UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
(formerly National Bureau of Standards)
Gaithersburg, Maryland 20899

February 28, 1990

Mr. Richard Weller, Section Leader
Materials Engineering Section
Division of High-Level Waste Management
Office of Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Re: Monthly Progress Report for January 1990 (FIN-A-4171-0)

Dear Mr. Weller:

Enclosed is the January 1990 progress report for the project "Evaluation and Compilation of DOE Waste Package Test Data" (FIN-A-4171-0). The financial information is reported separately.

Sincerely,

Anna C. Fraker

Anna C. Fraker
Metallurgist
Corrosion Group
Metallurgy Division

Enclosures

Distribution:
WM Docket Control Center (1-original)

Monthly Progress Report for January 1990

Published February 1990

(FIN-A-4171-0)

Performing Organization: National Institute for Standards and Technology (NIST)
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

STATUS OF DATABASE

	Current Month	Previous Quarter
Number of citations	1181	1131
Number of completed reviews	92	85

Appended to this report is the following Draft Review not previously submitted. Comments by the NRC and its contractors are solicited.

1. Beavers, J. A. and Thompson, N. G., "Container Corrosion in High Level Nuclear Waste Repositories," - First Semi-Annual Report/Year 2, September 1988 to February 1988.

As required under Task 1, drafts of two interpretive papers were submitted to the NRC on January 15, 1990.

1. "Examination of the Mechanisms of Stress Corrosion Cracking of Stainless Steels in a Tuff Environment", by Dr. R. E. Ricker

2. "Mechanisms of Internal Corrosion of Spent Fuel Rods", by Dr. A. C. Fraker

Status of Recently Listed Reviewable Documents

Reviewable documents are classified as follows: Category 1 documents are currently being reviewed. Categories 2 and 3 are documents that will be entered into the database with citation information and authors abstracts, and the Category 2 documents are flagged "to review when time permits."

YUCCA MOUNTAIN PROJECT

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

GLASS -- VITRIFIED WASTE FORM

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

Database searches for January 1990 include Metadex, NTIS, Engineered Materials Abstract, Compendex Plus and DOE Energy. Examples of the search conducted for each of these databases are in this report (see p. 13).

STATUS OF REVIEWS OF YUCCA MOUNTAIN PROJECT REPORTS

Yucca Mountain Project -- Reports recently identified for review

Four reports have been identified for review during this month. One on corrosion of copper, two on characterization of the environment, and one on dissolution of glass.

Copper

The corrosion of three candidate copper and copper alloys, CDA 102, CDA 613, and CDA 715, was measured in unirradiated 0.1 N $NaNO_3$ at 95°C. The results indicate that whereas all three materials are susceptible to

pitting corrosion in the environment investigated, they should not be disqualified as candidate materials for the waste package [Akkaya, 1988].

Site Characterization

This report is a brief overview of three areas of investigation during evaluation of the post-emplacement environment. The areas are described as laboratory studies, numerical simulations, and field experiments. Results from several studies are briefly discussed and the point is emphasized that the greatest challenge to investigators will be correlating fluid flow with chemical reaction processes [Glassley, 1989].

A study using simulation boreholes with heaters is used to develop data on the behavior of the rock and movement of moisture through the rock. Preliminary results indicate that immediate vicinity of the borehole is dry in the presence of heat, and adjacent to this dry zone is a region of increased saturation, as expected. Above the heaters, the temperature is elevated by 30°C compared to the region below the heater. This nonuniformity in temperature was unexpected, and presently there is no satisfactory explanation for the phenomenon [Ramirez, 1989].

Incorporated into the EQ3/6 geochemical modeling code is a kinetic model for the dissolution of borosilicate glass used to predict the dissolution rate of nuclear waste glass. Using the assumption that the rate of glass dissolution is controlled by the rate of dissolution of the surface gel layer above the diffusion layer, the model shows very good agreement predicted and observed dissolution behavior. The results suggest that the experimental non-linear glass release rates are not diffusion controlled, but instead are controlled by dissolution affinity of the gel layer [Bourcier, 1989].

1. Akkaya, M. and Verink, E. D., "Electrochemical Corrosion Studies on Copper-Based Waste Package Container Materials in Unirradiated 0.1 N $NaNO_3$ at 95°C", UCRL-21076, May 1988.

2. Glassley, W., "Evaluation of the Post-Emplacement Environment of High Level Radioactive Waste Packages at Yucca Mountain, Nevada", UCRL-100603, March 1989.

3. Ramirez, A. L., Beatty, J., Buscheck, T., Carlson, R., Daily, W., LaTorre, R., Lee, K., Lin, W., Mao, N., Nitao, J., Towe, D., Ueneg, T., Watwood, D., and Wilder, D., "Prototype Engineered Barrier System Field Tests Progress Report", UCRL-101615, July 1989.

4. Bourcier, W. L., Knauss, K. G., and Merzbacher, C. I., "A Kinetic Model for Dissolution of Borosilicate Glass", UCRL-101285, June 1989.

Yucca Mountain Project --

Category 1 -- Reports currently being reviewed

1. WHC-EP-0096 (formerly HEDL-7665), "Initial Report on Stress-Corrosion-Cracking Experiments Using Zircaloy-4 Spent Fuel Cladding C-Rings," September 1988.

2. UCID-21466, "Simulations of the Near-Field Transport of Radionuclides by Liquid Diffusion at Yucca Mountain -- Comparisons with and without Emplacement Backfill", July 1988.

3. UCID-21700, "Yucca Mountain Project Waste Package Design for MRS System Studies", April 1989.

4. UCID-21444, "Numerical Modeling of the Thermal and Hydrological Environment Around a Nuclear Waste Package Using the Equivalent Continuum Approximation: Horizontal Emplacement", May 1988.

5. WHC-EP-0065 (formerly HEDL-7637), "Electrochemical Corrosion - Scoping Experiments -- An Evaluation of Results", September 1988.

6. UCRL-100395, "Waste Package Performance Assessment for the Yucca Mountain Project", February 1989.

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
WHC-EP-0096	2/21/89			
UCID-21466	12/18/89			
UCID-21700	12/18/89	1/22/90		
UCID-21444	12/18/89			
WHC-EP-0065	12/18/89			
UCRL-100395	12/18/89			

Category 2 -- Review as time permits (new entries for this reference data file)

1. Glassley, W., "Evaluation of the Post-Emplacement Environment of High Level Radioactive Waste Packages at Yucca Mountain, Nevada", UCRL-100603, March 1989.

2. Bourcier, W. L., Knauss, K. G., and Merzbacher, C. I., "A Kinetic Model for Dissolution of Borosilicate Glass", UCRL-101285, June 1989.

Category 3 -- File and cross reference

None this month.

OTHER REPORTS ON VITRIFIED WASTE FORM --

Category 1 -- Reports currently being reviewed

None this month.

Category 2 -- Review as time permits

None this month.

Category 3 -- File and cross reference

None this month.

TASK 3 -- LABORATORY TESTING

The following two reports were submitted to the NRC on January 30, 1990 in accordance with our contractual requirements:

1. "Corrosion Behavior of Zirconium Alloy Nuclear Fuel Cladding", by Anna C. Fraker and Jonice S. Harris

2. "Corrosion in Simulated Repository Environments", by Edward Escalante

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

January 1990:

It is anticipated that Dr. Interrante will have the opportunity to do the data analysis and perhaps even to conduct the additional test in the next quarter. In any event, the apparatus for this work will be left intact until completion of these studies is assured.

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

January 1990:

The last of the laboratory modifications, installation of a ventilating hood, is near completion. A draft of the final laboratory report on this study has been submitted to the NRC.

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

Studies of literature and additional data and specimen analysis in preparation for writing a paper continue. The report that was submitted to NRC earlier will be put in the form of an NIST Internal Report.

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

January 1990:

The purpose of this study is to provide information and data on the corrosion behavior of Zircaloy that can be used to determine the long-term durability of nuclear fuel cladding made of this material. This experimental work involves electrochemical measurements made primarily using potentiostatic polarization techniques to study the corrosion behavior of bulk Zircaloy-2 and -4 as well as specimens of cladding tubes made from these two materials. Measurements are made on both the inner and outer walls of the cladding. Measurements have been made in simulated J-13 water, a water that may be typical of that which could be present in the Yucca Mountain, Nevada site.

Part of the work of this period involved preparing the final copy of the report on the first phase of this work. The draft report had been submitted to the NRC in August, 1989, and the final copy was submitted to the NRC on January 15, 1990. Plans were made for the continuation of studies of corrosion of Zircaloy and the investigation of the effects of selected ions in solution.

Two specimens of Zircaloy-2 cladding, one exposing the surface of the inner wall and one exposing the surface of the outer wall, were left in the J-13 water at a temperature of 70 C for since June 8, 1989. Measurements were made on these specimens in December, 1989 at 70 C, and the data showed only small changes when the recent curves were compared with the previous ones. There were small decreases in current levels and a positive shift in the corrosion potentials, and both of these changes indicate increased passivity. Measurements were made at 90 C on January 25, 1990 and results showed again, a more positive corrosion potential and no hysteresis. The current on the return cycle of the polarization was lower, indicating a passive film on the tubing surface. The specimens were dismounted and visual observation showed the presence of an overall surface film with no indication of local attack. These surfaces will be analyzed further and the oxide film removed to determine the condition of the underlying metal.Future work will be directed toward investigating of effects of selected halide ions on passivity and localized corrosion of Zircaloy. Other future work involves some measurements of longer term tests, and some additional specimen analysis and tests that can provide a more complete explanation of experimental results already obtained.

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

DATA SOURCE

(a) Organization Producing Data

Cortest Columbus, Inc., Columbus, OH.

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

Beavers, J. A. and Thompson, N. G., "Container Corrosion in High Level Nuclear Waste Repositories", First Semi-Annual Report/Year 2, September 1988 to February 1989.

DATE REVIEWED: 6/5/89; Revised 8/8/89; 1/22/90

PURPOSE

"The overall objective of the proposed program is to develop independent experimental data to assist the NRC in evaluating the uncertainties in DOE's claims concerning waste container corrosion. DOE has claimed in the environmental assessments, and is expected to claim in the license application, that corrosion rates can be so quantified and extrapolated as to make it possible to obtain credit for the container in meeting the containment requirement of 10CFR60."

"The purpose of task 1 is (1) to compile repository site specific data which are necessary to develop and update the work plan, (2) to provide continuity between the individual tasks of the program, and (3) to coordinate the program with other NRC projects."

"The purpose of task 2 is to examine the effects of environmental and metallurgical variables on the electrochemical behavior of the candidate container materials."

"The purpose of task 3 is to evaluate the corrosion behavior of the candidate container materials in the vapor phase and under alternate-immersion conditions."

"The purposes of task 4 are (1) to study the relationships between the pitting parameters E_{pit} and E_{prot} and long-term pit initiation studies, and (2) to evaluate pit-propagation behavior."

"The purpose of task 5 is to identify the environmental conditions under which the candidate alloys will undergo stress-corrosion cracking (SCC)."

"The purpose of task 6 is to explore failure modes that are likely, according to current knowledge, to produce accelerated attack and may lead to premature failure of the waste container."

"The purpose of task 7 is to provide long-term exposure data for evaluating the various modes of corrosion identified in tasks 2 through 6".

KEY WORDS

Experimental data, corrosion, electrochemical, slow-strain-rate, weight change, microscopy, laboratory, J-13 water, Yucca Mountain, high temperature, copper base, copper alloys, pitting, stress corrosion cracking.

CONTENTS

The report has sections of ABSTRACT, EXECUTIVE SUMMARY, INTRODUCTION, OBJECTIVE AND SCOPE OF WORK, 38 figures, 10 tables and the following contents:

AMOUNT OF DATA

There are 38 figures; mostly showing cyclic polarization curves with a few polarization resistance curves, a few scanning electron micrographs, a schematic showing weight loss change as a function of descaling, and a schematic of a slow strain rate specimen. There are ten tables showing test solutions, test parameters, and summaries of results.

TEST CONDITIONS

Tasks 1, 6 and 7 are not applicable to test conditions.

Task 2 -- Materials - alloy 304L, alloy 825, Copper CDA 102, Copper-30 Nickel, Alloy CDA 715
Specimen Preparation - typically 1.3 cm in length with the diameter depending on the metal being tested and polished with successively finer grades of silicon carbide paper, finishing a 600-grit grade
Environments - attached table 3 and 75°C tests in simulated J-13 well water for temperature-effects studies

Task 3 -- Materials - CDA 102 Cu and alloy CDA 715
Specimen Preparation - creviced and uncreviced specimens as well as u-bends
Environments - simulated J-13 well water and its vapor at 90°C for periods up to 2000 hours

Task 4 -- Materials - CDA 102 Cu and alloy CDA 715
Specimen Preparation - the same as task 2 and additional creviced specimens
Environments - attached table 3

Task 5 -- Materials - solution annealed alloy 304L
Specimen Preparation - cylindrical specimen without precrack at strain rate of $1x10^{-6}$ s^{-1} (additional $5x10^{-7}$ s^{-1} for the oil test)
Environment - oil, J-13, J-13 + CO_2 (purge rate of about 10 ml/min), all at 90°C

UNCERTAINTIES IN DATA

"Cyclic potentiostatic polarization (CPP) tests I33-I36 were performed in the same solution and provide an indication of the reproducibility of the polarization behavior; figures 8 and 9."

In the slow strain rate experiments of Task 5, the authors reported that "in the SCC of Task 5, "there was considerable scatter in the data which is not uncommon for slow strain rate (SSR) tests."

DEFICIENCIES/LIMITATIONS IN DATABASE

Not stated.

CONCLUSIONS OF AUTHOR

During this reporting period:

Task 1 -- "a minor addition was made to Task 4 of the work plan."

Task 2 -- "matrices of potentiodynamic polarization experiments were completed on Type 304L stainless steel and Incoloy Alloy 825 in simulated Tuff repository environments. While both alloys performed well in the simulated J-13 well water, pitting and crevice corrosion were observed under some of the simulated repository conditions."

Task 3 -- "2000-hour exposure tests were completed on CDA 102 Copper and CDA 715 Copper-Nickel in simulated J-13 well water at 90°C. Surprisingly, significant pitting was observed on vapor-phase specimens of CDA 715 after 2000 hours exposure."

Task 4 -- "potentiostatic pit-initiation studies were performed on Type 304L stainless steel, Incoloy Alloy 825, CDA 102 Copper and CDA 715 Copper-Nickel in simulated Tuff repository environments. The most significant finding was the confirmation that the cyclic-potentiodynamic-

polarization (CPP) technique provided relatively poor prediction of the long-term pitting behavior of the copper-based alloys."

Task 5 -- "SSR tests were completed on Type 304L stainless steel in the control environment (oil), in simulated J-13 well water and in J-13 well water with added CO_2. No SCC was observed in any of the test environments, but there was considerable scatter in the mechanical property data for the test specimens. This scatter is typical for SSR tests and indicates the variables in the mechanical properties of the small diameter gauge sections of the specimens."

Task 6 -- "set up of the thermogalvanic couples experimental apparatus was started."

Task 7 -- "Set up of the initial long-term exposure tests were started."

COMMENTS OF REVIEWER

This progress report summarizes the research results obtained in the first semi-annual period of year two of this contract. The scope of the present review is extended to the overall program without being restricted to the particular results obtained during this period, because (1) the related previous reports have not been reviewed extensively and (2) the program is being modified as the research progresses.

1. General Comments

   This work applies electrochemical and other measurements to determine parameters responsible for container failures by various corrosion modes. The study includes the present candidate materials for HLW containers in expected corrosion environments derived from the Tuffaceous solution. The results certainly would be useful in screening various candidate materials and in identifying key environmental conditions responsible for the container failure. There is a need for obtaining long-term data and identifying new failure modes, such as steam corrosion, that could be active in repository conditions.

   In deriving the matrix of environmental conditions, it is recommended that, where possible, the statistics be based on available generic information. There are corrosion data available for the candidate materials in various solutions which include some of the species present in the Tuffaceous solution. The knowledge from those, though not having been obtained under exactly the same repository conditions, will help the author to derive the optimum matrix, avoiding many time-consuming runs which may not be necessary. Likewise, in the interpretation of data from the selected matrix, it is recommended that efforts be directed toward interpreting the data as it relates to (1) the results from J-13 well water and (2) the generic data. These interpretations should (1) identify species responsible for the specific mode of corrosion and (2) specify the roles of those species in the corrosion processes. Finally, it is highly recommended to

include gamma-pool tests as variables in the experimental matrix. Short-lived radicals or hydrogen build-up may be important. For instance, the higher-order interaction term may become important in the synergistic effects of solution species in the presence of such radicals.

The current potentiostatic polarization (CPP) or slow strain rate (SSR) tests may be acceptable as screening tests. However, in the prediction of long-term behavior, other techniques also should be used. The efforts for long-term prediction of HLW containers may prevent any serious mistakes in designing the HLW packages, but may not allow for predicting the performance of the HLW packages precisely for 300-1000 years. In light of this concern, it is unclear how the present data provide us with information on the long-term behavior of the containers. The plan for the use of these data in the long-term prediction should be more specific. A couple of such examples are: (1) SSR tests with notched samples of passive materials can be performed to measure the crack initiation time at various strain (or extension) rates. Because the crack propagation time is normally short with respect to the design life of the container, measurement of it is of limited value. The measured crack initiation time can be extrapolated to zero strain rate and to very low values of stress intensity; (2) likewise, time to pit initiation of passive materials can be monitored by recording the current response at various potentials above and below the pitting potential to determine the potential limit by time-extrapolation to avoid pit initiation for an extended period of time.

The studies on hydrodynamics and mass-transport are largely ignored. Clarification is needed regarding (1) how the system goes above the pitting potential, (2) how severe the crevice (expected to form between the package and bore-hole wall or fallen rocks) solution would be, and (3) how the corrosion products, such as hydration products, accumulated affect the in-situ electrochemical monitoring of corrosion. This clarification will lead us (1) to include hydrogen embrittlement since a large amount of radiolytic hydrogen molecules can be dissociated on the surface of the containers; (2) to establish the text matrix more realistically; and (3) to understand the discrepancy between the data of weight measurement and electrochemical measurement and (3-b) time dependence of corrosion rates. Eventually, these studies should also include the thermodynamic consideration of the stability of passivity and of the solubility limit of dissolved (or hydrated) corrosion products and relate this to long-term prediction

The authors should have justified the use of the Stern-Geary equation for corrosion in the vapor phase. It is not clear how the measured data are interpreted with a partial exposure of specimens to vapor. The equation may not be valid in the absence of liquid solution or in the presence of corrosion products for both passive and non-passive materials. Also, the author do not address why no attempt has been made to study vapor corrosion of alloy 304L or 825.

RELATED HLW REPORTS

1. "The Literature Review in Subtask 1.1 (Draft), August, 1988"
   "The First Semi-Annual Report for Year 1 (9/87-2/88)"

2. R. S. Glass, G. E. Overturf, R. D. McCright and R. A. Van Konynenburg, Lawrence Livermore Laboratory, Livermore, CA, UCRL-92311, February, 1985.

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

(a) Relationship to Waste Package Performance Issues Already Identified

    2.2.4 What are the potential corrosion failure modes for the waste package container?

(b) New Licensing Issues

(c) Comments Related to Licensing

AUTHOR'S ABSTRACT

Cortest Columbus is investigating the long-term performance of container materials used for high-level waste packages as part of the information needed by the Nuclear Regulatory Commission to assess the Department of Energy's application to construct a geologic repository for high-level radioactive waste. The scope of work consists of employing short-term electrochemical techniques to examine a wide range of possible failure modes. In addition, the susceptibility of candidate container materials to stress-corrosion cracking is being studied utilizing slow-strain-rate testing. Long-term tests are being used to verify and further examine specific failure modes identified as important by the short-term studies. The original focus of the program was on the salt repository but the emphasis was shifted to the Tuff repository.

During the reporting period, matrices of potentiodynamic-polarization experiments were completed on Type 304L stainless steel and Incoloy Alloy 825 in simulated Tuff repository environments. Vapor-phase corrosion experiments were completed on CDA 102 Copper and CDA 715 Copper-Nickel in simulated J-13 well water. Potentiostatic pit-initiation tests were completed on all four of the above alloys in simulated repository environments. Slow-strain-rate stress-corrosion-cracking tests were started on Type 304L stainless steel.

SDI006, UD 9004, SER. DD016

File(s) searched:

File 6:NTIS - 64-90/ISSUE04
(COPR. 1990 NTIS)

Sets selected:

Set	Items	Description
1	1	WASTE(W)PACKAGE?
2	2	CANISTER?
3	29	CORROSION
4	4	LEACHING
5	65	GLASS
6	4	VITRIFICATION
7	97	S3-S6/OR
8	0	HIGH(W)LEVEL(W)WASTE?
9	52	RADIOACTIVE(W)WASTE?
10	5	NUCLEAR(W)WASTE?
11	1	(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
18jan	10:06EST	PR 11/5/1-25 (items 1-1)

Total items to be printed: 1

SDI293, UD 9002, SER. DD023

File(s) searched:

File 293:ENGINEERED MATERIALS ABS 86-90/FEB
(COPR. 1990 ASM INTERNATIONAL)

Sets selected:

Set	Items	Description
1	2	HIGH()LEVEL()WASTE? ? OR RADIOACTIVE()WASTE? OR NUCLEAR()WASTE?
2	230	STEEL? ? OR ZIRCALOY? ? OR TITANIUM? ? OR COPPER
3	0	S1*S2
4	0	ANNA FRAKER, 223, B-254, X6009

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

Date	Time	Description
21jan	23:41EST	PR 3/5/1-25 (no items to PRINT)

Total items to be printed: 0

14

SDI032, UD 9002, SER. DD022

File(s) searched:

File 32:METADEX 66-90/FEB
(COPR. 1990 ASM INTERNATIONAL)

Sets selected:

Set	Items	Description
1	1	HIGH()LEVEL()WASTE? ? OR RADIOACTIVE()WASTE? OR NUCLEAR()WASTE?
2	1584	STEEL? ? OR ZIRCALOY? ? OR TITANIUM? ? OR COPPER
3	1	1*2
4	0	ANNA FRAKER, 223, B-254, X6009

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

Date	Time	Description
14jan	23:38EST	PR 3/5/1-25 (items 1-1)

15

Total items to be printed: 1

SDI006, UD 9003, SER. DD016

File(s) searched:

File 6:NTIS - 64-90/ISSUE03
(COPR. 1990 NTIS)

Sets selected:

Set	Items	Description
1	1	WASTE(W)PACKAGE?
2	0	CANISTER?
3	21	CORROSION
4	8	LEACHING
5	61	GLASS
6	2	VITRIFICATION
7	85	S3-S6/OR
8	3	HIGH(W)LEVEL(W)WASTE?
9	41	RADIOACTIVE(W)WASTE?
10	6	NUCLEAR(W)WASTE?
11	1	(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
07jan	04:40EST	PR 11/5/1-25 (items 1-1)

Total items to be printed: 1

SDI008, UD 9001, SER. DA016

File(s) searched:

File 8:COMPENDEX PLUS - 70-90/Jan Copr. Engineering Info Inc. 1990)

Sets selected:

Set	Items	Description
1	0	WASTE(W)PACKAGE?
2	1	CANISTER?
3	168	CORROSION
4	17	LEACHING
5	266	GLASS
6	2	VITRIFICATION
7	443	S3-S6/OR
8	0	HIGH(W)LEVEL(W)WASTE?
9	5	RADIOACTIVE(W)WASTE?
10	4	NUCLEAR(W)WASTE?
11	0	(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
12jan	01:02EST	PR 11/5/1-20 (no items to PRINT)

Total items to be printed: 0

17

SDI103, UD 8922, SER. DD017

File(s) searched:

File 103:DOE ENERGY - 83-89/DEC(ISS23)

Sets selected:

Set	Items	Description
1	5	WASTE(W)PACKAGE?
2	12	CANISTER?
3	157	CORROSION (1974 DEC)
4	26	LEACHING (1974 DEC)
5	88	GLASS (1974 DEC)
6	9	VITRIFICATION (1974 DEC)
7	267	S3-S6/OR
8	15	HIGH(W)LEVEL(W)WASTE?
9	178	RADIOACTIVE(W)WASTE?
10	61	NUCLEAR(W)WASTE?
11	3	(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
24jan	14:02EST	PR 11/5/1-25 (items 1-3)

Total items to be printed: 3

18

SDI103, UD 8921, SER. DD017

File(s) searched:

File 103:DOE ENERGY - 83-89/DEC(ISS22)

Sets selected:

Set	Items	Description
1	3	WASTE(W)PACKAGE?
2	17	CANISTER?
3	211	CORROSION (1974 DEC)
4	59	LEACHING (1974 DEC)
5	141	GLASS (1974 DEC)
6	12	VITRIFICATION (1974 DEC)
7	401	S3-S6/OR
8	16	HIGH(W)LEVEL(W)WASTE?
9	247	RADIOACTIVE(W)WASTE?
10	43	NUCLEAR(W)WASTE?
11	8	(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

19

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

Date	Time	Description
23jan	21:15EST	PR 11/5/1-25 (items 1-8)

Total items to be printed: 8

SDI103, UD 8923, SER. DD017

File(s) searched:

File 103:DOE ENERGY - 83-89/DEC(ISS23)

Sets selected:

Set	Items	Description
1	6	WASTE(W)PACKAGE?
2	7	CANISTER?
3	141	CORROSION (1974 DEC)
4	36	LEACHING (1974 DEC)
5	137	GLASS (1974 DEC)
6	12	VITRIFICATION (1974 DEC)
7	301	S3-S6/OR
8	21	HIGH(W)LEVEL(W)WASTE?
9	162	RADIOACTIVE(W)WASTE?
10	39	NUCLEAR(W)WASTE?
11	3	(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
25jan	01:59EST	PR 11/5/1-25 (items 1-3)

Total items to be printed: 3

20