University of California
Lawrence Livermore National Laboratory

NUCLEAR WASTE MANAGEMENT PROGRAM

~~CONTROLLED COPY NO.~~ 141

EFFECTIVE DATE IS
MAY 11 1988

No.: 033-NNWSI-P 13.1
Revision: 0
Date: APRIL 21, 1987
Page: 1 of 7

Subject:
SEE BELOW

Approved:
(SEE PAGE 2)

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COLLECTION, STORAGE, AND DISTRIBUTION OF J-13 WATER

ENCLOSURE 2

8911270025 891115
PDR WASTE PDC
WM-11

Approved by:

J. Ramspott 4-30-87

Lawrence D. Ramspott
NNWSI Project Leader

Originated by: Dennis Peifer 4-30-87
Dennis Peifer Date

Reviewed by: Jesse L. Yow Jr. 4-29-87
Jesse L. Yow Jr. Date
Deputy Project Leader
for NNWSI

Reviewed by: William Glassley 4/30/87
William Glassley Date
Task Leader

Reviewed by: John J. Dronkers 4/29/87
John J. Dronkers Date
Deputy Program Leader
for QA

COPY

TABLE OF CONTENTS

13.1.1 SCOPE AND APPLICATION

13.1.1.1 This standard procedure applies to the collection, storage, and distribution of J-13 well water samples. J-13 water is water drawn from the J-13 well, located approximately 10 km to the east of Yucca Mountain.

13.1.1.2 Water from this well has been selected as the reference water for experimental and testing purposes and is believed to be representative of water that has flowed through and been conditioned by the same rock unit as the rock in the repository horizon. This water may be described as a nearly neutral, potable bicarbonate water containing atmospheric gases as well as trace amounts of heavy metal ion species.

13.1.2 SUMMARY OF METHOD

13.1.2.1 A standard procedure is given for collecting samples of J-13 water, both from the point of view of steps taken at Lawrence Livermore National Laboratory and at the Nevada Test Site. Procedures are also given for the storage of J-13 water and for the distribution of the water samples to individuals at Lawrence Livermore National Laboratory (LLNL) and to contractors.

13.1.3 RESPONSIBILITIES

13.1.3.1 The person responsible for use of this procedure is the laboratory technician and any technical personnel working under his direct supervision. The sample receival logbook is maintained by Dennis Peifer, Building 281, under the supervision of William Glassley.

13.1.4 EQUIPMENT AND SUPPLIES

13.1.4.1 The following is a list of equipment and supplies needed for this procedure. Equivalent items may be substituted, unless otherwise noted.

beaker, 150 mL
deionized water
drum, 55-gallon, clean, plastic-lined
drum cover, vinyl plastic
garden hose, 50 feet
nylon cable tie
pH meter/buffers (This equipment is to be calibrated in accordance with 033-NNWSI-P 12.6)
polyethylene bottle, capped
tape
thermometer

13.1.5 PROCEDURE

General

13.1.5.1 A clean, plastic-lined white 55-gallon drum is picked up from the Toxic Waste Group in Trailer 6179.

13.1.5.2 The drum is provided with a tamper-proof label with the identification of J-13, the date, and the drum serial number. The date is to include the month, day, and year.

13.1.5.3 Rinse the drum with deionized water. Fill the drum with deionized water, and take a sample of the water in a labeled bottle to conduct an anion and cation (ICP) analysis. The label on the bottle should include the identification of J-13, the date, and the drum serial number. This identifying information and the results of the analyses are recorded in the laboratory notebook.

13.1.5.4 Cover the drum with a vinyl plastic drum cover and seal it with a nylon cable tie to prevent tampering by unauthorized personnel. The cable tie is to be etched with the date and drum serial number.

13.1.5.5 Set the filled drum in the sun for 1 week. Take a sample of the water in a labeled bottle. Cover and seal the drum in the same manner described in paragraph 13.1.5.4. Conduct an anion and cation (ICP) analysis and record the results along with the identifying information in the laboratory notebook. Compare the two sample analyses to determine whether the water leached anything from the drum liner. If leaching is evident, discard the drum and water and begin the procedure again.

13.1.5.6 If leaching of the drum liner is not evident, the drum can be emptied, sealed, and shipped to the Nevada Test Site through the LLNL shipping department. When the drum arrives at the Nevada Test Site, it is to be stored at the LLNL warehouse.

13.1.5.7 Arrange through the LLNL Travel Office to have a three-quarter ton pick-up truck at the Nevada Test Site. The truck will be needed to pick-up the drum and the garden hose (labeled J-13) at the LLNL warehouse (the hose is stored on a rack inside the warehouse). Be sure the drum seal is not broken. If the drum seal is broken, a new drum must be obtained and the procedure started again.

13.1.5.8 Before leaving for the Nevada Test Site, contact John Green, ReeCo, and inform him when you expect to arrive. He will arrange to have someone ready to go to Well J-13 to turn it on.

Collection

13.1.5.9 After picking up the truck at the Nevada Test Site, contact John Green and let him know you have arrived. By the time you reach the site, which is about 1 hour away, the well should have been turned on.

13.1.5.10 When you arrive at the well pump, let the pump run for approximately 30 minutes to assure fresh water in the line.

13.1.5.11 When ready to collect samples, turn on the spigot and let the water run for 30 seconds. Measure and record in the field notebook the temperature and pH of the water collected in a clean beaker. Do not insert the thermometer probe into the sample collected for analysis. First rinse the bottle twice with a small amount of sample to assure an uncontaminated container. Then draw a 250-mL sample of water in a clean, labeled, capped polyethylene bottle and seal the bottle with tape.

13.1.5.12 Connect the 50-foot plastic garden hose; turn on the water and let it run for 5 minutes. Measure and record in the field notebook the temperature and pH of the water collected in a clean beaker. Rinse a clean polyethylene bottle twice with small amounts of the sample. Then draw a 250-mL sample of water into the clean, labeled, capped polyethylene bottle and seal the bottle with tape. Bring these samples back to LLNL for cation and anion analyses. Record the results and the identifying information in the laboratory notebook.

13.1.5.13 Rinse the drum with the J-13 water, twice. The proper way to rinse the drum is to fill it one-third full with water, set it on its side, and roll it before draining it.

13.1.5.14 Fill the drum with J-13 water until it overflows; do not let the outside surface of the hose touch either the drum bung or the water in the drum.

13.1.5.15 Place a cap on the drum, being careful not to permit any air between the water and the cap. Cover and seal the drum in accordance with paragraph 13.1.5.4. Return the drum to the LLNL warehouse for shipment to LLNL.

Storage

13.1.5.16 When the drum is received in the LLNL receiving department, it is put on a pallet and then delivered to Dennis Peifer in Building 281. When the drum arrives at Building 281, the date and the drum serial number are logged in the sample receival logbook kept in Building 281.

13.1.5.17 The seal is cut and a lockable stainless steel drum faucet is installed in the drum. The only key to the faucet is kept by Dennis Peifer. Samples are to be collected through this lockable faucet and are to be preceded by a 50-mL draw that is discarded.

13.1.5.18 Draw a 250 mL sample of water into a labeled polyethylene bottle, measure the temperature and pH, and send the sample for cation and anion analyses. Record the results and the identifying information in the laboratory notebook. Compare the sample analyses to determine whether there are discrepancies. If there are discrepancies, and they cannot be corrected, discard the drum and water and begin the procedure again.

13.1.5.19 Store the drum in refrigerated transportainer #28 (in Building 281), which will keep the temperature at approximately 30°C.

13.1.5.20 Keep a padlock on the door of the transportainer so that access is limited and can be controlled. Dennis Peifer presently has the keys to the transportainer.

13.1.5.21 Undistributed samples, whether in the drum or in sample bottles, are to be locked up in a cabinet or other similar storage facility. Only one or two designated persons are to have access to such facilities. Presently, Dennis Peifer and William Glassley have access to these facilities, which are in Building 281.

Distribution

13.1.5.22 When samples are distributed from the drum, the following information is entered in the sample receival logbook: the person who is receiving the sample, sample identification, the date, the serial number of the drum, the quantity received, and where the sample will be stored. The person who draws the sample must sign the logbook.

13.1.5.23 When samples are distributed from the drum, the following information is marked on the sample bottle: the person who is receiving the sample, sample identification, the date, the serial number of the drum, the quantity received, and where the sample will be stored.

13.1.6 RECORDS

13.1.6.1 The documents produced by this technical procedure are: (1) this procedure; (2) the results of the cation and anion analyses from paragraphs 13.1.5.3, 13.1.5.5, 13.1.5.12, and 13.1.5.18; (3) the samples; and (4) the sample logbooks maintained at the Nevada Test Site and at the LLNL.

University of California
Lawrence Livermore National Laboratory

EFFECTIVE DATE IS
MAY 11 1988

NUCLEAR WASTE MANAGEMENT PROGRAM

CONTROLLED COPY NO. 141

No.: 033-NNWSI-P 13.1
Revision: Interim Change Notice
Date: April 18, 1988
Page: of
Addition

Subject:
"Interim Change Notice"
Collection, Storage, and Distribution of J-13 Water

Approved: for David W. Short 4-19-88
NWMP Deputy Project Leader
for NNWSI

UNCONTROLLED

Reviewed by: John J. Dronkers 4/19/88
John J. Dronkers Date
Deputy Program Leader for
Quality Assurance

13.1.4.1 (third line down on list) Change to read:

drums, 55-gallon clean, plastic-lined (number of drums should correspond to the number of drums of water to be collected, as specified by the individual(s) requesting the action).

13.1.4.1 (fourth line down on list) Change to read:

drum covers, vinyl plastic, one for each 55-gallon drum.

13.1.4.1 (seventh line down on list) Change to read:

pH meter/buffers (This equipment to be calibrated in accordance with the manufacturer's instructions.)

13.1.4.1 (ninth line down on list) Change to read:

2 polyethylene bottles (250mL), capped.

UNCONTROLLED

13.1.5.11 (replace paragraph) Change to read:

When ready to collect samples, turn on the spigot and let the water run for 30 seconds to allow flushing of the piping and rinsing of the spigot surface. After the water has flowed for at least 30 seconds, rinse a clean beaker in the flowing water. Collect in the beaker a sample of water and immediately measure the water pH using a pH meter that has been calibrated before use according to the manufacturer's instructions. Record the result in the field notebook. Measure the water temperature by inserting a temperature probe or thermometer into the beaker immediately after completing the pH measurement. Record the temperature in the field notebook. Rinse a 250-mL polyethylene sample bottle twice in the flowing water to assure an uncontaminated container. Collect a 250-mL sample, cap and label the sample bottle with the date and identification number, and seal the bottle with tape. Record the sample bottle number in the field notebook.

13.1.5.15 (replace paragraph) Change to read:

Place a cap on the drum, being careful not to permit any air between the water and the cap. Cover and seal the drum in accordance with paragraph 13.1.5.4. Repeat the steps in paragraphs 13.1.5.13 through 13.1.5.15 for each drum to be collected. Return the drums to the LLNL warehouse for shipment to LLNL.

13.1.5.18 (last sentence of paragraph) Change to read:

If there are discrepancies, and they cannot be attributed to incorrect analyses, discard the drum.....

13.1.5.21 (first sentence of paragraph) Change to read:

Undistributed samples in sample bottles are to be.....

13.1.5.22 (first sentence) Change to read:

When samples are distributed from a drum, or when a whole drum is distributed, the following information.....

(second sentence) Change to read:

The person who draws the sample or is responsible for the transfer of a whole drum must sign the logbook.

13.1.5.23 (first sentence) Change to read:

When samples smaller in size than a whole drum are distributed from a drum....

I- 50612

Lawrence Livermore National Laboratory

LLYMP8910184
October 27, 1989

WBS 1.2.9.
QA: N/A

ACTION YMP
INFO
AMA
AMESH
AMOE
OER

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

SUBJECT: JULY 1989 Monthly Report - LLNL

Attached is LLNL's Technical Highlights and Status Report for the month of July 1989. A Status Report has been completed for each WBS.

Leslie Jardine
LLNL Technical Project
Officer for YMP

LJJ/DK/dk
Enclosure

YMPO, L. Little
YMPO, M. Cloninger
SAIC, B. McKinnon
SAIC, D. Morissette

ACTION
CC: HARRISON-GIESLER
CC: MORLEY/CRAWLEY
CC: DOBSON/DYER
CC: FRIDRICH/NEWBURY
CC: WATERS/JONES
CC: LIVINGSTON
CC: CLONINGER/RODRIGUEZ
CC: LEVICH/GILRAY-NRC
CC: BOAK/DYMMEL
CC: ROYER/SVENAR
MUKHERJEE
WHITE, R.
VALENTINE w/o ENCL

ENCLOSURE 3

REC'D IN WMPO 10/31/89

DISCLAIMER

QA checks on data contained here have only been performed to determine that the data has been obtained and documented properly. The LLNL Waste Management 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.

I-50618
ltr

YUCCA MOUNTAIN PROJECT

MONTHLY TECHNICAL HIGHLIGHTS AND STATUS REPORT
JULY 1989

TABLE OF CONTENTS

1.2.1 SYSTEMS

WBS 1.2.1.2.4 SYSTEMS ENGINEERING
M. Revelli, P.I.

OBJECTIVE

The Systems Engineering task will coordinate the integration of LLNL technical activities into the Yucca Mountain Project Technical Baseline to support the development of a Yucca Mountain Mined Geologic Disposal System that meets DOE and regulatory requirements. This task also supports the Project-wide development and implementation of a Yucca Mountain Systems Engineering Management Plan (SEMP) that contains detailed site-specific systems engineering procedures used to meet the unique needs of the Project, as well as the requirements established in the OGR SEMP.

ACTIVITIES AND ACCOMPLISHMENTS

LLNL resumed work on the Waste Package Design Requirements (WPDR) document. Draft A was submitted to the Project Office last October and was reviewed in accordance with QMP-06-03. LLNL will complete the revision of Draft A to incorporate the QMP-06-03 comment resolutions and will deliver Draft B to the Project Office by August 31, 1989.

M. Revelli represented LLNL at a joint YMP-OCRWM Technical Data Base Management Meeting in Las Vegas on July 12, 1989. The purpose of the meeting was to define the process for data base management at both the Project and Program levels and to identify the tasks/activities necessary for implementation. The Draft YMP/AP-5.1Q (Management and Development of Technical Data on the Yucca Mountain Project) was reviewed and several changes were suggested.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Draft B of the WPDR Document will be submitted to the Project Office by August 31, 1989.

LLNL will continue to work with the Project Office and other Participants to revise the draft YMP/AP-5.1Q for the Management and Development of Technical Data.

1.2.2 WASTE PACKAGE

WBS 1.2.2.1 MANAGEMENT AND INTEGRATION
L. Jardine, TPO

OBJECTIVE

To manage and integrate work performed within the waste package WBS elements

ACTIVITIES AND ACCOMPLISHMENTS

Resolution of comments on the Waste Package Postclosure Regulatory Compliance Strategy document continued. Reviewers returned the Document Review Sheets (DRS's) indicating their acceptance or rejection of the proposed resolutions. Disputed comments were discussed with the reviewers and, as necessary, referred to YMPO for resolution. LLNL, SAIC, Weston, YMPO, and DOE/HQ staff attended a comment resolution meeting in Las Vegas on July 26-27 to agree upon final changes to the document, resulting from the QMP-06-03 review.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

The Waste Package Strategy Document will be revised in accordance with the agreements reached at the July 26-27 comment resolution meeting, and a final draft will be delivered to YMPO by August 31, 1989.

PROBLEMS/ISSUES

None.

MILESTONE PROGRESS

WBS 1.2.2.2.1 GEOCHEMISTRY AND MINERALOGY
W. Glassley, P.I.

OBJECTIVE

The objective of this task is to develop a model of the geochemical and mineralogical behavior that may occur in the vicinity of high level waste packages emplaced in Topopah Spring tuff at the proposed repository at Yucca Mountain. Once developed, the model will be used to predict the chemical environment waste packages may experience for a range of possible scenarios, and to provide information necessary for establishing the source term to be used in calculations of travel times and release rates for those scenarios concerned with release of radionuclides.

Development of this model requires detailed information regarding the chemical and mineralogical consequences of liquid and vapor phase water interacting with tuff at elevated temperatures and radiation levels. Obtaining rates of chemical reactions, identification of reaction products, and description of initial rock and water conditions are the principle goals of this task. To accomplish these goals activities have been designed and undertaken to determine experimentally the nature of tuff/water interaction at elevated temperature, the rates at which reactions occur through dissolution and precipitation, the composition of water that exists in pores in the unsaturated tuff, and the nature of reaction processes in aqueous systems subjected to elevated radiation levels. The data resulting from these activities are incorporated into numerical simulations that will be used to generate models of the long term behavior of the near field environment.

ACTIVITIES AND ACCOMPLISHMENTS

Rock-Water Interaction

The experiments begun six months ago have continued normally. The purpose of these runs is to determine how a steady-state tuff-water system responds to perturbations in fluid composition. The approach to this problem has been to allow tuff and fluid to approach equilibrium and then inject into the reaction vessel an aliquout of fluid, which perturbs the steady state system. Sampling of fluid after perturbation allows monitoring of the approach to a new steady state. The current runs replace those that were prematurely terminated by a power outage.

The experiment is progressing normally. Solutions samples have been obtained through the first 66 days after injection of fluid. No samples were taken this month, but a solution sample will be obtained at day 120 post-injection. More than half of the solution has been removed from the bag, therefore caution must be used when considering removing more solution because of the possibility of rupturing the bag.

Data reduction continued using the analyses previously obtained. Si, Na, and Al concentrations are approaching those values obtained during the pre-injection period, and Ca and Mg remain very low. The Si concentrations

are considerably greater than expected for quartz saturation, but are lower than amorphous silica saturation values. However, the concentrations of the anions in solution are not following the trends observed before, indicating that the system is approaching a new steady state that is different from that initially attained by the system.

Solutions compositions will be monitored for approximately two months. Upon completion of the experiments, surface analysis of the rock waters will be undertaken.

Vadose Water Extraction

Work continues to be delayed because of the absence of appropriate sample material.

Single-Phase Dissolution

Dissolution and precipitation kinetics experiments of kaolinite at 80°C and low pH, and dissolution and precipitation of gibbsite at low pH and 80°C continued. The experiments are progressing normally.

Study of the dissolution and precipitation kinetics of cristobalite at 200°C continued. Steady state concentrations of silica were achieved in the dissolution experiments that were consistent with predictions from other studies. Precipitation experiments proceeded normally. However, amorphous silica, rather than cristobalite has appeared in the run products. Investigation of this material continues.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Samples will be taken of the perturbed rock-water system to monitor the resulting steady-state composition of the solution after it has been disturbed.

Dissolution and precipitation experiments will continue on the clays, cristobalites and zeolites. Expanding the experiments to cover a broader range of pH values is expected.

PROBLEMS/ISSUES

The absence of rock material continues to delay the vadose water extraction activity.

MILESTONE PROGRESS

No milestones in this reporting period.

WBS 1.2.2.2.2 NEAR-FIELD HYDROLOGY & TRANSPORT
D. Wilder, P.I.

OBJECTIVE

This objective is to provide a detailed conceptual and quantitative understanding of the flow and transport processes active in the near-field waste package environment. Activities will provide a basis for the near-field flow and transport submodel to be included in the waste package performance assessment system model.

ACTIVITIES AND ACCOMPLISHMENTS

Work continued on building the models for the vertical prototype heater test including both the large and the small diameter heater borehole options.

The large diameter and the small diameter vertical cases were run for the simulation time of two years each. A comparison of the two cases shows that the temperature and saturation fields are essentially the same for the two cases. The small diameter case was rerun for two years at full power in order to determine how long it will take for the saturation fields of the central and two guard heaters to begin to coalesce.

Work is continuing on the new version of the TOUGH code and the entire code will soon be vectorized. Verification runs were made to compare the new version of TOUGH with the preceding version.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Several USGS Hydrology Study plans will be reviewed during the next three months.

PROBLEMS/ISSUES

During verification testing, a software bug in the "CRAY2-optimized" linear equation solver was detected. The author of the solver is being consulted to correct this problem. Because this person no longer works at LLNL, this may involve additional time.

MILESTONE PROGRESS

No milestones this reporting period.

WBS 1.2.2.2.3 MAN-MADE MATERIALS EFFECTS
W. Glassley, P.I.

OBJECTIVE

The objective of this task is to determine the chemical, physical, and mineralogical consequences that result from the presence in the proposed repository of man-made materials. These materials have the potential of affecting the properties of the environment waste packages must survive, and may therefore influence the performance lifetime of waste containers and waste-form leach rates. To achieve the objective of this task, activities will address the interaction of man-made materials with the host tuff, and evaluate the extent to which synergistic effects may occur among various man-made materials.

ACTIVITIES AND ACCOMPLISHMENTS

Because of the absence of funding for the remainder of FY89, no work was conducted on this task. Interviews for a prospective task leader in this area are continuing.

Under the Mechanical Attributes part of this task, revision of the Study Plan 8.3.4.2.4.3 continues with the incorporation of comments received from the SAIC screening review.

Planning documents for activities described in the above study plan have been started.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Because of the absence of funding for the remainder of FY89, no work was conducted on this task. It is expected that a task leader will be available by the beginning of FY90, at which time scientific investigation plans will be developed.

PROBLEMS/ISSUES

The absence of funding has prevented further work.

MILESTONE PROGRESS

Technical review of the report entitled Evaluation of Bentonite Packing Material in Waste Packages for a Proposed Repository in Tuff at Yucca Mountain, Nevada was completed. The paper was revised by the authors and is currently being reformatted.

WBS 1.2.2.2.4 ENGINEERED BARRIER SYSTEM PROTOTYPE TESTING
A. Ramirez, P.I.

OBJECTIVE

This activity includes planning and implementation of prototype in situ tests of the waste package environment to test hardware, methods and procedures. The results of these tests will be used to evaluate candidate hardware and methods that will subsequently be used in the ESF (Exploratory Shaft Facility).

ACTIVITIES AND ACCOMPLISHMENTS

Les Jardine was taken on a familiarization tour of the Prototype Experiment in G-Tunnel.

We are getting our first results from the scoping calculations for the vertical heater test; the large diameter heater hole specifically.

Gas permeability data is beginning to be reduced.

All geophysical surveys for the G-Tunnel Prototype Test were completed.

Capital equipment orders are being prepared for equipment to be used in the next Prototype Test.

A draft TIP for user system calibration of CPN neutron and gamma density probes is being prepared.

Work is continuing on the draft for the activity plan for the vertical prototype test.

A paper for the FOCUS 89 conference, "Prototype Engineered Barrier System Field Tests-Progress Report" was submitted to the project office.

Much time spent was spent the last week of the month, on the network schedules for the Long Range Planning exercise.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Overcoring will be starting-6 ft per day using a 12" core bit. First borehole will be finished in early August.

Continuing work on the draft activity plan.

A Criteria Letter is being prepared for the Vertical Prototype Test.

PROBLEMS/ISSUES

No problems/issues this reporting period.

MILESTONE PROGRESS

No milestones this report period.

WBS 1.2.2.2.5 EXPLORATORY SHAFT FACILITY ENGINEERED BARRIER SYSTEM TESTING
A. Ramirez, P.I.

OBJECTIVE

This activity includes planning and implementation of in situ tests of the waste package environment. The results of these tests will be used in defining the waste package environment and will aid in validating models used in performance assessment of the waste package system. This task also includes the preparation and certification of LLNL input to the Exploratory Shaft design documents.

ACTIVITIES AND ACCOMPLISHMENTS

Work is continuing on the long range planning networks.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Continue work on Long Range Planning Exercise.

Continue to provide input to ESF Title II design as necessary.

PROBLEMS/ISSUES

ESF test durations are strongly driven by project milestone deadlines. Tests of longer duration may be necessary.

MILESTONE PROGRESS

No milestones this reporting period.

WBS 1.2.2.3.1.1.L WASTE FORM TESTING - SPENT FUEL
R. Stout, P.I.

OBJECTIVE

This task involves the measurement of the radionuclide release rate from spent fuel, the oxidation rate of irradiated UO_2, and the corrosion rate of spent fuel cladding. The data obtained from the testing program are to be used as input for performance modeling of the long-term radionuclide release rates from the waste package.

ACTIVITIES AND ACCOMPLISHMENTS

Spent Fuel Leaching/Dissolution Tests (H. Leider, P.I.)

Argonne National Laboratory

YMP Series 5 Spent Fuel Leach Tests

The previous Test Plan, written for NNWSI Series 5 Spent Fuel Leaching tests, is being reformatted to conform with the new QA Level I requirements for scientific investigations (QP3.1) as required by LLNL. In addition, substantial text alterations are being made to incorporate new knowledge gained during the mockup experiments and during the recently completed study on the dissolution of UO_2 powder in J-13 water.

Saturated Tests with Unirradiated UO_2

The initiation of this experiment is awaiting the arrival of UO_2 crystals from Materials Characterization Center at PNL. The crystals will constitute the solid reactant for leaching tests in which the leachant is doped with a monoisotopic U tracer. These experiments are designed to determine the dissolution rate of UO_2 as a function of U concentration in solution.

Unsaturated Tests with Unirradiated UO_2

This study is an extension of ongoing parametric experiments (Series PMP8U). The study has a twofold objective: (1) to assess the effects of Teflon deposits on the surface formation of U-bearing phases, and (2) to study the performance of two new alloys when they are exposed to the leachate solution at 90°C.

The first of these objectives is being accomplished by performing experiments in which clad UO_2 specimens are supported by perforated plates made of 304L stainless steel instead of the previously used Teflon stands. Four replicate experiments having this configuration were initiated during this month.

To accomplish the second objective, the specimen support plates will be made of two special alloys specified by LLNL: (1) CDA Alloy 715 (70% Cu, 30% Ni) and (2) Incoloy 825. Arrangements are underway to fabricate perforated plates from these alloys. Parametric experiments for both configurations can be started as soon as the plates become available.

Electrochemistry of UO_2 Dissolution (LBL)

The effort has concentrated on both the electrochemistry of UO_2 and Raman spectroscopy. A student assistant was hired for the summer to conduct a series of electrochemical studies using different UO_2 electrodes and numerous electrolytes. The existing potentiostat was modified in order to perform limited IR compensation. Some percentage of the resistance could be offset before the voltammograms were recorded, but the static circuit did not compensate for all the IR or compensate for changes in the IR during the scans. However, suitable scans were obtained using this technique.

Cyclic voltammograms were produced by varying anodic limits between -2V and 0.5V in 0.5M Na_2SO_4 (pH = 10.48) using maximum IR compensation. These conditions are similar to those reported by Shoesmith (AECL) although our curves continue to be slightly different. Successive scans were recorded with lower anodic potentials to determine the relationship between oxidation and reduction peaks.

The effect of continuous cycling and IR compensation was also investigated. The voltammogram changes slightly after 20 scans, but not significantly. The IR compensation establishes better resolution even after 21 scans. With interactive, interrupt IR compensation, the open-circuit resistance would be measured every 20 milliseconds during the scan, and a greater influence on resolution is expected.

The influence of scan rate was observed on the voltammogram. However, this type of response (increased peak height and resolution with scan rate) was only observed using a new UO_2 pellet for electrode. Pellets that have been used (cycled through a potential range) showed the opposite effect (reduced peak definition with increased scan rate). Several new electrodes must be constructed to verify this observation. Another observation was that H_2 production at reducing potentials was always higher for electrodes cycled many times, possibly indicating increased porosity. A relationship between increased H_2 production and reduced peak definition may exist.

Several electrodes were constructed using different sanding and bonding procedures. Several of the electrodes had as little as 700 ohms resistance (measured from the Pt contact to the face of the pellet). Using the same bonding conditions, two electrodes had resistances greater than 2500 ohms.

Considerable time was spent getting the acquired Raman spectrometer to work properly. The spectrometer came with a bad photomultiplier tube (PMT) and no photon counting electronics. A PMT was installed that gives some response, but it is not adequate for general purpose use. A modulated argon-ion laser and a lock-in amplifier are used for detection. Although records of Raman spectra from organic liquids and several reagent salts were obtained, records of Raman spectra from the UO_2 pellets were not obtained yet. Work will continue in this area.

Pacific Northwest Laboratories

Static and Flow-Through Dissolution Tests

See problem issues.

Zircaloy Cladding Corrosion (R. Stout, P.I.)

Stress Analysis of an Oxide Film on a Zircaloy Cladding (LLNL)

An analysis to model the elastic plus creep material response of a Zircaloy tube surrounded by a thin oxide film continued. The model provides for a coupling between Zircaloy creep deformation and oxide film fracture response. An analytic solution has been derived for the partial differential equations of the model. Because the Zircaloy fuel rods have a distribution of initial conditions (i.e., oxide film thickness, cladding dimensions, internal fission gas pressure, irradiation damage) and different rods of the same kind may potentially have different repository temperature histories, the solution procedure is being formulated with methods from stochastic differential equations. This will permit, in a probabilistic sense, a conservative model for Zircaloy cladding failure rate that would result from stress corrosion cracking. The conservatism is established by equating the cladding failure time to the time at which the oxide film first fractures. The rationale for this shorter failure time is because the fracture of the oxide film surrounding the Zircaloy is being observed at PNL as the critical step for the initiation of the stress corrosion cracking response in Zircaloy cladding.

Zircaloy Hydride Modeling (LLNL)

A write-up of a simplified deformation-thermodynamic model for hydride precipitation kinetics continued. The model considers the deformation from the formation of zirconium hydride platelets as a discontinuity displacement in the lattice structure. This means that the deformation response due to hydride platelets of various orientations can be coupled into the thermodynamics of hydride precipitation by a stress work term. In the thermodynamics, a thermodynamic chemical potential is a functional, and according to existing experimental evidence, it has different values for different sizes and orientations of the hydride platelets. For Zircaloy cladding, the two commonly observed orientations for hydride platelets are circumferential and radial. A model and experimental data to

describe the kinetics of transitions from one orientation to the other are necessary to predict cladding failure rates due to hydride platelet precipitation and growth.

Zircaloy Modeling of C - Ring Experiments (Bryan Chin, Auburn University)

Conceptual model development to predict the anticipated damage to the Zircaloy cladding during storage in a Tuff repository is continuing. Work involved determining the sensitivity of the predicted oxide stress to temperature of formation, internal fission gas pressure, thickness of oxide formed and conditions under which stress relaxation occurs. Preliminary results indicate that internal pressure of the fission gas was the variable that affects the stress in the oxide film the most. Temperature of formation and conditions of relaxation were found to only slightly affect the predicted stress in the oxide film.

Several in-depth discussions of the oxide film predictions and the results of the dissolution experiments on unirradiated Zircaloy conducted at Auburn University were held with Brian Cox, formerly an employee of the Chalk River Nuclear Lab. Dr. Cox has published several lengthy reviews on Zircaloy oxide formation. He indicates that the predicted magnitude of 100 Ksi compression in the oxide film corresponds well with experimental data that he has seen and generated. He will send a review article describing oxide film stresses. Dr. Cox also suggested that the C-ring dissolution experiment be investigated further because the results indicate that there is a stress gradient in the oxide film. He has always felt that the stress would vary from approximately 250 Ksi at the oxide-Zircaloy boundary to 50 Ksi at the outer surface.

Pacific Northwest Laboratories

Zircaloy Cladding Corrosion Degradation

C-Ring Experiments

A draft of the paper, An Interpretation of the High-Stress, Low-Temperature Cracking of Zircaloy-4 Spent Fuel Cladding, has been written and is being reviewed internally. It has been observed that the data fall on a straight line on a log(t) vs. % yield stress plot, where t is the time to failure of the C-ring.

Pressurized Cladding Stress Corrosion Cracking Test

The experiment intended to establish a solid correlation between strain and fracture of oxide on the surface of Zircaloy will be performed in August, not July as reported earlier. During the experiment, strain gauges will be used to measure the hoop strain of the internally pressurized, oxidized cladding. To detect oxide fracture, the electrical resistance between the specimen and the synthetic J-13 well water will be measured. Polymeric insulation will be used to electrically isolate all but the oxidized

cladding surface, so that the electrical resistance between the specimen and water, originally high, will drop suddenly when the oxide fractures. Acoustic emission monitoring will be performed during the experiments as a complimentary method or an alternative to resistance. After the tests, the methods will be compared to see which gives the clearest indication of failure for the effort involved.

Welding of the end caps on the two test specimens was completed, but one specimen was rendered useless because the oxide was inadvertently removed during weld preparation. Pressurization of the specimen will be done as soon as strain gauges and acoustic emission transducers are attached and after all of the bare metal is insulated in preparation for the electrical resistance monitoring. These preparations are currently in progress.

Fluoride/Cladding Interaction Test Development

Because of Zircaloy's sensitivity to fluoride-containing solutions and the potential for limited quantities of groundwater with elevated fluoride content to develop in a tuff repository environment, the influence of fluoride ion on Zircaloy spent fuel cladding corrosion is being studied. The ratio between measured weight loss (weighed before and after a corrosion experiment) and calculated weight loss (based on corrosion rates indicated by pH stat) is approximately 0.7. The relation holds true for specimens that were anodized to produce 400 and 1000 Angstrom oxide films before experimentation as well as those that were not. It appears that fluoride stimulates Zircaloy corrosion by altering the normally protective oxide film.

Work has begun on an activity plan for the Fluoride/Cladding Interaction Test.

Carbon-14 Release and Concentration Profiling for Spent Fuel Cladding

Work has begun on an activity plan for the carbon-14 thermal release work. The procedure, "Thermal Release Rate Measurements for Carbon-14 and Tritium from Irradiated Materials", is being incorporated into that plan.

SPENT FUEL OXIDATION

Pacific Northwest Laboratories

TGA Tests

Neither TGA apparatus is operating pending successful completion of a Readiness Review of this activity at LLNL. The polyethylene tubing in both systems has been replaced by flexible stainless steel tubing and a small gas pump has been installed in system #2. A residual gas analyzer (RGA) has been connected to system #1. All of these improvements have been made to tighten the system for better off-gas sampling. New system volumes will be measured prior to the next runs.

Dry Bath Test

The dry bath tests are operating normally. The next interim examination is scheduled for the end of August. A spare replacement humidity probe was ordered to be used on a rotational basis with the current probe. No samples are being examined pending successful completion of a Readiness Review of this activity at LLNL.

Oxidation Model Development (LLNL)

Statistical model development for oxidation kinetics of UO_2 spent fuel continued. The important physical mechanisms currently being observed during the initial oxidation process appear to strongly depend on grain boundary oxidation and grain volume oxidation phenomena. Thus, the species density of grain boundaries and their associated relationship to the grain volume is being represented in terms of statistical mechanics concepts. This statistical approach is well suited for describing dual rate kinetics where the magnitudes of the rates for the individual kinetics of grain boundaries and grain volumes are different. In addition, a statistical description based on observable physical attributes should be easier to relate to other physical mechanisms and states of UO_2 oxidation for the distribution of spent fuel that will be stored in a repository.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Integrate and resolve comments on the oxidation testing activity plans that will be obtained from reviewers; and submit revised activity plans for final approval in August 89.

Complete oxidation and hydride modeling papers for MRS meeting during November, 1989.

Readiness reviews at PNL and ANL are planned during August and September (89).

Test plans for pressurized cladding testing, fluoride-Zircaloy testing, carbon-14 release testing, and a revision of a test plan for Series 5 dissolution testing from PNL are being written and should be completed by September/October (89).

Beginning in late August/early September, carbon-14 and tritium release from spent fuel cladding under ultrapure argon will be measured. The experiment was delayed because of an unusually high work load in July.

PROBLEM ISSUES

Redirection of staff to meet new QA requirements has delayed conceptual model development.

A currently limited radiochemistry capability at PNL and a priority status given to Hanford defense waste tank samples are beginning to adversely impact the ongoing YMP work at PNL. Due to reduced staff, abnormally long delays are being encountered in the time between the sample submission and the receipt of the analyses. It appears that the chemistry technical staff are doing their best to serve customers in a difficult situation and efforts are being made to increase the staff support base. Every effort is being made to service all programs at PNL which require radiochemistry support. However, PNL did not anticipate the level of impact the Tri-Party Agreement (Hanford cleanup) would have on capabilities. PNL management is aware of LLNL programmatic needs, and has pledged to work with LLNL to satisfactorily complete all milestones.

MILESTONE PROGRESS

Milestone R205,(9/89), a report on the results of spent fuel leaching at 85°C has been returned to the author for revision at PNL.

Milestone P111 (10/89), initiation of dissolution testing of partially oxidized spent fuel will not be conducted as part of the LLNL program supported at PNL. It is being funded at PNL by RTP (Chicago).

Milestone P250 (10/89), initiation of parametric dissolution tests of spent fuel (Series 5 tests at ANL), is on schedule; however, issues that may arise from planned readiness review could result in a delay.

The new Scientific Investigation Plan (SIP) for YMP WBS Element 1.2.2.3.1.1 (1989) Rev. 1, was approved at LLNL and is at YMPO for approval. The SIP was written to comply with the existing Quality Assurance requirements and QA Level assignments of the activities being planned and conducted in the Spent Fuel Waste Form Modeling and Testing technical area.

Activity Plans D-20-44 and D-20-45 for spent fuel oxidation testing were written and distributed for comments. All comments that have been received are being addressed. The testing will be performed at Pacific Northwest Laboratories.

W.B.S. 1.2.2.3.1.2 WASTE FORM TESTING & MODELING - GLASS
F.J. Ryerson, P.I. (acting)

OBJECTIVE

This task involves the measurement of the radionuclide release from borosilicate glass; these are to be used as input for the performance modeling of long-term radionuclide release from the waste package

ACTIVITIES AND ACCOMPLISHMENTS

D-20-27 Unsaturated Testing (Argonne National Laboratory)

The N2 tests (SRL 165 glass) continued as scheduled with no sampling periods occurring this month. The N3 tests (ATM-10 glass) continued as scheduled with the two-year period occurring on 7/3/89. The interval for sampling both the N2 and N3 tests will be increased from 13 to 26 weeks to allow for a full set of analytical data to be collected at each sampling period. At the 26-week interval, approximately 4 mL of water will be available for analysis which should allow pH, carbon, cations, anions, and radionuclides to be analyzed.

No analyses of the ATM-10 test components have been conducted due to the reduced work order.

D-20-28 Static leach testing of DWPF and WVDP glass (Argonne National Laboratory)

The activity plan describing the methodology to perform vapor phase hydration in support of static leaching testing has been completed and is under review.

The activity plan describing the methodology to perform static leaching tests is undergoing revision. Upon approval, static leach testing can be initiated once glasses of average and bounding compositions have been received. These glasses were requested from Westinghouse Savannah River Co. on 11/88.

D-20-29 Parametric studies of DWPF and WVDP glasses based on the unsaturated test (Argonne National Laboratory)

The parametric tests are ongoing, and an activity plan to continue these tests is being prepared.

D-20-30 Parametric studies of DWPF and WVDP glass (Argonne National Laboratory)

To support the development of a study plan for the vapor phase hydration/leach tests a preliminary set of experiments was continued

7/28/89., SRL-165A and ATM-10 glasses, both of which contain transuranics, had been subjected to vapor phase hydration at 90-200°C, over time periods from a few days to over half a year. These glasses had been in dry storage until recently when they were examined to determine the extent of hydration. The examination was done using a stereomicroscope and the extent of hydration ranged from minimal in the 90°C samples to heavy in the 200°C samples. These samples will be subjected to 28-day MCC-1 test conditions.

D-20-31 Studies of glass surface layers and precipitation (Argonne National Laboratory)

As was reported last month, the newly installed Kratos quadropole looks promising, but has not operated properly. The spectrometer was not properly configured during installation, and Kratos staff people are looking into the problem.

D-20-32 Geochemical Interactions (Argonne National Laboratory)

As reported last month, both the initial series of flow-through experiments on a simple analogue glass have been completed and the solution data reduced. This work forms the basis of an MRS paper this Fall. Characterization (by FTIR, XRD, SEM and nuclear reaction depth profiling) of the recovered glass from these experiments is underway.

A series of static leaching experiments on the simple analogue glass in Dickson autoclaves has also been completed and the data are being analyzed. Characterization of the reacted glasses is underway.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Revision of the SIP will continue. Activity plans for D-20-27, D-20-28, D-20-32 will be drafted and submitted for approval. Flow-through tests on SRL-165 will commence. Static leach testing of vapor-phase aged glasses will commence.

PROBLEMS/ISSUES

DWPF glass samples are needed before testing can begin.

MILESTONE PROGRESS

2R32 Preliminary leaching database: Level I batch mode unsaturated tests are completed, and awaiting final QA readiness review before analysis of solids can begin.

2R22 Preliminary glass kinetics models: A report "Geochemical Modeling of Radioactive Waste Glasses Dissolution Using EQ3/6: Preliminary Results and Data Needs" has been submitted to YMPO for approval. An improved model has been developed and the results will be presented at the Fall MRS meeting. New flow- through data will be used in future models.

2R31 Glass leaching database: Activity plans for saturated testing have been completed.

WBS 1.2.2.3.4.1 WASTE FORM MODELING & TESTING - INTEGRATED TESTING

H. Shaw, P.I.

OBJECTIVE

The purpose of this task is to conduct tests and experiments that will yield an understanding of the performance of the waste package system in the repository environment. Emphasis is placed on multi-component tests and on examination of natural analogs.

ACTIVITIES AND ACCOMPLISHMENTS

No activity reported for this month.

WBS 1.2.2.3.2 CONTAINER MATERIALS MODELING AND TESTING
Metal Barrier Selection and Testing Task.
R. D. McCright, P.I.

OBJECTIVE

The goal is selection of a metallic material for fabrication of waste containers and characterization of the material behavior under expected conditions and environments. Test data derived from this work will be used in performance assessment modeling and for licensing. Current emphasis is on two alloy systems: (1) Fe to Ni-base austenitic alloys, and (2) Cu and Cu-base alloys.

ACTIVITIES AND ACCOMPLISHMENTS

Task Management

Metal Barrier staff reviewed and provided material for a presentation to be made to the Technical Review Board during their visit to the YMPO scheduled for August. This material involved the scope and direction of work in the Metal Barrier and related areas.

A list of questions for the readiness review meeting scheduled for this month was derived from QP 2.6 and perusal of the full slate of 18 elements that may be applicable to the affected activities. Because this was the first readiness review to be held at LLNL, there was little in the way of precedents.

Task Quality Assurance

Activity plans for four activities were finalized and submitted for approval. Plans for the "Establishment of Criteria for Container Material Selection" (E-20-15 in the SIP) and three parts of the Parametric Studies (E-20-18) were submitted. A readiness review of these four activities was conducted on July 31 and August 1 with representatives from YMPO and SAIC and LLNL who served as the "Board" and the "Team" (described in AP 5.13Q).

Degradation Modes Surveys

Possible degradation modes for high-performance metallic materials, such as titanium and nickel-base alloys, are being studied to complement the work already completed on the metals/alloys discussed as the candidate materials in the YMP Site Characterization Plan. During the past month, additional references were obtained for the performance of Alloys C-4, C-22, C-276 and 625 (all nickel-base alloys). Degradation modes considered are hydrogen embrittlement, general atmospheric corrosion, corrosion in sea water, pitting and crevice corrosion, stress corrosion cracking in high chloride environments, and phase instability.

Work has also continued on a review of the technical literature addressing the suitability of titanium as a corrosion resistant material for high level nuclear waste containers. The problem of sustained load cracking has been addressed. Hydrogen embrittlement due to hydrogen assimilated from the environment (e.g. radiolysis of water or water vapor, electrochemical reduction of water) and stress corrosion cracking is also being considered.

Coordination with Design, Fabrication, and Prototype Testing

A meeting with Babcock and Wilcox (B&W) is scheduled for next month. The purpose of the meeting will be to plan the container fabrication and closure studies for the coming FY. Results from these studies will provide information on the fabricability and weldability of the candidate container materials, which are important criteria for the container selection criteria.

Selection Criteria

The readiness review of this activity was conducted on July 31 and August 1. The final checklist was negotiated with the review board and answers provided for all questions. The report of the board is not yet available, but it is expected to be favorable. Meanwhile, consulting agreements are being renewed for the peer review panel members to complete their work (review of the revised selection criteria document after re-start of this activity is approved).

Model Development

J. C. Farmer of the Metal Barrier task staff participated in the ASTM C-26.13 meeting July 24-26 in Georgetown. The document being prepared by this committee on approaches to accelerating and testing long-term degradation phenomena was further reviewed. There was considerable discussion on stable material analogues (especially native copper and nickel-iron alloys found in meteorites).

Technique Development

Metal Barrier staff personnel have been requested to study failure of a super-invar resonator from experiments conducted in G-tunnel. The super-invar had been gold plated, but extensive corrosion of the super-invar exfoliated the plating. Corrosion initiated at breaks or other weak points in the plating, resulting in intensive localized attack. [Super-invar is an iron-nickel alloy with an extremely low thermal expansion coefficient. It is not a "stainless material" and is susceptible to general corrosion in aqueous environments.]

Parametric Studies

As discussed last month, this activity is being sub-divided into several sub-activities. Activity plans for three of these sub-activities have been

completed and readiness reviews were conducted on them [Use of Linear-Sweep Polarization to Determine Pitting Potentials, Measurement of Plane-Strain Fracture Toughness, and Measurement of Threshold Stress Intensity for Stress Corrosion Cracking]. Experimental work for these three areas will be conducted at LLNL and sub-contract services.

An activity plan has been drafted for a sub-activity dealing with a longer term comparative study of localized corrosion and stress corrosion cracking among the different candidate materials. It is proposed to test metal-to-metal creviced specimens and stressed U-bend specimens in environments simulating different Yucca Mountain repository conditions for exposure periods of up to 10 years. Specimens of the 6 candidate materials (high-nickel alloy 825, 316L and 304L stainless steels, CDA 613 aluminum bronze, CDA 715 copper-nickel, and unalloyed copper) plus specimens of highly corrosion resistant titanium, Monel 400, alloy C-22, alloy 625 and zirconium) will be exposed. A large number of specimens will be initially exposed, and periodic withdrawals of specimens for observation will be made to determine the time dependence of localized corrosion and stress corrosion initiation. The tests are planned to be conducted with a minimum of maintenance and surveillance during the exposure periods. As an adjunct to the long term laboratory efforts, a companion study is contemplated for exposure to environmental conditions in G-tunnel at the Nevada Test Site.

Work continues on a radiation effects study under sub-contract at Argonne National Laboratory (ANL). An extended monthly report was received from ANL. Highlights of the report include:

Analysis of gamma irradiated mixtures of N_2/O_2 (0.1% oxygen, balance nitrogen) and saturated with water vapor indicates formation of small amounts of N_2O in the vapor phase. Three exposure temperatures (28, 87, and 152°C) were used. Irradiations were conducted in stainless steel vessels.

Analysis of the distillates and rinsates of the above indicated small amounts of nitrate and ammonia formed. Also, a negligibly small amount of nitrite was present. The total ammonia concentration decreased with increasing temperature, and the amount of nitrate was immeasurably low in all the samples except the one irradiated at 28°C.

Since atomic nitrogen is known to be the most important intermediate formed from the radiolysis of nitrogen gas, these studies indicate that subsequent reactions favor only nitrogen reduction to form ammonia and oxidation to form nitrous oxide at temperatures higher than 28°C. The absence of atomic nitrogen to higher oxidation states (greater than +1) is not favorable under these conditions and this might be attributed to the very low level of oxygen (0.1%) in the initial mixture.

By contrast, these results are in agreement with the results obtained from gamma irradiation of moist air which showed only insignificant amounts of ammonia. Thus, the oxygen-poor internal environment in a spent fuel waste package containing water-logged fuel could produce

ammonia from radiolysis of the environment, while it is doubtful that ammonia would be produced in the air (and oxygen-rich) external environment surrounding the package. More experimental work covering a wide range of temperatures and different nitrogen/oxygen ratios are needed to substantiate this conclusion and to better understand the radiolysis mechanisms.

Container Material Selection

There is no progress to report this month since the start of this activity is linked to completion of the selection criteria document.

MAJOR ACTIVITIES UPCOMING IN NEXT THREE MONTHS

Readiness reviews for additional activities are being scheduled for August and September. Planning for work in this task and others in the Container Materials technical area is progressing, and some revision of the Scientific Investigation Plans (SIPs) is forecast.

PROBLEMS/ISSUES

Multiple activities are awaiting readiness reviews to allow start-up.

MILESTONE PROGRESS

Milestones are on schedule. Milestone M-265 on "Selection of Metal Barrier for Advanced Studies" has been rescheduled from September 1989 to April 1990.

WBS 1.2.2.4.2 CONTAINER FABRICATION AND CLOSURE TASK
E. W. Russell, P.I.

OBJECTIVE

To develop, analyze, fabricate and test waste package designs that incorporate qualified materials and that are fully compatible with the repository design in order to support license application by demonstrating conformance with requirements for safe handling emplacement, possible retrieval, and credible accident conditions per 10CFR60 and 40CFR191, in a cost efficient manner.

ACTIVITIES AND ACCOMPLISHMENTS

Container Fabrication Process Development:

1) Container Cost Estimate Report- A meeting was held with B&W R&DD in Alliance OH on July 12 to review the Cost Estimate Methodology and the Package to be sent out to perspective suppliers of data for this study. Twenty potential vendors were contacted to determine interests in participating in this HQ-directed study, which will include two alloys- Incoloy 825 and CDA 715- and six container design configurations. An annotated outline of the report was prepared, which included chapters on definition and interpretation of the cost estimates as well as quality assurance (QA) and quality control (QC) factors that will effect the container production cost.

2) External Roll Extrusion Processing of Containers- A proposal was submitted by B&W for flat-plate trials of the subject process in FY89 to support the metal selection milestone of April, 1990. This process will involve a combination of heat treatment and cold work of all weld/HAZ (heat affected zones) in the container to produce a uniform wrought-like microstructure throughout the container.

Container Closure Process Development:

1) Phase 2: Work was done to set-up weld stations to accomplish FY89 deliverables for the three weld-processes under development- Inertia welding (FRW), Plasma arc welding (PAW), and electron beam welding (EBW).

2) Accelerated FRW: A proposal was submitted for manufacture of subscale rings to support the Metal Selection milestone of April 1990. This FRW process development deliverable will be accelerated to supply data/ specimens in FY89 in support of the above milestone.

MAJOR ACTIVITIES UPCOMING IN NEXT THREE MONTHS

1) Submittal of Container Cost Estimate by 9/30/89 for YMPO review.

2) B&W deliverables as discussed above by 9/30/89 in support of Metal Selection milestone.3) Development of workscope and budget for B&W FY90 activities (H-20-4 and H-20-5).

PROBLEMS/ISSUES

A B&W scope of work for FY90 is being prepared to support the Metal Selection Milestone of April 1990. It appears that material and tooling must be committed in FY89 to meet deliverable dates.

MILESTONE PROGRESS

Milestones are on schedule

WBS 1.2.2.5.2 GEOCHEMICAL MODELING - MODEL DEVELOPMENT
K. Jackson/J. Johnson P.I.s

OBJECTIVE

This task is the development of advance calculational capabilities for modeling geochemical processes in the repository environment. The work is being carried out by extending the capabilities of the existing EQ3/6 software. The applications objective is to support site, waste package, and performance assessment through calculations of solubilities, rock/water interactions, etc., leading to long-term predictions of geochemical behavior necessary for the DEIS and license application.

ACTIVITIES AND ACCOMPLISHMENTS

Code and Development

Work delayed pending approval of the Software Quality Assurance Plan (SQAP).

Data Base Development

Primary effort was directed toward making the CATCH program operational on LLNL computers.. (The CATCH program was obtained from the National Institute of Standards and Technology, formerly NBS.) CATCH will be used to upgrade existing data base entries to a status comparable to that of the CODATA entries. Considerable work is required to make CATCH Operational. The d0out code was worked on to expand the Pitzer option to extract a self-consistent set of Pitzer data and to retrieve data from auxiliary tables instead of the primary tables. The new data file, data0R20, was generated and all associated programs were run. The Status table was made consistent with the Species table. Rare earth ion thermodynamics were reviewed. A draft manual for the data base was reviewed.

The Activity Plan for Data Base Development was revised.

Code Maintenance, Documentation, and Release

The verification effort was begun for the updated EQ3/6 release planned for August 1989. This package will probably be called 3245.0889. A set of directories was set up on the Alliant, and various EQ3/6 input files were compiled there. These input files will constitute input for the verification effort for this next release package.

A requirement document was written and reviewed for the addition of an ion exchange model to the EQ3/6 codes. Scoping work was begun for the possibility of adding a surface complexation (sorption) model to these codes. Thermodynamic data for the system CaO-CO2-H2O (log Ks for calcite, aragonite, CaHCO+3, CaCO3(aq)), were reviewed. An EQ3/6 bug was diagnosed concerning the iteration treatment of the activity of water and modified equations for the Jacobian matrix were derived. A small code that

creates a calling tree for EQ3NR, EQ6, or EQPT was written. This utility will be used to help update documentation and as an aid in debugging efforts.

A general form was derived for derivatives of activity coefficients of solid solution end-members with respect to the mole-fractions of all the other end-members in the solution. This was done in preparation for implementing the ideal site-mixing model in the 3245 version of EQ3/6 codes.

The speciation program was finished including the code package, test cases and user instructions. The speciation package is used to create graphics output of changes in aqueous speciation as a function of EQ6 reaction progress.

The Activity Plan for Code Maintenance was completed and forwarded to LLNL Project Management for approval. A draft of an Activity Plan for Documentation and Code Release was prepared.

Other

The requirements for a graphics software package were defined and market availability was investigated. Products called PicSure and Wave are to be purchased to satisfy user requirements.

Representatives of LLNL and YMPO met to discuss informal comments on the LLNL SQAP. An additional meeting in Las Vegas in August was scheduled to discuss further the basic requirements for the SQAP.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Continuing work on validation and verification of the data base.

Meetings and work on the SQAP to achieve its approval as soon as possible.

Preparation and approval of the necessary Scientific Investigation Plan (SIP), Activity Plans, and TIPs.

Successful completion of the Readiness Reviews.

Continuing work on code documentation and verification and validation projects.

Release of version 3245.0889 of the EQ3/6 code. (Ingress-based data base release.)

PROBLEMS/ISSUES

Code development work on the Quality Level 1 EQ3/6 code is delayed pending approval of the SQAP, Activity Plans, and TIPs, the preparation of revised SIP, and conducting successful Readiness Reviews.

MILESTONE PROGRESS

Internal technical reviews of the draft EQ6 User's Manual have begun. Subsequent to the review cycle, an updated version of the user's guide will be submitted to YMP to comprise completion of Milestone P314. **Code development milestones (e.g., L078, L084, L091, L092, and C395) will slip on a day for day basis until the items noted above, under Problems, are completed or resolved..**

WBS 1.2.2.3.4.2 GEOCHEMICAL MODELING - THERMODYNAMIC DATA DEVELOPMENT

R. Silva, P.I.

OBJECTIVE

The purpose of this task is to experimentally evaluate the thermodynamic properties of solids and solution species needed for geochemical modeling of waste form performance.

ACTIVITIES AND ACCOMPLISHMENTS

Hydrolysis and Carbonate Complexation of Pu(V).

The measurements to determine the hydrolysis constant for Pu(V) using the photoacoustic spectrometer have been completed.

High-temperature Calorimetry (Florida State University).

The high temperature calorimeter is still undergoing testing. A new stainless steel thermistor probe was constructed and tested. With this new design, the calorimeter operation is greatly improved and calibration titration will start in August.

High-temperature Calorimetry and Spectroscopy (LLNL).

A new system of thermal shields was constructed to reduce undesirable temperature fluctuations in the calorimeter. The new thermistor probe is operating satisfactorily. The calorimeter is sufficiently thermally stable and the thermistor is operating properly so that calibration titrations can begin in August. Technical implementing procedures for the calorimeter operations are being finalized.

Photoacoustic and Photothermal Deflection Spectroscopy.

All the components necessary to construct a photoacoustic spectroscopy system for use in a gloved, inert-atmosphere box were decided upon and have been ordered.

Solubility Studies.

The technical implementing procedures for operation and calibration of the solubility measuring equipment were completed.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Complete all TIP's and Activity Plans.

Complete calibrations of calorimeters.

PROBLEMS/ISSUES

Awaiting completion of TIP's and Activity Plans.

MILESTONE PROGRESS

None to report during this period.

WBS 1.2.2.5.1 PERFORMANCE ASSESSMENT
W. O'Connell, P.I.

OBJECTIVE

The objective for performance assessment is to provide predictions of post-closure waste package performance in order to assess compliance with EPA and NRC regulations (40CFR191 and 10CFR60, respectively). These assessments will consist of deterministic and probabilistic analyses. A source term necessary for total system performance assessment will also be provided.

ACTIVITIES AND ACCOMPLISHMENTS

Review of final USGS SCP/CD near-field environment comment responses was completed.

The draft report "Post-closure Performance Assessment of the Yucca Mountain Project Conceptual Design Waste Package: Preliminary Results and Recommendations" was distributed for formal internal review per Quality Procedure QP 3.3. This report describes the application of the PANDORA model to the proposed Yucca Mountain repository. The results of this preliminary, deterministic performance assessment of a single waste package are described, along with recommended improvements to the waste package performance assessment process.

YMPO and LLNL met on July 12 at LLNL to discuss YMPO's draft review comments on the LLNL Software QA Plan. A. Williams, DOE/YMPO, S. Harris, SAIC, L. Roy, MACTEC, and R. Schwartz, R. Aines, W. O'Connell, W. Kugler and W. Stockdale, LLNL-YMP staff participated. Clarifying information was exchanged. A further meeting was scheduled.

W. O'Connell attended the HQ Validation Oversight Group meeting on July 25 in Las Vegas. The group reviewed the working draft "Model Validation Methodology" document. This is now a 20-30 page guideline and management document, recognizing the iterative and progressive process of model validation and allowing flexibility in accord with the subject being validated. A "technical review board" description will be restructured to use existing guidance for peer reviews as far as possible. The VOG is doing parallel work to demonstrate validation efforts on two specific topics.

W. O'Connell attended the HQ/YMP Performance Assessment (PA) Technical Integration Group meeting on July 26-27 in Las Vegas. Technical work in progress was discussed in a seminar format. Planning was discussed on model data interface, HQ contractors/YMPO interface, and the next fiscal year's work content. LLNL will plan to present seminars at the next meeting on the metal barrier selection process and metal barrier modeling.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Further activities in establishing readiness to start QA Level I work will include SIP revision, Activity Plan draft, establishment of procedures and training needs, and finalization of the LLNL Software QA Plan.

Long range planning network logic, interconnects, and resource loading will be ongoing.

Issuance of draft report M260 on performance assessment of waste package conceptual design.

Finalization of enhancements to uncertainty methods model and revision of draft report.

PROBLEMS/ISSUES

The reduced budget this FY for performance assessment in comparison to the originally established passback budget, together with redirection of effort to a revised QA program and continuing long-range planning, have left little resources for the originally planned technical work and technical milestones.

The impact is that completion of past activities has had to slip in schedule. These and future planned performance assessments will not be available on the planned schedule, and needs for PA guidance for start of ACD or for performance assessments to support response to NRC comments may not be available in a timely fashion.

MILESTONE PROGRESS

Performance assessment participation in QA program implementation and in long-range planning are level-of-effort; the contents of successive end points and milestones have not been specifically defined. The degree of reprogramming of effort away from technical milestones has not been specifically defined.

WBS 1.2.2.4.1 SPECIAL STUDIES - DESIGN AND ANALYSIS
L. Ballou, P.I.

OBJECTIVE

The objective for package design is to develop and analyze waste package designs that incorporate Yucca Mountain Project qualified materials and that are compatible with the repository design. The designs and analyses are needed to support license application by documenting conformance with NRC requirements for safe handling, emplacement, retrieval, containment, and release rate.

ACTIVITIES AND ACCOMPLISHMENTS:

Spent Fuel Receipt Study

LLNL expanded its Spent Fuel Receipt Scenarios Study, at the request of OCRWM, to support Task 8 (Development of Technical Waste Acceptance Criteria) of OCRWM's "Technical Working Group on Acceptance of Spent Fuel of Various Characteristics". Previous work was limited to analysis of thermal effects for uniform energy deposition. New work adds analysis of thermal effects for an oldest fuel first receipt scenario and examines these effects at four locations in a simplified repository layout. The problem definition has been completed, computer codes have been modified to reflect the new repository layout and the analysis is in progress.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Preliminary results of the expanded Spent Fuel Receipt Scenario Study will be presented to OCRWM in August. Completion of the analysis and documentation of final results will follow.

PROBLEMS/ISSUES

None

MILESTONE PROGRESS

No LLNL milestones for this WBS.

1.2.5 REGULATORY INTERACTIONS

WBS 1.2.5.2.1 NRC INTERACTION SUPPORT

D. Emerson, PI.

OBJECTIVE

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

ACTIVITIES

None to report during this period

WBS 1.2.5.2.2 SITE CHARACTERIZATION PROGRAM

D. Emerson, P.I.

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 programs as appropriate, monitor each site program, serve as the interface between the principle investigator and the DOE/HQ

ACTIVITIES

Review of final USGS SCP/CD near-field environment comment responses completed.

WBS 1.2.5.2.3 REGULATORY REVIEW

D. Emerson, P.I.

OBJECTIVE

Support DOE/HQ in the review of site aspects of proposed NRC regulatory changes. Review Project technical products to determine relationship and compliance with site-related requirements. Review DOE licensing positions and related technical reports.

ACTIVITIES

None to report during this period.

WBS 1.2.5.2.5 STUDY PLAN REVIEW AND APPROVAL
D. Emerson, P.I.

OBJECTIVE

Coordinate the Project and Headquarters reviews of Study Plans.

ACTIVITIES

LLNL Study Plans

Work is continuing to resolve the YMP comments on LLNL-SP-8.3.4.2.4.2, Hydrologic Properties of the Waste Package Environment.

Other participant's Study Plans

The Study Plan, USGS-SP-8.3.1.2.3.1, R0 Characterization of the Site Saturated-Zone Ground-Water Flow System was received for technical review.

WBS 1.2.5.2.6 SEMI-ANNUAL PROGRESS REPORTS
D. Emerson, P.I.

OBJECTIVE

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

ACTIVITIES

None to report during this period.

1.2.9 PROJECT MANAGEMENT

WBS 1.2.9.1.1 PROJECT MANAGEMENT

L. Jardine, TPO

OBJECTIVE

This task manages and coordinates all LLNL Yucca Mountain Project activities to be consistent with the goals and objectives of the overall DOE Yucca Mountain Project, including planning, technical direction, cost, and schedule control.

ACTIVITIES AND ACCOMPLISHMENTS

Normal management activities continued, internal LLNL YMP organizational responsibilities at the Technical Area level have been re-aligned to reflect more closely the integration of activities within each area. A new Area, "Special Studies", has been added to provide accountability and direction to activities in WBS 1.2.5 and other ad-hoc design and performance-related studies as directed by YMPO or OCRWM.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

No new major activities anticipated.

PROBLEMS/ISSUES

None

MILESTONE PROGRESS

No LLNL milestones for the WBS.

WBS 1.2.9.1.4 RECORDS MANAGEMENT
B. Bryan, P.I.

OBJECTIVE

Establish and operate and LLNL Local Records Center that meets the requirements of the Quality Assurance Program Plan and other Project-level requirements, including receipt, retention, and protection of all records, issue of controlled documents, and operations of correspondence, logging, tracking, and distribution systems.

ACTIVITIES AND ACCOMPLISHMENTS

During the month of July, the Records staff concentrated on processing backlogged LLNL records. These records backlogged because of our records were not accepted at the Central Records Facility until our quality procedures for Records Management were approved, which occurred at the beginning of June. Included among these were five boxes of records from one of our subcontractors.

Work to update our internal records database has begun. New capabilities for listing and sorting as well as new menu items will be added. The Action Item report will be integrated into the records database. Backup procedure will be improved.

During July, Document Control issued controlled distributions for two change notices to Administrative Procedures and for one revision and eight change notices to the Quality Procedures.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

The updating of our internal records database should be completed in August. We will continue processing all backlogged records through to the Central Records Center of the Yucca Mountain Project. Efforts to obtain fire-rated cabinets for possible quality records located in task areas will begin.

PROBLEMS/ISSUES

None

MILESTONE PROGRESS

No LLNL Milestones for this WBS.

WBS 1.2.9.2 PROJECT CONTROL
J. Podobnik P.I.

OBJECTIVE

This task manages and coordinates all LLNL Yucca Mountain Project activities to be consistent with the goals and objectives of the overall DOE Yucca Mountain Project, including planning, technical direction, cost, and schedule control.

ACTIVITIES AND ACCOMPLISHMENTS

During July, Mr. John Podobnik joined the LLNL staff and was assigned as the Resource Planning and Control Manager for the YMP.

Participated in YMPO Long Range Planning. Developed detailed, intermediate and top level schedules. Schedules were analyzed for accuracy and representation. Made revisions as appropriate.

Attended PACs orientation on July 10.

Reviewed Project control assets and procedures.

Submitted FY89 budget revisions to Yucca Mountain Project Office.

Submitted the following reports:
Milestone Report
LLNL YMP population distribution
FY89 Cost Plan - June Actuals
Worker Data Report for 3rd Quarter of FY89

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

Continued Long Range Planning Activity.

Developed foundations for integrated cost schedule control systems including selection of software, convert existing network database, adapt LLNL procedures and conversions to PACs format.

Complete all activities required for final FY89 accounting.

Develop FY90 working budget.

PROBLEMS/ISSUES

None.

MILESTONE PROGRESS

No LLNL Milestones for this WBS.

WBS 1.2.9.3. QUALITY ASSURANCE
D. Short, P.I.

OBJECTIVE

The objective of Quality Assurance is to develop, implement, and maintain a Quality Assurance Program Plan in accordance with requirements set forth in the YMP QA Plan, NNWSI/88-9, and the Project Administrative Procedures.

ACTIVITIES AND ACCOMPLISHMENTS

LLNL-YMP comments and recommendations concerning YMP Administrative Procedures were transmitted to DOE-Las Vegas on July 5, 1989.

LLNL-YMP's responses to QA audit 88-05 Observations were forwarded to SAIC on July 3, 1989.

Review of PNL's QA Plan WTC-018 Rev. 5 was completed. The Plan was approved as meeting the requirements of LLNL-YMP QARS-001C, Rev 0.

Surveillance S89-15, Personnel Qualifications, was performed on July 6, 1989. One observation and no nonconforming conditions were found.

Quality Assurance audit, 89-10, Procurement Document Control, Document Control and Records Management, was conducted July 25-27, 1989. to verify continuing implementation of the LLNL-YMP QA Program.

LLNL-YMP's comments on Draft Procedure AP-5.11, Test Activity Work Authorization, were forwarded to SAIC in response to request JRK:ELS:L89-168 dated June 29, 1989.

QP 2.1 Rev 1, incorporating Change Notices 2.1-0-1 to 2.1-0-4, was distributed for internal review on July 17, 1989.

LLNL-YMP QA Surveillance Schedule Rev. 2 for the remainder of the fiscal year was finalized and forwarded to DOE-Las Vegas on July 31, 1989.

MAJOR ACTIVITIES UPCOMING NEXT THREE MONTHS

The process of qualifying the two LLNL Calibration facilities and their subcontractors is continuing.

A significant number of Readiness Reviews involving QA staff are planned during the last quarter of fiscal year 1989. Scientific Investigation Plans are to be revised and submitted.

QA is focusing its resources to assist in the restart of work, both at LLNL and by its subcontractors.

PROBLEMS/ISSUES

None.

MILESTONE PROGRESS

No LLNL Milestones for this WBS.

TECHNICAL DATA TRANSFER REPORT TO THE LLNL TECHNICAL RECORDS CENTER

1. Data Submitted to the Technical Records Center.

   A) Thermochemistry of Uranium Compounds XVII (UCRL-21053) Record ID No. LLYMP8904035A

   B) Electromagnetic Experiment to Map In Situ Water in Heated Welded Tuff (UCRL-96318) Record ID No. LLYMP8904035C

   C) Influence of Stress-Induced Deformation in Observed Water Flow in Fractures at the Climax Granite Stock (UCRL-95539) Record ID No. LLYMP8904035D

   D) Dissolution Kinetics of Quartz as a Function of pH and Time at 70°C (UCRL-96071) RECORD ID NO. LLYMP8904035E

   E) Hydrological Properties of Topopah Spring Tuff Under a Thermal Gradient: Laboratory Results (UCRL-96926)Record ID No. LLYMP8905008

2. Data formally entered into uncompleted notebooks or files.
   NONE

3. Notebooks or files completed, closed and submitted to local record center.

   A) Thermochemistry of Uranium Compounds XVII (UCRL-21053) Record ID No. LLYMP8904035A

   B) Electromagnetic Experiment to Map In Situ Water in Heated Welded Tuff (UCRL-96318) Record ID No. LLYMP8904035C

   C) Influence of Stress-Induced Deformation in Observed Water Flow in Fractures at the Climax Granite Stock (UCRL-95539) Record ID No. LLYMP8904035D

   D) Dissolution Kinetics of Quartz as a Function of pH and Time at 70°C (UCRL-96071) RECORD ID NO. LLYMP8904035E

   E) Hydrological Properties of Topopah Spring Tuff Under a Thermal Gradient: Laboratory Results (UCRL-96926) Record ID No. LLYMP8905008

TECHNICAL DATA TRANSFER REPORT TO THE TECHNICAL DATA BASE

1. Candidate information for the Technical Data Base (all participants provide input).

   NONE

2. TPO approved data formally submitted to the Technical Data Base (all participants provide input).

   NONE

3. Data formally entered into the Technical Data Base (SNL only provides input).

TECHNICAL DATA TRANSFER REPORT TO THE REFERENCE INFORMATION BASE

1. Candidate information for the Reference Information Base (all participants provide input).

   NONE

2. Data submitted via a Baseline Change Request (TBCR) for consideration as input to the Reference Information Base (all participants provide input and reference BCR).

   NONE

3. Data entered into the Reference Information Base (SNL only provides input, reference the approved BCR).