Department of Energy
Washington, DC 20585

OCT 2 4 1988

Mr. John Linehan, Chief
Project Management and Quality
Assurance Branch
Division of High-Level Waste
Management
Office of Nuclear Material
Safety and Safeguards
U.S. Nuclear Regulatory Commission

Dear Mr. Linehan:

During previous conversations, Mr. Edward Regnier (DOE) and Mr. W. Walker (NRC) agreed to exchange lists of open items regarding the Waste Acceptance Process (WAP). Similar discussions were also held during the DWPF WAP meeting on September 29-30, 1988. Accordingly, a consolidated list of open items regarding the Waste Acceptance Process is forwarded herewith. This consolidated list of open items was prepared from various letters and minutes of meetings, spanning a period of several years, approximately 1982 to present.

We will look forward to receiving a similar list from NRC with the intent of developing a single open items list that we both could work from in resolving the issues involved.

If you have any questions concerning this matter, please feel free to contact Mr. Gordon Appel of my staff at 586-1462.

Sincerely,

Ralph Stein

Ralph Stein
Associate Director for Systems
Integration and Regulations
Office of Civilian Radioactive
Waste Management

Enclosure

cc: W. Walker, NRC

109.1
NH01
wm-1

CONSOLIDATION LIST OF OPEN ITEMS REGARDING WASTE ACCEPTANCE PROCESS FROM VARIOUS LETTERS AND MEETING MINUTES

A. LETTER: A.T. CLARK TO W. HANNUM, APRIL 11, 1985
B. LETTER: H.J. MILLER TO R. STEIN, DECEMBER 16, 1985
C. MEMO: J.J. GREEVES TO J. LINEHAN, MAY 30, 1986
D. MEETING MINUTES: DOE NRC MEETING ON THE WASTE ACCEPTANCE PROCESS AND WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS JULY 31, 1986
E. MEETING MINUTES: DOE/NRC MEETING ON WASTE ACCEPTANCE DECEMBER 9-10, 1986
F. MEETING MINUTES: WVDP TECHNICAL EXCHANGE MEETING FEBRUARY 18-19, 1987
G. MEETING MINUTES: WEST VALLEY DEMO PROJECT TECHNICAL EXCHANGE WITH NRC, FEBRUARY 2-3, 1988

1.0 REPOSITORY RELATED ITEMS

1.1a Establish a Quality Assurance Program [This items includes QA Programs and production QC plan of the Waste form producers, which should be in conformance with the overall OCRWM QA program] (B)

b. Early NRC involvement through its own independent audits or reviews of the waste form producer facilities would be beneficial to DOE in licensing. Without such direct NRC involvement, there will be a risk that the QA program may be found inadequate or new issues raised late in the formal licensing process by NRC. (D)

1.2 Allocate performance for the Waste Package components. (B)

1.3 Identify design goals for the Waste Package components. (B)

1.4 Identify Waste Package performance assessment methods. (B)

1.5 Identify the data base required to support the performance assessment and the data base that exists.

1.6 Identify the plan to acquire performance assessment data.

1.7 If the DOE decides to take no credit for the waste form in controlling release of radionuclides, it will still be necessary to characterize the waste form. The DOE performance assessment should determine the level of sampling required to support it. (E)

2.0 WASTE GLASS RELATED ITEMS

2.1 3 pages of specific comments on West Valley Project Plan by NRC staff (see attachment 1). (A)

2.2(a) Provide data to show that the Waste form will not degrade the waste package. (Letter from J. Martin, NRC to T. Hindman, November 4, 1982. (B)

(b) The process canister material should be compatible with the overpack and it should not degrade the overpack. (B)

3 other design and QA items as listed below:

(1). Designers should also assure that sufficient materials margin exists in a 1/4 inch thick carbon steel canister to withstand the interim storage environment for a conservative period of time (perhaps 30 years). There will be some internal corrosion of the process canister by the glass during the pouring and cooling cycle. The canister will be stressed as a result of shrinking more than the glass during the cooling cycle. Finally, some external corrosion is likely to occur from storage in humid air while the waste form is at elevated temperature.

(2.) Designers should also assure that mechanical interactions between the process canister and the outer liner do not have an adverse impact on the outer liner during shipment.

(3.) An appropriate level of graded QA consistent with the importance of such interactive effects on Waste Package Performance will be needed from the outset.

2.3 NRC's need to review preliminary waste package performance assessments, the specifications for

the solidified product, and sampling procedures including a quality control plan for production and sampling. (B)

2.4 Perform glass testing under repository type conditions. (B)

2.5 The producer should demonstrate that the expected range of waste glasses have acceptable performance in the repository.

2.6 7 pages of NRC comments on Draft Waste Acceptance Preliminary Specifications (see attachment 2). (C)

2.7 Provide more details on specification 1.3, Radionuclides Release. (D)

2.8 a NRC believes that sampling of the Waste Glass during operations is necessary. (D)

b DWPF methods to measure properties of the waste form indirectly by microwave and by infrared techniques. DWPF indicated that the success of these indirect methods could affect the sampling program. DWPF asked if this would modify the need for production sampling. The NRC staff reply is that production sampling would still be required for process control and to obtain direct correlations with process qualification testing, although frequencies might potentially be modified. (E)

c DWPF plans to use process control and sampling as the basis for acceptance of the waste form. In order to do this, process variables and samples at various points in the process should be correlated with destructive testing of full-size non-radioactive glass monoliths. (E)

2.9 NRC wants verification of two key assumptions of the hydration model for glass leaching. (E)

2.10 Long-term testing of boresilicate glass should be considered. (E)

2.11 Nondestructive evaluation of the closure weld should be considered. (E)

2.12 Site-specific leach tests should be performed under a suitably conservative range of repository

conditions as defined in the Site Characterization Plan. (E)

2.13 Eh and Oxygen fugacity issues need to be resolved. (E)

2.14 7 NRC Observations (see attachment 3). (F)

2.15 Certain agreements made by the NRC at the Technical Exchange last year apparently still open items. (G)

a. A preliminary plan for the frequency of sampling of the melter feed product will be provided in the Waste Compliance Plan currently scheduled for release in September of 1988. WVDP is coordinating input from Savannah River with regard to the Waste Compliance Plan and resolution of WAPS.

b. Sampling Capability.

The capability for sampling glass shards from the top of the production canisters is included in test plans.

c. The effect of iron corrosion products in the groundwater on leaching behavior of glasses has not yet been assessed.

ATTACHMENT 1

LTR: CLAR TO HANNUM 4/11/1985

Specific Comments on
West Valley Project Plan by
NRC Staff

1. The following are topics selected for interest by NRC staff because of their inherent relation to public health and safety at the site. We encourage early discussion of the safety aspects of these topics prior to their treatment in Safety Analysis Reports: 1) testing of individual components of the off-gas system, 2) techniques to be used in accident analysis, 3) effects of natural phenomena on structures, systems, and components, 4) design and operational details on components to be used for radioactive liquid transfers from (or to) the waste tank farm and, 5) analysis of potential for (and consequences of) explosions or spills of molten glass from the melter or receiving canister.

2. We will continue our interest in your quality assurance program as it relates to those items identified as important to safety in your classification scheme. We will conduct some independent confirmatory analysis on these systems.

3. Possible use of Tank 8D-1 for supernatant processing should consider the need for emergency transfer if 8D-2 fails.

4. With respect to your schedule for submission of safety analysis reports, for our planning purposes it would be helpful to also show environmental and other similar documentation, as for example, the environmental assessment concerning the disposition of Project low-level waste, which we understand will be submitted for comment this year.

5. We request at the earliest availability a copy of the waste form qualification test plan. In your June 17, 1983 letter you acknowledged the intent of DOE to discuss the test matrix with NRC before undertaking such testing. Consultation with NRC on assessment of the waste form qualification test results should also be planned. These tests are especially important because, (1) tests to date supporting glass as a waste form have not been conducted using repository conditions, and (2) because of uncertainty about how the glass will interact with other components of the engineered barrier system. Also, the Savannah River Laboratory data base for borosilicate glass should not be used without demonstrating applicability to the West Valley glass.

   The waste form qualification tests should be designed to demonstrate degradation of the waste form under anticipated repository environmental conditions. The number of specimens, the number of tests, measurements

of the test specimens, test parameters and the results should be designed so that probability distribution functions may be calculated for the data that is generated. The test specimens must be representative of the product; therefore, the physical and chemical properties of the test specimens must represent the full range of properties that will be encountered in the borosilicate waste glass monoliths (i.e., range of chemical composition, radionuclide content, crystallinity and source strength). We are not aware of any DOE tests to date that have included this level of planning.

6. On page 16, the first full paragraph discusses the overall schedule leading to vitrification. NRC considers that this schedule (figure 1) would be more meaningful if the following items had been shown before vitrification:

   a. transmit detailed high-level waste qualification test plan showing integration with repository requirements to NRC for review and consultation.

   b. perform high-level waste form qualification tests.

   c. transmit assessment of high-level waste form qualification test results to NRC for review and consultation.

   We recommend that the above items be scheduled as early as practicable so as not to delay the vitrification schedule.

7. On page 18, the last sentence of the third full paragraph says "as with the waste form the NRC will be consulted regarding canister criteria and design."

   Early consultation on canister criteria and design will be important and productive. Note, however, that NRC will be unable to provide final guidance until the West Valley high-level waste form designs have been integrated with repository requirements.

8. On page 20, item 2 states that "mixing zeolite with borosilicate glass has not been resolved; other ion exchange media and precipitation are being investigated as backups as well as the zeolite being mixed into different glass formulations to determine which is best."

In addition, the discussion of sludge mobilization on pages 23-26 states "The physical and chemical properties of the sludge may vary considerably over the bottom of the tank. This could present a problem in that the vitrification process requires a relatively consistent feed composition of sludge so effective control of waste glass product composition and activity can be maintained."

Note NRC acceptance of process controls in qualifying the product for acceptance for disposal

As is implied in these statements, process controls through sampling, accurate feed rate measurement, and other means, will be important in demonstrating that the glass product meets standards for acceptability. Such sampling should include withdrawing at a sound statistical frequency, specimens of the actual radioactive product to verify composition and for other analytical purposes. We would appreciate the opportunity to review the quality assurance program as it relates to the process control program for vitrification.

9. On page 28, the first paragraph states that "a glass formulation based upon the data base at SRL was used in all the Pilot Scale Ceramic Melter (PSCM) runs in FY 1983 at PNL. Properties of the glass product (from the PSCM runs) such as leach rate, resistivity, viscosity and crystallinity were determined. In addition to the glass formulation used in the melter runs an optimum formulation is being developed through a statistically designed matrix study in which glass melting and testing of the properties cited above were determined." Please inform us of the reference(s) supporting the above statements.

Show need for PNL support for WIDF

10. Section 4.3.6 Canisters, page 36, states that the design of the canister will be based on the Defense Waste Pilot Facility Canister. The Project Schedule should show the target date for completion of canister design drawings and specifications, including development of the closure process and evaluation of sealed canisters containing glass logs.

ATTACHMENT 2

~~ENCLOSURE 1~~

NRC COMMENTS ON DRAFT WASTE ACCEPTANCE PRELIMINARY SPECIFICATIONS FOR THE WEST VALLEY DEMONSTRATION PROJECT HIGH-LEVEL WASTE FORM and for the DEFENSE WASTE PROCESSING FACILITY HIGH-LEVEL WASTE FORM.

1. Page 3. Section 1.1 CHEMICAL SPECIFICATION

The first sentence states that the waste form is borosilicate glass.

This statement is consistent with the definition in the glossary (page 11) of the term "borosilicate glass" but we believe the term should be "borosilicate waste (emphasis added) glass". This first sentence on page 3, therefore, should be revised to state that the waste form is borosilicate waste glass.

2. Page 3. Paragraph 1.1.2 Chemical Composition During Production

The first sentence states that the waste form 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...

We understand the difficulty in measuring oxygen, but we also wish to point out that it may be desirable to determine the valence state of some of the elements present. This may not be possible if the oxygen content is not reported.

Also, it should be clarified whether the measurements of elemental composition will be made on production waste forms themselves, or samples of production glass, or "cold" glass or calculated from the charge.

3. Page 3. Paragraph 1.2.1 Radionuclide Inventory Projections

This paragraph states that the Waste Qualification Report shall contain the producer's estimates of the total quantities of individual radionuclides to be shipped to the repository. It also requires that he provide estimates of the inventories of individual radionuclides expected to be present in canistered waste forms at the facility and the expected range of variations due to process variations during the life of the facility. These estimates are to be calculated for the year 2025.

There seem to be redundant requirements in this paragraph. It is not clear that estimates of total quantities of individual radionuclides to be shipped to the repository (first sentence) is any different than estimates (second sentence) of individual radionuclides expected to be present in canistered waste forms at the facility (because all waste forms emplaced at the repository will be canistered). It also is not clear what is meant by expected range of variations (of inventories of individual radionuclides) due to process variations during the life of the facility.

4. Page 3. Paragraph 1.2.2 Radionuclide Inventory During Production

This paragraph requires the producer to provide at the time of shipment estimates of inventories of individual radionuclides in the canistered waste forms.

This requirement appears to be redundant to the previous paragraph on radionuclide inventory projections. Also, it is not clear whether this means the inventories in individual canisters or the total inventory in a shipment of canisters.

5. Pages 3 and 4. Section 1.3 SPECIFICATION FOR RADIONUCLIDE RELEASE PROPERTIES

This paragraph requires the producer to 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 tests to be specified by the repositories. The paragraph also requires the producer to describe the intended method for demonstrating compliance with each repository requirement in the Waste Compliance Plan. The producer is required to provide in the Waste Qualification Report supporting technical documentation for the selected method of compliance.

A schedule should be provided for completion of the action required by this paragraph, i.e.,

a. Acceptance tests or criteria to be specified by the repositories

b. The Waste Compliance Plan

c. The Waste Qualification Report

We would appreciate an opportunity to review the schedule for these three items and the items themselves (Steps 9, 10 and 11 of the Waste Acceptance Process).

6. Page 4. Section 1.4 SPECIFICATION FOR CHEMICAL AND PHASE STABILITY

The last paragraph requires the producer to certify that the maximum waste form temperature is at least 100°C below the transition temperature. In addition, the producer is required to certify that after initial cooldown, the waste forms are handled, stored and shipped in such a manner that the transition temperature of the waste form is not exceeded.

The waste form producer should be required to obtain prior approval from the repository project(s) for the methods to be used to support the required certification.

7. Page 6. Section 2.1 MATERIAL SPECIFICATION

This section requires that the waste form canister and any secondary canisters be fabricated from austenitic stainless steel. It also requires that the ASTM alloy specification and the composition of the canister material, the secondary canister material, and any filler material in the welding be included in the Waste Compliance Plan. The producer is required to describe the method for demonstrating compliance in the Waste Compliance Plan and document it in the Waste Qualification Report.

a. There should be a materials specification over and above the ASTM alloy specification. This specification should specify the attributes and the acceptance tests or criteria for the canister material, the secondary canister material and any weld filler material, including destructive and non-destructive testing methods and frequency.

b. The producer should be required to obtain prior approval from the repository project(s) of the methods he will use to demonstrate compliance.

c. The term "documented" should be defined, i.e., each document to be included and its content should be identified.

8. Page 8. Section 2.2 FABRICATION AND CLOSURE SPECIFICATION

This section requires the producer to identify the canister fabrication methods, as well as those for any secondary canisters that the producer may apply, in the Waste Compliance Plan and document them in the Waste Qualification Report. The section also requires that the method for

demonstrating compliance with the leaktightness specification (ANSI-14.5-1977) be described by the producer in the Waste Compliance Plan and documented in the WQR.

The producer should be required to gain prior approval from the repository project(s) of the acceptance tests that he plans to use to demonstrate compliance with the Waste Acceptance Specification. The producer should then publish the process that will be used to fabricate the canister and make the closure after the canister is filled with waste glass.

The producer should then fabricate an agreed upon quantity of qualification waste forms (using the process that was published) and evaluate them using the acceptance tests for which prior approval had been obtained. Only after the approved acceptance tests show that the qualification waste forms are acceptable should the producer be released for production. It is not clear that this sequence of events is anticipated. A schedule would be helpful in this regard.

9. Page 5. Paragraph 2.3.2 Labeling

The label material, method of attachment and design life should be specified.

10. Page 6. Section 3.2 GAS SPECIFICATION

The third sentence states that the maximum internal gas pressure immediately after closure shall be 7 psig at 25°C.

The rationale for the 7 psig should be given. Also, the specification should provide a limit on maximum internal pressure generated subsequently by internal processes/mechanisms. The rationale for the limit on subsequently generated internal pressure should also be provided.

11. Page 7. Section 3.6 SPECIFICATION FOR REMOVABLE RADIOACTIVE CONTAMINATION ON EXTERNAL SURFACES

This section includes a requirement that the producer remove visible waste glass on the exterior of the canistered waste form before shipment. This section should also specify that removal of the glass from the exterior of the canister shall not impair the integrity of the canister.

12. Page 6. Section 3.7 FREE-VOLUME SPECIFICATION and Section 3.6 Page A-5, RATIONALE,

This section requires that after closure the free-volume within the canistered waste form shall not exceed 20 percent of the total internal volume of an empty canister.

The rationale for the 20 percent maximum free-volume should be provided.

13. Page 7. Section 3.7 HEAT GENERATION SPECIFICATION and Section 3.7 RATIONALE, Page A-6.

The heat generation rate of 800 watts is almost twice the design value for DHLW for the Salt Project (423 watts). This discrepancy should be explained.

14. Page 8. Paragraph 3.11.1 Weight Specification

The second sentence states that the measured weight shall be specified in the production records.

Does "specified" mean "reported"?

15. Page 8. Paragraph 3.11.3 Diameter Specification

The diameter is specified as 61.0 cm for the West Valley Demonstration Project High-Level Waste Form.

We note that the diameter of the NNWSI high-level waste form was specified as 32 cm in UCID 19926, December 1983. This apparent discrepancy should be resolved.

Also, no dimensions are given for the possible secondary canister mentioned in Section 2.1.

16. Page 9. Section 3.12 DROP TEST SPECIFICATION

This section requires the canistered waste form to be capable of withstanding a drop of 7 meters onto a flat surface without breaching.

The repository designs for surface handling of the canister show the possibility of a drop on a sharp corner. The 7 meter drop on a flat surface, therefore, does not appear to represent the maximum credible drop accident.

17. Page 9. Section 3.13 HANDLING FEATURES SPECIFICATION

This section requires the producer to design and provide the canistered waste form with a neck and a lifting flange that meets very general criteria, e.g., "that meets applicable codes and standards for use at the repository."

The applicable codes and standards should be identified.

18. Page 11. Glossary Organic Material and Page A-4, Section 3.4 RATIONALE FOR THE ORGANIC MATERIALS SPECIFICATION

Organic material is defined in the glossary as 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.

This definition should be more definitive so as to consider carbon compounds which are not organic materials but which may react with other materials to form organic materials (e.g., carbon dioxide and carbon monoxide reacting with water to form organics such as formaldehyde and formic acid within the canisters).

19. Page A-2. Section 1.4- RATIONALE FOR THE SPECIFICATION FOR CHEMICAL AND PHASE STABILITY

The first paragraph states that the borosilicate glass waste forms will retain release properties similar to those obtained under Specification 1.3 (RADIONUCLIDE RELEASE PROPERTIES) so long as the phase structures and compositions of the glass are unchanged from those provided under Specification 1.1 (CHEMICAL SPECIFICATION).

We do not think the above statement has been substantiated. We believe changes in release properties may result from any energy input. DOE should state that (1) tests to date support the conclusion that neither energy input nor radioactive decay contribute to degradation of the glass structure during the design life of the waste form (the appropriate references should be included) and that (2) it is unlikely that any spontaneous transitions, such as that of beta dicalcium silicate to gamma dicalcium silicate at about 525°C as reported in studies of cement chemistry, will occur (appropriate references should also be provided for this statement). Any other mechanisms for structural degradation that were observed during development of the glass waste form should be noted and the reasons for dismissal stated. For example, the cracking of the waste form during cooling and the cooling rate needed to minimize cracking should be discussed.

20. Page A-5. Section 3.6 RATIONALE FOR THE SPECIFICATION FOR REMOVABLE RADIOACTIVE CONTAMINATION ON EXTERNAL SURFACES

The second paragraph in this section states that the specification limits chosen are used extensively in the nuclear industry practice and regulations to indicate surfaces are free of removable contamination. The appropriate references should be cited.

ATTACHMENT 3

WVDP TECHNICAL EXCHANGE MEETING, February 18-19, 1987

NRC Observations:

1. The final closure design for the canister is yet to be selected. The canister configuration and design of the final closure should be resolved prior to production processing. The design of the final closure should be established so that the canister can be machined or otherwise prepared or shaped before being loaded and, therefore, minimize the necessity for future remote operations.

2. Envelope conditions that bound the significant environmental parameters should be established for each of the candidate repository sites. The degradation behavior of WVDP glass should be determined under these envelope conditions. The envelope conditions from the salt and basalt sites should include the presence of iron in the groundwater that will result from the corrosion of carbon steel overpacks.

3. Glass density determinations can serve as sensitive indicators of compositional changes. Changes in density of ±0.0005 ($gram/cm^3$) can be used to signal compositional changes on the order of ±0.5 to 1.0% by weight in certain oxides. Offsetting changes in certain oxide components can, however, produce no change in density. For that reason, density could be only one of several methods used to monitor compositional constancy. Slurry feed viscosity may be useful as would composition analyses on the finished product.

   Density determinations could be performed on each and every log, whereas compositional analyses could be performed on a corroborating sampled basis. Samples for both the above determinations could be obtained from shards from the top surfaces of each canister.

   A target density could be established for a desired composition. If that composition were to change, a new target would then be established.

4. West Valley noted that a small percentage of the total glass log production might be outside the waste acceptance specifications. Perhaps the greatest concern is that the durability of the logs might be lower than targeted. Discussions with the repository organizations should be initiated to identify whether these are a problem and, if so, to outline an approach to dealing with it.

5. Some glass compositions will degrade more rapidly when exposed to high humidity (e.g., 75% RH) than when totally wet (e.g., 100% RH) or relatively dry (e.g., <50% RH). If such a condition alternates with a wet (washing) condition, then long-term degradation may be enhanced. It is suggested that this phenomenon be studied.

6. Leach test programs at CUA and PNL involve testing some samples of the same composition at both laboratories. This interlaboratory cross testing offers an important validation of leach rates and other glass properties. The NRC staff encourages use of this approach in DOE test programs.

7. Under contract from the NRC, the NBS has a Data Base Management System (DBMS) for use in compiling reviews of DOE waste package test data. Software is being written to adapt the DBMS to the requirements of this data base. The experiences of the NBS workers may serve the Materials Characterization Center in the current database activity being undertaken.