PLAN FOR QUALIFICATION OF EXISTING DATA FOR WASTE ACCEPTANCE (U)

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PLAN FOR QUALIFICATION OF EXISTING DATA FOR WASTE ACCEPTANCE (U)**INTRODUCTION AND SUMMARY**

Research and development in support of the DWPF began during the 1970's at the Savannah River Technology Center (formerly the Savannah River Laboratory). A large amount of data relevant to compliance with the Waste Acceptance Product Specifications¹ (WAPS) was generated prior to the preparation and issue of the WAPS. Thus, most of this data was not generated under a quality assurance program which meets the Office of Civilian Radioactive Waste Management's requirements.²

The DWPF has developed a plan for qualification of existing data sets which will be used to establish compliance with the WAPS, which is reported here. In this document, the existing data sets which will be used for compliance are identified, and the method(s) of qualification of each data set for use in the Waste Form Qualification Report is defined. This document thus provides a link between the detailed descriptions of all of the compliance activities in the Waste Form Compliance Plan³ (WCP), and the requirements for qualification of existing data sets used for compliance purposes. All of these data sets will be qualified by the end of Qualification Runs in the DWPF.

BACKGROUND

Research and development in support of the DWPF began during the 1970's at the Savannah River Technology Center (formerly the Savannah River Laboratory). A large amount of data relevant to compliance with the WAPS was generated in support of facility and equipment design. Facility and equipment design, much of the construction, and fabrication of some of the major equipment systems (e.g., the canister welder) were completed prior to the preparation and issue of the WAPS and the WCP. Prudent stewardship of public monies demands that this data not be discarded unnecessarily.

These data collection efforts were initiated under the quality assurance programs and accepted practices of the Department of Energy (and its predecessors) and the operating contractor. However, the WAPS requires that the DWPF

"shall establish, maintain and execute a quality assurance (QA) program that applies to the testing and analysis activities that demonstrate compliance with these WAPS during waste form qualification ... The [DWPF] shall impose a QA program consistent with the QA requirements that govern HLW as identified in the RW Quality Assurance Requirements and Description (QARD)² and the Civilian Radioactive Waste Management System's Waste Acceptance Systems Requirements Document.⁴"

The DWPF has complied with this requirement by developing a quality assurance program which has been described in a Quality Assurance Program Description,⁵ and implemented through procedures. The Savannah River Technology Center actually implemented these requirements in 1989 for work used to establish compliance with the WAPS. However, earlier work clearly could not be performed in accordance with this quality assurance program, because the completion of much of this early work preceded imposition of the requirements by several years. Thus, this early work must be qualified prior to its use to establish compliance with the WAPS.

Each of the existing data sets and qualification of data activities in this report are already identified in the Waste Form Compliance Plan. However, the qualification of data activities in the WCP are not discussed in those terms. Thus, in this report, the qualification of data activities are extracted from the WCP, and viewed in the light of the Office of Civilian Radioactive Waste Management's quality assurance requirements. No additional activities are identified beyond those in the WCP are identified; each of these is already in the DWPF Integrated Schedule. Qualification of each of the existing data sets discussed will be completed by the end of the DWPF Qualification Runs.

QUALIFICATION METHODS

Existing data sets to be used to establish compliance with the WAPS must be qualified using the methods identified in NUREG-1298.⁶ These methods are:

- Determination of equivalent controls. This requires establishing that the controls actually applied to generation of the data set in fact are equivalent to those which would be applied under the current quality assurance program.
- Use of corroborating data. This requires collection of other relevant independent data sets (for example, from the literature on a particular topic) and their comparison to the data set in question. Corroborating data are thus used to establish that there is a high probability that the data or the conclusions to be qualified are correct, through a preponderance of evidence.
- Use of confirmatory testing. This requires selection of a significant subset of the existing data set, and independent re-performance of the experiments which generated the data. Confirmatory testing thus is used to establish that there is a high probability that the data or the conclusions to be qualified are correct, by reproducing a portion of the existing data set.
- Peer review. This requires selection of a team of individuals skilled in the technology under question, and their independent review of the data to be qualified. Peer review thus is used to establish that there is a high probability that the data or the conclusions to be qualified are correct, in the judgement of the

peer reviewers. Peer reviews must be conducted in accordance NUREG-1297.⁷

All of the data sets described below (i.e., which will be used to establish compliance with the WAPS and which were completed prior to implementation of the current DWPF quality assurance program⁵) will be qualified using at least one of these methods. In most cases, a combination of corroborating data and confirmatory testing will be used, as described below. The only exception to this is when the confirmatory testing being performed is more extensive than the original testing. In these cases, the original testing will be used to further corroborate the confirmatory testing performed under the current quality assurance program. It should also be noted that the Waste Acceptance Technical Review Group sponsored by the Department of Energy's Office of Environmental Restoration and Waste Management is reviewing all volumes of the WQR. Thus, all data sets used to establish compliance are being independently reviewed. This review process conforms to the requirements for an independent peer review in NUREG-1297.

Existing data sets which will be qualified by Savannah River Technology Center (SRTC) will be qualified in accordance with the Glass Technology Group's Procedures Manual L13-1.⁸ This manual contains procedures which implement the requirements of both NUREG-1297 and NUREG-1298. For existing data sets which will be qualified through testing conducted as part of the DWPF Startup Test Program, the testing will be performed in accordance with the DWPF Startup Manual.⁹ All of this work will be completed by the end of the DWPF Qualification Runs.

EXISTING DATA SETS TO BE QUALIFIED

In the following sections, the criteria used to determine which data sets should be qualified are identified. Then, for each specification in the WAPS, any existing data set to be qualified has been identified, along with the methods to be used for its qualification. The descriptions of the data sets are summary in nature; for details, the reader is directed to the Waste Form Compliance Plan, or the documents referenced in Table 1.

Criteria for Selection of Existing Data Sets

Existing data sets have been selected for qualification based on the following criteria:

- The data set must be important to compliance, as described in the Waste Form Compliance Plan. As the plan for compliance with the WAPS, the WCP identifies all data sets which will be used to establish compliance with the WAPS.
- The existing data set must have been generated prior to imposition of the current quality assurance program. In practice, this means that any data set used to establish compliance with the WAPS

which was generated prior to 1989 is necessarily included.

Existing Data Sets to be Qualified, and Method of Qualification

The existing data sets to be qualified are identified below, as is the method(s) to be used for qualification. Each of these is described in more detail in the WCP. The information presented below is tabulated in Table 1 along with the references for the existing work.

- Specification 1.1.1 (Chemical Composition Projections). There are two data sets to be qualified for this specification. These are the determination of glass temperatures after canister filling, performed by R. E. Edwards, and the projections of chemical composition carried out by J. R. Fowler. Edwards' data will be qualified both through corroborating data, and through confirmatory testing. Earlier data generated by Pellarin has been used as corroborating information, so that Edwards' data could be used for centerline cooling experiments required by this specification. As part of the Startup Test Program (WP-23), confirmatory testing will also be performed. This testing will be conducted by measuring the temperatures at several points in canisters equipped with thermocouples, on both the drain and pour turntables, and in an insulated canister storage rack.

Fowler's chemical composition projections will be qualified through comparison of his projections to the analyzed chemical compositions of actual waste glasses. This form of confirmatory testing will also establish the uncertainties in the projections.

- Specification 1.1.2 (Chemical Composition During Production), 1.2.2 (Radionuclide Inventory During Production), and 1.3 (Product Consistency). The work performed by Jenkins establishing the uncertainties of the sampling and agitation systems in the Slurry Mix Evaporator and the Melter Feed Tank will be qualified to establish compliance with these specifications. Earlier data of Weber, Caplan, and Voogd will be used to corroborate the general conclusions of Jenkins' work. Confirmatory testing will be performed as part of Startup Test WP-19, to establish that the errors determined by Jenkins using prototypical systems adequately represent those for the actual systems.

- Specification 1.1.2 (Chemical Composition During Production), 1.2.2 (Radionuclide Inventory During Production), and 1.3 (Product Consistency). The development of a usable glass sampler by the task team headed by Wehner must also be qualified. This will be accomplished as part of the testing performed in accordance with Startup Test WP-39 (NB: there are no test procedures under WP-39; however, the test procedures for WP-14 through 17 will also carry out the testing required by WP-39).

- Specification 1.2.1 (Radionuclide Inventory Projections). The projected radionuclide inventories at various times are based on calculations performed by SRTC using classified computer codes, which cannot be easily independently verified and validated. The temporal portion of these calculations will be qualified by using ORIGEN 2 calculations to corroborate the decay calculations performed. The projections will also be qualified by comparison of the projections to actual radionuclide inventories, which will be determined in SRTC's Shielded Cells Facility. This form of confirmatory testing will also establish the uncertainties in the projections.
- Specification 1.3 (Product Consistency). The current glass frit formulation, Frit 202, was developed prior to the inclusion of the Product Consistency Test in the WAPS. Its adequacy has been confirmed by testing which has established that projected waste glasses based on Frit 202 satisfy the Product Consistency specification.
- Specification 1.4 (Phase Stability). An important part of the DWPF's compliance strategy is the contention that the transition temperature of waste glasses produced by the DWPF should be greater than 400°C, for a wide variety of frit formulations and waste compositions. Confirmatory testing has been conducted using simulated waste glasses based on Frit 202, which confirms this for the glasses projected to be produced in the DWPF.
- Specification 1.4 (Phase Stability). Several sets of calculations have been performed which lead to the conclusion that the canistered waste form should be maintained below 400°C in the Glass Waste Storage Building, most notably those of Tennant. This conclusion will be corroborated by comparing previous calculations to new ones, performed in accordance with the current quality assurance program.
- Specification 1.5 (Hazardous Waste). As part of the effort which led to EPA declaring glass to be Best Demonstrated Available Technology, Applewhite performed TCLP and EP Toxicity testing on samples of simulated waste glass. The glass used was an "average" composition which had been doped with higher than expected levels of the hazardous metals. These tests will be repeated using projected waste glass compositions, again doped with the hazardous metals to high levels.
- Specification 2.2 (Fabrication and Closure). The compliance strategy of the DWPF is based on control of the force required to push the weld plug into the canister, the current applied while the force is applied, and the time of application of the current. Previous work by Kelker, performed in support of development of the welding process, leads to the conclusion that control of these variables will produce a leaktight final canister closure, and that these are the only variables which must be controlled. As part of Startup Test WP-24, a parametric study will be performed

to confirm that these are the only variables which must be controlled during the welding process. Further testing during WP-24 and VN-31 will confirm that the DWPF welding process will produce a leaktight canister closure, if procedures are followed.

- Specifications 2.4 (Canister Length and Diameter), and 3.11 (Weight and Overall Dimensions). Work performed by Edwards and Goudelock demonstrated that canister filling at both the reference rate, and at a rate similar to that expected for upset conditions, did not significantly affect the dimensions of the filled canister. This will be confirmed by measuring canisters produced as part of the Qualification Runs.
- Specifications 3.1 (Free Liquid), and 3.5 (Chemical Compatibility). Based on work performed by Langton, DWPF canistered waste forms should not contain free liquids, most notably water. Harbour confirmed Langton's conclusions using simulated canistered waste forms produced during pilot plant testing. Work performed by Rankin showed virtually no attack of the canister wall by the molten glass pouring into the canister. These conclusions will be confirmed through characterization of canistered waste forms produced during the Qualification Runs. This testing will be conducted as part of Startup Tests WP-22 and WP-23.
- Specification 3.1 (Free Liquid). The most likely manner in which free liquids could enter a DWPF canister would be during the canister decontamination process, when a frit-water slurry is blasted at the canister's surface. Kelker showed that the Inner Canister Closure (ICC) would prevent water from entering the canister during decontamination. This data will be confirmed through testing performed during Startup Tests WP-22. By characterizing the contents of canisters produced as part of the Startup test Program, this testing will demonstrate that the ICC, when installed properly, will prevent liquids from entering the canister.
- Specification 3.7 (External Surfaces). The data of Rankin, Ward, and Magoulas have all shown that the amount of canister wall removed during the canister decontamination process is very small - less than 1 μm . This has been confirmed by testing performed as part of FA-25, during which the amount of canister wall removed by frit slurry blasting has been determined using the actual DWPF systems.
- Specification 3.10 (Subcriticality). The original calculations performed by Clark were intended to be upper bounds in terms of the neutron multiplication factor. Additional calculations have been performed, using more realistic glass compositions and radionuclide inventories, which corroborate that the original calculations were, in fact, bounding.
- Specification 3.12 (Canister Drop Test). The canister impact testing in the WQR was performed under the current quality assurance program, although it was in its infancy. All of the actual

impact testing was performed by Battelle-PNL under a Level 1 procurement. Appropriate procedures were used, and the procedures and the data were included in the document package for this work. Thus, the controls applied were equivalent to those which would be applied now. Corroborating data (results of dropping canisters from 9 m) has been used to further to support the contention that the canisters will withstand a 7 m drop without breach.

REFERENCES

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2. Office of Civilian Radioactive Waste Management, **Quality Assurance Requirements and Description**, USDOE Document RW/0333P, Revision 0, Washington, DC (1992).
3. S. L. Marra, M. J. Plodinec, **DWPF Waste Form Compliance Plan**, WSRC-IM-91-116-0, Revision 1, Westinghouse Savannah River Co., Aiken, SC (1992).
4. Office of Civilian Radioactive Waste Management, **Waste Acceptance System Requirements Document, Revision 0**, USDOE Document RW-0351P, Washington, DC (1993).
5. Defense Waste Processing Facility, **Quality Assurance Program Description, Revision 6**, Document SW4-1.8, Westinghouse Savannah River Company, Aiken, SC (1992).
6. U. S. Nuclear Regulatory Commission, **Qualification of Existing Data for High-Level Waste Repositories**, USNRC Document NUREG-1298, Washington, DC (1988).
7. U. S. Nuclear Regulatory Commission, **Peer Review of Existing Data for High-Level Waste Repositories**, USNRC Document NUREG-1297, Washington, DC (1988).
8. **Glass Technology Procedures Manual**, Procedures Manual L13-1, Revision 29, Westinghouse Savannah River Company, Aiken SC (1993).
9. Defense Waste Processing Facility, **Startup Manual**, Manual SW4-3, Westinghouse Savannah River Company, Aiken, SC (1992).

TABLE 1
EXISTING DATA SETS TO BE QUALIFIED

Data Set	Reference Document(s)
Projected glass compositions	WSRC-RP-89-129, Major Waste Proc. Streams for Waste Glass from Sludge Batch 1 WSRC-RP-89-130, Major Waste Proc. Streams for Waste Glass from Sludge Batch 2 WSRC-RP-89-131, Major Waste Proc. Streams for Waste Glass from Sludge Batch 3 WSRC-RP-89-132, Major Waste Proc. Streams for Waste Glass from Sludge Batch 4 WSRC-RP-89-133, Major Waste Proc. Streams for High Viscosity Waste Glass WSRC-RP-89-134, Major Waste Proc. Streams for Low Viscosity Waste Glass WSRC-RP-89-128, Major Waste Proc. Streams for Waste Glass from Blended Sludge Inventory
Glass temperatures during canister filling and cooling	DPST-87-801, SGM Run 8 - Canister and Glass Temperatures During Filling and Cooldown
Uncertainties of sampling and agitation systems in the SME and MFT	WSRC-RP-91-214, Precision and Accuracy of the SME Prototypic Liquid Sampler
Projected radionuclide inventories of each waste type	WSRC-IM-91-116-3, Projected Radionuclide Inventories and Radiogenic Properties of the DWPF Product (WQR Volume 3)
Development of glass sampler	DPST-88-722, DWPF Glass Sampler Design
Maximum canistered waste form temperature in GWSB	DPST-78-380, Thermal Analysis of DWPF Canister Processing
EPA testing of simulated waste glass	WSRC-TR-90-22, EPA Tests of Simulated DWPF Waste Glass
Development of final closure method for canisters	WSRC-RP-89-693, DWPF Final Closure Welding Development
Canister dimensional changes during pouring	WSRC-RP-89-510 Summary of Post Filling Operations for DWPF Reference Drop Test Canisters
Demonstration that waste glass does not contain free liquids	DPST-83-806, Characterization of Internal Canister Environment during Interim Storage DP-MS-77-155, Compatibility Testing of Vitrified Waste Forms
Development of leaktight temporary seal to be used during decontamination	DP-1720, Development of DWPF Canister Temporary Shrink-Fit Seal
Amount of canister material removed during decontamination	DPST-87-784, Canister Decon Chamber #1 Operability Test Results
Bounding calculation to show $k_{eff} < 1$	DPST-82-965, Nuclear Criticality Safety Assessment of DWPF
Drop testing of prototypic canisters	PNL-6812 UC-721, DWPF Canister Impact Testing

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