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To: Everett A. Wick
Fm: Charles G. Interrante

A-4171

Monthly Letter Status Report for July 1985

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Performing Organization: National Bureau of Standards
Gaithesburg, MD 20899

Sponsor: Nuclear Regulatory Commission
Office of Nuclear Materials Safety and Safeguards
Silver Spring, MD 20910

Task 1 - Review of Waste Package Data Base

Familiarization studies of the literature pertinent to the waste package for HLW storage were continued by the NBS workers who will be conducting reviews. Although the documents on hand at the NBS did not include much of the available literature, the more pertinent summary documents were available and quite suitable for the background information needed at this stage of the work.

Task 2 - Data File for Waste Package Performance Analysis

On July 19, a meeting was held to discuss ways in which the NBS Center for Programming Science and Technology could further assist in the work of this task. The selection of a database management system (DBMS), for use in storing information compiled from reviews and evaluations of technical reports, was the principal topic of discussion. The requirements of the system were outlined, based on the experiences of those present, and it was agreed that these requirements would be modified to incorporate views of others not present. It was also agreed that Mr. Charles Sheppard would lead the effort aimed at selecting a DBMS for this application. (A copy of Mr. Sheppard's biographical sketch is attached for your information.)

In an earlier meeting, it was concluded that DBMSs with fixed fields are inappropriate for this application, and therefore only the systems with free form (not fixed) fields were to be studied and compared in relation to the requirements. These systems include Oracle, Sci-mate, Revelation, and DAYFLO. September 30 was set as the target date for completion of the selection, and the work was to include both a literature study of features, and hands-on experience and recommendations.

Task 3 - General Technical Assistance

On July 11, at the NRC Silver Spring facility (Willste Building, Room 106), various workers from the NBS met with NRC and other workers to review the Engineering Branch's Waste Package Program. This afforded the

NBS workers an excellent opportunity to interact with workers of the NRC and its contractors. C. Interrante gave a presentation for the NBS on the work being done under FIN-A-4171-5. The presentation focused on the task relating to development of an automated database for reviews and evaluations of HLW data. In this work, it has been assumed that a microcomputer (compatible with NRC equipment) would be used for the task. The NBS has taken the approach that commercially available database management systems should be examined to determine if any are suitable for this task. A copy of the vugraphs presented is appended to this report.

On July 12, C. Interrante and E. Escalante met at the Willste Building with NRC and other workers to discuss technical topics and papers pertinent to an NNWSI/NRC Waste Package Meeting to be held at Lawrence Livermore Laboratory. T. Jungling, NRC, led the meeting. Activities of the Materials Characterization Center (MCC), the Materials Review Board (MRB), and the Advisory Committee on Reactor Safeguards (ACRS) were highlighted, and several technical papers were reviewed: UCRL 91257, 91464, 89988, and 91804; HEDL 7452; and UCRL 20174, which was reviewed by E. Escalante of NBS.

Report on the Review of Lawrence Livermore
National Laboratory's NNWSI Program:

C. G. Interrante and E. Escalante, NBS, attended the NNWSI/NRC Waste Package Meeting, held at Lawrence Livermore National Laboratory on July 23-24, 1985. The following is a synopsis of the meeting topics and our comments on the various presentations.

Tuesday, July 23

Update on Package Design Concepts (E. Russell)

Ed Russell talked about the design of the nuclear waste package, and described a compartmented and uncompartmented package for various nuclear waste components. His evaluation included a computerized model simulating the dropping of a waste package onto a horizontally positioned, 4 inch diameter easily deformed mild-steel tube from a height of 7 feet. The simulation gave a graphic view of the extent of damage expected at different points on the container.

Comments: A 7 foot drop is conservative; for example, a container could undergo a longer drop than 7 ft. in and about a repository, and it could encounter a blow more severe than that offered by this horizontal tubing. Thus, the container simulation should include dropping the container from a higher height onto some sharp object, such as a wedge or a rod that is vertically positioned. This point of view was supported by the view of Mr. Paul McConnell, a worker from Fracture Control Corporation, who has worked in the U.S.A. and in Germany on fracture-safe design of transportation vessels for nuclear waste.

Potential Implications of MRS on NNWSI (L. Ballou)

Lyn Ballou described design considerations for monitored retrievable storage (MRS) containers, and described the effect of container size and weight on portability.

Comments: No mention was made of the effects of residual stress of welding on the expected performance of the canister's weldments. Perhaps residual stresses are not being considered. We feel that they must be considered in any complete plan.

Bob Glass discussed the criteria that control the design of the container (e.g., 300 - 1000 y containment, retrievable for 50 y, transportable, drop test, withstand 500 °C for 30 min.). Corrosion considerations are very important, and he mentioned that stainless steels 316L and 321, and the high-nickel alloy Incoloy 825 are resistant to localized/stress corrosion.

Comments: Any alloys that can be sensitized should be avoided.

Container Material Testing (D. McCright)

Dan McCright discussed container materials. He indicated relative cleanliness values for two favored grades of stainless steel, 316LN and 316LN(F); he showed unetched micrographs (with inclusions), which presumably were taken as representative samples of the pieces from which he drew conclusions. These micrographs showed dot-shaped inclusions, indicating that the inclusions were either all spherical or that they were rods sectioned normal to the long axis of the inclusion. We believe the latter, and note that:

(1) A significant number of samples, 5 or more per component tested, are usually required to characterize some steels. It was not clear that these workers concerned themselves with sampling and variability in their inclusion measurements.

(2) While the area percent of inclusions is independent of the orientation of the section viewed, the section actually chosen was one that represents the inclusions as dots, and this presents a practical measurement problem. The area of a dot-like inclusion is made with the least precision, when compared with the precision of measurement for all other sections of a rod-like inclusion. The reason is that the major error of measurement is in the edge effects and the ratio of perimeter/area is greater for the dot than for the shape of any other section of a rod.

McCright also spoke about the various corrosion tests being carried out on the candidate materials--including long-term immersion tests, polarization studies, pitting potential measurements of stainless steels (austenitic)--in J-13 water at various concentrations and temperatures.

Comments: The group certainly has the talent and equipment to do high quality work, yet what McCright described was recent (less than one year) data on polarization studies made with a P.A.R. Model 350 that has

very limited capabilities, and long-term data (less than two year experiment) obtained from sandwiched disk specimens that reveal crevice corrosion susceptibility. It appeared that, except for the sandwiched disk specimens, the work reported was carried out recently (perhaps in preparation for this review). In addition, the corrosive environments they are using are those they consider "reasonable"--10X concentration J-13 water, 90 °C, 3% NaCl solution, etc. What about "unreasonable" or unexpected, but possible, conditions--saturated J-13 H_2O, 350 °C, saturated NaCl, etc.? These conditions should be given some consideration in their test program.

Wednesday, July 24

Waste Form Testing - Spent Fuel; Waste Form Testing - Glass; and Reliability Considerations (V. Oversby)

Virginia Oversby was the only speaker on the agenda. She spoke about nuclear waste and associated concerns (isotope generation, effects of radiation on materials, etc.). She also described a matrix for testing of materials. The amount of material covered was extensive, and some of the topics are complex. Thus, we found this work difficult to follow during this (our first) exposure to it.

On waste form testing, many questions were fielded on the topics of precision, accuracy, and adequacy of the testing. Oversby's responses led us to believe the testing of release rates, as a function of time for radionuclides from spent fuel would involve estimates of precision and bias in the measurements. The precision is being assessed from the reproducibility of the results of measurements taken as a function of time. For accuracy determinations, standards of known values can be used to assess bias.

A considerable number of replicate tests of fuel rods from virtually identical fuel, as well as from different (as available) fuels would be conducted, so as to permit estimates of mean and variance values for the population. The largest and most realistic measure of the degree of variation that might be encountered would be obtained from samples of multiple fuel rods taken from various reactors, i.e., non-identical fuels.

A calculation of interest (to us), but one which was not addressed in the presentation is the following: What release rates obtain for radionuclides if the canisters (stainless steel, high nickel, or whatever) are unexpectedly breached very early in the life of the repository, perhaps by an unexpected localization of corrosion, as for example, by stress corrosion cracking of defective weldments.

EVALUATION AND COMPILATION OF DOE WASTE PACKAGE TEST DATA (FIN A – 4171 – 5)

National Bureau of Standards
Gaithersburg, MD 20899

Evaluations are reviews and assessments of DOE and NRC reports that are related to the performance of the waste package.

The Compilation contains the Evaluations, but not the tabulated numerical data.

- Loose – leaf pages
- Computer – retrievable form

Purpose of Database:

(a) To contain the evaluations

(b) Identify the reports and retrieve their evaluations so that specific technical questions may be addressed readily in conducting analyses of waste package performance.

Forms used by reviewers and users:

(a) Document Review Form

(b) Waste Package Review Form

(c) Form(s) to be developed for use by reviewers and users

DOCUMENT REVIEW FORM

Author:

Title:

Reference:

Availability:

Key Words:

Data Summary:

(a) Property and Form of Data:

(b) Materials and Specimen Geometry:

(c) Test Conditions:

Comments on Data Validity:

Abstract:

WASTE PACKAGE DATA REVIEW FORM

Type of Data:

Materials/Components:

Test Conditions:

Methods of Data Collection/Analysis:

Amount of Data:

Uncertainties in Data:

Deficiencies/Limitations in Data Base:

WASTE PACKAGE DATA REVIEW FORM

Applicability of Data to Licensing
[Ranking: key data ( ), supporting data ( )]:

(a) Relationship to Waste Package Performance Issues Already Identified

(b) New Licensing Issue

(c) General Comments

Data Source:

(a) Organization Producing Data

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

Key Words:

Date Reviewed:

1. : Citation No. 2. : Publication type
3. : Authors 4. : Editors of Publication
5. : Article No. 6. : Article Title
7. : Publication Series 8. : CODEN
9. : Vol., Ed. or No. 10. : Issue
11. : Page 12. : Contract No.
13. : Publication Date
14. : Publisher; City, State
15. : Sponsor and address
16. : Site Address 17. : Patent Nos.
18. : Application or Meeting Date
19. : Dissertation Degree
21. : Country of Patent issue
22. : No. of Authors
23. : Country (Authors) 24. : Language
25. : ISSN, ISBN 26. : Abstract Source
27. : Abstract Nos.
28. : Related Citation Nos.
29. : CA Registry No. 30. : PDFC Volume No.
31. : PDFC Working No.
32. : CONTRIBUTING EDITORS
33. : CHEMICAL SYSTEM 34. : Elements
35. : Diagram End Members 36. : Phases
37. : PDFC Figure No. 38. : Figure Title
39. : Abstract 40. : Diagram Variables
41. : Diagram Source
42. : Temperature Range
43. : Pressure Range
44. : Composition Range
45. : Experimental Methods
46. : Characterization Methods
47. : Supplementary Data 48. : Keywords
49. : Comments
20. : Date of last Data record update

CHARACTERISTICS OF VENDOR SUPPLIED SOFTWARE

Features of Databases	dBase III	Revelation
1. Field width	Fixed – requires greater RAM and DISK capacities	Variable (free form), so data is packed
2. Maximum field width	254 characters	Any
3. Maximum record size	4000 characters	RAM size
4. Number of files in database	One	Many, usually one per logical set of fields
5. Search speed	Usually better	Better when field width is highly variable
6. Data retrieval and report formatting	Complex syntax requires greater user knowledge.	Syntax is simple.

Hardware Requirements:

- Disk: 10 mb per 1000 pages of data.
- Data Transfer:

  Media

  - Floppy (640 Kb)
  - Bernouli (10 Mb)

  Required capacities:

  - 10 Mb stores 2000 pages of data, e.g. for crash restoration.
  - 640 Kb stores 133 pages of data for monthly updates.

- Data structured by files (author, keywords, temperature) may require transfer of the entire database to update the database.

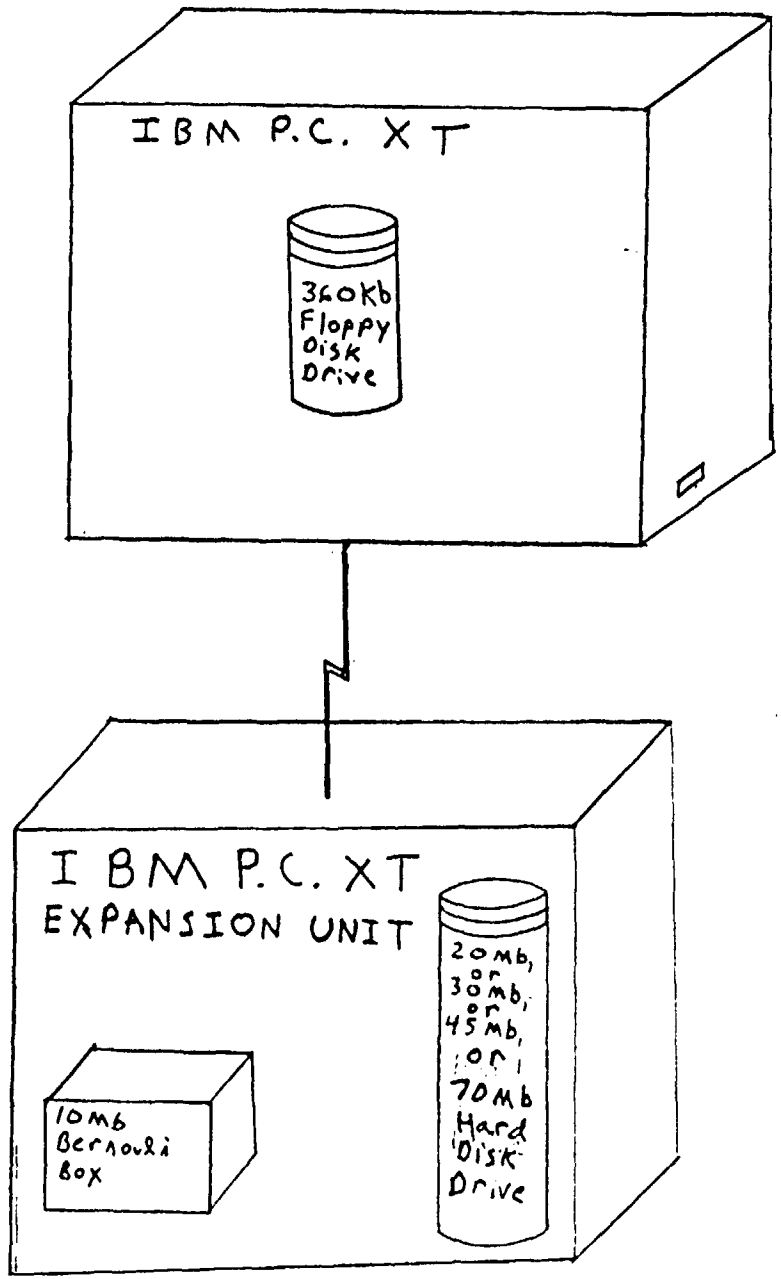
Quality Assurance:

- NRC requires Peer Review.
- NBS is likely to require additional reviews, e.g. outside reviewers on selected technical questions.

A potentially useful aid for making quality statements is the "Guide for ASTM Standard Specification on Quality Statements", developed recently by Committee E – 46 on Quality Provisions in ASTM Standards:

- Calibration and Measurement Accuracy
- Inspection and Testing
- Handling, Storage, Preservation, and Shipping
- Nonconforming Materials
- Documentation

Block Diagram of the Data Base's Offline Storage Facilities For an IBM P.C. XT



IBM P.C. XT DATA BASE COSTS

1) IBM P.C. XT :

KEYBOARD
PROCESSOR
256Kb RAM
360Kb FLOPPY DISK DRIVE
PRICE : $1795

2) ASYNCHRONOUS BOARD : $85

3) MONOCHROME MONITOR : $192

4) MONOCHROME ADAPTER : $175

5) AST 384 Kb RAM MEMORY EXTENSION FOR THE IBM P.C. XT : $400

6) DIABLO 630 ECS PRINTER : $1595

7) 10 Mb BERNOULI BOX : $2895

8) REVELATION : $695

TOTAL : $7832

20 Mb HARD DISK DRIVE - PRICE : $1099
TOTAL SYSTEM COST : $8931

OR

30 Mb HARD DISK DRIVE - PRICE : $3095
TOTAL SYSTEM COST : $10927

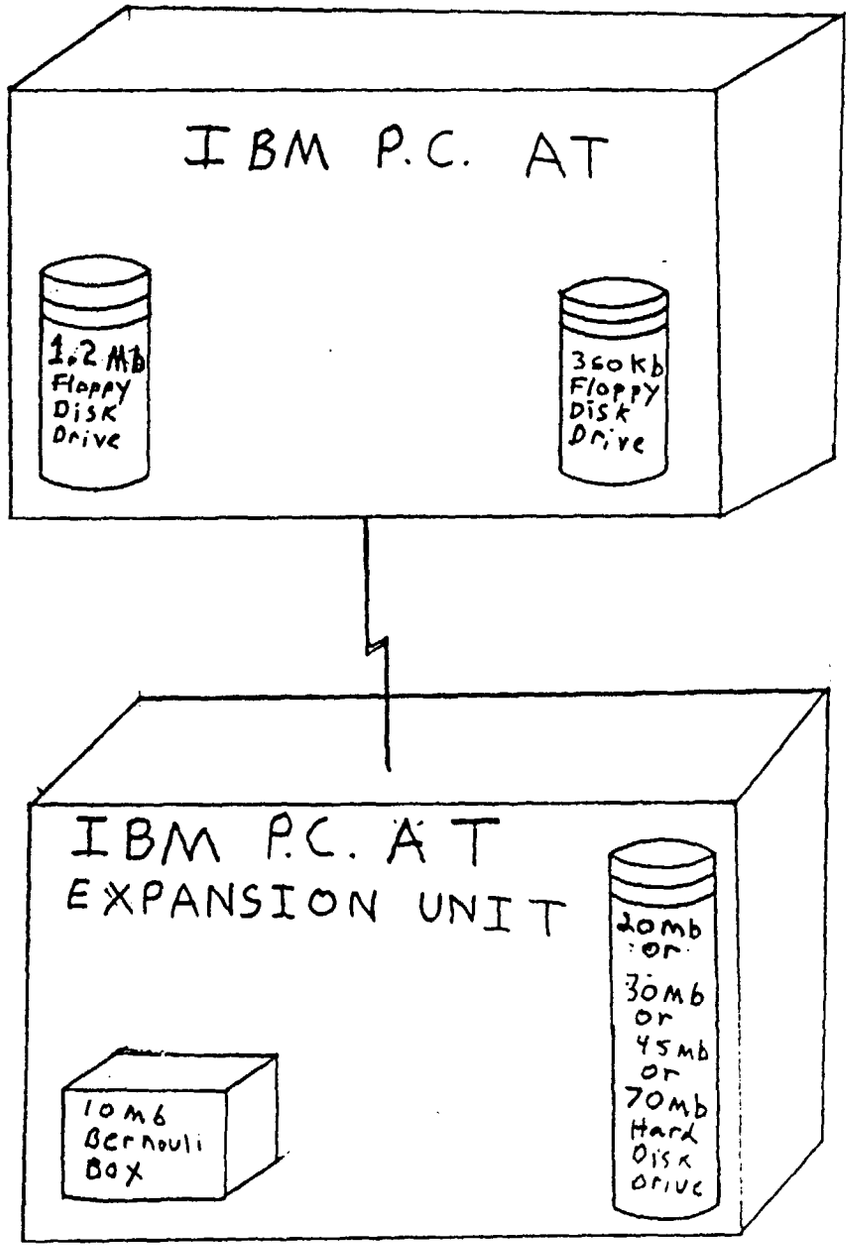
OR

45 Mb HARD DISK DRIVE - PRICE : $5495
TOTAL SYSTEM COST : $13327

OR

70 Mb HARD DISK DRIVE - PRICE : $7695
TOTAL SYSTEM COST : $15527

Block Diagram of the Data Base's OFFline Storage Facilities for an IBM P.C. AT



IBM P.C. AT DATA BASE COSTS

1) IBM P.C. AT WITH :
   KEYBOARD
   PROCESSOR
   512 Kb RAM
   1.2 Mb FLOPPY DISK DRIVE
   PRICE : $2995

2) SERIAL PARALLEL BOARD : $129

3) MONOCHROME MONITOR : $192

4) MONOCHROME ADAPTER : $175

5) AST ADVANTAGE 128Kb RAM EXPANSION FOR THE AT : $416

6) DIABLO 630 ECS PRINTER : $1595

7) 10 Mb BERNOULI BOX : $2895

8) 360 Kb DRIVE : $350

9) REVELATION : $695

TOTAL : $9442

20 Mb HARD DISK DRIVE - PRICE : $1099
TOTAL SYSTEM COST : $10541

OR

30 Mb HARD DISK DRIVE - PRICE : $3095
TOTAL SYSTEM COST : $12537

OR

45 Mb HARD DISK DRIVE - PRICE : $5495
TOTAL SYSTEM COST : $14937

OR

70 Mb HARD DISK DRIVE - PRICE : $7695
TOTAL SYSTEM COST : $17137