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

June 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 May 1988 (FIN-A-4171-7)

Dear Mr. Peterson:

Enclosed is the May 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. Draft Reviews are presented in the progress report, as Attachment B; comments on them are solicited.

Sincerely,

C. G. Interrante

Charles G. Interrante
Program Manager
Corrosion Group
Metallurgy Division

Enclosures

Distribution:
NMSS PM (1)
Ofc of the Director
NMSS (Attn: PMPDAS) (1)
HLWM Div. Director (1)
HLTR Branch Chief (1)
WM Docket Control Center (4)
Office of Research (1)
Office of Administration
and Resource Mgmt.,
Div. of Computer and
Telecommunications
Services (Attn: Director) (1)



A4171
Wm-11 NH14

(May 1988)

CURRENT OVHD RATES
CTR 35.50%
LAB 08.40%
BUR 45.70%

PREPARED FOR: DIVISION 450

NATIONAL BUREAU OF STANDARDS
DIVISION ONE-LINE
DOLLAR AMOUNTS ARE CURRENT YEAR OBLIGATIONS
PAY PERIOD 09 ENDING 05/07/88
PAY PERIOD 10 ENDING 05/21/88

| (---------CURRENT PERIOD---------) | | | | | | (----------FISCAL YEAR TO DATE----------) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COST CNTR | PROG TASK | LABOR HOURS | * LABOR+ APPLS $ | OTHER OBJ $ | TOTAL OBLG $ | LABOR HOURS | LABOR + LV & BN $ | TOTAL OVHDS $ | OTHER OBJ $ | TOTAL OBLG $ | AUTHOR $ | CURRENT BALANCE $ | Percentage of FY87 Funds Obligated To Date |
| 0480 | 14200 | 493 | 30030 | 854 | 30884 | 7431 | 196519 | 182653 | 19943 | 399115 | 659975 | 260860 | 60.5 |
| 0480 | 14200 | 484 | 28472 | 232 | 28704 | 7915 | 211536 | 196108 | 20175 | 427819 | 659975 | 232156 | 64.8 |

Monthly Letter Report for May 1988

Published June 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) under separate cover. Comments by NRC and its contractors are solicited.

1. UCRL-92311, "Gamma Radiation Effects on Corrosion, I. Electrochemical Mechanisms for the Aqueous Corrosion Process of Austenitic Stainless Steels," February 1985.

2. UCRL-97936, "Effect of Ionizing Radiation on Moist Air Systems," December 1987.

Status of database

886 Documents in HLW database.
53 Completed reviews in HLW database (taken from Vol. 1 to 3).
25 Completed reviews from Vol. 4 are ready for database entry.
12 Nearly completed reviews for Vol. 5.

Status of recently listed reviewable documents

NNWSI

10 NNWSI reports currently under review (Category 1).
16 NNWSI reports to review when time permits (Category 2).
0 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 (on glass) currently under review (Category 1).
6 Reports (on glass) to review when time permits (Category 2).
7 Reports (on glass) to file with cross reference(s) to other reports (Category 3).
0 Reports (on glass) identified and not yet categorized.

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

During the month of May, eleven documents were identified in the outputs from four searches conducted (using Dialog SDI bibliographic updates) on the NTIS and the DOE Energy database files. Selected documents (identified from the list of citations furnished by these searches) were already under consideration for review. Several others documents were ordered as a result of this search. Enclosed is the search strategy used: see p. 9, Attachment A.

STATUS OF REVIEWS OF NNWSI REPORTS

NNWSI -- Reports under consideration

Three publications are considered for review this month. The first is a published paper dealing with the dissolution of quartz in dilute buffered solutions. Two other reports are considered, the first is on the long-term safety of a high-level-waste repository, and the second is on the release and transport properties of radionuclides to the near field environment.

The rate of hydrolysis of quartz is investigated in dilute buffered solutions as a function of pH and time at 70°C (Knauss 1988). The authors find that above a pH of 6 the rate of dissolution begins to increase suggesting a change in dissolution mechanism. Their high-magnification examination of the reacted surfaces indicates that dissolution is very nonuniform and results in the formation of etch pits on the quartz.

The possible mechanisms by which radionuclides might be released to the environment from a high-level waste repository are investigated in this study (Ross 1987). The author considers the various existing barriers and their interactions, and fifty-eight processes that would affect the performance of

these barriers are identified. The report describes scenarios whereby one or more of these barriers could fail. A list of recommendations for further investigation is developed.

This report describes plans for experiments for obtaining data on properties related to radionuclide transport in the near-field environment, and for developing and validating a model to describe the rate of release of radionuclides from this near-field environment (Oversby 1987). The report specifically avoids the issue of developing data for use in the EQ3/6 geochemical modeling code.

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

3. Oversby, M. V., "Plan for Integrated Testing for NNWSI Non EQ3/6 Data Base Portion," UCID-21274, May 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-53767, "Geomechanics of the Spent Fuel Test - Climax," July 1987.

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

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

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

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

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

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

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

10. 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.

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-53767 | * | | | |
| UCRL-21005 | | x | | |
| UCID-21190 | | x | | |
| UCRL-21019 | x | | | |
| UCRL-97562 | | x | | |
| UCRL-96318 | * | | | |
| UCID-21272 | x | | | |
| UCRL-21013 | x | | | |
| UCRL-53795 | | x | | |

*Document must be reassigned to a more suitable reviewer.

Category 2 -- Review as time permits

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

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

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

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

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

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

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

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

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

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

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

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

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

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

15. 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.

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

Category 3 -- File and cross reference

None this month.

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 when a suitable reviewer is available.

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.

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

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

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.

An attempt is being made to consolidate 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 May 1988 is reported below. Work conducted in previous months was reported earlier.

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

After various calibrations and measurements were made on the test apparatus and the test solution, specimen SL3 was tested but no cracking was detected. Next month, the reason for this will be sought and another trial will be made.

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

The new experimental set-up is near completion, however, further evaluation of the data taken during the first series of experiments indicates that particle size of the sand is important to the transport and resistivity measurements. Thus, a series of short term experiments are being conducted to verify this observation. Furthermore, the use of agar as an electrolyte media introduces problems difficult to avoid (e.g. separation of the electrodes from the agar as the agar ages). These questions should be cleared up soon so that we can begin the next phase of measurements.

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

Comments received from the NRC regarding the draft report on "Corrosion Behavior of Low Carbon Steel in High pH Aqueous Media" have been received. These comments have been reviewed and will be considered for preparing the final version of the report.

Anodic polarization measurements in J-13 water at 95°C have been made on three 304 stainless steel specimens. Some additional studies will be conducted with the 304 stainless steel to show effects of temperature and chloride ion concentration. Specimens of 316L stainless steel will be prepared for testing in J-13 water at 95°C.

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

The initial portion of this study of this study has been completed. The work was included in the three following work statements;

(1) Obtain materials and testing environment - Zircaloy-2 and Zircaloy-4 alloys were obtained from Teledyne Wah Chang in Albany, Oregon. Zircaloy-2 and Zircaloy-4 cladding tubes were obtained from General Electric and Babcock and Wilcox, respectively. The testing environment, simulated J-13 water, was prepared in the laboratory.

(2) A brief literature survey. - A literature survey was conducted and a draft report was submitted to the NRC.

(3) Anodic polarization curves for Zircaloy in J-13 water at 95°C. - Anodic polarization measurements showed that Zircaloy passivates in the J-13 water, both in the alloy form and in the cladding material form. The usual breakdown potential was +0.8V vs a saturated calomel electrode.

The work described in these statements has been completed. This study was extended to include cyclic polarization studies of Zircaloy in J-13 water to investigate susceptibility to pitting. This work is in progress and should be completed within the next six months. Additional studies should be conducted relating to passivity and pitting of Zircaloy and effects of ion concentrations, temperature and environmental pH.

At the beginning of this project, the NRC requested that welded material be studied. This is planned for both the Zircaloy and one of the steels. Other plans for these studies include recent requests from the NRC that materials be tested for extended times and at ambient temperatures as well as at 95°C. This work will be in progress and should be completed within the next six to twelve months.

# SDI006, UD 8813, SER. DD016

**File(s) searched:**

File 6:NTIS - 64-88/ISS13
(COPR. 1988 NTIS)

**Sets selected:**

| Set | Items | Description |
|---|---|---|
| 1 | 2 | WASTE(W)PACKAGE? |
| 2 | 9 | CANISTER? |
| 3 | 44 | CORROSION |
| 4 | 9 | LEACHING |
| 5 | 50 | GLASS |
| 6 | 4 | VITRIFICATION |
| 7 | 96 | S3-S6/OR |
| 8 | 2 | HIGH(W)LEVEL(W)WASTE? |
| 9 | 106 | RADIOACTIVE(W)WASTE? |
| 10 | 7 | NUCLEAR(W)WASTE? |
| 11 | 2 | (S1 OR S2) AND S7 AND (S8 OR S9 OR S10) |
| 12 | 0 | ANNA FRAKER RM. B-106 BLDG. 223 X6009 |
| 13 | 0 | JILL RUSPI |

**Prints requested** ('*' indicates user print cancellation) :

| Date | Time | Description |
|---|---|---|
| 31may | 07:10EST | PR 11/5/1-25 (items 1-2) |

**Total items to be printed: 2**

Attachment A

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

Glass, R. S., Overturf, G. E., Van Konynenburg, R. A., and McCright, R. D., "Gamma Radiation Effects on Corrosion: I - Electrochemical Mechanisms for the Aqueous Corrosion Processes of Austenitic Stainless Steels," UCRL-92311, February 1986.

DATE REVIEWED: 3/16/88; Revised 6/8/88.

## PURPOSE

Determine the effects of gamma irradiation with the addition of $H_2O_2$ on the electrochemical behavior of austentic stainless steels.

## TYPE OF DATA

Experimental.

## MATERIALS/COMPONENTS

316L SS, annealed.

## TEST CONDITIONS

J-13 and concentrated J-13 groundwater, with and without $\gamma$-radiation, T = 30°C.

## METHODS OF DATA COLLECTION/ANALYSIS

Open circuit potentials and polarization curve.

## AMOUNT OF DATA

Tables

1. Composition of the metal.
2. Composition of the J-13 water.
3. Possible redox reactions in $\gamma$-irradiation solution.

Figures

1. Schematic of the electrochemical cell.

2. Corrosion potential behavior of 316L stainless steel in 10x concentrated J-13 well water under gamma irradiation. The solution was not exposed to irradiation prior to initiation of the first "on/off" irradiation cycle.
3. Open circuit potential of pressure vs time (up to 500 min), showing the effect of $\gamma$-radiation, addition of $H_2O_2$ and $O_2$.
4. Open circuit potential of 316L as a function of time (up to 600 min), showing the effect of $\gamma$-radiation and of $H_2O_2$ addition.
5. Response of the corrosion potential for 316L stainless steel in J-13 well water to which successive additions of $H_2O_2$ were made. In this figure, one drop of $H_2O_2$ (from a 30% solution) represents a resulting solution concentration of 0.49 mM. The solution was continuously stirred by a magnetic stirrer throughout the experiment.
6. Open-circuit potential behavior for platinum irradiated J-13 well water.
7. Same as Figure 6, only with continuous purging of the solution by argon throughout the experiment,
8. Response of the open-circuit potential for platinum unirradiated J-13 well water to successive additions of $H_2$, $H_2O_2$, and $O_2$. The points of introduction of these species into solution are indicated on the figure. In this figure, two drops of $H_2O_2$ (from a 30% solution) results in a solution concentration of 0.98 mM. Purging of the solution with $H_2$ and $O_2$ resulted in successive saturated solutions of these gases. The solution was continuously stirred by a magnetic stirrer during the experiment.
9. Response of the corrosion potential for 316L stainless steel in J-13 well water to successive additions of $H_2O_2$ and $H_2$. The points of introduction of these species into solution are indicated on the figure. In this experiment the addition of two drops of $H_2O_2$ (from a 30% solution) results in a solution concentration of 0.98 mM. Purging of the solution with solution with $H_2$. The solution was continuously stirred with a magnetic stirrer in this experiment.
10. Response of the corrosion potential for 316L stainless steel in argon-purged J-13 well water to gamma irradiation. Initiation of argon deaeration and gamma irradiation are indicated on the figure. Once initiated, argon purging was continued throughout the remainder of the experiment.
11. Comparison of the potentiostatic anodic polarization behavior for 316L stainless steel in 650 ppm $Cl^-$ solution in deionized water with and without gamma irradiation. The polarization curves were scanned anodically starting from the corrosion potential in each case. Upon reaching the anodic limit, the scans were reversed to more negative potentials. In this figure, $E_{corr}$ and $E_p$ represent values of the corrosion potential and pitting potential, respectively, for the unirradiated case. The corresponding values for the irradiated experiment are indicated on the figure as $*E_{corr}$ and $*E_p$.

UNCERTAINTIES IN DATA

None given. Results of single experiments.

DEFICIENCIES/LIMITATIONS IN DATABASE

Considered preliminary results by the authors.

KEY WORDS

316L SS, J-13 water, $\gamma$-irradiation, corrosion.

CONCLUSIONS

1. "Gamma irradiation increases the oxidizing nature of the aqueous solutions used in this study through production of $\bullet OH$ and $H_2O_2$. These species probably account for the observed positive corrosion potential shifts. Such shifts may be generic for austenitic stainless steels in J-13 well water and in similar environments."

2. "By analogy to previous work on Pt in aqueous $H_2O_2$ media, the electrochemical equilibrium between adsorbed hydroxyl species and hydroxide ions may be important in determining the corrosion potentials of stainless steel in irradiated aqueous solutions. Also a cyclical catalytic scheme for the decomposition of $H_2O_2$ involving adsorbed species (e.g., $\bullet OH$, $HO_2$, or $O_2$) participating in anodic and cathodic processes may also be important. However, a stainless steel surface certainly forms a more complex electrochemical interface than does a Pt surface, and other reactions also serve to establish a mixed corrosion potential, as discussed in the text."

3. "The generation of oxidizing species in the solution layers adjacent to the stainless steel surface is responsible for the rapid potential shifts observed upon imposition of the gamma field. Upon continued radiolysis, a rise in concentration of oxidizing species (particularly $H_2O_2$) in the bulk solution also gradually increases the steady-state corrosion potential of the stainless steel."

4. "The corrosion potential of 316L stainless steel, while sensitive to the presence of $H_2O_2$, does not appear to be sensitive to the presence of $H_2$ under our experimental conditions. While the corrosion potential is not sensitive to molecular $H_2$, it may be sensitive to atomic hydrogen, which is also produced under radiolysis. Molecular hydrogen may only play a role in helping to establish steady-state bulk $H_2O_2$ concentrations."

5. "Preliminary results suggest that the susceptibility of 316L stainless steel to pitting is not increased under gamma irradiation. It appears that both the corrosion and pitting potentials are shifted positively by approximately the same amount. The more positive pitting potentials observed under gamma irradiation may be related to reaction of radiolytic products with defects (e.g., oxygen vacancies) in the oxide film, or to film-repair reactions. Further work is needed to understand the effect of gamma irradiation over wide ranges of the polarization curves."

GENERAL COMMENTS OF REVIEWER

Although data are very limited and preliminary, they are in general agreement with the expected effects of $\gamma$-irradiation. The discussion concerning the reactions and mechanisms that alter the corrosion potential of stainless steel under $\gamma$-irradiation, is reasonable, but it must be emphasized that it is highly speculative. Finally, the results of a single potentiodynamic scan are interpreted as indicating no detrimental effect of $\gamma$-radiation on pitting. However, the fact that the repassivation potential seems to be below the open circuit potential under irradiation could very well mean that if pitting were initiated for whatever reason, no spontaneous repassivation and pit death (pit deactivation) would be expected.

RECOMMENDATIONS

None.

RELATED HLW REPORTS

Reed, D. T. and Van Konynenburg, R. A., "Effect of Ionizing Radiation on Moist Air Systems," UCRL-97936, December 1987.

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

(a) Relationahip to Waste Package Performance Issues Already Identified

Related to NNWSI ISTP issue, 2.2.4.2., what are the effects of radiation on the corrosion failure modes and associated corrosion rates for the waste package container?

(b) New Licensing Issues

(c) General Comments on Licensing

AUTHOR'S ABSTRACT

The Nuclear Regulatory Commission regulations for geologic disposal of high level nuclear wastes require multibarriered packages for waste containment that are environmentally stable for time periods of 300 to 1000 years. In addition to examining the usual corrosion failure modes which must be evaluated in choosing a corrosion resistant material for waste containment (e.g., resistant to pitting, crevice attack, and stress-corrosion cracking), the effects of gamma radiation on the chemical environment surrounding the waste container must also be considered. Austenitic stainless steels have been proposed for use as waste container materials for a potential nuclear repository to be located at Yucca Mountain in Nye County, Nevada. This study focuses on the effects of gamma radiation on the corrosion mechanisms of 316L stainless steel in groundwater regional to this site. When gamma irradiation is initiated, corrosion potential shifts in the positive direction are observed for 316L in in groundwater regional to the repository site. These potential shifts, as well as the subsequent effect on pitting resistance are considered.

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

DATA SOURCE

(a) Organization Producting Data

Lawrence Livermore National Laboratory, Livermore, CA.

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

Reed, D. T. and Van Konynenburg, R. A., "Effect of Ionizing Radiation on Moist Air Systems," UCRL-97936, December 1987.

DATE REVIEWED: 3/17/88, Revised 4/4/88.

PURPOSE

The purpose is to summarize and review the radiation chemistry of the $H_2/O_2/H_2O$ systems.

TYPE OF DATA

Literature review.

MATERIALS/COMPONENTS

None given.

TEST CONDITIONS

None given.

METHODS OF DATA COLLECTION/ANALYSIS

None given.

AMOUNT OF DATA

Two Tables

Table I. Partial pressures of Gases after irradiation of $N_2/O_2$ mixtures.

Table II. Summary of experiments on radiation chemistry of moist air.

UNCERTAINTIES/LIMITATIONS IN DATABASE

None given.

KEY WORDS

Radiation chemistry, nitrogen, air, nitrogen oxides.

CONCLUSIONS

"There remain a significant number of apparent discrepancies and gaps in the experimental results just reviewed. Some of these discrepancies can be resolved by considering the differences in the experimental conditions of the studies performed. Many of these discrepancies, particularly in the heterogeneous experiments that have been performed, can only be resolved by further experimentation."

GENERAL COMMENTS OF REVIEWER

A fairly comprehensive literature survey, which gives some general indications on the extent of nitric acid formation to be expected under repository conditions. The survey also highlights the need for further experimental work in order to obtain reliable quantitative data on the effects of radiation on the corrosion of the metal containers.

RECOMMENDATIONS

Further experimental work, possibly under conditions more similar to those expected in the repository, is recommended. A radiation chemist could give detailed recommendations on how to proceed.

RELATED HLW REPORTS

Ebert, W. L., Bates, J. K., Gerding, T. J., and Van Konynenburg, R. A., "The Effects of Gamma Radiation on Groundwater Chemistry and Glass Reaction in a Saturated Tuff Environment," UCRL-95884, December 1986.

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

(a) Relationship to Waste Package Performance Issues Already Identified

Related to NNWSI ISTP issue, 3.2.1.3, what are the changes in the geochemical conditions of the groundwater due to increased temperature and radiolysis within the saturated/unsaturated zone?

(b) New Licensing Issues

(c) General Comments on Licensing

AUTHOR'S ABSTRACT

The radiation chemistry of nitrogen/oxygen/water systems is reviewed. General radiolytic effects in dry nitrogen/oxygen systems are relatively well characterized. Irradiation results in the formation of steady state

concentrations of ozone, nitrous oxide and nitrogen dioxide. In closed systems, the concentration observed depends on the total dose, temperature and initial gas composition. Only three studies have been published that focus on the radiation chemistry of nitrogen/oxygen/water homogeneous gas systems. Mixed phase work that is relevant to the gaseous system is also summarized. The presence of water vapor results in the formation of nitric acid and significantly changes the chemistry observed in dry air systems. Mechanistic evidence from the studies reviewed are summarized and discussed in relation to characterizing the gas phase during the containment period of a repository in tuff.