UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAR 2 1985

MEMORANDUM FOR: On-Site Licensing Representatives

FROM: Michael J. Bell, Deputy Director
Division of Waste Management

SUBJECT: UPCOMING DWPF/REPOSITORIES COORDINATION MEETING

A DWM representative will be attending the DWPF/Repositories Intersite Coordination meeting to be held in conjunction with the Waste Management '85 meeting. The planned agenda is enclosed.

A main topic of discussion will be the Program for DWPF HLW Acceptance Specifications at Geologic Repositories (attached to the Agenda). In reviewing this plan, we noted mention of unresolved issues and some objections on the part of SRL to some of the information being requested by the repository projects (page 2 of plan). Attachment A to the plan indicates that a final testing protocol for salt and tuff should be available, and that interim acceptance requirements for DWPF glass in basalt should be available. Please obtain additional information on these issues, protocols and requirements to assist the HQ staff who will be attending the meeting. In order to be useful, written material should be received by Friday, March 22.

for Jean Dunkle
Michael J. Bell, Deputy Director
Division of Waste Management

Enclosure:
As stated

[redacted]

NRC FORM 17A
(4-81)
NRCM 0240

U.S. NUCLEAR REGULATORY COMMISSION

ROUTING SLIP

ORGANIZATION

TO ("X" as appropriate)	NAME	MAIL STOP	TO	NAME	MAIL STOP
	R. BROWNING			JOAN H.	
	M. BELL			JEAN D.	
X	L. BARRETT				
	J. BUNTING			SHARON R.	
	L. HIGGINBOTHAM			JOANNE M.	
	M. KNAPP			DEBBIE W.	
X	H. MILLER			CATHY G.	

REMARKS

Please review attached and meet with me to discuss NRC participation in the March 26 meeting.

Cc: R Browning

X AS REQUESTED	FILE	PER CONVERSATION
APPROVAL/SIGNATURE	INFORMATION	SEE ME
COMMENT/CONCURRENCE	NECESSARY ACTION	SIGNATURE OF
CORRECTION	NOTE AND DESTROY	
ANSWER/ACKNOWLEDGE FOR	NOTE AND RETURN TO	

FROM (Name): Mike Bell | OFFICE | PHONE | DATE

Bell — Pls keep me informed — How far from [illegible] are we [illegible] [illegible] [illegible] RG

[redacted]

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED

ATOMIC ENERGY DIVISION
SAVANNAH RIVER LABORATORY
AIKEN, SOUTH CAROLINA 29808-0001
TWX 810-[illegible]-2670 TEL 803-725-6211 AU AUGUSTA GA

CC: S. P. Cowan, DOE-SR
E. Randklev, BWIP
M. J. Bell, NRC
J. M. Pope, WVDP
D. D. Wodrich, RHO

January 14, 1985

PATRICIA SALTER, BWIP
VIRGINIA OVERSBY, LLNL
DONALD E. CLARK, ONWI
SY VOGLER, ANL
MARTIN A. MOLECKE, SNL
M. JOHN PLODINEC, SRL
RICHARD N. GURLEY, RHO

DWPF/REPOSITORIES INTERSITE COORDINATION GROUP
NEXT MEETING MARCH 26, 1985

The next meeting of the Group is now scheduled for March 26, 1985, in the Holiday Inn (formerly the Marriott) in Tucson, Arizona. Waste Management '85 will be held in Tucson on March 24-28, 1985 and I believe many of you already plan to attend. I have attached a preliminary agenda which I will update following your suggestions. We have many important items to discuss and I hope all of you will be able to attend. If not, I urge you to send a substitute. For your information, I have elaborated below on several items that appear on the agenda.

DWPF HLW Acceptance at Federal Repositories

On November 8, 1984, I sent you a proposed Plan of Action on this item. I have attached a revised plan that incorporates suggestions received in response to my letter. DOE-SR had modified this plan, only slightly, and is circulating it to the various field offices that have responsibility for repository work. They plan to reach a consensus prior to our March 26 meeting at which site representatives may also be present. I have also attached a copy of the letter outlining the formation of the Group and some comments from Sy Vogler that arrived too late to be incorporated in the revised plan. At our March meeting I hope we can develop a final schedule and to accept the Plan of Action so that we can proceed to reach the announced goals within the next two calendar years as proposed.

Quality Assurance

It is quite clear that quality assurance is of great importance to data now being generated that may be used to meet regulatory requirements for the disposal of HLW, in our particular case DWPF-HLW. I have received written indications of concerns about current QA practices and believe that this may be one of the most important issues to be settled for the 1985-86 time period. I would propose a substantial amount of our meeting be devoted to this subject with each member being a substantial contributor.

Technical Program Review

I believe it would be very helpful if each site provided a very brief summary of technical items developed since reports at the Leaching Mechanisms meeting in September 1984 in Germantown. Current application of QA to these data would be appropriate to the report

Defense Waste to Commercial Repositories

By the time we meet, President Reagan is scheduled to have found that defense waste will go to a commercial repository. This action, in support of a DOE report called for in the NWPA-82, will require even closer cooperation between the DWPF and HLW repository and regulatory groups. I am hopeful that decisions will have been made by DOE by the time of our meeting in March so that the impact of the President's action and the subsequent improvements in financing repository work in support of the disposal of DWPF canisters, will meet the needs of our mutual programs for the future.

Waste Acceptance Criteria at WIPP

Since is is planned to send the first 30-40 DWPF canisters to WIPP for emplacement and testing, the National Research Council's Panel on WIPP* urged that "Waste Acceptance Criteria should be defined for DHLW that is to be used in the experimental program .... before experimental operations begin." I would like to consider whether the ONWI document will meet this requirement now that defense waste is to go to a commercial repository.

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* DOE/DP/48015-1, 1984.

Future Reports of Coordination Group

The DWPF/Repositories Group members presented brief reports at the Leaching Mechanisms Workshop in September 1984 in the DOE Auditorium in Germantown. The question is: Should we use similar workshops to present results to the Washington community? If yes, how often? I would suggest for discussion purposes to consider next Fall or the following Spring as possible dates for a workshop. Also, some method of reporting periodically to the Materials Steering Committee would be helpful to our activities and to mutual understanding of goals and objective.

General Discussions

- I would like to continue our general discussion of the MIO-MRB-MCC relationships to our regulatory future.
- I would like to obtain the group members' views on future repository regulatory activities such as:
  - Methods of meeting requirements
  - Methods of assuring QA
  - Long term acceptability of data

  This is important to the DWPF because canisters will be produced well in advance of repository availability.

Sincerely,

Edward J. Hennelly
Planning Coordinator
Waste Technology Coordination

EJH:hp
Enclosures:

(1) Agenda

(2) Letter, E. J. Hennelly to S. P. Cowan, Plan for DWPF HLW Acceptance at Federal Repositories (Revision), dated 11-19-84, (with attachments A & B)

(3) Letter, S. Vogler to Edward J. Hennelly, dated 12-18-84.

PRELIMINARY AGENDA
DWPF/REPOSITORIES INTERSITE COORDINATION GROUP
MARCH 26, 1985
Holiday Inn - Broadway
Tucson, Arizona
(Room To Be Assigned)
2:00 p.m.

2:00 p.m. Opening Remarks - E. J. Hennelly, Chairman

2:10 Discussion of and Acceptance of Plan for DWPF Canister Acceptance Documentation at Repositories

- Details
- Schedule
- Special WIPP Documentation?

3:00 Quality Assurance

- Reports from Repository Sites on Current Status
- Discussion of Plan of Action
- Need for Workshop on Informal Discussions
- Is there an end in sight?

4:15 Regulatory Interactions

- Current Status
- Future Plans and Activities
- Commercial vs Defense Requirements
  - Funding
  - Priorities

4:50 Future Reporting of Group

5:00 General Discussion Items

5:25 Date for Next Group Meeting

5:30 Adjourn

E. I. DU PONT DE NEMOURS & COMPANY
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AIKEN, SOUTH CAROLINA 29808-0001
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December 19, 1984

Mr. S. P. Cowan
Deputy Project Manager
DWPF Project Office
Savannah River Operations Office
U. S. Department of Energy
Aiken, South Carolina 29801

Dear Mr. Cowan:

PLAN FOR DWPF HLW ACCEPTANCE AT FEDERAL REPOSITORIES (Revision)

On October 30, 1984, I sent a proposal with the same title to T. B. Hindman. Following recent discussions with your staff, we have developed a revised plan of action for preparing DWPF/repository waste acceptance documentation by 1987. In conjunction with the extensive experimental program currently underway, and also discussed in the plan of action, we believe that the DWPF canistered waste forms can be identified as repository acceptable well in advance of the DWPF startup.

The revised action plan is attached. We are ready to move forward with the plan in cooperation with your staff and the other participants.

Sincerely,

E. J. Hennelly

Edward J. Hennelly
Planning Coordinator
Waste Technology Coordination

EJH:hp
Att

PROGRAM FOR DEVELOPING THE DWPF HLW ACCEPTANCE SPECIFICATIONS AT GEOLOGIC REPOSITORIES

OBJECTIVES

1. Develop, in concert with each DOE repository project, repository Waste Acceptance Documentation for DWPF waste forms.

2. Provide assistance to Hanford (HWVP) and West Valley (WVDP) as they work with DOE repository projects to develop equivalent documentation.

BACKGROUND

The current program to develop acceptance specifications for DWPF high-level waste forms at geologic repositories was established on July 1982 under the surveillance of a DWPF/Repositories Intersite Coordination Group set up through the DOE Materials Steering Committee.* This program was an outgrowth of work begun in the late seventies between Savannah River and the repository lead office at Oak Ridge. The initial issues were whether the proposed DWPF waste glass canister, two feet in diameter and ten feet long, could be handled by a repository and whether the DWPF plans for surface decontamination of the canister were acceptable. Alternative canister sizes, both larger and smaller, were considered in these initial studies, but it was eventually decided not to change from the original selection. Similarly after study, it was agreed that DWPF canister contamination levels based upon transportation standards could be expected to be acceptable to the repositories.

In 1980 repository lead office functions were transferred to ONWI at Battelle-Columbus, and a system of Intersite Coordination Groups was set up between Savannah River and ONWI. At that time SRL/SRP also began to develop documented specifications with ONWI for receipt of DWPF waste forms in a salt repository. A final document was agreed to in September 1982 at a DWPF/Repositories Intersite Coordination Group Workshop. It was approved by DOE and issued in June 1983 as ONWI-464, entitled **Conceptual Waste Package Interim Product Specifications and Data Requirements for Disposal of Borosilicate Glass Defense High-Level Waste Forms in Salt Geologic Repositories.**

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* Letter, T. B. Hindman to J. L. Crandall, Establishment of DWPF/Geologic Repository Working Group, 8-2-82.

Fri Mark Weston
Ed Rondiff

The document was intended to be interim and subject to periodic review that we hoped would be at about two-year intervals. It is primarily for use in the development of conceptual waste package designs in salt. However, if we, SRL/SRP, were to suggest to OCRWM how to prepare waste acceptance documentation, the approach used by ONWI would be at the top of our list as a model.

SRL/SRP-DWPF has also worked with the other repository sites to prepare documents equivalent to ONWI-464 for basalt and tuff geologies. Preliminary versions of these documents are available.* However, the repositories have tended to give lower priority to this work because the major emphasis has shifted to the disposal of commercial spent fuel, and because the repositories do not believe that they have been funded sufficiently to work on the disposal of DWPF borosilicate glass waste forms.

Each repository will probably always require its own waste acceptance documentation. There are still some unresolved issues with the the drafts of the tuff and the basalt interim acceptance documentation. To date we have found no reasonable requirement from any repository group that the DWPF borosilicate glass waste form could not meet. Nonetheless, we do have objections to some of the test and operating data the repositories are requesting from the DWPF because these data would be costly to obtain and do not seem to relate to the regulatory requirements on waste forms with which we are familiar.

STATUS

The current situation can be summarized as follows:

- Waste acceptance documentation development for all candidate repositories is on schedule to meet a January 1987 deadline for the ~~repository license~~ applications required in the Nuclear Waste Policy Act of ~~1982~~ (NWPA). They would thus be well in advance of DOE's suggested revised timing for license submission in January 1990.

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* Draft Waste Acceptance Requirements for the Basalt Waste Isolation Project, SD-BWI-CR-018 - June 27, 1983.
The Nevada Nuclear Waste Storage Investigation Project Interim Acceptance Specification for DWPF and WVDP Waste Forms and Canisterized Waste, UCID-2016~~5~~ - August 1984.

- Experiments at Savannah River in support of DWPF waste acceptance in salt, tuff, basalt and granite geologies are on schedule. The experimental program has been developed over the past two years in support of a major program function of the DWPF/Repositories Intersite Coordination Group. This program has been moving forward in two phases. Phase I experiments are a "test of a test". They are complete for tuff and nearing completion for salt and basalt. These experiments verify that future Phase II tests needed for waste acceptance at a repository are pertinent, acceptable, feasible, and can be agreed upon between SRL/SRP and the respective repository groups. Phase II experiments are beginning and will be completed on a schedule compatible with a January 1987 deadline. They are repository specific and are being developed in consultation with the Materials Characterization Center. It is planned that the test procedures will eventually be submitted to MCC/MRB. Attachment A provides a detailed schedule of the glass testing programs including proposed milestones. A review of the current status of this program was given at DOE Germantown Headquarters on September 19, 1984, on the second day of a workshop on "The Performance of Borosilicate Glass HLW Forms in Disposal Systems". Funding at SRL in support of this plan for FY 1985 is $700K/600K (BA/BO) and requested for FY 1986 is $560K/500K. This funding includes: (1) work with the repositories on the draft Waste Acceptance Specifications, (2) exchange of technical information, (3) development of test procedures, and (4) conduct of the leaching tests.

- Comparison experimentation by the repository groups is also proceeding but it has been difficult to assure proper funding and a high enough priority to stay on schedule in some cases. With the increased utility funding of the Waste Management Fund, the focus of the repository groups is shifting to commercial spent fuel. Interim funding by DP of the repository groups' effort may be necessary to maintain the desired schedule. However, if the President concurs in DOE's forthcoming report that defense waste is to be disposed in a commercial repository, the subsequent contribution of DOE defense funds to the Waste Management Fund will help to resolve funding problems.

PROPOSED PROGRAM

The next step in the timely preparation of the waste acceptance documentation for DWPF borosilicate glass waste forms at each of the three leading candidate repository types is to obtain agreement with those sites as to the schedule, priority and objectives of the waste acceptance program. The program must assure that each candidate repository has sufficient technical information about DWPF HLW forms at the time application is made for a license to dispose HLW in a proposed repository. Also, repository funding must be adequate to achieve their assigned tasks. Questions that need resolution are:

- Will the documentation be available prior to DWPF startup in 1989 even if the repository license application is delayed until 1990?

- Will funding be available and priorities set at the repositories to meet the schedule in Attachment A?

The DWPF waste form acceptance documentation should be paralleled by closely coordinated programs to develop equivalent acceptance documentation for the very similar waste forms to be produced by the West Valley Demonstration Project and the proposed Hanford Waste Vitrification Plant. It is expected that much of the DWPF work will be applicable to both of these projects. However, West Valley may need to develop a separate schedule in view of its planned 1988 hot startup. The schedule for Hanford is not as urgent in view of a planned HWVP startup in 1992 or later.

A plan of action is proposed that involves the following sequential steps:

- DOE/SR will call a meeting as soon as possible of the DOE field offices and their contractor representatives to discuss the program for waste form testing and acceptance criteria. A major purpose of the meeting would be to review and modify as necessary the schedule outlined in Attachment A and to develop schedules to include repository experimentation and milestones. An excellent proposal I received would be to hold the meeting at the Waste Management '85 Conference in Tucson in late March in conjunction with the next meeting of the DWPF/Repositories Intersite Coordination Group.

- DOE field offices through DOE/SR will supply DOE Headquarters with mutually approved schedules with milestones and obtain assurance that adequate funding will be available in FY 1985, 86, and 87 budgets.

- DOE field offices through DOE/SR will direct the DWPF/Repositories Intersite Coordination Group to monitor the program and to report semiannually to the Materials Steering Committee on progress and problem areas.

- The DWPF/Repositories Intersite Coordination Group will provide DOE/SR with agreed-upon interim waste acceptance documentation for DWPF HLW canisters by January 1987. After concurrence by the other field offices, these documents will be forwarded to DOE Headquarters.

- West Valley will provide equivalent documentation for West Valley by January 1987.

- HWVP will provide a plan for equivalent documentation for HWVP by January 1989.

We believe, if this plan has the blessing of the respective DOE field offices and obtains the proper priority and financial support, that the agreed upon site-specific waste acceptance documentation can be available for review and concurrence by DOE Headquarters in advance of any repository license application and well in advance of DWPF startup when they are also expected to be needed.

EJH:hp
Att
D#5

Plan
Waste Acceptance Process -

ATTACHMENT A
SCHEDULE FOR INTERIM ACCEPTANCE SPECIFICATIONS AND GLASS TESTING

DATE	DESCRIPTION	RESPONSIBILITY
Completed	Interim waste acceptance specifications for DWPF glass in salt published.	ONWI
Completed	Interim waste acceptance specifications for DWPF glass in tuff published.	NNWSI
11/84	Scouting tests in salt completed.	SRL
12/84	Meeting to discuss draft interim waste acceptance requirements for DWPF glass in basalt.	SRL/BWIP
1/85*	Testing protocol for salt finalized.	ONWI/SRL
1/85	Testing in tuff cups of known permeability begins.	SRL/NNWSI
2/85	Phase I salt tests begin.	SRL/ONWI
~~1/85~~ 3/85*	Interim waste acceptance requirements for DWPF glass in basalt published.	BWIP
3/85	Protocol for Phase II tuff tests completed.	NNWSI/SRL
6/85	Phase II tuff tests (very low flow) begin.	SRL/NNWSI
7/85	Radioactive Phase I basalt tests (low Eh, static) begin.	SRL/BWIP
4/86*	Tests in tuff cups of known permeability completed, and documented.	SRL/NNWSI
6/86*	Phase I salt tests completed, and documented.	SRL/ONWI
12/86*	Phase II tuff tests completed, and documented.	SRL/NNWSI
1/87*	Phase I basalt tests completed, and documented.	SRL/BWIP

CR-018
SD-018

3/85

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* Milestone.

June Revised Version -
Q Waste Acc Rq #5
West Valley

ATTACHMENT B

Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29801

Dr. J. L. Crandall, Director
Advanced Planning
Savannah River Laboratory
E. I. du Pont de Nemours and Company
Aiken, South Carolina 29801

Dear Dr. Crandall:

ESTABLISHMENT OF DWPF/GEOLOGIC REPOSITORY WORKING GROUP

The Material Steering Committee, which met in Germantown, Md., on July 22, 1982, has requested SR to establish a working group to identify and resolve issues associated with the acceptance of DWPF HLW canisters in a licensed geologic repository. The primary objective of this working group will be to coordinate a program for developing acceptance criteria, product specifications, data requirements, and test procedures which are needed for the disposal of DWPF canisters in a federally licensed repository.

You are requested to take the necessary action to establish and chair a DWPF Repository Working Group. The membership of this group should include contractor representatives of the three repository projects (BWIP-Basalt, ONWI-Salt, and NNWSI-Tuff), and the Materials Integration Office (MIO). Participation as necessary for specific issues should be extended to the WIPP Project and the Transportation Technology Center at Sandia.

The program objectives are:

1) To define and characterize the reference DWPF high-level waste form and canister.
2) To characterize the expected repository environments and determine their effect on the DWPF high-level waste form and any other package components.
3) To develop interactive tests and calculational models to determine the long-term behavior of DWPF waste in the repository environment.
4) To establish acceptance criteria, product specifications, data requirements, and test procedures which are needed for disposal of DWPF canisters in a federally licensed repository.

In view of the potential impacts which these product and data requirements may have on the DWPF final design, this working group should be established

and functioning as soon as possible. An initial progress report is required for the next MSC meeting in October, 1982.

In addition to the DWPF/Repository Working Group, you are also requested to interface one-on-one with the individual repository projects to identify detailed actions and milestones required to develop agreements, specifications, and test data for repository acceptance of the DWPF product. Identification of overall actions and associated milestones for DWPF/BWIP is requested by August 13, 1982.

Sincerely,

Thomas B. Hindman, Jr., Acting Director
Defense Waste Processing Facility
Project Office

PD:WBW:dwj

ARGONNE NATIONAL LABORATORY
9700 South Cass Avenue, Argonne, Illinois 60439

December 18, 1984

Mr. Edward Hennelly
Savannah River Laboratory
Aiken, SC 29808-0001

Dear Ed:

Please excuse the delay in responding to your letter of November 8, 1984, concerning DWPF/Repositories Intersite Coordination Group, Plan of Action. In general, the plan for preparing repository waste acceptance documentation seems reasonable. However, it should be pointed out that this plan was not discussed at the November 6, 1984, meeting other than Plodinec's discussion of the SRL experimental program.

The schedule includes dates for developing a testing protocol for salt and for tuff tests, but there is no mention of a corresponding protocol for basalt testing.

Only in passing is there any mention of the MCC. If acceptance tests are being formulated for measuring the glass properties demanded by the repositories, then consultation with the MCC is essential to ensure that the procedures and the supporting data will meet the NRB standards. Points at which consultation seems reasonable are the following.

1/85	Testing protocol for salt finalized.
3/85	Protocol for phase II tuff tests completed.
4/86	Tests in tuff cups of known permeability completed and documented.
6/86	Phase I salt tests completed and documented.
12/86	Phase II tuff tests completed and documented.
1/87	Phase I basalt tests completed.

Sincerely,

S. Vogler

S. Vogler
Materials Integration Office
Chemical Technology Division

SV:rr

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UCID- 20165

The Nevada Nuclear Waste Storage Investigations Project Interim Acceptance Specifications for Defense Waste Processing Facility and West Valley Demonstration Project Waste Forms and Canisterized Waste

Virginia M. Oversby

August 1984

Lawrence Livermore National Laboratory

THE NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT
INTERIM ACCEPTANCE SPECIFICATIONS FOR
DEFENSE WASTE PROCESSING FACILITY AND WEST VALLEY DEMONSTRATION PROJECT
WASTE FORMS AND CANISTERIZED WASTE

1.1 BACKGROUND

The U. S. Department of Energy (DOE) has the responsibility for implementing the provisions of the national Nuclear Waste Policy Act of 1982. Under the provisions of this law, DOE will investigate sites to determine their suitability for construction of a high level nuclear waste repository, recommend a limited number of sites for further, detailed site characterization, and ultimately design a repository for one of the sites. The Nuclear Regulatory Commission (NRC) has the responsibility to provide rules that govern the disposal of high level wastes, and technical criteria that will be used in evaluation of license applications for repository construction and operation under those rules. The technical criteria used by the NRC will include provisions which satisfy the requirements developed by the Environmental Protection Agency (EPA) to limit release of radionuclides to the environment.

The disposal strategy for high level nuclear waste adopted by DOE involves the use of a mined repository located deep within a stable geological setting. Several different types of rock are included in the candidate sites that are under consideration by DOE. Prior to passage of the Nuclear Waste Policy Act, DOE had established the National Waste Terminal Storage (NWTS) program; the functions formerly handled under the NWTS program are now part of the Office of Civilian Radioactive Waste Management (OCRWM). THe NWTS program was established to provide the technology and facilities necessary to design, license, construct, and operate a high level nuclear waste repository. Other DOE programs have the responsibility for the development of process technology to produce suitable waste forms for disposal and for the study of transportation requirements to cover delivery of the waste forms from the

producer to the repository. The Nevada Nuclear Waste Storage Investigations Project (NNWSI) was established under the NWTS Program to investigate the suitability of rocks at the Nevada Test Site for the construction of a licensed high level waste repository. The NNWSI Project has selected a site in the unsaturated Topopah Spring Member of the Paintbrush tuff at Yucca Mountain for further study to determine whether this location might be suitable for a high level nuclear waste repository.

The DOE/NWTS-33 document series serves as the general program guidance for site-specific repository development projects. DOE/NWTS-33(1) discusses the general program objectives, functional requirements, and system performance criteria. DOE/NWTS-33(2) and (3) present the general site and repository criteria, respectively. DOE/NWTS-33(4) addresses the functional requirements and performance criteria for waste packages containing high level waste either as reprocessed waste or as spent fuel. Work is still in progress within the OCRWM on documenting the functional requirements and performance criteria for waste packages containing commercial transuranic wastes (CTRU) and on documenting the specific character of such wastes.

The waste acceptance specifications presented in this document represent the first stage of the NNWSI effort to establish specifications for the acceptance of waste forms for disposal at a nuclear waste repository in Yucca Mountain tuff. The only waste forms that will be dealt with in this document are the reprocessed waste forms resulting from solidification of the Savannah River Plant defense high level waste and the West Valley high level wastes. Specifications for acceptance of spent fuel will be covered in a separate document.

1.2 PROGRAM STATUS (NNWSI)

The NNWSI Project has completed the initial stages of site investigations and is preparing a formal Site Characterization Plan for further study of the Yucca Mountain site. The NNWSI Project has also completed, with the support of Westinghouse-Waste Technology Services Division, conceptual designs of waste packages for disposal sites located below the water table (AESD-TME-3138, 1982). Conceptual waste package designs for a repository located above the water table will be completed in 1984. The conceptual design for the repository is under development.

1.3 PURPOSE

The purpose of this document is to provide a set of acceptance specifications and data requirements for waste forms that might be disposed of in a repository in tuff at Yucca Mountain in Nye County, Nevada. These specifications are preliminary in nature and are limited by the present level of knowledge about the Yucca Mountain site. As more information becomes available about the geology and hydrology of the site, particularly following construction of the Exploratory Shaft, it will be necessary to revise these acceptance specifications. The draft specifications provided in this document can serve as guidance for waste form producers in the design and operation requirements for their production facilities, and will be used as input for the preliminary waste package and repository design stage.

2.0 SCOPE AND CLASSIFICATION

2.1 SCOPE

This document presents the first draft of the NNWSI specifications that will govern the acceptance of waste forms by NNWSI for emplacement in a deep geologic repository located in the Yucca Mountain tuffs. The quantitative limits associated with a given specification, and the data requirements to show that the waste form meets the specification, are presented if sufficient information is available to support their selection. Brief summary discussions on the basis and rationale supporting the selection of each specification are presented in Appendix A.

It should be noted that the limits presented with the specifications in this document were derived primarily from assessing the information that is presently available concerning the Yucca Mountain site and the estimates that could then be made concerning the effect of that environment on the performance of the repository engineered barrier system. The integration of requirements imposed by the waste form producer, the shipper, and the repository developers will be an on-going effort. Revision of the numerical limits given in this document may be necessary as more information becomes available.

2.2 CLASSIFICATION

2.2.1 Waste Types

This document presents the waste acceptance specifications proposed by NNWSI for the products to be made at the Defense Waste Processing Facility (DWPF) planned for location at the Savannah River Plant in Aiken, South Carolina, and at the West Valley Demonstration Project, West Valley, New York.

2.2.2 Canisterized Waste

The waste acceptance specifications given in this document apply to waste forms that are appropriately canisterized to be shipped from the waste form producers for receipt by NNWSI at the repository location.

2.2.3 Waste Form

The reference waste form for both the DWPF and West Valley is borosilicate glass.

2.2.4 Status of Specifications

The specifications and associated numerical values and qualifications presented in this document were developed by consideration of the regulatory criteria and requirements, the repository and waste package design requirements, predictions of system performance, and the results of testing conducted as part of the NNWSI Project. Data referenced in this document or used in developing the specifications was in published form as of April 30, 1984.

2.2.5 NNWSI

The term NNWSI is used in this document to include both the NNWSI Project and individuals or groups with specific responsibility or authority delegated to them by the Project Manager. Where information is to be provided to NNWSI by the waste form producer, the NNWSI Project Office will designate the person(s) to receive the information. In cases where NNWSI is stated to "decide", "accept", or otherwise act, the term NNWSI refers to the responsible person(s) designated by the NNWSI Project Manager.

The term repository is used to designate any high level waste repository constructed as a result of NNWSI Project activities. The term is used in this document to indicate both the physical repository and individuals or groups who have designated responsibilities related to design, construction, and/or operation of the repository.

3.0 APPLICABLE DOCUMENTS

3.1 REGULATORY CRITERIA

3.1.1 Federal Regulatory Criteria

10 CFR Part 60 - Disposal of High-Level Radioactive Wastes in Geologic Repositories, Technical Criteria, Final Rule, U. S. Nuclear Regulatory Commission, Federal Register Vol. 48, No. 120, June 21, 1983.

40 CFR Part 191 - Environmental Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, U. S. Environmental Protection Agency, proposed rule, 1982.

10 CFR Part 20 - Standards for Protection Against Radiation, U. S. Nuclear Regulatory Commission, June 15, 1979.

10 CFR Part 50 - Appendix B - Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, U. S. Nuclear Regulatory Commission, November 10, 1978.

10 CFR Part 71 - Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions, U. S. Nuclear Regulatory Commission, August 5, 1983.

49 CFR Part 173 - Shippers - General Requirements for Shipments and Packagings, U. S. Department of Transportation, March 10, 1983.

30 CFR Part 57 - Safety and Health Standards, - Metal and Nonmetallic Underground Mines, U. S. Department of Labor, July 1, 1982.

3.1.2 State Regulatory Criteria

At this time no applicable state regulatory criteria that affect the development of Waste Acceptance Specifications for NNWSI have been identified.

3.2 SPECIFICATION STANDARDS

ANSI/ASME - NQA-1-1979 Quality Assurance Program Requirements for Nuclear Power Plants and latest addenda, An American National Standard sponsored and published by The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, New York.

ANSI/ASTM A-167-77, American National Standard for Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, American Society of Mechanical Engineers, New York, New York.

3.3 OTHER DOCUMENTS

AESD-TME-3138, Conceptual Waste Package Designs for Disposal of Nuclear Waste in Tuff, Westinghouse Electric Corporation - Advanced Energy Systems Division, September 1982.

DOE/NWTS-30, Proceedings of the 1982 National Waste Terminal Storage Program Information Meeting, Session II-A (NNWSI Programmatic Review) and Session II-E (NNWSI Technology Review), U. S. Department of Energy, December 1982.

ONWI-464, Conceptual Waste Package Interim Product Specifications and Data Requirements for Disposal of Borosilicate Glass Defense High-Level Waste Forms in Salt Geologic Repositories, Battelle Memorial Institute, Columbus, Ohio, May 1983.

AESD-TME-3055, Engineered Waste Package System Design Specifications, Westinghouse Electric Corp., Pittsburgh, Pennsylvania, November 1980.

DOE/NWTS-33, NWTS Program Criteria for Mined Geologic Disposal of Nuclear Waste, U.S. Department of Energy, 4 vols.

DOE/EIS-0081, Final Environmental Impact Statement Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, U.S. Department of Energy, June 1982.

DP-1606 Rev 1, R. G. Baxter, Description of DWPF Reference Waste Form and Canister, E. I. Du Pont de Nemours, Savannah River Laboratory, Aiken, South Carolina, August 1983.

4.1 GENERAL

The product specifications and data requirements for acceptance by the Nevada Nuclear Waste Storage Investigations Project (NNWSI) of high level waste forms and canisterized waste to be produced by the Defense Waste Processing Facility (DWPF) and the West Valley Demonstration Project are presented in this document. These specifications are preliminary in nature and will be revised as more information about the potential Yucca Mountain repository site, the repository design, and the waste package design becomes available.

This document is intended to be a guide to the waste form producer as to the types of information and quality control testing that will be required by NNWSI before waste forms can be accepted for disposal. The numerical limits given in specifications are in some cases controlled by existing regulatory requirements; those limits will change only if the relevant regulations change. In other cases, the numerical limits are based on our current state of knowledge concerning the environment in which the waste form will be placed and the conceptual designs for the repository and the waste package. Those limits will be subject to alteration as our state of knowledge improves and becomes more detailed, and as the designs for the repository and waste package are further developed.

Some of the specifications for canisterized waste were developed to allow for the possibility of using the canister in which the glass is cast as the waste disposal containment barrier. Those specifications are labeled as optional. If those specifications are not met, the waste forms would still be acceptable for disposal by NNWSI, but the canister would be overpacked with a suitable containment barrier.

4.2 WASTE FORM SPECIFICATIONS - DWPF and WEST VALLEY REPROCESSED WASTE

4.2.1 Chemical

4.2.1.1 Waste Form Matrix

The reference waste forms for DWPF and West Valley are based on a borosilicate glass (DP-1606, Rev. 1; DOE/EIS-0081). The waste form producer shall supply to NNWSI sufficient chemical data to characterize the average product of the waste production facility and the range in chemical composition of the expected output of the facility. For each waste form produced for shipment to a repository developed by NNWSI, the producer will provide the chemical composition of the waste form for all non-radioactive elements that are present in concentrations greater than 0.5 percent by weight (see section 4.2.6.1). Data requirements for radionuclides are given in section 4.2.4. The required compositional data may be calculated from the results of feed stock analyses.

4.2.1.2 Free Liquids

The waste form shall not contain free liquids. Free liquid is defined as liquid, including liquid mechanically trapped in the waste form, that could be drained or evaporated from the waste form at temperatures of less than 500 degrees C. Free liquids do not include liquids that are chemically bound into the matrix of the waste form in such a way as to make removal of the liquid at temperatures below 500 degrees C impossible at a pressure of 1 atm.

4.2.1.3 Gases

The waste form shall not contain free gases, other than helium, argon, and air, or contain substances that could contribute to the generation of free gases at temperatures below 500 degrees C. The pressure of the total mixture of all gases within the waste form container upon completion of the sealing of the container shall be no more than 7 psig at 25 degrees C. See also section 4.3.2.6.

4.2.1.4 Explosives

The waste form shall not contain explosive materials, as defined in 49 CFR Part 173 Subparts C and G, in concentrations that could compromise, by either corrosion (see also section 4.2.1.7) and/or explosion, the integrity of the canisterized waste form during shipment to the receiver and during activities associated with the handling and operational periods of repository operations.

4.2.1.5 Pyrophoric Materials

The waste form and internal volume of the waste form canister shall not contain pyrophoric, flammable, and/or oxidizer materials, as defined in 49 CFR Part 173, Subpart E.

4.2.1.6 Organic Materials

The waste form and internal volume of the waste form canister shall not contain organic materials.

4.2.1.7 Chemical Compatibility

The waste form shall be chemically compatible (i.e., nonreactive and noncorrosive) with the canister material and any additional materials included within the internal volume of the canister under conditions that are expected during storage and final disposal.

4.2.1.8 Waste Form Degradation by Fire

Waste form material that has been involved in an accidental fire will be accepted by NNWSI for disposal provided that the producer demonstrates that the waste form can withstand the fire test specified below without

(1) Degrading to a level that compromises its performance in isolating the radionuclides present as per specifications in section 4.2.5 and in meeting the specifications in sections 4.2.1.1 through 4.2.1.7 and 4.2.2.1.

(2) Degrading so as to act as a primary contributor to breach of the canister (e.g., via pressurization from volatile materials released from the waste form or via production and release of materials that rapidly corrode the canister).

The fire test will be the thermal exposure test specified in 10 CFR Part 71.73 paragraph (c)(3). "Thermal. Exposure of the whole specimen for not less than 30 minutes to a heat flux not less than that of a radiation environment of 800°C (1475°F) with an emissivity coefficient of at least 0.9. For purposes of calculation, the surface absorptivity must be either that value which the package may be expected to possess if exposed to a fire or 0.8, whichever is greater. In addition, when significant, convective heat input must be included on the basis of still, ambient air at 800°C (1475°F). Artificial cooling must not be applied after cessation of external heat input and any combustion of materials of construction must be allowed to proceed until it terminates naturally. The effects of solar radiation may be neglected prior to, during, and following the test."

4.2.2 Physical

4.2.2.1 Particle Sizes and Fractions

The amounts of waste form within a container that are present as particles in the size ranges of (1) less than 200 microns but greater than 10 microns in equivalent sphere diameter and (2) less than 10 microns in equivalent sphere diameter shall not lead to exceeding the limits established by 10 CFR Part 20 and the "as low as reasonably achievable" (ALARA) public and occupational limits (to be determined) for control of dispersal (less than 200 microns) and inhalation (less than 10 microns) of particles by personnel during the handling and operations period of the repository. The limiting amounts of particles will be specified in the final version of the acceptance specifications for waste forms. The particle size fractions that are to be inventoried and controlled will also include the generation of such particles by both anticipated processes and events (e.g., section 4.2.3.1, devitrification control) and unanticipated processes and events (e.g.. section 4.3.2.7, the drop test).

4.2.3 Thermal

4.2.3.1 Peak Temperature

The borosilicate glass waste form shall not exceed 500 degrees C at any point within the waste form due to steadystate self heating in a 40 degree C air environment after pouring of the glass and initial cool-down are completed.

4.2.3.2 Peak Thermal Load

The waste form shall not exceed a total thermal heat generation rate of 800 watts per waste form loaded canister at the time of shipment to the repository. (NOTE: The heat generation rate of the average canister is expected to be substantially lower than 800 watts (DP-1606, Rev. 1.)

4.2.4 Radionuclide Inventory

4.2.4.1 General Inventory

The inventory of radioactive material in the waste form at the time when the canisterized waste is to be shipped to the repository shall not exceed 1000 curies of fission products nor 200 curies of actinides per liter of fabricated glass waste form. Data provided to show compliance with specification 4.2.4.2 will be used to show that this product specification has been met.

4.2.4.2 Specific Inventory

The specific radionuclide inventory per unit weight of waste form (expressed in curies and in grams) shall be provided by the producer for each canister of fabricated waste form. The waste form producer shall also supply to the repository an estimate of the total amount of radionuclides to be disposed of in the repository arising from waste forms to be produced in their facility over the operational lifetime of the facility. This estimate will be provided in a form which will allow the repository to make any calculations required by NRC or EPA regulations. This estimate shall be based on measurements of existing inventories of waste and on estimates of future production. Should any of the information required under this specification be deemed to be of a classified nature, the estimate may be given in the form of total projected inventory for each isotope only, provided that details of

the calculations be made available to persons connected with NNWSI who possess the required security clearances should the information be necessary in order to safely dispose of the waste. The radionuclide inventory shall include all nuclides which have half-lives greater than 10 years and which will represent more than 0.05 percent of the activity of the radionuclide inventory at 1000 years, or more than 0.1 percent of the "as produced" total activity in the waste form. The accuracy of the estimate shall be within + or - 10 relative percent for the per canister inventory determined during production of the waste forms. The estimates for future production shall state the bases for the estimates and be as accurate as reasonably achievable. The inventories referred to above shall be the quantities of radionuclides present at the time when the waste is to be shipped to the repository.

4.2.5 Radionuclide Release

4.2.5.1 Quality Control on Production of Waste Forms

The waste form shall limit the release of radionuclides to the near field repository environment. The ability of the waste form to meet this specification will be shown by the results of testing of actual production samples of waste forms. The test to be used is the MCC-1 test (Materials Characterization Center, 1982), conducted in deionized water at 90 degrees C. Test duration is to be 28 days. The normalized elemental leach rate for the matrix elements Na, Si, and B, and for the radionuclides cesium-137 and uranium-238 shall be less than 1 gram per square-meter-day averaged over the 28 day period. The minimum testing schedule will include a sample from every twentieth canister of waste form produced. The sample is to be taken from a convenient location near the top of the canister before the top is closed. The temperature of the glass at the time of sampling is to be no higher than 50 degrees C. Samples will also be required when there are known variations in the production parameters. These variations will include changes in the feed stream which would result in a change larger than 10 relative percent in the chemical composition of the non-radioactive elements in the glass, and any change in the production routine which is considered likely to affect the quality of the waste form product. The results of these tests will be part of the required documentation to be delivered prior to shipment of the waste

forms to the repository (see section 4.4.3). An alternative method of sampling may be used, provided that the waste form producer establishes the relationship between the test results obtained on samples collected by that method to the test results obtained on samples collected by the specified method.

4.2.6 Properties Affecting Radionuclide Release

4.2.6.1 Chemical Homogeneity

Waste form production will be controlled by monitoring of the feed stream and sampling of the finished waste forms in a manner which allows the producer to provide to NNWSI a calculated or measured chemical composition of the waste form which is accurate to within 5 relative percent for all non-radioactive elements present in the waste form in amounts greater than 0.5 percent by weight. The compositions of waste forms that will be acceptable for receipt by NNWSI will lie within the range of compositions used by NNWSI for testing in support of the repository license application made by NNWSI to the NRC. The abundance of crystalline and metallic phases within glass waste forms will be controlled so as not to exceed 5 percent by volume of the total waste form.

4.2.6.2 Chemical and Physical Stability

The waste form producer will provide data to show that the alteration of the waste form, if any, during the first 300 years after disposal will not compromise the performance of the waste form as specified under section 4.2.5. Data shall include an estimate of the extent of devitrification that will be expected to occur in glass waste forms during the first 300 years after disposal, together with the expected uncertainty in this estimate.

4.2.7 Criticality

4.2.7.1 Quality Control on Fissile Nuclide Concentrations

The content of fissile nuclides (U-233 + U-235 + Pu-238 + Pu-239 + Pu-241) in the finished waste form shall not exceed 6 milligrams per cubic centimeter (Pu-238 is not generally considered to be fissile; however, it is included in the list of fissile nuclides in 10CFR Part 71. As a consequence of that inclusion, Pu-238 is included here.). Compliance with this specification will

require analysis of actual production samples. The analysis may be done either (1) by a chemical and isotopic analysis of the feed stream, or (2) by a chemical and isotopic analysis of a sample of the finished waste form. The sampling schedule will be the same as that given under section 4.2.5.

4.2.8 Properties and Characteristics

The waste form producer shall provide data to NNWSI on the following properties and characteristics of the waste forms to be produced. Data may be obtained on simulated waste forms unless otherwise specified. The choice of test method or analytical technique may be made by the waste form producer unless specified in this section.

4.2.8.1 Chemical

4.2.8.1.1 Bulk Composition

Waste form chemical composition for actual production run waste forms given in weight percent for non-radioactive elements and in curies and grams per unit weight for radioactive species must be provided to NNWSI. Data are required for all non-radioactive elements which are present in concentrations greater than 0.5 percent by weight, and for all radioactive species which have half-lives greater than 10 years and are present in concentrations which are greater than either (1) 0.1 percent of the total activity in the as produced waste form, or (2) would constitute more than 0.05 percent of the 1000 year inventory of radioactivity in the waste form, assuming no chemical leaching of the waste form had occurred. Required accuracy of the data is 5 relative percent for non-radioactive elements and 10 relative percent for radioactive species. Data for radioactive species must be given on an individual isotope basis. Data may be derived from analyses of feed stock or finished products.

4.2.8.1.2 Phase Composition

Phase composition of the waste form given as volume percent of homogeneous glass, crystalline material, and metals must be provided to NNWSI. For crystalline materials and metals, the chemical composition of the phase must be specified as well as the proportion of the phase. Data may be derived from

the analysis of simulated waste forms produced during full scale trials of the production facility.

4.2.8.1.3 Simulated Waste Forms used in Testing

Data must be provided to NNWSI giving the chemical characteristics of any simulated waste forms used to demonstrate compliance with any of the specifications which allow for non-radioactive testing. Accuracy of the data will be as specified in section 4.2.8.1.1.

4.2.8.1.4 Restricted Substances

Data must be provided to NNWSI to show that the following are not present in the waste form or within the free volume of the canister:

(a) free liquids (section 4.2.1.2)
(b) free gases other than helium, argon, and air (section 4.2.1.3)
(c) gases with total pressure greater than 7 psig (section 4.2.1.3)
(d) explosives in amounts greater than allowed in section 4.2.1.4
(f) pyrophoric, flammable, or oxidizer materials (section 4.2.1.5)
(g) organic materials (section 4.2.1.6).

Data used in complying with these requirements may be obtained using simulated waste forms which are produced according to the reference process flow sheet for the waste form production plant. At least one set of data for each of the above requirements must come from waste forms (simulated) which are produced during the cold trial stage after construction of the production facility. The analytical techniques to be used must include methods which are recognized to be sensitive for determining each of the materials specified above.

4.2.8.1.5 Compatibility

Data must be provided to NNWSI which demonstrates that the canister material is compatible with the waste form. This requirement will be met if the results of an MCC-1 test at 90 degrees C of 28 days duration using either deionized water or site specific water show that the total release of each element in the following list is no more than twice as great in the presence of the canister material as that for the waste form alone. Elements for which data must be given are Na, Si, B, Cs-137, U-238, Tc-99, and Pu.

4.2.8.1.6 Fire Test

The results of a fire test using a canister filled with simulated waste form must be provided to NNWSI. Details of the test are given in section 4.2.1.8.

4.2.8.1.7 Small Particulates

Data must be provided on the chemical composition of the debris, and particle size distribution and total amount of release of waste form from the canister during, and present within the canister after, the following tests:

(a) Drop test (section 4.3.2.7)
(b) Burst strength test (section 4.3.2.6)

4.2.8.1.8 Release Rate Control

The results of testing of actual production samples as specified in section 4.2.5 must be provided by the producer to NNWSI.

4.2.8.1.9 Criticality Control

Data showing that each canister of waste complies with the specifications given in section 4.2.7 which limit fissile nuclide content must be supplied by the producer to the repository. This data may be obtained by either of the methods given in section 4.2.7. Accuracy of the measurements must be sufficient to ensure that the fissile nuclide content is below the stated limit at the 99 percent level of confidence.

4.2.8.2 Physical

4.2.8.2.1 Dimensions

Data must be provided to NNWSI for each finished waste form that gives the geometry and dimensions of the waste form, and an estimate of the fill height of waste form in the canister.

4.2.8.2.2 Density

The density of the finished waste form with an accuracy of 10 percent must be supplied to NNWSI.

4.2.8.2.3 Control of Volatile Substances

Data must be supplied to NNWSI to show that volatile materials will not be released from the waste form at temperatures below 500 degrees C (section 4.2.1.3). Compliance with this specification will require that a sample of waste form containing actual waste, but not necessarily one produced in the final production facility, be tested by heating a crushed sample of the waste form in a closed vial to 500 degrees C and holding at that temperature for 30 minutes. The initial atmosphere in the vial is to be air at a pressure of 1 atmosphere. After cooling to room temperature, the contents of the vial must be analyzed for all components present in amounts greater than 0.1 volume percent. The volume of air in the vial prior to heating may not be greater than the volume of waste form used in the test. The interior surface of the vial after testing must be treated with a 50 percent aqueous solution of nitric acid for 30 minutes at a temperature greater than 50 degrees C to remove any material which might have condensed on the vial. The nitric acid solution must be analyzed for all elements present in amounts greater than 0.01 percent of the initial glass sample weight.

4.2.8.3 Thermal

Data on the following thermal properties of the waste form shall be provided by the producer to NNWSI:

(a) Thermal conductivity and diffusivity as a function of temperature between 25 and 500 degrees C, accurate to plus or minus 5 percent;

(b) Heat capacity as a function of temperature between 25 and 500 degrees C, accurate to plus or minus 5 percent;

(c) Heat generation rate for the finished waste form expressed as watts per canister on the date of shipment to the repository, accurate to plus or minus 5 percent and not to exceed 800 watts (section 4.2.3.2);

(d) Coefficient of thermal expansion for the waste form as a function of temperature between 25 and 500 degrees C, accurate to plus or minus 5 percent.

4.3 CANISTERIZED WASTE FORM SPECIFICATIONS

4.3.1 Chemical

4.3.1.1 Canister Material

The waste form canister shall be fabricated from type 304-L stainless steel . The chemical composition of the steel must comply with the ASTM specification for that material (ANSI/ASTM A-167). The chemical requirements (in weight percent) are Ni = 8.00 - 12.00 %, Cr = 18.00 - 20.00 %, and the following maximum concentrations for specified elements: C, 0.03 %; Mn, 2.00 %; P, 0.045 %; S, 0.03 %; Si, 1.00%.

4.3.2 Physical

4.3.2.1 Weight

The weight of the waste form plus its canister shall not exceed 2700 kilograms.

4.3.2.2 Length

The length of the final canisterized waste form, including any pintle or lifting device, shall not exceed 3.01 meters.

4.3.2.3 Diameter

The outer diameter of the canisterized waste form will nominally be 61 cm, with a minimum wall thickness of 0.95 cm. (See also Section 4.3.2.4)

4.3.2.4 Overall dimensions

The dimensions of the canisterized waste form will be controlled so that at the time of shipment to the repository the canister will stand upright without support and will fit without forcing into a 63.5 cm diameter by 3.01 meter long right circular cylinder.

4.3.2.5 Free Volume

The free volume within the waste form loaded canister will not exceed 30 percent of the total internal volume of the canister prior to loading with the waste form.

4.3.2.6 Burst Strength

The waste form canister, as filled with waste form, shall be capable of withstanding, without breaching, a fire test. Details of the fire test are given in section 4.2.1.8.

4.3.2.7 Drop Test

The waste form canister, as filled with waste form, shall be capable of withstanding a drop of two times the canister length onto an unyielding surface without breach of the canister. The canister shall be oriented during the test so as to create the most severe loading of the canister upon impact with the surface. Proof of compliance with this specification may be accomplished by testing of full sized canisters containing simulated waste forms.

4.3.3 Handling Features

4.3.3.1 Lifting Device

The waste form canister shall have a neck with a lifting flange or have a pintle which is compatible with handling requirements for the shipment of canisterized waste forms to the repository and with the removal of canisters from the shipping cask. The diameter of the lifting device shall not exceed the diameter of the canister.

4.3.4 Thermal

4.3.4.1 Thermal History of the Canister during Fabrication of the Waste Form

OPTIONAL, IF CANISTER WILL BE OVERPACKED BY NNWSI

The thermal history of the canister during waste form fabrication will be monitored. Measurements of temperature of the canister surface that will provide the maximum temperature reached by any portion of the canister are to be taken during actual glass casting operations and the canister temperature as a function of time during casting and subsequent cool down will be monitored. Frequency of temperature measurements during cooling will be one

every 30 minutes. Accuracy of the measurements will be plus or minus 20 Centigrade degrees. Measurements will be made on every waste form canister filled at the production facility.

4.3.5 External Contamination

4.3.5.1 Radioactive Contamination

The external surface of the waste form canister shall not have removable radioactive contamination greater than the following amounts

Alpha	220 disintegrations/minute-100 sq. cm
Beta + Gamma	2200 disintegrations/minute-100 sq. cm

These limits are the same as those given in 10 CFR Part 71.87. The test procedures described in 10 CFR Part 71.87 paragraph i(1) shall be used to show compliance with this specification.

4.3.6 Criticality Control

There are no additional specifications concerning criticality. See section 4.2.7 for criticality control on waste forms.

4.3.7 Properties and Characteristics

The waste form producer will supply to NNWSI data on the following properties and characteristics of the waste form canister and the canisterized waste form.

4.3.7.1 Chemical

4.3.7.1.1 Canister

The chemical composition of the canister material must be supplied to NNWSI. This data may take the form of analytical results on the steel from which the canisters were fabricated. Results must be provided for each heat of steel used for canister fabrication. The data must include the following elements: Fe, C, Mn, P, S, Si, Cr, Ni, and N, and have an accuracy of plus or minus 2 relative percent for elements present in greater than one percent abundance and plus or minus 10 relative percent for elements present in less than one percent abundance. Where elements are present in concentrations that are too low to be measured to the stated accuracy, an upper limit may be

given. In addition, data are required on the maximum amounts of Co, Cu and Mo in the steel.

4.3.7.1.2 Weldments

Chemical composition data for weldments or heat affected zones must be supplied to NNWSI. This data may be obtained by analysis of fabricated canisters containing simulated waste forms that were produced according to the production facility process flow sheet. Data requirements in section 4.3.7.1.1 apply.

4.3.7.1.3 Internal Contamination

Data must be supplied to NNWSI to show that each canister was cleaned to remove internal contamination from organic materials prior to entry into the waste form fabrication facility.

4.3.7.1.4 Radiochemical Contamination

Data must be supplied to NNWSI to document the results of smear tests specified in section 4.3.5.1.

4.3.7.2 Physical

4.3.7.2.1 Weight

Data must be provided to NNWSI to prove that the weight of the canisterized waste form is less than 2700 kg.

4.3.7.2.2 Overall Dimensions

Data must be supplied to NNWSI to show that the canisterized waste form will stand upright without support and will fit without forcing into a 63.5 cm diameter by 301 cm long right circular cylinder.

4.3.7.2.3 Free Volume

An estimate of the free volume in the canister after cooling of the waste form to ambient temperature must be supplied to NNWSI.

4.3.7.2.4 Fire Test Results

Proof that the canisterized waste form meets specification 4.3.2.6 must be supplied to NNWSI. This proof may be supplied in the form of the results of fire testing of canisters of simulated waste processed according to the reference process flow sheet for the waste solidification facility.

4.3.7.2.5 Drop Test Results

Proof that the canisterized waste form meets the specification given in section 4.3.2.7 must be supplied to NNWSI. This proof may be in the form of the results of testing of canisters containing simulated waste forms so long as those canisterized waste forms were produced according to the reference process flow sheet for the facility.

4.3.7.2.6 Canister Fabrication History

OPTIONAL, NOT REQUIRED IF CANISTER WILL BE OVERPACKED BY NNWSI.

Details of the fabrication and welding history of the unfilled canister must be provided to NNWSI, including the number of welds, welding process used, composition of the filler metal (if any), and annealing treatments applied prior to waste form casting.

4.3.7.2.7 Final Closure of Canister

OPTIONAL, NOT REQUIRED IF CANISTER WILL BE OVERPACKED BY NNWSI.

Details of the final weld used to seal the filled canister must be provided to NNWSI, including the current applied, the duration of current application, and the mechanical force applied. This data must be supplied for each canister.

4.3.7.3 Mechanical

4.3.7.3.1 Required Data on Mechanical Properties

The following properties shall be determined for the canister after it has been fully loaded with waste form. These properties may be measured on

canisters that were loaded with simulated waste form, so long as they were filled according to the reference facility process flow sheet. Data are required for canister materials taken from the area above the waste form fill line, for the areas of maximum curvature of the canister surface, and for the regions of the canister that reach the highest temperature during waste form casting operations. Data are required for the canister in the condition immediately following cooling of the waste form, and for the canister following completion of the fire test. Properties for which data are required are:

Tensile strength
Compressive strength
Shear strength
Yield strength
Charpy impact
Elongation

Data may be obtained using any test procedures approved by ASTM. Accuracy required is plus or minus 10 percent.

4.3.7.3.2 Residual Stress

OPTIONAL, NOT REQUIRED IF CANISTER IS TO BE OVERPACKED BY NNWSI.

The mechanical history of stress accumulated by the canister during waste form fabrication operations must be documented, and residual stress existing in the canister material after cooling of the waste form to ambient temperature must be measured.

4.3.7.4 Thermal Data

4.3.7.4.1 Required Thermal Properties Data

Data on the following thermal properties of the canister material as a function of temperature between 25 and 500 degrees C must be supplied to NNWSI: Thermal conductivity, heat capacity, thermal diffusivity, and the coefficient of thermal expansion. The required accuracy is plus or minus 5

percent. Results of tests made using samples of canister materials taken from canisters filled with simulated waste forms that have been processed according to the reference process flow sheet for the facility will be acceptable in meeting this specification.

4.3.7.4.2 Thermal History Data

OPTIONAL, NOT REQUIRED IF CANISTER IS TO BE OVERPACKED BY NNWSI.

The thermal history of the canister during original fabrication must be documented, including all welding and annealing stages. The thermal history of the canister during waste form filling and cooling operations must be documented according to the specifications given in section 4.3.4.1.

4.4 IDENTIFICATION, LABELING, AND DOCUMENTATION

4.4.1 Identification

The waste form producer shall assign an alphanumeric code to each waste form canister which is produced. This alphanumeric code will appear on the label and on all documentation related to the waste form and canisterized waste form.

4.4.2 Labeling

Each waste canister produced will be labeled with the identification code specified above. The label will consist of a stamping or engraving on the side surface of the flange. The minimum depth for the stamping or engraving will be (to be determined). The identification code will contain characters which are at least 3 cm in minimum dimension within the plane of the label.

4.4.3 Documentation

Prior to shipment, the waste form producer will provide to NNWSI the following documentation:

(1) Name of waste form producer;
(2) Data required under section 4.2.8;
(3) Data required under section 4.3.7;

(4) Data required to show compliance with any other specifications not covered by the data supplied above;

(5) An explicit statement of any deviations from the reference process flow sheet that occurred during production of the waste form;

(6) Date of production of the waste form;

(7) History of storage conditions for the canisterized waste form between fabrication and scheduled time of shipment to the repository.

Prior to shipment, this documentation will be reviewed by authorized personnel at the repository operations office to confirm that the product is in compliance with the specifications given in this document. When compliance is confirmed, the repository management will notify the producer that shipment to the repository may take place. See section 6 for further details.

4.4 WASTE FORMS AND CANISTERIZED WASTE FORMS THAT ARE NOT IN COMPLIANCE WITH THESE SPECIFICATIONS.

Waste forms and canisterized waste forms that are not in compliance with these specifications will not, in general, be accepted by the repository for disposal. Exceptions to these specifications will be allowed for all optional specifications, provided that the producer realizes that it will be necessary for NNWSI to overpack canisterized waste forms which do not conform to those specifications. Specification 4.3.2.5 (limitations on the free volume in the canister) may be waived at the discretion of NNWSI, if an application for a waiver is received from the waste form producer. For specifications that involve periodic testing of actual production samples, all finished waste forms produced between the time of the last satisfactory test and the first unsatisfactory result will be deemed to be within specification unless there is evidence to the contrary.

5.0 QUALITY ASSURANCE PROGRAM

5.1 ORGANIZATION

The waste form producer shall establish, maintain, and execute a quality assurance program for waste form production, canisterizing the waste form, and preparing it for shipment to the repository. The quality assurance program shall be established in accordance with 10 CFR 50, Appendix B and as defined by ANSI/ASME NQA-1 and latest addenda.

5.2 QUALITY ASSURANCE PROGRAM

A quality assurance program in accordance with ANSI/ASME NQA-1 shall be established by the waste form producer. The quality assurance program shall identify the activities and requirements to which it applies, assign responsibility for activities, and shall provide a documented record of the compliance with the requirements of the waste acceptance specifications. The producer's records and facilities applicable to the certification program shall be subject to audit, surveillance, and approval by the repository's Quality Assurance organization or designated representative, both of whom shall have right of access to the producer's plant(s) at all reasonable times.

5.3 QUALITY ASSURANCE PLAN (QA PLAN)

The producer shall provide a written QA plan indicating the structures, systems, components or services to be covered by the Quality Assurance Program for the waste form certification activities. The major organizations participating in the program, together with the designated function of these organizations, shall also be defined. The methods that the producer will use to judge compliance with the requirements of the waste acceptance specification shall be noted in the QA plan. The QA plan must be approved by the appropriate repository personnel prior to the start of any activity subject to the QA plan.

5.4 DATA COLLECTION AND ARCHIVING

Data collection and archiving of backup certification documentation shall be maintained by the waste form producers for at least fifty years after the waste material is shipped to the repository. The control of this documentation shall be described in the QUALITY ASSURANCE PLAN. Records shall be marked so they can be identified as corresponding to the specific waste canisters that are shipped and received. The documentation of the certification of waste acceptance shall be forwarded, along with all the records pertaining to the requested/approved waste form disposal, to the repository system for retention. Document transfer will take place prior to shipment of the waste canisters covered by the documents. Retention by the producer of duplicate documentation on the certification and requests and approvals to ship shall be specified in the QUALITY ASSURANCE PLAN of both the shipper and receiver.

5.5 CERTIFICATION METHODS

The following section 5.5.1 Certification Methods--Waste form and Canisterized Waste Form, presents the acceptable methods for certifying that the waste form and the as-canisterized waste form are in compliance with the acceptance specifications given in Section 4. The method specified in Section 5.5.1 will be used by the repository management to evaluate applications for permission to ship waste to the repository. The only exceptions to the certification method presented in Section 5.5.1 will be (1) where an alternative certification method(s) is proposed to and approved by the repository management or (2) where the repository management has agreed to a proposed waiver (not to be for reasons of nonconformance with the specifications) of all or part of a given waste acceptance specification and/or its corresponding certification method. Such waivers as noted in Item (2) will be considered by the repository management only on a case-by-case basis. See Section 5.6 for discussion of Nonconformance with the Waste Acceptance Specifications.

5.5.1 Certification Methods -- Waste Form and Canisterizer Waste Form

The repository management will examine the documents supplied by the producer that are specified in Section 4.4.3 to determine whether the data requirements have been met by the producer and whether the waste form and canisterized waste form meet the product specifications given in Section 4. If, in the opinion of the repository management, the documentation is complete and the product meets the specifications, a Certificate of Conformance will be sent to the producer. The Certificate of Conformance will specify the unique identification code each certified canister. The producer may arrange for shipment of the waste to the repository after receipt of the Certificate of Conformance. A copy of the certificate must accompany the shipment.

5.6 NONCONFORMANCE WITH THE WASTE ACCEPTANCE REQUIREMENTS

Waste forms and containers that do not meet all of the requirements of this document shall not be shipped to the receiver without prior written approval by the repository management, subject to the limits on nonconformance for the operating license for the repository system. The documented request for approval shall describe the nonconformity, its cause, and what measures will be taken to prevent a recurrence. The request for approval shall be accompanied by permission for the repository Quality Assurance representative or designated representative to visit the waste form generator's plant to verify, if the repository management system believes this is needed, the extent of nonconformance. In cases where the waste form and/or container, upon arrival at the repository, are found to be in nonconformance with the requirements described herein the repository management may, at its discretion, return the waste shipment to the waste form producer at the producer's expense, or arbitrate a special fee and agreement to dispose of the waste in the condition in which it was received.

6.0 PREPARATION FOR SHIPPING

6.1 GENERAL REQUIREMENTS

6.1.1 Compliance with Other Packaging and Transportation Requirements It shall be the shipper's responsibility to be in compliance with the Federal regulations governing the packaging and transportation of materials (e.g., 10 CFR 171 and 49 CFR 173) that are applicable but were not listed as specific waste acceptance specifications in this document.

6.1.2 Permission to Ship Waste form material shall not be shipped to the receiver without submitting a written request to the receiver and obtaining written approval in the form of Certificates of Conformance (Section 5.5.1) from the receiver to initiate the shipment.

6.1.3 Shipment The delivery date, mode of transportation and place of receiving shall be arranged and agreed to in writing by both the waste form shipper and the receiver prior to the shipment leaving the shipper's facilities.

6.1.4 Administrative Procedures The waste form shipper shall establish as per approval by the receiver procedures to coordinate shipping activities and responsibilities.

7.0 NOTES

7.1 DEFINITIONS

Definitions applicable to these specifications are as follows:

Administrative Controls - A general or specific management directive designed to ensure the health and safety of the public and employees, protection of property and an acceptable product.

Approved Containers - Containers that are certified by the producer as meeting applicable requirements of 49 CFR 173, interim storage site requirements, and other requirements provided in the Waste Acceptance Specifications.

Barrier - Feature of waste disposal system that acts either to limit or preclude radionuclide release or transport.

Canister - The metal container into which waste glass is poured during glass fabrication.

Canisterized Waste Form - Canister and contents including waste form.

Certification - The act of verifying and attesting in writing to the qualifications of personnel, processes, procedures, or items in accordance with specified requirements.

Certificate of Conformance - A document signed by an authorized individual certifying the degree to which items or services meet specified requirements.

Combustible - Any material that will sustain combustion in atmospheric air when exposed to an ignition source at 80°C (147°F) for a period of five minutes.

Commercial High-Level Waste (CHLW) - High-level radioactive waste generated in private industrial and other nongovernment facilities; principally waste generated in power reactors and, if involved, its subsequent reprocessing.

Compressed Gas - Any gas which is exerting a pressure on the container greater than 7 psig.

Container - The external containment vessel for the waste form that will provide a containment function after emplacement in the repository.

Container Breach - A release rate from a container of greater than 10^{-5} cc (gas)/sec. Conditions of the release rate are defined as dry air at 25°C with a pressure differential of one atmosphere between the inside and outside of the container.

Credible Accident - Plausible but highly improbable incident in which applied loads may substantially exceed those encountered in a design basis accident.

Criteria - A set of guidelines or standards (usually qualitative) that state the necessary quality, functions, or performance of a device or system.

Design Basis Accident - Extreme thermal and/or mechanical load conditions assumed as a basis for design of a system and/or its components.

High-Level Radioactive Wastes - As used by NRC (1983) it applies to (1) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, in a facility for reprocessing irradiated spent nuclear fuels, (2) the concentrated wastes from subsequent extraction cycles or equivalent, (3) solids derived from such wastes, and (4) spent nuclear fuel if disposed of without reprocessing.

Mined Geologic Disposal System - A waste management system in which radioactive waste is emplaced in cavities excavated deep in a stable geologic formation.

Multibarrier System - A succession of barriers, which act to limit or preclude radionuclide release or transport.

Natural Barrier - The portions of the geological environment whose physical, mechanical, chemical, and hydrological characteristics, individually or collectively, act to limit radionuclide release or transport.

Nonconformance - A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate.

Overpack - A container placed over a canisterized waste form.

Packing Material - Barrier material that surrounds the waste package components providing control of radionuclide release from the waste. It may differ in composition and function from repository backfill but must be compatible with and support the function of the repository backfill.

Performance Criterion - A criterion establishing the required performance of a a system or subsystem and qualitative operational, safety, or environmental limits.

Qualified Procedure - An approved procedure that has been demonstrated to meet the specified requirements for its intended purpose.

Quality - The properties or characteristics constituting those requisites of specifications, codes, standards, industrial practices, other recognized methods, and/or acceptance criteria by which an item is judged.

Quality Assurance - All those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily and meet specified requirements. When the end product is a report, quality assurance includes all those planned and systematic actions necessary to provide confidence in the validity and integrity of the reported data, methods, or processes and to assure the protection and retrievability of the data.

Quality Assurance Plan - A document which identifies the requirements, judiciously selected from the overall Quality Assurance Program, that are applicable to a particular program or project, and provides an index or a description of the procedures that implement these and any necessary supplementary requirements. The document also includes specific responsibilities and authorities for the implementation of the Quality Assurance Plan.

Quality Assurance Program - The generic plans and procedures, and the implementation thereof, established at the producer's plant or site to meet the requirements of the Waste Acceptance Specifications.

Quality Assurance Record - A completed document that furnishes evidence of the quality of items and/or activities affecting certification.

Repository System - The configuration of man-made features designed to provide for receipt, inspection, handling, emplacement, and potential retrieval of nuclear wastes during the operating phase and to act with the included natural system to provide long-term containment and isolation of nuclear wastes.

Retrievability - The ability to remove nuclear waste from its position of emplacement in the repository using planned engineering procedures.

Site - The place, both at and below the surface, where the repository and ancillary facilities are constructed, including the surrounding controlled zone.

Specification - A set of detailed statements (usually quantitative) that serve as the final basis for guiding the fabrication of a device or system, and for judging whether the quality and performance are acceptable.

Spent Fuel - Irradiated reactor fuel that has been used to the extent that it can no longer be efficiently used in a nuclear reactor.

Testing - The determination of the capability of an item to meet specified requirements by subjecting the item to a set of physical, chemical, environmental, or operating conditions.

Traceability - The ability to trace the history, application, or location of an item and like items or activities by means of recorded identification.

Verification - The act of reviewing, inspecting, testing, checking, auditing, or otherwise determining and documenting whether items, processes, services, or documents conform to specified requirements.

Waste Form - Radioactive waste, in either treated or untreated condition, including any inerts, binders, or stabilizers.

Waste Management - The range of activities for dealing with radioactive waste including generation, treatment, packaging, storage, transportation, and disposal.

Waste Package - The waste form and envelope of all materials that separate the waste either from the host rock when emplacement occurs in a borehole or from the room backfill when emplacement occurs in a disposal room or drift. There have been various applications of the term waste package, such as a package containing waste that is received at the repository for disposal--(here called canisterized waste) or to the package as emplaced in the repository. In this document, the latter usage is applied to the waste package.

8.0 DATA SUBMITTAL REQUIREMENTS

8.1 GENERAL REQUIREMENTS

The waste form producer will supply to the repository all documents specified in 4.4.3. The format for these documents will be standardized. These documents will be sent to the repository prior to shipment of the canisterized waste form and will be examined by the repository management to determine whether the proposed waste shipment meets the specifications given in this document. If, in the opinion of the repository, the proposed shipment is within the requirements of this document, a Certificate of Conformance will be issued to the producer.

Data concerning projected rates of shipment for the waste form producer will be supplied to the repository every six months. Should the expected rate of production exceed the rate at which the repository staff can receive shipments of that waste type, the repository management will inform the producer that some delay in shipment authorization is likely to occur.

Additional data requirements for proposed shipments which are found not to be in conformance with the product specifications given in this document will be provided on a case by case basis.

APPENDIX A

BASIS AND RATIONALE FOR PRODUCT SPECIFICATIONS AND DATA REQUIREMENTS

A4.2 WASTE FORM SPECIFICATIONS-DEFENSE WASTE PROCESSING FACILITY AND WEST VALLEY DEMONSTRATION PROJECT

Note: Section numbers in this appendix correspond to section numbers in Section 4.

A4.2.1 Chemical

A4.2.1.1 Waste Form Matrix. For purposes of this document, the U.S. Department of Energy (DOE) instructed the Nevada Nuclear Waste Storage Investigations Project (NNWSI) to assume that the present reference waste form for DWPF and for West Valley is a borosilicate glass. The above assumption as to the reference waste form is consistent with the Nuclear Regulatory Commission (NRC) criterion (10 CFR 60) that the waste form must be a solid.

A4.2.1.2 Free Liquids. The specification that the waste form(s) not contain free liquids is based on the following concerns:

1. That such free liquid(s) could be an easily dispersable medium
2. That such free liquid(s) could contribute to pressurizing the canister
3. That such free liquid(s) could become separated from the glass either through their corrosive nature, or through the design range of post-fabrication processes for canisterized waste form
4. That such free liquid(s) could be a corrosive medium within the waste form canister and contribute to breach of the container.

This requirement is in keeping with and goes beyond the NRC criterion that the waste form contain no free liquids (10 CFR 60.135b(2)).

A4.2.1.3 Gases. The basis and rationale for requiring that the waste form(s) not contain free gases, other than helium, argon, and air, are the concerns that free gases, other than those noted, could result in a corrosive medium. Such free gases could also contribute to pressurizing the canister and significantly contribute to breach of the container and dispersion of radionuclide containing material. (See also the concerns (1) through (3) noted in A4.2.1.2 for Free Liquids.)

A4.2.1.4 Explosives. The specification that the waste form(s) not contain explosive materials, as defined by 49 CFR 173, Subparts C and G, is based on the concern that such explosives could significantly contribute to the breach of the container and, thus, endanger operating personnel, and the concern of preventing exposure of operating personnel and the public to the radionuclides in the waste form. This requirement is consistent with the NRC criteria that the waste form be nonexplosive and noncombustible (10 CFR 60.135b(1)).

A4.2.1.5 Pyrophoric Materials. The specification that the waste form(s) not contain pyrophoric materials (49 CFR 173, Subpart E) is based on the concerns that they could contribute to the breach of the container, and the objective of preventing exposure of the operating personnel and the public to the radionuclides in the waste form. This requirement is consistent with the NRC criteria that the waste form be nonpyrophoric and noncombustible (10 CFR 60.135b(1)).

A4.2.1.1 Organic Materials. The specification that the waste form(s) for DHLW and that the internal free volume in the canisters not contain organic materials is based on the following:

1. The concern that organics could contribute to the formation of complexes, polymers, colloids, etc.
2. That such complexes, polymers, colloids, etc. could incorporate radionuclides released from the waste form and thus increase the mobility of the radionuclides.

3. That the presence of organic materials would increase the release of radionuclides from the waste form.

The formation of such complexes, etc. could seriously complicate the geochemistry of the waste package, host rock, and water environment both with respect to radionuclide transport and to subsequent reactions that could involve the radionuclides, (DOE/RL 82-3, 1982; Early et al., 1982; McVay and Buckwalter, 1983; Oloffsson et al., 1982; Champ et al., 1982).

A4.2.1.7 Chemical Compatibility. The specification that the waste form(s) be chemically compatible with the canister and any additional material included within the internal volume of the canister is based on the following concerns:

1. That the waste form could significantly contribute to breach of the container through a corrosion process.
2. That the waste form could react with the canister and/or any additional material present (e.g., filler material added to reduce the free volume within the container) to form gases or corrosive agents that could contribute to breach of the container.
3. That the products formed by corrosion of the canister might increase the mobility of radionuclides in the post-containment period.

A4.2.1.8 Waste Form Degradation by Fire. The specification that the waste form(s) be capable of withstanding exposure to fire at the surface of the canister is based on the following:

1. The concern that a fire could result from an accident involving combustible materials prior to, during, or after receipt, at the repository system.
2. The concern that the waste form should not significantly contribute to failure of the container under such accident conditions involving fire.

3. The concern that the chemical performance of the waste form(s) not be adversely affected, namely the requirements on Radionuclide Release.

The specific conditions of the fire are taken from the Federal Regulations (10 CFR 71) on the transportation of nuclear materials.

Although it is recognized that the time duration and conditions of the fire test are likely to represent extreme conditions, it is felt that they provide appropriately conservative conditions with respect to a specification on waste form degradation by a hypothetical fire accident.

A4.2.2 Physical

A4.2.2.1 Particle Size and Fractions. The specification which limits amount(s) of waste form per canister that exists in particle sizes less than 200 microns in equivalent sphere diameter and particle sizes less than 10 microns in equivalent sphere diameter are based upon the following concerns:

1. That the canister could be accidentally breached (e.g., see the requirement on Drop Test for canisterized waste form) during transportation, handling, or the operational period of the repository,
2. That if the canister were breached as noted in Item 1, the waste form, as present in the form of particulates, could be easily dispersed and, thus, present a personnel hazard and a problem with respect to isolation performance of the repository system, if it were involved in the incident,
3. That the particle sizes below 200 microns in equivalent sphere diameter are considered to represent a significant dispersal hazard (10 CFR 20, 30 CFR 57, OSHA regulations),
4. That the particle sizes below 10 microns in equivalent sphere diameter are considered to represent a significant inhalation hazard (10 CFR 20, 30 CFR 57, and OSHA regulations).

The specific limits for the allowable quantities of particles in these size ranges will be specified when the final waste acceptance specifications document(s) is drafted. The limits (to be determined) will be based upon assessment of the effects and consequences associated with these ranges of particles if composed of waste form containing the respective types of high level waste.

A4.2.3 Thermal.

A4.2.3.1 Peak Temperature. The specification that the borosilicate glass waste form not exceed 500°C at any position within the canisterized waste form once the fabrication process is completed, is based upon the following concerns:

1. That the kinetics of the devitrification process within the glass waste form would be unacceptably fast at higher temperatures,
2. That the devitrification would result in a structural breakdown of the monolithic character of the waste form,
3. That this resultant structural breakdown of the waste form could compromise other requirements on the waste form (e.g., Particle Sizes and Fractions--see the discussion in A4.2.2.1, or Radionuclide Release--see the discussion in A4.2.5).

A4.2.3.2 Peak Thermal Load. The specification that the waste form shall not exceed a decay heat generation rate for the final waste form and canister design of 800 watts per waste form loaded canister is based upon the following concerns:

1. That the thermal load limits assumed in the transportation of the waste form (canisterized) to the repository system are not violated nor violate the limits imposed by the U.S. Department of Transportation (DOT) regulations (10 CFR 71 and 49 CFR 173),
2. That the thermal load limits assumed in reference design of the repository system (i.e., surface and below ground facilities) are not violated,
3. That the thermal inventory limits are consistent with the waste form requirements on Peak Temperature.

A4.2.4 Radionuclide Inventory

A4.2.4.1 General Inventory. The specification that the glass waste form shall not exceed 1000 curies of fission products nor 200 curies of actinides per liter of glass is based on the following concerns:

1. To place some limitations upon the exposure of the waste form and other components of the waste package to ionizing radiation,
2. To provide an upper limit relative to design considerations of the transportation, handling, interim storage, and repository system operations.

The specific limits on curies of fission products and on curies of actinides per liter of glass are set at levels which are substantially higher than those which would be consistent with a thermal limit of 800 watts per canister. This has been done to allow for inhomogeneity of fission product and actinide distribution in the waste form.

A4.2.4.2 Specific Inventory. The specifications for data that characterize the specific inventory of the radionuclides for the total production lifetime of the producer and the inventory for these same radionuclides as present in the actual waste form(s) are based on the need for such source term information to assist in the following:

(1) Certification that the limits on total radioactivity (4.2.4.1) and fissile nuclides (4.2.7.1) have not been exceeded.
(2) Determination of the amount of each radionuclide which will be present in the repository during the operational period and at the end of the containment period.
(3) Calculation of the fractional release rate of radionuclides during the post-containment period.

Data on projected total inventories of radionuclides are needed to assist in repository design. Data on radionuclide content for actual production of waste forms are needed in order to interpret the results of tests required under section 4.2.5.1.

A4.2.5 Radionuclide Release. The NRC regulation 10 CFR 60 states that "the engineered barrier system shall be designed, assuming anticipated processes and events, so that: ...[B] The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; ..." The hydrogeologic setting of the NNWSI repository, and the engineering design of the repository, will limit the amount of water that can contact the waste form, and will ensure that the temperature of any liquid water under anticipated unsaturated zone conditions will be less than 95°C.

The standard waste form test MCC-1 (Materials Characterization Center, 1982) conducted at 90°C will produce data at a temperature near the maximum liquid water temperature expected in the repository. The NNWSI waste form testing task will establish the relationship between the results of the MCC-1 test and the release rate for the waste form in the repository. Preliminary calculations based on the expected composition of the water in the repository horizon, the expected flow rate of water and volume of water per waste container, and the solubility limits of silica at 90°C indicate that a borosilicate glass waste form that meets the specification given in section 4.2.5.1 will have an annual release rate in the repository which is close to the NRC release rate limit of 1 part in 100,000 per year of the radionuclide inventory present 1000 years after closure.

A4.2.6 Properties Affecting Radionuclide Release

A4.2.6.1 Chemical Homogeneity. The specification on the monitoring of the waste form chemical homogeneity is based upon the concern

that the constituents (i.e., radioisotopes and associated compositional phases) would become segregated within the waste form during the fabrication process and not be represented by samples used to certify compliance with the following requirements:

1. Radionuclide Release (see A4.2.5).
2. Peak Temperature (see A4.2.3.1).
3. Peak Thermal Load (see A4.2.3.2).
4. Criticality (see A4.2.7).

The limit of ± 5 relative percent was selected as a reasonable limit of variations in chemical composition of finished product to allow prediction of product performance based on prior laboratory testing of waste forms.

A4.2.6.2 Chemical and Physical Stability. The basis for this specification is to ensure that there is no unacceptable degradation of the waste form during the containment period.

A4.2.7 Criticality. The specification which limits the content of fissile nuclides in the waste form to not exceed 6 milligrams per cubic centimeter will ensure that the effective neutron multiplication factor, K_{eff}, is less than 0.95 for all conceivable scenarios.

A4.2.8 Properties and Characteristics

A4.2.8.1 Chemical. This section of the specification (section 4.2.8.1.1) provides a reiteration of the chemical specifications for the waste form and a list of data requirements to show that the specifications have been met. The general purpose of the data requirements is to ensure that simulated waste forms used to show compliance with specifications are representative of the expected product of actual waste form production, and that the actual output of the waste form producer is sufficiently well characterized to allow NNWSI to predict performance of the waste form in the repository.

A4.2.8.2 Physical. The physical properties data required are needed to

(1) Design the handling equipment for the repository.
(2) Ensure that the health and safety of repository workers and the general public are protected under both normal and accident situations.

A4.2.8.3 Thermal. The thermal properties data specified are required in order to

(1) Calculate the temperature of the waste form as a function of time.
(2) Predict the extent of devitrification which occurred during post-casting cooling of the glass.
(3) Predict the extent of devitrification of the glass during the containment period.

A4.3 CANISTERIZED WASTE FORM SPECIFICATIONS

A4.3.1 Chemical

A4.3.1.1 Canister Material. This specification corresponds to the reference canister material for the DWPF (Baxter). It is the reference disposal container material for NNWSI.

A4.3.2 Physical

A4.3.2.1 Weight. This specification is to ensure that the waste loaded canister is compatible with NNWSI handling and emplacement equipment.

A4.3.2.2 Length. As for A4.3.2.1

A4.3.2.3 Diameter. As for A4.3.2.1.

A4.3.2.4 Overall Dimensions. As for A4.3.2.1

A4.3.2.5 Free Volume. This specification is to ensure that space allocated in the repository will be economically used, and to allow calculation of the water volume which might be able to accumulate inside the canister following breach.

A4.3.2.6 Burst Strength. The specification on burst strength of the waste form canister was established to place minimum performance limits on the ability of the container to survive, without breaching (ANSI-N14.5) an accident involving a fire.

A4.3.2.7 Drop Test. The specification for a drop test of the canisterized waste form was established to ensure the ability of the filled canister to withstand a mechanical impact in the type of accident situation which might occur during handling or transportation of the canisterized waste form.

A4.3.3 Handling Features. The specification concerning handling features is included to ensure compatibility of the canisters with NNWSI repository equipment.

A4.3.4 Thermal. The specification which requires that the surface temperature of the canister be monitored during glass casting and subsequent cool down arises from the plan to dispose of glass waste form canisters without adding another container or overpack. The 304L steel is subject to sensitization under certain time-temperature scenarios. Sensitized steel would be more susceptible to specialized corrosion mechanisms than non-sensitized steel. The time-temperature data required in section 4.3.4.1 will allow NNWSI to judge whether sensitization of the steel has occurred.

A4.3.5 External Contamination

A4.3.5.1- Radioactive Contamination. The requirement on removable radioactive contamination of the external surfaces of the waste form canisters is based primarily on concern that the receiving and handling facilities (hot cells) of the repository system's surface facilities might become unacceptably contaminated.

The upper limits that are proposed for the removable radioactive contamination on the external surfaces of canisters received at the repository are the same as those specified by the Federal Regulation 10 CFR Part 71.87.

A4.3.6 Criticality. The control provided under specification 4.2.7 will ensure that no conceivable configuration of canisterized waste forms will have a neutron multiplication factor which is greater than 0.95.

A4.3.7 Properties and Characteristics. Data required by this specification are needed to show (1) that the canisterized waste form will be safe to handle during repository operations, and (2) to determine whether the canister is suitable for use as the final disposal container without overpacking.

A4.3.7.1 Chemical. The chemical composition of the 304L stainless steel will affect its susceptibility to specialized and localized corrosion mechanisms. This will be especially important in heat affected zones and weldments. These chemical data are needed so that NNWSI can predict the lifetime without breaching of the container in the repository. Even if an overpack is used on the canister, these data will be needed to ensure compatibility of the overpack with the canister material.

A4.3.7.2 Physical. These data requirements are a summation of items discussed in section A4.3.2, plus two items which relate to data needed if the canister is not to be overpacked.

A4.3.7.3 Mechanical. These data are required in order to determine

(1) Behavior of the canister during repository handling operations.
(2) Behavior of the canister during repository emplacement operations.
(3) Behavior of the canister in response to stress conditions arising during the containment period.

A4.3.7.4 Thermal. These data are needed in order to calculate the thermal history of the canisterized waste after disposal, and to address concerns discussed in sections A4.3.4 and A4.3.7.1.

A4.4 Identification, Labeling and Documentation. These specifications are included to ensure that each waste form canister can be uniquely identified and related to a data package which describes the contents and history of the canister.

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