

CHP/A4171 MEMO 8903

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DEC 20 1988

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 FY89. The associated PDS is enclosed for your information. The SOW has been approved by the WMRG and the SCRB.

Please provide additional funding in the amount of \$131,000 to cover operations for the second quarter of FY89, making the total advanced 50% of the agreement amount.

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

15
Joseph O. Bunting, Chief
Engineering Branch
Division of High-Level Waste
Management, NMSS

Enclosure: As Stated

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PDR WMRG EUSNBS
A-4171 PDC

*(see previous concurrence)

CONCURRENCES

OFC :HLEN	:HLEN	:HLEN	:	:	:	:
NAME :CHPeterson*	:RAWeller *	:JOBunting	:	:	:	:
DATE :88/12/	:88/12/	:88/12/20	:	:	:	:

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Change LPDR-3

Add: ACN/W

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CONCURRENCES

OFC :HLEN	:HLEN	:HLEN	:	:	:	:
NAME :CHPeterson	:RAWeller	:JOBunting	:	:	:	:
DATE :88/12/20	:88/12/20	:88/12/	:	:	:	:

PROJECT DESCRIPTIVE SUMMARY

DATE: 88/11/09

OFFICE: NMSS

PROJECT TITLE: Evaluation and Compilation of DOE Waste Package Test Data

FIN NO.: A4171

PPSAS NO.: 411230

TYPE OF CONTRACT: Interagency Agreement

CONTRACTOR: National Institute of Standards and Technology

ESTIMATED PERIOD OF PERFORMANCE: October 1, 1988 - September 30, 1989

PROJECT MANAGER: C. H. Peterson

<u>FY BUDGET (\$K):</u>	<u>FY85</u>	<u>FY86</u>	<u>FY87</u>	<u>FY88</u>	<u>FY89</u>	<u>FY90</u>	<u>FY91</u>
<u>PRIOR:</u>	200	950	700	550			
<u>OPERATING:</u>					524		
<u>FOLLOW-ON:</u>						TBD	TBD

PREVIOUS APPROVALS BY WMRG:

This project was approved by WMRG on June 6, 1985 through FY88, and on November 8, 1988 through FY89. It was approved for FY86 by SCRB on July 19, 1985 and for FY87-FY88 on February 23, 1987.

SCOPE OF WORK:

In Task 1, the performing organization (PO) will review on a continuing basis DOE's existing and planned data base for waste packages for emplacement in tuff. The PO will utilize all available sources of information on published documents, such as bibliographies, other data bases, and literature references, to select the most pertinent documents and prepare evaluations of them that will include descriptive information on the nature and amount of the information in those documents. The PO shall enter each evaluation into the NIST/NRC computerized database. The objective is to make the reviewer's findings retrievable by high speed computer search techniques for preparation of state of the art papers for pro-active guidance for the DOE and for use in resolution of licensing issues.

CHP/A4171 PDS FY89

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The format of the evaluations shall be modified from that developed to date to add fields to contain results and conclusions as stated by the authors of the documents being reviewed. The PO will in a separate field enter any questions, concerns, reservations, references to other work, interpretations, or agreements with the reviewed work that the PO considers relevant to the evaluations. The objective of the evaluations is to identify and assess the information content of the documents for its applicability in resolving waste package licensing issues. The reviews will also identify items that may require clarification and further study. The PO will evaluate other documents selected by the NRC Project Manager (PM) that will supplement the DOE documents in achieving the necessary degree of completeness of coverage of specific technical areas.

Beginning in FY89, the PO shall prepare technical position papers on three specific degradation phenomena, such as stress corrosion cracking, sensitization, pitting corrosion, and the like. Proposals shall be coordinated with the CNWRA and approved by the NRC PM.

This task will continue through FY89.

In Task 2, the PO will prepare brief outlines of proposals for specific studies or laboratory work to resolve questions, uncertainties or deficiencies identified in the documents reviewed. The PO will recommend priorities for these proposals.

The PO will also identify the types of tests which should be performed to demonstrate that DOE's waste package can satisfy the performance objectives and the design requirements of 10 CFR Part 60. The PO will also suggest waste package test conditions for these tests. This may be done by analyzing DOE's conceptual waste package design and repository environment(s) and identifying ranges of key design parameters (e.g., temperature, heat flux, radiation and pressure) which can be expected to influence waste package performance. Task 2 will continue through FY89.

In Task 3, the PO will perform studies and experimental tests proposed under Task 1 or Task 2 and approved by the NRC. This task will continue through FY89.

In Task 4, the PO will review the structure of the Transitional Licensing Support System (TLSS) developed by NMSS/HLWM to determine the feasibility of modifying the structure of the NIST/NRC database to permit copying this database into the TLSS. The PO will provide the NRC PM with an estimate of the resources required to effect such a modification. This task will be completed in FY89.

The PO shall also provide short-term technical assistance per written request from the NRC. This generally consists of providing on short notice information which would not be provided in the normal course of the work. Typical examples include:

- Review of DOE documents related to site characterization

- Statutory SCP review
 - Test and study plans
 - SC progress reports

- Preparation of the NRC Site Characterization Analysis (SCA)
 - Preparation of GTPs
 - Participation in development of ASTM national standards for accelerated testing and extrapolation of short term data
 - Review of documents generated by the West Valley and the Defense Waste Projects
 - Review of SOWs from the NRC Office of Nuclear Regulatory Research (RES)

This task will continue through FY89.

USER NEED:

The NRC must review the information being generated by the DOE Waste Package Program and assess the quality and applicability of this information for resolving waste package licensing issues. Although the amended DOE Mission Plan indicates 1995 as the year in which the DOE will apply for a construction authorization, nearer term milestones include providing guidance to the DOE with respect to their test plans. The broad review of the DOE waste package programs, evaluation of the database and identification of additional data required will provide input to assessment of DOE's waste package designs, now limited to the tuff repository. The review of the quality of the database will also enable the NRC to provide guidance to the DOE regarding the technical adequacy of their waste package program.

PRODUCTS:

The products will include semi-annual reports containing the information described above, focussing on identification of data and findings judged useful in resolving or eliminating technical issues at licensing time. Other products will be GTPs, ASTM methods, state of the art papers, and letters to the DOE containing comments or guidance on their waste package programs.

CONTINUATION OF PROJECTS:

This project is a continuation of one that began on December 1, 1985. Products to date have included a report entitled, "An Analysis of the Requirements for Computer-Assisted Database for Reviews and Evaluations of High-Level

Waste Data" and semiannual reports. Technical assistance has included participation in the review of the waste package portion of DOE's Final Assessments of three repository sites, in a waste package meeting with the Salt Repository Project, in NRC reviews of waste package test data for the Basalt Repository Project, in a meeting with the DOE on the feasibility of using copper as a waste package containment material, and in ASTM meetings to develop methods for predicting service lives of materials used in waste packages.

NIST has also submitted draft proposals for testing programs. Four of these have been approved:

- Pitting Corrosion of Steel Used for Nuclear Waste Storage
- Corrosion Behavior of Zircaloy Nuclear Fuel Cladding
- Effect of Resistivity and Transport on Corrosion of Waste Package Materials
- Evaluation of Methods for Detection of Stress Corrosion Crack Propagation in Fracture Mechanics Samples.

PRIOR RELATED NRC PROJECTS:

- A3158 Development of Nuclear Waste Package Criteria, BNL
- A3163 Overview/Schedule Document, BNL
- A3164 Review of DOE Waste Package Program, BNL
- A3167 Review of Waste Package Verification Tests, BNL
- A3168 Draft Staff Technical Positions, BNL
- A3237 Container Assessment, BNL
- B6340 Thermal Stress in Glass, Iowa State University
- B6352 Surface Characteristics of Radwaste Glass, University of Florida
- A4165 Preparation of Engineering Analysis for High-Level Waste Packages in Geological Repositories, Aerospace Corporation
- B0288 Effect of Repository Environment on Performance of Waste Package/Engineered System Components, ORNL
- A3269 Pitting Corrosion, BNL
- B6764 Long-Term Performance of Waste Package Materials, BCL
- D1146 Statistics of Waste Package Failure by Pitting, NBS
- B7278 Research on the Effect of Manufacturing Processes on Material Properties Affecting Failure Mechanisms in High-Level Waste Containers, Manufacturing Science Corporation

CURRENT RELATED NRC PROJECTS:

- D1670 Study of Overpack/Backfill Corrosion Interaction in Disposal of High-Level Radioactive Waste
- D1690 Assessment of Metrologic Uncertainties for Waste Package Testing
- D1692 Environmental Degradation of Overpack Materials
- B6663 Integrated Experiments on Corrosion of Candidate Materials (CNWRA)

INTERAGENCY COORDINATION AND INTEREST:

Brookhaven National Laboratory is now under contract to DOE's Office of Civilian Waste Management to perform an overview of the waste package programs of the DOE contractors. Although this project may overlap some of that work, there is no unnecessary duplication because there is a need for the NRC also to perform this work to gain an independent assessment of the DOE program. This was discussed with Don Alexander of the DOE and he agrees that this NRC effort is necessary. The consequence of such work by BNL is the need for the NRC to review the BNL assessments of DOE programs. This will be recognized as an additional effort under Task 1.

NRC OFFICE/REGION COORDINATION:

This project has been coordinated within the Division of High-Level Waste Management of NMSS (HLGP and RLPD), with RES, with the CNWRA and with the SCRB.

JUSTIFICATION FOR SOURCE SELECTED AND DISCUSSION OF ALTERNATIVES:

This contract requires technical excellence in materials science and engineering analysis, particularly in the areas of metals corrosion and glass dissolution. The ability to critically review technical information released by the DOE in connection with its waste package programs is crucial to establishing a valid database for use in resolving licensing issues. It is not sufficient to have the physical means to retrieve documents. This contract aims at providing access to the technical information content of those documents.

An understanding of the mechanisms of materials failure modes is considered at this time to be necessary for identifying the information needed to predict waste package performance and to evaluate information generated by the DOE program. The National Institute of Standards and Technology, because of its depth of technical expertise and its wealth of experience in evaluating materials and preparing standards, is best qualified to perform this work.

The NIST is currently performing technical assistance under this FIN as well as research for NRC on high-level waste package concerns as noted above under Current Related NRC Projects.

Since NBS is not performing any work on high-level waste disposal for the DOE, DOE contractors or any other sponsor, there is no conflict of interest.

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

FIN A-4171-9

B&R No. 950-19-03-01

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

The scope of this activity has been reduced by the elimination of the Basalt and Salt Repository Projects. It now involves review of waste package designs for only 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. The DOE is investigating three stainless steels and three copper-base alloys for waste package containers.

At the time of the initial agreement with the NBS, it was expected that the 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, is not in a position to perform the tasks described in this SOW for FY89. Nevertheless, coordination with its activities will be necessary; this is discussed in Section 3, below.

TASK 1 Review of Waste Package Data Base

The performing organization (PO) shall review DOE's existing and planned data base. After reviewing the available data, the PO shall identify the most pertinent documents and evaluate them 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 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 data set 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. The reviews are not intended to present detailed data but to permit a user to select 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 diskettes, shall be transmitted quarterly to NRC. Drafts of these Data Reviews shall be included in the Monthly Letter Reports and final versions shall be included in the Semi-annual Reports.

This portion of Task 1 is considered reactive, i.e., driven by DOE's schedule. The following portion is intended as pro-active work to permit the NRC to reach necessary technical understandings prior to license submittal.

For FY89, the PO shall concentrate on documents dealing with specific degradation phenomena, such as stress corrosion cracking, sensitization, passivation, pitting corrosion, and the like. The PO shall use information from documents received directly from NNWSI, from available databases, and from that in the NIST (formerly NBS) 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 preparation of Standard Review Plans for use in review of a DOE License Application?

The PO shall propose work on three phenomena selected from those mentioned above or from other areas that the PO considers central to the task of predicting long-term performance of waste package materials.

The level of funding shall not exceed 250K 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 reviews made 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 contract in FY89. 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 24K 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 continuation 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 given in Appendix A.

The level of funding for this task shall not exceed 200K 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. 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.

The PO shall become familiar with the structure of the NRC Transitional Licensing Support System (TLSS) and with that of the CNWRA to permit coordination of the NBS/NRC database with these systems and facilitate copying into these systems.

The level of funding for this task shall not exceed 50K 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 are and shall be produced in electronic form to facilitate entry into the NRC TLSS. Copies of all documents are and 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 enter into discussions with the CNWRA to develop and recommend to the NRC an integrated plan for the years beyond FY89 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 as specified in Section 3.0.

It is anticipated that the CNWRA will begin reviewing technical documents in the waste package area sometime in FY89. As the CNWRA demonstrates its capability, responsibility for the bulk of Task 1 may be transferred to it so that the PO can focus on reviewing documents related to the position papers it will prepare.

The PO shall have its representatives visit the CNWRA in San Antonio, TX, to become familiar 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 Monthly Status Reports

Every month, by the 15th of the month, the PO shall submit an original of a brief status report which summarizes (1) the work performed; (2) significant findings and conclusions; (3) personnel time and cost expenditures; and (4) work planned for the next reporting period. Costs shall be presented 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. In addition, the PO shall report costs on a timely basis in the level of detail shown on Schedule A. The PO shall supply additional details of personnel costs by individual as required by the PM.

4.2 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.

4.3 Deliverable Products

The deliverable products will consist of formal reports and Data Review Sheets as listed in Schedule B. The formal reports shall be issued semi-annually and shall cover the work performed under Tasks 1, 2 and 3. The reports will provide an overview assessment of the state-of-knowledge of the properties and predicted performance of waste package components as evidenced by the developing data base. The Data Review Sheets (see Enclosure 1) and the Data Records (duplicated copies of diskette(s) on which the Data Reviews have been entered) shall be submitted quarterly. Deliverables for FY90 are shown solely for planning purposes.

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.

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. Semi-annual Rpt.	1, 2, 3	Dec. 30, 1988	Mar. 31, 1989
2. Semi-annual Rpt.	1, 2, 3	Jun. 30, 1989	Sep. 29, 1989
3. Semi-annual Rpt.	1, 2, 3	Dec. 29, 1989	Mar. 30, 1990
4. Semi-annual Rpt.	1, 2, 3	Jun. 29, 1990	Sep. 28, 1990
5. Data Records	1		Dec. 30, 1988
6. Data Records	1		Mar. 31, 1989
7. Data Records	1		Jun. 30, 1989
8. Data Records	1		Sep. 29, 1989
9. Data Records	1		Dec. 29, 1989
10. Data Records	1		Mar. 30, 1990
11. Data Records	1		Jun. 29, 1990
12. Data Records	1		Sep. 28, 1990
13. Formal Reports	1, 2, 3	Mar. 31, 1989	Jun. 30, 1989
14. Formal Reports	1, 2, 3	Mar. 30, 1990	Jun. 29, 1990

*Camera-ready copy

SCHEDULE C. REPORT DISTRIBUTION

<u>Distribution</u>	<u>Monthly Ltr 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

4.5 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 Quarterly Program Reviews

Beginning December 15, 1988, the PO shall provide quarterly program reviews 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.

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 progress letter. Copies of trip reports issued separately shall be sent to the NMSS PM within 15 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, 1988 through September 30, 1989.

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.

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 524K for a period of 1 year.

16.0 SUBCONTRACTING

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.

17.0 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.

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.

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

ENCLOSURE 2

June 10, 1986

Office of Resource Management Division of Automated Information Services

Development, Submittal, Distribution and Documentation Requirements for Machine-Readable Contract Deliverables

This document provides requirements for contractors developing software, data or other machine-readable deliverables for the Nuclear Regulatory Commission (NRC). Its purpose is to assure that any such deliverables can be readily implemented and used on NRC equipment and can, if required, be easily disseminated or transferred to other data processing sites. This implies the use of standard software packages, programming languages, and compilers as well as adherence to good programming and documentation practices.

All computer codes, and associated data developed under contract to the NRC are the property of the NRC unless stated otherwise in the contract or DOE laboratory agreement. These items must be submitted to the NRC project manager in machine-readable form at or before contract completion. Microcomputer software and data deliverables should be supplied on diskette and conform to the criteria stated in section 1 below. Mainframe or minicomputer software and data deliverables should be submitted on tape and conform to the criteria in section 2 below.

All machine-readable deliverables must be accompanied by appropriate documentation as specified in sections 1, 2, and 4 below. Conversely, contractor reports citing the use of computer codes must be accompanied by said computer codes.

1. Deliverables for Use on Microcomputers

All deliverables developed for use on microcomputers must meet the following criteria unless a written waiver is obtained in advance from the NRC project manager and approved by the Division of Automated Information Services (RM/D):

- a. Deliverables should be submitted on diskettes.
- b. All diskettes should be capable of use on an IBM PC or compatible microcomputer using one of the software packages supported by the NRC Division of Automated Information Services (see Table 1, attached). All programs developed for the NRC must be written using one of the standard software packages.
- c. In particular, documents (e.g., reports) submitted in machine-readable form should be produced with IBM DisplayWrite word processing software. This will allow them to be used both on NRC microcomputers and word processing equipment.

- d. Failing criteria b or c above, data or text only may be provided as ASCII files in standard IBM PC diskette format.
- e. All diskettes must be accompanied by documentation, including a printed copy of the disk directory, a description of each file in the directory and how it is to be used and installation instructions. Refer to section 4 for software documentation requirements.

No microcomputer software or hardware may be purchased by a contractor or DOE laboratory for subsequent delivery to the NRC without written concurrence in advance by the NRC Project Manager and the Division of Automated Information Services.

Updated information about software supported for use on NRC-accessible computer facilities and microcomputers may be obtained from the NRC ITS Support Center, (301) 492-4160 (FTS 492-4160).

2. Deliverables for Use on Mainframes or Minicomputers

These requirements apply to scientific/technical computer codes and associated data deliverables intended for use on mainframes or minicomputers. All such deliverables must meet the following criteria unless a written waiver is obtained in advance from the NRC project manager and approved by the Division of Automated Information Services.

- a. All new mainframe or minicomputer programs developed or converted for NRC shall be written in American National Standards (ANS) FORTRAN (ANSI Standard X3.9-1978).
- b. Mainframe or minicomputer programs which generate plots must do so using the Display Integrated Software System and Plotting Language (DISSPLA) or CALCOMP plot software (DISSPLA is a standard at all DOE laboratories).
- c. The recommended mathematical/statistical subroutines are the International Mathematical Statistical Libraries (IMSL).
- d. Proprietary software packages should be avoided except where standard readily available packages exist and are supported for use at NRC-accessible computer facilities by the NRC ITS Support Center (see Table 1, attached). Machine-dependent and installation-specific packages and features including assembly language should not be used.
- e. Deliverables should be submitted on tape according to the following tape format requirements:

- Recording: 9-track
 - Density: 1600 BPI
 - Internal Tape Label: NO Label
 - Character Code: EBCDIC or ASCII
 - Record Size: FIXED RECORD LENGTH (80 char/record preferred for source code when possible)
 - Block Size: FIXED BLOCK LENGTH (maximum = 2048 char/block)
 - All files on one physical tape must each have the same number of char/record and char/block.
 - Tapes must not be generated using system-dependent copy routines. Tapes must be made so as to be transportable from one computer system to another. This is most easily accomplished by means of a FORTRAN READ-WRITE routine rather than a system utility; however, use of IBM IEBGENER is acceptable.
- f. All tapes must be accompanied by documentation, including a copy of the job that created the tape, a list of the files on the tape, a description of each file and how it is to be used, and installation instructions. Refer to section 4 for software documentation requirements.
- g. Tapes should include the following files:
- Source Code - Compiler input records
 - Sample Input - Test case input data. (The output generated by execution of the program using the sample input must also be provided in printed form.)
 - Data Libraries - External data files required for program execution (e.g., cross-section libraries, dose conversion factors, etc.).
 - Control Information - Operating system control language statements required for compilation and execution.
- Optional files include object or load modules.

Questions concerning the above instructions should be addressed to the NRC Information Technology Services Support Center (FTS) 492-4160.

3. Distribution

Contractors may not distribute NRC computer codes. Public and internal distribution of machine-readable contract deliverables such as computer software and associated data is the responsibility of the NRC Division of Technical Information and Document Control (TIDC). Before release for distribution, NRC-sponsored computer codes must be appropriately reviewed, tested, documented and approved for release by the sponsoring NRC office. A machine-readable copy of the computer code and data along with appropriate documentation, distribution availability forms, and release authorization must be sent by the NRC project manager to TIDC. Copies of these forms are available from the ITS Support Center (301-492-4160 or FTS 492-4160) or the Publishing and Translation Section, TIDC (301-492-8523 or FTS 492-8523).

4. Documentation

All reports, including code documentation, must conform to NRC Manual Chapters 3201 and 3202. Copies of these manual chapters are available from the Division of Technical Information and Document Control (301-492-7333 or FTS 492-7333). DOE laboratory staff may obtain copies from their respective technical information offices.

In addition, the content of all scientific/technical computer code documentation shall conform to ANSI Standard N-413, "Guidelines for Documentation of Digital Computer Programs." The major documentation requirements included in the standard are:

- a) Computer Program Abstract
- b) Application Information (User's Guide)
- c) Problem or Function Definition (Theoretical Development)
- d) Programming Information (Programmer's Guide)

A copy of this standard may be obtained for \$8.50 plus \$2.00 shipping and handling from:

The American National Standards Institute
1430 Broadway
New York, New York 10018
ATTN: Sales Department

In addition to or instead of conforming to ANSI Standard N-413, documentation for large codes or complex systems may be required to conform to FIPS Pub 38 (02/12/78), "Documentation of Computer Programs and Automated Systems." Applicability of FIPS Pub 38 will be determined by the Office of Resource Management, Division of Automated Information Services in consultation with the NRC Project Manager. Specific documentation requirements under FIPS Pub 38 shall be decided at the discretion of the NRC Project Manager depending on project size and complexity.

Each program developed for the Nuclear Regulatory Commission should include the following program title block and disclaimer in the main program:

Program Title:

Developed for: U.S. Nuclear Regulatory Commission
Office of (fill in NRC Office)
Division of (fill in NRC Division)

Date:

NRC Contact(s):

Phone:

Code Developer:

Phone:

Title(s) of Associated Documentation and NUREG Number(s):

This program was prepared for an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for any third party's use, or the results of such use, of any portion of this program or represents that its use by such third party would not infringe privately owned rights.

Table 1. NRC Supported Software

MAINFRAME SOFTWARE:

Brookhaven National Laboratory Computer System

NOS/BE	Operating System for CDC 6600
SCOPE 2.1	Operating System for CDC 7600
INTERCOM	Text Editor/Command Language
UPDATE	Text Editor Utility
FORTRAN 5*	Programming Language
CALCOMP	Graphics
DISSPLA	Graphics
IMSL	Math/Statistical Subroutines

Idaho National Energy Laboratories Computer System

NOS	Operating System for CYBER 176
FSE	Text Editor
XEDIT	Text Editor
UPDATE	Text Editor Utility
FORTRAN 5*	Programming Language
DISSPLA	Graphics
IMSL	Math/Statistical Subroutines

National Institutes of Health Computer System

OS/MVS	Operating System for IBM 3081
TSO	Command Language
WYLBUR	Text Editor/Command Language
VS FORTRAN*	Programming Language
DISSPLA	Graphics
TELL-A-GRAF	Graphics
FOILS	Word Charts for Overhead Projection
MARK IV	File Management/Report Generator
SYSTEM 2000	Data Base Management System (Reports and Queries only)
RAMIS II	Data Base Management System (Reports and Queries only)
UCFTP	Communications (PC's)
IMSL	Math/Statistical Subroutines

Oak Ridge National Laboratory Computer System

OS/MVS	Operating System
FORTRAN H	Programming Language
VS FORTRAN*	Programming Language

* Adheres to current ANSI Standard for FORTRAN (FORTRAN77)

NOTE: This list of software is changed periodically. For an updated list, call the Information Technology Services Support Center (301) 492-4160 or (FTS) 492-4160.

NRC Supported Software (continued)

MINICOMPUTER SOFTWARE:

NRC Data General MV/8000

CLI	Command Language Interface
SED	Text Editor
SPEED	Text Editor
BASIC	Programming Language
FORTRAN 77*	Programming Language
SSI*CALC	Spreadsheet
IMSL	Math/Statistical Subroutines

MICROCOMPUTER SOFTWARE:

IBM PC DOS & BASIC	Operating System, language
COMPAQ MS-DOS & BASIC	Operating System, language
IBM BASIC Compiler	Programming Language
IBM FORTRAN Compiler	Programming Language
IBM DisplayWrite	Word Processor
IBM DisplayComm	WP Communications
IBM 5520 Attachment Program	5520 Terminal Emulation
Microstuf CROSSTALK	Communications
Persoft Smarterm	DG Terminal Emulation
LOTUS 1-2-3	Spreadsheet
Ashton-Tate dBASE III	Data Base Management
Westminister Software	
Pertmaster	Project Management
Decision Resources	
Chartmaster	Graphics
Decision Resources	
Signmaster	Graphics
Borland International	
Sidekick	Multi-purpose Utility

Adheres to current ANSI Standard for FORTRAN 77.

**MICROFORM SPECIFICATIONS FOR
DIVISION OF WASTE MANAGEMENT CONTRACTS**

Microfiche used for submittal purposes shall conform to the following specifications:

1. Microfiche containing source documentation shall conform to the NMA Type 1 format (ANSI/NMA MS.5) consisting of 98 frames arranged in 7 rows and 14 columns.
2. The reduction ratio shall be 24:1 for all microfiche.
3. The microfiche shall be standard 148mm x 105mm.
4. The microfiche shall be one silver-halide master and one diazo placed in individual acid free envelopes.
5. Diazo duplicates may be either blue/black or black.
6. The microfiche shall be titled in the following manner:

FIN No.	Title of Report	Date
Contract No.		
NUREG/CR No.		
Fiche No.		

Fiche number refers to pagination information, e.g., 1 of 2, 2 of 2, etc.

7. Title information shall be eye readable on a clear background.
8. The submittal of microfiche containing proprietary material shall be coordinated with the Information & Records Management Branch, Division of Technical Information and Document Control, U.S. Nuclear Regulatory Commission, 20555 to set format and procedures for submittal.
9. Foldouts, if any, shall be segmented and filmed in logical order.
10. The first frame shall be blank, and the second frame shall contain the resolution target (NBS 1010A).
11. Questions on microfiche specifications should be submitted in writing to:

Information & Records Management Branch, Division of Technical Information
and Document Control, U.S. Nuclear Regulatory Commission,
Washington, DC 20555.