See pocket 1 for encl.

Department of Energy
Washington, DC 20585

APR 16 1986

Mr. Robert E. Browning
Director, Division of Waste Management
Mail Stop 623-SS
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Browning:

The Waste Acceptance Process (WAP), which formalizes the waste acceptance activities within the Office of Civilian Radioactive Waste Management (OCRWM), was submitted to your office on August 19, 1985 for review and comment. A copy of the WAP is provided as Attachment (A). Subsequently, we received your letter of December 16, 1985 which recommended a meeting to discuss the WAP in further detail and establish a mechanism for NRC involvement early in the process.

As previously discussed with Mr. William Lilley of your staff, the Waste Acceptance Preliminary Specifications (WAPS) for the Defense Waste Processing Facility (DWPF) and the West Valley Demonstration Project (WVDP) have been drafted and should provide an excellent basis to initiate discussions with the NRC on acceptance specifications for these high level waste forms. The WAPS address the current regulatory and handling requirements for acceptance at any of the proposed candidate repository sites and will be updated to include additional OCRWM system requirements (e.g. transportation) in the near future. The DWPF and WVDP specifications have been provided as attachments (B) and (C), respectively, for your information and review.

We propose to host a meeting with your staff on May 8, 1986 to discuss the DOE waste acceptance process, the WAPS for DWPF and WVDP, and possible future interactions with the NRC. We have also prepared a suggested agenda for the meeting. A copy is attached for your consideration (Attachment D). Please let us know as soon as possible concerning our proposed date and agenda for the meeting. To ensure a focused and well considered discussion on the major points, we request that informal written comments be provided to Mark Frei of my staff one week prior to the meeting. I believe this approach will allow both agencies to be as well prepared as possible and thus ensure a productive interchange.

If you have any questions on this matter, please contact Ralph Stein or Mark Frei on 252-5355.

Sincerely,

William J. Purcell
Associate Director for
Geologic Repositories
Office of Civilian Radioactive
Waste Management

Attachments

Rec'd 4/21/86 with letter of 4/16/86 to RE Browning 109.1

ATTACHMENT A

DESCRIPTION OF THE WASTE ACCEPTANCE PROCESS

Introduction

Geologic repositories for disposal of high level nuclear wastes are required to be licensed by the NRC. Requirements for licensing are contained in 10CFR60 which sets specific performance requirements on the waste package and on the engineered barrier system. Draft EPA regulation 40CFR191 sets requirements on the cumulative release of radionuclides to the accessible environment from the repository system. As a subelement of the waste package, the engineered barrier system, and the overall repository system, the waste form plays a role in satisfying these regulatory requirements, and consequently, the regulatory requirements result in derivative requirements on the waste forms and indicate the need for waste form specifications and tests to demonstrate compliance. A waste form which cannot be shown to be in compliance with regulatory requirements with reasonable assurance will not be acceptable for disposal in a geologic repository. Thus, waste acceptance is intimately and inseparably related to repository licensing.

The Waste Acceptance Process has been developed to outline the documentation and activities required to ensure that waste forms, other than spent fuel, will be acceptable at any of the potential repositories. The motivations behind the development of the process are the waste sources other than spent fuel, and the complexity of developing and qualifying waste forms on a schedule that, in some cases, has repository site selection and licensing subsequent to initial waste form production.

The attached time line schedule shows that both high-level waste from the West Valley Demonstration Project (WVDP) and defense waste from the Defense Waste Processing Facility (DWPF) will be under production before the repository site is selected. The importance of this is that waste form performance requirements cannot be considered final until the NRC issues a license. This will not occur until several years after the site is selected for the repository, and the repository license application, which will include waste form performance requirements, is submitted to and approved by the NRC. Thus, in some cases, significant quantities of waste forms are likely to be produced prior to final assurance of their acceptability for disposal. In view of the potential problems that could arise as a result of the forecasted production schedule the preliminary Waste Acceptance Specifications for WVDP and DWPF will be provided to the NRC for review prior to their issuance.

The DOE has legislated and contractual obligations to accept for disposal commercial high-level waste from possible future reprocessing of spent fuel, commercial TRU wastes, and wastes from other defense-related sources. In the cases of the WVDP and DWPF, the production processes are well developed. Each of the repository projects has prepared a draft Waste Acceptance Specification for the DWPF wastes. In regard to WVDP, NNWSI has identified the same set of specifications for WVDP as was identified for the DWPF wastes; however, BWIP and SRPO have issued specifications for CHLW wastes but these exclude the WVDP wastes. Other producers, such as Hanford and the Idaho National Engineering Laboratory, are at intermediate stages in the selection and development of waste forms. Use of the WAS's prepared for WVDP and DWPF may be inappropriate for waste forms of potentially diverse compositions and configurations. Although no domestic commercial spent fuel reprocessing venture is currently planned, the DOE is required by its contract with nuclear utilities (10 CFR 961, Appendix E, Subpart D) to identify requirements for acceptance of a

commercial high-level waste form at the time of submittal of the license application for the first repository to the NRC. Thus, there is a need for the OCRWM to provide guidance to waste producers in the early stages of the development of waste forms, as well as to those with fairly well-defined waste form characteristics. There is also a need for the waste producers to identify and provide the required documentation and information on the waste form that will assure acceptance of the waste at a repository. A key element of this process is to provide consistent and cohesive acceptance requirements for high-level waste forms which ensure compatibility of the waste forms with each of the candidate repository sites, while satisfying the data requirements of the licensing process.

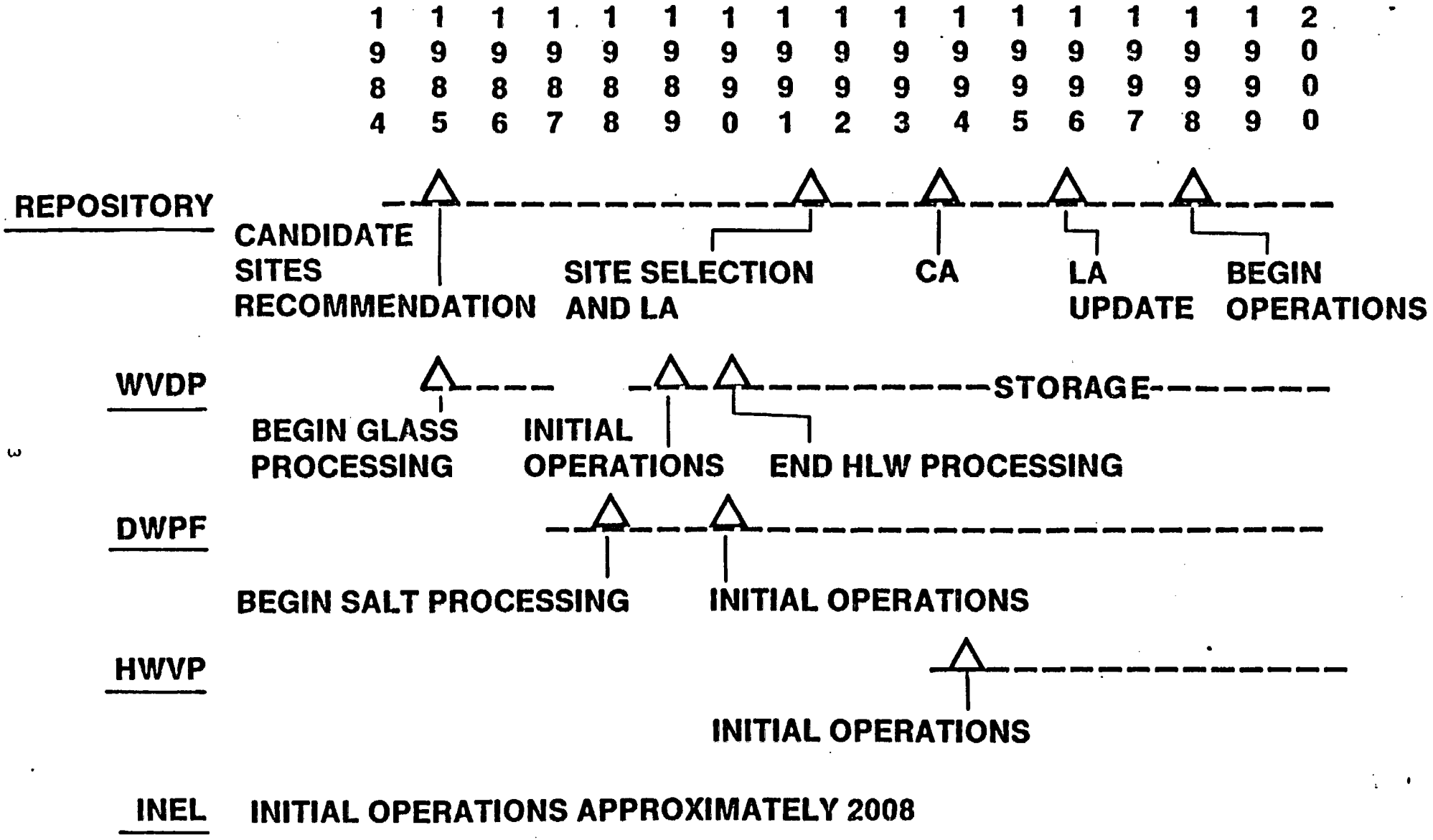
WAP Description

With reference to the attached conceptual diagram of the Waste Acceptance Process, Step 1 refers to a site-specific, generic waste form, waste acceptance requirements* document (SS-GWF WAR). In this document, each repository project would identify requirements for an unspecified waste form for its candidate site. Topics considered in developing the SS-GWF WAR would include regulatory constraints and limitations created by the host geologic environment and repository design. Examples of such limitations might be rock thermal limits or waste form solubility. The dashed lines in the diagram for Step 1 indicate that actual issuance of SS-GWF WAR's is not necessary but that identification of WAR by each project must be completed for use in Step 2.

The multiple SS-GWF WAR's will be combined into a single generic site, generic waste form, waste acceptance requirements* document (GS-GWF WAR, Step 2). The contents of this document would envelope the requirements of the SS-GWF WAR's, with some parallel site-specific requirements. The purpose of this GS-GWF WAR would be to provide uniform early guidance (prior to development of waste acceptance specifications) to future high-level waste producers on the minimum requirements for a waste form for it to be acceptable at any of the candidate repository sites. This document would be the vehicle for compliance with the 10 CFR 961, Appendix E, Subpart D requirement for identification of the minimum requirements for a CHLW form. It would also provide guidance for selection of waste forms to such potential generators as INEL and for the determination of processing activities required for such miscellaneous waste forms as HTGR fuel, TMI rubble, etc. It will also provide requirements for an acceptable TRU waste form (if disposal is required in a repository). It is highly desirable to develop the GS-GWF WAR to a quality sufficient for inclusion in the license application as the basis for accepting future waste forms for repository disposal without further regulatory review. This may not be practicable, and it may be necessary to present some lower level, more specific document such as the WAS to serve this function.

Using the GS-GWF WAR, the waste form producers would prepare a Waste Form Description (generic site, specific waste form, Step 3). This WFD would be the waste form producers proposal for meeting the requirement of the

* Waste Acceptance Requirements - A compilation of generally applicable criteria which specify the minimum conditions for acceptability of a waste form at one (specific-site) or all (generic-site) repository sites. The requirements will include identification of repository environmental conditions, constraints imposed by the geologic media, packaging and handling limitations, regulatory requirements, and minimum levels of acceptable performance for candidate waste forms.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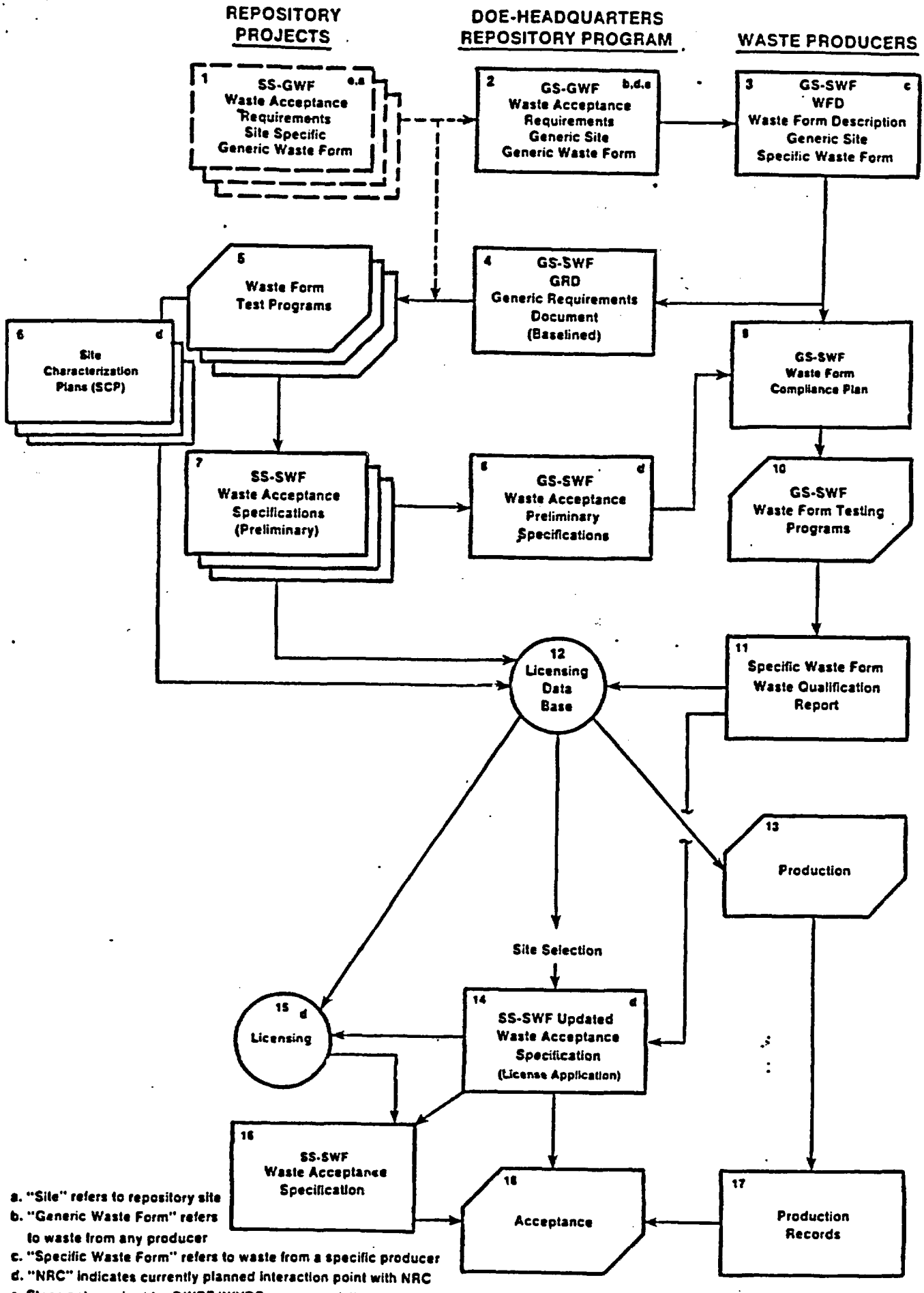
REPOSITORY
CANDIDATE SITES RECOMMENDATION
SITE SELECTION AND LA
CA
LA UPDATE
BEGIN OPERATIONS
WVDP
STORAGE
BEGIN GLASS PROCESSING
INITIAL OPERATIONS
END HLW PROCESSING
DWPF
BEGIN SALT PROCESSING
INITIAL OPERATIONS
HWVP
INITIAL OPERATIONS
INEL
INITIAL OPERATIONS APPROXIMATELY 2008

WASTE ACCEPTANCE PROCESS



a. "Site" refers to repository site
b. "Generic Waste Form" refers to waste from any producer
c. "Specific Waste Form" refers to waste from a specific producer
d. "NRC" indicates currently planned interaction point with NRC
e. Steps not required for DWPF/WVDP as prerequisites to steps 7 & 8

GS-GWF-WAR, and would address each of the GS-GWF requirements and the proposed means of compliance. The WFD should also identify waste form limits (e.g., maximum temperature) to assure waste form adequacy. For purposes of comparison, the WFD would be similar to the "Description of Defense Waste Processing Facility Waste Form and Canister", DP-1606.

Portions of the WFD will be baselined by OCRWM in the Generic Requirements document (OGR/B-2) as generic site, specific waste form (GS-SWF GRD, Step 4) information. (The WFD will also be the source of information for developing waste management system interface information in the "OCRWM Systems Requirements Document"). The repository projects use the GR document as the generic basis for site-specific design requirements. Information on spent fuel, West Valley high-level waste and defense high-level waste currently appears in Appendix B of the GR document, "Waste Source System Interface". As more waste producers reach the point where a WFD can be written, there will be information on additional waste forms added to the GR document.

Information in the GR document and the waste package performance requirements of 10 CFR 60 are used to generate the repository projects' site-specific, specific waste form testing programs (Step 5). Tests described in these programs will provide data relevant to waste form performance in the repository environment for use in waste package performance assessments and licensing. These test programs as they become developed are fully described in the repository projects' Site Characterization Plans (Step 6).

Each of the sites' test programs along with the information in the WFD, GRD and GS-GWF WAR will be used by the repository projects to produce site-specific, specific waste form preliminary Waste Acceptance Specifications* (SS-SWF WAS, Step 7). These site-specific specifications will feature a more extensive level of detail than the SS-GWF WAR because they are targeted to a particular waste form (e.g., borosilicate glass) from a specified producer (e.g., DWPF). Included in the specifications are constraints and data requirements to be supplied by the producer which will ensure that performance expectations derived from repository test program results are applicable to the actual product. Also, design features and details for handling storage, packaging, and placement will be specified to ensure compatibility with repository design. Examples of these documents are the Interim WAS's issued by BWIP, NNWSI, and SRPO for borosilicate glass from the DWPF. The SS-GWF WAS will include a discussion of the bases for each of the specifications and the rationale used in developing them.

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* Waste Acceptance Specifications - A compilation of quantitative, detailed criteria which define specific waste form materials, acceptable ranges for various properties of the waste forms and its container (if applicable) which ensure that each individual waste form produced will perform satisfactorily in a repository environment, and will be within limits of operation of the repository facility. Requirements for documentation which must be provided by the waste producer on a one time basis, for each production lot and for each individual waste form, will also be specified. The Waste Acceptance Preliminary Specifications will be developed based on the best currently available information and will be revised as necessary from time to time. As the repository program proceeds through the site selection and licensing steps, the preliminary specification (Step 8) will evolve into the Updated (License Application) WAS (Step 14) and ultimately into the final WAS (Step 16).

The SS-SWF WAS from each of the repository sites will be compiled to produce the repository program Waste Acceptance Preliminary Specification for a generic site, specific waste form (GS-SWF WAPS, Step 8). This document is produced to provide a single unified source for use by the specific waste form producers and repository designers. Where appropriate, the GS-SWF WAPS will incorporate envelope or "worst case" specifications. Repository site-specific specifications may also be included where an envelope approach is not effective. The GS-SWF WAPS will identify the minimum specifications and data requirements to ensure that the waste is acceptable at any of the repository sites. This document will include a discussion of the rationale used in developing the individual specifications from the project-specific specifications. In developing the preliminary GS-SWF WAPS, reconciliation of conflicting or inconsistent requirements from the site-specific WAS's will be undertaken.

Based on the GS-SWF WAPS, the specific waste producer will develop a Waste Form Compliance Plan (Step 9). This plan will identify the specific tests and procedures including specific tests as outlined by the repository projects to be used to demonstrate compliance with the WAPS. The waste producers will undertake waste form testing programs (Step 10) to produce the data necessary to show compliance with the WAS. A compilation of results from these tests and related analyses will be compiled in the generic site-specific waste form Waste Qualification Report (GS, SWF WQR, Step 11). The WQR will contain information on the waste form itself and on the processes used to produce it, such as process controls, limits on ranges of variability, quality assurance, and demonstration that the actual waste product meets the product specifications, is represented by waste forms tested in repository test programs, and will be consistently and verifiably produced by the reference process.

The supporting information in the WQR along with the repository licensing data from the waste form test program and SS-SWF WAS will all become a part of the Licensing Data Base (Step 12). At some time, prior to repository site selection in the cases of the DWPF and WVDP, the available data base may be used as the basis to support the start of production (Step 13). For the DWPF and WVDP, start-up prior to repository licensing involves a degree of risk that the waste will indeed be acceptable for disposal. The start-up decision will thus be an important milestone decision within the DOE. It is expected that OCRWM input on the acceptability of the product to the repository program will be provided to the appropriate waste producer program as part of the DOE start-up decision. This emphasizes the need to carefully plan the content of the licensing data base and the execution of the requisite testing to ensure the timely availability of data of sufficient quantity and quality to enable this decision to be made with minimum residual risk.

After site selection, the specific waste form updated Waste Acceptance Specifications (SS-SWF WAS, Step 14) for the License Application (LA) can be prepared. This LA WAS will likely not be largely different from the earlier GS-SWF WAPS, but the selection of one site, or elimination of others, may allow for the relaxation of some requirement or set of requirements that were included because of one of the unchosen sites.

Following completion of licensing (Step 15) the SS-SWF WAS will be upgraded to incorporate any additional specifications or modifications generated during licensing to its final form (Step 16). The final WAS and production records

(Step 17) from the waste producers will provide the basis for acceptance (Step 18) of the production waste forms at the repository for disposal.

Application of the WAP

The Waste Acceptance Process described above is intended to be general and to address a wide variety of potential waste sources. As noted, two major waste producers (DWPF and WVDP) are well-advanced in the development of waste forms, and the development of waste acceptance documentation is also well-advanced for these producers. Repository site-specific waste acceptance specifications have been drafted for each of the candidate first repository media for DWPF waste forms (ONWI-464, 1983; SD-BWI-CR-018, 1983; UCID-20165, 1984). NNWSI has issued the same set of specifications for WVDP and DWPF waste forms (UCID-20165, 1984). BWIP and SRPO have issued specifications for CHLW waste forms (SD-BWI-CR-018, 1983; BMI/ONWI-521, 1983), which, however, do not apply to WVDP waste forms. These are essentially equivalent to the SS-SWF WAS's (Step 6) of the WAP but do not apply to WVDP waste forms. DWPF has also issued DP-1606, which is considered to be essentially equivalent to a WFD (Step 3). The repository-specific waste acceptance specifications provided for DWPF and WVDP waste forms are being used to develop a preliminary GS-SWF-WAS (Step 8) for these two producers. The repository projects and DWPF and WVDP are developing waste acceptance tests (Steps 9 & 10) which will be used to show compliance with the WAS's and which will generate data for the WQR (Step 11).

In the implementation of the WAP, it is not intended to delay the more advanced waste form producers (DWPF and WVDP) while generic documentation is developed (although a WFD similar to DP-1606 is required from WVDP). Rather, it is the intent to build upon the experience gained in developing the documentation for these two producers to produce the more generic documentation for less advanced waste producers. In parallel, it is intended to continue an aggressive advancement of the development of waste acceptance specifications, compliance tests, and waste form testing to ensure that necessary information is available to allow product approval and meet repository licensing needs in a timely fashion with minimum risk.

Although the emphasis of the WAP is on acceptance of waste at the repository, it is clear that there are important potential implications on other elements of the waste management system (e.g., the MRS, and Transportation). Development of the WAP documentation must be done with full cognizance of the potential impacts on these system elements. However, coverage of transportation and storage requirements within the WAP documentation is not planned at this time.

It is noted that development of the waste acceptance documentation and activities must, of necessity, proceed in parallel with other design and development activities in both repository and waste producer projects. Indeed, some waste form testing (e.g., radionuclide release testing) is likely to continue well beyond development of the WAS's and submittal of license applications as part of the performance confirmation program required by 10 CFR 60. Thus, the various pieces of documentation must be produced on "best available" rather than "final" information and periodic updating of all documentation developed may be required. Thus it is considered essential that the basis and rationale for each requirement and specification be provided as part of the document developed, and that "preliminary information" and "reservations" be carefully identified in the documentation.

Waste form testing programs will be developed by the waste producer to assure compliance with the repository specifications. Additionally, the repository will develop a test program to support the repository site Licensing requirements. Therefore, it may be desirable to coordinate these tests and the WAP is not intended to limit flexibility in this area in any way.

Because of the tie-in with repository licensing, it is apparent that involvement of the NRC in the Waste Acceptance Process is needed. NRC consultation will be solicited at appropriate points in the process prior to licensing, such as prior to issuing the preliminary GS-SWF-WAS. More definitive plans for NRC involvement will be developed in the near future.

Implementation of the WAP

The Materials Steering Committee (MSC) will be responsible for implementation and coordination of the Waste Acceptance Process. A Waste Acceptance Committee (WAC), composed of a chairman from RW and contractor personnel directly involved in waste acceptance, will be charged with responsibility for detailed definition of the WAP and preparation of certain WAP documentation. The WAC will report to a MSC Executive Committee, composed of three members, one each from RW, DP, and NE, and receive guidance from them (see WAC Charter).

A WAC chairman will be selected by the RW member of the MSC Executive Committee, with NE and DP member concurrence. Contractor personnel will be drawn from the OCRWM Technical Support Contractor, (who will serve as Executive Secretary) the MCC, and contractors from each of the repository projects (BWIP, NNWSI, SRP, and CRP) and each waste producing project (DWPF, WVDP, HWVP, INEL, and CWTP). The NRC will not be directly involved nor participate in the activities of the WAC. However, the MSC Executive Committee, with the support of the WAC as necessary, may authorize discussions with the NRC on WAP documents. The executive committee will work through the RW Engineering and Licensing Division to arrange meetings with the NRC. Further, the RW member of the executive committee will chair any such meetings. The meetings will be coordinated with the repositories and appropriate waste producer projects.

The WAC is to be responsible for the initial preparation of the various site-specific, product-specific, and generic documents identified in the WAP. The schedule and sequence for preparation of documents will be determined by the MSC Executive Committee. The lifetime of the WAC beyond the initial preparation of WAP documents will be at the discretion of the MSC.

The pre-existing DWPF/Repositories Intersite Coordination Group will continue to function, if deemed necessary by the WAC, as a subgroup of the WAC, receiving direction from the MSC Executive Committee through the WAC chairman. Other similar subgroups may be formed for specific purposes at the discretion of the WAC chairman with the concurrence of the MSC Executive Committee. However, the participation of individual contractor members in the activities of the WAC or its subgroups will only be with the approval of the contractor's operations office.

Products of the WAC and its subgroups will be submitted as "Draft for Review" to involved project offices and the MSC Executive Committee. Operations offices can provide their comments directly to their WAC representative, or alternatively, to a member of the MSC Executive Committee. The WAC will be responsible for resolution of comments as directed by the MSC Executive Committee.

Documents with comments resolved will be returned as "Draft for Concurrence" to the MSC Executive Committee, which will then solicit concurrence from appropriate operations office and Headquarters personnel. Following concurrence, OCRWM will issue approved documents for use by repository projects and waste producers. The MSC Executive Committee is responsible for establishing the frequency of review and update of WAP documents based on evaluations within individual projects.

The WAC Charter contains details of the WAC organization, scope, purpose, responsibilities, and planned mode of operation.

ATTACHMENT B

WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS for the Defense Waste Processing Facility High Level Waste Form

Draft for Concurrence

April, 1986

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, D.C. 20585

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DRAFT

WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS for the Defense Waste Processing Facility High-Level Waste Form

DRAFT FOR CONCURRENCE

April 1986

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, D.C. 20585

DRAFT

WASTE ACCEPTANCE

PRELIMINARY SPECIFICATIONS

for the

Defense Waste Processing Facility

High-Level Waste Form

DRAFT FOR CONCURRENCE

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WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS for the Defense Waste Processing Facility High-Level Waste Form

Introduction

These Waste Acceptance Preliminary Specifications (WAPS) specify the properties and requirements for the high-level waste (HLW) forms to be produced by the Defense Waste Processing Facility (DWPF) at the Savannah River Plant, South Carolina. The WAPS establish the minimum requirements which the DWPF waste form must meet in order to be compatible with any of the three geologic media (i.e., basalt, salt, or tuff) under consideration for the first geologic repository.

The WAPS has been developed by the Waste Acceptance Committee (WAC), which is responsible for the preparation of the various site-specific and generic documents identified in the Waste Acceptance Process (WAP). The development and the approval of the WAPS have been carried out in accordance with procedures outlined in the WAC charter. The WAPS specify technical requirements that the waste form must meet and documentation that the producer must provide in order to fulfill the producer's role in the repository licensing process. The WAPS also provide the bases for developing design specifications for the repository and the waste package. The rationale for each specification is presented in Appendix A.

It is recognized that some individual canistered waste forms may not comply in every respect with these specifications. For these cases, the producer will identify nonconformities and propose a remedy for evaluation by the receiving repository on a case-by-case basis. The repository will evaluate the proposed remedy, and a final disposition of the nonconforming waste form will be determined in accordance with the repository license.

Within the waste acceptance process, the WAPS follow the repository-site-specific, waste-form-specific Waste Acceptance Specifications. Where possible, the WAPS reflect generic requirements; however, in one case (i.e., Specification 1.3, Specification for Radionuclide Release Properties), it is not possible to set a single specification that is adequate for all repositories. In this case, producers must demonstrate compliance with repository-specific requirements, at least until the site for the first repository is chosen. The required release properties for the waste form will be based on the overall performance allocation for different parts of the engineered barrier system since containment and isolation requirements are to be met by the total engineered barrier system and not necessarily by the waste form alone. The WAPS require demonstration of compliance via three different documents, each prepared by the producer and concurred with by the repository projects through the waste acceptance process: (1) the Waste Form Compliance Plan (WCP), (2) the Waste Form Qualification Report (WQR), and (3) Production Records.

The Waste Form Compliance Plan (WCP) is the producer's plan for demonstrating compliance with each specification in the WAPS. The WCP is to include detailed descriptions of the testing (including detailed test

procedures), analyses, and process controls to be performed by the producer, including the identification of production records to be provided, to demonstrate compliance with the specifications. The plan for compliance with each specification is to be concurred with by each of the repository projects. To meet schedule demands, it may be necessary for WCP preparation and concurrence to proceed specification by specification, and such an approach is permissible, with the agreement of the WAC Chairman. Concurrence by repository projects means that the producer's proposed method of compliance will satisfactorily meet the intent of the specification, acceptance criteria (as applicable), and support requirements for licensing arguments.

The WQR is a compilation of all results from testing and analysis that presents detailed evidence of compliance with each specification. This document is also prepared by the producer and concurred with by each repository project. Concurrence by the repository projects will be required for each specification and will mean that the testing and analysis as described and documented provide a satisfactory demonstration of compliance with the specification and are adequate for the intended use in repository licensing. Again, consideration of the basis of individual specifications is permissible if the WAC Chairman concurs.

Production Records refers to documentation, provided by the producer, that describes the actual canistered waste forms for review by the repository operator before the waste is shipped. The format and the content of the production records will be specified in the WCP. Concurrence means that the canistered waste forms described are in compliance with the specifications and are therefore acceptable for disposal.

The WAPS are based on the best available information current as of the date of issue. They are likely to be revised as the repository program proceeds through design and licensing. Eventually the WAPS will evolve into the Updated Waste Acceptance Specifications (WAS), which will be used for the License Application, and ultimately into the Final WAS, after the incorporation of applicable NRC licensing technical specifications. All changes will be made in accordance with the Waste Acceptance Process, through the WAC.

When these WAPS were prepared, there was insufficient information available to firmly fix several of the specifications. These specifications remain reserved and are denoted by [R#] in the text of the specification. An explanation of all reserved items is found in Appendix B.

1. WASTE FORM SPECIFICATIONS

1.1 CHEMICAL SPECIFICATION

The waste form for DWPF is borosilicate glass.

1.1.1 Chemical Composition Projections

The producer shall include in the Waste Form Qualification Report (WQR), sufficient chemical and microstructural data to characterize the elemental composition and crystalline phases for the product of the waste production facility and expected variations in the product due to process variations during the life of the facility. The method to be used to make these projections shall be described by the producer in the Waste Form Compliance Plan (WCP).

1.1.2 Chemical Compositon During Production

For the production waste forms the producer shall include in the production records the elemental composition of the glass waste form for all elements, excluding oxygen, present in concentrations greater than 0.5 percent by weight with a precision and an accuracy to be reported in the WCP. The producer shall describe the method to be used for compliance in the WCP.

1.2 RADIONUCLIDE INVENTORY SPECIFICATION

For all radionuclide inventory estimates required by this specification, the producer shall report all radioisotopes that have half-lives longer than 10 years and are present in concentrations greater than 0.05% (curies) [R1] of the total radioactivity inventory (aggregate or canistered waste form, as applicable) at any time up to 1100 years after production.

1.2.1 Radionuclide Inventory Projections

The producer shall provide in the WQR estimates of the total quantities of individual radionuclides to be shipped to the repository and of the uncertainties in the expected values. The producer shall also provide in the WQR estimates of the inventories of individual radionuclides expected to be present in canistered waste forms produced at the facility and the expected range of variations due to process variations during the life of the facility. These estimates shall be calculated for the year 2025. The method used to make these projections shall be described by the producer in the WCP.

1.2.2 Radionuclide Inventory During Production

At the time of shipment, the producer shall provide in the production records estimates of inventories of individual radionuclides in the canistered waste forms. The producer shall also report the expected precision and accuracy of these estimates in the WCP.

1.3 SPECIFICATION FOR RADIONUCLIDE RELEASE PROPERTIES

The producer shall document that the radionuclide release properties of the waste form have been controlled so that the production waste glass can meet the limits specified in repository-specified tests TBD* [R2]. Before

shipment the producer shall document that the waste forms at time of TBD* [R4] are in compliance with the radionuclide release specifications for the receiving repository. The producer shall describe the intended method for demonstrating compliance with each repository-site-specific requirement in the WCP. Supporting technical documentation for the selected method of compliance shall be included in the WQR.

1.4 SPECIFICATION FOR CHEMICAL AND PHASE STABILITY

The producer shall provide the following data on the borosilicate glass waste form:

(a) The transition temperature where the slope of the thermal expansion vs. temperature curve shows a sharp increase.

(b) A time-temperature transformation (TTT) diagram that identifies temperatures and the duration of exposure at the temperature that causes significant changes in either the phase structure or the phase compositions of the borosilicate glass waste form. The producer shall provide TTT diagrams characteristic of the expected range of waste form composition. The waste form radionuclide release properties called for under Specification 1.3 shall also be provided for representative samples covering the same ranges of temperature, duration of exposure, and waste form composition.

The requested data, analysis, and appropriate technical support shall be provided in the WQR. The method used to produce these data shall be described in the WCP.

At the time of shipment, the producer shall certify that the maximum waste form temperature is at least 100°C below the transition temperature of 1.4(a) above. In addition, the producer shall certify that after the initial cooldown, the waste forms to be shipped have been handled and stored in a manner such that the maximum temperature of the waste form has not exceeded the transition temperature specified in Specification 1.4(a). Waste forms shall be transported under conditions that ensure that the transition temperature of Specification 1.4(a) above is not exceeded; certification that this has been accomplished will be required on receipt at the repository.

* TBD - to be determined.

2. CANISTER SPECIFICATIONS

2.1 MATERIAL SPECIFICATION

The waste form canister and any secondary canisters applied by the producer shall be fabricated from austenitic stainless steel. The ASTM alloy specification and the composition of the canister material, the secondary canister material, and any filler material used in welding shall be included in the WCP.

2.2 FABRICATION AND CLOSURE SPECIFICATION

The canister fabrication methods, as well as those for any secondary canister applied by the producer, shall be identified in the WCP and documented in the WQR. The outermost closure shall be leaktight in accordance with the definition of "leaktightness" in ANSI N14.5-1977, "American National Standard for Leakage Tests on Packages for Shipment of Radioactive Materials." The method for demonstrating compliance shall be described by the producer in the WCP and documented in the WQR.

2.3 IDENTIFICATION AND LABELING SPECIFICATIONS

2.3.1 Identification

The producer shall assign an alphanumeric code to each canister or secondary canister, if one is used, that is produced. This alphanumeric code shall appear on the labels of the canistered waste form and on all documentation pertinent to that particular canistered waste form.

2.3.2 Labeling

Each canister shall be labeled with the identification code specified above. Two labels shall be firmly affixed, with one visible from the top and one from the side of the canister. The identification code shall be printed in a type size of at least 92 point using a sans serif type face (Megaron Bold Condensed or equivalent). A proposed layout shall be provided in the WCP. Labels, meeting the requirements above, shall be applied to the exterior of the outermost canister. Labels affixed to the outside of the outermost canister shall not cause dimensional limits of Specification 3.11 to be exceeded.

3. CANISTERED WASTE FORM SPECIFICATIONS

3.1 FREE-LIQUID SPECIFICATION

After closure the canistered waste form shall not contain free-liquids that could be drained from the canister either initially or after having been subjected to the transition temperature of Specification 1.4(a). The producer shall describe the method of compliance in the WCP and provide documentation in the WQR.

3.2 GAS SPECIFICATION

After closure, the canistered waste form shall not contain free-gas other than cover and radiogenic gases. Cover gases shall be helium, argon, other inert gases, or air or combinations thereof. The maximum internal gas pressure immediately after closure shall 7 psig at 25°C. The producer shall describe the method of compliance in the WCP and shall document in the WQR the quantities and compositions of any gases that might accumulate inside the canister after the canister has been subjected to temperatures up to the transition temperature of Specification 1.4(a).

The producer shall also document in the WQR the quantities and compositions of any gases that might accumulate inside the canisters as a result of radioactive decay.

3.3 SPECIFICATION FOR EXPLOSIVENESS, PYROPHORICITY, AND COMBUSTIBILITY

After closure the canistered waste form shall not contain explosive, pyrophoric, and combustible materials. The producer shall describe in the WCP those administrative controls and other factors that prevent the introduction of explosive, pyrophoric, or combustible materials into canistered waste form. The producer shall present in the WQR an evaluation of the canistered waste form to demonstrate that, for the range of material compositions, it remains nonexplosive, nonpyrophoric, and noncombustible after having been subjected to temperatures up to the transition temperature of Specification 1.4(a).

3.4 ORGANIC MATERIALS SPECIFICATION

After closure the canistered waste form shall not contain organic materials. The producer shall describe the method for complying with this specification in the WCP and document the detection limit for organic materials in the WQR.

3.5 FREE-VOLUME SPECIFICATION

After closure, the free-volume within the canistered waste form shall not exceed 20 percent [R3] of the total internal volume of an empty canister. The producer shall identify the nominal free-volume and expected range of variation in the WCP and describe the method of compliance in the WCP. The producer shall also provide in the WCP the expected frequency distribution of free-volumes in the canistered waste forms.

3.6 SPECIFICATION FOR REMOVABLE RADIOACTIVE CONTAMINATION ON EXTERNAL SURFACES

The level of removable radioactive contamination on all external surfaces of each canistered waste form shall not exceed the following limits:

Alpha radiation: 220 dpm/100 cm^2

Beta and Gamma radiation: 2200 dpm/100 cm^2

In addition, the producer shall visually inspect the canistered waste forms and remove visible waste glass on the exterior of the canistered waste form before shipment. The producer shall describe the method of compliance in the WCP and provide supporting documentation in the WQR.

3.7 HEAT GENERATION SPECIFICATION

The canistered waste form shall not exceed a total heat generation rate of 800 watts per canister at the time of shipment to the repository.

3.7.1 Heat Generation Projections

The producer shall document in the WQR the expected thermal output and the range of expected variation due to process variation during the life of the production facility. The method to be used in making these projections shall be described by the producer in the WCP.

3.7.2 Heat Generation During Production

The producer shall specify in the production records the heat generation rate and its accuracy to $\pm$ 15% for canistered waste forms at time of shipment. The expected accuracy of the heat generation rates shall be supplied in the WCP. The producer shall describe the plan for compliance in the WCP.

3.8 SPECIFICATION FOR MAXIMUM DOSE RATES

At the time of shipment the canistered waste form shall not exceed a maximum surface gamma dose rate of 10^5 rem/hr and a maximum neutron dose rate of 10^3 rem/hr.

3.8.1 Projections of Maximum Dose Rates

The producer shall specify in the WQR the expected values and the range of expected variation for both gamma and neutron dose rates. The producer shall describe in the WCP the method to be used in making these projections.

3.8.2 Maximum Dose Rates at Time of Shipment

The producer shall provide in the production records the gamma and neutron dose rates for the canistered waste forms at the time of shipment. The producer shall describe the method of compliance in the WCP.

3.9 CHEMICAL COMPATIBILITY SPECIFICATION

The contents of the canistered waste form shall not lead to internal corrosion of the canister such that there will be an adverse effect on normal

handling during storage, transportation, and repository operation. The producer shall describe the method of compliance in the WCP and document in the WQR the extent of corrosiveness and chemical reactivity among the waste form, the canister, and any filler materials. Corrosion, chemical interactions, and any reaction products generated within the canistered waste forms after exposure to temperatures up to the transition temperature of Specification 1.4(a) shall be evaluated in the WQR.

3.10 SUBCRITICALITY SPECIFICATION

The producer shall ensure that the canistered waste form will remain subcritical under all credible conditions likely to be encountered from production through receipt at the repository. The calculated effective neutron multiplication factor, k_{eff}, shall be sufficiently below unity to show at least a 5% margin after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation. The producer shall describe the method of compliance in the WCP and provide supporting documentation in the WQR. The WQR shall also include sufficient information on the nuclear characteristics of the canistered waste form to enable the repository designer to confirm subcriticality under repository storage and disposal conditions.

3.11 SPECIFICATIONS FOR WEIGHT, LENGTH, DIAMETER, AND OVERALL DIMENSIONS

The configuration, dimensions, and weights of the canistered waste form shall be controlled as indicated below, and the following parameters of the canistered waste form shall be documented at the time of shipment.

3.11.1 Weight Specification

The weight of the canistered waste form shall not exceed 3,000 kg. The measured weight shall be specified in the production records, accurate to within ±5%.

3.11.2 Length Specification

The overall length of the final canistered waste form at the time of shipment shall be 3.000 m (+ 0.005 m, - 0.020 m)

3.11.3 Diameter Specification

The outer diameter of the canistered waste form shall be 61.0 cm (+ 1.5 cm, - 1.0 cm). The minimum wall thickness of the empty canister shall be 0.85 cm. The producer shall state in the WCP the minimum canister wall thickness of the filled canister, and the thickness of any secondary canisters, along with their technical bases.

3.11.4 Specification for Overall Dimensions

The dimensions of the canistered waste form shall be controlled so that, at the time of shipment to a repository, the canistered waste form will stand upright without support on a flat horizontal surface and will fit without forcing when lowered vertically into a right-circular, cylindrical cavity, 64.0 cm in diameter and 3.01 m in length.

3.12 DROP TEST SPECIFICATION

The canistered waste form at time of shipment shall be capable of withstanding a drop of 7 m onto a flat, essentially unyielding surface without breaching. The producer shall describe the method of compliance in the WCP and present the supporting documentation of analysis and test results in the WQR. The test results shall include information on measured canister leak rates and canister deformation after the drop test.

3.13 HANDLING FEATURES SPECIFICATION

The canistered waste form shall have a neck with a lifting flange. The lifting flange geometry and maximum loading capacity shall be described in the WCP.

The producer shall design the lifting flange and a suitable grapple, which could be used at the repository, that meets applicable codes and standards for use at the repository. The grapple and the flange shall be designed to satisfy the following requirements:

(a) The grapple shall be capable of being remotely engaged and disengaged from the flange.

(b) The grapple, when attached to a suitable hoist (to be supplied by the repository), and when engaged with the flange, shall be capable of raising and lowering a canistered waste form in a vertical direction.

(c) The grapple, in the disengaged position, shall be capable of being inserted into and withdrawn in a vertical direction from a right-circular cylindrical cavity with a diameter equal to that of the canistered waste form.

The design of the flange and grapple shall be capable of fulfilling the requirements of Specification 3.13(a) through 3.13(c) without contacting or penetrating the walls of an imaginary right-circular, cylindrical cavity with a diameter equal to that of the canistered waste form, coaxial with the canistered waste form, and extending for a height of 0.7 m above the highest point on the canistered waste form. The design of the grapple shall include features that will prevent an inadvertant release of a suspended canistered waste form when the grapple is engaged with the flange. The producer shall describe the grapple and the flange design concepts in the WCP and provide the designs in the WQR.

4. QUALITY ASSURANCE SPECIFICATION

The 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 the Office of Civilian Radioactive Waste Management, as quality assurance management policies and requirements of the DOE/RW-0032, October 1985. The producer shall document the method of compliance with this specification in the WCP and provide supporting documentation in the WQR.

Borosilicate glass - glass typically containing approximately 20 to 35 wt% waste oxides, 40 to 50 wt% silicas, 5 to 10 wt% boron oxides, and 10 to 20 wt% alkali oxides, plus additives.

Canister - the metal vessel into which borosilicate glass is poured during waste form fabrication.

Canister breach - loss of canister leaktightness.

Canistered waste form - the waste form and the surrounding canister as well as any secondary canisters applied by the producer.

Combustible material - any material that can be ignited readily, and, when ignited, burns rapidly, and is therefore liable to cause fires.

Corrosiveness - the tendency of a substance to wear away or alter a material by a chemical or electrochemical (essentially oxidizing) process.

Explosive material - a substance that, in its normal condition, is characterized by chemical stability, but may be made to undergo rapid chemical change without an outside source of oxygen, whereupon it produces a large quantity of energy generally accompanied by the evolution of hot gases. These substances include those specified in 40 CFR Part 173, Subpart C, Classes A and B.

Free-gas - any gas, including radiogenic gases and cover gases like helium, argon, or air, that could contribute to the pressurization of the canister at temperatures below the glass transition temperature. This includes gases mechanically trapped in the waste form and those generated by chemical reaction and radiolytic decomposition.

Free-liquid - liquid that could be drained or evaporated from the canistered waste form at temperatures below the glass transition temperature; free-liquid includes liquid that is mechanically trapped in the waste form.

Free-volume - volume inside the sealed canister that is not occupied by the borosilicate glass, including voids within the glass itself.

Grapple - a device designed to mate with the lifting flange, used to suspend the canistered waste form from an overhead crane for lifting and transporting.

Leaktightness - a leakage rate of 10^{-7} atm-cm^3/s or less based on dry air at 25°C and for a pressure differential of 1 atm against a vacuum of 10^{-2} atm or less (ANSI N14.5-1977, "American National Standard for Leakage Tests on Packages for Shipment of Radioactive Materials.").

Lifting flange - a protruding rim, edge, rib or collar used to handle the canister.

Organic material - any material based on carbon chains or rings, generally containing hydrogen with or without oxygen, nitrogen, or other elements, whether or not derived from living organisms.

Production records - the documentation, provided by the producer, that describes the actual canistered waste forms.

Pyrophoric material - any liquid that will ignite spontaneously in air below 54.4°C. Any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials, and especially the materials specified in 49 CFR Part 173, Subpart E.

Radiogenic gas - any gas produced by radioactive transformation; that is, the transmutation of an element into a gaseous element by a change in the atomic nucleus through processes such as fission, fusion, neutron capture, or radioactive decay.

Removable radioactive contamination - radioactive material not fixed to a surface. The level of this contamination is determined by wiping an area of 300 cm^2 with an absorbent material, using moderate pressure, and measuring the activity on the wiping material.

Secondary canister - a sealed metal vessel that is applied by the producer and completely surrounds the waste form and its canister.

Transition temperature - the dilatometric softening point where the slope of the thermal expansion versus temperature curve shows a sharp increase.

Waste form - the radioactive waste materials and any encapsulating or stabilizing matrix (10 CFR 60.2).

Waste Form Compliance Plan (WCP) - the document that describes the producer's plan for demonstrating compliance with each waste acceptance specification in the WAPS. The WCP includes descriptions of the tests, analyses, and process controls to be performed by producer.

Waste Form Qualification Report (WQR) - a compilation of results from waste form testing and analysis which develops in detail the case for compliance with each waste acceptance specification.

APPENDIX A

RATIONALE FOR DEFENSE WASTE PROCESSING FACILITY HIGH-LEVEL WASTE FORM WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS

1. WASTE FORM SPECIFICATIONS

1.1 RATIONALE FOR THE CHEMICAL SPECIFICATION

The regulatory requirements outlined in 10 CFR 60.135(c)(1) state that, "All such radioactive wastes shall be in solid form and placed in sealed containers". The chemical specification addresses two repository information needs. Information on the planned production is required to allow testing of material that is representative of what is to be produced. Secondly, information on production waste forms confirms that actual product is within the range of materials tested.

Expected accuracy of measurement of production waste form compositions is necessary to allow adequate evaluation of uncertainties in waste form composition for repository performance assessment.

1.2 RATIONALE FOR THE RADIONUCLIDE INVENTORY SPECIFICATION

The total radionuclide inventory is required for a determination of the producer's contribution to the repository source term for calculations to show compliance with 40 CFR 191 total release standards. A year was needed for indexing radionuclide inventory values. The year 2025 was chosen as a reasonable date for completion of emplacement operations in the first repository. Inventory estimates for canistered waste forms are required to confirm that canistered waste forms fall within ranges considered in licensing, safety, and isolation assessments, and for estimates of releases under unanticipated processes and events, and accident scenario conditions. Expected variations in radionuclide inventories are necessary to adequately quantify uncertainties in radionuclide release estimates for repository performance assessments. The minimum concentration of 0.05% [R1]* is needed to ensure that all isotopes of possible consequence to safety and isolation analyses are included, assuming that congruent dissolution of all nuclides occurs upon contact with an aqueous environment. It provides a factor of 2 reduction with respect to the 0.1% limit on isotopes which must be considered in meeting the 10 CFR 60.113 release rate criterion; it also provides a reasonable lower bound for assessment of releases during accidents. The half-life criterion needs to be as low as 10 years so that "pre-closure" exposure and accident concerns can be addressed.

The 1100 years is based on 1000 year containment period plus 100 years after production for storage, transportation, and operation prior to repository closure, and will be used as the basis for calculating the inventory for the 10 CFR 60.113 release rate criterion.

1.3 RATIONALE FOR THE SPECIFICATION FOR RADIONUCLIDE RELEASE PROPERTIES

The justification for this specification is based on the need of the repository for information concerning the release of radionuclides from the waste form. The test procedures and correlation of these data with release properties under repository conditions are being developed by the repository projects to satisfy regulatory criteria. Both the NRC criteria (10 CFR 60)

*[R] - denotes a value which has been reserved for final determination.

and the EPA criteria (40 CFR 191) have defined long-term radionuclide release in terms of the engineered barrier system and the mined geologic disposal system respectively. As a component part of these systems, the waste form may be required to contribute to the compliance with these requirements. The preliminary allocation of performance requirements among the various components of the engineered barrier system and the repository system is to be described in the Site Characterization Plans being developed for each candidate repository site. Therefore, site-specific tests and acceptance specifications are required.

1.4 RATIONALE FOR THE SPECIFICATION FOR CHEMICAL AND PHASE STABILITY

The borosilicate glass waste forms will retain release properties similar to those obtained under Specification 1.3 so long as the phase structures and compositions of the glass are unchanged from those provided under Specification 1.1.

The waste form temperature exceeding the transition temperature is the only process which can result in significant changes in the phase structures and compositions; thus, ensuring that significant change in the phase structure does not occur ensures that waste form release properties will be unchanged from those obtained under Specification 1.3.

Specifications 1.4.(a) and 1.4.(b) will provide data useful to the repository project for establishment of repository and waste package design limits. The certifications required will provide assurance that producers and transporters have not handled or stored the wastes in such a way as to cause significant changes in the phase structure, as well.

At the time of publication of the WAPS, the organizational responsibility for transportation of the wastes from the production facility has not been established. The requirement for certification of conditions during transportation has been included herein to identify the need for consideration of these requirements during design of the transportation system.

2. CANISTER SPECIFICATIONS

2.1 RATIONALE FOR THE MATERIAL SPECIFICATION

The repository must have a complete materials inventory to evaluate long term performance under repository conditions. Austenitic stainless steel has been selected as the container material for DWPF. This specification acknowledges that fact and establishes the repository's interest in this interface. Additionally, identification of the materials is necessary to assure that the canister material, and the material of any other component present in significant quantities (i.e., secondary canisters and welding fillers), are compatible with other materials in the repository.

2.2 RATIONALE FOR THE FABRICATION AND CLOSURE SPECIFICATION

The canister is designed to provide containment of the waste during handling up to packaging in a repository container to prevent escape of waste, liquids, gases, and particulates. Additionally, the canister must provide protection of the waste form from contact with externally derived liquids and gases until the canister is sealed in a repository container.

2.3 RATIONALE FOR THE IDENTIFICATION AND LABELING SPECIFICATIONS

The regulatory requirements in 10 CFR 60.135(b)(4) state that "A label or other means of identification shall be provided for each waste package. The identification shall not impair the integrity of the waste package and shall be applied in such a way that the information shall be legible at least to the end of the period of retrievability. Each waste package identification shall be consistent with the waste package's permanent written records."

This specification provides a means of tying the waste package and the waste form together through the retrievability period. The 92 point sans serif type face (Megaron Bold Condensed or equivalent) results in a letter height of approximately 3 cm and width of approximately 2 cm which has been judged to be adequate dimensions for visibility.

3. CANISTERED WASTE FORM SPECIFICATIONS

3.1 RATIONALE FOR THE FREE-LIQUID SPECIFICATION

The regulatory requirements outlined in 10 CFR 60.135(b)(2) state that, "The waste package shall not contain free-liquids in an amount that could compromise the ability of the waste package to achieve the performance objectives relating to containment of HLW (because of chemical interactions or formation of pressurized vapor) or result in spillage and spread of contamination in the event of waste package perforation during the period through permanent closure."

3.2 RATIONALE FOR THE GAS SPECIFICATION

The regulatory requirements in 10 CFR 60.135(a) require that "packages for HLW shall be designed so that in-situ chemical, physical, and nuclear properties of the waste package...do not compromise the function of the waste package... "and "The design shall include...consideration of...oxidation/reduction reactions, corrosion, hydriding, gas generation, thermal effects...mechanical stress, radiolysis radiation damage...." In order to demonstrate compliance with the regulations, waste package designers require information on gas generation potential of the waste form.

The intent of this specification is to ensure that gas pressure will not build up inside the container and contribute to loss of containment and dispersion of radionuclides. This specification provides a limit to initial gas pressure and information to index calculation of gas pressure build-up with time due to nuclear decay and temperature changes.

3.3 RATIONALE FOR THE SPECIFICATION FOR EXPLOSIVENESS, PYROPHORICITY, AND COMBUSTIBILITY

This specification is needed to ensure that after closure, the canistered waste form does not explode or burn during normal repository operations and accident conditions.

The regulatory requirements as outlined in 10 CFR 60.135(b)(1) state that, "The waste package shall not contain explosive or pyrophoric materials in an amount that could compromise the ability of the underground facility to contribute to waste isolation or the ability of the geologic repository to satisfy the performance objectives."

The regulatory requirements on the waste package as outlined in 10 CFR 60.135(a)(2) state that, "The design shall include but not be limited to consideration of...fire and explosion hazards." The waste form, as a component of the waste packages must comply with this requirement.

3.4 RATIONALE FOR THE ORGANIC MATERIALS SPECIFICATION

This specification is needed to ensure that organic materials that tend to mobilize radionuclides by formation of complexes, etc., or generate gases due to radiolysis are not present in the canistered waste form.

The regulatory requirements on the waste package as outlined in 10 CFR 60.135(2) state that, "The design shall include but not be limited to consideration of the following factors: ...gas generation, radiolysis, radionuclide retardation, leaching...." The waste form, as a component of the waste package must be assessed for compliance.

3.5 RATIONALE FOR THE FREE-VOLUME SPECIFICATION

In general, free-volume is to be minimized for the following reasons: 1) repository design; 2) economical use of repository space; and 3) less volume of water in contact with waste form after breach of containment. Specifically, BWIP has a concern about collapse of the packing into the void, resulting in less than desired density and creating preferential flow paths for radionuclide release. The value of 20% [R3] free-volume has been chosen as the best estimate for repository design requirements and is achievable by the producer under normal operating conditions.

Although it is desirable to have the vast majority of canistered waste forms to have free-volume less than 20 percent [R3], it is recognized that a small fraction of canisters may have free-volumes in excess of this due to operational occurences at the producer's facility. The specification, as drafted, is intended to allow for these cases, to provide the information necessary for assessment of their impact on performance, and to provide the canister-by-canister certifications necessary to demonstrate compliance with likely repository license conditions.

3.6 RATIONALE FOR THE SPECIFICATION FOR REMOVABLE RADIOACTIVE CONTAMINATION ON EXTERNAL SURFACES

This specification is necessary to protect personnel, prevent uncontrolled spread of contamination in repository facilities, minimize need for remote maintenance of facility equipment, and minimize need for cleanup of contamination during normal operations.

The specification limits chosen are used extensively in the nuclear industry practice and regulations to indicate surfaces are free of removable contamination.

3.7 RATIONALE FOR THE HEAT GENERATION SPECIFICATION

A heat generation rate limit must be set to ensure that the temperatures reached in other disposal package components or the host rock do not significantly reduce their performance capabilities.

Repository designers need a number with which to work to ensure that repository thermal load limits are not violated. The value of 800 watts was chosen as an expected upper bound for production from DWPF facilities. An accuracy of $\pm$15% is judged to be a reasonable working value, acceptable to both repositories and to DWPF. The variation in normal expected heat generation rates is necessary to allow assessment of uncertainties in repository performance.

3.8 RATIONALE FOR THE SPECIFICATION FOR MAXIMUM DOSE RATES

The repository projects need the maximum gamma and neutron dose rates in order to design shielding for the receipt and handling facilities. The value of 10^5 rem/hr for maximum gamma dose rate and 10^3 rem/hr for maximum neutron dose rate provide a reasonable basis for repository design and operation and are judged to be sufficiently above the expected dose rates for DWPF wastes to provide reasonable flexibility for normal operations.

3.9 RATIONALE FOR THE CHEMICAL COMPATIBILITY SPECIFICATION

The specification is required to assure that the canister can be safely handled during storage, transportation, and repository operational periods, and to provide needed data for assessment of long term performance of the waste package components.

3.10 RATIONALE FOR THE SUBCRITICALITY SPECIFICATION

The regulatory requirements as outlined in 10 CFR 60.134(b)(7) state that, "The calculated effective multiplication factor k_{eff} must be sufficiently below unity, to show at least a 5% margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to evaluate the method of calculation."

Subcriticality of multiple canister arrays at the repository is the responsibility of the repository designer.

3.11 RATIONALE FOR THE SPECIFICATIONS FOR WEIGHT, LENGTH, DIAMETER, AND OVERALL DIMENSIONS

The specifications on weight, length, diameter and wall thickness of the canistered waste form are needed for the repository design of handling requirements and waste packages. The overall dimensions of the canistered waste form must be such that (1) no forcing is required to place it in the disposal package container to prevent damage to the inside of the container and (2) there is compatibility with container geometry.

3.12 RATIONALE FOR THE DROP TEST SPECIFICATION

This specification is necessary to ensure that the canistered waste form is not breached after a drop. The height of 7 m was chosen as representative of the maximum drop height under normal operating conditions. Repository facilities will be designed to ensure that larger drops of bare canisters are not possible. The surface which is characteristic of repository conditions has been defined as a "flat, essentially unyielding" surface.

3.13 RATIONALE FOR THE HANDLING FEATURES SPECIFICATION

This specification reflects the lifting and handling requirements necessary for compatibility with current waste package concepts. The specification is drafted to allow the waste producer maximum flexibility in design of the canister handling arrangements.

4.0 RATIONALE FOR THE QUALITY ASSURANCE SPECIFICATION

All activities relevant to licensing of a repository must be conducted in accordance with appropriate Quality Assurance controls. OCRWM quality assurance policies and requirements are described in the referenced document. Producer activities must be conducted to comply with the program established by OCRWM.

APPENDIX B

EXPLANATION OF RESERVED ITEMS

R1 - Radionuclide Inventory Specification

Specification 1.2 establishes a numerical concentration of 0.05% (curies) of the total inventory for the reporting of radionuclides. This value is considered to be adequate based on a preliminary analysis by one of the repository projects alone; consequently, 0.05% is being held on reserve pending final analysis by repository projects.

R2 - Specification for Radionuclide Release Properties

At the time of publication of the WAPS, the test procedures and acceptance criteria for Specification 1.3, Specification for Radionuclide Release Properties, are not available. These procedures and criteria are being developed along with each project's Site Characterization Plan and depend upon site-specific performance allocations for the waste form. These procedures and acceptance criteria will be added to the specifications when they become available.

R3 - Free-Volume Specification

Specification 3.5 allows 20% free-volume within the canistered waste forms. 20% is being held in reserve pending a final analysis by the repository projects.

R4 - Time of Compliance

The time for compliance for the specification remains reserved pending further discussions within the DOE.

ATTACHMENT C

DRAFT

OGR/B-9

WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS for the West Valley Demonstration Project High Level Waste Form

Draft for Concurrence

April, 1986

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, D.C. 20585

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for the

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High-Level Waste Form

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Introduction

These Waste Acceptance Preliminary Specifications (WAPS) specify the properties and requirements for the high-level waste (HLW) forms to be produced by the West Valley Demonstration Project (WVDP) at West Valley, New York. The WAPS establish the minimum requirements that the WVDP waste form must meet in order to be compatible with any of the three geologic media (i.e., basalt, salt, or tuff) under consideration for the first geologic repository.

The WAPS has been developed by the Waste Acceptance Committee (WAC), which is responsible for the preparation of the various site-specific and generic documents identified in the Waste Acceptance Process (WAP). The development and the approval of the WAPS have been carried out in accordance with procedures outlined in the WAC charter. The WAPS specify technical requirements that the waste form must meet and documentation that the producer must provide in order to fulfill the producer's role in the repository licensing process. The WAPS also provide the bases for developing design specifications for the repository and the waste package design. The rationale for each specification is presented in Appendix A.

It is recognized that some individual canistered waste forms may not comply in every respect with these specifications. For these cases, the producer will identify nonconformities and propose a remedy for evaluation by the receiving repository on a case-by-case basis. The repository will evaluate the proposed remedy, and a final disposition of the nonconforming waste form will be determined in accordance with the repository license.

Within the waste acceptance process, the WAPS follow the repository-site-specific, waste-form-specific Waste Acceptance Specifications. Where possible, the WAPS reflect generic requirements; however, in one case (i.e., Specification 1.3, Specification for Radionuclide Release Properties), it is not possible to set a single specification that is adequate for all repositories. In this case, producers must demonstrate compliance with repository-specific requirements, at least until the site for the first repository is chosen. The required release properties for the waste form will be based on the overall performance allocation for different parts of the engineered barrier system since containment and isolation requirements are to be met by the total engineered barrier system and not necessarily by the waste form alone. The WAPS require demonstration of compliance via three different documents, each prepared by the producer and concurred with by the repository projects through the waste acceptance process: (1) the Waste Form Compliance Plan (WCP), (2) the Waste Form Qualification Report (WQR), and (3) Production Records.

The Waste Form Compliance Plan (WCP) is the producer's plan for demonstrating compliance with each specification in the WAPS. The WCP is to

include detailed descriptions of the testing (including detailed test procedures), analyses, and process controls to be performed by the waste producer, including the identification of production records to be provided to demonstrate compliance with the specifications. The plan for compliance with each specification is to be concurred with by each of the repository projects. To meet schedule demands, it may be necessary for WCP preparation and concurrence to proceed specification by specification, and such an approach is permissible, with the agreement of the WAC Chairman. Concurrence by repository projects means that the producer's proposed method of compliance will satisfactorily meet the intent of the specification, acceptance criteria (as applicable), and support requirements for licensing arguments.

The WQR is a compilation of all results from testing and analysis that presents detailed evidence of compliance with each specification. This document is also prepared by the producer and concurred with by each repository project. Concurrence by the repository projects will be required for each specification and will mean that the testing and analysis as described and documented provide a satisfactory demonstration of compliance with the specification and are adequate for the intended use in repository licensing. Again, consideration of the basis of individual specifications is permissible if the WAC Chairman concurs.

Production Records refers to documentation, provided by the producer, that describes the actual canistered waste forms for review by the repository operator before the waste is shipped. The format and the content of the production records will be specified in the WCP. Concurrence means that the canistered waste forms described are in compliance with the specifications and are therefore acceptable for disposal.

The WAPS are based on the best available information current as of the date of issue. They are likely to be revised as the repository program proceeds through design and licensing. Eventually the WAPS will evolve into the Updated Waste Acceptance Specifications (WAS), which will be used for the License Application, and ultimately into the Final WAS, after the incorporation of applicable NRC licensing technical specifications. All changes will be made in accordance with the Waste Acceptance Process through the WAC.

When these WAPS were prepared, there was insufficient information available to firmly fix several of the specifications. These specifications remain reserved and are denoted by [R#] in the text of the specification. An explanation of all reserved items is found in Appendix B.

1. WASTE FORM SPECIFICATIONS

1.1 CHEMICAL SPECIFICATION

The waste form for WVDP is borosilicate glass.

1.1.1 Chemical Composition Projections

The producer shall include in the Waste Form Qualification Report (WQR), sufficient chemical and microstructural data to characterize the elemental composition and crystalline phases for the product of the waste production facility and expected variations in the product due to process variations during the life of the facility. The method used to make these projections shall be described by the producer in the Waste Form Compliance Plan (WCP).

1.1.2 Chemical Composition During Production

For the production waste forms, the producer shall include in the production records the elemental composition of the glass waste form for all elements, excluding oxygen, present in concentrations greater than 0.5 percent by weight with a precision and an accuracy to be reported in the WCP. The producer shall describe the method to be used for compliance in WCP.

1.2 RADIONUCLIDE INVENTORY SPECIFICATION

For all radionuclide inventory estimates required by this specification, the producer shall report all radioisotopes that have half-lives longer than 10 years and are present in concentrations greater than 0.05% (curies) [R1] of the total radioactivity inventory (aggregate or canistered waste form, as applicable) at any time up to 1100 years after production.

1.2.1 Radionuclide Inventory Projections

The producer shall provide in the WQR estimates of the total quantities of individual radionuclides to be shipped to the repository and of the uncertainties in the expected values. The producer shall also provide in the WQR estimates of the inventories of individual radionuclides expected to be present in canistered waste forms produced at the facility and the expected range of variations due to process variations during the life of the facility. These estimates shall be calculated for the year 2025. The method used to make these projections shall be described by the producer in the WCP.

1.2.2 Radionuclide Inventory During Production

At the time of shipment the producer shall provide in the production records estimates of inventories of individual radionuclides in the canistered waste forms. The producer shall also report the expected precision and accuracy of these estimates in the WCP.

1.3 SPECIFICATION FOR RADIONUCLIDE RELEASE PROPERTIES

The producer shall document that the radionuclide release properties of the waste form have been controlled so that the production waste glass can

meet the limits specified in repository-specified tests TBD* [R2]. Before shipment the producer shall document that the waste forms at time of TBD* [R5] are in compliance with the radionuclide release specification for the receiving repository. The producer shall describe the intended method for demonstrating compliance with each repository-site-specific requirement in the WCP. Supporting technical documentation for the selected method of compliance shall be included in the WQR.

1.4 SPECIFICATION FOR CHEMICAL AND PHASE STABILITY

The producer shall provide the following data on the borosilicate glass waste form:

(a) The transition temperature where the slope of the thermal expansion vs. temperature curve shows a sharp increase.

(b) A time-temperature-transformation (TTT) diagram that identifies temperatures and the duration of exposure at the temperature that causes significant changes in either the phase structure or the phase compositons of the borosilicate glass waste form. The producer shall provide TTT diagrams characteristic of the expected range of waste form composition. The waste form radionuclide release properties called for under Specification 1.3 shall also be provided for representative samples covering the same ranges of temperature, duration of exposure, and waste form composition.

The requested data, analysis, and appropriate technical support shall be provided in the WQR. The method used to produce these data shall be described in the WCP.

At the time of shipment, the producer shall certify that the maximum waste form temperature is at least 100°C below the transition temperature of 1.4(a) above. In addition, the producer shall certify that after the initial cooldown, the waste forms to be shipped have been handled and stored in a manner such that the maximum temperature of the waste form has not exceeded the transition temperature specified in Specification 1.4(a). Waste forms shall be transported under conditions that ensure that the transition temperature of Specification 1.4(a) above is not exceeded; certification that this has been accomplished will be required on receipt at the repository.

*TBD - to be determined

2. CANISTER SPECIFICATIONS

2.1 MATERIAL SPECIFICATION

The waste form canister and any secondary canisters to be applied by the producer shall be fabricated from austenitic stainless steel. The ASTM alloy specification and the composition of the canister material, the secondary canister material, and any filler material used in welding shall be included in the WCP.

2.2 FABRICATION AND CLOSURE SPECIFICATION

The canister fabrication methods, as well as those for any secondary canisters applied by the producer, shall be identified in the WCP and documented in the WQR. The outermost closure shall be leaktight in accordance with the definition of "leaktightness" in ANSI 14.5-1977, "American National Standard for Leakage Testing on Packages for Shipment of Radioactive Materials." The method for demonstrating compliance shall be described by the producer in the WCP and documented in the WQR.

2.3 IDENTIFICATION AND LABELING SPECIFICATIONS

2.3.1 Identification

The producer shall assign an alphanumeric code to each canister or secondary canister, if one is used, that is produced. This alphanumeric code shall appear on the labels of the canistered waste form and on all documentation pertinent to that particular canistered waste form.

2.3.2 Labeling

Each canister shall be labeled with the identification code specified above. Two labels shall be firmly affixed, with one visible from the top and one from the side of the canister. The identification code shall be printed in a type size of at least 92 points using a sans serif type face (Megaron Bold Condensed or equivalent). A proposed layout shall be provided in the WCP. Labels meeting the requirements above shall be applied to the exterior of the outermost canister. Labels affixed to the outside of the outermost canister shall not cause the dimensional limits of Specification 3.11 to be exceeded.

3. CANISTERED WASTE FORM SPECIFICATIONS

3.1 FREE-LIQUID SPECIFICATION

After closure the canistered waste form shall not contain free-liquids that could be drained from the canister either initially or after having been subjected to the transition temperature of Specification 1.4(a). The producer shall describe the method of compliance in the WCP and provide documentation in the WQR.

3.2 GAS SPECIFICATION

After closure the canistered waste form shall not contain free gases, other than cover and radiogenic gases. Cover gases shall be helium, argon, other inert gases, or air or combinations thereof. The maximum internal gas pressure immediately after closure shall be 7 psig at 25°C. The producer shall describe the method of compliance in the WCP and shall document in the WQR the quantities and compositions of any gases that might accumulate inside the canister after the canister has been subjected to temperatures up to the transition temperature of Specification 1.4(a).

The producer shall also document in the WQR the quantities and compositions of any gases that might accumulate inside the canisters as a result of radioactive decay.

3.3 SPECIFICATION FOR EXPLOSIVENESS, PYROPHORICITY, AND COMBUSTIBILITY

After closure the canistered waste form shall not contain explosive, pyrophoric, and combustible materials. The producer shall describe in the WCP those administrative controls and other factors that prevent the introduction of explosive, pyrophoric, or combustible materials into canistered waste forms. The producer shall present in the WQR an evaluation of the canistered waste form to demonstrate that, for the range of material compositions, it remains nonexplosive, nonpyrophoric, and noncombustible after having been subjected to the temperatures up to the transition temperature of Specification 1.4(a).

3.4 ORGANIC MATERIALS SPECIFICATION

After closure the canistered waste form shall not contain organic materials. The producer shall describe the method for complying with this specification in the WCP and document the detection limit for organic materials in the WQR.

3.5 FREE-VOLUME SPECIFICATION

After closure, the free-volume within the canistered waste form shall not exceed 20 percent [R3] of the total internal volume of an empty canister. The producer shall identify the nominal free-volume and expected range of variation in the WCP and describe the method of compliance in the WCP. The producer shall provide in the WCP the expected frequency distribution of free-volumes in canistered waste forms.

3.6 SPECIFICATION FOR REMOVABLE RADIOACTIVE CONTAMINATION ON EXTERNAL SURFACES

The level of removable radioactive contamination on all external surfaces of each canistered waste form shall not exceed the following limits:

Alpha radiation: 220 dpm/100 cm^2

Beta and Gamma radiation: 2200 dpm/100 cm^2

In addition, the producer shall visually inspect the canistered waste forms, and remove visible waste glass on the exterior of the canistered waste form before shipment. The producer shall describe the method of compliance in the WCP and provide supporting documentation in the WQR.

3.7 HEAT GENERATION SPECIFICATION

The canistered waste form shall not exceed a total heat generation rate of 800 watts per canister at the time of shipment to the repository.

3.7.1 Heat Generation Projections

The producer shall document in the WQR the expected thermal output and the range of expected variation due to process variations during the life of the production facility. The method to be used in making these projections shall be described by the producer in the WCP.

3.7.2 Heat Generation During Production

The producer shall specify in the production records the heat generation rate and its accuracy for canistered waste forms at time of shipment. The expected accuracy of the heat generation rates shall be supplied in the WCP. The producer shall describe the plan for compliance in the WCP.

3.8 SPECIFICATION FOR MAXIMUM DOSE RATES

At the time of shipment, the canistered waste form shall not exceed a maximum surface gamma dose rate of 10^5rem/hr and a maximum neutron dose rate of 10^3rem/hr.

3.8.1 Projections of Maximum Dose Rates

The producer shall specify in the WQR the expected values and the range of expected variation for both gamma and neutron dose rates. The producer shall describe in the WCP the method to be used in making these projections.

3.8.2 Maximum Dose Rates at Time of Shipment

The producer shall provide in the production records the gamma and neutron dose rates for the canistered waste forms at the time of shipment. The producer shall describe the method of compliance in the WCP.

3.9 CHEMICAL COMPATIBILITY SPECIFICATION

The contents of the canistered waste form shall not lead to internal corrosion of the canister such that there will be an adverse effect on normal handling during storage, transportation, and repository operation. The producer shall describe the method of compliance in the WCP and document in the WQR the extent of corrosiveness and chemical reactivity among the waste form, the canister, and any filler materials. Corrosion, chemical interactions, and any reaction products generated within the canistered waste forms after exposure to temperatures up to the transition temperature of Specification 1.4(a) shall be evaluated in the WQR.

3.10 SUBCRITICALITY SPECIFICATION

The producer shall ensure that the canistered waste form will remain subcritical under all credible conditions likely to be encountered from production through receipt at the repository. The calculated effective neutron multiplication factor, k_{eff}, shall be sufficiently below unity to show at least a 5% margin after allowance for bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation. The producer shall describe the method of compliance in the WCP and provide supporting documentation in the WQR. The WQR shall also include sufficient information on the nuclear characteristics of the canistered waste forms to enable the repository designer to confirm subcriticality under repository storage and disposal conditions.

3.11 SPECIFICATIONS FOR WEIGHT, LENGTH, DIAMETER, AND OVERALL DIMENSIONS

The configuration, dimensions, and weights of the canistered waste form shall be controlled as indicated below, and the following parameters of the canistered waste form shall be documented at the time of shipment.

3.11.1 Weight Specification

The weight of the canistered waste form shall not exceed 3,000 kg. The measured weight shall be specified in the production records, accurate to within $\pm$5%.

3.11.2 Length Specification

The overall length of the final canistered waste form at the time of shipment shall be 3.000 m (+ 0.005 m, - 0.020 m)

3.11.3 Diameter Specification

The outer diameter of the canistered waste form shall be 61.0 cm (+ 1.5 cm, - 1.0 cm). The minimum wall thickness of the empty canister shall be TBD [R6]. The producer shall state in the WCP the minimum canister wall thickness of the filled canister, and the thickness of any secondary canisters, along with their technical bases.

3.11.4 Specification for Overall Dimensions

The dimensions of the canistered waste form shall be controlled so that, at the time of shipment to a repository, the canister will stand upright

without support on a flat horizontal surface and will fit without forcing when lowered vertically into a right-circular, cylindrical cavity 64.0 cm in diameter and 3.01 m in length.

3.12 DROP TEST SPECIFICATION

The canistered waste form at time of shipment shall be capable of withstanding a drop of 7 m [R4] onto a flat essentially unyielding surface without breaching. The producer shall describe the method of compliance in the WCP and present the supporting documentation of analysis and test results in the WQR. The test results shall include information on measured canister leak rates and canister deformation after the drop test.

3.13 HANDLING FEATURES SPECIFICATION

The canistered waste form shall have a neck with a lifting flange. The lifting flange geometry and maximum loading capacity shall be described in the WCP.

The producer shall design the lifting flange and a suitable grapple, which could be used at the repository, that meets applicable codes and standards for use at the repository. The grapple and the flange shall be designed to satisfy the following requirements:

(a) The grapple shall be capable of being remotely engaged and disengaged from the flange.

(b) The grapple, when attached to a suitable hoist (to be supplied by the repository), and when engaged with the flange, shall be capable of raising and lowering a canistered waste form in a vertical direction.

(c) The grapple, in the disengaged position, shall be capable of being inserted into and withdrawn in a vertical direction from a right-circular, cylindrical cavity with a diameter equal to that of the canistered waste form.

The design of the flange and the grapple shall be capable of fulfilling the requirements of Specifications 3.13(a) through 3.13(c) without contacting or penetrating the walls of an imaginary right-circular, cylindrical cavity with a diameter equal to that of the canistered waste form, coaxial with the canistered waste form, and extending for a height of 0.7 m above the highest point on the canistered waste form. The design of the grapple shall include features that will prevent an inadvertant release of a suspended canistered waste form when the grapple is engaged with the flange. The producer shall describe the grapple and the flange design concepts in the WCP and provide the detailed designs in the WQR.

4. QUALITY ASSURANCE SPECIFICATION

The 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 the Office of Civilian Radioactive Waste Management, as quality assurance management policies and requirements of the DOE/RW-0032, October 1985. The producer shall document the method of compliance with this specification in the WCP and provide supporting documentation in the WQR.

Borosilicate glass - glass typically containing approximately 20 to 35 wt% waste oxides, 40 to 50 wt% silicas, 5 to 10 wt% boron oxides, and 10 to 20 wt% alkali oxides, plus additives.

Canister - the metal vessel into which borosilicate glass is poured during waste form fabrication.

Canister breach - loss of canister leaktightness.

Canistered waste form - the waste form and the surrounding canister as well as any secondary canisters applied by the producer.

Combustible material - any material that can be ignited readily, and, when ignited, burns rapidly, and is therefore liable to cause fires.

Corrosiveness - the tendency of a substance to wear away or alter a material by a chemical or electrochemical (essentially oxidizing) process.

Explosive material - a substance that, in its normal condition, is characterized by chemical stability, but may be made to undergo rapid chemical change without an outside source of oxygen, whereupon it produces a large quantity of energy generally accompanied by the evolution of hot gases. These substances include those specified in 40 CFR Part 173, Subpart C, Classes A and B.

Free-gas - any gas, including radiogenic gases and cover gases like helium, argon, or air, that could contribute to the pressurization of the canister at temperatures below the glass transition temperature. This includes gases mechanically trapped in the waste form and those generated by chemical reaction and radiolytic decomposition.

Free-liquid - liquid that could be drained or evaporated from the canistered waste form at temperatures below the glass transition temperature; free-liquid includes liquid that is mechanically trapped in the waste form.

Free-volume - volume inside the sealed canister that is not occupied by the borosilicate glass, including voids within the glass itself.

Grapple - a device designed to mate with the lifting flange, used to suspend the canistered waste form from an overhead crane for lifting and transporting.

Leaktightness - a leakage rate of 10^{-7} atm-cm^3/s or less based on dry air at 25°C and for a pressure differential of 1 atm against a vacuum of 10^{-2} atm or less (ANSI N14.5-1977, "American National Standard for Leakage Tests on Packages for Shipment of Radioactive Materials.").

Lifting flange - a protruding rim, edge, rib or collar used to handle the canister.

Organic material - any material based on carbon chains or rings, generally containing hydrogen with or without oxygen, nitrogen, or other elements, whether or not derived from living organisms.

Production records - the documentation, provided by the producer, that describes the actual canistered waste forms.

Pyrophoric material - any liquid that will ignite spontaneously in air below 54.4°C. Any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials, and especially the materials specified in 49 CFR Part 173, Subpart E.

Radiogenic gas - any gas produced by radioactive transformation; that is, the transmutation of an element into a gaseous element by a change in the atomic nucleus through processes such as fission, fusion, neutron capture, or radioactive decay.

Removable radioactive contamination - radioactive material not fixed to a surface. The level of this contamination is determined by wiping an area of 300 cm^2 with an absorbent material, using moderate pressure, and measuring the activity on the wiping material.

Secondary canister - a sealed metal vessel that is applied by the producer and completely surrounds the waste form and its canister.

Transition temperature - the dilatometric softening point where the slope of the thermal expansion versus temperature curve shows a sharp increase.

Waste form - the radioactive waste materials and any encapsulating or stabilizing matrix (10 CFR 60.2).

Waste Form Compliance Plan (WCP) - the document that describes the producer's plan for demonstrating compliance with each waste acceptance specification in the WAPS. The WCP includes descriptions of the tests, analyses, and process controls to be performed by producer.

Waste Form Qualification Report (WQR) - a compilation of results from waste form testing and analysis which develops in detail the case for compliance with each waste acceptance specification.

APPENDIX A

RATIONALE FOR WEST VALLEY DEMONSTRATION PROJECT HIGH-LEVEL WASTE FORM WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS

1. WASTE FORM SPECIFICATIONS

1.1 RATIONALE FOR THE CHEMICAL SPECIFICATION

The regulatory requirements outlined in 10 CFR 60.135(c)(1) state that, "All such radioactive wastes shall be in solid form and placed in sealed containers". The chemical specification addresses two repository information needs. Information on the planned production is required to allow testing of material that is representative of what is to be produced. Secondly, information on production waste forms confirms that actual product material is within the range of materials tested.

Expected accuracy of measurement of production waste form compositions is necessary to allow adequate evaluation of uncertainties in waste form composition for repository performance assessment.

1.2 RATIONALE FOR THE RADIONUCLIDE INVENTORY SPECIFICATION

The total radionuclide inventory is required for a determination of the producer's contribution to the repository source term for calculations to show compliance with 40 CFR 191 total release standards. A year was needed for indexing radionuclide inventory values. The year 2025 was chosen as a reasonable date for completion of emplacement operations in the first repository. Inventory estimates for canistered waste forms are required to confirm that canistered waste forms fall within ranges considered in licensing, safety, and isolation assessments, and for estimates of releases under unanticipated processes and events, and accident scenario conditions. Expected variations in radionuclide inventories are necessary to adequately quantify uncertainties in radionuclide release estimates for repository performance assessments. The minimum concentration of 0.05% [R1]* is needed to ensure that all isotopes of possible consequence to safety and isolation analyses are included, assuming that congruent dissolution of all nuclides occurs upon contact with an aqueous environment. It provides a factor of 2 reduction with respect to the 0.1% limit on isotopes which must be considered in meeting the 10 CFR 60.113 release rate criterion; it also provides a reasonable lower bound for assessment of releases during accidents. The half-life criterion needs to be as low as 10 years so that "pre-closure" exposure and accident concerns can be addressed.

The 1100 years is based on 1000 year containment period plus 100 years after production for storage, transportation, and operation prior to repository closure, and will be used as the basis for calculating the inventory for the 10 CFR 60.113 release rate criterion.

1.3 RATIONALE FOR THE SPECIFICATION FOR RADIONUCLIDE RELEASE PROPERTIES

The justification for this specification is based on the need of the repository for information concerning the release of radionuclides from the waste form. The test procedures and correlation of these data with release properties under repository conditions are being developed by the repository projects to satisfy regulatory criteria. Both the NRC criteria (10 CFR 60) and the EPA criteria (40 CFR 191) have defined long-term radionuclide release in terms of the engineered barrier system and the mined geologic disposal

*[R] - denotes a value which has been reserved for final determination.

system respectively. As a component part of these systems, the waste form may be required to contribute to the compliance with these requirements. The preliminary allocation of performance requirements among the various components of the engineered barrier system and the repository system is to be described in the Site Characterization Plans being developed for each candidate repository site. Therefore, site-specific tests and acceptance specifications are required.

1.4 RATIONALE FOR THE SPECIFICATION FOR CHEMICAL AND PHASE STABILITY

The borosilicate glass waste forms will retain release properties similar to those obtained under Specification 1.3 so long as the phase structures and compositions of the glass are unchanged from those provided under Specification 1.1.

The waste form temperature exceeding the transition temperature is the only process which can result in significant changes in the phase structures and compositions; thus, ensuring that significant change in the phase structure does not occur ensures that waste form release properties will be unchanged from those obtained under Specification 1.3.

Specifications 1.4(a) and 1.4(b) will provide data useful to the repository project for establishment of repository and waste package design limits. The certifications required will provide assurance that producers and transporters have not handled or stored the wastes in such a way as to cause significant changes in the phase structure, as well.

At the time of publication of the WAPS, the organizational responsibility for transportation of the wastes from the production facility has not been established. The requirement for certification of conditions during transportation has been included herein to identify the need for consideration of these requirements during design of the transportation system.

2. CANISTER SPECIFICATIONS

2.1 RATIONALE FOR THE MATERIAL SPECIFICATION

The repository must have a complete materials inventory to evaluate long term performance under repository conditions. Austenitic stainless steel has been selected as the container material for WVDP. This specification acknowledges that fact and establishes the repository's interest in this interface. Additionally, identification of the materials is necessary to assure that the canister material, and the material of any other component present in significant quantities (i.e., secondary canisters and welding fillers), are compatible with other materials in the repository.

2.2 RATIONALE FOR THE FABRICATION AND CLOSURE SPECIFICATION

The canister is designed to provide containment of the waste during handling up to packaging in a repository container to prevent escape of waste, liquids, gases, and particulates. Additionally, the canister must provide protection of the waste form from contact with externally derived liquids and gases until the canister is sealed in a repository container.

2.3 RATIONALE FOR THE IDENTIFICATION AND LABELING SPECIFICATIONS

The regulatory requirements in 10 CFR 60.135(b)(4) state that "A label or other means of identification shall be provided for each waste package. The identification shall not impair the integrity of the waste package and shall be applied in such a way that the information shall be legible at least to the end of the period of retrievability. Each waste package identification shall be consistent with the waste package's permanent written records."

This specification provides a means of tying the waste package and the waste form together through the retrievability period. The 92 point sans serif type face (Megaron Bold Condensed or equivalent) results in a letter height of approximately 3 cm and width of approximately 2 cm which has been judged to be adequate dimensions for visibility.

3. CANISTERED WASTE FORM SPECIFICATIONS

3.1 RATIONALE FOR THE FREE-LIQUID SPECIFICATION

The regulatory requirements outlined in 10 CFR 60.135(b)(2) state that, "The waste package shall not contain free-liquids in an amount that could compromise the ability of the waste package to achieve the performance objectives relating to containment of HLW (because of chemical interactions or formation of pressurized vapor) or result in spillage and spread of contamination in the event of waste package perforation during the period through permanent closure."

3.2 RATIONALE FOR THE GAS SPECIFICATION

The regulatory requirements in 10 CFR 60.135(a) require that "packages for HLW shall be designed so that in-situ chemical, physical, and nuclear properties of the waste package...do not compromise the function of the waste package... "and "The design shall include...consideration of...oxidation/reduction reactions, corrosion, hydriding, gas generation, thermal effects...mechanical stress, radiolysis radiation damage...." In order to demonstrate compliance with the regulations, waste package designers require information on gas generation potential of the waste form.

The intent of this specification is to ensure that gas pressure will not build up inside the container and contribute to loss of containment and dispersion of radionuclides. This specification provides a limit to initial gas pressure and information to index calculation of gas pressure build-up with time due to nuclear decay and temperature changes.

3.3 RATIONALE FOR THE SPECIFICATION FOR EXPLOSIVENESS, PYROPHORICITY, AND COMBUSTIBILITY

This specification is needed to ensure that after closure the canistered waste form does not explode or burn during normal repository operations and accident conditions.

The regulatory requirements as outlined in 10 CFR 60.135(b)(1) state that, "The waste package shall not contain explosive or pyrophoric materials in an amount that could compromise the ability of the underground facility to contribute to waste isolation or the ability of the geologic repository to satisfy the performance objectives."

The regulatory requirements on the waste package as outlined in 10 CFR 60.135(a)(2) state that, "The design shall include but not be limited to consideration of...fire and explosion hazards." The waste form, as a component of the waste packages must comply with this requirement.

3.4 RATIONALE FOR THE ORGANIC MATERIALS SPECIFICATION

This specification is needed to ensure that organic materials that tend to mobilize radionuclides by formation of complexes, etc., or generate gases due to radiolysis are not present in the canistered after closure.

The regulatory requirements on the waste package as outlined in 10 CFR 60.135(2) state that, "The design shall include but not be limited to consideration of the following factors: ...gas generation, radiolysis, radionuclide retardation, leaching...." The waste form, as a component of the waste package must be assessed for compliance.

3.5 RATIONALE FOR THE FREE-VOLUME SPECIFICATION

In general, free-volume is to be minimized for the following reasons: 1) repository design; 2) economical use of repository space; and 3) less volume of water in contact with waste form after breach of containment. Specifically, BWIP has a concern about collapse of the packing into the void, resulting in less than desired density and creating preferential flow paths for radionuclide release. The value of 20% [R3] free-volume has been chosen as the best estimate for repository design requirements and is achievable by the producers under normal operating conditions.

Although it is desirable to have the vast majority of canistered waste forms to have free-volume less than 20 percent [R3], it is recognized that a small fraction of canisters may have free-volumes in excess of this due to operational occurences at the producer's facility. The specification, as drafted, is intended to allow for these cases, to provide the information necessary for assessment of their impact on performance, and to provide the canister-by-canister certifications necessary to demonstrate compliance with likely repository license conditions.

3.6 RATIONALE FOR THE SPECIFICATION FOR REMOVABLE RADIOACTIVE CONTAMINATION ON EXTERNAL SURFACES

This specification is necessary to protect personnel, prevent uncontrolled spread of contamination in repository facilities, minimize need for remote maintenance of facility equipment, and minimize need for cleanup of contamination during normal operations.

The specification limits chosen are used extensively in the nuclear industry practice and regulations to indicate surfaces are free of removable contamination.

3.7 RATIONALE FOR THE HEAT GENERATION SPECIFICATION

A heat generation rate limit must be set to ensure that the temperatures reached in other disposal package components or the host rock do not significantly reduce their performance capabilities.

Repository designers need a number with which to work to ensure that repository thermal load limits are not violated. The value of 800 watts was chosen as an expected upper bound for production from the WVDP facility. WVDP will determine the attainable accuracy in planned testing and report it for evaluation by repositories in the WCP. The variation in normal expected heat generation rates is necessary to allow assessment of uncertainties in repository performance.

3.8 RATIONALE FOR THE SPECIFICATION FOR MAXIMUM DOSE RATES

The repository projects need the maximum gamma and neutron dose rates in order to design shielding for the receipt and handling facilities. The value of 10^5 rem/hr for maximum gamma dose rate and 10^3 rem/hr for maximum neutron dose rate provide a reasonable basis for repository design and operation and are judged to be sufficiently above the expected dose rates for WVDP wastes to provide reasonable flexibility for normal operations.

3.9 RATIONALE FOR THE CHEMICAL COMPATIBILITY SPECIFICATION

The specification is required to assure that the canister can be safely handled during storage, transportation, and repository operational periods, and to provide needed data for assessment of long term performance of the waste package components.

3.10 RATIONALE FOR THE SUBCRITICALITY SPECIFICATION

The regulatory requirements as outlined in 10 CFR 60.134(b)(7) state that, "The calculated effective multiplication factor k_{eff} must be sufficiently below unity, to show at least a 5% margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to evaluate the method of calculation."

Subcriticality of multiple canister arrays at the repository is the responsibility of the repository designer.

3.11 RATIONALE FOR THE SPECIFICATIONS FOR WEIGHT, LENGTH, DIAMETER, AND OVERALL DIMENSIONS

The specifications on weight, length, diameter and wall thickness of the canistered waste form are needed for the repository design of handling requirements and waste packages. The overall dimensions of the canistered waste form must be such that (1) no forcing is required to place it in the disposal package container to prevent damage to the inside of the container and (2) there is compatibility with container geometry.

3.12 RATIONALE FOR THE DROP TEST SPECIFICATION

This specification is necessary to ensure that the canistered waste form is not breached after a drop. The height of 7 m [R4] was chosen as representative of the maximum drop height under normal operating conditions. Repository facilities will be designed to ensure that larger drops of bare canisters are not possible. The surface which is characteristic of repository conditions has been defined as a "flat, essentially unyielding" surface.

3.13 RATIONALE FOR THE HANDLING FEATURES SPECIFICATION

This specification reflects the lifting and handling requirements necessary for compatibility with current waste package concepts. The specification is drafted to allow the producer maximum flexibility in design of the canister handling arrangements.

4.0 RATIONALE FOR THE QUALITY ASSURANCE SPECIFICATION

All activities relevant to licensing of a repository must be conducted in accordance with appropriate Quality Assurance controls. OCRWM quality assurance policies and requirements are described in the referenced document. Producer activities must be conducted to comply with the program established by OCRWM.

APPENDIX B

EXPLANATION OF RESERVED ITEMS

R1 - Radionuclide Inventory Specification

Specification 1.2 establishes a minimum concentration of 0.05% (curies) of the total inventory for the reporting of radionuclides. This value is considered to be adequate based on a preliminary analysis by one of the repository projects; consequently, 0.05% is being held in reserve pending final analysis by repository projects.

R2 - Specification for Radionuclide Release Properties

At the time of publicationof the WAPS, the test procedures and acceptance criteria for Specification 1.3, Specification for Radionuclide Release Properties, are not available. These specifications and criteria are being developed along with each project's Site Characterization Plan and depend upon site-specific performance allocations for the waste form. These procedures and acceptance criteria will be added to the specifications when they become available.

R3 - Free-Volume Specification

Specification 3.5 allows 20% free-volume within the canistered waste forms. 20% is being held in reserve pending final analysis by the repository projects.

R4 - Drop Test Specification

Specification 3.12 requires a drop test be performed from a height of 7 m. This value is being held in reserve pending testing analyses by WVDP.

R5 - Time of Compliance

"Time of Compliance" for the specification remains reserved pending further discussions within the DOE.

R6 - West Valley Canister Wall Thickness

The West Valley Canister Wall Thickness remains reserved pending further analyses by WVDP and repository projects.

Attachment D

PROPOSED AGENDA
MAY 8, 1986

NRC - DOE MEETING ON WASTE ACCEPTANCE

Forrestal Building

o	Introductions	DOE, NRC	8:30 a.m.
o	Presentation on Waste Acceptance Process (WAP)	DOE	8:45 a.m.
o	Comments and Discussion	NRC, DOE	9:15 a.m.
o	Presentation on the Waste Acceptance Preliminary Specifications (WAPS)	DOE	10:15 a.m.
o	Comments and Discussion	NRC, DOE	11:15 a.m.
o	Lunch		12:00 noon
o	Comments and Discussion (Con't)	NRC, DOE	1:00 p.m
o	Future DOE/NRC Interactions	DOE, NRC	2:15 p.m.
o	Agreements	DOE, NRC	2:45 p.m.