

CHP/A4171 MEMO 8906

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AUG 18 1989

MEMORANDUM FOR: Jesse L. Funches, Director
 Program Management, Policy Development and
 Analysis Staff, NMSS

FROM: Joseph O. Bunting, Chief
 Engineering Branch
 Division of High-Level Waste Management, NMSS

SUBJECT: FIN A4171-9, "EVALUATION AND COMPILATION OF DOE WASTE
 PACKAGE TEST DATA"

This is to request that a Form 173 be sent to the National Institute of Standards and Technology (NIST) requesting their proposal on the attached SOW for FY90. This project was approved by WMRG on November 8, 1988 through FY89 and by the SCRB on December 19, 1988 through FY89. It is our understanding that, due to the low level of funding for FY90, approval of the SOW by the WMRG and the SCRB is not required.

If you have any questions, please contact either me (x23394) or Chuck Peterson (x20531).

Original Signed By *Richard A. Weller for*

Joseph O. Bunting, Chief
 Engineering Branch
 Division of High-Level Waste
 Management, NMSS

Enclosure: As Stated

DISTRIBUTION

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CONCURRENCES

OFC :HLEN <i>CP</i>	:HLEN <i>RAW</i>	:HLEN <i>RAW</i>	:	:	:
NAME :CHPeterson	:RAWeller	:JOBunting	:	:	:
DATE :89/08/17	:89/08/17	:89/08/17	:	:	:

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STATEMENT OF WORK (SOW)
FOR
EVALUATION AND COMPILATION OF DOE WASTE PACKAGE TEST DATA

FIN A-4171-0

B&R No. 050-19-03-01

1.0 BACKGROUND

The technical responsibilities of the DOE and the NRC in achieving the goal of an acceptable engineered barrier system for the disposal of high-level waste (HLW) may be defined as follows:

The DOE has the responsibility to design, develop, manufacture, test and demonstrate a waste package and an engineered barrier system (EBS) that meet NRC requirements.

The NRC has the responsibility to advise the DOE of the type of information needed from tests and analyses to determine whether the proposed EBS components meet the performance objectives and design requirements of 10 CFR Part 60. Those rules which affect the waste package include:

§§ 60.11a(6), (7), and (8)	Site Characterization Report
§§ 60.111, 60.112, 60.113	Performance Objectives
§ 60.135	Criteria for the Waste Package and its Components
§§ 60.137, 60.140	Performance Confirmation
§ 60.142	Design Testing
§ 60.143	Monitoring and Testing of Waste Packages
§§ 60.150, 60.151	Quality Assurance

To fulfill its responsibility, the NRC must perform the research and technical investigations necessary:

- (1) to develop an understanding of the actions and interactions of materials and agents under repository conditions as they relate to possible failure modes for materials being considered, including the rate controlling processes which can lead to failure of anticipated containment barriers or which can affect the rates of radionuclide releases from the EBS after breach of containment;
- (2) to identify the design parameters and repository conditions which must be controlled or accounted for to avoid premature failure of specific waste package/repository designs; and

- (3) to determine the significant limitations of analytic and test techniques used to predict the performance of any proposed EBS, including:
- (a) analytical sensitivities of the measurements of chemical, physical, and nuclear properties of material test samples, leachants and corrosive agents.
 - (b) validity and reliability of predictive equations used to extrapolate short-term data to long-term performance for leaching, corrosion, sorption, transport and other phenomena pertinent to demonstrating compliance with performance criteria and waste package design requirements.
 - (c) scaling of non-prototype tests to repository field conditions.
 - (d) verification of analytical procedures for integrating single component test data to whole system performance and applicability of test procedures used for evaluating individual engineered barriers and multi-component barrier systems.

On the basis of the understandings achieved and the determinations made in the areas above, NRC will define its information needs via staff technical positions and periodic letters to the DOE.

DEVELOPMENT OF UNDERSTANDING

The development of understanding of performance-related phenomena associated with the waste packages will be achieved through projects described in Technical Assistance and Research contracts. These projects will address three general areas: 1) waste package container integrity, 2) waste form integrity, and 3) characterization of potential radionuclide releases from the waste packages. Retention of waste package container integrity for 300 to 1000 years after permanent closure of the repository, or for such other period as may be approved or specified by the NRC, is the most apparent way of complying with the performance objective of containment. To make a finding on this performance objective, the NRC must understand the processes by which containers are likely to fail. To reach a finding on the controlled release of radionuclides for any time after the containment period, NRC must also understand the processes by which radionuclides are released from the waste form and transported out of the waste packages. Progress toward achieving this understanding has been provided through four Research contracts.

BCL: FIN B6764, "Long Term Performance of Waste Package Materials"

Provided development of an understanding of the uncertainties in actual or anticipated DOE claims concerning waste package failure and for analyses of potential errors in DOE contractor test procedures. Particular emphasis was placed on actual engineering alloys.

BNL: FIN A3269, "Pitting Corrosion"

Provided an understanding of corrosion pit growth kinetics and an ability to judge DOE projections of corrosion pit growth.

NBS: FIN D1146, "Statistics of Waste Package Failure"

Provided an understanding of the statistical problems underlying failure by localized corrosion and an ability to judge the probabilistic issues involved in the prediction of waste package failure.

Manufacturing Science Corporation: FIN B7278, "Research on the Effect of Manufacturing Processes on Material Properties Affecting Failure Mechanisms in High-Level Waste Containers"

Provided an analysis of the sensitivity to changes in metallurgical characteristics due to the manufacturing and welding technologies expected to be used by DOE in producing waste containers.

APPLICATIONS

The HLW regulatory program was supported in part through the BNL contract "Development of Nuclear Waste Package Criteria" (FIN A3158) which described reasonably achievable waste packages that would comply with 10 CFR Part 60. FIN A3158 provided materials guidance to the NRC and the DOE through a task which assessed the DOE technical program and identified unresolved technical issues which required further NRC or DOE attention. FIN A3158 was completed in FY81, but this review and assessment activity continued under FIN A3164 and FIN A3167. Under FIN A3168, BNL assisted the NRC Staff in the development of draft staff technical positions (DSTPs) to provide guidance to DOE for achieving compliance with 10 CFR Part 60.

An Aerospace Corporation contract, "Preparation of Engineering Analyses for HLW Packages in Geologic Repositories", (FIN A4165) evaluated analytical methodologies for assessment of waste package performance. This work is continuing at the Center for Nuclear Waste Regulatory Analyses (CNWRA).

One of the objectives of this project is to utilize reviews and assessments as appropriate of results from projects at various laboratories. Projects discussed in the "Development of Understanding" section above and in this section supply understanding and identify information needs and data needs on container failure processes, waste package materials and waste stability. Other projects sponsored by the NRC that generated information that can be used in the performance of the work described in Section 2.0 of this SOW are:

LBL: FIN B3040, "Geochemistry Assessment of Waste Isolation"

Identified geochemical variables, processes and mechanisms that affect the performance of the canisters, overpack, and backfill.

ORNL: FIN B0287, "Technical Assistance in Geochemistry"

Reviewed the geochemical data related to DOE's candidate sites for repositories, and compiled and evaluated site specific geochemical data needed to quantify radionuclide migration and characterize the chemical environment important in determining waste package performance.

ORNL: FIN B0290, "Laboratory Evaluation of DOE Radionuclide Solubility Data and Selected Retardation Parameters, Experimental Strategies, Laboratory Techniques and Procedures"

Examined the reproducibility of the geochemical data being generated by the same DOE program. This was done by conducting selected routine laboratory and/or field measurements and tests to determine the accuracy of the techniques used by DOE. The information is useful in the evaluation of uncertainties in the data.

ORNL: FIN B0288, "Effect of Repository Environment on the Performance of High-Level Waste Packages"

Applied the results of FINs B0287 and B0290 to identify pertinent chemical variables and their ranges (e.g., pH and Eh as well as ionic and colloidal species concentrations) needed to accomplish waste package failure mode analyses. This information was used in the specification of the methodology/models for determining the repository environment which the waste package must withstand.

2.0 WORK REQUIRED

This agreement originally covered the work of reviewing and assessing DOE's waste package development activities, and included accession and assessment of DOE's existing and planned data base. It also included identification of the types of tests that will yield additional data needed to demonstrate that DOE waste package designs will meet the performance objectives of 10 CFR Part 60.

The scope of this activity was reduced by the elimination of the Basalt and Salt Repository Projects. It is now concerned only with the Tuff Repository Project plus vitrification of high-level waste (HLW) under the West Valley Demonstration Project, vitrification of defense HLW at the Savannah River Plant's (SRP) Defense Waste Processing Facility (DWPF), and certain related work as described herein. In particular, the DOE has nominated three stainless steels and three copper-base alloys as candidate materials for waste package containers.

Originally, it was expected that the performing organization (PO) would address the full range of technical areas affecting the waste package. On 15 October 1987, the Center for Nuclear Waste Regulatory Analyses (CNWRA) was established as an FFRDC under OMB/OFPP Policy Letter 84-1. Subsequently, essentially all technical activities to be performed by outside contractors for the NRC were transferred to the CNWRA. The CNWRA, however, has not yet reached a position to perform the tasks described in this SOW for FY90. Nevertheless, coordination with its activities will be necessary as discussed in Section 3, below.

TASK 1 Review of Waste Package Data Base

In FY89, work was begun on the following interpretive papers on the mechanisms of degradative phenomena for waste package materials:

Mechanisms of Stress Corrosion Cracking of Stainless Steels in a Tuff Environment

Mechanisms of Internal Corrosion of Spent Fuel Rods

Mechanisms of Localized Aqueous Corrosion of Copper and Its Alloys.

The objective of these papers was to identify and make available by electronic retrieval the technical information that will provide the basis for assessments of long-term behavior of materials used in the disposal of HLW in a geologic repository.

For FY90, the PO shall continue to prepare interpretive papers on the mechanisms of degradation phenomena, such as stress corrosion cracking, sensitization, passivation, pitting corrosion, general corrosion and the like. The PO shall use information from documents received directly from NNWSI, from available databases, and from that in the NIST database to prepare papers which in effect are summary statements of the technical understandings of these phenomena. It is recognized that the initial versions of these papers will probably not be sufficiently comprehensive to be considered as state of the art papers but, as resources permit, they shall be updated to approach that status. Generic questions that should be answered by these papers include:

1. Under what conditions do these phenomena occur for the materials of interest? Correspondingly, are there conditions under which these phenomena have never been observed?
2. Are these conditions likely to occur in the NNWSI site as the result of either anticipated or unanticipated events?
3. What is the status of predictive models of these phenomena?
4. Which portions of the information found will be useful in Standard Review Plans for use in review of a DOE License Application?

The PO shall propose continuation of the work on the three phenomena selected for FY89 and/or initiation of work in other areas that the PO considers central to the task of predicting long-term performance of waste package materials. At least three papers shall be prepared in FY90.

In conjunction with this work, the PO shall continue to review additions to DOE's data base to identify documents pertinent to the waste package area and enter them without detailed review into the NIST/NRC database. They shall, however, be appropriately flagged as documents to be reviewed in detail as resources permit. Selected documents may be proposed for detailed review and after approval of the NRC PM shall be evaluated for:

- (a) the accuracy, reliability and applicability of the data
- (b) the technical approach
- (c) the conclusions drawn
- (d) the significance of the data regarding resolution of waste package issues.

The objective of such a review goes beyond merely identifying and cataloguing documents. It is to perform critical in-depth studies of technical documents to (1) identify the ultimate technical information on which the NRC may base licensing decisions and (2) to determine how well understood are phenomena of materials degradation under service conditions.

The PO shall document its findings from the critique of each document in a format agreed to by the NRC. An example of the current format is provided as Enclosure 1. The most important sections of these reviews are the conclusions found and the in-depth critique. The aim is to make available to a user of the database the findings of each investigation with an appropriate assessment of how firm those findings are. The reviews are not intended to present detailed data but to facilitate selection by a user for his purposes documents containing definitive data and information.

These critiques, or Waste Package Data Reviews, shall be entered on diskettes in accordance with Enclosure 2. Data Records, i.e., duplicated copies of these updated diskettes, shall be transmitted quarterly to NRC. Drafts of these Data Reviews shall be included in the Bimonthly Letter Reports and final versions shall be included in the Semi-annual Reports.

The level of funding shall not exceed 1.3 staff years (SY) in any fiscal year unless approved in advance by the NMSS Project Manager. The total fiscal year cost for the project shall remain unchanged, and direction shall be within the Project Manager's authority specified in Section 10.0.

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

On the basis of the work done under Task 1, the PO shall identify specific technical questions with respect to performance of the waste packages in a repository environment that appear to be insufficiently investigated from a regulatory point of view. The PO shall identify (1) any additional data which in its judgment are needed to demonstrate that the DOE waste package designs will meet the performance objectives of 10 CFR Part 60 and (2) the types of verification tests that could generate the needed information. Account shall be taken of the results of the materials research and modeling effort made at BCL (FIN B6764, Long Term Performance of Waste Package Materials), and the effort at ORNL (FIN B0288, Effect of Repository Environment on Performance of Waste Package/Engineered System Components) to identify additional data base requirements. The PO shall then identify the types of performance verification testing that could be performed by the DOE to yield the desired information, prioritize the needed tests and report these to the NRC for its consideration.

To the extent that the DOE is not known to be conducting work in these areas, the PO shall propose experimental work in these areas to be initiated under this agreement in FY90. These proposals shall not be aimed at filling gaps in the DOE experimental program, but rather at developing information to permit independent confirmation of DOE conclusions and at augmenting the NRC capability for assessment of those conclusions. The proposals shall include areas that should be investigated but which may not be within the normal scope of the activities of the PO. The experimental test program proposed under this task will be limited to that required (1) to confirm the accuracy of DOE data, (2) to assess the reasonableness of the conclusions deduced from them, and (3) to determine the feasibility of possible techniques for measurements, prediction of performance, and monitoring of waste package performance.

The tests shall be described in meaningful detail, including suggested test parameters and generalized procedures, since this information should provide support for NRC technical positions.

The PO shall submit at appropriate times written proposals for any experimental tests needed to confirm the adequacy of the types of verification tests being considered above. Upon receipt of written approval by the NMSS PM, the proposed experimental testing shall be performed under Task 3.

The results of this activity shall be reported in accordance with the schedule of reports identified in Section 4.3.

The level of funding for this task shall not exceed 0.1 SY in any fiscal year unless approved in advance by the NMSS Project Manager. The total fiscal year cost for the project shall remain unchanged, and direction shall be within the Project Manager's authority specified in Section 10.0.

TASK 3 Testing

The PO shall perform experimental tests proposed under Task 2 and approved by the NRC. This SOW anticipates completion in FY89 of work on three existing projects at the NIST. One is concerned with investigating the feasibility of using acoustic emission as a means of detecting and monitoring slow rates of crack propagation in metals. A second is an investigation into the role of resistivity on the transition from general to pitting corrosion. The third is aimed at fuller understanding of passivation of Zircaloy. Further details are in Appendix A.

The level of funding for this task shall not exceed 1.3 SY in any fiscal year unless approved in advance by the NMSS Project Manager. The total fiscal year cost for the project shall remain unchanged, and direction shall be within the Project Manager's authority specified in Section 10.0.

TASK 4 General Technical Assistance

The PO shall provide general technical assistance on engineering evaluation of waste form/waste package matters as requested by the NMSS PM. Generally, the nature of such technical assistance will be to respond on relatively short notice to requests for information which would not be provided in the normal course of work. Examples of general technical assistance are (a) preparation for and participation in waste package meetings with DOE contractors for the NNWSI site, (b) review of selected portions of waste package performance assessment codes, and (c) review of the DOE site characterization plan. The PO shall allocate up to 0.2 SY of the available funding for use in the areas of glass technology and statistical treatment of data. No work, however, shall be done in these areas without specific approval of the NMSS PM. When specific work requirements are identified, the scope, duration, reporting requirements and funding limits for individual general technical assistance tasks shall be set forth by the NMSS PM in writing after discussion with the PO.

The PO shall become familiar with the structure of the NRC NUDOCS system and with that of the CNWRA to permit coordination of the NBS/NRC database with these systems and facilitate copying into it.

The level of funding for this task shall not exceed 0.5 SY in any fiscal year unless approved in advance by the NMSS PM. The total fiscal year cost for the project will remain unchanged, and direction will be within the Project Manager's authority specified in Section 10.0.

3.0 COORDINATION WITH OTHER PROGRAMS

Tasks in this SOW have been structured to avoid duplication of efforts made by other Offices of the NRC. At the same time, this SOW seeks to utilize the accumulated expertise of the present PO in meeting the needs of the DHLWM on a timely basis.

3.1 Database Construction

Semi-annual reports and other technical reports generated by the PO shall be produced in electronic form to facilitate entry into the NRC NUDOCS system. Copies of all documents shall be routinely sent to the CNWRA so that they are kept fully informed as to the progress of the work of the PO. In structuring its database, the CNWRA has adopted all of the fields used in the NIST database. Thus, an interface has been established to permit further transfer of NIST work to the CNWRA when appropriate.

3.2 Experimental Work

No duplication or overlap of experimental work under this SOW relative to other NRC programs exists. The Waste Management Branch of the Office of RES is sponsoring research at the NIST on uncertainties in the measurement of pH, transport of water and radionuclides in tuff, natural analogs, and microbially accelerated corrosion. Failure mechanisms for DOE candidate waste package materials will be investigated under another RES contract. Finally, the CNWRA is planning a large matrix of experiments to collect additional corrosion data.

The Materials Engineering Branch of RES has a continuing program with ANL but the focus is on problems with the primary system of BWRs. We have been advised by M. Mayfield (RES/MEB) that the environments in their studies are so different that there is little chance of duplication.

The Materials Engineering Branch, Division of Engineering and System Technology, NRR, is concerned with analysis of specific failures in field applications and thus does not have technical work in the areas of interest in this SOW.

3.3 Coordination with the CCNwRA

The PO shall continue to interface with the CNWRA to develop and recommend to the NRC an integrated plan for the years beyond FY90 that utilize the specialized capabilities of the PO in a manner consistent with and supportive of the overall program of the CNWRA. Technical direction of the PO program shall be provided by the NRC.

The PO shall have its representatives visit the CNWRA in San Antonio, TX, as appropriate to retain familiarity with the facilities available and to

develop a good working relationship with the CNWRA personnel. Similarly, the PO shall schedule visits as appropriate by the CNWRA personnel for them to become familiar with the capabilities of the PO.

4.0 REPORTING AND PROJECT REVIEW REQUIREMENTS

4.1 Status Reports

The PO shall submit on a bimonthly basis by the 15th of the following month an original of a status report which summarizes (1) the work performed during the previous two months; (2) significant findings and conclusions; and (3) specific work planned for the next reporting period.

Every month, by the 15th of the following month, the PO shall report costs for the previous month in the level of detail shown on Schedule A. In a separate tabulation, the PO shall present costs as a one line summary showing: direct labor hours, labor costs, overhead costs, and other costs for both the current month and for the fiscal year to date as well as the total of funds obligated and authorized, and the current balance. The summary shall also show the percent of fiscal year funds obligated to date. The PO shall supply additional details of personnel costs by individual as required by the PM. The PO shall also report separately the total costs for specific work performed under Task 4.

4.2 Deliverable Products

The deliverable products will consist of semiannual reports and bimonthly reports as listed in Schedule B. Other deliverables include interpretive reports, laboratory reports, and trip reports. The semiannual reports shall cover the work performed under Tasks 1, 2 and 4. They shall provide an overall assessment of the state-of-knowledge of the properties and predicted performance of waste package components as evidenced by the developing data base.

First drafts of the Data Review Sheets (see Enclosure 1) shall be submitted when available or as attachments to the monthly cost reports. The NIST PM shall revise them within 30 days of receipt of comments from the NMSS PM. The Data Records (duplicated copies of diskette(s) on which the Data Reviews have been entered) shall be submitted semiannually. Trip reports are due within 30 days after completion of the trip.

Outlines of interpretive reports shall be submitted within 30 days after agreement has been reached regarding their subject and scope. First draft versions of these reports shall be submitted within 120 days after approval of the outlines. Final versions are due no later than August 31, 1990.

Schedules for laboratory reports shall be determined on the basis of the projects authorized by the NMSS PM.

SCHEDULE A
Cost Report for (Month, Year)

	Current Expense	Cumulative Expense Plus Unliquidated Obligations, YTD
1. Direct Labor		
Sponsoring Division		
Professional		
Technical Support		
Other Divisions		
2. Project Management & Administration		
3. Benefits		
4. Overhead		
5. Other Costs		
5.1 Sci/Tech Services		
5.2 Supplies		
5.3 Equipment		
5.4 Travel		
5.5 Personnel Expense		
5.6 Other		
Totals		

Notes

1. Direct Labor is Base Rate plus any Leave Surcharge. Project Management and Administration includes supervision, project planning, and personnel and departmental administration.
2. Overhead includes charges distributed on the basis of direct labor.
3. Sci/Tech Services is the total cost of scientific and technical services.
4. Supplies is the sum of direct purchase and storeroom issues.
5. Equipment is the sum of ADP and other equipment.
6. Travel is the sum of per diem, common carrier, mileage allowances, and other travel expenses.
7. Personnel Expense is the sum of transportation and storage charges for personnel moves, training (tuition and fees), and awards.
8. Other is the sum of all other items on the CSS. If any item in this group is more than 5% of the total monthly expense, identify such item.

SCHEDULE B. DELIVERABLES

<u>DELIVERABLE PRODUCTS</u>	<u>TASK UNDER WHICH WORK IS DONE</u>	<u>DRAFT REPORT (FOR NRC COMMENT)</u>	<u>DATA RECORDS AND FINAL REPORT*</u>
1. Bimonthly Rpt.	1, 2, 4	Dec. 15, 1989	Feb. 28, 1990
2. Bimonthly Rpt.	1, 2, 4	Feb. 15, 1990	Apr. 30, 1990
3. Semi-annual Rpt.	1, 2, 4	Apr. 15, 1990	Jun. 30, 1990
4. Bimonthly Rpt.	1, 2, 4	Jun. 15, 1990	Aug. 31, 1990
5. Bimonthly Rpt.	1, 2, 4	Aug. 15, 1990	Not reqd.
6. Semiannual Rpt.	1, 2, 4	Sep. 15, 1990	TBD
7. Interpretive Rpts.	1	TBD	Aug. 31, 1990
6. Laboratory Rpts.	3	TBD	TBD

*Camera-ready copy for semiannual reports only.

SCHEDULE C. REPORT DISTRIBUTION

<u>Distribution</u>	<u>Bimonthly Status Reports</u>	<u>Meetings, Workshops, & Trip Rpts</u>	<u>Draft Report</u>	<u>Final Rpt</u>	<u>Final Fiche*</u>
Docket Control Center (TLSS)	1	1	1	1**	0
NMSS PM	0	0	0	0	1

*Refer to Enclosure 3, Microfiche Specifications

**Camera-ready copy

4.3 Draft and Final Technical Reports

All draft and final technical reports delivered under this agreement must satisfy the quality assurance requirements discussed in Section 7.0 of this SOW. Final reports called for by this SOW shall be presented in draft form to the NRC for review. The NRC shall provide comments within 30 days after receipt of each draft report. These comments shall be reflected in the final reports.

4.4 Report Distribution

Schedule C summarizes the required report distribution under this agreement. The NMSS PM shall provide the PO with current NRC mailing addresses for this distribution.

4.5 Submission of Documents to NRC Public Document Room

All NMSS technical high-level waste project documents will be transmitted to the NRC Public Document Room (PDR) and appropriate Local Public Document Rooms (LPDR's) by the Division of High-Level Waste Management. All administrative documents, e.g., financial reports, should be submitted separately from technical reports. Proprietary documents must be properly identified by the PO in accordance with 10 CFR Part 2.790, Availability of Official Records, and shall not be submitted to the PDR's.

5.0 PROGRAM REVIEW, MEETING AND TRAVEL

5.1 Program Reviews

About December 15, 1989, the PO shall provide a program review that shall evaluate progress made in the previous months and reaffirm and lay out work for the remaining periods of the contract. The NMSS PM shall advise the PO on areas of emphasis and/or modification to the original work plan submitted by the PO. These reviews may be waived at the discretion of the PM if there has been sufficient communication between NBS and the NRC on the status of the work. A second such review shall be held about June 15, 1989.

5.2 Meetings

The PO shall provide for up to four visits to DOE sites and to White Flint to attend NRC/DOE meetings and review meetings with other NRC contractors.

5.3 Travel

- 5.3.1 The NMSS PM will be notified prior to all travel performed under this SOW. All foreign travel requires identification and approval per NRC Manual Chapter 1501.
- 5.3.2 All travel associated with this SOW shall result in trip reports, which may be issued separately or as part of the next monthly cost report. Copies of trip reports issued separately shall be sent to the NMSS PM within 30 days of the completion of such travel.
- 5.3.3 Costs incurred in any fiscal year for travel associated with this SOW shall not exceed 2% of the total funding authorized in the respective fiscal year for the SOW unless specific additional amounts within the total authorized are approved by the NMSS PM in advance of their expenditure. Travel costs covered by this provision shall include costs for transportation, lodging, meals, registrations and communication resulting from the travel. Upon request by the NMSS PM, the PO shall identify travel costs expended in the fiscal year up to the date of the request.

6.0 NRC FURNISHED MATERIAL

NRC shall provide the PO with pertinent reports, data, and information received from other sources which the contractor identifies as beneficial to its understanding of the study and schedules for key NRC and DOE actions. For example, it is the NRC's responsibility to see that the PO is placed on distribution for other pertinent NRC contractor progress and topical reports and notice of program review meetings.

7.0 QUALITY ASSURANCE

- 7.1 For all draft and final technical reports delivered under this agreement, the PO shall assure that an independent review and verification of all numerical computations and mathematical equations and derivations are performed by qualified contractor personnel other than the original author(s) of the reports. If the PO proposes to verify/check less than 100 percent of all computations and mathematical equations and derivations in the report(s), (such as might be the case when there are a large number of routine, repetitive calculations), the PO must first obtain written approval from the NMSS PM.

Computer-generated calculations will not require verification where the computer program has already been verified but the source of the

computer services must be identified. The NMSS PM has the option of auditing all documentation including project correspondence, drafts, calculations, and unrefined data.

- 7.2 In addition, all reports, including those which do not contain numerical analyses, must be reviewed by the PO's management and approved with two signatures, one of which is for management at a level above the program manager for the PO.
- 7.3 When revisions for those reports are issued, a section must be included in the revised report to document dates, reasons and scope of all changes made since the issuance of the first approved report of the PO.
- 7.4 NRC has the option of appointing a Peer Group to review the draft report and make changes to the final report. The PO may recommend candidates for the Peer Group for approval by the NMSS PM. In the occasion of dissent in the content of the final report, the dissenting party will have the option of stating its viewpoints and findings in a section of the report.
- 7.5 As part of the coordination with the CNWRA, QA requirements shall be reviewed and modified as necessary to assure products will satisfy current requirements.

8.0 PERIOD OF PERFORMANCE

The period of performance covered by the work specified in this SOW including preparation and submission of the final report shall be from October 1, 1989 through September 30, 1990.

9.0 KEY PERSONNEL

The PO shall submit a list of Key Personnel who are considered to be essential to the successful performance of the work proposed and shall not be replaced without the prior approval of the NMSS PM. In such event, the PO agrees to substitute persons possessing substantially equal abilities and qualifications satisfactory to the NMSS PM.

10.0 TECHNICAL DIRECTION

Charles H. Peterson (FTS 492-0531) is designated the NMSS PM for the purpose of assuring that the services required under this SOW are delivered in accordance herewith. All technical instructions to the PO shall be issued through the NMSS PM. As used herein, technical instructions are those which provide details, suggest possible lines of inquiry, or otherwise complete the general scope of work set forth herein. Technical instructions shall not constitute

new assignments of work or changes of such nature as to justify an adjustment in cost or period of performance. Direction for changes in cost or period of performance will be provided by the NBS Administrative Officer after receipt of an appropriate Standard Order for Work (NRC Form 173A) from the Office of NMSS.

If the PO receives guidance from the NMSS PM or others that is believed to be invalid under the criteria cited above, the PO shall immediately notify the NMSS PM. If the NMSS PM and the PO are not able to resolve the questions within five days, the PO shall notify the PO's Administrative Officer.

11.0 SUBCONTRACTS

The PO shall notify the NMSS PM of potential subcontracts before inquiries are made. The PO shall also afford NRC the opportunity to be present at initial contacts between itself and the subcontractor and to participate in the discussion of the scope of work. The PO shall provide a brief description of work that each potential subcontractor has done for the PO so that the NRC can review it for potential conflicts of interest. The PO shall also forward a copy of the anticipated scope of work and give the NRC one week advance notice of meetings between the PO and the subcontractor. A copy of all written correspondence (including contract change, progress reports, and final reports) for the subcontracts will be forwarded to the NMSS PM.

In addition to paragraph 10 of the Standard Terms and Conditions, any subcontracting under this Interagency Agreement shall conform to the requirements of the Competition in Contracting Act of 1984 (CICA) as implemented in Part 6 of the Federal Acquisition Regulation (FAR), entitled Competitive Requirements. A copy of the justification for any proposed other-than-competitive subcontracting shall be provided to the NRC prior to award.

12.0 TECHNICAL PRESENTATIONS AND PUBLICATIONS

The PO shall, prior to release by the PO, obtain approval of the NMSS PM of final drafts of any speeches, journal articles, press release or other form of communication for information generated under this agreement. Costs for actions associated with these communications are beyond the scope of this agreement unless specifically approved by the NMSS PM.

13.0 DISPOSAL OF PROPERTY

Prior to the closeout or termination of this project, a reconciled report will be developed by the NBS to record available equipment and material purchased with NRC funds. This report should be developed as soon as possible after project completion or a termination decision has been made, but not later than 60 days after the termination date. This report should be submitted to the NRC Division of Facilities and Operations Support, ADM and to the NMSS PM.

14.0 NBS ACQUIRED MATERIAL

The PO must notify the Office of Nuclear Materials Safety and Safeguards (Attn: Program Management, Policy Development and Analysis Staff) and the NMSS PM prior to acquisition of any capital, ADP, or word processing equipment.

15.0 ESTIMATED LEVEL OF EFFORT

The estimated level of funding required to perform this work is 3.2 SY for a period of 1 year.

16.0 CONFLICT OF INTEREST

The PO shall not perform any work on high-level waste management or disposal for the DOE, DOE contractors, or any other sponsor in order that there be no possibility of a conflict of interest in any aspect of the work, and especially in the interpretation of results.

Enclosure 1

WASTE PACKAGE DATA REVIEW FORMAT

Data Source

- (a) Organization Producing Data
- (b) Citation

Date Reviewed

Purpose/Scope

Key Words

Contents

Amount of Data

Test Conditions

Uncertainties in Data

Deficiencies/Limitations in Data Base

Conclusions

Comments of Reviewer

Related HLW Reports

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

- (a) Relationship to Waste Package Performance Issues Already Identified
- (b) New Licensing Issues
- (c) General Comments

Author's Abstract

APPENDIX A

DESCRIPTION OF CURRENT EXPERIMENTAL WORK

Title: Evaluation of Methods for the Detection of Stress Corrosion Crack Propagation in Fracture Mechanics Samples

Problem: Metal containers used for disposal of HLW will be required to provide substantially complete containment for all radionuclides in the HLW for a period of 300 to 1000 years, unless otherwise approved by the Commission. If cracking occurs, the rate of crack propagation will have to be extremely slow, perhaps 10 microns/year. A method is needed for detecting and measuring microscopic cracks developed over relatively short periods of time.

Question: Can acoustic emissions be utilized as a basis for such measurements?

Objective: To demonstrate feasibility of AE as an investigative tool for slow crack propagation experiments. To obtain preliminary information on the actual crack propagation rates in materials of interest.

Approach: Initial experiments will use the A36 and A387-9 steel alloys used by James and Duncan in DOE-sponsored tests to determine crack propagation rates. They reported no significant stress corrosion cracking after 2000 hours of testing. Acoustic emission (AE) is considered to be a more sensitive technique than those used by James and Duncan. Crack length will be measured by a D.C. electrical resistance technique and AE will be detected at the surface of the samples. Specimens will also be examined by scanning electron microscope. These experiments will serve to validate the experimental procedure, following which other materials may then be investigated.

Title: Corrosion in Simulated Repository Environments

Problem: Steels are subject to degradation by both general corrosion and pitting corrosion. Two of the factors known to be involved are the transport of oxygen through the medium in which the steel is embedded to the surface of the steel and the electrical resistivity of the medium. The literature indicates that the relative importance and interaction between these two factors

is not well understood. Such understanding could permit conclusions about the conditions under which pitting and general corrosion occur in the tuff medium. Other investigators appear to be using only low resistivity and high transport conditions.

Question: How do the electrical resistivity and transport properties of the tuff interact to affect the corrosion of steels?

Objective: To determine whether pitting corrosion is a likely mode of failure of steel in tuff.

Approach: A matrix of experiments is being used in which both of these parameters will be varied systematically. Initially carbon steel will be used because it corrodes more rapidly so the experimental technique can be developed and validated more quickly.

Title: Corrosion Behavior of Zircaloy Nuclear Fuel Cladding

Problem: The DOE has not yet stated that they will not take any credit for the Zircaloy cladding on spent fuel rods. Under the tuff conditions, it is conceivable that detailed analyses will support the conclusion that even if any overall container for spent fuel rods fails the Zircaloy will be and remain passivated and thus serve as an important barrier to radionuclide release.

Question: Will Zircaloy remain passive when exposed to tuff conditions?

Objective: To obtain evidence to support a conclusion either that the Zircaloy cladding on spent fuel can serve as part of the engineered barrier system or that it cannot.

Approach: The electrochemical response of specimens of Zircaloy-2 and Zircaloy-4 in J-13 and 10 x J-13 well water at 95°C will be observed to determine susceptibility to localized corrosion. Observations will be made on both the cylindrical surfaces and transverse surfaces of coupons cut from tube stock.