ASPECTS OF THE DWPF MELTER SIGNIFICANT TO WASTE ACCEPTANCE (U)

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WSRC-RP-92-323

KEY WORDS: Melter, DWPF,
quality assurance,
RW-0214

February 24, 1992

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ASPECTS OF THE DWPF MELTER SIGNIFICANT TO WASTE ACCEPTANCE

INTRODUCTION AND SUMMARY

The repository program has established quality assurance requirements¹ which are to be applied to activities and items which affect compliance with the Waste Acceptance Preliminary Specifications (WAPS).² In this report, the aspects of the melter which are significant to meeting the WAPS are identified. Based on the Waste Form Compliance Plan³ (WCP), the melter plays a significant role in satisfying specification 1.3 (Product Consistency) by ensuring that feed material is sufficiently vitrified before the glass is poured into the canister.

As discussed below, the aspects of the melter system important for meeting the WAPS are

- The administrative controls and process instrumentation which will be used to assure that glass pouring is not initiated at melt temperatures < 950°C.
- The composition and rate of degradation of the glass contact refractory.

Thus, these are the aspects of the DWPF melter system to which the controls in RW-0214 must be applied.

SPECIFICATIONS OF INTEREST

The WAPS¹ describe the attributes the DWPF product must have in order to be accepted by the repository program for disposal. The Waste Form Compliance Plan (WCP) describes in detail how the DWPF will produce a product with the required attributes. Thus, the WCP can be used to identify those aspects of any item which are important in the DWPF's strategy for satisfying the WAPS. These are the aspects which need to be controlled in accordance with RW-0214.

As discussed in the WCP³ (Part 3, Item 500), the melter plays a role only in meeting the Product Consistency Specification. The DWPF will assure that the glass product meets the Product Consistency Specification through control of the chemical composition of the melter feed material (in the SME). The melter's role is to deliver a vitreous product to the canister which satisfies the specification, i.e., to avoid negating the control actions in the SME, and to heat the material to high enough temperatures to convert the feed to glass.

The melter could conceivably fail in its role if it did not sufficiently convert the feed to glass, if it added significant quan-

titles of detrimental chemical constituents to the glass (e.g., through materials degradation), or if the melter allowed the glass to separate into phases in such a way that an unacceptable product was formed.

Conversion of feed to glass

Bickford⁴ has shown that melter feed needs only to be heated to 750°C to produce an acceptable glass. Based on discussions with J. A. Gentilucci, D. C. Iverson, and the Waste Compliance Group, the DWPF intends to control pouring so that the melt temperature will have to be $\geq 950^\circ\text{C}$ before pouring is initiated. This will assure that melter feed has been converted to glass. Thus, the administrative actions taken to ensure that glass is not poured unless the temperature is $\geq 950^\circ\text{C}$ must be controlled as required by RW-0214. Of necessity, this also means that process instrumentation (particularly that used to monitor the temperature in the melter) must be similarly controlled.

The path followed by the DWPF is not the only one which leads to compliance. Testing of the drain valve and of the pour spout and riser of the current DWPF melter indicate that it is probably not possible for feed material which has not been converted to glass to reach the canister.⁵ Glascock showed that it is not possible to deliver glass from the DWPF melter drain valve at temperatures below 950°C.⁵ Thus, the present design of the drain valve ensures that vitreous material which is delivered to the canister has been heated hot enough to make a glass which meets the Product Consistency Specification. Testing at TNX of the pour spout showed that it was extremely difficult to fill a canister at such low temperatures. Thus, the DWPF could choose to control those aspects of the drain valve and pour spout which prevent glass pouring at low temperatures. In that case, the activities which would need to be controlled would be the design of the orifices, the Zone 1 heater of the drain valve, and the riser and pour spout heater configurations. Since the DWPF has chosen not to follow that path, the testing of the drain valve and of the pour spout and riser give additional confidence that melter feed will be converted to glass prior to delivery to the canister, but these items need not be controlled in accordance with RW-0214.

Materials degradation

The current melter refractory in contact with the glass is Monofrax® K-3. It has a negligible rate of corrosion in the melt, and thus does not significantly affect the composition of the glass. In addition, the species which leach from the refractory into the glass (primarily Al_2O_3 and Cr_2O_3) enhance glass durability, based on the DWPF process control correlations. This theoretical argument is borne out by the results of experimental studies on both large and small-scale, in which simulated waste has been melted in K-3 refractory, with no deleterious effects. Based on the same theoretical arguments, other common refractories should also be

suitable for this service, but these would need testing. If a new refractory were to be proposed for use in the melter, it will also have to be evaluated from this standpoint. Thus, both the composition and the rate of degradation of the refractory must be controlled in accordance with RW-0214.

Phase separation

Molten glass can separate into separate liquid phases, some of which may be less durable than the original melt. The DWPF's glass compositions are designed so that deleterious phase separation is avoided. The melter has no role to play in this.

CONCLUSIONS

Based on the above, the aspects of the melter system important for meeting the WAPS are

- The administrative controls which will be applied to assure that glass pouring is not initiated at melt temperatures $< 950^{\circ}\text{C}$.
- The composition and the rate of degradation of the glass contact refractory.

The design of the drain valve and the pour spout contribute additional assurance that unacceptable glass will not be delivered to the canister, but maintaining the temperature above 950°C is of greater importance.

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