packet #3

UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Gaithersburg, Maryland 20899

July 15, 1988

Mr. Charles Peterson
Technical Review Branch
Division of High-Level Waste Management
Office of Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: Monthly Letter Status Report for June 1988 (FIN-A-4171-7)

Dear Mr. Peterson:

Enclosed is the June 1988 monthly progress report for the project "Evaluation and Compilation of DOE Waste Package Test Data" (FIN-A-4171-7). The financial information is attached to this letter.

Sincerely,

Charles G. Interrante
Program Manager
Corrosion Group
Metallurgy Division

Enclosures

Distribution:
NMSS PM (1)
Ofc of the Director
  NMSS (Attn: PMPDAS) (1)
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  Div. of Computer and
  Telecommunications
  Services (Attn: Director) (1)

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WM-11
NH14

Monthly Letter Report for June 1988

Published July 1988

(FIN-A-4171-7)

Performing Organization: National Bureau of Standards (NBS)
Gaithersburg, MD 20899

Sponsor: Nuclear Regulatory Commission (NRC)
Office of Nuclear Materials Safety and Safeguards
Washington, DC 20555

Task 1 -- Review of Waste Package Data Base

Appended to this report are the following two Draft Reviews not previously submitted (see p. 1, Attachment B). Comments by NRC and its contractors are solicited.

1. UCID-21190, "Plan For Glass Waste Form Testing For NNWSI", September 1987.

2. UCRL-97562, "Impact of Phase Stability on the Corrosion Behavior of the Austenitic Candidate Materials for NNWSI," October 1987.

Status of database

905 Documents in HLW database.
78 Completed reviews in HLW database (taken from Vol. 1 to 4).
12 Nearly completed reviews for Vol. 5.

Papers currently being reviewed (Category 1), review when time permits (Category 2) and file with cross reference(s) to related report(s) (Category 3).

Status of recently listed reviewable documents

NNWSI

8 NNWSI reports currently under review (Category 1).
16 NNWSI reports to review when time permits (Category 2).
3 NNWSI reports to file with cross reference(s) to other reports (Category 3).
3 NNWSI reports identified and not yet categorized.

GLASS -- VITRIFIED WASTE FORM

1 Reports currently under review (Category 1).
4 Reports to review when time permits (Category 2).
9 Reports to file with cross reference(s) to other reports (Category 3).
0 Reports identified and not yet categorized.

During the month of June, no new documents were identified in the outputs from searches conducted (using Dialog SDI bibliographic updates) on the NTIS and the DOE Energy database files. The search strategy will be modified to include modelling in July.

STATUS OF REVIEWS OF NNWSI REPORTS

NNWSI -- Reports under consideration

Three publications are considered for review this month. The oxidation of spent fuel is investigated in the first report. A plan directed at developing information necessary in the design of the NNWSI waste package is described in the second report. The third report describes the results of a study on the thermochemistry of high-purity uranium oxide.

Present information indicates that the rate of oxidation of UO_2 is sufficiently low to not allow complete conversion to UO_3 in 10,000 y at repository temperatures [Einziger 1987]. This study examines the rate of formation of other oxidation states of uranium (e.g., U_4O_9 and U_3O_7). The results indicate that the rate of formation is independent of moisture content, and dependent on particle size.

Russell, et al., describe a plan on developing data needed in the design of the NNWSI waste package, including container fabrication, closure, and evaluation through prototype testing. The plan is designed to provide answers to specific issues.

Using calorimetric methods, high-precision chemical thermodynamic properties of a sample of pure schoepite ($UO_2(OH)_2 \bullet H_2O$) are measured [Tasker 1987]. These data are developed to provide information for the modelling of the dissolution of uranium in a nuclear waste repository.

1. Einziger, R. E. and Buchanan, H. C., "Long-Term, Low-Temperature Oxidation of PWR Spent Fuel - Interim Transition Report," WHC-EP-0070, May 1988.

2. Russell, E. W. and Nelson, T. A., "Plan for Waste Package Design, Fabrication and Prototype Testing for NNWSI," UCID-21347, February 1988.

3. Tasker, I. R., O'Hare, P. A. G., Lewis, B. M., Johnson, G. K., and Cordfunke, E. H. P., "Thermochemistry of Uranium Compounds. XVI. Calorimetric Determination of the Standard Molar Enthalpy of Formation at 298.15 K, Low-Temperature Heat Capacity, and High-Temperature Enthalpy Increments of $UO_2(OH)_2 \bullet H_2O$ (Schoepite)," August 1987.

NNWSI --

Category 1 -- Reports currently being reviewed

1. HEDL-TME 85-22, "Results from Cycles 1 and 2 of NNWSI Series 2 Spent Fuel Dissolution Tests," May 1987.

2. UCRL-21005, SANL 616-007, "Corrosion Testing of Type 304L Stainless Steel in Tuff Groundwater Environments," December 1987.

3. UCRL-21019, SAN-662,-027, "Recent Results from NNWSI Spent Fuel Leaching/Dissolution Tests," April 1987.

4. UCID-21272, "Plan for Spent Fuel Waste Form Testing for NNWSI," February 1987.

5. UCRL-53795, "Reaction of Vitric Topopah Spring Tuff and J-13 Ground Water under Hydrothermal Conditions Using Dickson-Type, Gold-Bag Rocking Autoclaves," November 1986.

6. UCRL-21013, "Summary of Results from the Series 2 and Series 3 NNWSI Bare Fuel Dissolution Tests," November 1987.

7. UCRL-94708, "Carbon-14 in Waste Packages for Spent Fuel in a Tuff Repository," October 1986.

8. SAND85-7117, "A First Survey of Disruption Scenarios for a High-Level Waste Repository at Yucca Mountain, Nevada," December 1985.

Category 1 (continued) - Status of Reviews not yet sent to NRC and WERB

Document No.	Assigned to Reviewer	First Draft Completed	Lead Worker	Program Manager
HEDL-TME 85-22	x			
UCRL-21005		x		
UCRL-21019	x			
UCID-21272	x			
UCRL-53795		x		
UCRL-21013	x			
UCRL-94708	x			
SAND85-7117	x			

Category 2 -- Review as time permits

1. UCRL-94633, "Experimental Study of the Dissolution Spent Fuel at 85°C in Natural Groundwater," December 1986.

2. UCRL-95962, "Hydrogen Speciation in Hydrated Layers on Nuclear Waste Glass," January 1987.

3. UCRL-94658, "Integrated Testing of the SRL-165 Glass Waste Form," December 1986.

4. UCRL-91258, "Leaching Savannah River Plant Nuclear Waste Glass in a Saturated Tuff Environment," November 1984.

5. ANL-84-81, "NNWSI Phase II Materials Interaction Test Procedures and Preliminary Results," January 1985.

6. UCRL-53761, "Waste Package Performance Assessment: Deterministic System Model Program Scope and Specification," October 1986.

7. HEDL-7540, "Technical Test Description of Activities to Determine the Potential for Spent Fuel Oxidation in a Tuff Repository," June 1985.

8. HEDL-SA-3627, "Predicting Spent Fuel Oxidation States in a Tuff Repository," April 1987.

9. UCRL-15976, SANL-522-006, "Microstructural Characteristics of PWR Spent Fuel Relative to its Leaching Behavior", April 1985.

10. UCRL-96703, "Geochemical Simulation of Dissolution of West Valley and DWPF Glasses in H-13 Water at 90°C," November 1987.

11. UCRL-96555, Rev. 1, "Thermodynamic Data Bases for Multivalent Elements: An Example for Ruthenium," November 1987.

12. UCRL-96702, "Geochemical Simulation of Reaction Between Spent Fuel Waste Form and J-13 Water at 25°C and 90°C," November 1987.

13. UCRL-53645, "Hydrothermal Interaction of Solid Wafers of Topopah Spring Tuff with J-13 Water and Distilled Water at 90, 150, and 250°C, Using Dickson-Type, Gold-Bag Rocking Autoclaves," September 1985.

14. UCRL-53702, "Spent Fuel Test - Climax: An Evaluation of the Technical Feasibility of Geologic Storage of Spent Nuclear Fuel in Granite," March 1986.

15. UCID-21274, "Plan for Integrated Testing for NNWSI Non EQ3/6 Data Base Portion," May 1987.

16. UCRL-96318, Ramirez, W. L. and Daily, W. D., "Electromagnetic Experiment to Map in Situ Water in Heated Welded Tuff: Preliminary Results," March 1987.

Category 3 -- File and cross reference

1. Knauss, K. G. and Wolery, T. J., "The Dissolution Kinetics of Quartz as a Function of pH and Time at 70°C," Pergamon Press, Geochimica et Cosmochimica Acta, v52, n1, p43, January 1988.

2. UCRL-94363, "Hydrological Properties of Topopah Spring Tuff - Laboratory Measurements," December 1985.

3. UCRL-53767, "Geomechanics of the Spent Fuel Test - Climax," July 1987.

VITRIFIED WASTE FORM --

The NBS review of PNL-5157, "Final Report of the Defense High-Level Waste Leaching Mechanisms Program" is continuing: Chapter 3, "Environmental Interaction," is expected to be available in July. Chapter 4, "Dissolution of Specific Radionuclides," is expected to be completed shortly thereafter. Chapter 6, "Phenomenological Models of Nuclear Waste Glass Leaching" will be assigned in July.

VITRIFIED WASTE FORM --

Category 1 -- Reports currently being reviewed

1. PNL-5157, "Final Report of the Defense High-Level Waste Leaching Mechanisms Program," August 1984.

Category 2 -- Review as time permits

1. "Large Scale Leach Testing of DWPF Canister Sections," Proceedings of the Materials Research Society Symposium, "Scientific Basis for Nuclear Waste Management X," December 1986.

2. "Waste Glass Leaching: Chemistry and Kinetics," Proceedings of the Materials Research Society Symposium, "Scientific Basis for Nuclear Waste Management X," December 1986.

3. PNL-6353, "Comprehensive Data Base of High-Level Nuclear Waste Glasses: September 1987 Status Report: Volume 2, Additional Appendices," December 1987.

4. DOE/NE/44139--34, "Preliminary Results of Durability Testing with Borosilicate Glass Composition," January 1987.

Category 3 -- File and cross reference

1. "Long Term Leach Behavior of West Valley HLW Glasses," P. B. Macedo, et al., ANS Spectrum, 1986.

2. "Leach Mechanisms of Borosilicate Glass Defense Waste Forms -- Effects of Composition," A. Barkatt, et al., Waste Management '86: Waste Isolation in the U.S.-Technical Programs and Public Education, March 1986.

3. "Chemical Determination of West Valley Waste Form Products," D. M. Oldman, J. R. Stimmel, and J. H. Marlow, March 1987.

4. "Physical Chemistry of Glass Surfaces," J. Non-Cryst. Solids, 1978.

5. DP-MS-86-96, "Process and Mechanical Development for the Savannah River TRU Waste Facility," Paper proposed for presentation at the American Nuclear Society International Meeting, Spectrum '86, September 1986.

6. PNL-4382, "Materials Characterization Center's Workshop on Leaching Mechanisms of Nuclear Waste Forms," May 19-21, 1982.

7. PNL-6353, "Comprehensive Data Base of High-Level Nuclear Waste Glasses: September 1987 Status Report: Volume 1, Discussion and Glass Durability Data," December 1987.

8. PNL-6320-1M "LFCM Vitrification Technology," September 1986.

9. WHC-EP--0008, "Hanford Waste Vitrification Plant Preliminary Description of Waste Form and Canister," September 1987.

TASK 2 -- Identification of Additional Data Required and Identification of Tests to Generate the Data

NBS lead workers are continuing their studies concerning the types of additional data and verification tests needed to demonstrate that the DOE waste package designs will meet the performance objectives of 10 CFR 60.

Work is continuing on consolidation of the various recommendations that have been made to date by the NBS.

TASK 3 -- Laboratory Testing

The work on each of the three projects reported below is on schedule with the work statements listed in their respective proposals. The work conducted in June 1988 is reported below. Work conducted in previous months was reported earlier. Summaries of two of the current laboratory testing studies are presented below and for the other two studies summaries will be given next month.

Title of Study: Evaluation of Methods for Detection of Stress Corrosion Crack Propagation in Fracture Mechanics Samples.
Principal Investigator: Charles Interrante

Test apparatus was rebuilt to overcome contamination problems. In addition, another test specimen SL2 was precracked and prepared for use in the next test. It is expected that at least one test and hopefully two tests will be conducted in July.

Title of Study: Effect of Resistivity and Transport on Corrosion of Waste Package Materials.
Principal Investigator: Edward Escalante

A new experimental set-up is now in operation. This new experiment includes features that were not a part of the first experiment. For example, two coupons are in each cell, relative humidity is controlled, and particle size of the sand is a variable. However, the measurements performed are the same. Thus, the corrosion rate of the coupons is measured by polarization techniques, and transport is measured by polarographic methods, as before. A total of 24 coupons are exposed, but because of time constraints, corrosion measurements are being made on only half.

Title of Study: Pitting Corrosion of Steel Used for Nuclear Waste Storage.
Principal Investigator: Anna C. Fraker

The status of this project was given in the May, 1988 monthly report. Work continues on data analysis, preparation of the paper for presentation. Data from tests in media of varying salinity and ionic content will be correlated in an effort to provide information on the corrosion behavior of A27 steel in various environments. Some of the work in progress and other planned work are listed below.

Specimens of 316L and 304 stainless steels are being prepared for testing in J-13 water, and some testing has been done. Effects (on pitting and other corrosion) of temperature, ionic content of water and other environmental parameters will be studied.

Specimens of A27 low-carbon steel have been prepared and tested in J-13 water and 3.5 percent NaCl solution. These data will be analyzed and correlated with earlier work, which dealt with tests of this material in a high pH aqueous media.

Additional microscopic work has been carried out to provide information on sites of shallow localized attack and also on increased corrosion of the pearlite phase over the ferrite phase. Photomicrographs were taken after exposure to anodic and cathodic polarization measurements.

Future plans include testing both types of steels in the welded condition.

Title of study: Corrosion Behavior of Zircaloy Nuclear Fuel Cladding
Principal Investigator: Anna C. Fraker

The status of the work of this project was given in the May, 1988 monthly report. The statements which follow are an update and work in progress is listed.

Zircaloy-2 and Zircaloy-4 specimens, of both the wrought and the cladding material, are being prepared for further testing. One test has been set up to measure electrochemical changes over time when Zircaloy is exposed to J-13 water. Other tests are being planned and will be set up to study if any changes occur with time in the laboratory tests.

Additional cyclic polarization measurements will be made. Parameters of these tests will be changed from values used in earlier tests. These parameters to be changed include time and the rate at which the applied potential is increased or decreased, and the ionic content of the solution.

Contact will be made in the future with Babcock and Wilcox Co. or with some other appropriate place where welded samples of the Zircaloy materials can be prepared. The corrosion behavior of weldments will be analyzed and tested.

Attachment B

Draft Reviews (May 1988)

NBS Review of Technical Reports on the High Level Waste Package for Nuclear Waste Storage

DATA SOURCE

(a) Organization Producing Data

Lawrence Livermore National Laboratory, Livermore, CA.

(b) Author(s), Reference, Reference Availability

Bullen, D. B., Gdowski, G. E. and McCright, R. D., "Impact of Phase Stability on the Corrosion Behavior of the Austenitic Candidate Materials for NNWSI," UCRL-97562, October 1987.

DATE REVIEWED: 4/18/88; Revised 6/30/88.

PURPOSE

The purpose of this paper is to review the technical literature regarding phase stability of 304L, 316L and the 825 alloy and to summarize the impact of phase stability on the degradation of these materials in the repository environment.

CONTENTS

This paper consists of 10 pages and it includes one table showing alloy compositions, six figures showing phase diagrams, phase precipitation temperature vs. time, Charpy impact strength vs. percent sigma phase, and 32 references.

TYPE OF DATA

A review article.

MATERIALS/COMPONENTS

304L stainless steel, 316L stainless steel and Alloy 825

TEST CONDITIONS

No tests were conducted. Test conditions reviewed included high temperature studies and phase transformations. The equilibrium phase diagram for Fe-Cr-Ni at 650°C is shown. Effects of quenching from 1100°C on austenite and other phases are shown. Iron melts at 1539°C, and it has a body-centered-cubic crystal structure (bcc) from 1539°C to 1390°C and a face-centered-cubic (fcc) structure from 1390°C to 910°C, and below 910°C, the structure returns to bcc Additions of Cr as well as Mo, Si, Al, Ti and Nb stabilize the bcc ferrite. Additions of Ni as well as Mn, Cu, Co, C and N stabilize the fcc. austenite. Thermomechanical treatments are important in producing nonequilibrium states of iron based materials. Conditions of composition, temperature of exposure, temperature at quenching and previous history of mechanical or thermomechanical treatment are identified as important to the austenite to martensite transformation and to other transformations.

METHODS OF DATA COLLECTION/ANALYSIS

Light microscopy, electron microscopy, and x-ray diffraction were used in articles surveyed for this review.

AMOUNT OF DATA

There is one table giving the compositions of the three alloys. There are six figures including the Fe-Cr-Ni phase diagram at 650°C, metastable phase diagrams of Fe-Cr-Ni after quenching, carbide precipitation vs. time and its effects on corrosion, effeet of sigma phase formation on impact strength, time vs. temp. precipitation of carbide phases and a cross section of the Fe-Cr-Ni phase diagram.

UNCERTAINITIES IN DATA

The metastable austenitic phase should be in equilibrium with the ferritic phase at 200°C but the ferrite is absent and due to this, the austenitic phase is metastable. This austenitic microstructure is known to be stable for up to 40 years but its stability is not known for 1000 years under repository conditions. Transformation of austenite to martensite due to effects of temperature, strain, or composition can occur with 304L and 316L stainless steel. This transformation could adversely affect mechanical properties. The precipitation of carbides, predominately $M_{23}C_6$, at grain boundaries could occur after long periods of time, and this would affect the corrosion and mechanical properties. The formation of intermediate phases such as the sigma phase can result in reduced fracture toughness. Long hold times, at repository temperatures or even during the time period for container retrieval, could cause precipitation of these phases or carbides, and all low-temperature phase transformations should be considered when selecting the material.

DEFICIENCIES/LIMITATIONS IN DATABASE

Data are needed on long-term, low-temperature (below 650°C) phase transformations for all of the phases.

KEYWORDS

Literature review, supporting data, microscopy, x-ray diffraction, electron microscopy, ambient temperature, high temperature, stainless steel, austenitic alloys, 304L stainless steel, 316L stainless steel, 825 alloy, annealed (austenitized and transformed), sensitized, impact strength, corrosion (galvanic), corrosion (intergranular), corrosion (stress cracking), cracking, cracking environmentally assisted, hydrogen embrittlement.

CONCLUSIONS

"Types 304L and 316L stainless steels were identified as metastable materials at repository relevant conditions."

Diffusion processes needed for precipitation reactions, occur slowly at temperatures below 650°C, and the predicted maximum repository temperature of 250°C is significantly lower.

"Carbide precipitation was identified in all of the austenitic candidate alloys."

Carbide precipitation may lead to sensitization in 304L and 316L and the potential for intergranular stress corrosion cracking.

Intermetallic phases such as sigma, chi and Laves, were noted to occur in 316L. These phases result in brittleness and reduce the impact strength. However, "No intermetallic phases formation was documented in alloy 825," and "Very few phase instability data were identified for alloy 825."

Limited data were available on $M_{23}C_6$ carbide precipitation in the 825 alloy and varying compositions of the carbide in the 825 alloy were reported.

Speculation regarding the possible existence of submicroscopic sigma phase in the 825 alloy was noted but not substantiated with data.

GENERAL COMMENTS OF REVIEWER

This review of phase stability in austenitic candidate materials covers a number of topics which need to be studied. Attention should be given to items mentioned in the sections of this review entitled comments, uncertainities in data, and conclusions.

The phase stability of 304L and 316L stainless steels at repository temperatures is questionable and must be resolved. Although diffusion reactions would be slower at 250°C than at 650°C, the time of exposure is longer and more data are needed at the lower temperatures. More studies on effects of composition, temperature, time and deformation on phase stability of these materials are needed. It is not clear whether the forty year successful use of these materials could furnish useful data for repository conditions or if it does, whether this time period could be greatly extended. This stability question may not lend itself to a resolution, and the question that must be raised is should metastable materials be used in the engineered barrier.

The review indicates that the 825 alloy is more promising than the stainless steels, but much more data are needed on carbide and other possible phase formations in this material. These data should be correlated with mechanical properties and and assessed in relation to temperature, time and repository conditions. The review relates phase instability to intergranular stress corrosion cracking. There are additional corrosion problems, such as pitting or galvanic corrosion, which could occur.

The following is a summary of recommendations related to this work:

1. The question should be addressed regarding whether metastable materials should be considered for use in the repository.

2. Additional studies of phase stability of austenitic materials are needed.

3. Carbide precipitation in 304L, 316L and the 825 alloy should be studied under temperatures involved in preparing the canister for storage and temperatures that will exist in the repository. Effects of long-time exposures must be considered.

4. Effects of carbon content and the total alloy composition on carbide precipitation in all austenitic materials should be studied at temperatures of preparation and storage in the repository.

5. Intermetallic phase formation and effects of temperature, time and composition should be studies for 304L, 316L and the 825 alloy.

6. Combined effects of gamma radiation and repository temperatures on phase stability of austenitic materials should be analyzed.

7. Measurements of mechanical properties and corrosion behavior should be made and correlated with phase change data.

RELATED HLW REPORTS

McCright, R. D. Halsey, W. G. and Van Konynenburg, R. A. Progress Report on the Results of Testing Advanced Conceptual Design Metal Barrier Materials Under Relevant Environmental Conditions for a Tuff Repository, UCID-21044, December, 1987.

APPLICABILITY OF DATA TO LICENSING
[Ranking: key data (X), supporting ( )]

(a) Relationship to Waste Package Performance Issues Already Identified

2.2.3, possible mechanical failure modes for waste package

2.2.4, potential corrosion failure modes for the waste package.

(b) New Licensing Issues

Sensitization and/or phase stability of austenitic materials

(c) Comments Related to licensing

Phase stability and/or effects of metastability on mechanical properties, corrosion behavior and overall durability of austenitic materials need to be determined. A material should be used only if it can be established that the transformation and these effects do not limit the integrity of the container in the repository environment over the needed containment time.

NBS Review of Technical Reports on the High Level Waste Package for Nuclear Waste Storage

DATA SOURCE

(a) Organization Producing Data

Lawrence Livermore National Laboratory, Livermore, CA. under U. S. Department of Energy Contract W-7405-Eng-48.

(b) Author(s), Reference, Reference Availability

Aines, R. D., "Plan for Glass Waste Form Testing for NNWSI," UCID-21190, September 1987.

DATE REVIEWED: 5/23/88; Rev. 6/28/88.

PURPOSE

The purpose of the glass waste form testing plan is to provide accurate data and models concerning glass leaching in the repository and to ascertain that there is adequate information to assess the importance of all release mechanisms.

TYPE OF DATA

(1) Collection and integration of existing glass waste form information.

(2) New glass waste form leach data to determine overall degradation rates, radionuclide release rates, solution compositions in contact with glass and mechanism of degradation.

(3) Glass release modeling using existing glass waste form information and computer code EQ3/6.

MATERIALS/COMPONENTS

Glasses identified in the producer's Waste Compliance Plans and Waste Qualification Reports will be tested. These presently include West Valley Demonstration Project (WVDP) and Defense Waste Processing Facility (DWPF) glasses. Other components will include materials likely to be found in the repository such as stainless steel and tuff.

TEST CONDITIONS

Parametric studies based on the unsaturated test and static leaching methods will be made. The unsaturated test method will be based on that developed by Bates and co-workers while the static methods will be based on MCC-1 and the pulsed flow method developed at the Vitreous State Laboratory, Catholic University of America.

Tests will be conducted at 90°C with J-13 water previously equilibrated with tuff rock at the test temperature. Some data will be obtained at 60°C to determine temperature dependence of the leach rates and some data will be obtained using deionized water for comparison with data currently available. Testing will be conducted on both simulated and radioactive samples of glass from both producers (Savannah River Plant (SRP) and WVDP).

METHODS OF DATA COLLECTION/ANALYSIS

These subjects are not addressed in this document but may be found in the related High Level Waste (HLW) documents cited below. These documents are included in the data base.

CONTENTS

29 pages; 1 figure cited below; purpose and objectives, 3 pgs; rational for selected studies and quality assurance 3 pgs; description of tests and analysis, and previous work, 9 pgs; glass release modeling 3 pgs; application of results 1 pg; schedule and milestones, 3 pgs ; list of test plans to support this study plan, 1 pg; references 2 pgs.

AMOUNT OF DATA

Figure

1. Glass Waste Form Testing Information Flow.

UNCERTAINTIES IN DATA

None given.

DEFICIENCIES/LIMITATIONS IN DATABASE

None given.

KEY WORDS

Planned work, leaching, EQ3/6, laboratory, J-13 water, deionized, tuff composition, tuff, basic (alkaline) solution (pH >7), high temperature, glass (West Valley reference glass), glass (defense waste reference glass), matrix dissolution (glass).

CONCLUSIONS

There are no conclusions.

GENERAL COMMENTS OF REVIEWER

The basic organization of the plan is excellent. The functions described in the plan will be carried out by many organizations so that careful and diligent overview of the effort will be required.

Three main efforts in the plan are compilation and selection of existing data for preliminary modeling tests, obtaining new leaching data on waste glasses supplied by SRP and WVDP, and development of a long-range modeling program based on the EQ3/6 program.

The author states that elucidation of the glass leaching mechanism is paramount to the success of the modeling effort. The leach mechanism may be extremely difficult if not impossible to define so that validation of a geochemical model is a formidable challenge.

The coupling of kinetic and thermodynamic modeling in the EQ3/6 model needs to be subjected to much thought. The basic assumption appears to be that glass will be leached by a kinetic process and that leach components will crystallize out on the glass surface by a thermodynamic process. However, in this coupled process either the thermodynamic or kinetic process could be rate controlling. For example, crystallization of SiO_2 in the form of a complex silicate will decrease the concentration of dissolved silica in the reaction zone and may lead to an increased leach rate.

Many reports have dealt with the formation of crystalline deposits on leached glass surfaces. An often unstated assumption concerning this phenomena is that the crystalline deposit protects the glass from further leaching. Because of the coupled kinetic leaching and thermodynamic recrystallization equilibria, leach rates could actually increase rather than decrease due to this effect. An important data need is the fate of radioactive nuclides in the host glass. The fraction of radionuclides captured in the recrystallized glass needs to be known.

RELATED HLW REPORTS

Bates, J. K., and T. Gerding (1986). One-Year Results of the NNWSI Unsaturated Test Procedure: SRL-165 Glass Application, ANL-85-41, Argonne National Laboratory, Argonne, IL.

Mendel, J. E. (compiler) (1984). Final Report of the Defense High-Level Leaching Mechanisms Program, PNL-5157, Ch. 1, Pacific Northwest Laboratories, Richland, WA.

APPLICABILITY OF DATA TO LICENSING
[Ranking: key data ( ), supporting data (X)

(a) Relationship to Waste Package Performance Issues Already Identified

Related to issue 2.3 concerning when, how, and at what rate will radionuclides be released from the waste form.

(b) New Licensing Issues

(c) Comments Related to Licensing