSE telecons.

As part of LLNL's support to the ESSE activity, LLNL completed a draft evaluation of the Postclosure Rock Characteristics Guideline for internal review.

WBS 1.2.5.2.4 TECHNICAL SUPPORT DOCUMENTATION

J. Blink, Assistant Project Leader

OBJECTIVE

Support DOE/HQ in the development and implementation of the plan for documenting DOE's compliance with NRC regulatory requirements.

ACTIVITIES AND ACCOMPLISHMENTS

No significant activities.

WBS 1.2.5.2.5 STUDY PLAN COORDINATION

L. Ballou, Associate Project Leader

OBJECTIVE

Coordinate the preparation review and revision of SCP Study Plans.

ACTIVITIES AND ACCOMPLISHMENTS

D. Emerson reviewed the comment responses to USGS Study Plan 8.3.1.17.3.4, "Effects of Local Site Geology on Surface and Subsurface Motions".

C. Bruton reviewed the LANL Study Plan 8.3.1.3.1.1, "Ground Water Chemistry Model of Yucca Mountain".

WBS 1.2.5.2.6 SEMI-ANNUAL PROGRESS REPORTS

J. Blink, Assistant Project Leader

OBJECTIVE

Provide support to DOE/HQ for the development and preparation of the Site Characterization Semi-Annual Progress Reports.

ACTIVITIES AND ACCOMPLISHMENTS

The draft report was received from YMPO for comments on May 31.

1.2.9 PROJECT MANAGEMENT

LLNL responded to 15 CCB-Affected Document Notices.

WBS 1.2.9.1.1 MANAGEMENT

L. Jardine, Technical Project Officer

OBJECTIVE

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

ACTIVITIES AND ACCOMPLISHMENTS

Technical presentations were given at a LLNL-YMP staff meeting:

- 1) C. Hoenig gave a presentation on "The Role of Ceramic Materials in High Level Radioactive Waste".
- 2) J. Blink and B. Bryan gave a presentation on QA grading, scientific notebook procedures, and document reviewer procedures.

An internal QA grading transition plan was prepared.

LLNL hosted the YMP Quality Integration Group Meeting on May 7.

J. Blink and S. Sprague participated as hosts for the YMP Open House held at NTS on May 10.

WBS 1.2.9.1.4 RECORDS MANAGEMENT

B. Bryan, Project Administrator

OBJECTIVE

Provide a Yucca Mountain Project Records Management System that will meet the requirements of; DOE-NNWSI, Quality Assurance Plan, DOE-NNWSI/88-9; DOE-OCRWM Records Management Policies and Requirements, DOE/RW-1094; and the Licensing Support System (LSS). Establish and operate all local records centers.

ACTIVITIES AND ACCOMPLISHMENTS

Document Control issued eight Change Notices and seven new issues under controlled distributions. Routine follow-up for receipt acknowledgements continues.

A total of 279 items were logged into the LLNL-YMP tracking system. This includes 86 records/records packages that were processed through to the CRF. Seventeen actions items were closed.

As part of the cross training for Records/Document control, two staff members from LLNL visited the Project Office on May 1 for a tour and to observe the operations of the CRF.

WBS 1.2.9.2 PROJECT CONTROL

J. Podobnik, Resource Planning and Control Manager

OBJECTIVE

Provide Project management support in the areas of cost and schedule planning and control. Develop and maintain an integrated project management system. Implement performance measurement. Support change control system. Establish WBS.

ACTIVITIES AND ACCOMPLISHMENTS

The May FTE report and Cost Plan were submitted to YMPO.

The YMPO Performance Measurement Baseline and LLNL PACS database are being analyzed to determine differences and make modifications as required.

Actual costs, latest revised estimates, and actual schedule data were submitted to the YMPO PACS system. A down loaded LLNL accounting system report was obtained for use as a database for future monthly PACS status reports.

J. Podobnik attended a YMPO Project Control Steering Committee meeting in Las Vegas on May 22.

Staff attended LLNL meetings held for the DOE budget verification process of the FY93 FWP. YMP planning process documents and procedures were provided to audit teams. No specific findings or observations were recorded.

Staff are preparing for the Capital Equipment Audit and the DOE QA audit both scheduled for June 1991.

Staff are preparing responses to YMPO inquiries regarding potential use of counterfeit parts in LLNL-YMP activities.

P. Comstock attended a five day Primavera 4.0 training course in project control techniques and procedures using Primavera and Primavision.

WBS 1.2.9.3 QUALITY ASSURANCE

R. Dann, Quality Assurance Manager

OBJECTIVE

Establish and implement a Yucca Mountain quality assurance program.

ACTIVITIES AND ACCOMPLISHMENTS

Completed Internal Audit 91-08, "LLNL-YMP Near-Field Environment Characterization", and issued AFR-006.

Completed Internal Audit 91-03, "LLNL-YMP Materials Testing and Characterization", and issued AFR-010.

Completed Internal Audit 91-09 "LLNL-YMP Performance Analyses", and issued AFRs-007 through -009.

Completed Internal Surveillance S91-01, "Status Review of SIPs, Activity Plans, TIPs, and QA Grading for Scheduled Audits". No NCRs or AFRs were issued.

Placed the LLNL Electronic Services Group on the LLNL-YMP Qualified Suppliers List based on LLNL-YMP Audit 91-13.

Transmitted to YMPO QAPP Change Notice 033-YMP-R 1-0-5 for Project approval.

Responded to Corrective Action Request (CAR) YM-91-042 resulting from YMQAD Surveillance YMP-SR-91-013.

R. Dann attended the QA Managers Meeting in Las Vegas on May 9-10.

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