Westinghouse
Savannah River Company

P.O. Box 616
Aiken, SC 29802

WSRC-RP-89-740-TL

Keywords: DWPF Melter, Startup

Retention Period: Permanent

CC: D. C. Nichols, 704-S (5)
R. M. Harral, 704-S
H. H. Elder, 704-S
J. A. Gentilucci, 704-S
W. T. Davis, 704-12S
D. C. Witt, 704-S
R. G. Baxter, 704-S
K. O. Darden, 704-S
P. D. Guidotti, 704-11S
G. F. Rabon, 704-30S
R. M. Novak, 704-30S
G. A. Griffin, 704-16S
SRL Records (4)

August 11, 1989

L. M. PAPOUCHADO, MANAGER WASTE MANAGEMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

ATTENTION: J. B. MELLEN, 704-S (5)

THE DWPF MELTER PROPOSED HEATUP SEQUENCE (U)

The attached memorandum (WSRC-RP-89-740) outlines the proposed heatup sequence of the DWPF Melter. DWPF personnel will use this outline to write the detailed DWPF Melter startup procedure. Any questions concerning this report should be directed to M. E. Smith (5-6471) of my staff.

J R Knight by [signature]

J. R. KNIGHT, RESEARCH MANAGER
DEFENSE WASTE PROCESSING TECHNOLOGY DIVISION

[signature]

C. T. Randall, 704-T
Authorized Derivative Classifier

WESTINGHOUSE SAVANNAH
RIVER COMPANY

WSRC-RP-89-740

Keywords: DWPF Melter, Startup

Retention Time: Lifetime

CC: D. L. McIntosh, 773-A
J. R. Knight, 773-A
L. F. Landon, 704-T
M. J. Plodinec, 773-A
C. T. Randall, 704-T
Large Scale Exper. Group (12)

August 11, 1989

TO: J. T. CARTER

FROM: M. E. SMITH *mes*

THE DWPF MELTER PROPOSED HEATUP SEQUENCE (U)

SUMMARY AND INTRODUCTION

Per the request of DWPT supervision[1], a proposed heatup sequence for the DWPF Melter has been documented in this report. DPST-88-481[2], TNX Job Plan 675-T-88-3-1[3], and WSRC-RP-89-321[4] were used as references for the startup sequence. DWPF personnel will use this report as a guide to write the detailed DWPF Melter startup plan.

C. T. Randall, 704-T
Authorized Derivative Classifier

DESCRIPTION

The DWPF Melter will be started using the lid heaters, riser heater, pour spout heater, zone 1 drain valve heater, and electrodes.

The lid heaters consist of 8 Inconel™ 690 heater tubes mounted horizontally in the melter vapor space. High current is passed through the tubes, producing heat which is then radiated to the vapor space and melt surface.

The riser heater consists of an Inconel™ 690 serpentine strip heater which surrounds the 4.0" inside diameter Inconel™ 690 riser channel. The pour spout heater also consists of an Inconel™ 690 strip heater and surrounds the pour spout channel. Current passing through these strip heaters produces the heat to keep the glass flowing through the riser and pour spout channels between 1050-1100°C.

The drain valve has 5 Inconel™ 690 drain valve heaters. Only the zone 1(top) heater will be used during startup. The others will only be energized when the melter is drained. The bottom four zones of the drain valve heater must normally remain deenergized and locked out to ensure glass containment in the melter.

Four Inconel™ 690 electrodes located below the melt line provide the heat input required to complete the startup and maintain the glass between 1100 - 1150°C. One power supply is connected to the lower electrodes and one to the upper electrodes.

PREREQUISITES

Before starting the heatup of the melter, the following prerequisites must be completed. It should be noted that this is not a complete list for the DWPF Melter, but it includes many of the essential tasks to be done before heatup begins.

1) The first slurry feed batch must be completed and transferred to the Melter Feed Tank. All feed process control criteria must be passed. It is recommended that the calculated liquidus temperature of the first slurry feed batch be no higher than 1030°C, as the startup frit charged in the melter has a high liquidus temperature of approximately 1075°C[5]. By using a feed with a liquidus temperature below 1030°C, the resultant glass in the melter should have a liquidus temperature less than 1050°C after the melter has been filled to its operating level. This frit was selected based on it's relatively low electrical resistance at 700°C[6].

2) The feed delivery system to the melter must be fully operational.

3) The current limit on the lower electrodes must be set at 1000 amps. This is based on the current limit of 5 $amps/in^2$ of electrode surface area that is covered by the glass after the frit has slumped. The frit should slump to cover about the bottom 5 inches of the lower electrodes during the heatup.

4) All electrical and mechanical systems must be checked out, including thermocouples, transmitters, bellows, siphon break, canister turntable, canister handling system, canister level detector systems, melter cooling water system, drain valve, melter/off-gas pressure control, pouring system, sightglass and borescope cameras, and emergency power generators.

5) The power supplies for the melter should be checked. This will require using a dummy load for the electrodes, as well as checking the polarity of the electrodes.

6) Meg-ohm testing of all melter heaters should be done after they are installed without the water hoses, as well as after cooling water flows have been established[4].

7) All melter and off-gas interlocks should be checked. In addition, all alarms values should be in place for the melter and off-gas systems.

8) An empty canister must be in place under the melter, and the bellows should be down on the canister.

9) To minimize the amount of air flow from the melter to the off-gas system (and thereby minimize energy losses), the melter pressure should be set at -1" wc.

DWPF MELTER STARTUP OUTLINE

The DWPF Melter will be brought online in four steps:

STEP 1

A) The lid heaters and zone 1 drain valve heater will be used to heat the startup frit from room temperature to ~700°C. The melter temperature will be monitored by thermocouples in the plenum thermowell and two melt pool thermowells.

Amperage should be manually ramped to the lid heaters such that the surface temperatures of the elements increase less than or equal to 10°C/hr until the lid heater temperatures reach 350°C, or until the lid heater controllers have been tuned. Once the automatic temperature controllers are tuned, they can be used to gradually raise both lid heaters to their operating temperatures (950°C) by increasing their setpoints.

The zone 1 drain valve heater will provide heat input to its surrounding area. Amperage will be manually ramped to the zone 1 drain valve heater from room temperature to 350°C, or until the drain valve heater controller has been tuned. Once the automatic temperature controller is tuned, it can be used to gradually raise the Zone 1 drain valve temperature to 1000°C by increasing its setpoint. The heater element surface temperature rate of rise should be less than or equal to 10°C/hr.

B) After the lid heater temperatures have reached 950°C, the riser and pour spout heaters should be energized and amperage to each adjusted such that their skin temperatures reach 950°C at a rate equal to or less than 10°C/hr. When the temperature controllers for these heaters are used, the controller feedback temperature should be the thermocouple measuring the highest temperature. The riser and pour spout temperatures can be increased concurrently with the melt pool temperature after joule heating has been established as described in Step II.

The riser, pour spout, and drain valve zone 1 temperatures should be increased at such a rate as not to exceed the bulk glass temperatures of the lower glass pool thermocouples. If any problems are encountered during attempts to initiate joule heating via the lower electrodes (Step II), heatup of the riser and pour spout heaters should be discontinued until joule heating can be established. This criteria should be followed to mitigate the possibility of the riser block shifting during the heatup.

STEP II

Joule heating will be established when the frit charge reaches approximately 700°C by using the lower electrodes. As the frit temperature approaches 700°C, the electrical resistivity drops to the point where current can be passed through the molten glass. The combination of energy input from the lid heaters and joule heating by the lower electrodes will raise the melt temperature from 700°C to 1150°C. Due to the high liquidus of the startup frit, every effort should be made to minimize any lost heatup time up to 1150°C. This will reduce possible spinel precipitation. Also, the melt pool temperature should not be allowed to decrease below 1075°C after the normal operating temperature is reached for the same reason.

The lower electrode power supplies will be energized when the glass temperature reaches 700°C as measured by the melt pool thermocouples located just below the frit level. The exact measured temperature at which joule heating can be established will depend on how far below the top of the frit level the thermocouples are located. Each inch level of frit will correspond to a ΔT of ~25°C per inch depth in the frit charge[2]. The lower electrode power supply transformer should be set in the series position for a maximum of 300V to provide the necessary voltage. Due to the inability to tune the power control mode on the lower electrode heater controllers, the amperage control mode should be used. If on the initial application of power to the electrodes a power input of at least 1 kw cannot be achieved, then the electrodes will be de-energized and the procedure repeated after the glass temperature increases 20°C. Once joule heating has been established, power will be manually ramped to the electrodes to achieve a heatup rate of less than or equal to 10°C per hour until 1150°C is reached. Tuning of the controller can then be achieved, and the automatic cascade temperature controller will then be the means to control the lower glass temperature at 1150°C.

The melt pool, riser, and pour spout heaters (steps IB and II) should be slowly increased concurrently at 10°C/hr as described in Step IB. The rate of temperature rise of these heaters should match the bulk glass temperatures obtained in Step II. The temperature of the riser, pour spout, and drain valve zone 1 heaters should be increased until they reach their normal operating temperatures (1100°C for the riser and pour spout and 1000°C for the drain valve zone 1).

STEP III

The melt inventory will be brought up to the normal operating level by slowly feeding slurry to the melter. This slurry feeding (202 blended waste slurry) should be initiated as quickly as possible to mix with the startup frit glass in the melter to lower the liquidus temperature of the glass.

NOTE: The DWPF melter has an interlock that does not allow feeding to the melter if the upper glass temperature is low. At the time that feeding is initiated, the upper glass thermocouples will not be in the glass pool, and will be below the interlock setpoint. The interlock will have to be bypassed until the glass pool is above the level of the control thermocouples. The interlock should be reinstated when the measured temperature is above the interlock value.

The electrical resistivity of the glass at 1150°C is about 1/100th of that at 700°C. The resistance of the glass pool also decreases as the melt level increases. As a result, the current provided to the melter must be increased past the amount which can be delivered with a series power supply configuration. At this point during the filling of the melt pool, the lower electrodes power supply transformer must be changed to the parallel position which has the sufficient amperage.
The lower electrode power supplies must be deenergized to switch the transformer settings. Feeding of the melter will have to be stopped during this timeframe, and then restarted after the tap change is completed.

NOTE: The current limit for the lower electrodes may need to be raised with the increasing melt pool level as long as the curent density does not exceed 5 amps/in^2.

STEP IV

At the time when the molten glass inventory is brought up to the normal level, slurry feeding will be stopped and the upper electrode power supply will be energized. The upper electrode power supply transformer should be configured to the proper parallel position. Power will be manually ramped to the upper electrodes to achieve a heatup rate of less than or equal to 10°C per hour until 1150°C is reached. Tuning of the controller can then be achieved, and the automatic cascade temperature controller will then be the means to control the upper glass temperature at 1150°C.

After the heatup is complete, it is recommended that a temperature profile of the pour spout be taken before pouring glass to determine if the pour spout area (especially the glass exit point) is hot enough for glass pouring. This profile should be evaluated by DWPT Technical personnel. It is also recommended that pouring be initiated as soon as possible after the profile has been approved so that subsequent feeding of the 202 blended waste slurry can further lower the liquidus temperature of the glass pool.

REFERENCES

1. L. F. Landon, "SRL Support Prior to Startup of DWPF Integrated Cold Runs," SRL-PTD-89-25 (August 4, 1989).

2. M. R. Baron and M. E. Smith, "Summary of the Drain and Restart of the DWPT Scale Glass Melter," DPST-88-481 (May 16, 1988).

3. M. R. Baron, "Scale Melter Startup," TNX Job Plan #675-T-88-3-1 (March 1, 1988).

4. M. E. Smith, et al. "Checkout and Startup of the Integrated DWPF Melter System," WSRC-RP-89-321 (in preparation).

5. C. M. Jantzen, "Characterization of the Defense Waste Processing Facility (DWPF) Startup Frit," WSRC-RP-89-18 (April 18, 1989).

6. M. J. Plodinec, "DWPF Melter Startup Frit and Drain Valve Testing,' DPST-87-627 (August, 1987).