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APR 07 1997

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Dear Mr. Saric and Mr. Schneider:

OPERABLE UNIT 4 VITRIFICATION PILOT PLANT PHASE I INTERIM TREATABILITY STUDY REPORT - CAMPAIGN 4

The purpose of this letter is to transmit the Operable Unit 4 (OU4) Vitrification Pilot Plant (VitPP) Phase I, Campaign 4 Interim Treatability Study Report. The submittal of this report satisfies the previously agreed upon reporting requirement as mentioned in the letter dated September 26, 1996, titled, "Operable Unit 4 Vitrification Pilot Plant, Phase I Treatability Study Reporting."

The objectives of Campaign 4 were to: 1) Verify the vitrification of Silos 1 and 2 surrogate material; 2) Gain experience in handling sulfates; 3) Gain experience in handling the high Barium and Lead concentrations; 4) Determine the impacts of Bentonite on the glass chemistry and the process; 5) Determine if low temperature vitrification of surrogate material of Silos 1 and 2 is feasible; and, 6) Determine the maximum production rate of the melter with the surrogate composition.

As you are aware, the melter incident occurred on December 26, 1996, at which time the objectives 1) through 3) had been accomplished. The remaining objectives are expected to be accomplished at a later date to complete the scope of Phase I Treatability Study. The implementation of several recommendations from the Data Analysis and Path Forward Team of the Melter Incident Report will satisfy the remaining Phase I scope. As soon as the remaining data for Phase I are gathered, the final Phase I Treatability Study Report will be transmitted for your review.

Recycled and Recyclable

If you have any questions or concerns with this report, please contact Nina Akgündüz at (513) 648-3110.

Sincerely,

Johnny Reising

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OPERABLE UNIT 4 VITRIFICATION PILOT PLANT PHASE I INTERIM TREATABILITY STUDY REPORT

Campaign 4

40110-WP-0003
REVISION 1

FLUOR DANIEL FERNALD

March 1997
Fernald Environmental Management Project
Fernald, Ohio

OPERABLE UNIT 4 VITRIFICATION PILOT PLANT PHASE I INTERIM TREATABILITY STUDY REPORT

Campaign 4

40110-WP-0003
REVISION 1

INFORMATION ONLY

FLUOR DANIEL FERNALD

March 1997
Fernald Environmental Management Project
Fernald, Ohio

OPERABLE UNIT 4
VITRIFICATION PILOT PLANT

PHASE I INTERIM TREATABILITY STUDY REPORT

40110-WP-0003 - Campaign 4
REVISION 1
March 1997

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LIST OF COMMON ACRONYMS AND ABBREVIATIONS

AEDO	Assistant Emergency Duty Officer
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirements
AWWT	Advanced Wastewater Treatment
AWWTS	Advanced Wastewater Treatment System
Ba	Barium
BAT	Best Available Technology
BST	Building Sump Tank
°C	degrees Celsius or Centigrade
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci/yr	curies per year
cm^2	square centimeter
Cr	Chromium
DACS	Foxboro Data Acquisition and Control System
DCS	Distributed Control System
DOE	U.S. Department of Energy
DOP	DiOctyl Phthalate
DP	Differential Pressure
EOG	Emergency Offgas
EOGS	Emergency Offgas system
EPA	Environmental Protection Agency
°F	degrees Fahrenheit
FACTS	Fernald Analytical Computerized Tracking System
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
ft	feet (foot)
ft^2	square feet
ft^3	cubic feet
gal/hr	gallons per hour
gpm	gallons per minute
HEPA	high efficiency particulate air
HNT	High Nitrate Tank
HVAC	heating, ventilation and air conditioning
HWMU	Hazardous Waste Management Units
kg/m^3	kilogram per cubic meter
KVA	kilovolt-amp
LAN	local access network
lb/d	pound per day
lb/hr	pound per hour
m^3	cubic meter
MAWS	Minimum Additive Waste Stabilization
MEF	Material Evaluation Form
MEPA	medium efficiency particulate air

mg/kg	milligram per kilogram
mg/l	milligram per liter
mL	mililiter
mrem/yr	millirem per year
MT	metric ton
MT/d	metric ton per day
NESHAP	National Emission Standards for Hazardous Air Pollutants
No.	number
NOG	Normal Offgas
NO_x	nitrogen oxides
NPDES	National Pollution Discharge Elimination System
OAC	Ohio Administrative Codes
OATP	Ohio Air Toxics Policy
OGS	Off-gas system
OU1	Operable Unit 1
OU4	Operable Unit 4
OU5	Operable Unit 5
Pb	lead
PbO	lead oxide
PK	Process knowledge
PPE	Personal Protective Equipment
ppm	parts per million
psig	Pounds per square inch gage
PSP	Project Specific Plan
RCRA	Resource Conservation and Recovery Act
RH	relative humidity
ROD	Record of Decision
SCFM	standard cubic feet per minute
S/cm	Siemens/cm, units for conductivity, equivalent to one ampere per volt per cm.
Se	selenium
SOP	System Operating Procedure
SOT	System Operability Test
SO_x	sulfur oxides
TBC	to be considered
TC	toxicity characteristic
TCLP	toxicity characteristic leaching procedure (RCRA)
TDS	total dissolved solids
TSS	total suspended solids
V	volt
VitPP	Vitrification Pilot Plant
VPPS	Vitrification Pilot Plant System (computer database)
VSL	Vitreous State Laboratory of the Catholic University of America, Washington, D.C.
W.C.	water column
WMB	white metal boxes
wt%	weight percent

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1.0 EXECUTIVE SUMMARY

This document, *Operable Unit 4 Vitrification Pilot Plant Phase I Interim Treatability Study Report, Campaign 4*, discusses the glass chemistry and operations activities pertinent to the testing and production of Silo 1 and Silo 2 surrogate glass during Campaign 4. The first Operable Unit 4 (OU4) Vitrification Pilot Plant (VitPP) Interim Treatability Study Report discussing Campaign 1[1] was issued on October 14, 1996. The second OU4 VitPP Interim Treatability Study Report discussing Campaign 2[2] was issued on December 13, 1996. Non-radioactive glass recipes, known as Series A glasses[3], were used In Campaign 4 to simulate the chemical composition of Silos 1 and 2 contents.

1.1 Phase I Treatability Study Background

A total of three campaigns were performed during Phase I testing of the VitPP:

Campaign 1 -- Startup and benign glass tests (completed and interim report issued)

Campaign 2 -- Glasses made from the blending of the Silos 1, 2, and 3 residue surrogates (completed and interim report issued.)

Campaign 3 --Omitted because of proposed stabilization of Silo 3.[4]

Campaign 4 -- Silos 1 and 2 surrogate glass recipes (commenced November 30, 1996 and terminated on December 26, 1996.)

Campaign 4 ended with the inadvertent draining of the molten glass from the melter through bubbler #3 on December 26, 1996. Immediately after this event, three teams were convened to investigate the incident. The Vitrification Pilot Plant Melter Incident: Final Report[5] was issued in February 1997. This Campaign 4, Interim Treatability Study Report does not discuss the Melter incident. The Melter Incident Report recommended that the balance of Phase I data not yet supplied by the VitPP operations, that is needed to support design of the full-scale facility, be gathered at alternate facilities. When this data is available, the final Phase I report can be issued.

The VitPP has a high-temperature (1400 degrees Celsius [°C] design), joule-heated[6] ceramic melter with a nominal production capacity rated at one metric ton of glass per day (MT/d) from slurries. The melter is of a unique three-chamber design to protect the electrodes from the corrosiveness of the silo wastes. The electrodes are placed in two side chambers containing benign glass. The surrogate glass is contained within the center chamber located between the side chambers. In addition to protecting the electrodes from the corrosive surrogate glass, the separation also shields the electrodes from the agitation and oxygenation that occurs in the center chamber. The glass pool surface area of the melter's center chamber is one square yard (3 feet by 3 feet).

1.2 Test Description

VitPP Campaign 4 testing officially started when the first transition slurry batch to adjust the glass in the center chamber from a benign formula to a Series A formula was prepared on November 29, 1996. The Campaign ended on December 26, 1996 with Batch C4B09. Most of the nine batches processed by the melter were high-temperature Series A formulas. (Note: High-temperature testing in this report refers to a 1250°C ± 25°C range; while low-temperature testing refers to a 1150°C ± 25°C range.)

1.3 Objectives

The Campaign 4 general objectives and objective status as of December 26, 1996, included:

1. **Determine if vitrification of OU4 Silos 1 and 2 residues (using surrogates) is feasible.**

   This objective was achieved. Approximately 15,000 pounds (lbs) of glass were produced at 1250°C using six batches of Surrogate Series A slurry. The slurry batches, as fed to the Melter, contained 23 to 57 weight percent (wt%) solids, as measured by the analytical laboratory. Based on the results from the Campaign 4 runs, vitrification of Silos 1 and 2 waste surrogates is feasible at 1250 °C with 78% waste loading by dry weight basis.

2. **Gain experience in handling sulfates when vitrifying Silos 1 and 2 residues.**

   This objective was achieved. Sulfate events occurred (as expected from experience gained by earlier laboratory and bench-scale studies). Operational experience gained during Campaign 2 proved to be useful in handling the sulfates in Campaign 4. A combination of adding water and/or urea to the slurry with adjustments to the amount of power to the melter were effective in controlling sulfate events.

3. **Gain experience in handling the high-barium and lead concentrations in Silo 1 and Silo 2 residues.**

   This objective was achieved for the glass formulas tested. Based on Silos 1 and 2 characterization, the target concentrations of barium oxide and lead oxide in the glass were approximately 4½ wt% and 8½ wt% respectively. The concentrations of barium and lead oxides in the glass approached these target concentrations by Batch C4B05.

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All glasses produced during Campaign 4 passed the toxicity characteristic leaching procedure (TCLP) test for the Resource Conservation and Recovery Act (RCRA). Metals of greatest concern were barium and lead. The barium TCLP regulatory limit is 100 parts per million (ppm) for barium and 5 ppm for lead. The Campaign 4 glasses passed with barium and lead TCLP values below 1 ppm. TCLP samples were run in lots. One lot of samples (Lot 2) consistently gave high values above 1 ppm. Therefore, some of the samples in Lot 2 were rerun. The rerun numbers were significantly lower with values again below 1 ppm. It was discovered that the Lot 2 glass samples were ground signifcantly finer than the other lots prior to the TCLP leaching step. This could account for the higher TCLP numbers of Lot 2.

4. **Determine the impacts of bentonite (from the clay cap in the Silos 1 and 2) on the glass chemistry and the vitrification process.**

   This objective was not achieved; batches containing bentonite were not run.

5. **Determine if low-temperature vitrification of the OU4 Silos 1 and 2 residues (using surrogates) is feasible.**

   This objective was not achieved since the low-temperature runs were not performed.

6. **Determine the maximum production rate of VitPP melter based upon Series A glass production at 1250 °C.**

   Data supporting this objective was gathered during Run 1. Upon review of the data, it can be postulated that the realistic process throughput of the VitPP melter for a series of consecutive batches of Series A formula glass at 1250 °C is approximately 0.9 MT/d. This is in contrast to the maximum production rate of 1.1 MT/d that can be obtained after an idle period that allows the sulfate inventory in the glass pool to be reduced.

The Campaign 4 System Operability Test (SOT) Procedure 2504-SU-0039, Rev.0 provided a plan to meet the Campaign 4 objectives. The following transitions and runs were scheduled:

- Transition 1 consisted of transitioning the glass in the center chamber of the Melter from benign to Series A high-temperature formula.

- Run 1 consisted of testing with Series A glass formulation surrogate slurry at 1250°C. The scheduled testing included:

- Maintaining slurry feed for extended periods at a rate that would produce 1 to 1½ MT/d of glass.
- Gathering process control data to support the slurry formula selection for Run 2.

- Transition 2 consisted of transitioning the glass in the center chamber of the Melter from the high-temperature Series A formula to the low-temperature Series A formula.

Campaign 4 testing was terminated prior to the initiation of Run 2 when the Melter inadvertently bottom drained. The following runs were not executed:

- Run 2 would have tested with low-temperature Series A glass formulas at 1150°C. The scheduled testing included:
  - Maintaining slurry feed for extended periods at a rate that would produce one to one and one-half MT/d of glass.
  - Determining the operating range of the low-temperature Series A formula slurry.
- Run 3 would have tested with Series B formulas. The scheduled testing included:
  - Maintaining slurry feed for extended periods at a rate that would produce 1 to 1 ½ MT/d of glass.
  - Gathering data pertaining to feeding the Melter with bentonite. The operating temperature range was scheduled to vary between 1150 and 1250°C, depending upon initial results.
- Transition 3 would have transitioned the center chamber glass from Series B formula to Series A formula.
- Run 4 would have tested the melter and its ancillary support systems to determine the limiting operational capacities throughout the vitrification process.

1.4 Campaign 4 Operational Results and Issues

1.4.1 Glass Production

During Campaign 4, approximately 70,000 lbs of slurry were vitrified to produce 23,171 lbs of glass in monolith form.

The amount of slurry in each batch ranged from approximately 5,223 lbs for Batch C4B06 to 10,305 lbs for Batch C4B07. The amount of solids in the slurry, fed to the Melter, ranged from approximately 23 wt% for the last portion of Batch C4B08 to 51 wt% for the first portion of Batch C4B09. The amount of glass produced ranged from approximately 1,749 lbs for Batch C4B06 to 4,220 lbs for Batch C4B07. The total production rate of glass ranged from 0.69 MT/d for Batch C4B05 to 1.1 MT/d for C4B07.

A small portion of the glass product was a result of benign side-chamber glass passing through the E-walls (side chamber inner walls) into the center chamber. The glass in the side chambers was introduced as frit and protected the electrodes from corrosion and oxidation. For Campaign 4, the density of the frit added to the side chambers was increased by changing its formulation including the addition of barium. The density of the glass was increased in an effort to retard the flow of glass from the center chamber to the side chamber. The primary uses of the barium-containing frit were to maintain the inventory in the side chambers and to address the foaming that occurred. Barium-containing frit also was added directly to the center chamber in a few instances when the inventory in the center chamber was too low and slurry feeding was not an option.

Approximately 2,300 lbs of frit were added during Campaign 4: 1,050 lbs to the west side chamber, 950 lbs to the east side chamber, and 300 lbs to the center chamber. Frit additions to the three chambers account for approximately 10% of the total amount of glass produced during Campaign 4. Frit additions to the side chambers account for approximately 8.6% of the glass produced. The remaining 1.4% of the frit was added to the center chamber of the melter. Leakage of the frit around and through the E-wall between the melter chambers was only expected to be approximately 5 wt% or 100 lbs per 2,200 lbs. Even though the barium-containing frit was denser than the benign frit used in the previous campaigns, the amount of leakage was greater than originally expected. Most of the additional leakage can be explained by the reduced integrity of the E-walls caused by thermal stress cracking and corrosion by the surrogate waste glass.

Average sustained glass production was 0.9 MT/d when the facility was operating (i.e. when the melter was being fed). The highest process rate of 1.1 MT/d of glass (at 1250°C and 28 to 38 wt% solids) produced 4,220 lbs glass in 41 hours of run time. While Campaign 4 batch slurries initially were between 40 and 50 wt% solids as determined by laboratory results, most batches were thinned to 30 to 35 wt% solids during the feeding process due to slurry feed system problems.

An unanticipated benefit of the additional water in the slurry was the decreased amount of foaming experienced in the Melter. There was repeated evidence that as the slurry

contained more water, the foaming subsided and the production rate improved. This data provided evidence that for Series A formula, which contained approximately 4% barium sulfate, the optimum slurry consistency is approximately 30 to 35 wt% solids. Feeding a Series A formula slurry with a higher wt% solids and a lower wt% water concentration resulted in foaming, which disrupted operations.

1.4.2 Melter Erosion

Slurry feed and glass samples were collected from each batch and analyzed for chemical and physical characteristics. Analytical results indicated that the levels of chromium (Cr) in the glass were low. Mass balance calculations indicated that approximately 46 lbs of chromium oxide (Cr_2O_3) were leached from the refractories during Campaign 4. In comparison, approximately 61 lbs of Cr_2O_3 were leached during Campaign 2.

The concentrations of molybdenum (Mo) in the glass equated to approximately 46 lbs of molybdenum contained in the glass produced during Campaign 4. In comparison, approximately 58 lbs of molybdenum were contained in the glass produced during Campaign 2. While there was a total of 1500 lbs of molybdenum in the electrodes as a whole, there was originally only approximately 500 lbs of it in the sections of the ten electrodes exposed in the side chambers of the Melter. The remaining portions of the electrodes were not exposed to the glass in the side chambers.

1.4.3 Sulfate Issues

During Campaign 4, sulfate effervescence events were varied, but frequent. Slight or minor foaming was reported during batches C4B02, C4B04, and C4B07, while significant or major foaming was reported during batches C4B03 and C4B05. Vitreous State Laboratory (VSL) at Catholic University and FDF laboratory analyses indicated that sulfate solubility in molten glass at 1150 to 1250°C is only ½ to 1% as SO_3. The surrogate slurry contained approximately 1¾ wt% sulfates as SO_3. During feeding, the excess sulfates accumulated near the surface of the glass bath, where they decomposed to SO_x and O_2 gases. When the sulfate accumulation rate was faster than the rate of decomposition, a sulfate layer formed.

Various temperature excursions occurred because the sulfate layer was more electrically conductive than the glass bath. This uneven current distribution was accompanied by a thermal gradient since the surface of the glass melt was hotter than the bottom of the melt, where the main chamber thermocouple was located. (Under normal circumstances, the bottom of the melt pool was 60 to 100 °C hotter than the top of the melt pool.) Frequently, the increased temperature resulted in a foaming event, which decreased the sulfate inventory in the melter and re-established the normal temperature gradient.

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1.4.4 Productivity

The percentage of time the VitPP was producing glass during Campaign 4, known as "uptime," increased from Campaign 2. Uptime is defined as the percentage of time that the melter feed pump feeds slurry to the melter during a 24-hour day. The average amount of uptime during Campaign 2 was 27%. The average amount of uptime during Campaign 4 was 42%.

1.4.5 Redox Issues

The redox state[7] in the melter was maintained in a significantly non-reducing state. The glass bath was not reduced enough for molten lead sulfide and elemental lead to precipitate from the glass melt. The redox state that is conducive to precipitation is when the ratio of Fe^{+2}/total Fe is 0.6 or greater. This was determined by an FDF laboratory study using simulated waste glass reacted with increasing amounts of urea reductant.

Elemental lead that occurred in the melter appears to have resulted from direct reduction of lead oxide (in the glass) with the molybdenum metal of the electrodes or with the molybdenum disilicide ($MoSi_2$) alloy of the bubbler tubes. Also, reboil (super heating) of the glass in cracks of the melter E-wall may be partially responsible for some of the elemental lead.

1.5 Additional Phase I Testing

As a result of the melter incident, the Data Analysis and Path Forward Team recommended in the Vitrification Pilot Plant Melter Incident: Final Report, 40100-RP-00019, Rev. 0[5] a practical approach in pursuing needed data for design, construction, and operation of a vitrification facility -- that is, to focus on techniques and materials of construction. This approach can best be accomplished by eliminating the high-sulfate Silo 3 waste from the vitrification program, thus eliminating the need for a three-chamber design, reducing waste loading to target 60 percent, ensuring an oxidizing environment with close redox monitoring, and providing a means of dealing with molten metals when it occurs.

After evaluating 21 options for obtaining these data, the Melter Incident Final Report Team recommended that the VitPP melter be placed in a safe shutdown condition, and not be restarted. Alternatively, the needed data should be obtained through a combination of:

- Waste retrieval demonstrations
- Melter (or refractory) materials of construction
- Laboratory testing to validate and optimize surrogate formulas that model K-65 residues.
- Pilot Plant scale-up at a 1 MT/d off-site facility with surrogate materials

[1]Operable Unit 4 Vitrification Pilot Plant Phase I Interim Treatability Study Report 40110-WP-0001, Rev. 0, October 14, 1996.

[2]Operable Unit 4 Vitrification Pilot Plant Phase I Interim Treatability Study Report, 40110-WP-0002, Rev. 1, December 12, 1996.

[3]During glass formula development studies, the glasses made were grouped according to the silo wastes they contained or simulated. This designation has continued. Series A glass formulations contain a blend of Silos 1 and 2 residues. Series B glass formulations are the same as Series A, except they also contain high concentrations of the bentonite used as a cap in the silos. Series C glass formulations contain only Silo 3 residues. Series D glass formulations contain a blend of all three silos.

[4]DOE letter, DOE-0041-97, "Deletion of Campaign 3 (Series C Glass Formula - Silo3) From The Operable Unit 4 Vitrification Pilot Plant, Phase I Treatability Study Work Plan, Revision 2," J.W. Reising DOE Ohio Field Office to J.A. Saric U.S. EPA and T. Schneider Ohio EPA,Dated October 15, 1996.

[5]Vitrification Pilot Plant Melter Incident: Final Report, 40100-RP-00019, Rev. 0.

[6]Heat produced from electrical current passing through a conductive material; in this case, it is molten glass.

[7]Redox is a commonly used abbreviation for reduction/oxidation. Reduction is the process during which atoms lose electrons. Oxidation is the process during which atoms gain electrons.

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2.0 GLASS CHEMISTRY AND PROCESS SCALE UP

Campaign 4 deals with the vitrification of the K-65 residues within Silos 1 and 2. This section presents a brief synopsis of the glass chemistry development for the vitrification of the Silos wastes in a chronological order of the following studies: (1) laboratory-scale; (2) bench-scale; (3) the pilot-scale VitPP. Process scale-up relationships between the development studies is presented. Glass chemistry aspects are discussed to gain a better understanding of vitrification for the K-65 wastes. Also included are a brief history of the Silos and descriptions of the wastes within the Silos.

2.1 Silo Background and Contents

2.1.1 Silos Background

Silos 1 and 2 contain thorium and radium residues, known as K-65 wastes. The wastes are residues remaining from processing of pitchblende ores. They are a major source of radon gas because of the high radium concentrations they contain. These wastes also contain high concentrations of radioactive lead, ^{210}Pb. Bentonite clay was placed in the silos to form a cap over the wastes to prevent the escape of radon gas from the waste. The bentonite has now become part of the Silos 1 and 2 wastes.

2.1.2 Silo Contents

Approximately five years ago, samples of the silo residues were collected during the OU4 Remedial Investigation/Feasibility Study (RI/FS). These samples were collected from three zones in each silo using a vibrating core-drilling instrument. Portions of the core-drilled samples were sent to Battelle Pacific Northwest Laboratories (PNL) for characterization; portions were archived. Analytical results of these tests were presented in a treatability report prepared by PNL[1] and are summarized in Table 2-1. Some of the archived samples were analyzed by the FD Fernald labs[2] to verify the PNL results. These results are shown in Tables 2-2 and 2-3. The FDF lab results closely compare to the PNL data. Development activities, thus far, and the data presented in this document are based on the PNL data. Exceptions are noted in Tables 2-2 and 2-3. The elemental composition of the bentonite, for the silo caps is shown in Table 2-4.

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[1] R. A. Merrill and D. S. Janke, Battelle-Pacific Northwest Laboratory, "Results of the Vitrification Treatability Study for OU-4 Residues," dated February 1993.

[2] Other outside laboratories are currently being considered to analyze the silo wastes to verify the data.

Table 2-1
Silos 1 and 2 Compositions According To PNL Analysis
(Quantities in wt%)

Rank	SILO 1			SILO 2		
	Component	Measured	Normalized	Component	Measured	Normalized
1	SiO_2	50.00	58.06	SiO_2	51.00	60.23
2	PbO	12.00	13.93	PbO	6.20	7.32
3	BaO	6.30	7.32	Fe_2O_3	6.10	7.20
4	CO_2	3.20	3.72	Al_2O_3	3.40	4.02
5	Al_2O_3	2.60	3.02	CO_2	3.40	4.02
6	Fe_2O_3	2.50	2.90	BaO	3.00	3.54
7	Na_2O	1.80	2.09	CaO	2.50	2.95
8	SO_3	1.80	2.09	MgO	1.70	2.01
9	MgO	1.20	1.39	SO_3	1.70	2.01
10	K_2O	0.68	0.79	Na_2O	0.88	1.04
11	P_2O_5	0.62	0.72	K_2O	0.68	0.80
12	MoO_2	0.43	0.50	P_2O_5	0.68	0.80
13	La_2O_3	0.42	0.49	N_2O_5	0.62	0.73
14	NiO	0.42	0.49	UO_2	0.47	0.56
15	Ce_2O_3	0.41	0.48	NiO	0.36	0.43
16	CaO	0.37	0.43	Ce_2O_3	0.33	0.39
17	N_2O_5	0.29	0.34	TiO_2	0.33	0.39
18	TiO_2	0.28	0.33	La_2O_3	0.29	0.34
19	CoO	0.19	0.22	CoO	0.21	0.25
20	Nd_2O_3	0.19	0.22	Nd_2O_3	0.16	0.19
21	SrO	0.08	0.10	ZrO_2	0.14	0.17
22	Cl	0.08	0.09	CuO	0.08	0.10
23	V_2O_3	0.06	0.07	Cr_2O_3	0.08	0.10
24	CuO	0.06	0.07	V_2O_3	0.08	0.10
25	ZrO_2	0.05	0.06	MoO_2	0.08	0.09
26	SeO_2	0.05	0.05	SrO	0.06	0.07
27	Cr_2O_3	0.02	0.02	As_2O_3	0.05	0.06
28	MnO_2	0.01	0.02	SeO_2	0.04	0.05
29	BeO	0.01	0.01	MnO_2	0.03	0.04
30	F	0	0.01	ZnO	0.01	0.01
31	As_2O_3			Cl	0	0.01
32	CdO			F	0	0.01
33	Li_2O			BeO		
34	ThO_2			CdO		
35	UO_2			Li_2O		
36	Y_2O_5			ThO_2		
37	ZnO			Y_2O_3		
	Totals	86.12	100.00		84.68	100.00

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Table 2-2
Silo 1 Residue Composition
as Measured by FDF Labs 11/22/96

a Element as Oxide	b Analyzed wt%	c Normalized wt%	d Stoichiometric mole %	e PNL Anal. Wt%	f c - e wt%
Al_2O_3	2.63	2.91	2.04	3.02	-0.11
B_2O_3	0.36	0.40	0.41	0.00	0.40
BaO	5.81	6.44	3.00	7.32	-0.88
CO_2	3.36	**3.72**	6.05	3.72	0.00
CaO	0.24	0.27	0.34	0.43	-0.16
Fe_2O_3	2.10	2.33	1.04	2.90	-0.57
K_2O	0.12	0.13	0.10	0.79	-0.66
Li_2O	0.19	0.21	0.50	0.00	0.21
MgO	0.29	0.32	0.57	1.39	-1.07
MnO_2	0.01	0.01	0.01	0.01	0.00
N_2O_5	0.31	**0.34**	0.23	0.34	0.00
Na_2O	1.73	1.92	2.21	2.09	-0.17
NiO	0.44	0.49	0.47	0.49	-0.00
P_2O_5	0.65	**0.72**	0.36	0.72	0.00
PbO	12.69	14.06	4.51	13.93	0.13
SO_3	3.40	3.77	3.37	2.09	1.68
SiO_2	53.49	59.26	70.56	58.06	1.20
V_2O_5	0.08	0.09	0.03	0.07	0.02
Others	2.37	**2.63**	4.20	2.63	-0.00
Totals	90.27	100.00	100.00	100.00	0.00

Sample Number: 200222611

Numbers in bold were not analyzed by FDF. They are taken from the PNL analysis. The "others" are other elements in the residue that are less than 0.5 wt% each, but total collectively to the amount shown.

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Table 2-3
Silo 2 Residue Composition
as Measured by FDF Labs 11/22/96

a Element as Oxide	b Analyzed wt%	c Normalized wt%	d Stoichiometric mole %	e PNL Anal. Wt%	f c - e wt%
Al_2O_3	3.01	3.47	2.37	4.02	-0.55
B_2O_3	0.00	0.00	0.00	0.00	0.00
BaO	4.47	5.15	2.34	3.54	1.61
CO_2	3.49	**4.02**	6.36	4.02	0.00
CaO	2.81	3.24	4.02	2.95	0.29
Fe_2O_3	4.82	5.56	2.42	7.20	-1.64
K_2O	0.25	0.29	0.21	0.80	-0.51
Li_2O	0.00	0.00	0.00	0.00	0.00
MgO	0.39	0.45	0.78	2.01	-1.56
MnO_2	0.00	0.00	0.00	0.04	-0.04
N_2O_5	0.63	**0.73**	0.47	0.73	-0.00
Na_2O	0.74	0.85	0.96	1.04	-0.19
NiO	0.38	0.44	0.41	0.43	0.01
P_2O_5	0.69	**0.80**	0.39	0.80	0.00
PbO	7.59	8.75	2.73	7.32	1.43
SO_3	3.5	4.03	3.51	2.01	2.02
SiO_2	51.58	59.46	68.85	60.23	-0.77
V_2O_5	0.01	0.01	0.00	0.10	-0.09
Others	2.39	**2.76**	4.20	2.76	-0.00
Totals	86.75	100.00	100.00	100.00	0.00

Sample Number: 200222612

Numbers in bold were not analyzed by FDF. They are taken from the PNL analysis. The "others" are other elements in the residue that are less than 0.5 wt% each, but total collectively to the amount shown.

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Table 2-4
Average Bentonite Composition

Rank	Bentonite		
	Component	Measured (wt%)	Normalized (wt%)
1	SiO_2	65.40	67.35
2	Al_2O_3	15.80	16.27
3	MgO	6.30	6.49
4	Fe_2O_3	3.60	3.71
5	Na_2O	3.40	3.50
6	CaO	1.80	1.85
7	K_2O	0.80	0.82
	Total	97.10	100.00

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Tables 2-2 and 2-3 show higher sulfate concentrations than Table 2-1. Recent analyses done by FDF, with a Leco® sulfur analyzer, indicate that the sulfate content in Silos 1 and 2 is between 3 and 3½ dry wt% (per a single sample measured for each silo) instead of the 1¾ and 2% measured by PNL in Table 2-1. Process knowledge indicates that the sulfates in Silos 1 and 2 may be barium sulfate ($BaSO_4$) because barium was used to strip radium from the refining process as radium sulfate ($RaSO_4$). These new measurements more closely match the measured barium stoichiometric concentrations. Also, analysis using the Leco® sulfur analyzer showed that the destruction temperature of the sulfates is high (≥1450°C). Table 2-5 shows the decomposition temperatures for the potential sulfates in the silos. Calcium and barium sulfates have destruction temperatures approximately 1450°C or higher.

As seen in the tables, the K-65 wastes contain significant quantities of glass formers (50 - 51 wt%). The wastes also contain high concentrations of lead and barium and, in lower concentrations, other hazardous constituents. Because of the presents of these substances the glass must pass TCLP.

2.2 Silo 1 and 2 Surrogates

Silo 1 and 2 residues were analyzed for elemental composition. However, the manner in which these elements are combined into compounds is not known. Generally, this information is not needed in determining the glass composition because the identity of the compounds are lost once the glass is made. The exception is sulfur because of its low solubility in the glass; it can affect the processing rate in the melter. This is discussed Section 2.4.9.

Surrogates were formulated for each of the silo wastes in accordance with the elemental analysis. The elements were simulated as follows:

> The elements sulfur, phosphorus, nitrogen, and carbon were simulated as sulfates, phosphates, nitrates, and carbonates respectively. It is not known which metals of the silo residues are attached with sulfates, phosphates, etc. However, the surrogates were made to ensure the ratios of the elements and sulfates, phosphates, etc., were consistent with the PNL analysis of the silo residues. Tables 2-6 and 2-7 are spreadsheets used to determine the compounds used in the surrogates for Campaign 4.

Only those components in the silo wastes ≥0.5 wt% were included in the silo surrogates. Those components simulated in the surrogate are those that appear above the line in Table 2-1. Generally, it is accepted among the glass-making community that concentrations less than 0.5 wt% have minor impact on glass properties, except for glass color, which is of little concern in the vitrification of wastes. Collectively, these small concentration components are called "minors" in the glass-recipe calculations.

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Table 2-5
Decomposition Temperatures of Sulfates

Compound	Melting Point, °C	Decomposition Temperature, °C	Behavior
$Al_2(SO_4)_3$	--	770	Low temperature decomposition.
$BaSO_4$	1580	>1580	Melts without decomposition.
$CaSO_4$	1450	Graduated	Some decomposition before melting, but slow.
$Fe_2(SO_4)_3$	—	480	Low temperature decomposition.
Li_2SO_4	860	860	Decomposition is not far above melting temperature.
$MgSO_4$	--	<1124	Decomposes before melting.
Na_2SO_4	884	Graduated	Volatilization and decomposition both take place; however, both are slow at lower molten glass temperatures. Volatilization and decomposition increases with temperature.
$PbSO_4$	1170	< 1170	Decomposes noticeably below the melting point.

Sources:

The Chemical Rubber Company (CRC) Handbook of Chemistry and Physics, 51st Edition, and

High Temperature Properties and Decomposition of Inorganic Salts, "Part 1. Sulfates," October 1, 1966, K. H. Stern and E. L. Weise, Institute for Basic Standards, National Bureau of Standards, Washington, D.C.

Table 2-6
Silo 1 Surrogate

Compound	mo. wt.	Silo wt%	Silo, n wt%	mols X100	Metal	Nonmetal	Surrogate Compound	Oxide	CO2	N2O5	P2O5	SO3	as metal Oxide	Compound Mols%	Compound wt%	Compound wt%, n	Compound wt%, c
Al2O3	101.96	2.60	3.14	3.08	3.08		Al2O3	3.08					3.08	3.08	3.14	3.15	3.02
B2O3	69.62																
H3BO3	61.83																
BaO	153.34	6.30	7.62	4.97	4.97												
BaCO3	197.35						BaCO3		2.25				2.25	2.25	4.44	4.44	4.27
BaSO4	233.40						BaSO4					2.72	2.72	2.72	6.35	6.35	6.10
CO2	44.01	3.20	3.87	8.79		8.79											
CaO	56.08																
CaCO3	100.09																
CaSO4	136.14																
Ca3(PO4)2	310.18																
Fe2O3	159.69	2.50	3.02	1.89	1.89		Fe2O3	1.89					1.89	1.89	3.02	3.02	2.90
K2O	94.20	0.68	0.82	0.87	0.87												
K2CO3	138.21						K2CO3		0.87				0.87	0.87	1.21	1.21	1.16
KNO3	101.11																
Li2O	29.88																
Li2CO3	73.89																
MgO	40.31	1.20	1.45	3.60	3.60												
MgCO3	84.32						MgCO3		2.02				2.02	2.02	1.70	1.70	1.63
MgSO4	120.37																
Mg3(PO4)2	262.88						Mg3(PO4)2				0.53		1.58	0.53	1.39	1.39	1.33
MnO2	70.94																
N2O5	108.01																
Na2O	61.98	1.80	2.18	3.51	3.51												
Na2B4O7	201.22																
Na2SO4	142.04																
Na2CO3	105.99						Na2CO3		3.51				3.51	3.51	3.72	3.72	3.58
NaNO3	84.99						NaNO3										
NiO	74.71																
P2O5	141.94	0.62	0.75	0.53		0.53											
PbO	223.19	12.00	14.51	6.50	6.50		PbO	6.50					6.50	6.50	14.51	14.52	13.94
SO3	80.06	1.80	2.18	2.72		2.72											
SiO2	60.08	50.00	60.46	100.63	100.63		SiO2	100.63					100.63	100.63	60.46	60.50	58.09
TiO2	79.90																
V2O3	149.88																
Other																	3.97
Bentonite	na																
		82.70	100.00	137.10	125.06	12.04		112.11	8.65		0.53	2.72	125.06	124.01	99.94	100.00	100.00
							Difference:		-0.14								

Note: n = data normalized to 100 wt%
c = Corrected. The actual wastes contain other compounds that are less than 0.5 wt%, but total to the amount labeled "other" in this table. Therefore, the compound concentrations are adjusted for the mass the "others" occupy in the real waste.

Table 2-7
Silo 2 Surrogate

Compound	mol. wt.	Silo wt %	Silo, n wt %	mols x100	Metal	Nometal	Surrogate Compound	Oxide	CO2	N2O5	P2O5	SO3	as metal Oxide	Compound mols	Compound wt%	Compound wt%, n	Compound wt%, c
Al2O3	101.96	3.40	4.15	4.07	4.07		Al2O3	4.07					4.07	4.07	4.15	4.15	4.02
B2O3	69.62																
H3BO3	61.83																
BaO	153.34	3.00	3.66	2.39	2.39												
BaCO3	197.35																
BaSO4	233.40						BaSO4					2.39	2.39	2.39	5.58	5.58	5.39
CO2	44.01	3.40	4.15	9.44		9.44											
CaO	56.08	2.50	3.05	5.45	5.45		CaO	1.12					1.12	1.12	0.63	0.63	0.61
CaCO3	100.09						CaCO3		4.12				4.12	4.12	4.13	4.13	3.99
CaSO4	136.14						CaSO4					0.20	0.20	0.20	0.28	0.28	0.27
Ca3(PO4)2	310.18																
Fe2O3	159.69	6.10	7.45	4.67	4.67		Fe2O3	4.67					4.67	4.67	7.45	7.45	7.20
K2O	94.20	0.68	0.83	0.88	0.88												
K2CO3	138.21						K2CO3		0.88				0.88	0.88	1.22	1.22	1.18
KNO3	101.11																
Li2O	29.88																
Li2CO3	73.89																
MgO	40.31	1.70	2.08	5.15	5.15												
MgCO3	84.32						MgCO3		3.40				3.40	3.40	2.86	2.86	2.77
MgSO4	120.37																
Mg3(PO4)2	262.88						Mg3(PO4)2				0.59		1.76	0.59	1.54	1.54	1.49
MnO2	70.94																
N2O5	108.01	0.62	0.76	0.70		0.70											
Na2O	61.98	0.88	1.08	1.73	1.73												
Na2B4O7	201.22																
Na2SO4	142.04																
Na2CO3	105.99						Na2CO3		1.03				1.03	1.03	1.10	1.10	1.06
NaNO3	84.99						NaNO3			0.70			0.70	1.40	1.19	1.19	1.15
NiO	74.71																
P2O5	141.94	0.68	0.83	0.59		0.59											
PbO	223.19	6.20	7.57	3.39	3.39		PbO	3.39					3.39	3.39	7.57	7.57	7.32
SO3	80.06	1.70	2.08	2.59		2.59											
SiO2	60.08	51.00	62.30	103.70	103.70		SiO2	103.70					103.70	103.70	62.30	62.30	60.23
TiO2	79.90																
V2O3	149.88																
Other																	3.33
Bentonite	na																
		81.86	100.00	144.75	131.43	13.32		116.95	9.43	0.70	0.59	2.59	131.43	130.97	100.00	100.00	100.00
							Difference:		-0.00				-0.00				

Note: n = data normalized to 100 wt%
c = Corrected. The actual wastes contain other compounds that are less than 0.5 wt%, but total to the amount labeled "other" in this table. Therefore, the compound concentrations are adjusted for the mass the "others" occupy in the real waste.

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2.3 Glass Recipe Formulation Using Surrogates

These surrogates which simulate Silos 1 and 2 wastes were blended with additives to give the wastes the proper properties for vitrification.

Table 2-8 is the spreadsheet used to determine the glass chemistry for a Series A glass (Series A is the name given, from previous studies, for glasses made with Silos 1 and 2 wastes or surrogates). The silo wastes and bentonite then are blended in proportion to their total amounts in the silos. Then the additives are added to the blend to make a close approximation of the target glass shown toward the right in the spreadsheet. The amounts shown in the spreadsheet are those necessary to make 100 grams of glass. It takes more than 100 grams of silo wastes and additives to make 100 grams of glass because some of the components are lost, as gases, to the Off-gas System. The spreadsheet shows silo waste concentrations, as oxides, as per Table 2-1. Showing the constituents as oxides is a standard glass-making convention that simplifies calculations.

Table 2-9 converts the elemental concentrations (shown as oxides in Table 2-7) into the actual compounds used in the surrogates and additives. Most of the additives used in Campaign 4 were carbonates chosen for ease in handling and cost. For example, sodium oxide (Na_2O) is a very corrosive, toxic substance that reacts violently with water to form sodium hydroxide (NaOH), commonly known as lye (also a corrosive substance). Therefore, sodium carbonate (Na_2CO_3) is used instead of Na_2O.

Table 2-10 shows similar information as Table 2-9 except: (1) the quantities are converted to batch quantities; and (2) the "minors" component is removed from the batch. A batch was normally formulated to make 2200 lbs, or 1 metric ton of glass.

2.4 Glass Chemistry

The development of the glass formulas and the Melter are dependent upon one another. Both are significantly influenced by the waste materials in Silos 1 and 2. Characteristics of the glass that are key formula and Melter design parameters include the concentration of sulfate and other components in the slurry feed, and the viscosity, liquidus temperature, redox state, foaming, and conductivity of the resultant glass. The slurry formulas address the task of transforming the silo waste into acceptable glass without generating unacceptable waste streams (such as waste water and off-gas) and reactions (such as foaming and devitrification).

Table 2-8
Series A Glass Formula Development Spreadsheet

Series A per C4A-03 (w/boric acid)

Component	mol. wt.	Silo 1	Silo 1n	Silo 2	Silo 2n	Silo 3	Silo 3n	Bento-grout	Bento-grout n	Portions norm.	Portions in glass	Additives as oxides	Glass Result	Target C4A-03	Delta	Additives mol%	Glass mol%
Al2O3	101.96	2.60	3.02	3.40	4.02	5.30	6.10	13.60	13.74	3.48	2.76	3.15	5.91	5.89	0.02	2.18	4.09
As2O3	197.84			0.05	0.06	0.29	0.33			0.03	0.02		0.02		0.02		0.01
B2O3	69.62											12.90	12.90	12.89	0.01	13.06	13.06
BaO	153.34	6.30	7.32	3.00	3.54	0.03	0.04			5.56	4.42		4.42	4.47	-0.05		2.03
BeO	25.01	0.01	0.01			0.01	0.01			0.00	0.00		0.00		0.00		0.01
CO2	44.01	3.20	3.72	3.40	4.02	1.90	2.19			3.85	3.06		3.06	released	-		4.90
CaO	56.08	0.37	0.43	2.50	2.95	4.70	5.41	1.53	1.55	1.60	1.27	3.80	5.07	5.08	-0.01	4.78	6.37
CdO	128.40					0.00	0.01										
Ce2O3	328.24	0.41	0.48	0.33	0.39	0.02	0.02			0.44	0.35		0.35		0.35		0.07
CoO	74.93	0.19	0.22	0.21	0.25	0.36	0.41			0.23	0.19		0.19		0.19		0.17
Cr2O3	151.99	0.02	0.02	0.08	0.10	0.08	0.10			0.06	0.05		0.05		0.05		0.02
CuO	79.54	0.06	0.07	0.08	0.10	0.41	0.47			0.08	0.06		0.06		0.06		0.06
Fe2O3	159.69	2.50	2.90	6.10	7.20	8.00	9.21	3.07	3.10	4.90	3.89		3.89	3.98	-0.09		1.72
K2O	94.20	0.68	0.79	0.68	0.80	1.80	2.07	0.66	0.67	0.80	0.63		0.63	0.61	0.02		0.47
La2O3	325.82	0.42	0.49	0.29	0.34	0.01	0.01			0.42	0.33		0.33	0.34	-0.01		0.07
Li2O	29.88					0.47	0.54					1.50	1.50	1.52	-0.02	3.54	3.54
MgO	40.31	1.20	1.39	1.70	2.01	10.00	11.51	5.40	5.46	1.68	1.33		1.33	1.32	0.01		2.33
MnO2	86.94	0.01	0.02	0.03	0.04	0.67	0.77	0.05	0.05	0.03	0.02		0.02		0.02		0.02
MoO2	127.94	0.43	0.50	0.08	0.09	0.18	0.21			0.31	0.25		0.25		0.25		0.14
N2O5	108.01	0.29	0.34	0.62	0.73	6.10	7.02			0.52	0.41		0.41	released	-		0.27
Na2O	61.98	1.80	2.09	0.88	1.04	5.90	6.79	2.92	2.95	1.60	1.27	4.40	5.67	5.68	-0.01	5.00	6.45
Nd2O3	336.48	0.19	0.22	0.16	0.19	0.01	0.01			0.21	0.16		0.16		0.16		0.03
NiO	74.71	0.42	0.49	0.36	0.43	0.52	0.60			0.46	0.36		0.36	0.38	-0.02		0.34
P2O5	141.94	0.62	0.72	0.68	0.80	9.30	10.70	1.22	1.23	0.76	0.60		0.60	0.63	-0.03		0.30
PbO	223.19	12.00	13.93	6.20	7.32	0.19	0.22			10.86	8.62		8.62	8.63	-0.01		2.72
SO3	80.06	1.80	2.09	1.70	2.01	15.00	17.26			2.05	1.63		1.13	released	-		0.99
SeO2	110.96	0.05	0.05	0.04	0.05	0.03	0.03			0.05	0.04		0.04		0.04		0.03
SiO2	60.08	50.00	58.06	51.00	60.23	14.00	16.11	56.20	56.80	59.06	46.87		46.87	46.90	-0.03		54.98
SrO	103.62	0.08	0.10	0.06	0.07	0.03	0.03			0.09	0.07		0.07		0.07		0.05
ThO2	264.04					0.31	0.36										
TiO2	79.90	0.28	0.33	0.33	0.39	0.22	0.25	0.22	0.22	0.36	0.28		0.28		0.28		0.25
UO2	270.03			0.47	0.56	0.34	0.39			0.26	0.20		0.20		0.20		0.05
V2O3	149.88	0.06	0.07	0.08	0.10	0.50	0.58			0.08	0.07		0.07		0.07		0.03
Y2O3	225.81					0.04	0.04										
ZnO	81.37			0.01	0.01	0.07	0.08			0.01	0.00		0.00		0.00		0.00
ZrO2	123.22	0.05	0.06	0.14	0.17	0.02	0.02			0.11	0.09		0.09	0.09	-0.00		0.05
Cl	35.45	0.08	0.09	0.00	0.01	0.02	0.02			0.05	0.04		0.04		0.04		0.08
F	19.00	0.00	0.01	0.00	0.01	0.08	0.09			0.01	0.00		0.00		0.00		0.02
Ignition loss								14.08	14.23					released	-		
SO3 in glass	80.06												0.50	0.50			0.44
Other A	1.00																
Other B	1.00																
Total	n/a	86.12	100.00	84.68	100.00	86.90	100.00	98.95	100.00	93.57	74.25	25.75	100.50	98.91	1.59	28.56	100.00
Gases		5.29	6.14	5.72	6.75	23.00	26.47	14.08	14.23	6.43	5.10		4.60				6.16

Ratios (dry wt.)	Silo 1	Silo 2	Silo 3	Bentonite	All Wastes	Additives	Total In	Glass	Gases	Total Out
Mass balance:	42.52	36.83			79.35	25.75	105.10	100.50	4.60	105.10
Silo mix Ratio	53.58	46.42			100.00	--	--	--	--	--

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Table 2-9
Series A Surrogate Development Spreadsheet

Compound	Mol. Wt.	%Moisture	Silo 1 Su. wt%	Silo 2 Su. wt%	Silo 3 Su. wt%	Bentonite Makeup	Silo 1 Surrogate	Silo 2 Surrogate	Silo 3 Surrogate	Silo 1 S. w/H2O	Silo 2 S. w/H2O	Silo 3 S. w/H2O	Tot. Silos S. w/H2O	Additives Mix Tank	Add. & Sur.-H2O	Add & Sur. as oxides	Glass Result	Glass Result, adj.	Glass Mol%
		Series A per C4A-03 (w/boric acid)																	
Al2O3	101.96		3.02	4.02	6.05	13.74	1.28	1.48		1.28	1.48		2.76	3.15	5.91	5.91	5.91	6.05	4.16
B2O3	69.62																12.90	13.20	13.29
H3BO3	61.83													22.91	22.91	12.90			
BaO	153.34																4.42	4.52	2.07
BaCO3	197.35		4.27				1.81			1.81			1.81		1.81	1.41			
BaSO4	233.40		6.10	5.39			2.59	1.99		2.59	1.99		4.58		4.58	3.01			
CO2	44.01															11.35	released		
CaO	56.08			0.61		1.55		0.22			0.22		0.22		0.22	0.22	4.89	5.00	6.25
CaCO3	100.09			3.99				1.47			1.47		1.47	6.78	8.25	4.62			
CaSO4	136.14	6.20		0.27	13.04			0.10			0.11		0.11		0.10	0.04			
Fe2O3	159.69		2.90	7.20	7.83	3.10	1.23	2.65		1.23	2.65		3.89		3.89	3.89	3.89	3.98	1.75
Fe2(SO4)3	399.87				3.30														
K2O	94.20					0.67											0.63	0.65	0.48
K2CO3	138.21		1.16	1.18			0.49	0.43		0.49	0.43		0.93		0.93	0.63			
KNO3	101.11				4.42														
Li2O	29.88																1.50	1.53	3.60
Li2CO3	73.89				1.33									3.71	3.71	1.50			
MgO	40.31					5.46											1.33	1.36	2.37
MgCO3	84.32		1.63	2.77			0.69	1.02		0.69	1.02		1.71		1.71	0.82			
MgSO4	120.37				7.08														
Mg3(PO4)2	262.88		1.33	1.49	19.69		0.57	0.55		0.57	0.55		1.12		1.12	0.51			
MnO2	86.94				0.77	0.05													
N2O5	108.01															0.27	released		
Na2O	61.98					2.95											5.67	5.80	6.56
Na2B4O7	201.22	30.90																	
Na2SO4	142.04				4.94														
Na2CO3	105.99		3.58	1.06	3.33		1.52	0.39		1.52	0.39		1.91	7.52	9.43	5.52			
NaNO3	84.99			1.15	7.26			0.42			0.42		0.42		0.42	0.15			
NiO	74.71				0.59														
P2O5	141.94					1.23										0.60	0.60	0.62	0.30
PbO	223.19		13.94	7.32			5.93	2.70		5.93	2.70		8.62		8.62	8.62	8.62	8.82	2.77.
SO3	80.06															1.13	released		
SiO2	60.08		58.09	60.23	16.00	56.80	24.70	22.18		24.70	22.18		46.88		46.88	46.88	46.88	47.96	55.96
TiO2	79.90					0.22													
V2O5	181.88				0.63	-													
Minors	na		3.97	3.33	3.73		1.69	1.23		1.69	1.23		2.92		2.92	2.92	2.92	--	
Bentonite	na	14.23													--	--	--	--	
F	19.00																		
SO3 in glass	80.06															0.50	0.50	0.51	0.45
CO(NH2)2	60.06													0.78	0.78	released			
Other A	1.00																		
Other B	1.00																		
			100.00	100.00	100.00	85.77	42.52	36.83		42.52	36.84		79.36	44.86	124.21	113.42	100.67	100.00	100.00

Ratios (dry wt.)	Silo 1	Silo 2	Silo 3	Bentonite	All Wastes	Additives	Total In	Glass	Gases	Total Out
Mass balance:	42.52	36.83			79.35	44.86	124.21	100.50	23.71	124.21
Silo mix Ratio	53.58	46.42			100.00	--	--	--	--	--
Urea, Stoichiometric %:		50.00								

(includes water of hydration in additives)

Total In:	124.22	Gases released:	12.75	12.66
		Urea products:	0.78	0.78
		Steam:	10.80	10.73
		Total Out:	124.22	124.17

Table 2-10
Series A Batch Sheet Spreadsheet

Series A per C4A-03 (w/boric acid)

Compound	Common Name	%Moisture	Silo 1 Surrogate	Silo 2 Surrogate	Silo 3 Surrogate	Surrogate Total	Additives Mix Tank	Batch Total	As Oxides	Glass Makeup	Glass Makeup, %	Off Gas Makeup
Al2O3	Alumina		29	33		62	71	**133**	133	133	6.05	
B2O3										290	13.20	
H3BO3	Boric acid						516	**516**	290			
BaO										99	4.52	
BaCO3	Barium carbonate		41			41		**41**	32			
BaSO4	X-ray milkshake		58	45		103		**103**	68			
CO2												255
CaO	Lime			5		5		**5**	5	110	5.00	
CaCO3	Chalk, calcite			33		33	153	**186**	104			
CaSO4	Gypsum	6.20		2		2		**2**	1			
Fe2O3	Rust		28	60		88		**88**	88	88	3.98	
Fe2(SO4)3	Iron sulfate, III											
K2O										14	0.65	
K2CO3	Potassium carbonate		11	10		21		**21**	14			
KNO3	Salt peter											
Li2O										34	1.53	
Li2CO3	Lithium carbonate						83	**83**	34			
MgO										30	1.36	
MgCO3	Magnesium carbonate		16	23		39		**39**	18			
MgSO4	Epson salt											
Mg3(PO4)2	Magnesium phosphate		13	12		25		**25**	12			
MnO2												
N2O5												6
Na2O										128	5.80	
Na2B4O7	Borax	30.90										
Na2SO4	Sodium sulfate											
Na2CO3	Washing soda		34	9		43	169	**212**	124			
NaNO3	Soda niter			10		10		**10**	3			
NiO	Nickel oxide											
P2O5									14	14	0.62	
PbO	Lead oxide		133	61		194		**194**	194	194	8.82	
SO3												25
SiO2	Silica, sand, quartz		556	499		1,055		**1,055**	1,055	1,055	47.96	
TiO2												
V2O5	Vanadium pentoxide											
Bentonite		14.23							--	--	--	--
CO(NH2)2	Urea						18	**18**				18
SO3 in glass	Sulfate								11	11	0.51	
Other A												
Other B												
H20	Water							--	--			243
			919	802		1,720	1,010	**2,730**	2,200	2,200	100.00	548
Batch, lbs glass:		2,200										

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2.4.1 Viscosity versus Temperature

Viscosity is the most important parameter to characterize a prescribed glass. If the glass melt becomes too thick, the waste dissolution (glass production) rate will decrease and may result in freezing or blockage of the melter discharge chamber. If the glass melt is too thin, glass can leak through joints of the melter refractories and result in problems causing premature corrosion and erosion of melter components. Additionally, final waste form production (e.g., gem production) is sensitive to glass viscosity. For example, the glass needs to be thick enough to be cut into pieces, yet the pieces must be fluid enough to flow (or puddle) and form a gem. The desired viscosity of the molten glass in the melter is between 10 and 80 poise. Due to heat loss during melter discharge and glass-forming production, the viscosity of the glass may increase. For gem production, it is expected that the viscosity of the glass "gob" should not be below 200 poise when it reaches the conveyor. This allows the gob of glass to flow and have enough time to "pull" itself together, much like water beads on the surface of freshly waxed car. If the glass is too thick, the glass does not have enough time to form a gem before it freezes. If it is too thin, it can not be cut by the gob cutter and will flow through the mechanism onto the conveyor, making large puddles.

2.4.2 Conductivity vs. Temperature

Like viscosity, maintaining electrical conductivity of the glass within a prescribed range is necessary for proper joule heating in the melter. The VitPP has a joule-heated melter where electrical resistance of the glass produces the heat for melting. A low-conductive glass requires electrical transformer taps that produce power at a higher voltage and lower amperage, compared to a high-conductive glass that requires electrical transformer taps that produce power at a lower voltage and higher amperage.

In the VitPP, if a glass is too conductive, excessive heat is generated in the melter electrode chambers and/or the electrically semi-transparent chamber walls between the center and side chambers, resulting in less heat transfer to the glass melt. This could cause melter failure or premature deterioration of key melter components. Higher resistivity of the glass melt requires higher voltage in order to provide the same amount of power. A glass that is too resistive may exceed the voltage capability of the melter.

With the three-chamber melter design, the conductivity of the side chamber (electrode chamber) glass also is very important. Originally, it was decided that the side-chamber glass should be of much higher conductance (five times higher) than the waste glass in the main chamber so that the side-chamber glass generates less heat (this allows most of the heat to be generated in the main chamber glass). However, minimelter runs indicated that the side chamber remained cool even with more resistive glasses. The VitPP also confirmed this characteristic. Current design values for glass conductivity (resistivity) have been approximated at 1.0 Siemens/cm (S/cm, 1.0 ohm·cm) for the side-chamber glass and 0.15 to 0.33 S/cm (3.0 to 6.7 ohm·cm) for the main chamber.

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2.4.3 Liquidus Temperature Range

Liquidus temperature range is a temperature band below (and often near) the melting point of glass where crystallization, precipitation, and/or phase separation occurs within the glass melt. Different glass compositions have different liquidus temperature range profiles. The best liquidus temperature profile is one that is narrow, allows a low melting point of the glass, and has minor sensitivity to compositional changes. A wide profile, or one that approaches the melt temperature, can make pouring and forming glass difficult because the glass can crystallize or separate (devitrify) as it cools before it has a chance to solidify. Likewise, a liquidus temperature profile that approaches the operating temperature can result in high viscosity and blockage(s) where the temperature can drop (e.g., the discharge chamber). A liquidus temperature profile that is sensitive to compositional changes can result in blockage of a melter if the melter feed composition inadvertently drifts.

The glass has a good liquidus temperature if visible crystals, phase separation, or other defects are not detected at a temperature 200°C below the glass's operating temperature in the melter and melter discharge chamber. Adjustment should be made to the bath chemistry if the melter's operating temperature approaches the liquidus temperature. The liquidus temperature often dictates what the idling temperature of the melter can be. During Campaign 4, the liquidus temperature of the glass in the center and side chambers was checked before lowering the melter to idle temperatures.

2.4.4 Redox Control

Redox control in the VitPP Melter is a significant concern with the operation of the melter. Excess oxygen in the side chambers can lead to excessive corrosion of the electrodes. The adverse redox conditions in the VitPP Melter are theoretically mitigated because the electrodes are protected in the side chambers from the oxidized glass in the center chamber. However, the cracks in the E-wall allowed oxidized glass to enter the side chambers during Campaign 4. The effectiveness of the west side chamber was impacted significantly by the loss of the two top electrodes.

Oxygen fed to the melt bath with the agitation air and melter in leakage was sufficient to prevent the "soft" metals such as lead (Pb) from precipitating. Precipitation of elemental metal(s) in the glass melt could produce an electrical short circuit across the electrodes or migrate to the under structure of the melter.

Another component in the glass that affected redox was urea. Urea was added to the slurry feed to aid in the destruction of sulfates, and thus, increase glass production rates. The concern with using reductants to destroy sulfates is that the concentration and reduction power of the reductant may be so strong that the molten bath is reduced sufficiently and produces molten metallic lead or lead sulfide - both of which are electrically conductive. Urea was the reductant chosen from several alternatives tried during minimelter (bench-scale) testing because it is a simple organic compound that produces only gasses when oxidized and leaves no carbon residue that can be carried down into the

glass melt, thus reducing the glass bath further than intended. Therefore, the reduction power of urea can be applied only at or above the surface of the glass bath.

FDF laboratory reduction studies showed that simple reduction of the surrogate glass (e.g., through the use of urea) will produce lead sulfide (PbS) because of the presence of dissolved sulfur (sulfate) in the glass. It takes a high (localized) reduction potential (such as molybdenum metal or molybdenum disilicide) to produce molten metal. Figure 2-1 shows the results of the crucible melts using urea. Most of the crucible melts were heated in the furnace for two hours at 1250°C. The urea was increased in approximately 2 wt% increments, using the weight of the surrogate as a basis. Lead sulfide started to precipitate at 10 wt% urea. This equates to a redox ratio of 0.605 Fe^{+2}/Total Fe, or 60.5% reduced. Another crucible melt was done at 10 wt%, but it was heated in the furnace for six hours. Interestingly, no PbS was seen and the redox state of the glass was more oxidized. Apparently, the PbS may have formed and then redissolved as the molten glass in the crucible reoxidized from the air in the furnace. The glasses were dark in color, but transparent. It took a white light source placed behind the glass to see the color. However, the glasses that are less than 60.5% reduced were brown and the glasses greater than 60.5% reduced were bluish-green.

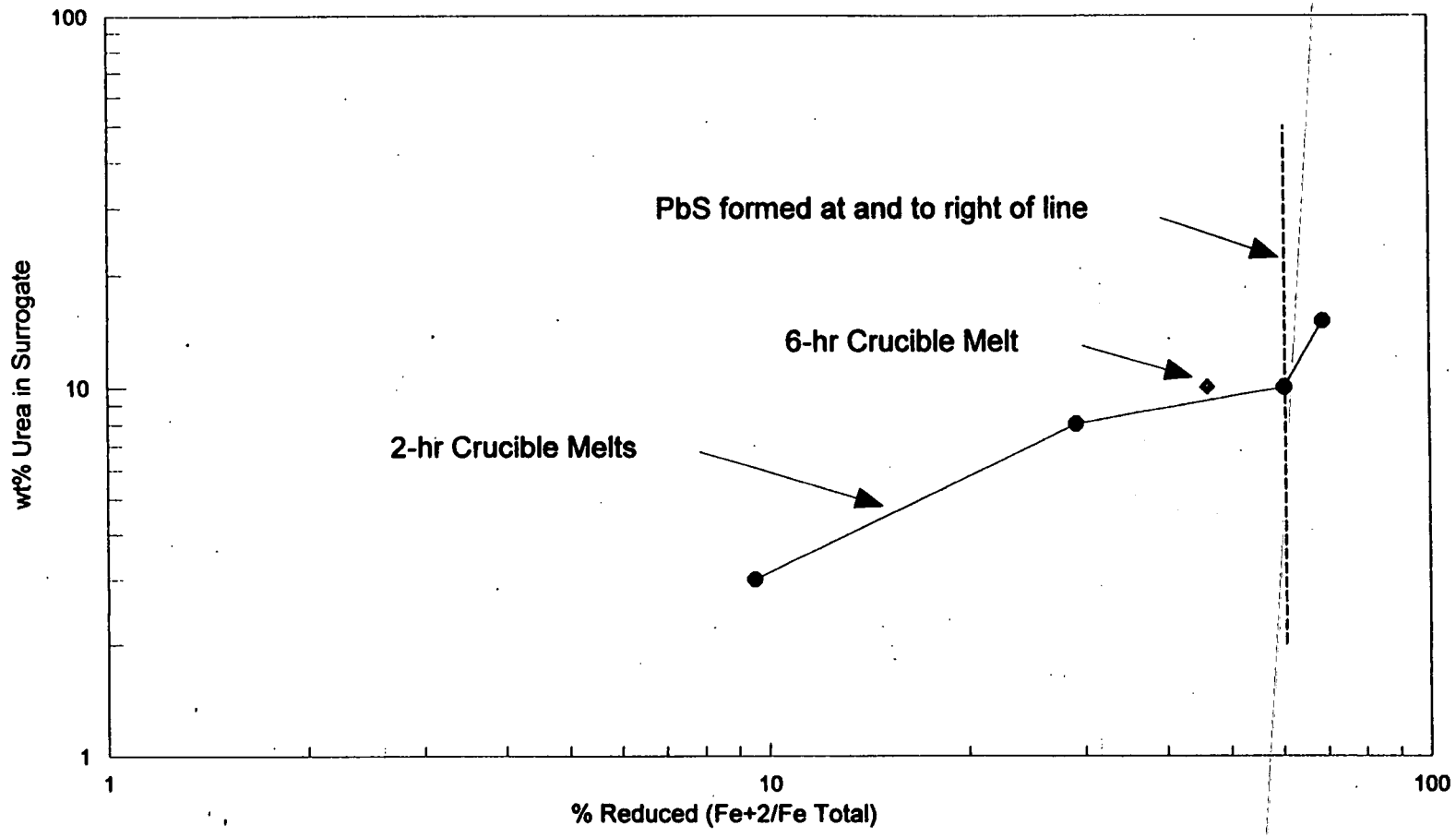
The color of the glasses may be used to indicate a reduction state. If the glasses contain hues of brown, which is an indicator that they are oxidized, then they can be considered oxidized. The ratio of Fe^{+2}/Fe^{+3} or Fe^{+2}/Total Fe is an indicator of redox in the glass. An oxidized glass looks brown because Fe^{+3}, which is the oxidized species of iron (Fe), produces a brown color. Whereas Fe^{+2}, which is the reduced species of iron, produces a blue-green color. Therefore, if the brown hue leaves the glass, there is concern that the glass may become too reduced and produce metallic lead or lead sulfide.

2.4.5 Foaming

Foaming is a release of gases within the molten glass which causes the whole glass volume to swell (or foam). If the reactions occur closer to the surface, the gases can be released easily and foaming is less likely. Thin (less viscous) glasses are less likely to foam because the bubbles that trap the gases "pop" at the surface and do not have the chance to collect and build up a "head". Foaming of the molten glass was shown to be a potential problem in the PNL crucible melts and in several of the FDF laboratory melts.

A change in redox or temperature can cause rapid foaming. It was found in Vitreous State Laboratory (VSL) minimelter runs that the latter appears to be the case with the silo wastes. Foaming was observed in the minimelter runs when the glass was discharged, feed to the melter ceased, or the temperature of the melter was ramped up too quickly. The minimelter was not temperature controlled, but rather, power controlled. When the glass was discharged or the feed to the melter ceased, the same

Figure 2-1
Redox of Surrogate Glass vs. Urea Crucible Melts



Redox of Surrogate Glass vs. Urea Crucible Melts
Figure 2-1

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amount of power went into the smaller volume of glass. The net increase of power per unit mass of glass resulted in the temperature climbing. Since gas solubility decreases with increasing temperature, the saturated molten glass released dissolved sulfate as a gas. Under certain conditions where the glass is viscous enough and the temperature increase is rapid enough, foaming occurs.

Foaming events were controlled in the minimelter and the VitPP by decreasing the viscosity of the glass through: 1) controlling glass chemistry;(2) increasing power into the molten glass slowly;(3) destroying sulfates with urea; and (4) increasing the percent water in the feed. Water can behave similar to a reductant because hot metal sulfates will react with water to form sulfuric acid, per the following equations:

$$RSO_4 + H_2O \rightarrow H_2SO_4\uparrow + RO \quad \text{, where R = a metal} \qquad \text{(eq. 2-1)}$$

Decreasing the feed rate with a corresponding decrease in power to the melter also can help control foaming events.

2.4.6 Devitrification

Devitrification is the forming of opacity, crystals, or precipitates in the glass upon cooling. Devitrification was not noticed in the K-65 surrogate glasses during the minimelter or VitPP runs.

2.4.7 Additives

Additives are necessary to impart the desired properties necessary to make glass in the melter. The following paragraphs list and summarize additives used during Campaign 4. A brief summary is provided to discuss the effect of the additives.

- Fluxes (lower the melting point of the glass formers):
  - Sodium oxide (added as soda ash, Na_2CO_3)
  - Calcium oxide (added as chalk, $CaCO_3$)
  - Lithium oxide (added as lithium carbonate, Li_2CO_3)
  - Boron oxide (added as boric acid or borax pentahydrate).

Lithium (Li) was the most effective flux (because it produces the highest waste loading), but is also the most expensive. Boron (B) is the next most expensive.

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- Modifiers (impart some desired property to glass):
  - Aluminum oxide -- Aids in the dissolution of phosphates into the molten glass and improves durability of the glass (added as alumina, Al_2O_3).
  - Boron oxide -- makes the molten glass more vitreous and helps prevent devitrification of the glass upon cooling (added as boric acid, H_3BO_3).
  - Calcium oxide -- stabilizes the molten glass and possibly aids in the handling and destruction of sulfates in the glass (added as chalk, $CaCO_3$).
  - Urea, $CO(NH_2)_2$ -- a reductant used to destroy sulfates without reducing lead from the molten glass.

2.4.8 Phosphate - Treatment and Resulting Glass Devitrification

Glass containing high concentrations of phosphate has a tendency to devitrify, but the phosphate concentrations in Silos 1 and 2 wastes were low enough not to be a concern with devitirification. This was a concern with glass made with Silo 3 since it contained a higher concentration of phosphates. However, this proved not to be a problem either, because alumina (one of the glass additives mentioned above) proved successful in preventing devitrification in the minimelter and VitPP runs.

2.4.9 Sulfate - Treatment

2.4.9.1 Selection of Sulfate Surrogate Compounds

Originally, during early investigations, it was assumed that the choice of which compound to be used in the slurry to make the glass surrogates was of little importance since most chemical constituents thermally break down in the molten glass pool and loose their identity. However, this is probably not the case with sulfates because the glass has a low affinity for sulfates. Therefore, excess sulfates that do not dissolve in the glass must float to the surface of the glass melt or be destroyed. This process can be the rate limiting step in the production of glass. Most of the sulfate surrogates used in the tests conducted by PNL and VSL were calcium sulfate. The FDF crucible melts and VitPP runs were conducted with barium sulfate for Silo 1 and 2 surrogates because it is more difficult to destroy and would lead to more conservative production rate estimates.

Even though barium sulfate is more difficult to destroy, its use is probably more

representative of the Silo 1 and 2 wastes (see Section 2.2). The glass from crucible studies, and as verified in the melter runs, can only contain approximately ½ to 1 wt% sulfate measured as SO_3. The remaining sulfate must be destroyed. This was accomplished during the VitPP operation.

Table 2-5 shows that barium sulfate can only be destroyed at temperatures greater than 1,580°C. If so, how can barium sulfate be destroyed at the lower temperatures in the melter? Answers are as follows:

- The barium sulfate dissolves into the glass and losses its identity as such. The strong bonds that hold barium sulfate together are broken in the dissolution process. Therefore, the temperature to destroy the sulfate is decreased.

- Because of the broken bonds mentioned in the item above, the free sulfate momentarily may attach itself to another metal (ion) with a low-melting point, disassociate from the bath, and float to the surface as an undissolved liquid. Sodium and lithium form low melting sulfates. These sulfates decompose at lower temperatures. They can also collect as a group and form a sulfate puddle(s) on the surface awaiting decomposition. These sulfates also can dissolve more barium sulfate and aid in its destruction. The sulfate layers found in crucible and melter runs were rich in sodium and lithium, and were very fluid -- like water.

- The reaction of water in the slurry to form sulfuric acid, according to Equation 2-1.

- Use of a reductant. Reductants are starving for oxygen and will breakdown sulfates at high temperatures to obtain oxygen.

2.4.9.2 Sulfate Reductants/Sulfate Treatment

Several reductants or treatment methods were investigated to treat sulfates. Experiments were performed at the FDF labs to investigate the effects on sulfate treatment. These experiments are listed below. It was determined that urea performed the best.

- Urea addition: Urea decomposes forming only gasses and these gasses themselves are reductive. The gasses can only react with the wastes at or above the surface. No residues, such as charred carbon residues form, that can be carried down into the glass bath and cause unwanted reduction in the bath. Unfortunately, urea may only be effective with thin cold caps because the urea can thermally break down in the thick cold cap before it has a chance to react with

sulfates at the molten glass interface.

- Water addition: Water converted the sulfate to sulfuric acid at the molten sulfate layer's surface. In the lab the water addition was accomplished by metering water through a hole in the furnace onto the molten sulfate layer. A couple of times this method produced a frothy foam on top of the molten glass, however, it worked effectively on the sulfate layer. As mentioned earlier, slurries with a 65 - 70 wt% water concentration appeared to increase the production rate in the VitPP.

- Calcium addition: Calcium oxide was added to the melt to hold the sulfate in the glass long enough for it to be destroyed by the heat. Results indicated that this treatment worked for lower concentrations (approximately 1 - 2 wt%) of sulfates, but not higher concentrations. Extra calcium was added to batches C4B07, C4B08, and C4B09. There was less foaming, but this was not conclusive because of the extra calcium and because other parameters were changed at the same time.

- Carbon addition: Carbon tests were conducted in the lab only. Carbon was added to the melt mix (feed) to reduce the sulfates to SO_x. Results indicated that this does destroy the sulfates; however, balancing the reactions between destroying the sulfates and reducing lead to metallic lead was difficult to control. Reduced metallic lead was not observed; however, lead sulfide, which looks like metal, was observed. Lead sulfide is similar to metallic lead because it is molten, precipitates and sinks to the bottom, and is conductive.

- Sugar-water addition: Sugar water addition tests were performed in the lab and the minimelter runs only (not the VitPP). The goal was to limit carbon reduction to the sulfate layer (and not the entire glass melt). However, results indicated this method had similar problems as when carbon was mixed with the feed.

- Catalytic destruction: These tests were performed in the laboratory only. Some chemicals do not form sulfates well at higher temperature because the oxides act as catalysts to destroy the sulfates that form. Vanadium or tungsten form such oxides. Vanadium pentoxide was used to prevent a sulfate layer formation. The results indicate the catalyst did not work at a low concentration when mixed with the slurry feed mix. However, it quickly destroyed the sulfate layer when sprinkled on a formed sulfate layer. Cost should be considered when using this alternative because the oxide compounds used for the catalysts are expensive.

- Temperature and residence time: Higher temperatures destroyed the sulfates more quickly. Also, longer residence allowed more time for the sulfates to be destroyed. Idle time or down time in the minimelter or VitPP runs inadvertently may increase the residence time of the glass in the Melter and give a false impression of the effectiveness of destroying sulfates and high production rates. Downtime/Residence time needs to be taken into account when calculating production rates of a given run and comparing production rates between or among runs.

2.5 Minimelter Runs

A minimelter was used at the VSL to develop and test FDF glass formulas with corrolary viscosities and electrical conductances for operation and testing in the FDF VitPP. The minimelter was of similar type construction as the VitPP Melter and provided data for scale-up to the large pilot facility.

VSL crucible melt No. C4A-03 was the glass formulation chosen for the minimelter run, and later, the VitPP Campaign 4 run. It became known as "Series A Glass" during Campaign 4. Viscosity and conductivity curves for this glass are shown in Figures 2-2 and 2-3. Although the viscosity of the C4A-03 glass was high, it performed well in the minimelter. There was some concern that the glass would be too thick to operate efficiently in the VitPP melter. Therefore, a less viscous glass was formulated at FDF. Its crucible melt was S12-04 and became known as "Modified Series A Glass." The viscosity curve of the S12-04 is shown in Figure 2-4. The chemical composition and addition properties of these glasses are shown in Table 2-11.

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Table 2-11
Minimelter Melter Glass Formulas

Series - Run	A		Ax	
Melt Number	C4A-03		S12-04	
Comp. (Wt%)	Calc.	Analy.	Calc.	Analy.
Al_2O_3	5.89	6.08	6.15	na
B_2O_3	12.89	11.84	10.51	na
BaO	4.47	4.11	4.09	na
CaO	5.08	5.49	13.31	na
Fe_2O_3	3.98	3.60	3.6	na
K_2O	0.61	0.55	0.58	na
La_2O_3	0.34	0.02	-	na
Li_2O	1.52	1.44	1.28	na
MgO	1.32	1.20	1.23	na
MnO_2	-	-	-	na
Na_2O	5.68	4.66	7.33	na
NiO	0.38	0.33	0.56	na
P_2O_5	0.63	0.65	0.56	na
PbO	8.63	7.87	7.98	na
SO_3	1.62	1.44	-	na
SiO_2	46.90	40.70	43.38	na
V2O5	-	-	-	na
ZrO_2	0.09	0.11	-	na
Total	100.00	90.81	100.00	na
Appearance upon cooling	Dark brown glass		Brown clear transparent glass	
Liquidus	<1100°C		<1000°C	
Density, g/cm^3	2.76			
Temp., °C				
1150	234.0	0.06-0.08	140	0.11
1200	123.1	--	84	0.15
1250	76.2	0.07-0.09	53	0.21
1300	52.6		35	0.28
1350	39.1	--	23	0.38
1400		--	17	--
TCLP, ppm				
Pb	2.6			
Ba	2.06			
Ni	0.10			
Waste Loading:				
g dry waste/g glass	79.08 %		71.6.00 %	
as oxides in glass (100% - additives)	74.00% (74.50% w/SO_3)		67% (~68% w/SO_3)	

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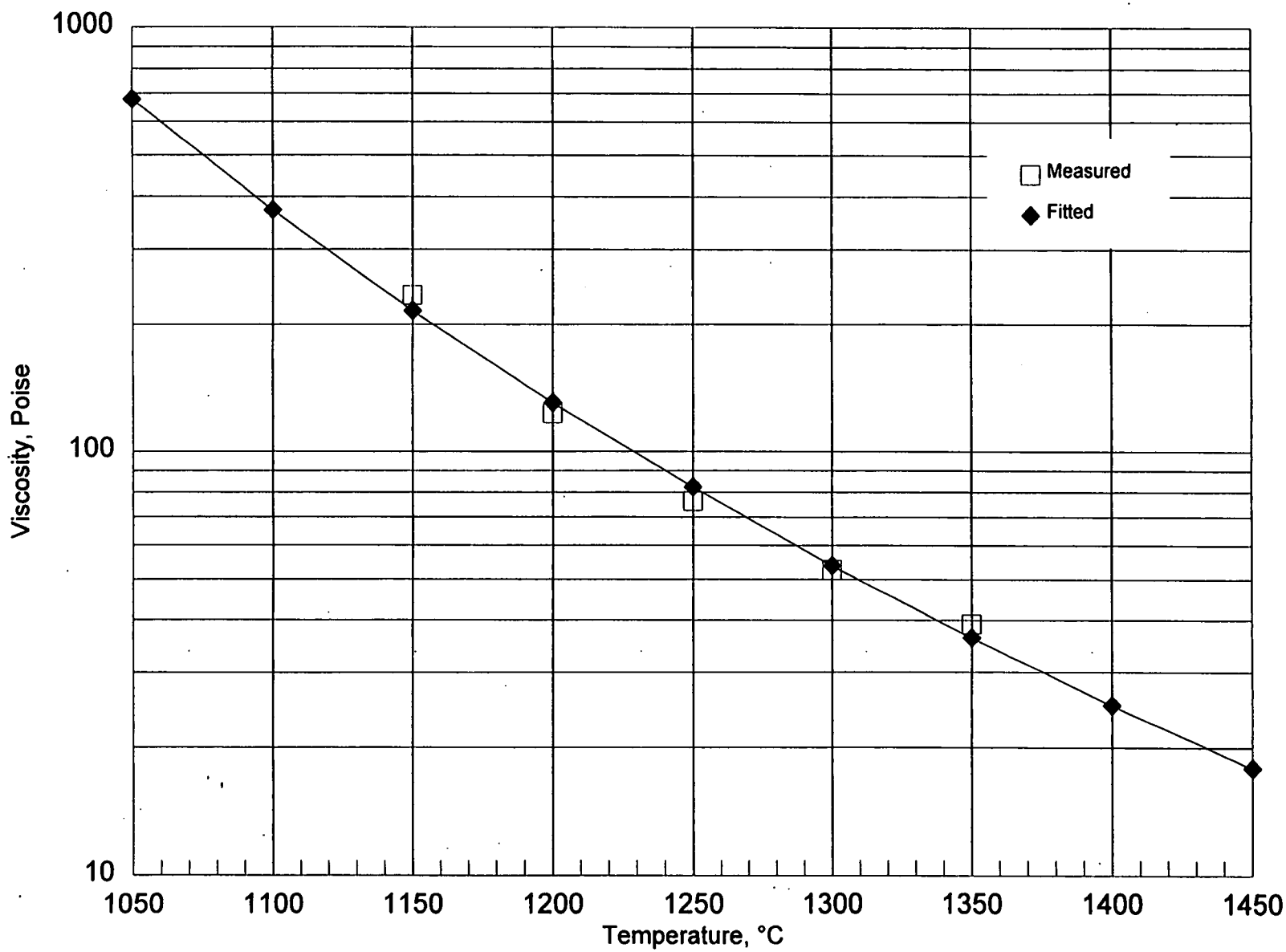

C4A-03 Viscosity Curve "Series A Glass"
Figure 2-2

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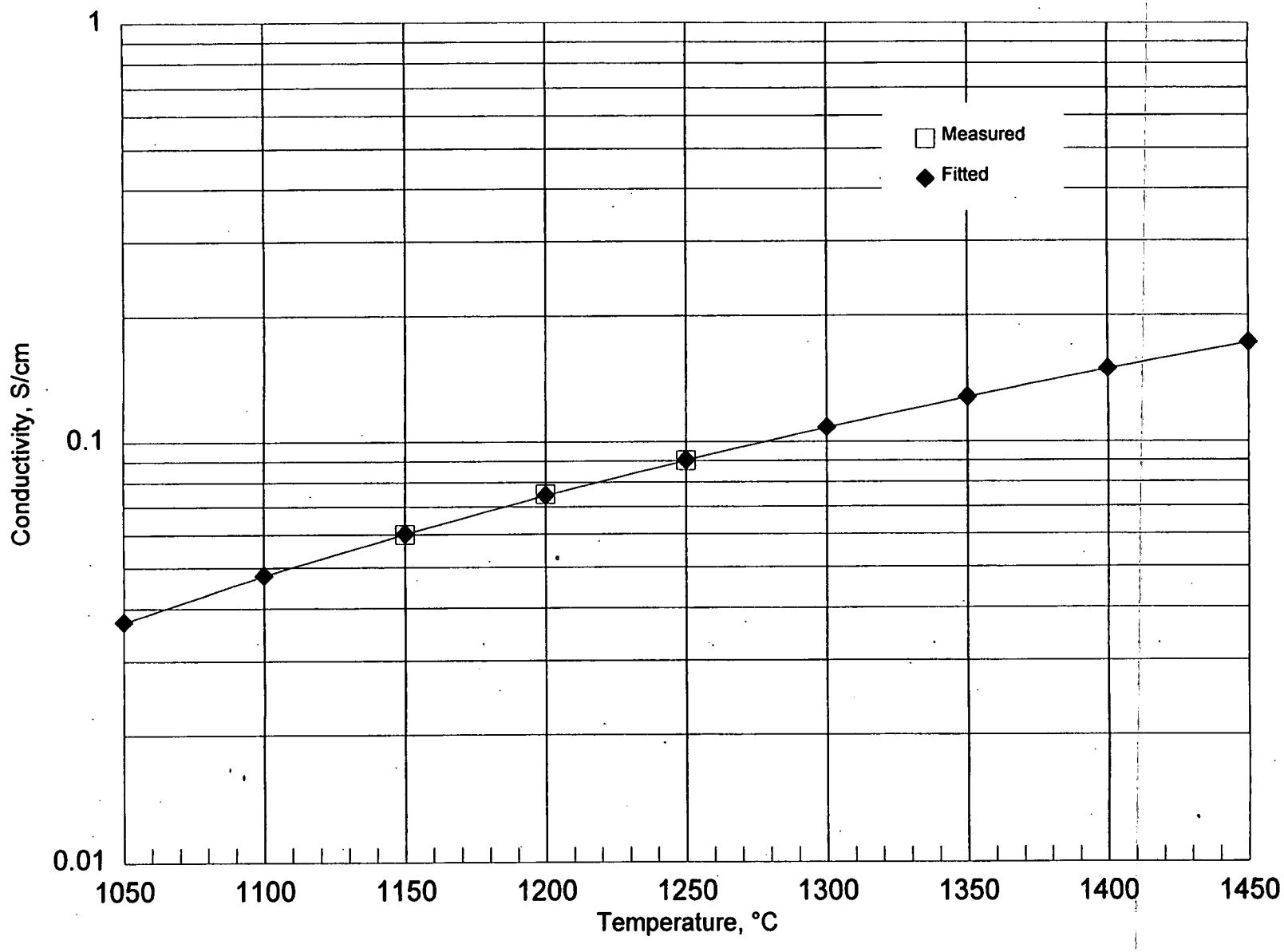

C4A-03 Conductivity Curve "Series A Glass"
Figure 2-3

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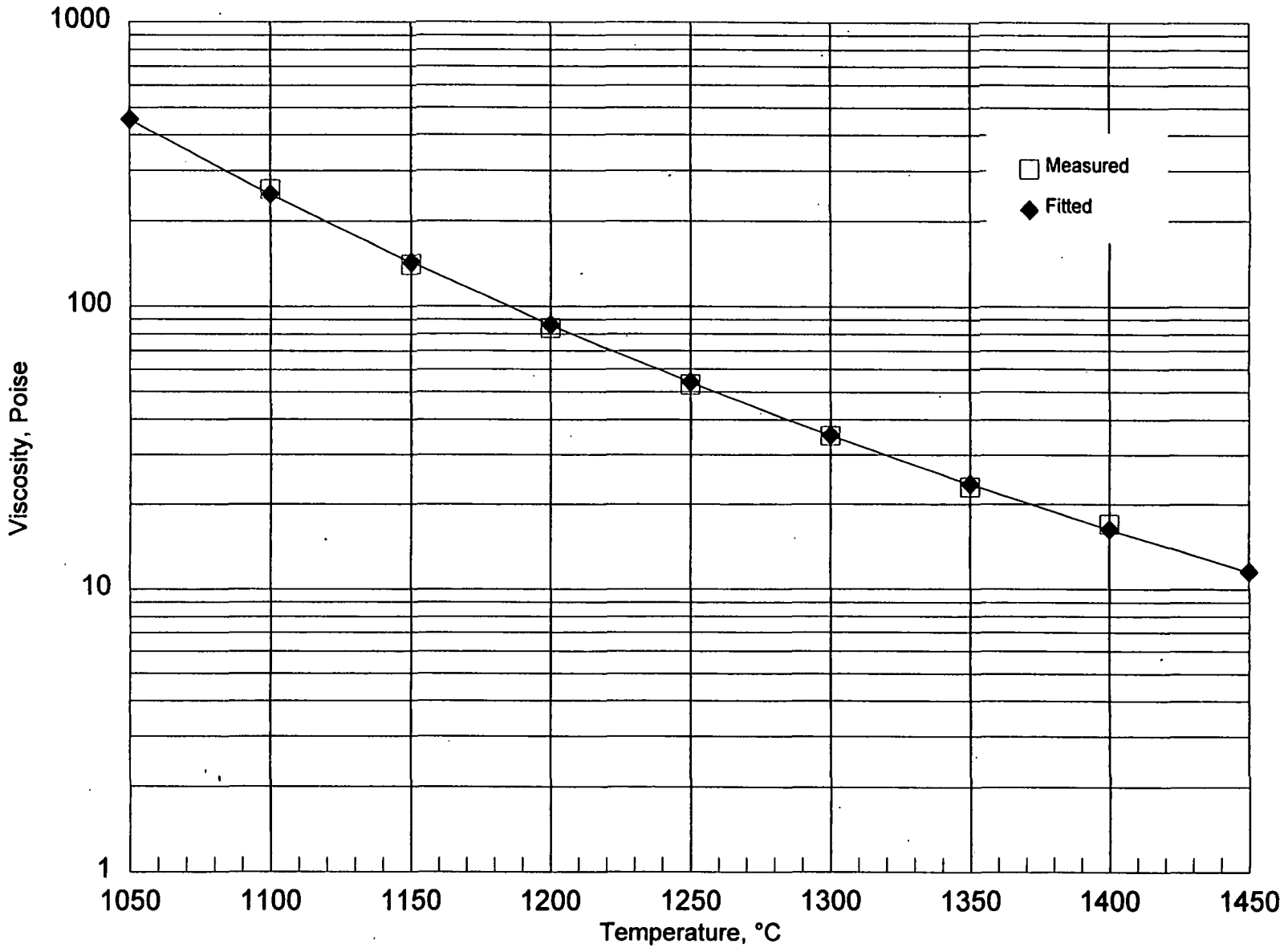

S12-04 Viscosity Curve "Series A Mod. Glass"
Figure 2-4

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2.6 Series B -- Silo 1 and Silo 2 Blend with Bentonite Minimelter and VitPP

A minimelter run was not performed for Silos 1 and 2 Series B glass because bentonite is now considered less of a problem than originally thought (with the latest glass recipes). This also applies to the VitPP runs. Since alumina had been used as an additive in the glass recipes and since fluxes already had been added to adjust for its impact, the higher alumina concentration in the bentonite had less of an impact than originally expected. As a matter of fact, at low-to-moderate blends of bentonite, less alumina is required as an additive. However, when the alumina concentration becomes excessive, fluxes will need to be added to reduce the viscosity of the glass.

2.7 Waste Loading and Series A Runs in the VitPP Melter

Tables 2-12 and 2-13 show a summary of the glass chemistry and slurry makeup for the Series A Glasses. The slurry wt% and the side chamber frit are averages throughout the run. The slurry concentrations are consistent with those seen in Campaign 2. The amount of frit added is considerably less in Campaign 4; 20 wt% was added during Campaign 2. Gasses produced from the decomposition of the surrogates are totaled in the right column.

The waste loadings are calculated on a dry weight basis which is determined by the number of parts of dry waste (by weight) that will produce 100 parts of glass. The waste loading of the Series A glasses are as follows:

	Dry Weight Basis
Series A , C4A-03 glass	78.20
Modified Series A, S12-04 glass	70.73

These numbers assume the glass contains 0.5 wt% sulfate. Also, the waste loading will increase approximately 2 wt% if the waste "minors" constituents are included in the glass.

2.8 Scale-Up and Maximum Production Rates

The VitPP performed in accordance with its design basis. The Melter was administratively limited to process at approximately 1 MT/d which is the design basis for the Melter. Several batches were processed at approximately 1 MT/d or approximately 1¼ MT/m²•d for the selected C4A-03 surrogate recipe. This is somewhat more than the generally accepted (maximum) production rate of 1 MT/m²•d. However, based on minimelter runs production rates, it is lower than expected

Minimelter runs demonstrated that a select C4A-03 surrogate recipe could be processed into glass between 1130°C and 1310°C. Table 2-14 gives a summary of the production rates and key parameters of the minimelter runs. Included in the table are expected

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Table 2-12
Optimum Series A Glass for Campaign 4

Basis: 100 lbs Glass from Slurry

Melter Input -- Feed Oxide	Glass wt%	Moisture wt%	Silo 1 Surrogate lbs	Silo 2 Surrogate lbs	Silo 3 Surrogate lbs	Surrogate Total lbs	Additives lbs	Batch lbs
Al_2O_3	6.05		1.31	1.51		2.83	3.22	6.05
B_2O_3	13.20							
H_3BO_3							23.44	23.44
BaO	4.52							
$BaCO_3$			1.86			1.86		1.86
$BaSO_4$			2.65	2.03		4.68		4.68
CaO	5.00			0.23		0.23		0.23
$CaCO_3$				1.50		1.50	6.94	8.44
$CaSO_4$		6.20		0.11		0.11		0.11
Fe_2O_3	3.98		1.26	2.71		3.98		3.98
$Fe_2(SO_4)_3$								
K_2O	0.65							
K_2CO_3			0.50	0.44		0.95		0.95
KNO_3								
Li_2O	1.53							
Li_2CO_3							3.79	3.79
MgO	1.36							
$MgCO_3$			0.71	1.04		1.75		1.75
$MgSO_4$								
$Mg_3(PO_4)_2$			0.58	0.56		1.14		1.14
MnO_2								
Na_2O	5.80						7.70	7.70
$Na_2B_4O_7$		30.90						
Na_2SO_4								
Na_2CO_3			1.56	0.40		1.95		1.95
$NaNO_3$				0.43		0.43		0.43
NiO								
P_2O_5	0.62							
PbO	8.82		6.06	2.76		8.82		8.82
SiO_2	47.97		25.27	22.69		47.96		47.96
TiO_2								
V_2O_5								
Bentonite	--	14.23						
$CO(NH_2)_2$	--						0.80	0.80
SO_3 in glass	0.50							
Total Solids	100.00	na	41.77	36.43		78.20	45.89	124.09

Water for average 34 wt% Solids	240.88
Total	364.96

Note:

The surrogates that were used for the silo residues is shown in the columns above. Another column shows the additives that were used for making the glass. Amounts are shown with moisture.

Melter Output

Glass	100.00
CO_2 (to off-gas system)	11.35
SOx	1.13
NOx	0.27
Urea decomposition products	0.78
Water (H_2O to off-gas system)	251.43
Subtotal	364.96

Frit Addition Impact

Glass from slurry	100.00
Frit addition, lbs glass	10.00
Total glass produced, lbs	110.00

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Table 2-13
Modified series A Glass (S12-04) for Campaign 4

Basis: 100 lbs Glass from Slurry

Melter Input -- Feed Oxide	Glass wt%	Moisture wt%	Silo 1 Surrogate lbs	Silo 2 Surrogate lbs	Silo 3 Surrogate lbs	Surrogate Total lbs	Additives lbs	Batch lbs
Al2O3	6.12		1.19	1.37		2.56	3.59	6.15
B2O3	10.46							
H3BO3							18.67	18.67
BaO	4.07							
BaCO3			1.68			1.68		see note
BaSO4			2.40	1.84		4.24		4.24
CaO	13.24			0.21		0.21		0.21
CaCO3				1.36		1.36	21.96	23.32
CaSO4		6.20		0.10		0.10		0.10
Fe2O3	3.58		1.14	2.46		3.60		3.60
Fe2(SO4)3								
K2O	0.58							
K2CO3			0.46	0.40		0.86		0.86
KNO3								
Li2O	1.27							see note
Li2CO3							3.17	1.58
MgO	1.22							
MgCO3			0.64	0.94		1.59		1.59
MgSO4								
Mg3(PO4)2			0.52	0.51		1.03		1.03
MnO2								
Na2O	7.29							
Na2B4O7		30.90						
Na2SO4								
Na2CO3			1.41	0.36		1.77	10.52	12.29
NaNO3				0.39		0.39		0.39
NiO								
P2O5	0.56							
PbO	7.94		5.49	2.50		7.98		7.98
SiO2	43.16	22.85	20.53	22.85		43.38		43.38
TiO2								
V2O5								
Bentonite	--	14.23						
CO(NH2)2	--						1.45	1.45
SO3 in glass	0.50							
Total Solids	100.00	na	35.45	35.28		70.73	59.36	126.82

Water for average 31 wt% Solids	282.28
Total	409.11

Notes:

The surrogates that were used for the silo residues is shown in the columns above. Another column shows the additives that were used for making the glass. Amounts are shown with moisture.

One batch was transition and the other per above formula. % solids of batches were 35 and 23, average 31. Batch w/35% was approx. twice the size as the 23% batch.

Some barium oxide and lithium oxide was supplied by the side chamber fritg. Therefore, full amounts were not added.

Melter Output

Glass	100.00
CO2 (to off-gas system)	18.26
SOx	0.97
NOx	0.24
Urea decomposition products	1.45
Water (H2O to off-gas system)	288.19
Subtotal	409.11

Frit Addition Impact

Glass from slurry	100.00
Frit addition, lbs glass	4.50
Total glass produced, lbs	104.50

Table 2-14
Series A (C4A-03) Minimelter Runs and Scale-up to VitPP

Run Segment	Time	Feed Rate (1/h) and Glass Production Rate + (kg/day)	Bubbling Rate (SCFH)	Target Temp. (°C)	Temp. of Glass Pool During This Period* (°C)	Plenum Temp. (°C)	Percent Cold Cap Once Steady State is Reached ***	SO_2 (ppm)**	(% of feed)	Glass Discharge (kg)	Comments	Expected VitPP Production Rate (MT/d)
I	11-13-95 17:26-24:00 (turnover)	4.5/62	10	1330	1315-1350	800-824	30-40%	37-47	35-44	18.9	Little or no foaming	2.68
II	11-14-95 10:40-19:50	4.5/62	10	1250	1230-1300	744-775	40-80%	30-55	28-52	23.1	No foaming but on the edge of cold cap limitation	2.68
III	11-15-95 1245-19:00	1.4/19	10	1130	1105-1170	696-816	20-40%	<10	<30	5.1	No foaming	0.82
IV	11-16-95 9:50-11:15	4.5/62	10	1250	1225-1258	740	85% by 11:00 a.m.	11	10	1.9	Cold cap limited	2.68
V	11-16-95 11:15-14:13	0		Heat to ~1300	1230-1350	-	-	-		0	While heating to ~1300°C, some foaming observed, most likely from the sulfate in the glass from run segment II to IV	-
VI	11-16-95 14:13-18:10	6.7/93	10	1310	1290-1350	740-784	20-85%	55-110	35-70	14.2	Controlled foaming in main chamber during discharge	4.03

*Measured using a two-color pyrometer
**Sampled before quencher
***After about 2 hours of continuous feeding
+Based on feed rate

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scale-up glass production rates for the VitPP Melter based on a ratio of the bath surface area between the two melters. Notice that the expected glass production for the VitPP Melter is 2.68 MT/d at 1,250°C. The VitPP Melter actually performed at approximately 1 MT/d. A slightly higher production rate may have been possible with this glass recipe and these operating conditions, but not a large amount, because the Melter consistently had a rather thick, rigid cold cap that covered 90% of the Melter surface. Such a cold cap normally leaves little room for increased production rates.

The main cause(s) for the difference between the expected scale-up and the actual production rates for the VitPP could be explained as follows:

- Slurry wt% Solids

  The amount of water in the slurry batches for the minimelter and the VitPP melter contrasted significantly. The minimelter slurry was prepared as 50 wt% solids and was not adjusted throughout the batch run. The VitPP melter slurry was prepared as approximately 35 wt% solids and was adjusted throughout the batch. Water was added to the slurry when the slurry pipes clogged and when valves on the recycle water system leaked by. As the feeding of each batch progressed, the weight percent of water in the slurry increased, but typically, additional slurry samples to measure the weight percent of solids were not collected.

  The additional amount of water in the slurry decreased the production rate of glass. The additional water required additional heat for evaporation. This heat could have been used in the dissolution of the slurry solids and increased the glass production rate.

- Agitation:

  The minimelter was run at 10 SCFH air agitation and the VitPP was run at approximately 24 to 40 SCFH. The VitPP would have to operate at 230 SCFH (based on surface area ratios) to be equivalent to the minimelter agitation.

- Lower Quantities of Lithium from the Slurry Feed Entered the VitPP Melter than Entered the Minnimelter:

  In order to maintain the lithium concentration in the bath close to the desired glass recipe, lithium in the molten frit that leaked into the center chamber was accounted for. This was done to keep the lithium concentration in the glass lower than in Campaign 2 and thus reduce the TCLP numbers for Pb in the glass. This appears to have worked because the TCLP numbers in Campaign 4 are considerably lower. However, to accomplish this, an adjustment equal to the amount of lithium that leaked into the center chamber was subtracted from the slurry feed. Lithium in the slurry feed melts early and can start "wetting" and dissolving the wastes before

they get to the glass interface. Thus, the decrease of lithium in the slurry, made to offset the lithium migrating from the west side chamber, could have an adverse impact on the glass even though the concentration in the glass will ultimately be the same.

- Different Sulfates Used in the Surrogates:

  Tables 2-15 and 2-16 identify the surrogate composition for the minimelter runs. The components that made up the CMIXB (minor component mix) material are shown in Table 2-16. Both the VitPP and the minimelter surrogate recipes are formulated to make essentially the same glass, C4A-03. However, some of the chemical compounds used to make the glass are different. Most notable is the sulfate compound. Calcium sulfate was used in the minimelter surrogate and barium sulfate was used in the VitPP surrogate (see Tables 2-12 and 2-13). The higher destruction temperature of the barium sulfate may make it more difficult to destroy the barium sulfate than calcium sulfate, and consequently, reduce the glass production rate.

- Support Systems to the VitPP are Limiting:

  The feed and offgas systems, at times, could not support the Melter operating greater than 1 MT/d. Therefore, the Melter had to move back to a slow production rate.

Table
Feed Recipe Used for Series A Minimelter Run

C410-kgA-01A				Target Amount (g) 8000		
Components	Mol. Wt.	Wt%	Wt% (Norm.)	Starting Material	Mol. Wt.	Target Wt. (g)
Al_2O_3	102	5.9	5.92	Al_2O_3	102	473.5
B_2O_3	69.6	12.9	12.94	H_3BO_2	61.8	1838.4
BaO	153	4.5	4.51	$Ba(CO_3)$	197.3	464.8
CaO	56.1	5.1	5.12	$CaCO_3$	100	567.4
			0.00	$CaSO_4*2(H_2O)$	172.2	279.6
Fe_2O_3	160	4	4.01	Iron Hydroxide Slurry	-----	2568.0
K_2O	94.2	0.61	0.61	$K_2(CO_3)$	138	71.7
Li_2O	29.9	1.52	1.52	$Li_2(CO_3)$	73.8	301.1
MgO	40.3	1.32	1.32	$Mg_3(PO_4)_2*8(H_2O)$	406.9	144.9
Na_2O	62	5.68	5.70	Na_2CO_3	106	779.3
P_2O_5	142	0.63	0.63	$Mg(CO_3)$	84.3	131.5
PbO	223	8.63	8.66	Pb_3O_4	685.6	709.1
SO_3	80.1	1.62	1.63			
SiO_2	60.1	46.9	47.05	SiO_2	60.09	3763.7
NiO	74.7	0.38	0.38	NiO	74.7	30.5
Total		99.7	100.00	C4MIXB		99.0
				Total Weight (g)		12222.3
				Project/Task # = CRU-4/#8001		

Source: VSL

To the Crucible Lab:
Mix the above ingredients together except for iron hydroxide slurry.
Add 7.5 liter of RO water to the iron hydroxide slurry and then add the rest of the additives to the water/iron hydroxide slurry.

Table 2-16
Recipe for C4MIXB (Minor Component Mix) Used in Series A Minimelter Runs

				Target Amount (g) 1650		
Components	Mol. Wt.	Wt%	Wt% (Norm.)	Starting Material	Mol. Wt.	Target Wt. (g)
As_2O_3	198	0.02	1.87	As_2O_3	198	30.78
CeO_3	188	0.17	15.86	CeO_2	172	239.39
CoO	74.9	0	0.00	CoO	74.9	0.00
Cr_2O_3	152	0.04	3.73	Cr_2O_3	152	61.57
CuO	79.55	0.06	5.60	CuO	79.55	92.35
La_2O_3	325.8	0.19	17.72	$La_2(CO_3)*8(H_2O)$	601.97	540.34
MnO_2	86.9	0.02	1.87	MnO	70.9	25.12
MoO_2	127.9	0	0.00	MoO_3	143.9	0.00
Nd_2O_3	336.48	0.165	15.39	Nd_2O_3	336.48	253.96
SeO_2	111	0.009	0.84	SeO_2	111	13.85
TiO_2	79.9	0.28	26.12	TiO_2	79.9	430.97
V_2O_3	149.8	0.038	3.54	V_2O_5	181.88	71.01
ZrO_2	123.22	0.08	7.46	ZrO_2	123.22	123.13
Total		1.072	100			1882.5

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Campaign 2 had production rates which were closer to the minimelter production rates than Campaign 4 production rates. For example, the Campaign 2 Series D glass batches had an average production rate of 1.79 MT/d (with a range from 0.97 to 2.91 MT/d). This could be explained by four possible reasons:

- The glass chemistry of the Series D is more amenable to faster production rates, or

- Something changed with the operation of the Melter between the two campaigns.

  The main differences were the cracks in the E-wall of the west chamber and its associated problems. Because of cracks in the west chamber E-wall, excessive foaming in the west chamber started very early in Campaign 4 and the top two electrodes in the chamber corroded away. The Melter was designed with significantly more electrode surface area than needed to deliver the power to the glass so the loss of the two electrodes did not stop operations. However, the power (and thus, heat) was confined more to the bottom of the Melter. Relocation of the power could have left the surface of the Melter cooler than in the previous campaigns and thus, as mentioned above, the Melter production rate would be expected to drop.

- Administrative Operation Requirements

  During Campaign 4, operations personnel were directed to avoid triggering the EOG system due the collapse of a cold cap that had a pool of liquid on it. To avoid creating these circumstances, operations personnel often limited the cold cap to approximately 85% coverage and a 2 inch thickness. This effectively limited the amount of liquid that could collect on the cold cap, but it also limited the rate at which glass could be produced.

- Actual Amount of Water in the Slurry

  Due to operational requirements and operational circumstances, the amount of water in a slurry batch would often increase through the life of the batch. This increasing concentration of water would decrease the production rate of the glass. The heat required to remove the water could have been used to dissolve the solids in the slurry into the glass melt.

In conclusion, the Series A Glass, C4A-03 (with a barium sulfate base), appears to have a production rates of approximately 1¼ MT/d•m² at 1,250°C for the VitPP Melter. Similar production rates are expected for a large-scale facility unless key limiting parameter(s) (which could be any of the reasons listed above) can be identified and eliminated. The Modified Series A recipe appears to have more production potential than C4A-03 recipe because the cold cap was thinner and more fluid than the cold cap for C4A-03. The operators noted that there were times when it was difficult to maintain a cold cap on the surface of the bath when running with the modified Series A recipe. This is an indication that increased production rates were achievable. Also, little or no foaming was noted in the center chamber and the Melter appeared to be handling sulfates with more ease.

3.0 VitPP SYSTEMS

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The VitPP systems described in the previous campaign reports were used during Campaign 4. Figure 3-1 is a process flow diagram which shows the movement of material through the VitPP. Waste surrogate chemicals mixed with glass making chemicals were manually added through the bag dump station. These materials were pneumatically conveyed via the filter/receiver and into one of the slurry preparation tanks where they were mixed into a slurry using process water. The slurry was circulated through a recirculation loop from the slurry tank to the inlet of the melter feed pump and back to the tank using the air-driven slurry tank pump. The feed pump would draw a metered amount of slurry from the loop and feed it into the Melter. Periodic discharges of molten glass were performed to control the level in the Melter. The molten glass was discharged as a monolithic pour into 55-gallon drums located under the Gem Making Machine. The remaining equipment shown in Figure 3-1 was used to cool the Melter or to cool and treat the Melter off-gas. The waste-water filters were used to remove solids that accumulated in the recycled off-gas quench-water.

Prior to Campaign 4, some modifications were made to improve system operating efficiencies. A brief description of the VitPP systems and the modifications made to improve the operation of these systems prior to and during Campaign 4 are detailed in the following subsections, that cover the feed preparation system, melter system, glassforming/gem-making machine, off-gas treatment system, recycle watersystems, and data gathering.

.1 Feed Preparation System

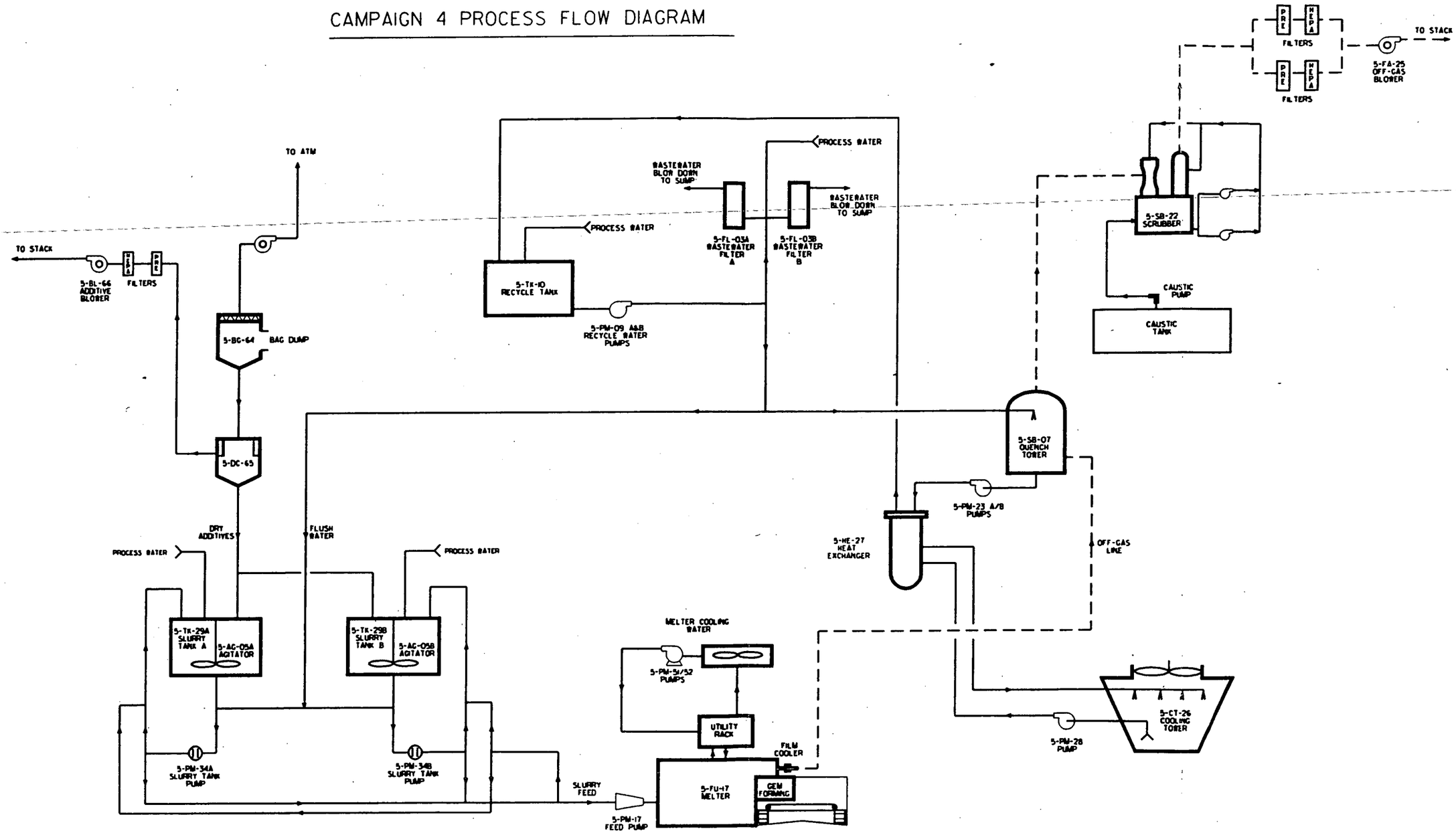
The feed preparation system includes additive systems (equipment for preparing the melter feed) and the slurry (refer to figure 3-1).

3.1.1 Additive Systems

The equipment for preparing the melter feed included a standard industrial bag slitting and dumping station, filter/receiver, HEPA filter train, blower, melter feed pump and two slurry tanks with dedicated pumps and shared piping loops (reference Figure 3-1). The bag dump station has its own ventilation fan and includes filters to control fugitive dust during the dumping operation. The surrogate and additive materials, which were introduced as dry powders, were conveyed pneumatically to the filter/receiver. During Campaigns 1 and 2, the bag Dump station was plugged with dry additive and surrogate materials many times. In addition, the HEPA filter unit installed on the bag dump station blower did not meet site standards for DOP testing. This blower and its associated HEPA filter unit were replaced before the start of Campaign 4.

During Campaign 4, all of the slurry feed ingredients except magnesium phosphate were added directly to one of the slurry tanks (tank A or tank B). During Campaign 2, when added to the slurry, the magnesium phosphate formed small "rocks" that ultimately plugged the slurry recirculating system.

CAMPAIGN 4 PROCESS FLOW DIAGRAM



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NOTE: FLUOR DANIEL FERNALD CADD DRAWING. DO NOT REVISE MANUALLY.

CONFIGURATION MANAGEMENT DRAWING

COGNIZANT ENGINEER DATE

APPROVALS

CIVIL & STR.		SAFETY ENG.	
ELECTRICAL		MAINTENANCE	
ENGINEER		FIRE PROTECT.	
INSTRUMENT		WASTE MANAGE	
MECHANICAL		SECURITY	
		CRU	
CHECKED			
APPROVED			

Fernald Environmental Management Project

FLUOR DANIEL FERNALD

U.S. DEPARTMENT OF ENERGY

CAMPAIGN 4 PROCESS FLOW DIAGRAM

FIGURE 000062

DES. 2549
DATE 03/03/97
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Therefore, in Campaign 4, the magnesium phosphate was added directly to the melter as a dry material. To prepare the slurries, water was added to a slurry tank. Dry ingredients were pre-weighed and added to a slurry tank via the pneumatic transfer system. The slurry was mixed using the tank agitators and recirculated through the Melter feed loop for feed to the Melter or through the bypass loop if the slurry was being held in standby.

The replacement blower was a positive displacement Roots™ blower with a DOP-testable Flanders™ HEPA filter unit. The higher-capacity blower was installed to eliminate the frequent plugging in the base of the bag dump station that had occurred in Campaigns 1 and 2.

During Campaign 4, the bag dump station plugged once. This plugging was solved by changing the dumping sequence of the additives. The filter/receiver plugged on several occasions. Moisture in the head space of the slurry tanks was drawn into the filter/receiver housing and condensed. When the bag dumping operation started, the moist filter/receiver became blocked with dry additive material. A vibrator was installed on the base of the Filter/Receiver to help prevent the blockage. Even with the vibrator, blockage of the Filter/Receiver continued. The filter/receiver had to be partially disassembled to clear the blockage. In ensuing bag dumping operations, increases in the slurry tank weight were closely monitored to ensure that the material dumped into the bag dump station proceeded into the slurry tank. The dry additive materials also were added at a slower rate. If the additives did not pass through the Filter/Receiver, operations personnel would manually agitate the receiver using a rubber mallet until the material fell into the slurry tank.

Solids from the filter/receiver fell into one of two slurry tanks for mixing with water. The slurry was agitated with internal agitators and recirculated with double-diaphragm, air-driven pumps to maintain the slurry in suspension. The slurry transfer pumps recirculated the slurry through either: (1) a bypass short-loop directly back to the slurry tank; or (2) through a long-loop to the melter feed pump and back to the slurry tank. Often during Campaign 4, operations personnel noted a loss in flow of the system. The flow would return after the agitator was shut down. A vortex in the slurry tanks was causing the pumps to draw air from the slurry tank head space. To alleviate the problem, the slurry tank agitators were cycled to prevent a vortex from occurring in the tank. This was very effective in stopping the pumps from drawing air through the slurry tanks.

3.1.2 Slurry System

The slurry system consisted of two slurry tanks with agitators, two air-driven double diaphragm slurry pumps and a shared piping system containing automatic and manually controlled valves. A metered positive displacement screw type melter feed pump delivered the prepared slurry from the distribution piping system to the Melter.

Throughout Campaigns 1 and 2, the slurry system provided many operational challenges. The pipes of the slurry recirculation and Melter feed system frequently were plugged with packed slurry solids. The blockages were a result of two primary causes: (1) poorly designed piping with too many 90-degree bends, horizontal sections, and dead sections

with too few access ports for flushing and cleaning; and (2) the physical and chemical characteristics of the slurry. In addition, the melter feed pump seals required replacement on many occasions. During Campaigns 1 and 2, the seals leaked both sealant water and slurry onto the melter feed pump support structure. The leakage was caused by improperly designed seal face finishes that were causing the seals to prematurely wear out.

To correct the above mentioned deficiencies, prior to Campaign 4, several 90-degree elbow sections in the piping that were prone to plugging during Campaigns 1 and 2 were replaced with flexible chemical hoses. These cam-locked sections facilitated removal and provided a smoother travel path for slurry distribution. The seal faces for the melter feed pump were changed from a smooth-finished tungsten-carbide-to-carbon face, to a matt finished tungsten carbide-to-carbon face. The seal cooling fluid tank was also modified to include a low seal fluid interlock switch. To prevent running the seals without cooling fluid, this switch was designed to shut down the melter feed pump automatically when the low seal tank fluid level was.

Slurry pump modifications were also made to the slurry system prior to Campaign 4. Both slurry pumps were replaced with larger top-suction, bottom-discharge pumps. The top-suction, bottom-discharge design incorporates a flap-type check valve. The original bottom-suction, top-discharge pumps used ball-and-seat type check valves. The flap-type check valve was much more resilient. The rapid wear seen in the ball-and-seat type valves during Campaigns 1 and 2 was not observed in the flap-type valves used in the replacement pumps.

During Campaign 4, plugging in the dead sections of slurry piping and in the slurry tank outlets remained a frequent problem. The new slurry pumps delivered a much higher flow per stroke than the original pumps. This more aggressive pumping helped keep the slurry moving through the piping system. Unfortunately, in Campaign 4 the plugging problem appeared in the dead sections of piping. By design, the long-to-short loop cross-over piping and sample-port piping had no flow during normal operations. These dead sections of piping frequently were blocked due to packing of the slurry from the higher-capacity pumps. The lesson here is that the slurry system needs to be designed without dead sections of piping. The system used was designed with one feed loop shared by the two slurry tanks. In the future, dedicated loops of smooth piping with minimal valving should be provided for each slurry tank. This will eliminate the need for long-loop, short-loop cross over sections that ultimately plug during operation.

Another area prone to plugging was the outlet of the slurry tanks. The dished bottom slurry tanks contained no outlet flow baffle plates. Solids dumped into the tanks often settled directly to the bottom of the slurry tank and plugged the outlet of the tank. Better design of the mixing, dumping, and slurry tank exit hardware is required to prevent these plugging.

3.2 Melter System

The Melter manufactured by GTS Duratek is a joule-heated, three-chamber, refractory-lined furnace. The general arrangement of the Melter is shown in Figure 3-2. Some parts of this Melter design are proprietary and/or patented by GTS Duratek. Slurry feed enters the

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Contains Proprietary Information

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Contains Attorney-Client Privileged Information

a loss of the top two electrodes. Amperage readings on the top two electrodes also indicated that little, if any, electrode material remained. This observation supports the fact that the waste glass rapidly consumes molybdenum electrodes.

3.2.1 Melter Agitation

Agitation increases the glass production rate. Mechanical agitation is difficult (if not impossible) to construct because of material-of-construction and cooling issues at high temperature. Therefore, the VitPP Melter uses bubbler tubes for agitation. The tubes are located in a row down the center of the melter main chamber and bubble air through the bath. Agitation helps in the dissolution of the cold cap and distribution of heat in the bath; it also reduces the potential of the settling of elemental metals and debris in the glass melt.

3.2.2 Melter Discharge

Molten glass could be discharged from the Melter in either a continuous or batch mode. The continuous mode was accomplished by the molten glass passing through the discharge Chamber and out through the discharge trough and the discharge orifice. The batch method was accomplished by using a unique air-lift feature located in the bottom of the discharge Chamber. The air lift injected air bubbles that lift molten glass into the discharge chamber over the edge of the trough. The rate of discharge could be controlled by the rate of air flow applied. The air lift provided flexibility in the control of glass flow through the Melter and to the gem making machine. The ability of the gem making machine was largely dependent on the ability of the discharge orifice to deliver a consistent stream of molten glass and on the viscosity of the glass stream.

3.2.3 Melter Wall Design

The walls of the Duratek melter were designed for free air convection cooling. This required the melter to have thicker walls and insulation as compared to water-cooled melters. The Duratek melter walls were made from layers of refractories. The lower section of the melter contained the molten glass. The upper section was a plenum for capturing the melt off-gas. The first layer of the lower section was the glass contact refractory. This layer was surrounded by three layers of back-up refractory. These four layers of refractories were inserted into an Inconel™ metal tub. The tub was insulated and placed in a carbon steel shell. The upper section of the melter was enclosed with a thermal expansion resistant refractory surrounded by insulation and a carbon-steel outer shell. Near the end of Campaign 4, operations personnel noted that the refractory in the roof of the plenum had cracked. The cracks penetrated completely through the refractory. Because of structural integrity, operations installed Inconel™ supports under the cracked refractories. The supports were inserted into the roof of the Melter using penetrations originally designed for the lid heaters. The lid heaters were out of service and were no longer required for Melter operation. Production was resumed after the supports were installed.

Both air-/water-cooled melters require a temperature drop across the thickness of the walls

to prevent the seepage of molten glass past the refractory bricks in contact with the glass. The heat loss from the Melter walls produced a temperature gradient through the walls. The refractory layers were designed such that the only portion of the wall contacting the molten glass was the glass contact refractory.

With the power supply off, the cooling rate of the Melter for Campaign 4 was 0.6 to 1.0 °C per minute. This low cooling rate allowed ample time for performing maintenance operations on the Melter systems.

3.2.4 Melter Cooling Design

[redacted]

3.3 Glass Forming

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3.4 OffGas Treatment System

[redacted]

[redacted]

3.5 Recycle Water System

The recycle water system starts with the recycle water tank that holds a controlled inventory of recycle water. Recycle water is pumped from the recycle water tank by one of two recycle water pumps to the quench tower for melter off-gas cooling via direct, water-spray contact. Recycle water collects in the base of the quench tower and is

pumped by one of two quench tower pumps to the heat exchanger where the recycled water is cooled with cooling tower water. During Campaign 4, the recycle water bypassed the Thickener and was routed directly back to the Recycle Water Tank to complete the loop. Additionally, recycle water was piped to various slurry lines for flushing. The original design used a pressure safety valve to prevent the maximum rinse pressure from exceeding 90 psig. This relief valve was modified during Campaign 4 to allow the rinse pressure to be increased to 140 psig. The higher-pressure rinse water worked much better for flushing frequently blocked slurry pipes than did the lower pressure rinse water. This higher-pressure also provided slightly more flow to the Quench Tower and transition-line spray systems.

3.6 Data Gathering

The Vitrification Pilot Plant System (VPPS) is an ORACLE-based system developed to provide data management support for the VitPP. ORACLE is a database program by ORACLE Corporation that is leased and used at the FEMP site. VPPS contains specific tables, fields, and programs and acts as a central repository for several types of data collected during the operation of the VitPP. The system consists of a central database and related data collection and reporting software as shown: Figure 3-4.

3.6.1 System Overview

The core of VPPS is an ORACLE-based relational database running on one of the site VAX (trade name of computer) mainframe computers. Information from the VitPP data streams are loaded into this database.

The operation of the VitPP currently produces data streams from the following sources:

- Process data was collected via the Foxboro Distributed Acquisition and Control System (DACS). The Foxboro system automatically recorded and temporarily stored the plant process data. The system had data storage capacity for approximately 24 hours. After this time period, the stored data was overwritten and replaced with current data. The Foxboro acquisition cycle was approximately 1 minute.

  Three programs perform the data transfer to ORACLE:

  - IMMRUN, which is a computer program, sends the data for selected data tags to a port on the VitPP control Foxboro.

  - GETDATA.WAX is a computer program that creates data files from the IMMRUN output. Files are saved locally until picked up by the computer program VPPSLOAD.

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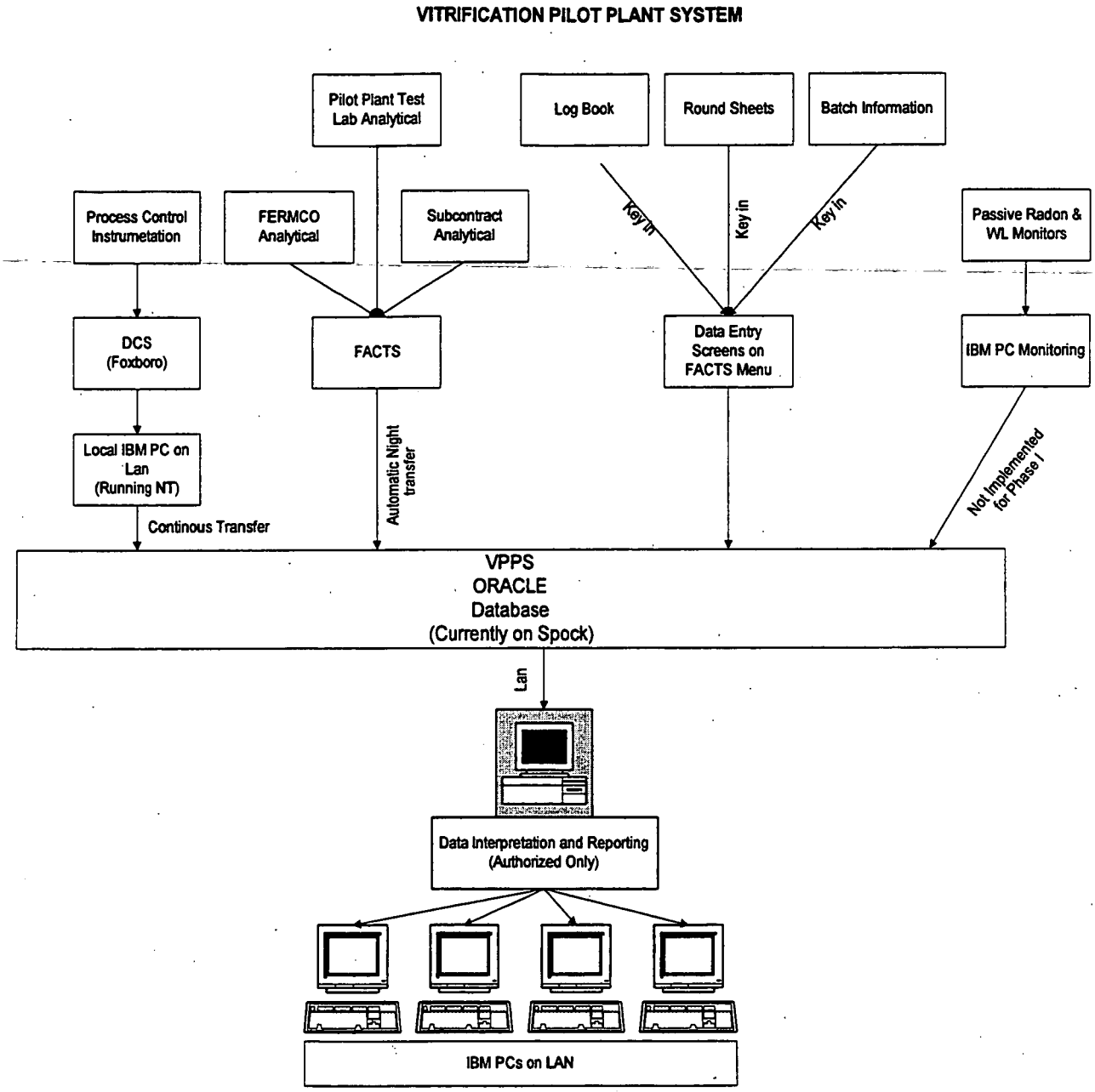
VITRIFICATION PILOT PLANT SYSTEM
Pilot Plant Test Lab Analytical
Log Book
Round Sheets
Batch Information
Process Control Instrumetation
FERMCO Analytical
Subcontract Analytical
Key in
Key in
Key in
Passive Radon & WL Monitors
DCS (Foxboro)
FACTS
Data Entry Screens on FACTS Menu
IBM PC Monitoring
Local IBM PC on Lan (Running NT)
Automatic Night transfer
Not Implemented for Phase I
Continous Transfer
VPPS
ORACLE
Database
(Currently on Spock)
Lan
Data Interpretation and Reporting (Authorized Only)
IBM PCs on LAN

Figure 3-4

- VPPSLOAD computer program copies the waiting files to the site network and loads the files onto ORACLE. All files are saved in the ARCHIVE program; rejected files are saved in a separate directory known as BAD.

- Analytical data from on-site and off-site labratories as well as the VitPP labratory were available in the site Fernald Analytical Computerized Tracking System (FACTS).

- Operations logbook information such as the Test Coordinators' Log, Shift turnover log, and operator's comments may be keyed manually into the database using the VPPS data entry module. This module was accessed using the FACTS in a manner similar to the analytical data. The VPPS combines these data streams into a set of tables that are stored in the ORACLE database.

- Data from shift roundsheets and other special data-collection sheets could be entered into the ORACLE database manually using the data entry module. The Roundsheet data were collected by plant operators on a routine time cycle throughout an operating shift.

VPPS combined these data streams into a set of tables that could be accessed for reporting and analysis.

3.6.2 Data Reporting

The VPPS database was accessed through the VPPS reporting application available to selected users on the local access network (LAN). Individual data tags (instrument data) or groups of data tags as specified by the user could be accessed on an hourly averaged basis or a minute-by-minute basis. Reports could be printed or read to an electronic file.

4.0 DATA ACQUISITION AND PROCESS CONTROL

For Melter control, the process instrumentation system and Melter observation points provided the means to measure, observe, and respond to changes in the Melter vitrification process to maintain steady-state conditions. The following "real-time" parameters were measured or observation noted:

Melter Chamber

- Glass temperature - thermowells into the waste chamber glass
- Amperage, voltage, and power Silicon Control Rectifier (SCR) to resistance heaters - SCRs 3 and 4 to resistance heaters for the main chamber lid
- Agitation - air flow rate to bubblers
- Glass level in the main chamber - observation ports
- Glass surface of melt - observation ports
- % cold cap and appearance - observation ports and CCTV camera
- Foaming - observation ports and CCTV camera
- Response time to changed conditions - process instrumentation recorded on the Data Acquisition and Control System (DACS)
- Chamber glass - periodic sampling
- Feeder tubes - surface thermocouples, cooling water temperature, and water flow rate
- Main chamber drains - 2 bottom drains, surface thermocouples, cooling water temperature, and water flow rate
- Refractory wall - thermocouple behind refractory in main chamber

Electrode Chamber(s)

- Electrode amperage, volts, and power - SCR 1
- Temperature - thermowells into the glass and optical infrared glass surface measurement (IR detectors out of service during Campaign 4)
- Electrode holders - surface thermocouple, cooling water temperature, and water flow rate
- Chamber glass level - level probes with molybdenum disilicide electrical contacts (level probes out of service during Campaign 4)
- Chamber glass - periodic sampling
- Drains - surface thermocouples, cooling water temperature, and water flow rate

Glass Discharge Chamber

- Glass temperature - thermowell into glass
- Amperage, voltage, and power to resistance heaters - SCR 2 controlling resistance heaters for the glass discharge chamber
- Glass discharge - air flow rate and pressure for bubbler and air lift for glass

transfer between the main chamber and the discharge chamber
- Appearance and thickness of glass discharged - observation ports
- Plenum temperature - thermowell into plenum area

The following ancillary systems were provided with instrumentation and observation points to support the control and operation of the Melter.

Feed Preparation

- Dry materials addition - Bag dump station, vacuum pneumatic transfer system, filter/receivers, level instrumentation, rotary airlocks, diverter valves, and transfer lines
- Slurry preparation - Slurry tanks A and B, tank agitators, recirculation pumps A and B, recirculation and Melter feed piping, and slurry flow metering
- Glass feed composition - batch formulation sheets
- Feed rate - Melter feed pump rpm, feed rate calibration, and feed slurry tank weight
- Laboratory support - Slurry determination of percent solids, density, constituent concentration analyses, and physical and chemical properties

Off-gas and Melter Plenums

- Melter pressure - differential pressure between room and Melter, Emergency Offgas (EOG) System and Melter, and Normal Offgas (NOG) System and Melter
- Plenum temperature - thermowells into plenum area of each electrode chamber
- Film Cooler - air flow rates, temperature, and pressure drop
- Film Cooler Air Lance - cooling air flow rate
- Normal Offgas System - pressure, temperature, and flow in lines and at components
- Volatilization and particulate carry over - sampling of NOG and EOG pre-filters and HEPA filters, observation of lines and components
- Moisture content - moisture instrumentation in the NOG System

Gem Machine

- Enclosure pressure - differential pressure between room and enclosure
- Enclosure temperature - thermocouples at top, bottom, and expansion joint
- Conveyor - head and tail component temperatures, speed, and cooling water temperature and flow rate
- Gem roller and cutter - component temperatures and speed
- Glass diverters - position indicators, and cooling water temperature and flow rate
- Material receivers - emergency, startup, and gem receivers temperatures and weights

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Closed-Loop Cooling Water

- System water - level indicators, flow rate, supply and return pressure and temperature
- Pumps - discharge pressure and operating mode
- Water to air cooler - fan speed and operating mode

Recycle /Waste Water

- System water composition - Water samples, analyses
- Waste Water Filter performance - pressure drop and flow
- Recycle Water components - liquid levels, temperatures, flow rates, and pressures
- Building Sump Tank - liquid level and sump pump run time

Environmental Discharge

- Building Sump Tank - liquid sampling and analyses
- Waste Water Filter - sampling and analyses
- Exhaust Stack - liquid condensate sampling and analyses, total discharge flow, iso-kinetic gas discharge sampling and analyses (in place for Campaign 4 to confirm satisfactory operation)
- Offgas systems - NOG, EOG, and building HVAC filter sampling and analyses
- Glass product - sampling, analyses and production rate

5.0 CAMPAIGN 4 RESULTS

This section presents the results obtained from Campaign 4 VitPP test runs. Presented are batch-by-batch descriptions of the runs including the operational problems encountered; power, feed, and temperature profiles; and production rates. In addition, elemental mass balances of lead and barium, and the amount of molybdenum and chromium consumed from the Melter are presented. The final sub-sections present discussions on individual system operations and the operational parameters that affected the systems. During the runs, four specific Campaign objectives were met. These objectives are as follows:

1. **Determined that vitrification of OU4 Silos 1 and 2 residues (using surrogates) is feasible.**

   Approximately 15,000 lbs of glass were made from approximately 46,000 lbs of Series A slurry surrogates. The processing temperature was 1250 °C. The slurry surrogates modeled the combination of the materials in Silos 1 and 2, standard glass forming chemicals, and water. The vitrified glass product contained approximately 78% Silo waste surrogates and 22% glass forming chemicals. The glasses produced during Campaign 4 passed the TCLP test as defined by RCRA. Based on the results from the Campaign 4 runs, vitrification of Silo 1 and 2 waste surrogates is feasible with up to 78% (dry weight basis) waste loading processed at 1250 °C.

2. **Gained experience in handling sulfates when vitrifying Silos 1 and 2 residues.**

   Analyses indicate that sulfate solubility in molten glass at 1150 to 1250°C is only ½ to 1% as SO_3. The surrogate slurry contained approximately 1¾ wt% sulfates as SO_3. During feeding, the excess sulfates accumulated near the surface of the glass bath, where they decomposed to SO_x and O_2 gases. When the sulfate accumulation rate was faster than the rate of decomposition, a sulfate layer formed. The released gases produced in the decompostion had to travel through the glass and into the offgas system. If the glass was too thick, the gas bubbles collected and built up a "head" of foam on the glass melt pool.

   Campaign I Melter operating parameters showed that during normal operation, the top of the glass bath was approximately 50 °C cooler than the bottom of the bath. On several occasions, production was halted due to temperature control problems. An accumulation of sulfate compounds near the surface of the Melter is believed to be the cause of the temperature control problems. A sulfate layer in the bath would be more electrically conductive than the rest of the glass bath. This more conductive layer would allow more electrical current to pass through the upper surface of the melt pool. This uneven current distribution would be accompanied by a thermal gradient. This in turn would cause the surface of the glass melt to be hotter than bottom of the melt, where the main chamber thermocouple was located. This would lead to temperature control problems and to temperature excursions. Operational experience gained during Campaign 2 enabled personnel to respond to the cause of the excursions and re-establish control of these situations.

3. **Gained experience in handling the high barium and lead concentrations in Silo 1 and Silo 2 residues.**

Metals in Silos 1 and 2 of greatest concern to vitrification are barium and lead. The Series A formula glass contained approximately 4.5 wt%, (40,000 ppm) barium oxide and 8.5 wt% (60,000 ppm) lead oxide. The barium TCLP regulatory limit for the vitrified waste glass is 100 parts per million (ppm).

The lead TCLP regulatory limit is 5 ppm. The Campaign 4 glasses passed TCLP with barium values ranging between 0.016 ppm and 3.47 ppm and lead values ranging between 0.002 ppm and 4.56 ppm. These results indicate that vitrification of the silo waste stream stabilizes the lead and barium.

During Campaign 4, molten metal was observed leaking through the floor of the Melter. Analysis of a sample of the metal indicated that it was primarily elemental lead. This experience shows that in the future, processing techniques and materials of construction should be chosen such that elemental metal formation is minimized. In addition, future Silo waste vitrification Melter designs must accommodate the possible accumulation of heavy metals.

4. **Determined the maximum production rate of VitPP based on series A glass processed at 1250 °C.**

Table 5-1 shows on-line and total production rates. The on-line production rates were calculated by dividing the amount of glass produced by the run times of the Melter feed pump. The total production rates were calculated by dividing the amount of glass produced by the start to finish batch run times. Idle periods between batches are not considered. The idle periods were typically scheduled outages and are therefore not figured into the production rate calculations.

The on-line production rates ranged from 0.69 MT/d to 1.1 MT/d and the total production rates ranged from 0.55 to 1.1 MT/d. Approximately 70,000 lbs of slurry and 2300 lbs of frit were vitrified to produce a total of 23,171 lbs of glass. The throughput of a series of consecutive batches in the VitPP Melter for a Series A formula glass at 1250 °C is approximately 0.9 MT/d. This production rate reflects the affect the increasing inventory of sulfates in the glass has on production. A maximum production rate of 1.1 MT/d can be obtained after an idle period that allows the sulfate inventory of the glass pool to be reduced.

Some of the glass product was a result of benign glass passing through the E-walls into the Center Chamber. For Campaign 4, the density of the side chamber frit was increased by the addition of barium in an effort to retard the flow of glass from the center chamber to the side chamber. Barium-containing frit was added to the side chambers to maintain the glass level and to address the foaming that occurred. Frit was also added directly to the center chamber in a few instances when the inventory in the center chamber was too low and slurry feeding was not an option.

Table 5-1
Campaign 4 Production Rate Summary

Batch	Interruptions in feed that lasted for greater than 1 hr	Glass (lbs)	On-line Feed Time (Hrs)	On-line Production Rate (MT/d) with frit[1]	Total Feed Time (Hrs)	Total Production Rate (MT/d)	Comments
B01	None, although minor feed reductions did occur during film cooler and transition line cleanings	2517	29	0.95	29	0.95	40% thinned to 30% slurry. No foaming. No temperature control problems. Fed after long idle period.
B02	Two; 1 for plugged offgas and 1 for HEPA filter changes totaling 5.5 hrs	2636	33	0.87	39	0.74	35% slurry fed after 48 hr idle period. Minor foaming at end of run. No temperature control problems.
B03	Two; 1 for recovery of accidentally shut down Melter power supply and 1 due to heavy foaming totaling 7 hrs	2140	26	0.90	33	0.71	34% slurry, unplugging of slurry system. Heavy foaming and moderate temperature control problems.
B04	None.	3206	33	1.1	33	1.1	30% thinned to approximately 23% during the run, due to leaking rinse valve. Minor foaming. No temperature control problems.
B05	None, although for 3 hrs during this run water was feed in lieu of slurry to control sulfates.	1955	31	0.69	34	0.63	38% slurry. Heavy foaming after water feed followed by no foaming. Temperature control problems noted throughout the run.
B06	Two, 1 due to the orifice plugging and 1 due to the offgas transition line plugging totaling 4 hrs.	1749	20	0.95	24	0.80	40% slurry fed after 12 hr idle period. No foaming noted. No temperature control problems.
B07-8	Six, 1 due to bottom drain leakage, 1 due to offgas transition line plugging, 1 due to discharge heater failures, 2 due to discharge chamber plugging and 1 due to EOG actuation totaling 50 hrs.	6171	72	0.93	122	0.55	23% to 38% slurry. Slight foaming at the beginning, no foaming at the end of the run. Temperature control problems noted throughout the run.
B09	One, due to temperature control problems totaling 15 hrs.	2797	29	1.1	44	0.69	50% slurry fed after a 6 day idle period. Slurry reduced to 24 wt% solids for last half of run no foaming noted. Temperature control problems noted throughout the run. Operations unable to maintain 1250, batch run at 1150.
Totals	13 totaling 85 hrs	23171	272	0.9	357	0.69	

1 Includes the weight of glass produced from the addition of frit as-well-as Series A surrogate.

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Approximately 2,300 lbs of frit were added during Campaign 4: 1,050 lbs to the West Side Chamber, 950 lbs to the East Side Chamber, and 300 lbs to the Center Chamber. Frit additions contributed to less than 10% of the glass produced During Campaign 4.

There was a pattern to the frequency and amount of foaming experienced in the Melter. There was repeated evidence that as the slurry contained more water, the foaming subsided and the sustained production rate improved. This data provided evidence that for Series A formula, the optimum slurry consistency is approximately 30 wt% solids. Feeding a Series A formula slurry with a higher wt% solids and a lower wt% water concentration resulted in foaming and sulfate layer events, which disrupted operations.

Uptime efficiency is defined as the percentage of time that the Melter feed pump feeds slurry to the Melter during a 24-hour day. This calculation includes idle periods as well as temporary production period shutdowns. The amount of uptime during Campaign 2 was 27%. The amount of uptime during Campaign 4 was 42%. This exceeds the scheduled and budgeted uptime for Phase I activities of 30%. Figures 5-1 and 5-2 graphically show the percentage of uptime efficiency per day. Figure 5-1 graphically shows the daily uptime efficiency for the Melter feed pump from the start to the termination of Campaign 4 The measured 42 % uptime efficiency includes all downtime during Campaign 4. However, some downtime events can be factored from the uptime calculations. These events include the time the VitPP was administratively removed from production during the campaign due to the issues raised about the condition of the west E-wall and the time to charge a slurry tank between batches when only one Slurry Tank was available. If these adjustments are made, the uptime efficiency changes to 52% as shown in Figure 5-2.

Figure 5-1
Campaign 4 Daily Uptime Efficiency

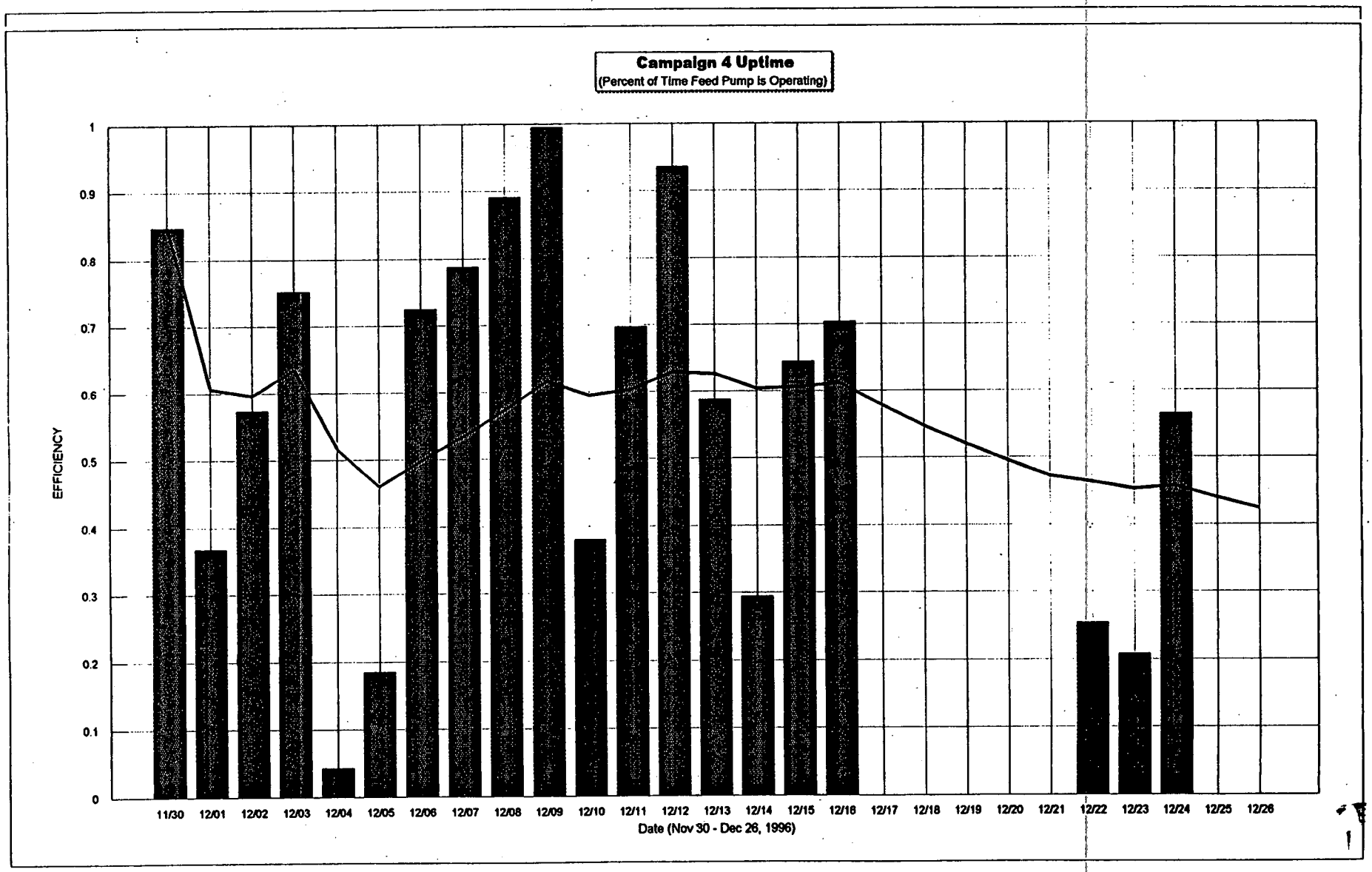

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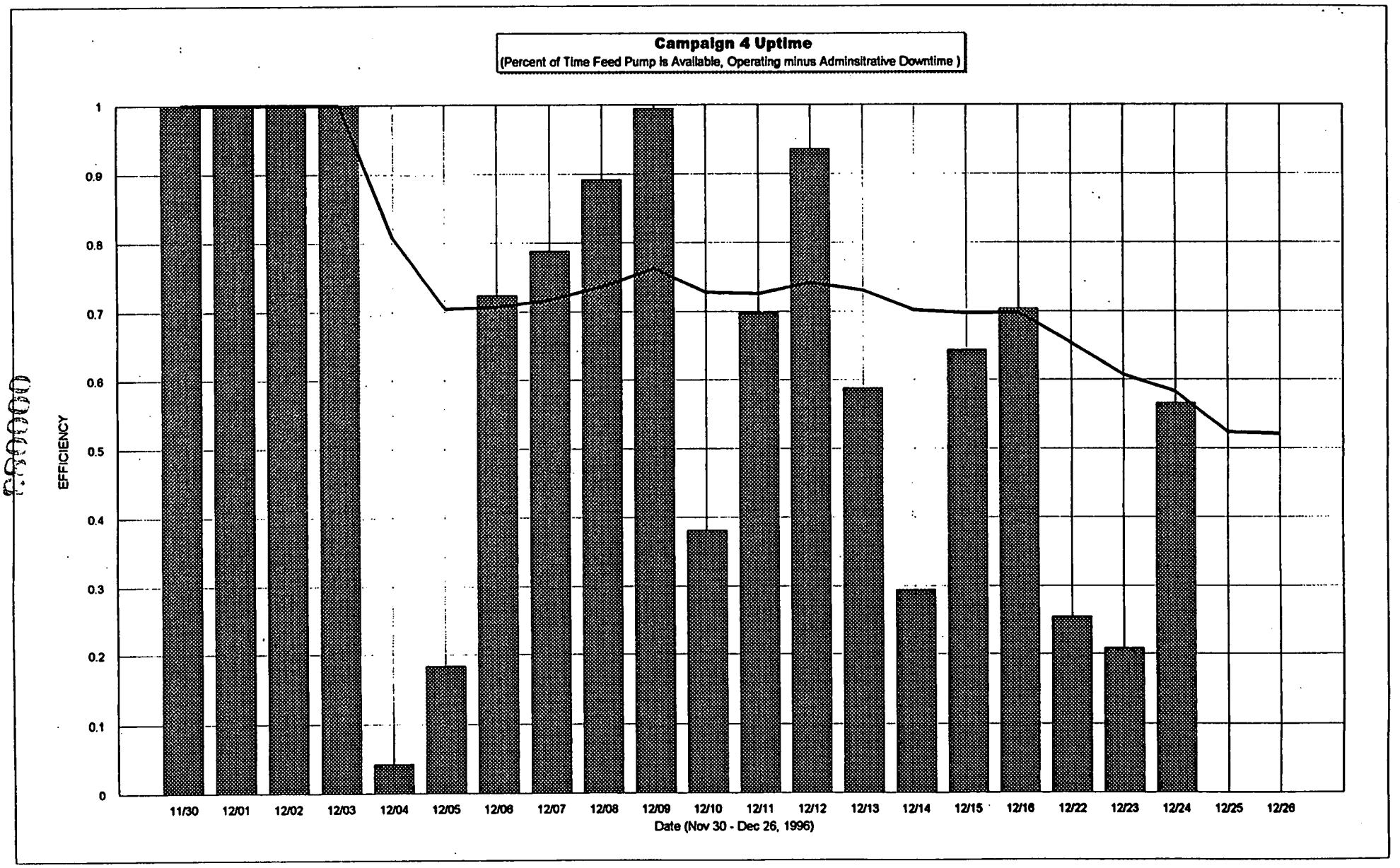
Figure 5-2
Campaign 4 Daily Uptime Efficiency - Minus Administratve Downtime



1 Campaign 4 Runs

The SOT for Campaign 4 (2504-SU-0039) documents the processing of nine Campaign 4 slurry batches. This processing performed the following:

1) Transition to Series A Glass surrogate formula in the Melter main chamber to displace the benign glass formula established following Campaign 2

2) High temperature Series A Glass surrogate formula testing (1250 °C)

3) Transition to Low Temperature Series A (1150 °C) Glass surrogate formula in the main chamber to adjust the higher temperature Series A Glass formula

Campaign 4 testing was started with the feeding of Batch 01 (C4B01) at 0340 hours on 11/30/96 and ended on 12/24/96 at approximately 1354 hours. Nine slurry batches were processed. Table 5-2 lists the batches and the dates they were run, and summarizes the amount of glass produced. Batches C4B01 and C4B02 were transitional batches processed to change the main chamber benign glass formula of post-Campaign 2 to the Series A glass formula. These batches contained higher levels of potassium, lead, nickel and barium, no urea and lower levels of alumina and calcium than the standard Series A formula.

Batches C4B03 through C4B06 were standard Series A formulas. Batches C4B07 and C4B08 were modified Series A batches. In Batch C4B07, the amount of urea was increased. The increase in urea content reduced Melter foaming. In batch C4B08, the amounts of urea, sodium, and calcium were increased compared to the Series A. These changes were made to thin the glass to minimize foaming. During the processing of Batch C4B07, calcium carbonate and lithium carbonate were added to the Melter main chamber. The changes pulled the glass melt chemistry to the modified Series A Glass formula. Changing to the modified Series A formula accomplished three things by making the glass melt less viscous. First, the changes controlled foaming. Second, they helped the discharge of the molten glass and finally, the changes increased the glass production rate. The effects of these changes in chemistry combined with an increase in operator experience were effective in controlling the foaming events in the Melter. Reports of foaming decreased steadily from the end of Batch C4B08 to the end of Campaign 4.

Batch C4B09 was the transitional batch to adjust the Series A Glass formula to a low-temperature formula. This batch contained high levels of lithium and sodium, and its purpose was to increase the conductivity of the Melter bath in preparation for the low-temperature (1150 °C) Series A glass. Most of Batch C4B09 was processed at a glass melt temperature of 1150 °C. After feeding Batch C4B09, the conductivity measured from electrode bank to electrode bank doubled. Increasing conductivity by adding cation compounds proved to be easy to accomplish. Past experience reveals that the converse was not true. It was very difficult to decrease Melter conductivity through the use of additives.

Table 5-2
GLASS PRODUCTION SUMMARY CAMPAIGN 4

Date	Slurry Batch Type	Batch No.	Solids Weight %	Melter Feeder Run Time Hours	Total Glass Produced lbs	Glass Production Rate MT/Day
11-30-96/ 12-1-96	Transition to Series A Glass	C4B01	35 - 40	29.2	2517 Monolith	0.94
12-2/4-96	Transition to Series A Glass	C4B02	34	32.8	2636 Monolith	0.88
Average Transition to Series A Glass production rate						0.91
12-5/7-96	Series A Glass	C4B03	31	26.6	2140 Monolith	0.91
12-7/8-96	Series A Glass	C4B04	23 - 30	33.0	3206 Monolith	1.06
12-8/10-96	Series A Glass	C4B05	37 - 40	31.4	1955 Monolith	0.68
12-10/11-96	Series A Glass	C4B06	38	19.6	1749 Monolith	0.97
12-11/15-96	Series A Glass	C4B07	28 - 38	41.4	4220 Monolith	1.11
12-15/16-96	Series A Glass	C4B08	23	30.5	1951 Monolith	0.70
Average Series A Glass production rate						0.91
12-22/24-96	Transition to Low Temperature Series A Glass	C4B09	24 - 51	28.7	2797 Monolith	1.06
Totals Campaign 4 11-30-96 thru 12-24-96	Glass produced includes 2300 Lbs frit charged to main and electrode chambers			272.2	23171	0.93

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The following sections describe batch by batch operations of the Melter as described in the test logs, control room operator's log book, and shift turn over logs. The austere format reflects the nature of the sources of the information. Production rates are based on glass produced during feeding periods. Shut down periods during each batch were subtracted from the run times.

5.1.1 Transition to the Campaign 4 Series A Glass

Before processing the Campaign 4 slurry batches, the Melter contained a benign glass formula. Campaign 4 runs involved the Series A surrogate that simulated Silo 1 and 2 waste residue. The transition of the main chamber benign glass to the Series A Glass was accomplished using a variation of the "pulling" technique developed during Campaign 2 and was described in Section 5.1.1 of the Campaign 2 interim report. The batch quantities that were required to pull the benign glass to the Series A Glass formula are shown in Table 5-3. The transition was accomplished using two batches, C4B01 and C4B02.

5.1.1.1 Batch One Feed and Control

Batch C4B01 was continuously fed (Figure 5-3) to the Melter. This batch represented the closest to steady-state feed during Campaign 4. The slurry ranged from 40 wt% solids at the beginning of the run to 30 wt% solids from the middle to the end of the run. The slurry was thinned on two occasions because of a need to flush plugs from the slurry system piping. The power input and feed rate were constant during the 29 hour feed period. A total of 2,517 lbs of glass was produced. During the run, 125 lbs of frit were added to mitigate possible foaming. No foaming was reported during the run. The biggest problem encountered was clogging in the film cooler. The film cooler was cleaned during the run approximately once every three hours. The Melter temperature responded normally to increases and decreases of the power input. Temperature was maintained within +/- 25 °C of the 1250 °C set point. The average power rate was approximately 200 kW. The production rate was 0.94MT/d. The production rate minus the frit material was 0.89 MT/d. This production rate would have been higher except for the fact that 1500 lbs of water had to be added to the slurry batch to flush plugs in the slurry system, and the film cooler had to be cleaned eight times during the feeding operation.

5.1.1.2 Batch Two Feed and Control

Batch C4B02 was intermittently fed in three periods, (Figure 5-4). This batch was fed following Batch C4B01 after a one day idle period. Slurry was approximately 35 wt% for the duration of the run. The first break in production occurred due to a plug in the offgas transition line. The second break was a required break to allow the off-gas system HEPA filters to be changed and Di-Octyl Phthalate (DOP) tested. The power input and feed rate were relatively constant during the first two feeding periods. In the third period, there was a slightly higher and more erratic power curve. This erratic behavior coincides with the first campaign 4 report of foaming in the Melter. This occurred on December 3, 1996 at 1420. By this time, approximately 175 lbs of barium sulfate had been added to the Melter bath via slurry. This amounted to approximately 4 wt% of the Melter bath.

Table 5-3
Batch Quantities to Pull Benign Standby Glass to Series A Glass
(Based on C4A-03 or S12-04)

Compound	Common Name	Slurry Batch Total lbs.	Mixing Order
Al2O3	Alumina	87	2
H3BO3	Boric acid	645	1
BaCO3	Barium carbonate	112	4
BaSO4	X-ray milkshake	79	4
CaCO3	Chalk, calcite	87	2
Fe2O3	Rust	124	4
K2CO3	Potassium carbonate	23	1
KNO3	Potassium nitrate	32	1
Li2CO3	Lithium carbonate	54	1
MgO	Magnesium oxide	15	2
Mg3(PO4)2	Magnesium phosphate	40 (add to main chamber 2-20 lb increments)	
Na2CO3	Washing soda	176	1
NiO	Nickel oxide	15	2
PbO	Lead oxide	286	4
SiO2	Silica, sand, quartz	1,146	3 (1000 lbs) 5(146 lbs)
H2O	Water	2,921	
Totals		5,842 @ 50 wt% solids	

Oxides/lift/batch, lbs	404	2,422
Melter contents and SO3 amount at 0.75 wt%	4,037	61
Transition glass made, approx lbs		2,483
Frit addition (resulting glass mix assumes this amount), lbs		200
		2,683

Directions for transition from startup glass to acceptance glass in six lifts:

1. Mix the soluble chemical labeled "1" in the right column. Then let system mix for an hour before adding the chemical labeled "2". Then mix "2s" and "3s". Make sure system is running smoothly before adding the iron and RCRA chemicals labeled "4". Then add remaining sand labeled "5". Note some foaming and warming may occur because of acid-base and hydration reactions.
2. Discharge 10% of the melter's bath for the addition of a lift. Note draining bath can increase temperature under constant power control and could cause foaming from SO3 effervescence during last lifts.
3. Feed 1/6 of the batch to the melter.
4. Repeat Steps 2 and 3 until batch is complete.

Figure 5-3
Campaign 4 Batch B01

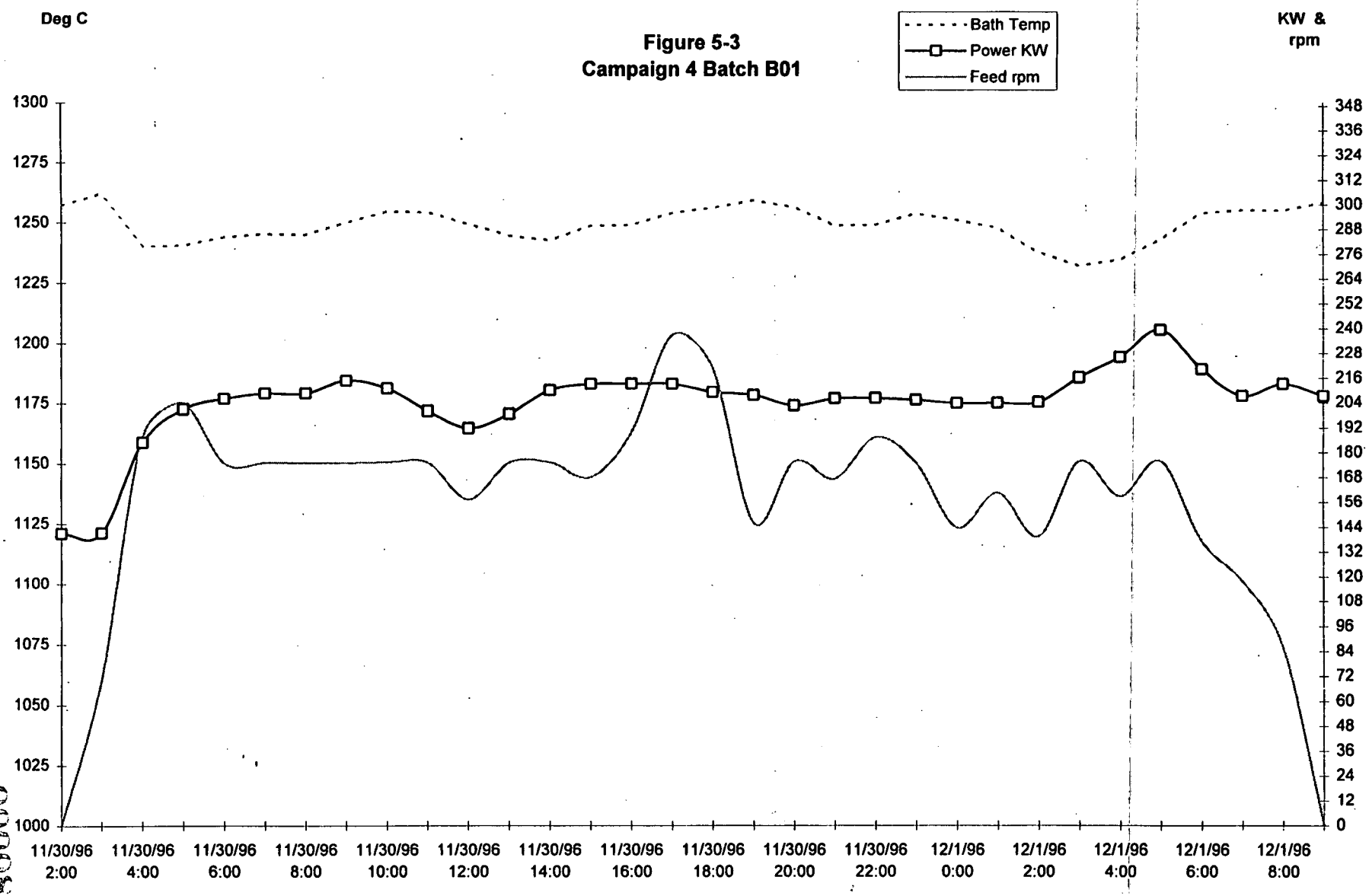

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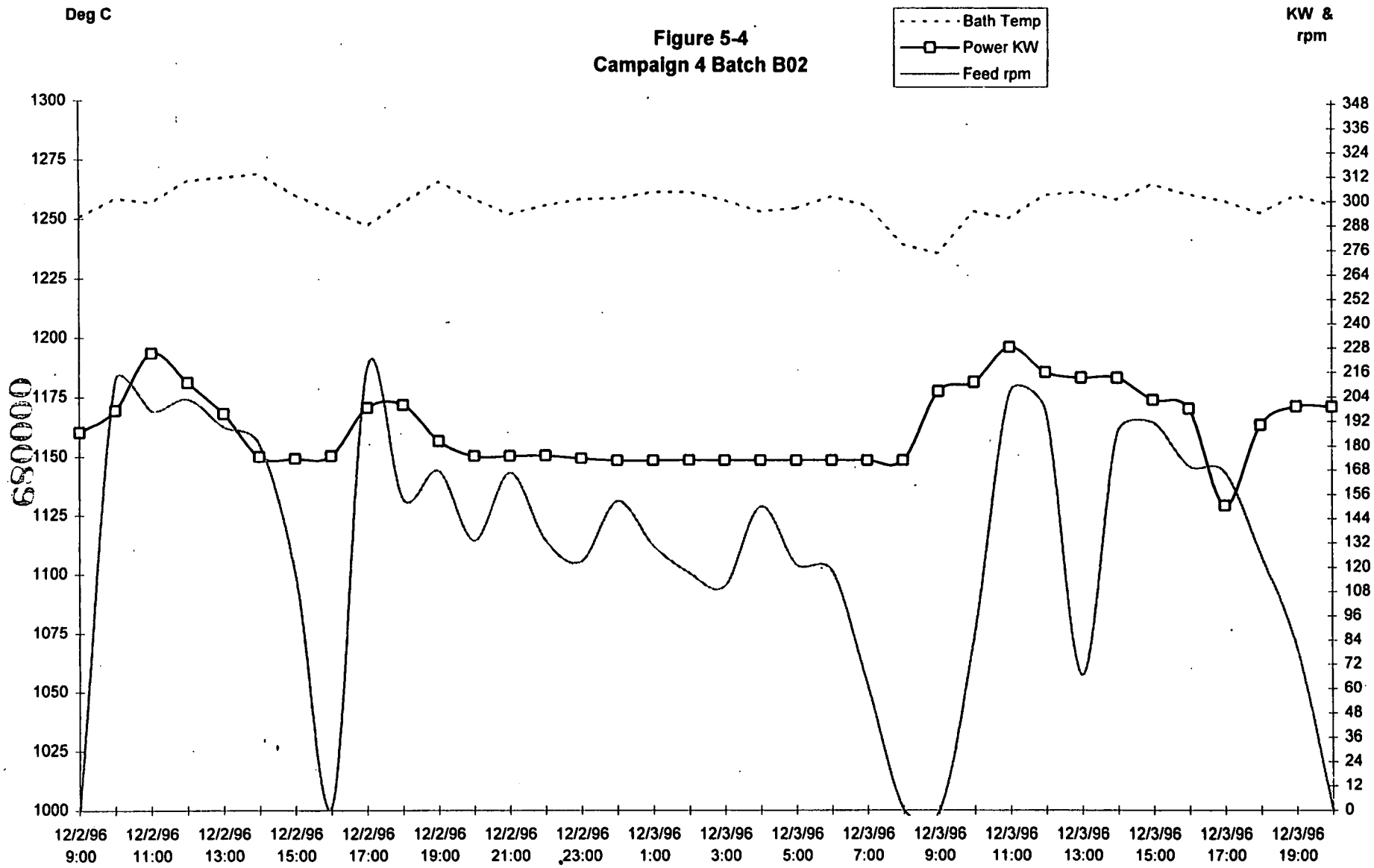
Figure 5-4
Campaign 4 Batch B02



The three feeding periods total approximately 33 hours of feed time. During the run, 2,636 lbs of glass were produced and 575 lbs of frit were added to the Melter. The Melter temperature responded normally to increases and decreases of the power input. Temperature was maintained within +/- 25 °C of the 1250 °C set point. The average power rate was approximately 185 kW. The production rate was 0.87 MT/d. The production rate minus the frit material was 0.68 MT/d. The production rate would have been higher except for the fact that only one Slurry Tank was available. In an effort to mitigate slurry system plugging, the last three hours of the run were used to rinse Slurry Tank B. The rinse residue contained approximately a 7 wt% solids slurry and could be fed at an equivalent rate of only 0.2 MT/d. The large amount of water in the thinned slurry took more time and energy to evaporate and, therefore, reduced the production rate. Another contributing factor to the low production rate was the fact that the feed had to be stopped and restarted due to offgas system plugging problems on several occasions.

5.1.2 Campaign 4 Series A Glass Test

Six batches, C4B03 through C4B08, comprised the Series A run. The formula for batches C4B03 through C4B06 was based on the VSL minimelter run C4A-03[1] using boric acid for the boron oxide constituent (see Table 5-4). The formula for Batches C4B07 and C4B08 (see Table 5-5) were a modified Series A glass designed to reduce the viscosity of the molten glass to accomplish the following:

1) Aid in controlling excessive foaming in the main chamber believed to be the result of SO_x generation in the glass and relatively strong bubble retention by the molten glass. Reducing the viscosity of the molten glass resulted in the glass becoming more fluid and reduced the retention of the gases within the melt and at the melt surface. These changes allowed the SO_x bubbles to be readily released to the offgas and reduced foaming on the surface of the main chamber and side chambers.

2) Reduce the interface mass transfer resistance between the cold cap and the glass surface, improving the dissolution rate of the cold cap constituents into the glass. The results were the decrease in the required residence time and the increase in the glass throughput.

3) Improve the flow of molten glass through the Discharge Chamber and the Gem Machine.

Batch C4B08 formulation (see Table 5-5) was modified to accomplish the viscosity change by decreasing the boric acid, and increasing the calcium carbonate, and sodium bicarbonate constituents. The urea content was increased to aid in reducing the generation of SO_x.

[1]The minimelter runs performed by VSL are described in Section 2.5 of the Campaign 2 Treatability Study Report.

Table 5-4
Series A Glass from VSL C4A-03
(Boric Acid Substituted for Boron Oxide)

Compound	Common Name	Surrogate Composition				Additives	Slurry Batch	Glass Makeup	Target Glass Composition
		Silo 1	Silo 2	Silo 3	Total				
		lbs.	lbs.	lbs.	lbs.	lbs.	Total	lbs.	%
Al_2O_3	Alumina	29	33		62	71	133	133	6.05
B_2O_3	Boron oxide							290	13.20
H_3BO_3	Boric acid					516	516		
BaO	Barium oxide							99	4.52
$BaCO_3$	Barium carbonate	41			41		41		
$BaSO_4$	X-ray milkshake	58	45		103		103		
CaO	Lime		5		5		5	110	5.00
$CaCO_3$	Chalk, calcite		33		33	153	186		
$CaSO_4$	Gypsum		2		2		2		
Fe_2O_3	Rust	28	60		88		88	88	3.98
K_2O	Potassium oxide							14	0.65
K_2CO_3	Potassium carbonate	11	10		21		21		
Li_2O	Lithium oxide							34	1.53
Li_2CO_3	Lithium carbonate					83	83		
MgO	Magnesium oxide							30	1.36
$MgCO_3$	Magnesium carbonate	16	23		39		39		
$Mg_3(PO_4)_2$	Magnesium phosphate	13	12		25		25		
Na_2O	Sodium oxide							128	5.80
Na_2CO_3	Washing soda	34	9		43	169	212		
$NaNO_3$	Soda niter		10		10		10		
P_2O_5	Phosphorous Pentoxide							14	0.62
PbO	Lead oxide	133	61		194		194	194	8.82
SiO_2	Silica, sand, quartz	556	499		1,055		1,055	1,055	47.96
$CO(NH_2)_2$	Urea					18	18		
SO_3 in glass	Sulfate							11	0.51
H_2O	Water								
Totals		919	802	0	1,721	1,010	2,731	2,200	100.00

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Table 5-5
Series A Glass Modified for Lower Viscosity
(Based on C4A-[illegible]S12-04)

Compound	Common Name	Surrogate Composition Silo 1 lbs.	Silo 2 lbs.	Silo 3 lbs.	Total lbs.	Additives lbs.	Slurry Batch Total	Glass Makeup lbs.	Target Glass Composition %
Al2O3	Alumina	26	30		56	79	135	135	6.15
B2O3	Boron oxide							231	10.51
H3BO3	Boric acid					411	411		
BaO	Barium oxide							90	4.09
BaCO3	Barium carbonate	37			37		see note		
BaSO4	X-ray milkshake	53	40		93		93		
CaO	Lime		5		5		5	293	13.31
CaCO3	Chalk, calcite		30		30	483	513		
CaSO4	Gypsum		2		2		2		
Fe2O3	Rust	25	54		79		79	79	3.60
K2O	Potassium oxide							13	0.58
K2CO3	Potassium carbonate	10	9		19		19		
Li2O	Lithium oxide						see note	28	1.28
Li2CO3	Lithium carbonate					70	35		
MgO	Magnesium oxide							27	1.23
MgCO3	Magnesium carbonate	14	21		35		35		
Mg3(PO4)2	Magnesium phosphate	12	11		23		23		
Na2O	Sodium oxide							161	7.33
Na2CO3	Washing soda	31	8		39	231	270		
NaNO3	Soda niter		9		9		9		
P2O5	Phosphorous pentoxide							12	0.56
PbO	Lead oxide	121	55		176		176	176	7.98
SiO2	Silica, sand, quartz	503	452		954		954	954	43.38
CO(NH2)2	Urea					32	32		
SO3 in glass	Sulfate								
H2O	Water								
Totals		831	726		1,556	1,306	2,791	2,200	100.00

Note: Some barium oxide and lithium oxide are expected to be supplied by side chamber frit. Therefore, full amounts are not added per batch recipe.

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5.1.2.1 Batch Three Feed and Control

Batch C4B03 was intermittently fed in three periods, (Figure 5-5). This batch was fed following batch C4B02 after a 2 day idle period. The slurry was approximately 31 wt% solids. Approximately 400 lbs of flush water were added to the slurry while clearing clogs in the slurry distribution system. The first delay occurred due to an accidental outage of the Melter power supply. The second delay occurred because of excess Melter foaming in the west and main chambers. This batch was the first batch in Campaign 4 to contain urea.

Eighteen lbs of urea were added to the batch to speed up the surface sulfate destruction and, in effect, reduce the foaming problems experienced near the end of Batch C4B02. The power input and feed rate were relatively constant during the first feeding period. In the second period, the power and feed rate were steadily reduced to control foaming. This resulted in a steady loss of temperature. Near the end of the second period and at the beginning of the third period, water was fed for one hour to combat the foaming. The three feed periods total approximately 26 hours of process time.

Approximately 2,140 lbs of glass were produced and 325 lbs of frit were added during the run. The Melter temperature responded normally to increases and decreases of the power input until about 2000 hours on December 6, 1996. At this point, for approximately six hours, as power was increased and feed rate was decreased, the temperature continued to fall. Operations tried feeding water to combat the foaming. Eventually all feed was completely stopped for approximately three hours due to foaming over the west wall. Feed was re-started after foaming stopped and the Melter temperature recovered. Overall, fluctuations in temperature were maintained within +15 and - 60 °C of the 1250 °C set point. The average power rate was approximately 160 KW.

The production rate was 0.90 MT/d. The production rate minus the frit material was 0.76 MT/d. The production rate would have been higher except for the fact that the feed had to be stopped and restarted on two separate occasions. Once for feed pump and SCR control power maintenance and once due to Melter foaming problems. The high amount of frit addition for this run also contributed to the low production rate.

5.1.2.2 Batch Four Feed and Control

Batch C4B04, initiated immediately after Batch C4B03, was continuously fed (Figure 5-6). The slurry was approximately 30 wt% solids. A leaking rinse line valve on the slurry system was adding approximately 30 to 60 lbs of water per hour to the slurry. The power input and feed rate were relatively constant during the 33-hour feed period. West side chamber foaming occurred throughout this batch. This foaming was not as intense as in C4B03. The thinner slurry in Batch C4B04 may have reduced foaming. During the batch, 3,206 lbs of glass were produced and 375 lbs of frit were added. The Melter temperature response was normal. Temperature was maintained within +/- 25 °C of the 1250 °C set point until the very end of the run. Near the end of the run, the feed rate was increased, but the power was held constant. This resulted in a 45 °C drop in Melter temperature. The average power rate was

Figure 5-5
Campaign 4 Batch B03

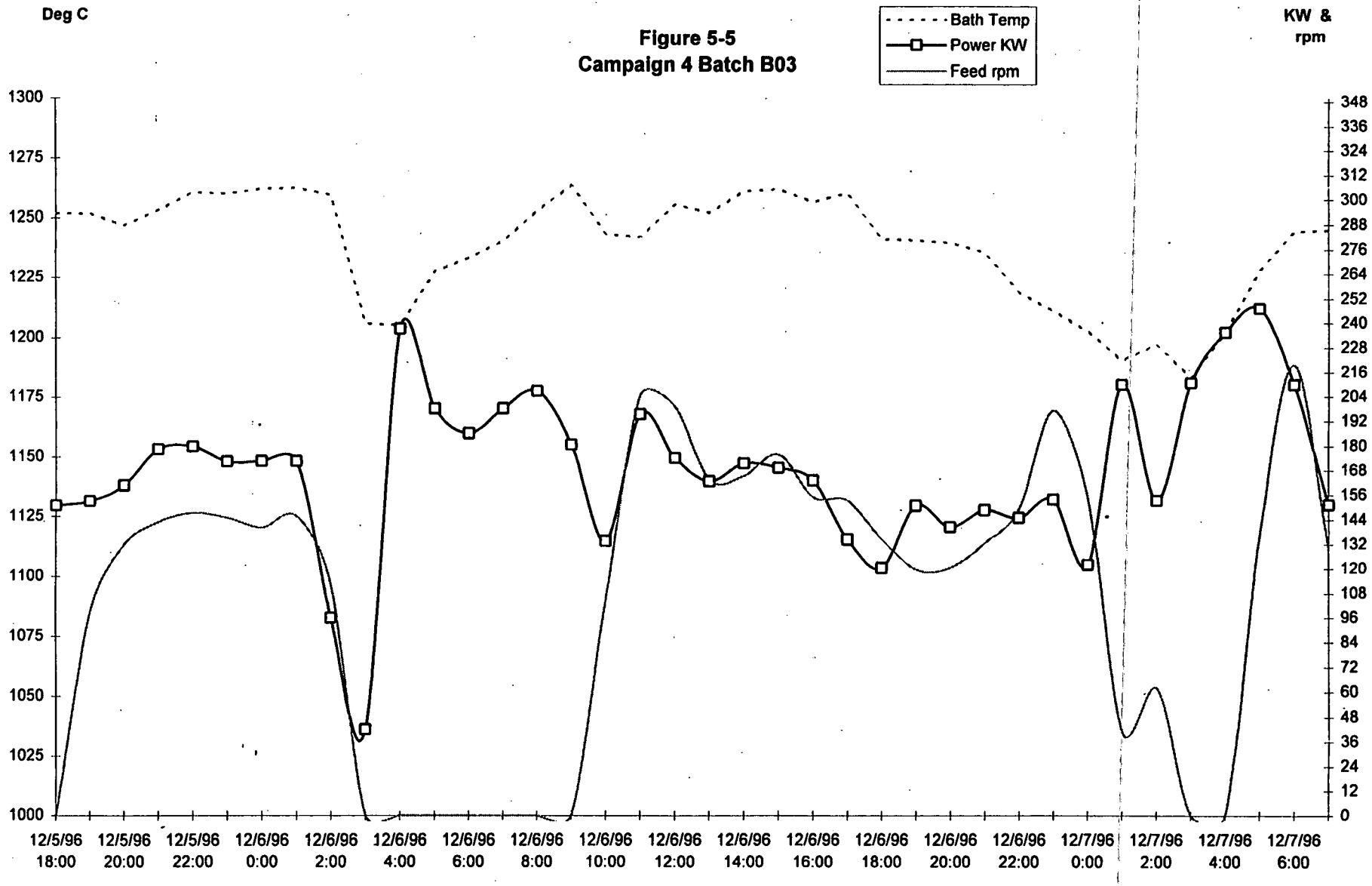

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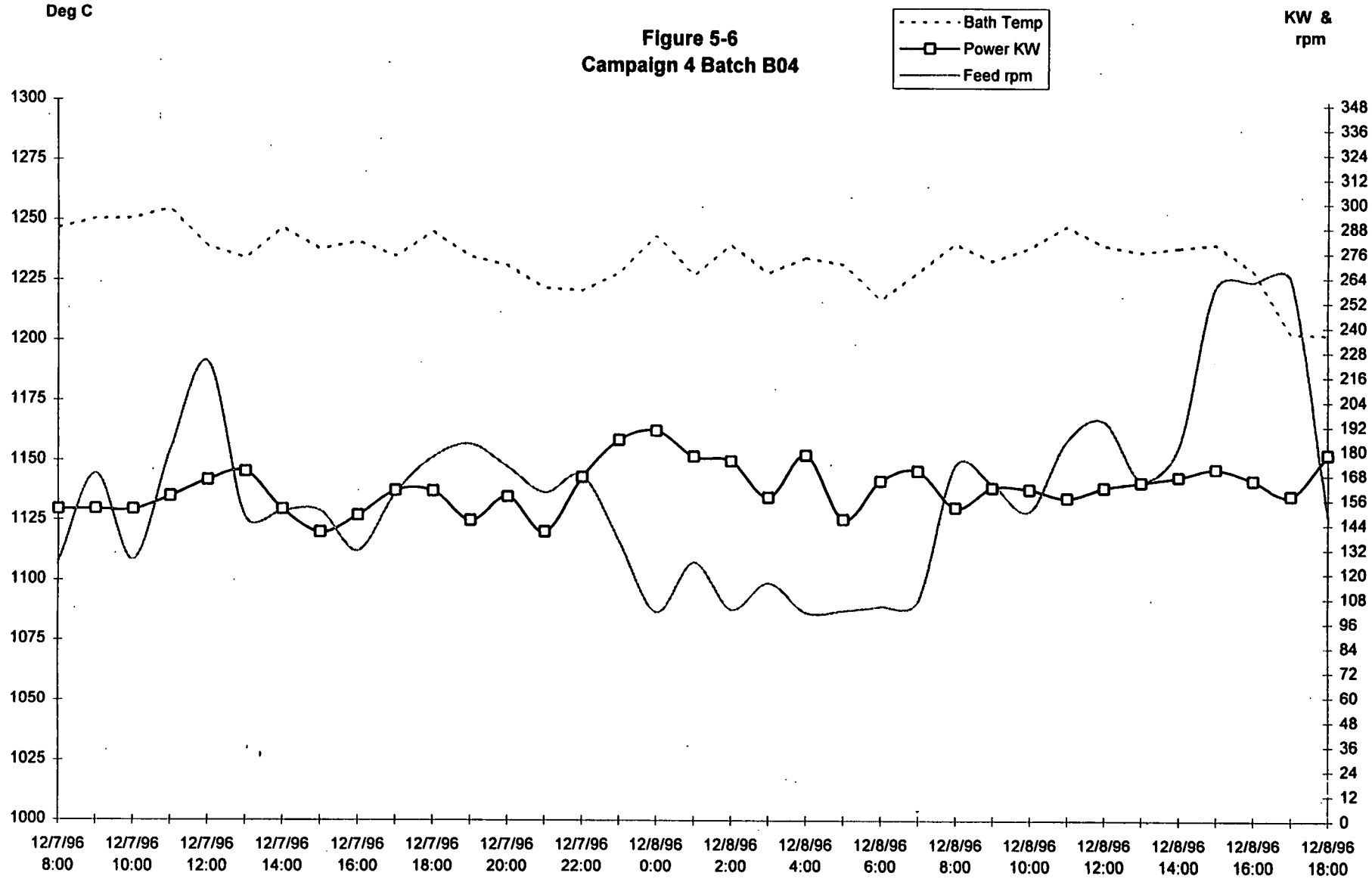
Figure 5-6
Campaign 4 Batch B04



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approximately 160 kW. The production rate was 1.06 MT/d. The production rate minus the frit material was 0.94 MT/d. This production rate would have been higher except for the fact that the slurry was constantly thinned due to the leaking rinse valve. The thin slurries resulted in a lower production rate due to the time and energy required to evaporate the excess water in the slurry.

5.1.2.3 Batch Five Feed and Control

Batch C4B05 (Figure 5-7) was fed immediately following Batch C4B04 without any idle period. The slurry contained approximately 40 wt% solids initially and was thinned to 37wt% in the last 1/4 of the batch when approximately 1000 lbs of water was added. The water was added in an attempt to flush the clogged Melter feed pump tube. The power and temperature response was erratic during the first six 6 hours of the batch. The slight foaming noted at the end of C4B04 immediately turned to heavy foaming in the beginning of C4B05. This foaming problem prohibited early steady-state operation. Slurry feed was stopped and water was fed to the Melter for slightly more that two hours during the beginning of the run. The power input and feed rate are relatively constant during the last 24 hours of the run. The total slurry feed period was 30 hours. Foaming over the west chamber wall was reported at 1930 on December 9, 1996. This foaming completely stopped during the last four hours of the run. Approximately 1955 lbs of glass were produced and 225 lbs of frit were added. The Melter temperature response was reversed during portions of this run. Increases in power resulted in decreasing temperatures. Temperature was maintained at + 0 and - 60 °C of the 1250 °C set point. The average operating temperature was below 1225 °C. The average power rate was approximately 190 kW. The production rate was 0.68 MT/d. The production rate minus the frit material was 0.60 MT/d. This production rate would have been higher except for the fact that feed rates and power input were reduced to control heavy foaming. Secondly, the feed rate was also reduce because operations was unable to obtain the desired 1250 °C bath temperature during the run.

5.1.2.4 Batch Six Feed and Control

Batch C4B06 was intermittently fed in three periods (Figure 5-8). This batch was fed following bath C4B05 after a 12 hour idle period. The first delay occurred only 45 minutes into the run due to plugging of the glass discharge orifice. The second interruption was due to plugging in the offgas system. The slurry was approximately 38% solids. The power and temperature response was erratic during the first 3 hrs of the run. Then interestingly enough, the power input steadily dropped for 10 hrs during the middle of this run, and at the same time, the temperature of the bath was maintained at more than 1250 °C. In the final period of the run the temperature, power and feed rate were steady state. No foaming was reported for the duration of this run. The total slurry feed period was 20 hours. The urea added to the slurry starting with batch C4B03 may have been responsible for reducing the foaming. This is the only variable that had changed and the foaming problem had significantly decreased. During the run, 1749 lbs of glass were produced in the batch C4B06 and 125 lbs of frit were added. The Melter temperature response was good during this run. The main chamber glass melt temperature was maintained at +/- 25 °C of the 1250 °C set point for most of the run. Operations effectively raised the bath temperature during the run.

Figure 5-7
Campaign 4 Batch B05

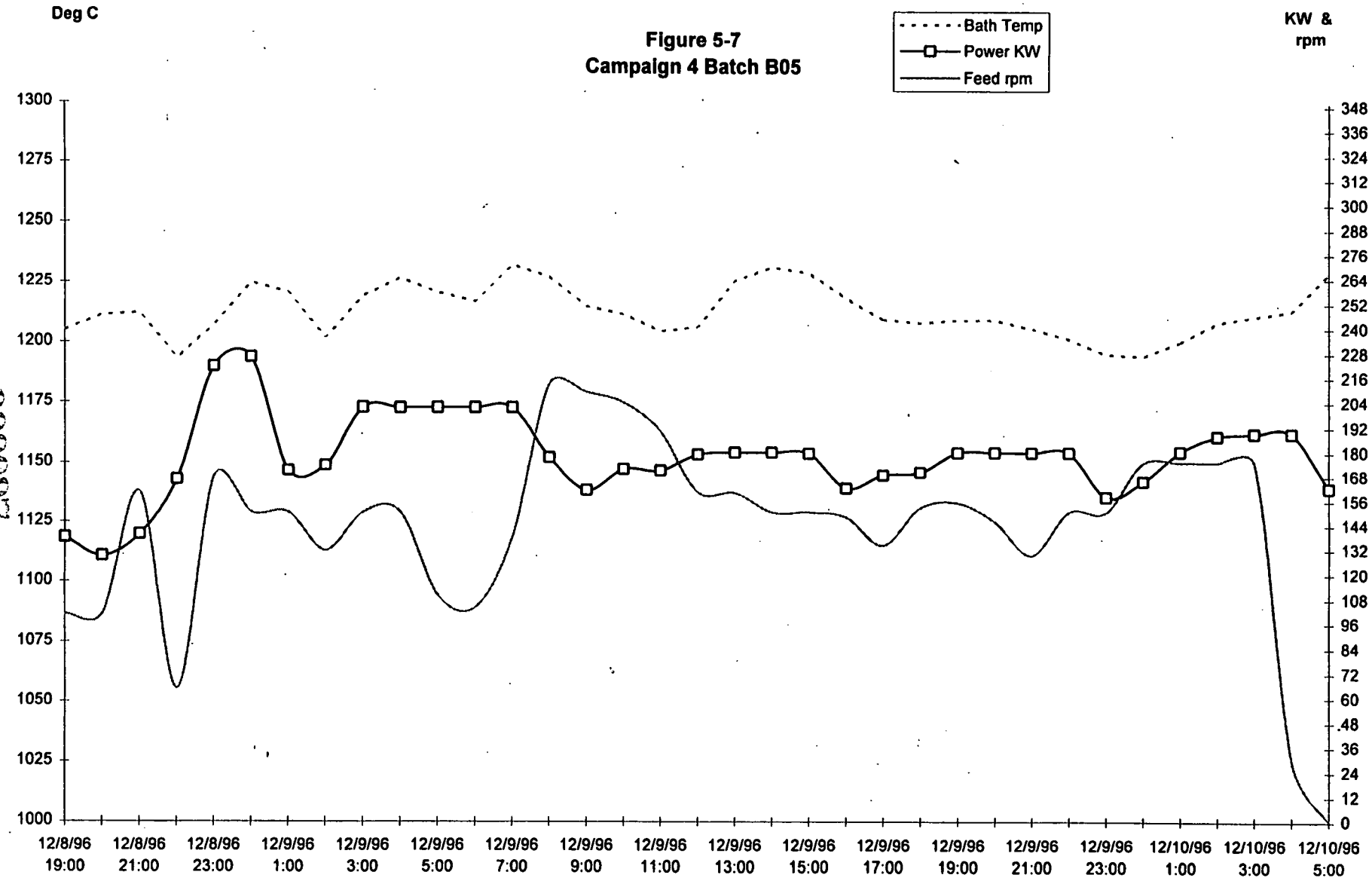
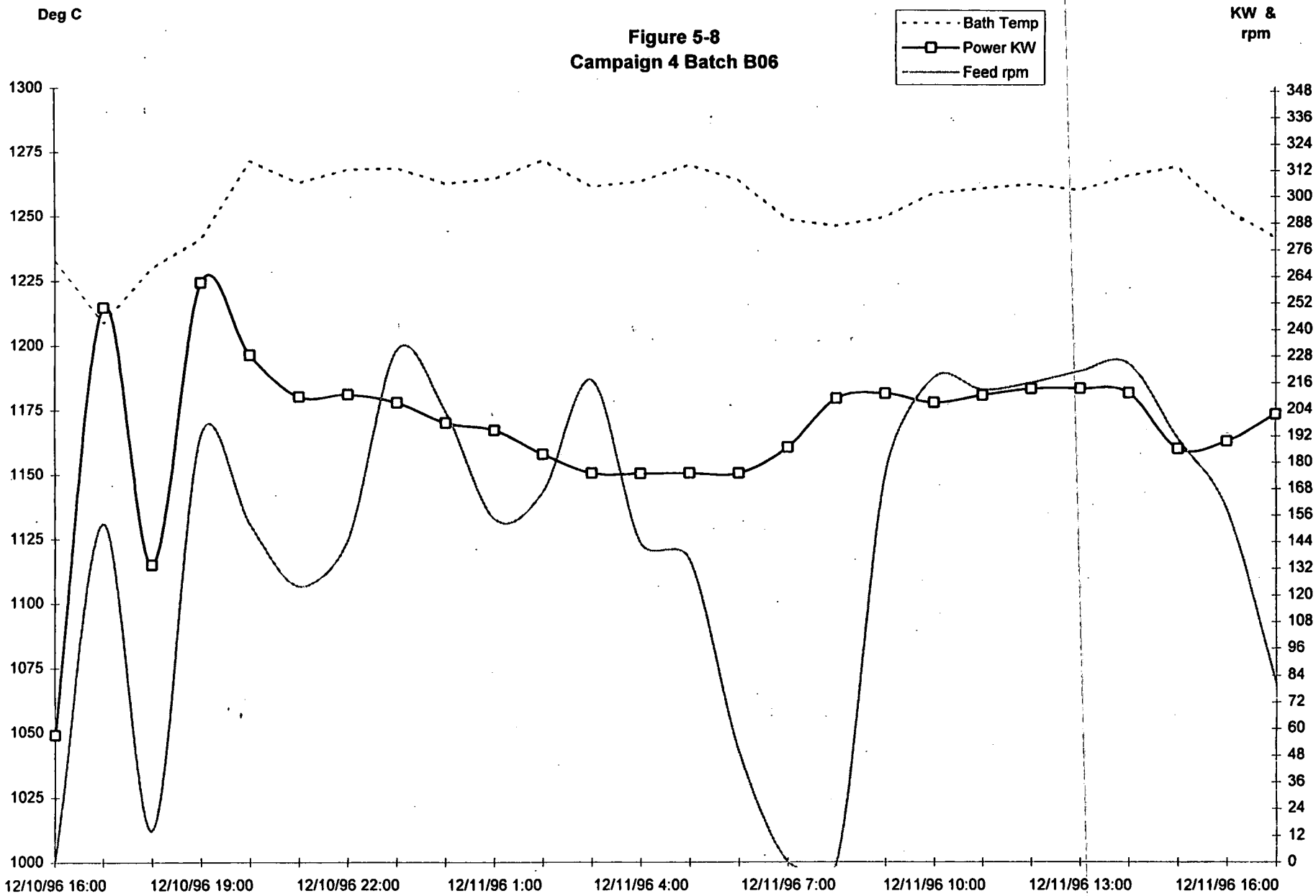


Figure 5-8
Campaign 4 Batch B06



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6.2.3

The average power rate was approximately 195 kW. The production rate was 0.97 MT/d. The production rate minus the frit material was 0.90 MT/d. The production rate would have been higher except for the fact that the feed had to be stopped and restarted on two separate occasions. Once due to the glass discharge orifice plugging and once due to plugging in the offgas system.

5.1.2.5 Batch Seven and Eight Feed and Control

At the beginning the C4B07 run, during the preparation of batch C4B08, approximately 250 lbs of sodium carbonate and 91 lbs of sodium nitrate were inadvertently added to batch C4B07 in Slurry Tank A. About 10 hours into the run, batch C4B07 chemistry was corrected by dumping an additional 1425 lbs of chemicals, creating batch C4B07A. At 2230, on December 12, in the middle of the batch C4B07A run, 1500 lbs of flush water mixed with a 400 lb heel from C4B06 were transferred to C4B07A to make room for the C4B08 mix in Slurry Tank B. Near the end of Batch C4B07A the Slurry Tank outlet plugged and a decision was made to start feeding C4B08 before finishing C4B07A. After clearing the slurry line plug the feed was switched from C4B08 back to C4B07A until C4B07A was completed. For these reasons, the following discussion combines batches C4B07, C4B07A and C4B08 as one batch called C4B7-8.

Batch C4B7-8 was intermittently fed in 7 periods (Figures 5-9 and 5-10). This batch was fed immediately after batch C4B06 without an idle period. The first interruption occurred 2 hours into the run due to a maintenance job required to fix a leak on the Melter bottom drain #2. The second delay lasted for more than 12 hours and was due to a plugged offgas line. The third break was due to a maintenance job to repair the discharge chamber heater elements that failed during the run. The fourth production delay was due to a maintenance job to remove an object blocking the discharge chamber orifice. The object was apparently dislodged during the glass discharge chamber heater replacement job. The fifth break was due to glass freezing in the glass discharge orifice. The orifice was not at the proper operating temperature when operations decided to resume production. The first discharge, after production resumed, froze in the chamber and blocked the orifice. The sixth and final break in production was due to a cold cap event that tripped the emergency offgas system.

The slurry ranged between 23 wt% and 47 wt% solids. The power and temperature responses were erratic in the last 5 hours of the run. Prior to this, the Melter temperature response was normal. Foaming was reported at the beginning of the run. The total slurry feed period was 72 hours. During the run 6171 lbs of glass were produced and 225 lbs of frit were added. The Melter temperature response was good during this run. Temperature was maintained at +10 and -60 °C of the 1250 °C set point for the run. The average power rate was approximately 220 kW. The total glass production rate was 0.93 MT/d. The production rate minus the frit material was 1.08 MT/d. The production rate ranged from 0.7 to 1.11 MT/d would have been higher except for the fact that the feed had to be stopped and restarted on several occasions.

Figure 5-9
Campaign 4 Batch B07 and B07a

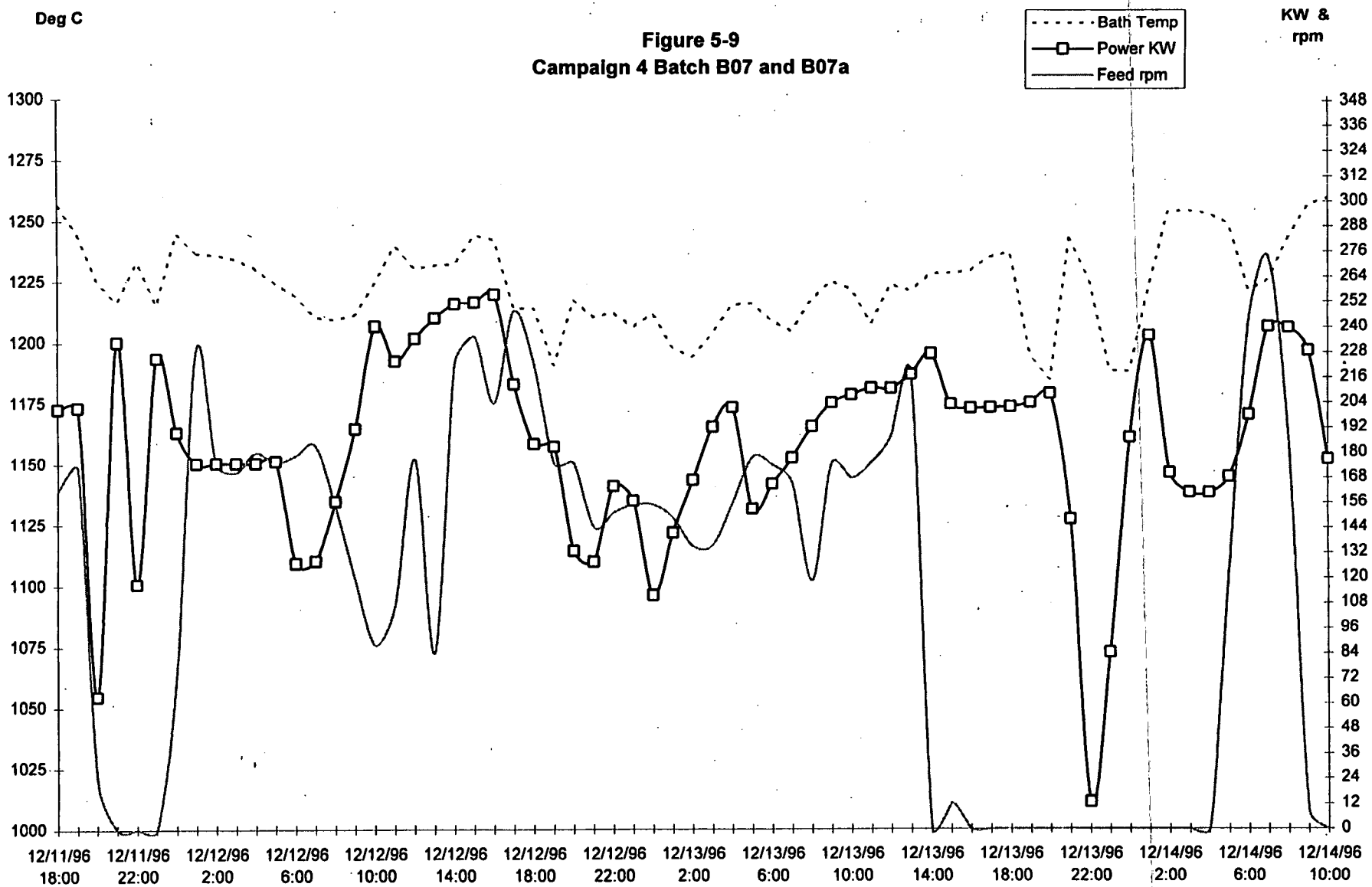

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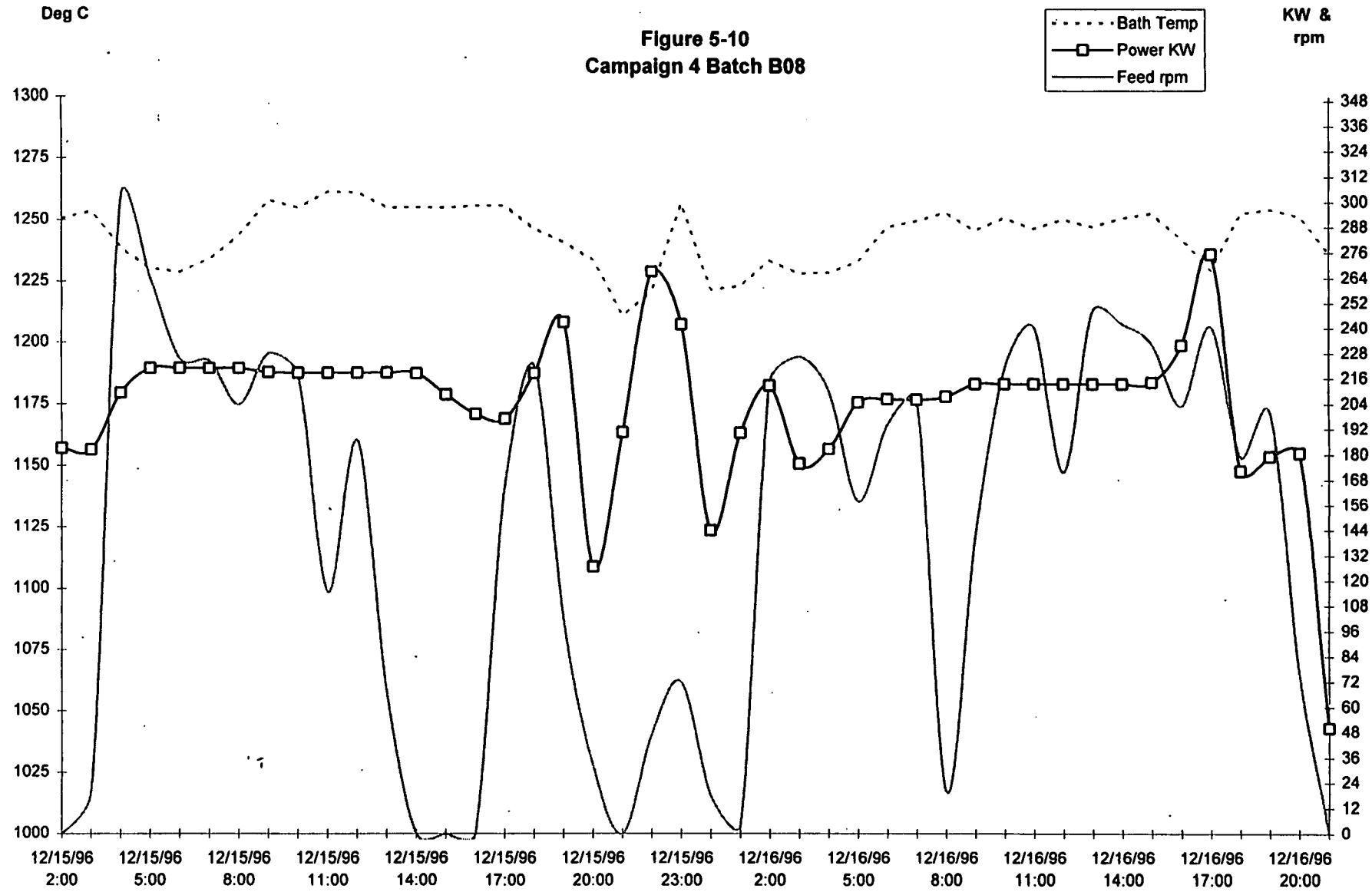
Figure 5-10
Campaign 4 Batch B08



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5.1.3 Campaign 4 Transition to Low Temperature Series A Glass

The transition of the Melter main chamber Series A Glass to a low-temperature formulation was accomplished using a variation of the "pulling" technique described in Section 5.1.1 of the Campaign 2 interim report. Table 5-6 shows the target composition of the low temperature Series A glass and the constituents required to pull the molten glass to the low temperature formulation. The low-temperature Series A Glass formulation was substantially changed compared with the modified Series A Glass formulation (reduced viscosity, Table 5-5). The silica constituent in the molten glass was increased by about 15%, boron oxide was increased by about a factor of 1.4, and lithium oxide was increased by about a factor of 3. The alumina constituent was reduced by about 60% and the calcium oxide was reduced by a factor of about 7.

5.1.3.1 Batch Nine Feed and Control

Batch C4B09, initiated six days after the previous batch, was intermittently fed in two periods, (Figure 5-11). The long idle period was required to perform maintenance on the Melter lid. The slurry ranged from 24 to 50 wt% solids for the run. A break in production occurred because operations was unable to maintain the Melter temperature. Two hours into the run increases in power were accompanied with decreases in feed rate. This resulted in a steady loss of Melter temperature. The lowest temperature was 1157 °C, reached shortly after the feed was stopped. During this interruption, the Slurry Tank Pump failed and the slurry batch was transferred from Slurry Tank A to Tank B. The feed was resumed with the Melter at 1150 °C. Operations requested and was granted permission to use the reduced temperature because of the difficulties encountered maintaining the bath temperature at 1250 °C. Near the end of the run increasing power was again accompanied by decreasing temperature. No foaming was noted during the run. The two feed periods add up to a total slurry feed time of 29 hrs. Approximately 2797 lbs of glass were produced and 325 lbs of frit were added during the run. The temperature set point of 1150 °C approved for the second attempt was maintained within + 28 and - 10 °C. The average power rate during the 1250 °C set point was approximately 200 kW. The average power rate during the 1150 °C set point was approximately 230 kW. The overall production rate was 1.06 MT/d. The production rate minus the frit material was 1.05 MT/d. The production rate would have been higher except for the fact that temperature control problems caused the feed to be stopped and restarted. The maximum short term feed rate for Campaign 4 occurred in the second part of this run. The Slurry Tank weight decreased by 5440 lbs in just 15 hrs. That amounts to an average of 362 lbs/hr. Assuming the slurry was 51 wt% solids, and approximately 20 % of the solid compounds decomposed to volatiles that were discharged to the off-gas system, the resulting production rate would have been approximately 1.61 MT/d.

5.2 Elemental Mass Balance and Accumulation

A mass balance for Campaign 4 was performed around the VitPP system to make an environmental and process account of lead and barium. An accurate account of lead and barium introduced into the system in the forms of lead oxide, barium oxide, barium sulfate and barium-containing frit was recorded in logbooks maintained by the VitPP test coordinators.

Table 5-6
Batch Quantities to Pull Series A Glass to Low Temperature Series A Glass

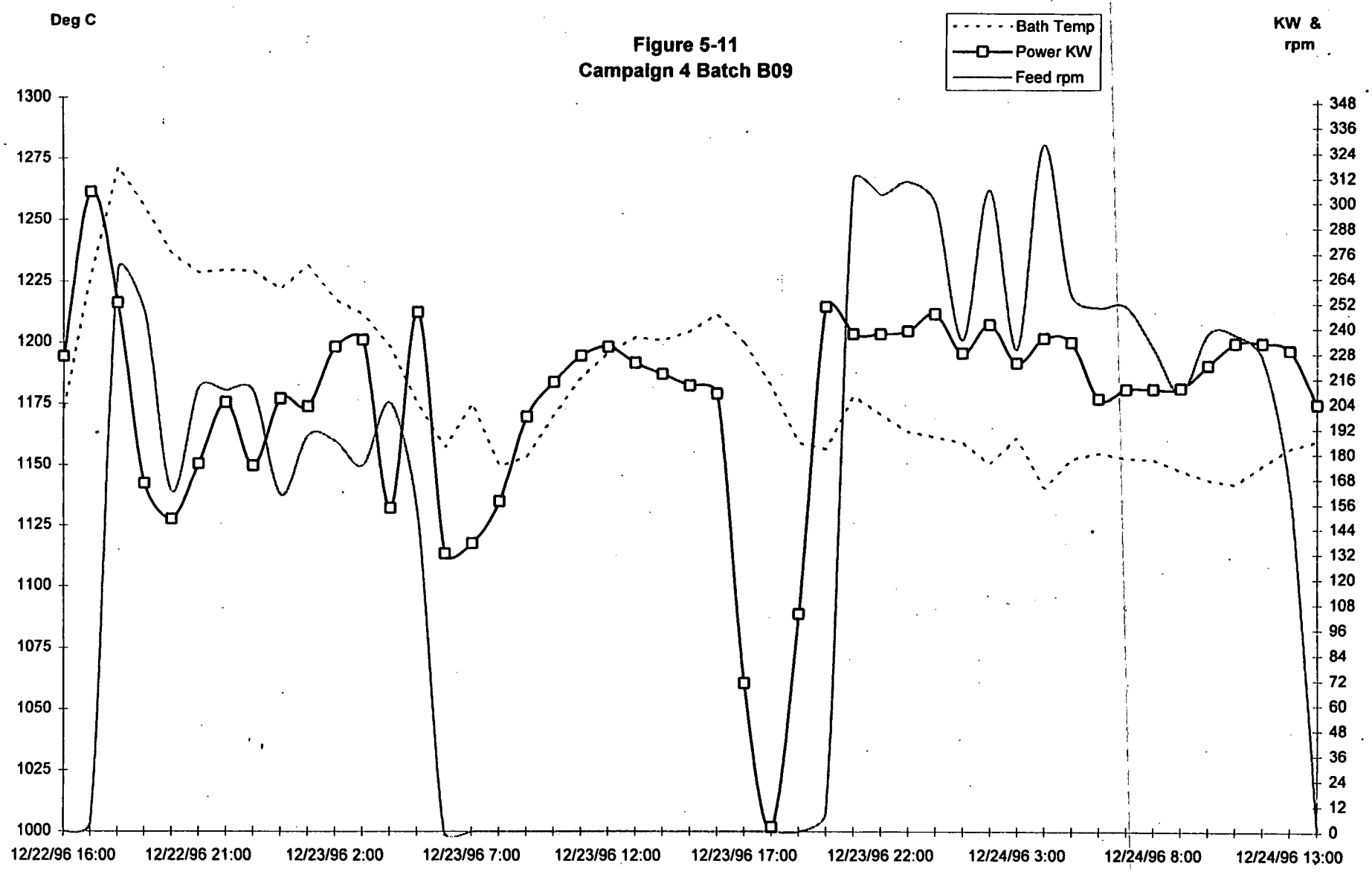
Compound	Common Name	Slurry Batch Mix lbs.	Mixing Order	Target Glass Composition, %
Al2O3	Alumina			3.54
BO2O3	Boron oxide			14.29
H3BO3	Boric acid	800	1	
BaO	Barium oxide			4.19
BaCO3	Barium carbonate	28	4	
BaSO4	X-ray milkshake	93	4	
CO2	Carbon dioxide			1.95
Fe2O3	Rust	61	4	3.69
K2O	Potassium oxide			0.60
Li2O	Lithium oxide			4.08
Li2CO3	Lithium carbonate	381	1	
MgO	Magnesium oxide	13	2	1.36
Mg3(PO4)2	Magnesium phosphate	13 add to main	1	
Na2O	Sodium oxide			7.26
NaCO3	Washing soda	292	1	
P2O5	Phosphorous			0.57
PbO	Lead oxide	184	4	8.19
SiO2	Silica, sand, quartz	1,269	3 (1000 lbs) 5 (269 lbs)	50.26
CO(NH2)2	Urea			
SO3 in glass	Sulfate			1.00
H2O	Water	3,135		
Totals		6,270 @ 50 wt% solids		100.98

Oxides/lift,/batch, lbs	404	2,422
Melter contents and SO3 amount at 0.75 wt%, lbs	4,037	61
Transition glass made, approx. lbs.		2,483
Frit addition (resulting glass mix assumes this amount), lbs		200
		2,683

Directions for transition:

1. Mix the soluble chemical labeled "1" in the right column. Then let system mix for an hour before adding the chemical labeled "2". Then mix "2s" and "3s". Make sure system is running smoothly before adding the iron and RCRA chemicals labeled "4". Then add remaining sand labeled "5". Note some foaming and warming may occur because of acid-base and hydration reactions.
2. Discharge could cause foaming from SO3 effervescence during last lifts. Note: Draining bath can increase temperature under constant power control and could cause foaming from SO3 effervescence during last lifts.
3. Feed 1/6 of the batch to the melter.
4. Repeat Steps 2 and 3 until batch is complete.

Figure 5-11
Campaign 4 Batch B09



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The amount of molybdenum and chromium detected in the VitPP systems was also tabulated and is discussed and presented in the following sections.

5.2.1 Molybdenum

It was expected that the majority of molybdenum (Mo) eroding from the Melter electrodes would be captured in the glass product. However, because Mo is somewhat volatile in its highest oxidation state, some of it escaped to the Off-Gas System. The amount of Mo detected in the water system, on the HEPA Prefilter and the HEPA Filters is presented in Tables 5-7 and 5-8. The amount of Mo in the Quench Tower and Recycle Water remained below the analytical laboratory's reportable detection limit throughout Campaign 4 with the exception of a small number of samples. For these few samples the concentration remained below ten parts per million (ppm). The concentration trend of Mo in the Scrubber water is shown in Figure 5-12. Using the average run time of the Building Sump Tank (BST) Pumps and the average concentration of Mo in the BST water, the amount of Mo collected in the BST was negligible (less than 0.20 lbs). The total amount of Mo detected in the glass produced during Campaign 4 was approximately 45 lbs is shown in Table 5-9.

A comparison of the wt% of Mo detected in the glasses of Campaigns 1, 2 and 4 is shown in Figure 5-13 and a comparison of the total amount of Mo eroded during each campaign is shown in Figure 5-14. The weight percents of Mo in the glass in Campaigns 2 and 4 is more than in Campaign 1. This increase is due to the following: a) the deterioration of the E-wall, b) the corrosive nature of the Series D and the Series A glasses.

During Campaign 4, attempts were made to maintain a higher density glass in the side chambers by introducing a denser barium-containing frit. This was expected to decrease the rate of center chamber glass migration into the side chambers and the rate of electrode erosion. The change to denser frit proved ineffective in the west side chamber due to the increased leakage through the west E-wall.

5.2.2 Chromium Oxide

The Melter walls are comprised of two types of refractory. The partition walls are constructed of Monofrax Type E Fused Cast Refractory. This refractory consisted of 77.7% Cr_2O_3. The remaining Melter walls are constructed of Monofrax Type K-3 Fused Cast Refractory, consisting of 27.1% Cr_2O_3.

The chromium oxide was tracked to determine the amount of refractory wall corrosion. No Cr_2O_3 was introduced into the system through slurry feed or glass frit addition. All Cr_2O_3 present in the system and product glass was attributed to corrosion of the refractory brick. It was expected that the amount of Cr_2O_3 in the system would be higher in Campaigns 2 and 4 due to the more corrosive nature of the Series D and Series A glass recipes. During Campaign 1, the total weight of Cr_2O_3 detected was 16 lbs. Sixty-one pounds of Cr_2O_3 were accounted for in Campaign 2 glass and 45 lbs of Cr_2O_3 were accounted for in the 9 batches of Campaign 4 glass (Table 5-9).

Table
Molybdenum & Chromium Tracking in the Water System

S07 (Scrubber Water)				S14 (Recycle Water)			S06 (Quench Tower Water)		
Date	Time	Cr Conc. (mg/L)	Mo Conc. (mg/L)	Time	Cr Conc. (mg/L)	Mo Conc. (mg/L)	Time	Cr Conc. (mg/L)	Mo Conc. (mg/L)
11/28	14:00	BDL	14.2		BDL	BDL		BDL	BDL
11/29	08:20	7.40	15.2		BDL	BDL		BDL	BDL
11/30	10:00	13.10	31.3		BDL	BDL		BDL	BDL
12/01	09:30	16.10	53.5		BDL	BDL		BDL	BDL
12/02	08:15	20.70	66.9		BDL	BDL		BDL	BDL
12/03	08:55	23.30	80.1		BDL	BDL		BDL	BDL
12/04	08:50				BDL	BDL		BDL	BDL
12/05	08:45	BDL	4.7		BDL	BDL		BDL	BDL
12/06	09:30	3.21	17.9		BDL	BDL		BDL	BDL
12/07	10:20	BDL	12.3		BDL	BDL		BDL	BDL
12/08	08:55	BDL	18.5		BDL	BDL		BDL	BDL
12/11	07:40	BDL	14.9		BDL	BDL		BDL	BDL
12/12	01:02				BDL	BDL		BDL	BDL
12/13	08:05				BDL	BDL		BDL	BDL
12/14	09:40	2.50	15.0	10:20	BDL	3.0	09:15	BDL	3.4
12/15	08:55	4.70	28.4		BDL	BDL		BDL	BDL
12/16	10:05	6.50	43.6		BDL	BDL		BDL	BDL
12/17	08:20	5.00	28.9		BDL	BDL		BDL	BDL
12/18	11:30	10.80	42.8		BDL	BDL		BDL	BDL
12/19	08:15	4.70	13.3		BDL	BDL		BDL	BDL
12/20	08:12	5.06	19.8		BDL	BDL		BDL	BDL
12/21	08:15	BDL			BDL	BDL		BDL	BDL
12/23	08:25	4.90	11.9		BDL	BDL		BDL	BDL
12/24	08:10	6.61			BDL	BDL	08:02	BDL	7.9
12/25	08:30	12.18			BDL	BDL		BDL	BDL
12/26	08:20	25.37			BDL	BDL		BDL	BDL
12/27		BDL		08:20	BDL	3.1	08:02	BDL	4.9
12/28		BDL		09:00	BDL	3.5		BDL	BDL
12/29		BDL			BDL	BDL		BDL	BDL
12/30		BDL			BDL	BDL		BDL	BDL

BDL = Below the Detection Limit

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Table 5-8
Chromium & Molybdenum Detected on Pre and HEPA Filters

Customer Sample I. D.	FACTS Sample I.D.	Sample Concentration (mg/Kg) molybdenum	Chromium	Dry Filter Weight (Kg)	Total Moly on Filter (lbs)	Total Cr2O3 on Filter (lbs)
S64PAF-961130-1230	200270999			1.346	0.000	0.000
S64HAF-961130-1235	200271004			1.704	0.000	0.000
S48PAFA-961201-1050	200270486	9100.00	3300.00	1.346	0.027	0.010
S48PAFB-961201-1039	200270487	79.00	31.10	1.346	0.000	0.000
S48PAFA-961202-0920	200270755	4200.00	1600.00	1.346	0.012	0.005
S48PAFA-961202-0900	200270756			1.346	0.000	0.000
S48PAFA-961203-0900	200270939	94.80	54.03	1.346	0.000	0.000
S48PAFB-961203-0625	200270942			1.346	0.000	0.000
S48HAFB-961203-0627	200270943	60.73	11.13	1.704	0.000	0.000
S48PAFA-961204-2000	200271181			1.346	0.000	0.000
S48AAFP-961205-0440	200271413	58.85	16.24	1.346	0.000	0.000
S48BAFP-961205-1420	200271415	6800.00	1800.00	1.346	0.020	0.005
S48HAFA-961208-1020	200271689			1.704	0.000	0.000
S48PAFB-961211-1512	200273755			1.346	0.000	0.000
S48PAFA-961213-0900				1.346	0.000	0.000
S37	200271327			1.500	0.000	0.000
S48	200271328			1.500	0.000	0.000
S48PAFB-961215-0810				1.346	0.000	0.000
S48A-961216-0800				1.500	0.000	0.000
S48PA-961217-1325	200273721			1.346	0.000	0.000
S48PB-961217-1330	200273722			1.346	0.000	0.000
S37PS-961218-0930	200274560	4100.00	1300.00	1.346	0.012	0.004
S48HAFA-961218-0935	200274561	2700.00	1900.00	1.704	0.010	0.007
S48HAFB-961218-0940	200274562	3800.00	1900.00	1.704	0.014	0.007
S48PAFA-961219-0835	200274504	2300.00	1600.00	1.346	0.007	0.005
S48PAFB-961219-0840	200274505			1.346	0.000	0.000
S48PAFB-961220-0930	200274753	5400.00	2200.00	1.346	0.016	0.007
S48PAFA-961221-0840	200274782			1.346	0.000	0.000
S48PAFA-962122-0935	200275453			1.346	0.000	0.000
S48PAFB-961222-0940	200275454			1.346	0.000	0.000
S48APB-961223-0905	200276287			1.346	0.000	0.000
S48AFB-961223-0915	200276288			1.346	0.000	0.000
S48AFA-961223-1035	200276289			1.346	0.000	0.000
S48PAFB-961224-0835	200276462	15300.00	2400.00	1.346	0.045	0.007
S48PAFA-961225-0845	200276464	5200.00	1500.00	1.346	0.015	0.004
S48PAFB-961226-1310	200275999			1.346	0.000	0.000
S48PAFA-961227-0830	200276497			1.346	0.000	0.000
				Total (lbs)	0.2	0.1

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Table 5-9
Analytical Results for Batch Glass: Normalized Averages of Campaign 4

	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 6	Batch 7	Batch 8	Batch 9
SiO_2	47.09	47.82	51.72	50.66	47.54	49.47	43.02	47.60	39.21
B_2O_3	9.50	11.42	11.76	11.54	10.21	11.41	12.15	10.46	6.90
Li_2O	1.81	1.65	2.14	2.08	1.78	2.06	1.58	1.13	2.58
Al_2O_3	11.01	8.28	6.69	7.30	8.10	7.41	8.26	7.63	9.17
BaO	1.82	3.61	3.82	4.52	4.56	3.50	3.52	3.30	4.96
CaO	11.18	7.28	5.36	5.24	5.55	5.10	7.07	8.04	8.50
Cr_2O_3	0.31	0.24	0.22	0.22	0.15	0.23	0.21	0.31	0.61
Fe_2O_3	2.16	3.60	3.03	3.36	4.14	4.00	4.40	3.96	4.65
PbO	3.22	6.22	6.16	6.41	8.72	8.69	8.23	7.49	9.82
MgO	1.43	1.42	1.36	1.39	1.54	1.41	1.64	1.54	2.16
Mn_3O_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.18	0.37	0.19	0.16	0.06	0.00	0.21	0.22	0.22
K_2O	0.49	0.83	0.38	0.07	0.25	0.35	0.38	0.36	0.16
V_2O_5	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Na_2O	9.54	7.16	6.96	6.81	7.08	6.07	9.05	7.67	10.55
ZrO_2	NR	NR	NR	NR	NR	NR	NR	NR	NR
Molybdenum (ppm)	0.26	0.10	0.19	0.25	0.34	0.29	0.26	0.28	0.51
Total Percent	99.74	99.90	99.81	99.75	99.66	99.71	99.74	99.72	99.49

										Totals
Glass Prod. (lbs.)	2517	2636	2140	3206	1955	1749	4220	1951	2797	23171
Total Cr_2O_3 (lbs.)	7.560	3.510	1.090	6.110	1.950	3.850	5.820	5.510	10.850	46.250
Total Molybdenum	5.510	3.020	0.990	6.970	1.940	4.870	8.300	4.810	9.270	45.680

Viscosity (Poise)									
@ 1150 C	110.80	125.80	141.30	138.10	151.70	NR	136.10	131.80	77.30
@ 1250 C	45.85	52.71	57.17	53.94	63.54	NR	51.53	49.73	32.50
Density (g/cc)	2.75	2.75	2.74	2.77	2.77	2.76	2.67	2.77	2.76

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Figure 5-12
Mo & Cr in the Scrubber Water

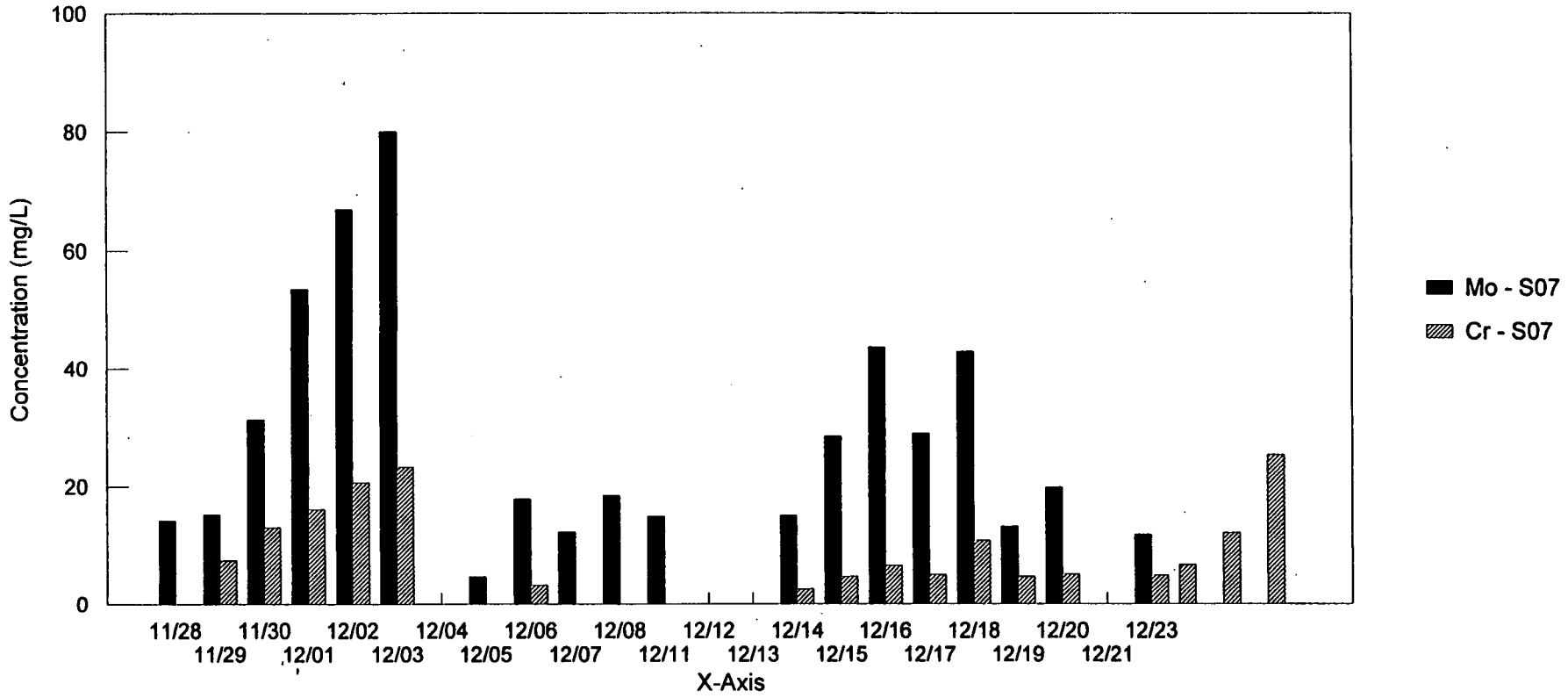

Figure 5-13

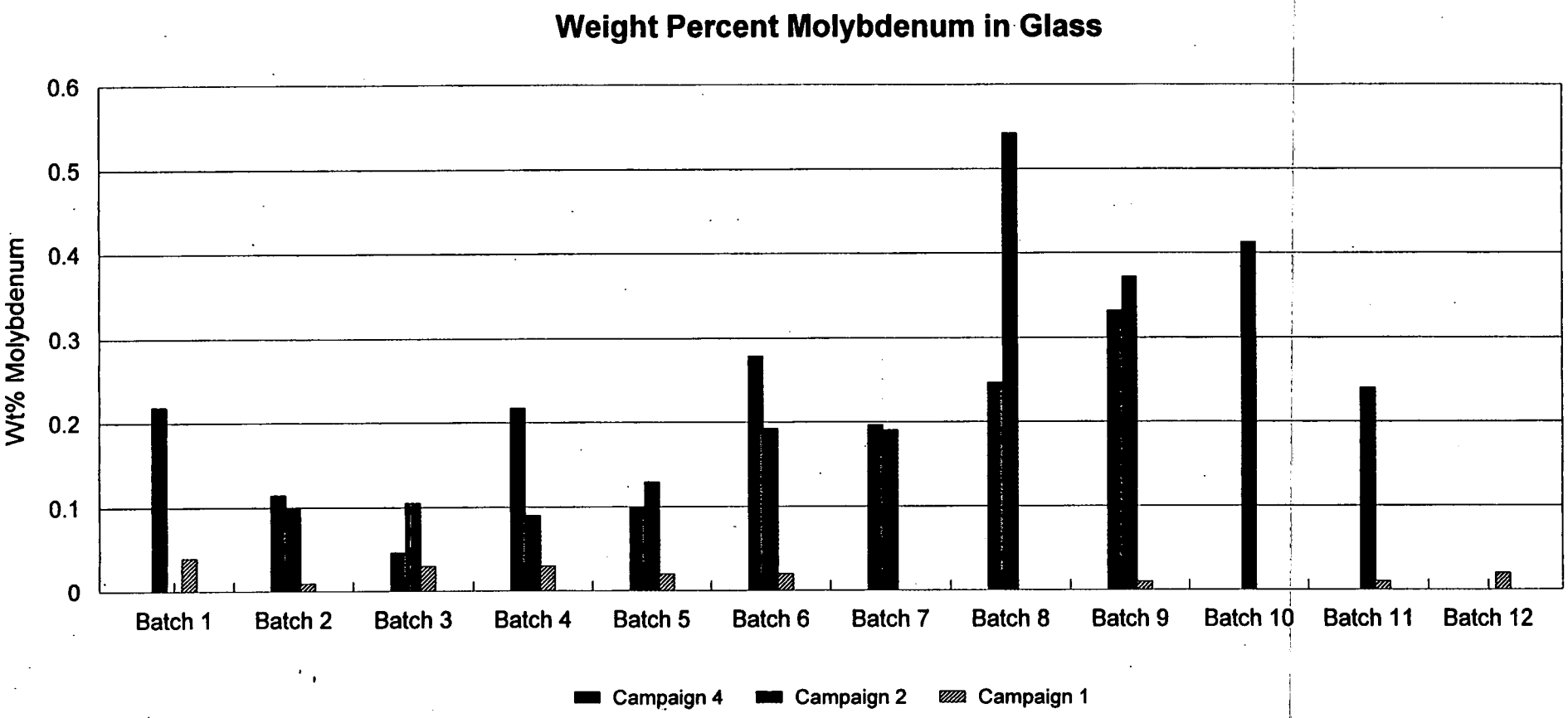

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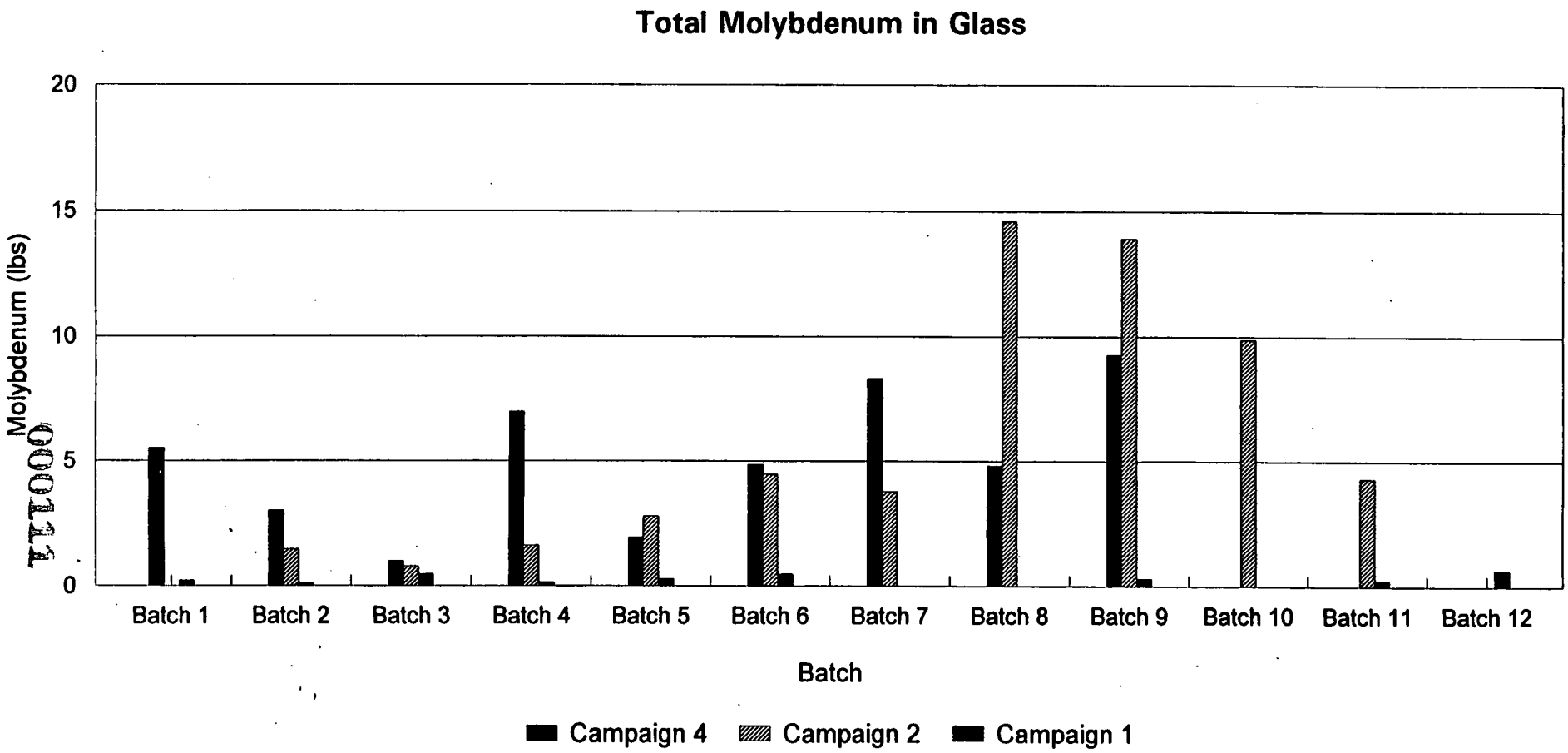
Figure 5-14



000111

A comparison of the weight percents of Cr_2O_3 in the glass of Campaigns 1, 2 and 4 is presented in Figure 5-15 and a comparison of the total weight of Cr_2O_3 is presented in Figure 5-16.

The amounts of chromium detected in the recycle water and the amount detected on the Off-Gas System HEPA and HEPA Prefilters are shown in Tables 5-8 and 5-9. The amount of chromium in the Scrubber water is presented in Figure 5-12.

5.2.3 Lead

Lead was introduced into the VitPP Melter via slurry, which is composed in part of lead oxide (PbO). During Campaign 4, a total of 1926 lbs of lead oxide was introduced into the system (Table 5-10). The average, normalized results of the glass analyses for lead for each product glass drum are presented in Tables 5-11. Based on the straight analytical results, 1,571 lbs of lead were recovered. This accounts for 81.6% of the lead that was introduced into the system. Calculated with the normalized weight percents listed on Table 5-11, the total amount of lead recovered was 1,856 lbs, or 96.4%.

The amount of lead detected in the water that was discharged from the BST is listed in Table 5-12. This accounts for approximately one pound of the lead that was introduced into the system. Lead accumulated on the Off-Gas System HEPA Filters, HEPA Prefilters, and in the water drained from the filter housing is accounted for in Tables 5-13 and 5-14. This totals less than 3.2 pounds.

Based on calculations from the analysis of the isokinetic filter that was placed in the stack during Campaign 4, a negligible amount of the lead introduced into the system escaped out the stack. Calculated using the normalized results, a total of 96.7% of the lead that was introduced into the VitPP system, was accounted for in the mass balance.

5.2.4 Barium

Barium (Ba) was introduced into the VitPP system by two means, slurry and frit addition. Slurries were comprised in part of barium carbonate ($BaCO_3$) and barium sulfate ($BaSO_4$). The frit added during Campaign 4 to increase the density of Side Chamber glass was composed of 15.75% barium oxide (BaO).

During Campaign 4, a total of 1141 lbs of Ba was introduced into the system (Table 5-10). The average results of the glass analysis for Ba are listed in Table 5-9. The results of the glass analyses per individual drum are listed in Table 5-11. These values are adjusted for the LCS percent recoveries and are normalized to 100 wt%. The total amount of barium retained in the glass is 1,097 lbs (96%).

The amount of Ba detected in the water that was discharged from the BST is listed in Table 5-12. This accounts for approximately a half of one pound of the Ba that was introduced into the system. Barium accumulated on the Off-Gas System HEPA Filters, HEPA Prefilters, and in the water drained from the filter housing is accounted for in Tables 5-13

Figure 5-15

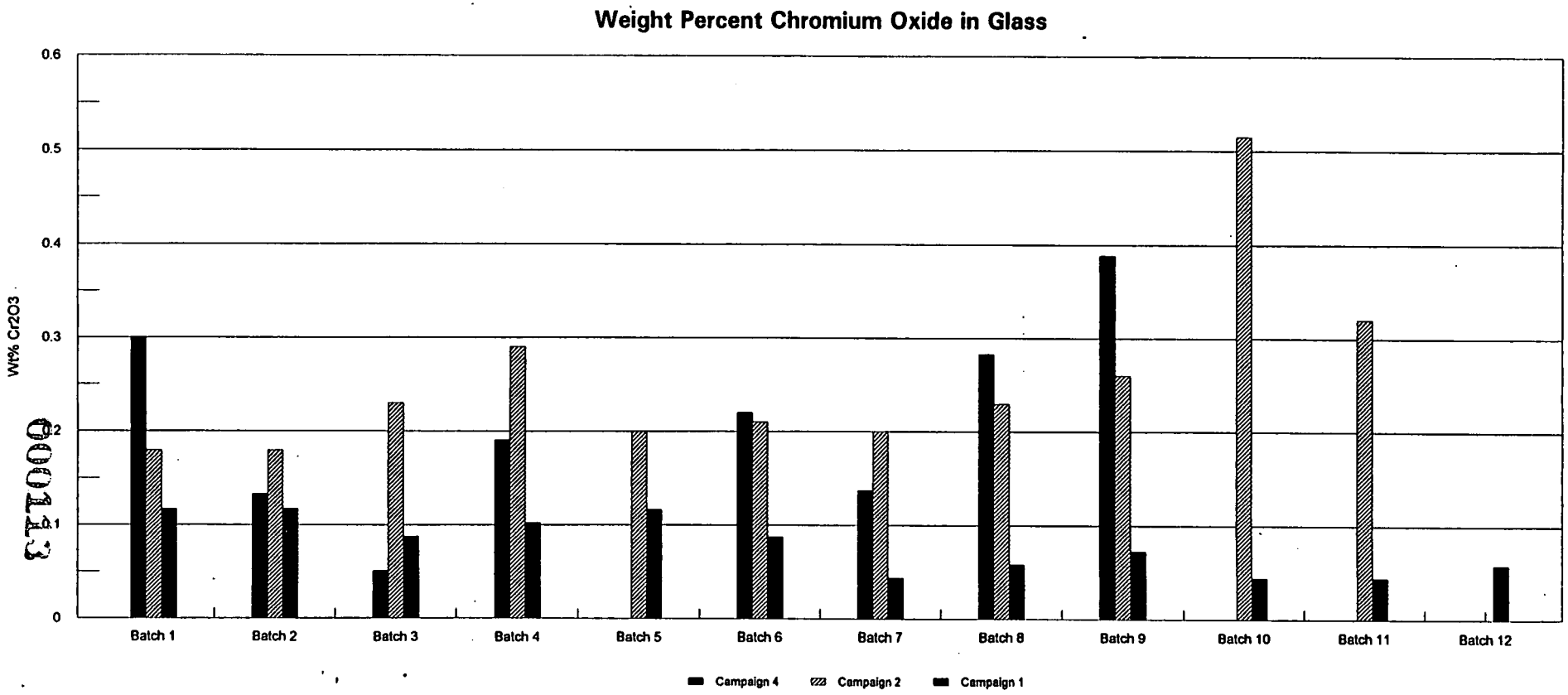


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Figure 5-16

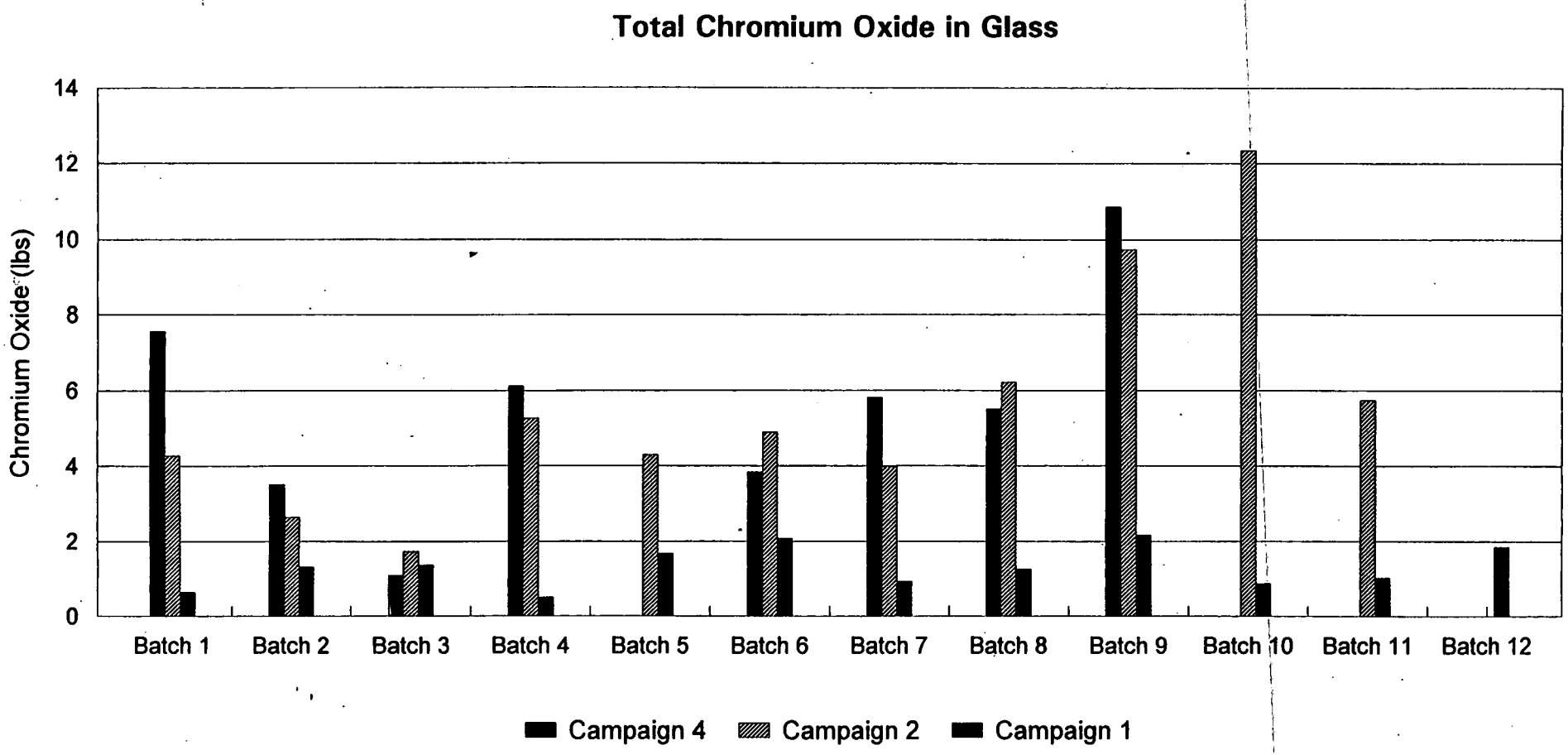

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Table 5-10
Pb & Ba Introduced into the VitPP System

BATCH	Lead (lbs) as PbO	Barium (lbs) as $BaSO_4$	Barium (lbs) as $BaCO_3$	Lbs Frit Added	Lbs Lead Introduced	Lbs Barium Introduced
C4B01	300	94	120	125	**278.5**	**156.5**
C4B02	300	80	100	725	**278.5**	**222.4**
C4B03	200	100	50.0	175	**185.7**	**122.7**
C4B04	200	100	0.00	375	**185.7**	**116.1**
C4B05	200	100	0.00	225	**185.7**	**94.9**
C4B06	200	100	0.00	125	**185.7**	**80.8**
C4B07	200	100	0.00	0	**185.7**	**63.2**
C4B07 1/2	100	50	0.00	125	**92.8**	**49.2**
C4B08	175	100	0.00	375	**162.5**	**116.1**
C4B09	200	100	25	50	**185.7**	**87.6**
Post C4B09	0.00	0.00	0.00	225	**0.0**	**31.7**

Total Lead introduced into system: 1926.3
Total Barium introduced into system: 1141.1

000115

Table 5-11
Pb & Ba Retained in Glass - Normalized

= approximation

User Sample I.D.	DRUM ID	FACTS I.D.	Concentration (wt%) Pb as PbO	Concentration (wt%) Ba as BaO	Lbs. of Glass Produced	Total Weght (lbs) Lead	Total Weght (lbs) Barium
S10-961202-1200	C4B01D1	200269566	2.89	1.50	783	18.7	10.8
S10-961201-1055	C4B01D3	200269365	4.22	2.42	879	30.7	19.5
S10-961201-1100	C4B01D4	200269366	2.54	1.54	855	19.5	12.0
S10-961203-1040	C4B02D1	200269601	5.23	2.87	698	30.2	18.4
S10-961203-2315	C4B02D2	200270231	6.48	3.63	539	31.6	18.8
S10-961203-2326	C4B02D3	200270230	6.09	4.11	886	48.8	35.1
S10-961204-1600	C4B02D5	200271183	6.60	3.90	118	7.6	5.2
S10-961204-2100	C4B02D6	200271184	6.76	3.65	395	26.2	16.4
S10-961211-2145	C4B03D1	200271764	7.38	3.98	782	51.2	35.5
S10-961207-1315	C4B03D2	200270497	5.51	3.79	619	30.8	20.8
S10-961207-1328	C4B03D4	200271680	5.37	3.68	739	35.8	24.1
S10-961208-0200	C4B04D1	200270260	5.65	4.17	776	39.6	28.7
S10-961209-1245	C4B04D3	200271330	7.88	5.33	730	53.4	34.8
S10-961208-1250	C4B04D4	200270520	6.75	4.97	941	57.3	41.5
S10-961209-1250	C4B04D5	200271331	5.42	3.67	759	37.1	24.7
S10-961209-2035	C4B05D1	200270471	10.34	6.15	842	78.6	45.9
S10-961210-1200	C4B05D2	200268027	8.38	4.02	989	73.5	45.4
S10-961210-0600	C4B05D5	200270472	8.22	4.28	124	9.0	6.1
S10-961211-1200	C4B06D1	200271736	8.31	3.62	815	60.1	33.7
0-961211-2015	C4B06D4	200271765	9.05	3.39	934	75.0	36.1
0-961212-2220	C4B07D1	200271801	7.47	3.51	821	55.3	25.6
S10-961215-1015	C4B07D2	200272136	7.65	3.47	263	20.9	9.3
S10-961212-1745	C4B07D4	200272634	7.90	3.76	1083	77.2	36.1
S10-961214-1000	C4B07D5	200272012	7.64	3.09	915	63.1	25.1
S10-961215-0540	C4B07D6	200271800	7.78	3.38	790	63.8	27.2
S10-961215-1000	C4B07D7	200272135	7.06	5.15	348	25.5	18.3
S10-961213-0200	C4B07D3	200272633	6.61	2.75	<5.0	0.0	0.0
S10-961217-2000	C4B08D1	200272754	7.58	3.41	856	67.3	29.8
S10-961217-2005	C4B08D4	200272755	7.63	3.25	645	51.0	21.4
S10-961217-2030	C4B08D5	200272780	7.26	3.25	450	33.9	14.9
S10-961223-1310	C4B09D1	200273902	8.57	4.57	995	87.3	47.0
S10-961224-0835	C4B09D4	200273040	11.74	6.17	1051	126.3	67.1
S10-961225-2142	C4B09D5	200273986	6.26	6.47	751	48.1	50.3
S10-961226-0203	C4B08AD1	200273987	5.41	2.36	368	20.4	9.0
	C4B10D1		6.00	3.00	340	18.9	9.1
S10-970107-1210	Catch Basin	200277155	5.53	3.07	3832	207.7	144.6
S10-970107-1145	C4BD1	200277152	5.53	2.89	448	24.3	15.9
S10-970107-1130	C4BD2	200277151	5.60	2.98	432	23.7	15.8
S10-970107-1200	C4BD3	200277153	5.76	2.95	478	27.0	17.3

Total Pb introduced into system:	**1926.3**		
Total Pb discharged as glass:	**1856.2**	**% of Pb Retained in the Glass**	**96.4**
Total Ba introduced into system:	**1141.1**		
Total Ba discharged as glass:	**1097.3**	**% of BaRetained in the Glass**	**96.2**

Table5-12
p1 of 3
Pb & Ba Discharged from Buiding Sump Tank**

Customer Sample I.D.	FACTS Sample I.D.	Concentration of S-17 Sample (ug/L) Lead	Barium	Run time of BST Pump (min)	Total Pb Discharged (lbs)	Total Ba Dischrged (lbs)
S17-961130-0040	200270203			11.40	0.00000	0.00000
S17-963011-1100	200270206	904.0	503.9	18.00	0.00204	0.00114
S17-961130-1832	200269372	699.8	266.0	128.34	0.01124	0.00427
S17-961130-0158	200270205	1895.0	983.0	35.28	0.00837	0.00434
S17-961201-0146	200270448	239.0	BDL	24.00	0.00072	0.00000
S17-961202-0610	200270727	130.7	BDL	39.00	0.00064	0.00000
S17-961202-0715	200270728	3669.0	BDL	39.00	0.01791	0.00000
S17-961202-0830	200270729	4136.0	BDL	40.00	0.02070	0.00000
S17-961202-0930	200270730	187.0	BDL	0.00	0.00000	0.00000
S17-961202-1030	200270731	3163.0	BDL	32.00	0.01267	0.00000
S17-961202-1130	200270732	507.2	BDL	27.00	0.00171	0.00000
S17961202-0945	200269573	4270.0	BDL	39.00	0.02084	0.00000
S17-961202-1230	200270746	1833.0	310.0	33.00	0.00757	0.00128
S17-961202-1334	200270747	971.4	218.3		0.00000	0.00000
S17-961203-0140	200270745	310.0	305.0	29.00	0.00113	0.00111
S17-961203-0243	200270940	1360.0	BDL	42.00	0.00715	0.00000
S17-961203-0400	200270919	3217.0	BDL	24.00	0.00966	0.00000
S17-961203-0425	200269606	4191.0	693.0	8.00	0.00420	0.00069
S17-961203-0500	200270920	615.3	BDL	39.00	0.00300	0.00000
S17-961203-0600	200270921	150.7	BDL	70.00	0.00132	0.00000
S17-961203-0800	200270922	108.0	BDL	32.00	0.00043	0.00000
S17-961203-0905	200270923	76.0	BDL	11.00	0.00010	0.00000
S17-961204-0915	200270237			163.02	0.00000	0.00000
S17-961204-2253	200271201	8330.0	709.0	39.00	0.04066	0.00346
S17-961205-0003	200271202	4131.0	BDL	49.00	0.02533	0.00000
S17-961205-0107	200271658	5651.0	148.6	64.00	0.04526	0.00119
S17-961205-0315	200271660	4426.0	54.3	178.00	0.09860	0.00121
S17-961205-0900	200270265			63.00	0.00000	0.00000
S17-961205-1200	200271296			28.00	0.00000	0.00000
S17-961205-1610	200271437	5259.0	535.0	15.00	0.00987	0.00100
S17-961206-0940	200270478	1008.0	BDL		0.00000	0.00000
S17-961207-1030	200270502	593.3	52.7		0.00000	0.00000
S17-961208-0410	200270527	29650.0	10010.0		0.00000	0.00000
S17961209-1200	200271337	2850.0	601.0		0.00000	0.00000
S17961209-1202	200271338	2933.0	606.5		0.00000	0.00000
S17-961210-0005	200272513				0.00000	0.00000
S17-961210-0935	200272497	1122	BDL		0.00000	0.00000

Pb discharged from Sump Tank (lbs): **0.351** **Estimated total:**** **0.886**

Ba discharged from Sump Tank (lbs): **0.020** **0.089**

** The results for the first third of the samples listed in this table were evaluated for total lead and barium detected. The analysis for the first third of the samples accounted for only 0.351 pounds of lead and 0.020 pounds of barium. It was determined that the amount of lead and barium detected in the building sump tank was negligible, and the remaining sample calculations be estimated by using the average pump run time. Results are listed in the "Estimated Total" Column.

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Table 5-12
p2 of 3
Pb & Ba Discharged from Buiding Sump Tank

Customer Sample I.D.	FACTS Sample I.D.	Concentration of S-17 Sample (ug/L) Lead	Barium	Run time of BST Pump (min)	Total Pb Discharged (lbs)	Total Ba Dischrged (lbs)
S17-961212-0105	200271773	16740.0	2882.0		0.0000	0.0000
S17-961212-0948	200271772	2309.0	562.2		0.0000	0.0000
S17-961214-1035	200272020	1719.0	BDL		0.0000	0.0000
S17-961214-1040	200272021	1636.0	BDL		0.0000	0.0000
S17-961215-1812	200272146				0.0000	0.0000
S17-961215-1910	200272143	16930.0	2295.0		0.0000	0.0000
S17-961215-2010	200273343	4345.0	529.0		0.0000	0.0000
S17-961215-2110	200273345	458.0	140.4		0.0000	0.0000
S17-961215-2210	200273597	785.0	238.0		0.0000	0.0000
S17-961215-2310	200273600	411.0	161.0		0.0000	0.0000
S17-961216-1200	200273311				0.0000	0.0000
S17-961216-0100	200273312	366.0	BDL		0.0000	0.0000
S17-961216-0200	200273313	851.2	BDL		0.0000	0.0000
S17-961216-0300	200273314	336.0	BDL		0.0000	0.0000
S17-961216-0400	200273315	273.0	BDL		0.0000	0.0000
S17-961216-0500	200273316				0.0000	0.0000
S17-961216-1030	200272664	1714.0	143.3		0.0000	0.0000
S17-961216-1032	200272665	1888.0	183.0		0.0000	0.0000
S17-961216-1600	200273269				0.0000	0.0000
961216-1830	200273270	2096.0	79.0		0.0000	0.0000
961216-1930	200273271	1186.0	216.0		0.0000	0.0000
S17-961216-2230	200273278	769.4	205.9		0.0000	0.0000
S17-961217-0006	200273281	344.7	76.6		0.0000	0.0000
S17-961217-0215	200273263				0.0000	0.0000
S17-961217-0410	200273266	220.2	73.0		0.0000	0.0000
S17-961217-1240	200272762	2197.0	1061.0		0.0000	0.0000
S17-961217-1242	200272761	2310.0	1100.0		0.0000	0.0000
S17-961218-2130	200272786				0.0000	0.0000
S17-961220-0435	200272880	251.3	41.8		0.0000	0.0000
S17-961220-1112	200272879	1110.0	119.0		0.0000	0.0000
S17-961220-1515	200274754	279.5	BDL		0.0000	0.0000
S17-961220-2040	200274770	2972.0	BDL		0.0000	0.0000
S17-961220-2147	200274771	2324.0	BDL		0.0000	0.0000
S17-961221-0930	200272986	324.0	57.0		0.0000	0.0000
S17-961221-1535	200272987	276.0	54.0		0.0000	0.0000
S17-961221-1850	200274806	419.7	BDL		0.0000	0.0000
S17-961221-2308	200275450	421.4	BDL		0.0000	0.0000

Pb discharged from Sump Tank (lbs): **0.351** **Estimated total:**** **0.886**

Ba discharged from Sump Tank (lbs): **0.020** **0.089**

** The results for the first third of the samples listed in this table were evaluated for total lead and barium detected. The ysis for the first third of the samples accounted for only 0.351 pounds of lead and 0.020 pounds of barium. It was hined that the amount of lead and barium detected in the building sump tank was negligible, and the remaining sample culations be estimated by using the average pump run time. Results are listed in the "Estimated Total" Column.

Table 5-12
p3 of 3
Pb & Ba Discharged from Buiding Sump Tank

Customer Sample I.D.	FACTS Sample I.D.	Concentration of S-17 Sample (ug/L) Lead	Barium	Run time of BST Pump (min)	Total Pb Discharged (lbs)	Total Ba Dischrged (lbs)
S17-961222-0405	200273047	300.0	52.9		0.0000	0.0000
S17-961222-1300	200273048	265.0	49.0		0.0000	0.0000
S17-961222-2201	200274784	347.7	BDL		0.0000	0.0000
S17-961223-0800	200273910				0.0000	0.0000
S17-961223-1230	200273911				0.0000	0.0000
S17-961223-2235	200276329	62.9	24.1		0.0000	0.0000
S17-961224-0015	200276338	99.7	BDL		0.0000	0.0000
S17-961224-0605	200276368	327.0	BDL		0.0000	0.0000
S17-961224-0920	200273932	230.0	38.1		0.0000	0.0000
S17-961224-1957	200273933				0.0000	0.0000
S17-961225-0930	200273948	38.6	15.6		0.0000	0.0000
S17-961225-1532	200273949	37.7	19.2		0.0000	0.0000
S17-961225-1747	200276489	93.0	BDL		0.0000	0.0000
S17-951225-2334	200273996	2040.0	24.0		0.0000	0.0000
S17-961226-0520	200275964				0.0000	0.0000
S17-961226-1019	200275966				0.0000	0.0000
S17-961226-1445	200275937	30.5	BDL		0.0000	0.0000
S17-961226-2353	200275939				0.0000	0.0000
S17-961227-0107	200275930	53.0	BDL		0.0000	0.0000
S17-961227-0408	200276490				0.0000	0.0000
S17-961227-0845	200274026	1975.0	263.0		0.0000	0.0000
S17-961227-1005	200276491				0.0000	0.0000
S17-961228-0125	200274083	3293.0	204.2		0.0000	0.0000
S17-961228-0350	200274084	211.0	110.9		0.0000	0.0000
S17-961228-0815	200275541	645.0	56.8		0.0000	0.0000
S17-961228-1030	200275547	765.7	42.3		0.0000	0.0000
S17-961228-1230	200275548	1502.0	62.7		0.0000	0.0000
S17-961229-0237	200274118	2191.0	233.8		0.0000	0.0000
S17-961229-0352	200274119	4470.0	351.6		0.0000	0.0000
S17-961229-1000	200275522	734.0	84.2		0.0000	0.0000
S17-961230-0900	200274190	2806.0	148.9		0.0000	0.0000
S17-961230-1700	200275785	3093.0	76.4		0.0000	0.0000
S17-970102-0830	200274588				0.0000	0.0000
S17-970103-0830	200274589				0.0000	0.0000
					0.0000	0.0000
					0.0000	0.0000

Pb discharged from Sump Tank (lbs): **0.351** **Estimated total:**** **0.886**

Ba discharged from Sump Tank (lbs): **0.020** **0.089**

** The results for the first third of the samples listed in this table were evaluated for total lead and barium detected. The analysis for the first third of the samples accounted for only 0.351 pounds of lead and 0.020 pounds of barium. It was determined that the amount of lead and barium detected in the building sump tank was negligible, and the remaining sample calculations be estimated by using the average pump run time. Results are listed in the "Estimated Total" Column.

Table 5-13
Pb & Ba Accumulated on Filters

Customer Sample I. D.	FACTS Sample I.D.	Sample Concentration (mg/Kg) Lead	Sample Concentration (mg/Kg) Barium	Dry Filter Weight (Kg)	Total Lead on Filter (lbs)	Total Barium on Filter (lbs)
S64PAF-961130-1230	200270999	29271.60	5359.10	1.346	0.087	0.016
S64HAF-961130-1235	200271004	BDL	3.12	1.704	0.000	0.000
S48PAFA-961201-1050	200270486	23791.00	4746.00	1.346	0.071	0.014
S48PAFB-961201-1039	200270487	334.00	64.19	1.346	0.001	0.000
S48PAFA-961202-0920	200270755	25400.00	3300.00	1.346	0.075	0.010
S48PAFA-961202-0900	200270756	9700.00	32100.00	1.346	0.029	0.095
S48PAFA-961203-0900	200270939	3.36	0.62	1.346	0.000	0.000
S48PAFB-961203-0625	200270942	BDL	3200.00	1.346	0.000	0.009
S48HAFB-961203-0627	200270943	4.37	0.60	1.704	0.000	0.000
S48PAFA-961204-2000	200271181	53000.00	5500.00	1.346	0.157	0.016
S48AAFP-961205-0440	200271413	351.00	56.00	1.346	0.001	0.000
S48BAFP-961205-1420	200271415	47500.00	5800.00	1.346	0.141	0.017
S48HAFA-961208-1020	200271689	29271.60	5359.10	1.704	0.110	0.020
S48PAFB-961211-1512	200273755	29271.60	5359.10	1.346	0.087	0.016
S48PAFA-961213-0900		29271.60	5359.10	1.346	0.087	0.016
S48PAFB-961215-0810	200273339	29271.60	5359.10	1.346	0.087	0.016
S48A-961216-0800		29271.60	5359.10	1.500	0.097	0.018
[illegible]-961217-1325	200273721	29271.60	5359.10	1.346	0.087	0.016
[illegible]B-961217-1330	200273722	29271.60	5359.10	1.346	0.087	0.016
S37PS-961218-0930	200274560	39424.00	11307.00	1.346	0.117	0.034
S48HAFA-961218-0935	200274561	53611.00	5188.00	1.704	0.201	0.019
S48HAFB-961218-0940	200274562	55719.00	4483.00	1.704	0.209	0.017
S48PAFA-961219-0835	200274504	43494.00	5553.00	1.346	0.129	0.016
S48PAFB-961219-0840	200274505	29271.60	5359.10	1.346	0.087	0.016
S48PAFB-961220-0930	200274753	51672.00	4652.00	1.346	0.153	0.014
S48PAFA-961221-0840	200274782	29271.60	5359.10	1.346	0.087	0.016
S48PAFA-962122-0935	200275453	29271.60	5359.10	1.346	0.087	0.016
S48PAFB-961222-0940	200275454	29271.60	5359.10	1.346	0.087	0.016
S48AFB-961223-0905	200276287	29271.60	5359.10	1.346	0.087	0.016
S48AFB-961223-0915	200276288	29271.60	5359.10	1.346	0.087	0.016
S48AFA-961223-1035	200276289	29271.60	5359.10	1.346	0.087	0.016
S48PAFB-961224-0835	200276462	45685.00	5110.00	1.346	0.135	0.015
S48PAFA-961225-0845	200276464	77200.00	5401.00	1.346	0.229	0.016
S48PAFB-961226-1310	200275999	29271.60	5359.10	1.346	0.087	0.016
S48PAFA-961227-0830	200276497	29271.60	5359.10	1.346	0.087	0.016

Lead accumulated on filters: 3.2
Barium accumulated on filters: 0.6

= Results based on the average of the analyzed filters

Table 5-14
Pb & Ba Accumulated in Filter Water

Customer Sample I. D.	FACTS Sample I.D.	Sample Concentration (mg/L)		Volume of Water (L)	Total Lead in Filter Water(lbs)	Total Barium in Filter Water(lbs)
		Lead	Barium			
S48HLA-961130-0935	200270398	9.60	BDL	0.25	0.000	0.000
S48HLB-961130-0945	200270399	BDL	BDL	0.25	0.000	0.000
S48PLB-961201-1040	200270484	NR	NR	0.25	0.000	0.000
S48PLA-961201-1035	200270485	11.10	BDL	0.25	0.000	0.000
S48P1A-961202-0910	200270754	3.71	BDL	0.25	0.000	0.000
S34-961202-1600	200270989	BDL	BDL	0.50	0.000	0.000
S48PB-961203-0625	200270936	BDL	BDL	0.25	0.000	0.000
S48HSB-961203-0627	200270937	BDL	BDL	0.25	0.000	0.000
S48PA-961203-0900	200270938	9.00	BDL	0.25	0.000	0.000
S34-961203-2138	200270945	BDL	BDL	0.75	0.000	0.000
S48PLA-961204-2010	200271182	BDL	BDL	0.25	0.000	0.000
S48ALP-061205-1410	200271408			0.25	0.000	0.000
S48ALP-061205-0430	200271411			0.25	0.000	0.000
S48BPL-061205-0437	200271412			0.25	0.000	0.000
S48PLA-961208-1020	200271687	BDL	BDL	0.25	0.000	0.000
S48PLB-961211-1507	200273754	BDL	BDL	0.25	0.000	0.000
S48-961213-0900	200272632	BDL	BDL	0.25	0.000	0.000
S34-961215-0935	200273340			0.25	0.000	0.000
S48PLB-961215-0800	200273338			0.25	0.000	0.000
S48A-961216-0800	200273376			55 gal drum	0.000	0.000
S48PA-961217-1317	200273719	BDL	BDL	0.25	0.000	0.000
S48PB-961217-1320	200273720	BDL	BDL	0.25	0.000	0.000
S37PL-961218-0930	200274556	BDL	BDL	0.25	0.000	0.000
S48PLB-961218-0850	200274557	BDL	BDL	0.25	0.000	0.000
S48PLA-961218-0855	200274559	BDL	BDL	0.25	0.000	0.000
S48PLA-961219-0825	200274502	0.60	0.18	0.25	0.000	0.000
S48PLB-961219-0830	200274503	0.60	BDL	0.25	0.000	0.000
S48P/B-961220-0920	200274752			0.25	0.000	0.000
S48PLA-961221-0945	200274796	BDL	BDL	0.25	0.000	0.000
S48PLA-961222-0945	200275455	BDL	BDL	0.25	0.000	0.000
S48PLB-961222-0950	200275456	BDL	BDL	0.25	0.000	0.000
S48PL-961223-0900	200276283	BDL	0.140	0.25	0.000	0.000
S48HL-961223-0920	200276284	BDL	BDL	0.25	0.000	0.000
S48PL-961223-1000	200276285	1.19	0.510	0.25	0.000	0.000
S48PLB-961224-0830	200276461	0.55	BDL	0.25	0.000	0.000
S48PLA-961225-0845	200276463	0.74	BDL	0.25	0.000	0.000
S48PLB-961226-1300	200275998	BDL	0.130	0.25	0.000	0.000
S48PLA-961227-0830	200276496	BDL	0.230	0.25	0.000	0.000
SVAC-961229-0130	200275528					

Lead accumulated in filter water: 0.0
Barium accumulated in filter water: 0.0

and 5-14 and totals approximately six-tenths of a pound. Based on calculations from the analysis of the isokinetic filter that was placed in the stack during Campaign 4, none of the barium introduced into the system escaped out the stack. Calculated using the normalized results, a total of 1,098 lbs (96.2%) of the barium that was introduced into the VitPP system, was accounted for in the mass balance.

5.3 TCLP

RCRA regulations require that the vitrified glass product be characterized prior to disposal. The method for characterizing the VitPP glass product is the Toxicity Characteristic Leaching Procedure (TCLP). The TCLP test determines the ability of the glass product to withstand leaching of barium, chromium and lead. The TCLP requirements for the VitPP glass are that the concentrations of barium, chromium and lead in the leachate remain below 100 mg/L for barium, 5 mg/L for chromium, and 5 mg/L for lead in order to be classified a non-hazardous waste.

TCLP tests were performed on glass samples representative of each drum in Campaign 4. The results are presented in Table 5-15.

Table 5-15
TCLP Results - Campaign 4 Glass

Drum ID	Results (mg/L)			TCLP Batch	Pass	Fail
	Barium	Chromium	Lead			
C4B01D1	0.026	BDL	0.038	1	X	
C4B01D3	0.043	0.004	0.141	1	X	
C4B01D4	0.091	BDL	0.002	1	X	
C4B02D1	0.067	0.010	0.124	1	X	
C4B02D2	0.045	BDL	0.086	1	X	
C4B02D3	0.181	0.012	0.081	1	X	
C4B02D5	0.033	BDL	0.061	1	X	
C4B02D6	0.070	BDL	0.083	1	X	
C4B03D1	0.061	0.001	0.064	1	X	
C4B03D2	0.033	BDL	BDL	1	X	
C4B03D4	0.641	0.013	0.749	1	X	
C4B04D1	0.029	BDL	0.037	1	X	
C4B04D3	0.0421	BDL	BDL	1	X	

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Drum ID	Results (mg/L)			TCLP Batch	Pass	Fail
	Barium	Chromium	Lead			
C4B04D4	0.225	BDL	0.076	1	X	
C4B04D5	0.079	BDL	0.040	1	X	
C4B05D1	0.016	BDL	0.077	1	X	
C4B05D2	2.251	0.013	1.745	2	X	
C4B05D2	**0.067**	**BDL**	**0.072**	**3**	**X**	
C4B05D5	1.494	0.009	1.808	2	X	
C4B06D1	0.039	BDL	0.057	1	X	
C4B06D4	0.027	BDL	0.056	1	X	
C4B07D1	0.248	BDL	0.060	1	X	
C4B07D2	0.145	0.014	0.371	1	X	
C4B07D4						
C4B07D5	0.064	0.005	0.225	1	X	
C4B07D6	1.532	0.016	2.74	2	X	
C4B07D6	**0.099**	**0.010**	**0.550**	**3**	**X**	
C4B07D7	1.537	0.039	2.089	2	X	
C4B08D1	1.083	0.010	2.451	2	X	
C4B08D4	1.012	0.012	2.257	2	X	
C4B08D4	**0.081**	**0.004**	**0.116**	**3**	**X**	
C4B08D5	1.277	0.015	1.586	2	X	
C4B09D1	1.643	0.017	2.08	2	X	
C4B09D4	1.478	0.013	2.204	2	X	
C4B09D5	3.469	0.012	4.556	2	X	
C4B09D5	**0.062**	**0.009**	**0.083**	**3**	**X**	

The TCLP tests of the thirty-two glass samples were run in three batches. Samples that were run in the first batch of TCLP runs are indicated by a "1" in the "TCLP Batch" column in Table 5-15. The

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Figure 17a
Campaign 4 TCLP Results - Lead

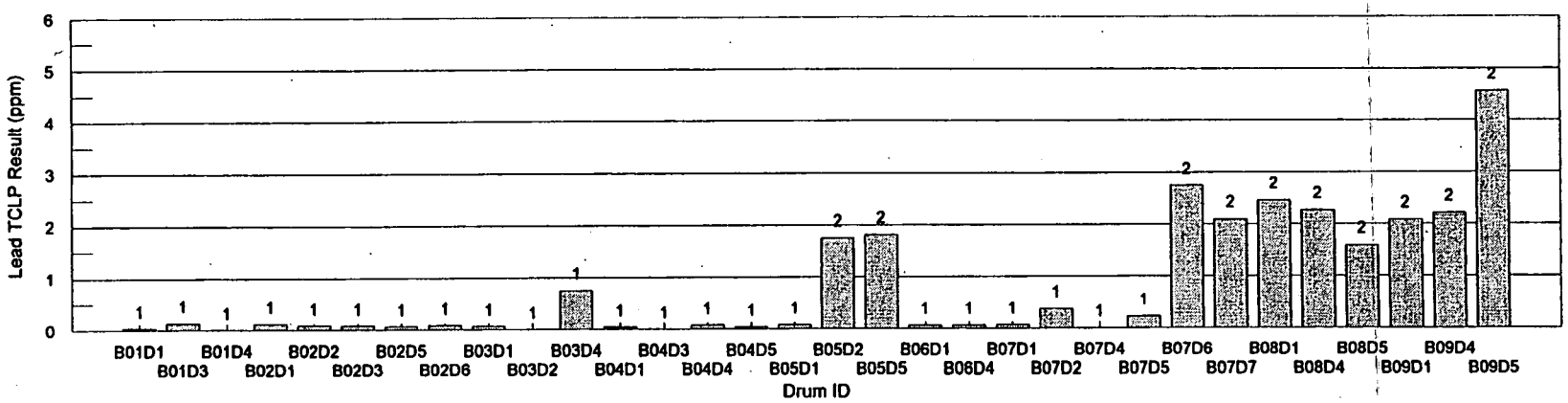
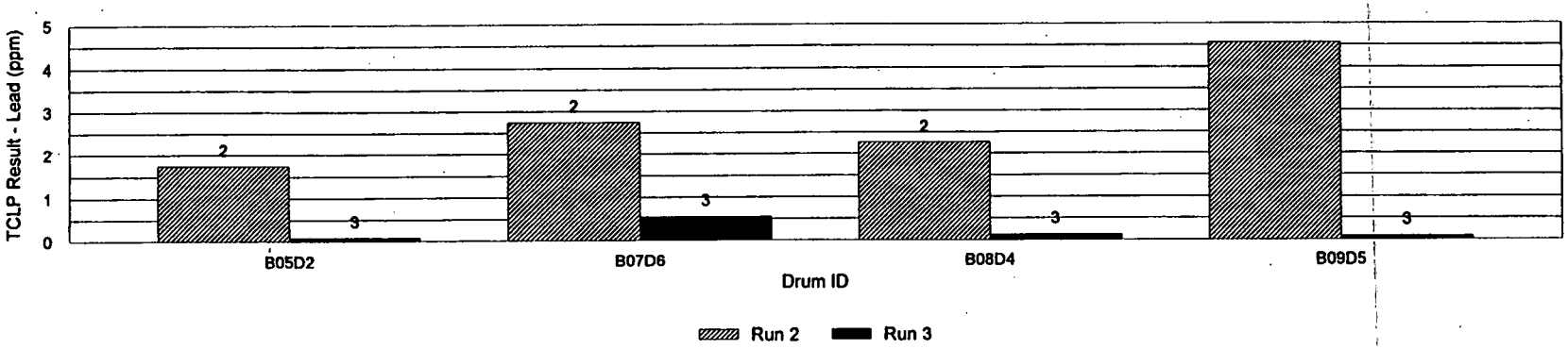


Figure 17b
TCLP Run 2 vs run 3



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samples run in the second batch of TCLP runs are indicated by a "2." The samples that were run in the second batch all had substantially higher concentrations than those run in the first batch. A third batch of TCLP runs was performed on four samples tested in second batch due to a variation in the preparation of the samples for the second batch. These samples are designated by a "3." The samples in the third set of TCLP runs were glass samples taken from the same sample container as the samples tested in the second TCLP set . The results of the third set of TCLP tests are significantly lower than the results from the second set. The sample with the highest TCLP result from Campaign 4 was 4.556 ppm. This same sample had a result of 0.083 ppm after being tested during the third set of TCLP runs. Figure 5-17a shows the trend of the lead TCLP results for batches 1 and 2 for each drum of Campaign 4. Lead is the only constituent shown from the thirty-two samples run because it was the only element that approaches the RCRA limit for hazardous waste. Figure 5-17b compares the lead TCLP results for batches 2 and 3 for four drums of Campaign 4 glass.

Figure 5-18 displays the TCLP lead results for Batch C4B07. Because the chemistry of the glass as well as the system conditions during the monolith pour were routinely consistent, the results in the same batch are not expected to vary to the degree that they did in Batch C4B07. The samples from the first three drums were run with the first batch and the samples from the last two drums were run in the second batch. Figure 5-19 displays the same scenario for Batch C4B05. Samples from drums prior to and following Drums C4B05D2 and C4B05D5 have similar chemistry and system conditions as drums C4B05D2 and C4B05D5. Although the TCLP test is a leaching process and the results are not expected to be the same for two samples or for a sample that is run twice, the results are expected to be similar.

The difference between the three batches of TCLP runs was that the glass samples in the second TCLP run were broken down into finer pieces than the glass from the first and third batches. A sample run with the first batch was also run with the second batch, and the result reported for the second batch was higher by a factor of ten. These results provide evidence of the impact that inconsistency in laboratory preparation has on the analytical results and supports the idea that analysts and the testing engineers should work closely together and share a common focus and understanding of the project.

5.4 Feed Preparation and Feed System

The performance of the Feed Preparation System during Campaign 4 improved in comparison to the performance of the system during Campaign 2. Modifications to the system between campaigns included the installation of direct-routed flexible piping and Sandpiper™ pumps. During the feeding of the slurry batches, there were two Slurry Pump failures. The slurry batches ranged from 23 wt% solids to 51 wt% solids (Sample point S05A samples collected and analyzed) and the amount of slurry fed to the Melter ranged from 5,223 lbs to 10,305 lbs per batch.

Throughout the campaign, there were a variety of problems with the operation of the Bag Dump Station and the Dry Additive Transfer System. Problems with the Dry Additive Transfer System can be divided into two area: (1) dry materials collecting in the Bag Dump Station piping and (2) Dry materials clogging in the Additive / Filter Receiver, Rotary Airlock, and the Slurry Tank diverter.

Figure 5
TCLP Results for C-B07: Lead

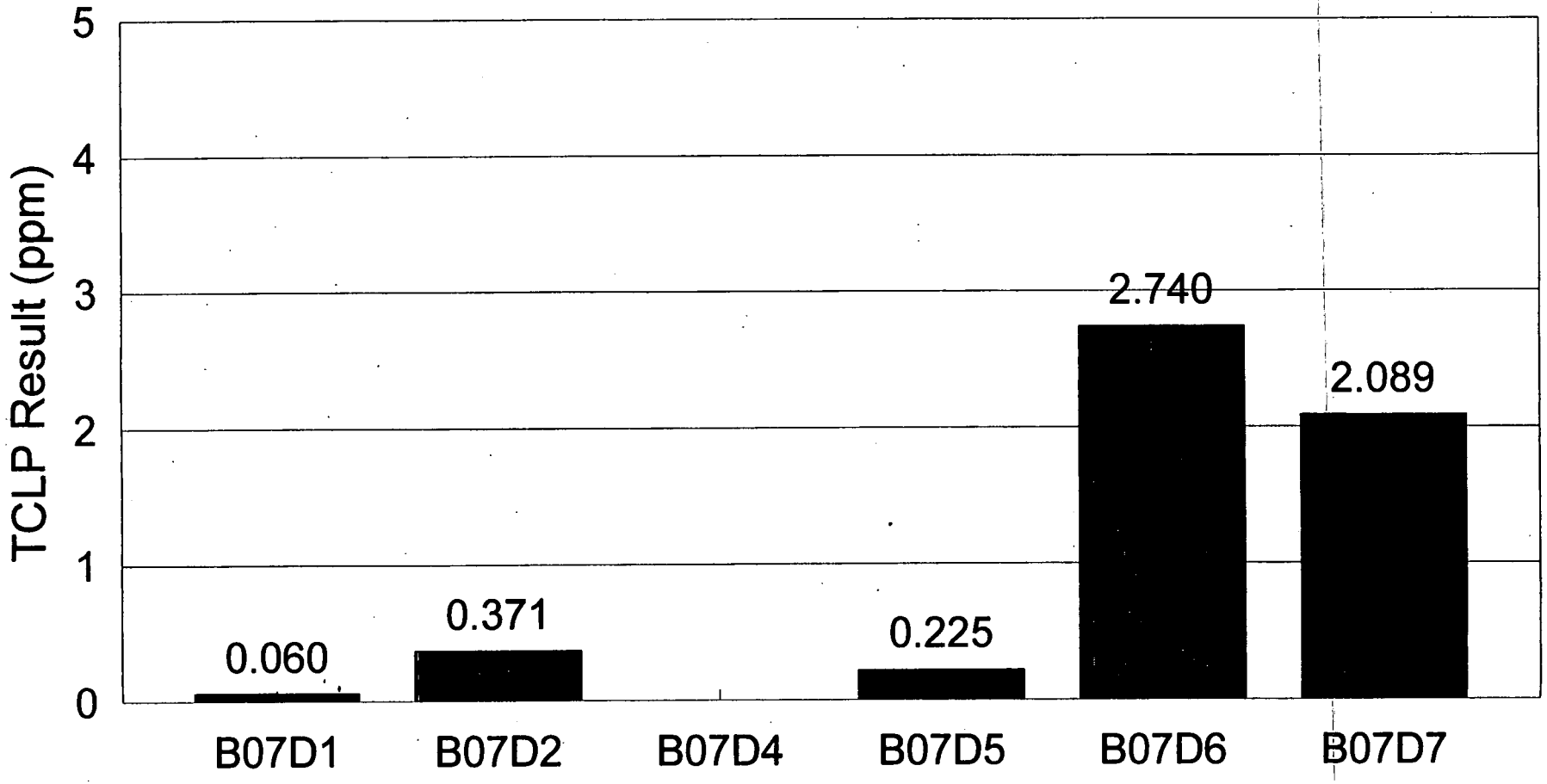

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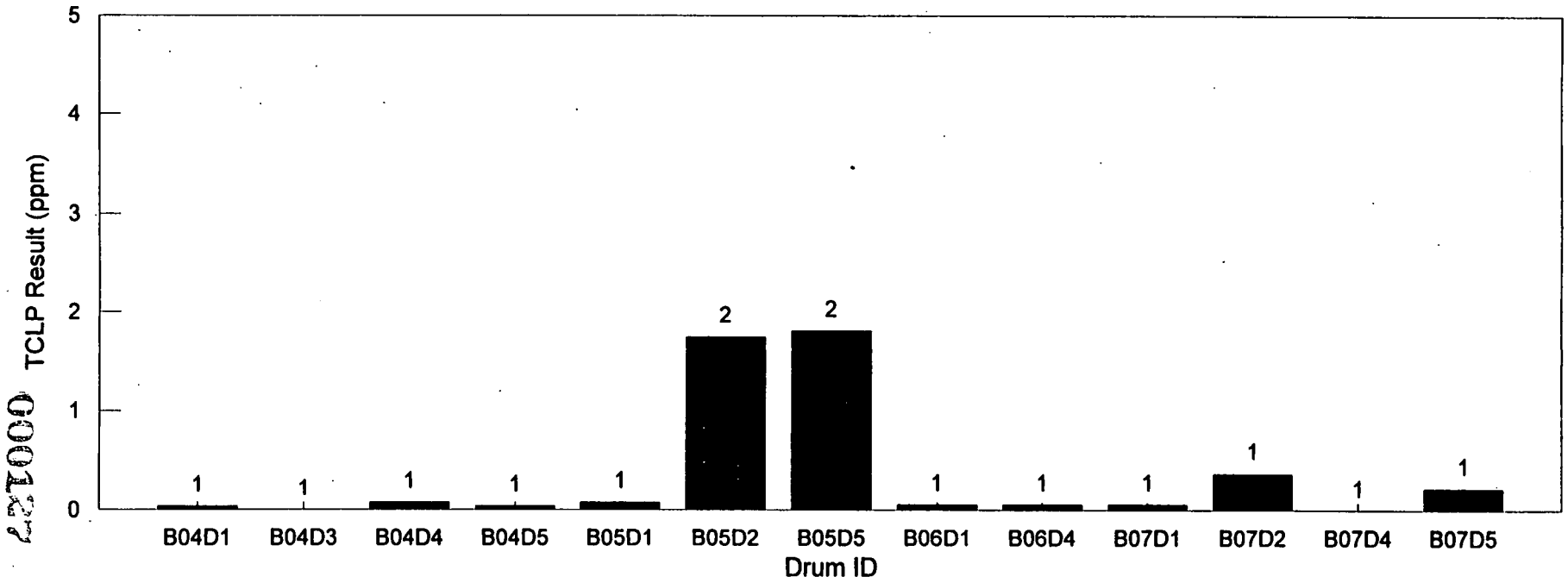
Figure 5-19
Campaign 4 TCLP Results: Lead - Batch C4B05



5.4.1 Blockages in the Bag Dump Station and Dry Transfer

The Vacuum Blower package used in Campaign 2 was replaced with a higher capacity Roots-Dresser® blower and DiOctyl Phthalate (DOP) testable filter unit. This blower has three times the pressure capability at the same flow rate as the original Vacuum Blower package. The changes in this Vacuum Blower package improved the operation of the system during Campaign 4 as compared to the operation in Campaign 2. Material blockage in the pipes near the Bag Dump Station due to additive build-up occurred once in Campaign 4, compared to three times during Campaign 2. Other problem areas in the system are detailed below.

Despite the efforts of VitPP operators to select materials that appeared to be generally powdery and free from large solid pieces, the Dry Additives System was completely plugged near the Bag Dump Station on one occasion. On this occasion, it required at least 30 minutes to clear the pipes. Inspection of the material that created the blockage revealed that the finer meshed and denser dry chemicals caused the blockage.

To avoid plugging the pipes the practice of sequencing materials was used throughout Campaign 4. The finer meshed and heavier dry materials were alternated with materials such as silica that did not plug or accumulate in the pipes. Slowing the addition rate for each 50-pound bag of dry material, and altering the addition sequence of materials significantly improved the operation.

Dry material accumulation was also found to be a problem within the Additive Filter/Receiver, the Additive Filter/Receiver Diverter, and the pipes downstream of the Diverter. On one occasion, approximately 550 pounds of materials accumulated in the Additive Filter/Receiver. There was also significant accumulation found in the Additive Filter/Receiver Diverter and the eight-inch pipe joining the Diverter to the selected Slurry Tank.

Solutions to these blockages were a combination of maintenance and operations activities and preventive measures. VitPP personnel avoided the blockage problem by installing an air vibrator, manually knocking on the outside of the unit, and closely monitoring the increase in weight of the Slurry Tank during dry material addition. It was also found that cycling the diverter between the Slurry Tanks and using metal rods to clear the eight-inch pipe under the diverter successfully transferred the dry materials to the appropriate Slurry Tank.

5.4.2 Blockages in the Slurry System Piping and Slurry Pumps

Piping and pump blockages were attributed to both slurry characteristics and system components. VitPP personnel altered the chemical addition order (as discussed previously), replaced pipe with flexible hose, substituted Red Valve® pinch valves for Marwin® ball valves, exchanged Marathon® pumps for larger Sandpiper® pumps, and installed matted mechanical seals on the Melter Feed Pump in order to decrease the amount of time spent on clearing blockages.

5.4.2.1 Slurry Characteristics

As in Campaign 2, magnesium phosphate ($MgPO_4$) was the primary material exhibiting tendencies to bind together and form solid rock-like lumps in the slurry recirculation system. $MgPO_4$ would form solid "rocks" upon introduction to water in the Slurry Tank and cause blockage of the slurry recirculation pipes. For this reason the desired amount of $MgPO_4$ was dumped twice per batch as a dry material directly into the center chamber of the Melter. This practice was continued for the first eight batches. The addition of the dry $MgPO_4$ material caused considerable dusting of the Melter plenum and allowed some of the $MgPO_4$ particulate to escape to the Off-Gas System. For Batch C4B09, the $MgPO_4$ was mixed with water before it was added directly to the Melter as a thick slurry, limiting the amount of material that was drawn into the Off-Gas System.

Once the composition of the slurry was adjusted, it became apparent that the consistency of the slurry also contributed to the blockage of the system piping. The current slurry feed system was not capable of operating with slurry batches greater than 45 wt% solids. Slurries in this wt% solids range were found to be very viscous and would eventually set up in the pipelines. Batch sheets were modified to keep the solids content below 45 wt% solids.

5.4.2.2 System Components

The Slurry System was upgraded by replacing piping located in problem areas with flexible hose. The flexible hose allowed sections of pipe to be replaced in the event of pipe plugging and permitted maintenance to be performed on the pipe. The problems with the ball-type Marwin valves during Campaign 2 were resolved by replacing these ball valves with pinch valves. The design of the Marwin® ball valves is insufficient for use with abrasive slurries. The rubber internals of the pinch valves used in Campaign 4 are more resistant to abrasive slurries. Also, the pinch valve closing action does not have a metal-to-metal interface, therefore the valve can be operated continuously without significant erosion to the valve.

The Marathon® Slurry Pumps were replaced with a higher pumping capacity Sandpiper® pumps. The Marathon® pumps were found to be 'hesitating' or missing a stroke as air was delivered to the pump diaphragm. The Sandpiper® pumps are more resistant to abrasive slurries. The Sandpiper pumps have a patented No-lube, No-stall Air Valve. The ball type check valves used in the Marathon pumps are not used in the Sandpiper design. The Sandpiper check valve uses a gravity activated flap valve. This flap valve is rubber coated to resist abrasion from slurries. The diaphragm used on the Sandpiper pumps is made of an advanced HYTREL rubber that is

resistant to abrasive slurries, acids and bases. During Campaign 4, Slurry Pump B failed two times, as compared to six times for both pumps during Campaign 2. This pump reliability was a significant improvement to the performance of Campaign 4 SOT.

During Campaign 4 the slurry pipes were often manually cleared by Operations and Maintenance. Piping sections were sometimes disconnected and the blockage was cleared using flush water from the Recycle Water System. The clay-like properties of the settled slurry not only resulted in blockage in pipes, but also a buildup of material on the Slurry Tank walls. During some batch operations, after as much of the slurry as possible was pumped to the Melter, hundreds of pounds of slurry remained caked on the walls of the Slurry Tanks. Adding water and agitating the material in the tank would remove some of the residue. To remove all of the slurry, VitPP personnel shoveled the residue from the tanks.

Sample ports located on the Slurry System also blocked with slurry. In one case a bolt was lodged in the inside valve of the double valve sample port. Once, the use of these plugged sample ports was discontinued and alternative sampling ports were used. These sample ports were cleared with metal rods and augurs after the completion of the batch. The section of pipe between the first sample isolation valve and the flowing slurry often plugged. This section of piping was not used continuously, and was prone to plugging because the slurry compacted in the "dead section" of the piping. Abandoned ports were manually cleared using metal rods and augurs after completion of the batch.

As Campaign 4 progressed, VitPP personnel developed some preventive measures to minimize plugging in the system. When the Slurry Pumps began to hesitate or low flow indications were received from the Flow Indicator FI-170 on the Melter Feed Loop of the slurry transfer line, VitPP personnel would flush the lines with recycle water back to the Slurry Tanks to remove the accumulation of slurry in the pipes. In addition, if feed to the Melter was interrupted, VitPP personnel would return slurry flow to the Melter Feed bypass loop (Short Loop) and flush the Melter Feed line to avoid settling of the slurry in the pipes.

The Melter Feed Pump seal was replaced one time in Campaign 4 because of a mechanical seal failure caused by loss of seal water to the seal. The reliability of the Melter Feed Pump was improved by installing mechanical seals with improved face design. The mechanical seals were cooled by a supply of liquid from a seal reservoir. This reservoir provided cooling and equalization pressure for the mechanical seal interfaces. To avoid Melter Feed Pump seal failure, the seal reservoir level was constantly monitored by Operators (per the round sheets) and DCS automatic level alarms.

While these solutions were available and somewhat successful, other solutions (such as tank design, piping layout, pump, and seal selection) must be developed for the preparation of the actual silo material. This is required to avoid repeated contact between plant personnel and feed material.

5.5 Melter Operation

This section focuses on the effect of the surrogate waste glass on the operation of the Melter. The Melter operated in one of two modes; (a) idle or (b) production. During the idle mode, the Melter was maintained at a constant temperature and no slurry was fed. During the production mode, slurries were fed and glass was discharged.

Operators were relied upon to continuously monitor and adjust the feed rate and the Melter power. During production periods, the Feed Pump speed was adjusted as needed to maintain a stable cold cap in the main chamber, which was characterized by 80% to 90% coverage of the glass pool with a ½ to 4 inch thick layer of slurry. The Melter temperature was controlled using SCR power control. The power controller set point was adjusted based on temperature observations of the bath as read on a thermocouple mounted approximately six inches above the main chamber floor. This temperature control method relies heavily on the relevance of the temperature indication of the main bath thermocouple and the power-to-temperature response of the Melter. Varying temperature response characteristics of the Melter combined with inaccuracies in reading the mean bath temperature resulted in control problems. Operator experience and observations were necessary to improve the control of the Melter.

Operating the Melter at a constant temperature required a balance between the energy input and the energy loss. While the energy input was the power applied to the electrodes, the energy losses were primarily from heat loss and energy requirements for chemical reactions. During production periods, steady-state cold caps were achieved (1) when the feed rate of the water in the slurry matched the evaporation rate of the water from the main chamber and (2) when the feed rate of the solids in the slurry matched the dissolution of the solids in the glass. During idling periods, steady-state operation of the Melter was achieved by establishing and maintaining a specified glass pool temperature. During idling periods, steady-state operation was easily accomplished However, during production periods, steady-state Melter operation was very difficult.

5.5.1 Film Cooler Outlet / Air Lance Plugging

Plugging of the Film Cooler outlet during production was a continuous problem. During idle periods, plugging of the Film Cooler outlet was not a problem. During the first two batches of Campaign 4, the Film Cooler outlet required cleaning approximately every three to four hours. Cleaning was accomplished by lowering the feed rate or stopping the feed completely. According to calculations using data collected during the Campaign 2 Acceptance Test, approximately 1/4 to 1% of the solid content in the feed was carried over to the offgas System through the Film Cooler. This carry-over of solids caused rapid plugging of the Film Cooler outlet and Air Lance. Once a cold cap was established, the rate at which the Film Cooler Outlet and Lance plugged decreased significantly. The reason was that after the cold cap was developed, the Melter plenum temperature dropped significantly. This reduction in plenum temperature violent spattering of slurry on the surface of the melt pool. Lowering the temperature, lowers the generation of dry feed particles and this reduces the amount of carry over to the offgas system.

A secondary source of the particulates that accumulated in the Film Cooler Outlet was the dry

$MgPO_4$ added directly to the main chamber of the Melter. Throughout Campaign 4, operations personnel would decrease the off-gas flow temporarily during the $MgPO_4$ additions to decrease the amount of particulates that were pulled into the Film Cooler Outlet. During Batch C4B09, Operations personnel also wetted the $MgPO_4$ prior to adding the material. The combined efforts of the decrease in off-gas flow and $MgPO_4$ wetting significantly reduced the amount of particulates that accumulated in the Film Cooler Outlet and on the air lance.

Plugging of the Film Cooler and the transition line prevented steady state production. When the plugging occurs, the capacity of the offgas system was reduced. With a reduced offgas capacity, the Melter negative pressure could not be maintained and feed had to be reduced or stopped until the plug was cleared.

5.5.2 Sulfate Effervescence Events

The problem of effervescence or "foaming," first seen during Campaign 2 recurred in Campaign 4. Glass, having a very low solubility for sulfate, absorbed little of the SO_X created during the decomposition of $BaSO_4$; therefore, SO_X and O_2 gases were produced and released from the bath. The rapid release of these gases caused foaming in the Melter. When the undesired conditions were created, the foaming occurred very rapidly. Rapid foaming prevented steady-state production due to the necessary control response actions.

Most of the foaming events were observed in the main and west side chambers of the Melter. On two separate occasions, west side chamber foaming increased the level of glass (foam) in the chamber to the point that foam flowed over the E-Wall from the west side chamber into the main chamber. Often the west side chamber would foam and the east would show no indication of foaming. The proposed reasons for this will be discussed later.

In addition to the foaming in the chambers, the destruction of barium sulfate has other chemical characteristics which hinder glass production. These characteristics can be represented by the following chemical formulas.

Decomposition of $BaSO_4$:

(1) $BaSO_4 \rightarrow BaO + SO_3$ $\Delta h = 122$ kcal/gmol

(2) $SO_3 \rightarrow SO_2 + O_2$ $\Delta h = 22$ kcal/gmol

Total $\Delta h = 144$ kcal/gmol

In this reaction heat energy is absorbed. For every 1% of $BaSO_4$ in the 4400 lbs bath, approximately 14 kWh of energy are required to decompose the sulfate to SO_2 and O_2 gas as follows:

(3) $$\frac{0.01 * 4400\ lb * 144\ kcal/gmol * 454\ g/lb}{233\ g/gmol} = 12{,}350\ kcal = 14\ kWh$$

Based on the physical and chemical characteristics of the decomposition of barium sulfate, several actions were taken to control and avoid the foaming during Campaign 4. These included:

- Increasing power.
- Decreasing power.
- Reducing feed rate.
- Switching feed from slurry to water.
- Addition of a dense glass frit directly to the side chamber.
- Addition of urea $CO(NH_2)_2$.

An effective method for preventing or limiting the foaming was the addition of the urea. Once foaming started the most effective method of control was to cut the power. Operations noted that when reduction in power was accompanied by the addition of the dense frit and a reduction of feed rate, the foaming was controlled. While the Melter was idling, accumulated sulfates slowly decomposed. After long idle periods, foaming was not immediately evident when the feed resumed. However, with sustained feeding, sulfates would eventually re-accumulate in the melt which would result in lower production rates. The net result of sulfate accumulation was a significant loss in the production rate.

During Campaign 4, the west side chamber foamed more rapidly and frequently than the main or east. Operations found the most effective method to reduce the foaming was to reduce the power to the Melter. When the power was reduced, the foaming would subside almost immediately. This reduction in foaming coinciding with power reduction is explained as follows.

Foaming was primarily caused by the release of gases produced during the destruction of the sulfate compounds introduced by the feed. The sulfate decomposition reaction kinetics were more favorable at higher temperatures. Holes and cracks that developed in the west E-wall allowed the sulfate-containing glass and slurry to enter the west side chamber. To compound the problem, the holes and cracks in the E-wall were a source of increased temperature.

The holes and cracks produced high current flux areas between the side chamber and the E-wall. The localized high current flux caused hot spots around the damaged areas of the E-wall and between these areas and the electrodes. These hot spots produced rapid localized decomposition of the sulfates. That in turn caused a rapid localized generation of SO_X and O_2 gas.

The on-line rate of production in the Melter was related to the speed that the sulfate compounds were decomposed. If the decomposition rate was slower than the feed rate, sulfates accumulated in the melt. This sulfate buildup resulted in uncontrollable foaming and temperature control problems. The overall effect was a reduction in the production rate. More testing is required to determine the exact rate of sulfate decomposition. Until this rate is known, accurate steady-state vitrification production rates for the K-65 waste stream cannot be determined.

5.5.3 Electrode Consumption and the Production of Elemental Lead

The surrogate waste glass leaking into the east and west side chambers from the main chamber altered the benign chemistry of the side chambers and resulted in the chemical attack of the Mo electrode material. One reaction of particular interest was as follows:

(4) $Mo + 3\,PbO \longrightarrow MoO_3 + 3\,Pb$

In this reaction, Mo is oxidized and lead is reduced. For each 1 lb of Mo oxidized, 6.5 lbs of lead is reduced. Over time this can result in a significant accumulation of elemental lead in the bottom of the Melter.

The chemical combination of O_2 and Mo is a second possible reaction that would consume the Mo electrodes during Campaign 4. This reaction occurs rapidly at temperatures above 500 °C. Considering the Melter chamber temperatures, the consumption of Mo electrodes in the presence of the O_2 produced during sulfate decomposition is significant.

(5) $2Mo + 3O_2 \longrightarrow 2MoO_3$

Probing of the top electrodes in both the east and west side chambers was periodically done during Campaign 4. The east side chamber top electrode length extended 24-30 inches inside the Melter for the duration of Campaign 4. Before the start of Campaign 4, the top west side chamber electrode also extended 24-30 inches inside the Melter. Midway through Campaign 4 probing of the top west side chamber electrode showed that it only extended 8 to 10 inches inside the chamber. This provided physical evidence that the West side chamber electrodes were being consumed.

Amperage readings on the west bank also indicated a shift of current to the lower electrodes. Prior to Campaign 4, current distributions in the west bank of electrodes were fairly even, but at the end of Campaign 4, amperage readings on the top two electrodes had decreased by over 66 %. This information supports the idea that the top two electrodes in the west side chamber were rapidly deteriorating.

Table 5-16 compares the chemical makeup of the original side chamber frit with that of the denser barium-containing frit used in Campaign 4. It was hypothesized that using this denser frit would help reduce the inflow of center chamber glass to the side chamber and reduce the migration of main chamber glass. It is not possible to determine that this method was effective since Campaign 4 ended prematurely and damage to the west E-Wall had increased from Campaign 2.

Table 5-16

Component	Molecular Weight	Light Glass wt%	Dense Glass wt%
Al2O3	101.96	12.70	11.43
BaO	153.34		15.75

Component	Molecular Weight	Light Glass wt%	Dense Glass wt%
CaO	56.08	6.40	
Li_2O	29.88	10.10	9.09
MgO	40.31	4.10	3.69
Na_2O	61.98	5.30	4.77
SiO_2	60.08	55.30	49.78
ZrO_2	123.22	6.10	5.49
Total		100.00	100.00

The reasons for a higher consumption rate of the electrodes in the west side chamber as compared to the east side chamber may be explained as follows:

The west side chamber E-Wall was badly cracked and had at least one hole that was approximately 2-inches in diameter. Glass samples from the west side chamber collected after feeding slurries to the Melter clearly indicated that the glass chemistry in the west side chamber closely matched that of the main chamber. Table 5-17 shows the lab analysis results for the glass chemistry in each chamber.

Table 5-17

ANALYTICAL RESULTS			
Chemical	Main Chamber S10C-961217-0213 ID# 2-353091	West Chamber S10W-961217-140 ID# 2-353228	East Chamber S10E-961217-159 ID# 2-253108
Silicon Si	17.07	19.4	19.35
Boron B	2.07	2.82	1.92
Lithium Li	0.42	0.43	1.39
Aluminum Al	3.29	3.28	4.71
Sodium Na	2.4	2.39	5.69
Calcium Ca	5.43	5.35	3.58
Iron Fe	2.11	2.34	1.69
Potassium K	0.34	0.91	0.38
Magnesium Mg	0.77	0.80	1.24

Manganese Mn			5.01
Nickel Ni			
Lead Pb	5.41	5.65	3.53
Vanadium V	0.00	0.00	0.00

These samples were collected on December 17, 1996 prior to feeding batch C4B09. The amount of lead (Pb) and sodium (Na) in the main chamber closely matched the amount in the west side chamber. Also worth noting, the amount of lithium (Li) in the east side chamber was considerably higher that the Li content in the main and west side chambers. Most of the Li comes from the side chamber frit. The high amount of Li in the east side chamber as compared to the amount of Li in the main chamber indicated that the east side chamber E-Wall was providing some chemical isolation from the main chamber. The fact that this difference in Li concentration was not apparent in the west side chamber supports the theory that the west side chamber E-Wall was not providing much chemical isolation from the main chamber. This analytical data supports the explanation that the surrogate glass migrated to the west side chamber and contributed to the electrode consumption.

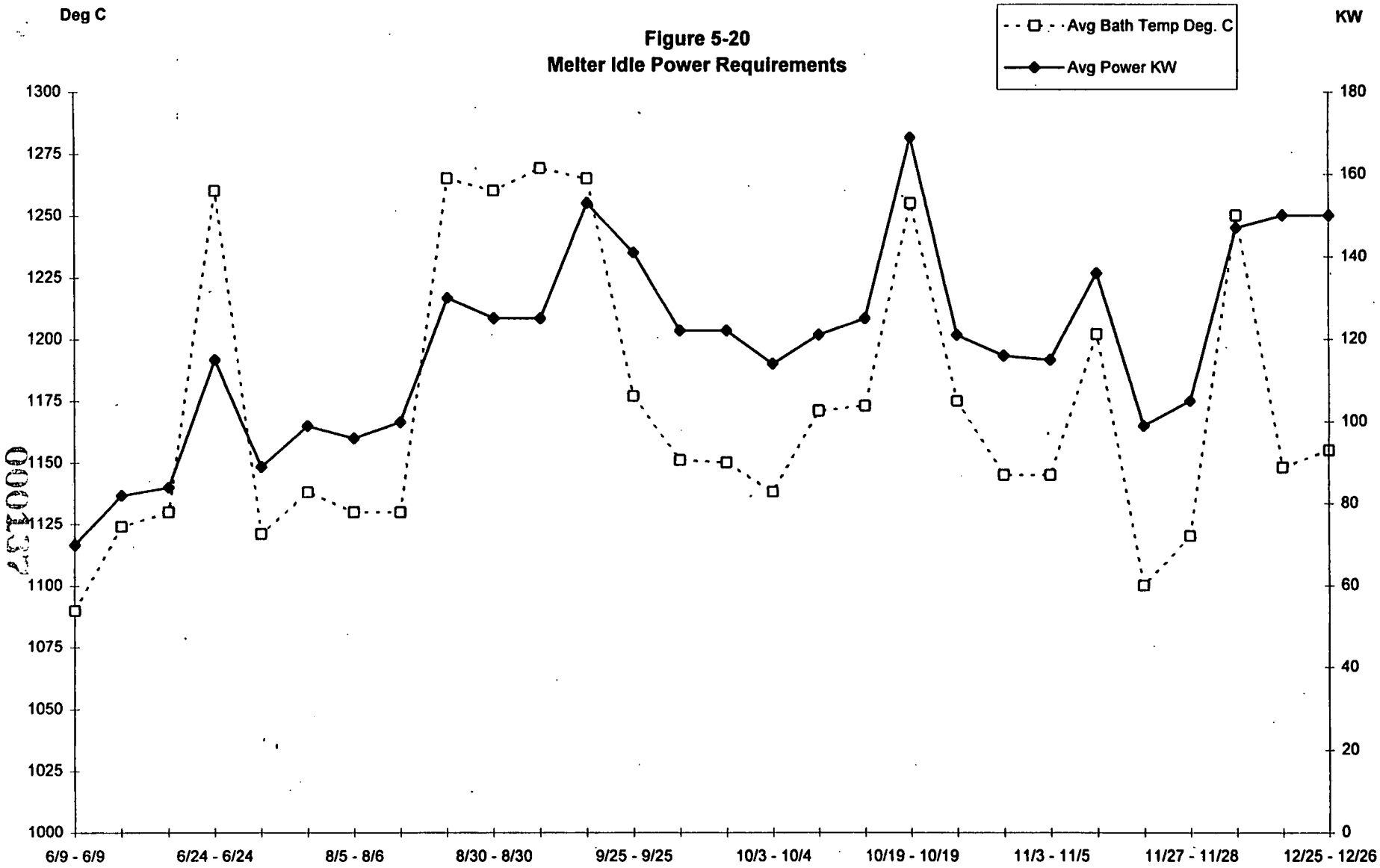
Isolation of Mo electrode material from the surrogate glass is essential in reducing the electrode consumption and lead production rates. Probing the west side chamber to determine electrode length during operation revealed that approximately 45 lbs of the west electrode bank was consumed during only three weeks of Campaign 4 operations.

5.5.4 Melter Idle Power

Figure 5-20 presents the approximate power usages during steady-state idle periods from the beginning of Campaign 1 to the end of Campaign 4. Dividing the power required by the temperature held helps to normalize these numbers over the life of the project. Figure 5-21 shows the normalized steady-state power requirements and the mean bath temperature for selected idle periods during the project. In Campaign 1, between June 25 and August 25, benign startup formula slurry was fed to the Melter. This glass required approximately 90 Watts per °C to idle at 1140 °C. During Campaign 2 after feeding four batches of acceptance formula slurry and seven batches of Series D formula slurry, the idle power requirements increased to 105 Watts per °C for the 1150 °C idle temperature. Prior to, and through batch C4B09, the 1150 °C idle requirement was steady at the 105 to 110 Watts per °C. However, after batch C4B09, the Melter idle power requirement increased dramatically to 130 Watts per °C to maintain the 1150 °C idle temperature (Reference Figure 5-21).

For the Melter to idle at a constant temperature, the energy input must be balanced against the energy losses. No mechanical force is created in the Melter. Energy requirements for the chemical reactions occurring in the Melter during idle periods are not significant enough to account for the dramatic increases in power. The only remaining variable is the heat loss from the Melter. Heat is lost from the Melter through the Offgas System, the Melter cooling water system and through convection and radiation to the Melter room. Analysis of the Offgas System parameters monitored by the data acquisition system show little

Figure 5-20
Melter Idle Power Requirements



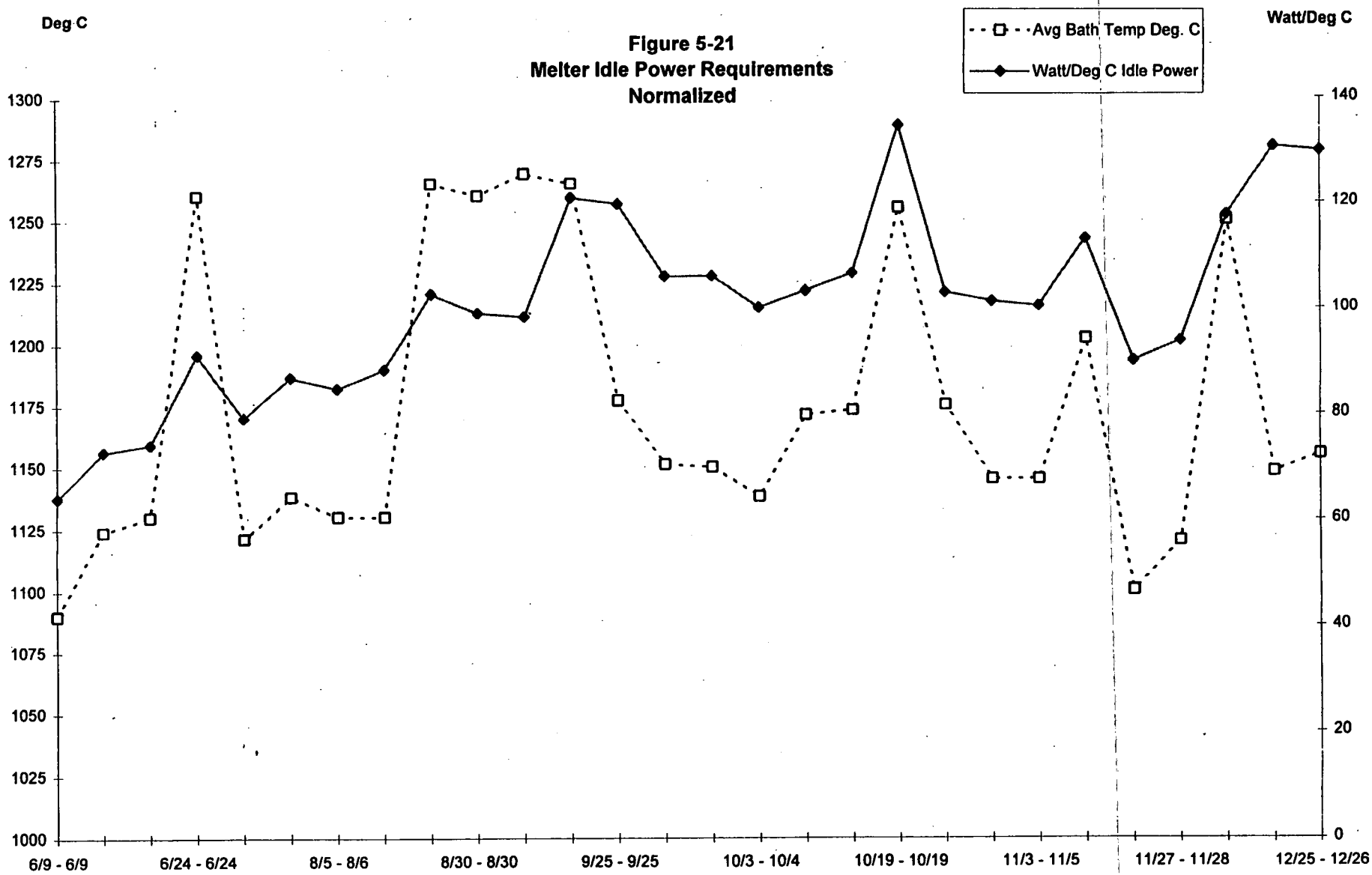


Figure 5-21
Melter Idle Power Requirements
Normalized

000138

673

change in the approximate 40 kW heat lost to the Off-gas System during the idle periods. Further analysis of the Melter cooling water system parameters again show little change in the approximate 15 kW Melter cooling water heat loss. No Melter skin temperature parameters are available through the data acquisition system. Thermal imaging photography taken in September and October show skin temperatures of 180 °F on the walls, 200 to 400 °F on the Melter bottom and 200 to 400 °F around the discharge chamber. Slight increases in these skin temperatures may be reason for the increased power requirement.

Increases in the Melter skin temperature can be explained as follows:

1. Glass may have been permeating toward the Melter outer shell. This would draw the Melter's heat closer to the Melter's shell, increase temperature at the surface, and therefore increases the heat loss. Batch C4B09 was a Series A low temperature transition batch. This batch produced a thin (less viscous) conductive glass. This thinner glass allowed deeper penetration through the Melter refractory floor and walls.

2. During Melter operation, some electrical power may have been conducting through the refractories. This would place heat closer to the surface of the Melter, and increases heat loss. Two major paths are possible:

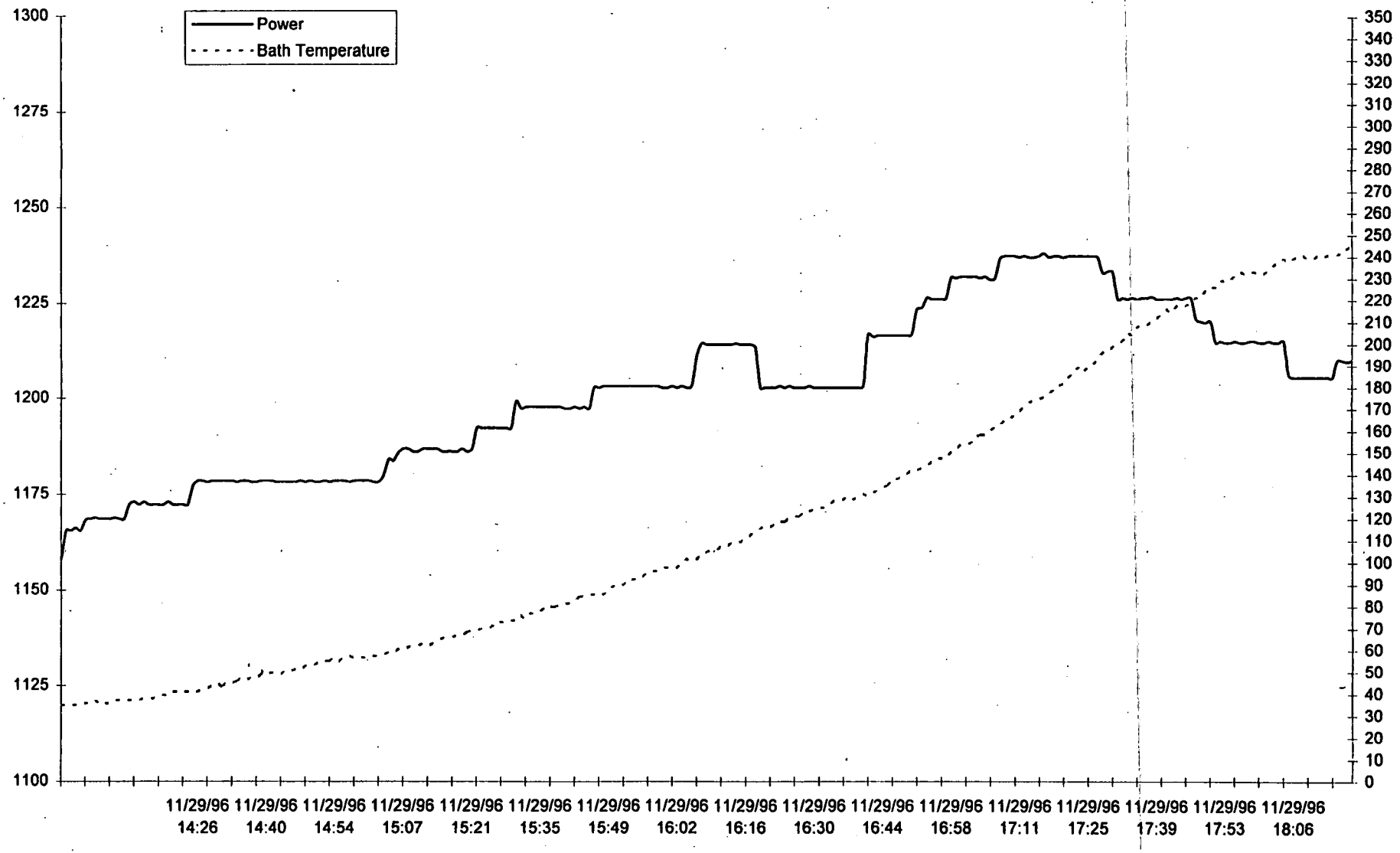
   a. Current path could have existed from electrode to electrode through the refractory floor and outer walls. Preliminary calculations show that only 1 to 2 percent of the power could pass through the refractories. This is because the path the electricity must follow through the Melter refractories is long and the refractory is much more electrically resistant than the molten glass.

   b Current path could have existed from electrode to electrode partially through the inner shell of the Melter. This could be a much shorter path than described in Item a) above. For this scenario to be valid, a conductive material such as molten glass or molten lead had to penetrate from the Melter bath to the inner shell in two independent places. This would allow the inner shell to complete a circuit between electrodes. The heat generated by this circuit would have been very close to the outer shell. This would increase the temperature of the outer shell and in turn increase the idle power requirements.

5.5.5 Melter Temperature Ramping

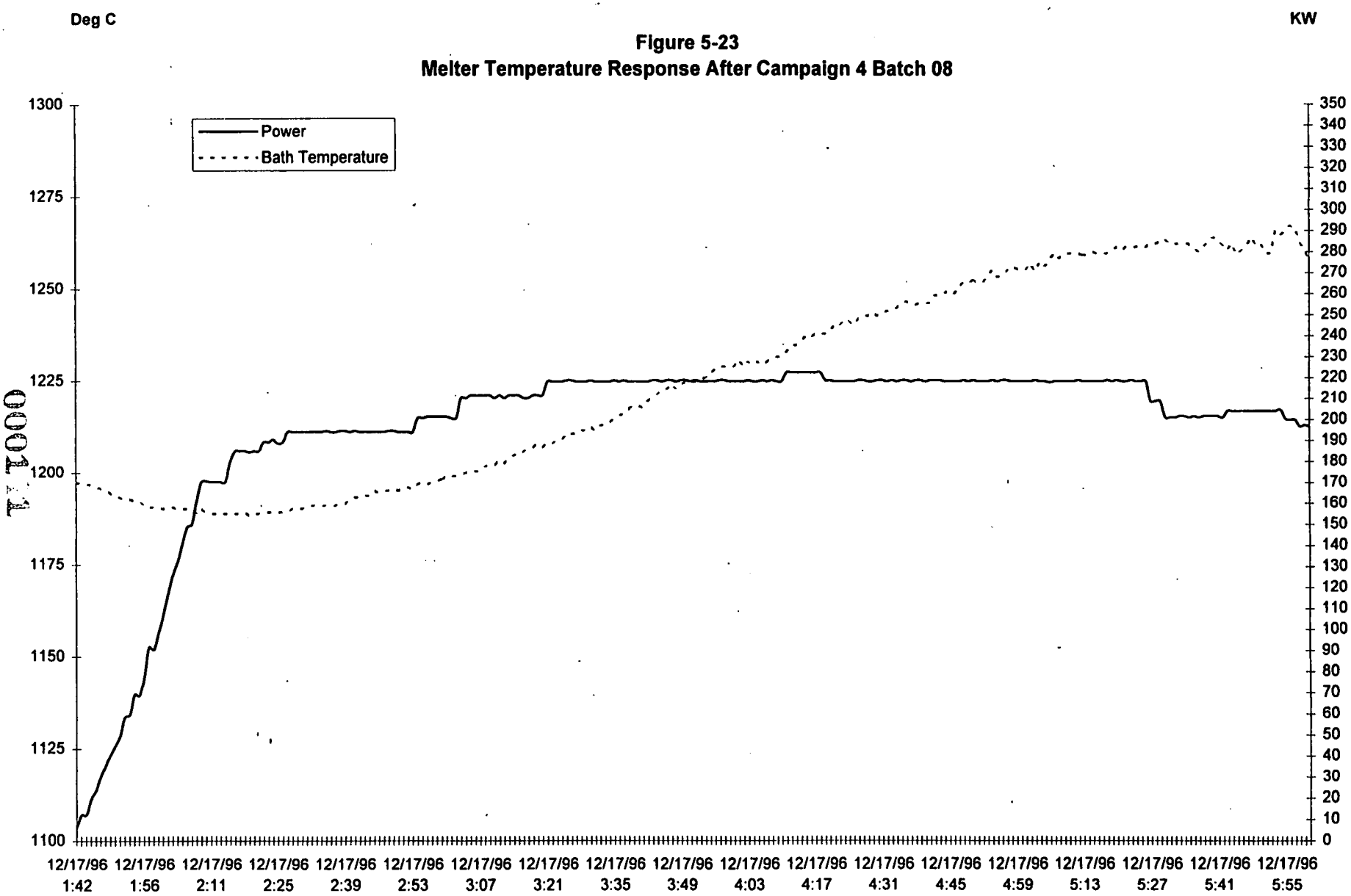
Figure 5-22 identifies Melter parameters during a period of ramping up Melter temperature on November 29, 1996, prior to the start of Campaign 4. Before this ramp-up, the Melter had been idling for a month and the glass in the Melter consisted of a benign formula. Figure 5-23 identifies Melter parameters during a similar period of temperature ramping on December 17, 1996. In the second case the Melter had only been idling for six hours and the glass in the Melter was a Series A surrogate. Operations had just completed feeding Batch C4B08. Both figures are plotted over 4 hour and 18 minute ramping periods.

Figure 5-22
Melter Temperature Response Prior to Campaign 4



000110

Figure 5-23
Melter Temperature Response After Campaign 4 Batch 08



To analyze the ramp-up temperature response versus power input, a numerical integration of the power curve is presented for a three hour period for each plot. In the first case (benign glass), 595 kWh of energy was added to the bath between 1430 hour and 1730 hour. This energy raised the bath temperature 89 °C from 1125 °C to 1214 °C. Dividing the energy requirement by the rise in temperature gave an energy per degree rise of 6.7 kWh/°C.

In the second case (Series A glass), 642 kWh of energy was added to the bath between 0230 hour and 0530 hour. This energy increased the bath temperature 72 °C from 1191 °C to 1263 °C. In the second ramp up the Melter bath temperature was approximately 66 °C higher. The higher temperature naturally required more power. Based on Campaign 4 idle power requirements, approximately 15 kW more power was expected to maintain a 60 °C higher temperature. Over the three hours this resulted in 45 kWh of energy. To compare the two ramp-up energy requirements, the additional power required to hold the higher temperature must be subtracted from the higher temperature ramp power requirement. The result indicates that it took 8.3 kWh/°C increase. This equates to a normalized increase in power of approximately 1.5 KWh/°C. Based on these figures, it required approximately 20% more energy to increase the Series A glass temperature compared with benign glass.

5.5.6 Gem Making

During Campaign 4, gem production was unsuccessful. The majority of the discharged glass was poured directly into 55 gallon drums. The problems experienced with gem making during Campaigns 1 and 2; sticking, stringing and over spillage again prevented continuous gem production during Campaign 4. A new designed water-cooled cutter was available to be tested; however, Campaign 4 ended before this could be installed. Further studies on gem production are required to determine the feasibility of gem making.

5.5.7 Diverters

During the discharge of glass from the Melter discharge chamber to form a monolith, the glass stream was not always completely captured by the diverter(s) or the diverter chute(s). Glass from the discharge chamber orifice would occasionally overflow the diverters and pour directly on the cutter wheel. The molten glass would occasionally solidify in the diverter. This would block the flow from the orifice and resulted in glass spilling over the side of the diverter. When the diverters were in place below the glass stream, the molten glass at times would accumulate on or adhere to the discharge chute(s) and/or to the inside walls of the gem machine housing prior to falling into the monolith drums. The monolith drums periodically were removed to access and break loose the solidified glass in the chute.

5.5.8 Discharge Chamber

During the discharge of glass from the Melter several problems were experienced. The chamber pour spout did not condone pouring a consistent single pour stream. The spout had a large hole (3 inches in diameter) at the bottom and the glass could pour off any point (or points) around this hole.

Migration of glass continued under and through the discharge chamber pour trough throughout Campaign 4. This migrating glass would eventually block the discharge chamber orifice. This flow was slow and generated a gradual buildup in and under the orifice to the point of completely blocking the opening to the gem machine housing. Prior to feeding the Melter, the blockage would require a welder using an acetylene torch to melt away the glass from the area below the orifice to clear the blockage. The timing of the clearing process was essential. If the orifice was cleared too early and glass flow was not established in a few hours (or minutes in some instances), the orifice would be blocked again due to the migration of glass.

5.6 Offgas System

For Campaign 4, the Offgas System consisted of the Film Cooler/Air Lance, transition line spray system, Quench Tower, Scrubber, HEPA Prefilters, HEPA Filters, heat tracing, Offgas Exhaust Fan, Stack, and the interconnecting offgas lines. The Offgas System continued to suffer from frequent plugging problems that required a lot of maintenance activity to keep it available for handling Melter off-gas.

5.6.1 Air Lance/Film Cooler

The air lance is a pipe inserted through the center of the Film Cooler which provided for injection of compressed air at the point where off-gas exited the Melter plenum into the normal offgas line. As in Campaign 2, the particulate leaving the Melter in the offgas caused plugging problems in the Film Cooler. While feeding the Melter, periodic removal of the air lance and manual cleaning of the Film Cooler was required up to several times a shift. The need for cleaning was based on the pressure drop through the Film Cooler. Pressure drops ranged from 5" W.C. (at the beginning of the campaign when clean and with no feed to the Melter) to 30" W.C. (when dirty and with feed to the Melter). Near the end of Campaign 4, even with no Melter feed, the pressure drop through the Film Cooler rarely decreased below 10" W.C.. The new air lances were made out of Inconel® and successfully resisted oxidation.

Compressed air flow to the air lance was fairly constant at about 40 SCFM. Compressed air flow to the Film Cooler remained turned off in favor of adding air only through the air lance. Because of the crude nature of the flow measurements, no material or energy balance was possible around the Film Cooler.

5.6.2 Transition Line

The transition line is the 4" diameter stainless steel pipe that carries off-gas from the Film Cooler to the Quench Tower. It was modified for Campaign 4 by the addition of a water spray nozzle at the first downturn leg after the line passed through the exterior Melter room wall. The intent was to prevent the type of plugging which occurred in Campaign 2 where the thermowell at the entrance to the Quench Tower accumulated solids which required rodding out. The addition of about 4 gpm of water spray to the transition line reduced the temperature of the gas entering the Quench Tower from about 600°F to about 160°F (while feeding the Melter).

The transition line experienced partial plugging a few times between the Film Cooler and the Quench Tower. The pressure drop through this line was about 6" W.C. at the beginning of Campaign 4 when clean and with no feed to the Melter. The pressure drop would rise to about 15" W.C. when feeding the Melter, and many times exceeded 20" W.C.

Beginning with Batch C4B06 on December 10, 1996, the pressure drop through the transition line was frequently above 20" W.C. and it was not possible to maintain the Melter pressure at -0.75" W.C. while feeding. Inspection of the line at the new spray nozzle revealed no blockage there. A plug was found in the transition line near where it passes through the Melter room exterior wall. Rapping on the line seemed to partially clear this plug at least once. High pressure drop through the transition line was a problem from Batch C4B06 to the end of Campaign 4.

5.6.3 Quench Tower

The Quench Tower operated satisfactorily, as it did during Campaign 2. Recycle water flow through the spray nozzles was close to 13 gpm throughout the campaign. During Melter operation at 1250°C, the Quench Tower typically cooled the offgas from an inlet temperature of 160°F to an outlet temperature of 125°F.

During Campaign 4, caustic (NaOH) was not added to the Quench Tower for pH control of recycle water. Instead, water was frequently purged from the Recycle Water Tank (via the Wastewater Filters) and replaced with clean water. The purpose for this purging was to keep the total solids content in the recycle water below 3,500 ppm, and also to keep the pH in the recycle water above 7.0 (to protect carbon steel vessels and piping).

5.6.4 Scrubber

During Campaign 4, caustic was added to the Scrubber to neutralize sulfur oxides in the offgas from the Melter. Caustic was added as 20 wt% NaOH from a bulk tank as necessary to maintain a pH above 9.5 in the scrubbing solution. After the first week of Campaign 4, the scrubbing solution pH was maintained between 10.5 and 12.5. To prevent the buildup of dissolved solids (sodium carbonate, sulfate, and sulfite), the Scrubber was drained and refilled about every other day while the Melter was being fed. Despite this, on December 10, 1996 solids plugged the inlet to the Scrubber pumps during a flushing operation.

5.6.5 Filters and Particulate Carryover

Significant amounts of particulate were getting through the Scrubber, as indicated by the frequency with which the HEPA Prefilters were changed. HEPA Prefilters lasted, on average, only 1 to 1½ days before high pressure drop necessitated they be changed. As in Campaign 2, significant amounts of particulate were getting through the Scrubber.

The previous problem of water condensation in the HEPA housings was essentially solved by heat tracing and insulating the new 6-in diameter offgas line installed between the Scrubber and the HEPA Filters and the HEPA Filter housings themselves. This reduced water condensation in the HEPA housings from several gallons per day down to just several ounces

per day. The prefilter fabric appeared to be dry when removed.

5.6.6 Offgas Systems Upgrades and Maintenance

The Offgas System problems with particulates down-stream of the Scrubber has resulted in system upgrades using spray nozzles up-stream of the Quench Tower to flush particles into the Quench Tower and spray nozzles on top of the Scrubber Tower to clean the mist eliminator in case of obstructions. The offgas piping from the Scrubber to the HEPA housings was enlarged and straightened.

5.7 Other Systems - Recycle Water System Overview

Operation of the recycle water loop (Recycle Water Tank to Recycle Water Pump to Quench Tower to Heat Exchanger and back to Recycle Water Tank) was modified by removing the Thickener from the loop. The flow through the loop remained stable at approximately 13 gpm during Campaign 4, with approximately 4 gpm of additional recycle water being introduced at the new spray nozzle installed in the transition line between the Melter and the Quench Tower. During periods of Melter feeding, the Heat Exchanger routinely cooled the water exiting the Quench Tower from 120-130°F down to less than 80°F using 60-70°F cooling water. This indicated good heat transfer and minimal fouling in the Heat Exchanger.

5.7.1 Recycled Water System Specifics

The Recycle Water System's most serious problem was the extensive fouling of the process piping system resulting in greatly reduced water flow to the Quench. The degree of fouling was sufficient to reduce water flow rates to the Quench Tower from a design flow of 40 gpm to a water flow rate of 25 gpm early in the project. This was further reduced to 8 gpm in November and December 1996 due to pipe scaling. Pressures at the pump were normal at 90 psig.

Reports of poor handling of process piping prior to construction resulted in corrosion and early rust. This situation was not corrected during construction and over time the pipes deteriorated. Recommendation for Phase II is that all process piping be handled properly and kept clean prior to installation. This may require additional handling and protection from the elements including storing materials in a dry, mud-free location. In addition, once the pipe is installed the system should be flushed and treated in accordance with industry standards. The result will be an initially clean, debris-free system.

During Campaign 4, it was determined that the recycle water system process piping was severely fouled with deposits of suspected metal oxides and sulfates. These deposits were consistent with those found in steel pipe in water applications where corrosion and oxidation have occurred. Alternatives were investigated and considered to remove the material clogging the pipes and restore the water flow to the original values. The viable alternatives included chemical cleaning, pipe replacement, and mild acid removal through operating at a lower pH, normal pH ranged between 6.8 and 8.0. It was decided that the most practical short-term solution was to allow the pH of the recycle water to fall between 4.0 and 6.0. This range was selected for two reasons

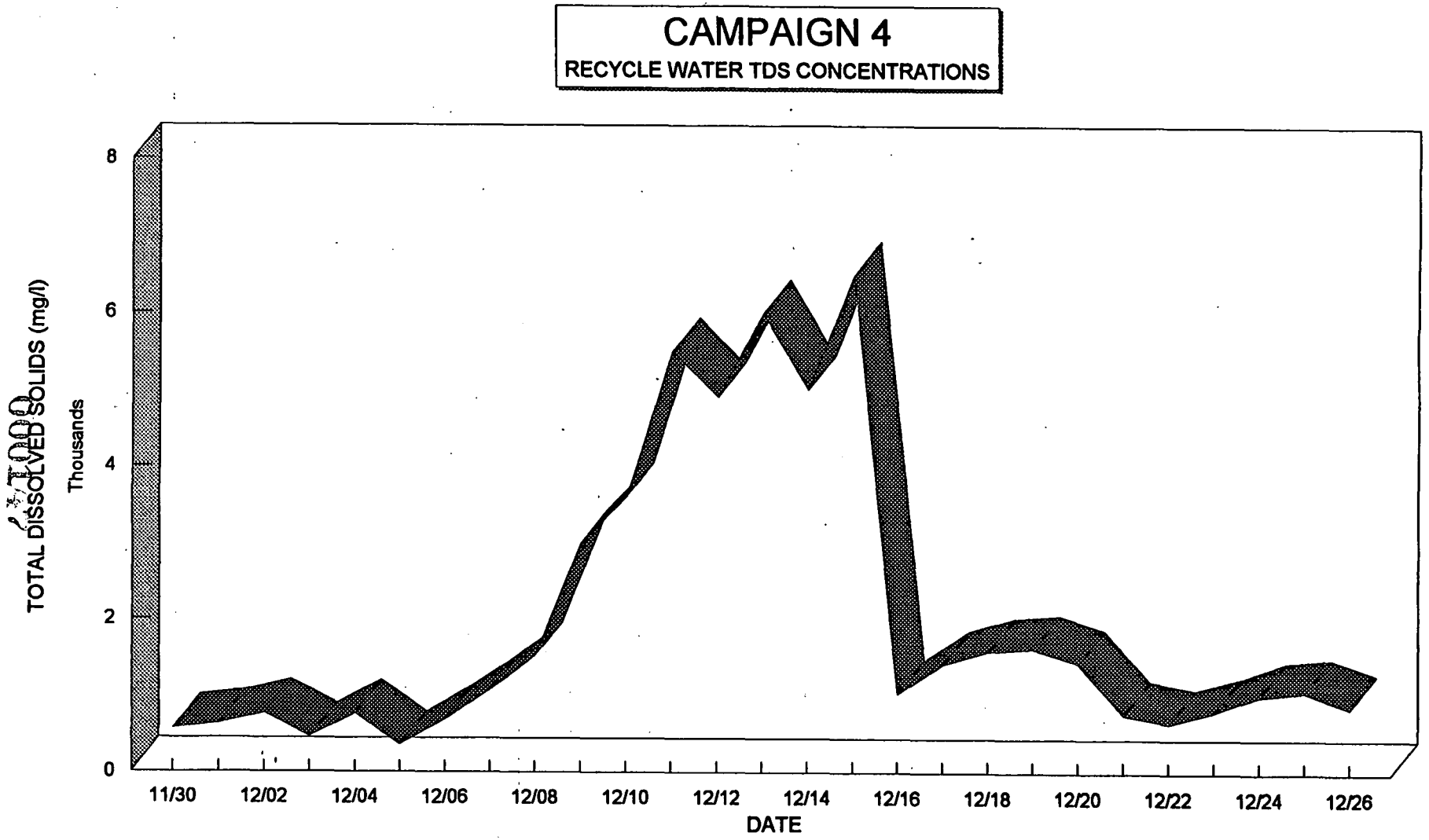
First, water with a pH of 4.0 to 6.0 is mildly acid and will attack steel in addition to the deposits of iron oxides. A lower pH range would have been possible; however, it was decided to remove the deposits slowly without attacking the steel pipes. The second reason for selecting this solution was that dissolved iron would stay in solution and not re-deposit. The result of the lower pH range presented other challenges to the operation of the system. As the concentration of dissolved solids increased in the water, the need to purge the system became apparent. Throughout Campaign 4, Operations personnel periodically transferred part of the Recycle Water System inventory through the Waste Water Filters and added treated water to the system. It was decided that a total dissolved solids (TDS) concentration of 3500 ppm would be the action level for adjusting the inventory. Due to the limited amount of time this corrective action was implemented, there is no definitive conclusion concerning the effectiveness of the solution. Figure 5-24 presents the varying concentrations of TDS in the Recycle Water.

It was also found that there was a degree of carryover and foaming resulting in solids (salts) in the Normal Offgas System HEPA Filters and Prefilters. It is common for high TDS water systems to foam and contribute to carryover of solids to an Offgas System.

Second, the untreated recycle water is highly corrosive under the best of conditions and is subject to pH swings and high salt and metals content. This water is prone to deposit and attack the steel. This deposit problem was severe enough that the system would require either a shut down and replacement or chemical cleaning in less than a year. The temperature of the process water limits the variety of materials that can be used in this system. Pipe constructed of 300 series stainless steel would minimize corrosion and the inevitable iron build up as a result of corrosion products. Other alternatives include Fiberglass Reinforced Plastic (FRP) pipe, Teflon (TFE) pipe, plastic-lined pipe, or Kynar pipe. Selection will most likely be based on the cost of materials and installation.

During Campaign 4, it became increasingly evident that additional action levels concerning the adjustments of the Recycle Water System were required. Issues that were beginning to be implemented included monitoring activities. Analysis of all pertinent metals were to be used as a method of tracking the materials leaving the Melter. It was apparent that the recycle water system is the system where all or most waste products present themselves and is the first line to identifying a problem. Key changes to the sampling process included informing the laboratory analysts about VitPP activities to build team involvement. At the VitPP, changes included trending the analytical results on a daily basis and updating the Operators on the current conditions of the system and implications.

Figure 5-24


CAMPAIGN 4
RECYCLE WATER TDS CONCENTRATIONS
TOTAL DISSOLVED SOLIDS (mg/l)
Thousands
8
6
4
2
0
11/30
12/02
12/04
12/06
12/08
12/10
12/12
12/14
12/16
12/18
12/20
12/22
12/24
12/26
DATE

5.8 Snapshot

Data tabulations and plots for the three run series performed during Campaign 4 are in Appendix C. The run series were:

1) Transition to Series A Glass; molten glass composition in the Melter transitioned to the Series A surrogate formula

2) Series A Glass; Series A surrogate molten glass composition

3) Transition to Low Temperature Series A Glass; molten glass composition in the Melter transitioned to a Series A surrogate glass formula to test lower temperature operation (~1150 °C)

Appendix C is organized as C1, Transition to Series A Glass; C2, Series A Glass; and C3, Transition to Low Temperature Series A Glass. Within each appendix, the data are organized by VitPP systems: Feed Preparation System, Furnace System, Gem Machine System, Normal Offgas System, Emergency Offgas System, and Recycle Water System.

The Transition to Series A Glass run is described in section 5.1.1. The conditions of the Melter components, glass and internal conditions, offgas and the Discharge Chamber at a representative time during this run are shown on Figure 5-25. These runs consisted of batches C4B01 and C4B02.

Section 5.1.2, describes the Series A Glass runs. Melter conditions are shown on Figures 5-26 and 5-27 which were representative of the two molten glass formulas used during the Series A runs:

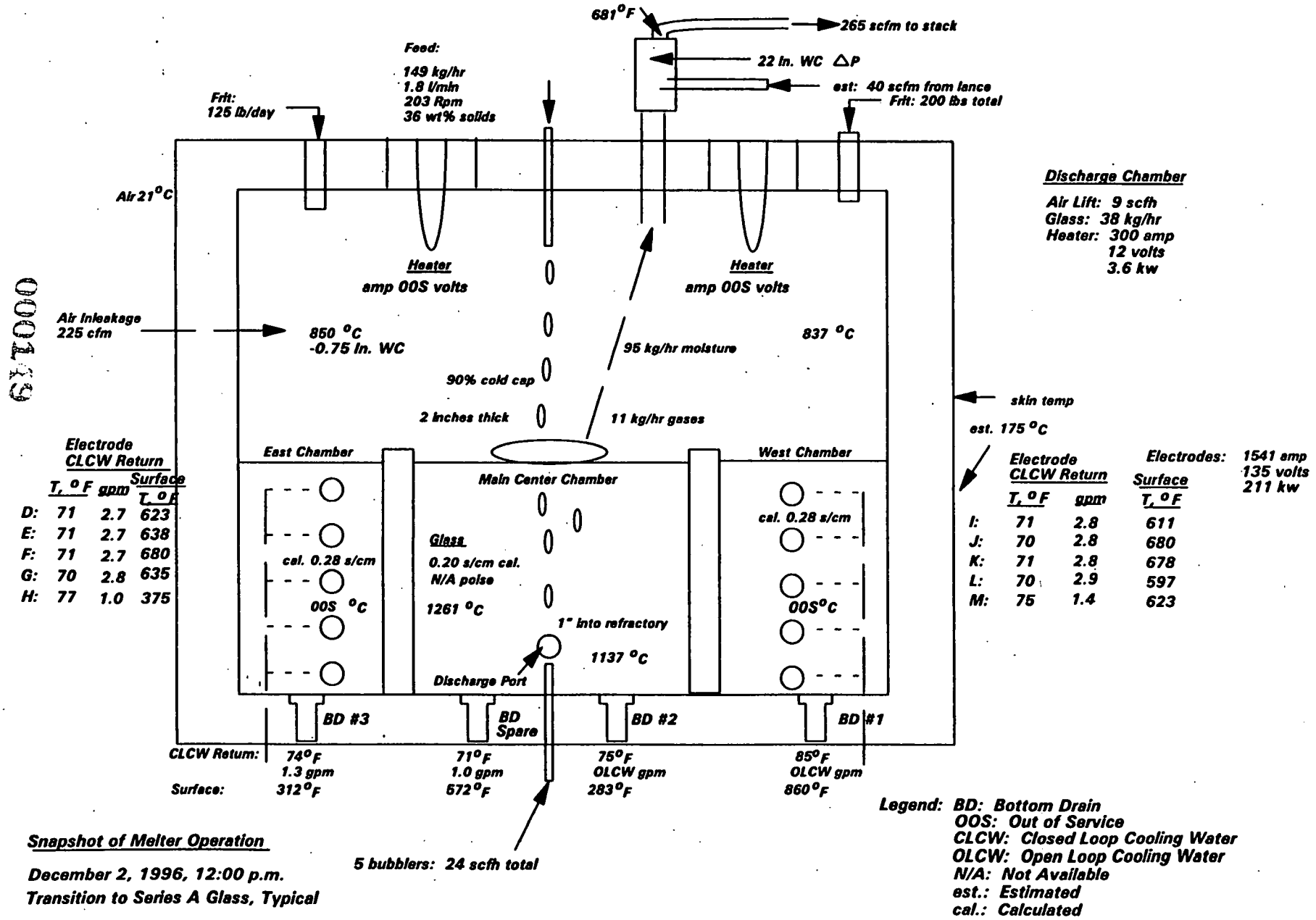
1) Batches C4B03, C4B04, C4B05, and C4B06 that replicate the molten glass formula for Series A Glass tested by VSL, and
2) Batches C4B07 and C4B08 that used a modified formula to lower the molten glass viscosity.

Melter snapshot data for typical conditions during the Transition to Low Temperature Series A Glass run, described in Section 5.1.3, are shown on Figure 5-28. This run consisted of Batch C4B09.

5.9 Redox in the VitPP Melter

Urea was used in Campaigns 2 and 4. The color of the glasses was monitored for signs of reduction. All the glasses contain hues of brown in them, which is an indicator that they are oxidized, not reduced. The ratio of Fe^{+2}/Fe^{+3} or $Fe^{+2}/(Fe^{+2}+Fe^{+3}$ or Total Fe) is used as an indicator of redox in the glass. An oxidized glass looks brown because Fe^{+3}, which is the oxidized species of iron (Fe), produces a brown color. Whereas, Fe^{+2}, which is the reduced species of iron, produces a blue-green color. Therefore, if the brown hue leaves the glass

Figure 5-25
Transition to Series A Glass, Typical Conditions



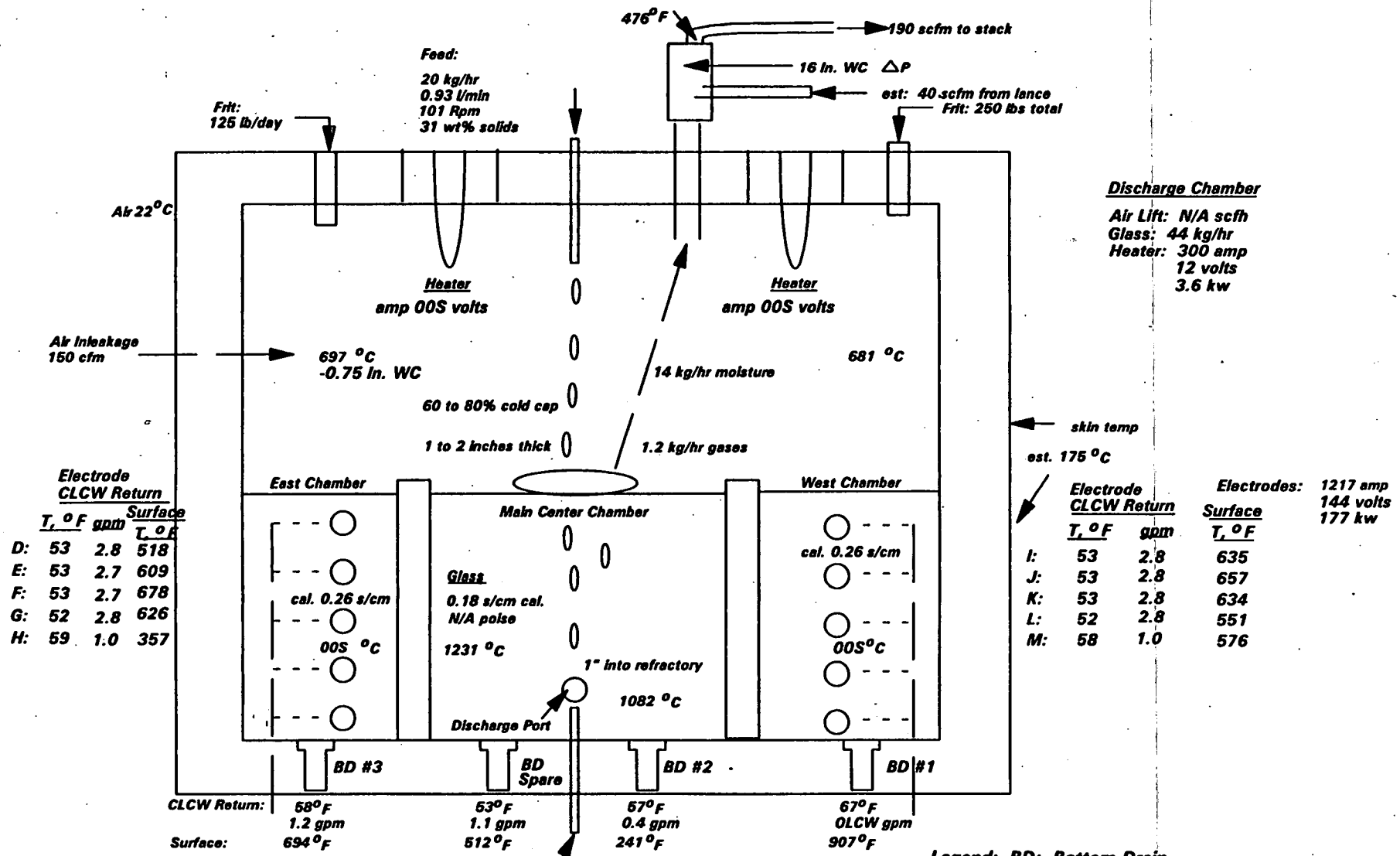
Electrode	CLCW Return T, °F	CLCW Return gpm	Surface T, °F
D:	71	2.7	623
E:	71	2.7	638
F:	71	2.7	680
G:	70	2.8	635
H:	77	1.0	375

Electrode	CLCW Return T, °F	CLCW Return gpm	Surface T, °F
I:	71	2.8	611
J:	70	2.8	680
K:	71	2.8	678
L:	70	2.9	597
M:	75	1.4	623

Snapshot of Melter Operation

December 2, 1996, 12:00 p.m.
Transition to Series A Glass, Typical

Figure 5-2
Series A Glass, VSL Tested Formula



Snapshot of Melter Operation

December 8, 1996, 4:00 a.m.
Series A Glass, VSL Tested Formula

Legend: BD: Bottom Drain
OOS: Out of Service
CLCW: Closed Loop Cooling Water
OLCW: Open Loop Cooling Water
N/A: Not Available
est.: Estimated
cal.: Calculated

0001710

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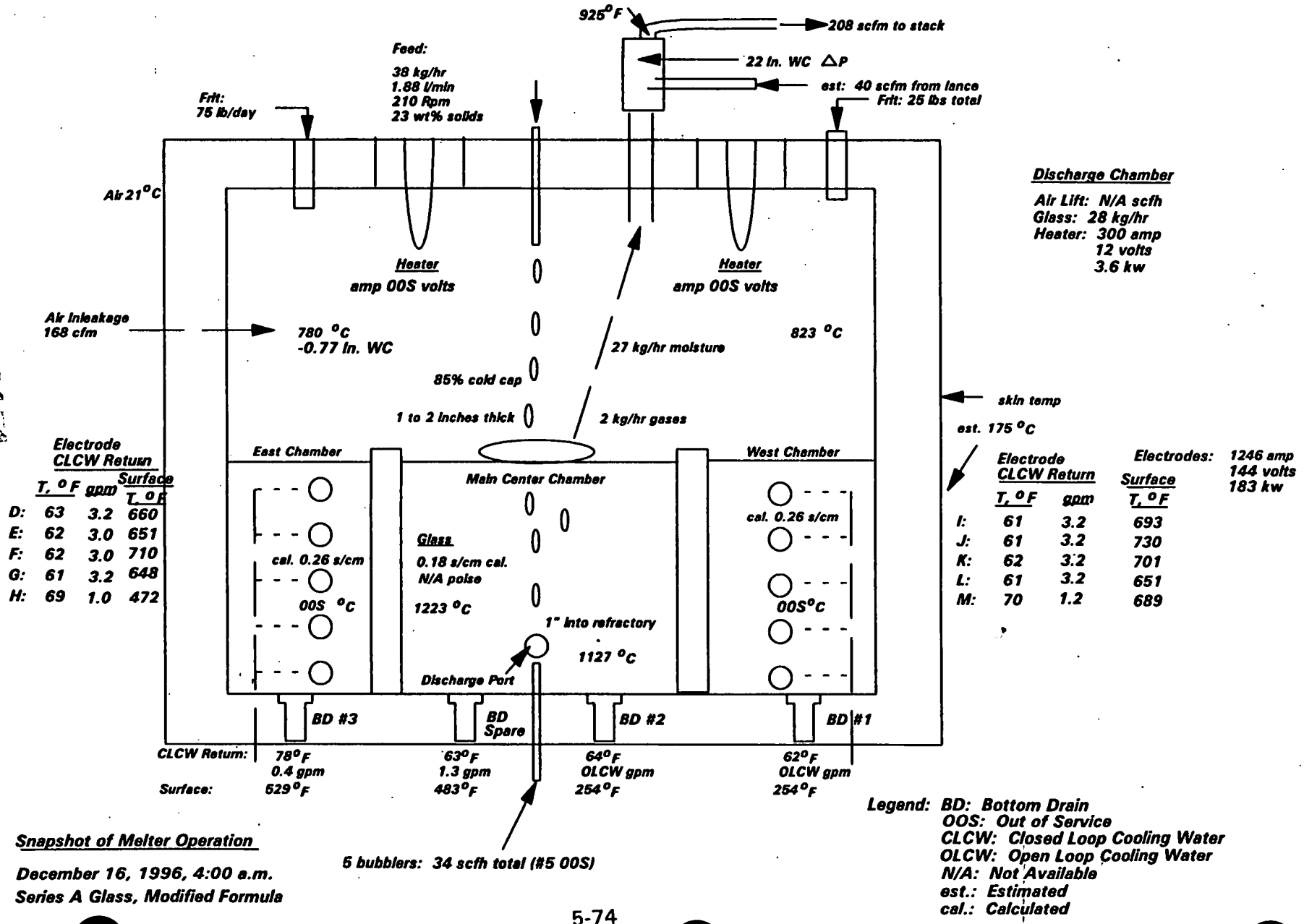
Figure 5-27
Series A Glass, Modified Formula

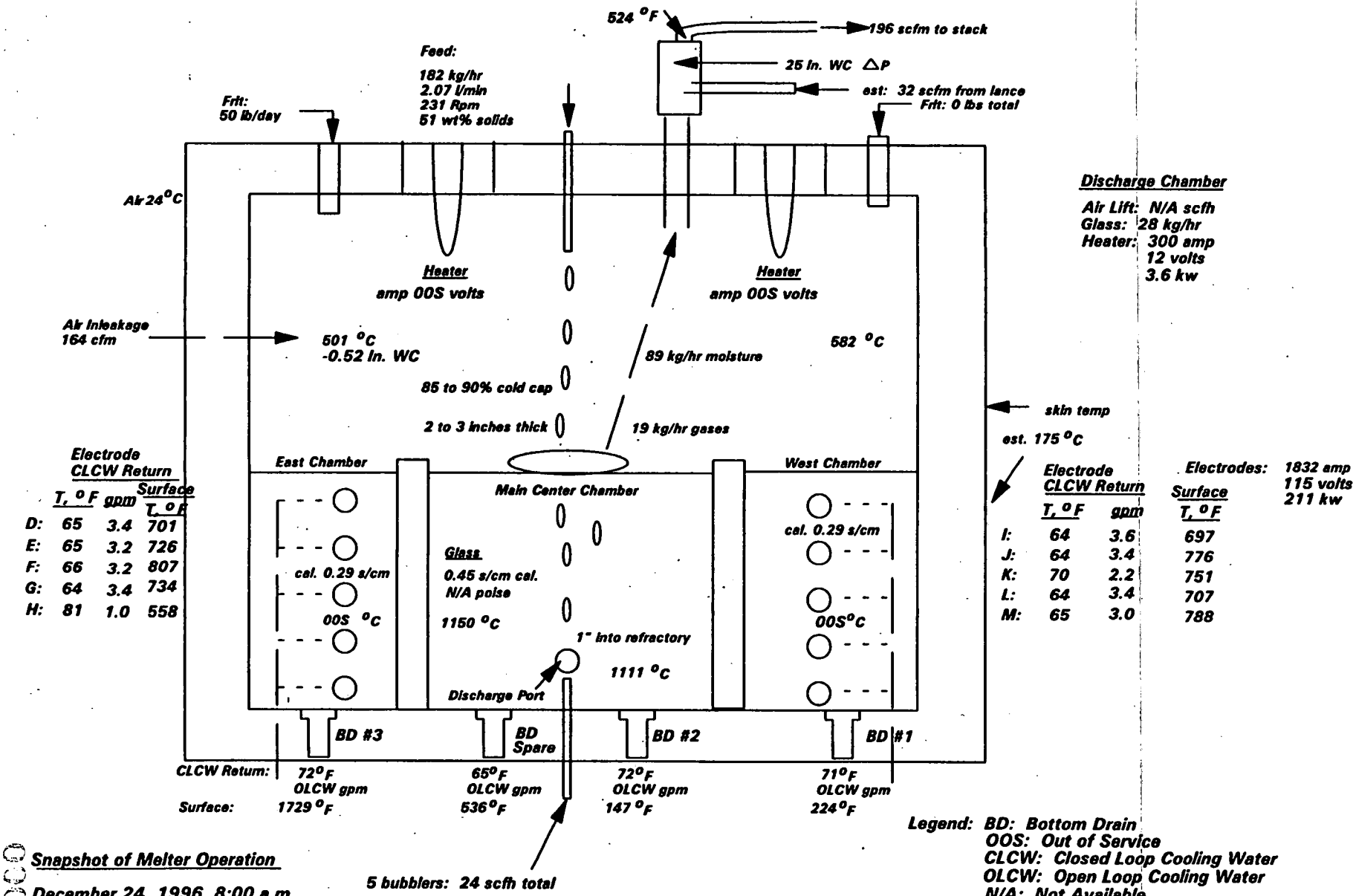


Snapshot of Melter Operation

December 16, 1996, 4:00 a.m.
Series A Glass, Modified Formula

0001121

Figure 5-28
Transition to Low Temperature Series A Glass, Typical Conditions



Snapshot of Melter Operation

December 24, 1996, 8:00 a.m.

Transition to Low Temperature Series A Glass, Typical

0001152

623

there is concern that the glass may become too reduced and produce metallic lead or lead sulfide. Glass from each batch was inspected for color. All batches contained the "brown hue."

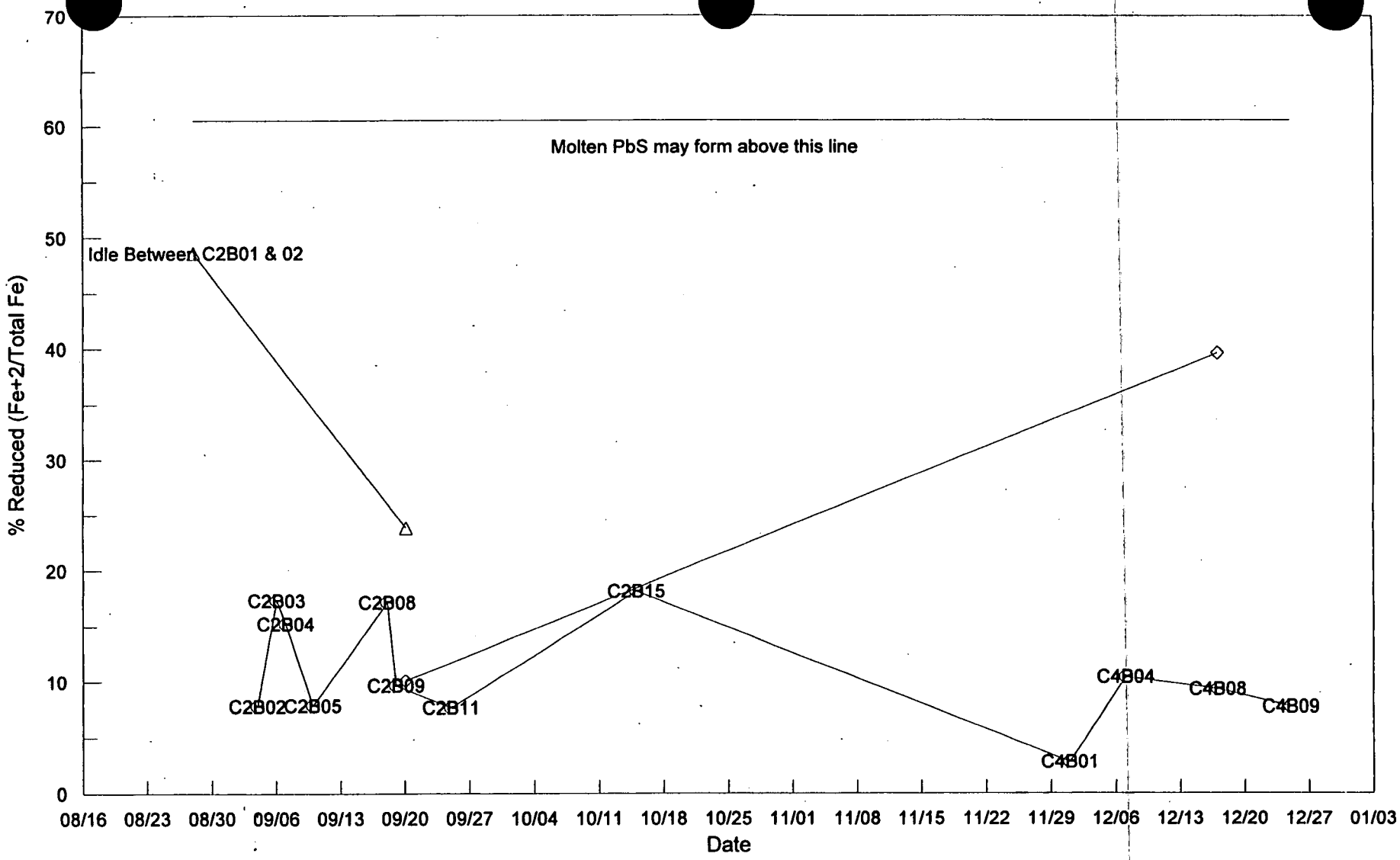
Glass samples from the lead-bearing campaigns (Campaigns 2 and 4) where analyzed for Redox at Corning Laboratory Services of Corning Incorporated. Redox showed oxidized conditions with Fe^{+2}/Total Fe ratios <0.2 or <20% reduced in the main chambers during the Phase I campaigns as shown in Figure 2-25. Redox in the side chambers is also shown in the Figure. Precipitated lead metal or lead sulfide is not known to happen under these redox conditions as determined by laboratory studies. See Section 2.3.4 "Redox Control" for more details about the laboratory study.

The amount of urea did not appear to have significant impact on the redox of the glass in the Melter. For example, some of the transition batches did not contain any urea. The urea concentrations in the batches for the corresponding points in Figure 5-29 are given in Table 5-18.

Table 5-18
Redox vs. Urea Usage

Batch	Urea, wt%	Redox, % Reduced
C2BO2	2.5	7.78
C2BO3	2.5	17.32
C2BO4	2.5	15.22
C2BO5	2.5	7.83
C2BO8	2.5	17.14
C2BO9	2.5	9.67
C2B11	2.5	7.67
C2B15	2.5	18.15
C4BO1	0	2.79
C4BO4	0.7	10.39
C4BO8	1.4	9.29
C4BO9	0	7.72

The highest reduced redox was recorded in the West Side Chamber during idle conditions. This makes sense because idling gives extra time for (1) the oxidizing sulfates to "burn away" from the glass bath and (2) the reducing power/influence of the metal molybdenum electrodes to increase in the glass.



Redox in Melter During Phase I

Figure 5-29

0001554

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6.0 Campaign 4 Maintenance Actions and Equipment Wear

During the period between the completion of Campaign 2 and the start of Campaign 4, several VitPP systems were modified. Specific discussions of these modifications can be found in Section 3.0. These modifications were designed to relieve repetitive operational and/or maintenance activities and to improve the operability and the reliability of the VitPP systems. During Campaign 4 the following were the source of the majority of the repetitive maintenance activities:

- Feed Preparation System.
- Slurry System.
- Melter Feed Pump.
- Normal Off-Gas System.
- Melter Discharge Chamber.
- Melter Bottom Drains.
- Melter Electrode Cooling Utility Rack.

The following sections describe the repetitive operational and/or maintenance activities that occurred during Campaign 4.

6.1 Feed Preparation System

The Feed Preparation System which includes the bag dumping and the pneumatic transfer of materials through the Additive Filter/Receiver to the Slurry Tanks was required maintenance actions on several occasions. The following sections describes this activity.

6.1.1 Additive Filter/Receiver

In previous campaigns, blockages in the Additive Filter/Receiver was a significant maintenance problem. In an attempt to prevent dry chemicals from bridging across the opening at the bottom of the Additive Filter/Receiver during bag dumping operations, an air-operated vibrator was temporarily installed on the outside of the Additive Filter/Receiver. This was added during Campaign 2. The vibrator became a permanent piece of VitPP equipment before the start of Campaign 4.

Even with the installation of the vibrator, during Campaign 4, dry chemicals accumulated within the Additive Filter/Receiver on three (3) occasions. Approximately 300 to 550 lbs of dry chemicals was retained each time. The number of times the Additive Filter/Receiver

was obstructed and the amount of dry chemicals retained in the Additive Filter/Receiver were reduced from what they were in Campaign 2, however the corrective action to remove the dry chemicals was more difficult and time consuming during Campaign 4. Although the vibrator was probably an enhancement while material was moving efficiently through the Additive Filter/Receiver, it was probably a detriment when blockage occurred. In these instances, the vibrations apparently compacted the material that was held up in the Additive Filter/Receiver, making it more difficult to clear the obstruction.

On one occasion, the Rotary Airlock was obstructed with dry chemical. Attempts to manually vibrate the equipment to remove the dry chemicals were unsuccessful. The Rotary Airlock needed to be removed in order to free the obstruction. While the Rotary Airlock was removed, Maintenance personnel accessed the obstructed section and cleared the remaining dry chemicals retained in the Additive Filter/Receiver. To clear the obstruction in the Rotary Airlock, the combined efforts of Maintenance, Operations, and Industrial Hygiene personnel required approximately 50 hours of down time between batches C4B08 and C4B09.

6.1.2 Bag Dump Station

During previous campaigns, blockage in the Bag Dump Station and related piping were significant. The higher-capacity Vacuum Blower that was installed prior to Campaign 4 was used to eliminate these problems. The frequency of blockages in this area were decreased, however other problems were created due to the new Vacuum Blower.

With the greater vacuum generated by the new Vacuum Blower, the pulse-air that was to remove particulate from the Additive Filter/Receiver's six bag filters became practically ineffective. The pulse air system was already running at its maximum capacity (90 psi, pulsing every 12 seconds). With the pulse-air effectiveness reduced, dry chemicals would accumulated on the six bag filters and significantly decreased the ability to transfer material from the Bag Dump Station to the Additive Filter/Receiver. Eventually, material accumulated within the elbow area of the transition line, requiring operations personnel to clear the elbow.

To avoid significant accumulation of dry chemicals in the elbow, the DCS Operator would monitor PDI-650 (Pressure Differential Indicator) for an increase in differential pressure across the Additive Filter/Receiver bag filters. When the Differential Pressure (DP) started to increase, bag dumping operations were stopped and 5-BL-66 was turned off for a period of 5 to 10 minutes. This would allow the pulse air to remove any material held on the six bag filters without the opposing effects of the 5-BL-66 vacuum action on the filters. After this period, approximately 40 to 50 lbs of dry chemicals would be released from the surface of the bag filters and fall into the Slurry Tank. These short interruptions to the dry chemical addition activity resulted in fewer lengthy interruptions and minimized down time for maintenance activities.

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6.2 Slurry System

The Slurry System which includes the Slurry Tanks, Slurry Pumps, miscellaneous valves and piping was a repetitive source of maintenance activity. This section describes maintenance activities relating to piping blockages, cold temperature pump operation, sample port plugging, and pump failures.

6.2.1 Slurry System A & B - Piping Blockages

During Campaign 4, both Slurry Tanks were utilized equally. The target weight percent solids for each batch was generally 35% to 45 %. The data presented below correlates the number of slurry pipe obstructions that occurred per batch, the weight percent solids (%wt) of each slurry batch, and the amount of flush water required to clear the piping.

Table 6-1

Batch	Slurry System	Percent Solids Weight (%wt)	Recorded NO. of Piping Obstructions	Approximate Amount Flush Water (lbs).
C4B01	B	30 - 40	1	1718
C4B02	B	34*	5	1100
C4B03	A	31	2	450
C4B04	B	30	0	0
C4B05	A	37 - 40	2	1088
C4B06	B	38	2	260
C4B07	A	28 - 38	4	250
C4B08	B	23	3	231
C4B09	A	24 - 51	2	712

*This batch did not have a sample taken from sample point S05A; data are from sample point S04B

During Batch C4B01, approximately 1718 lbs of flush water was used to clear the piping and was added to Slurry Tank B in the process. If batch C4B01 had been fed at an average feed rate of 300 lbs per hour, an additional six hours would have been required to feed the entire batch with the additional "flush water." This additional amount of water in the Slurry Tank impacted the performance of the other systems during VitPP operation.

In general, the addition of "flush water" to a slurry batch reduced the wt% solids. This reduction of wt% solids increased the feed rate required to form and maintain an effective cold cap in the Melter center chamber. The greater feed rate containing a greater amount of water pushed the Normal Off-Gas System to its operational limits. While attempting to build a cold cap in the Melter center chamber by feeding at higher than desired feed rates (300 to 400 rpm), the Film Cooler and air lance air flow was restricted due to particulate carryover. This required operations personnel to clear the Film Cooler and air lance frequently, which could be performed only when the Melter Feed Pump feed rate was

reduced to 100 rpm or less. Reducing speed or stopping the Melter Feed Pump during the off-gas component clearing operation resulted in the depletion of the cold cap. This cycle would repeat over a period of one to three hours until an effective cold cap could be maintained.

Approximately 75 % of the slurry obstructions were removed either by cycling valves, using flush water, or diverting the slurry flow path. The remaining 25 % required the chemical hoses to be removed and cleaned. Of that 25 %, 15 % required Maintenance personnel to remove piping and valves prior to clearing the obstruction.

During the 25% of the obstruction occurrences that required the removal of chemical hoses or valves, the potential for a slurry spill existed. In one event during Campaign 4, approximately 500 ml of water containing slurry chemicals was spilled into the secondary containment around the slurry pumps. Industrial Hygiene personnel and the Assistant Emergency Duty Officer (AEDO) were notified. This incident was a loggable event.

6.2.2 Cold Temperature Operation of Slurry Pump A and B (5-PM-34A and B)

During operations when the ambient temperature on the pad approached the freezing point (32°F), the exhaust of both Slurry Pumps A and B began to accumulate frost and ice. This frost/ice would start to restrict the flow of the exhaust air from the pump causing the pump to slow down and almost stop. Maintenance and Operations personnel placed heat lamps above the exhaust and directed large portable kerosene heaters at the affected slurry pump to reduce the effects of the frost/ice.

6.2.3 Slurry Tank Sample Ports (S04A and S04B)

On several occasions, the Slurry Tank sample port (S04A and S04B) lines were found to be blocked, preventing the collection of slurry samples. To remove these blockages, Operations cleaned out the slurry sample line through an open sample port. If Operations personnel could not remove the blockage using normal cleaning methods, Maintenance personnel would have to remove the two sample port valves to successfully remove the obstruction. In either case, the slurry system involved would have to be secured while the sample port lines were being cleaned/cleared.

6.2.4 Slurry Pump Failure

During Campaign 4, Slurry Pump B (5-PM-34B) failed twice in one week. The first failure was due to a problem with the pump's shuttle valve. Air was being passed directly through the pump shuttle valve and out the exhaust. It was determined that the failure was due to insufficient lubrication of the air shuttle mechanism. Maintenance removed the pump, corrected the shuttle valve failure, and reinstalled the pump. Lubrication problems with the pump air supply were corrected. This pump failure and associated maintenance activity resulted in Slurry Tank System B being out of service for a period of three days.

The second failure of Slurry Tank Pump B caused the pump to stop operating. The cause of the second failure is unknown. Maintenance removed the pump, disassembled it, and found nothing wrong. The pump was reassembled and placed back in service. Testing of the pump revealed the pump to be operational. Slurry Pump A (5-PM-34A) had no operational difficulties throughout Campaign 4.

6.3 Melter Feed Pump (5-PM-17)

During Campaign 4, the Melter Feed Pump seals and seal tanks required maintenance attention on a frequent basis. These activities are described below.

6.3.1 Melter Feed Pump Seal Tank Filling

In at least 20 separate occasions since the end of Campaign 2, the Melter Feed Pump seal tank required refilling. If this occurred during Melter feed, the Melter feed was stopped while the seal tank was being filled. On several occasions, the seal tank required refilling approximately every 15 minutes. Operations personnel observations of the seal tank levels and coordination with maintenance personnel was very important for the successful operation of the pump.

6.3.2 Melter Feed Pump Seal Failures

During Campaign 4, the Melter Feed Pump seals failed and required replacement one time. The seals were a new type of mechanical seals that were replaced during Campaign 2.

The Melter Feed Pump (5-PM-17) was removed and replaced one time due to seal problems during Campaign 4. This was caused by the failure of the seal tank level switch. An indication of a low level was not sent to the DCS, therefore the seal tank was not refilled. The tank emptied and damaged the seal.

6.4 Off-Gas System (Off-Gas Piping, Off-Gas Flow Monitoring/Control, & HEPA Filters)

Several problem with the Off-Gas System were encountered that required maintenance attention. The Film Cooler, air lance, system piping, HEPA filtration, and system instrumentation were the components that required most attention. The actions required are described below.

6.4.1 Film Cooler/Air Lance

During the 27 days of Campaign 4, particulate buildup in the Film Cooler and air lance continued to be a problem. The air lance required cleaning 35 times during this period.

The air lance was replaced during two of these cleaning activities due to heat damage to the end of the pipe.

In preparation for these cleaning activities, the Emergency Off-Gas System Auto/Manual switch (HS-361) was placed in the Manual mode of operation. The DCS Operator closely monitored the Melter pressure to determine if there was a need to activate the Emergency Off-Gas System.

These cleaning efforts were accomplished by coordinated efforts between Maintenance and Operations personnel. Maintenance personnel would remove the hardware from the Film Cooler flange and Operations personnel would clean the Film Cooler and Air Lance. Cleaning involved clearing the Film Cooler opening to remove any solid material that may have been restricting off-gas flow. It also involved quenching (cooling) the Air Lance pipe with cool water and ensuring that the holes in the pipe were clear and would allow air flow into the Film Cooler. In some instances, the horizontal line adjacent to the Film Cooler was inspected and cleaned. The total time involved for each activity varied from five to 30 minutes, depending upon the amount of work that was required.

6.4.2 Normal Off-Gas System Piping

Obstruction of the off-gas flow in the piping between the Melter and the Normal Offgas System Fan occurred on four occasions during Campaign 4. These were due to particulate buildup in the piping at various locations along the Off-Gas System.

The first obstruction was due to a partial blockage in the horizontal transition line immediately down stream of the Film Cooler. Operations and Maintenance personnel cleaned the transition line during one of the Film Cooler/air lance cleaning efforts.

The second time, a partial blockage reduced the off-gas flow from the Melter and made it difficult to maintain the recommended Melter negative pressure. The transition line differential pressure indication was off-scale. Operations personnel investigated the Normal Off-Gas System and discovered only one item that could have contributed to the problem: a loose blank flange covering the penetration where the center chamber frit feed hopper was installed. The flange was tightened and adjustments of the air lance air flow and the Gem Housing negative pressure were made to compensate for the impaired Normal Off-Gas System performance. By the time these adjustments were performed, the Normal Off-Gas System began to stabilize itself and system parameters returned to within normal operating ranges. It appeared the cause of the restriction (an obstruction) had passed through the system.

Two days later, the Normal Off-gas System developed a blockage for the third time during Campaign 4. This time the blockage was more substantial and required attention from Maintenance personnel. Melter feed was stopped and the Normal Offgas System line was opened near the Film Cooler and also at the off-gas spray nozzle located immediately downstream of the Melter Room wall. The blockage were determined to be located between the two breaks in the system. Pressurized air was used in an attempt to clear the obstruction. This method proved to be unsuccessful. The system was restored and the

insulation was removed from the area that was suspected to contain the blockage. This area of the piping was mechanically vibrated and the blockage eventually cleared. Once the blockage was cleared, the system was placed back into operation and Melter feed was resumed.

A few hours later, the line plugged once again, for the fourth time. The same method as described for the third time was repeated in order to clear the blockage. This cleaning operation for the third and fourth times had occurred over a two-day period. During this cleaning action, the Melter feed had been halted for approximately 32 total hours.

6.4.3 HEPA Prefilter and HEPA Filter Replacements

The Normal Off-Gas System HEPA filtration system required a significant amount of maintenance attention during Campaign 4. Prior to the initiation of Campaign 4, the HEPA filters and prefilters in the Normal and Emergency Off-Gas Systems were replaced and DOP tested. During Campaign 4, the prefilters and HEPA filters were changed frequently. The filter replacements were caused by both particulate buildup or system moisture (condensate) problems. Most of the moisture problems occurred to the Normal Off-Gas System A Train prior to the completion of the installation of heat tracing and insulation. Once the heat trace and insulation modification was completed, the moisture problems were reduced.

The Train A HEPA Prefilter in the Normal Off-Gas System was replaced a total of 13 times during Campaign 4. The HEPA Prefilter was replaced once prior to the completion of the heat trace and insulation. The Train A HEPA filter was replaced two times during this campaign and the new filter was DOP tested.

The Train B HEPA Prefilter in the Normal Off-Gas System was installed a total of 13 times during Campaign 4. Three of these were replaced before the completion of the heat trace and insulation. The Train B HEPA filter was replaced twice during this campaign and the new filters were DOP tested.

The HEPA Prefilter in the Emergency Off-Gas System was replaced one time during Campaign 4.

The filters that were replaced early in Campaign 4 were spent, due to both moisture and particulate buildup which caused differential pressure across the filters to be high. Late in Campaign 4, the filter high-differential pressures were primarily due to dry particulate buildup.

6.4.4 Off-Gas Flow Indication Instrumentation Maintenance

During Campaign 4, on at least five occasions the indication for flow through the Normal Off-Gas System had drifted or varied from the accepted indication. In some instances, false alarms were received at the DCS. This caused unnecessary time spent by Operations and Maintenance personnel to locate the "excess" off-gas flow indicated by the false reading.

Further investigations by Instrument Maintenance personnel indicated that the problem was caused by condensate that collected in the transmitter/sensing tubing. This transmitter was beneath the anubar sensing device and allowed any condensate to flow into the transmitter and disrupt the input to the transmitter signal. The anubar was located downstream of the HEPA filter housing, was in a section of pipe that was not heat traced, causing the collection of liquid condensate.

Once the problem was realized, the transmitter was moved to a location that was above the anubar sensor. This allowed any moisture that collected in the instrument sense lines to drain from the tubing back into the anubar and reduced the number of times that condensate caused problems and the need for corrective actions.

6.5 Discharge Chamber

6.5.1 Buildup of Glass in the Discharge Chamber and Consequences

During Campaign 4, molten glass migrated from an area below the discharge orifice and obstructed the normal glass discharge path. On 17 occasions, a welder was required to melt the glass with a torch. On at least twice as many occasions, Operations personnel were required to manually remove glass obstructions from the discharge orifice area. In both cases, power to the Melter and discharge chamber was secured during the clearing operation to protect personnel from electrical shock.

Operations personnel recognized the ramifications of allowing the glass to reach its liquidous temperature and monitored the temperature of the center-chamber glass pool. When readings indicated the side-chamber or center-chamber glass temperatures approached the liquidous temperature, discharge chamber clearing activities were interrupted and power was restored to the Melter. Once glass pool temperature increased and stabilized at an acceptable temperature, power again was secured and clearing activities continued.

While solutions to prevent glass migrations were limited, Operations personnel implemented methods to control the impact of the migration. Operations personnel closely monitored the discharge chamber orifice and when the orifice became partially blocked, glass would be discharged, clearing the orifice. Between batches, the discharging would deplete the inventory of glass in the center chamber. On these occasions, Operations personnel would increase the inventory in the Melter by adding frit or discontinuing flushing the orifice. Operations personnel opted to allow the orifice to be blocked only if there was no possibility of an auto-discharge of glass (i.e., level of the glass in the center chamber was well below the discharge orifice) and there was a delay in the next slurry batch.

6.5.2 Discharge Chamber Heaters

The discharge chamber Heaters failed in mid-December. The discharge chamber heaters are a combination of nine heating elements wired in series. One of the nine elements

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failed, causing a break in continuity and resulting in a total failure of the heating bank. Heater elements were pulled and replaced with new elements.

6.6 Melter Bottom Drains

6.6.1 Bottom Drain 1 (West Side Chamber)

During Campaign 4, bottom drain 1 remained on the temporary cooling system which was established in Campaign 2. An attempt to return bottom drain 1 to the Electrode Cooling System was made prior to Campaign 4, but was unsuccessful.

6.6.2 Bottom Drains 2 and 3 (Center Chamber & West Side Chamber)

Before and during Campaign 4, bottom drains 2 and 3 were transferred to and from the temporary cooling system several times. On several, separate instances, each bottom drain was found to have cooling water flow restricted or stopped and/or was found to be emitting steam. In response to the lack of cooling water flow, maintenance personnel altered the flow rate or reversed the flow through the bottom drains in an attempt to back-flush any material that could have been restricting normal flow. It was necessary to repeat this process of switching the direction of cooling water flow several times prior to establishing normal flow. Each time the flush direction was changed, black material was flushed from the bottom drain.

Maintenance personnel attempted to remove and replace the sleeve for bottom drain 3 prior to the start of Campaign 4. This attempt failed because the bottom drain sleeve installed during Campaign 2 could not be removed. Glass had sealed around the sleeve and prevented removal without risk of equipment damage. Plans to re-sleeve the bottom drains were canceled.

Near the end of Campaign 4, bottom drains 2 and 3 were altered in an attempt to achieve a higher cooling-water flow rate. The existing quarter-inch diameter supply and return fittings on the bottom drain sleeve were replaced with half-inch diameter fittings. After returning both bottom drains to the Electrode Cooling System, it was determined that a higher flow rate was not achieved and the drains were returned to the alternative cooling system.

6.6.3 Bottom Drain - Spare (Center Chamber)

When the Spare bottom drain began leaking cooling water and glycol into the Melter, resulting in the oxidizing of the glycol and the appearance of blue flames, the spare bottom drain was placed on the temporary cooling system.

7 Isolation and Flow Control Utility Rack

Because the Melter was intended to be a 24 hour-a-day, 7-day-a-week operation, the Utility Rack was required to provide continuous service. This need was neglected during the design stage of the Utility Rack, as evidenced by the lack of piping bypasses or related valves that allowed for maintenance on Utility Rack piping, flow rotameter, pressure regulators, etc. Since it was impossible to discontinue air and water flow during the operation of the Melter, maintenance activities on the Utility Rack were very difficult. Some maintenance activities that normally would have been completed were not performed or they were postponed due to the need to keep the equipment in service. These activities included air or water leak repairs and rotameter cleaning activities.

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7.0 Environmental

The environmental objective for the VitPP treatability testing is to ensure off-site protection of human health and the environment during the various vitrification campaigns. The degree to which the design and operation of the plant has met the environmental objective is determined by evaluation of compliance with the environmental regulatory requirements, as well as the application of environmental ALARA concepts and waste minimization practices during operation of the plant. Where appropriate, environmental data taken from sampling conducted prior to Campaign 4 (following Campaign 2) are discussed in this report.

Phase I Campaign 4 involved the use of glass additives and chemicals to make up a surrogate to simulate a blend of Silo 1 and 2 residues. During Campaign 4, lead and barium compounds were added to the surrogate feed. These metals were tracked and a mass balance accounting was conducted to determine the degree of partitioning of the metals into the glass, and to ensure that the metals were controlled and not released to the environment at levels which exceed regulatory limits.

7.1 Release Pathways and Monitoring Points

Sources of significant amounts of potential environmental contaminants during Campaign 4 of the VitPP include the feed introduced to the vitrification Melter, Offgas Systems, wastewater discharge, and glass produced in the plant. Generalized sources, environmental release pathways, and rationale for monitoring and/or control of the contaminants from the VitPP are summarized in Table 7-1.

Table 7-1

PATHWAY	WASTE STREAM OR MEDIUM	RATIONALE FOR MONITORING
AIR	VitPP stack emissions; also, other releases to atmosphere	Compliance with Ohio Air Toxics Policy (OATP); verify Offgas Treatment System and controls; conduct mass balance
WATER	VitPP wastewater and storm water on pad	Verify parameter concentrations for Advanced Wastewater Treatment (AWWT) System; evaluate pre-treatment; conduct mass balance
SOIL	Spills	Verify cleanup of spilled material
WASTE	Solid waste: glass, slurry, filters, PPE, misc. waste	Proper management of RCRA material; conduct mass balance

Specific sources of discharge and associated monitoring points for the release pathways are listed in Table 7-2. Process locations for the environmental sampling are shown on the process flow diagram in Figure 7-1. Note that there are no designated monitoring points for releases to soil; monitoring of spills or releases off the plant pad is on a case-by-case basis.

Figure 7-1 Sampling Points for Environmental Data

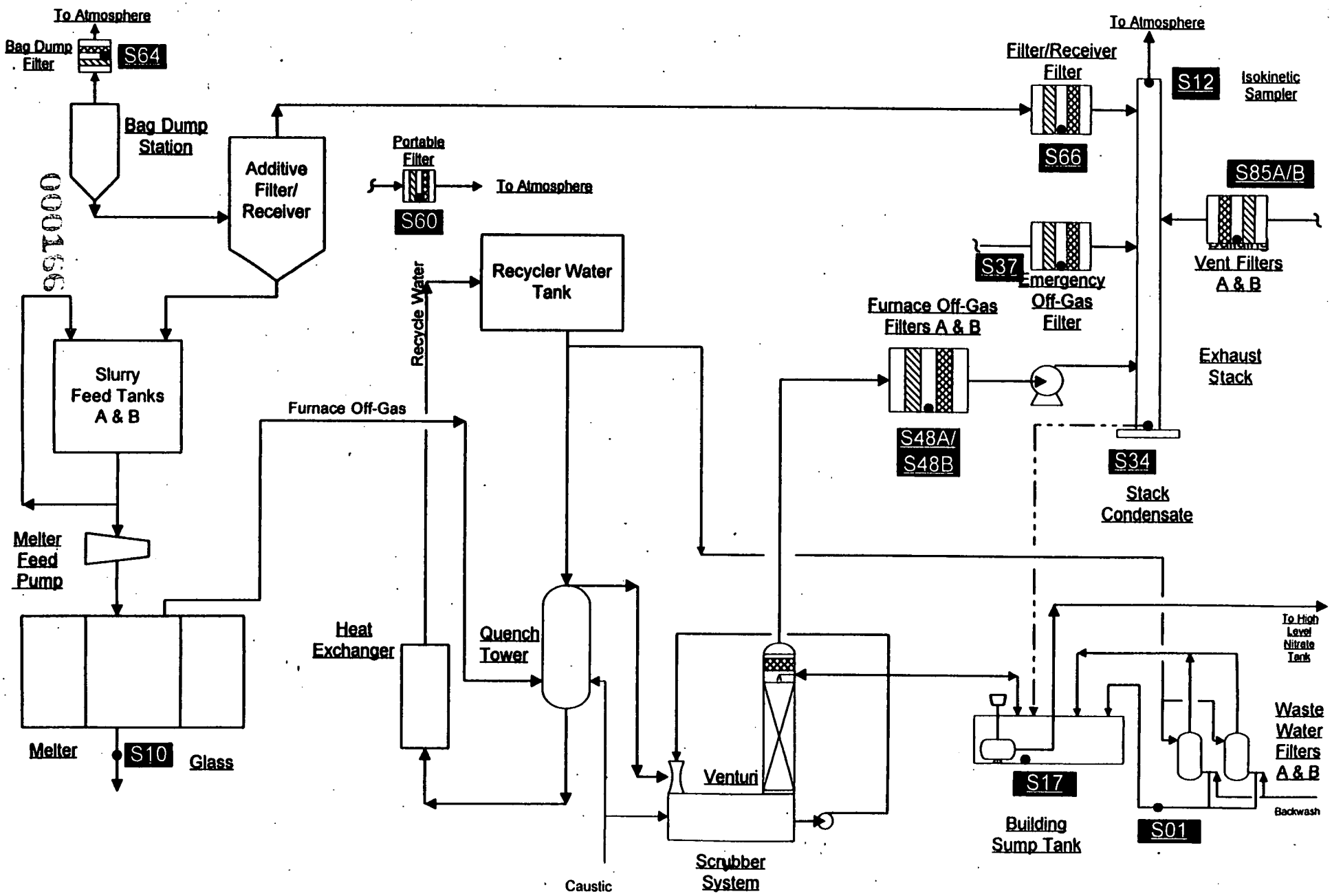

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Table 7-2
VitPP Sampling Points for Environmental Data

PATHWAY	POTENTIAL SOURCE	SAMPLING[1] or MONITORING POINT	ENVIRONMENTAL ANALYTES[2]
AIR	VITPP Melter - Toxic Particulate Material	**S-48** for Normal Offgas System Prefilter and HEPA filter	• Total metals and/or TCLP[3] for RCRA metals on filter media • Total metals for filter liquor • Analytes: Ba, Cr, Pb
		S-37 for Emergency Offgas System Prefilter and HEPA filter	• Total metals and/or TCLP for filter media • Total metals for filter liquor • Analytes: Ba, Cr, Pb
		S-85 for Building HVAC Prefilters and HEPA Filter	• Total metals and/or TCLP for filter media • Analytes: Ba, Cr, Pb
		S-12 for iso-kinetic monitor on VITPP stack, downstream of Offgas Treatment System and HEPA filtration	• Total metals and/or TCLP for filter media • Analytes: Ba, Cr, Pb, Se
		S-34 for Stack Condensate, collecting in bottom of stack	• Total metals • Analytes: Ba, Cr, Pb, Se
	Bag Dump Station - Toxic Feed Additives (particulate)	**S-60** for Prefilter and HEPA filter on portable unit used for feed additives batching	• Total metals and/or TCLP for filter media • Analytes: Ba, Pb
		S-64 for Prefilter and HEPA filters exhausting the Bag Dump Station via separate stack to atmosphere	• Total metals and/or TCLP for filter media • Analytes: Ba, Pb
		S-66 for Prefilter and HEPA filter exhausting the feed/additives transfer operation to the VITPP stack	• Total metals and/or TCLP for filter media • Analytes: Ba, Pb
WATER	Wastewater Filters	**S-1** for recycle water following filtration[4]	• Total metals • Analytes: Ba, Cr, Pb
	Miscellaneous wastewaters from VITPP	**S-17** for wastewater in Building Sump Tank (BST) prior to transfer to the High Nitrate Tank (HNT)	• Total metals • Analytes: Ba, Cr, Pb, Se
SOIL	Spills	Location on a case by case basis	Parameters on a case by case basis
WASTE	Glass	**S-10** for glass produced in the Melter	• Total metals and/or TCLP • Analytes: Ba, Cr, Pb, Se
	Misc. Waste	No designated sampling point - waste characterization on case by case basis	Parameters on a case by case basis

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[1] Sampling points are described, along with their locations, in the Project Specific Plan (PSP) for Operable Unit 4 Vitrification Pilot Plant, Phase I, Process Sampling, 2504-SU-0011, Rev. 1, May 1996. The "S" numbered sampling points are established locations where samples are routinely taken during operation. Other waste streams are sampled on a case- by-case basis. The PSP has been revised several times since Campaign 1.

[2] The Project Specific Plan (PSP) contains a complete list of analytical parameters and associated laboratory methods. The analytical parameters in this column do not constitute a complete list, but are included to present information of environmental significance.

[3] TCLP is used for testing for RCRA characteristic waste (40 CFR Part 261 Appendix II, Method 1311). TCLP is optional where process knowledge (PK) characterization is sufficient. Regulatory TCLP-based limits for barium, chromium, lead, and selenium are as follows:

Barium	100.0 mg/l
Chromium	5.0 mg/l
Lead	5.0 mg/l
Selenium	1.0 mg/l

[4] After filtration, the wastewater is released to the Building Sump Tank (BST), and not directly to the environment. Therefore, since the water will be sampled again in the BST, sampling of the wastewater filter effluent at S-1 is not essential for environmental characterization. The BST is sampled at Sample Point S-17.

7.2 Environmental Evaluation of Phase I Campaign 4

The Phase I Campaign 4 testing met all environmental regulatory requirements identified as applicable or relevant and appropriate requirements (ARARs) or environmental "to be considered" (TBC) criteria in the VitPP Phase I Work Plan, in accordance with the signed OU4 Record of Decision (ROD).

A summary of environmental data for Campaign 4 is presented in Table 7-3. This table includes the source, sampling point, analytical results, and a brief description of how the waste stream or contamination was managed. The Campaign 4 data that were evaluated in this report include data obtained prior to the Melter bottom-draining incident on 12/26/96. A discussion of environmental impacts due to the incident on 12/26/96 will be discussed in the final Phase I report.

Table 7-3
Summary of Environmental Data from Campaign 4

PATH	SOURCE	SAMPLING	DATA	MANAGEMENT
AIR	VitPP Melter via Stack	**S-48** Normal Offgas Prefilter and HEPA	Range of total metals on Prefilters and HEPAs: Ba 56 - 5800 mg/kg Cr 11 - 3300 mg/kg Pb 334 - 77200 mg/kg	HEPA filters meet BAT for particulate. Filters managed as Hazardous Waste on basis of process knowledge
		S-37 Emergency Offgas Prefilter and HEPA	Total metals on single Prefilter: Ba 11307 mg/kg Cr 1300 mg/kg Pb 39424 mg/kg (HEPA not changed during Campaign 4) Data from filter housing: Liquids: Cr 7.13 mg/l	HEPA filters meet BAT for particulate. Filters and housing residues that fail TCLP are managed as hazardous waste.
		S-85 Building HVAC Prefilter and HEPA	Prefilter and HEPA not changed; no data available at this time	NA[1]
		S-12 Stack Iso-kinetic Monitor Filter	Total metals[2]: Cr 12 mg/kg Pb 40.8 mg/kg	BAT for stack met by HEPA Filters on Offgas.
		S-34 Stack Condensate (2 samples)	Ba, Cr, Pb pass TCLP (2 samples); no Se data.	Condensate discharged to Building Sump Tank
	Bag Dump Station	**S-60** Portable HEPA and Prefilter	Filters were not changed during Campaign 4; no samples taken	BAT for air particulate source includes HEPA filter. Filters characterized for proper management.
		S-64 Bag Dump Station Prefilter and HEPA	Filters were not changed during Campaign 4; no samples taken	BAT for air particulate source includes fabric filter and HEPA filter. Filters characterized for proper management.
		S-66 Prefilter and HEPA on feed additives bin	Filters were not changed during Campaign 4; no data available at this time	BAT for air particulate source includes HEPA filter. Filters characterized for proper management.
WATER	WWTR Filters	S-1[3]	NA[1]	Wastewater from filters to Building Sump Tank[4]
	Bldg Sump	**S-17** (84 samples, all for TCLP)	TCLP results: Ba - up to 10.0 mg/l Cr - up to 4.1 mg/l Pb - up to 29.65 mg/l Se - BDL TDS 20-61000 mg/l TSS up to 414 mg/l	Wastewater sent to AWWT for further treatment[4]
SOIL	Spills	Case by Case	No spills reported	NA[1]

PATH	SOURCE	SAMPLING	DATA	MANAGEMENT
WASTE	Glass	S-10 (29 samples, of which 17 were for TCLP)	TCLP results: Ba - all pass TCLP Cr - all pass TCLP Pb - all pass TCLP Se - Not analyzed	Glass that passes TCLP staged for disposal as solid waste. Drums of glass that fail TCLP are stored for reprocessing.
	Misc. Waste	Characterization per procedure	Material Evaluation form generated or referenced	Disposal per site procedures

[1] Not applicable. No sampling conducted.

[2] Blank filters were found to contain RCRA metals. The data in the table are blank-corrected.

[3] Testing of the Thickener and the Wastewater Filters has been deleted from the Test Plan for Campaign 4. No filter effluent samples were taken during Campaign 4.

[4] Normal management of VitPP wastewater and storm water is by collection in the Building Sump Tank (BST) and discharge to the Advanced Waste Water Treatment (AWWT) plant via the High-Nitrate Tank.

7.3 Air

Air sampling during Campaign 4 consisted of samples from Medium Efficiency Particulate Air (MEPA) prefilters, High Efficiency Particulate Air (HEPA) filters, and the isokinetic stack sampler filters. Based on data from Campaign 2, it was determined that Normal Offgas System (NOG) and Emergency Offgas System (EOG) prefilters and HEPA filters removed from service during Campaign 4 would be considered RCRA hazardous waste. This characterization would be based on process knowledge, since Campaign 2 offgas filters typically failed the TCLP for lead and chromium because the filter material does not have the ability to withstand the TCLP leaching process.

No stack performance testing was conducted during Campaign 4. A summary of the sampling data for the air pathway is included in Table 7-3.

7.3.1 Normal Offgas HEPA Filters and Prefilters (S-48)

The NOG System consists of a pressurized air film cooler, water spray quench tower, jet venturi/packed tower scrubber, and parallel trains (A and B) of MEPA prefilters and HEPA filters for final filtration prior to exhaust through the 0.5 m diameter, 15 m high stack. Although not required to meet the Ohio Air Toxics Policy (OATP) for SO_x or NO_x during Campaign 4, the caustic scrubber was expected to remove 99% of the SO_x as well as a lesser percentage of the NO_x from the offgas. The HEPA filter was expected to remove 99.97% of particulate matter greater than 0.3 μm diameter, and is considered BAT for particulate.

During Campaign 2, frequent changes of the HEPA filters and prefilters were required. This was due to removal of the desiccant unit from the Offgas System, causing frequent

plugging of the filters due to moisture buildup on the filters. For this reason, the offgas lines were heat traced prior to Campaign 4 to keep the offgas temperature above the condensation point, thus helping prevent moisture from plugging the filters. Although this action helped, the frequent change-out of the prefilters continued due to build-up of solids on the filters.

Since it was decided that NOG filters would be managed as hazardous waste, sampling of HEPA filters and prefilters from the NOG was limited to analysis for wt% of total metals. Samples of free liquids and solid residues, when found in the filter housing, were taken and analyzed for RCRA metals. Several of the liquid samples taken from the filter housings failed (exceeded) the TCLP limit for lead. The source of the lead is the lead oxide additives used in the feed. Filters characterized as RCRA hazardous waste were staged in two white metal boxes in Building 80 pending final disposition.

7.3.2 Emergency Offgas System HEPA Filters and Prefilters (S-37)

The EOG System consists of two possible offgas pathways to the atmosphere. The "normal" EOG system path is designed to prevent Melter pressure from going positive as compared to the melter room pressure. It consists of an 8-inch line through a pressure activated flow control valve, a knockout pot, and a 6-inch line to a high temperature prefilter and HEPA filter to remove particulate material prior to discharge via the VitPP stack to the atmosphere. A continuously operating exhaust fan is situated downstream of the HEPA train. The pressure valve is set to open at -0.2 inches W.C. pressure in the Melter.

The off-normal, or "emergency" side of the EOG is designed to react and handle dangerous positive over-pressurization in the Melter. It consists of the same 8-inch line to the knockout pot, but bypasses the pressure controlled valve by way of a parallel rupture disk set to burst at a nominal 3 psi. From the knockout pot, a 10-inch line would then exhaust the unfiltered offgas to the atmosphere through a pressure relief valve that opens at +10 inches W.G. This EOG system flow path has not been activated during Campaign 4, or in any of the Phase I testing.

Only one EOG prefilter was changed during Campaign 4. Samples of free liquids also were taken from the EOG filter housing. The analytical data indicated high concentrations of barium and lead on the filter; chromium exceeded the TCLP limit in the liquid sample. Both filters and any additional residues from the EOG will be characterized for proper waste management. Filters that fail the TCLP will be managed as hazardous waste.

The EOG was initiated on various occasions during Campaign 4. The EOG was placed in manual operation during maintenance on the NOG or Melter that could affect the Melter pressure control. Maintenance activities included clean out of the transition line section of the NOG system. The EOG was also initiated during the various runs, mainly due to brief "pressure" surges caused by Melter cold cap upset, or the inability of the Offgas system to maintain sufficient negative pressure in the Melter. Flushing of the feed lines into the Melter was a common cause of EOG initiation. Since the HEPA filtration on the EOG met Best Available Technology (BAT) for the surrogate constituents in Campaign 4, inadvertent

use of the EOG did not violate any environmental regulatory requirements.

During Campaign 4, the EOG activated a total of 39 times. Total duration of EOG usage during Campaign 4 was 34.7 hours. The longest continuous period of use was 9.5 hours, for maintenance on the Offgas system and Melter. Most EOG events were either very short (3 minutes typical), associated with re-establishing the EOG in an AUTO/RESET configuration, or very long durations, usually associated with maintenance.

7.3.3 Building HVAC HEPA Filters and Prefilters (S-85)

The VitPP building HVAC filtration system consists of two trains of Prefilters and HEPA filters which exhaust to the VitPP stack. Each train contains a bank of three prefilters and three HEPA filters to accommodate the relatively high (8400 SCFM) ventilation flow rate. The Train B prefilters were changed prior to beginning Campaign 4. These refilters had been in place during and following Campaign 2 (since 7/23/96). Relatively high concentrations of total RCRA metals were found on these prefilters, as follows:

- Barium 4,866 - 20,500 mg/kg
- Chromium BDL up to 4,094 mg/kg
- Lead 1,200 - 51,678 mg/kg
- Selenium (data not yet available).

The source of the metals on the filters was investigated. High concentrations of aluminum and silica could be attributed to dust from side chamber frit addition or dust from glass making operations. Significant concentrations of molybdenum, barium, chromium, and lead must have come from the Melter. The Melter is not sealed with respect to air movement between the gem machine and melter plenum via the discharge chamber. Rather, the design and operation of the Melter relies on maintaining a negative pressure differential to ensure air movement is from the gem machine and discharge chamber into the plenum. There was a documented instance during Campaign 2 when the melter pressure went positive, and this flow path could have been reversed. In addition, pressure instrumentation on the melter plenum and gem machine indicates there were various occasions when a negative differential did not exist, which could have allowed melter offgas to reach the gem machine and subsequently been educted directly into the building HVAC. This is believed to be the source of the metal contamination found on these Campaign 2 prefilters.

Although the Building HVAC prefilters and HEPA filters that were in use during Campaign 4 have not been changed, it is expected that a similar pattern of contamination on the HVAC prefilters and HVAC filters will be seen on the Campaign 4 filters. No data from Campaign 4 HVAC prefilters and HEPA filters are available at this time. All filters will be characterized and managed accordingly.

7.3.4 Stack Iso-kinetic Sampler (S-12)

An isokinetic gas sampler was installed on the VitPP stack downstream of the NOG, EOG, and Building HVAC offgas and ventilation piping, and operated during Campaign 4. The

sampler filter was changed twice during Campaign 4, but only the data from the second monitoring period (12/6 through ½/97) were used. This is because the iso-kinetic flow data from the earlier (12/2 through 12/5/96) monitoring period were lost when the sampler pump failed and the flow monitor was not reset. The filters were prepared for total metals analysis by acid digest. Analyses on filter blanks indicated that unused (new) filters contained significant concentrations of RCRA metals. For example, barium was detected in the blanks at 29,400 mg/kg. The blank data were used to correct the analytical results; the corrected data indicate that barium and selenium were not present in significant concentrations in the stack gas. Chromium was detected at 12 mg/kg, and lead was detected at 40.8 mg/kg (again using the corrected data). Based on measured air flow through the stack, the blank-corrected sample data indicate that approximately 0.07 g of chromium and 0.23 g of lead were exhausted to the atmosphere during the Campaign 4 monitoring period.

7.3.5 Stack Condensate (S-34)

During Campaign 2, it was discovered that moisture in the Melter offgas was condensing in the VitPP stack. During Campaign 4, two samples of the stack condensate were taken and analyzed for total metals. Analysis of both samples of condensate did not detect any barium, chromium, or lead. (Note: Detection levels used in the analyses were the same as those used for process samples, rather than environmental samples [2.5 mg/l for barium and chromium, and 5.0 mg/l for lead]. Analytical data for selenium are not yet available). The stack condensate liquid was periodically drained and discharged to the BST.

7.3.6 Feed Preparation, Additives Transfer System (S-60, S-64, and S-66)

There are three HEPA filter systems used on the Feed Preparation, Additives Transfer System. A description and environmental sampling point for each filter system is as follows:

- S-60 A portable HEPA unit used in the Bag Dump additives area. S-60 is a portable HEPA unit ("Red Baron") used to control dust from small batching operations involving feed additives. The filter was changed prior to Campaign 4. Data from use of this filter during and following Campaign 2 indicates significant concentrations of barium (585 mg/kg) and lead (3745 mg/kg) on the filter. The S-60 filter was not changed during Campaign 4, but will be sampled and characterized following Campaign 4.

- S-64 Prefilter and HEPA exhausting the Bag Dump Station. To ensure effluent from the Feed Preparation, Additives Bag Dump Station meets the Ohio Air Toxics Policy (OATP) off-site limits, the Bag Dump Station hood fan exhaust is filtered first through a fabric filter to collect gross particulate, then passed through a MEPA prefilter and HEPA filter (S-64) before exhausting through its own stack to the atmosphere. Preliminary characterization data during and following Campaign 2 indicate that total metals on the HEPA filter were present in relatively low concentrations:

- Ba 315 mg/kg
- Cr BDL
- Pb 1 mg/kg

No data are available from the prefilter from this same time period.

Since lead and barium were dry additives fed through the Bag Dump Station during Campaign 4, it is expected that the Prefilter and HEPA used during Campaign 4 will show a similar pattern of metals contamination. Characterization of these filters will be conducted following their removal, and the data reported in the final report.

- S-66 A prefilter and HEPA filter exhausting the feed/additives transfer operation. The Feed Preparation, Additives Transfer System filter assembly (S-66) controls particulate from transfer of the dry feed additives to the Filter/Receiver (feed bin). The filtered air then exhausts to the VitPP stack. Following Campaign 2, use of the "invincible" MEPA filter assembly on top of the Filter/Receiver unit was discontinued to support the vacuum blower upgrade, and a replacement filter unit was installed at ground level on the VitPP pad. Since the replacement filter has not been changed during Campaign 4, no characterization data from Campaign 4 are available. Characterization sampling will be conducted on this filter following Campaign 4.

7.4 Water and Wastewater (S-17)

Wastewater generated during Campaign 4 consisted mainly of scrubber blowdown, wastewater from VitPP building sink drains, pad washdown, rainwater, slurry tank flush water. Minor sources of wastewater included stack condensate, and free liquids removed from the air filter housings. These wastewaters were routed to the BST, where they were sampled (S-17) and subsequently transferred to the High Nitrate Tank (HNT) by one of two sump pumps controlled by an automatic level switch. This VitPP wastewater is mixed with other FEMP wastewaters in the HNT where it is fed to the AWWT on a periodic basis for additional treatment prior to discharge under the site NPDES permit.

A total of 84 unfiltered wastewater samples were taken on a flow-frequency basis during Campaign 4 at sampling point S-17. These were acid digested in the lab, then filtered prior to analysis for the RCRA metals barium, chromium, lead and selenium. In addition, analyses for nitrate, total dissolved solids (TDS), and total suspended solids (TSS) were also conducted on the Campaign 4 wastewater. Analytical data from S-17 indicate the RCRA metals concentrations in the BST wastewater exceeded the TCLP limits for lead on seven occasions during Campaign 4. Barium, chromium, or selenium did not exceed environmental regulatory limits. Selenium was dropped from routine analysis after it was not detected in any of the previous samples. A summary of the analytical data on the wastewater is presented in Table 7-3.

Sludge from the VitPP pad sump used to collect pad washdown waters was cleaned out during Campaign 4. The sludge was transferred into drums pending further characterization.

The batch of slurry remaining in the feed tank following bottom draining was containerized and staged for characterization. Some decant water from the leftover feed was discharged as wastewater via the BST.

7.5 Soil and Spills

There were no reported off-pad spills of hazardous substances to soil during Campaign 4. There were minor instances of leaks, spills, and pump seal failures, etc., which occurred on the VitPP containment pad during Campaign 4. Any leaks or drips on the pad were containerized for reprocessing to the extent practicable; residues remaining on the pad were washed down to the BST.

7.6 Glass and Other Waste

Waste produced during Campaign 4 included glass product, used air filters, empty feed additive bags, and personal protective equipment (PPE). Each drum of glass has been characterized for metals in accordance with the TCLP. Analytical data from glass sampling (S-10) indicated that all glass produced during Campaign 4 passed the TCLP limit for the RCRA metals.

Management of air filters was discussed in the previous section. Empty bags that once contained lead and barium compounds (emptied in accordance with 40 CFR §261.7 and OAC 3745-51-07), and PPE that was not reused, were disposed in dumpsters as solid waste. Miscellaneous waste was characterized by process knowledge, or by sampling on a case by case basis, as required, to determine proper management.

7.7 Mass Balance for Lead and Barium

A mass balance for Campaign 4 was performed around the VitPP system for lead and barium to determine the fate of the materials introduced into the process. A record of lead and barium introduced into the system as feed additives in the forms of lead oxide, barium carbonate, barium sulfate, and barium-containing glass frit was maintained. An estimate of the lead and barium leaving the system via the environmental pathways (air, wastewater, and solid waste in the form of glass) was determined using environmental data collected during Campaign 4.

The air pathway was evaluated using data taken from the normal and emergency offgas prefilters and HEPA filters. An additional data point was established during Campaign 4 for the VitPP stack iso-kinetic sampler. Since the melter room HVAC filters were replaced prior

to Campaign 4 and have not been changed following Campaign 4, data from the melter room HVAC filters could not be included. Wastewater data were taken from samples gathered at the BST. Solid waste (glass) samples used in the mass balance were taken from each drum of glass produced during Campaign 4. A detailed mass balance analysis for various metals, in addition to lead and barium, is presented in Section 5.2.

7.7.1 Lead

Lead was introduced into the Melter as part of the slurry feed, in the form of lead oxide (PbO). During Campaign 4, a total of 1,926 lbs of lead oxide was introduced into the system. Based on the results of the normalized glass analyses for lead, the total amount of lead reported in the glass during Campaign 4 was approximately 1,856 lbs, or 96.4% of the added lead.

The amount of lead detected in the wastewater that was discharged from the BST accounts for approximately one pound of the lead that was introduced into the system. Lead accumulated on the Offgas System prefilters and HEPA filters, and in the water drained from the filter housing accounts for less than four pounds. Based on the data taken from the iso-kinetic filter sample, a negligible amount of lead (0.23 g) was released to the atmosphere from the VitPP stack during Campaign 4. Based on analysis of the three pathways out of the system (air, water, and solid waste), there remains a discrepancy of 3.4%, or 65 lbs of lead unaccounted.

7.7.2 Barium

Barium was introduced into the VitPP system during Campaign 4 both through the feed additives, and by the addition of frit containing barium oxide. Both barium carbonate ($BaCO_3$) and barium sulfate ($BaSO_4$) were added to the slurry fed to the Melter. The composition of the frit added directly to the melter side chambers during Campaign 4 was changed to increase the density of the east and west side chamber glass. Frit fed during Campaign 4 contained approximately 15.75% barium oxide (BaO), or 14.1% elemental barium.

During Campaign 4, a total of 1,141 lbs of barium was introduced into the system. Based on the results of the normalized analysis for barium in the Campaign 4 glass, the amount of barium reported in the glass totals approximately 1,097 lbs, or 96.1% of the barium added.

The amount of barium detected in the wastewater that was discharged from the BST accounts for approximately 0.1 pound of barium. Barium accumulated on the Offgas System prefilters and HEPA filters, and in the water drained from the filter housing totals less than 0.3 lb. Based on the data taken from the iso-kinetic filter sample, no measurable quantity of barium was released to the atmosphere from the VitPP stack during Campaign 4. Based on analysis of the three pathways out of the system (air, water, and solid waste), there remains a discrepancy of 3.9%, or 44 pounds of barium unaccounted.

7.7.3 Mass Balance Summary

Based on the collected data, approximately 96.7 and 96.2% of the lead and barium (respectively) that were introduced into the VitPP system during Campaign 4 can be accounted for by the environmental data, and these metals are primarily bound in the glass matrix. Less than 0.1% of the lead and barium added was measured leaving the system via the wastewater pathway. Less than 0.25% of the lead and barium was measured leaving the system via the offgas (air) pathway. The disproportionate amount of lead found on the offgas filters, in comparison to barium, can be explained by the difference in chemical properties of the two metals. Lead has a lower vapor pressure in the molten state than barium, hence a greater potential for volatilization to the offgas system. Vapor swept up into the offgas system and then condensed as particulate would be captured on the prefilters and HEPA filters.

A summary of the environmental data used in the mass balance is presented in Table 7-4.

Table 7-4
Summary of Mass Balance Data for Lead and Barium in Campaign 4

PATHWAY	LEAD IN	LEAD OUT		BARIUM IN	BARIUM OUT	
	Lbs.	Lbs.	% of Feed	Lbs.	Lbs.	% of Feed
AIR: NOG, EOG Offgas Filters		< 4	0.2		< 0.3	0.03
Stack		negligible	-		negligible	-
WASTEWATER: Building Sump Tank		1	0.05		0.1	0.01
SOLID WASTE: Glass		1856	96.4		1097	96.1
TOTAL	1926	1861	96.7	1141	1097	96.2
DIFFERENCE		65	3.4		44	3.9

The mass balance accounting indicates that most of the lead and barium added in the feed remained in the glass, and can be accounted for by analysis of the environmental data. However, as indicated in Table 7-3, there remains a discrepancy between the lead and barium added to the feed and the total amount of metals accounted for exiting the vitrification process. This deficit in the accounting for the lead and barium is explainable, as follows:

- A fraction of the feed containing the lead and barium settled out or was left as

holdup residues in the piping and/or equipment. In particular, there were high solids buildup reported in the recycle water line during Campaign 4. There may also be sludge in the bottom of the VitPP sump on the concrete pad, and in the BST. Due to the heterogeneous nature of the wastewaters entering the BST, it is possible some metals could have escaped to the HNT as suspended solids, or settled sludges become entrained in the discharge as the tank emptied. In addition, some dry powder feed residue may be left in the pneumatic feed transfer lines and equipment. Finally, a minimal amount of residues could have been carried out in "empty" bags, PPE, clothing, and equipment, or otherwise have been lost to the process.

- Lab analysis also could account for a large source of error in the mass balance. Since most of the metals are found in the glass, and since only one glass sample was taken per drum, a small error in analysis could result in a significant difference in the mass of metals. In addition, some sampling bias could have been introduced (e.g., if the wastewater was not homogeneously mixed prior to sampling).

- Both the lead and barium compounds were added as dry powders. Full bags of feed additives that were transferred into the feed were not individually weighed, but were reported at their marked weight. Partial bags of additives were weighed prior to introducing the material at the feed additives transfer station. Feed additives may have absorbed some moisture during storage and increased in weight, which would have resulted in an overestimate of the weight added. Errors also may have occurred during the weighing, or by using the marked weight on the container.

7.8 Problems and Concerns

There are several areas identified that were problematic for environmental protection or environmental data gathering during Campaign 4. These issues are Lessons Learned for the environmental component of the VITPP, and should be considered in any future planning for design or operation of vitrification or similar projects. These issues are identified and discussed below.

7.8.1 Offgas System

7.8.1.1 Emergency Offgas System (EOG)

As in the previous campaigns, Campaign 4 experienced a significant number of activations of the emergency offgas system. As noted in Section 7.3, the unmitigated (unfiltered) side of the Emergency Offgas System (EOG) reserved for off-normal or "emergency" use was not triggered during Campaign 4. Although the EOG stream was directed through the HEPA filtered side, and the EOG met BAT for all Campaign 4 runs, the continued reliance on the EOG during operations is a concern. During Campaign 4, modifications in operating procedures, such as operating with less cold cap coverage, reduced the number of times the EOG was triggered due to cold cap upset. Limitations due to design of the offgas

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system, and controls contributed to the frequent use of the EOG. Triggering of the EOG during times of Melter feeding is a particular concern since there is an increased risk of overwhelming the EOG filters with water vapor, entraining fine particulate from the feed directly into the offgas, and exceeding the OATP limits or CERCLA Reportable Quantity (RQ) limits for SO_x and NO_x.

Use of the EOG System on a routine basis negates the purpose of the EOG. Routine use of an emergency offgas system would normally require the same controls as a normal offgas system. For campaigns which could exceed regulatory limits for air pollutants, bypassing normal required control systems is not allowed under the OEPA Ohio Administrative Code (OAC). The corrective action alternative is to redesign the normal offgas system to improve control of the melter to bring utilization of the emergency offgas system back to only true emergency use. The EOG System does not treat the toxic, non-particulate components of the offgas. Although stopping feed to the melter whenever the EOG is being utilized is a prudent part of operations, toxic gases are still devolved from the Melter that are out-gassed through the EOG System. Operational controls and limits are not a substitute for proper design.

7.8.2 Sampling and Data Management

Although many of the problems discussed in the Campaign 1 and 2 Interim Reports associated with sampling or analytical issues have been corrected, problems concerning the environmental data gathering during Campaign 4 were noted.

7.8.2.1 Issues Involving Sampling

- Sample coding protocols were not always followed by the various sampling teams, and errors in coding sometimes persisted until discovery in the database. Due to problems in correlating air filter data to actual filters during Campaign 2, a logical coding system was developed to differentiate between the Prefilters and HEPA filters, between Train A and Train B, and between liquids and solids taken from the filter housings. This system was included in the PSP prior to Campaign 4. During Campaign 4, some of the NOG filter (S-48) data were reported using improper codes. Since the air filter data were not available to the environmental data user until late in Campaign 4, the problem was not completely addressed during Campaign 4. As a result, some of the lab data for the NOG System had to be correlated to a specific filter source by cross referencing to sample logs using operator knowledge.

7.8.2.2 Issues Involving Analytical

- Analytical data reported by the lab were sometimes difficult to interpret and required clarification by the lab. For example, some of the analytes reported for the NOG Prefilters and HEPA filters (S-48) were reported in what appeared to be duplicates for the same sample, but with different values. Lab clarification was required to differentiate the TCLP

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extract (which should have been reported in mg/l) from the totals metal analysis (reported in mg/kg or weight %).

- There was a considerable time delay between the environmental sampling event and the time the data were available for environmental analysis. Due to limited lab personnel during Campaign 4, some analytical data were not available until several weeks following submittal of the sample. In addition, an occasional sample was sometimes lost or misplaced, necessitating a gap in the data.

8.0 VitPP DESIGN DATA NEEDS FOR PHASE II

Data needs and test requirements were identified by the project for development of the VitPP for Phase II testing using silo waste and for design and cost information for a future higher throughput waste vitrification facility. These data needs were planned to be accomplished from the Phase I and Phase II VitPP operating campaigns.

The major VitPP systems operation and the test data obtained from Campaign 1, Campaign 2, and Campaign 4 were reviewed from the perspective of providing the identified data needs. Table 8-1 summarizes the status of the outstanding data needs.

Following the Melter bubbler #3 discharge event that occurred during Campaign 4, the data needs were reassessed in detail to determine the outstanding data needs and viable options for obtaining the data. This assessment was reported by the Vitrification Pilot Plant Melter Incident Data Analysis and Path Forward Team[1]

8.1 Feed Preparation System

The Feed Preparation System must be able to mix and homogenize the process slurry and to reliably pump the slurry through both horizontal and vertical piping containing valves and fittings. During Campaigns 1 and 2 operations, variations were observed in the slurry solids loading during gradual pumped withdrawals from the two slurry tanks (5-TK-29A & B). This nonhomogeniety is believed to be caused by insufficient slurry mixing and solids suspension by the existing slurry tank agitators (5-AG-05A & B).

The supplier of the existing slurry tank agitators (Mixmor) indicates that the following data are needed to assess the agitator design:

- Dimensions of process tank and range of operating levels
- Specific gravity of slurry
- Solids content of slurry (percent by weight)
- Particle size distribution
- Density of individual particles (as opposed to the apparent density of a layer of settled solids)
- Slurry viscosity
- Determination of force to overcome settled slurry conditions

When pumping the slurry, the lack of in-line pressure instrumentation in the slurry piping has precluded calculation of slurry friction losses and apparent viscosity under actual flow conditions. Providing instrumentation for pump suction and discharge pressures would provide information for adjusting the diaphragm pump motive air supply and discharge pressures to improve operations and reduce wear. Data needed on the flow characteristics

[1]Fernald Environmental Project Vitrification Pilot Plant Melter Incident: Data Analysis and Path Forward Team, Final Report, Revision 0, 40100-RP-0020, February 1997

Table 8-1
FRVP DATA NEEDS SUMMARY ASSESSMENT

FRVP DATA ID #	DATA REQUIRED	VitPP PHASE	REMEDIATION FACILITY DATA NEED	DATA ACQUISITION STATUS THROUGH PHASE I CAMPAIGN 4	REMARKS
SILO RESIDUAL MATERIAL RETRIEVAL					
11-1	Water flow to silo residue removal	II	Validate pilot plant material balance for Phase II operation	None Silo residue not used for Phase I	Future Waste Retrieval Demonstration and Phase II laboratory work with silo material to be determined
11-2	Retrieved residue slurry composition, density, suspended solids content, size and density of largest particles	II	Material balance and rheology of residue feed slurry	None Silo residue not used for Phase I	
11-3	Retrieved residue slurry flow rate	II	Validate pilot plant material balance for Phase II operation, rheology of residue slurry, and hydraulic characteristics	None Silo residue not used for Phase I	
THICKENER PERFORMANCE					
12-1	Flocculent addition rate	I & II	Thickener performance	None Thickener not used for Phase I	Future Waste Retrieval Demonstration and Phase II laboratory work with silo material to be determined
12-2	Thickener bottom slurry density, % suspended solids, size and density of largest particles	I & II	Thickener performance	None Thickener not used for Phase I	
12-3	Thickener overflow dissolved and suspended solids particle size and size distribution	I & II	Thickener performance, determine downstream treatment of overflow stream, and validate material balance	None Thickener not used for Phase I	
12-4	Recycle water flow to Quench Tower	I & II	Thickener performance	None Thickener not used for Phase I	
12-5	Thickener overflow stream flow rate	I & II	Thickener performance	None Thickener not used for Phase I	
12-6	Thickener underflow stream flow rate	I & II	Thickener performance	None Thickener not used for Phase I	
12-7	Residue Slurry Pump discharge pressure	I & II	Rheology of Thickener underflow stream	None Thickener not used for Phase I	
FEED PREPARATION SYSTEM					
12-8	Melter feed composition, slurry density, % solids, size and density of largest particles Feed slurry rheology data	I & II	Material balance, glass quality, slurry chemistry-glass correlations Feed slurry rheology data	Feed slurry composition, density, and % solids for benign glass, acceptance glass, Series D and Series A glass formulations None Feed loop instrumentation inadequate for Campaigns 1, 2, and 4	Future Waste Retrieval Demonstration and Phase II laboratory work with silo material to be determined
12-9	Slurry Tank Pump discharge pressure	I & II	Hydraulics of slurry feed preparation loop	None Slurry Tank Pump and pressure instrumentation performance inadequate for Campaigns 1, 2, and 4	

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FRVP DATA ID #	DATA REQUIRED	VitPP PHASE	REMEDIATION FACILITY DATA NEED	DATA ACQUISITION STATUS THROUGH PHASE I CAMPAIGN 4	REMARKS
12-10	Melter slurry feed flow rate Melter feed loop hydraulics	I & II	Hydraulics of Melter slurry feed loop	Melter slurry feed flow data for benign glass, acceptance glass, Series D glass, and Series A glass formulations None Feed loop instrumentation inadequate for Campaigns 1, 2, and 4	Future Waste Retrieval Demonstration and Phase II laboratory work with silo material to be determined
			MELTER		
13-1	Electrode movement	I & II	Determine electrode corrosion rate	Molybdenum concentration analyses of molten glass samples from Melter chambers, observation of electrode condition	No electrode insertion during Campaigns 1, 2, and 4 Future Phase II Melter operations to be determined
13-2	Electrode power	I & II	Melter energy consumption	Continuous amperage, voltage, and power data recorded	Future Phase II Melter operations to be determined
13-3	Glass production rate	I & II	Melter effectiveness	Produced glass weight recorded	
13-4	Glass properties	I & II	Determine required molten glass residence time Determine Melter component temperatures, etc.	Sustained glass production runs attained for Series D and Series A glass Melter component temperatures, component cooling temperatures and flow rates, glass agitation air flow rates, glass air lift flow rate, observations of interior conditions, etc. recorded	
13-5	Glass temperatures	I & II	Melter effectiveness	Molten glass and plenum temperatures recorded	
			MELTER OFFGAS		
14-1	Compressed air flow rate to Melter	I & II	Quantify Melter inleakage to validate offgas system dynamic simulation	Melter air agitator and airlift air flow rates recorded	Future Phase II Melter Offgas operations to be determined
14-2	Compressed air flow rate to film cooler	I & II	Quantify Melter inleakage to validate offgas system dynamic simulation	Film Cooler and Lance cooling air flow rate recorded	
14-3	Quench Tower offgas cooling	I & II	Evaluate Quench Tower performance	Offgas and water temperature data in and out of the Quench Tower and Quench Tower internal temperature recorded	
14-4	Quench Tower overhead offgas flow rate	I & II	Quantify Melter inleakage to validate offgas system dynamic simulation	None Offgas flow instrumentation in Quench Tower overhead stream not installed for Campaigns 1, 2, and 4	
14-5	Film Cooler outlet offgas temperature	I & II	Design data for Quench Tower Scrubber, and Melter Offgas system	Film Cooler offgas outlet temperature recorded	
14-6	Film Cooler offgas pressure drop	I & II	Film Cooler design	Film Cooler offgas pressure drop recorded	
14-7	Melter internal operating pressure	I & II	Develop Melter pressure control logic	Melter internal pressure recorded	

FRVP DATA ID #	DATA REQUIRED	VitPP PHASE	REMEDIATION FACILITY DATA NEED	DATA ACQUISITION STATUS THROUGH PHASE I CAMPAIGN 4	REMARKS
14-8	Quench Tower overhead gas composition (NOx, SOx, CO_2)	I & II	Design acid gas removal/abatement capabilities and verify material balance	None Instrumentation for Quench Tower overhead offgas composition not installed for Campaigns 1, 2, and 4	Future Phase II Melter Offgas operations to be determined
14-9	Composition and pH of spent Quench Tower liquid discharge	I & II	Decontamination efficiency of Quench Tower and verify material balance	Quench Tower discharge liquid stream composition data recorded during Campaigns 2 and 4	
14-10	Composition and pH of Quench Tower recycle water supply, suspended solids content and size distribution, dissolved solids content and size distribution Radon concentration during Phase II operation	I & II	Decontamination efficiency of Quench Tower, verify material balance, and evaluate Waste Water Filter performance Radon material balance	Quench Tower recycle water supply composition data recorded during Campaigns 2 and 4 None	
14-11	Composition and pH of Scrubber recirculation liquid	I & II	Quantify acid gas removal by Scrubber	None Insufficient Scrubber recirculation liquid and offgas sampling and analyses during Campaigns 1, 2, and 4 for material balance information	
14-12	Temperature of Scrubber liquid	I & II	Quantify Scrubber offgas cooling	Scrubber sump temperature recorded during Campaigns 1, 2, and 4	
14-13	Scrubber liquid supply pressure	I & II	Calculate total Scrubber liquid supply flow	Scrubber liquid recirculation pressure recorded during Campaigns 1 and 2	
14-14	Scrubber Packed Tower liquid flow	I & II	Evaluate packed tower performance	Scrubber Tower liquid flow recorded during Campaigns 1, 2, and 4	
14-15	Offgas temperature to Desiccant Tower	I & II	Evaluate Desiccant Tower performance	Offgas temperature at Desiccant Tower inlet recorded during Campaigns 1, 2, and 4	
14-16	Offgas temperature out of Desiccant tower	I & II	Evaluate Desiccant Tower performance	Offgas temperature at Desiccant Tower outlet recorded during Campaigns 1, 2, and 4	
14-17	Offgas moisture content of Desiccant Tower outlet	I & II	Evaluate Desiccant Tower performance	Offgas moisture content at Desiccant Tower outlet recorded during Campaigns 1,2 and 4	
14-18	Radon content of Offgas at inlet to Carbon Beds during Phase II operation	II	Quantify Radon removal by Carbon Beds	None	
14-19	Radon content of Offgas at outlet from carbon Beds	II	Quantify Radon removal by Carbon Beds	None	
14-20	Combined Melter Offgas and vessel vent non-condensibles flow rate	I & II	Evaluate Radon removal and Desiccant Tower performance	None	
14-21	Scrubber overhead Offgas composition	I & II	Measure NOx scrubbing performance	None Instrumentation for Scrubber Tower overhead offgas composition not installed for Campaigns 1, 2 and 4	

FRVP DATA ID #	DATA REQUIRED	VitPP PHASE	REMEDIATION FACILITY DATA NEED	DATA ACQUISITION STATUS THROUGH PHASE I CAMPAIGN 4	REMARKS
14-22	Desiccant Tower operating pressure	I & II	Quantify volumetric Offgas flow through Desiccant tower and Carbon Beds	None Insufficient data recorded during Campaigns 1, 2, and 4	Future Phase II Melter Offgas operations to be determined
14-23	Carbon Bed pressure drop	II	Quantify volumetric Offgas flow through Carbon Bed	None Carbon Beds bypassed during Campaigns 1, 2, and 4	
14-24	Radon concentration at exhaust stack	II	Quantify total Radon emissions	None	
14-25	Gamma concentration at exhaust stack	II	Quantify total gamma emissions	None	
14-26	Exhaust stack discharge rate	II	Quantify total radionuclide emissions	None	
14-27	Offgas temperature at inlet to HEPA filters	I & II	Material balance and pressure profile through system	HEPA filter inlet Offgas temperature data obtained for Campaign 4	
14-28	Exhaust Stack discharge rate	I & II	Material balance and pressure profile through system	Exhaust Stack total Offgas flow recorded during Campaigns 1, 2, and 4	
14-29	NOx loading on Carbon Beds	II	Quantify NOx interaction with activated carbon	None	
14-30	Pressure drop across Offgas Film Cooler outlet line	I & II	Provide indication of solids deposition/fouling inside line	Offgas Film Cooler transition line pressure drop recorded during Campaigns 1, 2, and 4	
14-31	Temperature of Sparge Tank liquid	II	Evaluate Radon stripping efficiency	None	
14-32	Air flow rate to Sparge Tank	II	Evaluate Radon stripping efficiency	None	
14-33	Radon content of Sparge Tank liquid effluent	II	Evaluate Radon stripping efficiency	None	
14-34	Radon emission from Stack	II	Demonstrate compliance to Rn-222 negotiated site release limit	None	
14-35	Emissions from Stack during Phase I tests to support Pb, Ba and Cr material balance	I & II	Demonstrate compliance with 40 CFR 61 and DOE Orders	No Stack Offgas sampling or analyses during Campaigns 1 and 2. Insufficient sampling and analyses of other plant streams to perform material balance during Campaign 2. Isokinetic data were collected during Campaign 4 only. They were used both to evaluate the effectiveness of the offgas control equipment for particulate, and for mass balance determination for lead and barium for Campaign 4.	
	Emissions from Stack during Phase II tests; radionuclides, TOC, NOx, SOx, HCL, fluorides, heavy metals, particulates			None	
14-36	1 time Stack performance test of emissions of radionuclide, visible particulates, heavy metals, TOC, NOx, SOx, HCL, and fluorides	II	Demonstrate compliance with OAC 3745-17-11 for particulate emissions	None	

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FRVP DATA ID #	DATA REQUIRED	VitPP PHASE	REMEDIATION FACILITY DATA NEED	DATA ACQUISITION STATUS THROUGH PHASE I CAMPAIGN 4	REMARKS
PROCESS VESSEL VENTS					
15-1	Operating pressure of Thickener, Slurry Tanks, Recycle Water Tank, Building Sump Tank, and Sparge Tank	I &II	Monitor pressure profile through process vessel vent system, confirm negative gauge pressure in each tank, monitor effects of tank filling and pump out	None	Future Phase II pilot pant operation to be determined
WASTE WATER TREATMENT					
20-1	Deleted; same data as item 14-10				
20-2	Waste Water Filter effluent, suspended solids content, and size distribution	I &II	Evaluate filter performance	Recycle Water Filter effluent samples analyzed during Campaigns 2 and 4	Future Phase II pilot pant operation to be determined
20-3	Pressure drop across Waste Water Filter	I &II	Evaluate filter performance	Waste Water Filter pressure drop recorded during Campaigns 1, 2 and 4	
20-4	Flow rate through Waste Water Filter	I &II	Evaluate filter performance	Waste Water Filter flow recorded during Campaigns 1, 2 and 4	
20-5	Cumulative flow through Waste Water Filter between back flushes	I &II	Evaluate filter performance	Waste Water Filter cumulative flow recorded during Campaigns 1, 2 and 4	
20-6	Pilot Plant Building Sump Tank effluent	I &II	Pilot Plant Building waste water characterization during Phase I for Ba, Pb, and Cr Phase II for hazardous materials and radionuclides	Pilot plant Building Sump effluent sampling and analyses performed during Campaigns 2 and 4	
GLASS PRODUCT HANDLING					
24-1	Gob cutter wheel and roller temperature as a function of time	I	Reliability/operability of the gem maker	None Insufficient Gem Machine operating time and instrumentation during Campaigns 1, 2, and 4	Future Gem Machine operation to be determined
24-2	Outside surface temperature of Gem Machine housing	I	Feasibility of locating equipment near Gem Machine conveyor housing	Gem Machine housing interior and expansion joint temperatures recorded during Campaigns 1, 2, and 4	
24-4	Operation hours before failure for all equipment in this system	I & II	To estimate mean time to failure for all equipment	None Insufficient Gem Machine operating time during Campaigns 1, 2, and 4	
GLASS PRODUCT PACKAGING					
25-1	Gem temperature as a function of time after discharge into hopper	I	Required staging time before gems can be loaded into concrete boxes	None Instrumentation not provided during Campaigns 1, 2, and 4	Future Gem packaging operations to be determined
25-2	Radiation field from glass [hopper] as a function of time after discharge from Melter	II	Design of shielding for material handling device and optimization of waste container	None	Future Phase II Gem packaging operations to be determined
25-3	Monolith temperature as a function of time after pouring	I	Required staging time before drums can be loaded into concrete boxes	None Instrumentation not provided during Campaigns 1, 2, and 4	Future monolith packaging operations to be determined
25-4	Radiation field at the surface of the concrete waste container	II	Verify the optimization of the waste container design to minimize shielding and weight of container, maximize payload, and minimize disposal costs	None	Future Phase II packaging operations to be determined

FRVP DATA ID #	DATA REQUIRED	VitPP PHASE	REMEDIATION FACILITY DATA NEED	DATA ACQUISITION STATUS THROUGH PHASE I CAMPAIGN 4	REMARKS
			RADIATION TECHNOLOGY SYSTEM		
62-1	Thickener Tank shield wall gamma dose rate survey	II	Modeling correlation	None	Future Phase II pilot plant operations and radiological data sources to be determined
62-2	Furnace room shield wall gamma dose rate survey	II	Modeling correlation	None	
62-3	Carbon Bed shield wall gamma dose rate survey	II	Modeling correlation	None	
62-4	Slurry Tank shield wall gamma dose rate survey	II	Modeling correlation	None	
62-5	Major component survey; Thickener	II	Modeling correlation	None	
62-6	Major component survey; Recycle Water Tank	II	Modeling correlation	None	
62-7	Major component survey; Carbon Bed(s)	II	Modeling correlation	None	
62-8	Major component survey; Melter Offgas HEPA Filter housing	II	Modeling correlation	None	
62-9	Major component survey; Building Sump Tank	II	Modeling correlation	None	
62-10	Major component survey; Silo material transfer piping	II	Modeling correlation	None	
62-11	Major component survey; Gem Hopper (over time)	II	Modeling correlation	None	
62-12	Major component survey; shipping container	II	Modeling correlation	None	
62-13	Major component survey; Quench Tower	II	Modeling correlation	None	
62-14	Major component survey; Desiccant Tower	II	Modeling correlation	None	
62-15	Major component survey; Slurry Tank(s)	II	Modeling correlation	None	
62-16	Deleted; same data as 62-10	II			
62-17	Silo 3 surge Bin	II	Modeling correlation	None	
62-18	Silo 3 Filter/Receiver	II	Modeling correlation	None	
62-19	Thickener area Radon concentration	II	Radon release from Thickener	None	

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and rheology of the slurries were not obtained during Campaigns 1, 2, and 4.

During Campaign 2 it was recognized that the continuing problems related to the operation of the slurry tanks, slurry pumps, valves in the slurry piping, and the layout of the slurry piping would be an unsatisfactory basis for design of an upgraded vitrification plant. The Feed Preparation System required significant retrofit to provide reliable operation to support Campaign 4 vitrification operations.

The OU4 project determined to replace the Feed Preparation System as necessary to provide reliable slurry feed operation for Campaign 4 (see Section 3.0). The basis for the retrofit design did not require the system to be prototypical of a Feed Preparation System for a higher throughput vitrification facility.

Additional system operation testing of a prototypical Feed Preparation System will be necessary to provide data needed for a higher throughput facility capable of vitrifying radioactive material.

Some of the Feed Preparation System deficiencies discussed in the Campaign 1 and Campaign 2 treatability reports did not occur during Campaign 4. The lessons learned from Campaigns 1 and 2 contributed to the design of the retrofit system for the Feed Preparation System and the operation of the Feed Preparation System for Campaign 4.

8.2 Glass Product Handling

Design data on the temperature and temperature decay with time of the glass product containers were not obtained during Campaign 4 operations.

8.3 Furnace Off-Gas System

During Campaign 4, the Furnace Off-Gas System performed satisfactorily in the same manner as in Campaign 2 using the Film Cooler Air Lance. As with the Feed Preparation System, the project determined to overhaul the Furnace Off-Gas System to provide reliable operation for Campaign 4 operation. The system revision, while satisfactory for Phase I nonradioactive operation, is not prototypical for a higher throughput vitrification facility for radioactive service. Additional system testing of a prototypical Furnace Off-Gas System will be necessary to provide process and design data needed for a higher throughput vitrification facility for radioactive material.

8.4 Gem Machine System

During Campaigns 1, 2, and 4 Gem Machine System deficiencies were experienced. These deficiencies are described in Section 5.5.6, Gem Making. System and equipment changes were considered for retrofit for Campaign 4, but were not completed prior to the Melter bubbler # 3 event. The planned Gem Machine run was not accomplished during Campaign 4. Additional system testing will be necessary to demonstrate acceptable operation of a prototypical Gem Machine for a higher throughput facility for radioactive material.

5 Maintenance Log Keeping

Maintenance actions and descriptions of equipment wear and longevity for the VitPP systems is presented in Section 6.0. This information addresses the post Campaign 2 through Campaign 4 operating periods and covers some of the maintenance information deficiencies discussed for Campaigns 1 and 2.

VitPP maintenance activities during Campaign 1 and Campaign 2 were reported in the Supervisor's Shift Turnover Log prepared at the end of each shift. For maintenance work, an FEMP Work Request/Order is prepared (see FEMP Work Request/Order Procedure, MT-0003, 6/28/96) and executed. The work request as written is general and typically does not describe in detail the work or activities performed to complete the work request. Section F of the procedure, Work Process/Package Closeout, provides for recording comments/lessons learned from the activity, however, these may be general comments since no guidelines are provided. Completed FEMP Work Request/Order forms are archived and controlled at the document control center.

The present Maintenance Log keeping is not adequate for tracking equipment performance, failure modes, diagnostics, and corrective actions in enough detail to provide design data for a future vitrification facility. It is suggested that log keeping guidelines/procedures be provided for recording information on logs, log keeping responsible party, and archiving of the log. The Maintenance Log should serve as a record for defining equipment maintenance history for both plant and engineering personnel, and it should be recorded and stored in a retrievable manner.

9.0 The Vitrification Pilot Plant Lessons Learned Program

The Vit Pilot Plant (VitPP) Lessons Learned Program is a compilation of the lessons learned during the course of the project. They are not all necessarily items to be incorporated in this or any other project, but, lessons learned to be considered when making facility modifications and or new designs and implementation of those designs into the field and operations of a facility. These lessons learned are accumulated from Total Quality meetings, Daily project meetings, Plan of the Day meetings, experience of design and field work accomplished to date, the input of operations and what has been learned in the VitPP program. These lessons are divided into areas of work scope of the project, and are divided according to alphabetical order of the defined area.

Some of the most significate "lessons learned" which is not to part of the formal Lessons Learned Program is that FDF has developed personnel with the necessary skills and experience for implementing disciplined management control systems necessary for further success. The VitPP has been successful due to the diligence of those people working and keeping operations ongoing. This experience has been developed and is imperative to the design, construction, start-up, and operation of a upgraded/final facility. It is important that this experience and expertise be available to support further development of the Silos Project mission.

The Lessons Learned Program is not a separate stand alone program. It is an integral part of the Testing Program of the VitPP and is included as a supplement to the VitPP Phase I Treatability Study Reports. The Lessons Learned are being reviewed by Fluor Daniels Fernald Engineering, Operations, Project Management, and Testing to ensure all activities are incorporated, documented, and implemented in the design procedures for operation for the VitPP, plant upgrades, and ultimately the final design, procurement, construction and operation of the facility and program.

Detailed descriptions of Lessons Learned are documented in Appendix A

9.1 The A/E Scope of Work

The A/E Scope of Work includes general comments to be considered in any additional A/E type of work prior to implementation of that scope of work.

9.2 Construction

The comments in this scope of work are general in nature and are intended to support earlier, and more precise work package completion.

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9.3 Design Criteria

The Design Criteria area of comments are more defined and are more specific than the previous scopes of work. These items are mostly a result of problems encountered in the startup and operation of the VitPP. These lessons are also the largest Percentage of the items of the data base.

9.4 Operations

There are comments in this area that are specific to the operation of the VitPP. These are the type of comments that are part of the Interim Treatability Reports for each Campaign. The final Report will address more of the operational lessons learned.

9.5 Procurement

The items in this area have been of significant concern and cost the project significantly in time and money. These items should be applicable to all projects on site as well as additional design or upgrades to the VitPP.

9.6 Project Management

This area is of vital concern to all projects on site, especially to larger projects. By not involving all support organizations in beginning caused many design changes early and field design changes later. Many design changes that effected other major operational systems were still being submitted (ie, melter) long after the design and construction was complete on other systems.

9.7 Startup

Concerns in this area are important to all projects on site and should be reviewed to ensure that they are incorporated in other phases of the VitPP.

Appendix A
VIT Pilot Plant Lessons Learned

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
A/E Scope of Work	General	188	Consider areas of uncertainty- Facility layout and Capacity and performance of ancillary systems
A/E Scope of Work	General	190	Incorporate "lessons learned" in the VITPP Upgrade.
A/E Scope of Work	General	195	Some functions could be shared between VITPP and Production facility: Waste water treatment, laboratory, utilities, and gem cooling/handling.
A/E Scope of Work	General	197	Have a clean separation between pilot plant and production plant operations
A/E Scope of Work	General	199	Upfront investments (safety, RAM) and planning will reduce long term costs.
Chemistry	Glass	217	Redox condition should be monitored closely through real-time monitoring or chemical analysis (FE2/fe3 ratio).
Chemistry	Glass	219	Reducing agents used to control sulfate foaming should be closely monitored.
Construction	General	62	Handle and stockpile soil, concrete, debris and other materials per EW-0006. Plan during design with Soil Remediation Project personnel.
Construction	General	70	Develop detailed, comprehensive inspection test plan during Title II. Involve Inspection Services personnel.
Construction	General	120	During construction, cover or plug open equipment nozzles, unconnected pipe and similar openings to prevent entry of rainwater or foreign materials.
Construction	General	122	Implement control of superseded and cancelled documents to ensure that only legible, properly marked current revisions of documents are used.
Construction	General	220	Ball valves used in the construction of Pilot Plant did not provide level of service required. They were always to difficult to operate, leaked, and general poor quality. Could not be rebuilt had to be replaced.
Design Criteria	Control Systems	8	Use logic diagrams from pilot plant Foxboro to extent feasible.
Design Criteria	Control Systems	22	Involve fire protection personnel early in design to assure acceptable deployment and fire protection instrumentation.
Design Criteria	Control Systems	51	Include training simulator in plant control system.
Design Criteria	Control Systems	66	Design for proper integration of thermocouples and other instrumentation into any local panels and DCS.

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Criteria	Control Systems	83	Develop DCS/PLC architecture early.
Design Criteria	Control Systems	84	Develop functional logic diagrams, for process programmers to work from for configuration control and for basis for program verification/validation later.
Design Criteria	Control Systems	85	Develop an instrument list that can be used by project personnel through local network but with built-in security for changes.
Design Criteria	Control Systems	86	Buy electronic/instruments that are magnetic/high frequency noise free, including instrument cabling. Route instrument cabling away from SCRs, VFDs, etc.
Design Criteria	Control Systems	91	Consider purchase of smart transmitters with any purchase of new control system (can check remotely).
Design Criteria	Control Systems	180	Need additional instrumentation for complete data for future design. DCN initiated.
Design Criteria	Electrical	5	Define requirements for grounding of melter, other systems as early as is appropriate. (Title I?)
Design Criteria	Electrical	55	Settle on requirements for emergency power early, and size emergency generator generously.
Design Criteria	Electrical	56	Provide normal power bypass to UPS for maintenance work on UPS.
Design Criteria	Electrical	74	Establish single line diagram early. Size power transformer with spare capacity. Use computerized calculation for load, short circuit, voltage drop and relay coordination. Establish tray and conduit routing envelope early, to avert layout interferences and signal interferences.
Design Criteria	Electrical	75	Generate standard design formats for drawings like layout, ladder diagram, connection wiring diagram, termination, cable conduit/tray routing, functional logic diagrams, grounding, lightning protection, etc.
Design Criteria	Electrical	76	Generate a electrical system description (SD) early. This SD and the design criteria will enable a smooth start in design with no guesswork.
Design Criteria	Electrical	77	Buy standard electrical equipment, do not custom build. Do not generate connection wiring diagrams; let the panel, switchgear or equipment vendor generate them based on ladder diagrams. Try to force vendors to match decided-upon wiring format for ease of checking. Do not accept catalog cuts from vendors, to maintain configuration control of documents.
Design Criteria	Electrical	79	Design grounding system properly, for installation with your foundation and footing works. Make calculation, and separate instrument grounding from power grounding. Define lightning

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VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Criteria	Electrical	81	Try to get the electric substation as close to the facility being built as close as you can, even inside the building if possible. Get load centers/MCC close to the loads. Cabling will be less and tray/conduit layout will be more manageable.
Design Criteria	Equipment	102	Specify removable insulation on pumps, valves and other equipment, as there are no insulators on FEMP maintenance staff.
Design Criteria	Feed Preparation	26	On any tanks on which load cells are used, isolate the tank physically from piping and instrumentation (flex connectors, etc.).
Design Criteria	Feed Preparation	97	Route slurry lines as directly as possible; use large radius bends instead of elbows.
Design Criteria	Feed Preparation	145	Lines Plugging with slurry/ Line flushing has been improved however, lines are not designed for slurry transfer.
Design Criteria	Feed Preparation	146	Erosion of ball valves/ replaced selected valves with pinch valves or better ball valves
Design Criteria	Feed Preparation	147	Slurry tank agitation is poor. Material settling out in tank. Are doing off-site agitation testing to determine best agitation method.
Design Criteria	Feed Preparation	148	Dry additive system plugging. Heavy materials plug lines, moisture gets in and help causes plugging. Lines must be kept dry
Design Criteria	Feed Preparation	193	Use proven technology to handle slurry: use gravity- take conservative actions to declog and rinse piping. Locate the slurry pump in dedicated rooms. Install equipment that needs periodic maintaince in a lower RAD area.
Design Criteria	Gem Maker	152	Gem maker cutter needs to have water cooling... not just air cooling. need to improve seal on water cooled cutter system
Design Criteria	Gem Maker	153	maker uses excessive lubrication/water spray. Fills drum with water solution
Design Criteria	General	3	Use engineered controls to minimize likelihood of contamination and radiation exposure of plant and personnel.
Design Criteria	General	23	Do not vent tanks directly to atmosphere - use vacuum breakers or other appropriate pressure protection.
Design Criteria	General	28	Allow adequate space within and adjacent to plot for emergency egress, maintenance, operation and other foot traffic and for possible future expansion.
Design Criteria	General	38	Fix plant design capacity as early as possible to minimize later changes and rework.

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VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Criteria	General	39	Thoroughly define process and functional requirements, rest of design basis as early as possible (i.e., what facility must do) and obtain widespread agreement, then design the facility itself.
Design Criteria	General	58	Provide adequate lighting for maintenance and operation (3 to 5 footcandles).
Design Criteria	General	67	Include provisions to facilitate maintenance of equipment, such as hoists, work platforms, etc. (note pilot plant gem maker maintenance).
Design Criteria	General	72	Establish exact design criteria for calculation requirements, sizing equipment, type of equipment, tray/conduit loading, codes and standards, etc.
Design Criteria	General	82	Develop P&IDs early. Agree on the format and detail of control/monitoring representation in the PIDs. There should only be one set of PIDs and one format. Tagging of equipment/instrument should be established early to avoid costs of retagging.
Design Criteria	General	88	For sampling, use double valve arrangement, sampling cell or glovebox, or other improved system.
Design Criteria	General	103	Obtain list of prohibited products, compounds, etc., from Industrial Hygiene, and require use of approved products for cements, solvents, cleaners and other construction uses.
Design Criteria	General	119	For any outdoor equipment with containment curbs, provide means for pumping out rainwater and adequate anchoring to prevent floating.
Design Criteria	General	177	Weather delays and equipment destroyed as a result of not having adequate protection from elements. No building around the water systems (pad). Temporary structure added. Additional cost of heating facility during winter, and heat tracing and insulating lines would more than justify a bilding and HVAC system.
Design Criteria	General	186	Contamination control- install SS drip trays under all pumps Paint all areas of possible contamination, to enable better clean-up
Design Criteria	General	187	Control radiation similar to production plant use shielding for sample taking and where operators are normally working.
Design Criteria	General	191	Use quick connectors for decoupling and refitting on key equipment
Design Criteria	General	192	Have redundancy on key process equipment
Design Criteria	General	194	Layout of facility should consider personnel path to avoid exposure, contamination, and risk.

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VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Criteria	General	203	Provide CLEAN water supply to any mechanical seals for pumps...and proper method for supplying clean water to seals.
Design Criteria	General	221	All valves, process equipment e.g....., pumps etc. should be installed with flanged fittings instead of welded fittings to facilitate easy replacement.
Design Criteria	HEPA Filters	32	Include DOP testing ports on all HEPAs. Set up to FEMP plant standards for hookup of test equipment. Include provisions for access to HEPAs by test personnel and equipment. Involve plant HEPA filtration personnel early.
Design Criteria	HVAC	14	Set up Silo 3 transfer system HEPA with DOP testing provisions, proper radiation shielding, appropriate prefilter, etc.
Design Criteria	HVAC	63	Design for proper ventilation of rooms with UPS or other batteries.
Design Criteria	Melter	10	Provide current monitor on each electrode.
Design Criteria	Melter	19	Avoid use of refractory ceramic fiber where feasible due to inhalation safety concerns.
Design Criteria	Melter	33	Provide means for safely adding cold frit to melter (all chambers, if more than one) for testing and other purposes.
Design Criteria	Melter	53	Avoid the use of high maintenance items such as the electrode turning requirements on the pilot plant melter.
Design Criteria	Melter	108	Properly size electrode cooling water lines.
Design Criteria	Melter	150	Use of air supply for bubblers is crucial to operation. Add secondary/emergency air supplies for bubblers
Design Criteria	Melter	151	Pour spout air inleakage/discharge plugging. Need redesign on pour spout to minimize inleakage.
Design Criteria	Melter	154	Film cooler is plugging at entry point. Installed air lance is helpful...but, needs additional work.
Design Criteria	Melter	156	All bottom drains failed. Started leaking water into melter and below on floor. Need better design
Design Criteria	Melter	157	Melter does an auto discharge of glass. This causes plugging of discharge outlet.
Design Criteria	Melter	158	E- walls leak glass through them. Causes substantial increase in use of side chamber frit to maintain level and conductivity of side chambers.
Design Criteria	Melter	161	Cooling wter lines to melter was to small. Changed to larger lines

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Criteria	Melter	165	Premature failure of lid heaters
Design Criteria	Melter	168	Level detector consumed in melt pool
Design Criteria	Melter	204	Ensure that any new design of melters are designed so that we do not have continious auto discharge such as we have experienced with our melter.
Design Criteria	Melter	212	Materials of construction, eg. molybdenum, should not be used as they will reduce lead on contact.
Design Criteria	Melter	216	Physcial engineering controls need to be considered for the formation or phase separation of metallic Pb regardless of Redox control. Engineering control could be through pretreatment or through tapping molten metal as it accumulates.
Design Criteria	Off-Gas System	29	Auxiliary / emergency off-gas system needs to match primary in design and capabilities unless justified otherwise.
Design Criteria	Off-Gas System	30	Do not use deliquescent dryer as primary means of moisture removal from off-gas. If one is used for final moisture removal, provide means for charging desiccant as appropriate for usage rate.
Design Criteria	Off-Gas System	45	Design off-gas system for control of melter pressure, not system flow.
Design Criteria	Off-Gas System	46	Place quench tower a very few feet away from the melter. Include provisions for mechanical cleaning.
Design Criteria	Off-Gas System	47	Avoid the use of a deliquescent dryer, especially as the only means of moisture removal. Consider the use of refrigeration or other means of moisture removal.
Design Criteria	Off-Gas System	49	Separate melter off-gas handling from vessel vents as appropriate. Also, use two blowers on off-gas system(s).
Design Criteria	Off-Gas System	92	Protect carbon beds from heating due to sunlight. Include roof, insulation, cooling or other.
Design Criteria	Off-Gas System	171	Rapid consumption of disiccant, possibly building up in lines. Wetting of HEPA's. Replacing of prefilters on almost daily basis. Heat tape not entirely sucessful. Need long term fix, chiller?
Design Criteria	Off-Gas System	172	Inability to DOP test filters while system on line. Need to add piping to add capability.
Design Criteria	Off-Gas System	173	inability of off-gas system to provide desired melter vacuum. Added additional blower, limited by duct/pipe size. Inleakage higher than anticipated
Design Criteria	Off-Gas System	174	scrubber pump failures because of seals (multiple)
Design Criteria	Piping	15	Avoid putting [illegible]meters in high points of piping systems.

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VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Criteria	Piping	54	Use double-valve isolation as appropriate for maintenance of equipment.
Design Criteria	Piping	57	Design manually operated valves for easy access (location, chain or extension operators, etc.)
Design Criteria	Utilities	6	Include utility drops / hose hookup stations at appropriate points in facility.
Design Criteria	Utilities	7	Pipe air directly to permanent usage points such as seal pots on pumps and others.
Design Criteria	Utilities	16	Make sure that utility supplies are adequate, with plenty of allowance for expansion. (Note problems with process water to VITPP.) Consider in-house supplies for air or others if plant systems will need to be taken out of service.
Design Criteria	Utilities	64	Develop requirements for heat tracing early in project and implement consistently.
Design Criteria	Utilities	121	Include nitrogen purge for diesel fuel tanks or other means to prevent moisture accumulation, oxidation, and possible fuel contamination.
Design Execution	Control Systems	107	Systems Engineering or A/E select instrument set points and alarm points; implement in initial calibrations.
Design Execution	Control Systems	181	Grounding problems on DACS. Brought in additional outside contractor to help resolve problem. Need ensure that qualified personnell are avaible to suppport data system installation and maintaince.
Design Execution	Cooling Water	207	Cooling water originally contained antifreeze...This also contained small amounts of chlorides that could lead to corrosion problems. This was removed during Campaign 1.
Design Execution	Feed Preparation	144	Damage to pump diaphragms due to material selection, other problems/ parts made of new materials have been installed: Little improvement in life.
Design Execution	Feed Preparation	202	Slurry system has poor agitation. Agitator only reaches about two/thirds of the material in the slurry tanks. Pump recirculation is weak. However it is the only agitation when level is below the agitator. Need variable speed on agitation
Design Execution	Gem Maker	209	Reverse the cutter wheel and carbon wheel on gem maker.
Design Execution	General	2	Prepare standard specifications in advance for common items such as pumps, motors, valves, instruments, HEPA filters.
Design Execution	General	98	Require A/E to provide lists with quality levels, inspection, other appropriate information - equipment, valves, instruments, lines, wall penetrations, other.
Design Execution	General	99	Obtain block of CMMS numbers for valves, other items before issuing numbers in design, and
Design Execution	General	100	Show flanges, unions, other fittings on P&IDs.

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Execution	General	101	Show pipe hangers on initial construction issue of piping drawings. Use typical details where appropriate.
Design Execution	General	104	As-build P&IDs, other drawings as appropriate, including equipment and other items actually installed.
Design Execution	General	106	Fully integrate various disciplines' space requirements into three-dimensional model to eliminate interferences and space allocation conflicts.
Design Execution	General	112	Visit M-Area, other melters as appropriate to obtain lessons learned and other information.
Design Execution	General	114	Implement configuration management from the inception of the project.
Design Execution	General	115	Carry out performance grading on all structures, systems and components during Title I, in conjunction with preparation of P&IDs, hazard analysis, and hazard categorization. Document grading rationale thoroughly and obtain Technical Review Board approval. Incorporate performance grades into specifications.
Design Execution	General	118	Modify DCN forms and procedure to include performance grade, project engineering technical evaluation, and approval by Technical Review Board chair. Design engineer and project engineer should review in parallel, and DCN should be walked through the TRB during review cycle.
Design Execution	General	179	Access to some equipment and valves/instruments inadequate for operation and maintaince. Added stairs and platforms, relocated some equipment.
Design Execution	Melter	155	Monyo melter feed pumpcontinually fails. Seals do not hold up/ and pump is insufficient to supply melter feed at required rates.
Design Execution	Melter	162	Side chamber frit feeder inoperable.
Design Execution	Melter	163	side drain on melter, non operable. Also, A/E, Engineering forgot to install method for discharge of glass.
Design Execution	Melter	164	Failure of Thermowells on melter. need resolution
Design Execution	Melter	166	Premature failure of I. R. detectors on side chambers
Design Execution	Melter	169	Air bubbler # 1 inoperable.
Design Execution	Off-Gas System	175	Quench tower has not been as effective as required. Plugging of spray nozzles. Replaced plugged spray nozzles.

000200

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Design Execution	Off-Gas System	176	Very lengthy and torturous off-gas routing, increased potential for plugging. Needto locate quench tower near melter.
Operation	Cooling Water	160	Water quality of cooling systems must be controlled to strick specifications
Operation	General	198	Prove equipment with cold running. Go HOT only when you are ready.(It's expensive and time consuming when your not)
Operation	Melter	149	development of cold cap on glass melt reduces quanity of solids to the off-gas system
Operation	Melter	210	Redox condition should be monitoried closely through real-time monitoring or chemical analysis (FE2/FE3 ratio).
Operation	Melter	214	Physcial engineering controls need to be considered for the formation or phase separation of metallic Pb regardless of Redox control. Engineering controls could be through pretreatment or though tapping molten metal as it accumulates.
Procurement	General	1	Require construction subcontractors to submit operation and maintenance manuals on equipment they purchase during construction.
Procurement	General	11	Specify desired equipment and "or equal" salient features tightly enough to assure likelihood of getting desired item.
Procurement	General	12	Fully define requirements for construction acceptance testing and turnover package contents in specifications (wiring checks, tests of motors, line flushing, hydrostatic testing, data sheets, submittals, QA checks, etc.). Include correction of deficiencies in subcontractor scope, estimate.
Procurement	General	20	Specify valves to accept plant standard locks. Also, specify all process valves to avoid problems observed with VITPP manual valves (difficulty in operating valves).
Procurement	General	31	Require vendors to number their equipment, valves, lines, instrumentation, etc., consistently with plant numbering standards. Provide blocks of numbers from project system for vendors to use.
Procurement	General	59	Require redlines from subcontractor upon completion of work.
Procurement	General	68	Plan major procurements well in advance to phase design and construction properly and to provide vendor design for interface early in detailed design.
Procurement	General	78	Establish number of sets of documents needed from vendors and list of recipients at site.

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Procurement	General	80	Equipment specification has to be exacting, no open-ended statements. Try to buy standard equipment and off-the-shelf items (avoid custom designs) where feasible.
Procurement	General	113	Engineer responsible for design of any system should review related procurement packages.
Procurement	General	183	Ensure that when a RFP goes out that acceptable Construction Acceptance Testing requirements are included, and that Startup Turnover and Testing approves requirements.
Procurement	General	184	Define the specifications for pipe flushing. In the SPECS.
Procurement	Melter	13	Include significant weight for past performance on deliverables, etc., in technical evaluation of melter vendors.
Procurement	Melter	50	Require vendor of melter and other major equipment assemble equipment off-site as much as possible. Also, require vendors to provide critical spares with equipment, or at least as part of contract.
Project Management	Control Systems	43	Define deliverables for documentation of control system software
Project Management	General	9	When design is frozen, set up in advance system for tracking and analyzing root causes of DCNs. Set up categories and system for tracking and controlling costs of each DCN.
Project Management	General	17	Plan for adequate resources at FERMCO and at A/E for Title III.
Project Management	General	18	Do plastic block model on general plant layout to allow for good review of layout, proximities, operability, etc.
Project Management	General	24	FERMCO and A/E use same numbering system for DCNs.
Project Management	General	25	Avoid the inclusion of used equipment in the design (for example, lab trailer, pumps, stack monitors, HEPA filters and associated problems during pilot plant construction and startup).
Project Management	General	34	Follow plant labeling standard (ED-12-4016) and all other applicable plant procedures (engineering, RSO, safety and others).
Project Management	General	35	Thoroughly spell out all vendor requirements in specifications - deliverables, documentation (O&M manual, cut sheets), interfaces with A/E, with rest of plant and other vendors, compliance with site procedures, in-plant test procedures by vendor, spares, supplies, chemicals. A/E integrate and check vendor packages.
Project Management	General	36	Make goals of project and facility clear from the outset to all personnel and organizations involved.
Project Management	General	37	Carry out decisions and design in logical order to reduce unnecessary rework.
Project Management	General	40	Include requirements for cold and hot operational testing in facility design criteria.

000202

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Project Management	General	41	Involve appropriate groups and subject matter experts from definition of design requirements on, and allow time for thorough reviews on their part. Include construction, procurement, operations, maintenance, safety and others.
Project Management	General	42	Avoid ratcheting effects of midstream changes in internal procedures or other requirements.
Project Management	General	52	Do not split up design work - have all design done by one agency.
Project Management	General	60	Before preparing Design Change Notices, concerned personnel in FERMCO engineering, construction and startup and A/E project management and design disciplines should discuss the problem and possible solutions (hold an alignment session) and spend time in the field as necessary to make sure that the solution is right.
Project Management	General	61	Design and construct systems for phased turnover and testing.
Project Management	General	65	Define requirements for review and checking of vendor drawings, calculations and other media as part of procurement specifications.
Project Management	General	69	Provide ample office trailer space as needed for various project personnel (construction, engineering, training, startup, etc.)
Project Management	General	93	To the extent feasible, arrange for the same engineers to do systems engineering and design, write and perform systems operability tests, start up the facility, and operate the plant.
Project Management	General	94	Institute system for transfer of information from systems operability testing and other VITPP activities to future design work.
Project Management	General	95	Have A/E redline drawings in the field, not the construction subcontractor.
Project Management	General	105	During SO testing, startup and operation, involve Engineering and Maintenance in any consideration of changes to or replacement of equipment, valves or piping.
Project Management	General	109	Design and construct plant with readiness review in mind. Functional area managers document how the plant and their activities meet specified requirements, company procedures.
Project Management	General	116	All project documents must be maintained in a single central project file, whether originated by FERMCO, A/E, vendor, construction subcontractor or other.
Project Management	General	123	Personnel reviewing plant operating data should hold frequent discussions with operations personnel for full understanding of operational changes, test results and other considerations.

VIT Pilot Plant - Lessons Learned

Area	Subarea	Number	Description
Project Management	General	124	The project manager should require all functional area managers to conduct readiness preparation in their areas. The project manager also needs to support training and other work by the functional area managers to learn what is needed for RA or ORR and to prepare for it.
Project Management	General	125	The ORR plan of action should be prepared early in the project. The ORR plan of action should define who is responsible for the various areas of readiness preparation (generally the functional area managers).
Project Management	General	126	The various functional areas should review other areas' preparations for ORR to avoid gaps and inconsistencies.
Project Management	General	127	The functional areas' preparation for readiness review should be built into the master schedule.
Project Management	General	128	Readiness reports from UNH, thorium overpack, other sites and VITPP RA should be reviewed as part of the planning and execution of future VITPP ORR.
Project Management	General	129	Self-assessments by FEMP personnel not on VITPP should be conducted to make sure that the systems put into place just before RA are functioning as intended and to otherwise prepare for VITPP ORR.
Project Management	General	196	Have good characterization of site residues
Project Management	Melter	111	Schedule project so that preliminary melter design is provided in time for design of off-gas, utility and other systems. Carefully define equipment interfaces and lines of communication between melter vendor, other vendors, and rest of project.
Project Management	Off-Gas System	110	Involve melter vendor in design of off-gas system - design system, provide or review system basis and design requirements.
Startup	Feed Preparation	189	Start ASAP the simulation tests of the whole retrieval system
Startup	General	21	Define during construction methods for documenting and resolving problems found by personnel from any functional area during startup and SO testing.
Startup	General	44	Define need and responsibility (Maintenance vs. construction subcontractor) for instrument calibration during Title II. Make sure requirements for documentation of any calibration are clear to subcontractor.
Startup	Melter	205	Ensure that during initial startup of amy new melter, that you fully understand the thermal heat stresses to be encountered during initial heat up.

000201

Appendix B
Final Test Report for
Test Procedure 2504-SU-0039
Pilot Plant Systems Operability Test Procedures
Glass Campaign 4

FINAL TEST REPORT FOR

TEST PROCEDURE 2504-SU-0039

PILOT PLANT SYSTEMS OPERABILITY TEST PROCEDURES

GLASS CAMPAIGN 4

Revision 0

March 11, 1997

FOR INFORMATION ONLY

APPROVED BY:

VITPP Quality Assurance	3-11-97 Date
VITPP OS&H	3/11/97 Date
VITPP CRU4 Project Manager	3/11/97 Date
VITPP Operations Manager	3/11/97 Date
VITPP Regulatory Programs	3/11/97 Date
VITPP Start-Up and Turnover	3-11-97 Date

Fernald Environmental Restoration Management Corporation
Fernald, Ohio

TEST DATA REPORT

Test Report Issue Date 3/11/97

Partial Test Report No. N/A

Supplement No. N/A

Final (All testing and identified retests are complete)

Test Procedure Number:	2504-SU-0039
Test Procedure Revision:	0
Test Title:	PILOT PLANT SYSTEMS OPERABILITY TEST PROCEDURES OPERATIONAL TESTING OF GLASS CAMPAIGN 4
Date(s) of Test:	November 28, 1996 through December 26, 1996
Test Sections Covered by this Report:	All sections completed
Procedure Completion Form Issued	3/11/97

Test Report Prepared By _____ 3-11-97
Test Coordinator Date

Test Report Approved By _____ 3/11/97
Project Manager Date

PROCEDURE COMPLETION FORM (PCF)

Test Number: 2504-SU-0039, Rev. 0	Date: 3/11/97
Test Title: Test Procedure 2504-SU-0039, Rev. 0, Vitrification Pilot Plant Startup Program, Phase I, Pilot Plant System Operability Test Procedures , Glass Campaign 4.	
Procedure Sections Completed : All Sections completed. (Current test period only)	
All TP Sections Complete? X YES ☐ NO	Previous PCFs Issued:NONE
Date(s):11/28/96 through 12/26/96	
Description of System Tested and Boundary: To demonstrate and document melter performance during processing series A glass for extended periods and with minimal down time. A secondary objective is to gather process data for formulations of future series A runs.	

Testing Started: November 28, 1996	Testing Completed: December 26, 1996

Unresolved or open Plant Work Request/Orders or RCAs/CWOs which effect system maintenance are as follows:

NONE

Evaluation of Testing: Data obtained in test sections complete. Appears to be satisfactory:

[illegible] — Test Coordinator

3-11-97 — Date

A. Disposition of Test Equipment

Remove the following at earliest convenience: N/A

Retain the following until notified otherwise: N/A

Justification for retaining: N/A

B. Plant Work Requests and System Tagouts:

Plant Work Requests and System Tagouts for performing this Test Procedure either have been cleared or are noted as exceptions in the Remarks section

N/A		N/A	
Test Coordinator	Date	Facility Owner	Date

000208

PROCEDURE COMPLETION FORM (PCF) (Continued)

C. **Jumpers and Disconnected Wires:**

Jumpers and Disconnected Wires used to conduct this Test Procedure have been cleared or are noted as exceptions in the Remarks section with explanations as to why they are in the system and under what conditions the system can be restored to normal. The FO accepts custody for all installed jumpers and disconnected wires.

Test Coordinator: [signature] Date: 3-11-97 Facility Owner: [signature] Date: 3/11/97

D. **Drawings Used for Testing:**

Indicated below (or attached) is a list of any drawings which were changed by Engineering Change Notice due to performance of this Test Procedure or the associated CG&A package.

Test Coordinator: [signature] Date: 3-11-97

Drawings/Revision No./ECN No. NONE

E. **Operating Procedures Used for Testing:**

All required changes to Operating Procedures used during CG&A or Test Procedure have been identified and transmitted to the Facility Owner

Test Coordinator: [signature] Date: 3-11-97

F. **REMARKS:**

NONE

The FO accepts responsibility for the system (or partial system) tested.

Facility Owner: [signature] Date: 3/11/97

FS-F-3982 (09/14/94)

000209

VITRIFICATION PILOT PLANT
PHASE I
CLOSEOUT OF
SYSTEM OPERABILITY TEST PROCEDURE 2504-SU-0039 REV.0
GLASS CAMPAIGN 4

The following report summarizes the Vitrification Pilot Plant (VitPP) System Operability Test Procedure Glass Campaign 4, 2504-SU-0039, Revision 0 in accordance with the requirements of ENG-12-6003 Startup and System Operability Test Procedure.

SUMMARY

System operability testing in accordance with revision 0 of the SOT for the VitPP Melter commenced on November 28, 1996 and was terminated on December 26, 1996. During Campaign 4, a total of nine (9) slurry tank batches were fed to the Melter. The scope of these nine (9) batches was as follows:

Series A Transition Glass (two (2) batches @ 1250°C)
Series A Glass (six (6) batches @ 1250°C)
Series A Transition to Low Temperature Glass (one (1) batch @ 1150°C)

Prior to the start of the series A low temperature run, the Melter (all three (3) chambers, East Side Chamber, West Side Chamber, & Center Chamber) unexpectedly drained through Bubbler #3. A majority of the drained glass was contained in the bottom drain container. Due to this event, the following runs were not performed as part of Campaign 4 System Operability Testing.

Series A Low Temperature Glass (1150°C)
Series B Glass (Bentonite @ 1150°C to 1250°C)
Transition to Series A Glass (1250°C)
Testing System Efficiency & Capacity (1150°C to 1350°C)

Summary data for the nine (9) batches is provided in the attached "Test Performance Parameters for SOT Campaign 4 at the Vitrification Pilot Plant" data sheets. Some noted highlights from these sheets are as follows:

Average Melter Temperature:	1250° C
Total Slurry Fed:	60,609 lbs
Total Glass Produced as Monolith:	22,412 lbs
Total Glass Produced as Gems:	0 lbs
Total West Side Chamber Frit:	1100 lbs
Total East Side Chamber Frit:	1025 lbs
Total Center Chamber Frit:	400 lbs

The following provides a correlation between the processed batch and the section of the SOT to which it corresponds:

Batch No.	SOT Section	Description
C4B01 & C4B02	7.1	Transition 1: Transition Glass in Center Chamber to Series A.
C4B03 - C4B08	7.2	Run 1: Testing with Series A Formula Surrogate Slurry at 1250°C.
C4B09	7.3	Transition 2: Transition Glass in Center Chamber to Low Temperature Series A.

Attached is a "Test Performance Parameters for SOT Campaign 4 at the Vitrification Pilot Plant" data sheet for each batch ran during Campaign 4. Each batch data sheet compiles operational data, sampling data, slurry feed/glass production data, etc. that pertain to each batch.

PURPOSE

The purpose of this test was to demonstrate and document the results of processing the series A glass for extended periods and with minimal down time. A secondary objective was to gather process data to assist in determining the formulation for other series A runs. Series A glass is a surrogate glass composition which is used to simulate the waste material in Silo 1. This System Operability Test covers:

Note - The remainder of this document will only address the sections of 2504-SU-0039, Rev. 0 that were completed (7.1, 7.2, & 7.3).

- The displacement of benign glass (idle state) with the series A (Silo 1 surrogate material) glass.
- The operation/feeding of series A glass for extended periods **(i.e. less than 30 minutes of slurry feed down time)** at a rate of one to one and one-half metric tons per day of glass production.
- The displacement of the existing series A glass formulation within the Melter with a modified series A glass formulation that supports a lower melt temperature.

INTERIM CHANGE PROCEDURE

A total of 13 Interim Change Procedures (ICP's) were written during the performance of this test. The ICP system addresses changes to the SOT methodology and criteria.

ICP 96-01 Written to revise/update the "Test Performance Parameters Sheets" to better reflect the identified needs of the end data user and to provide a better profile of each batch.

ICP 96-02 Written to add a column to the batch sheets to record the actual amount of material added during bag dumping.

ICP 96-03 Written to delete step 7.1.3.5 of attachment 2. This step stated the requirement to confirm the acceptance of the analytical data before feeding batch one (1).

ICP 96-04 Written to combine the "Melter Off-Gas Data Sheet" (attachment 7) and the "Melter Feed / Off-Gas Data Sheet (attachment 6) into one (1) data round sheet titled "Off-Gas System Performance Data". This new round sheet is referenced as attachment 6 and also includes the modifications made to the normal off-gas system prior to Campaign 4.

ICP 96-05 Written to correct references in attachment 2 pertaining to the "Test Performance Parameter Sheets" (attachment 5), the deletion of attachment 7 in ICP 96-04, and the addition of reference to pump curves for the Melter Feed Pump.

ICP 96-06 Written to incorporate direction stated in Long Term Order 96-25. The Long Term Order stated that the center chamber glass level must be maintained 1-3 inches below the seam on the West E-wall. Steps referring to "delaying discharge until auto discharge" in the SOT were changed to reflect requirements of this Long Term Order.

ICP 96-07 Written to delete step 7.2.3.5 & 7.2.3.6 of attachment 2. These steps stated the requirement to confirm the acceptance of the analytical data before feeding batch two (2).

ICP 96-08 Written to delete step 7.3.3.5 & 7.3.3.6 of attachment 2. These steps stated the requirement to confirm the acceptance of the analytical data before feeding batch three (3).

ICP 96-09 Written to delete step 7.4.3.5 & 7.4.3.6 of attachment 2. These steps stated the requirement to confirm the acceptance of the analytical data before feeding batch four (4).

ICP 96-10 Written to delete step 7.6.3.5 & 7.6.3.6 of attachment 2. These steps stated the requirement to confirm the acceptance of the analytical data before feeding batch six.

INTERIM CHANGE PROCEDURE (Continued)

ICP 96-11 Written to delete step 7.8.3.5 & 7.8.3.6 of attachment 2. These steps stated the requirement to confirm the acceptance of the analytical data before feeding batch eight (8).

ICP 96-12 Written to address an event during bag dumping of batch nine (9) when sequence one (1) material became clogged in the Additive Filter/Receiver. Some of the material was inadvertently transferred to Slurry Tank B as a result of the dislodging the clog. Additional sodium carbonate and lithium carbonate was added to Slurry Tank A to compensate for the error.

ICP 96-13 Written to address the inability to maintain Melter temperature of 1250°C for the portion of batch C4B09 remaining after the six lifts of glass were discharged from the Melter. Per the Testing and Data Manager, the permission was granted to reduce the target temperature to 1150°C (Batch C4B09 was the transition to a low temperature series A glass).

TEST EXCEPTIONS

No Test Exception (TE) was written against 2504-SU-0039 Rev. O.

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED

Electrode Cooling System

Problem: Bottom Drain #2 was found with no flow from the Electrode Cooling System, and was leaking cooling water from the cooling jacket.

Solution: Bottom Drain #2 was isolated from the Electrode Cooling System and transferred to a temporary cooling system. Bottom Drain #2 was isolated to protect the Electrode Cooling System from possibly draining if further problems occurred with Bottom Drain #2, and to achieve a higher cooling flow rate through Bottom Drain #2. Although Bottom Drain #2 was transferred to the temporary cooling system, cooling water flow did occasionally pause for extended periods of time. During periods of no flow, there were no indications of a temperature problem via TI-014 (Bottom Drain #2 temperature indicator).

Bottom Drain #2 continued to leak the remainder of Campaign 4. Corrective action and/or a determination of the exact location of the leak would have

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued)

required removing the bottom drain assembly and Bottom Drain #2, which was not an option during Campaign 4.

Material Additive System

Problem: Dry chemicals were found to be accumulated within the Additive Filter / Receiver on three (3) occasions preventing dry chemicals from entering the slurry tanks. Approximately 300 to 550 lbs. of material were inventoried each time.

Solution: The temporary Air Operated Vibrator installed during Campaign 2, on the outside of the Additive Filter/Receiver, was made a permanent piece of VitPP equipment. Monitoring the increase in weight of the slurry tank during dry material additions and adjusting the air on the vibrator decreased the problem of material accumulation in comparison to Campaign 2. Additionally, the practice of combining the finer meshed and denser material (clogging materials) with other non-clogging material (i.e. Silica) aided in successfully transferring material through the Additive Filter/Receiver.

Problem: During the efforts to mobilize the accumulated material in the Additive Filter /Receiver, the material moved downward and again accumulated in the Rotary Airlock and the Additive Filter/Receiver Diverter.

Solution: The Additive Filter/Receiver Diverter was cycled to loosen and mobilize any material inside the piping. The Rotary Airlock was removed and cleared of dry material. The removal of the Rotary Airlock also gave access to manually rodding the Additive Filter/Receiver from below.

Problem: The dry material clogged in the elbow just down stream of the Bag Dump Station during bag dumping operations.

Solution: Along with the practices listed above, the vacuum blower package (5-BL-66) used in Campaigns 1 & 2 was replaced. The new vacuum blower has higher vacuum pressure capabilities than the original blower. Additionally, it was determined when the filter within the Additive Filter/Receiver was beginning to clog, 5-BL-66 should be shut off momentarily to allow material to drop off the filter and into the receiver. Cycling 5-BL-66 from ON to OFF would increase the bag dumping process performance.

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued)

Gem Machine

Problem: While discharging glass to the Emergency Drum, large amounts of glass would collect and solidify on the Discharge Chute just below the diverter. The glass would build a column of glass down through the Emergency Gate and into the Emergency Drum. The glass restricted the closing of the Emergency Gate

Solution: After allowing the glass to solidify, the Gem Machine's front glass panel was removed and the glass was manually removed by rodding and hammering.

Problem: While discharging glass to the Start-up Drum Via the Start-up Diverter, the glass stream would miss the Start-up Diverter and spill onto the Gob Roller/ Cutter.

Solution: Initial solution was to switch to the Emergency Diverter. Torching or frequent discharging of glass, to prevent glass formations, allowed the discharge glass stream to flow through the normal path to the Start-up Diverter.

Melter

Problem: During Campaign 4, the Center Chamber foamed on five (5) occasions. Of these five (5), one lasted for 5 ½ hours, while another had symptoms of foaming with no visual signs. During Campaign 4, the increase in the deterioration rate of the East & West E-wall and the Discharge Chamber Riser Brick was noticed. Long Term Order 29-96, "*Prompt Failure Of The West Side Chamber E-wall*" addressed any possible failure/collapse in the West Side Chamber E-wall.

Solution: VitPP Long Term Order 30-96 states the requirements for reacting to Center Chamber foaming. These requirements are as follows.

> *"Slowly increase power approximately 40 KW. If temperature continues to decrease at a substantial rate, cut power approximately 100 KW. A temperature increase should be noted. Allow temperature rise to level off to the point at which it just begins to fall. At this point, power can be increased in approximately 10 KW increments to maintain, or slightly increase temperature."*

If the above was unsuccessful in correcting the foaming problem, water was fed at 50 to 100 rpms to help reduce the foaming.

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued)

Problem: During Campaign 4, the West Side Chamber foamed on eleven (11) occasions. Of these Eleven (11), two (2) times the West Side Chamber foamed over the E-wall into the Center Chamber.

Solution: Several different strategies were used to combat side chamber foaming. The combination of strategies were sometimes successful. Tactics used to correct foaming in the West Side Chamber are listed below:

- Reduce KW (at times reduced to 50 KW).
- Addition of frit to the Side Chamber. Addition of frit lowered the temperature of the foaming glass. Also, the weight of the frit would compress the foaming glass to its normal level.
- Flush the existing contents of the West Side Chamber with frit through the holes in the E-wall replaced the Side Chamber glass with benign glass. On one occasion, a total of 300 lbs. Of frit was added to the West Side Chamber over a period of 10 hours.

Problem: During Campaign 4, the East Side Chamber had one significant foaming . The one (1) foaming event caused the East Side Chamber to foam over the E-wall for an extended period of time.

Solution: The East Side Chamber was flushed with 175 lbs. of frit over a period of 5 hours and 45 minutes. The foaming event occurred during a time when maintaining Melter temperature was difficult and Melter temperature was below the desired operating range. Therefore, VitPP Operations could not afford to drop power long enough to correct the foaming problem.

Problems: The Discharge Chamber Heaters failed.

Solution: New Discharge Chamber Heater Elements were installed. Operation of the Discharge Chamber Heaters was regained.

Problem: During the pulling of control fuses to remove power from the Feed Pump Level Switch, the wrong fuses were pulled. The control power fuses on the Melter control panel were pulled which removed power from SCR #1 (Electrode power source) and SCR #2 (Discharge Chamber Heater power source). SCR #1 and SCR #2 both tripped their respective circuit breakers simultaneously. SCR #1's circuit

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued)

breaker was unable to be reset initially for reasons unknown. SCR #2's circuit breaker reset but the DCS was not able to regain control of the SCR #2. After approximately 30 minutes, SCR #1's circuit breaker was reset. As in SCR#2, the DCS was unable to regain control of SCR #1.

Solution: At approximately 1 hour and 15 minutes after both SCRs lost power, control was regained to both SCR #1 and SCR #2. Prior to the event, both SCRs were controlled at the DCS. To regain control, SCR #1 had to be controlled in manual at the ATHENA controller on the Melter Control Panel and SCR #2 had to be controlled in manual at the SCR. After both Melter temperature and the Discharge Chamber temperature were brought within the normal operating parameters, control to SCR #1 was returned to the DCS. The DCS never regained control of SCR #2 after Maintenance reprogrammed the control loop.

Discharge Chamber

Problem: As in Campaign 2, molten glass migrated to the Discharge Orifice and obstructed the normal glass flow path from the Discharge Orifice. A welder was required to melt the glass with a rosebud torch seventeen (17) times. Operations personnel were required to manually remove glass obstructions from the Discharge Orifice area on many occasions. In both cases, SCR #1 was required to be de-energized for the entire duration that personnel were in contact with molten glass. Depending on the amount of glass to be removed, this operation took up to ninety (90) minutes. Melter temperature was dependant on the time to perform this operation. When SCR #1 was secured, Melter temperature continually drops until power was restored. As the lower temperature limit was approached, glass removal operations are terminated and power was restored. The glass removal can continue once Melter temperature is regained.

Solution: The only proven remedy for this Discharge Chamber problem was to constantly visually check the Discharge Orifice for migrating glass. When the amount of migrating glass and its location to the Discharge Orifice began to approach the normal discharge path , a discharge of glass would be initiated to melt away the majority of the migrating glass. Discharging glass to maintain an clear Discharge Orifice during Melter idle periods

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued)

would lower the Center Chamber glass level below the desired lower limit. Therefore, if the Melter was in an idle state for an extended period of time, the Discharge Chamber would be allowed to be blocked by migrating glass. This glass would have to be removed, using a torch, prior to exiting the idle state.

Normal Off-Gas

Problem: The Air Lance/Film cooler was blocked with glass and Off-Gas particulate approximately thirty-three (35) times during Campaign 4 and prevented the Off-Gas System from maintaining -0.75 inches w.c. melter pressure.

Solution: Thirty-three (35) times, the Air Lance was removed, quenched in a 55 gal. Drum of water, and cleaned/replaced. Two (2) times the Air Lance was replaced due to permanently clogged air passage holes in the lance.

Problem: Normal Off-Gas system was unable to maintain Melter pressure at -.75" WC.

Solution: After unsuccessfully performing several actions to improve Melter pressure, it was found that the Emergency Drum had drifted down. This allowed an increase in air in leakage through the Emergency Gate. The Emergency Drum was raised to its normal position and Melter pressure returned to -.75" WC.

Problem: Normal Off-Gas system was unable to maintain Melter pressure at -.75" WC.

Solution: After checking the Air Lance and determining that it was not the source of the Off-Gas problem, it was determined that the clog was located between the Film Cooler and the Quench Tower. The Off-Gas piping near FV-175 was manually vibrated to clear the pipe. Hardened material was heard bouncing through the piping as each vibration occurred. After all material seemed to be removed from the piping (no more sound of material moving), an attempt to restore the Normal Off-Gas was unsuccessful. FV-175 was removed and a Boroscope was used in attempt to locate the clog. This attempt was unsuccessful. FV-175 was replaced and Off-Gas pipe insulation was removed from within the Melter Room. Again the Off-Gas piping was manually vibrated until seemingly all removable material within the Off-Gas piping was dislodged and Melter pressure returned to near -.75" WC.

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued)

Slurry System

Problem: The Slurry System was incapable of operating with batches greater than 45% weight solids. Slurries of this composition would setup within the slurry piping and/or the slurry tanks, or place excessive stresses on the slurry pumps. Slurry pumps were found hesitating, missing a stroke, or stopping.

Solution: Batches were prepared to have percent weight solids of less the 45. If a batch exceeded the 45% weight solids or if the slurry pumps was having difficulties moving the slurry, a controlled amount of water was added to the slurry tank to dilute the batch.

The following practice, that was developed during Campaign 2, was required to maintain a functioning slurry feed operation. An indication to a Slurry Pump problem was a Low Alarm on FI-170 "Melter Feed Loop Flow Indicator". The alarm sounds at ≤ 30 gpm. During normal operations the new Marathon® slurry pumps would register approximately 50 gpm on FI-170. With operational experience, it was known that the slurry was becoming too viscous when the DCS received a low flow alarm on FI-170. The corrective action was to add additional water to the respective slurry tank and cycle the agitator to stop the water from vortexing.

Problem: The slurry pumps and piping clogged on twenty-one (21) occasions.

Solution: Approximately 75% of the clogs were removed by cycling valves, using flush water, and diverting flow paths. The remaining 25% of the clogs required the removal of chemical hoses and either rodding or external water pressure applied to clear the lines. Of the 25%, 15% required maintenance to remove piping and valves prior to rodding and flushing.

Problems: Sample Port S4A was found to be clogged.

Solution: Maintenance was needed to remove the clog in the sample port (via either rodding, removal of piping and valves and/or applying external water pressure).

Problem: Slurry Pump B failed two times.

Solution: Maintenance removed and rebuilt the Slurry Pump B each time.

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued)

Problem: On several occasions it was found that the slurry percent weight solids was too low. Low %wt solids made it difficult to maintain an effective cold cap. The low %wt solids were a result of prior slurry clogging and flushing operations.

Solution: The agitator was turned off for a specified time period. This allowed the solids in the slurry to accumulate at the bottom of the Tank and raise the %wt solids near the suction of the Slurry Pump. Also, the rate of the Feed Pump would be lowered.

Problem: It was determined after completing a batch that solid material would remain adhered to the walls of the slurry tank. Sometimes several hundred pounds remained in the tank.

Solution: A procedure change was written to 11-C-267, "Feed Prep Phase I". Flush water would be added to the Slurry Tank and the contents of the tank were fed to the Melter until a low flow was indicated on FI-170. Flush water removed any slurry that remained on the walls of the slurry tanks.

Emergency Off-Gas Initiations

A total of 15 unintentional initiations of the Emergency Off-Gas occurred during Campaign 4. The causes of these initiations were as follows:

- Drifting of the emergency drum. This allowed for an increased amount of air in leakage in which the Normal Off-Gas could not maintain the normal operating Melter pressure.

- Off-Gas particulate clogging the Off-Gas transition line. This situation decreased the off-gas flow between the Melter and the Normal Off-Gas fan (5-FA-25).

- Flushing the slurry feed line between the Melter Feed Pump and the Melter while a cold cap exists. The cold cap allowed water to puddle on top and eventually caused the cold cap to collapse tripping the Emergency Off-Gas.

- Differences in the percent solids between consecutive batches The exchange between feeding batches C4B04 and C4B05 is one of few times that two batches were consecutively fed with a minimal duration

PROBLEMS ENCOUNTERED AND SOLUTIONS IMPLEMENTED (Continued

of time between the feeding of the two batches. Near the end of any batch, the percent weight significantly increases from its desired percent weight. This higher percent weight creates a thicker cold cap. After switching Melter feed to batch C4B05, the lower percent weight caused a build-up of a much less percent weight (more water) slurry on top of the existing cold cap causing it to collapse.

- Re-establishing flow through FV-175. Restoring Normal Off-Gas required re-establishing flow through FV-175. This process required manually opening a valve very slowly. If the valve was opened too quickly, the influx of water into the Normal Off-Gas line caused a momentarily increase in Melter pressure and initiated the Emergency Off-Gas.

APPLICABLE DOCUMENTS

The following drawings plus Constructor redline drawings were used to develop and perform this test.

94X-5900-F-851	Furnace and Gem Machine
94X-5900-F-278	Flow Diagram
94X-5900-F-279	Flow Diagram
94X-5900-F-280	Flow Diagram
94X-5900-N-272	Furnace and Gem Machine
94X-5900-N-315	Off-gas air
94X-5900-N-820	Emergency Off-gas system
94X-5900-N-891	Melter Water Cooling system
94X-5900-E-0935	Bottom Drain Electrical Drawing
CRU4-X-I-002	Melter PID
CRU4-X-I-003	Melter PID
CRU4-X-I-004	Utility Air PID
CRU4-X-I-005	Cooling Water PID
CRU4-X-E-002 SHTS 1-10	Melter Electrical Drawings
CRU4-X-EW-01	Utility Rack Wiring Diagram
CRU4-X-EW-02	Gem Machine Wiring Diagram
CRU4-ES-13	Gem Panel Annunciator Drawing
CRU4-M-M-26	Melter 1000 HT Drain Valve Assembly

A review of the Design Change Notices (DCN's) posted against VitPP was performed. The following DCN's were identified to have potential impact to the test boundaries. All DCN's listed below were satisfactorily implemented in the field and bounded by this test package.

DCN's 21, 29, 33, 37, 39, 55, 56, 95, 97, 117, 157, 200, 210, 243

Other DCN's initiated subsequent to this test package should be evaluated for impact to system performance and re-test requirements.

PROCEDURE ACCEPTANCE

System performance is found to be acceptable according to the criteria specified by SOT 2504-SU-0039 Rev. 0. The SOT is complete.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B01 Slurry Tank A or B
Date Charged 11/29/96	Formula: Transition - to pull to Series "A"

Batch Objectives: Transition Formula to pull

Melter glass to Series "A" composition.

Dry Weight Charged	2924 lbs
Barium Sulfate charged	94 lbs
Barium Carbonate charged	120 lbs
Lead Oxide charged	300 lbs
Initial Weight (full batch)	5637 lbs
Final Weight (heel before flush)	137 lbs
Amount of Slurry Fed	5500 lbs
Slurry Feed Duration	29 hr.
Amount of Glass Produced	2517 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04B-961129-2231	1.4	40.6
S05A-961130-0520	1.38	39.72
S05A-961130-1500	1.27	29.8

Notes:
(1) Start @ 0340 hrs on 11/30/96
(2) 11/30/96 @ 0700 Addition of 500 lbs of water (flush) to slurry tank B. The extra 500 lbs is not inluded in the initial weight listed above.
(3) 11/30/96 @ 1330 Addition of 1000 lbs of water (flush) to slurry tank B. The extra 1000 lbs is not included in the initial weight listed above.
(4) Added approx. 200 lbs of water @ 0700 hrs on 12-1-96.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B01D1	843	60	783	Mono	Emergency	12/01 @ 0945hrs
C4B01D2	0	60	0	Mono	Start-up	N/A
C4B01D3	939	60	879	Mono	Emergency	11/30
C4B01D4	915	60	855	Mono	Emergency	12/01 @ 0015hrs.
C4B01D5	0	60	0	Gem	Gem	N/A

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10-961201-1050	C4B01D4	*	2.66	N/A
S10-961201-1055	C4B01D3	*	N/A	Total TCLP Metals
S10-961201-1045	C4B01D3	*	2.71	N/A
S10-961201-1100	C4B01D4	*	N/A	Total TCLP Metals
S10E-961201-1300	Melter	*	2.68	Liquidus
S10E-961201-1305	Melter	*	N/A	Total Metals
S10C-961201-1315	Melter	*	2.70	Liquidus
S10C-961201-1320	Melter	*	N/A	Total Metals
S10W-961201-1330	Melter	*	2.67	Liquidus
S10W-961201-1335	Melter	*	N/A	Total Metals
S10-961202-1205	C4B01D1	*	2.68	N/A
S10-961202-1200	C4B01D1	*	N/A	Total Metals

* See attached "Laboratory Glass Analysis Results" sheet.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition		COLD CAP OBSERVATIONS	
West Side Chamber	25 lbs	Average Cold Cap Coverage	60 %
East Side Chamber	100 lbs	Average Cold Cap Thickness	1 in
Center Chamber	0 lbs	Comments: Per long term order 25-96	

Note: Frit amounts account for all frit added while batch 1 drums remained on the Material Handling Conveyor.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	10 scfm	0 scfm	12/01 0030	_____scfm	_____
Air Lance Flow Rate	40 scfm	45 scfm	11/30 1835	40 scfm	11/30 2130
Bubbler 1 Flow Rate	8 scfh	_____scfh	_____	_____scfh	_____
Bubbler 2 Flow Rate	8 scfh	_____scfh	_____	_____scfh	_____
Bubbler 3 Flow Rate	8 scfh	_____scfh	_____	_____scfh	_____
Bubbler 4 Flow Rate	8 scfh	_____scfh	_____	_____scfh	_____
Air Lift Flow Rate	0 scfh	4 scfh	11/30 0658	7 scfh	11/30 1111
Trickle Air Flow Rate	2 scfh	_____ scfh	_____	_____scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____scfm	_____	_____scfm	_____
Air Lance Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 2 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 3 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 4 Flow Rate	_____scfm	_____	_____scfm	_____
Air Lift Flow Rate	_____scfm	_____	_____scfm	_____
Trickle Air Flow Rate	_____scfm	_____	_____scfm	_____

000226

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped	1	No. of cleanings of Air Lance	8
No. of times filter trains switched for extended operation.	5	No. of cleanings of Film Cooler Outlet	3

Date/Time Train Switched	Train Switched to: (A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
11/29/96	A Train	Clean	Clean			
11/30/96 @ 0735	Stayed on A Train	N	N	N/A	S48HLB-961130-0735	N/A
11/30/96 @ 0922	B Train	N	N	N/A	S48HLA-961130-0945	N/A
11/30/96 @ 0952	A Train	N	N	N/A	N/A	N/A
11/30/96 @ 1700	B Train	N	N	N/A	N/A	N/A
12/01/96 @ 0841 Switched to Emergency Off-Gas	B Train	N	N	N/A	N/A	N/A
12/01/96 @ 1000	Stayed on B Train	Y	N	S48PAFA-961201-1039	S48PLA-961201-1035	N/A
12/01/96 @ 1031 Still on Emergency Off-Gas	Both Normal Off-Gas off line	Y	N	S48PAFB-961201-1050	S48PLB-961201-1040	N/A
12/01/96 @ 1138 Still on Emergency Off-Gas	A Train	N	N	N/A	N/A	N/A
12/01/96 @ 1139 Emergency Off-Gas off line	A Train	N	N	N/A	N/A	N/A
12/02/96 @ 0844	B Train	N	N	N/A	N/A	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B02 Slurry Tank A or B
Date Charged 12/1/96	Formula: Transition - to pull to Series "A"

Batch Objectives: Transition Formula to pull

Melter glass to Series "A" composition.

Dry Weight Charged	2915 lbs
Barium Sulfate charged	80 lbs
Barium Carbonate charged	100 lbs
Lead Oxide charged	300 lbs
Initial Weight (full batch)	6440 lbs
Final Weight (heel before flush)	250 lbs
Amount of Slurry Fed	6190 lbs
Slurry Feed Duration	32.8 hr.
Amount of Glass Produced	2636 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04B-961202-0430	1.35	N/A
S04B-961202-0435	1.36	36.32
S04B-961203-0055	1.31	33.81

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B02D1	758	60	698	Mono	Emergency	12/02 @ 0945hrs
C4B02D2	599	60	539	Mono	Start-up	12/03
C4B02D3	946	60	886	Mono	Emergency	12/03
C4B02D4	0	60	0	Gem	Gem	N/A
C4B02D5	178	60	118	Mono	Emergency	12/04
C4B02D6	455	60	395	Mono	Emergency	12/04

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10-961203-1030	C4B02D1	*	2.74	N/A
S10-961203-1040	C4B02D1	*	N/A	Total Metals
S10-961201-2315	C4B02D2	*	N/A	Total Metals
S10-961203-2316	C4B02D2	*	2.76	N/A
S10-961203-2326	C4B02D2	*	N/A	Total Metals
S10-961203-2325	C4B02D3	*	2.75	N/A
S10E-961204-0330	Melter	*	2.64	Liquidus
S10E-961204-0331	Melter	*	N/A	Total Metals
S10C-961204-0332	Melter	*	2.68	Liquidus
S10C-961204-0333	Melter	*	N/A	Total Metals
S10W-961204-0334	Melter	*	2.74	Liquidus
S10W-961204-0335	Melter	*	N/A	Total Metals
S10-961204-1600	C4B02D5	*	N/A	Total Metals
S10-961204-1610	C4B02D5	*	2.72	N/A
S10-961204-2100	C4B02D6	*	N/A	Total Metals
S10-961204-2115	C4B02D6	*	2.71	N/A

* See attached "Laboratory Glass Analysis Results" sheet.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start 1500 hr	Stop 1500hr	Gem Start ____ hr	Stop _____ hr
Gem Start _____ hr	Stop ____hr	Gem Start _____ hr	Stop _____ hr
Gem Start _____ hr	Stop ____hr	Gem Start _____ hr	Stop _____ hr
Gem Start _____ hr	Stop ____hr	Gem Start _____ hr	Stop _____ hr
Gem Start _____ hr	Stop ____hr	Gem Start _____ hr	Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition

West Side Chamber	325 lbs
East Side Chamber	250 lbs
Center Chamber	0 lbs

Note: Frit amounts account for all frit added while batch 2 drums remained on the Material Handling Conveyor.

COLD CAP OBSERVATIONS

Average Cold Cap Coverage	90 %
Average Cold Cap Thickness	2 in

Comments: Off-Gas problems were less prevalent

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	_____scfm	_____	_____scfm	_____
Air Lance Flow Rate	40 scfm	45 scfm	12/02 1700	40 scfm	unknown
Bubbler 1 Flow Rate	6 scfh	8 scfh	12/02 1115	_____ scfh	_____
Bubbler 2 Flow Rate	6 scfh	8 scfh	12/02 1115	_____ scfh	_____
Bubbler 3 Flow Rate	6 scfh	8 scfh	12/02 1115	_____ scfh	_____
Bubbler 4 Flow Rate	6 scfh	8 scfh	12/02 1115	_____ scfh	_____
Air Lift Flow Rate	0 scfh	6 scfh	12/02 1115	9 scfh	12/03 1208
Trickle Air Flow Rate	2 scfh	_____scfh	_____	_____ scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____scfm	_____	_____scfm	_____
Air Lance Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 2 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 3 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 4 Flow Rate	_____scfm	_____	_____scfm	_____
Air Lift Flow Rate	_____scfm	_____	_____scfm	_____
Trickle Air Flow Rate	_____scfm	_____	_____scfm	_____

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ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped	1	No. of cleanings of Air Lance	5
No. of times filter trains switched for extended operation.	4	No. of cleanings of Film Cooler Outlet	5

Date/Time Train switched	Train Switched to:(A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/02/96 @ 0900	B	Initial Conditions	Initial Conditions			
12/02/96 @ 0900	Stayed on B Train	Y	N	S48PAFA-961202-0920	S48PLA-961202-0910	N/A
12/03/96 @ 0615	A Train	Y	Y	S48PAFB-961203-0625 S48HAFB-961203-0627	S48PB-961203-0625 S48HSB-961203-0627	N/A
12/03/96 @ 0821 Switched to Emergency Off-Gas.	A Train.	N	N	N/A	N/A	N/A
12/03/96 @ 0851 Still on Emergency Off-Gas	B Train.	Y	N	S48PAFA-961203-0900	S48PA-961203-0900	N/A
12/03/96 @ 1004 Still on Emergency Off-Gas	A Train.	N	N	N/A	N/A	N/A
12/03/96 @ 1016 Switch back to Normal Off-Gas.	A Train	N	N	N/A	N/A	N/A
12/04/96 @ 1604	B Train	N	N	N/A	N/A	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B03 Slurry Tank A or B
Date Charged 12/4/96	Formula: Series "A"

Batch Objectives:Frist Series "A" batch.

Dry Weight Charged	2725 lbs
Barium Sulfate charged	100 lbs
Barium Carbonate charged	50 lbs
Lead Oxide charged	200 lbs
Initial Weight (full batch)	5588 lbs
Final Weight (heel before flush)	106 lbs
Amount of Slurry Fed	5482 lbs
Slurry Feed Duration	21 hr. 25 min
Amount of Glass Produced	2140 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04A-961205-1110	1.43	45.96
S05A-961206-1315	1.25	31.12

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B03D1	842	60	782	Mono	Emergency	12/06
C4B03D2	679	60	619	Mono	Start-up	12/07
C4B03D3	0	60	0	Gem	Gem	N/A
C4B03D4	799	60	739	Mono	Emergency	12/07

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10-961207-1315	C4B03D2	*	N/A	Total Metals
S10-961207-1318	C4B03D2	*	2.74 mg/l	N/A
S10-961207-1325	C4B03D4	•	2.75 mg/l	N/A
S10-961207-1328	C4B03D4	*	N/A	Total Metals
S10-961208-0200	C4B03D1	•	N/A	Total Metals
S10-961208-0201	C4B03D1	*	2.75 mg/l	N/A

• See attached "Laboratory Glass Analysis Results" sheet.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition		COLD CAP OBSERVATIONS	
West Side Chamber	250 lbs	Average Cold Cap Coverage	85 %
East Side Chamber	75 lbs	Average Cold Cap Thickness	2 in
Center Chamber	0 lbs	Comments:	

Note: Frit amounts account for all frit added while batch 3 drums remained on the Material Handling Conveyor.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	_____ scfm	_____	_____ scfm	_____
Air Lance Flow Rate	55 scfm	40 scfm	12/06 1230	_____ scfm	_____
Bubbler 1 Flow Rate	8 scfh	6 scfh	12/06 1230	_____ scfh	_____
Bubbler 2 Flow Rate	8 scfh	6 scfh	12/06 1230	_____ scfh	_____
Bubbler 3 Flow Rate	8 scfh	6 scfh	12/06 1230	_____ scfh	_____
Bubbler 4 Flow Rate	8 scfh	6 scfh	12/06 1230	_____ scfh	_____
Air Lift Flow Rate	0 scfh	3 scfh	12/05 2100	4 scfh	12/06 1113
Trickle Air Flow Rate	2 scfh	_____ scfh	_____	_____ scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____ scfm	_____	_____ scfm	_____
Air Lance Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 1 Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 2 Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 3 Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 4 Flow Rate	_____ scfm	_____	_____ scfm	_____
Air Lift Flow Rate	6 scfm	12/06 1550	_____ scfm	_____
Trickle Air Flow Rate	_____ scfm	_____	_____ scfm	_____

000236

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped 0 No. of cleanings of Air Lance 1

No. of times filter trains switched for extended operation. 3 No. of cleanings of Film Cooler Outlet 0

Date/Time Train switched	Train Switched to:(A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/04/96 @ 1607	B Train	Initial Conditions	Initial Conditions			
12/04/96 @ 2000	B Train	Y	N	S48PAFA-961204-2000	S48PLA-961204-2010	N/A
12/04/96 @ 2004	A Train	N	N	N/A	N/A	N/A
12/05/96 @ 0435	BTrain	Y	N	S48AAFP-9612025-0440	S48ALP-961205-0430 S48BPL-961205-0437	N/A
12/05/96 @ 1335	A Train	Y	N	S48BAFP-961205-1420	S48BLP-961205-1410	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B04 Slurry Tank A or B
Date Charged 12/6/96	Formula: Series "A"

Batch Objectives: Second Series "A" batch.

Dry Weight Charged	2635 lbs
Barium Sulfate charged	100 lbs
Barium Carbonate charged	0 lbs
Lead Oxide charged	200 lbs
Initial Weight (full batch)	6220 lbs
Final Weight (heel before flush)	290 lbs
Amount of Slurry Fed	5930 lbs
Slurry Feed Duration	33 hr. 40 min
Amount of Glass Produced	3206 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04B-961206-1243	1.27	31.28
S05A-961207-1000	1.27	30.29
S04B-961206-1245	1.25	29.50

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B04D1	836	60	776	Mono	Emergency	12/07
C4B04D2	0	60	0	Gem	Gem	N/A
C4B04D3	790	60	730	Mono	Start-up	12/08
C4B04D4	1001	60	941	Mono	Emergency	12/08
C4B04D5	819	60	759	Mono	Emergency	12/08
C4B04D6	0	60	0	Mono	Start-up	N/A

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10-961208-1257	C4B04D4	*	2.77 mg/l	N/A
S10-961208-1250	C4B04D4	*	N/A	Total Metals
S10-961208-0200	C4B04D1	*	N/A	Total Metals
S10-961208-0201	C4B04D1	*	2.75 mg/l	N/A
S10-961209-1245	C4B04D3	*	N/A	Total Metals
S10-961209-1255	C4B04D3	*	2.79 mg/l	N/A
S10-961209-1250	C4B04D5	*	N/A	Total Metals
S10-961209-1300	C4B04D5	*	2.77	N/A

* See attached "Laboratory Glass Analysis Results" sheet.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition		COLD CAP OBSERVATIONS	
West Side Chamber	250 lbs	Average Cold Cap Coverage	60 to 80 %
East Side Chamber	125 lbs	Average Cold Cap Thickness	1 to 2 in
Center Chamber	0 lbs	Comments:	

Note: Frit amounts account for all frit added while batch 4 drums remained on the Material Handling Conveyor.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	_____ scfm	_____	_____ scfm	_____
Air Lance Flow Rate	40 scfm	_____ scfm	_____	_____ scfm	_____
Bubbler 1 Flow Rate	8 scfh	7 scfh	Unknown	8 scfh	12/08
Bubbler 2 Flow Rate	8 scfh	7 scfh	Unknown	8 scfh	12/08
Bubbler 3 Flow Rate	8 scfh	7 scfh	Unknown	8 scfh	12/08
Bubbler 4 Flow Rate	8 scfh	7 scfh	Unknown	8 scfh	12/08
Air Lift Flow Rate	0 scfh	7 scfh	12/07 0955	14 scfh	12/07 1930
Trickle Air Flow Rate	2 scfh	_____ scfh	_____	_____ scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____ scfm	_____	_____ scfm	_____
Air Lance Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 1 Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 2 Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 3 Flow Rate	_____ scfm	_____	_____ scfm	_____
Bubbler 4 Flow Rate	_____ scfm	_____	_____ scfm	_____
Air Lift Flow Rate	_____ scfm	_____	_____ scfm	_____
Trickle Air Flow Rate	_____ scfm	_____	_____ scfm	_____

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped 1

No. of cleanings of Air Lance 1

No. of times filter trains switched for extended operation. 1

No. of cleanings of Film Cooler Outlet 1

Date/Time Train switched	Train Switched to:(A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/05/96 @ 1336	A Train	Initial Conditions	Initial Conditions			
12/08/96 @ 0940	B Train	Y	N	S48HAFA-961208-1020	S48PLA-961208-1020	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B05 Slurry Tank A or B
Date Charged 12/7/96	Formula: Series "A"

Batch Objectives: Third Series "A" batch.

Dry Weight Charged	2675 lbs
Barium Sulfate charged	100 lbs
Barium Carbonate charged	0 lbs
Lead Oxide charged	200 lbs
Initial Weight (full batch)	6027 lbs
Final Weight (heel before flush)	335 lbs
Amount of Slurry Fed	5692 lbs
Slurry Feed Duration	30 hr.
Amount of Glass Produced	1955 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04A-961208-0229	1.38	N/A
S04A-961208-0230	1.36	36.7
S05A-961209-1245	1.34	36.9
S05A-961209-0500	1.39	39.9

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B05D1	902	60	842	Mono	Start-up	12/09
C4B05D2	1049	60	989	Mono	Emergency	12/09
C4B05D3	0	60	0	Gem	Gem	N/A
C4B05D4	0	60	0	Mono	Start-up	N/A
C4B05D5	184	60	124	Mono	Emergency	12/10

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10-961209-2030	C4B05D1	*	2.78 mg/l	N/A
S10-961209-2035	C4B05D1	*	N/A	Total Metals
S10-961210-0660	C4B05D5	*	2.76 mg/l	Total Metals

* See attached "Laboratory Glass Analysis Results" sheet.

0002444

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition		COLD CAP OBSERVATIONS	
West Side Chamber	50 lbs	Average Cold Cap Coverage	90 %
East Side Chamber	175 lbs	Average Cold Cap Thickness	2 in
Center Chamber	0 lbs	Comments:	Slurry very watery after adding water after 12/9 day shift

Note: Frit amounts account for all frit added while batch 5 drums remained on the Material Handling Conveyor.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	_____scfm	_____	_____scfm	_____
Air Lance Flow Rate	40 scfm	_____scfm	_____	_____ scfm	_____
Bubbler 1 Flow Rate	6 scfh	8 scfh	12/09 2000	_____ scfh	_____
Bubbler 2 Flow Rate	6 scfh	8 scfh	12/09 2000	_____ scfh	_____
Bubbler 3 Flow Rate	6 scfh	8 scfh	12/09 2000	_____ scfh	_____
Bubbler 4 Flow Rate	6 scfh	8 scfh	12/09 2000	_____ scfh	_____
Air Lift Flow Rate	0 scfh	4 scfh	12/09 0450	_____ scfh	_____
Trickle Air Flow Rate	2 scfh	_____scfh	_____	_____ scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____ scfm	_____	_____scfm	_____
Air Lance Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 2 Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 3 Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 4 Flow Rate	_____ scfm	_____	_____scfm	_____
Air Lift Flow Rate	_____ scfm	_____	_____scfm	_____
Trickle Air Flow Rate	_____scfm	_____	_____scfm	_____

000246

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped 2 No. of cleanings of Air Lance 0

No. of times filter trains switched for extended operation. 0 No. of cleanings of Film Cooler Outlet 0

Date/Time Train switched	Train Switched to:(A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/08/96 @ 1805	B Train	Initial Conditions	Initial Conditions			
12/10/96 @ 0428 Switched to the Emergency Off-Gas to flush the scrubber	B Train	N	N	N/A	N/A	N/A
12/10/96 @ 0623 Switched back to the Normal Off-Gas	B Train	N	N	N/A	N/A	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B06 Slurry Tank A or B
Date Charged 12/9/96	Formula: Series "A"

Batch Objectives: Fourth Series "A" batch.

Dry Weight Charged	2671 lbs
Barium Sulfate charged	92 lbs
Barium Carbonate charged	0 lbs
Lead Oxide charged	200 lbs
Initial Weight (full batch)	5610 lbs
Final Weight (heel before flush)	387 lbs
Amount of Slurry Fed	5223 lbs
Slurry Feed Duration	20 hr. 10 min
Amount of Glass Produced	1749 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04B-961209-1225	1.42	44.5
S04B-961210-0805	1.42	42.6
S05A-961210-2015	1.36	38.4
S05A-961210-1220	1.36	43.05

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B06D1	875	60	815	Mono	Emergency	12/11 0330
C4B06D2	0	60	0	Mono	Start-up	N/A
C4B06D3	0	60	0	Gem	Gem	N/A
C4B06D4	994	60	934	Mono	Emergency	12/11 1444
C4B06D5	0	60	0	Mono	Emergency	N/A

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10-961211-1200	C4B06D1	*	N/A	Total Metals
S10-961211-1210	C4B06D1	*	2.76 mg/l	N/A
S10-961211-2010	C4B06D4	*	2.76 mg/l	N/A
S10-961211-2015	C4B06D4	*	N/A	Total Metals

* See attached "Laboratory Glass Analysis Results" sheet.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition		COLD CAP OBSERVATIONS	
West Side Chamber	50 lbs	Average Cold Cap Coverage	85 %
East Side Chamber	50 lbs	Average Cold Cap Thickness	2 to 3 in
Center Chamber	25 lbs	Comments:	

Note: Frit amounts account for all frit added while batch 6 drums remained on the Material Handling Conveyor.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	_____scfm	_____	_____scfm	_____
Air Lance Flow Rate	40 scfm	_____scfm	_____	_____ scfm	_____
Bubbler 1 Flow Rate	6 scfh	7 scfh	12/11 2330	_____ scfh	_____
Bubbler 2 Flow Rate	6 scfh	7 scfh	12/11 2330	_____ scfh	_____
Bubbler 3 Flow Rate	6 scfh	7 scfh	12/11 2330	_____ scfh	_____
Bubbler 4 Flow Rate	6 scfh	7 scfh	12/11 2330	_____ scfh	_____
Air Lift Flow Rate	0 scfh	_____scfh	_____	_____ scfh	_____
Trickle Air Flow Rate	2 scfh	_____scfh	_____	_____ scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____ scfm	_____	_____scfm	_____
Air Lance Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 2 Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 3 Flow Rate	_____ scfm	_____	_____scfm	_____
Bubbler 4 Flow Rate	_____ scfm	_____	_____scfm	_____
Air Lift Flow Rate	_____ scfm	_____	_____scfm	_____
Trickle Air Flow Rate	_____scfm	_____	_____scfm	_____

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped 0 No. of cleanings of Air Lance 4

No. of times filter trains switched for extended operation. 1 No. of cleanings of Film Cooler Outlet 0

Date/Time Train switched	Train Switched to:(A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/10/96 @ 1716	B Train	Initial Conditions	Initial Conditions			
12/11/96 @ 1428	A Train	Y	N	S48PAFB-961211-1512	S48PLB-961211-1507	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B07 Slurry Tank A or B
Date Charged 12/10/96	Formula: Series "A"

Batch Objectives:

Melter glass Series "A" composition.

Dry Weight Charged	2960 lbs
Barium Sulfate charged	150 lbs
Barium Carbonate charged	0 lbs
Lead Oxide charged	300 lbs
Initial Weight* (full batch)	10,393 lbs
Final Weight (heel before flush)	505 lbs
Amount of Slurry Fed	10,434 lbs
Slurry Feed Duration	48 hr.
Amount of Glass Produced	4220 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04A-961211-1220	1.36	43.05
S05A-961211-1920	1.36	37.73
S05A-961212-1800	1.46	47.2
S04A-961212-1930	1.43	44.3
S05A-961213-0430	1.27	28.4
S05A-961213-0435	1.28	47.2

Note: Combination of batches C4B07, C4B07A, and a transfer from C4B08.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B07D1	881	60	821	Mono	Emergency	12/12/96
C4B07D2	323	60	263	Mono	Start-up	12/15/96
C4B07D3		60		Gem	Gem	
C4B07D4	1143	60	1083	Mono	Emergency	12/12/96
C4B07D5	975	60	915	Mono	Emergency	12/13/96
C4B07D6	850	60	790	Mono	Emergency	12/14/96
C4B07D7	408	60	348	Mono	Emergency	12/15/96

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10-961215-1015	C4B07D2	*	N/A	Total Metals
S10-961212-2220	C4B07D1	*	N/A	Total Metals
S10-961212-2225	C4B07D1	*	2.76	N/A
S10-961213-0206	C4B07D3	*	2.75	N/A
S10-961212-1745	C4B07D4	*	N/A	Total Metals
S10-961214-1005	C4B07D4	*	N/A	Total Metals
S10-961214-1010	C4B07D4	*	2.62	N/A
S10-961214-1000	C4B07D5	*	N/A	Total Metals
S10-961214-1015	C4B07D5	*	2.75	N/A
S10-961215-0540	C4B07D6	*	N/A	Total Metals
S10-961215-1010	C4B07D7	*	2.67	N/A
S10-961215-1005	C4B07D7	*	2.67	N/A

* See attached "Laboratory Glass Analysis Results" sheet.

000254

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition		COLD CAP OBSERVATIONS	
West Side Chamber	75 lbs	Average Cold Cap Coverage	80 %
East Side Chamber	125 lbs	Average Cold Cap Thickness	1.5 in.
Center Chamber	0 lbs		

Note: Frit amounts account for all frit added while batch 7 drums remained on the Material Handling Conveyor.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	0 scfm	12/11 1905	_____scfm	____
Air Lance Flow Rate	40 scfm	40 scfm	12/11 1905	_____scfm	
Bubbler 1 Flow Rate	6 scfh	7 scfh	12/11 1905	6 scfh	12/11 2030
Bubbler 2 Flow Rate	6 scfh	7 scfh	12/11 1905	6 scfh	12/11 2030
Bubbler 3 Flow Rate	6 scfh	7 scfh	12/11 1905	6 scfh	12/11 2030
Bubbler 4 Flow Rate	6 scfh	7 scfh	12/11 1905	6 scfh	12/11 2030
Air Lift Flow Rate	0 scfh	0 scfh	12/11	7 scfh	12/11 2030
Trickle Air Flow Rate	2 scfh	2 scfh	12/11 1905	_____scfh	____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	40 scfm	_____	40 scfm	1855 12/13
Air Lance Flow Rate	_____scfm	_____	_____scfm	____
Bubbler 1 Flow Rate	7 scfm	12/12 0230	____scfm	____
Bubbler 2 Flow Rate	7 scfm	12/12 0203	_____scfm	____
Bubbler 3 Flow Rate	7 scfm	12/12 0230	_____scfm	____
Bubbler 4 Flow Rate	7 scfm	12/12 0230	_____scfm	____
Air Lift Flow Rate	_____scfm	_____	_____scfm	____
Trickle Air Flow Rate	2 scfm	12/13	_____scfm	____

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped 4 No. of cleanings of Air Lance 5

No. of times filter trains switched for extended operation. 3 No. of cleanings of Film Cooler Outlet 3

Date/Time Train Switched	Train Switched to: (A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/12/96	B Train	Y	N	S48PAFA-961213-0900	N/A	N/A
12/13/96 @ 0900	Stayed on B Train	Y	N	S48PAFA-961214-1300 S37PAF-961214-1230	N/A	N/A
12/14/96 @ 1500	A Train	Y	N	S48PAFB-961215-0810	S48PLB-961215-0800	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B08 Slurry Tank A or B
Date Charged 12/12/96 12/13/96	Formula: Modified Series A

Batch Objectives: Continue Run 1 Series A

Dry Weight Charged	2811 lbs
Barium Sulfate charged	100 lbs
Barium Carbonate charged	0 lbs
Lead Oxide charged	175 lbs
Initial Weight (full batch)	7390 lbs
Final Weight (heel before flush)	190 lbs
Amount of Slurry Fed	7200 lbs
Slurry Feed Duration	24 hr.
Amount of Glass Produced	1951 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04B-961213-0415	1.32	N/A
S04B-961213-0410	1.31	34.40
S05A-961215-0930	1.21	22.85

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B08D1	916	60	856	Mono	Emergency	12/16/96
C4B08D2	N/A	60	N/A	Mono	Start-up	N/A
C4B08D3	N/A	60	N/A	Gem	Gem	N/A
C4B08D4	705	60	645	Mono	Emergency	12/16/96
C4B08D5	510	60	450	Mono	Emergency	12/17/96

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10E-961217-0130	N/A	*	2.72	Total Metals
S10E-961217-0140	N/A	*	N/A	Liquidus
S10W-961217-0150	N/A	*	2.76	N/A
S10W-961217-0159	N/A	*	N/A	Liquidus
S10C-961217-0215	N/A	*	2.77	Liquidus
S10-961217-2000	C4B08D1	*	N/A	Total Metals
S10-961217-2015	C4B08D1	*	2.76	N/A
S10-961217-2005	C4B08D4	*	N/A	Total Metals
S10-961217-2020	C4B08D4	*	2.79	N/A
S10-961217-2030	C4B08D5	*	N/A	Total Metals
S10-961217-2035	C4B08D5	*	2.79	N/A

* See attached "Laboratory Glass Analysis Results" sheet.

000259

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition

West Side Chamber	25 lbs
East Side Chamber	100 lbs
Center Chamber	0 lbs

Note: Frit amounts account for all frit added while batch 8 drums remained on the Material Handling Conveyor.

COLD CAP OBSERVATIONS

Average Cold Cap Coverage	85-90 %
Average Cold Cap Thickness	1 to 2 in.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	____scfm	_____	_____scfm	_____
Air Lance Flow Rate	40 scfm	_____scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	6 scfh	8 scfh	12/15 0930	_____scfh	_____
Bubbler 2 Flow Rate	6 scfh	8 scfh	12/15 0930	_____scfh	_____
Bubbler 3 Flow Rate	6 scfh	8 scfh	12/15 0930	_____scfh	_____
Bubbler 4 Flow Rate	6 scfh	8 scfh	12/15 0930	_____scfh	_____
Air Lift Flow Rate	0 scfh	8 scfh	12/16	_____scfh	_____
Trickle Air Flow Rate	2 scfh	_____scfh	_____	_____scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____scfm	_____	_____scfm	____
Air Lance Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 2 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 3 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 4 Flow Rate	_____scfm	_____	_____scfm	_____
Air Lift Flow Rate	_____scfm	_____	_____scfm	_____
Trickle Air Flow Rate	_____scfm	_____	_____scfm	_____

000261

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped	5	No. of.cleanings of Air Lance	3
No. of times filter trains switched for extended operation.	4	No. of cleanings of Film Cooler Outlet	1

Date/Time Train Switched	Train Switched to: (A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/15/96 @ 1150	B Train	Y	N	S48PAFA-961216-0800	S48SPLA-961216-0805	N/A
12/16/96 @ 1715	A Train	Y	N	S48PAFB-961217-1330	S48PLB-961217-1320	N/A
12/17/96 @ 0900	B Train	Y	N	S48PAFA-961217-1325	S48PLA-961217-1317	N/A
12/17/96 @ 1300	A Train	Y	N	S48PBF-961217-1330	S48PBL-9612171320	N/A

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Campaign Number C4	Batch Number C4B09 Slurry Tank A or B
Date Charged 12/20/96	Formula: Transition From High to Low Temp.

Batch Objectives: Transition from High-Temp. To Low-Temp Glass Formula

Dry Weight Charged	3448 lbs
Barium Sulfate charged	100 lbs
Barium Carbonate charged	25 lbs
Lead Oxide charged	200 lbs
Initial Weight (full batch)	6920 lbs
Final Weight (heel before flush)	150 lbs
Amount of Slurry Fed	*6770 lbs
Slurry Feed Duration	29 hr. 1 min.
Amount of Glass Produced	2797 lbs

Slurry Samples

Customer Number	Density (g/ml)	Solids (wt %)
S04A-961220-2148	1.18	20.4
S05A-961222-2127	1.47	50.73

Note: The amount of slurry fed does not include the volume in tank B prior to transfer from A to B. Tank B is assumed to be mostly water.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Drum Information

Drum ID	Gross Weight (lbs)	Tare Weight (lbs)	Net Weight (lbs)	Form	Position	Date Removed
C4B09D1	1055	60	995	Mono	Emergency	12/23/96
C4B09D2	N/A	60	N/A	Mono	Start-up	N/A
C4B09D3	N/A	60	N/A	Gem	Gem	N/A
C4B09D4	1111	60	1051	Mono	Emergency	12/23/96
C4B09D5	811	60	751	Mono	Emergency	12/25/96

Glass Samples

Customer Number	Drum ID	TCLP (pass/fail)	Density	Other Analysis
S10C-961223-1833	N/A	*	2.75	Liquidus
S10E-961223-1841	N/A	*	2.76	Liquidus
S10W-961223-1851	N/A	*	2.76	Liquidus
S10-961223-1310	C4B09D1	*	N/A	Total Metals
S10-961223-1315	C4B09D1	*	2.78	N/A
S10-961224-1235	C4B09D4	*	2.80	Total Metals
S10C-961225-1046	N/A	*	2.73	N/A
S10-961225-2142	C4B09D5	*	2.75	Total Metals
S10-961225-2144	C4B09D5	*	2.74	N/A

* See attached "Laboratory Glass Analysis Results" sheet.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Gem Production

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Start _____ hr Stop _____ hr Gem Start _____ hr Stop _____ hr

Gem Production Duration 0 hr min

Frit Addition	
West Side Chamber	0 lbs
East Side Chamber	50 lbs
Center Chamber	275 lbs

Note: Frit amounts account for all frit added while batch 9 drums remained on the Material Handling Conveyor.

COLD CAP OBSERVATIONS	
Average Cold Cap Coverage	85-90 %
Average Cold Cap Thickness	2 to 3 in.

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Utility Air Flow Settings

	Initial Settings	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	0 scfm	25 Scfm	12/24 0210	_____scfm	_____
Air Lance Flow Rate	35 scfm	_____scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	6 scfh	_____scfh	_____	_____scfh	_____
Bubbler 2 Flow Rate	6 scfh	_____scfh	_____	_____scfh	_____
Bubbler 3 Flow Rate	6 scfh	_____scfh	_____	_____scfh	_____
Bubbler 4 Flow Rate	6 scfh	_____scfh	_____	_____scfh	_____
Air Lift Flow Rate	0 scfh	4 scfh	12/12 1940	_____scfh	_____
Trickle Air Flow Rate	2 scfh	_____scfh	_____	_____scfh	_____

	Adjusted Settings	Time/ Date	Adjusted Setting	Time/ Date
Film Cooler Flow Rate	_____scfm	_____	_____scfm	____
Air Lance Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 1 Flow Rate	_____scfm	_____	____scfm	_____
Bubbler 2 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 3 Flow Rate	_____scfm	_____	_____scfm	_____
Bubbler 4 Flow Rate	_____scfm	_____	_____scfm	_____
Air Lift Flow Rate	_____scfm	_____	_____scfm	_____
Trickle Air Flow Rate	_____scfm	_____	_____scfm	_____

000266

ICP 96-01 TO ATTACHMENT 5
TEST PERFORMANCE PARAMETERS FOR
SOT CAMPAIGN 4 (2504-SU-0039, REV.0)
AT THE VITRIFICATION PILOT PLANT

Off-Gas System

No. of times EOG tripped 1 No. of cleanings of Air Lance 2

No. of times filter trains switched for extended operation. 3 No. of cleanings of Film Cooler Outlet 0

Date/Time Train Switched	Train Switched to: (A or B)	Pre-filter Replaced (Y or N)	HEPA filter Replaced (Y or N)	Filter Sample Customer ID	Liquid Sample Customer ID	Solid Sample Customer ID
12/23/96 @ 0900	A Train	Y	Y	S48PAF - 961223-0915 S48AF- 961223-0905	S48HL- 961223-00920 S48PL- 961223-0900	N/A
12/23/96 @ 1000	B Train	N	Y	S48AF- 961223-1035	S48HL- 961223-1020 S48PL- 961223-1000	N/A
12/24/96 @ 0900	A Train	Y	N	S48AF- 961224-0830	S48AFB- 961224-0835	N/A

Batch Number: C4B01 **Laboratory Glass Analysis Results**

Analyte	CUSTOMER I.D. S10-961202-1200 Result (wt %-abs)	CUSTOMER I.D. S10-961202-1200 Result (wt %-norm.)	CUSTOMER I.D. S10-961201-1055 Result (wt %-abs)	CUSTOMER I.D. S10-961201-1055 Result (wt %-norm.)	CUSTOMER I.D. S10-961201-1100 Result (wt %-abs)	CUSTOMER I.D. S10-961201-1100 Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	47.20	46.80	45.70	46.54	44.98	48.03	45.96	47.12
B2O3	9.90	9.82	9.90	10.08	8.02	8.56	9.27	9.49
Li2O	1.87	1.85	1.80	1.83	1.63	1.74	1.77	1.81
Al2O3	11.28	11.18	10.20	10.39	10.78	11.51	10.75	11.03
BaO	1.51	1.50	2.38	2.42	1.44	1.54	1.78	1.82
CaO	11.62	11.52	10.11	10.30	10.99	11.73	10.91	11.18
Cr2O3	0.35	0.35	0.26	0.27	0.29	0.31	0.30	0.31
Fe2O3	2.01	1.99	2.66	2.71	1.66	1.77	2.11	2.16
PbO	2.89	2.87	4.14	4.22	2.38	2.54	3.14	3.21
MgO	1.47	1.46	1.40	1.43	1.33	1.42	1.40	1.43
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.16	0.16	0.24	0.24	0.13	0.14	0.18	0.18
K2O	0.56	0.56	0.87	0.89	0.00	0.00	0.48	0.48
V2O5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	9.78	9.70	8.34	8.49	9.81	10.47	9.31	9.56
ZrO2	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum	0.25	0.25	0.20	0.20	0.21	0.21	0.22	0.22
	sum (wt%) 100.85	norm sum (wt%) 100	sum (wt%) 98.203	norm sum (wt%) 100.0	sum (wt%) 93.65	norm sum (wt%) 100.0	sum (wt%) 97.57	norm sum (wt%) 100.0
	multiplier	0.99	multiplier	1.02	multiplier	1.07		

							Total/Batch
Total Glass Prod. (lbs)		783		879		855	2517
Total Cr2O3 in Glass		2.75		2.31		2.50	7.56
Total Moly in Glass		1.96		1.76		1.80	5.51

TCLP Results

ANALYTE'	S10-961202-1200 (ppm)	S10-961201-1055 (ppm)	S10-961201-1100 (ppm)				Averages (ppm)
BARIUM	0.026	0.043	0.091				0.05
LEAD	0.038	0.141	BDL				0.06
CHROMIUM	BDL	0.004	0.002				0.00

Density

	S10-961202-1205	S10-961201-1045	S10-961201-1050	S10E-961201-1300	S10C-961201-1315	S10W-961201-1330	(g/cc)
DENSITY (g/cc)	2.68	2.71	2.66	2.68	2.7	2.67	2.68

Viscosity	Poise
1150 C	110.8
1250 C	45.85

Conductivity
ohms, 1250 C
162.04

Batch Number: C4B02

Laboratory Glass Analysis Results

	CUSTOMER I.D.		CUSTOMER I.D.		CUSTOMER I.D.		CUSTOMER I.D.		CUSTOMER I.D.			
	S10-961203-1040	S10-961203-1040	S10-961203-2315	S10-961203-2315	S10-961203-2326	S10-961203-2326	S10-961204-1600	S10-961204-1600	S10-961204-2100	S10-961204-2100		
Analyte	Result (wt %-abs)	Result (wt %-norm.)	Result (wt %-abs)	Result (wt %-norm.)	Result (wt %-abs)	Result (wt %-norm.)	Result (wt %-abs)	Result (wt %-norm.)	Result (wt %-abs)	Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	46.80	47.67	42.50	48.03	40.05	46.84	45.10	48.55	43.51	47.99	43.59	47.82
B2O3	10.90	11.10	9.84	11.12	9.33	10.91	11.14	11.99	10.84	11.96	10.41	11.42
Li2O	1.57	1.60	1.37	1.55	1.35	1.58	1.78	1.92	1.41	1.56	1.50	1.64
Al2O3	8.97	9.14	7.35	8.31	7.61	8.90	7.01	7.55	6.61	7.51	7.55	8.28
BaO	2.82	2.87	3.21	3.63	3.51	4.11	3.62	3.90	3.31	3.65	3.29	3.63
CaO	8.32	8.47	6.48	7.32	6.46	7.56	5.85	6.30	6.07	6.70	6.64	7.27
Cr2O3	0.29	0.30	0.23	0.26	0.02	0.03	0.29	0.31	0.23	0.26	0.22	0.23
Fe2O3	3.13	3.19	3.25	3.67	3.41	3.99	3.38	3.64	3.22	3.55	3.28	3.61
PbO	5.13	5.23	5.73	6.48	5.21	6.09	6.13	6.60	6.13	6.76	5.67	6.23
MgO	1.35	1.38	1.27	1.44	1.27	1.49	1.20	1.29	1.37	1.51	1.29	1.42
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00
NiO	0.34	0.35	0.33	0.37	0.35	0.41	0.35	0.38	0.34	0.38	0.34	0.38
K2O	0.92	0.94	0.36	0.41	0.52	0.61	0.79	0.85	1.20	1.32	0.76	0.83
V2O5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	7.47	7.61	6.43	7.27	6.28	7.34	6.24	6.72	6.21	6.85	6.53	7.16
ZrO2	NR	0.00	NR	0.00	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum	0.16	0.16	0.14	0.16	0.13	0.15		0.00		0.00	0.09	0.09
	sum (wt%)	norm sum (wt%)	sum (wt%)	norm sum (wt%)	sum (wt%)	norm sum (wt%)	sum (wt%)	norm sum (wt%)	sum (wt%)	norm sum (wt%)	sum (wt%)	norm sum (wt%)
	98.17	100.00	88.49	100.00	85.50	100.00	92.89	100.00	90.66	100.00	91.15	100.00
	multiplier	1.02	multiplier	1.13	multiplier	1.17	multiplier	1.08	multiplier	1.10		

											Total/Batch
Total Glass Prod. (lbs)		698		539		886		118		395	2636
Total Cr2O3 in Glass		2.04		1.26		0.21		0.34		0.92	4.78
Total Moly in Glass		1.12		0.75		1.15		0.00		0.00	3.02

TCLP Results

	S10-961203-2315	S10-961203-2326	S10-961204-1600	S10-961204-2100	S10-961203-1040						Averages
ANALYTE	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)						(ppm)
BARIUM	0.045	0.181	0.033	0.070	0.067						0.079
LEAD	0.086	0.081	0.061	0.083	0.124						0.087
CHROMIUM	BDL	0.012	BDL	BDL	0.010						0.005

Density

	S10-961203-1030	S10-961203-2316	S10-961203-2325	S10-961204-1610	S10-961204-2115	S10E-1204-0330	S10C-961204-0332	S10W-961204-0334			(g/cc)
DENSITY (g/cc)	2.74	2.76	2.75	2.72	2.71	2.64	2.68	2.74			2.72

Viscosity	Poise
1150 C	125.8
1250 C	52.71

Conductivity
ohms, 1250 C
-345.60

Batch Number: C4B03

Laboratory Glass Analysis Results

Analyte	CUSTOMER I.D. S10-961211-2145 Result (wt %-abs)	S10-961211-2145 Result (wt %-norm.)	CUSTOMER I.D. S10-961207-1315 Result (wt %-abs)	S10-961207-1315 Result (wt %-norm.)	CUSTOMER I.D. S10-961207-1328 Result (wt %-abs)	S10-961207-1328 Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SIO2	47.98	49.63	46.34	52.85	41.20	53.04	45.17	51.84
B2O3	10.14	10.49	10.87	12.40	9.81	12.63	10.27	11.84
Li2O	2.01	2.08	1.86	2.12	1.73	2.23	1.87	2.14
Al2O3	7.27	7.52	5.62	6.41	4.63	5.96	5.84	6.63
BaO	3.85	3.98	3.32	3.79	2.86	3.68	3.34	3.82
CaO	5.88	6.08	4.67	5.33	3.49	4.49	4.68	5.30
Cr2O3	0.26	0.27	0.18	0.20	0.15	0.19	0.19	0.22
Fe2O3	3.25	3.38	2.47	2.82	2.22	2.86	2.65	3.01
PbO	7.13	7.38	4.83	5.51	4.17	5.37	5.38	6.08
MgO	1.34	1.39	1.17	1.33	1.05	1.35	1.19	1.36
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.26	0.27	0.15	0.17	0.11	0.14	0.17	0.19
K2O	0.99	1.02	0.00	0.00	0.00	0.00	0.33	0.34
V2O5	0.03	0.03	0.00	0.00	0.00	0.00	0.01	0.01
Na2O	6.07	6.28	6.04	6.89	6.12	7.88	6.08	7.02
ZrO2	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum	0.21	0.22	0.16	0.18	0.14	0.18	0.17	0.19
	sum (wt%) 96.67307	norm sum (wt%) 100	sum (wt%) 87.6754	norm sum (wt%) 100.0	sum (wt%) 77.67615	norm sum (wt%) 100	sum (wt%) 87.34	norm sum (wt%) 100.00
	multiplier	1.03	multiplier	1.14	multiplier	1.29		

							Total/Batch
Total Glass Prod. (lbs)		782		619		739	2140
Total Cr2O3 in Glass		2.06		1.09		1.08	4.22
Total Moly in Glass		1.64		0.99		1.03	3.67

TCLP Results

ANALYTE	S10-961211-2145 (ppm)	S10-961207-1315 (ppm)	S10-961207-1328 (ppm)				Averages (ppm)
BARIUM	0.0605	0.0325	0.641				0.24
LEAD	0.0642	BDL	0.7488				0.27
CHROMIUM	0.0015	BDL	0.013				0.00

Density

	S10-961207-1325	S1-961207-1318	S10-961208-0201				(g/cc)
DENSITY (g/cc)	2.75	2.74	2.75				2.75

Viscosity	Poise
1150 C	141.3
1250 C	57.17

Conductivity
ohms, 1250 C
155.82

Batch Number: C4B04

Laboratory Glass Analysis Results

Analyte	CUSTOMER I.D. S10-961208-0200 Result (wt %-abs)	S10-961208-0200 Result (wt %-norm.)	CUSTOMER I.D. S10-961209-1245 Result (wt %-abs)	S10-961209-1245 Result (wt %-norm.)	CUSTOMER I.D. S10-961208-1250 Result (wt %-abs)	S10-961208-1250 Result (wt %-norm.)	CUSTOMER I.D. S10-961209-1250 Result (wt %-abs)	S10-961209-1250 Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	45.54	52.26	39.35	47.05	44.87	49.30	48.66	53.90	44.61	50.63
B2O3	10.45	11.99	8.66	10.35	10.47	11.50	11.06	12.25	10.16	11.53
Li2O	1.89	2.17	1.72	2.06	1.87	2.05	1.84	2.04	1.83	2.08
Al2O3	5.75	6.60	7.02	8.39	7.27	7.99	5.69	6.30	6.43	7.32
BaO	3.63	4.17	4.46	5.33	4.52	4.97	3.31	3.67	3.98	4.53
CaO	4.43	5.08	4.82	5.76	5.00	5.49	4.17	4.62	4.61	5.24
Cr2O3	0.18	0.20	0.20	0.24	0.20	0.22	0.18	0.19	0.19	0.22
Fe2O3	2.62	3.01	3.39	4.05	3.28	3.60	2.54	2.81	2.96	3.37
PbO	4.92	5.65	6.59	7.88	6.14	6.75	4.89	5.42	5.64	6.42
MgO	1.20	1.38	1.39	1.66	1.14	1.25	1.15	1.27	1.22	1.39
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.15	0.17	0.11	0.13	0.14	0.15	0.14	0.16	0.14	0.15
K2O	0.00	0.00	0.22	0.26	0.00	0.00	0.00	0.00	0.06	0.07
V2O5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	6.22	7.14	5.42	6.48	5.88	6.46	6.46	7.16	6.00	6.81
ZrO2	NR	0.00	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum (ppm)	0.17	0.20	0.28	0.33	0.23	0.25	0.19	0.21	0.22	0.25
	sum (wt%) 87.1454	norm sum (wt%) 100	sum (wt%) 83.6346	norm sum (wt%) 100	sum (wt%) 91.0146	norm sum (wt%) 100	sum (wt%) 90.2754	norm sum (wt%) 100	sum (wt%) 88.02	norm sum (wt%) 100.0
	multiplier	1.15	multiplier	1.20	multiplier	1.10	multiplier	1.11		

									Total/Batch
Total Glass Prod. (lbs)		776		730		941		759	3206
Total Cr2O3 in Glass		1.36		1.49		1.93		1.33	6.11
Total Moly in Glass		1.32		2.04		2.16		1.44	6.97

TCLP Results

ANALYTE	S10-961208-0200 (ppm)	S10-961209-1245 (ppm)	S10-961208-1250 (ppm)	S10-961209-1250 (ppm)					Averages (ppm)
BARIUM	0.0291	0.0421	0.2248	0.0793					0.09
LEAD	0.0371	BDL	0.0759	0.04					0.04
CHROMIUM	BDL	BDL	BDL	BDL					0.00

Density

	S10-961208-0201	S10-961208-1257	S10-961209-1255	S10-961209-1300					(g/cc)
DENSITY (g/cc)	2.75	2.77	2.79	2.77					2.77

Viscoity	Poise
1150 C	138.1
1250 C	53.94

Conductivity
ohms, 1250 C
-247.49

Number: C4B05

Laboratory Glass Analysis Results

Analyte	CUSTOMER I.D. S10-961209-2035 Result (wt %-abs)	S10-961209-2035 Result (wt %-norm.)	CUSTOMER I.D. S10-961210-1200 Result (wt %-abs)	S10-961210-1200 Result (wt %-norm.)	CUSTOMER I.D. S10-961210-0600 Result (wt %-abs)	S10-961210-0600 Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	19.66	39.49	46.95	49.64	48.23	49.60	38.28	46.24
B2O3	2.99	6.01	10.83	11.45	10.85	11.16	8.22	9.54
Li2O	0.81	1.63	1.69	1.79	1.78	1.83	1.43	1.75
Al2O3	5.27	10.58	6.94	7.34	7.34	7.55	6.52	8.49
BaO	3.06	6.15	3.80	4.02	4.16	4.28	3.67	4.81
CaO	3.49	7.01	4.83	5.11	5.10	5.24	4.47	5.79
Cr2O3	0.00	0.00	0.18	0.19	0.18	0.18	0.12	0.12
Fe2O3	2.59	5.20	3.61	3.82	3.80	3.91	3.33	4.31
PbO	5.15	10.34	7.93	8.38	7.99	8.22	7.02	8.98
MgO	1.04	2.09	1.28	1.35	1.41	1.45	1.24	1.63
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.00	0.00	0.08	0.08	0.08	0.08	0.05	0.06
K2O	0.00	0.00	0.39	0.41	0.21	0.22	0.20	0.21
V2O5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	5.50	11.05	5.80	6.13	5.80	5.98	5.70	7.71
ZrO2	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum	0.23	0.46	0.27	0.29	0.32	0.33	0.27	0.27
	sum (wt%) 49.79	norm sum (wt%) 100	sum (wt%) 94.57538	norm sum (wt%) 100.0	sum (wt%) 97.25	norm sum (wt%) 100.0	sum (wt%) 80.54	norm sum (wt%) 99.9
	multiplier	2.01	multiplier	1.06	multiplier	1.03		

							Total/Batch
Total Glass Prod. (lbs)		842		989		124	1955
Total Cr2O3 in Glass		0.00		1.73		0.22	1.95
Total Moly in Glass		1.94		2.67		0.40	5.00

TCLP Results

ANALYTE	S10-961209-2035 (PPM)	S10-961210-1200 (PPM)	S10-961210-0600 (PPM)				Averages (PPM)
BARIUM	0.016	2.251	1.494				1.25
LEAD	0.077	1.745	1.808				1.21
CHROMIUM	BDL	0.013	0.009				0.01

Density

	S10-961209-2030	S10-961210-0600					(g/cc)
DENSITY (g/cc)	2.78	2.76					2.77

Viscoity	Poise
1150 C	151.7
1250 C	63.54

Conductivity
ohms, 1250 C
-553.92

Batch Number: C4B06

Laboratory Glass Analysis Results

Analyte	CUSTOMER I.D. S10-961211-1200 Result (wt %-abs)	CUSTOMER I.D. S10-961211-1200 Result (wt %-norm.)	CUSTOMER I.D. S10-961211-2015 Result (wt %-abs)	CUSTOMER I.D. S10-961211-2015 Result (wt %-norm.)	CUSTOMER I.D. Result (wt %-abs)	CUSTOMER I.D. Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	46.91	49.59	48.97	49.38			47.94	49.49
B2O3	10.79	11.41	11.32	11.42			11.06	11.41
Li2O	2.08	2.20	1.92	1.94			2.00	2.07
Al2O3	7.12	7.53	7.24	7.30			7.18	7.41
BaO	3.42	3.62	3.36	3.39			3.39	3.50
CaO	4.67	4.94	5.20	5.24			4.94	5.09
Cr2O3	0.20	0.22	0.23	0.24			0.22	0.23
Fe2O3	3.72	3.93	4.04	4.07			3.88	4.00
PbO	7.86	8.31	8.97	9.05			8.42	8.68
MgO	1.27	1.34	1.47	1.48			1.37	1.41
Mn3O4	0.00	0.00	0.00	0.00			0.00	0.00
NiO	0.00	0.00	0.00	0.00			0.00	0.00
K2O	0.41	0.43	0.27	0.27			0.34	0.35
V2O5	0.00	0.00	0.00	0.00			0.00	0.00
Na2O	5.84	6.17	5.91	5.96			5.88	6.07
ZrO2	NR	0.00	NR	0.00			0.00	0.00
Molybdenum	0.30	0.32	0.26	0.26			0.28	0.29
	sum (wt%) 94.5946	norm sum (wt%) 100	sum (wt%) 99.1638	norm sum (wt%) 100.0	sum (wt%) NA	norm sum (wt%) NA	sum (wt%) 96.88	norm sum (wt%) 100.0
	multiplier	1.06	multiplier	1.01	multiplier	NA		

							Total/Batch
Total Glass Prod. (lbs)		815		934			1749
Total Cr2O3 in Glass		1.67		2.18			3.85
Total Moly in Glass		2.45		2.43			4.87

TCLP Results

ANALYTE	S10-961211-1200 (PPM)	S10-961211-2015 (PPM)					Averages (PPM)
BARIUM	0.0394	0.0266					0.03
LEAD	0.0567	0.0556					0.06
CHROMIUM	BDL	BDL					0.00

Density

	S10-961211-1210	S10-961211-2010					(g/cc)
DENSITY (g/cc)	2.76	2.76					2.76

Viscoity	Poise
1150 C	
1250 C	

Conductivity
ohms, 1250 C
-470.35

000213

Batch Number: [redacted]7

La[redacted]ory Glass Analysis Results

Analyte	CUSTOMER I.D. S10-961212-2220 Result (wt %-abs)	S10-961212-2220 Result (wt %-norm.)	CUSTOMER I.D. S10-961215-1015 Result (wt %-abs)	S10-961215-1015 Result (wt %-norm.)	CUSTOMER I.D. S10-961212-1745 Result (wt %-abs)	S10-961212-1745 Result (wt %-norm.)	CUSTOMER I.D. S10-961214-1000 Result (wt %-abs)	S10-961214-1000 Result (wt %-norm.)	CUSTOMER I.D. S10-961215-0540 Result (wt %-abs)	S10-961215-054 Result (wt %-norm.)	CUSTOMER I.D. S10-961215-1000 Result (wt %-abs)	S10-961215-1000 Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	32.97	47.58	39.00	46.60	38.15	48.65	36.28	46.71	47.20	49.70	4.69	9.04	32.72	41.05
B2O3	7.59	10.95	9.00	10.75	8.37	10.80	8.50	10.94	11.10	11.69	10.90	21.01	9.24	12.69
Li2O	1.22	1.76	1.00	1.19	1.47	1.90	1.13	1.45	1.20	1.26	1.18	2.27	1.20	1.64
Al2O3	5.13	7.40	6.90	8.25	6.18	7.98	5.71	7.35	7.10	7.48	6.63	12.78	6.28	8.54
BaO	2.21	3.19	2.90	3.47	2.91	3.76	2.40	3.09	3.00	3.16	2.67	5.15	2.68	3.63
CaO	4.13	5.96	5.80	6.93	4.73	6.10	5.38	6.93	6.20	6.53	6.03	11.62	5.38	7.35
Cr2O3	0.15	0.21	0.23	0.28	0.00	0.00	0.18	0.23	0.23	0.25	0.16	0.31	0.16	0.21
Fe2O3	2.72	3.93	3.67	4.39	3.19	4.12	3.07	3.95	3.80	4.00	3.65	7.04	3.35	4.57
PbO	5.15	7.43	6.40	7.65	6.12	7.90	5.93	7.64	6.90	7.27	7.06	13.61	6.26	8.58
MgO	1.13	1.63	1.30	1.55	1.30	1.68	1.19	1.53	1.30	1.37	1.25	2.41	1.25	1.70
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.00	0.00	0.24	0.29	0.11	0.14	0.20	0.26	0.22	0.23	0.21	0.40	0.16	0.22
K2O	0.49	0.71	0.00	0.00	0.34	0.44	0.53	0.68	0.22	0.23	0.15	0.29	0.29	0.39
V2O5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	6.25	9.02	7.02	8.39	6.39	8.25	7.02	9.04	6.26	6.59	7.09	13.67	10.01	9.16
ZrO2	NR	0.00	NR	0.00	NR	0.00	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum	0.16	0.23	0.22	0.26	0.23	0.30	0.15	0.19	0.23	0.24	0.21	0.40	0.20	0.27
	sum (wt%) 69.30	norm sum (wt%) 100.00	sum (wt%) 83.68	norm sum (wt%) 100.00	sum (wt%) 77.49	norm sum (wt%) 100.00	sum (wt%) 77.67	norm sum (wt%) 100.00	sum (wt%) 94.96	norm sum (wt%) 100.00	sum (wt%) 51.88	norm sum (wt%) 100.00	sum (wt%) 79.17	norm sum (wt%) 100.00
	multiplier	1.44	multiplier	1.19	multiplier	1.29	multiplier	1.29	multiplier	1.05	multiplier	1.93		

													Total/Batch
Total Glass Prod. (lbs)		821		263		1083		915		790		348	4220
Total Cr2O3 in Glass		1.20		0.61		0.00		1.60		1.85		0.56	5.82
Total Moly in Glass		1.31		0.58		2.49		1.37		1.82		0.73	8.30

TCLP Results

ANALYTE	S10-961212-2220 (PPM)	S10-961215-1015 (PPM)	S10-961212-1745 (PPM)	S10-961214-1000 (PPM)	S10-961215-0540 (PPM)	S10-961215-1000 (PPM)	Averages (PPM)
BARIUM	0.248	0.1449		0.0644	1.532	1.537	0.71
LEAD	0.0599	0.3711		0.2247	2.74	2.089	1.10
CHROMIUM	BDL	0.0139		0.0052	0.0163	0.0389	0.01

Density

	S10-961212-2225	S10-961213-0206	S10-961214-1010	S10-961214-1015	S10-961215-1010	S10-961215-1005	(g/cc)
DENSITY (g/cc)	2.76	2.75	2.62	2.75	2.67	2.67	2.70

Viscosity	Poise
1150 C	138.1
1250 C	51.53

Conductivity
ohms, 1250 C
-0.01

Batch Number: C4B08 **Laboratory Glass Analysis Results**

Analyte	CUSTOMER I.D. S10-961217-2000 Result (wt %-abs)	S10-961217-2000 Result (wt %-norm.)	CUSTOMER I.D. S10-961217-2005 Result (wt %-abs)	S10-961217-2005 Result (wt %-norm.)	CUSTOMER I.D. S10-961217-2030 Result (wt %-abs)	S10-961217-2030 Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	43.10	47.34	42.30	47.45	44.30	47.99	43.23	47.60
B2O3	9.80	10.76	9.30	10.43	9.40	10.18	9.50	10.46
Li2O	1.00	1.10	1.10	1.23	1.00	1.08	1.03	1.14
Al2O3	7.00	7.69	6.80	7.63	7.00	7.58	6.93	7.63
BaO	3.10	3.41	2.90	3.25	3.00	3.25	3.00	3.30
CaO	6.80	7.47	7.30	8.19	7.80	8.45	7.30	8.04
Cr2O3	0.29	0.32	0.26	0.30	0.29	0.32	0.28	0.31
Fe2O3	3.70	4.06	3.50	3.93	3.60	3.90	3.60	3.96
PbO	6.90	7.58	6.80	7.63	6.70	7.26	6.80	7.49
MgO	1.40	1.54	1.40	1.57	1.40	1.52	1.40	1.54
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.20	0.22	0.20	0.22	0.20	0.22	0.20	0.22
K2O	0.40	0.44	0.20	0.22	0.40	0.43	0.33	0.37
V2O5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	7.10	7.80	6.84	7.67	6.96	7.54	6.97	7.67
ZrO2	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum	0.25	0.27	0.24	0.27	0.25	0.27	0.25	0.24
	sum (wt%) 91.0423	norm sum (wt%) 100	sum (wt%) 89.143	norm sum (wt%) 100.0	sum (wt%) 92.30	norm sum (wt%) 100.0	sum (wt%) 90.83	norm sum (wt%) 100.0
	multiplier	1.10	multiplier	1.12	multiplier	1.08		

							Total/Batch
Total Glass Prod. (lbs)		856		645		450	1951
Total Cr2O3 in Glass		2.50		1.70		1.32	5.51
Total Moly in Glass		2.14		1.55		1.13	4.81

TCLP Results

ANALYTE	S10-961217-2000 (PPM)	S10-961217-2005 (PPM)	S10-961217-2030 (PPM)				Averages (PPM)
BARIUM	1.083	1.012	1.277				1.12
LEAD	2.451	2.257	1.586				2.10
CHROMIUM	0.0097	0.0122	0.015				0.01

Density

	S10E-961217-0130	S10W-961217-0150	S10C-961217-0215	S10-961217-2015	S10-961217-2020	S10-961217-2035	(g/cc)
DENSITY (g/cc)	2.72	2.76	2.77	2.76	2.79	2.79	2.77

Viscoity	Poise
1150 C	131.8
1250 C	49.73

Conductivity
ohms, 1250 C
75.39

000225

Batch Number: C4B09

Laboratory Glass Analysis Results

Analyte	CUSTOMER I.D. S10-961223-1310 Result (wt %-abs)	CUSTOMER I.D. S10-961223-1310 Result (wt %-norm.)	CUSTOMER I.D. S10-961224-0835 Result (wt %-abs)	CUSTOMER I.D. S10-961224-0835 Result (wt %-norm.)	CUSTOMER I.D. S10-961225-2142 Result (wt %-abs)	CUSTOMER I.D. S10-961225-2142 Result (wt %-norm.)	Average (wt %-abs)	Average (wt %-norm.)
SiO2	36.98	44.53	19.14	33.68	19.58	36.83	25.23	38.35
B2O3	8.34	10.04	4.50	7.92	0.47	0.88	4.44	6.28
Li2O	2.38	2.87	1.40	2.46	1.19	2.24	1.66	2.52
Al2O3	6.53	7.86	5.51	9.70	5.66	10.65	5.90	9.40
BaO	3.49	4.20	3.09	5.44	2.99	5.62	3.19	5.09
CaO	6.37	7.67	5.08	8.94	4.96	9.33	5.47	8.65
Cr2O3	0.38	0.46	0.38	0.67	0.41	0.77	0.39	0.63
Fe2O3	3.23	3.89	2.89	5.09	2.86	5.38	2.99	4.79
PbO	6.54	7.88	6.17	10.86	6.26	11.78	6.32	10.17
MgO	1.42	1.71	1.35	2.38	1.39	2.61	1.39	2.23
Mn3O4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NiO	0.14	0.17	0.14	0.25	0.14	0.26	0.14	0.23
K2O	0.21	0.25	0.10	0.18	0.00	0.00	0.10	0.14
V2O5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	6.71	8.08	6.73	11.84	6.93	13.04	6.79	10.99
ZrO2	NR	0.00	NR	0.00	NR	0.00	0.00	0.00
Molybdenum	0.32	0.39	0.35	0.62	0.32	0.60	0.33	0.33
	sum (wt%) 83.04	norm sum (wt%) 100	sum (wt%) 56.83	norm sum (wt%) 100.0	sum (wt%) 53.16	norm sum (wt%) 100.0	sum (wt%) 64.34	norm sum (wt%) 99.8
	multiplier	1.20	multiplier	1.76	multiplier	1.88		

							Total/Batch
Total Glass Prod. (lbs)		995		1051		751	2797
Total Cr2O3 in Glass		3.78		3.99		3.07	10.85
Total Moly in Glass		3.18		3.68		2.40	9.27

TCLP Results

ANALYTE	S10-961223-1310 (PPM)	S10-961224-0835 (PPM)	S10-961225-2142 (PPM)				Averages (PPM)
BARIUM	1.643	1.478	3.469				2.20
LEAD	2.08	2.204	4.556				2.95
CHROMIUM	0.0165	0.0129	0.0124				0.01

Density

	S10961223-1315	S10-961224-1235	S10-961225-1046	S10-961225-2142	S10-961225-2144		(g/cc)
DENSITY (g/cc)	2.78	2.8	2.73	2.75	2.74		2.76

Viscoity	Poise
1150 C	77.3
1250 C	32.75

Conductivity
ohms, 1250 C
NR

Appendix C
SNAPSHOT DATA

Appendix C1 Transition to Series A Glass

Appendix C2 Series A Glass

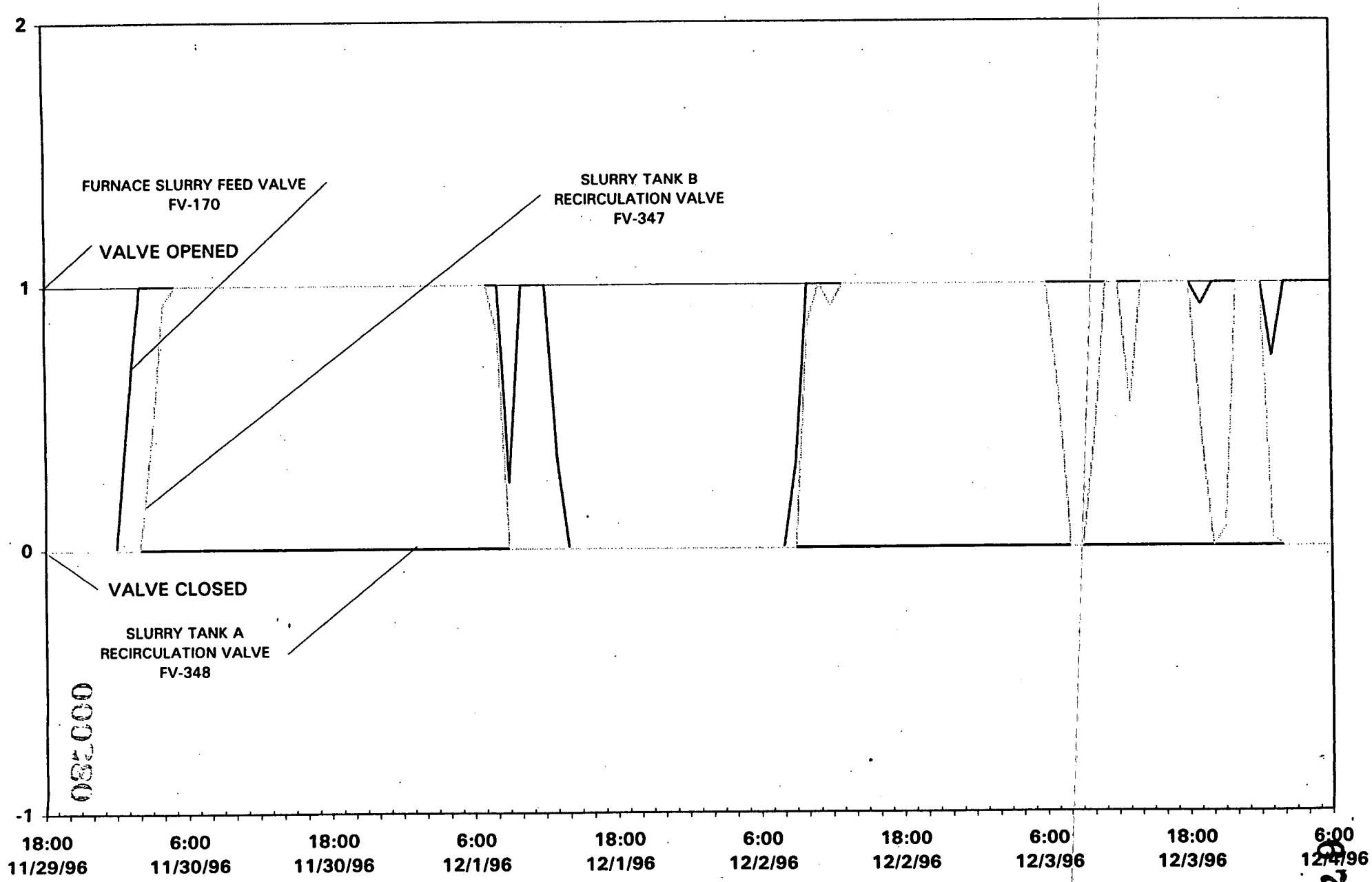
Appendix C3 Transition to Low Temperature Series A Glass

Appendix C1

Transition to Series A Glass

FEED PREPARATION SYSTEM

CAMPA[illegible]4
TRANSITION TO SERIES A GLASS FEED PREPARATION SYSTEM

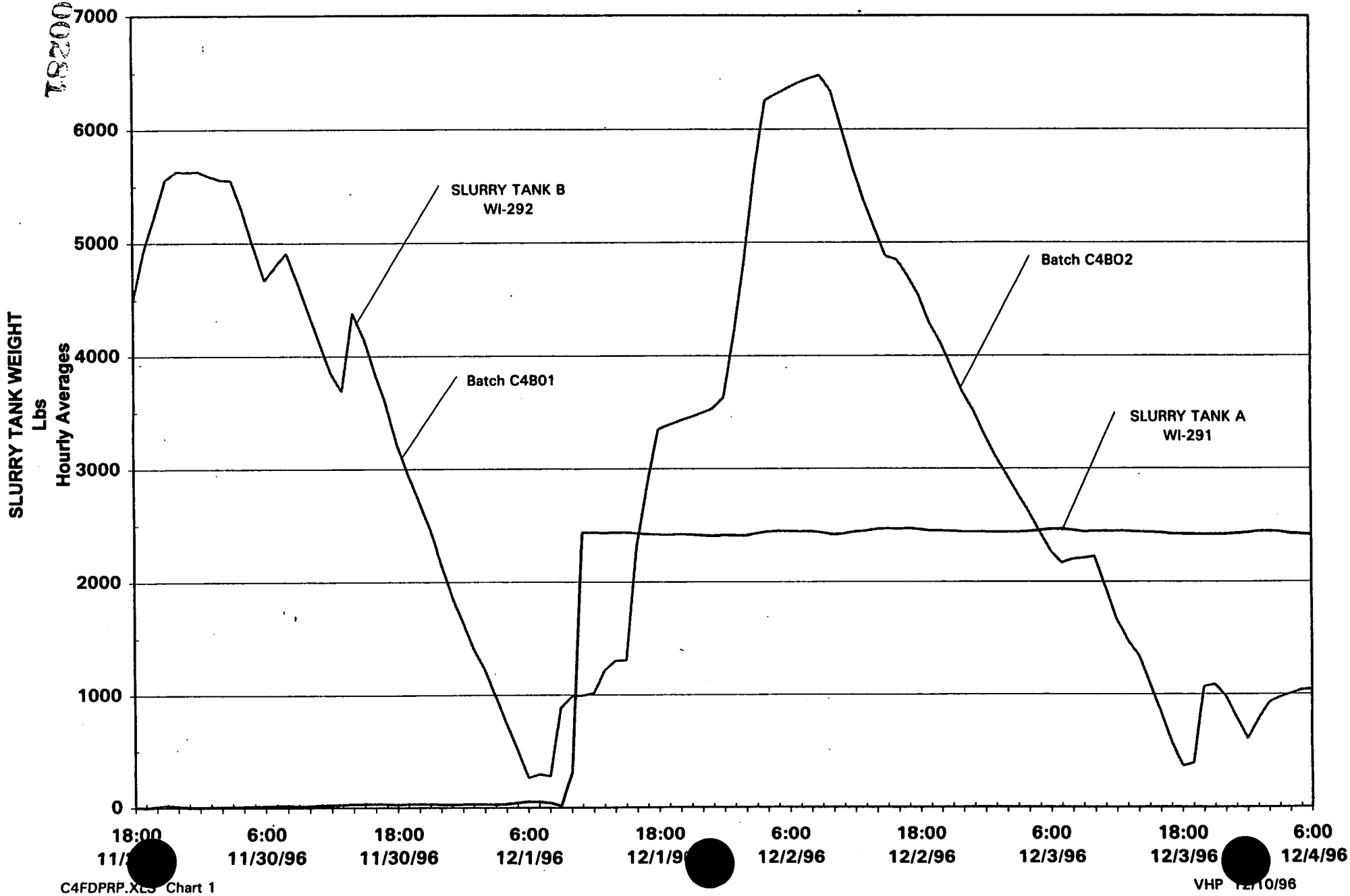


C4FDPRP.XLS Chart 2

VHP 12/18/96

000380

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FEED PREPARATION SYSTEM



C4FDPRP.XLS Chart 1

VHP 12/10/96

182000

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY RECIRC VALVE	AGITATOR	WEIGHT	SLURRY RECIRC VALVE	AGITATOR	RECIRC FLOW	SLURRY FEED VALVE	SLURRY FEED PUMP RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
11/29/96	18:00	1.17	0.0	0.0	4492.58	0.0	1.0	0.00	0.0	0.05
11/29/96	19:00	-3.63	0.0	0.0	4918.46	0.0	1.0	0.00	0.0	0.04
11/29/96	20:00	8.38	0.0	0.0	5235.13	0.0	1.0	0.00	0.0	0.04
11/29/96	21:00	15.54	0.0	0.0	5556.00	0.0	1.0	0.00	0.0	0.05
11/29/96	22:00	9.88	0.0	0.0	5629.29	0.0	1.0	0.00	0.0	0.05
11/29/96	23:00	2.58	0.0	0.0	5624.92	0.0	1.0	0.00	0.0	0.05
11/30/96	0:00	2.04	0.0	0.0	5627.88	0.0	1.0	0.00	0.0	0.04
11/30/96	1:00	2.92	0.0	0.0	5587.67	0.6	1.0	25.55	0.0	0.03
11/30/96	2:00	3.25	0.0	0.0	5556.54	1.0	1.0	47.19	0.0	0.04
11/30/96	3:00	6.50	0.0	0.0	5548.79	1.0	1.0	47.78	0.4	70.85
11/30/96	4:00	9.63	0.0	0.0	5277.54	1.0	1.0	48.54	0.9	188.21
11/30/96	5:00	11.92	0.0	0.0	4966.63	1.0	1.0	48.76	1.0	204.12
11/30/96	6:00	12.92	0.0	0.0	4671.63	1.0	1.0	47.52	1.0	175.20
11/30/96	7:00	15.96	0.0	0.0	4794.96	1.0	1.0	30.38	1.0	175.32
11/30/96	8:00	17.33	0.0	0.0	4909.33	1.0	1.0	49.64	1.0	175.20
11/30/96	9:00	12.67	0.0	0.0	4654.25	1.0	1.0	48.84	1.0	175.17
11/30/96	10:00	15.13	0.0	0.0	4378.75	1.0	1.0	47.74	1.0	175.51
11/30/96	11:00	18.46	0.0	0.0	4105.42	1.0	1.0	46.27	1.0	175.24
11/30/96	12:00	20.98	0.0	0.0	3846.86	1.0	1.0	46.00	1.0	157.59
11/30/96	13:00	24.63	0.0	0.0	3689.50	1.0	1.0	38.37	1.0	175.33
11/30/96	14:00	29.00	0.0	0.0	4384.58	1.0	1.0	43.82	1.0	175.39
11/30/96	15:00	30.25	0.0	0.0	4154.32	1.0	1.0	45.85	1.0	168.45
11/30/96	16:00	29.54	0.0	0.0	3854.00	1.0	1.0	45.08	1.0	190.14
11/30/96	17:00	29.04	0.0	0.0	3563.04	1.0	1.0	44.83	1.0	237.19
11/30/96	18:00	25.88	0.0	0.0	3206.13	1.0	1.0	44.57	1.0	221.02
11/30/96	19:00	30.46	0.0	0.0	2949.79	1.0	1.0	45.07	1.0	146.04
11/30/96	20:00	28.96	0.0	0.0	2710.54	1.0	1.0	45.14	1.0	175.91
11/30/96	21:00	30.83	0.0	0.0	2471.00	1.0	1.0	45.30	1.0	167.61
11/30/96	22:00	27.13	0.0	0.0	2170.46	1.0	1.0	49.47	1.0	187.70
11/30/96	23:00	25.38	0.0	0.0	1876.70	1.0	1.0	51.00	1.0	175.10
12/1/96	0:00	29.38	0.0	0.0	1649.75	1.0	1.0	51.00	1.0	143.87
12/1/96	1:00	30.79	0.0	0.0	1408.75	1.0	1.0	51.00	1.0	160.81
12/1/96	2:00	31.83	0.0	0.0	1223.38	1.0	1.0	51.00	1.0	139.45
12/1/96	3:00	27.54	0.0	0.0	981.83	1.0	1.0	51.00	1.0	175.83
12/1/96	4:00	33.38	0.0	0.0	735.54	1.0	1.0	51.00	1.0	159.20
12/1/96	5:00	45.00	0.0	0.0	503.96	1.0	1.0	51.00	1.0	176.01
12/1/96	6:00	53.25	0.0	0.0	269.75	1.0	1.0	42.39	1.0	137.13
12/1/96	7:00	51.71	0.0	0.0	298.92	1.0	1.0	47.69	1.0	117.72
12/1/96	8:00	43.08	0.0	0.0	284.50	1.0	1.0	41.91	0.8	85.64
12/1/96	9:00	18.04	0.0	0.0	884.54	0.3	1.0	8.49	0.0	0.05
12/1/96	10:00	315.58	0.0	0.0	984.21	1.0	1.0	46.52	0.0	0.05
12/1/96	11:00	2432.71	0.0	0.0	993.50	1.0	1.0	49.75	0.0	0.04
12/1/96	12:00	2434.42	0.0	0.0	1016.13	1.0	1.0	45.97	0.0	0.04
12/1/96	13:00	2431.46	0.0	0.0	1219.13	0.4	1.0	13.52	0.0	0.05
12/1/96	14:00	2436.13	0.0	0.0	1305.04	0.0	1.0	0.00	0.0	0.05
12/1/96	15:00	2434.33	0.0	0.0	1311.46	0.0	1.0	0.00	0.0	0.04
12/1/96	16:00	2427.21	0.0	0.0	2314.08	0.0	1.0	0.00	0.0	0.05
12/1/96	17:00	2419.88	0.0	0.0	2857.67	0.0	1.0	0.00	0.0	0.06
12/1/96	18:00	2415.75	0.0	0.0	3349.33	0.0	1.0	0.00	0.0	0.05
12/1/96	19:00	2414.08	0.0	0.0	3387.79	0.0	1.0	0.00	0.0	0.05
12/1/96	20:00	2416.92	0.0	0.0	3423.79	0.0	1.0	0.00	0.0	0.07
12/1/96	21:00	2414.54	0.0	0.0	3455.58	0.0	1.0	-0.01	0.0	0.05
12/1/96	22:00	2407.29	0.0	0.0	3491.96	0.0	1.0	0.00	0.0	0.05
12/1/96	23:00	2402.67	0.0	0.0	3531.90	0.0	1.0	0.00	0.0	0.06
12/2/96	0:00	2409.75	0.0	0.0	3625.54	0.0	1.0	0.00	0.0	0.04
12/2/96	1:00	2408.09	0.0	0.0	4193.31	0.0	1.0	0.00	0.0	0.06

100282

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM										
CAMPAIGN 4 TRANSITION TO SERIES A GLASS										
		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY	AGITATOR	WEIGHT	SLURRY	AGITATOR	RECIRC	SLURRY	SLURRY
			RECIRC			RECIRC		FLOW	FEED VALVE	FEED PUMP
			VALVE			VALVE				RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/2/96	2:00	2406.25	0.0	0.0	4869.25	0.0	1.0	0.00	0.0	0.06
12/2/96	3:00	2425.63	0.0	0.0	5651.29	0.0	1.0	0.00	0.0	0.05
12/2/96	4:00	2441.54	0.0	0.0	6256.54	0.0	1.0	0.00	0.0	0.06
12/2/96	5:00	2447.25	0.0	0.0	6309.54	0.0	1.0	0.00	0.0	0.04
12/2/96	6:00	2445.63	0.0	0.0	6360.63	0.0	1.0	0.00	0.0	0.06
12/2/96	7:00	2440.42	0.0	0.0	6408.25	0.0	1.0	0.00	0.0	0.07
12/2/96	8:00	2442.46	0.0	0.0	6445.67	0.0	1.0	0.00	0.0	0.07
12/2/96	9:00	2432.25	0.0	0.0	6475.88	0.3	1.0	11.55	0.0	0.05
12/2/96	10:00	2413.96	0.0	0.0	6337.17	1.0	1.0	43.66	0.9	211.94
12/2/96	11:00	2421.21	0.0	0.0	6005.38	1.0	1.0	44.09	1.0	197.26
12/2/96	12:00	2438.92	0.0	0.0	5673.92	1.0	1.0	44.11	0.9	203.18
12/2/96	13:00	2447.71	0.0	0.0	5370.89	1.0	1.0	44.03	1.0	189.35
12/2/96	14:00	2462.63	0.0	0.0	5123.25	1.0	1.0	44.35	1.0	181.03
12/2/96	15:00	2467.83	0.0	0.0	4877.54	1.0	1.0	44.37	1.0	116.88
12/2/96	16:00	2465.04	0.0	0.0	4848.92	1.0	1.0	44.15	1.0	1.99
12/2/96	17:00	2469.13	0.0	0.0	4708.42	1.0	1.0	43.77	1.0	217.90
12/2/96	18:00	2458.17	0.0	0.0	4534.21	1.0	1.0	43.40	1.0	153.74
12/2/96	19:00	2446.79	0.0	0.0	4284.83	1.0	1.0	43.29	1.0	167.48
12/2/96	20:00	2446.42	0.0	0.0	4119.88	1.0	1.0	43.12	1.0	133.13
12/2/96	21:00	2444.54	0.0	0.0	3897.67	1.0	1.0	43.10	1.0	166.66
12/2/96	22:00	2438.00	0.0	0.0	3676.58	1.0	1.0	43.03	1.0	133.25
12/2/96	23:00	2437.67	0.0	0.0	3512.58	1.0	1.0	42.95	1.0	122.88
12/3/96	0:00	2436.83	0.0	0.0	3301.58	1.0	1.0	42.95	1.0	152.81
12/3/96	1:00	2436.08	0.0	0.0	3113.29	1.0	1.0	42.91	1.0	130.58
12/3/96	2:00	2436.04	0.0	0.0	2947.92	1.0	1.0	42.94	1.0	117.25
12/3/96	3:00	2435.92	0.0	0.0	2776.75	1.0	1.0	42.89	1.0	110.81
12/3/96	4:00	2440.51	0.0	0.0	2619.58	1.0	1.0	43.06	1.0	150.10
12/3/96	5:00	2450.08	0.0	0.0	2436.79	1.0	1.0	44.20	1.0	121.20
12/3/96	6:00	2459.83	0.0	0.0	2274.04	1.0	1.0	44.22	1.0	118.38
12/3/96	7:00	2461.50	0.0	0.0	2166.38	1.0	1.0	44.01	0.6	61.39
12/3/96	8:00	2452.50	0.0	0.0	2199.67	1.0	1.0	43.80	0.0	0.05
12/3/96	9:00	2438.88	0.0	0.0	2208.96	1.0	1.0	43.85	0.0	0.05
12/3/96	10:00	2442.75	0.0	0.0	2222.42	1.0	1.0	44.13	0.4	86.43
12/3/96	11:00	2444.96	0.0	0.0	1954.50	1.0	1.0	44.76	1.0	206.36
12/3/96	12:00	2442.96	0.0	0.0	1669.00	1.0	1.0	45.09	1.0	197.34
12/3/96	13:00	2443.60	0.0	0.0	1484.49	1.0	1.0	44.83	0.5	66.58
12/3/96	14:00	2436.70	0.0	0.0	1351.48	1.0	1.0	44.91	1.0	186.57
12/3/96	15:00	2433.79	0.0	0.0	1095.08	1.0	1.0	45.24	1.0	191.51
12/3/96	16:00	2429.92	0.0	0.0	839.21	1.0	1.0	45.40	1.0	169.84
12/3/96	17:00	2420.00	0.0	0.0	570.75	1.0	1.0	44.84	1.0	166.88
12/3/96	18:00	2417.71	0.0	0.0	362.50	1.0	1.0	41.12	1.0	126.08
12/3/96	19:00	2415.55	0.0	0.0	389.45	0.9	1.0	7.10	0.4	80.67
12/3/96	20:00	2414.83	0.0	0.0	1067.42	1.0	1.0	37.48	0.0	0.05
12/3/96	21:00	2414.42	0.0	0.0	1086.58	1.0	1.0	40.72	0.1	2.95
12/3/96	22:00	2413.04	0.0	0.0	978.29	1.0	1.0	40.98	1.0	123.28
12/3/96	23:00	2420.89	0.0	0.0	788.18	1.0	1.0	40.63	1.0	89.57
12/4/96	0:00	2427.96	0.0	0.0	604.42	1.0	1.0	39.69	1.0	92.21
12/4/96	1:00	2439.79	0.0	0.0	775.83	0.7	1.0	25.74	0.0	10.85
12/4/96	2:00	2440.92	0.0	0.0	927.21	1.0	1.0	43.76	0.0	0.05
12/4/96	3:00	2436.50	0.0	0.0	972.79	1.0	1.0	43.87	0.0	0.03
12/4/96	4:00	2421.14	0.0	0.0	1003.29	1.0	1.0	43.80	0.0	0.05
12/4/96	5:00	2415.76	0.0	0.0	1037.67	1.0	1.0	43.70	0.0	0.05
12/4/96	6:00	2409.96	0.0	0.0	1045.22	1.0	1.0	43.60	0.0	0.06

000283

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/22/96	12:00	0.0	0.0	0.138	0.011
12/22/96	13:00	0.3	0.0	0.111	-0.005
12/22/96	14:00	0.0	0.0	0.089	-0.014
12/22/96	15:00	0.0	0.0	0.090	-0.012
12/22/96	16:00	0.0	0.0	0.102	-0.006
12/22/96	17:00	0.0	0.0	0.149	0.015
12/22/96	18:00	0.0	0.0	0.097	-0.006
12/22/96	19:00	0.0	0.0	0.090	-0.011
12/22/96	20:00	0.0	0.0	0.089	-0.008
12/22/96	21:00	0.2	0.0	0.095	-0.009
12/22/96	22:00	0.1	0.0	0.094	-0.007
12/22/96	23:00	0.0	0.0	0.096	-0.007
12/23/96	0:00	0.0	0.0	0.097	-0.006
12/23/96	1:00	0.0	0.0	0.100	-0.006
12/23/96	2:00	0.0	0.0	0.099	-0.004
12/23/96	3:00	0.0	0.0	0.101	-0.003
12/23/96	4:00	0.0	0.0	0.102	-0.005
12/23/96	5:00	0.0	0.0	0.102	-0.004
12/23/96	6:00	0.0	0.0	0.098	-0.007
12/23/96	7:00	0.0	0.0	0.099	-0.003
12/23/96	8:00	0.3	0.0	0.101	-0.003
12/23/96	9:00	0.0	0.0	0.097	-0.005
12/23/96	10:00	0.0	0.0	0.098	-0.001
12/23/96	11:00	0.3	0.0	0.097	0.003
12/23/96	12:00	0.3	0.0	0.095	0.010
12/23/96	13:00	0.0	0.0	0.096	0.023
12/23/96	14:00	0.0	0.0	0.096	0.031
12/23/96	15:00	0.0	0.0	0.100	0.038
12/23/96	16:00	0.3	0.0	0.099	0.042
12/23/96	17:00	0.0	0.0	0.098	0.047
12/23/96	18:00	0.0	0.0	0.098	0.050
12/23/96	19:00	0.0	0.0	0.096	0.054
12/23/96	20:00	0.0	0.0	0.091	0.068
12/23/96	21:00	0.0	0.0	0.089	0.077
12/23/96	22:00	0.6	0.5	0.093	0.087
12/23/96	23:00	0.1	0.1	0.091	0.093
12/24/96	0:00	0.3	0.0	0.092	0.092
12/24/96	1:00	0.0	0.0	0.093	0.093
12/24/96	2:00	0.0	0.0	0.092	0.098
12/24/96	3:00	0.0	0.0	0.091	0.114
12/24/96	4:00	0.0	0.0	0.088	0.123
12/24/96	5:00	0.0	0.0	0.091	0.130
12/24/96	6:00	0.6	0.0	0.091	0.137
12/24/96	7:00	0.0	0.0	0.135	0.164

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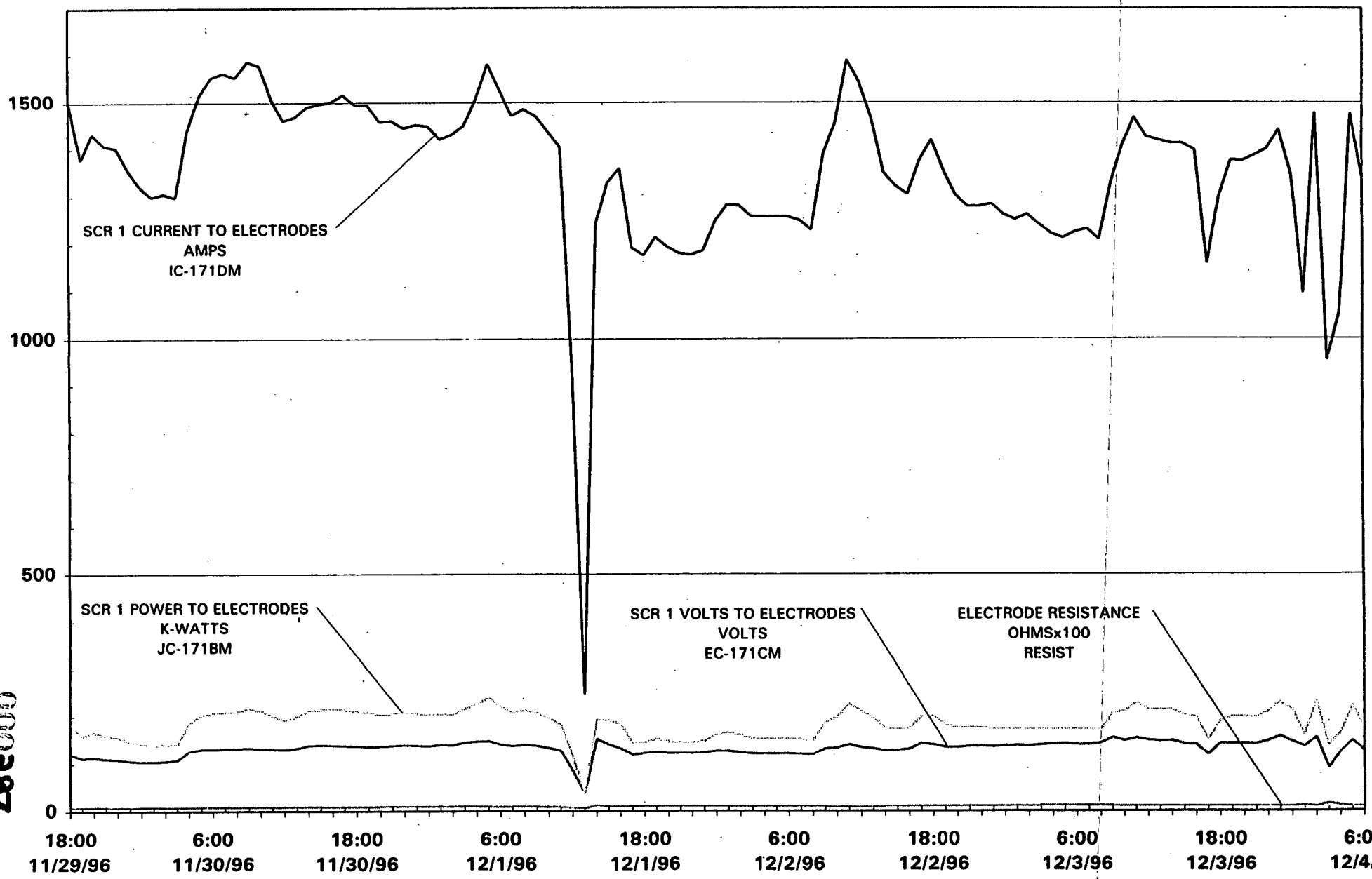
VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/24/96	8:00	0.0	0.0	0.114	0.157
12/24/96	9:00	0.0	0.0	0.092	0.154
12/24/96	10:00	0.0	0.0	0.143	0.184
12/24/96	11:00	0.0	0.0	0.103	0.175
12/24/96	12:00	0.0	0.0	0.125	0.191
12/24/96	13:00	0.0	0.0	0.115	0.194
12/24/96	14:00	0.0	0.0	0.118	0.204
12/24/96	15:00	0.0	0.0	0.116	0.207
12/24/96	16:00	0.0	0.0	0.117	0.218
12/24/96	17:00	0.0	0.0	0.112	0.223
12/24/96	18:00	0.0	0.0	0.126	0.244
12/24/96	19:00	0.3	0.0	0.098	0.242
12/24/96	20:00	0.1	0.0	0.125	0.265
12/24/96	21:00	0.0	0.0	0.103	0.262
12/24/96	22:00	0.0	0.0	0.102	0.265
12/24/96	23:00	0.0	0.0	0.105	0.276
12/25/96	0:00	0.0	0.0	0.083	0.263
12/25/96	1:00	0.0	0.0	0.109	0.284
12/25/96	2:00	0.0	0.0	0.075	0.264
12/25/96	3:00	0.0	0.0	0.093	0.282
12/25/96	4:00	0.0	0.0	0.084	0.274
12/25/96	5:00	0.0	0.0	0.078	0.271
12/25/96	6:00	0.0	0.0	0.088	0.283
12/25/96	7:00	0.0	0.0	0.067	0.267
12/25/96	8:00	0.0	0.0	0.092	0.288
12/25/96	9:00	0.0	0.0	0.070	0.273
12/25/96	10:00	0.0	0.0	0.079	0.274
12/25/96	11:00	0.0	0.0	0.084	0.267
12/25/96	12:00	0.0	0.0	0.072	0.241
12/25/96	13:00	0.0	0.0	0.082	0.217
12/25/96	14:00	0.2	0.0	0.076	0.182
12/25/96	15:00	0.2	0.0	0.056	0.127
12/25/96	16:00	0.0	0.0	0.098	0.124
12/25/96	17:00	0.4	0.0	0.052	0.061
12/25/96	18:00	0.0	0.0	0.086	0.060
12/25/96	19:00	0.4	0.0	0.065	0.033
12/25/96	20:00	0.0	0.0	0.085	0.045
12/25/96	21:00	0.0	0.0	0.062	0.024
12/25/96	22:00	0.0	0.0	0.093	0.047
12/25/96	23:00	0.3	0.0	0.061	0.020
12/26/96	0:00	0.0	0.0	0.092	0.042
12/26/96	1:00	0.0	0.0	0.071	0.017
12/26/96	2:00	0.0	0.0	0.081	0.022
12/26/96	3:00	0.0	0.0	0.078	0.017

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/26/96	4:00	0.0	0.0	0.073	0.004
12/26/96	5:00	0.1	0.0	0.081	0.009
12/26/96	6:00	0.2	0.0	0.064	-0.004
12/26/96	7:00	0.0	0.0	0.085	0.005
12/26/96	8:00	0.0	0.0	0.065	-0.008
12/26/96	9:00	0.0	0.0	0.084	0.006
12/26/96	10:00	0.3	0.0	0.060	-0.009
12/26/96	11:00	0.0	0.0	0.080	0.001
12/26/96	12:00	0.0	0.0	0.074	-0.004
12/26/96	13:00	0.3	0.0	0.048	-0.013
12/26/96	14:00	0.2	0.0	0.088	0.004
12/26/96	15:00	0.0	0.0	0.073	-0.007
12/26/96	16:00	0.0	0.0	0.049	-0.014
12/26/96	17:00	0.0	0.0	0.068	-0.004
12/26/96	18:00	0.0	0.0	0.088	0.002
12/26/96	19:00	0.0	0.0	0.052	-0.012
12/26/96	20:00	0.0	0.0	0.069	-0.004

CAMPA[illegible]4
TRANSITION TO SERIES A GLASS FURNACE SYSTEM



C4FURN.XLS Chart 1

vhp 12/11/96

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

		HOURLY AVERAGES						
READINGS		ELECTRODE CURRENT	CURRENT CONTROLLER SET POINT	ELECTRODE VOLTAGE	VOLTAGE CONTROLLER SET POINT	ELECTRODE POWER	POWER CONTROLLER SET POINT	ELECTRODE RESISTANCE
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
11/29/96	18:00	1499.68	246.00	120.86	454.80	185.97	185.28	8.06
11/29/96	19:00	1378.25	246.00	112.46	454.80	159.05	159.08	8.16
11/29/96	20:00	1432.68	246.00	114.32	454.80	167.80	167.64	7.98
11/29/96	21:00	1407.88	246.00	111.38	454.80	160.64	160.56	7.92
11/29/96	22:00	1402.18	246.00	109.55	454.80	157.08	157.00	7.81
11/29/96	23:00	1356.33	246.00	106.31	454.80	147.52	147.52	7.84
11/30/96	0:00	1321.20	246.00	104.69	454.80	141.79	141.76	7.93
11/30/96	1:00	1299.73	246.00	104.44	454.80	139.09	139.20	8.03
11/30/96	2:00	1306.40	246.00	105.74	454.80	141.12	141.32	8.10
11/30/96	3:00	1298.80	246.00	108.26	454.80	141.34	141.60	8.34
11/30/96	4:00	1437.70	246.00	126.89	454.80	185.29	185.40	8.83
11/30/96	5:00	1514.60	246.00	131.00	454.80	201.25	201.40	8.65
11/30/96	6:00	1552.55	246.00	130.97	454.80	206.30	206.24	8.44
11/30/96	7:00	1561.58	246.00	132.28	454.80	208.95	208.80	8.47
11/30/96	8:00	1552.18	246.00	132.98	454.80	208.94	208.80	8.56
11/30/96	9:00	1585.30	246.00	133.88	454.80	215.14	215.04	8.44
11/30/96	10:00	1577.50	246.00	132.38	454.80	211.25	211.41	8.39
11/30/96	11:00	1508.20	246.00	131.15	454.80	200.24	200.32	8.69
11/30/96	12:00	1460.70	246.00	130.22	454.80	192.08	192.00	8.91
11/30/96	13:00	1468.70	246.00	133.42	454.80	198.86	198.88	9.08
11/30/96	14:00	1490.40	246.00	139.00	454.80	210.31	210.60	9.33
11/30/96	15:00	1496.67	246.00	140.31	454.80	213.47	213.60	9.37
11/30/96	16:00	1501.23	246.00	139.62	454.80	213.48	213.60	9.30
11/30/96	17:00	1515.65	246.00	138.63	454.80	213.38	213.60	9.14
11/30/96	18:00	1494.85	246.00	137.63	454.80	209.35	209.04	9.21
11/30/96	19:00	1495.43	246.00	136.77	454.80	207.95	207.76	9.14
11/30/96	20:00	1458.68	246.00	136.99	454.80	202.83	203.04	9.39
11/30/96	21:00	1460.50	246.00	138.93	454.80	206.34	206.40	9.51
11/30/96	22:00	1445.20	246.00	140.58	454.80	206.45	206.40	9.73
11/30/96	23:00	1452.74	246.00	139.38	454.80	205.61	205.51	9.59
12/1/96	0:00	1449.45	246.00	138.79	454.80	203.89	204.00	9.57
12/1/96	1:00	1422.10	246.00	141.31	454.80	204.00	204.00	9.93
12/1/96	2:00	1431.68	246.00	140.53	454.80	204.37	204.40	9.82
12/1/96	3:00	1450.30	246.00	146.80	454.80	216.45	216.48	10.12
12/1/96	4:00	1505.45	246.00	148.47	454.80	226.40	226.32	9.86
12/1/96	5:00	1580.68	246.00	149.50	454.80	239.60	239.40	9.46
12/1/96	6:00	1526.55	246.00	142.28	454.80	220.40	220.28	9.32
12/1/96	7:00	1472.10	246.00	138.59	454.80	207.46	207.56	9.41
12/1/96	8:00	1485.75	246.00	141.53	454.80	213.33	213.60	9.52
12/1/96	9:00	1471.50	246.00	139.01	454.80	207.39	207.60	9.44
12/1/96	10:00	1437.85	246.00	134.31	454.80	195.67	195.60	9.34
12/1/96	11:00	1405.55	246.00	128.53	454.80	183.07	183.12	9.15
12/1/96	12:00	935.08	246.00	85.37	454.80	116.14	114.84	6.99
12/1/96	13:00	247.45	246.00	37.84	454.80	36.53	35.88	6.86
12/1/96	14:00	1242.75	246.00	152.72	454.80	192.26	192.00	12.31
12/1/96	15:00	1330.53	246.00	141.73	454.80	191.00	190.64	10.65
12/1/96	16:00	1360.38	246.00	132.92	454.80	182.91	182.80	9.77
12/1/96	17:00	1192.50	246.00	119.18	454.80	144.05	144.16	10.00
12/1/96	18:00	1176.23	246.00	122.58	454.80	146.30	146.36	10.43
12/1/96	19:00	1214.48	246.00	125.60	454.80	152.95	153.04	10.34
12/1/96	20:00	1194.30	246.00	123.24	454.80	148.21	148.20	10.32

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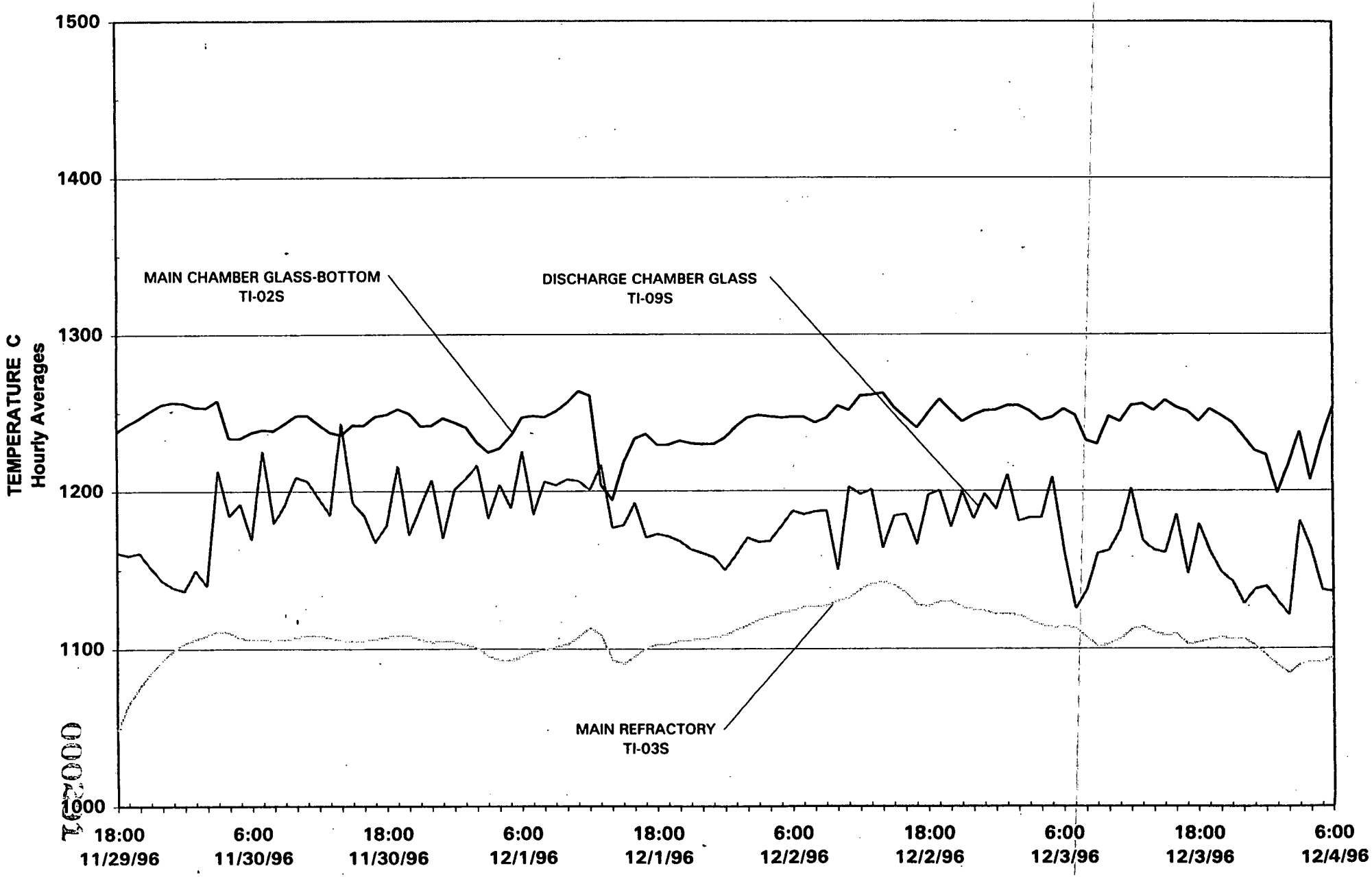
VITRIFICATION PILOT PLANT FURNACE SYSTEM								
CAMPAIGN 4 TRANSITION TO SERIES A GLASS								
		HOURLY AVERAGES						
READINGS		ELECTRODE CURRENT	CURRENT CONTROLLER SET POINT	ELECTRODE VOLTAGE	VOLTAGE CONTROLLER SET POINT	ELECTRODE POWER	POWER CONTROLLER SET POINT	ELECTRODE RESISTANCE
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/1/96	21:00	1180.50	246.00	123.00	454.80	146.33	146.40	10.42
12/1/96	22:00	1177.53	246.00	123.35	454.80	146.36	146.40	10.47
12/1/96	23:00	1186.14	246.00	124.51	454.80	149.01	148.88	10.50
12/2/96	0:00	1247.83	246.00	127.95	454.80	161.55	161.60	10.25
12/2/96	1:00	1284.05	246.00	127.59	454.80	165.65	165.89	9.93
12/2/96	2:00	1282.05	246.00	124.82	454.80	161.27	161.24	9.74
12/2/96	3:00	1259.50	246.00	122.29	454.80	153.83	153.92	9.72
12/2/96	4:00	1258.63	246.00	122.26	454.80	153.51	153.60	9.72
12/2/96	5:00	1258.53	246.00	122.21	454.80	153.52	153.60	9.72
12/2/96	6:00	1258.53	246.00	122.06	454.80	153.52	153.60	9.70
12/2/96	7:00	1250.30	246.00	121.10	454.80	151.75	151.72	9.69
12/2/96	8:00	1229.60	246.00	120.37	454.80	148.94	148.80	9.79
12/2/96	9:00	1389.35	246.00	132.51	454.80	186.81	186.68	9.55
12/2/96	10:00	1456.35	246.00	134.03	454.80	197.60	197.88	9.20
12/2/96	11:00	1589.35	246.00	140.95	454.80	225.69	225.80	8.87
12/2/96	12:00	1541.55	246.00	135.29	454.80	211.01	210.84	8.77
12/2/96	13:00	1466.06	246.00	132.32	454.80	195.91	196.03	9.03
12/2/96	14:00	1350.85	246.00	128.22	454.80	174.88	175.04	9.50
12/2/96	15:00	1322.68	246.00	128.84	454.80	173.90	174.00	9.74
12/2/96	16:00	1305.65	246.00	131.31	454.80	175.22	175.20	10.06
12/2/96	17:00	1375.78	246.00	143.45	454.80	198.84	199.04	10.43
12/2/96	18:00	1419.83	246.00	140.70	454.80	200.17	200.00	9.91
12/2/96	19:00	1355.13	246.00	135.13	454.80	182.46	182.52	9.98
12/2/96	20:00	1303.55	246.00	134.89	454.80	175.10	175.20	10.35
12/2/96	21:00	1279.73	246.00	137.29	454.80	175.14	175.20	10.73
12/2/96	22:00	1279.38	246.00	137.46	454.80	175.34	175.20	10.74
12/2/96	23:00	1284.93	246.00	136.19	454.80	173.87	173.80	10.60
12/3/96	0:00	1262.78	246.00	138.21	454.80	172.89	172.80	10.95
12/3/96	1:00	1251.88	246.00	138.91	454.80	172.86	172.80	11.10
12/3/96	2:00	1262.93	246.00	137.88	454.80	172.93	172.80	10.93
12/3/96	3:00	1241.14	246.00	140.19	454.80	172.89	172.80	11.30
12/3/96	4:00	1221.71	246.00	142.40	454.80	172.88	172.80	11.65
12/3/96	5:00	1212.23	246.00	142.83	454.80	172.88	172.80	11.78
12/3/96	6:00	1224.68	246.00	141.17	454.80	172.86	172.80	11.53
12/3/96	7:00	1231.05	246.00	140.33	454.80	172.80	172.80	11.40
12/3/96	8:00	1209.58	246.00	143.59	454.80	172.86	172.80	11.87
12/3/96	9:00	1328.10	246.00	154.63	454.80	206.88	206.72	11.68
12/3/96	10:00	1408.32	246.00	148.55	454.80	211.29	211.24	10.55
12/3/96	11:00	1467.80	246.00	153.91	454.80	228.59	228.60	10.49
12/3/96	12:00	1426.98	246.00	149.45	454.80	216.04	216.16	10.30
12/3/96	13:00	1419.43	246.00	147.87	454.80	213.45	213.60	10.42
12/3/96	14:00	1412.90	246.00	148.47	454.80	213.34	213.60	10.51
12/3/96	15:00	1412.15	246.00	141.39	454.80	202.57	202.64	10.02
12/3/96	16:00	1397.80	246.00	140.07	454.80	198.37	198.48	10.02
12/3/96	17:00	1158.20	246.00	119.60	454.80	150.50	150.68	10.50
12/3/96	18:00	1300.88	246.00	142.68	454.80	190.37	190.52	11.00
12/3/96	19:00	1376.75	246.00	142.16	454.80	199.35	199.20	10.32
12/3/96	20:00	1375.53	246.00	142.63	454.80	199.29	199.20	10.37
12/3/96	21:00	1387.20	246.00	141.41	454.80	199.12	199.20	10.20
12/3/96	22:00	1400.23	246.00	148.23	454.80	210.48	210.48	10.58
12/3/96	23:00	1442.53	246.00	157.98	454.80	230.15	230.40	10.96

VITRIFICATION PILOT PLANT FURNACE SYSTEM								
CAMPAIGN 4 TRANSITION TO SERIES A GLASS								
		HOURLY AVERAGES						
READINGS		ELECTRODE	CURRENT	ELECTRODE	VOLTAGE	ELECTRODE	POWER	ELECTRODE
		CURRENT	CONTROLLER	VOLTAGE	CONTROLLER	POWER	CONTROLLER	RESISTANCE
			SET POINT		SET POINT		SET POINT	
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/4/96	0:00	1347.55	246.00	146.04	454.80	213.25	213.24	10.96
12/4/96	1:00	1096.13	246.00	136.33	454.80	161.45	162.40	12.59
12/4/96	2:00	1477.73	246.00	155.24	454.80	233.08	232.80	10.52
12/4/96	3:00	953.51	246.00	91.44	454.80	137.50	138.10	16.39
12/4/96	4:00	1050.79	246.00	124.23	454.80	165.39	166.06	12.28
12/4/96	5:00	1475.72	246.00	148.43	454.80	222.28	222.40	10.08
12/4/96	6:00	1339.15	246.00	126.40	454.80	177.97	171.27	9.45

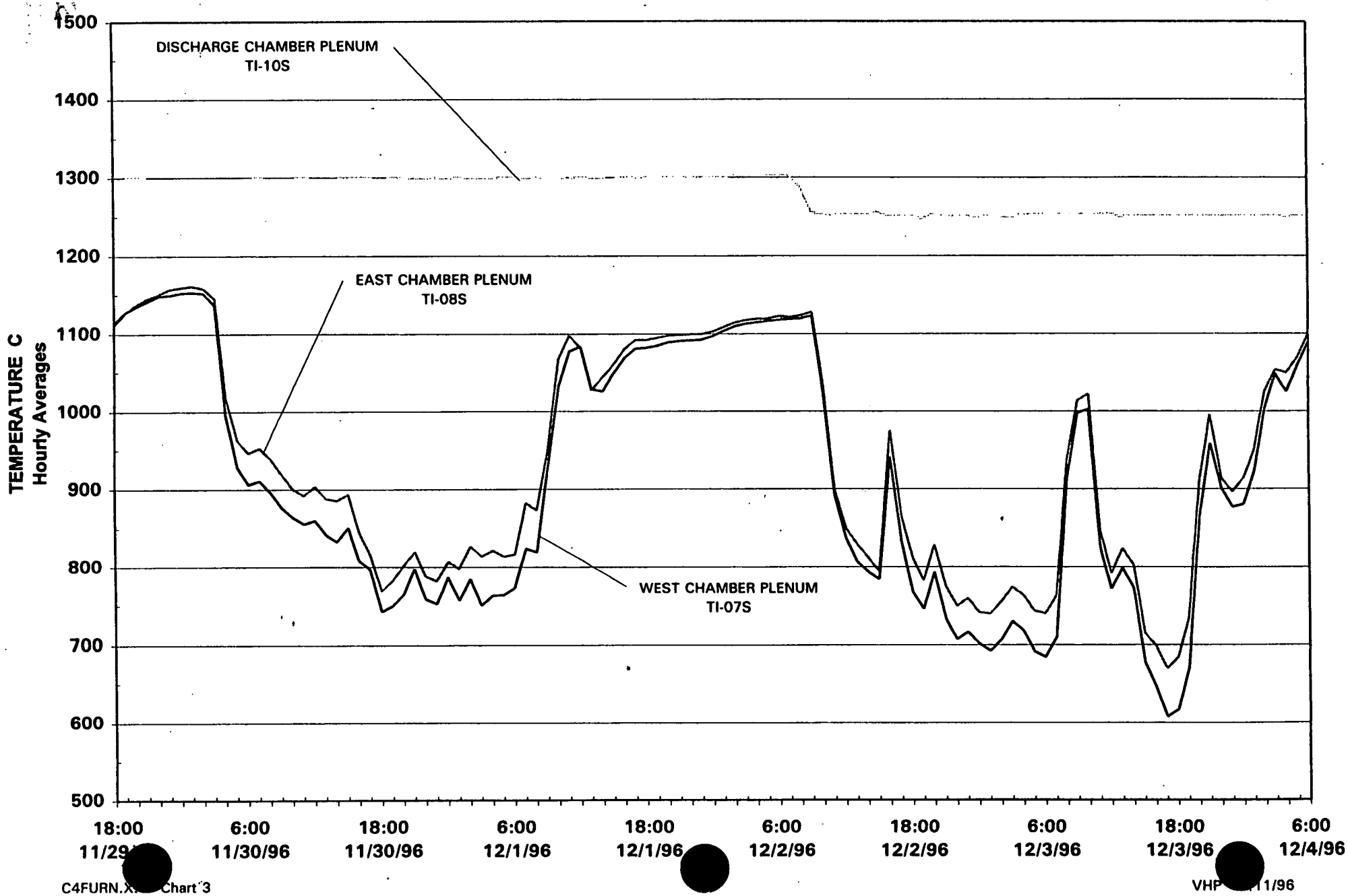
CAMPA[illegible]4
TRANSITION TO SERIES A GLASS FURNACE SYSTEM



C4FURN.XLS Chart 2

VHP 12/11/96

CAMPAIGN 4
TRANSITION TO SERIES A GLASS FURNACE SYSTEM



C4FURN.X Chart 3

VHP 11/96

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

		HOURLY AVERAGES										
READINGS		MAIN CHAMBER	MAIN CHAMBER	WEST CHAMBER	WEST CHAMBER	EAST CHAMBER	EAST CHAMBER	DISCH CHAMBER	WEST CHAMBER	EAST CHAMBER	DISCH CHAMBER	MAIN
		GLASS TOP	GLASS BOTTOM	GLASS	IR GLASS	GLASS	IR GLASS	GLASS	PLENUM	PLENUM	PLENUM	REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
11/29/96	18:00	OUT OF SERVICE	1238.17	OUT OF SERVICE	OUT OF SERVICE	OUT OF SERVICE	OUT OF SERVICE	1161.11	1113.66	1111.95	1301.16	1048.59
11/29/96	19:00		1242.77					1159.27	1127.43	1127.08	1301.16	1064.81
11/29/96	20:00		1246.56					1160.94	1135.14	1137.31	1301.03	1075.75
11/29/96	21:00		1251.01					1151.54	1141.83	1144.95	1301.35	1084.81
11/29/96	22:00		1255.24					1143.38	1148.35	1150.33	1301.12	1092.50
11/29/96	23:00		1256.75					1138.78	1149.50	1157.01	1301.16	1098.82
11/30/96	0:00		1256.21					1136.62	1152.50	1159.45	1301.11	1103.35
11/30/96	1:00		1253.65					1149.78	1153.17	1161.02	1301.31	1106.28
11/30/96	2:00		1253.24					1139.99	1151.95	1158.39	1301.35	1108.77
11/30/96	3:00		1257.92					1213.10	1136.82	1145.73	1301.49	1111.21
11/30/96	4:00		1234.21					1184.58	993.63	1017.04	1301.46	1110.47
11/30/96	5:00		1234.13					1191.91	929.05	963.26	1301.14	1107.07
11/30/96	6:00		1237.68					1169.39	906.29	946.79	1301.64	1105.86
11/30/96	7:00		1239.47					1225.74	910.38	952.60	1300.90	1105.69
11/30/96	8:00		1238.91					1179.99	895.80	939.70	1301.41	1105.52
11/30/96	9:00		1243.36					1191.43	876.19	918.72	1301.87	1105.84
11/30/96	10:00		1248.05					1209.11	864.30	900.55	1301.57	1107.45
11/30/96	11:00		1248.26					1206.62	855.77	891.99	1300.65	1108.55
11/30/96	12:00		1242.92					1195.61	860.07	903.47	1301.50	1108.52
11/30/96	13:00		1237.72					1185.11	841.62	887.78	1301.29	1106.99
11/30/96	14:00		1236.22					1243.35	832.89	885.29	1301.64	1105.60
11/30/96	15:00		1242.39					1192.72	850.74	893.13	1300.31	1105.14
11/30/96	16:00		1242.27					1185.03	807.70	844.32	1300.90	1105.32
11/30/96	17:00		1247.56					1167.61	796.81	815.31	1301.08	1106.30
11/30/96	18:00		1248.81					1178.30	742.77	769.83	1301.86	1107.61
11/30/96	19:00		1252.53					1216.21	750.06	782.75	1300.82	1108.60
11/30/96	20:00		1249.61					1172.51	764.58	801.23	1299.72	1108.27
11/30/96	21:00		1241.71					1190.01	797.65	819.66	1299.34	1105.99
11/30/96	22:00		1242.13					1207.10	758.71	788.25	1299.36	1104.29
11/30/96	23:00		1246.66					1170.22	752.87	782.36	1299.90	1104.93
12/1/96	0:00		1243.91					1200.85	787.03	806.32	1299.04	1104.52
12/1/96	1:00		1240.97					1207.83	757.39	797.98	1300.15	1102.65
12/1/96	2:00		1231.24					1216.40	784.50	826.71	1299.26	1100.59
12/1/96	3:00		1224.92					1182.92	750.60	813.48	1299.59	1095.38
12/1/96	4:00		1227.60					1203.98	763.32	821.33	1299.37	1092.75
12/1/96	5:00		1235.42					1189.17	764.19	813.54	1300.01	1092.61
12/1/96	6:00		1247.00					1225.44	773.51	816.06	1300.09	1094.95
12/1/96	7:00		1247.97					1185.30	823.54	882.36	1299.19	1098.44
12/1/96	8:00		1247.39					1206.16	818.95	872.78	1299.81	1099.32
12/1/96	9:00		1251.18					1203.84	929.84	951.30	1299.56	1101.22
12/1/96	10:00		1256.69					1207.72	1031.55	1067.00	1299.64	1103.07
12/1/96	11:00		1263.90					1206.59	1076.90	1097.79	1298.82	1107.58
12/1/96	12:00		1261.07					1200.78	1083.25	1081.86	1301.02	1113.05
12/1/96	13:00		1203.75					1216.82	1028.80	1026.97	1299.15	1108.52
12/1/96	14:00		1194.20					1176.78	1025.68	1043.51	1299.48	1092.90
12/1/96	15:00		1218.22					1178.39	1048.37	1059.99	1297.84	1090.32
12/1/96	16:00		1233.71					1192.29	1067.94	1079.59	1301.38	1095.28
12/1/96	17:00		1236.65					1170.66	1080.44	1091.94	1299.54	1100.74
12/1/96	18:00		1229.55					1172.77	1081.35	1091.88	1299.76	1102.68
12/1/96	19:00		1229.75					1171.39	1084.35	1094.55	1299.67	1103.27
12/1/96	20:00		1232.17					1168.14	1088.80	1097.76	1300.03	1104.92
12/1/96	21:00		1230.53					1162.91	1090.44	1098.48	1299.94	1105.53
12/1/96	22:00		1229.98					1160.61	1091.37	1099.33	1300.03	1106.05

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

HOURLY AVERAGES

READINGS		MAIN CHAMBER GLASS TOP	MAIN CHAMBER GLASS BOTTOM	WEST CHAMBER GLASS	WEST CHAMBER IR GLASS	EAST CHAMBER GLASS	EAST CHAMBER IR GLASS	DISCH CHAMBER GLASS	WEST CHAMBER PLENUM	EAST CHAMBER PLENUM	DISCH CHAMBER PLENUM	MAIN REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/1/96	23:00		1230.02					1158.10	1092.06	1099.45	1300.10	1107.01
12/2/96	0:00		1234.14					1149.80	1096.70	1102.82	1300.06	1108.32
12/2/96	1:00		1241.07					1159.58	1103.63	1108.73	1300.47	1111.65
12/2/96	2:00		1247.04					1170.36	1109.79	1114.30	1301.94	1114.80
12/2/96	3:00		1248.58					1167.69	1112.95	1117.55	1301.92	1118.19
12/2/96	4:00		1247.76					1168.37	1114.85	1119.38	1301.87	1120.62
12/2/96	5:00		1246.91					1177.52	1116.40	1119.48	1302.02	1122.68
12/2/96	6:00		1247.66					1187.31	1118.09	1122.63	1301.95	1124.12
12/2/96	7:00		1247.46					1185.32	1119.18	1121.54	1301.97	1126.12
12/2/96	8:00		1243.70					1187.00	1120.23	1123.65	1287.86	1126.71
12/2/96	9:00		1246.79					1187.56	1123.52	1127.72	1256.12	1127.02
12/2/96	10:00		1254.44					1149.81	1023.74	1033.20	1252.91	1130.31
12/2/96	11:00		1251.72					1202.62	891.55	898.28	1252.41	1132.11
12/2/96	12:00		1260.75					1197.71	837.21	849.97	1253.62	1137.49
12/2/96	13:00		1261.35					1200.77	806.82	829.49	1253.57	1140.94
12/2/96	14:00		1262.55					1163.89	793.81	811.88	1253.72	1142.33
12/2/96	15:00		1253.42					1184.11	784.51	794.30	1256.24	1140.13
12/2/96	16:00		1246.93					1185.27	941.14	974.78	1250.49	1135.53
12/2/96	17:00		1240.10					1165.91	833.46	865.35	1251.61	1127.66
12/2/96	18:00		1250.05					1197.23	768.02	811.69	1252.09	1126.75
12/2/96	19:00		1258.52					1200.05	746.28	783.20	1247.27	1129.88
12/2/96	20:00		1251.23					1176.93	793.13	828.02	1253.54	1130.17
12/2/96	21:00		1244.38					1199.31	732.66	775.02	1251.99	1125.98
12/2/96	22:00		1248.43					1182.24	707.46	749.70	1251.19	1124.44
12/2/96	23:00		1251.21					1197.96	716.83	759.69	1250.68	1123.70
12/3/96	0:00		1251.67					1188.26	701.63	741.60	1250.03	1121.71
12/3/96	1:00		1254.58					1210.33	692.18	739.72	1250.86	1121.53
12/3/96	2:00		1254.48					1180.75	707.27	755.47	1250.31	1121.24
12/3/96	3:00		1250.96					1182.94	730.25	774.24	1248.36	1117.49
12/3/96	4:00		1245.41					1182.89	718.79	763.72	1253.85	1114.87
12/3/96	5:00		1247.12					1208.95	691.14	743.28	1252.74	1113.27
12/3/96	6:00		1252.40					1162.51	684.47	739.99	1253.42	1113.92
12/3/96	7:00		1248.43					1125.17	709.84	763.02	1252.89	1113.00
12/3/96	8:00		1232.06					1136.87	912.39	936.02	1254.35	1107.08
12/3/96	9:00		1229.99					1160.26	997.97	1013.41	1253.41	1101.20
12/3/96	10:00		1247.74					1162.26	1002.14	1022.08	1253.78	1103.08
12/3/96	11:00		1244.50					1174.96	824.85	844.98	1253.65	1106.36
12/3/96	12:00		1254.65					1201.29	771.89	791.84	1254.82	1111.97
12/3/96	13:00		1255.48					1168.13	798.60	823.13	1249.61	1114.06
12/3/96	14:00		1251.39					1162.58	773.36	802.88	1252.65	1110.00
12/3/96	15:00		1257.72					1160.71	677.39	714.90	1251.54	1108.62
12/3/96	16:00		1253.43					1185.04	645.66	698.34	1252.24	1109.32
12/3/96	17:00		1250.86					1147.53	608.04	669.56	1251.23	1102.67
12/3/96	18:00		1244.65					1178.59	617.14	684.62	1251.08	1103.98
12/3/96	19:00		1252.31					1161.29	671.48	734.43	1251.40	1105.60
12/3/96	20:00		1248.27					1148.26	864.25	911.12	1251.04	1107.31
12/3/96	21:00		1243.83					1142.42	958.54	995.23	1250.89	1105.56
12/3/96	22:00		1234.33					1128.56	900.87	913.31	1251.08	1106.39
12/3/96	23:00		1225.65					1137.73	876.73	896.35	1251.13	1101.71
12/4/96	0:00		1222.89					1139.34	880.41	913.93	1251.84	1095.59
12/4/96	1:00		1198.35					1129.98	922.40	950.70	1251.41	1089.14
12/4/96	2:00		1216.54					1121.13	1003.55	1024.57	1250.63	1084.28
12/4/96	3:00		1237.49					1180.52	1047.66	1053.30	1252.11	[illegible].92

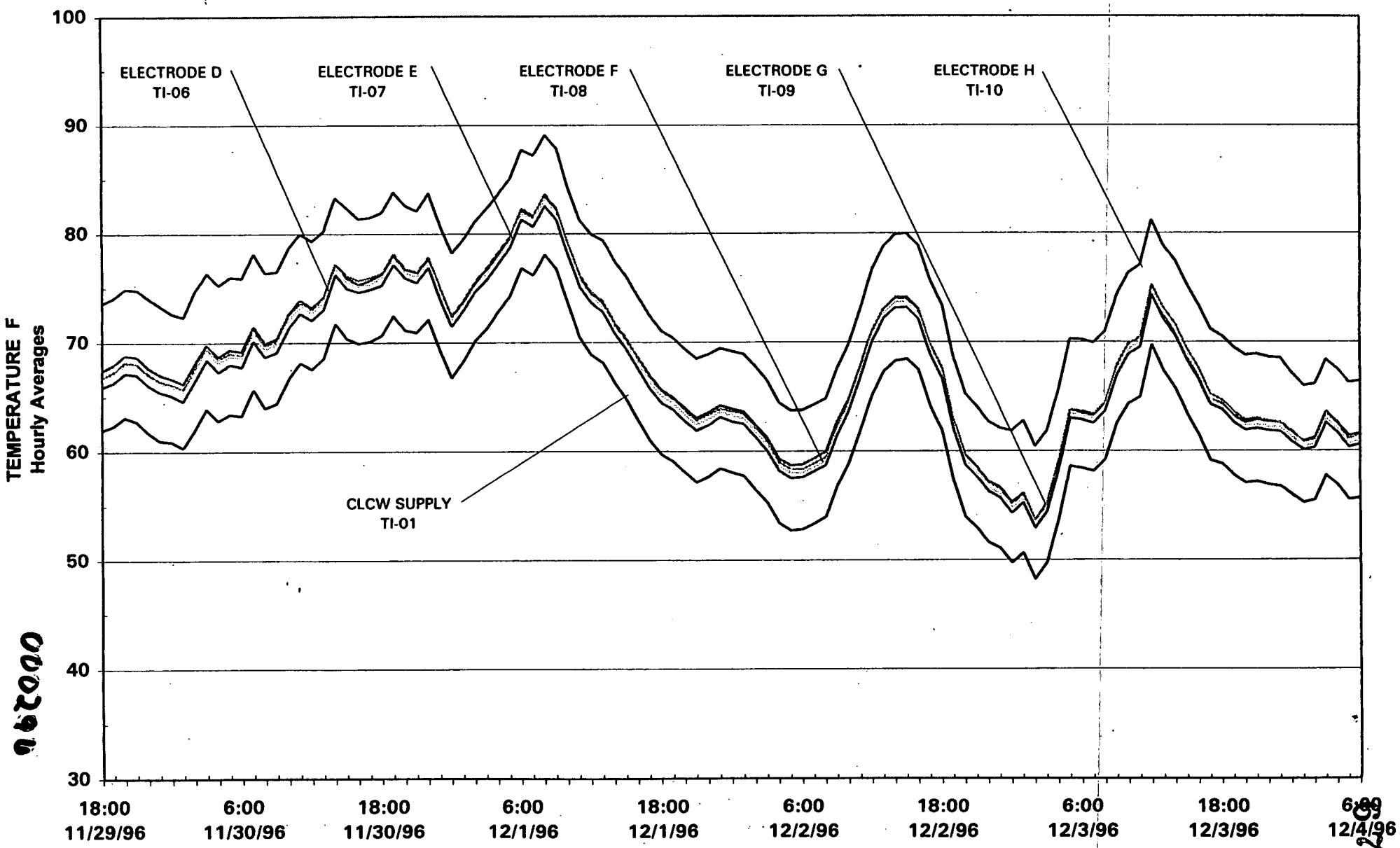
00023 4

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

		HOURLY AVERAGES										
READINGS		MAIN CHAMBER	MAIN CHAMBER	WEST CHAMBER	WEST CHAMBER	EAST CHAMBER	EAST CHAMBER	DISCH CHAMBER	WEST CHAMBER	EAST CHAMBER	DISCH CHAMBER	MAIN
		GLASS TOP	GLASS BOTTOM	GLASS	IR GLASS	GLASS	IR GLASS	GLASS	PLENUM	PLENUM	PLENUM	REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/4/96	4:00		1207.04					1163.61	1024.77	1049.43	1249.55	1091.51
12/4/96	5:00		1232.39					1137.07	1058.16	1068.69	1251.37	1091.03
12/4/96	6:00		1253.04					1135.74	1088.83	1098.39	1251.73	1094.41

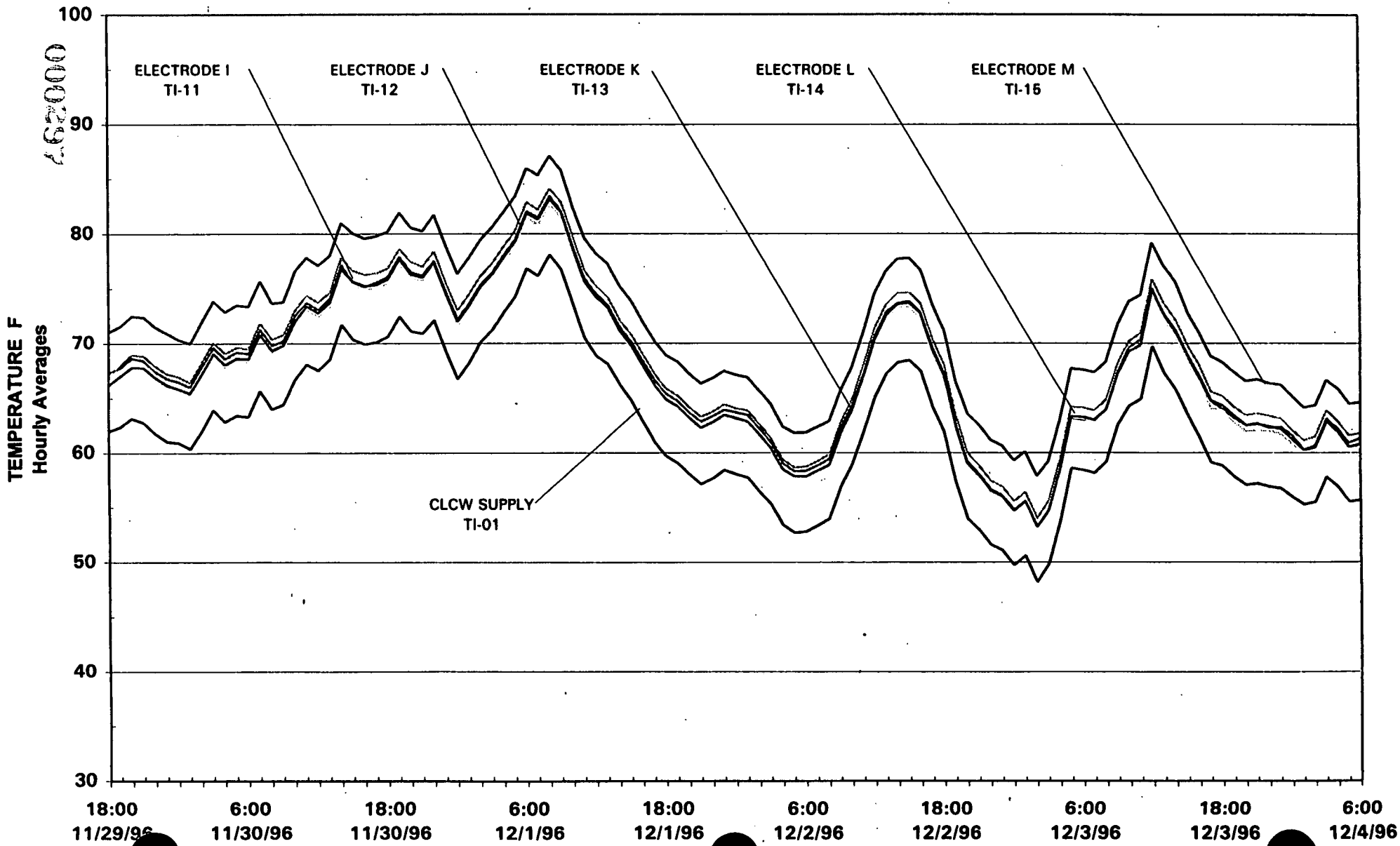
CAMPAIGN 4
TRANSITION TO SERIES A GLASS FURNACE SYSTEM
EAST ELECTRODE CLCW RETURN



C4FURN.XLS Chart 4

VHP 12/11/96

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE SYSTEM
WEST ELECTRODE CLCW RETURN



C4FURN.X[illegible]hart 5

VHP[illegible]1/96

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

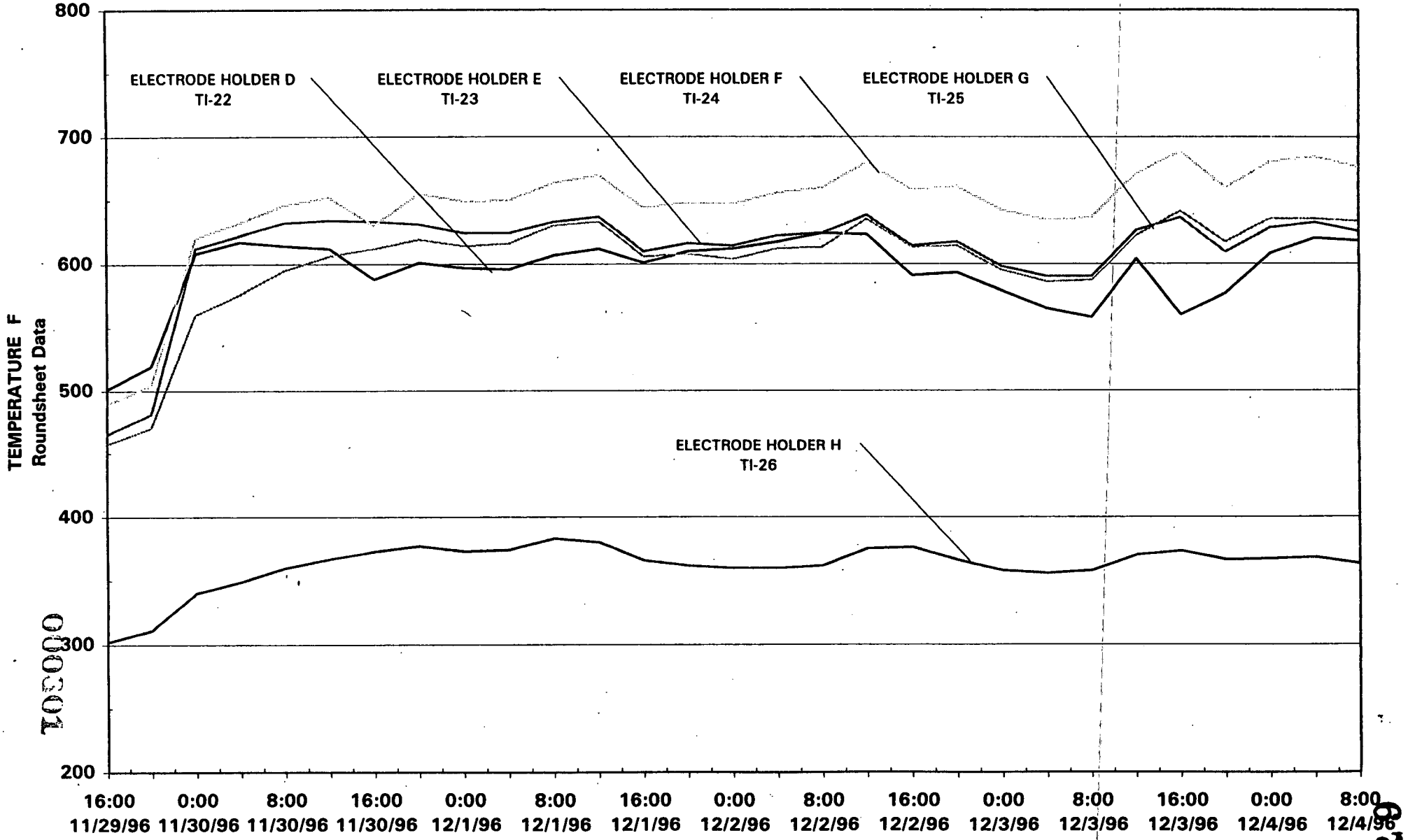
		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
11/29/96	18:00	61.96	67.42	66.58	66.81	65.91	73.59	67.29	66.51	67.14	66.19	71.06
11/29/96	19:00	62.36	67.93	67.12	67.28	66.32	74.09	67.79	67.09	67.94	66.98	71.56
11/29/96	20:00	63.11	68.79	67.98	68.16	67.18	74.90	68.64	67.92	68.93	67.82	72.48
11/29/96	21:00	62.74	68.65	67.89	68.00	67.05	74.82	68.45	67.75	68.82	67.79	72.39
11/29/96	22:00	61.75	67.65	67.01	67.11	66.07	74.05	67.44	66.76	67.93	66.90	71.51
11/29/96	23:00	61.02	67.04	66.33	66.47	65.45	73.36	66.79	66.06	67.24	66.22	70.92
11/30/96	0:00	60.93	66.69	65.96	66.15	65.12	72.66	66.49	65.79	66.94	65.84	70.36
11/30/96	1:00	60.37	66.23	65.55	65.72	64.60	72.36	66.03	65.36	66.42	65.46	69.98
11/30/96	2:00	61.91	68.02	67.41	67.63	66.43	74.68	67.82	67.03	68.21	67.18	71.94
11/30/96	3:00	63.89	69.80	69.22	69.43	68.38	76.32	69.60	68.93	70.06	69.06	73.84
11/30/96	4:00	62.81	68.67	68.16	68.45	67.28	75.26	68.58	67.84	69.06	68.04	72.84
11/30/96	5:00	63.40	69.32	68.71	69.00	67.93	75.97	69.19	68.48	69.63	68.65	73.49
11/30/96	6:00	63.26	69.18	68.62	68.84	67.72	75.89	69.04	68.38	69.48	68.58	73.36
11/30/96	7:00	65.65	71.45	70.93	71.19	70.14	78.16	71.29	70.69	71.84	70.83	75.66
11/30/96	8:00	63.96	69.90	69.39	69.71	68.67	76.35	69.78	69.19	70.39	69.33	73.64
11/30/96	9:00	64.41	70.37	69.88	70.21	69.11	76.50	70.23	69.66	70.81	69.80	73.78
11/30/96	10:00	66.70	72.64	72.10	72.53	71.35	78.72	72.55	71.93	73.02	72.05	76.56
11/30/96	11:00	68.08	73.85	73.41	73.68	72.67	79.98	73.68	73.09	74.36	73.39	77.82
11/30/96	12:00	67.52	73.22	72.77	73.07	72.08	79.32	73.05	72.45	73.74	72.75	77.09
11/30/96	13:00	68.53	74.18	73.77	74.08	73.03	80.25	74.03	73.43	74.65	73.74	77.97
11/30/96	14:00	71.72	77.25	76.85	77.21	76.19	83.31	77.11	76.53	77.79	76.81	80.99
11/30/96	15:00	70.34	75.93	75.59	76.09	74.96	82.38	75.60	75.36	76.65	75.65	80.05
11/30/96	16:00	69.91	75.30	75.19	75.68	74.60	81.36	75.17	74.96	76.28	75.24	79.58
11/30/96	17:00	70.09	75.70	75.38	75.92	74.87	81.50	75.57	75.10	76.42	75.35	79.80
11/30/96	18:00	70.64	76.24	75.90	76.33	75.25	81.94	76.07	75.53	76.83	75.87	80.19
11/30/96	19:00	72.45	78.03	77.76	78.15	77.13	83.80	77.90	77.28	78.64	77.66	81.93
11/30/96	20:00	71.11	76.72	76.41	76.78	75.89	82.57	76.49	76.05	77.42	76.31	80.57
11/30/96	21:00	70.90	76.41	76.10	76.47	75.48	82.11	76.20	75.70	76.99	76.02	80.24
11/30/96	22:00	72.12	77.76	77.40	77.82	76.89	83.72	77.52	77.01	78.38	77.36	81.73
11/30/96	23:00	69.23	74.84	74.56	74.99	73.89	80.65	74.70	74.16	75.48	74.52	78.87
12/1/96	0:00	66.76	72.37	72.03	72.44	71.49	78.21	72.19	71.68	73.00	72.01	76.36
12/1/96	1:00	68.24	73.74	73.39	73.86	72.92	79.50	73.61	73.15	74.48	73.43	77.80
12/1/96	2:00	70.11	75.49	75.20	75.59	74.67	81.14	75.34	74.88	76.18	75.18	79.47
12/1/96	3:00	71.24	76.71	76.35	76.86	75.73	82.33	76.46	76.07	77.28	76.33	80.61
12/1/96	4:00	72.82	78.15	77.84	78.32	77.24	83.66	78.05	77.52	78.87	77.84	82.02
12/1/96	5:00	74.25	79.58	79.35	79.75	78.74	85.14	79.46	78.91	80.25	79.32	83.39
12/1/96	6:00	76.82	82.17	81.92	82.35	81.29	87.73	82.06	81.55	82.90	81.87	85.96
12/1/96	7:00	76.15	81.55	81.33	81.65	80.62	87.20	81.47	80.77	82.20	81.31	85.34
12/1/96	8:00	78.07	83.48	83.28	83.66	82.56	89.05	83.44	82.76	84.14	83.18	87.13
12/1/96	9:00	76.75	82.17	81.99	82.35	81.28	87.86	82.10	81.54	82.88	81.98	85.79
12/1/96	10:00	73.59	78.93	78.65	79.11	78.03	84.12	78.87	78.37	79.69	78.69	82.41
12/1/96	11:00	70.50	76.08	75.74	76.19	75.12	81.21	75.95	75.44	76.66	75.67	79.61
12/1/96	12:00	68.85	74.52	74.20	74.63	73.63	79.93	74.46	73.83	75.21	74.20	78.17
12/1/96	13:00	68.11	73.66	73.29	73.79	72.78	79.39	73.51	72.98	74.20	73.28	77.27
12/1/96	14:00	66.31	71.67	71.42	71.79	70.85	77.46	71.55	71.04	72.18	71.23	75.28

VITRIFICATION PILOT PLANT FURNACE SYSTEM												
CAMPAIGN 4 TRANSITION TO SERIES A GLASS												
		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/1/96	15:00	64.73	70.29	69.88	70.40	69.37	76.03	70.12	69.64	70.81	69.78	73.85
12/1/96	16:00	62.84	68.56	68.13	68.49	67.53	74.19	68.41	67.80	69.02	68.00	72.01
12/1/96	17:00	61.00	66.91	66.37	66.75	65.74	72.42	66.70	66.05	67.23	66.26	70.22
12/1/96	18:00	59.71	65.61	65.03	65.45	64.39	71.06	65.38	64.70	65.86	64.84	68.93
12/1/96	19:00	59.06	64.89	64.35	64.72	63.78	70.39	64.70	64.05	65.21	64.23	68.30
12/1/96	20:00	58.05	63.91	63.35	63.72	62.73	69.36	63.67	63.07	64.14	63.21	67.26
12/1/96	21:00	57.10	63.04	62.42	62.82	61.87	68.48	62.84	62.10	63.27	62.26	66.34
12/1/96	22:00	57.65	63.54	62.92	63.34	62.34	68.87	63.31	62.61	63.71	62.77	66.82
12/1/96	23:00	58.41	64.14	63.62	63.87	63.12	69.44	63.89	63.28	64.40	63.43	67.49
12/2/96	0:00	58.03	63.85	63.27	63.64	62.70	69.16	63.67	63.05	64.04	63.14	67.13
12/2/96	1:00	57.73	63.60	63.01	63.41	62.49	68.90	63.43	62.71	63.83	62.83	66.91
12/2/96	2:00	56.41	62.39	61.78	62.15	61.27	67.73	62.19	61.53	62.56	61.69	65.65
12/2/96	3:00	55.28	61.18	60.54	60.89	60.01	66.41	60.96	60.30	61.32	60.44	64.40
12/2/96	4:00	53.40	59.27	58.58	58.99	58.20	64.38	59.03	58.43	59.36	58.48	62.36
12/2/96	5:00	52.70	58.70	58.02	58.35	57.51	63.71	58.31	57.84	58.66	57.85	61.78
12/2/96	6:00	52.80	58.78	57.99	58.35	57.60	63.73	58.35	57.84	58.73	57.83	61.83
12/2/96	7:00	53.34	59.31	58.57	58.86	58.14	64.21	58.83	58.34	59.24	58.36	62.34
12/2/96	8:00	53.95	59.96	59.11	59.43	58.70	64.79	59.44	58.90	59.85	58.87	62.88
12/2/96	9:00	56.84	62.77	61.99	62.29	61.50	67.63	62.25	61.73	62.72	61.78	65.71
12/2/96	10:00	58.92	64.80	64.17	64.48	63.70	69.85	64.32	63.88	64.88	63.95	67.86
12/2/96	11:00	61.95	67.84	67.27	67.58	66.79	73.07	67.23	66.98	68.04	67.10	71.07
12/2/96	12:00	65.09	71.04	70.63	70.97	70.03	76.67	70.72	70.18	71.42	70.43	74.59
12/2/96	13:00	67.26	73.04	72.65	73.08	72.15	78.75	72.82	72.28	73.55	72.56	76.63
12/2/96	14:00	68.24	74.04	73.66	74.14	73.13	79.88	73.66	73.29	74.57	73.57	77.70
12/2/96	15:00	68.43	74.00	73.67	74.17	73.18	79.96	73.81	73.36	74.64	73.70	77.77
12/2/96	16:00	67.45	72.96	72.62	73.10	72.11	78.91	72.80	72.31	73.60	72.69	76.72
12/2/96	17:00	64.12	69.81	69.43	69.86	68.90	75.70	69.59	69.03	70.33	69.38	73.52
12/2/96	18:00	61.89	67.55	67.16	67.62	66.64	73.40	67.28	66.77	68.07	67.10	71.19
12/2/96	19:00	57.28	62.86	62.43	62.88	61.99	68.49	62.54	62.15	63.30	62.40	66.43
12/2/96	20:00	53.96	59.62	59.13	59.53	58.73	65.23	59.17	58.85	60.00	59.05	63.55
12/2/96	21:00	52.94	58.51	57.96	58.43	57.61	64.00	58.05	57.71	58.83	57.92	62.50
12/2/96	22:00	51.59	57.19	56.62	57.09	56.28	62.70	56.62	56.42	57.42	56.56	61.19
12/2/96	23:00	51.07	56.64	56.08	56.51	55.70	62.09	56.08	55.87	56.90	56.00	60.65
12/3/96	0:00	49.72	55.29	54.76	55.14	54.32	61.85	54.79	54.58	55.57	54.68	59.30
12/3/96	1:00	50.62	56.11	55.59	56.01	55.25	62.79	55.53	55.52	56.38	55.57	60.11
12/3/96	2:00	48.20	53.66	53.20	53.62	52.91	60.42	53.14	53.10	53.99	53.21	57.85
12/3/96	3:00	49.76	55.20	54.69	55.12	54.42	61.84	54.70	54.60	55.56	54.69	59.21
12/3/96	4:00	53.70	59.02	58.51	58.95	58.20	65.54	58.46	58.35	59.33	58.44	62.93
12/3/96	5:00	58.60	63.75	63.36	63.75	62.99	70.26	63.15	63.17	64.19	63.29	67.72
12/3/96	6:00	58.40	63.50	63.29	63.62	62.86	70.20	62.97	63.05	64.10	63.23	67.60
12/3/96	7:00	58.14	63.24	63.07	63:36	62.54	69.92	62.90	62.77	63.85	62.97	67.38
12/3/96	8:00	59.22	64.38	64.04	64.42	63.60	70.94	63.98	63.81	64.86	63.96	68.30
12/3/96	9:00	62.54	67.84	67.39	67.78	66.94	74.27	67.42	67.13	68.16	67.27	71.67
12/3/96	10:00	64.29	69.81	69.34	69.78	68.86	76.35	69.64	69.17	70.19	69.25	73.81
12/3/96	11:00	64.90	70.39	70.00	70.42	69.50	77.06	70.32	69.75	70.92	69.89	74.40

VITRIFICATION PILOT PLANT FURNACE SYSTEM												
CAMPAIGN 4 TRANSITION TO SERIES A GLASS												
		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/3/96	12:00	69.73	75.15	74.87	75.28	74.33	81.21	75.00	74.58	75.85	74.88	79.18
12/3/96	13:00	67.32	72.50	72.62	73.04	72.03	78.82	72.47	72.26	73.62	72.67	77.06
12/3/96	14:00	65.74	70.92	71.08	71.62	70.61	77.47	70.98	70.64	72.15	71.20	75.59
12/3/96	15:00	63.43	68.86	68.85	69.35	68.32	75.25	68.66	68.48	69.83	68.93	72.85
12/3/96	16:00	61.47	66.75	66.97	67.53	66.48	73.32	66.81	66.50	68.07	67.08	70.98
12/3/96	17:00	59.13	64.67	64.66	65.17	64.22	71.18	64.69	64.05	65.57	64.76	68.82
12/3/96	18:00	58.83	64.30	64.07	64.61	63.76	70.53	64.00	63.89	65.16	64.30	68.29
12/3/96	19:00	57.79	63.23	63.04	63.56	62.60	69.47	63.15	62.77	64.16	63.33	67.39
12/3/96	20:00	57.06	62.60	62.31	62.81	61.92	68.76	62.52	61.96	63.39	62.50	66.54
12/3/96	21:00	57.19	62.86	62.43	62.99	62.06	68.86	62.66	62.09	63.59	62.63	66.71
12/3/96	22:00	56.90	62.68	62.22	62.75	61.85	68.59	62.27	62.01	63.33	62.38	66.34
12/3/96	23:00	56.74	62.58	62.14	62.61	61.77	68.51	62.33	61.72	63.07	62.20	66.19
12/4/96	0:00	55.95	61.73	61.26	61.81	60.84	67.09	61.55	60.84	62.04	61.24	65.11
12/4/96	1:00	55.25	60.86	60.36	60.81	60.09	65.94	60.27	60.11	61.17	60.27	64.11
12/4/96	2:00	55.47	61.20	60.59	61.02	60.28	66.07	60.66	60.37	61.49	60.48	64.32
12/4/96	3:00	57.76	63.56	62.94	63.41	62.59	68.35	63.08	62.69	63.85	62.87	66.63
12/4/96	4:00	56.87	62.60	62.02	62.39	61.65	67.48	62.14	61.75	62.81	61.91	65.81
12/4/96	5:00	55.52	61.36	60.72	61.08	60.32	66.21	60.92	60.42	61.58	60.57	64.47
12/4/96	6:00	55.64	61.59	60.89	61.39	60.56	66.38	61.34	60.65	61.80	60.77	64.59

000200

CAMPA[illegible]4
TRANSITION TO SE[illegible]IES A GLASS
FURNACE SYSTEM
EAST ELECTRODE HOLDER TEMPERATURES



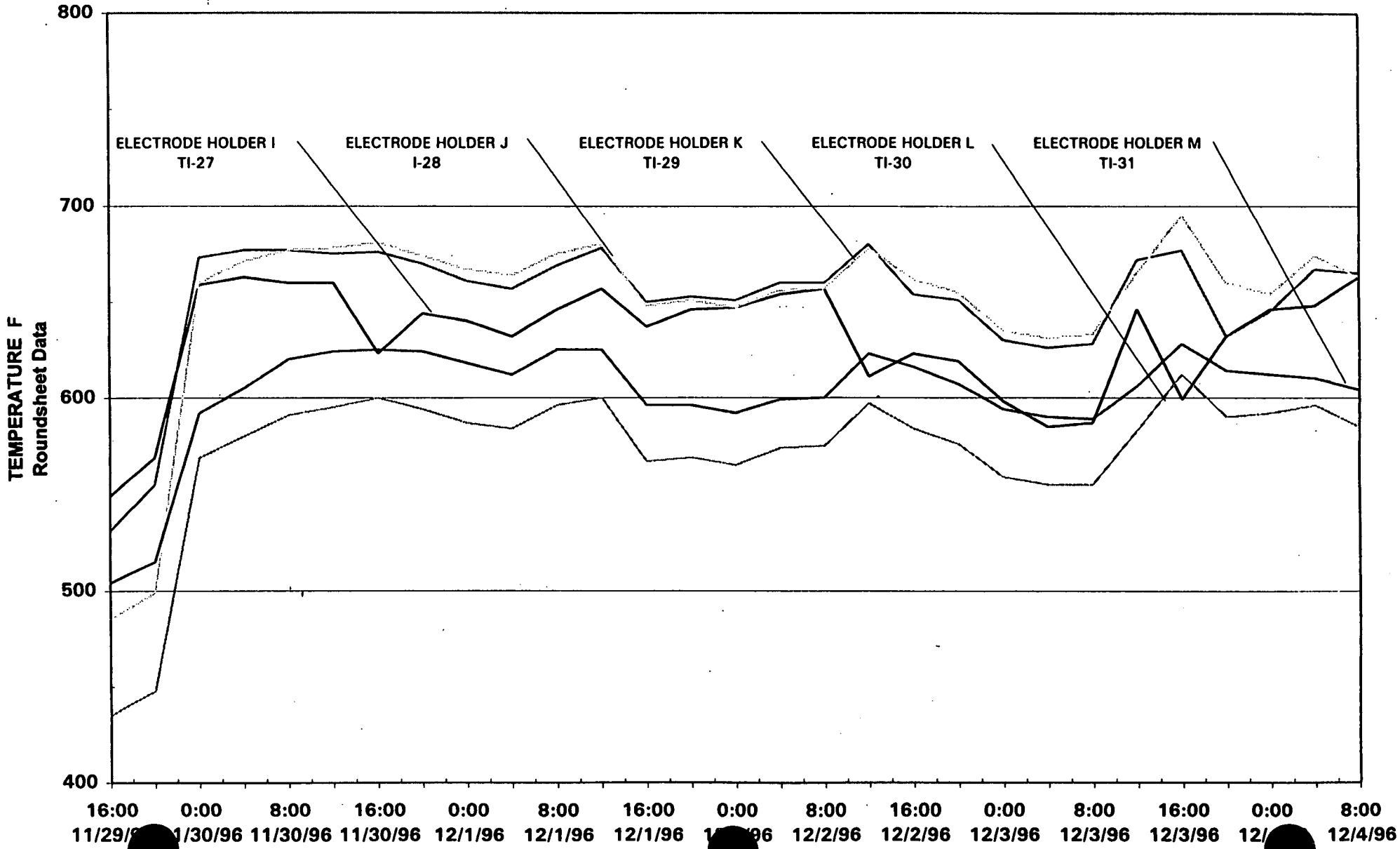
C4FURN.XLS Chart 6

VHP 12/11/96

000301

9273

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE SYSTEM
WEST ELECTRODE HOLDER TEMPERATURES



C4FURN.XL Chart 7

VHP 11/96

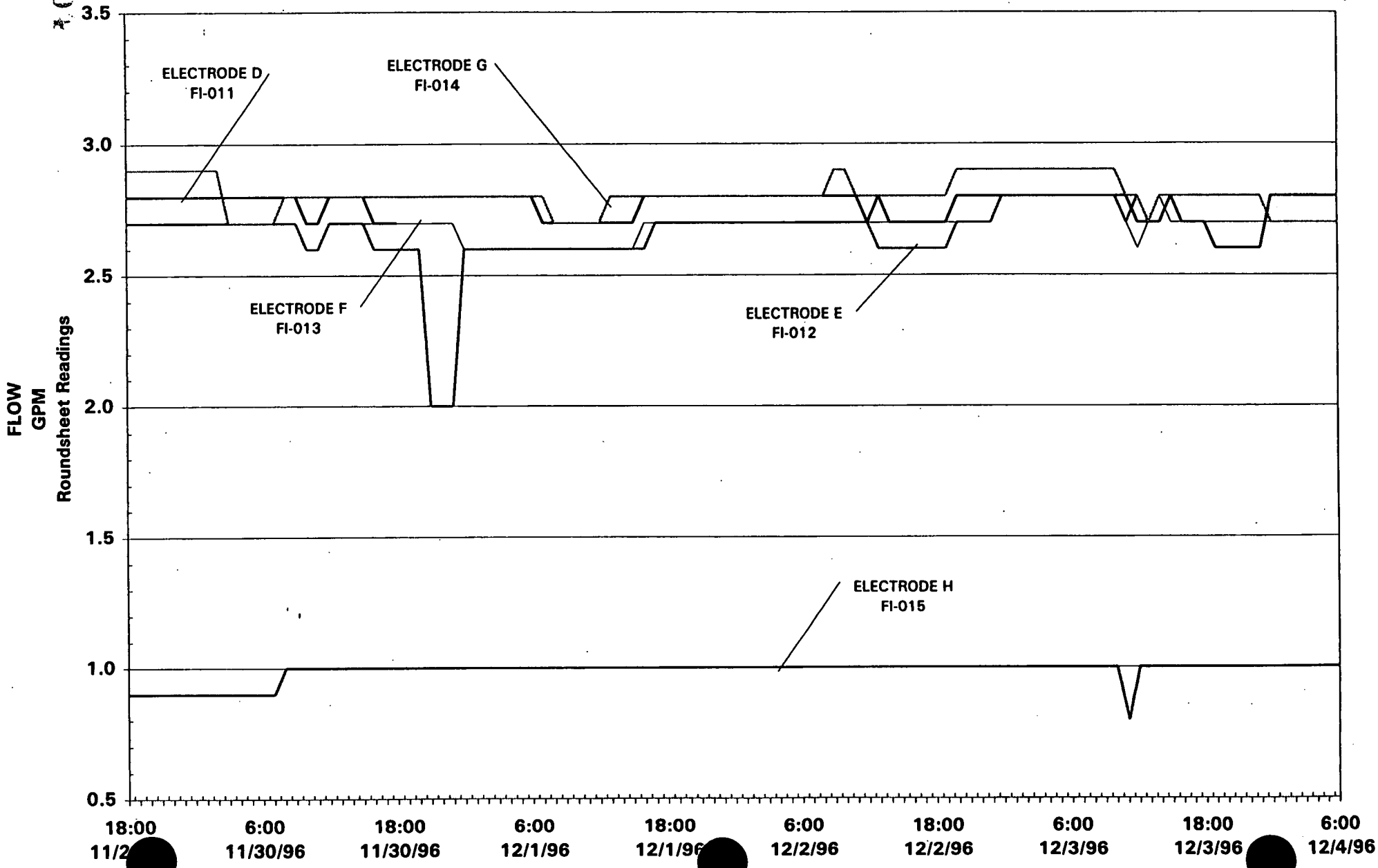
000302

VITRIFICATION PILOT PLANT FURNACE SYSTEM
CAMPAIGN 4 TRANSITION TO SERIES A GLASS

		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE HOLDER TEMPERATURES									
		D	E	F	G	H	I	J	K	L	M
		TI-022	TI-023	TI-024	TI-025	TI-026	TI-027	TI-028	TI-029	TI-030	TI-031
DATE	HOUR	F	F	F	F	F	F	F	F	F	F
11/29/96	16:00	501	465	489	457	302	549	531	485	435	504
11/29/96	20:00	519	481	504	470	311	569	555	499	448	515
11/30/96	0:00	608	612	620	560	340	659	673	660	569	592
11/30/96	4:00	617	622	632	576	349	663	677	671	580	605
11/30/96	8:00	614	632	646	595	360	660	677	677	591	620
11/30/96	12:00	612	634	652	606	367	660	675	678	595	624
11/30/96	16:00	588	633	630	612	373	623	676	681	600	625
11/30/96	20:00	601	631	655	619	377	644	670	674	594	624
12/1/96	0:00	597	624	649	614	373	640	661	667	587	618
12/1/96	4:00	596	624	650	616	374	632	657	664	584	612
12/1/96	8:00	607	633	664	630	383	646	669	675	596	625
12/1/96	12:00	612	637	670	633	380	657	678	680	600	625
12/1/96	16:00	601	610	644	606	366	637	650	648	567	596
12/1/96	20:00	610	616	648	608	362	646	653	651	569	596
12/2/96	0:00	612	614	647	604	360	647	651	647	565	592
12/2/96	4:00	617	622	656	612	360	654	660	656	574	599
12/2/96	8:00	624	624	660	613	362	657	660	657	575	600
12/2/96	12:00	623	638	680	635	375	611	680	678	597	623
12/2/96	16:00	591	614	658	613	376	623	654	662	584	616
12/2/96	20:00	593	617	661	614	366	619	651	655	576	607
12/3/96	0:00	579	598	642	595	358	598	630	635	559	594
12/3/96	4:00	565	590	634	586	356	585	626	631	555	590
12/3/96	8:00	558	590	636	587	358	587	628	633	555	589
12/3/96	12:00	604	626	671	622	370	646	672	665	583	606
12/3/96	16:00	560	636	688	641	373	599	677	695	612	628
12/3/96	20:00	577	609	660	617	366	632	632	660	590	614
12/4/96	0:00	608	628	680	635	367	646	645	654	592	612
12/4/96	4:00	620	632	684	635	368	648	667	674	596	610
12/4/96	8:00	618	625	676	633	363	663	665	663	585	604

000303

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE SYSTEM
EAST ELECTRODE CLCW SUPPLY

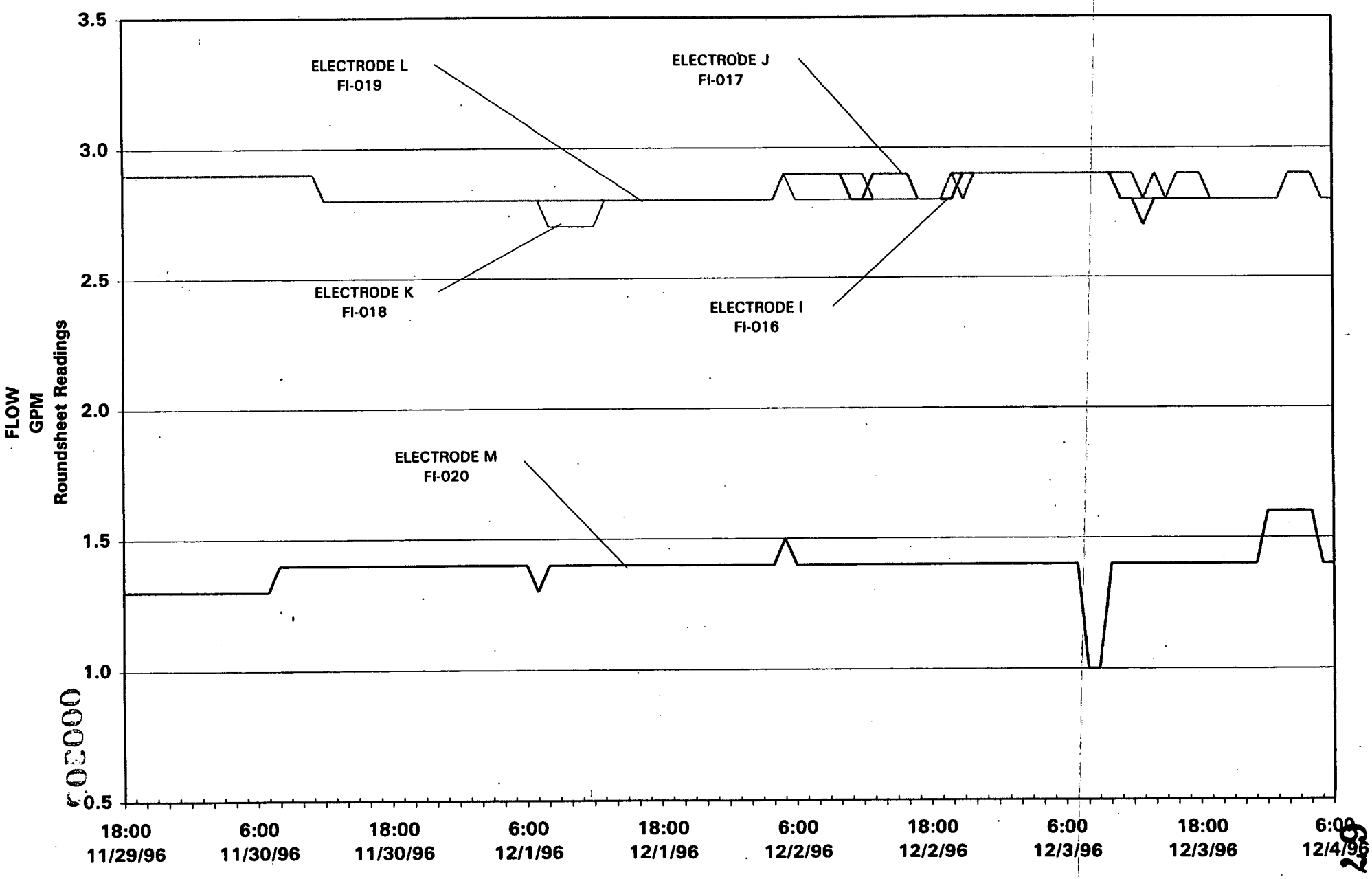


C4FURN.XLS Chart 8

VHP 1/20/97

000304

CAMPA[illegible]4
TRANSITION TO SERIES A GLASS FURNACE SYSTEM
WEST ELECTRODE CLCW SUPPLY



C4FURN.XLS Chart 9

VHP 1/20/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM
CAMPAIGN 4 TRANSITION TO SERIES A GLASS
HOURLY READINGS ROUNDSHEETS

READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
11/29/96	18:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/29/96	19:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/29/96	20:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/29/96	21:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/29/96	22:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/29/96	23:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	0:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	1:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	2:00	2.8	2.7	2.7	2.9	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	3:00	2.8	2.7	2.7	2.7	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	4:00	2.8	2.7	2.7	2.7	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	5:00	2.8	2.7	2.7	2.7	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	6:00	2.8	2.7	2.7	2.7	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	7:00	2.8	2.7	2.7	2.7	0.9	2.9	2.9	2.9	2.9	1.3
11/30/96	8:00	2.8	2.7	2.7	2.8	1.0	2.9	2.9	2.9	2.9	1.4
11/30/96	9:00	2.8	2.7	2.7	2.8	1.0	2.9	2.9	2.9	2.9	1.4
11/30/96	10:00	2.7	2.6	2.6	2.8	1.0	2.9	2.9	2.9	2.9	1.4
11/30/96	11:00	2.7	2.6	2.6	2.8	1.0	2.9	2.9	2.9	2.9	1.4
11/30/96	12:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	13:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	14:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	15:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	16:00	2.7	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	17:00	2.7	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	18:00	2.7	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	19:00		2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	20:00		2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	21:00		2.0	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	22:00		2.0	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
11/30/96	23:00		2.0	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	0:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	1:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	2:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	3:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	4:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	5:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	6:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	7:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.3
12/1/96	8:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.7	2.8	1.4
12/1/96	9:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.7	2.8	1.4
12/1/96	10:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.7	2.8	1.4
12/1/96	11:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.7	2.8	1.4
12/1/96	12:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.7	2.8	1.4
12/1/96	13:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	14:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	15:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	16:00	2.8	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	17:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	18:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	19:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	20:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	21:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	22:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/1/96	23:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

HOURLY READINGS ROUNDSHEETS

READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/2/96	0:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	1:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	2:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	3:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	4:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	5:00	2.8	2.7	2.7	2.8	1.0	2.9	2.9	2.9	2.9	1.5
12/2/96	6:00	2.8	2.7	2.7	2.8	1.0	2.9	2.9	2.8	2.9	1.4
12/2/96	7:00	2.8	2.7	2.7	2.8	1.0	2.9	2.9	2.8	2.9	1.4
12/2/96	8:00	2.8	2.7	2.7	2.8	1.0	2.9	2.9	2.8	2.9	1.4
12/2/96	9:00	2.8	2.7	2.7	2.9	1.0	2.9	2.9	2.8	2.9	1.4
12/2/96	10:00	2.8	2.7	2.7	2.9	1.0	2.9	2.9	2.8	2.9	1.4
12/2/96	11:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.9	1.4
12/2/96	12:00	2.7	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.9	1.4
12/2/96	13:00	2.8	2.6	2.7	2.8	1.0	2.8	2.9	2.8	2.8	1.4
12/2/96	14:00	2.7	2.6	2.7	2.8	1.0	2.8	2.9	2.8	2.8	1.4
12/2/96	15:00	2.7	2.6	2.7	2.8	1.0	2.8	2.9	2.8	2.8	1.4
12/2/96	16:00	2.7	2.6	2.7	2.8	1.0	2.8	2.9	2.8	2.8	1.4
12/2/96	17:00	2.7	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	18:00	2.7	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	19:00	2.7	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/2/96	20:00	2.8	2.7	2.7	2.9	1.0	2.8	2.9	2.9	2.9	1.4
12/2/96	21:00	2.8	2.7	2.7	2.9	1.0	2.9	2.9	2.9	2.8	1.4
12/2/96	22:00	2.8	2.7	2.7	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/2/96	23:00	2.8	2.7	2.7	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	0:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	1:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	2:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	3:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	4:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	5:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	6:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	7:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	8:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.0
12/3/96	9:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.0
12/3/96	10:00	2.8	2.8	2.8	2.9	1.0	2.9	2.9	2.9	2.9	1.4
12/3/96	11:00	2.8	2.7	2.7	2.8	0.8	2.8	2.8	2.8	2.9	1.4
12/3/96	12:00	2.7	2.8	2.6	2.8	1.0	2.8	2.8	2.8	2.9	1.4
12/3/96	13:00	2.7	2.7	2.7	2.7	1.0	2.7	2.7	2.8	2.8	1.4
12/3/96	14:00	2.7	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.9	1.4
12/3/96	15:00	2.8	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/3/96	16:00	2.7	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.9	1.4
12/3/96	17:00	2.7	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.9	1.4
12/3/96	18:00	2.7	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.9	1.4
12/3/96	19:00	2.6	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/3/96	20:00	2.6	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/3/96	21:00	2.6	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/3/96	22:00	2.6	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/3/96	23:00	2.6	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/4/96	0:00	2.8	2.7	2.7	2.7	1.0	2.8	2.8	2.8	2.8	1.6
12/4/96	1:00	2.8	2.7	2.7	2.7	1.0	2.8	2.8	2.8	2.8	1.6
12/4/96	2:00	2.8	2.7	2.7	2.7	1.0	2.9	2.9	2.9	2.9	1.6
12/4/96	3:00	2.8	2.7	2.7	2.7	1.0	2.9	2.9	2.9	2.9	1.6
12/4/96	4:00	2.8	2.7	2.7	2.7	1.0	2.9	2.9	2.9	2.9	1.6
12/4/96	5:00	2.8	2.7	2.7	2.7	1.0	2.8	2.8	2.8	2.8	1.4

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 TRANSITION TO SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/4/96	6:00	2.8	2.7	2.7	2.7	1.0	2.8	2.8	2.8	2.8	1.4

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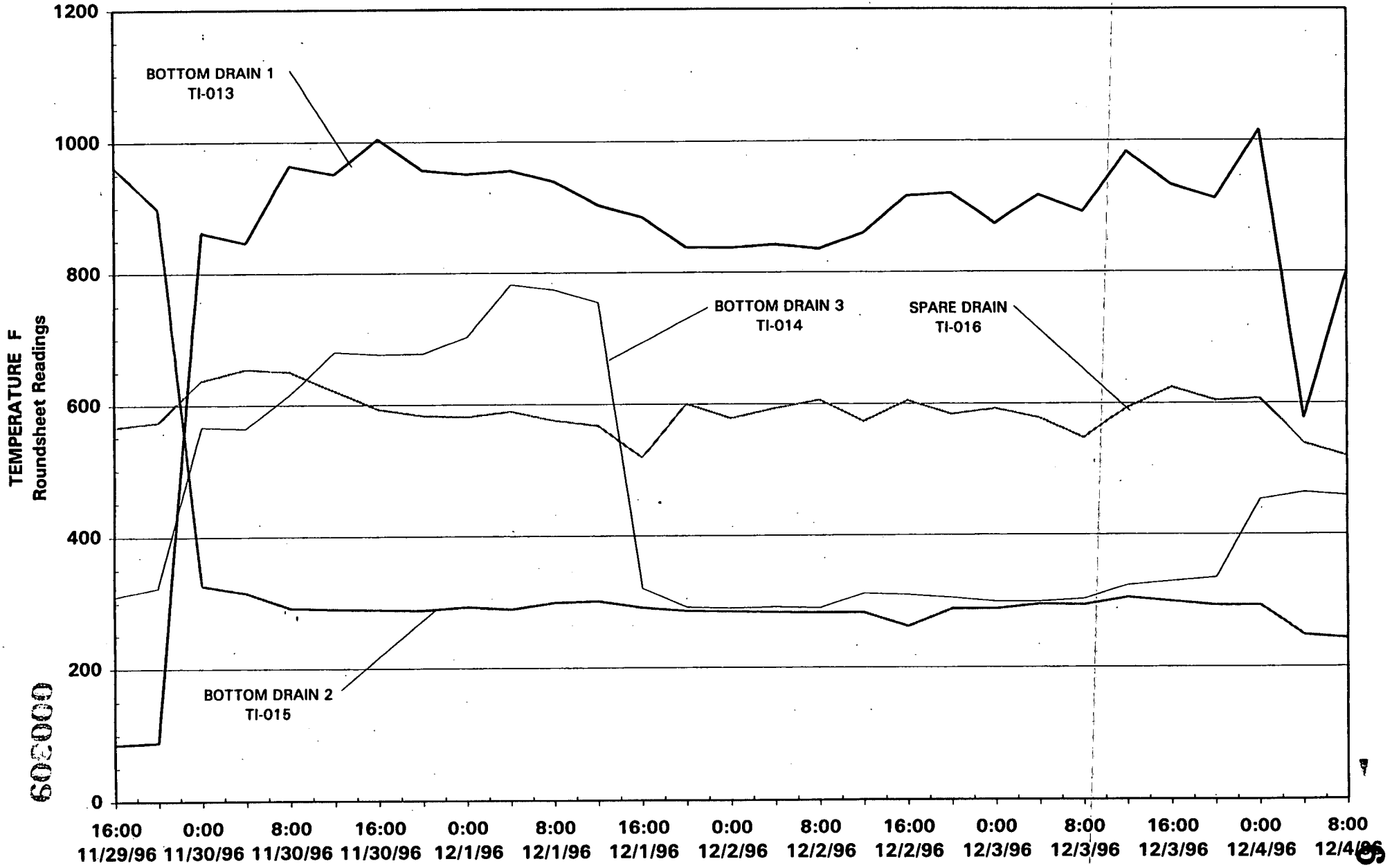
CAMPAIGN 4
TRANSITION TO SERIES A GLASS FURNACE SYSTEM
BOTTOM DRAIN TEMPERATURES



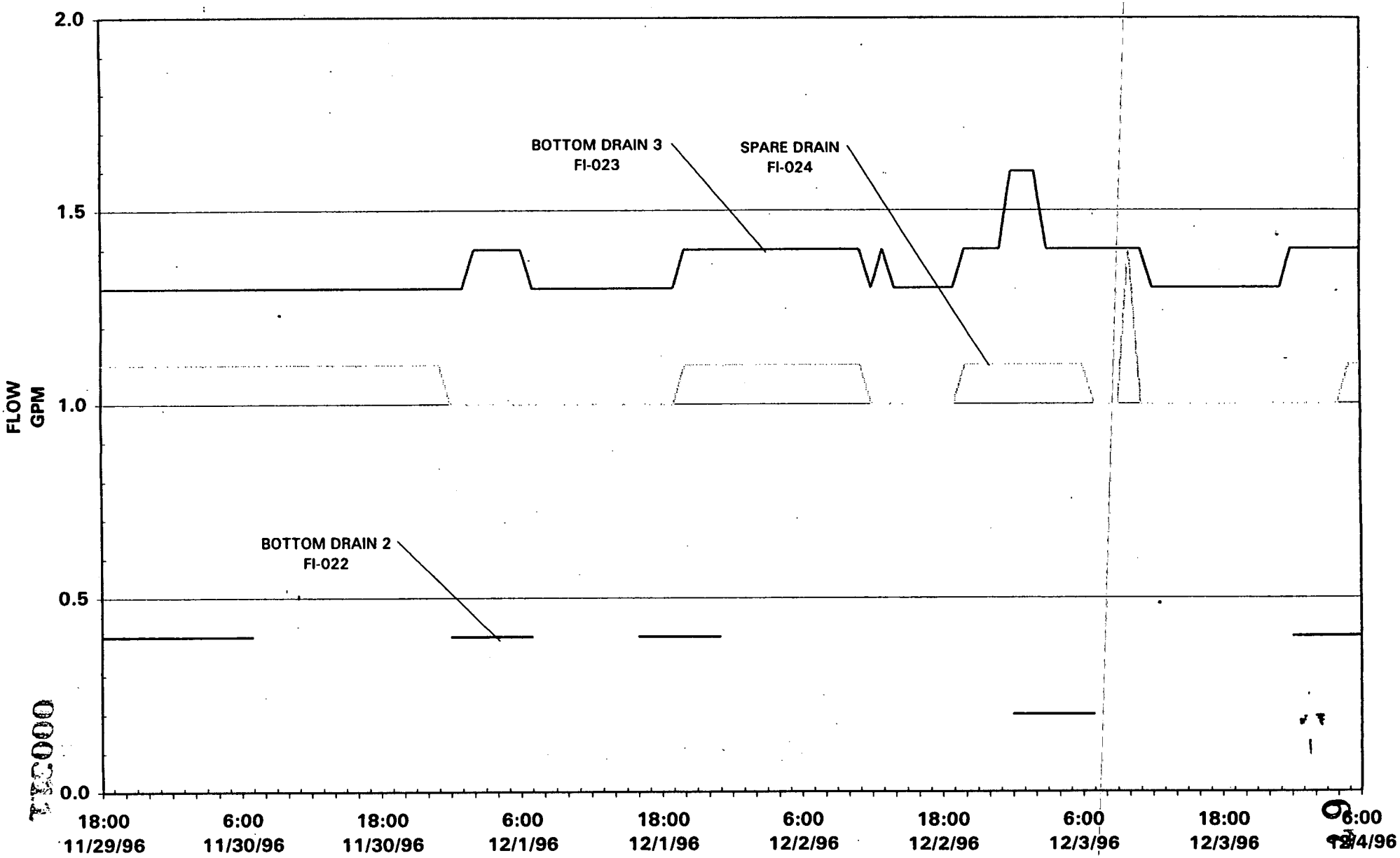
C4FURN.XLS Chart 10

VHP 1/20/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM					
CAMPAIGN 4 TRANSITION TO SERIES A GLASS					
MELTER BOTTOM DRAINS					
READINGS		ROUNDSHEET READINGS			
		SURFACE TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		TI-013	TI-15	TI-014	TI-016
DATE	HOUR	F	F	F	F
11/29/96	16:00	86	961	310	566
11/29/96	20:00	89	899	323	573
11/30/96	0:00	863	326	566	638
11/30/96	4:00	847	315	564	655
11/30/96	8:00	964	292	616	651
11/30/96	12:00	951	290	681	621
11/30/96	16:00	1004	289	677	593
11/30/96	20:00	957	288	678	583
12/1/96	0:00	951	293	703	581
12/1/96	4:00	956	289	782	589
12/1/96	8:00	939	299	774	575
12/1/96	12:00	903	301	755	567
12/1/96	16:00	885	291	320	518
12/1/96	20:00	839	286	292	600
12/2/96	0:00	838	285	290	578
12/2/96	4:00	843	284	292	593
12/2/96	8:00	836	283	290	606
12/2/96	12:00	860	283	312	572
12/2/96	16:00	916	262	310	605
12/2/96	20:00	920	288	305	583
12/3/96	0:00	874	288	299	592
12/3/96	4:00	917	295	299	577
12/3/96	8:00	891	294	303	547
12/3/96	12:00	983	305	324	593
12/3/96	16:00	933	299	330	624
12/3/96	20:00	912	293	335	604
12/4/96	0:00	1016	293	453	607
12/4/96	4:00	576	248	463	538
12/4/96	8:00	800	243	458	518

000310

CAMPAIGN 4
TRANSITION TO SERIES A GLASS FURNACE SYSTEM
BOTTOM DRAIN CLCW FLOW

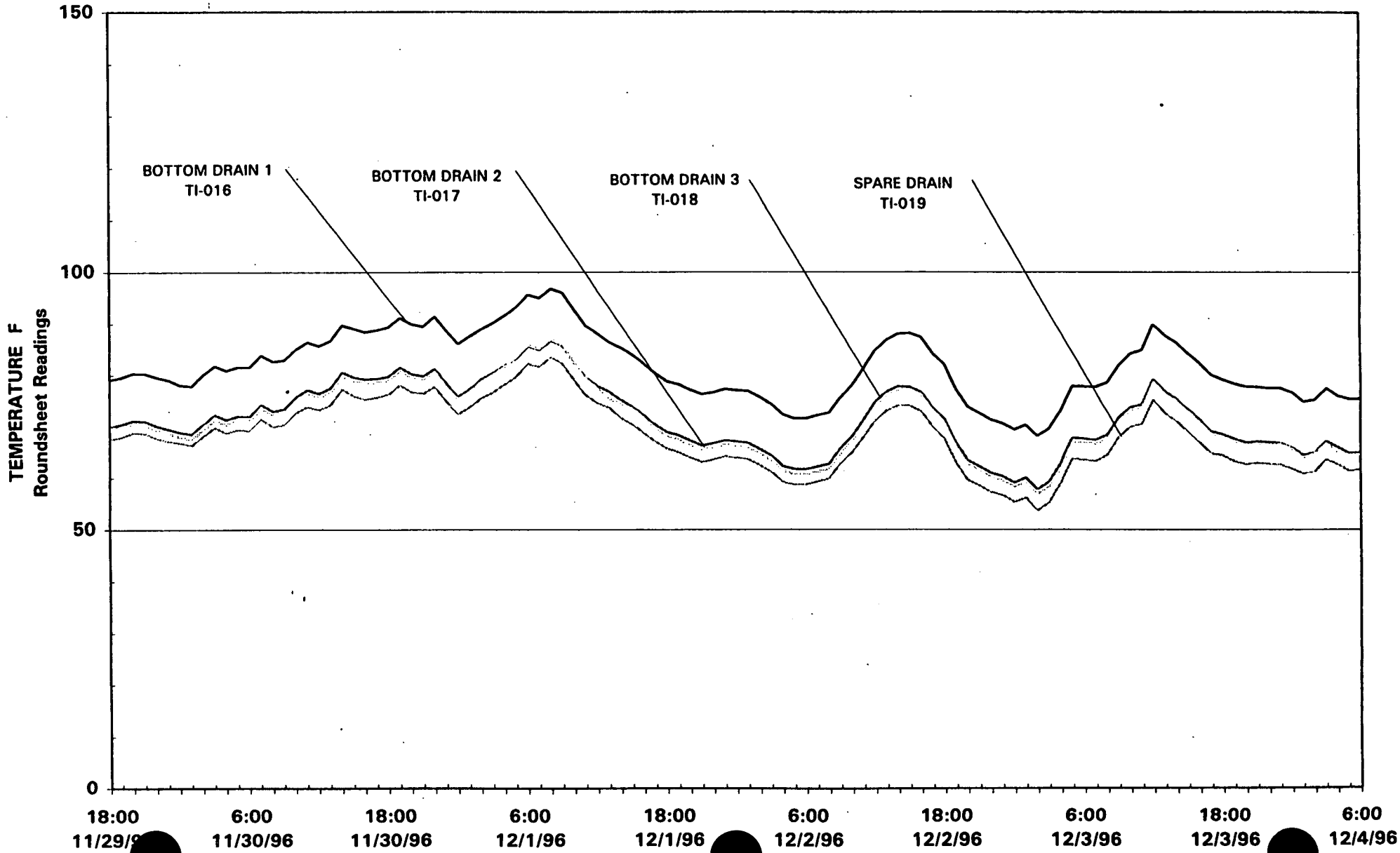


C4FURN.XLS Chart 11

VHP 12/17/96

PC0000

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE SYSTEM
BOTTOM DRAIN CLCW RETURN



C4FURN.XLS Chart 12

VHP 12/17/96

000342

VITRIFICATION PILOT PLANT FURNACE SYSTEM
CAMPAIGN 4 TRANSITION TO SERIES A GLASS

		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
11/29/96	18:00	OUT OF SERVICE	0.4	1.3	1.1	79.07	69.89	69.77	67.42
11/29/96	19:00		0.4	1.3	1.1	79.54	70.45	69.91	67.93
11/29/96	20:00		0.4	1.3	1.1	80.37	71.15	70.62	68.79
11/29/96	21:00		0.4	1.3	1.1	80.32	71.05	70.27	68.65
11/29/96	22:00		0.4	1.3	1.1	79.62	70.15	69.34	67.65
11/29/96	23:00		0.4	1.3	1.1	79.04	69.46	68.64	67.04
11/30/96	0:00		0.4	1.3	1.1	78.06	68.88	67.89	66.69
11/30/96	1:00		0.4	1.3	1.1	77.82	68.52	67.41	66.23
11/30/96	2:00		0.4	1.3	1.1	80.06	70.39	69.36	68.02
11/30/96	3:00		0.4	1.3	1.1	81.75	72.25	71.21	69.80
11/30/96	4:00		0.4	1.3	1.1	80.87	71.32	70.43	68.67
11/30/96	5:00		0.4	1.3	1.1	81.56	71.99	71.20	69.32
11/30/96	6:00		0.4	1.3	1.1	81.50	71.96	71.16	69.18
11/30/96	7:00		0.4	1.3	1.1	83.84	74.33	73.52	71.45
11/30/96	8:00			1.3	1.1	82.61	72.97	72.32	69.90
11/30/96	9:00			1.3	1.1	82.88	73.41	72.85	70.37
11/30/96	10:00			1.3	1.1	85.07	75.72	75.23	72.64
11/30/96	11:00			1.3	1.1	86.42	77.13	76.54	73.85
11/30/96	12:00			1.3	1.1	85.74	76.44	75.71	73.22
11/30/96	13:00			1.3	1.1	86.73	77.46	76.66	74.18
11/30/96	14:00			1.3	1.1	89.74	80.53	79.70	77.25
11/30/96	15:00			1.3	1.1	89.10	79.57	78.91	75.93
11/30/96	16:00			1.3	1.1	88.42	79.15	78.41	75.30
11/30/96	17:00			1.3	1.1	88.79	79.28	78.60	75.70
11/30/96	18:00			1.3	1.1	89.38	79.67	78.96	76.24
11/30/96	19:00			1.3	1.1	91.12	81.44	80.76	78.03
11/30/96	20:00			1.3	1.1	89.95	80.19	79.46	76.72
11/30/96	21:00			1.3	1.1	89.52	79.77	79.10	76.41
11/30/96	22:00			1.3	1.1	91.40	81.19	80.75	77.76
11/30/96	23:00			1.3	1.1	88.67	78.35	77.82	74.84
12/1/96	0:00		0.4	1.3	1.0	86.14	75.86	75.45	72.37
12/1/96	1:00		0.4	1.3	1.0	87.60	77.28	76.91	73.74
12/1/96	2:00		0.4	1.4	1.0	88.97	79.17	78.82	75.49
12/1/96	3:00		0.4	1.4	1.0	90.15	80.41	80.18	76.71
12/1/96	4:00		0.4	1.4	1.0	91.59	81.77	81.73	78.15
12/1/96	5:00		0.4	1.4	1.0	93.22	83.15	83.24	79.58
12/1/96	6:00		0.4	1.4	1.0	95.72	85.64	85.75	82.17
12/1/96	7:00		0.4	1.3	1.0	95.12	84.91	85.07	81.55
12/1/96	8:00			1.3	1.0	96.87	86.71	86.89	83.48
12/1/96	9:00			1.3	1.0	96.13	85.73	85.83	82.17
12/1/96	10:00			1.3	1.0	92.66	82.35	82.37	78.93
12/1/96	11:00			1.3	1.0	89.65	79.47	79.33	76.08
12/1/96	12:00			1.3	1.0	88.15	77.87	77.56	74.52
12/1/96	13:00			1.3	1.0	86.44	76.77	75.31	73.66
12/1/96	14:00			1.3	1.0	85.30	75.14	74.46	71.67
12/1/96	15:00			1.3	1.0	83.95	73.84	73.59	70.29
12/1/96	16:00		0.4	1.3	1.0	82.15	72.12	71.79	68.56
12/1/96	17:00		0.4	1.3	1.0	80.23	70.20	69.54	66.91
12/1/96	18:00		0.4	1.3	1.0	78.76	68.80	68.04	65.61
12/1/96	19:00		0.4	1.3	1.0	78.18	68.21	67.37	64.89
12/1/96	20:00		0.4	1.4	1.1	77.13	67.19	66.31	63.91
12/1/96	21:00		0.4	1.4	1.1	76.29	66.20	65.36	63.04
12/1/96	22:00		0.4	1.4	1.1	76.63	66.67	65.76	63.54
12/1/96	23:00		0.4	1.4	1.1	77.31	67.25	66.35	64.14

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VITRIFICATION PILOT PLANT FURNACE SYSTEM									
CAMPAIGN 4 TRANSITION TO SERIES A GLASS									
		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/2/96	0:00			1.4	1.1	77.04	67.02	66.12	63.85
12/2/96	1:00			1.4	1.1	76.91	66.68	65.84	63.60
12/2/96	2:00			1.4	1.1	75.68	65.52	64.66	62.39
12/2/96	3:00			1.4	1.1	74.35	64.34	63.39	61.18
12/2/96	4:00			1.4	1.1	72.34	62.27	61.49	59.27
12/2/96	5:00			1.4	1.1	71.56	61.72	60.72	58.70
12/2/96	6:00			1.4	1.1	71.54	61.70	60.72	58.78
12/2/96	7:00			1.4	1.1	72.16	62.19	61.20	59.31
12/2/96	8:00			1.4	1.1	72.69	62.69	61.78	59.96
12/2/96	9:00			1.4	1.1	75.63	65.66	64.71	62.77
12/2/96	10:00			1.4	1.1	77.99	67.93	67.09	64.80
12/2/96	11:00			1.4	1.1	81.24	71.25	70.55	67.84
12/2/96	12:00			1.3	1.0	84.81	74.79	74.11	71.04
12/2/96	13:00			1.4	1.0	86.82	76.74	76.08	73.04
12/2/96	14:00			1.3	1.0	88.05	77.80	77.12	74.04
12/2/96	15:00			1.3	1.0	88.17	77.67	77.31	74.00
12/2/96	16:00			1.3	1.0	87.38	76.71	76.28	72.96
12/2/96	17:00			1.3	1.0	84.19	73.62	73.20	69.81
12/2/96	18:00			1.3	1.0	82.00	71.36	70.93	67.55
12/2/96	19:00			1.3	1.0	77.14	66.72	66.07	62.86
12/2/96	20:00			1.4	1.1	73.85	63.39	62.72	59.62
12/2/96	21:00			1.4	1.1	72.54	62.22	61.54	58.51
12/2/96	22:00			1.4	1.1	71.25	61.02	60.24	57.19
12/2/96	23:00			1.4	1.1	70.54	60.37	59.56	56.64
12/3/96	0:00		0.2	1.6	1.1	69.33	59.08	58.31	55.29
12/3/96	1:00		0.2	1.6	1.1	70.23	60.04	59.26	56.11
12/3/96	2:00		0.2	1.6	1.1	68.07	57.78	56.87	53.66
12/3/96	3:00		0.2	1.4	1.1	69.45	59.20	58.28	55.20
12/3/96	4:00		0.2	1.4	1.1	73.02	62.88	62.03	59.02
12/3/96	5:00		0.2	1.4	1.1	77.79	67.69	66.92	63.75
12/3/96	6:00		0.2	1.4	1.1	77.76	67.52	66.80	63.50
12/3/96	7:00		0.2	1.4	1.0	77.68	67.28	66.52	63.24
12/3/96	8:00			1.4	1.0	78.51	68.24	67.55	64.38
12/3/96	9:00			1.4	1.0	81.73	71.61	71.00	67.84
12/3/96	10:00			1.4	1.4	84.10	73.68	73.18	69.81
12/3/96	11:00			1.4	1.0	84.81	74.24	73.84	70.39
12/3/96	12:00			1.3	1.0	89.84	79.12	78.75	75.15
12/3/96	13:00			1.3	1.0	87.76	76.81	76.41	72.50
12/3/96	14:00			1.3	1.0	86.30	75.35	75.02	70.92
12/3/96	15:00			1.3	1.0	84.19	73.20	72.93	68.86
12/3/96	16:00			1.3	1.0	82.30	71.32	70.92	66.75
12/3/96	17:00			1.3	1.0	79.98	68.95	68.60	64.67
12/3/96	18:00			1.3	1.0	79.09	68.37	67.89	64.30
12/3/96	19:00			1.3	1.0	78.29	67.47	67.11	63.23
12/3/96	20:00			1.3	1.0	77.69	66.76	66.29	62.60
12/3/96	21:00			1.3	1.0	77.63	66.94	66.56	62.86
12/3/96	22:00			1.3	1.0	77.41	66.80	66.39	62.68
12/3/96	23:00			1.3	1.0	77.41	66.60	66.48	62.58
12/4/96	0:00		0.4	1.4	1.0	76.57	65.73	65.60	61.73
12/4/96	1:00		0.4	1.4	1.0	74.74	64.41	63.96	60.86
12/4/96	2:00		0.4	1.4	1.0	75.15	64.79	64.75	61.20
12/4/96	3:00		0.4	1.4	1.0	77.35	67.01	66.72	63.56
12/4/96	4:00		0.4	1.4	1.0	75.92	65.85	64.99	62.60
12/4/96	5:00		0.4	1.4	1.1	75.30	64.76	64.60	61.36

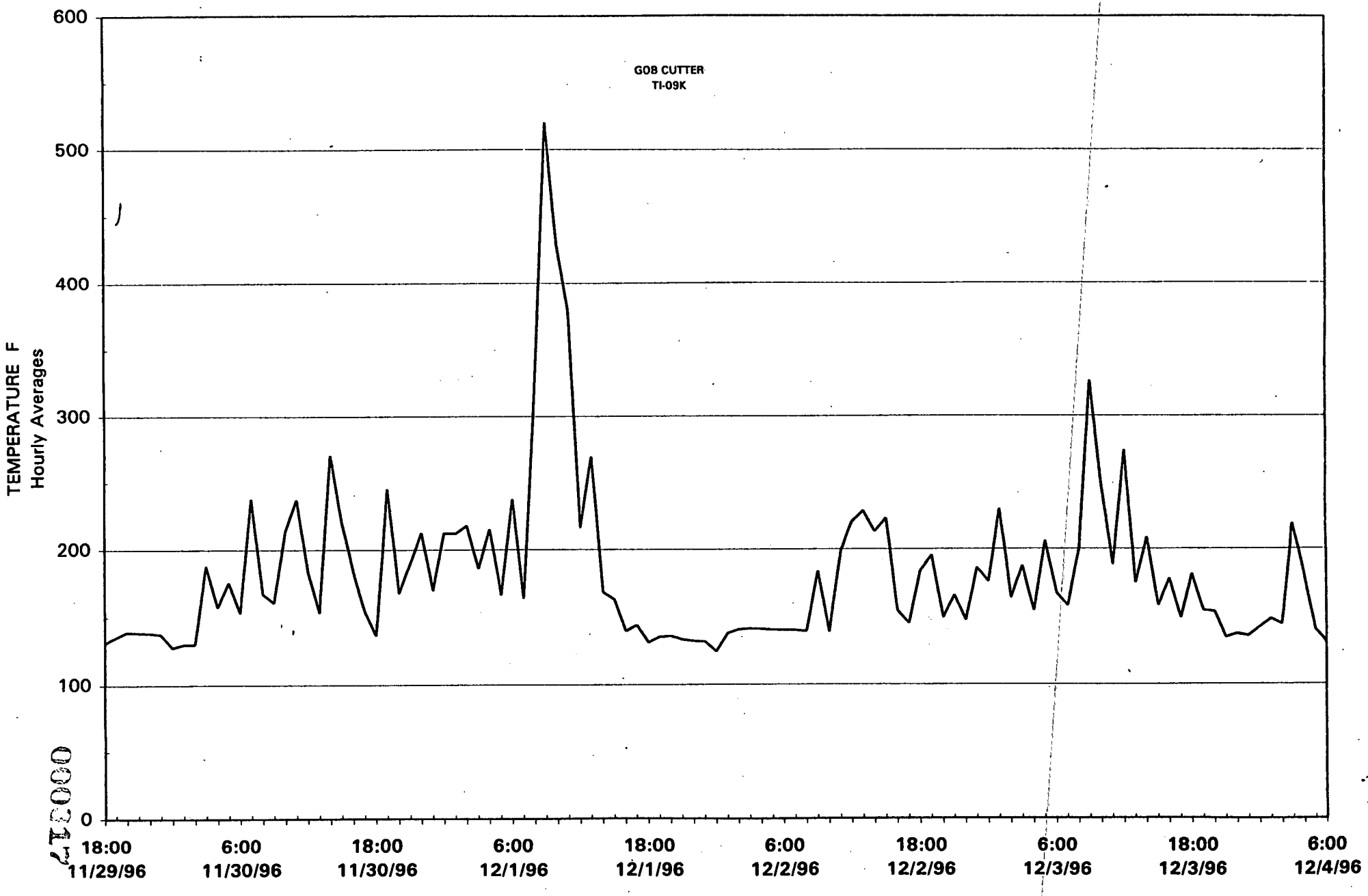
000316

VITRIFICATION PILOT PLANT FURNACE SYSTEM									
CAMPAIGN 4 TRANSITION TO SERIES A GLASS									
		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/4/96	6:00		0.4	1.4	1.1	75.33	64.88	64.56	61.59

000315

GEM MACHINE SYSTEM

CAMPA[illegible]
TRANSITION TO S[illegible]ES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 1

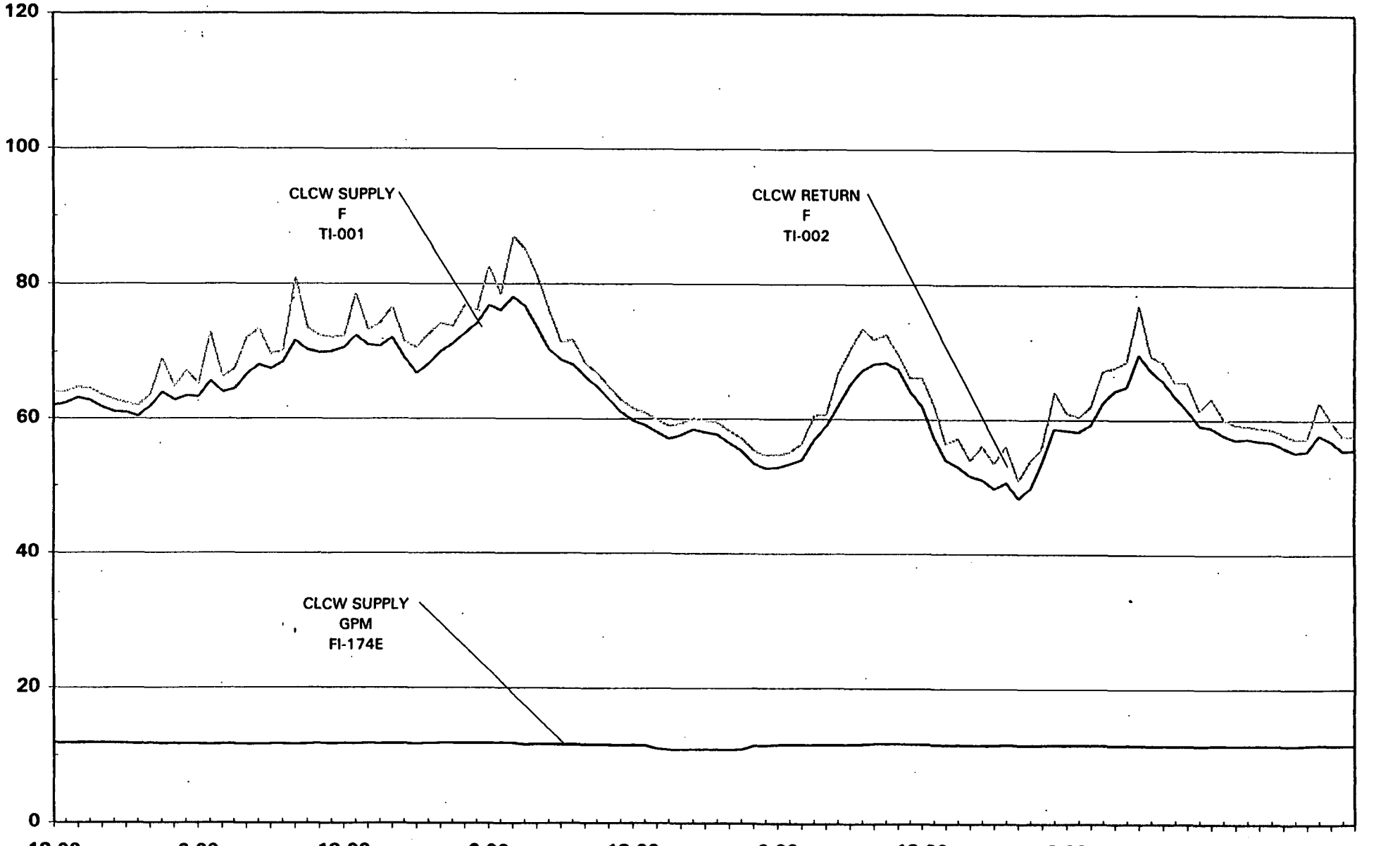
VHP 12/17/96

000317

673

000343

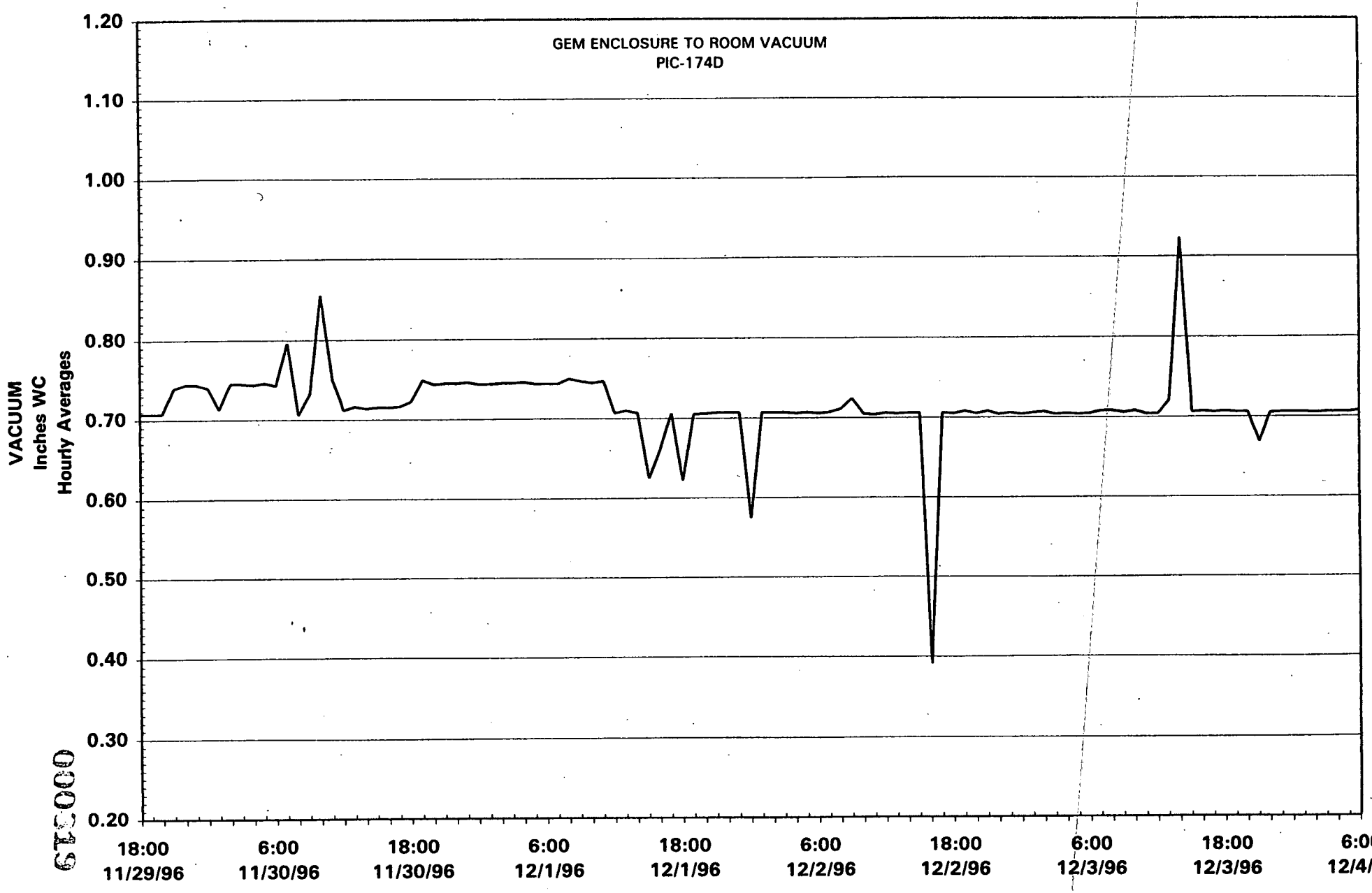
CAMPAIGN 4
TRANSITION TO SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 3

VHP 1/9/97

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 4

VHP 12/17/96

GEC000

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

READINGS		HOURLY AVERAGES									
		GEM HOPPER	GOB CUTTER	GOB CUTTER TEMP	GOB CUTTER	GOB ROLLER	CONVEYOR SPEED	GEM ENCLOSURE TO ROOM VACUUM	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
11/29/96	18:00	68.65	130.83		0.14	0.20	0.08	0.71	11.82	61.96	63.73
11/29/96	19:00	69.05	135.14		0.14	0.20	0.09	0.71	11.80	62.36	64.00
11/29/96	20:00	69.58	139.01		0.14	0.20	0.09	0.71	11.85	63.11	64.70
11/29/96	21:00	69.93	138.49		0.14	0.20	0.09	0.74	11.87	62.74	64.51
11/29/96	22:00	69.92	138.24		0.14	0.20	0.09	0.74	11.83	61.75	63.56
11/29/96	23:00	69.52	137.28		0.14	0.20	0.09	0.74	11.83	61.02	62.82
11/30/96	0:00	57.92	127.48		0.14	0.20	0.08	0.74	11.80	60.93	62.40
11/30/96	1:00	57.40	129.57		0.15	0.20	0.09	0.71	11.75	60.37	61.97
11/30/96	2:00	62.78	129.70		3.60	4.60	6.80	0.75	11.85	61.91	63.66
11/30/96	3:00	72.98	187.94		19.10	24.65	39.19	0.75	11.74	63.89	69.01
11/30/96	4:00	64.60	157.25		19.03	25.01	39.21	0.74	11.78	62.81	64.76
11/30/96	5:00	64.28	175.38		19.04	24.96	39.19	0.75	11.74	63.40	67.21
11/30/96	6:00	64.24	153.14		19.11	24.95	39.22	0.74	11.73	63.26	65.19
11/30/96	7:00	67.09	237.79		19.10	25.26	39.12	0.80	11.68	65.65	72.94
11/30/96	8:00	68.88	167.12		19.08	25.55	39.17	0.71	11.76	63.96	66.23
11/30/96	9:00	71.24	160.66		19.05	25.62	39.17	0.73	11.75	64.41	67.46
11/30/96	10:00	72.21	214.09		18.95	25.66	39.19	0.86	11.69	66.70	72.10
11/30/96	11:00	72.51	237.19		21.19	26.08	39.26	0.75	11.67	68.08	73.48
11/30/96	12:00	68.41	183.33		22.06	22.43	37.39	0.71	11.73	67.52	69.74
11/30/96	13:00	68.12	153.31		22.08	22.06	37.17	0.72	11.74	68.53	70.19
11/30/96	14:00	69.35	270.56		22.26	22.06	37.13	0.71	11.69	71.72	80.98
11/30/96	15:00	72.10	220.30		22.06	22.05	37.22	0.72	11.76	70.34	73.60
11/30/96	16:00	69.13	183.48		22.10	22.02	37.25	0.72	11.79	69.91	72.44
11/30/96	17:00	65.80	153.87		22.05	22.05	37.23	0.72	11.75	70.09	72.20
11/30/96	18:00	64.79	136.21		22.09	22.03	37.21	0.72	11.79	70.64	72.36
11/30/96	19:00	63.14	245.62		22.04	22.06	37.21	0.75	11.73	72.45	78.53
11/30/96	20:00	63.25	167.51		21.99	22.04	37.19	0.74	11.81	71.11	73.31
11/30/96	21:00	62.23	189.53		22.05	22.05	37.19	0.75	11.74	70.90	74.37
11/30/96	22:00	62.25	212.60		22.04	21.98	37.23	0.75	11.74	72.12	76.58
11/30/96	23:00	66.06	169.57		22.18	22.02	37.15	0.75	11.78	69.23	71.55
12/1/96	0:00	66.08	212.42		22.16	22.06	37.23	0.74	11.72	66.76	70.74
12/1/96	1:00	66.80	212.08		21.97	22.03	37.26	0.74	11.77	68.24	72.67
12/1/96	2:00	67.27	218.02		22.01	22.03	37.24	0.75	11.81	70.11	74.29
12/1/96	3:00	66.37	185.84		22.03	22.02	37.20	0.75	11.80	71.24	73.83
12/1/96	4:00	67.59	214.99		22.05	22.05	37.25	0.75	11.78	72.82	76.91
12/1/96	5:00	69.25	165.99		22.12	22.03	37.24	0.74	11.79	74.25	76.07
12/1/96	6:00	75.57	237.56		22.16	22.07	37.26	0.74	11.77	76.82	82.60
12/1/96	7:00	71.79	163.66		21.96	22.04	37.19	0.74	11.89	76.15	78.42
12/1/96	8:00	76.58	317.80		22.00	22.04	37.23	0.75	11.81	78.07	86.95
12/1/96	9:00	79.24	520.20		6.37	5.08	37.24	0.75	11.61	76.75	85.27
12/1/96	10:00	75.07	428.46		0.16	0.20	37.20	0.75	11.72	73.59	81.21
12/1/96	11:00	68.99	379.30		0.16	0.20	37.24	0.75	11.66	70.50	76.08
12/1/96	12:00	70.35	216.20		0.15	0.20	37.20	0.71	11.65	68.85	71.50
12/1/96	13:00	70.44	269.32		4.48	0.77	37.21	0.71	11.63	68.11	71.87
12/1/96	14:00	69.72	168.24		17.01	12.45	37.21	0.71	11.63	66.31	68.30
12/1/96	15:00	69.63	162.91		16.98	14.17	37.21	0.63	11.61	64.73	66.92
12/1/96	16:00	69.34	139.34		16.74	14.79	37.26	0.66	11.62	62.84	64.67
12/1/96	17:00	68.64	143.70		16.67	15.15	37.25	0.71	11.59	61.00	62.85
12/1/96	18:00	68.35	130.70		0.99	0.96	37.18	0.62	11.60	59.71	61.55
12/1/96	19:00	67.36	135.01		0.16	0.20	37.26	0.71	11.58	59.06	60.91
12/1/96	20:00	66.70	135.53		0.15	0.20	37.23	0.71	11.09	58.05	59.82
12/1/96	21:00	65.98	132.98		0.15	0.20	37.21	0.71	10.93	57.10	58.92
12/1/96	22:00	65.27	131.86		0.16	0.20	37.18	0.71	10.94	57.65	59.38
12/1/96	23:00	64.84	131.51		0.16	0.20	37.26	0.71	10.94	58.41	60.04
12/2/96	0:00	64.59	123.98		10.08	8.26	33.50	0.58	10.96	58.03	59.74
12/2/96	1:00	64.28	137.59		16.37	12.77	37.18	0.71	10.93	57.73	59.44
12/2/96	2:00	63.91	140.33		16.43	12.70	37.24	0.71	10.89	56.41	58.22
12/2/96	3:00	62.55	140.97		16.42	12.43	37.20	0.71	10.97	55.28	57.17
12/2/96	4:00	60.98	140.67		16.37	11.98	37.16	0.71	11.52	53.40	55.31
12/2/96	5:00	60.20	140.18		16.34	11.88	37.24	0.71	11.56	52.70	54.64
12/2/96	6:00	59.49	139.96		16.30	12.11	37.16	0.71	11.64	52.80	54.59

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VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM											
CAMPAIGN 4 TRANSITION TO SERIES A GLASS											
		HOURLY AVERAGES									
READINGS		GEM	GOB	GOB	GOB	GOB	CONVEYOR	GEM	CLCW	CLCW	CLCW
		HOPPER	CUTTER	CUTTER	CUTTER	ROLLER	SPEED	ENCLOSURE	DIVERTERS	DIVERTERS	DIVERTERS
				TEMP				TO ROOM	& CONVEYOR	& CONVEYOR	& CONVEYOR
								VACUUM	SUPPLY	SUPPLY	RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/2/96	7:00	59.12	139.90		16.27	12.33	37.28	0.71	11.62	53.34	55.11
12/2/96	8:00	61.46	138.99		16.77	14.41	37.21	0.71	11.62	53.95	56.29
12/2/96	9:00	65.39	183.14		20.80	20.23	37.20	0.72	11.64	56.84	60.53
12/2/96	10:00	62.27	138.40		21.34	22.82	37.21	0.71	11.65	58.92	60.66
12/2/96	11:00	63.50	198.42		21.35	24.11	37.18	0.70	11.65	61.95	66.64
12/2/96	12:00	66.12	220.40		21.49	25.27	37.20	0.71	11.71	65.09	70.31
12/2/96	13:00	68.31	228.71		21.68	25.54	37.18	0.71	11.75	67.26	73.64
12/2/96	14:00	70.51	213.08		21.68	25.23	37.22	0.71	11.85	68.24	71.90
12/2/96	15:00	76.84	223.10		22.29	20.84	5.67	0.71	11.85	68.43	72.71
12/2/96	16:00	73.91	154.30		17.36	14.41	0.10	0.39	11.84	67.45	69.80
12/2/96	17:00	72.49	144.89		22.13	16.46	15.43	0.71	11.77	64.12	66.11
12/2/96	18:00	68.45	183.43		22.35	18.46	18.70	0.71	11.78	61.89	66.19
12/2/96	19:00	66.27	195.37		22.49	18.67	18.76	0.71	11.72	57.28	61.96
12/2/96	20:00	64.03	148.90		22.52	18.52	18.95	0.71	11.65	53.96	56.30
12/2/96	21:00	62.05	165.40		22.42	18.51	18.27	0.71	11.66	52.94	57.15
12/2/96	22:00	60.86	147.08		22.36	18.63	18.35	0.70	11.63	51.59	53.88
12/2/96	23:00	61.64	185.95		22.34	18.70	19.00	0.71	11.62	51.07	56.00
12/3/96	0:00	61.23	175.78		22.37	18.57	19.18	0.70	11.62	49.72	53.45
12/3/96	1:00	64.54	229.88		22.74	17.65	18.85	0.71	11.69	50.62	56.01
12/3/96	2:00	59.00	163.64		22.87	17.11	18.51	0.71	11.65	48.20	50.90
12/3/96	3:00	60.55	187.27		22.90	19.79	19.15	0.70	11.65	49.76	53.84
12/3/96	4:00	60.00	154.03		22.83	19.62	18.52	0.71	11.67	53.70	55.79
12/3/96	5:00	62.12	205.79		22.87	17.64	18.48	0.70	11.67	58.60	64.13
12/3/96	6:00	63.26	167.15		22.89	16.30	18.98	0.71	11.71	58.40	60.99
12/3/96	7:00	65.44	157.65		22.79	18.86	18.31	0.71	11.69	58.14	60.40
12/3/96	8:00	64.09	199.89		15.41	14.90	18.51	0.71	11.69	59.22	61.94
12/3/96	9:00	64.97	326.10		1.73	2.84	18.84	0.71	11.72	62.54	67.25
12/3/96	10:00	66.66	245.65		0.08	10.84	27.21	0.71	11.68	64.29	67.74
12/3/96	11:00	76.09	188.08		5.75	21.08	37.21	0.70	11.75	64.90	68.66
12/3/96	12:00	93.83	273.98		16.05	21.04	37.21	0.70	11.71	69.73	77.02
12/3/96	13:00	78.01	174.38		19.15	21.03	37.23	0.72	11.64	67.32	69.56
12/3/96	14:00	73.78	208.20		21.36	20.98	37.28	0.92	11.65	65.74	68.52
12/3/96	15:00	71.84	157.70		14.97	14.37	37.19	0.71	11.65	63.43	65.47
12/3/96	16:00	71.46	177.59		5.81	6.37	37.26	0.71	11.63	61.47	65.51
12/3/96	17:00	70.18	148.64		0.12	0.38	37.25	0.71	11.63	59.13	61.37
12/3/96	18:00	69.05	180.81		12.92	12.97	37.16	0.71	11.67	58.83	63.22
12/3/96	19:00	68.28	154.23		20.64	20.45	37.24	0.71	11.66	57.79	60.12
12/3/96	20:00	67.36	153.28		20.82	20.49	37.14	0.71	11.63	57.06	59.28
12/3/96	21:00	66.56	134.20		13.42	13.46	37.22	0.67	11.63	57.19	59.08
12/3/96	22:00	66.00	136.79		0.07	0.27	37.22	0.71	11.64	56.90	58.84
12/3/96	23:00	65.55	135.25		0.07	0.29	37.22	0.71	11.63	56.74	58.62
12/4/96	0:00	64.68	141.37		0.07	0.30	37.23	0.71	11.65	55.95	57.96
12/4/96	1:00	63.13	147.87		0.07	0.29	37.22	0.71	11.60	55.25	57.13
12/4/96	2:00	62.09	143.89		0.07	0.29	37.19	0.71	11.69	55.47	57.23
12/4/96	3:00	64.79	218.67		1.85	2.11	37.22	0.71	11.72	57.76	62.69
12/4/96	4:00	62.97	180.73		0.07	0.28	37.24	0.71	11.67	56.87	59.82
12/4/96	5:00	62.31	139.63		0.07	0.29	37.14	0.71	11.63	55.52	57.59
12/4/96	6:00	61.44	130.86		0.07	0.29	37.20	0.71	11.64	55.64	57.57

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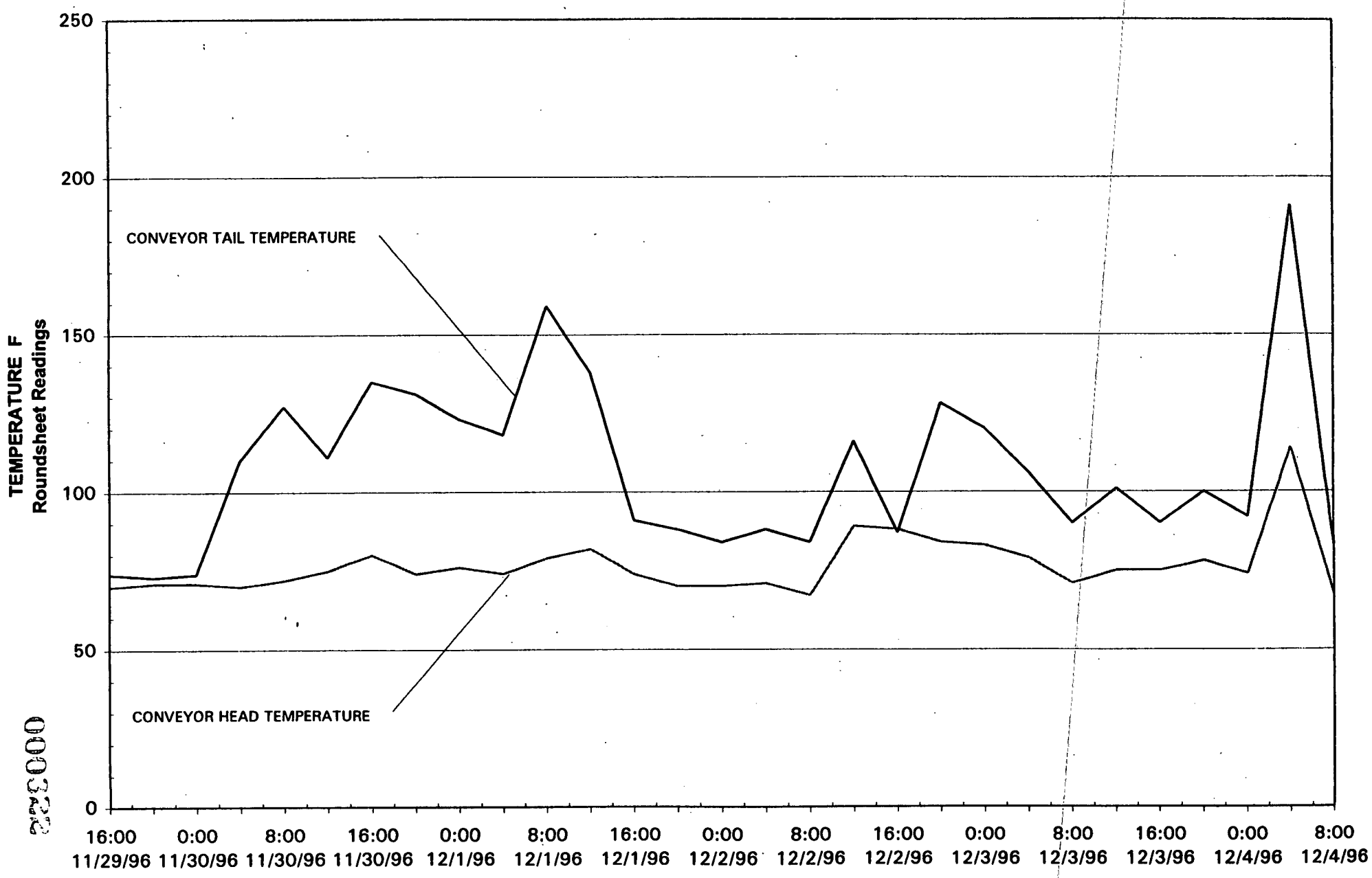
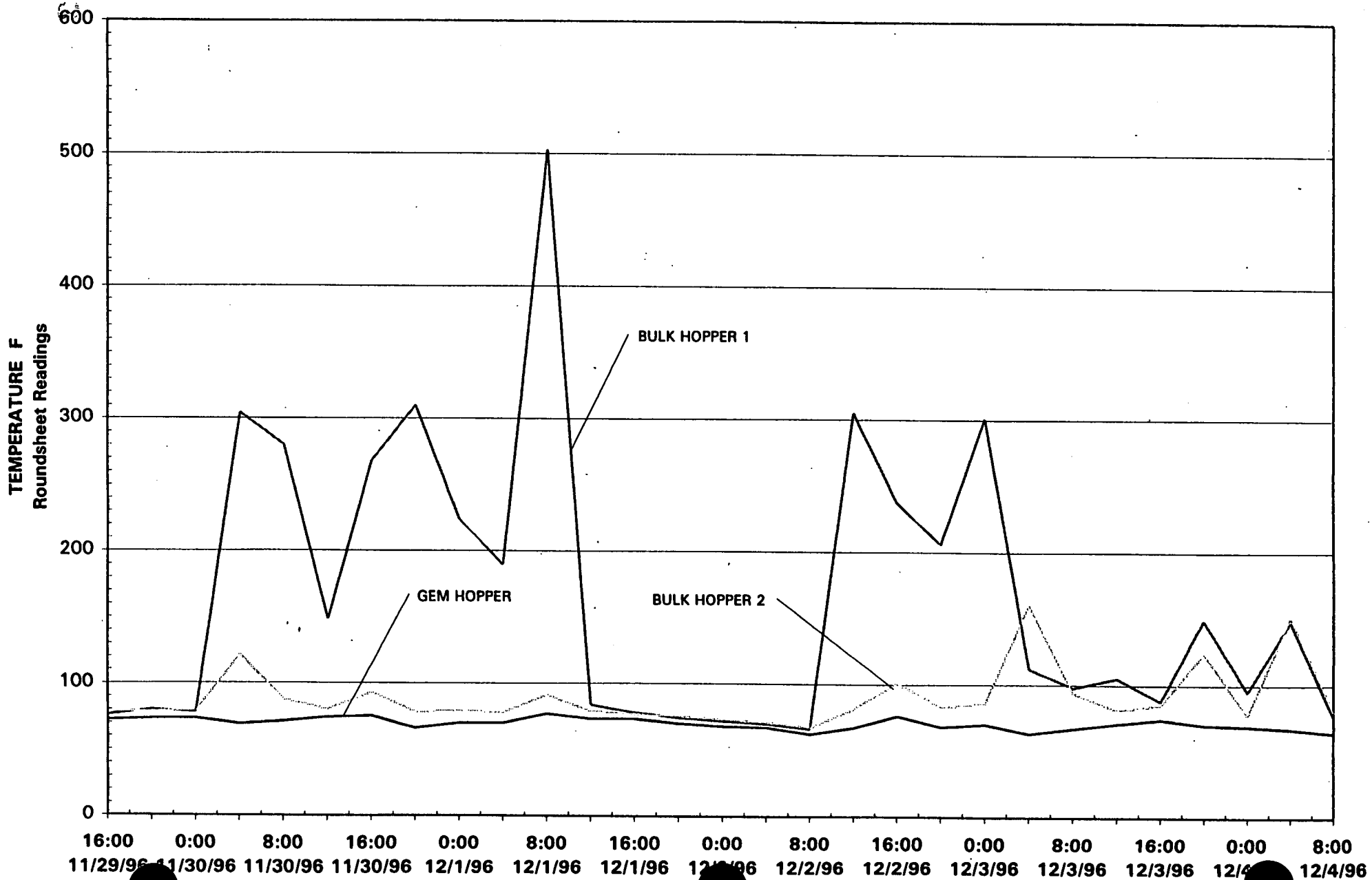
CAMPA[illegible]4
TRANSITION TO SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 2

VHP 12/18/96

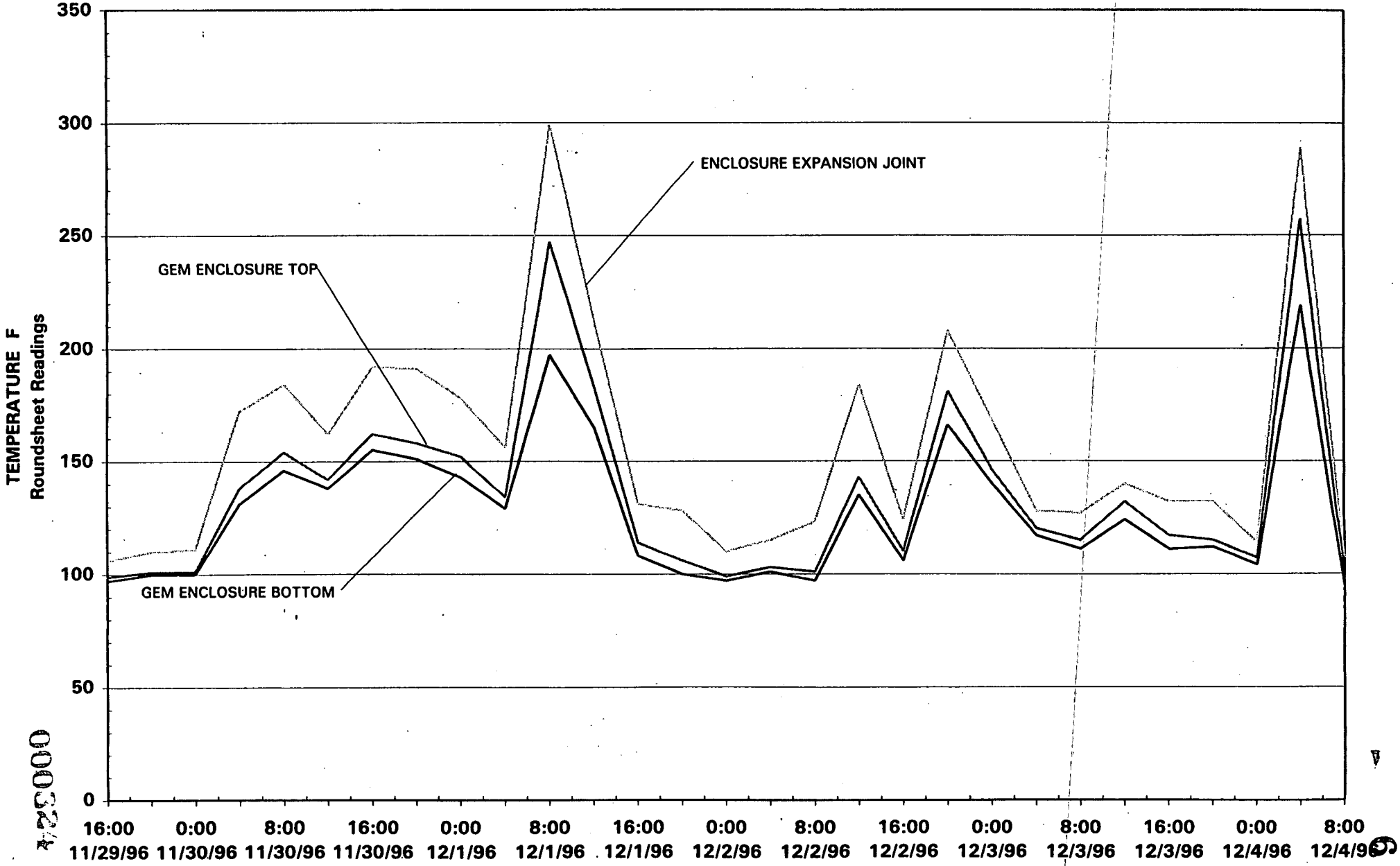
CAMPAIGN 4
TRANSITION TO SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMC Chart 5

VHP 12/18/96

CAMPA[illegible]4
TRANSITION TO SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 6

VHP 1/9/97

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VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM									
CAMPAIGN 4 TRANSITION TO SERIES A GLASS									
		ROUNDSHEET READINGS							
READINGS		CONVEYOR TAIL TEMP	CONVEYOR HEAD TEMP	GEM HOPPER TEMP	BULK HOPPER #1 TEMP	BULK HOPPER #2 TEMP	GEM ENCLOSURE BOTTOM TEMP	GEM ENCLOSURE TOP TEMP	ENCLOSURE EXPANSION JOINT TEMP
DATE	HOUR	F	F	F	F	F	F	F	F
11/29/96	16:00	74	70	72	76	78	97	99	106
11/29/96	20:00	73	71	73	80	79	100	101	110
11/30/96	0:00	74	71	73	78	79	100	101	111
11/30/96	4:00	110	70	69	304	121	131	138	172
11/30/96	8:00	127	72	71	280	88	146	154	184
11/30/96	12:00	111	75	74	148	80	138	142	162
11/30/96	16:00	135	80	75	268	93	155	162	192
11/30/96	20:00	131	74	66	310	78	151	158	191
12/1/96	0:00	123	76	70	224	79	143	152	178
12/1/96	4:00	118	74	70	190	78	129	134	156
12/1/96	8:00	159	79	77	503	91	197	247	299
12/1/96	12:00	138	82	73	84	79	165	183	212
12/1/96	16:00	91	74	73	78	77	108	114	131
12/1/96	20:00	88	70	70	74	75	100	106	128
12/2/96	0:00	84	70	68	72	73	97	99	110
12/2/96	4:00	88	71	67	70	71	101	103	115
12/2/96	8:00	84	67	62	66	67	97	101	123
12/2/96	12:00	116	89	67	305	81	135	143	184
12/2/96	16:00	87	88	76	237	101	106	110	124
12/2/96	20:00	128	84	68	206	83	166	181	208
12/3/96	0:00	120	83	70	301	86	140	146	168
12/3/96	4:00	106	79	63	112	160	117	120	128
12/3/96	8:00	90	71	67	98	94	111	115	127
12/3/96	12:00	101	75	71	105	81	124	132	140
12/3/96	16:00	90	75	74	88	85	111	117	132
12/3/96	20:00	100	78	70	149	124	112	115	132
12/4/96	0:00	92	74	69	95	77	104	107	114
12/4/96	4:00	191	114	67	148	151	219	257	289
12/4/96	8:00	83	67	64	76	80	95	101	107

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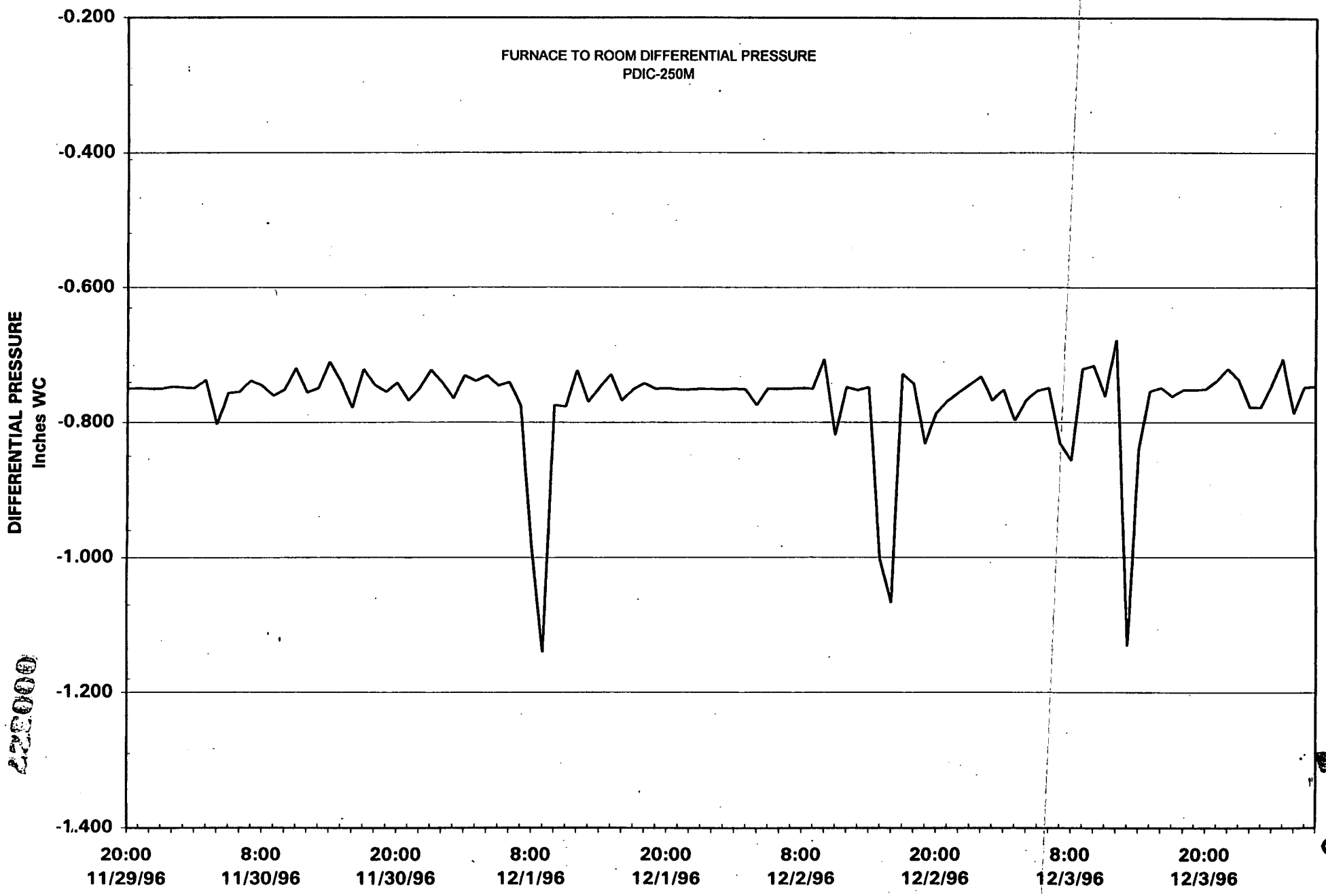
FURNACE OFFGAS SYSTEM

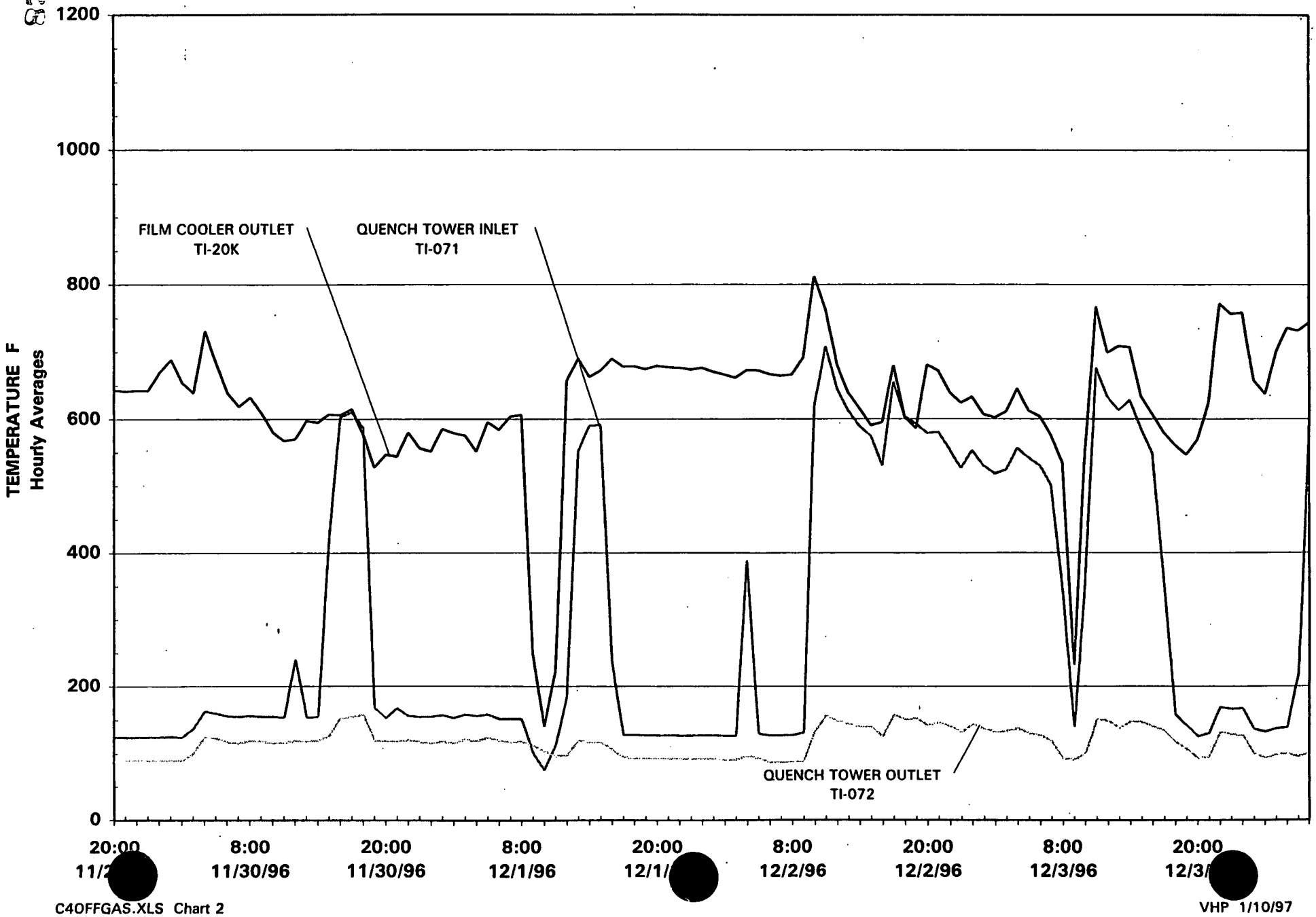
CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 1

VHP 1/10/97

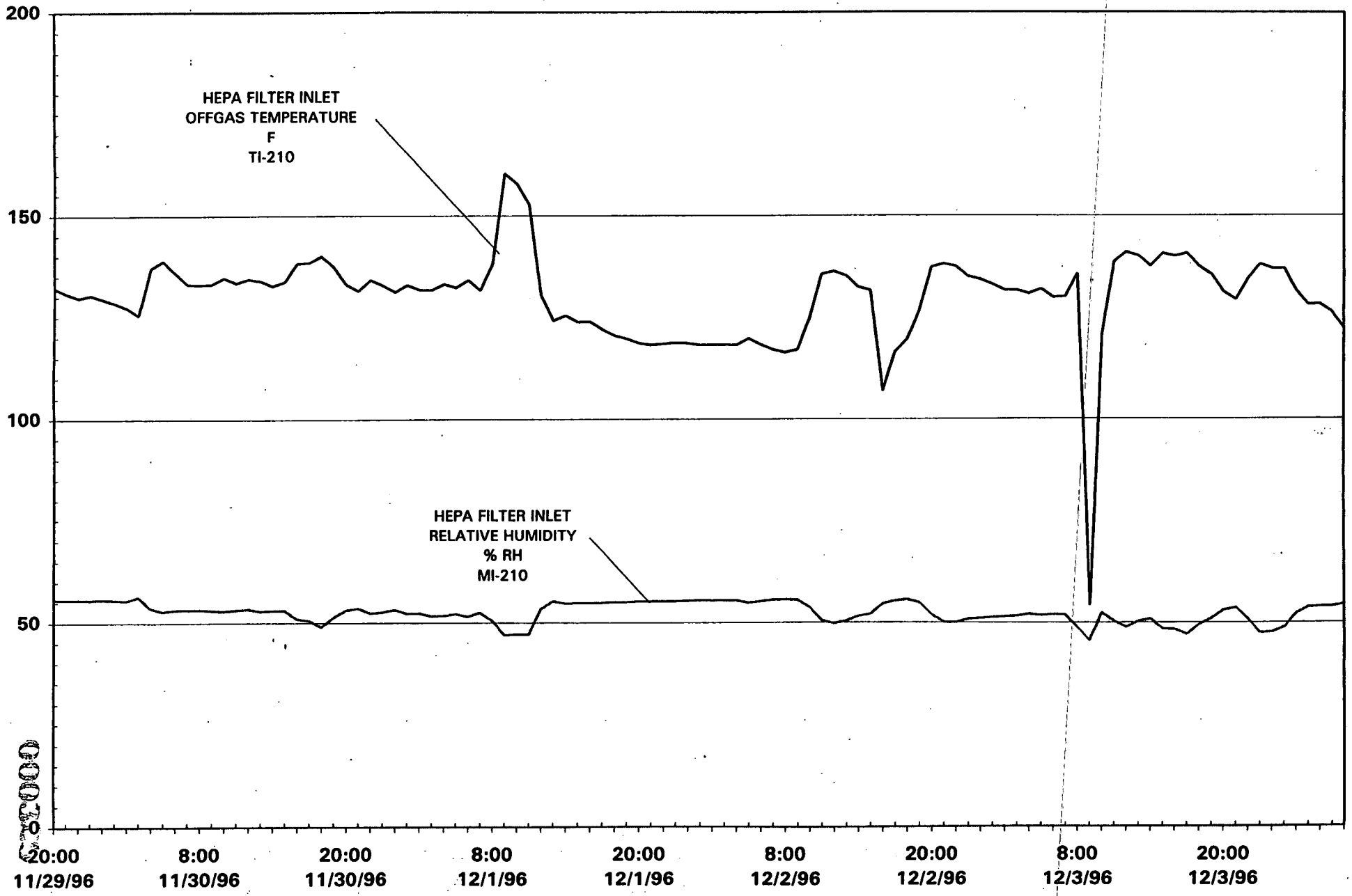
CAMPAIGN 4
TRANSITION TO SERIES A GLASS
OFFGAS SYSTEM



C4OFFGAS.XLS Chart 2

VHP 1/10/97

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 20

VHP 1/14/97

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
11/29/96	20:00	-0.750	643.51	124.59	88.89	OUT OF SERVICE	132.17	55.71
11/29/96	21:00	-0.749	641.52	124.20	88.76		130.87	55.67
11/29/96	22:00	-0.750	642.83	124.29	88.85		129.87	55.66
11/29/96	23:00	-0.750	642.48	124.39	88.89		130.45	55.60
11/30/96	0:00	-0.747	669.22	124.50	88.92		129.50	55.65
11/30/96	1:00	-0.748	688.67	125.12	89.44		128.59	55.60
11/30/96	2:00	-0.749	654.36	124.31	88.95		127.38	55.41
11/30/96	3:00	-0.737	638.90	136.76	99.93		125.55	56.29
11/30/96	4:00	-0.803	731.02	163.27	124.65		137.16	53.67
11/30/96	5:00	-0.756	682.36	160.31	122.75		138.88	52.85
11/30/96	6:00	-0.754	638.89	156.24	117.66		135.97	53.14
11/30/96	7:00	-0.738	618.85	155.48	115.46		133.21	53.22
11/30/96	8:00	-0.745	631.93	156.37	119.31		133.07	53.26
11/30/96	9:00	-0.760	609.70	155.28	118.51		133.22	53.07
11/30/96	10:00	-0.751	580.77	155.40	115.43		134.77	52.89
11/30/96	11:00	-0.719	567.63	153.90	116.58		133.52	53.17
11/30/96	12:00	-0.755	570.08	240.18	118.99		134.47	53.41
11/30/96	13:00	-0.749	597.39	154.23	118.44		133.99	52.85
11/30/96	14:00	-0.710	595.01	154.79	119.18		132.79	53.00
11/30/96	15:00	-0.739	607.10	424.48	126.44		133.79	53.04
11/30/96	16:00	-0.778	605.97	601.93	153.25		138.30	50.99
11/30/96	17:00	-0.721	615.23	610.80	154.42		138.57	50.54
11/30/96	18:00	-0.744	576.56	586.94	158.03		140.22	49.07
11/30/96	19:00	-0.754	528.16	169.04	119.59		137.56	51.41
11/30/96	20:00	-0.741	547.24	152.67	118.58		133.16	53.10
11/30/96	21:00	-0.767	544.32	167.91	118.01		131.56	53.63
11/30/96	22:00	-0.749	579.48	156.09	120.29		134.26	52.42
11/30/96	23:00	-0.722	556.31	154.47	117.25		132.94	52.66
12/1/96	0:00	-0.740	551.65	154.87	115.20		131.30	53.26
12/1/96	1:00	-0.764	585.29	157.16	117.96		132.99	52.31
12/1/96	2:00	-0.730	578.88	152.78	115.44		131.86	52.40
12/1/96	3:00	-0.738	574.87	158.02	121.14		131.78	51.65
12/1/96	4:00	-0.730	551.34	155.90	118.36		133.22	51.79
12/1/96	5:00	-0.745	595.40	157.99	123.82		132.41	52.23
12/1/96	6:00	-0.740	583.87	151.53	119.44		134.18	51.57
12/1/96	7:00	-0.775	603.63	151.43	117.03		131.66	52.54
12/1/96	8:00	-0.983	606.01	151.03	117.79		138.27	50.49
12/1/96	9:00	-1.141	249.80	102.12	112.07		160.45	47.02
12/1/96	10:00	-0.774	140.50	75.02	103.64		158.00	47.17
12/1/96	11:00	-0.776	221.20	111.04	96.26		152.91	47.14
12/1/96	12:00	-0.723	656.83	184.18	96.53		130.33	53.31
12/1/96	13:00	-0.769	689.93	551.25	118.89		124.20	55.22
12/1/96	14:00	-0.748	662.68	590.10	116.28		125.35	54.63
12/1/96	15:00	-0.729	672.11	591.55	116.44		123.85	54.79

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM								
CAMPAIGN 4 TRANSITION TO SERIES A GLASS								
HOURLY AVERAGES								
READINGS		FURNACE TO	FILM	QUENCH	QUENCH	DESICCANT	HEPA	HEPA FILTER
		ROOM	COOLER	TOWER	TOWER	TOWER	FILTER	OFFGAS INLET
		DIFF PRESS	OFFGAS	OFFGAS	OFFGAS	OFFGAS	OFFGAS	RELATIVE
			OUTLET	INLET	OUTLET	INLET	INLET	HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/1/96	16:00	-0.767	690.18	238.35	106.42		123.93	54.75
12/1/96	17:00	-0.751	678.14	127.67	93.97		122.10	54.82
12/1/96	18:00	-0.742	678.68	127.39	93.34		120.55	55.07
12/1/96	19:00	-0.750	674.08	126.99	92.55		119.78	55.07
12/1/96	20:00	-0.749	679.22	126.82	92.18		118.68	55.22
12/1/96	21:00	-0.751	676.92	126.72	91.98		118.24	55.21
12/1/96	22:00	-0.751	676.29	126.62	91.69		118.49	55.25
12/1/96	23:00	-0.750	673.59	126.58	91.48		118.74	55.30
12/2/96	0:00	-0.750	675.83	126.88	91.73		118.62	55.38
12/2/96	1:00	-0.751	670.34	126.35	91.23		118.25	55.48
12/2/96	2:00	-0.750	666.18	126.04	90.82		118.23	55.45
12/2/96	3:00	-0.751	661.35	126.18	90.59		118.31	55.48
12/2/96	4:00	-0.774	672.64	387.89	96.20		118.15	55.47
12/2/96	5:00	-0.750	672.21	129.05	92.38		119.79	54.87
12/2/96	6:00	-0.750	666.79	126.49	86.77		118.30	55.27
12/2/96	7:00	-0.750	664.38	126.47	86.45		117.01	55.59
12/2/96	8:00	-0.749	665.91	126.96	87.12		116.32	55.73
12/2/96	9:00	-0.750	691.61	130.49	88.36		117.01	55.61
12/2/96	10:00	-0.706	811.99	620.87	132.42		124.69	53.83
12/2/96	11:00	-0.819	763.72	708.11	156.52		135.58	50.48
12/2/96	12:00	-0.748	681.01	645.24	148.18		136.32	49.77
12/2/96	13:00	-0.752	638.62	612.02	143.57		135.23	50.36
12/2/96	14:00	-0.748	616.14	589.01	139.29		132.46	51.56
12/2/96	15:00	-1.002	590.05	574.01	138.92		131.59	52.16
12/2/96	16:00	-1.067	595.14	530.88	124.87		106.86	54.68
12/2/96	17:00	-0.728	679.63	655.18	157.38		116.51	55.39
12/2/96	18:00	-0.743	602.73	603.70	150.36		119.50	55.70
12/2/96	19:00	-0.832	585.98	592.31	152.22		126.65	54.95
12/2/96	20:00	-0.786	680.97	578.81	141.47		137.34	51.94
12/2/96	21:00	-0.768	671.94	580.36	145.77		138.12	50.06
12/2/96	22:00	-0.756	639.72	553.95	139.38		137.53	50.09
12/2/96	23:00	-0.744	624.36	527.01	131.28		135.01	50.92
12/3/96	0:00	-0.732	632.96	553.00	142.54		134.27	51.14
12/3/96	1:00	-0.767	606.97	530.77	136.21		133.07	51.31
12/3/96	2:00	-0.752	602.03	518.48	131.69		131.63	51.48
12/3/96	3:00	-0.797	610.88	524.13	133.12		131.56	51.67
12/3/96	4:00	-0.767	644.86	556.59	136.27		130.74	52.11
12/3/96	5:00	-0.753	612.21	542.43	130.06		131.86	51.79
12/3/96	6:00	-0.749	603.49	530.73	127.32		129.87	52.03
12/3/96	7:00	-0.831	575.16	501.29	118.40		130.02	51.91
12/3/96	8:00	-0.857	534.64	344.21	92.49		135.62	48.55
12/3/96	9:00	-0.721	232.43	139.44	90.70		54.13	45.48
12/3/96	10:00	-0.716	544.57	349.17	99.78		120.33	52.40
12/3/96	11:00	-0.762	766.91	676.17	150.45		138.49	50.31

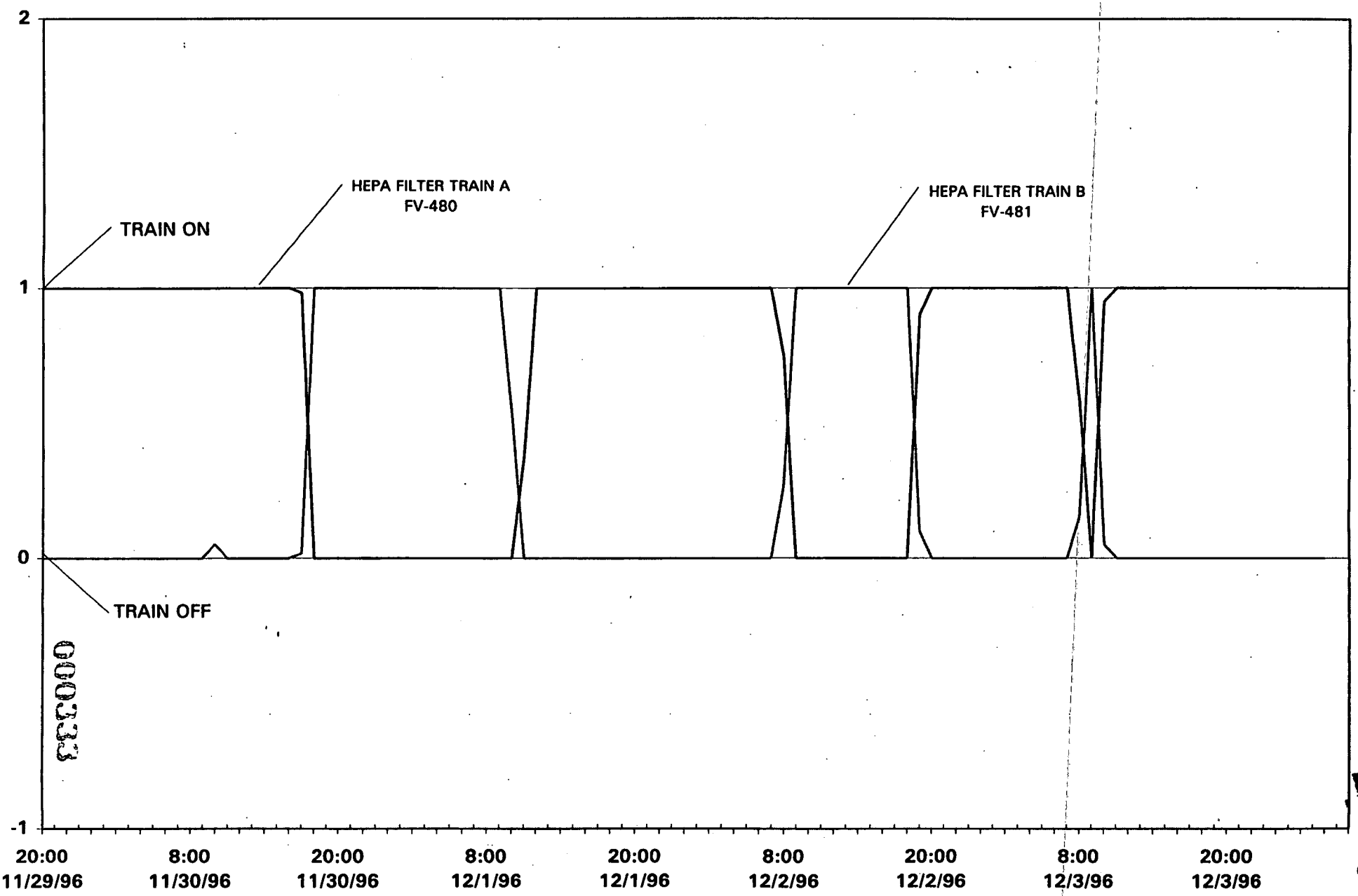
VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/3/96	12:00	-0.678	698.75	633.29	148.43		140.86	48.81
12/3/96	13:00	-1.132	708.59	612.78	137.64		139.95	50.31
12/3/96	14:00	-0.840	707.03	628.39	146.42		137.41	50.82
12/3/96	15:00	-0.754	634.00	584.46	146.54		140.54	48.34
12/3/96	16:00	-0.749	607.26	549.01	140.46		139.87	48.27
12/3/96	17:00	-0.762	579.32	359.30	134.38		140.61	46.97
12/3/96	18:00	-0.752	560.86	157.31	117.38		137.37	49.54
12/3/96	19:00	-0.752	547.03	142.00	106.64		135.45	51.03
12/3/96	20:00	-0.751	569.08	125.55	93.48		131.13	52.98
12/3/96	21:00	-0.739	623.95	130.51	94.75		129.20	53.55
12/3/96	22:00	-0.721	771.60	168.76	131.99		134.37	50.70
12/3/96	23:00	-0.737	756.52	166.27	128.05		137.88	47.43
12/4/96	0:00	-0.778	758.12	167.19	127.37		136.81	47.61
12/4/96	1:00	-0.778	657.03	136.31	100.34		136.80	48.84
12/4/96	2:00	-0.746	637.45	132.31	93.91		131.42	52.23
12/4/96	3:00	-0.706	699.32	136.88	97.77		128.04	53.67
12/4/96	4:00	-0.787	735.49	138.56	100.11		128.16	53.85
12/4/96	5:00	-0.748	731.68	216.47	95.76		126.17	53.86
12/4/96	6:00	-0.747	743.21	571.79	100.13		122.19	54.35

CAMPAIGN 4
TRANSITION TO SERIES A GLASS OFFGAS SYSTEM



C4OFFGAS.XLS Chart 3

VHP 1/13/97

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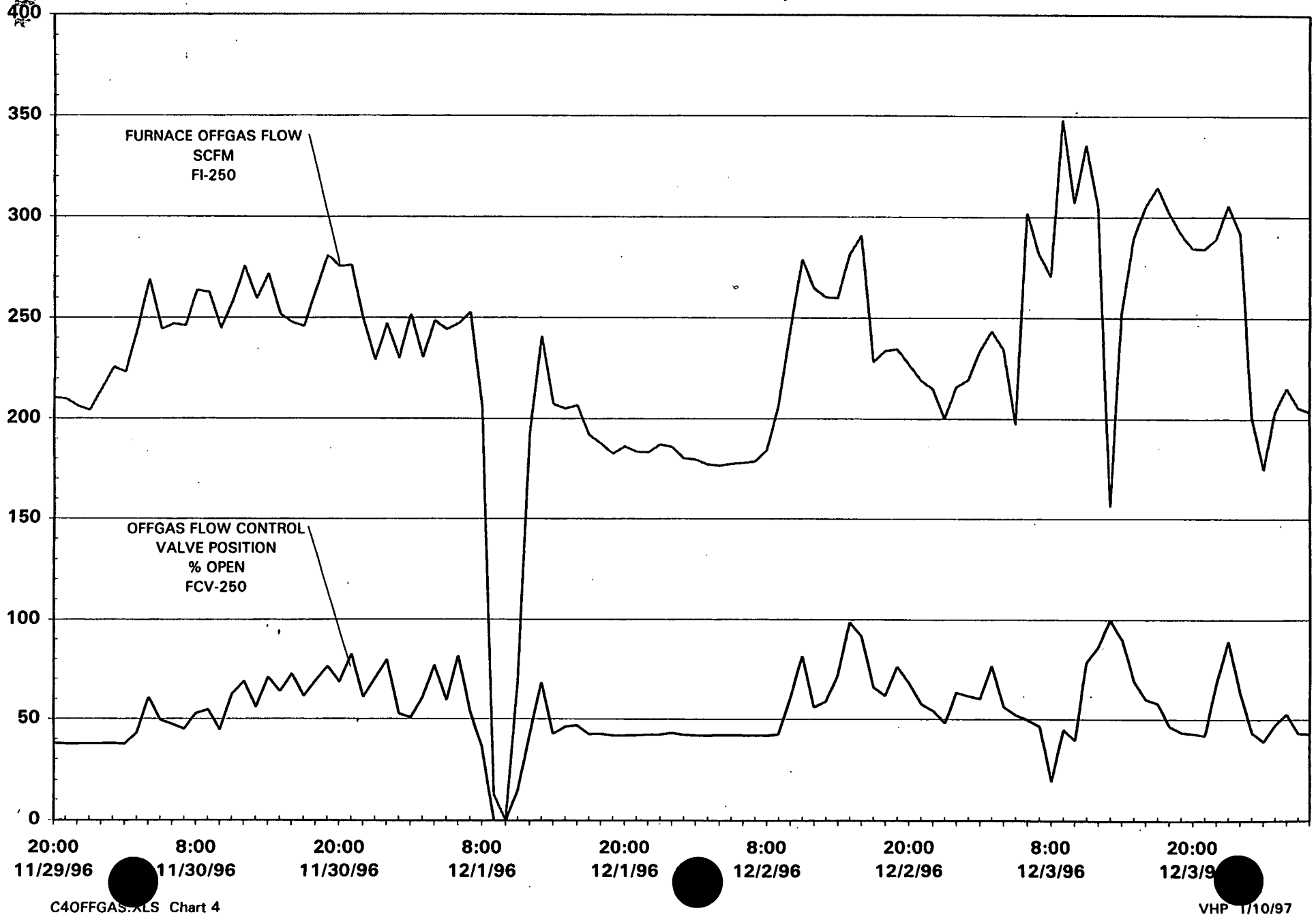
CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 4

VHP 1/10/97

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 TRANSITION TO SERIES A GLASS

HOURLY AVERAGES

READINGS		HEPA FILTER TRAIN A	HEPA FILTER TRAIN B	HEPA FILTERS DIFF PRESS	OFFGAS FLOW CONTROL VALVE POSITION	FLOW TO STACK	TOTAL STACK FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
11/29/96	20:00	1.00	0.00	0.15	38.08	210.44	8011.58
11/29/96	21:00	1.00	0.00	0.16	37.77	209.86	7933.67
11/29/96	22:00	1.00	0.00	0.16	37.84	206.16	7948.17
11/29/96	23:00	1.00	0.00	0.17	37.90	204.09	7956.17
11/30/96	0:00	1.00	0.00	0.18	37.94	214.68	7841.25
11/30/96	1:00	1.00	0.00	0.19	38.04	225.69	7399.25
11/30/96	2:00	1.00	0.00	0.19	37.71	223.17	7770.33
11/30/96	3:00	1.00	0.00	0.25	42.93	245.43	7974.49
11/30/96	4:00	1.00	0.00	0.24	60.65	268.80	8048.00
11/30/96	5:00	1.00	0.00	0.23	49.39	244.33	8061.92
11/30/96	6:00	1.00	0.00	0.22	47.43	246.97	8056.67
11/30/96	7:00	1.00	0.00	0.21	45.04	246.07	7994.42
11/30/96	8:00	1.00	0.00	0.25	52.86	263.64	7758.33
11/30/96	9:00	1.00	0.00	0.23	54.61	262.58	7651.58
11/30/96	10:00	1.00	0.05	0.22	44.59	244.66	7560.61
11/30/96	11:00	1.00	0.00	0.26	62.55	258.15	7613.67
11/30/96	12:00	1.00	0.00	0.30	68.77	275.16	7725.34
11/30/96	13:00	1.00	0.00	0.30	55.83	259.30	7708.33
11/30/96	14:00	1.00	0.00	0.31	70.91	271.62	7576.25
11/30/96	15:00	1.00	0.00	0.32	63.87	251.60	7445.25
11/30/96	16:00	1.00	0.00	0.33	72.53	247.66	7542.92
11/30/96	17:00	0.98	0.02	0.32	61.30	245.78	7382.33
11/30/96	18:00	0.00	1.00	0.27	69.27	263.65	7425.67
11/30/96	19:00	0.00	1.00	0.29	76.27	280.37	7321.83
11/30/96	20:00	0.00	1.00	0.28	68.50	275.28	7434.33
11/30/96	21:00	0.00	1.00	0.29	82.58	275.77	7522.83
11/30/96	22:00	0.00	1.00	0.26	60.91	248.95	7122.33
11/30/96	23:00	0.00	1.00	0.26	70.35	229.18	7387.97
12/1/96	0:00	0.00	1.00	0.29	79.67	247.13	7554.50
12/1/96	1:00	0.00	1.00	0.25	52.63	230.07	7467.42
12/1/96	2:00	0.00	1.00	0.26	50.71	251.72	7590.75
12/1/96	3:00	0.00	1.00	0.28	60.83	230.43	7582.00
12/1/96	4:00	0.00	1.00	0.31	76.97	248.58	7572.83
12/1/96	5:00	0.00	1.00	0.30	59.39	244.23	7442.67
12/1/96	6:00	0.00	1.00	0.34	81.60	247.14	7369.75
12/1/96	7:00	0.00	1.00	0.34	53.53	252.75	7334.08
12/1/96	8:00	0.00	1.00	0.23	36.12	205.11	7929.08
12/1/96	9:00	0.00	1.00	-0.03	0.09	12.54	7852.42
12/1/96	10:00	0.00	0.53	-0.04	0.10	0.00	8192.33
12/1/96	11:00	0.37	0.00	0.06	14.52	68.60	8307.50
12/1/96	12:00	1.00	0.00	0.24	41.53	192.58	8175.83
12/1/96	13:00	1.00	0.00	0.33	68.12	240.70	8280.92
12/1/96	14:00	1.00	0.00	0.27	42.72	207.02	8322.92
12/1/96	15:00	1.00	0.00	0.28	46.37	204.91	8318.81

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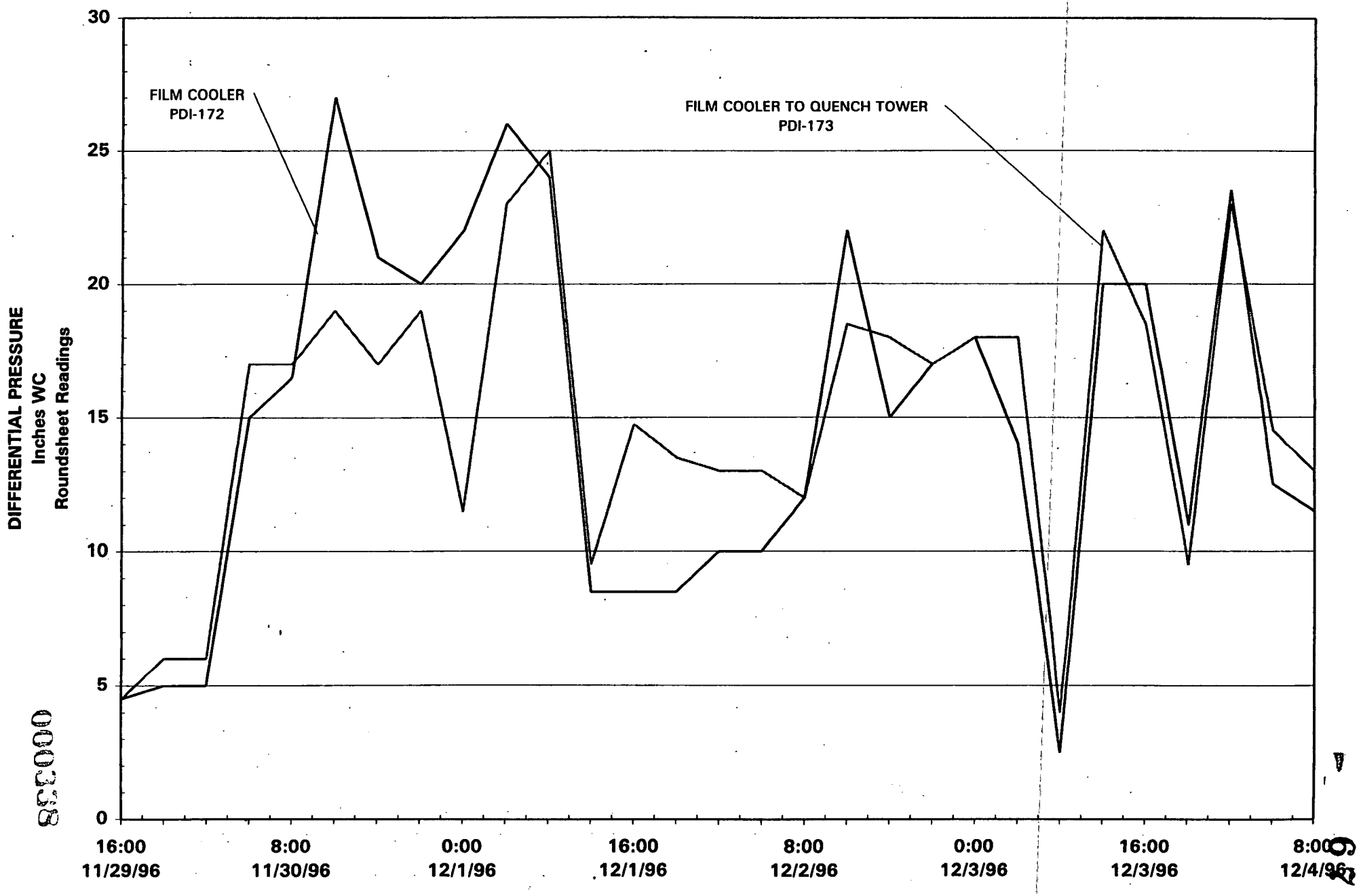
VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 TRANSITION TO SERIES A GLASS							
HOURLY AVERAGES							
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/1/96	16:00	1.00	0.00	0.30	47.01	206.47	8245.33
12/1/96	17:00	1.00	0.00	0.29	42.54	191.84	8492.25
12/1/96	18:00	1.00	0.00	0.30	42.70	187.78	8474.67
12/1/96	19:00	1.00	0.00	0.31	41.88	182.59	8486.25
12/1/96	20:00	1.00	0.00	0.32	41.89	186.28	8547.17
12/1/96	21:00	1.00	0.00	0.33	42.01	183.62	8558.58
12/1/96	22:00	1.00	0.00	0.35	42.21	183.26	8621.83
12/1/96	23:00	1.00	0.00	0.36	42.29	187.30	8619.91
12/2/96	0:00	1.00	0.00	0.38	43.05	186.06	8547.42
12/2/96	1:00	1.00	0.00	0.39	42.20	180.19	8514.92
12/2/96	2:00	1.00	0.00	0.41	41.92	179.60	8569.42
12/2/96	3:00	1.00	0.00	0.42	41.80	177.24	8635.17
12/2/96	4:00	1.00	0.00	0.44	42.15	176.50	8723.58
12/2/96	5:00	1.00	0.00	0.46	42.11	177.55	8812.92
12/2/96	6:00	1.00	0.00	0.47	41.97	177.96	8826.08
12/2/96	7:00	1.00	0.00	0.49	41.95	178.74	8783.75
12/2/96	8:00	0.75	0.27	0.45	41.84	183.99	8279.00
12/2/96	9:00	0.00	1.00	0.31	42.42	206.39	8166.75
12/2/96	10:00	0.00	1.00	0.36	60.24	244.03	8114.17
12/2/96	11:00	0.00	1.00	0.42	81.52	278.67	7983.83
12/2/96	12:00	0.00	1.00	0.42	55.90	264.51	7725.33
12/2/96	13:00	0.00	1.00	0.46	58.67	260.20	7683.64
12/2/96	14:00	0.00	1.00	0.53	71.82	259.77	7612.67
12/2/96	15:00	0.00	1.00	0.65	98.69	281.26	7656.00
12/2/96	16:00	0.00	1.00	0.66	91.77	290.52	7643.75
12/2/96	17:00	0.00	1.00	0.66	65.93	228.19	7768.75
12/2/96	18:00	0.00	1.00	1.38	61.71	233.81	7899.75
12/2/96	19:00	0.90	0.10	0.77	76.10	234.55	8021.50
12/2/96	20:00	1.00	0.00	0.31	68.13	227.12	8162.08
12/2/96	21:00	1.00	0.00	0.30	57.73	219.10	8234.67
12/2/96	22:00	1.00	0.00	0.29	54.44	214.78	8278.92
12/2/96	23:00	1.00	0.00	0.27	48.16	200.12	8303.08
12/3/96	0:00	1.00	0.00	0.31	63.30-	215.83	8266.25
12/3/96	1:00	1.00	0.00	0.32	61.56	219.31	8233.42
12/3/96	2:00	1.00	0.00	0.31	60.22	233.62	8428.83
12/3/96	3:00	1.00	0.00	0.34	76.39	243.47	8440.68
12/3/96	4:00	1.00	0.00	0.34	56.40	234.30	8251.78
12/3/96	5:00	1.00	0.00	0.34	52.00	197.26	8139.58
12/3/96	6:00	1.00	0.00	0.34	49.73	301.79	8081.67
12/3/96	7:00	1.00	0.00	0.32	46.59	281.36	8194.75
12/3/96	8:00	0.58	0.15	0.04	19.34	270.28	8249.83
12/3/96	9:00	0.00	1.00	-0.05	45.00	348.19	8499.17
12/3/96	10:00	0.95	0.05	0.21	39.80	307.09	7936.10
12/3/96	11:00	1.00	0.00	0.36	78.41	335.61	7928.33

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 TRANSITION TO SERIES A GLASS							
HOURLY AVERAGES							
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/3/96	12:00	1.00	0.00	0.38	86.46	304.58	7748.58
12/3/96	13:00	1.00	0.00	0.46	99.77	156.32	7851.78
12/3/96	14:00	1.00	0.00	0.43	90.34	252.36	7766.78
12/3/96	15:00	1.00	0.00	0.44	69.08	289.24	7913.75
12/3/96	16:00	1.00	0.00	0.44	60.02	305.27	7903.25
12/3/96	17:00	1.00	0.00	0.45	57.89	314.71	7950.67
12/3/96	18:00	1.00	0.00	0.42	46.71	302.12	7960.75
12/3/96	19:00	1.00	0.00	0.41	43.59	291.73	8006.86
12/3/96	20:00	1.00	0.00	0.41	42.93	284.33	7944.33
12/3/96	21:00	1.00	0.00	0.40	42.00	283.98	7908.58
12/3/96	22:00	1.00	0.00	0.45	67.44	289.27	7961.75
12/3/96	23:00	1.00	0.00	0.48	89.30	305.78	7985.09
12/4/96	0:00	1.00	0.00	0.47	63.47	291.71	8038.50
12/4/96	1:00	1.00	0.00	0.43	43.42	201.19	8109.42
12/4/96	2:00	1.00	0.00	0.38	38.90	174.60	8076.75
12/4/96	3:00	1.00	0.00	0.47	47.63	203.69	8005.09
12/4/96	4:00	1.00	0.00	0.54	52.53	215.16	8035.98
12/4/96	5:00	1.00		0.54	43.09	205.62	8049.04
12/4/96	6:00	1.00	0.00	0.57	42.61	203.43	8055.75

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE OFFGAS SYSTEM

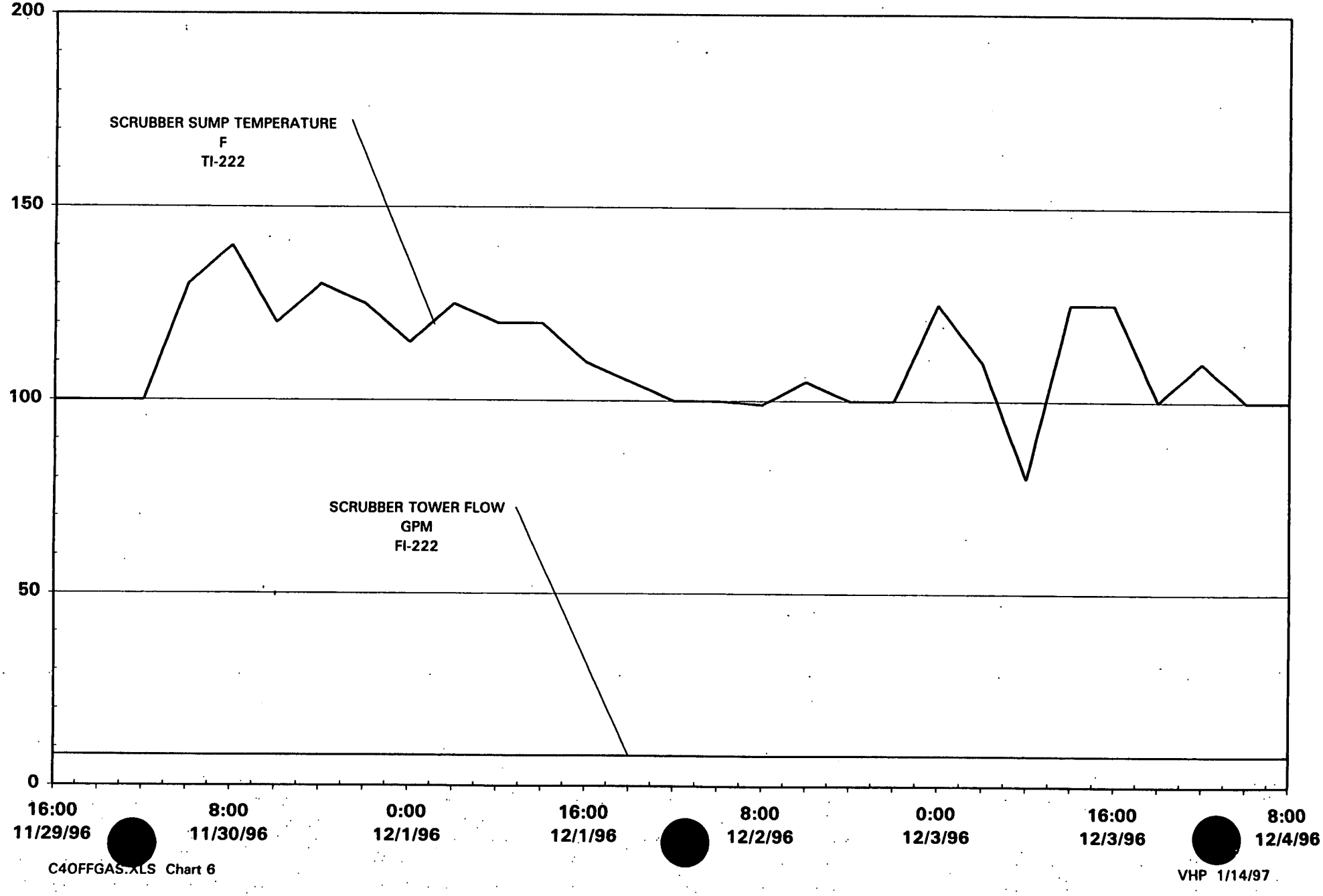


C4OFFGAS.XLS Chart 5

VHP 1/13/97

000338

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE OFFGAS SYSTEM

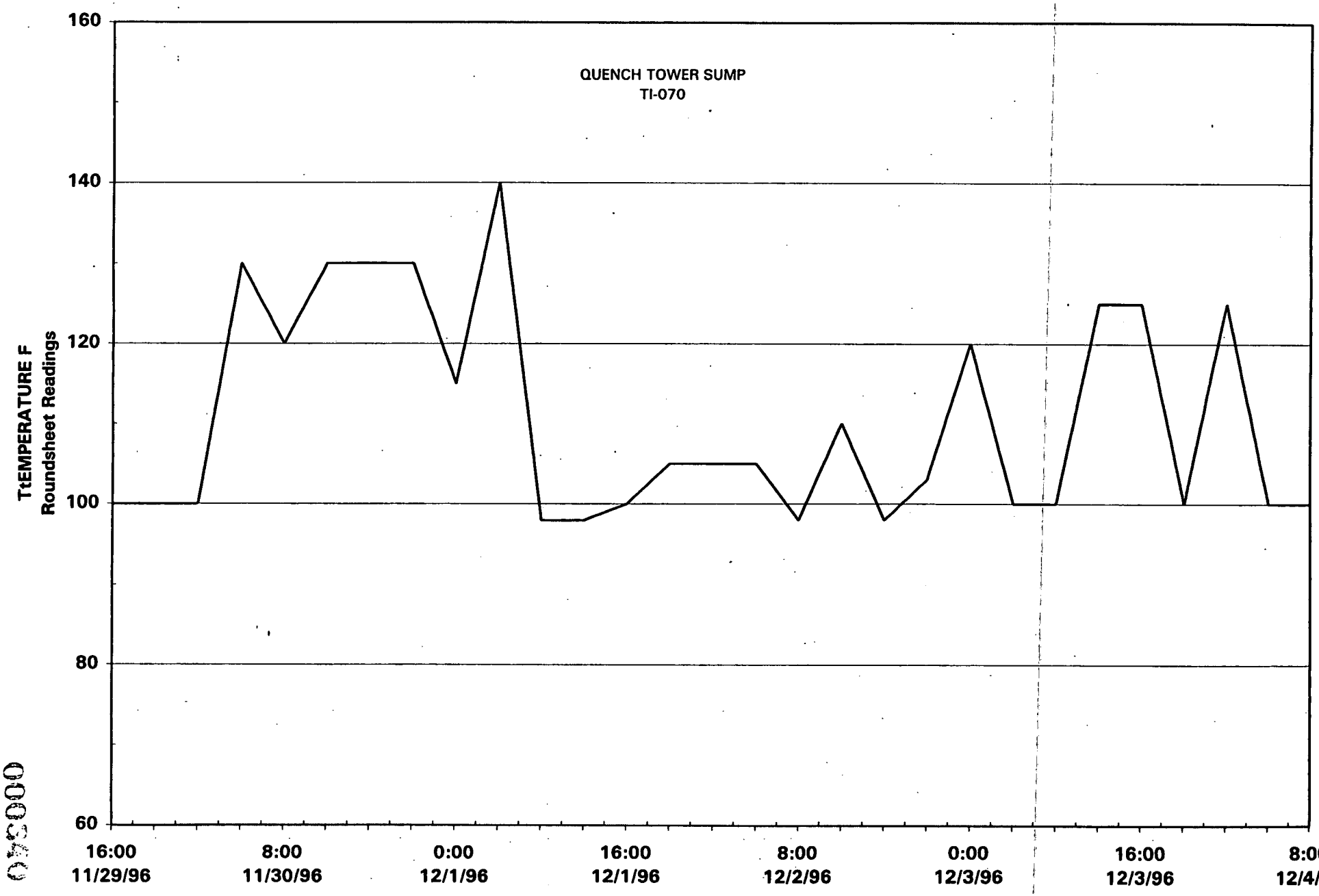


C4OFFGAS.XLS Chart 6

VHP 1/14/97

000339

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 7

VHP 1/13/97

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

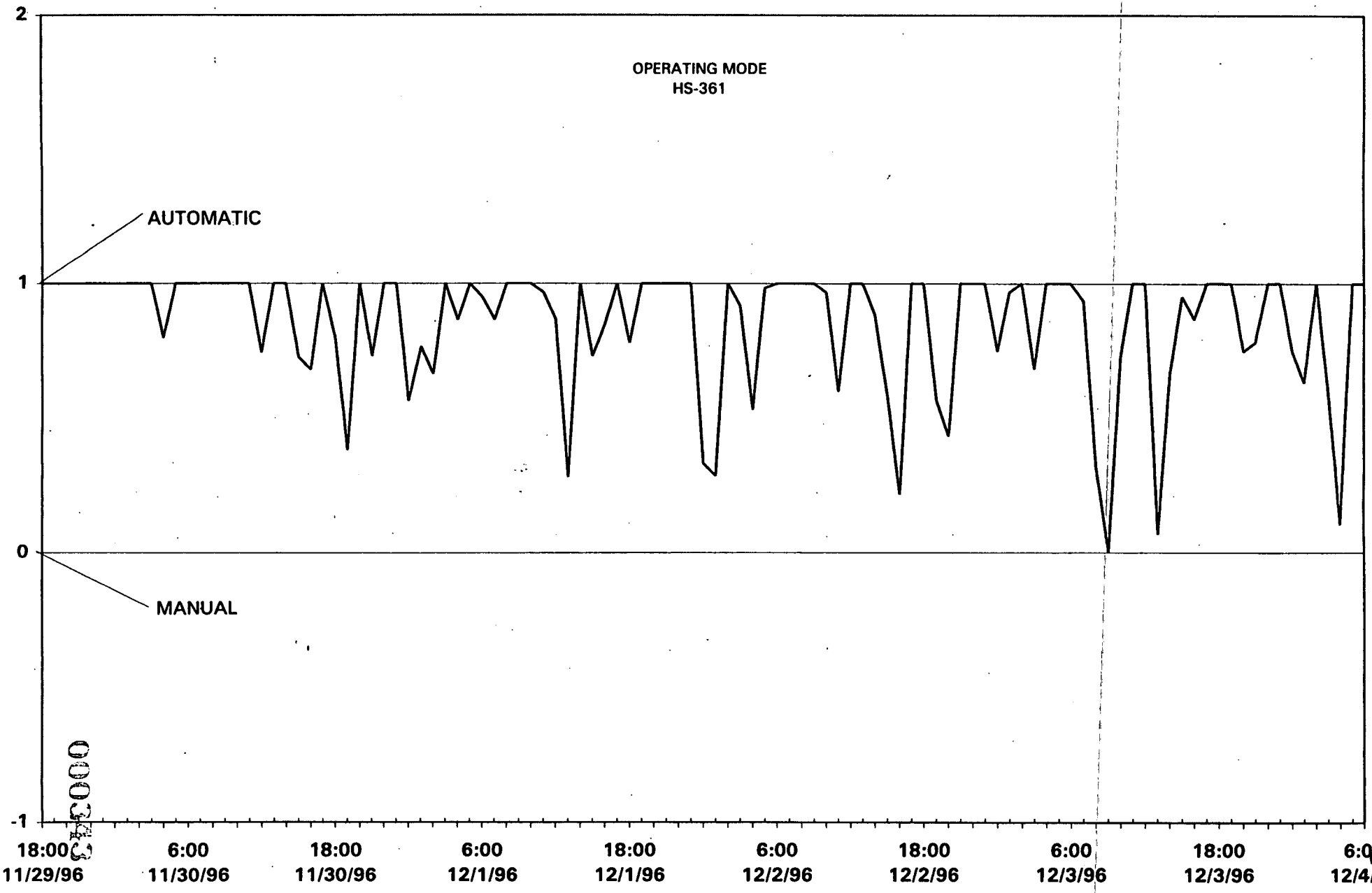
CAMPAIGN 4 TRANSITION TO SERIES A GLASS

		ROUNDSHEET DATA							
READINGS		FILM COOLER DIFF PRESS	FILM COOLER TO QT DIFF PRESS	QUENCH TOWER SUMP TEMP	SCRUBBER TOWER VACUUM	SCRUBBER SUMP TEMP	SCRUBBER TOWER FLOW	DESICCANT TOWER INTERNAL TEMP	DESICCANT TOWER VACUUM
		PDI-172	PDI-173	TI-070	PI-222	TI-222	FI-222	TI-210	PI-210
DATE	HOUR	In WC	In WC	F	In WC	F	GPM	F	In WC
11/29/96	16:00	4.5	4.5	100	0.0	100	8	OUT OF SERVICE	OUT OF SERVICE
11/29/96	20:00	5.0	6.0	100	0.0	100	8		
11/30/96	0:00	5.0	6.0	100	0.0	100	8		
11/30/96	4:00	15.0	17.0	130	2.0	130	8		
11/30/96	8:00	16.5	17.0	120	1.5	140	8		
11/30/96	12:00	27.0	19.0	130	3.0	120	8		
11/30/96	16:00	21.0	17.0	130	2.8	130	8		
11/30/96	20:00	20.0	19.0	130	2.8	125	8		
12/1/96	0:00	22.0	11.5	115	3.0	115	8		
12/1/96	4:00	26.0	23.0	140	4.0	125	8		
12/1/96	8:00	24.0	25.0	98	0.0	120	8		
12/1/96	12:00	8.5	9.5	98	0.0	120	8		
12/1/96	16:00	8.5	14.8	100	0.0	110	8		
12/1/96	20:00	8.5	13.5	105	0.0	105	8		
12/2/96	0:00	10.0	13.0	105	0.5	100	8		
12/2/96	4:00	10.0	13.0	105	0.4	100	8		
12/2/96	8:00	12.0	12.0	98	0.0	99	8		
12/2/96	12:00	22.0	18.5	110	0.6	105	8		
12/2/96	16:00	15.0	18.0	98	0.8	100	8		
12/2/96	20:00	17.0	17.0	103	0.8	100	8		
12/3/96	0:00	18.0	18.0	120	0.8	125	8		
12/3/96	4:00	14.0	18.0	100	0.8	110	8		
12/3/96	8:00	2.5	4.0	100	0.8	80	8		
12/3/96	12:00	20.0	22.0	125	0.3	125	8		
12/3/96	16:00	20.0	18.5	125	0.3	125	8		
12/3/96	20:00	11.0	9.5	100	0.0	100	8		
12/4/96	0:00	23.5	23.0	125	2.0	110	8		
12/4/96	4:00	12.5	14.5	100	0.0	100	8		
12/4/96	8:00	11.5	13.0	100	0.0	100	8		

000341

EMERGENCY OFFGAS SYSTEM

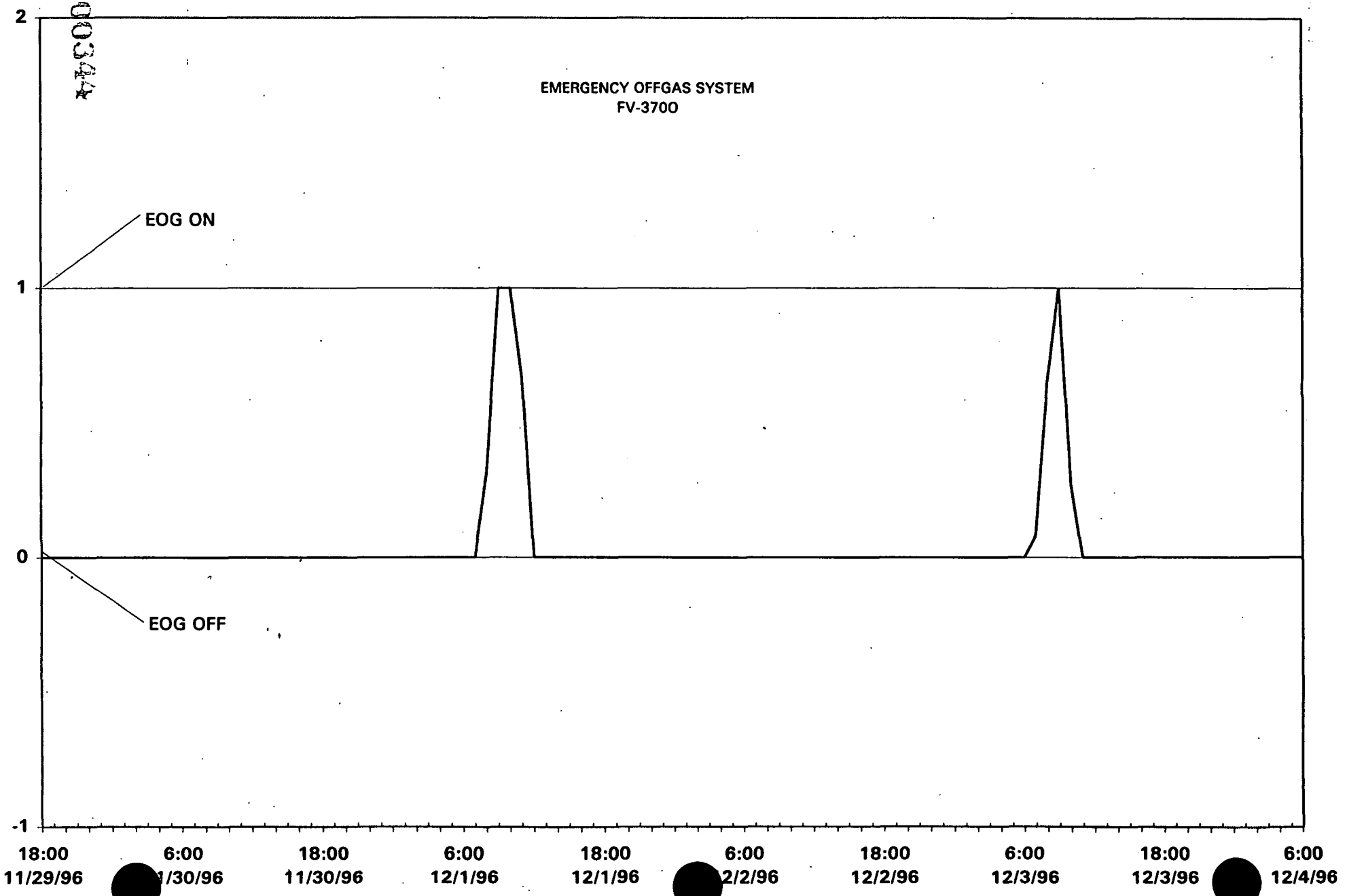
CAMPA[illegible]4
TRANSITION TO SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS Chart 7

VHP 1/29/97

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
EMERGENCY OFFGAS SYSTEM

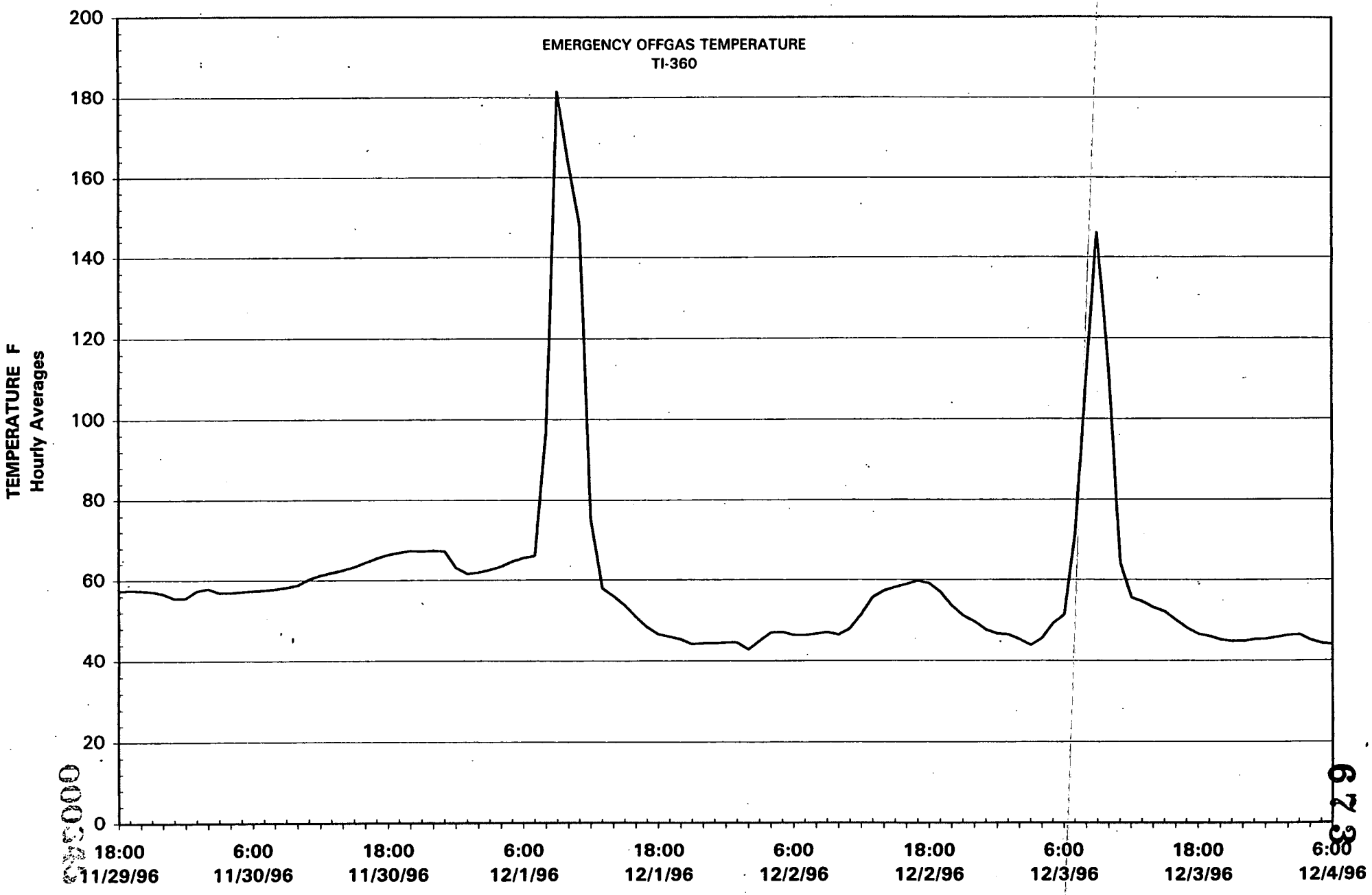


C4EOG.XLS Chart 2

VHP 1/14/97

000344

CAMPA[illegible]4
TRANSITION TO SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS Chart 3

VHP 1/14/97

000329

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 TRANSITION TO SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
11/29/96	18:00	1.00	0.0	57.38	8011.17		
11/29/96	19:00	1.00	0.0	57.54	8042.08		
11/29/96	20:00	1.00	0.0	57.45	8011.58	0.2	0.0
11/29/96	21:00	1.00	0.0	57.24	7933.67		
11/29/96	22:00	1.00	0.0	56.70	7948.17		
11/29/96	23:00	1.00	0.0	55.50	7956.17		
11/30/96	0:00	1.00	0.0	55.56	7841.25	0.2	0.0
11/30/96	1:00	1.00	0.0	57.40	7399.25		
11/30/96	2:00	1.00	0.0	57.97	7770.33		
11/30/96	3:00	1.00	0.0	56.95	7974.49		
11/30/96	4:00	0.80	0.0	56.95	8048.00	0.2	0.0
11/30/96	5:00	1.00	0.0	57.23	8061.92		
11/30/96	6:00	1.00	0.0	57.41	8056.67		
11/30/96	7:00	1.00	0.0	57.56	7994.42		
11/30/96	8:00	1.00	0.0	57.82	7758.33	0.2	0.0
11/30/96	9:00	1.00	0.0	58.20	7651.58		
11/30/96	10:00	1.00	0.0	58.78	7560.61		
11/30/96	11:00	1.00	0.0	60.17	7613.67		
11/30/96	12:00	0.75	0.0	61.20	7725.34	0.2	0.0
11/30/96	13:00	1.00	0.0	61.77	7708.33		
11/30/96	14:00	1.00	0.0	62.38	7576.25		
11/30/96	15:00	0.73	0.0	63.22	7445.25		
11/30/96	16:00	0.68	0.0	64.38	7542.92	0.2	0.0
11/30/96	17:00	1.00	0.0	65.45	7382.33		
11/30/96	18:00	0.80	0.0	66.35	7425.67		
11/30/96	19:00	0.38	0.0	66.92	7321.83		
11/30/96	20:00	1.00	0.0	67.33	7434.33	0.2	0.0
11/30/96	21:00	0.73	0.0	67.25	7522.83		
11/30/96	22:00	1.00	0.0	67.37	7122.33		
11/30/96	23:00	1.00	0.0	67.22	7387.97		
12/1/96	0:00	0.57	0.0	63.07	7554.50	0.3	0.0
12/1/96	1:00	0.77	0.0	61.49	7467.42		
12/1/96	2:00	0.67	0.0	61.84	7590.75		
12/1/96	3:00	1.00	0.0	62.52	7582.00		
12/1/96	4:00	0.87	0.0	63.41	7572.83	0.3	0.0
12/1/96	5:00	1.00	0.0	64.64	7442.67		
12/1/96	6:00	0.95	0.0	65.53	7369.75		
12/1/96	7:00	0.87	0.0	66.02	7334.08		
12/1/96	8:00	1.00	0.3	96.67	7929.08	0.6	0.7
12/1/96	9:00	1.00	1.0	181.48	7852.42		
12/1/96	10:00	1.00	1.0	163.45	8192.33		
12/1/96	11:00	0.97	0.7	148.57	8307.50		
12/1/96	12:00	0.87	0.0	75.15	8175.83		
12/1/96	13:00	0.28	0.0	58.07	8280.92		
12/1/96	14:00	1.00	0.0	56.07	8322.92		
12/1/96	15:00	0.73	0.0	53.84	8318.81		
12/1/96	16:00	0.85	0.0	50.90	8245.33		
12/1/96	17:00	1.00	0.0	48.36	8492.25		
12/1/96	18:00	0.78	0.0	46.58	8474.67		
12/1/96	19:00	1.00	0.0	45.96	8486.25		

009746

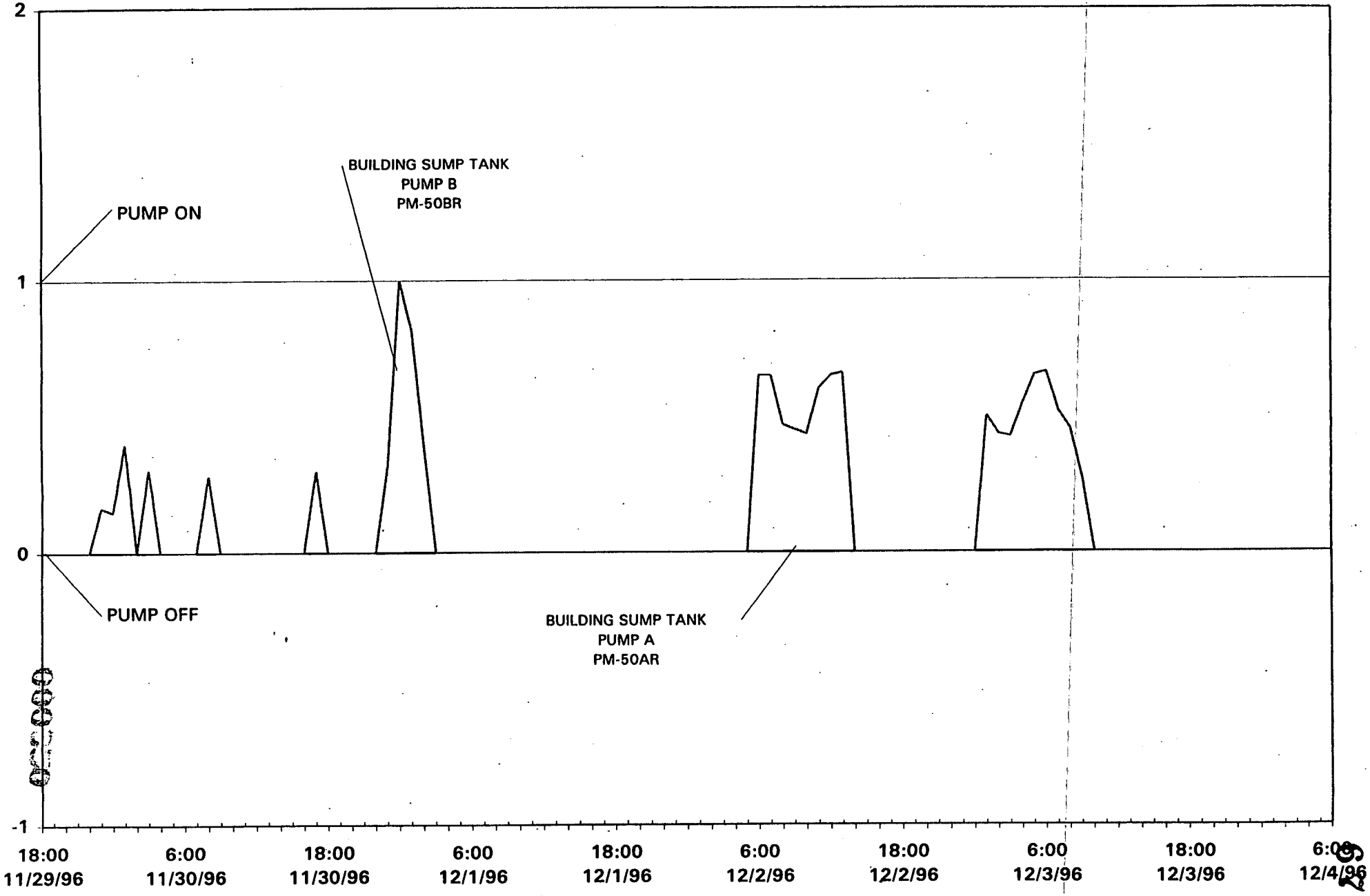
VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 TRANSITION TO SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/1/96	20:00	1.00	0.0	45.29	8547.17		
12/1/96	21:00	1.00	0.0	44.14	8558.58		
12/1/96	22:00	1.00	0.0	44.38	8621.83		
12/1/96	23:00	1.00	0.0	44.35	8619.91		
12/2/96	0:00	0.33	0.0	44.53	8547.42		
12/2/96	1:00	0.29	0.0	44.52	8514.92		
12/2/96	2:00	1.00	0.0	42.82	8569.42		
12/2/96	3:00	0.92	0.0	44.87	8635.17		
12/2/96	4:00	0.53	0.0	47.02	8723.58		
12/2/96	5:00	0.98	0.0	47.16	8812.92		
12/2/96	6:00	1.00	0.0	46.43	8826.08		
12/2/96	7:00	1.00	0.0	46.36	8783.75		
12/2/96	8:00	1.00	0.0	46.75	8279.00		
12/2/96	9:00	1.00	0.0	47.09	8166.75		
12/2/96	10:00	0.97	0.0	46.51	8114.17		
12/2/96	11:00	0.60	0.0	47.99	7983.83		
12/2/96	12:00	1.00	0.0	51.39	7725.33		
12/2/96	13:00	1.00	0.0	55.70	7683.64		
12/2/96	14:00	0.88	0.0	57.22	7612.67		
12/2/96	15:00	0.58	0.0	58.08	7656.00		
12/2/96	16:00	0.22	0.0	58.89	7643.75		
12/2/96	17:00	1.00	0.0	59.73	7768.75		
12/2/96	18:00	1.00	0.0	59.07	7899.75		
12/2/96	19:00	0.57	0.0	56.96	8021.50		
12/2/96	20:00	0.43	0.0	53.67	8162.08	0.2	0.0
12/2/96	21:00	1.00	0.0	51.18	8234.67		
12/2/96	22:00	1.00	0.0	49.68	8278.92		
12/2/96	23:00	1.00	0.0	47.64	8303.08		
12/3/96	0:00	0.75	0.0	46.74	8266.25	0.2	0.0
12/3/96	1:00	0.97	0.0	46.51	8233.42		
12/3/96	2:00	1.00	0.0	45.35	8428.83		
12/3/96	3:00	0.68	0.0	43.89	8440.68		
12/3/96	4:00	1.00	0.0	45.63	8251.78	0.2	0.0
12/3/96	5:00	1.00	0.0	49.26	8139.58		
12/3/96	6:00	1.00	0.0	51.37	8081.67		
12/3/96	7:00	0.93	0.1	71.50	8194.75		
12/3/96	8:00	0.32	0.7	110.65	8249.83	0.4	0.5
12/3/96	9:00	0.00	1.0	146.26	8499.17		
12/3/96	10:00	0.73	0.3	112.06	7936.10		
12/3/96	11:00	1.00	0.0	64.15	7928.33		
12/3/96	12:00	1.00	0.0	55.54	7748.58	0.2	0.0
12/3/96	13:00	0.07	0.0	54.56	7851.78		
12/3/96	14:00	0.66	0.0	53.11	7766.78		
12/3/96	15:00	0.95	0.0	52.14	7913.75		
12/3/96	16:00	0.87	0.0	49.99	7903.25	0.2	0.0
12/3/96	17:00	1.00	0.0	48.13	7950.67		
12/3/96	18:00	1.00	0.0	46.54	7960.75		
12/3/96	19:00	1.00	0.0	46.04	8006.86		
12/3/96	20:00	0.75	0.0	45.19	7944.33	0.2	0.0
12/3/96	21:00	0.78	0.0	44.85	7908.58		

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 TRANSITION TO SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/3/96	22:00	1.00	0.0	44.87	7961.75		
12/3/96	23:00	1.00	0.0	45.32	7985.09		
12/4/96	0:00	0.75	0.0	45.38	8038.50	0.2	0.0
12/4/96	1:00	0.63	0.0	45.82	8109.42		
12/4/96	2:00	1.00	0.0	46.27	8076.75		
12/4/96	3:00	0.60	0.0	46.50	8005.09		
12/4/96	4:00	0.11	0.0	45.16	8035.98	0.1	0.3
12/4/96	5:00	1.00	0.0	44.31	8049.04		
12/4/96	6:00	1.00	0.0	44.04	8055.75		

000348

RECYCLE WATER SYSTEM

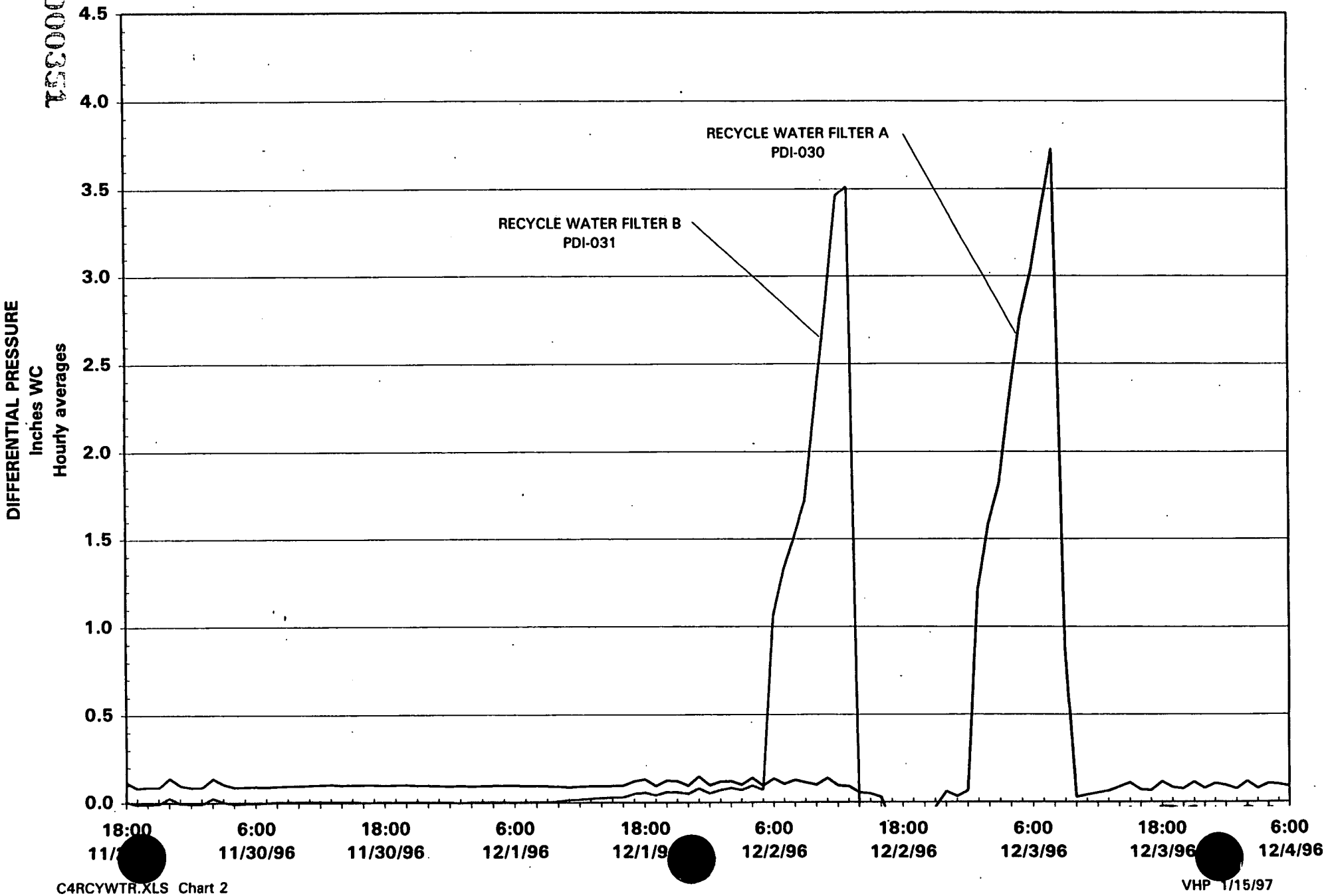
CAMPA[illegible]4
TRANSITION TO SERIES A GLASS RECYCLE WATER SYSTEM



C4RCYWTR.XLS Chart 1

VHP 3/12/97

CAMPAIGN 4
TRANSITION TO SERIES A GLASS
RECYCLE WATER SYSTEM



C4RCYWTR.XLS Chart 2

VHP 1/15/97

000351

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 TRANSITION TO SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
11/29/96	18:00	0.0	0.0	0.114	0.005
11/29/96	19:00	0.0	0.0	0.082	-0.010
11/29/96	20:00	0.0	0.0	0.087	-0.009
11/29/96	21:00	0.0	0.0	0.086	-0.006
11/29/96	22:00	0.0	0.0	0.138	0.023
11/29/96	23:00	0.0	0.2	0.096	-0.004
11/30/96	0:00	0.0	0.2	0.085	-0.007
11/30/96	1:00	0.0	0.4	0.086	-0.008
11/30/96	2:00	0.0	0.0	0.135	0.022
11/30/96	3:00	0.0	0.3	0.104	0.002
11/30/96	4:00	0.0	0.0	0.086	-0.007
11/30/96	5:00	0.0	0.0	0.087	-0.005
11/30/96	6:00	0.0	0.0	0.090	-0.004
11/30/96	7:00	0.0	0.0	0.088	0.000
11/30/96	8:00	0.0	0.3	0.091	0.003
11/30/96	9:00	0.0	0.0	0.093	0.004
11/30/96	10:00	0.0	0.0	0.094	0.004
11/30/96	11:00	0.0	0.0	0.096	0.006
11/30/96	12:00	0.0	0.0	0.098	0.005
11/30/96	13:00	0.0	0.0	0.101	0.003
11/30/96	14:00	0.0	0.0	0.096	0.003
11/30/96	15:00	0.0	0.0	0.098	0.004
11/30/96	16:00	0.0	0.0	0.097	0.000
11/30/96	17:00	0.0	0.3	0.097	0.001
11/30/96	18:00	0.0	0.0	0.095	0.001
11/30/96	19:00	0.0	0.0	0.096	0.001
11/30/96	20:00	0.0	0.0	0.097	0.001
11/30/96	21:00	0.0	0.0	0.094	0.002
11/30/96	22:00	0.0	0.0	0.094	0.001
11/30/96	23:00	0.0	0.3	0.092	0.002
12/1/96	0:00	0.0	1.0	0.090	0.002
12/1/96	1:00	0.0	0.8	0.093	-0.001
12/1/96	2:00	0.0	0.4	0.090	0.004
12/1/96	3:00	0.0	0.0	0.092	0.004
12/1/96	4:00	0.0	0.0	0.094	0.005
12/1/96	5:00	0.0	0.0	0.093	0.004
12/1/96	6:00	0.0	0.0	0.095	0.003
12/1/96	7:00	0.0	0.0	0.091	0.004
12/1/96	8:00	0.0	0.0	0.092	0.002
12/1/96	9:00	0.0	0.0	0.090	0.003
12/1/96	10:00	0.0	0.0	0.087	0.008
12/1/96	11:00	0.0	0.0	0.084	0.014
12/1/96	12:00	0.0	0.0	0.087	0.016
12/1/96	13:00	0.0	0.0	0.090	0.021

000352

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 TRANSITION TO SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/1/96	14:00	0.0	0.0	0.090	0.026
12/1/96	15:00	0.0	0.0	0.091	0.028
12/1/96	16:00	0.0	0.0	0.093	0.030
12/1/96	17:00	0.0	0.0	0.118	0.049
12/1/96	18:00	0.0	0.0	0.129	0.055
12/1/96	19:00	0.0	0.0	0.091	0.042
12/1/96	20:00	0.0	0.0	0.122	0.059
12/1/96	21:00	0.0	0.0	0.118	0.058
12/1/96	22:00	0.0	0.0	0.094	0.050
12/1/96	23:00	0.0	0.0	0.145	0.079
12/2/96	0:00	0.0	0.0	0.096	0.053
12/2/96	1:00	0.0	0.0	0.117	0.070
12/2/96	2:00	0.0	0.0	0.118	0.081
12/2/96	3:00	0.0	0.0	0.099	0.070
12/2/96	4:00	0.0	0.0	0.137	0.093
12/2/96	5:00	0.0	0.0	0.092	0.070
12/2/96	6:00	0.0	0.7	0.132	1.060
12/2/96	7:00	0.0	0.7	0.102	1.324
12/2/96	8:00	0.0	0.5	0.124	1.512
12/2/96	9:00	0.0	0.5	0.111	1.720
12/2/96	10:00	0.0	0.4	0.098	2.297
12/2/96	11:00	0.0	0.6	0.135	2.851
12/2/96	12:00	0.0	0.7	0.095	3.463
12/2/96	13:00	0.0	0.7	0.091	3.512
12/2/96	14:00	0.0	0.0	0.057	-0.167
12/2/96	15:00	0.0	0.0	0.050	-0.268
12/2/96	16:00	0.0	0.0	0.029	-0.227
12/2/96	17:00	0.0	0.0	-0.141	-0.190
12/2/96	18:00	0.0	0.0	-0.206	-0.130
12/2/96	19:00	0.0	0.0	-0.191	-0.049
12/2/96	20:00	0.0	0.0	-0.182	-0.161
12/2/96	21:00	0.0	0.0	-0.031	-0.207
12/2/96	22:00	0.0	0.0	0.063	-0.157
12/2/96	23:00	0.0	0.0	0.033	-0.148
12/3/96	0:00	0.0	0.0	0.067	-0.115
12/3/96	1:00	0.0	0.5	1.208	-0.096
12/3/96	2:00	0.0	0.4	1.585	-0.082
12/3/96	3:00	0.0	0.4	1.823	-0.058
12/3/96	4:00	0.0	0.5	2.320	-0.064
12/3/96	5:00	0.0	0.7	2.760	-0.049
12/3/96	6:00	0.0	0.7	3.026	-0.067
12/3/96	7:00	0.0	0.5	3.376	-0.068
12/3/96	8:00	0.0	0.5	3.727	-0.044
12/3/96	9:00	0.0	0.3	0.886	-0.047

000353

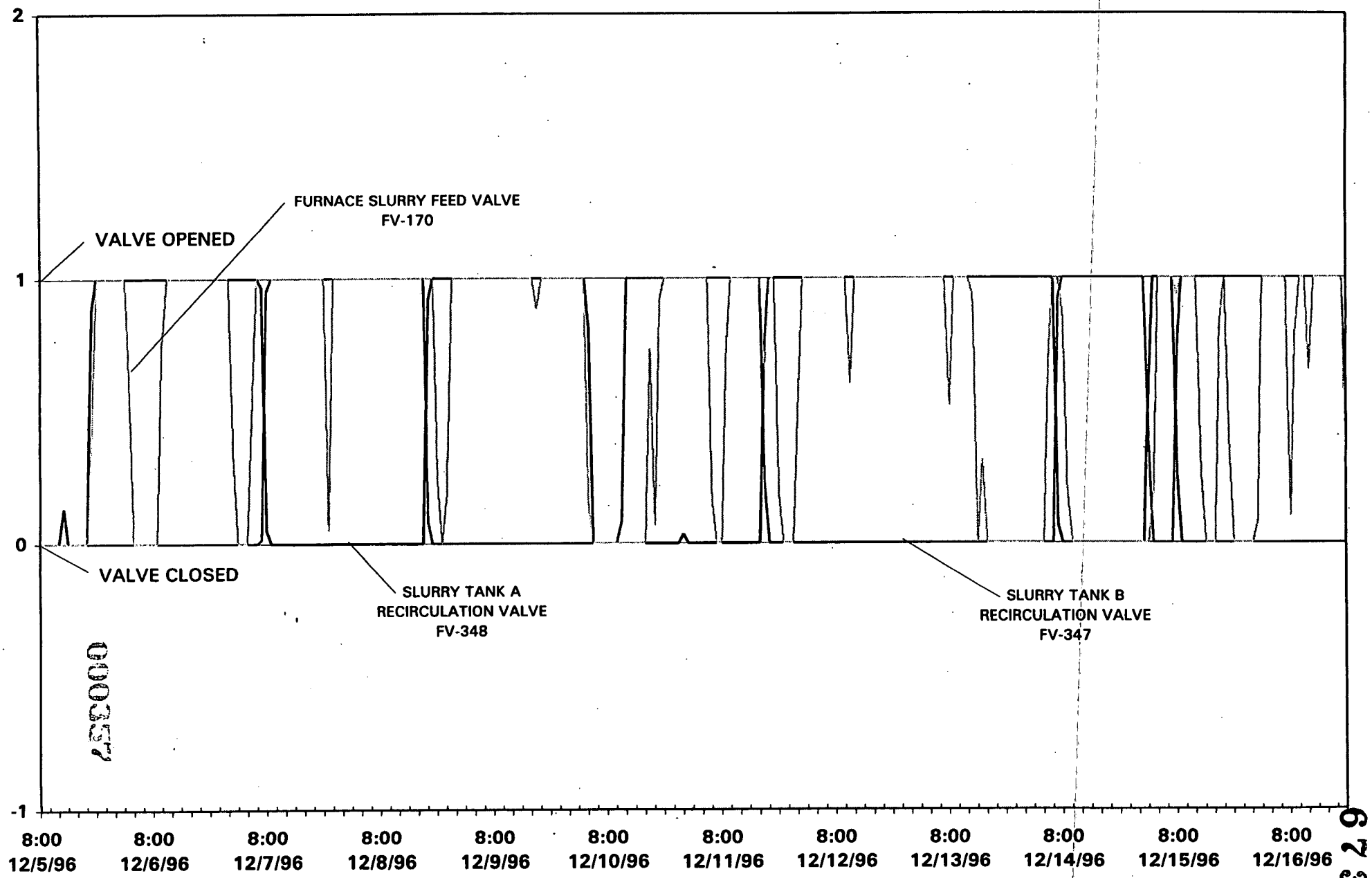
VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 TRANSITION TO SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/3/96	10:00	0.0	0.0	0.028	-0.053
12/3/96	11:00	0.0	0.0	0.042	-0.060
12/3/96	12:00	0.0	0.0	0.054	-0.059
12/3/96	13:00	0.0	0.0	0.065	-0.056
12/3/96	14:00	0.0	0.0	0.089	-0.044
12/3/96	15:00	0.0	0.0	0.112	-0.031
12/3/96	16:00	0.0	0.0	0.071	-0.053
12/3/96	17:00	0.0	0.0	0.068	-0.058
12/3/96	18:00	0.0	0.0	0.118	-0.024
12/3/96	19:00	0.0	0.0	0.085	-0.027
12/3/96	20:00	0.0	0.0	0.077	-0.041
12/3/96	21:00	0.0	0.0	0.117	-0.023
12/3/96	22:00	0.0	0.0	0.080	-0.053
12/3/96	23:00	0.0	0.0	0.108	-0.032
12/4/96	0:00	0.0	0.0	0.097	-0.040
12/4/96	1:00	0.0	0.0	0.076	-0.051
12/4/96	2:00	0.0	0.0	0.121	-0.023
12/4/96	3:00	0.0	0.0	0.079	-0.042
12/4/96	4:00	0.0	0.0	0.107	-0.031
12/4/96	5:00	0.0	0.0	0.102	-0.036
12/4/96	6:00	0.0	0.0	0.089	-0.044

Appendix C2

Series A Glass

FEED PREPARATION SYSTEM

CAMPA[illegible]4
SERIES A GLASS
FEED PREPARATION SYSTEM

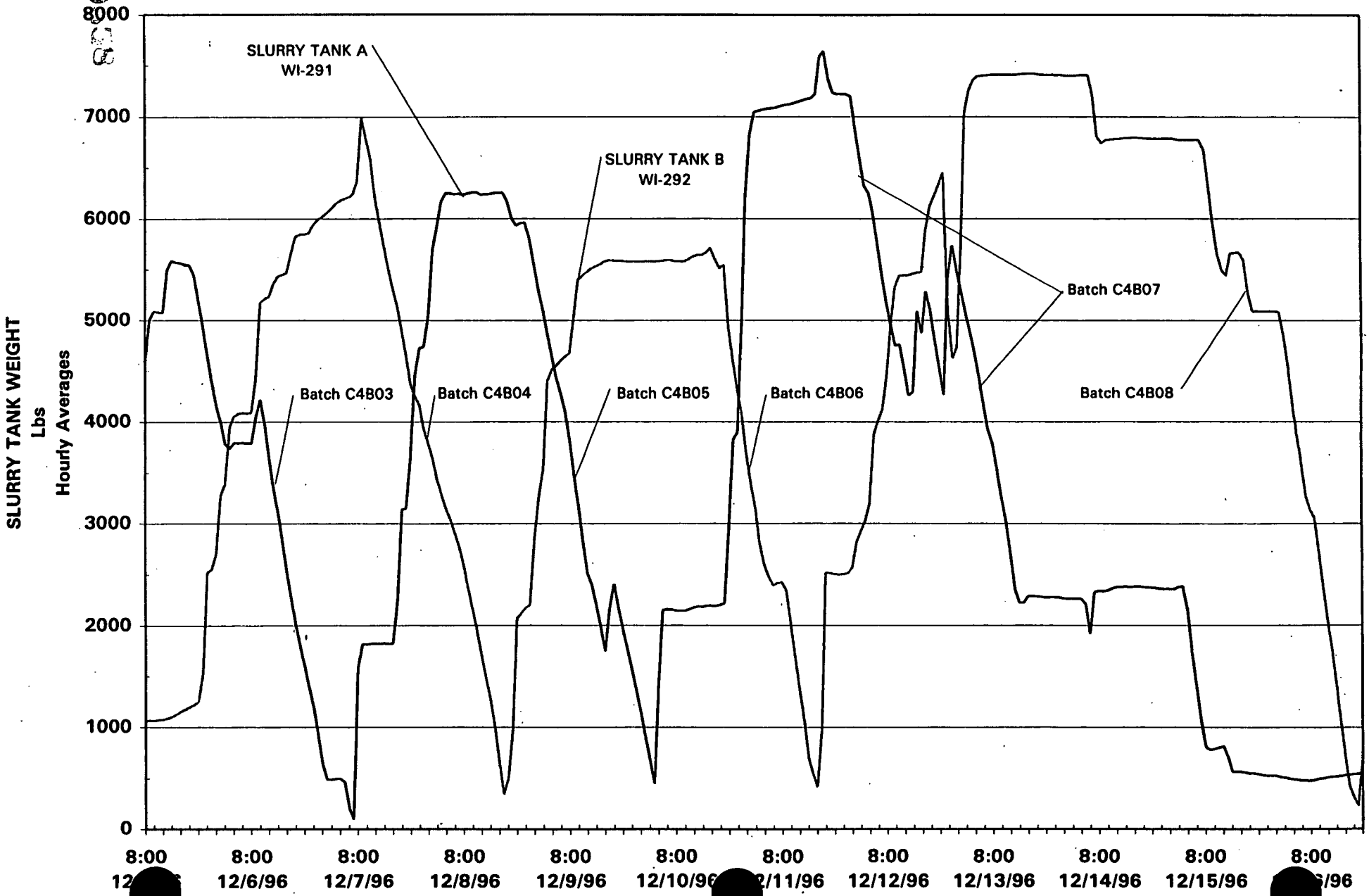


000357

C4FDPRP.XLS Chart 4

VHP 12/31/96

CAMPAIGN 4
SERIES A GLASS
FEED PREPARATION SYSTEM



C4FDPRP.XLS Chart 3

VHP 2/13/97

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY RECIRC VALVE	AGITATOR	WEIGHT	SLURRY RECIRC VALVE	AGITATOR	RECIRC FLOW	SLURRY FEED VALVE	SLURRY FEED PUMP RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/5/96	8:00	4580.29	0.0	1.0	1063.25	0.0	1.0	0.00	0.0	0.04
12/5/96	9:00	4998.96	0.0	1.0	1068.71	0.0	1.0	-0.01	0.0	0.05
12/5/96	10:00	5088.33	0.0	1.0	1068.08	0.0	1.0	-0.00	0.0	0.06
12/5/96	11:00	5083.25	0.0	1.0	1074.92	0.0	1.0	-0.01	0.0	0.28
12/5/96	12:00	5075.17	0.0	1.0	1079.54	0.0	1.0	0.00	0.0	0.05
12/5/96	13:00	5497.46	0.1	1.0	1090.58	0.0	1.0	0.00	0.0	0.04
12/5/96	14:00	5587.17	0.0	1.0	1104.38	0.0	1.0	0.00	0.0	0.04
12/5/96	15:00	5572.33	0.0	1.0	1127.88	0.0	1.0	-0.01	0.0	0.03
12/5/96	16:00	5565.63	0.0	1.0	1156.67	0.0	1.0	0.00	0.0	0.05
12/5/96	17:00	5550.83	0.0	1.0	1176.63	0.0	1.0	0.00	0.0	0.05
12/5/96	18:00	5545.83	0.0	1.0	1199.13	0.0	1.0	0.00	0.0	0.04
12/5/96	19:00	5450.79	0.9	1.0	1221.58	0.0	1.0	42.87	0.4	98.81
12/5/96	20:00	5192.38	1.0	1.0	1253.75	0.0	1.0	44.92	1.0	131.88
12/5/96	21:00	4957.92	1.0	1.0	1516.33	0.0	1.0	42.50	1.0	142.96
12/5/96	22:00	4665.46	1.0	1.0	2520.58	0.0	1.0	39.08	1.0	147.51
12/5/96	23:00	4402.00	1.0	1.0	2550.00	0.0	1.0	38.17	1.0	145.15
12/6/96	0:00	4165.09	1.0	1.0	2709.03	0.0	1.0	34.64	1.0	140.35
12/6/96	1:00	3997.04	1.0	1.0	3277.67	0.0	1.0	25.60	1.0	145.94
12/6/96	2:00	3789.00	1.0	1.0	3386.33	0.0	1.0	25.67	1.0	112.30
12/6/96	3:00	3741.13	1.0	1.0	3949.29	0.0	1.0	25.40	0.6	0.25
12/6/96	4:00	3796.21	1.0	1.0	4052.25	0.0	1.0	25.50	0.0	0.17
12/6/96	5:00	3793.88	1.0	1.0	4081.54	0.0	1.0	25.56	0.0	0.05
12/6/96	6:00	3797.54	1.0	1.0	4087.71	0.0	1.0	25.46	0.0	0.06
12/6/96	7:00	3791.75	1.0	1.0	4087.42	0.0	1.0	25.47	0.0	0.05
12/6/96	8:00	3793.21	1.0	1.0	4091.46	0.0	1.0	25.40	0.0	0.03
12/6/96	9:00	4044.46	1.0	1.0	4421.83	0.0	1.0	24.55	0.0	0.07
12/6/96	10:00	4213.08	1.0	1.0	5174.25	0.0	1.0	26.71	0.8	104.78
12/6/96	11:00	3963.58	1.0	1.0	5214.58	0.0	1.0	26.53	1.0	204.54
12/6/96	12:00	3615.33	1.0	1.0	5233.58	0.0	1.0	26.31	1.0	199.12
12/6/96	13:00	3341.17	1.0	1.0	5352.67	0.0	1.0	26.21	1.0	163.73
12/6/96	14:00	3089.90	1.0	1.0	5430.82	0.0	1.0	26.43	1.0	165.39
12/6/96	15:00	2791.04	1.0	1.0	5450.17	0.0	1.0	37.61	1.0	175.95
12/6/96	16:00	2491.75	1.0	1.0	5466.33	0.0	1.0	45.95	1.0	154.95
12/6/96	17:00	2232.46	1.0	1.0	5660.17	0.0	1.0	50.05	1.0	153.31
12/6/96	18:00	1983.60	1.0	0.4	5824.96	0.0	1.0	48.58	1.0	134.66
12/6/96	19:00	1770.38	1.0	0.0	5846.33	0.0	1.0	49.53	1.0	119.75
12/6/96	20:00	1586.58	1.0	0.0	5849.88	0.0	1.0	48.67	1.0	120.53
12/6/96	21:00	1382.04	1.0	0.0	5857.88	0.0	1.0	50.57	1.0	132.59
12/6/96	22:00	1188.54	1.0	0.0	5933.08	0.0	1.0	51.00	1.0	148.97
12/6/96	23:00	910.83	1.0	0.0	5985.33	0.0	1.0	50.73	1.0	197.05
12/7/96	0:00	642.88	1.0	0.0	6015.33	0.0	1.0	50.50	1.0	155.53
12/7/96	1:00	491.38	1.0	0.0	6050.71	0.0	1.0	50.89	0.3	40.86
12/7/96	2:00	489.38	1.0	0.0	6096.38	0.0	1.0	50.72	0.0	62.03
12/7/96	3:00	498.29	1.0	0.0	6139.83	0.0	1.0	50.52	0.0	0.04
12/7/96	4:00	498.58	1.0	0.0	6173.29	0.0	1.0	50.43	0.0	0.04
12/7/96	5:00	462.83	1.0	0.0	6195.83	0.0	1.0	50.09	0.5	138.48
12/7/96	6:00	196.44	1.0	0.0	6212.63	0.0	1.0	22.32	1.0	219.68
12/7/96	7:00	97.92	1.0	0.0	6238.46	0.0	1.0	21.58	1.0	129.35
12/7/96	8:00	1572.96	0.1	0.8	6365.13	1.0	1.0	44.60	1.0	125.87
12/7/96	9:00	1816.61	0.0	1.0	6985.76	1.0	1.0	50.43	1.0	168.55
12/7/96	10:00	1816.71	0.0	1.0	6781.33	1.0	1.0	51.00	1.0	126.71
12/7/96	11:00	1824.33	0.0	1.0	6587.08	1.0	1.0	51.00	1.0	180.57
12/7/96	12:00	1824.04	0.0	1.0	6225.17	1.0	1.0	50.93	1.0	222.62
12/7/96	13:00	1823.79	0.0	1.0	5965.08	1.0	1.0	50.90	1.0	147.20
12/7/96	14:00	1827.00	0.0	1.0	5744.17	1.0	1.0	51.00	1.0	150.33
12/7/96	15:00	1823.35	0.0	1.0	5515.13	1.0	1.0	51.00	1.0	150.34

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM										
CAMPAIGN 4 SERIES A GLASS										
		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY	AGITATOR	WEIGHT	SLURRY	AGITATOR	RECIRC	SLURRY	SLURRY
			RECIRC			RECIRC		FLOW	FEED VALVE	FEED PUMP
			VALVE			VALVE				RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/7/96	16:00	1822.79	0.0	1.0	5324.54	1.0	1.0	51.00	1.0	131.07
12/7/96	17:00	2276.21	0.0	1.0	5136.16	1.0	1.0	50.86	1.0	158.96
12/7/96	18:00	3139.38	0.0	1.0	4895.18	1.0	1.0	49.98	1.0	176.62
12/7/96	19:00	3147.75	0.0	1.0	4649.53	1.0	1.0	40.00	1.0	182.78
12/7/96	20:00	3658.58	0.0	1.0	4371.75	1.0	1.0	48.90	1.0	171.58
12/7/96	21:00	4455.04	0.0	1.0	4252.38	1.0	1.0	46.62	0.1	159.40
12/7/96	22:00	4725.38	0.0	1.0	4167.17	1.0	1.0	46.31	1.0	167.49
12/7/96	23:00	4736.08	0.0	1.0	3938.17	1.0	1.0	50.72	1.0	135.55
12/8/96	0:00	5019.28	0.0	1.0	3793.73	1.0	1.0	50.00	1.0	101.13
12/8/96	1:00	5691.75	0.0	1.0	3634.04	1.0	1.0	50.05	1.0	125.38
12/8/96	2:00	5901.17	0.0	1.0	3440.83	1.0	1.0	50.98	1.0	102.34
12/8/96	3:00	6163.17	0.0	1.0	3291.83	1.0	1.0	49.97	1.0	115.23
12/8/96	4:00	6249.92	0.0	1.0	3149.21	1.0	1.0	50.98	1.0	100.82
12/8/96	5:00	6251.54	0.0	1.0	3038.33	1.0	1.0	50.23	1.0	101.74
12/8/96	6:00	6246.83	0.0	1.0	2911.83	1.0	1.0	51.00	1.0	103.97
12/8/96	7:00	6249.33	0.0	1.0	2771.29	1.0	1.0	50.41	1.0	106.68
12/8/96	8:00	6238.50	0.0	1.0	2591.88	1.0	1.0	50.49	1.0	172.40
12/8/96	9:00	6251.46	0.0	1.0	2362.17	1.0	1.0	50.46	1.0	163.40
12/8/96	10:00	6258.63	0.0	1.0	2155.25	1.0	1.0	48.75	1.0	150.31
12/8/96	11:00	6262.29	0.0	1.0	1950.33	1.0	1.0	50.97	1.0	184.59
12/8/96	12:00	6240.08	0.0	1.0	1691.88	1.0	1.0	50.98	1.0	194.29
12/8/96	13:00	6244.17	0.0	1.0	1480.42	1.0	1.0	50.91	1.0	165.69
12/8/96	14:00	6246.00	0.0	1.0	1275.82	1.0	1.0	50.90	1.0	181.78
12/8/96	15:00	6255.21	0.0	1.0	1002.75	1.0	1.0	50.36	1.0	259.75
12/8/96	16:00	6256.25	0.0	1.0	640.63	1.0	1.0	48.83	1.0	262.24
12/8/96	17:00	6256.83	0.0	1.0	340.21	1.0	1.0	22.15	1.0	263.62
12/8/96	18:00	6167.58	0.9	1.0	490.58	0.1	1.0	42.04	1.0	147.46
12/8/96	19:00	5999.33	1.0	1.0	983.33	0.0	1.0	37.63	1.0	100.91
12/8/96	20:00	5934.17	1.0	1.0	2072.25	0.0	1.0	27.16	0.2	100.90
12/8/96	21:00	5955.92	1.0	1.0	2126.46	0.0	1.0	24.28	0.0	160.57
12/8/96	22:00	5960.29	1.0	1.0	2172.79	0.0	1.0	24.12	0.2	64.67
12/8/96	23:00	5804.63	1.0	1.0	2210.08	0.0	1.0	24.05	1.0	167.95
12/9/96	0:00	5551.83	1.0	1.0	2837.71	0.0	1.0	23.86	1.0	150.55
12/9/96	1:00	5301.83	1.0	1.0	3249.29	0.0	1.0	23.84	1.0	150.36
12/9/96	2:00	5092.08	1.0	1.0	3534.96	0.0	1.0	23.66	1.0	131.95
12/9/96	3:00	4869.04	1.0	1.0	4395.42	0.0	1.0	23.57	1.0	150.34
12/9/96	4:00	4637.50	1.0	1.0	4508.92	0.0	1.0	23.41	1.0	150.39
12/9/96	5:00	4430.00	1.0	1.0	4549.92	0.0	1.0	23.15	1.0	110.14
12/9/96	6:00	4279.42	1.0	1.0	4599.54	0.0	1.0	23.20	1.0	104.10
12/9/96	7:00	4098.60	1.0	1.0	4637.46	0.0	1.0	23.09	1.0	138.29
12/9/96	8:00	3822.13	1.0	0.9	4670.29	0.0	1.0	23.05	1.0	212.98
12/9/96	9:00	3494.21	1.0	1.0	5023.63	0.0	1.0	22.63	1.0	208.89
12/9/96	10:00	3176.33	1.0	1.0	5402.88	0.0	1.0	22.24	1.0	204.04
12/9/96	11:00	2811.04	1.0	0.2	5439.54	0.0	1.0	35.13	1.0	189.98
12/9/96	12:00	2515.79	1.0	0.0	5474.38	0.0	1.0	38.35	1.0	160.26
12/9/96	13:00	2399.58	1.0	0.5	5508.01	0.0	1.0	42.02	1.0	159.89
12/9/96	14:00	2204.13	1.0	0.8	5530.88	0.0	1.0	48.50	1.0	150.61
12/9/96	15:00	1972.00	1.0	0.1	5553.46	0.0	1.0	46.74	1.0	150.66
12/9/96	16:00	1746.00	1.0	0.0	5581.00	0.0	1.0	48.78	1.0	148.09
12/9/96	17:00	2163.50	1.0	0.5	5594.13	0.0	1.0	20.73	0.9	134.39
12/9/96	18:00	2403.79	1.0	1.0	5592.25	0.0	1.0	31.42	1.0	152.74
12/9/96	19:00	2171.25	1.0	1.0	5586.54	0.0	1.0	47.53	1.0	155.21
12/9/96	20:00	1958.08	1.0	0.6	5587.13	0.0	1.0	38.45	1.0	145.92
12/9/96	21:00	1766.54	1.0	0.0	5581.17	0.0	1.0	39.54	1.0	129.39
12/9/96	22:00	1563.96	1.0	0.0	5579.08	0.0	1.0	38.17	1.0	150.89
12/9/96	23:00	1358.46	1.0	0.0	5579.38	0.0	1.0	38.74	1.0	150.59

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY RECIRC VALVE	AGITATOR	WEIGHT	SLURRY RECIRC VALVE	AGITATOR	RECIRC FLOW	SLURRY FEED VALVE	SLURRY FEED PUMP RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/10/96	0:00	1143.33	1.0	0.0	5580.75	0.0	1.0	39.55	1.0	175.01
12/10/96	1:00	913.04	1.0	0.0	5579.13	0.0	1.0	38.89	1.0	175.37
12/10/96	2:00	680.13	1.0	0.0	5579.25	0.0	1.0	37.13	1.0	175.36
12/10/96	3:00	441.96	1.0	0.0	5579.38	0.0	1.0	27.92	1.0	175.19
12/10/96	4:00	1384.67	0.8	0.0	5583.00	0.0	1.0	25.11	0.2	29.65
12/10/96	5:00	2152.29	0.0	0.0	5587.12	0.0	1.0	-0.01	0.0	0.04
12/10/96	6:00	2162.83	0.0	0.0	5593.58	0.0	1.0	0.00	0.0	0.04
12/10/96	7:00	2160.38	0.0	0.0	5592.38	0.0	1.0	0.00	0.0	0.04
12/10/96	8:00	2148.96	0.0	0.0	5583.67	0.0	1.0	0.00	0.0	0.05
12/10/96	9:00	2147.08	0.0	0.0	5582.58	0.0	1.0	0.00	0.0	0.04
12/10/96	10:00	2146.33	0.0	0.0	5580.67	0.0	1.0	0.00	0.0	0.04
12/10/96	11:00	2162.75	0.0	0.0	5600.63	0.1	1.0	2.19	0.0	0.04
12/10/96	12:00	2179.50	0.0	0.0	5630.00	1.0	1.0	43.00	0.0	0.04
12/10/96	13:00	2188.60	0.0	0.0	5642.75	1.0	1.0	44.43	0.0	0.04
12/10/96	14:00	2186.58	0.0	0.0	5645.83	1.0	1.0	44.69	0.0	0.04
12/10/96	15:00	2197.58	0.0	0.0	5667.33	1.0	1.0	44.89	0.0	0.03
12/10/96	16:00	2197.17	0.0	0.0	5715.25	1.0	1.0	30.48	0.0	0.05
12/10/96	17:00	2195.04	0.0	0.3	5612.42	1.0	1.0	39.05	0.7	152.63
12/10/96	18:00	2203.79	0.0	1.0	5511.46	1.0	1.0	43.18	0.1	14.19
12/10/96	19:00	2220.33	0.0	1.0	5543.21	1.0	1.0	43.56	0.9	192.60
12/10/96	20:00	2937.58	0.0	1.0	4933.46	1.0	1.0	42.82	1.0	152.37
12/10/96	21:00	3822.50	0.0	1.0	4587.08	1.0	1.0	46.06	1.0	124.23
12/10/96	22:00	3896.83	0.0	1.0	4312.83	1.0	1.0	48.44	1.0	144.74
12/10/96	23:00	4951.63	0.0	1.0	4062.25	1.0	1.0	50.35	1.0	231.07
12/11/96	0:00	6234.92	0.0	1.0	3684.00	1.0	1.0	49.04	1.0	203.07
12/11/96	1:00	6826.83	0.0	1.0	3390.08	1.0	1.0	44.28	1.0	154.53
12/11/96	2:00	7047.17	0.0	1.0	3142.38	1.0	1.0	43.13	1.0	166.70
12/11/96	3:00	7060.17	0.0	1.0	2799.25	1.0	1.0	48.83	1.0	217.54
12/11/96	4:00	7070.58	0.0	1.0	2596.04	1.0	1.0	48.75	1.0	143.76
12/11/96	5:00	7079.92	0.0	1.0	2476.83	1.0	1.0	50.22	1.0	136.12
12/11/96	6:00	7086.04	0.0	1.0	2392.63	1.0	1.0	49.83	0.2	49.78
12/11/96	7:00	7089.96	0.0	1.0	2413.75	1.0	1.0	49.82	0.0	0.04
12/11/96	8:00	7104.42	0.0	1.0	2423.08	1.0	1.0	50.09	0.0	0.04
12/11/96	9:00	7116.50	0.0	1.0	2340.58	1.0	1.0	49.46	0.7	175.51
12/11/96	10:00	7123.94	0.0	0.8	2006.61	1.0	1.0	50.61	1.0	218.58
12/11/96	11:00	7135.00	0.0	1.0	1678.53	1.0	1.0	51.00	1.0	212.97
12/11/96	12:00	7148.33	0.0	1.0	1361.58	1.0	1.0	50.99	1.0	216.14
12/11/96	13:00	7161.25	0.0	1.0	1040.63	1.0	1.0	50.84	1.0	221.35
12/11/96	14:00	7173.96	0.0	1.0	692.33	1.0	1.0	43.95	1.0	224.62
12/11/96	15:00	7182.17	0.0	1.0	537.58	1.0	1.0	41.45	1.0	190.78
12/11/96	16:00	7218.58	0.0	1.0	409.58	1.0	1.0	32.70	1.0	158.11
12/11/96	17:00	7592.17	0.7	0.8	1002.33	0.2	1.0	20.94	0.7	80.15
12/11/96	18:00	7643.38	1.0	1.0	2519.13	0.0	1.0	20.73	1.0	162.45
12/11/96	19:00	7366.54	1.0	0.9	2513.54	0.0	1.0	18.26	1.0	172.57
12/11/96	20:00	7233.01	1.0	0.0	2502.97	0.0	1.0	27.64	0.2	22.72
12/11/96	21:00	7222.42	1.0	0.0	2499.17	0.0	1.0	43.71	0.0	0.04
12/11/96	22:00	7222.00	1.0	0.0	2502.13	0.0	1.0	44.27	0.0	0.03
12/11/96	23:00	7222.63	1.0	0.0	2509.17	0.0	1.0	44.44	0.0	0.05
12/12/96	0:00	7198.58	1.0	0.0	2572.33	0.0	1.0	44.39	0.5	74.95
12/12/96	1:00	6889.33	1.0	0.0	2816.25	0.0	1.0	44.20	1.0	229.88
12/12/96	2:00	6595.08	1.0	0.0	2924.21	0.0	1.0	44.26	1.0	175.56
12/12/96	3:00	6322.46	1.0	0.0	3027.58	0.0	1.0	43.87	1.0	170.99
12/12/96	4:00	6255.63	1.0	0.0	3201.13	0.0	1.0	42.72	1.0	180.30
12/12/96	5:00	6042.08	1.0	0.0	3868.58	0.0	1.0	42.72	1.0	175.46
12/12/96	6:00	5756.75	1.0	0.0	4006.63	0.0	1.0	42.46	1.0	178.97
12/12/96	7:00	5441.29	1.0	0.0	4114.67	0.0	1.0	42.66	1.0	183.77

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM										
CAMPAIGN 4 SERIES A GLASS										
		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY	AGITATOR	WEIGHT	SLURRY	AGITATOR	RECIRC	SLURRY	SLURRY
			RECIRC			RECIRC		FLOW	FEED VALVE	FEED PUMP
			VALVE			VALVE				RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/12/96	8:00	5165.17	1.0	0.0	4445.71	0.0	1.0	43.22	1.0	154.27
12/12/96	9:00	4945.00	1.0	0.0	4971.38	0.0	1.0	44.93	1.0	119.58
12/12/96	10:00	4749.33	1.0	0.0	5323.83	0.0	1.0	46.63	1.0	88.45
12/12/96	11:00	4754.50	1.0	0.0	5441.79	0.0	1.0	47.60	0.6	106.59
12/12/96	12:00	4504.75	1.0	0.0	5444.33	0.0	1.0	48.75	1.0	177.16
12/12/96	13:00	4261.00	1.0	0.3	5444.67	0.0	1.0	42.11	1.0	84.65
12/12/96	14:00	4289.58	1.0	0.9	5458.42	0.0	1.0	28.09	1.0	222.46
12/12/96	15:00	5084.08	1.0	1.0	5469.71	0.0	1.0	26.63	1.0	236.14
12/12/96	16:00	4872.96	1.0	1.0	5474.29	0.0	1.0	26.21	1.0	204.36
12/12/96	17:00	5277.21	1.0	1.0	5874.75	0.0	1.0	25.00	1.0	247.86
12/12/96	18:00	5096.79	1.0	1.0	6118.92	0.0	1.0	24.95	1.0	223.08
12/12/96	19:00	4790.38	1.0	1.0	6228.04	0.0	1.0	24.36	1.0	175.46
12/12/96	20:00	4521.63	1.0	0.9	6335.38	0.0	1.0	23.64	1.0	175.32
12/12/96	21:00	4264.83	1.0	1.0	6451.88	0.0	1.0	23.34	1.0	144.69
12/12/96	22:00	5421.63	1.0	1.0	5102.79	0.0	1.0	27.36	1.0	151.44
12/12/96	23:00	5735.83	1.0	1.0	4622.04	0.0	1.0	26.32	1.0	155.40
12/13/96	0:00	5505.67	1.0	1.0	4731.13	0.0	1.0	25.91	1.0	155.33
12/13/96	1:00	5279.08	1.0	1.0	5715.92	0.0	1.0	26.23	1.0	148.99
12/13/96	2:00	5077.38	1.0	1.0	7039.17	0.0	1.0	26.00	1.0	135.36
12/13/96	3:00	4883.38	1.0	1.0	7263.00	0.0	1.0	25.79	1.0	135.76
12/13/96	4:00	4670.71	1.0	1.0	7362.96	0.0	1.0	25.90	1.0	155.76
12/13/96	5:00	4436.08	1.0	1.0	7396.17	0.0	1.0	25.82	1.0	178.12
12/13/96	6:00	4163.21	1.0	1.0	7400.50	0.0	1.0	25.59	1.0	174.51
12/13/96	7:00	3915.50	1.0	0.8	7404.63	0.0	1.0	29.21	1.0	165.73
12/13/96	8:00	3790.21	1.0	1.0	7409.13	0.0	1.0	25.56	0.5	118.88
12/13/96	9:00	3548.75	1.0	0.6	7411.83	0.0	1.0	32.98	1.0	175.10
12/13/96	10:00	3257.79	1.0	0.5	7410.25	0.0	1.0	39.30	1.0	168.09
12/13/96	11:00	2990.67	1.0	0.5	7412.17	0.0	1.0	38.04	1.0	175.77
12/13/96	12:00	2705.29	1.0	0.6	7410.71	0.0	1.0	37.68	1.0	188.31
12/13/96	13:00	2356.71	1.0	0.1	7409.63	0.0	1.0	48.69	0.9	218.50
12/13/96	14:00	2223.88	1.0	0.0	7414.25	0.0	1.0	51.00	0.0	0.05
12/13/96	15:00	2224.71	1.0	0.0	7418.17	0.0	1.0	47.71	0.3	12.26
12/13/96	16:00	2289.67	1.0	0.0	7421.58	0.0	1.0	51.00	0.0	0.03
12/13/96	17:00	2291.50	1.0	0.0	7421.21	0.0	1.0	51.00	0.0	0.06
12/13/96	18:00	2288.25	1.0	0.0	7421.08	0.0	1.0	50.64	0.0	0.05
12/13/96	19:00	2283.71	1.0	0.0	7414.83	0.0	1.0	46.68	0.0	0.04
12/13/96	20:00	2276.67	1.0	0.0	7409.96	0.0	1.0	47.68	0.0	0.05
12/13/96	21:00	2278.33	1.0	0.0	7409.13	0.0	1.0	50.96	0.0	0.05
12/13/96	22:00	2278.46	1.0	0.0	7411.46	0.0	1.0	51.00	0.0	0.04
12/13/96	23:00	2275.88	1.0	0.0	7408.96	0.0	1.0	51.00	0.0	0.05
12/14/96	0:00	2266.92	1.0	0.0	7407.88	0.0	1.0	50.56	0.0	0.04
12/14/96	1:00	2264.33	1.0	0.0	7404.04	0.0	1.0	51.00	0.0	0.04
12/14/96	2:00	2265.46	1.0	0.0	7402.88	0.0	1.0	51.00	0.0	0.04
12/14/96	3:00	2263.04	1.0	0.0	7404.29	0.0	1.0	43.52	0.0	0.04
12/14/96	4:00	2262.54	1.0	0.0	7408.79	0.0	1.0	50.95	0.0	0.05
12/14/96	5:00	2211.25	1.0	0.0	7407.00	0.0	1.0	48.58	0.7	124.99
12/14/96	6:00	1915.00	1.0	0.0	7408.50	0.0	1.0	38.18	1.0	242.36
12/14/96	7:00	2330.88	0.1	0.0	7215.71	0.9	1.0	45.01	1.0	273.78
12/14/96	8:00	2341.13	0.0	0.0	6807.08	1.0	1.0	50.90	0.9	187.39
12/14/96	9:00	2340.25	0.0	0.0	6737.08	1.0	1.0	51.00	0.2	8.50
12/14/96	10:00	2346.92	0.0	0.0	6770.71	1.0	1.0	50.89	0.0	0.03
12/14/96	11:00	2363.92	0.0	0.0	6774.75	1.0	1.0	50.59	0.0	0.04
12/14/96	12:00	2377.00	0.0	0.0	6779.42	1.0	1.0	50.24	0.0	0.05
12/14/96	13:00	2377.58	0.0	0.0	6781.38	1.0	1.0	49.95	0.0	0.05
12/14/96	14:00	2383.83	0.0	0.0	6788.58	1.0	1.0	50.53	0.0	0.04
12/14/96	15:00	2377.25	0.0	0.0	6791.83	1.0	1.0	50.52	0.0	0.05

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM										
CAMPAIGN 4 SERIES A GLASS										
		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY	AGITATOR	WEIGHT	SLURRY	AGITATOR	RECIRC	SLURRY	SLURRY
			RECIRC			RECIRC		FLOW	FEED VALVE	FEED PUMP
			VALVE			VALVE				RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/14/96	16:00	2382.50	0.0	0.0	6796.67	1.0	1.0	50.94	0.0	0.04
12/14/96	17:00	2384.54	0.0	0.0	6796.63	1.0	1.0	50.94	0.0	0.03
12/14/96	18:00	2379.42	0.0	0.0	6791.17	1.0	1.0	50.68	0.0	0.04
12/14/96	19:00	2374.13	0.0	0.0	6786.63	1.0	1.0	49.92	0.0	0.04
12/14/96	20:00	2372.79	0.0	0.0	6785.29	1.0	1.0	49.76	0.0	62.40
12/14/96	21:00	2368.54	0.0	0.0	6781.46	1.0	1.0	47.97	0.0	145.17
12/14/96	22:00	2363.33	0.0	0.0	6782.00	1.0	1.0	49.40	0.0	69.78
12/14/96	23:00	2360.08	0.0	0.0	6784.42	1.0	1.0	48.25	0.0	17.15
12/15/96	0:00	2359.00	0.0	0.0	6784.46	1.0	1.0	49.63	0.0	0.06
12/15/96	1:00	2359.96	0.0	0.0	6783.79	1.0	1.0	49.44	0.0	0.05
12/15/96	2:00	2377.42	0.6	0.0	6774.75	0.4	1.0	48.58	0.0	0.05
12/15/96	3:00	2387.08	1.0	0.0	6770.50	0.0	1.0	46.85	0.2	20.35
12/15/96	4:00	2147.42	1.0	0.0	6770.21	0.0	1.0	47.06	1.0	302.08
12/15/96	5:00	1728.25	1.0	0.0	6770.92	0.0	1.0	44.77	1.0	264.07
12/15/96	6:00	1394.83	1.0	0.0	6771.58	0.0	1.0	48.04	1.0	225.56
12/15/96	7:00	1059.75	1.0	0.0	6770.55	0.0	1.0	44.29	1.0	224.57
12/15/96	8:00	804.75	0.3	0.0	6677.88	0.7	1.0	47.51	0.9	203.77
12/15/96	9:00	783.17	0.0	0.0	6331.38	1.0	1.0	48.83	1.0	228.11
12/15/96	10:00	791.91	0.0	0.0	5968.26	1.0	1.0	48.39	1.0	217.08
12/15/96	11:00	804.50	0.0	0.0	5664.96	1.0	1.0	48.79	1.0	114.98
12/15/96	12:00	816.33	0.0	0.0	5498.71	1.0	1.0	50.68	1.0	186.67
12/15/96	13:00	704.08	0.0	0.0	5438.17	1.0	1.0	46.68	0.3	67.97
12/15/96	14:00	566.00	0.0	0.0	5661.33	1.0	1.0	50.62	0.0	0.04
12/15/96	15:00	563.71	0.0	0.0	5666.29	1.0	1.0	50.82	0.0	0.03
12/15/96	16:00	563.04	0.0	0.0	5669.31	1.0	1.0	50.88	0.0	0.03
12/15/96	17:00	555.31	0.0	0.0	5592.04	1.0	1.0	50.98	0.8	165.40
12/15/96	18:00	548.17	0.0	0.0	5270.33	1.0	1.0	45.16	1.0	222.07
12/15/96	19:00	547.29	0.0	0.0	5083.83	1.0	1.0	33.33	0.4	101.46
12/15/96	20:00	540.13	0.0	0.0	5090.17	1.0	1.0	30.14	0.0	32.20
12/15/96	21:00	530.75	0.0	0.0	5088.29	1.0	1.0	30.13	0.0	0.04
12/15/96	22:00	524.08	0.0	0.0	5086.58	1.0	1.0	30.12	0.0	47.17
12/15/96	23:00	526.00	0.0	0.0	5088.00	1.0	1.0	30.22	0.0	71.95
12/16/96	0:00	525.71	0.0	0.0	5086.88	1.0	1.0	30.21	0.0	17.80
12/16/96	1:00	512.38	0.0	0.0	5081.08	1.0	1.0	30.22	0.1	4.33
12/16/96	2:00	503.90	0.0	0.0	4861.78	1.0	1.0	30.82	1.0	213.92
12/16/96	3:00	495.25	0.0	0.0	4557.88	1.0	1.0	30.83	1.0	226.41
12/16/96	4:00	489.20	0.0	0.0	4173.56	1.0	1.0	29.41	1.0	210.17
12/16/96	5:00	483.04	0.0	0.0	3869.54	1.0	1.0	28.81	1.0	158.06
12/16/96	6:00	477.17	0.0	0.0	3600.71	1.0	1.0	28.68	1.0	194.30
12/16/96	7:00	476.83	0.0	0.0	3267.04	1.0	1.0	28.59	1.0	205.77
12/16/96	8:00	475.92	0.0	0.0	3140.25	1.0	1.0	28.38	0.1	20.06
12/16/96	9:00	481.88	0.0	0.0	3060.25	1.0	1.0	33.00	0.8	140.75
12/16/96	10:00	493.38	0.0	0.0	2717.71	1.0	1.0	49.95	1.0	220.36
12/16/96	11:00	497.08	0.0	0.0	2358.04	1.0	1.0	50.26	1.0	240.55
12/16/96	12:00	509.13	0.0	0.0	2026.63	1.0	1.0	48.52	0.7	171.76
12/16/96	13:00	513.96	0.0	0.0	1758.79	1.0	1.0	48.90	1.0	248.52
12/16/96	14:00	516.53	0.0	0.0	1393.81	1.0	1.0	48.90	1.0	242.11
12/16/96	15:00	521.38	0.0	0.0	1029.29	1.0	1.0	44.99	1.0	232.47
12/16/96	16:00	530.09	0.0	0.0	690.17	1.0	1.0	44.96	1.0	203.01
12/16/96	17:00	534.29	0.0	0.0	421.00	1.0	1.0	36.35	1.0	240.70
12/16/96	18:00	537.50	0.0	0.0	308.92	1.0	1.0	38.01	1.0	178.79
12/16/96	19:00	542.08	0.0	0.0	227.75	1.0	1.0	22.38	1.0	199.90
12/16/96	20:00	549.83	0.0	0.0	683.88	0.5	1.0	6.08	0.3	75.29

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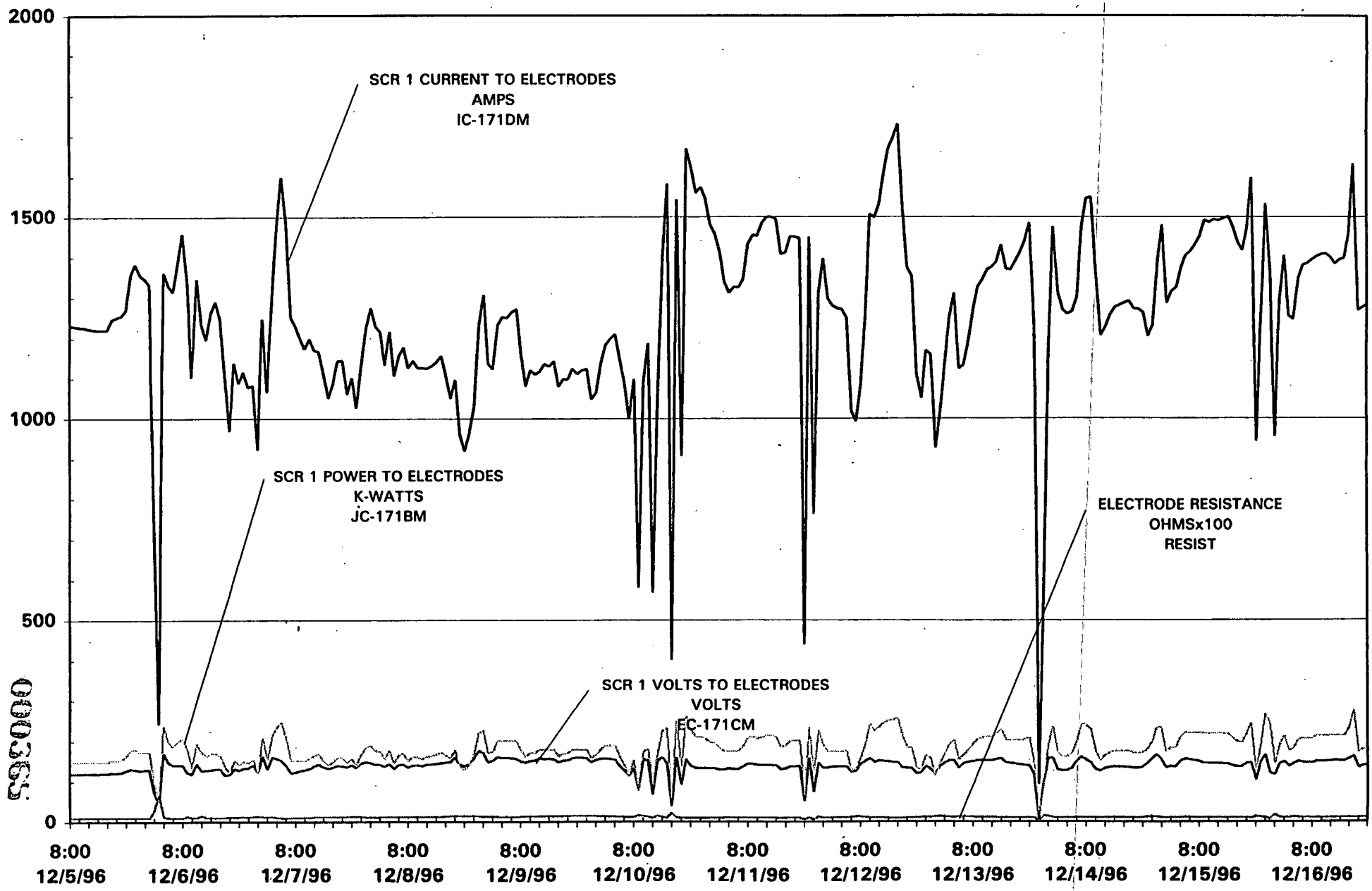
FURNACE SYSTEM

CAMPA[illegible]4
SERIES A GLASS
FURNACE SYSTEM



C4FURN.XLS Chart 13

VHP 12/31/96

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES						
READINGS		ELECTRODE CURRENT	CURRENT CONTROLLER SET POINT	ELECTRODE VOLTAGE	VOLTAGE CONTROLLER SET POINT	ELECTRODE POWER	POWER CONTROLLER SET POINT	ELECTRODE RESISTANCE
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/5/96	8:00	1230.85	246.00	118.37	454.80	146.52	146.40	9.61
12/5/96	9:00	1229.48	246.00	118.35	454.80	146.36	146.40	9.62
12/5/96	10:00	1227.48	246.00	118.76	454.80	146.54	146.40	9.68
12/5/96	11:00	1227.15	246.00	118.89	454.80	146.56	146.40	9.69
12/5/96	12:00	1224.00	246.00	118.97	454.80	146.31	146.40	9.73
12/5/96	13:00	1222.05	246.00	119.11	454.80	146.45	146.40	9.75
12/5/96	14:00	1221.20	246.00	119.18	454.80	146.35	146.40	9.76
12/5/96	15:00	1221.08	246.00	119.36	454.80	146.55	146.40	9.77
12/5/96	16:00	1221.28	246.00	119.46	454.80	146.73	146.80	9.78
12/5/96	17:00	1246.80	246.00	121.04	454.80	151.14	151.20	9.71
12/5/96	18:00	1251.25	246.00	120.71	454.80	151.31	151.20	9.65
12/5/96	19:00	1256.03	246.00	121.87	454.80	153.30	153.36	9.70
12/5/96	20:00	1269.65	246.00	126.15	454.80	161.01	160.96	9.94
12/5/96	21:00	1356.13	246.00	130.47	454.80	178.63	178.44	9.62
12/5/96	22:00	1382.03	246.00	129.04	454.80	179.88	179.68	9.34
12/5/96	23:00	1355.35	246.00	126.47	454.80	172.54	172.44	9.33
12/6/96	0:00	1346.39	246.00	127.71	454.80	172.85	172.80	9.49
12/6/96	1:00	1332.68	246.00	128.60	454.80	172.86	172.80	9.64
12/6/96	2:00	755.95	246.00	73.58	454.80	96.25	140.84	29.23
12/6/96	3:00	243.45	246.00	44.97	454.80	42.19	5.56	66.97
12/6/96	4:00	1361.08	246.00	170.55	454.80	237.33	0.00	12.53
12/6/96	5:00	1330.80	246.00	146.31	454.80	198.17	0.00	10.99
12/6/96	6:00	1314.33	246.00	139.61	454.80	186.36	0.00	10.63
12/6/96	7:00	1382.98	246.00	140.56	454.80	198.16	0.00	10.17
12/6/96	8:00	1457.55	246.00	139.34	454.80	206.71	0.00	9.57
12/6/96	9:00	1331.55	246.00	122.36	454.80	180.86	0.00	13.86
12/6/96	10:00	1102.83	246.00	117.40	454.80	133.76	0.00	10.61
12/6/96	11:00	1345.90	246.00	143.02	454.80	195.46	0.00	10.62
12/6/96	12:00	1235.18	246.00	125.84	454.80	174.28	0.92	15.30
12/6/96	13:00	1196.60	246.00	126.90	454.80	162.83	162.96	10.74
12/6/96	14:00	1262.25	246.00	128.03	454.80	171.48	182.21	11.53
12/6/96	15:00	1289.65	246.00	129.67	454.80	169.41	169.52	10.06
12/6/96	16:00	1246.18	246.00	129.55	454.80	163.22	163.20	10.39
12/6/96	17:00	1107.50	246.00	115.16	454.80	134.44	134.20	10.48
12/6/96	18:00	970.25	246.00	116.45	454.80	120.41	120.61	12.03
12/6/96	19:00	1137.60	246.00	130.34	454.80	150.81	150.84	11.46
12/6/96	20:00	1088.78	246.00	126.78	454.80	140.43	140.20	11.64
12/6/96	21:00	1115.08	246.00	131.44	454.80	148.69	148.68	11.79
12/6/96	22:00	1077.80	246.00	132.72	454.80	144.94	144.96	12.31
12/6/96	23:00	1081.60	246.00	139.67	454.80	153.83	154.00	12.92
12/7/96	0:00	923.95	246.00	121.94	454.80	122.02	122.12	13.38
12/7/96	1:00	1248.13	246.00	162.49	454.80	209.79	209.84	13.17
12/7/96	2:00	1065.50	246.00	128.77	454.80	153.30	152.32	12.42
12/7/96	3:00	1293.08	246.00	160.23	454.80	210.84	210.96	12.44
12/7/96	4:00	1476.73	246.00	157.13	454.80	235.60	235.68	10.66
12/7/96	5:00	1599.25	246.00	152.41	454.80	247.22	247.20	9.53
12/7/96	6:00	1488.41	246.00	137.98	454.80	209.78	209.65	9.28
12/7/96	7:00	1252.28	246.00	120.02	454.80	151.26	151.20	9.58
12/7/96	8:00	1230.25	246.00	121.95	454.80	151.15	151.20	9.92
12/7/96	9:00	1201.68	246.00	124.90	454.80	151.27	151.20	10.39
12/7/96	10:00	1174.02	246.00	127.62	454.80	151.11	151.20	10.87

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VITRIFICATION PILOT PLANT FURNACE SYSTEM								
CAMPAIGN 4 SERIES A GLASS								
		HOURLY AVERAGES						
READINGS		ELECTRODE	CURRENT	ELECTRODE	VOLTAGE	ELECTRODE	POWER	ELECTRODE
		CURRENT	CONTROLLER	VOLTAGE	CONTROLLER	POWER	CONTROLLER	RESISTANCE
			SET POINT		SET POINT		SET POINT	
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/7/96	11:00	1198.13	246.00	130.05	454.80	157.52	157.56	10.86
12/7/96	12:00	1170.70	246.00	137.59	454.80	165.29	165.56	11.79
12/7/96	13:00	1167.43	246.00	142.10	454.80	169.48	169.76	12.18
12/7/96	14:00	1109.85	246.00	134.50	454.80	151.18	151.20	12.12
12/7/96	15:00	1051.04	246.00	130.96	454.80	139.96	139.97	12.47
12/7/96	16:00	1087.28	246.00	134.07	454.80	148.19	148.32	12.34
12/7/96	17:00	1143.25	246.00	138.53	454.80	160.30	161.34	12.12
12/7/96	18:00	1144.42	246.00	137.63	454.80	160.13	159.34	12.03
12/7/96	19:00	1060.55	246.00	134.76	454.80	145.73	145.83	12.70
12/7/96	20:00	1101.48	246.00	140.25	454.80	157.26	157.12	12.74
12/7/96	21:00	1026.98	246.00	133.28	454.80	140.09	140.12	12.99
12/7/96	22:00	1131.23	246.00	144.79	454.80	166.72	166.72	12.81
12/7/96	23:00	1226.50	246.00	148.36	454.80	184.93	184.80	12.10
12/8/96	0:00	1274.44	246.00	146.48	454.80	189.42	189.60	11.49
12/8/96	1:00	1231.78	246.00	141.55	454.80	176.90	177.08	11.49
12/8/96	2:00	1215.65	246.00	141.37	454.80	174.57	174.56	11.63
12/8/96	3:00	1133.53	246.00	136.66	454.80	156.81	156.84	12.05
12/8/96	4:00	1217.05	246.00	143.56	454.80	177.39	177.12	11.79
12/8/96	5:00	1106.50	246.00	130.35	454.80	146.11	146.04	11.78
12/8/96	6:00	1155.38	246.00	140.86	454.80	164.95	165.16	12.20
12/8/96	7:00	1177.63	246.00	142.25	454.80	169.81	169.76	12.08
12/8/96	8:00	1125.60	246.00	134.22	454.80	151.97	152.00	11.92
12/8/96	9:00	1143.70	246.00	139.68	454.80	161.63	161.68	12.22
12/8/96	10:00	1125.60	246.00	141.03	454.80	160.82	160.80	12.53
12/8/96	11:00	1125.70	246.00	137.95	454.80	156.70	156.72	12.25
12/8/96	12:00	1124.83	246.00	142.08	454.80	161.78	162.04	12.63
12/8/96	13:00	1130.83	246.00	143.01	454.80	164.36	164.64	12.65
12/8/96	14:00	1140.25	246.00	144.36	454.80	167.15	167.35	12.66
12/8/96	15:00	1156.08	246.00	146.12	454.80	171.16	171.00	12.64
12/8/96	16:00	1105.95	246.00	147.65	454.80	165.50	165.72	13.35
12/8/96	17:00	1050.40	246.00	148.81	454.80	158.17	157.80	14.17
12/8/96	18:00	1095.23	246.00	160.60	454.80	178.35	178.20	14.66
12/8/96	19:00	959.00	246.00	141.68	454.80	138.26	138.36	14.79
12/8/96	20:00	920.00	246.00	138.21	454.80	129.35	129.60	15.03
12/8/96	21:00	962.88	246.00	142.52	454.80	139.73	140.00	14.80
12/8/96	22:00	1028.98	246.00	158.56	454.80	166.64	166.96	15.42
12/8/96	23:00	1234.08	246.00	176.97	454.80	221.60	221.64	14.36
12/9/96	0:00	1307.18	246.00	170.53	454.80	226.14	226.24	13.05
12/9/96	1:00	1136.23	246.00	148.17	454.80	170.96	171.00	13.07
12/9/96	2:00	1122.88	246.00	152.13	454.80	173.56	174.04	13.56
12/9/96	3:00	1233.33	246.00	160.92	454.80	201.64	201.60	13.05
12/9/96	4:00	1252.53	246.00	158.72	454.80	201.38	201.60	12.67
12/9/96	5:00	1250.75	246.00	159.14	454.80	201.53	201.60	12.72
12/9/96	6:00	1264.81	246.00	157.64	454.80	201.53	202.09	12.47
12/9/96	7:00	1270.89	246.00	156.84	454.80	201.54	201.60	12.34
12/9/96	8:00	1164.83	246.00	149.94	454.80	177.55	177.00	12.89
12/9/96	9:00	1080.85	246.00	147.33	454.80	161.16	161.56	13.63
12/9/96	10:00	1119.73	246.00	151.07	454.80	171.65	171.28	13.50
12/9/96	11:00	1109.13	246.00	152.15	454.80	170.96	171.00	13.72
12/9/96	12:00	1116.03	246.00	157.84	454.80	179.00	178.72	14.14
12/9/96	13:00	1135.20	246.00	155.83	454.80	179.96	180.00	13.73

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES						
READINGS		ELECTRODE CURRENT	CURRENT CONTROLLER SET POINT	ELECTRODE VOLTAGE	VOLTAGE CONTROLLER SET POINT	ELECTRODE POWER	POWER CONTROLLER SET POINT	ELECTRODE RESISTANCE
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/9/96	14:00	1129.68	246.00	156.69	454.80	180.05	180.00	13.87
12/9/96	15:00	1142.58	246.00	154.68	454.80	179.55	179.48	13.54
12/9/96	16:00	1080.28	246.00	148.27	454.80	162.22	162.24	13.73
12/9/96	17:00	1096.70	246.00	151.83	454.80	168.79	168.80	13.85
12/9/96	18:00	1097.45	246.00	152.97	454.80	170.21	170.40	13.94
12/9/96	19:00	1123.55	246.00	157.45	454.80	179.99	180.00	14.02
12/9/96	20:00	1111.25	246.00	159.48	454.80	180.15	180.00	14.35
12/9/96	21:00	1120.15	246.00	158.23	454.80	180.01	180.00	14.13
12/9/96	22:00	1123.00	246.00	157.83	454.80	180.05	180.00	14.05
12/9/96	23:00	1047.15	246.00	148.18	454.80	158.05	157.32	14.16
12/10/96	0:00	1064.40	246.00	152.61	454.80	165.70	165.76	14.35
12/10/96	1:00	1136.83	246.00	156.03	454.80	180.55	180.36	13.73
12/10/96	2:00	1182.50	246.00	156.82	454.80	188.07	188.08	13.26
12/10/96	3:00	1198.33	246.00	155.78	454.80	189.40	189.60	13.00
12/10/96	4:00	1210.25	246.00	154.03	454.80	189.43	189.60	12.73
12/10/96	5:00	1148.42	246.00	139.15	454.80	162.54	162.75	12.11
12/10/96	6:00	1088.10	246.00	127.38	454.80	140.51	140.52	11.71
12/10/96	7:00	999.40	246.00	112.78	454.80	114.49	114.20	11.29
12/10/96	8:00	1096.50	246.00	132.71	454.80	151.47	151.48	12.11
12/10/96	9:00	582.15	206.60	76.48	454.80	75.20	74.16	15.55
12/10/96	10:00	1090.98	36.00	155.45	454.80	173.85	174.04	14.35
12/10/96	11:00	1186.88	36.00	150.38	454.80	181.25	181.08	12.68
12/10/96	12:00	569.38	36.00	67.15	454.80	90.61	216.80	8.76
12/10/96	13:00	1057.35	36.00	150.97	454.80	168.00	168.29	14.54
12/10/96	14:00	1399.78	36.00	159.12	454.80	225.39	225.28	11.41
12/10/96	15:00	1582.68	36.00	144.15	454.80	230.40	230.24	9.11
12/10/96	16:00	403.33	36.00	39.46	454.80	57.33	55.20	22.01
12/10/96	17:00	1543.98	36.00	159.49	454.80	250.48	250.68	10.38
12/10/96	18:00	907.63	36.00	91.12	454.80	134.10	129.96	8.94
12/10/96	19:00	1668.50	36.00	154.38	454.80	261.56	261.60	9.26
12/10/96	20:00	1624.40	36.00	138.58	454.80	228.94	228.84	8.53
12/10/96	21:00	1560.95	36.00	132.80	454.80	210.15	210.08	8.51
12/10/96	22:00	1574.95	36.00	132.56	454.80	211.10	211.20	8.42
12/10/96	23:00	1547.35	36.00	132.49	454.80	207.32	207.40	8.56
12/11/96	0:00	1481.68	36.00	131.79	454.80	198.13	198.12	8.90
12/11/96	1:00	1458.15	36.00	132.17	454.80	194.77	194.76	9.06
12/11/96	2:00	1414.13	36.00	128.89	454.80	183.96	184.00	9.12
12/11/96	3:00	1340.00	36.00	129.34	454.80	175.28	175.20	9.65
12/11/96	4:00	1311.23	36.00	131.88	454.80	175.11	175.20	10.06
12/11/96	5:00	1325.75	36.00	130.16	454.80	175.30	175.20	9.82
12/11/96	6:00	1324.63	36.00	130.38	454.80	175.17	175.20	9.84
12/11/96	7:00	1344.78	36.00	136.31	454.80	187.01	187.04	10.14
12/11/96	8:00	1432.73	36.00	143.28	454.80	209.03	209.04	10.00
12/11/96	9:00	1454.70	36.00	143.12	454.80	211.26	211.20	9.84
12/11/96	10:00	1452.95	36.00	140.42	454.80	207.17	207.33	9.66
12/11/96	11:00	1483.99	36.00	139.84	454.80	210.51	210.98	9.42
12/11/96	12:00	1499.18	36.00	139.73	454.80	213.43	213.60	9.32
12/11/96	13:00	1499.28	36.00	139.93	454.80	213.50	213.60	9.33
12/11/96	14:00	1493.85	36.00	139.03	454.80	211.57	211.68	9.30
12/11/96	15:00	1407.88	36.00	129.92	454.80	186.28	186.16	9.23
12/11/96	16:00	1411.95	36.00	132.04	454.80	189.67	189.56	9.35

VITRIFICATION PILOT PLANT FURNACE SYSTEM								
CAMPAIGN 4 SERIES A GLASS								
		HOURLY AVERAGES						
READINGS		ELECTRODE	CURRENT	ELECTRODE	VOLTAGE	ELECTRODE	POWER	ELECTRODE
		CURRENT	CONTROLLER	VOLTAGE	CONTROLLER	POWER	CONTROLLER	RESISTANCE
			SET POINT		SET POINT		SET POINT	
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/11/96	17:00	1451.45	36.00	136.46	454.80	201.83	201.60	9.40
12/11/96	18:00	1450.60	36.00	136.66	454.80	201.50	201.60	9.42
12/11/96	19:00	1446.93	36.00	137.48	454.80	202.23	202.40	9.50
12/11/96	20:00	440.42	36.00	51.85	454.80	63.58	62.85	6.45
12/11/96	21:00	1449.58	36.00	158.42	454.80	233.42	233.32	10.94
12/11/96	22:00	763.00	36.00	73.64	454.80	117.32	116.00	5.00
12/11/96	23:00	1313.05	36.00	145.98	454.80	225.62	225.96	13.68
12/12/96	0:00	1395.60	36.00	132.98	454.80	190.16	188.72	9.54
12/12/96	1:00	1297.28	36.00	133.36	454.80	175.26	175.20	10.28
12/12/96	2:00	1280.00	36.00	135.03	454.80	175.30	175.20	10.55
12/12/96	3:00	1273.88	36.00	135.84	454.80	175.30	175.20	10.66
12/12/96	4:00	1271.60	36.00	136.07	454.80	175.40	175.20	10.70
12/12/96	5:00	1250.50	36.00	135.71	454.80	176.34	175.16	10.89
12/12/96	6:00	1017.55	36.00	123.36	454.80	127.40	127.36	12.12
12/12/96	7:00	992.88	36.00	125.58	454.80	128.42	128.68	12.69
12/12/96	8:00	1085.28	36.00	141.84	454.80	157.00	157.08	13.09
12/12/96	9:00	1257.48	36.00	149.67	454.80	191.88	191.68	11.92
12/12/96	10:00	1506.48	36.00	156.78	454.80	240.84	240.88	10.44
12/12/96	11:00	1498.48	36.00	147.24	454.80	224.11	224.08	9.83
12/12/96	12:00	1531.53	36.00	151.06	454.80	235.14	235.20	9.86
12/12/96	13:00	1608.80	36.00	150.00	454.80	244.77	244.88	9.33
12/12/96	14:00	1671.70	36.00	148.56	454.80	251.55	251.60	8.89
12/12/96	15:00	1695.45	36.00	146.98	454.80	252.31	252.00	8.67
12/12/96	16:00	1729.55	36.00	146.39	454.80	256.02	256.00	8.47
12/12/96	17:00	1533.18	36.00	132.87	454.80	213.28	213.16	8.75
12/12/96	18:00	1373.03	36.00	132.63	454.80	184.54	185.08	9.67
12/12/96	19:00	1353.60	36.00	132.13	454.80	183.30	183.44	9.78
12/12/96	20:00	1105.60	36.00	119.00	454.80	133.26	133.48	10.76
12/12/96	21:00	1050.90	36.00	120.44	454.80	128.11	127.69	11.46
12/12/96	22:00	1168.75	36.00	137.25	454.80	164.41	164.72	11.76
12/12/96	23:00	1159.58	36.00	129.64	454.80	157.33	157.28	11.24
12/13/96	0:00	927.53	36.00	118.49	454.80	112.04	112.04	12.77
12/13/96	1:00	1016.20	36.00	136.62	454.80	141.76	142.16	13.45
12/13/96	2:00	1133.35	36.00	144.71	454.80	167.20	167.20	12.77
12/13/96	3:00	1251.75	36.00	151.22	454.80	192.68	192.64	12.08
12/13/96	4:00	1310.15	36.00	151.20	454.80	202.09	202.16	11.55
12/13/96	5:00	1124.25	36.00	132.40	454.80	153.24	151.84	11.84
12/13/96	6:00	1131.83	36.00	143.69	454.80	165.25	165.36	12.70
12/13/96	7:00	1190.98	36.00	146.98	454.80	177.72	177.72	12.34
12/13/96	8:00	1270.00	36.00	149.62	454.80	192.85	192.80	11.78
12/13/96	9:00	1325.72	36.00	151.42	454.80	204.15	204.20	11.42
12/13/96	10:00	1343.60	36.00	152.25	454.80	208.04	208.00	11.33
12/13/96	11:00	1368.93	36.00	151.81	454.80	211.23	211.20	11.09
12/13/96	12:00	1375.50	36.00	151.61	454.80	211.19	211.20	11.03
12/13/96	13:00	1387.58	36.00	154.55	454.80	217.83	217.76	11.14
12/13/96	14:00	1430.38	36.00	156.60	454.80	227.48	227.44	10.95
12/13/96	15:00	1371.18	36.00	146.27	454.80	203.46	203.52	10.66
12/13/96	16:00	1368.85	36.00	144.85	454.80	201.46	201.60	10.58
12/13/96	17:00	1389.13	36.00	142.70	454.80	201.68	201.60	10.27
12/13/96	18:00	1411.48	36.00	140.77	454.80	202.08	202.24	9.97
12/13/96	19:00	1440.98	36.00	139.25	454.80	204.02	204.00	9.66

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES						
READINGS		ELECTRODE CURRENT	CURRENT CONTROLLER SET POINT	ELECTRODE VOLTAGE	VOLTAGE CONTROLLER SET POINT	ELECTRODE POWER	POWER CONTROLLER SET POINT	ELECTRODE RESISTANCE
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/13/96	20:00	1484.03	36.00	138.23	454.80	208.53	208.76	9.32
12/13/96	21:00	1229.98	36.00	116.84	454.80	148.17	148.28	9.51
12/13/96	22:00	92.80	36.00	8.23	454.80	12.95	10.24	3.37
12/13/96	23:00	602.10	36.00	93.82	454.80	84.51	84.84	14.03
12/14/96	0:00	1165.30	36.00	156.55	454.80	187.35	187.28	13.53
12/14/96	1:00	1475.13	36.00	157.77	454.80	236.08	235.92	10.71
12/14/96	2:00	1311.43	36.00	128.14	454.80	170.53	170.24	9.78
12/14/96	3:00	1269.90	36.00	125.46	454.80	161.02	160.80	9.87
12/14/96	4:00	1260.48	36.00	126.35	454.80	160.89	160.80	10.02
12/14/96	5:00	1265.45	36.00	131.73	454.80	168.65	168.72	10.40
12/14/96	6:00	1300.70	36.00	150.13	454.80	198.29	198.52	11.54
12/14/96	7:00	1474.60	36.00	160.71	454.80	240.29	240.00	10.90
12/14/96	8:00	1546.55	36.00	153.29	454.80	239.82	240.00	9.91
12/14/96	9:00	1549.78	36.00	145.79	454.80	228.91	228.80	9.40
12/14/96	10:00	1356.05	36.00	128.98	454.80	177.06	176.64	9.53
12/14/96	11:00	1206.78	36.00	125.06	454.80	151.02	151.20	10.37
12/14/96	12:00	1227.68	36.00	131.82	454.80	163.53	163.68	10.74
12/14/96	13:00	1257.58	36.00	134.43	454.80	170.75	170.64	10.69
12/14/96	14:00	1275.40	36.00	135.95	454.80	175.06	175.20	10.65
12/14/96	15:00	1281.15	36.00	135.36	454.80	175.14	175.20	10.57
12/14/96	16:00	1286.48	36.00	134.84	454.80	175.09	175.20	10.48
12/14/96	17:00	1291.13	36.00	134.33	454.80	175.34	175.20	10.40
12/14/96	18:00	1272.75	36.00	132.27	454.80	170.60	170.60	10.39
12/14/96	19:00	1271.35	36.00	132.48	454.80	170.51	170.40	10.42
12/14/96	20:00	1263.38	36.00	134.26	454.80	171.65	171.72	10.63
12/14/96	21:00	1205.30	36.00	144.54	454.80	177.66	177.76	11.99
12/14/96	22:00	1232.10	36.00	156.39	454.80	196.53	196.64	12.70
12/14/96	23:00	1387.25	36.00	165.71	454.80	234.11	234.20	11.96
12/15/96	0:00	1479.55	36.00	154.46	454.80	232.49	232.56	10.44
12/15/96	1:00	1286.20	36.00	133.38	454.80	173.88	173.84	10.36
12/15/96	2:00	1315.78	36.00	137.13	454.80	183.29	183.24	10.42
12/15/96	3:00	1324.53	36.00	136.06	454.80	182.49	182.48	10.27
12/15/96	4:00	1371.58	36.00	150.20	454.80	209.27	209.28	10.95
12/15/96	5:00	1403.80	36.00	155.45	454.80	220.96	220.80	11.07
12/15/96	6:00	1414.75	36.00	153.98	454.80	220.94	220.80	10.89
12/15/96	7:00	1432.44	36.00	151.82	454.80	220.90	220.80	10.60
12/15/96	8:00	1452.73	36.00	149.82	454.80	220.86	220.80	10.31
12/15/96	9:00	1491.70	36.00	144.70	454.80	219.02	218.96	9.70
12/15/96	10:00	1486.70	36.00	144.89	454.80	218.64	218.40	9.75
12/15/96	11:00	1493.85	36.00	144.21	454.80	218.62	218.40	9.65
12/15/96	12:00	1491.18	36.00	144.31	454.80	218.58	218.40	9.68
12/15/96	13:00	1496.20	36.00	143.86	454.80	218.73	218.40	9.61
12/15/96	14:00	1500.93	36.00	143.22	454.80	218.41	218.40	9.54
12/15/96	15:00	1477.20	36.00	139.01	454.80	208.49	208.72	9.41
12/15/96	16:00	1438.68	36.00	136.43	454.80	199.21	199.20	9.48
12/15/96	17:00	1417.31	36.00	137.22	454.80	196.85	196.80	9.68
12/15/96	18:00	1472.53	36.00	145.69	454.80	218.54	218.48	9.91
12/15/96	19:00	1597.28	36.00	146.06	454.80	242.94	243.28	9.18
12/15/96	20:00	944.00	36.00	103.30	454.80	126.71	125.48	13.13
12/15/96	21:00	1247.65	36.00	149.71	454.80	190.55	190.48	12.00
12/15/96	22:00	1532.35	36.00	165.69	454.80	267.10	267.08	10.95

VITRIFICATION PILOT PLANT FURNACE SYSTEM								
CAMPAIGN 4 SERIES A GLASS								
		HOURLY AVERAGES						
READINGS		ELECTRODE	CURRENT	ELECTRODE	VOLTAGE	ELECTRODE	POWER	ELECTRODE
		CURRENT	CONTROLLER	VOLTAGE	CONTROLLER	POWER	CONTROLLER	RESISTANCE
			SET POINT		SET POINT		SET POINT	
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/15/96	23:00	1365.23	36.00	120.84	454.80	241.84	240.92	6.65
12/16/96	0:00	955.18	36.00	116.62	454.80	144.00	143.12	17.66
12/16/96	1:00	1292.18	36.00	144.41	454.80	190.20	190.32	11.19
12/16/96	2:00	1403.72	36.00	148.98	454.80	212.57	212.58	10.61
12/16/96	3:00	1255.83	36.00	136.91	454.80	175.82	176.16	10.96
12/16/96	4:00	1246.12	36.00	144.36	454.80	182.72	182.97	11.59
12/16/96	5:00	1345.53	36.00	149.92	454.80	204.80	204.96	11.14
12/16/96	6:00	1379.88	36.00	147.36	454.80	206.39	206.40	10.67
12/16/96	7:00	1385.03	36.00	146.66	454.80	206.19	206.40	10.59
12/16/96	8:00	1394.25	36.00	146.59	454.80	207.60	207.72	10.52
12/16/96	9:00	1401.10	36.00	150.12	454.80	213.49	213.60	10.72
12/16/96	10:00	1406.80	36.00	149.15	454.80	213.49	213.60	10.60
12/16/96	11:00	1408.78	36.00	149.77	454.80	213.41	213.60	10.63
12/16/96	12:00	1399.85	36.00	150.58	454.80	213.39	213.60	10.76
12/16/96	13:00	1384.00	36.00	152.03	454.80	213.40	213.60	10.99
12/16/96	14:00	1393.83	36.00	150.70	454.80	213.46	213.60	10.81
12/16/96	15:00	1397.65	36.00	150.79	454.80	214.14	214.24	10.79
12/16/96	16:00	1458.13	36.00	156.06	454.80	231.79	231.70	10.71
12/16/96	17:00	1632.28	36.00	161.40	454.80	275.35	275.88	9.92
12/16/96	18:00	1268.73	36.00	134.16	454.80	172.26	172.40	10.58
12/16/96	19:00	1275.69	36.00	138.54	454.80	179.06	179.19	10.86
12/16/96	20:00	1281.30	36.00	139.30	454.80	180.69	180.60	10.88

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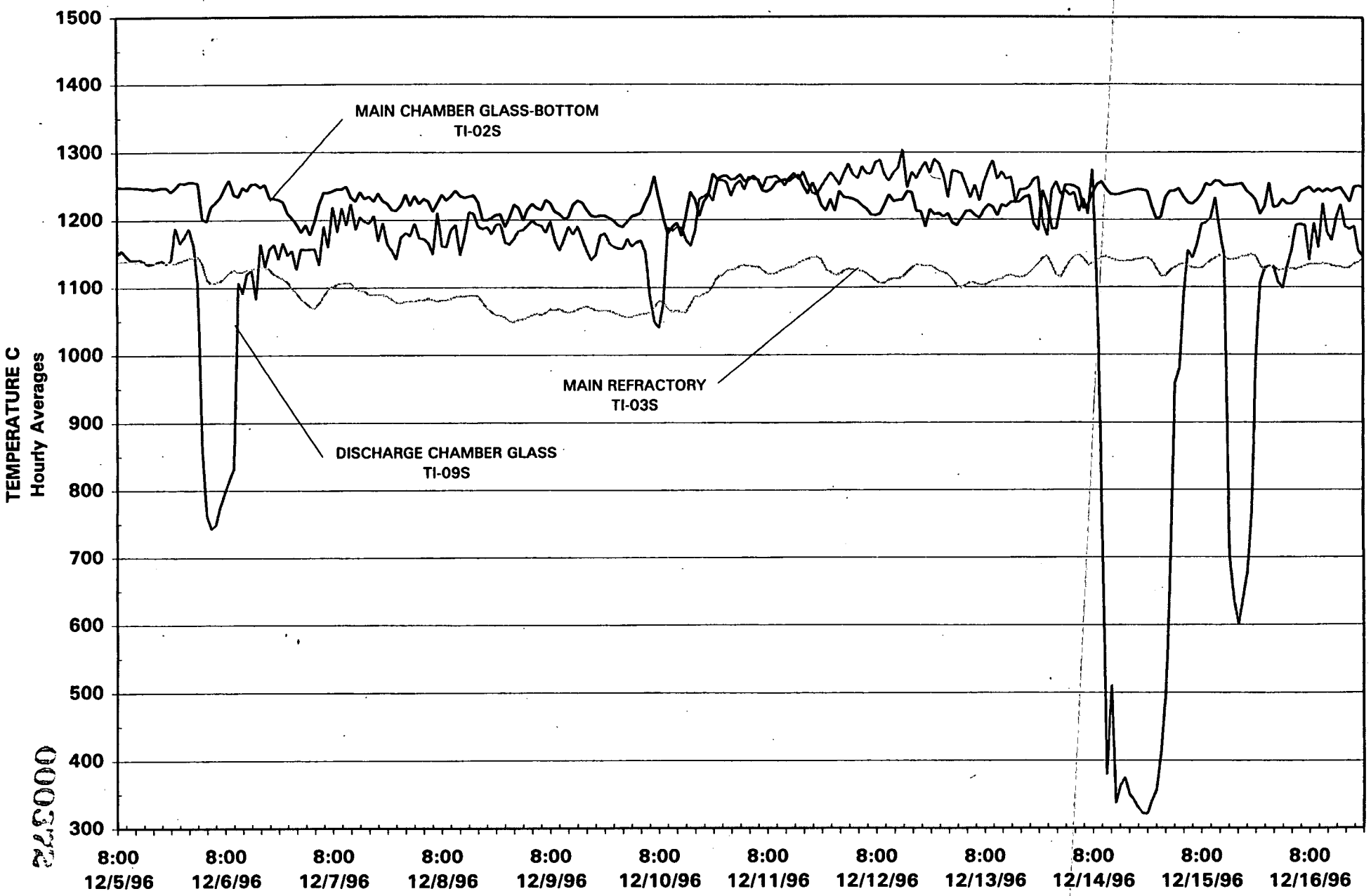
CAMPA[illegible]4
SERIES A GLASS
FURNACE SYSTEM

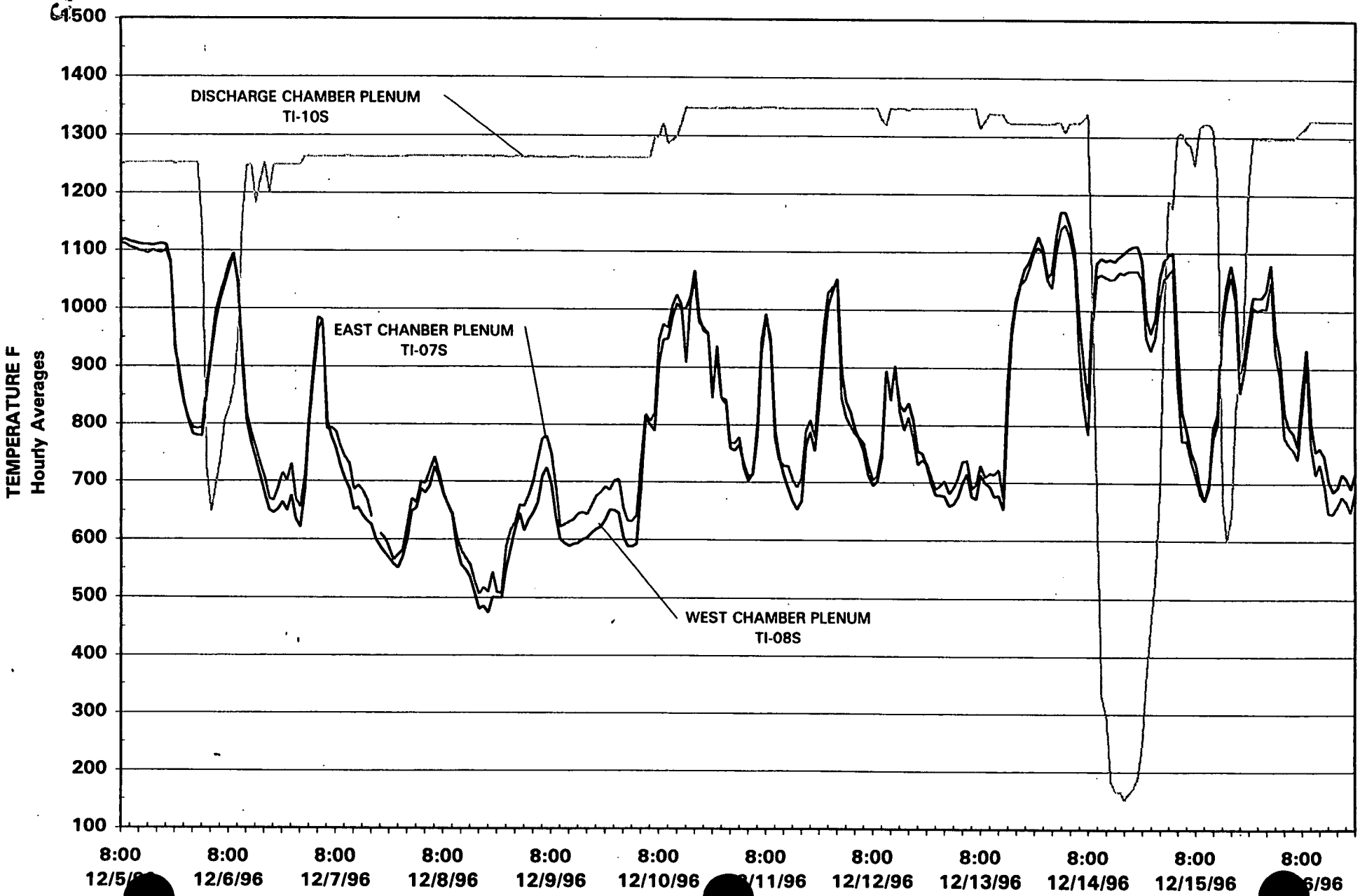


C4FURN.XLS Chart 14

VHP 12/31/96

000372

CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM



C4FURN.X[illegible] Chart 15

VHP 12/31/96

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		MAIN CHAMBER GLASS TOP TI-4S	MAIN CHAMBER GLASS BOTTOM TI-2S	WEST CHAMBER GLASS TI-5S	WEST CHAMBER IR GLASS TI-IRW	EAST CHAMBER GLASS TI-6S	EAST CHAMBER IR GLASS TI-IRE	DISCH CHAMBER GLASS TI-9S	WEST CHAMBER PLENUM TI-7S	EAST CHAMBER PLENUM TI-8S	DISCH CHAMBER PLENUM TI-10S	MAIN REFRACTORY TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/5/96	8:00	OUT OF SERVICE	1247.87	OUT OF SERVICE	OUT OF SERVICE	OUT OF SERVICE	OUT OF SERVICE	1149.39	1117.73	1112.96	1251.65	1138.81
12/5/96	9:00		1247.94					1154.17	1118.80	1111.20	1252.14	1138.78
12/5/96	10:00		1247.75					1146.81	1115.25	1105.70	1251.37	1138.72
12/5/96	11:00		1247.88					1140.48	1113.22	1103.08	1251.91	1138.50
12/5/96	12:00		1247.65					1141.08	1111.23	1099.60	1252.12	1138.28
12/5/96	13:00		1246.94					1141.54	1109.75	1098.65	1252.03	1137.79
12/5/96	14:00		1246.31					1138.30	1109.75	1095.41	1252.33	1137.22
12/5/96	15:00		1246.62					1134.26	1108.70	1100.27	1252.33	1136.85
12/5/96	16:00		1244.91					1135.65	1110.27	1097.94	1252.19	1136.78
12/5/96	17:00		1246.23					1137.83	1111.42	1096.66	1252.29	1135.93
12/5/96	18:00		1247.10					1139.98	1109.74	1100.75	1252.43	1136.28
12/5/96	19:00		1246.93					1135.16	1079.49	1077.61	1253.54	1136.93
12/5/96	20:00		1241.31					1140.99	930.81	937.81	1250.54	1136.78
12/5/96	21:00		1246.99					1188.10	884.75	872.27	1251.91	1136.42
12/5/96	22:00		1253.97					1165.10	834.85	832.82	1252.15	1138.49
12/5/96	23:00		1253.29					1174.06	804.47	807.42	1251.65	1141.69
12/6/96	0:00		1255.25					1186.93	781.75	793.22	1251.16	1143.60
12/6/96	1:00		1255.26					1162.20	779.40	791.74	1251.74	1145.35
12/6/96	2:00		1254.02					1104.38	779.11	794.08	1135.93	1145.58
12/6/96	3:00		1201.90					857.03	857.08	868.89	722.39	1134.64
12/6/96	4:00		1198.03					763.74	923.97	928.77	647.66	1112.02
12/6/96	5:00		1219.32					743.06	978.24	994.57	693.83	1105.60
12/6/96	6:00		1225.83					749.14	1016.17	1025.79	737.51	1107.01
12/6/96	7:00		1233.34					776.32	1041.96	1050.12	806.35	1109.46
12/6/96	8:00		1246.54					795.28	1068.12	1077.51	828.83	1114.04
12/6/96	9:00		1258.15					814.53	1091.58	1095.92	864.12	1121.28
12/6/96	10:00		1237.17					832.06	1044.27	1048.77	950.86	1125.79
12/6/96	11:00		1234.43					1107.44	908.14	920.25	1157.55	1122.41
12/6/96	12:00		1247.45					1091.24	805.76	816.79	1247.19	1123.54
12/6/96	13:00		1243.01					1119.85	766.55	784.62	1248.90	1125.25
12/6/96	14:00		1252.50					1125.02	738.96	758.32	1181.72	1126.58
12/6/96	15:00		1252.77					1082.79	709.75	730.30	1220.56	1128.47
12/6/96	16:00		1247.47					1163.56	679.09	705.83	1252.38	1129.54
12/6/96	17:00		1251.60					1130.79	650.63	670.72	1200.64	1129.77
12/6/96	18:00		1232.38					1158.47	646.06	667.58	1248.37	1126.94
12/6/96	19:00		1231.74					1163.50	651.83	688.47	1248.22	1119.55
12/6/96	20:00		1230.39					1142.06	663.96	713.68	1248.29	1115.63
12/6/96	21:00		1226.59					1165.08	649.37	701.46	1248.36	1112.74
12/6/96	22:00		1209.98					1147.12	675.71	730.00	1248.22	1107.58
12/6/96	23:00		1202.49					1153.84	634.52	669.25	1248.18	1098.74
12/7/96	0:00		1194.34					1126.70	620.82	656.21	1248.76	1092.33
12/7/96	1:00		1182.28					1156.18	686.37	708.76	1263.12	1083.16
12/7/96	2:00		1192.64					1155.62	808.32	818.91	1263.17	1077.43
12/7/96	3:00		1177.83					1156.01	892.08	907.11	1263.06	1071.29
12/7/96	4:00		1197.29					1156.68	964.58	985.09	1263.11	1069.16
12/7/96	5:00		1223.06					1133.65	977.89	979.53	1263.23	1076.39
12/7/96	6:00		1239.70					1190.10	806.94	791.13	1263.24	1087.85
12/7/96	7:00		1239.84					1158.58	777.71	793.51	1263.11	1097.08
12/7/96	8:00		1242.00					1219.13	756.71	786.66	1263.18	1101.74
12/7/96	9:00		1245.09					1182.15	726.39	759.86	1263.40	1104.91
12/7/96	10:00		1244.99					1217.47	703.87	742.05	1263.60	1106.07
12/7/96	11:00		1248.81					1191.94	687.68	730.56	1263.59	1106.79
12/7/96	12:00		1233.50					1223.39	651.36	685.82	1263.52	1106.29

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

READINGS		HOURLY AVERAGES										
		MAIN CHAMBER	MAIN CHAMBER	WEST CHAMBER	WEST CHAMBER	EAST CHAMBER	EAST CHAMBER	DISCH CHAMBER	WEST CHAMBER	EAST CHAMBER	DISCH CHAMBER	MAIN
		GLASS TOP	GLASS BOTTOM	GLASS	IR GLASS	GLASS	IR GLASS	GLASS	PLENUM	PLENUM	PLENUM	REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/7/96	13:00		1227.63					1185.43	654.86	692.67	1263.26	1097.50
12/7/96	14:00		1240.38					1204.77	641.76	684.04	1263.39	1095.38
12/7/96	15:00		1231.54					1197.65	631.61	668.89	1263.03	1094.21
12/7/96	16:00		1234.29					1194.73	624.97	638.89	1263.09	1089.84
12/7/96	17:00		1227.87					1206.10	599.56		1263.03	1088.94
12/7/96	18:00		1238.35					1168.39	586.76	611.44	1262.80	1089.84
12/7/96	19:00		1228.18					1195.14	576.50	601.68	1262.93	1089.38
12/7/96	20:00		1224.42					1163.45	567.14	584.44	1263.06	1087.36
12/7/96	21:00		1215.01					1154.09	557.25	564.63	1263.44	1082.06
12/7/96	22:00		1213.73					1141.20	550.81	573.30	1263.52	1078.12
12/7/96	23:00		1221.42					1174.00	569.09	581.03	1263.50	1077.10
12/8/96	0:00		1237.22					1180.78	599.03	624.00	1263.84	1079.08
12/8/96	1:00		1221.04					1176.25	648.70	670.68	1263.61	1080.01
12/8/96	2:00		1234.79					1194.48	654.19	663.81	1263.86	1079.07
12/8/96	3:00		1223.85					1173.06	686.88	699.79	1263.75	1082.15
12/8/96	4:00		1230.61					1171.62	680.76	697.08	1263.67	1081.69
12/8/96	5:00		1227.52					1165.93	692.60	718.20	1263.62	1083.95
12/8/96	6:00		1212.36					1148.22	724.94	741.67	1263.92	1081.85
12/8/96	7:00		1224.59					1210.48	706.10	715.00	1264.17	1079.70
12/8/96	8:00		1236.30					1161.18	679.08	681.28	1263.71	1081.83
12/8/96	9:00		1228.77					1159.72	659.86	658.55	1263.75	1081.11
12/8/96	10:00		1234.45					1184.90	642.16	644.09	1263.84	1083.52
12/8/96	11:00		1242.92					1192.33	586.60	602.34	1264.15	1086.22
12/8/96	12:00		1235.12					1147.18	555.92	580.99	1263.69	1087.21
12/8/96	13:00		1232.44					1174.44	547.12	567.96	1264.17	1086.81
12/8/96	14:00		1234.16					1211.14	534.26	556.42	1264.33	1087.88
12/8/96	15:00		1235.74					1209.22	509.25	527.45	1264.12	1088.49
12/8/96	16:00		1225.29					1189.45	480.25	506.72	1264.34	1087.32
12/8/96	17:00		1199.92					1186.39	485.12	516.83	1264.14	1078.28
12/8/96	18:00		1199.59					1188.82	473.59	509.56	1264.09	1068.18
12/8/96	19:00		1202.80					1178.70	500.90	542.34	1263.49	1063.29
12/8/96	20:00		1207.33					1192.53	500.49	509.29	1264.46	1058.65
12/8/96	21:00		1207.84					1193.28	499.83	507.61	1263.94	1057.75
12/8/96	22:00		1189.12					1166.80	549.99	587.77	1263.45	1054.61
12/8/96	23:00		1204.34					1163.83	583.57	617.08	1263.47	1049.09
12/9/96	0:00		1222.00					1171.64	620.19	629.86	1263.61	1048.16
12/9/96	1:00		1217.76					1183.18	644.92	659.58	1263.60	1051.95
12/9/96	2:00		1198.89					1184.82	616.09	658.19	1263.45	1052.36
12/9/96	3:00		1216.11					1191.35	634.68	677.20	1263.62	1055.10
12/9/96	4:00		1223.21					1198.90	646.17	700.75	1263.73	1058.84
12/9/96	5:00		1217.58					1192.88	664.31	739.27	1263.46	1060.86
12/9/96	6:00		1214.62					1190.85	709.23	775.61	1263.28	1058.87
12/9/96	7:00		1228.91					1180.68	723.08	778.82	1263.33	1062.32
12/9/96	8:00		1224.31					1197.56	696.33	749.74	1263.36	1067.63
12/9/96	9:00		1211.99					1169.75	641.56	690.92	1263.34	1066.34
12/9/96	10:00		1208.65					1153.90	600.73	622.69	1262.95	1068.21
12/9/96	11:00		1201.88					1170.14	593.33	626.59	1263.20	1064.51
12/9/96	12:00		1203.50					1189.52	588.80	631.44	1263.57	1062.60
12/9/96	13:00		1221.87					1177.82	592.13	635.42	1263.57	1064.20
12/9/96	14:00		1227.61					1189.95	593.84	645.42	1263.77	1067.01
12/9/96	15:00		1225.25					1172.25	600.22	647.25	1263.41	1070.20
12/9/96	16:00		1215.10					1154.37	602.59	644.24	1263.36	1071.74
12/9/96	17:00		1206.30					1139.57	612.28	659.13	1263.27	1069.47

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		MAIN CHAMBER GLASS TOP	MAIN CHAMBER GLASS BOTTOM	WEST CHAMBER GLASS	WEST CHAMBER IR GLASS	EAST CHAMBER GLASS	EAST CHAMBER IR GLASS	DISCH CHAMBER GLASS	WEST CHAMBER PLENUM	EAST CHAMBER PLENUM	DISCH CHAMBER PLENUM	MAIN REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/9/96	18:00		1204.70					1147.12	618.83	675.58	1263.49	1066.18
12/9/96	19:00		1206.14					1175.70	622.32	681.90	1263.38	1065.07
12/9/96	20:00		1206.12					1179.40	634.68	691.64	1263.28	1066.16
12/9/96	21:00		1202.98					1165.95	651.98	686.34	1263.53	1065.57
12/9/96	22:00		1198.43					1160.07	651.45	701.52	1263.33	1062.76
12/9/96	23:00		1191.60					1157.52	646.44	704.14	1263.40	1060.01
12/10/96	0:00		1189.64					1156.98	603.89	655.40	1263.38	1057.11
12/10/96	1:00		1196.93					1170.98	589.17	633.80	1263.17	1055.84
12/10/96	2:00		1204.88					1160.21	588.40	632.74	1263.17	1056.20
12/10/96	3:00		1207.22					1166.45	592.43	642.95	1263.42	1058.44
12/10/96	4:00		1209.63					1168.65	692.57	735.33	1263.45	1059.76
12/10/96	5:00		1224.95					1151.07	810.76	817.46	1263.27	1061.40
12/10/96	6:00		1238.31					1087.65	799.67	806.60	1263.28	1062.98
12/10/96	7:00		1263.22					1048.84	789.19	819.54	1295.10	1069.96
12/10/96	8:00		1232.13					1039.58	908.12	947.73	1298.32	1079.66
12/10/96	9:00		1202.87					1076.19	947.72	974.27	1321.18	1077.34
12/10/96	10:00		1179.02					1187.74	949.21	968.43	1287.69	1068.58
12/10/96	11:00		1189.11					1183.64	987.98	1006.49	1292.85	1063.69
12/10/96	12:00		1195.26					1188.99	1009.62	1025.47	1299.43	1065.87
12/10/96	13:00		1175.77					1188.14	1000.74	1007.88	1320.12	1063.08
12/10/96	14:00		1204.52					1169.99	1001.95	907.82	1348.45	1062.67
12/10/96	15:00		1240.40					1161.10	1020.69	1014.79	1348.06	1075.22
12/10/96	16:00		1230.05					1183.45	1066.21	1048.27	1348.02	1087.37
12/10/96	17:00		1205.61					1231.18	984.17	976.16	1348.12	1086.23
12/10/96	18:00		1226.84					1234.56	963.47	968.58	1347.54	1090.87
12/10/96	19:00		1237.23					1238.48	958.06	959.19	1346.55	1093.29
12/10/96	20:00		1266.98					1228.52	860.62	845.94	1346.77	1103.69
12/10/96	21:00		1258.80					1256.90	921.50	936.77	1348.96	1115.17
12/10/96	22:00		1263.46					1257.82	845.76	845.68	1346.90	1117.26
12/10/96	23:00		1264.40					1255.04	842.88	836.68	1348.03	1123.65
12/11/96	0:00		1258.10					1235.15	759.02	768.55	1347.91	1125.13
12/11/96	1:00		1259.70					1250.86	754.52	768.03	1348.10	1126.51
12/11/96	2:00		1265.86					1256.50	764.93	777.65	1347.89	1130.64
12/11/96	3:00		1256.30					1244.24	730.97	724.42	1348.04	1131.89
12/11/96	4:00		1257.76					1262.35	709.26	701.95	1348.04	1130.80
12/11/96	5:00		1263.57					1259.30	713.19	713.82	1348.12	1129.72
12/11/96	6:00		1257.81					1258.58	779.97	795.45	1348.09	1129.85
12/11/96	7:00		1242.68					1245.97	928.53	945.34	1348.53	1124.31
12/11/96	8:00		1241.13					1261.56	985.65	993.05	1348.58	1119.67
12/11/96	9:00		1244.86					1261.45	947.52	938.85	1348.78	1118.58
12/11/96	10:00		1254.35					1264.04	791.71	776.44	1348.41	1120.13
12/11/96	11:00		1256.57					1258.00	742.73	737.61	1348.19	1124.47
12/11/96	12:00		1258.30					1250.01	712.34	728.54	1348.05	1126.55
12/11/96	13:00		1256.30					1261.14	688.88	727.61	1347.71	1128.76
12/11/96	14:00		1261.80					1268.00	667.67	703.90	1347.55	1129.97
12/11/96	15:00		1265.30					1258.61	653.92	691.91	1347.14	1135.54
12/11/96	16:00		1249.51					1270.24	667.57	706.05	1347.21	1139.23
12/11/96	17:00		1238.53					1251.51	764.37	790.16	1347.29	1141.55
12/11/96	18:00		1253.51					1240.05	787.12	808.33	1347.28	1144.19
12/11/96	19:00		1240.87					1236.86	754.05	777.48	1347.28	1144.93
12/11/96	20:00		1221.86					1247.84	843.30	876.12	1347.21	1140.37
12/11/96	21:00		1212.89					1258.54	933.53	969.36	1347.91	1124.86
12/11/96	22:00		1230.03					1269.25	1006.91	1029.59	1347.60	1121.88

0003276

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		MAIN CHAMBER GLASS TOP TI-4S	MAIN CHAMBER GLASS BOTTOM TI-2S	WEST CHAMBER GLASS TI-5S	WEST CHAMBER IR GLASS TI-IRW	EAST CHAMBER GLASS TI-6S	EAST CHAMBER IR GLASS TI-IRE	DISCH CHAMBER GLASS TI-9S	WEST CHAMBER PLENUM TI-7S	EAST CHAMBER PLENUM TI-8S	DISCH CHAMBER PLENUM TI-10S	MAIN REFRACTORY TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/11/96	23:00		1212.57					1260.79	1031.78	1038.97	1347.69	1117.49
12/12/96	0:00		1241.61					1250.46	1052.77	1045.48	1347.86	1118.84
12/12/96	1:00		1233.11					1268.77	894.09	845.63	1347.90	1123.74
12/12/96	2:00		1232.55					1281.93	840.30	813.59	1348.16	1126.57
12/12/96	3:00		1230.89					1266.35	822.46	798.04	1347.81	1125.21
12/12/96	4:00		1227.25					1260.04	792.65	784.87	1347.88	1124.41
12/12/96	5:00		1221.01					1277.87	774.50	776.93	1348.13	1122.84
12/12/96	6:00		1216.08					1268.43	753.74	768.01	1347.96	1119.44
12/12/96	7:00		1207.06					1267.36	712.60	729.03	1347.82	1114.16
12/12/96	8:00		1206.26					1284.38	694.44	704.08	1348.22	1108.96
12/12/96	9:00		1208.31					1287.82	701.60	711.02	1348.15	1105.47
12/12/96	10:00		1221.49					1265.89	741.42	752.01	1328.86	1105.90
12/12/96	11:00		1236.43					1256.34	892.58	894.95	1318.17	1110.79
12/12/96	12:00		1227.10					1269.42	849.22	842.75	1347.36	1112.03
12/12/96	13:00		1228.75					1276.14	896.02	903.54	1346.28	1112.23
12/12/96	14:00		1229.27					1303.23	834.85	824.52	1347.15	1114.62
12/12/96	15:00		1240.71					1246.30	824.14	790.80	1347.17	1122.11
12/12/96	16:00		1239.52					1270.06	837.74	813.60	1343.82	1128.50
12/12/96	17:00		1212.59					1260.36	809.80	778.94	1347.15	1132.79
12/12/96	18:00		1212.14					1273.70	753.77	731.05	1346.99	1131.81
12/12/96	19:00		1188.90					1284.79	749.83	737.91	1346.92	1131.61
12/12/96	20:00		1214.98					1268.79	730.05	732.98	1346.45	1131.65
12/12/96	21:00		1207.78					1289.41	699.69	708.91	1346.68	1128.00
12/12/96	22:00		1209.32					1283.28	679.50	688.29	1346.64	1123.24
12/12/96	23:00		1204.03					1265.40	678.50	694.71	1346.53	1121.23
12/13/96	0:00		1208.62					1232.11	676.95	702.77	1346.61	1117.87
12/13/96	1:00		1194.35					1272.06	660.05	681.80	1346.72	1110.73
12/13/96	2:00		1191.04					1271.13	663.52	691.28	1346.69	1102.26
12/13/96	3:00		1201.18					1267.87	676.26	707.70	1346.79	1099.07
12/13/96	4:00		1212.21					1248.81	699.29	735.98	1346.73	1103.38
12/13/96	5:00		1212.95					1232.21	714.06	737.46	1346.68	1107.23
12/13/96	6:00		1206.22					1249.82	676.11	689.96	1346.82	1105.54
12/13/96	7:00		1202.22					1227.42	672.08	695.34	1346.82	1102.78
12/13/96	8:00		1214.50					1253.88	712.44	729.01	1313.03	1102.37
12/13/96	9:00		1222.03					1272.95	699.50	708.91	1324.87	1106.04
12/13/96	10:00		1219.08					1287.47	692.95	715.55	1337.42	1109.32
12/13/96	11:00		1206.00					1259.71	676.24	713.29	1337.00	1110.47
12/13/96	12:00		1221.69					1270.30	678.05	722.68	1337.19	1112.05
12/13/96	13:00		1219.24					1259.95	653.90	673.66	1336.98	1116.44
12/13/96	14:00		1225.63					1262.38	824.82	872.32	1324.67	1117.08
12/13/96	15:00		1225.61					1225.53	958.61	968.91	1322.32	1115.37
12/13/96	16:00		1226.41					1243.22	1013.40	1020.58	1322.55	1113.75
12/13/96	17:00		1232.71					1243.71	1046.24	1044.15	1322.55	1115.80
12/13/96	18:00		1234.69					1247.16	1072.01	1052.53	1322.72	1120.94
12/13/96	19:00		1193.35					1259.04	1083.21	1072.55	1322.89	1127.88
12/13/96	20:00		1183.58					1262.69	1105.14	1099.38	1322.15	1134.09
12/13/96	21:00		1241.97					1194.72	1127.22	1108.75	1322.71	1143.33
12/13/96	22:00		1223.21					1175.77	1107.61	1098.49	1320.77	1146.02
12/13/96	23:00		1185.88					1242.86	1057.46	1052.19	1320.25	1131.47
12/14/96	0:00		1185.68					1255.42	1064.44	1038.24	1322.92	1116.43
12/14/96	1:00		1220.12					1237.27	1126.97	1102.52	1323.19	1115.19
12/14/96	2:00		1250.67					1242.65	1169.98	1140.23	1323.29	1127.82
12/14/96	3:00		1250.99					1235.43	1169.79	1147.45	1307.43	1139.14

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		MAIN CHAMBER GLASS TOP	MAIN CHAMBER GLASS BOTTOM	WEST CHAMBER GLASS	WEST CHAMBER IR GLASS	EAST CHAMBER GLASS	EAST CHAMBER IR GLASS	DISCH CHAMBER GLASS	WEST CHAMBER PLENUM	EAST CHAMBER PLENUM	DISCH CHAMBER PLENUM	MAIN REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/14/96	4:00		1249.12					1239.37	1144.47	1125.67	1323.11	1145.27
12/14/96	5:00		1244.58					1212.24	1102.90	1085.12	1323.28	1147.39
12/14/96	6:00		1216.78					1230.36	985.74	930.84	1323.18	1142.39
12/14/96	7:00		1220.97					1209.09	905.65	832.95	1329.14	1132.55
12/14/96	8:00		1237.92					1274.08	846.12	783.82	1338.19	1135.15
12/14/96	9:00		1251.72					1071.22	995.87	972.49	1025.05	1140.83
12/14/96	10:00		1255.44					719.14	1081.37	1057.75	657.21	1144.14
12/14/96	11:00		1245.25					378.83	1089.80	1061.44	330.43	1145.23
12/14/96	12:00		1237.10					510.83	1085.54	1056.91	295.72	1142.14
12/14/96	13:00		1236.34					336.98	1087.81	1053.52	182.58	1139.56
12/14/96	14:00		1237.11					362.41	1084.38	1054.66	165.17	1138.25
12/14/96	15:00		1239.51					374.52	1092.43	1065.56	166.33	1138.23
12/14/96	16:00		1241.14					349.89	1098.34	1062.85	151.67	1139.06
12/14/96	17:00		1243.06					341.08	1105.71	1067.45	163.37	1140.01
12/14/96	18:00		1244.27					329.69	1109.70	1067.17	172.58	1141.42
12/14/96	19:00		1243.66					321.90	1111.17	1067.89	189.50	1142.51
12/14/96	20:00		1241.97					321.18	1087.38	1053.85	253.61	1143.26
12/14/96	21:00		1219.79					341.41	986.58	951.24	360.34	1139.11
12/14/96	22:00		1201.38					356.28	960.49	931.08	456.87	1127.59
12/14/96	23:00		1203.40					414.40	984.67	953.44	535.42	1116.78
12/15/96	0:00		1231.42					510.04	1055.86	1019.95	695.27	1116.47
12/15/96	1:00		1241.61					703.34	1084.91	1052.82	983.15	1124.32
12/15/96	2:00		1241.86					957.89	1095.97	1063.31	1190.81	1128.97
12/15/96	3:00		1245.67					979.90	1099.62	1071.82	1177.25	1132.62
12/15/96	4:00		1233.26					1088.52	949.08	874.37	1303.18	1134.70
12/15/96	5:00		1224.71					1154.30	824.22	772.15	1306.97	1131.18
12/15/96	6:00		1222.71					1142.81	792.15	772.30	1292.42	1128.40
12/15/96	7:00		1228.37					1163.16	753.22	738.39	1285.66	1127.44
12/15/96	8:00		1237.59					1193.32	734.22	712.11	1250.98	1127.84
12/15/96	9:00		1252.63					1195.12	692.04	682.57	1316.39	1133.00
12/15/96	10:00		1249.96					1201.86	670.16	669.60	1321.80	1138.97
12/15/96	11:00		1256.79					1231.38	694.15	701.38	1322.27	1142.85
12/15/96	12:00		1256.32					1183.31	794.36	777.13	1313.26	1146.44
12/15/96	13:00		1249.94					1148.21	820.22	803.72	1223.02	1143.80
12/15/96	14:00		1250.33					702.07	986.69	970.91	666.60	1141.07
12/15/96	15:00		1250.67					635.29	1043.96	1026.22	599.09	1140.49
12/15/96	16:00		1251.90					600.36	1078.12	1057.43	643.71	1142.40
12/15/96	17:00		1252.47					638.40	1036.60	1017.75	827.04	1145.53
12/15/96	18:00		1242.43					677.39	891.61	856.33	889.48	1145.41
12/15/96	19:00		1236.55					768.24	915.60	893.42	984.24	1148.61
12/15/96	20:00		1228.43					996.99	971.37	947.00	1210.54	1146.04
12/15/96	21:00		1208.24					1105.91	1023.71	1005.33	1296.75	1131.91
12/15/96	22:00		1218.45					1127.74	1022.91	1000.54	1297.00	1125.15
12/15/96	23:00		1253.15					1130.60	1023.27	1003.33	1296.91	1128.80
12/16/96	0:00		1217.53					1129.29	1035.16	1003.89	1296.78	1130.94
12/16/96	1:00		1219.08					1108.15	1078.86	1050.44	1296.34	1124.14
12/16/96	2:00		1229.34					1098.20	962.09	927.22	1296.75	1125.34
12/16/96	3:00		1222.82					1129.90	922.80	885.34	1296.87	1128.09
12/16/96	4:00		1222.82					1153.77	822.69	779.66	1296.54	1126.82
12/16/96	5:00		1227.28					1191.96	796.14	765.23	1296.88	1126.30
12/16/96	6:00		1241.14					1193.28	786.93	757.34	1296.59	1128.55
12/16/96	7:00		1244.08					1191.70	763.05	740.68	1302.59	1131.53
12/16/96	8:00		1247.55					1139.56	856.52	828.21	1310.39	1133.83

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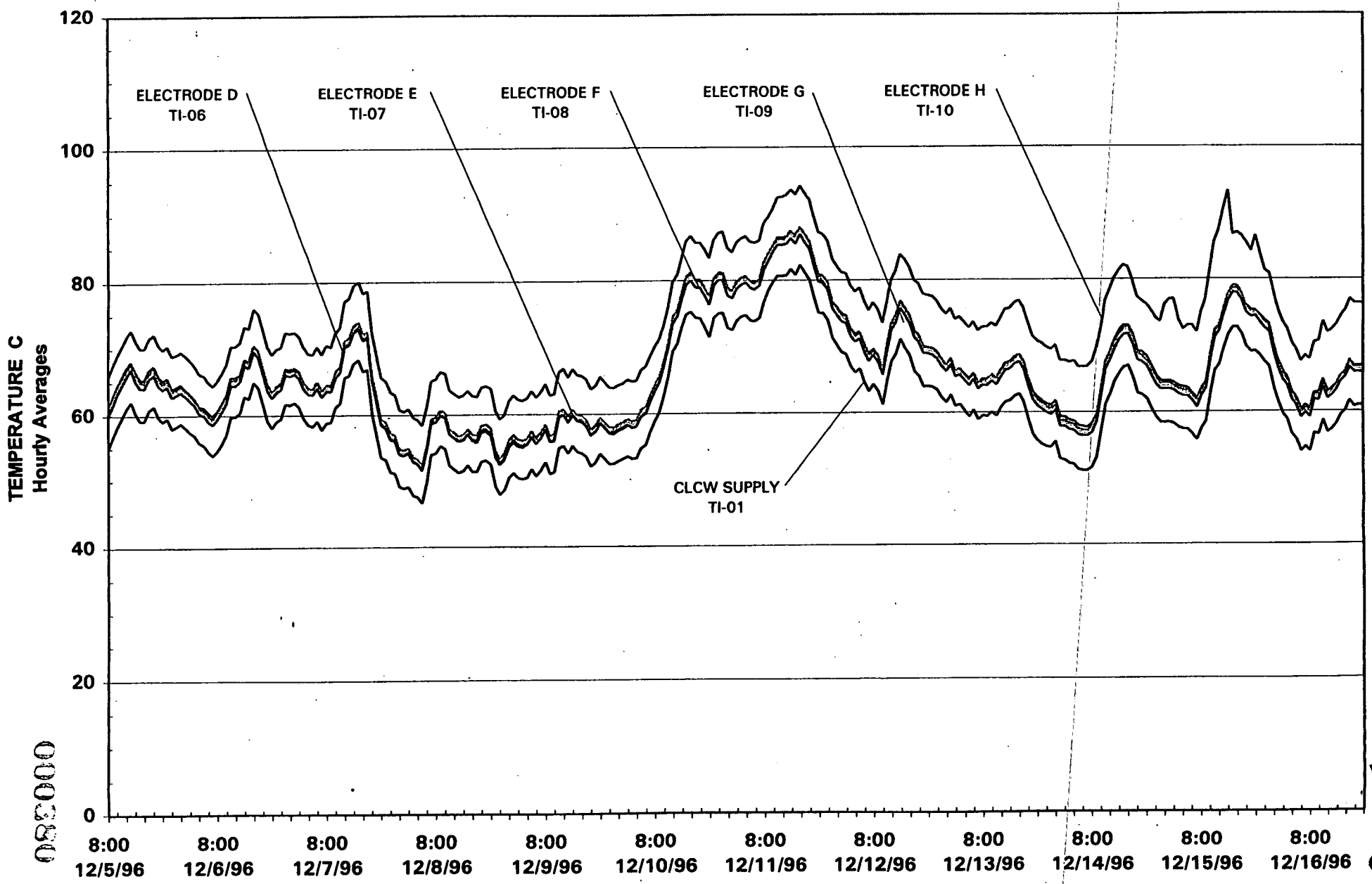
VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		MAIN CHAMBER GLASS TOP TI-4S	MAIN CHAMBER GLASS BOTTOM TI-2S	WEST CHAMBER GLASS TI-5S	WEST CHAMBER IR GLASS TI-IRW	EAST CHAMBER GLASS TI-6S	EAST CHAMBER IR GLASS TI-IRE	DISCH CHAMBER GLASS TI-9S	WEST CHAMBER PLENUM TI-7S	EAST CHAMBER PLENUM TI-8S	DISCH CHAMBER PLENUM TI-10S	MAIN REFRACTORY TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/16/96	9:00		1240.37					1194.50	933.17	902.10	1317.41	1133.76
12/16/96	10:00		1245.20					1157.88	804.97	765.25	1327.59	1133.24
12/16/96	11:00		1240.95					1223.47	754.40	714.68	1327.74	1134.56
12/16/96	12:00		1244.86					1180.82	760.47	732.49	1327.69	1134.09
12/16/96	13:00		1241.67					1168.68	746.30	697.43	1327.21	1131.48
12/16/96	14:00		1245.16					1202.73	703.85	648.74	1327.11	1130.20
12/16/96	15:00		1246.96					1221.52	686.01	647.34	1327.08	1129.67
12/16/96	16:00		1236.75					1189.98	693.22	660.09	1327.06	1128.12
12/16/96	17:00		1225.96					1185.77	715.88	677.15	1327.28	1128.92
12/16/96	18:00		1247.71					1190.34	708.60	668.87	1326.84	1133.97
12/16/96	19:00		1249.31					1154.14	691.28	650.40	1326.89	1136.58
12/16/96	20:00		1247.30					1144.64	715.72	683.11	1327.02	1140.37

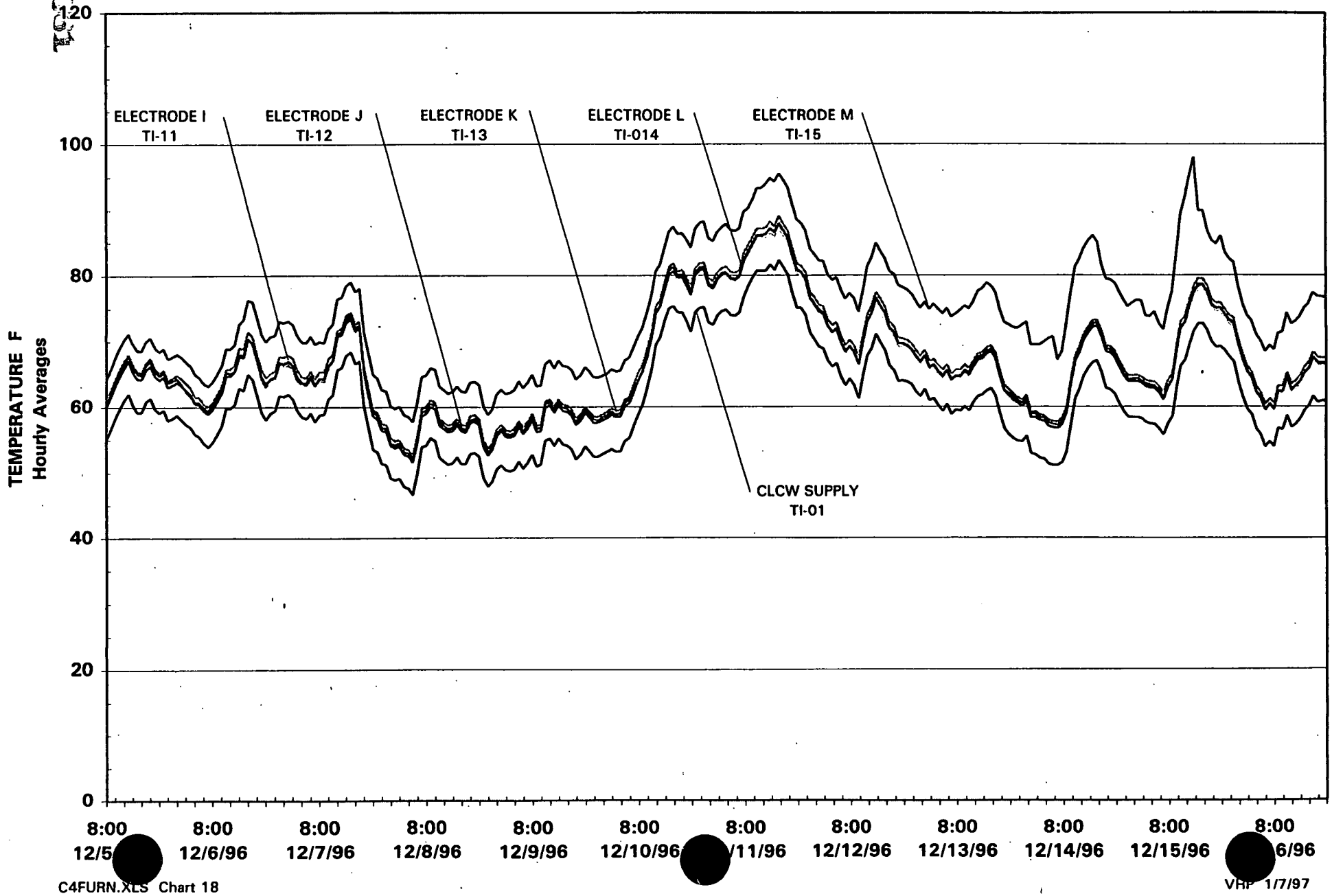
CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM
EAST ELECTRODE CLCW RETURN



C4FURN.XLS Chart 16

VHP 1/7/97

CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM
WEST ELECTRODE CLCW RETURN



C4FURN.XLS Chart 18

VHP 1/7/97

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/5/96	8:00	55.05	61.31	60.42	60.83	60.05	65.95	60.88	60.20	61.12	60.09	64.34
12/5/96	9:00	56.62	62.85	61.99	62.32	61.54	67.45	62.34	61.69	62.62	61.63	65.82
12/5/96	10:00	58.25	64.38	63.60	63.92	63.19	69.04	63.90	63.29	64.16	63.20	67.44
12/5/96	11:00	59.72	65.86	65.11	65.41	64.56	70.51	65.42	64.74	65.67	64.69	68.94
12/5/96	12:00	61.08	67.18	66.43	66.76	65.89	71.89	66.71	66.06	67.03	66.00	70.26
12/5/96	13:00	62.04	68.12	67.41	67.77	66.91	72.85	67.75	67.14	68.00	67.04	71.19
12/5/96	14:00	60.32	66.53	65.75	66.07	65.22	71.27	66.06	65.34	66.39	65.32	69.64
12/5/96	15:00	59.20	65.43	64.64	65.09	64.17	70.16	65.03	64.38	65.36	64.30	68.60
12/5/96	16:00	59.23	65.37	64.60	64.92	64.13	70.17	64.89	64.23	65.22	64.21	68.54
12/5/96	17:00	60.83	66.91	66.17	66.47	65.60	71.63	66.43	65.81	66.81	65.73	70.03
12/5/96	18:00	61.31	67.42	66.71	66.98	66.07	72.14	66.94	66.31	67.35	66.19	70.56
12/5/96	19:00	59.74	65.89	65.11	65.48	64.57	70.62	65.46	64.82	65.79	64.73	69.05
12/5/96	20:00	59.10	65.29	64.46	64.80	63.93	69.93	64.78	64.19	65.22	64.10	68.45
12/5/96	21:00	59.55	65.59	64.85	65.25	64.38	70.44	65.26	64.62	65.54	64.58	68.85
12/5/96	22:00	58.00	63.98	63.33	63.66	62.78	68.95	63.68	63.10	64.03	63.02	67.31
12/5/96	23:00	58.36	64.28	63.61	64.02	63.13	69.23	64.01	63.41	64.39	63.38	67.68
12/6/96	0:00	58.77	64.65	63.96	64.32	63.47	69.58	64.29	63.80	64.85	63.73	68.05
12/6/96	1:00	58.12	63.96	63.39	63.80	62.96	69.05	63.44	63.35	64.29	63.35	67.59
12/6/96	2:00	57.41	63.18	62.53	63.04	62.17	68.28	62.39	62.46	63.65	62.60	66.89
12/6/96	3:00	56.93	62.43	61.81	62.26	61.51	67.50	61.68	61.84	62.93	61.96	66.23
12/6/96	4:00	55.89	61.30	60.59	61.02	60.27	66.30	60.67	60.57	61.57	60.56	65.02
12/6/96	5:00	55.48	61.14	60.45	60.78	59.99	65.96	60.64	60.43	61.45	60.39	64.48
12/6/96	6:00	54.49	60.32	59.59	59.92	59.07	65.00	59.84	59.51	60.42	59.41	63.60
12/6/96	7:00	53.88	59.93	59.10	59.48	58.62	64.47	59.36	59.06	60.01	58.98	63.19
12/6/96	8:00	54.59	60.56	59.83	60.23	59.41	65.18	60.19	59.75	60.64	59.66	63.78
12/6/96	9:00	55.69	61.79	61.02	61.42	60.57	66.33	61.36	60.84	61.86	60.79	64.92
12/6/96	10:00	57.11	63.11	62.35	62.72	61.88	67.75	62.65	62.09	63.11	62.08	66.28
12/6/96	11:00	59.83	65.70	64.96	65.34	64.53	70.42	65.23	64.72	65.70	64.71	68.86
12/6/96	12:00	59.81	65.70	64.98	65.31	64.50	70.44	65.09	64.79	65.76	64.73	68.88
12/6/96	13:00	60.39	66.14	65.53	65.88	65.11	71.00	65.32	65.46	66.41	65.46	69.46
12/6/96	14:00	62.87	68.47	67.89	68.28	67.49	73.37	67.65	67.89	68.99	67.95	72.66
12/6/96	15:00	62.54	68.14	67.64	67.97	67.19	73.12	67.48	67.66	68.86	67.81	73.39
12/6/96	16:00	64.95	70.60	70.17	70.56	69.64	76.02	70.12	70.12	71.53	70.42	76.28
12/6/96	17:00	64.15	69.70	69.32	69.76	68.82	75.34	69.40	69.15	70.67	69.69	76.05
12/6/96	18:00	61.71	67.24	66.82	67.32	66.33	72.95	66.92	66.73	67.95	67.05	73.63
12/6/96	19:00	59.20	64.66	64.26	64.75	63.81	70.38	64.23	64.37	65.62	64.58	71.09
12/6/96	20:00	58.08	63.51	63.14	63.55	62.61	69.21	63.04	63.26	64.44	63.45	69.97
12/6/96	21:00	59.04	64.36	63.99	64.41	63.47	69.96	64.25	63.94	65.09	64.22	70.71
12/6/96	22:00	59.45	64.75	64.38	64.80	63.92	70.24	64.47	64.20	65.47	64.58	70.93
12/6/96	23:00	61.69	66.86	66.55	67.02	66.12	72.43	66.78	66.43	67.67	66.67	73.07
12/7/96	0:00	61.57	66.70	66.43	66.91	65.95	72.32	66.22	66.23	67.56	66.53	72.89
12/7/96	1:00	61.91	66.88	66.66	67.16	66.24	72.51	66.37	66.65	67.91	66.87	73.14
12/7/96	2:00	61.20	66.43	66.13	66.59	65.60	71.88	65.96	66.09	67.32	66.33	72.62
12/7/96	3:00	59.55	64.84	64.50	64.97	64.02	70.29	64.05	64.43	65.63	64.59	70.96
12/7/96	4:00	58.53	64.03	63.72	64.01	63.17	69.27	63.41	63.49	64.60	63.68	69.90

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/7/96	5:00	58.27	63.96	63.65	63.94	63.12	69.18	63.73	63.21	64.41	63.44	69.78
12/7/96	6:00	59.05	64.97	64.53	64.95	64.05	70.26	64.79	64.18	65.39	64.37	70.76
12/7/96	7:00	57.78	63.68	63.26	63.69	62.75	69.20	63.33	63.09	64.22	63.28	69.55
12/7/96	8:00	58.80	64.54	64.06	64.55	63.65	70.52	64.03	64.13	65.32	64.28	69.93
12/7/96	9:00	58.94	64.41	63.92	64.34	63.55	70.24	63.87	63.99	65.27	64.27	69.78
12/7/96	10:00	61.16	66.49	66.02	66.50	65.64	72.32	66.19	65.75	67.27	66.30	71.89
12/7/96	11:00	61.79	66.98	66.84	67.29	66.46	73.21	66.99	66.51	67.96	67.04	72.67
12/7/96	12:00	65.64	70.63	70.75	71.17	70.21	77.14	71.02	70.42	71.64	70.81	76.47
12/7/96	13:00	65.97	70.80	71.06	71.62	70.56	77.57	71.50	70.83	72.02	71.05	76.73
12/7/96	14:00	67.79	72.66	72.99	73.43	72.39	79.43	73.30	72.80	73.84	72.91	78.42
12/7/96	15:00	68.35	73.21	73.52	74.04	72.96	80.02	74.00	73.33	74.46	73.46	79.05
12/7/96	16:00	66.58	71.37	71.71	72.22	71.21	78.33	72.09	71.46	72.66	71.63	77.58
12/7/96	17:00	66.87	71.80	72.13	72.46	71.61	78.66	72.50	71.89	73.11	72.06	78.01
12/7/96	18:00	60.24	65.26	65.54	66.05	64.99	72.30	65.92	65.28	66.36	65.41	71.57
12/7/96	19:00	56.85	61.92	62.13	62.64	61.69	68.83	62.49	61.85	62.93	61.94	68.17
12/7/96	20:00	53.54	58.63	58.88	59.42	58.48	65.67	59.19	58.60	59.61	58.67	64.94
12/7/96	21:00	53.14	58.18	58.41	58.90	57.99	65.11	58.73	58.24	59.14	58.19	64.34
12/7/96	22:00	51.38	56.39	56.64	57.23	56.24	63.41	56.80	56.52	57.42	56.38	62.61
12/7/96	23:00	51.14	56.13	56.41	56.94	56.01	63.01	56.65	56.33	57.25	56.20	62.36
12/8/96	0:00	49.16	53.97	54.32	54.83	53.95	60.77	54.35	54.11	55.22	54.15	60.13
12/8/96	1:00	48.85	53.79	54.12	54.62	53.81	60.45	54.19	53.90	54.83	53.77	59.78
12/8/96	2:00	49.08	54.11	54.34	54.88	54.15	60.86	54.47	54.15	54.93	53.99	60.06
12/8/96	3:00	47.78	52.85	53.01	53.54	52.89	59.61	53.14	52.89	53.62	52.74	58.77
12/8/96	4:00	47.56	52.66	52.67	53.22	52.54	59.23	52.94	52.68	53.45	52.51	58.49
12/8/96	5:00	46.64	51.79	51.69	52.39	51.56	58.38	52.13	51.76	52.60	51.58	57.73
12/8/96	6:00	49.81	54.85	54.80	55.30	54.62	61.17	55.08	54.81	55.60	54.63	60.54
12/8/96	7:00	53.89	58.92	58.79	59.28	58.61	65.08	59.18	58.87	59.68	58.67	64.52
12/8/96	8:00	54.13	59.05	59.07	59.60	58.85	65.37	59.46	59.12	60.02	58.97	64.82
12/8/96	9:00	55.24	60.14	60.25	60.65	59.93	66.48	60.54	60.20	61.06	60.07	65.85
12/8/96	10:00	54.82	59.73	59.83	60.31	59.52	66.20	60.19	59.88	60.68	59.73	65.64
12/8/96	11:00	52.28	57.08	57.34	57.77	57.04	63.65	57.65	57.30	58.15	57.17	63.08
12/8/96	12:00	51.75	56.51	56.84	57.30	56.50	63.18	57.12	56.85	57.65	56.69	62.60
12/8/96	13:00	51.23	55.93	56.30	56.73	56.00	62.64	56.62	56.29	57.17	56.15	62.01
12/8/96	14:00	51.46	56.20	56.46	56.96	56.16	62.89	56.83	56.54	57.38	56.36	62.29
12/8/96	15:00	52.29	57.06	57.34	57.80	57.03	63.59	57.66	57.34	58.16	57.22	63.08
12/8/96	16:00	51.37	56.01	56.50	56.97	56.13	62.79	56.71	56.41	57.29	56.30	62.35
12/8/96	17:00	51.36	55.75	56.36	56.87	56.05	62.69	56.56	56.27	57.09	56.11	62.21
12/8/96	18:00	52.82	57.23	57.75	58.32	57.52	64.09	57.96	57.70	58.58	57.58	63.67
12/8/96	19:00	52.99	57.43	57.90	58.49	57.70	64.29	58.18	57.88	58.79	57.78	63.78
12/8/96	20:00	52.46	56.83	57.30	57.93	57.09	63.92	57.60	57.30	58.16	57.20	63.36
12/8/96	21:00	49.09	53.48	53.89	54.50	53.73	60.55	54.30	53.95	54.85	53.82	60.04
12/8/96	22:00	47.87	52.35	52.77	53.25	52.55	59.30	53.08	52.77	53.59	52.63	58.81
12/8/96	23:00	48.54	53.05	53.50	54.02	53.24	59.90	53.79	53.49	54.41	53.43	59.61
12/9/96	0:00	50.41	54.97	55.41	56.06	55.17	62.00	55.85	55.39	56.49	55.50	61.81
12/9/96	1:00	51.10	55.66	56.31	56.91	56.07	62.85	56.64	56.25	57.23	56.35	62.61

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/9/96	2:00	50.38	55.11	55.60	56.18	55.30	62.21	55.87	55.36	56.40	55.51	62.00
12/9/96	3:00	50.19	55.00	55.41	56.00	55.12	62.02	55.74	55.27	56.29	55.37	62.11
12/9/96	4:00	50.42	55.52	55.64	56.27	55.42	62.40	55.98	55.58	56.59	55.64	62.52
12/9/96	5:00	51.65	56.90	56.93	57.41	56.54	63.51	57.32	56.75	57.82	56.92	63.83
12/9/96	6:00	50.60	55.95	55.88	56.37	55.51	62.51	56.30	55.82	56.84	55.92	62.82
12/9/96	7:00	51.48	56.75	56.73	57.19	56.37	63.34	57.19	56.67	57.68	56.72	63.62
12/9/96	8:00	52.70	57.91	57.95	58.43	57.61	64.54	58.41	57.87	58.90	57.92	64.84
12/9/96	9:00	50.95	55.81	56.22	56.71	55.85	62.87	56.61	56.12	57.07	56.19	63.11
12/9/96	10:00	51.20	55.92	56.46	56.93	56.05	63.02	56.84	56.28	57.28	56.32	63.20
12/9/96	11:00	54.86	59.60	59.94	60.42	59.59	66.36	60.39	59.87	60.81	59.88	66.51
12/9/96	12:00	55.15	60.17	60.25	60.71	59.88	66.83	60.77	60.19	61.14	60.24	67.03
12/9/96	13:00	54.04	59.00	59.11	59.54	58.73	65.58	59.60	59.06	60.03	59.12	65.85
12/9/96	14:00	55.16	60.05	60.23	60.70	59.80	66.77	60.72	60.18	61.15	60.21	67.01
12/9/96	15:00	54.23	59.05	59.35	59.86	58.96	65.90	59.87	59.36	60.36	59.36	66.21
12/9/96	16:00	54.04	58.94	59.19	59.77	58.79	65.77	59.73	59.16	60.14	59.19	66.10
12/9/96	17:00	53.47	58.37	58.64	59.11	58.22	65.24	59.05	58.62	59.55	58.64	65.59
12/9/96	18:00	52.00	57.05	57.17	57.66	56.71	63.79	57.71	57.19	58.10	57.19	64.14
12/9/96	19:00	52.70	57.77	57.82	58.25	57.36	64.27	58.29	57.86	58.81	57.87	64.73
12/9/96	20:00	53.93	58.95	59.05	59.48	58.59	65.59	59.61	59.13	59.99	59.11	66.01
12/9/96	21:00	53.23	58.11	58.35	58.77	57.93	64.84	58.81	58.30	59.31	58.38	65.31
12/9/96	22:00	52.38	57.17	57.49	58.03	57.07	64.01	58.05	57.50	58.46	57.51	64.46
12/9/96	23:00	52.41	57.29	57.53	57.94	56.92	63.93	57.95	57.58	58.46	57.64	64.40
12/10/96	0:00	52.81	57.74	57.92	58.39	57.44	64.34	58.38	57.92	58.82	57.96	64.70
12/10/96	1:00	53.16	57.97	58.26	58.68	57.77	64.55	58.71	58.19	59.17	58.31	64.98
12/10/96	2:00	53.53	58.31	58.73	59.21	58.26	65.17	59.19	58.60	59.70	58.81	65.66
12/10/96	3:00	53.17	57.91	58.44	58.90	57.93	64.89	58.84	58.26	59.39	58.48	65.35
12/10/96	4:00	53.23	58.10	58.56	59.01	58.07	64.99	58.95	58.39	59.44	58.55	65.47
12/10/96	5:00	54.77	59.68	60.05	60.60	59.61	66.53	60.61	59.97	61.01	60.03	66.98
12/10/96	6:00	55.25	60.26	60.52	61.01	60.03	67.13	61.21	60.48	61.59	60.55	67.48
12/10/96	7:00	57.21	61.99	62.25	62.74	61.79	68.69	62.79	62.25	63.33	62.36	69.10
12/10/96	8:00	58.78	63.61	63.82	64.23	63.34	70.04	63.93	63.89	65.03	63.99	70.75
12/10/96	9:00	60.23	64.94	65.14	65.63	64.69	71.20	65.46	65.03	66.29	65.32	72.10
12/10/96	10:00	62.70	67.30	67.51	67.90	67.07	73.36	67.26	67.50	68.59	67.58	74.27
12/10/96	11:00	65.47	70.07	70.25	70.62	69.75	75.94	70.41	70.26	71.26	70.27	76.82
12/10/96	12:00	69.37	74.16	74.18	74.58	73.60	79.79	74.42	74.21	75.24	74.18	80.62
12/10/96	13:00	70.59	75.37	75.30	75.68	74.69	80.92	75.34	75.20	76.26	75.28	81.66
12/10/96	14:00	73.13	78.04	77.92	78.29	77.21	83.44	78.17	77.77	78.92	77.81	84.21
12/10/96	15:00	74.97	80.36	80.15	80.57	79.37	85.93	80.70	80.03	81.21	80.10	86.66
12/10/96	16:00	75.35	80.98	80.68	81.21	79.95	86.76	81.26	80.47	81.82	80.68	87.42
12/10/96	17:00	74.43	79.90	79.74	80.13	79.00	85.75	80.03	79.44	80.65	79.70	86.44
12/10/96	18:00	74.36	80.01	79.69	80.16	78.93	85.70	80.13	79.55	80.80	79.73	86.41
12/10/96	19:00	73.08	78.76	78.55	78.91	77.76	84.72	78.87	78.27	79.58	78.55	85.50
12/10/96	20:00	71.47	77.49	77.13	77.64	76.37	83.45	77.72	76.91	78.28	77.15	84.26
12/10/96	21:00	74.43	80.31	79.92	80.42	79.21	86.17	80.40	79.70	81.13	80.08	87.11
12/10/96	22:00	75.06	81.04	80.73	81.17	80.03	87.09	81.20	80.52	81.85	80.83	88.04

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/10/96	23:00	75.15	81.14	80.80	81.26	80.07	87.37	81.29	80.55	82.00	80.96	88.23
12/11/96	0:00	72.90	78.80	78.45	78.87	77.69	84.80	78.81	78.18	79.59	78.51	85.73
12/11/96	1:00	72.56	78.39	78.06	78.45	77.36	84.24	78.33	77.84	79.14	78.08	85.24
12/11/96	2:00	73.91	79.75	79.41	79.77	78.73	85.67	79.65	79.22	80.48	79.45	86.68
12/11/96	3:00	74.55	80.40	80.05	80.40	79.31	86.34	80.37	79.80	81.06	80.08	87.35
12/11/96	4:00	74.79	80.62	80.34	80.67	79.64	86.66	80.45	80.15	81.34	80.34	87.82
12/11/96	5:00	73.98	79.76	79.53	79.88	78.84	85.85	79.66	79.32	80.51	79.54	86.99
12/11/96	6:00	73.91	79.66	79.31	79.75	78.63	85.68	79.43	79.23	80.39	79.31	86.82
12/11/96	7:00	74.36	80.15	79.77	80.11	79.18	86.00	79.95	79.66	80.77	79.86	87.20
12/11/96	8:00	76.76	82.76	82.33	82.68	81.58	88.64	82.50	82.13	83.37	82.32	89.74
12/11/96	9:00	78.45	83.95	83.52	83.92	82.89	89.44	83.75	83.37	84.61	83.52	90.29
12/11/96	10:00	79.65	85.16	84.79	85.18	84.16	90.77	84.97	84.55	85.84	84.77	91.58
12/11/96	11:00	80.72	86.30	86.06	86.47	85.36	92.40	86.18	85.82	87.20	86.09	93.26
12/11/96	12:00	80.68	86.18	86.06	86.39	85.34	92.50	86.18	85.81	87.20	86.13	93.33
12/11/96	13:00	80.74	86.31	86.20	86.57	85.51	92.78	86.38	85.86	87.36	86.34	93.98
12/11/96	14:00	81.66	87.12	87.03	87.45	86.29	93.59	87.20	86.55	88.24	87.21	94.84
12/11/96	15:00	80.83	86.38	86.27	86.80	85.57	92.89	86.55	85.92	87.52	86.65	94.33
12/11/96	16:00	82.29	87.70	87.58	88.00	86.88	94.16	87.82	87.32	89.10	87.99	95.55
12/11/96	17:00	81.17	86.62	86.48	86.97	85.73	93.05	86.81	86.07	87.83	86.93	94.54
12/11/96	18:00	80.05	85.55	85.41	85.88	84.75	92.08	85.66	85.07	86.82	85.78	93.43
12/11/96	19:00	77.34	83.04	82.83	83.27	82.14	89.47	83.00	82.56	84.23	83.20	90.92
12/11/96	20:00	75.10	80.67	80.48	80.96	79.83	87.24	80.74	80.27	81.85	80.87	88.54
12/11/96	21:00	75.04	79.94	80.25	80.63	79.53	86.89	80.51	80.03	81.40	80.50	88.05
12/11/96	22:00	74.01	79.29	79.25	79.64	78.58	85.94	79.59	79.14	80.49	79.45	86.90
12/11/96	23:00	71.27	76.66	76.33	76.75	75.71	83.12	76.66	76.24	77.47	76.55	84.04
12/12/96	0:00	70.19	75.97	75.42	75.84	74.77	82.18	75.75	75.31	76.61	75.61	83.21
12/12/96	1:00	69.14	74.95	74.45	74.82	73.79	81.18	74.78	74.32	75.51	74.59	82.30
12/12/96	2:00	68.85	74.62	74.12	74.52	73.53	81.06	74.30	74.04	75.27	74.25	82.18
12/12/96	3:00	66.98	72.61	72.22	72.58	71.58	79.15	72.40	72.10	73.31	72.37	80.10
12/12/96	4:00	66.07	71.82	71.31	71.68	70.73	78.23	71.47	71.22	72.44	71.36	79.31
12/12/96	5:00	66.58	72.19	71.79	72.12	71.17	78.81	71.93	71.69	72.88	71.84	79.64
12/12/96	6:00	64.51	70.20	69.69	70.10	69.15	76.83	69.90	69.65	70.83	69.85	77.77
12/12/96	7:00	63.24	68.80	68.30	68.71	67.77	75.45	68.43	68.20	69.33	68.36	76.41
12/12/96	8:00	64.21	69.58	69.11	69.55	68.62	76.59	69.17	69.02	70.13	69.22	77.30
12/12/96	9:00	63.28	68.64	68.29	68.66	67.76	75.64	68.36	68.12	69.30	68.30	76.52
12/12/96	10:00	61.20	66.58	66.37	66.63	65.70	73.56	66.55	66.37	67.52	66.45	74.50
12/12/96	11:00	64.77	70.21	69.75	70.12	69.17	76.60	70.04	69.80	70.90	69.90	77.72
12/12/96	12:00	67.68	73.33	72.83	73.10	72.33	79.92	73.03	72.86	74.00	72.98	81.36
12/12/96	13:00	68.85	74.61	74.09	74.50	73.58	81.40	74.38	74.05	75.32	74.34	82.74
12/12/96	14:00	71.05	76.85	76.33	76.75	75.76	83.77	76.58	76.34	77.41	76.42	84.87
12/12/96	15:00	69.72	75.78	75.19	75.68	74.69	83.07	75.40	75.19	76.40	75.38	83.70
12/12/96	16:00	68.59	74.64	74.09	74.48	73.50	81.93	74.27	74.05	75.21	74.31	82.54
12/12/96	17:00	66.19	72.35	71.85	72.23	71.35	79.92	72.05	71.63	72.99	72.07	80.60
12/12/96	18:00	65.50	71.66	71.11	71.57	70.61	79.40	71.27	70.90	72.20	71.34	80.12
12/12/96	19:00	63.87	69.95	69.43	69.85	68.94	77.82	69.64	69.19	70.47	69.64	78.45

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/12/96	20:00	63.95	69.84	69.36	69.80	68.92	77.63	69.63	69.16	70.38	69.57	78.17
12/12/96	21:00	63.80	69.67	69.15	69.57	68.63	77.49	69.33	68.91	70.15	69.29	77.81
12/12/96	22:00	63.38	69.10	68.56	69.00	68.10	76.78	68.77	68.36	69.58	68.69	77.16
12/12/96	23:00	62.25	67.98	67.46	67.89	66.96	75.69	67.71	67.29	68.51	67.59	76.06
12/13/96	0:00	61.53	67.21	66.69	67.15	66.17	74.85	66.81	66.55	67.63	66.78	75.06
12/13/96	1:00	62.61	68.06	67.62	68.02	67.17	75.67	67.71	67.43	68.59	67.70	75.95
12/13/96	2:00	60.94	66.32	65.89	66.30	65.41	74.09	65.92	65.71	66.90	65.98	74.89
12/13/96	3:00	61.20	66.58	66.26	66.54	65.64	74.39	66.33	66.02	67.11	66.28	75.68
12/13/96	4:00	60.19	65.74	65.28	65.69	64.77	73.51	65.46	65.11	66.28	65.35	74.88
12/13/96	5:00	59.33	65.02	64.51	64.92	64.02	72.77	64.65	64.32	65.59	64.59	74.22
12/13/96	6:00	60.31	65.85	65.40	65.80	64.93	73.62	65.54	65.26	66.38	65.48	75.04
12/13/96	7:00	58.86	64.43	64.06	64.38	63.54	72.36	64.15	63.87	64.94	64.06	73.69
12/13/96	8:00	59.52	65.03	64.58	64.96	64.08	72.83	64.68	64.49	65.56	64.63	74.20
12/13/96	9:00	59.36	64.99	64.49	64.94	64.04	72.88	64.63	64.41	65.61	64.63	74.75
12/13/96	10:00	60.02	65.67	65.17	65.64	64.70	73.44	65.54	65.10	66.34	65.43	75.41
12/13/96	11:00	59.42	65.17	64.66	65.07	64.17	73.02	65.20	64.65	65.78	64.87	74.98
12/13/96	12:00	60.72	66.38	65.99	66.28	65.34	74.26	66.44	65.92	66.95	66.15	76.11
12/13/96	13:00	61.56	67.36	66.90	67.27	66.35	75.53	67.49	66.88	68.03	67.13	77.61
12/13/96	14:00	61.74	67.62	67.12	67.47	66.54	75.69	67.79	67.13	68.21	67.37	77.99
12/13/96	15:00	62.41	68.37	67.81	68.24	67.29	76.45	68.42	67.82	68.93	68.08	78.87
12/13/96	16:00	62.73	68.70	68.20	68.63	67.60	76.80	68.73	68.17	69.26	68.45	78.40
12/13/96	17:00	61.52	67.56	66.98	67.47	66.52	75.78	67.56	66.97	68.12	67.27	77.35
12/13/96	18:00	58.92	65.06	64.44	64.91	63.99	73.48	64.85	64.40	65.55	64.65	74.78
12/13/96	19:00	56.63	62.92	62.32	62.70	61.83	71.41	62.57	62.14	63.33	62.49	72.88
12/13/96	20:00	55.70	62.23	61.57	61.94	61.01	70.76	61.96	61.47	62.52	61.73	72.57
12/13/96	21:00	55.12	61.65	60.84	61.41	60.44	70.37	61.45	60.78	61.89	61.07	72.14
12/13/96	22:00	54.74	61.26	60.50	60.84	59.96	69.82	60.95	60.50	61.39	60.58	72.01
12/13/96	23:00	54.67	61.00	60.15	60.51	59.62	69.54	60.51	60.09	60.97	60.11	72.53
12/14/96	0:00	55.50	61.70	60.82	61.16	60.28	70.11	61.28	60.72	61.69	60.70	72.91
12/14/96	1:00	52.90	59.26	58.44	58.70	57.84	67.77	58.89	58.34	59.24	58.31	69.42
12/14/96	2:00	52.66	59.24	58.40	58.73	57.80	67.76	58.92	58.38	59.25	58.34	69.38
12/14/96	3:00	52.16	58.75	57.91	58.26	57.32	67.50	58.36	57.83	58.75	57.94	69.41
12/14/96	4:00	52.01	58.61	57.81	58.15	57.18	67.70	58.26	57.74	58.58	57.80	69.86
12/14/96	5:00	51.24	57.93	56.99	57.42	56.48	66.83	57.53	56.92	57.91	57.00	70.42
12/14/96	6:00	51.10	57.80	56.85	57.23	56.34	66.83	57.28	56.75	57.74	56.81	70.67
12/14/96	7:00	51.08	57.67	56.77	57.15	56.35	66.86	57.16	56.59	57.61	56.72	67.11
12/14/96	8:00	51.52	58.22	57.37	57.75	56.82	67.59	57.68	57.17	58.22	57.32	68.33
12/14/96	9:00	53.08	59.62	59.04	59.37	58.50	69.75	59.29	58.85	59.89	59.02	72.56
12/14/96	10:00	57.28	63.74	63.22	63.57	62.70	72.55	63.49	62.94	64.07	63.22	77.27
12/14/96	11:00	61.19	67.61	66.95	67.30	66.44	76.79	67.32	66.72	67.74	66.90	81.33
12/14/96	12:00	62.63	68.97	68.30	68.73	67.79	78.29	68.66	67.99	69.05	68.20	82.50
12/14/96	13:00	64.61	70.87	70.23	70.55	69.57	80.11	70.51	69.96	70.94	70.13	84.25
12/14/96	14:00	65.88	72.23	71.46	71.78	70.89	81.29	71.80	71.18	72.29	71.37	85.37
12/14/96	15:00	66.74	73.05	72.38	72.63	71.64	82.16	72.67	72.03	73.12	72.26	86.11
12/14/96	16:00	66.95	73.09	72.46	72.85	71.75	81.87	72.84	72.27	73.26	72.40	85.09

VITRIFICATION PILOT PLANT FURNACE SYSTEM

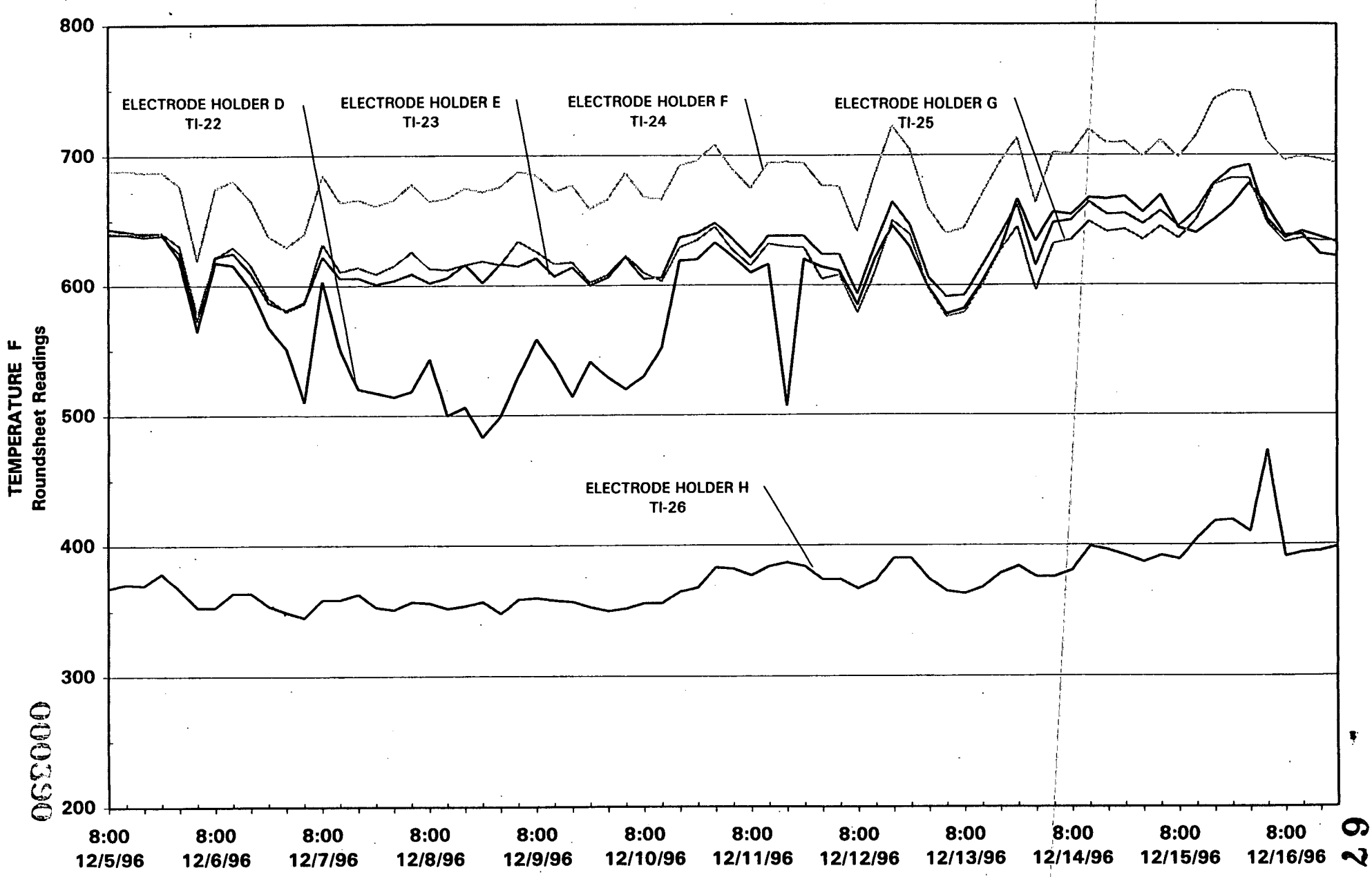
CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/14/96	17:00	65.22	71.61	70.89	71.25	70.18	79.80	71.25	70.63	71.70	70.79	81.58
12/14/96	18:00	62.78	69.15	68.50	68.85	67.81	77.35	68.84	68.23	69.26	68.40	79.45
12/14/96	19:00	62.56	69.07	68.33	68.62	67.59	76.78	68.59	68.02	69.11	68.19	79.30
12/14/96	20:00	61.92	68.40	67.54	67.91	66.92	76.28	67.89	67.37	68.41	67.47	78.84
12/14/96	21:00	60.46	66.93	66.13	66.51	65.52	75.22	66.47	65.94	66.93	66.06	77.51
12/14/96	22:00	59.25	65.64	64.81	65.24	64.18	74.17	64.99	64.54	65.62	64.69	76.24
12/14/96	23:00	58.41	64.69	63.98	64.34	63.43	73.65	64.09	63.71	64.64	63.84	75.26
12/15/96	0:00	58.39	64.59	63.91	64.31	63.43	76.22	64.15	63.78	64.62	63.80	75.86
12/15/96	1:00	58.40	64.65	63.95	64.29	63.46	76.98	64.23	63.78	64.73	63.87	76.28
12/15/96	2:00	58.17	64.41	63.71	63.96	63.20	77.05	63.88	63.47	64.44	63.62	76.15
12/15/96	3:00	57.59	63.90	63.16	63.52	62.66	73.89	63.47	62.96	63.92	63.04	73.92
12/15/96	4:00	57.37	63.74	62.98	63.28	62.36	72.47	63.24	62.78	63.77	62.89	73.77
12/15/96	5:00	57.31	63.56	62.84	63.23	62.31	73.03	63.14	62.71	63.70	62.77	74.46
12/15/96	6:00	56.60	62.80	62.08	62.48	61.61	73.09	62.43	62.00	63.02	62.08	72.79
12/15/96	7:00	55.67	61.84	61.09	61.55	60.64	72.03	61.44	61.05	62.05	61.09	71.81
12/15/96	8:00	57.44	63.51	62.82	63.29	62.47	75.16	62.98	62.80	63.86	62.93	74.88
12/15/96	9:00	58.56	64.52	63.98	64.31	63.49	76.92	64.06	63.87	64.97	64.13	77.63
12/15/96	10:00	62.76	68.68	68.12	68.51	67.70	81.27	68.22	67.97	69.30	68.39	83.51
12/15/96	11:00	66.21	72.23	71.72	72.06	71.20	85.66	71.71	71.60	72.99	72.13	89.37
12/15/96	12:00	67.12	73.10	72.62	73.08	72.15	87.42	72.70	72.53	73.84	73.00	92.00
12/15/96	13:00	69.57	75.24	75.02	75.61	74.68	90.68	75.12	75.02	76.38	75.57	95.28
12/15/96	14:00	71.57	77.00	77.24	77.70	76.70	93.18	77.05	76.91	78.35	77.57	97.98
12/15/96	15:00	72.71	78.45	78.40	78.98	77.98	86.74	78.44	78.09	79.51	78.68	89.91
12/15/96	16:00	72.75	78.71	78.43	78.96	77.91	87.01	78.56	78.15	79.47	78.62	89.94
12/15/96	17:00	71.69	77.73	77.41	77.85	76.90	86.53	77.59	77.11	78.43	77.58	86.93
12/15/96	18:00	69.82	75.97	75.53	75.97	74.98	85.48	75.63	75.20	76.48	75.68	85.34
12/15/96	19:00	69.04	75.35	74.89	75.28	74.30	84.12	75.00	74.58	75.80	75.02	84.82
12/15/96	20:00	69.14	75.31	74.97	75.35	74.47	86.51	75.05	74.61	75.89	75.07	86.08
12/15/96	21:00	68.52	74.54	74.11	74.47	73.52	83.82	74.13	73.62	74.85	74.17	83.56
12/15/96	22:00	67.57	73.70	73.20	73.56	72.60	81.33	73.30	72.76	73.99	73.23	82.55
12/15/96	23:00	66.83	73.22	72.67	73.09	72.09	80.80	72.98	72.44	73.59	72.78	82.04
12/16/96	0:00	63.64	70.01	69.47	69.88	68.98	77.74	69.64	69.10	70.27	69.49	78.25
12/16/96	1:00	61.40	67.72	67.11	67.53	66.60	75.27	67.28	66.83	67.89	67.13	75.78
12/16/96	2:00	59.60	66.03	65.25	65.69	64.79	73.46	65.46	65.09	66.13	65.33	74.01
12/16/96	3:00	58.76	65.06	64.34	64.80	63.90	72.47	64.57	64.20	65.16	64.42	73.15
12/16/96	4:00	56.60	62.95	62.23	62.68	61.80	70.41	62.39	62.06	63.09	62.34	71.10
12/16/96	5:00	55.74	62.01	61.28	61.65	60.85	69.35	61.44	61.14	62.19	61.37	70.05
12/16/96	6:00	53.86	60.19	59.46	59.81	59.03	67.61	59.64	59.38	60.41	59.56	68.39
12/16/96	7:00	54.62	60.92	60.28	60.65	59.78	68.43	60.45	60.19	61.20	60.37	69.27
12/16/96	8:00	53.90	60.28	59.52	60.00	59.11	67.90	59.58	59.44	60.48	59.64	68.68
12/16/96	9:00	56.65	62.83	62.17	62.63	61.75	70.40	62.35	62.12	63.18	62.40	71.15
12/16/96	10:00	56.48	62.81	62.16	62.53	61.66	70.60	62.22	62.04	63.15	62.28	71.44
12/16/96	11:00	58.63	64.75	64.19	64.62	63.69	73.52	64.15	64.08	65.15	64.37	74.27
12/16/96	12:00	56.81	63.00	62.41	62.88	61.93	71.94	62.43	62.27	63.45	62.63	72.72
12/16/96	13:00	57.31	63.45	63.00	63.33	62.40	72.34	63.00	62.81	63.90	63.17	73.08

VITRIFICATION PILOT PLANT FURNACE SYSTEM												
CAMPAIGN 4 SERIES A GLASS												
		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/16/96	14:00	58.16	64.17	63.71	64.15	63.26	73.12	63.66	63.59	64.68	63.91	73.89
12/16/96	15:00	59.41	65.40	64.94	65.39	64.50	74.46	64.89	64.83	66.02	65.18	75.03
12/16/96	16:00	60.07	66.04	65.61	66.03	65.15	75.34	65.52	65.49	66.70	65.80	75.71
12/16/96	17:00	61.56	67.70	67.19	67.68	66.66	76.97	67.37	67.11	68.27	67.45	77.38
12/16/96	18:00	60.67	66.83	66.42	66.92	65.94	76.35	66.48	66.23	67.44	66.67	76.85
12/16/96	19:00	60.88	66.81	66.46	66.89	65.96	76.39	66.49	66.29	67.37	66.63	76.77
12/16/96	20:00	60.84	66.85	66.41	66.86	65.90	76.32	66.49	66.22	67.35	66.60	76.62

FURNACE SYSTEM

CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM
EAST ELECTRODE HOLDER TEMPERATURES

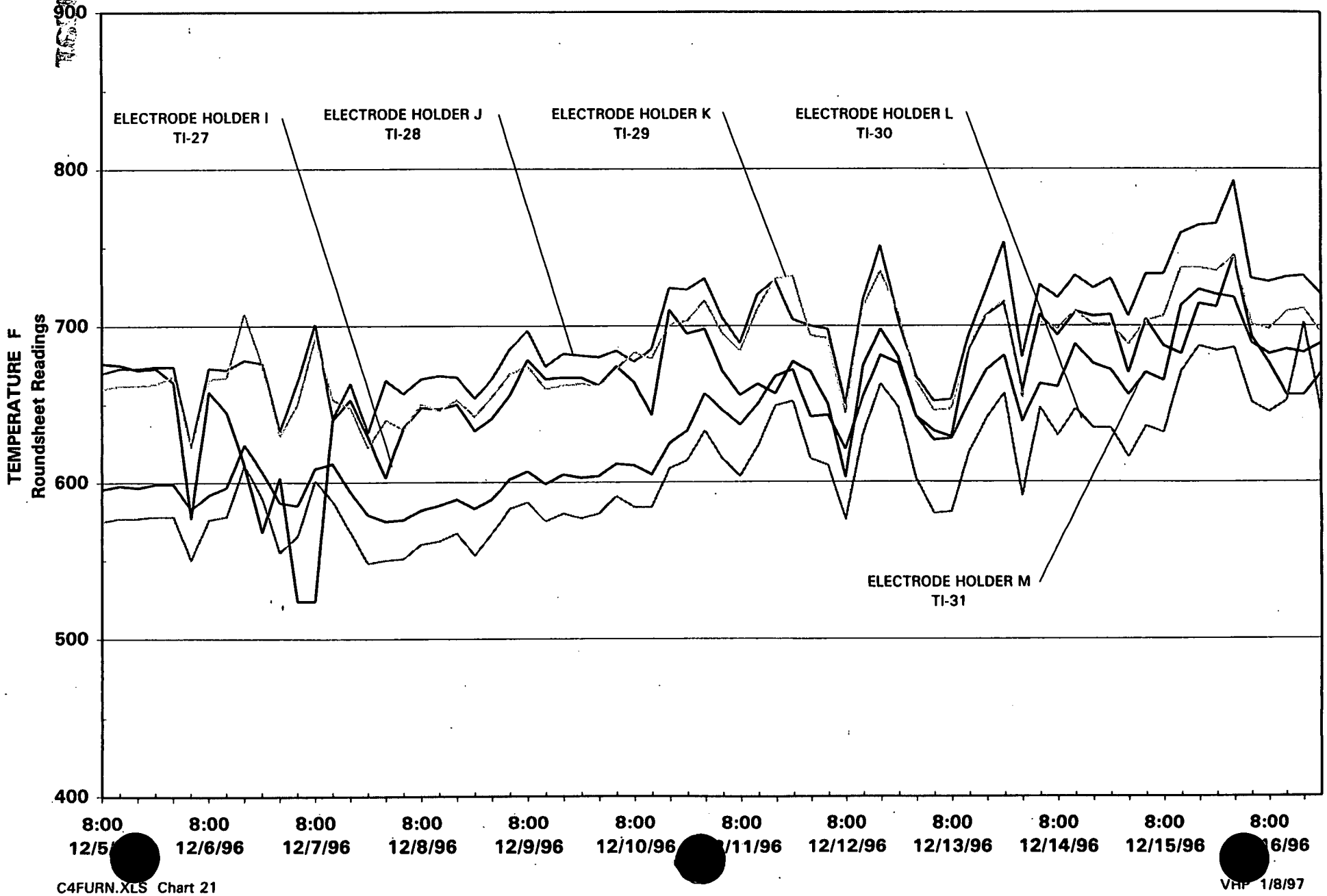


C4FURN.XLS Chart 19

VHP 1/8/97

000330

CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM
WEST ELECTRODE HOLDER TEMPERATURES



C4FURN.XLS Chart 21

VHP 1/8/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

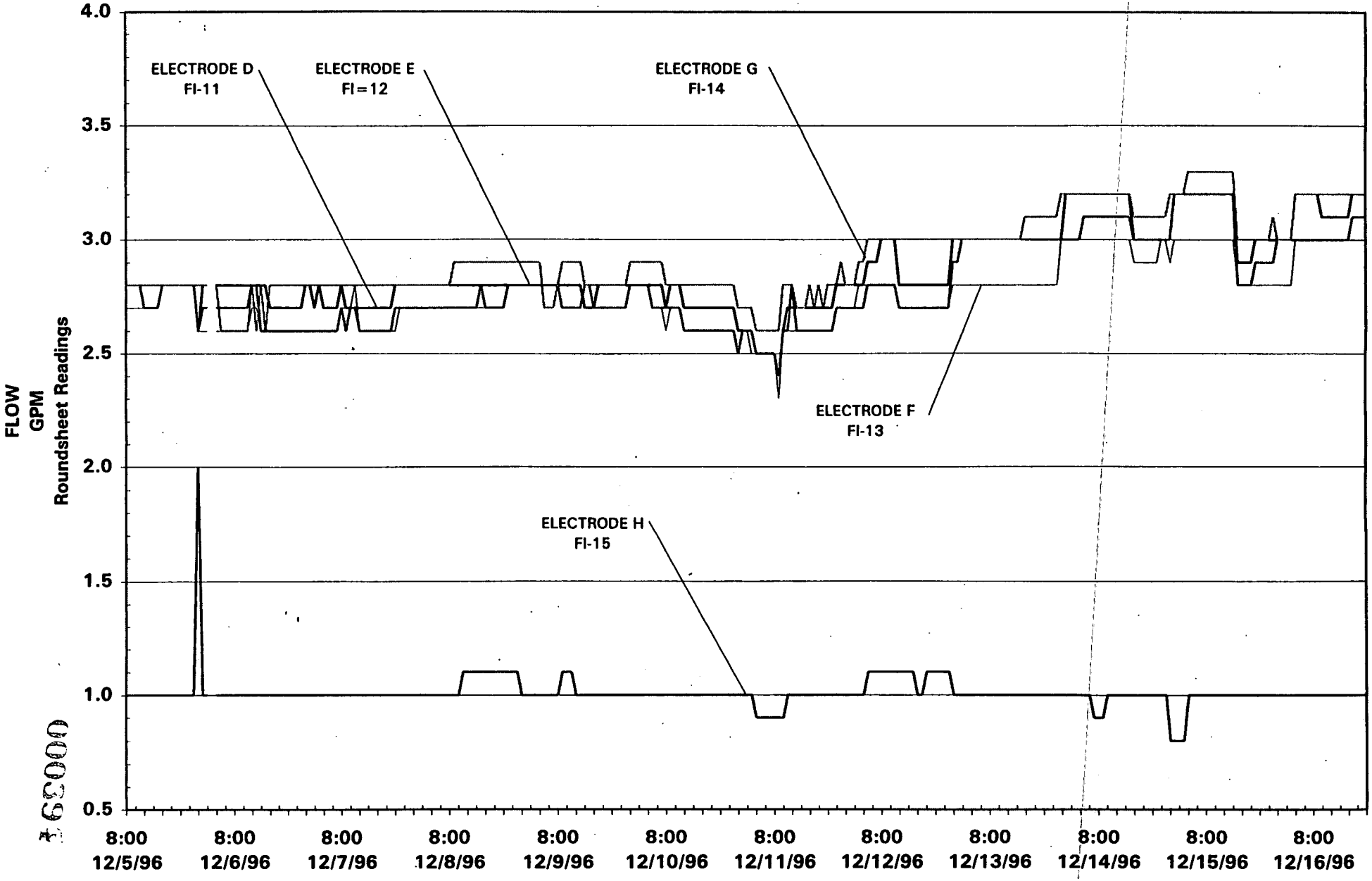
READINGS		HOURLY READINGS ROUNDSHEETS ELECTRODE HOLDER TEMPERATURES									
		D	E	F	G	H	I	J	K	L	M
		TI-022	TI-023	TI-024	TI-025	TI-026	TI-027	TI-028	TI-029	TI-030	TI-031
DATE	HOUR	F	F	F	F	F	F	F	F	F	F
12/5/96	8:00	644	640	688	641	368	676	670	660	575	596
12/5/96	12:00	642	640	689	641	371	675	673	662	577	598
12/5/96	16:00	640	638	687	641	370	672	673	662	577	597
12/5/96	20:00	641	639	688	641	379	673	674	663	578	599
12/6/96	0:00	620	625	677	631	367	664	674	668	578	599
12/6/96	4:00	565	573	619	576	353	577	622	622	550	583
12/6/96	8:00	618	622	675	621	353	658	673	666	576	592
12/6/96	12:00	616	625	681	630	364	645	672	667	578	597
12/6/96	16:00	598	610	665	616	364	611	678	708	611	624
12/6/96	20:00	568	587	638	590	354	568	676	675	590	607
12/7/96	0:00	551	581	630	580	349	603	633	630	555	587
12/7/96	4:00	510	587	640	586	345	524	664	650	565	585
12/7/96	8:00	603	622	685	632	359	524	701	692	601	609
12/7/96	12:00	550	606	664	611	359	640	641	653	588	612
12/7/96	16:00	520	606	666	614	363	653	663	648	568	594
12/7/96	20:00	517	601	661	609	353	629	632	622	548	579
12/8/96	0:00	514	604	666	615	351	603	665	640	550	575
12/8/96	4:00	518	609	678	626	357	635	657	634	551	576
12/8/96	8:00	543	602	665	613	356	648	666	650	560	582
12/8/96	12:00	500	606	667	612	352	647	668	646	562	585
12/8/96	16:00	506	616	675	616	354	650	667	653	567	589
12/8/96	20:00	483	602	672	619	357	633	654	642	553	583
12/9/96	0:00	499	617	676	616	348	641	666	655	567	589
12/9/96	4:00	530	615	688	634	359	656	685	669	583	602
12/9/96	8:00	558	621	685	626	360	678	697	674	587	607
12/9/96	12:00	539	607	672	617	358	666	674	660	575	599
12/9/96	16:00	514	614	677	618	357	667	682	662	580	605
12/9/96	20:00	541	600	659	602	353	667	681	663	577	603
12/10/96	0:00	529	606	666	608	350	662	680	662	580	604
12/10/96	4:00	520	622	687	623	352	674	684	672	591	612
12/10/96	8:00	530	605	668	610	356	664	677	683	584	611
12/10/96	12:00	552	606	666	603	356	643	685	679	584	605
12/10/96	16:00	619	637	692	629	365	710	724	701	609	625
12/10/96	20:00	620	640	696	635	368	695	723	703	614	633
12/11/96	0:00	633	648	708	645	383	698	730	716	633	657
12/11/96	4:00	622	636	689	627	382	671	705	695	615	646
12/11/96	8:00	610	621	675	615	377	656	689	684	604	637
12/11/96	12:00	616	638	694	632	384	663	720	711	623	650
12/11/96	16:00	507	638	695	630	387	657	729	730	649	668
12/11/96	20:00	620	638	694	629	384	677	704	732	652	672
12/12/96	0:00	614	624	677	605	374	671	700	694	615	642
12/12/96	4:00	611	624	676	608	374	650	698	692	611	643
12/12/96	8:00	585	593	641	579	367	603	650	644	576	621
12/12/96	12:00	620	630	684	610	373	674	716	712	631	655
12/12/96	16:00	646	664	722	650	390	698	751	735	663	681
12/12/96	20:00	629	646	704	639	390	680	704	708	648	676

000392

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE HOLDER TEMPERATURES									
		D	E	F	G	H	I	J	K	L	M
		TI-022	TI-023	TI-024	TI-025	TI-026	TI-027	TI-028	TI-029	TI-030	TI-031
DATE	HOUR	F	F	F	F	F	F	F	F	F	F
12/13/96	0:00	598	606	659	597	374	642	668	665	602	642
12/13/96	4:00	578	591	640	576	365	633	652	646	580	627
12/13/96	8:00	582	592	644	579	363	629	653	647	581	628
12/13/96	12:00	602	614	669	600	368	685	694	686	619	651
12/13/96	16:00	626	638	694	626	379	707	723	707	641	672
12/13/96	20:00	666	662	713	645	384	715	753	716	657	681
12/14/96	0:00	634	615	663	596	376	658	680	654	591	639
12/14/96	4:00	656	648	702	632	376	707	726	702	648	663
12/14/96	8:00	654	650	701	635	381	694	718	698	630	661
12/14/96	12:00	667	664	719	649	399	709	732	709	647	688
12/14/96	16:00	666	654	709	641	396	706	724	701	635	676
12/14/96	20:00	668	655	710	643	392	707	730	701	635	672
12/15/96	0:00	656	647	699	635	387	670	706	688	616	656
12/15/96	4:00	669	657	711	645	392	704	733	703	636	670
12/15/96	8:00	644	645	698	636	389	687	733	706	632	665
12/15/96	12:00	640	657	714	650	405	682	759	737	671	713
12/15/96	16:00	650	678	742	677	418	714	764	737	687	723
12/15/96	20:00	661	689	749	682	419	712	765	735	684	720
12/16/96	0:00	678	692	748	682	410	745	792	744	686	718
12/16/96	4:00	660	651	710	648	472	693	730	701	651	689
12/16/96	8:00	638	636	696	633	391	676	728	698	645	682
12/16/96	12:00	639	641	699	636	394	656	731	709	652	685
12/16/96	16:00	624	637	697	634	395	656	732	711	702	683
12/16/96	20:00	622	633	694	634	398	670	720	695	644	689

000393

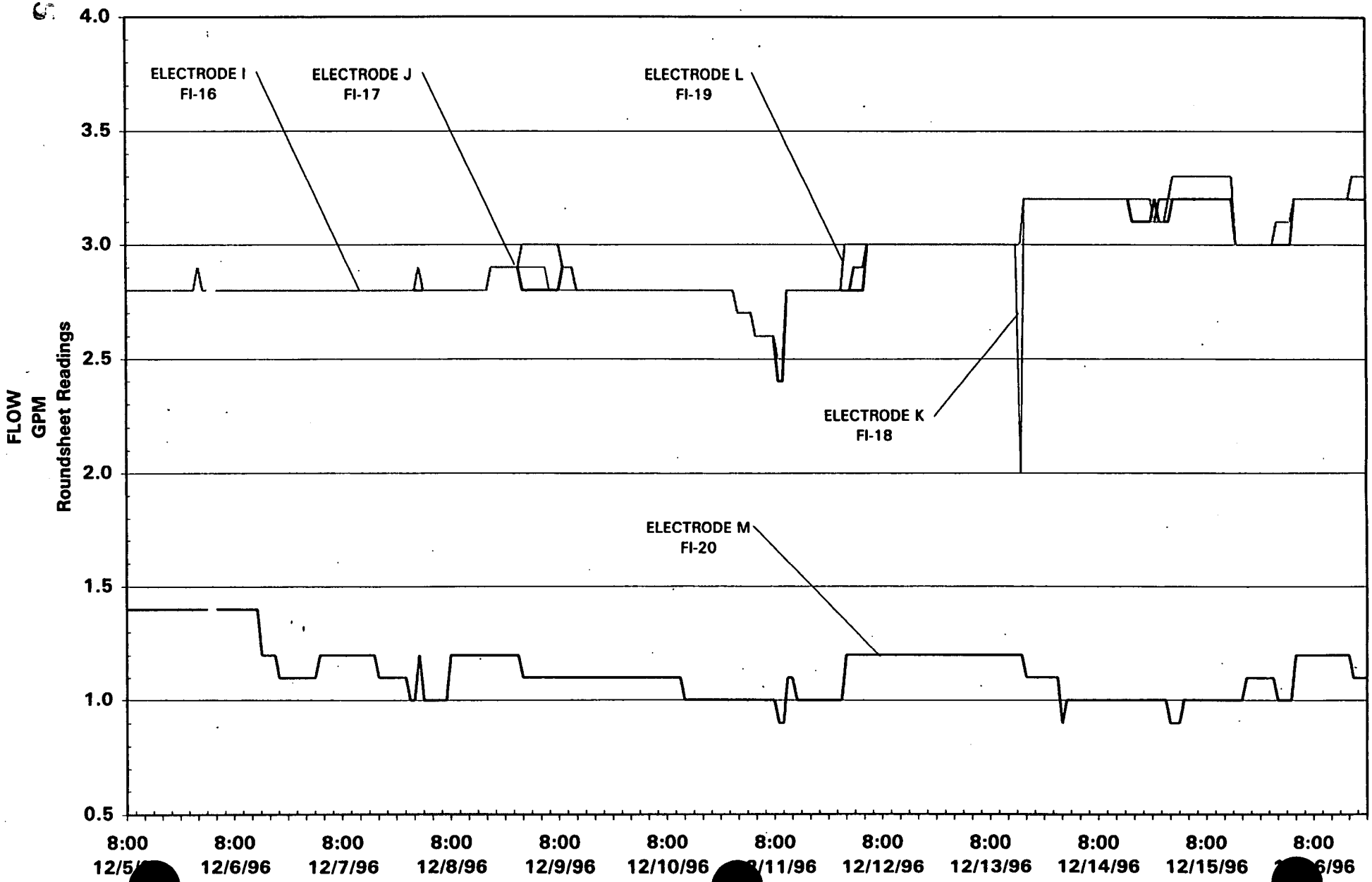
CAMPA[illegible]4
SERIES A GLASS
FURNACE SYSTEM
EAST ELECTRODE CLCW SUPPLY



C4FURN.XLS Chart 23

VHP 1/20/97

CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM
WEST ELECTRODE CLCW SUPPLY



C4FURN.X[illegible] Chart 25

VHP [illegible]/20/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY READINGS ROUNDSHEETS

READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/5/96	8:00	2.8	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	9:00	2.8	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	10:00	2.8	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	11:00	2.8	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	12:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	13:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	14:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	15:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	16:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	17:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	18:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	19:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	20:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	21:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	22:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/5/96	23:00	2.8	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	0:00	2.6	2.6	2.6	2.8	2.0	2.9	2.9	2.9	2.9	1.4
12/6/96	1:00	2.8	2.7	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	2:00	2.8	2.7	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	3:00										
12/6/96	4:00	2.8	2.7	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	5:00	2.8	2.7	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	6:00	2.8	2.7	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	7:00	2.8	2.7	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	8:00	2.8	2.7	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	9:00	2.8	2.7	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	10:00	2.8	2.7	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	11:00	2.8	2.7	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	12:00	2.8	2.8	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	13:00	2.8	2.8	2.7	2.6	1.0	2.8	2.8	2.8	2.8	1.4
12/6/96	14:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/6/96	15:00	2.8	2.6	2.6	2.6	1.0	2.8	2.8	2.8	2.8	1.2
12/6/96	16:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/6/96	17:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/6/96	18:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/6/96	19:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/6/96	20:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/6/96	21:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/6/96	22:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/6/96	23:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	0:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	1:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	2:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	3:00	2.8	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	4:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2

000396

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/7/96	5:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	6:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	7:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	8:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	9:00	2.7	2.6	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	10:00	2.7	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	11:00	2.7	2.7	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	12:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	13:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	14:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	15:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/7/96	16:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	17:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	18:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	19:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	20:00	2.8	2.7	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	21:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	22:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/7/96	23:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	0:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	1:00	2.8	2.7	2.7	2.8	1.0	2.8	2.9	2.8	2.9	1.2
12/8/96	2:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	3:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	4:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	5:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	6:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	7:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/8/96	8:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.2
12/8/96	9:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.2
12/8/96	10:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.2
12/8/96	11:00	2.8	2.7	2.7	2.9	1.1	2.8	2.8	2.8	2.8	1.2
12/8/96	12:00	2.8	2.7	2.7	2.9	1.1	2.8	2.8	2.8	2.8	1.2
12/8/96	13:00	2.8	2.7	2.7	2.9	1.1	2.8	2.8	2.8	2.8	1.2
12/8/96	14:00	2.8	2.7	2.7	2.9	1.1	2.8	2.8	2.8	2.8	1.2
12/8/96	15:00	2.8	2.8	2.7	2.9	1.1	2.8	2.8	2.8	2.8	1.2
12/8/96	16:00	2.8	2.7	2.7	2.9	1.1	2.8	2.8	2.8	2.8	1.2
12/8/96	17:00	2.8	2.7	2.7	2.9	1.1	2.9	2.9	2.9	2.9	1.2
12/8/96	18:00	2.8	2.7	2.7	2.9	1.1	2.9	2.9	2.9	2.9	1.2
12/8/96	19:00	2.8	2.7	2.7	2.9	1.1	2.9	2.9	2.9	2.9	1.2
12/8/96	20:00	2.8	2.7	2.7	2.9	1.1	2.9	2.9	2.9	2.9	1.2
12/8/96	21:00	2.8	2.8	2.8	2.9	1.1	2.9	2.9	2.9	2.9	1.2
12/8/96	22:00	2.8	2.8	2.8	2.9	1.1	2.9	2.9	2.9	2.9	1.2
12/8/96	23:00	2.8	2.8	2.8	2.9	1.1	2.9	2.9	2.9	2.9	1.2
12/9/96	0:00	2.8	2.8	2.8	2.9	1.0	2.8	3.0	2.9	3.0	1.1
12/9/96	1:00	2.8	2.8	2.8	2.9	1.0	2.8	3.0	2.9	3.0	1.1

000397

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/9/96	2:00	2.8	2.8	2.8	2.9	1.0	2.8	3.0	2.9	3.0	1.1
12/9/96	3:00	2.8	2.8	2.8	2.9	1.0	2.8	3.0	2.9	3.0	1.1
12/9/96	4:00	2.8	2.8	2.8	2.9	1.0	2.8	3.0	2.9	3.0	1.1
12/9/96	5:00	2.8	2.8	2.8	2.7	1.0	2.8	3.0	2.9	3.0	1.1
12/9/96	6:00	2.8	2.8	2.8	2.7	1.0	2.8	3.0	2.8	3.0	1.1
12/9/96	7:00	2.8	2.8	2.8	2.7	1.0	2.8	3.0	2.8	3.0	1.1
12/9/96	8:00	2.8	2.8	2.8	2.8	1.0	2.8	3.0	2.8	3.0	1.1
12/9/96	9:00	2.8	2.7	2.7	2.9	1.1	2.9	2.9	2.8	2.9	1.1
12/9/96	10:00	2.8	2.7	2.7	2.9	1.1	2.9	2.9	2.8	2.9	1.1
12/9/96	11:00	2.8	2.7	2.7	2.9	1.1	2.9	2.9	2.8	2.9	1.1
12/9/96	12:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	13:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	14:00	2.7	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	15:00	2.7	2.8	2.8	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	16:00	2.7	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	17:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	18:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	19:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	20:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	21:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	22:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/9/96	23:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	0:00	2.8	2.8	2.8	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	1:00	2.8	2.8	2.8	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	2:00	2.8	2.8	2.8	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	3:00	2.8	2.8	2.8	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	4:00	2.8	2.8	2.8	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	5:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	6:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	7:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	8:00	2.7	2.7	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	9:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	10:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	11:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/10/96	12:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	13:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	14:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	15:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	16:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	17:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	18:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	19:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	20:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	21:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/10/96	22:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0

000398

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/10/96	23:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	0:00	2.6	2.5	2.5	2.7	1.0	2.7	2.7	2.7	2.7	1.0
12/11/96	1:00	2.6	2.6	2.6	2.7	1.0	2.7	2.7	2.7	2.7	1.0
12/11/96	2:00	2.6	2.6	2.6	2.7	1.0	2.7	2.7	2.7	2.7	1.0
12/11/96	3:00	2.6	2.6	2.5	2.7	1.0	2.7	2.7	2.7	2.7	1.0
12/11/96	4:00	2.5	2.5	2.5	2.6	0.9	2.6	2.6	2.6	2.6	1.0
12/11/96	5:00	2.5	2.5	2.5	2.6	0.9	2.6	2.6	2.6	2.6	1.0
12/11/96	6:00	2.5	2.5	2.5	2.6	0.9	2.6	2.6	2.6	2.6	1.0
12/11/96	7:00	2.5	2.5	2.5	2.6	0.9	2.6	2.6	2.6	2.6	1.0
12/11/96	8:00	2.5	2.5	2.5	2.6	0.9	2.6	2.6	2.6	2.6	1.0
12/11/96	9:00	2.4	2.4	2.3	2.6	0.9	2.4	2.5	2.5	2.5	0.9
12/11/96	10:00	2.6	2.6	2.6	2.8	0.9	2.4	2.5	2.5	2.5	0.9
12/11/96	11:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/11/96	12:00	2.7	2.8	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.1
12/11/96	13:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	14:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	15:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	16:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	17:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	18:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	19:00	2.7	2.6	2.6	2.7	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	20:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	21:00	2.7	2.6	2.6	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	22:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	2.8	1.0
12/11/96	23:00	2.8	2.7	2.7	2.9	1.0	2.8	2.8	2.8	2.8	1.0
12/12/96	0:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	3.0	1.2
12/12/96	1:00	2.8	2.7	2.7	2.8	1.0	2.8	2.8	2.8	3.0	1.2
12/12/96	2:00	2.8	2.7	2.7	2.8	1.0	2.8	2.9	2.9	3.0	1.2
12/12/96	3:00	2.8	2.7	2.8	2.9	1.0	2.8	2.9	2.9	3.0	1.2
12/12/96	4:00	2.8	2.7	2.8	2.9	1.0	2.8	2.9	2.9	3.0	1.2
12/12/96	5:00	2.9	2.8	2.8	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	6:00	2.9	2.8	2.8	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	7:00	2.9	2.8	2.8	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	8:00	3.0	2.8	2.8	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	9:00	3.0	2.8	2.8	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	10:00	3.0	2.8	2.8	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	11:00	3.0	2.8	2.8	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	12:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	13:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	14:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	15:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	16:00	2.8	2.7	2.7	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/12/96	17:00	2.8	2.7	2.7	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/12/96	18:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	19:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2

000391

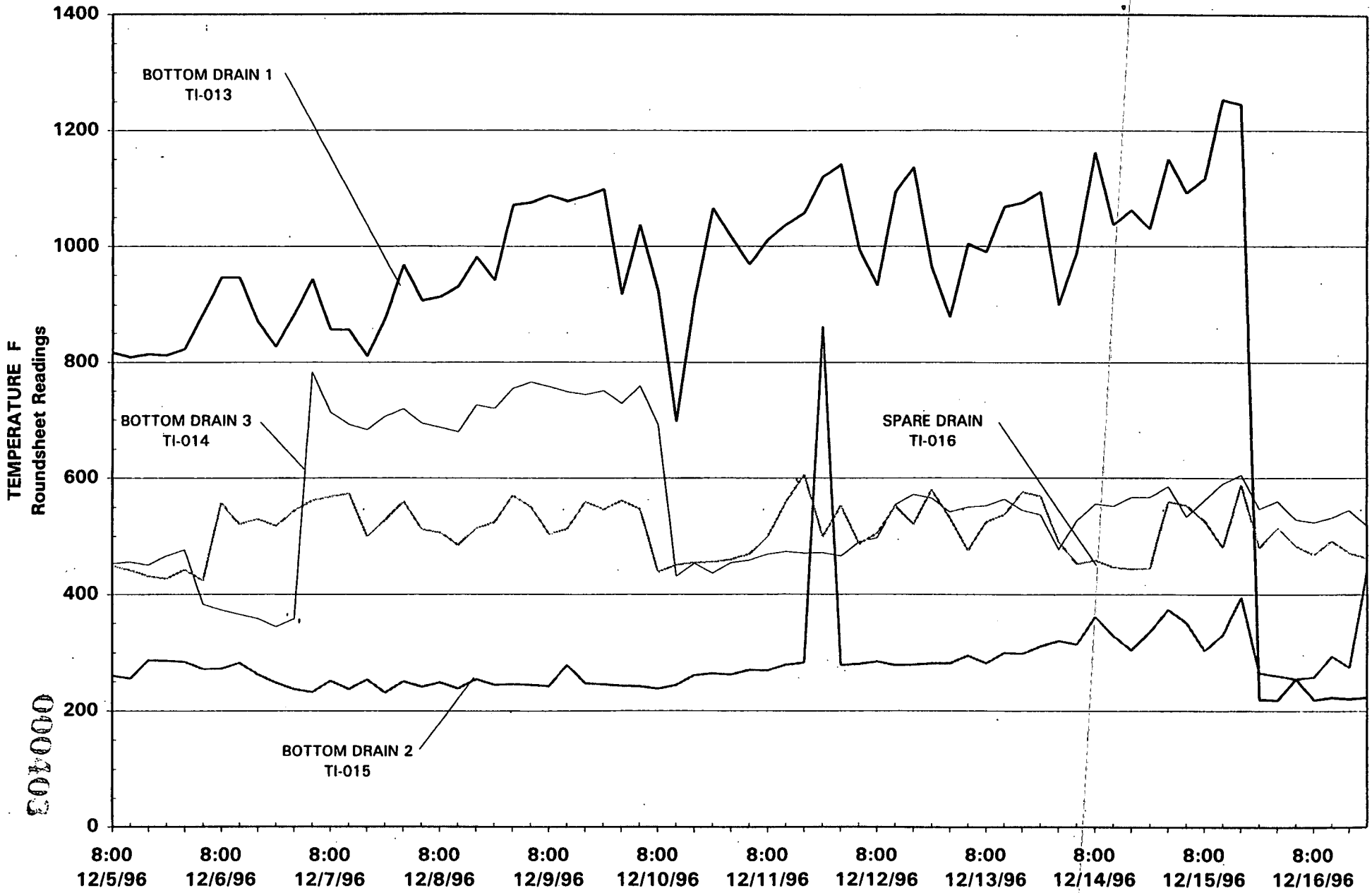
VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/12/96	20:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	21:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	22:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/12/96	23:00	2.8	2.7	2.7	3.0	1.1	3.0	3.0	3.0	3.0	1.2
12/13/96	0:00	3.0	2.9	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	1:00	3.0	2.9	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	2:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	3:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	4:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	5:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	6:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	7:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	8:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	9:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	10:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	11:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	12:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	13:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	14:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.2
12/13/96	15:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	2.0	3.0	1.2
12/13/96	16:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/13/96	17:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/13/96	18:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/13/96	19:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/13/96	20:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/13/96	21:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/13/96	22:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/13/96	23:00	3.0	3.0	2.8	3.1	1.0	3.2	3.2	3.2	3.2	1.1
12/14/96	0:00	3.0	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	0.9
12/14/96	1:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	2:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	3:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	4:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	5:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	6:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	7:00	3.2	3.1	3.0	3.2	0.9	3.2	3.2	3.2	3.2	1.0
12/14/96	8:00	3.2	3.1	3.0	3.2	0.9	3.2	3.2	3.2	3.2	1.0
12/14/96	9:00	3.2	3.1	3.0	3.2	0.9	3.2	3.2	3.2	3.2	1.0
12/14/96	10:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	11:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	12:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	13:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	14:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	15:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/14/96	16:00	3.0	3.0	2.9	3.1	1.0	3.1	3.2	3.1	3.2	1.0

000400

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/14/96	17:00	3.0	3.0	2.9	3.1	1.0	3.1	3.2	3.1	3.2	1.0
12/14/96	18:00	3.0	3.0	2.9	3.1	1.0	3.1	3.2	3.1	3.2	1.0
12/14/96	19:00	3.0	3.0	2.9	3.1	1.0	3.1	3.2	3.1	3.2	1.0
12/14/96	20:00	3.0	3.0	2.9	3.1	1.0	3.1	3.2	3.1	3.2	1.0
12/14/96	21:00	3.0	3.0	2.9	3.1	1.0	3.2	3.1	3.1	3.1	1.0
12/14/96	22:00	3.0	3.0	3.0	3.1	1.0	3.1	3.2	3.1	3.1	1.0
12/14/96	23:00	3.0	3.0	3.0	3.1	1.0	3.1	3.2	3.1	3.1	1.0
12/15/96	0:00	3.0	3.0	2.9	3.2	0.8	3.1	3.2	3.2	3.2	0.9
12/15/96	1:00	3.2	3.2	3.0	3.2	0.8	3.2	3.3	3.2	3.3	0.9
12/15/96	2:00	3.2	3.2	3.0	3.2	0.8	3.2	3.3	3.2	3.3	0.9
12/15/96	3:00	3.2	3.2	3.0	3.2	0.8	3.2	3.3	3.2	3.3	1.0
12/15/96	4:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	5:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	6:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	7:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	8:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	9:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	10:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	11:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	12:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	13:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	14:00	3.2	3.2	3.0	3.3	1.0	3.2	3.3	3.2	3.3	1.0
12/15/96	15:00	2.9	2.8	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.0
12/15/96	16:00	2.9	2.8	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.0
12/15/96	17:00	2.9	2.8	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.1
12/15/96	18:00	2.9	2.8	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.1
12/15/96	19:00	3.0	2.9	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.1
12/15/96	20:00	3.0	2.9	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.1
12/15/96	21:00	3.0	2.9	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.1
12/15/96	22:00	3.0	2.9	2.8	3.0	1.0	3.0	3.0	3.0	3.0	1.1
12/15/96	23:00	3.0	2.9	2.8	3.1	1.0	3.0	3.0	3.0	3.0	1.1
12/16/96	0:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.1	1.0
12/16/96	1:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.1	1.0
12/16/96	2:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.1	1.0
12/16/96	3:00	3.0	3.0	2.8	3.0	1.0	3.0	3.0	3.0	3.1	1.0
12/16/96	4:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	5:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	6:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	7:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	8:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	9:00	3.2	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	10:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	11:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	12:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	13:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/16/96	14:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	15:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	16:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/16/96	17:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.3	1.1
12/16/96	18:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.3	1.1
12/16/96	19:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.3	1.1
12/16/96	20:00	3.2	3.1	3.0	3.2	1.0	3.2	3.2	3.2	3.3	1.1

CAMPA[illegible]4
SERIES A GLASS
FURNACE SYSTEM
BOTTOM DRAIN TEMPERATURES



C4FURN.XLS Chart 26

VHP 3/12/97

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VITRIFICATION PILOT PLANT FURNACE SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
MELTER BOTTOM DRAINS					
READINGS		ROUNDSHEET READINGS			
		SURFACE TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		TI-013	TI-15	TI-014	TI-016
DATE	HOUR	F	F	F	F
12/5/96	8:00	817	260	454	449
12/5/96	12:00	809	255	456	442
12/5/96	16:00	814	287	451	432
12/5/96	20:00	812	286	466	427
12/6/96	0:00	823	284	477	443
12/6/96	4:00	885	271	383	424
12/6/96	8:00	946	272	373	557
12/6/96	12:00	946	282	365	521
12/6/96	16:00	871	262	358	530
12/6/96	20:00	827	248	344	518
12/7/96	0:00	883	237	357	544
12/7/96	4:00	943	232	783	561
12/7/96	8:00	857	251	713	568
12/7/96	12:00	856	237	692	573
12/7/96	16:00	811	253	683	499
12/7/96	20:00	877	231	706	529
12/8/96	0:00	968	250	719	559
12/8/96	4:00	907	241	694	512
12/8/96	8:00	913	248	687	506
12/8/96	12:00	931	238	679	485
12/8/96	16:00	982	254	726	514
12/8/96	20:00	942	244	720	524
12/9/96	0:00	1071	245	755	570
12/9/96	4:00	1075	244	766	550
12/9/96	8:00	1087	242	758	504
12/9/96	12:00	1077	278	749	513
12/9/96	16:00	1086	247	744	559
12/9/96	20:00	1098	245	751	546
12/10/96	0:00	917	243	728	561
12/10/96	4:00	1036	242	759	547
12/10/96	8:00	923	238	692	439
12/10/96	12:00	697	244	432	451
12/10/96	16:00	910	261	454	455
12/10/96	20:00	1065	264	437	456
12/11/96	0:00	1016	262	455	460
12/11/96	4:00	969	270	459	469
12/11/96	8:00	1011	269	469	499
12/11/96	12:00	1037	279	474	559
12/11/96	16:00	1057	282	471	606
12/11/96	20:00	1119	862	472	499
12/12/96	0:00	1141	278	466	553
12/12/96	4:00	994	280	490	486
12/12/96	8:00	933	284	497	505
12/12/96	12:00	1093	278	554	552
12/12/96	16:00	1136	279	572	521

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VITRIFICATION PILOT PLANT FURNACE SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
MELTER BOTTOM DRAINS					
READINGS		ROUNDSHEET READINGS			
		SURFACE TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		TI-013	TI-15	TI-014	TI-016
DATE	HOUR	F	F	F	F
12/12/96	20:00	964	281	566	579
12/13/96	0:00	878	281	542	532
12/13/96	4:00	1004	294	550	475
12/13/96	8:00	990	281	553	525
12/13/96	12:00	1068	299	564	537
12/13/96	16:00	1075	298	545	576
12/13/96	20:00	1093	311	537	569
12/14/96	0:00	900	320	477	490
12/14/96	4:00	990	314	527	453
12/14/96	8:00	1162	361	556	459
12/14/96	12:00	1037	329	552	447
12/14/96	16:00	1062	304	567	444
12/14/96	20:00	1030	335	567	445
12/15/96	0:00	1150	373	585	559
12/15/96	4:00	1092	351	534	553
12/15/96	8:00	1116	303	562	526
12/15/96	12:00	1254	330	590	480
12/15/96	16:00	1246	395	605	588
12/15/96	20:00	220	264	547	480
12/16/96	0:00	219	259	560	514
12/16/96	4:00	254	254	529	483
12/16/96	8:00	219	257	524	468
12/16/96	12:00	223	293	532	492
12/16/96	16:00	221	274	545	471
12/16/96	20:00	223	441	519	462

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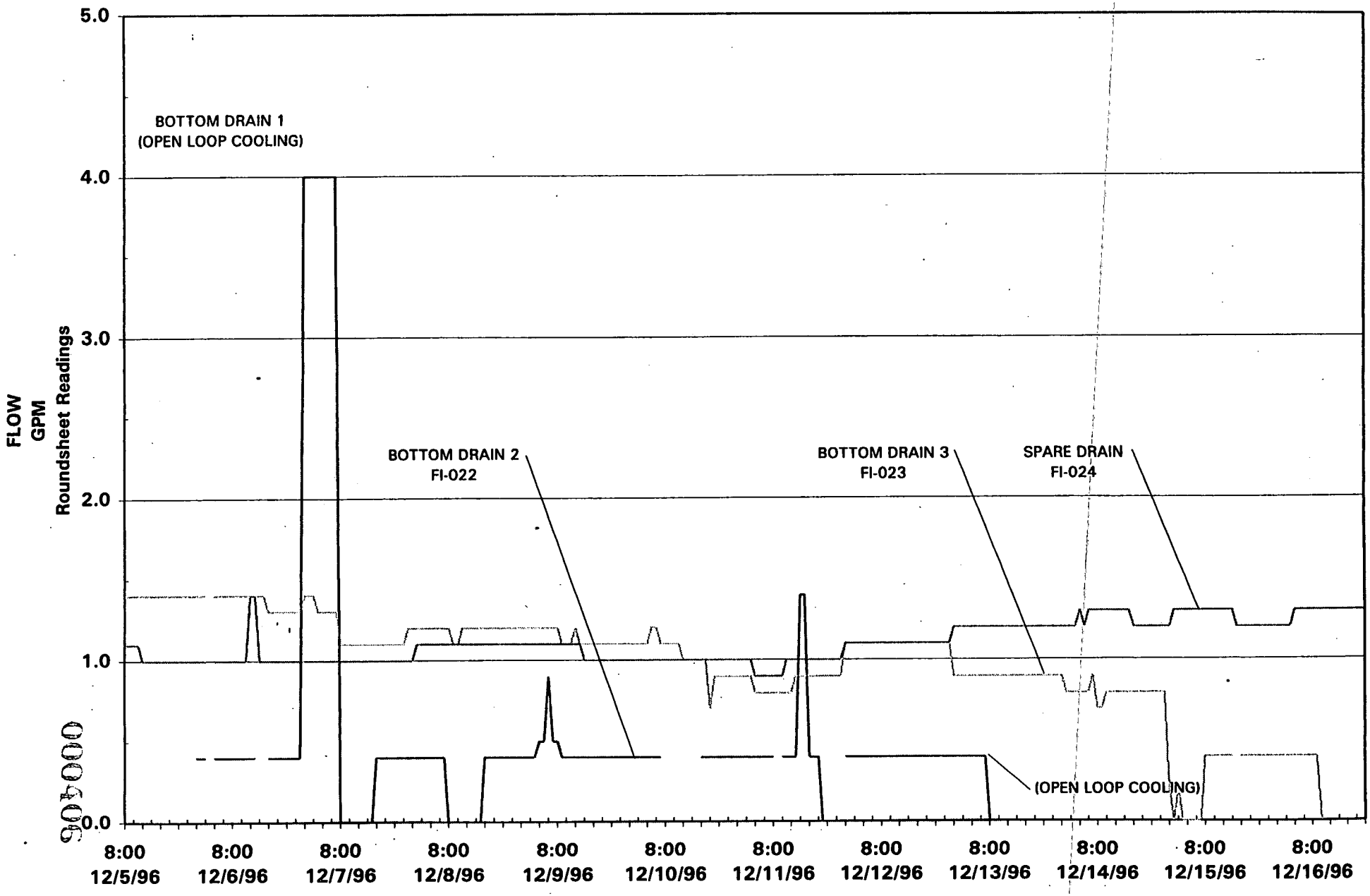
CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM
BOTTOM DRAIN CLCW FLOW



C4FURN.XLS Chart 27

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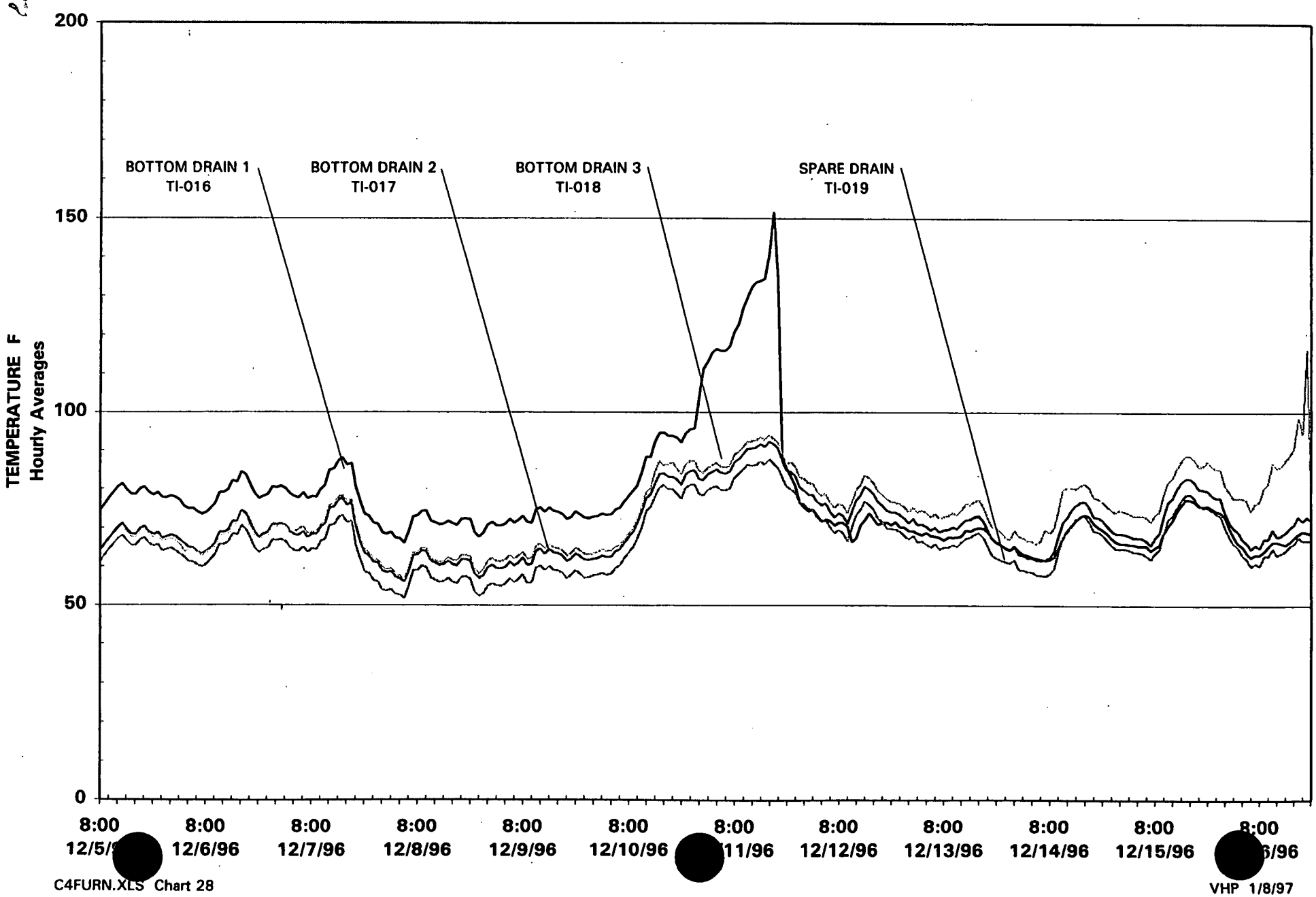
CAMPAIGN 4
SERIES A GLASS
FURNACE SYSTEM
BOTTOM DRAIN CLCW RETURN



C4FURN.XLS Chart 28

VHP 1/8/97

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/5/96	8:00	OPEN LOOP COOLING	OUT OF SERVICE	1.4	1.1	74.50	64.25	63.53	61.31
12/5/96	9:00			1.4	1.1	76.03	65.78	65.03	62.85
12/5/96	10:00			1.4	1.1	77.65	67.35	66.62	64.38
12/5/96	11:00			1.4	1.1	79.11	68.84	68.16	65.86
12/5/96	12:00			1.4	1.0	80.41	70.11	69.40	67.18
12/5/96	13:00			1.4	1.0	81.30	71.07	70.39	68.12
12/5/96	14:00			1.4	1.0	79.71	69.47	68.82	66.53
12/5/96	15:00			1.4	1.0	78.62	68.51	67.73	65.43
12/5/96	16:00			1.4	1.0	78.55	68.36	67.68	65.37
12/5/96	17:00			1.4	1.0	79.95	69.88	69.18	66.91
12/5/96	18:00			1.4	1.0	80.43	70.38	69.66	67.42
12/5/96	19:00			1.4	1.0	79.06	68.93	68.24	65.89
12/5/96	20:00			1.4	1.0	78.39	68.36	67.67	65.29
12/5/96	21:00			1.4	1.0	79.06	68.84	68.28	65.59
12/5/96	22:00			1.4	1.0	77.82	67.27	66.66	63.98
12/5/96	23:00			1.4	1.0	77.72	67.62	66.94	64.28
12/6/96	0:00		0.4	1.4	1.0	78.16	68.12	67.31	64.65
12/6/96	1:00		0.4	1.4	1.0	77.76	67.72	66.91	63.96
12/6/96	2:00		0.4	1.4	1.0	77.03	66.84	65.80	63.18
12/6/96	3:00					75.34	65.81	63.84	62.43
12/6/96	4:00		0.4	1.4	1.0	74.81	64.98	64.36	61.30
12/6/96	5:00		0.4	1.4	1.0	74.88	64.61	64.37	61.14
12/6/96	6:00		0.4	1.4	1.0	74.01	63.59	63.40	60.32
12/6/96	7:00		0.4	1.4	1.0	73.46	63.17	62.93	59.93
12/6/96	8:00		0.4	1.4	1.0	73.91	63.76	63.54	60.56
12/6/96	9:00		0.4	1.4	1.0	75.00	64.84	64.51	61.79
12/6/96	10:00		0.4	1.4	1.0	76.17	65.98	65.14	63.11
12/6/96	11:00		0.4	1.4	1.0	79.03	68.87	68.20	65.70
12/6/96	12:00		0.4	1.4	1.4	79.06	68.94	68.46	65.70
12/6/96	13:00		0.4	1.4	1.4	79.85	69.41	68.61	66.14
12/6/96	14:00			1.4	1.0	82.12	71.74	71.29	68.47
12/6/96	15:00			1.4	1.0	81.71	71.63	71.03	68.14
12/6/96	16:00		0.4	1.3	1.0	84.52	74.38	73.75	70.60
12/6/96	17:00		0.4	1.3	1.0	83.75	73.68	73.00	69.70
12/6/96	18:00		0.4	1.3	1.0	81.06	71.21	70.19	67.24
12/6/96	19:00		0.4	1.3	1.0	78.79	68.75	67.99	64.66
12/6/96	20:00		0.4	1.3	1.0	77.48	67.54	66.91	63.51
12/6/96	21:00		0.4	1.3	1.0	78.07	68.35	67.81	64.36
12/6/96	22:00		0.4	1.3	1.0	78.50	68.78	68.25	64.75
12/6/96	23:00		0.4	1.3	1.0	80.59	71.01	70.62	66.86
12/7/96	0:00		4.0	1.4	1.0	80.35	70.81	70.47	66.70
12/7/96	1:00		4.0	1.4	1.0	80.77	71.03	70.84	66.88
12/7/96	2:00		4.0	1.4	1.0	80.14	70.63	70.31	66.43
12/7/96	3:00		4.0	1.3	1.0	78.71	68.94	69.03	64.84
12/7/96	4:00		4.0	1.3	1.0	77.99	68.15	68.82	64.03
12/7/96	5:00		4.0	1.3	1.0	77.66	68.04	69.69	63.96
12/7/96	6:00		4.0	1.3	1.0	79.00	68.95	70.37	64.97
12/7/96	7:00		4.0	1.3	1.0	77.50	67.47	68.32	63.68
12/7/96	8:00		0.0	1.1	1.0	77.95	68.35	68.91	64.54
12/7/96	9:00		0.0	1.1	1.0	77.85	68.35	68.71	64.41
12/7/96	10:00		0.0	1.1	1.0	79.97	70.42	70.78	66.49
12/7/96	11:00		0.0	1.1	1.0	80.92	71.12	71.54	66.98
12/7/96	12:00		0.0	1.1	1.0	84.91	75.08	75.70	70.63
12/7/96	13:00		0.0	1.1	1.0	85.28	75.32	76.05	70.80
12/7/96	14:00		0.0	1.1	1.0	87.33	77.07	77.72	72.66
12/7/96	15:00		0.0	1.1	1.0	88.11	77.62	78.28	73.21
12/7/96	16:00		0.4	1.1	1.0	86.31	75.86	76.51	71.37
12/7/96	17:00		0.4	1.1	1.0	86.60	76.41	77.07	71.80
12/7/96	18:00		0.4	1.1	1.0	80.27	70.02	70.92	65.26
12/7/96	19:00		0.4	1.1	1.0	76.82	66.56	67.49	61.92
12/7/96	20:00		0.4	1.1	1.0	73.62	63.52	64.31	58.63
12/7/96	21:00		0.4	1.1	1.0	73.03	62.80	63.49	58.18
12/7/96	22:00		0.4	1.1	1.0	71.27	61.11	61.76	56.39
12/7/96	23:00		0.4	1.2	1.0	70.97	60.96	61.70	56.13
12/8/96	0:00		0.4	1.2	1.0	68.65	58.87	59.73	53.97
12/8/96	1:00		0.4	1.2	1.1	68.35	58.45	59.07	53.79
12/8/96	2:00		0.4	1.2	1.1	68.75	58.72	59.41	54.11
12/8/96	3:00		0.4	1.2	1.1	67.33	57.29	57.91	52.85

VITRIFICATION PILOT PLANT FURNACE SYSTEM									
'CAMPAIGN 4 SERIES A GLASS									
		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/8/96	4:00		0.4	1.2	1.1	67.15	56.93	57.64	52.66
12/8/96	5:00		0.4	1.2	1.1	66.03	56.08	56.50	51.79
12/8/96	6:00		0.4	1.2	1.1	68.89	58.82	59.38	54.85
12/8/96	7:00		0.4	1.2	1.1	72.92	62.90	63.51	58.92
12/8/96	8:00		0.0	1.2	1.1	73.22	63.13	63.73	59.05
12/8/96	9:00		0.0	1.1	1.1	74.30	64.11	64.70	60.14
12/8/96	10:00		0.0	1.1	1.1	74.41	63.96	64.59	59.73
12/8/96	11:00		0.0	1.2	1.1	71.74	61.38	61.94	57.08
12/8/96	12:00		0.0	1.2	1.1	71.36	60.87	61.47	56.51
12/8/96	13:00		0.0	1.2	1.1	70.79	60.32	60.92	55.93
12/8/96	14:00		0.0	1.2	1.1	71.02	60.56	61.21	56.20
12/8/96	15:00		0.0	1.2	1.1	71.76	61.34	62.26	57.06
12/8/96	16:00		0.4	1.2	1.1	71.04	60.48	61.61	56.01
12/8/96	17:00		0.4	1.2	1.1	70.58	60.22	61.42	55.75
12/8/96	18:00		0.4	1.2	1.1	72.27	61.69	62.96	57.23
12/8/96	19:00		0.4	1.2	1.1	72.36	61.74	62.99	57.43
12/8/96	20:00		0.4	1.2	1.1	72.13	61.40	62.49	56.83
12/8/96	21:00		0.4	1.2	1.1	68.77	58.12	59.11	53.48
12/8/96	22:00		0.4	1.2	1.1	67.66	56.96	58.05	52.35
12/8/96	23:00		0.4	1.2	1.1	68.67	57.73	59.10	53.05
12/9/96	0:00		0.4	1.2	1.1	70.74	59.74	61.39	54.97
12/9/96	1:00		0.4	1.2	1.1	71.40	60.33	62.08	55.66
12/9/96	2:00		0.4	1.2	1.1	70.50	59.57	61.28	55.11
12/9/96	3:00		0.4	1.2	1.1	70.47	59.44	61.20	55.00
12/9/96	4:00		0.5	1.2	1.1	70.91	59.84	61.66	55.52
12/9/96	5:00		0.5	1.2	1.1	72.20	61.17	62.90	56.90
12/9/96	6:00		0.9	1.2	1.1	71.23	60.15	61.86	55.95
12/9/96	7:00		0.5	1.2	1.1	71.97	60.97	62.69	56.75
12/9/96	8:00		0.5	1.2	1.1	73.02	62.21	63.78	57.91
12/9/96	9:00		0.4	1.1	1.1	71.40	60.39	61.89	55.81
12/9/96	10:00		0.4	1.1	1.1	71.21	60.60	62.08	55.92
12/9/96	11:00		0.4	1.1	1.1	74.68	64.02	65.41	59.60
12/9/96	12:00		0.4	1.2	1.1	75.26	64.57	65.98	60.17
12/9/96	13:00		0.4	1.1	1.1	74.11	63.25	64.64	59.00
12/9/96	14:00		0.4	1.1	1.0	75.25	64.45	65.84	60.05
12/9/96	15:00		0.4	1.1	1.0	74.34	63.61	64.88	59.05
12/9/96	16:00		0.4	1.1	1.0	74.11	63.36	64.69	58.94
12/9/96	17:00		0.4	1.1	1.0	73.51	62.81	64.17	58.37
12/9/96	18:00		0.4	1.1	1.0	72.21	61.37	62.74	57.05
12/9/96	19:00		0.4	1.1	1.0	72.68	61.90	63.33	57.77
12/9/96	20:00		0.4	1.1	1.0	74.22	63.33	64.78	58.95
12/9/96	21:00		0.4	1.1	1.0	73.39	62.58	64.09	58.11
12/9/96	22:00		0.4	1.1	1.0	72.54	61.78	63.23	57.17
12/9/96	23:00		0.4	1.1	1.0	72.37	61.64	63.00	57.29
12/10/96	0:00		0.4	1.1	1.0	72.74	61.94	63.28	57.74
12/10/96	1:00		0.4	1.1	1.0	72.93	62.14	63.67	57.97
12/10/96	2:00		0.4	1.1	1.0	73.60	62.72	64.31	58.31
12/10/96	3:00		0.4	1.1	1.0	73.22	62.41	64.00	57.91
12/10/96	4:00		0.4	1.1	1.0	73.40	62.52	64.06	58.10
12/10/96	5:00		0.4	1.2	1.0	74.71	63.90	65.19	59.68
12/10/96	6:00		0.4	1.2	1.0	75.14	64.35	65.44	60.26
12/10/96	7:00		0.4	1.1	1.0	76.81	66.15	66.76	61.99
12/10/96	8:00			1.1	1.0	78.22	67.71	68.45	63.61
12/10/96	9:00			1.1	1.0	79.49	68.96	69.54	64.94
12/10/96	10:00			1.1	1.0	80.88	71.31	72.20	67.30
12/10/96	11:00			1.1	1.0	84.29	74.05	75.57	70.07
12/10/96	12:00			1.0	1.0	88.33	77.73	79.09	74.16
12/10/96	13:00			1.0	1.0	88.28	78.64	80.07	75.37
12/10/96	14:00			1.0	1.0	92.17	81.28	84.50	78.04
12/10/96	15:00			1.0	1.0	94.52	83.81	87.20	80.36
12/10/96	16:00		0.4	1.0	1.0	94.67	84.07	86.14	80.98
12/10/96	17:00		0.4	1.0	1.0	93.84	83.11	86.47	79.90
12/10/96	18:00		0.4	0.7	1.0	93.80	83.14	86.85	80.01
12/10/96	19:00		0.4	0.9	1.0	93.32	82.36	85.24	78.76
12/10/96	20:00	[illegible]	0.4	0.9	1.0	92.10	80.95	83.78	77.49
12/10/96	21:00		0.4	0.9	1.0	94.41	83.72	86.34	80.31
12/10/96	22:00		0.4	0.9	1.0	95.58	84.69	87.23	81.04
12/10/96	23:00		0.4	0.9	1.0	95.73	84.85	87.23	81.14

VITRIFICATION PILOT PLANT FURNACE SYSTEM									
CAMPAIGN 4 SERIES A GLASS									
		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/11/96	0:00		0.4	0.9	1.0	103.46	82.57	84.72	78.80
12/11/96	1:00		0.4	0.9	1.0	111.18	82.30	84.19	78.39
12/11/96	2:00		0.4	0.9	1.0	113.06	83.86	85.60	79.75
12/11/96	3:00		0.4	0.9	1.0	115.45	84.39	86.22	80.40
12/11/96	4:00		0.4	0.8	0.9	116.44	85.06	86.77	80.62
12/11/96	5:00		0.4	0.8	0.9	115.92	84.22	85.87	79.76
12/11/96	6:00		0.4	0.8	0.9	115.95	84.01	85.65	79.66
12/11/96	7:00		0.4	0.8	0.9	117.19	84.53	86.06	80.15
12/11/96	8:00		0.4	0.8	0.9	120.77	86.81	88.77	82.76
12/11/96	9:00			0.8	0.9	122.82	87.76	89.64	83.95
12/11/96	10:00		0.4	0.8	0.9	126.92	88.94	90.88	85.16
12/11/96	11:00		0.4	0.8	1.0	129.46	90.33	92.31	86.30
12/11/96	12:00		0.4	0.8	1.0	132.26	90.43	92.42	86.18
12/11/96	13:00		0.4	0.9	1.0	133.55	90.79	92.70	86.31
12/11/96	14:00		1.4	0.9	1.0	133.92	91.60	93.55	87.12
12/11/96	15:00		1.4	0.9	1.0	134.48	90.88	92.79	86.38
12/11/96	16:00		0.4	0.9	1.0	140.82	92.33	93.97	87.70
12/11/96	17:00		0.4	0.9	1.0	151.58	91.64	93.09	86.62
12/11/96	18:00		0.4	0.9	1.0	133.95	90.48	92.05	85.55
12/11/96	19:00		OUT OF SERVICE	0.9	1.0	89.14	87.49	89.35	83.04
12/11/96	20:00			0.9	1.0	85.38	84.74	86.35	80.67
12/11/96	21:00			0.9	1.0	83.15	84.40	86.99	79.94
12/11/96	22:00			0.9	1.0	80.89	83.42	85.83	79.29
12/11/96	23:00			0.9	1.0	76.55	80.52	83.03	76.66
12/12/96	0:00		0.4	1.1	1.1	75.23	79.73	82.75	75.97
12/12/96	1:00		0.4	1.1	1.1	74.27	78.60	81.55	74.95
12/12/96	2:00		0.4	1.1	1.1	74.63	78.64	81.42	74.62
12/12/96	3:00		0.4	1.1	1.1	73.13	76.69	79.41	72.61
12/12/96	4:00		0.4	1.1	1.1	71.73	75.86	78.44	71.82
12/12/96	5:00		0.4	1.1	1.1	72.14	76.29	78.88	72.19
12/12/96	6:00		0.4	1.1	1.1	71.83	74.13	76.47	70.20
12/12/96	7:00		0.4	1.1	1.1	70.70	72.72	75.09	68.80
12/12/96	8:00		0.4	1.1	1.1	71.42	73.71	76.24	69.58
12/12/96	9:00		0.4	1.1	1.1	71.33	73.11	75.69	68.64
12/12/96	10:00		0.4	1.1	1.1	70.41	71.15	73.81	66.58
12/12/96	11:00		0.4	1.1	1.1	66.40	74.05	76.49	70.21
12/12/96	12:00		0.4	1.1	1.1	67.41	77.23	79.85	73.33
12/12/96	13:00		0.4	1.1	1.1	70.72	78.46	81.19	74.61
12/12/96	14:00		0.4	1.1	1.1	72.04	80.80	83.63	76.85
12/12/96	15:00		0.4	1.1	1.1	73.72	79.89	82.88	75.78
12/12/96	16:00		0.4	1.1	1.1	72.29	78.77	81.55	74.64
12/12/96	17:00		0.4	1.1	1.1	70.93	76.69	79.53	72.35
12/12/96	18:00		0.4	1.1	1.1	71.34	75.81	78.67	71.66
12/12/96	19:00		0.4	1.1	1.1	71.51	74.46	77.43	69.95
12/12/96	20:00		0.4	1.1	1.1	70.85	74.03	76.63	69.84
12/12/96	21:00		0.4	1.1	1.1	71.60	73.94	76.52	69.67
12/12/96	22:00		0.4	1.1	1.1	70.23	73.38	76.05	69.10
12/12/96	23:00		0.4	1.1	1.1	70.22	72.49	75.36	67.98
12/13/96	0:00		0.4	0.9	1.2	69.26	71.35	74.10	67.21
12/13/96	1:00		0.4	0.9	1.2	69.24	72.43	75.23	68.06
12/13/96	2:00		0.4	0.9	1.2	68.62	70.88	74.04	66.32
12/13/96	3:00		0.4	0.9	1.2	68.18	71.08	74.62	66.58
12/13/96	4:00		0.4	0.9	1.2	68.79	70.36	73.94	65.74
12/13/96	5:00		0.4	0.9	1.2	68.00	69.43	72.88	65.02
12/13/96	6:00		0.4	0.9	1.2	67.86	70.19	73.59	65.85
12/13/96	7:00		0.4	0.9	1.2	67.50	68.95	72.56	64.43
12/13/96	8:00		OPEN LOOP COOLING	0.9	1.2	66.90	69.49	72.94	65.03
12/13/96	9:00			0.9	1.2	67.62	69.64	73.19	64.99
12/13/96	10:00			0.9	1.2	67.60	70.26	73.83	65.67
12/13/96	11:00			0.9	1.2	67.64	69.79	73.33	65.17
12/13/96	12:00			0.9	1.2	67.90	71.03	74.50	66.38
12/13/96	13:00			0.9	1.2	69.46	72.12	76.19	67.36
12/13/96	14:00			0.9	1.2	69.15	72.32	75.93	67.62
12/13/96	15:00			0.9	1.2	69.83	72.88	76.75	68.37
12/13/96	16:00			0.9	1.2	70.11	73.09	77.21	68.70
12/13/96	17:00			0.9	1.2	69.89	71.79	75.19	67.56
12/13/96	18:00			0.9	1.2	68.99	69.29	72.56	65.06
12/13/96	19:00			0.9	1.2	67.27	67.12	70.29	62.92

VITRIFICATION PILOT PLANT FURNACE SYSTEM									
CAMPAIGN 4 SERIES A GLASS									
		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/13/96	20:00			0.9	1.2	66.29	66.41	69.75	62.23
12/13/96	21:00			0.9	1.2	65.60	65.54	68.87	61.65
12/13/96	22:00			0.9	1.2	64.77	64.73	67.57	61.26
12/13/96	23:00			0.9	1.2	64.38	64.29	67.05	61.00
12/14/96	0:00			0.9	1.2	64.99	65.34	69.36	61.70
12/14/96	1:00			0.8	1.2	64.08	63.20	67.93	59.26
12/14/96	2:00			0.8	1.2	63.27	62.98	67.48	59.24
12/14/96	3:00			0.8	1.2	62.98	62.30	66.75	58.75
12/14/96	4:00			0.8	1.3	62.40	62.28	66.57	58.61
12/14/96	5:00			0.8	1.2	62.10	61.69	65.94	57.93
12/14/96	6:00			0.8	1.3	61.82	61.61	66.74	57.80
12/14/96	7:00			0.9	1.3	61.63	61.77	69.62	57.67
12/14/96	8:00			0.7	1.3	61.90	62.34	68.61	58.22
12/14/96	9:00			0.7	1.3	62.53	63.83	69.95	59.62
12/14/96	10:00			0.8	1.3	64.72	67.76	74.18	63.74
12/14/96	11:00			0.8	1.3	67.46	71.40	79.79	67.61
12/14/96	12:00			0.8	1.3	69.33	72.75	80.40	68.97
12/14/96	13:00			0.8	1.3	70.58	74.63	80.31	70.87
12/14/96	14:00			0.8	1.3	72.15	75.84	80.08	72.23
12/14/96	15:00			0.8	1.3	72.93	76.62	80.95	73.05
12/14/96	16:00			0.8	1.2	73.38	76.75	81.41	73.09
12/14/96	17:00			0.8	1.2	72.92	75.39	80.26	71.61
12/14/96	18:00			0.8	1.2	71.13	72.88	77.75	69.15
12/14/96	19:00			0.8	1.2	70.20	72.73	77.51	69.07
12/14/96	20:00			0.8	1.2	69.57	72.09	76.75	68.40
12/14/96	21:00			0.8	1.2	68.74	70.67	75.60	66.93
12/14/96	22:00			0.8	1.2	67.39	69.35	74.65	65.64
12/14/96	23:00			0.8	1.2	66.48	68.61	73.99	64.69
12/15/96	0:00			0.2	1.2	66.04	68.62	74.68	64.59
12/15/96	1:00			BELOW SCALE	1.3	66.02	68.38	74.25	64.65
12/15/96	2:00			0.2	1.3	65.81	68.03	73.80	64.41
12/15/96	3:00			BELOW SCALE	1.3	65.77	67.52	73.19	63.90
12/15/96	4:00			BELOW SCALE	1.3	65.44	67.44	73.13	63.74
12/15/96	5:00			BELOW SCALE	1.3	65.40	67.38	73.20	63.56
12/15/96	6:00			BELOW SCALE	1.3	65.35	66.70	72.69	62.80
12/15/96	7:00			BELOW SCALE	1.3	64.16	65.59	71.52	61.84
12/15/96	8:00			0.4	1.3	65.00	67.46	73.38	63.51
12/15/96	9:00			0.4	1.3	65.59	68.60	74.16	64.52
12/15/96	10:00			0.4	1.3	68.73	72.99	78.40	68.68
12/15/96	11:00			0.4	1.3	70.58	76.70	81.83	72.23
12/15/96	12:00			0.4	1.3	71.94	77.63	82.91	73.10
12/15/96	13:00			0.4	1.3	74.36	80.00	85.46	75.24
12/15/96	14:00			0.4	1.3	75.83	81.66	87.29	77.00
12/15/96	15:00				1.2	77.41	82.73	88.72	78.45
12/15/96	16:00			0.4	1.2	77.27	82.77	88.52	78.71
12/15/96	17:00			0.4	1.2	76.83	81.77	87.65	77.73
12/15/96	18:00			0.4	1.2	75.82	80.03	85.99	75.97
12/15/96	19:00			0.4	1.2	75.49	79.82	86.12	75.35
12/15/96	20:00			0.4	1.2	75.73	79.53	87.23	75.31
12/15/96	21:00			0.4	1.2	75.06	78.42	85.97	74.54
12/15/96	22:00			0.4	1.2	74.38	77.76	85.37	73.70
12/15/96	23:00			0.4	1.2	73.99	77.74	85.22	73.22
12/16/96	0:00			0.4	1.2	72.78	73.82	80.80	70.01
12/16/96	1:00			0.4	1.2	69.97	71.45	79.31	67.72
12/16/96	2:00			0.4	1.2	67.83	69.91	77.76	66.03
12/16/96	3:00			0.4	1.2	66.13	69.15	77.80	65.06
12/16/96	4:00			0.4	1.3	65.27	67.12	77.65	62.95
12/16/96	5:00			0.4	1.3	63.56	66.25	77.09	62.01
12/16/96	6:00			0.4	1.3	62.51	64.57	74.28	60.19
12/16/96	7:00			0.4	1.3	63.14	65.61	76.24	60.92
12/16/96	8:00			0.4	1.3	63.11	64.90	76.85	60.28
12/16/96	9:00			0.4	1.3	64.06	67.28	80.26	62.83
12/16/96	10:00			OUT OF SERVICE	1.3	65.24	67.30	81.41	62.81
12/16/96	11:00				1.3	66.48	69.62	86.97	64.75
12/16/96	12:00				1.3	66.52	67.81	85.74	63.00
12/16/96	13:00				1.3	66.11	68.16	86.05	63.45
12/16/96	14:00				1.3	65.78	68.96	87.48	64.17
12/16/96	15:00				1.3	66.54	70.13	88.87	65.40

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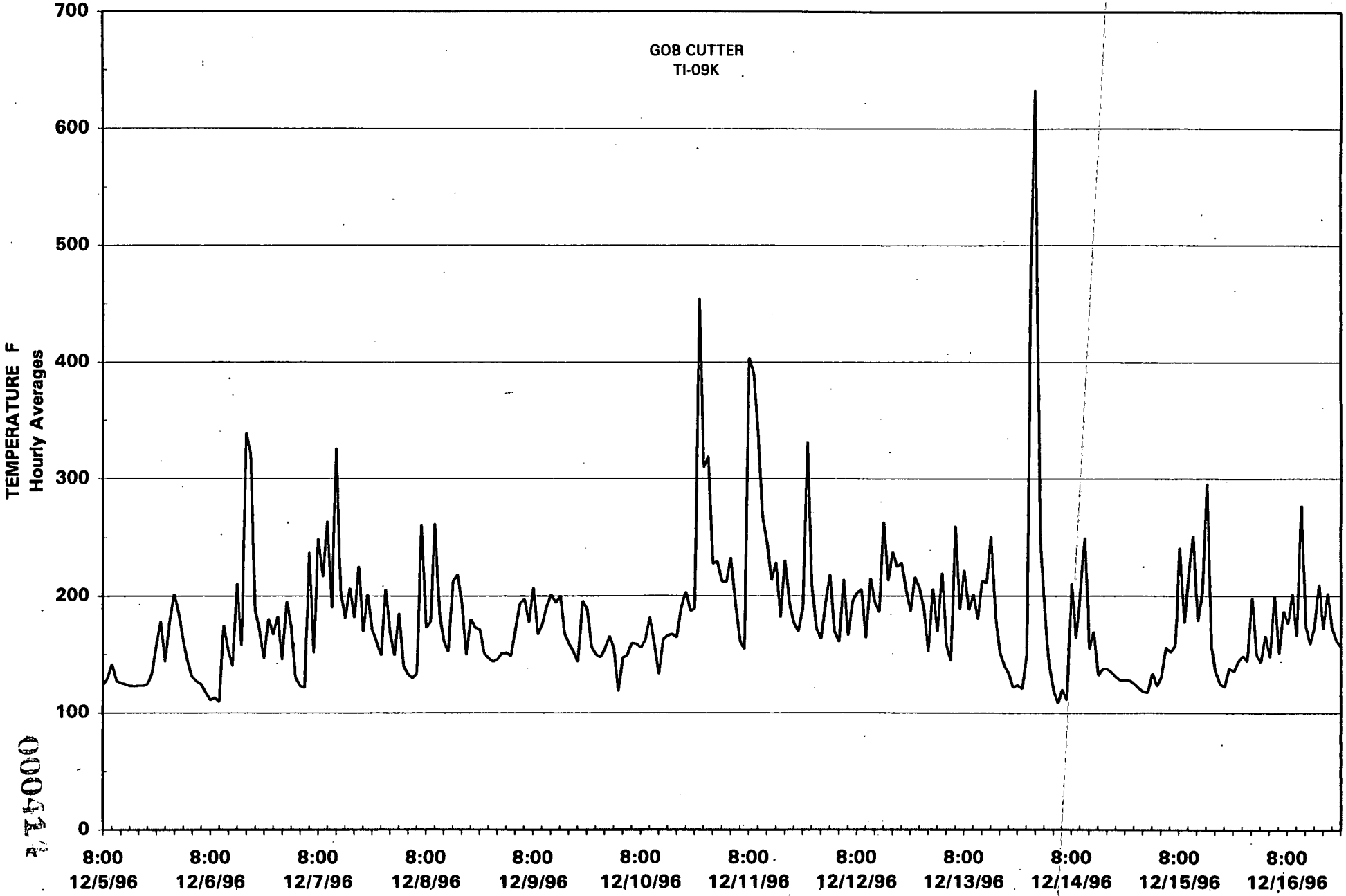
VITRIFICATION PILOT PLANT FURNACE SYSTEM									
CAMPAIGN 4 SERIES A GLASS									
		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CLCW RETURN TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/16/96	16:00				1.3	67.64	70.86	90.79	66.04
12/16/96	17:00				1.3	68.47	72.91	98.66	67.70
12/16/96	18:00				1.3	69.20	71.84	94.23	66.83
12/16/96	19:00				1.3	68.89	72.84	116.37	66.81
12/16/96	20:00				1.3	68.68	72.00	76.56	66.85

000412

GEM MACHINE SYSTEM

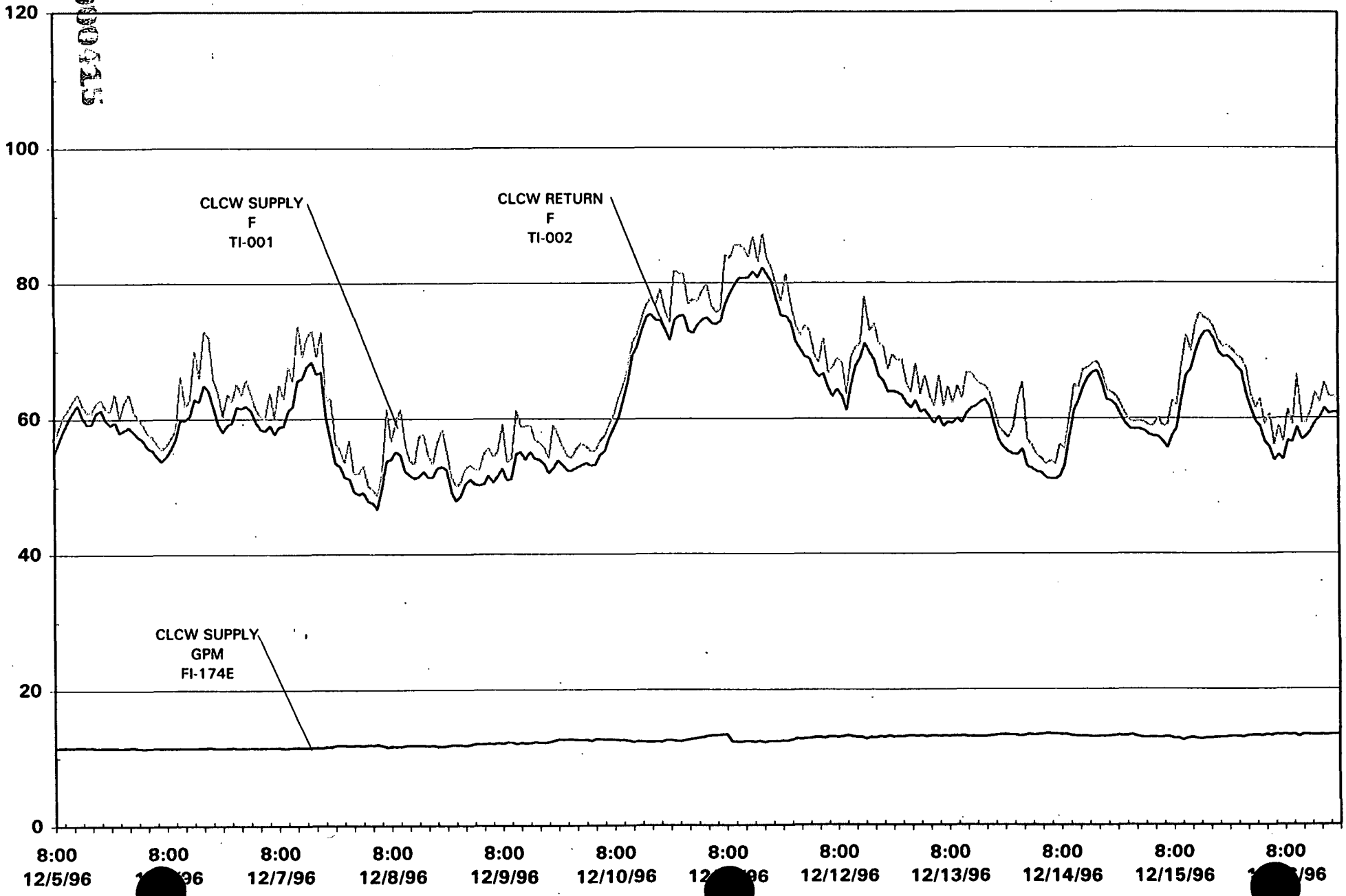
CAMPA 4
SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 7

VHP 1/9/97

CAMPAIGN 4
SERIES A GLASS
GEM MACHINE SYSTEM



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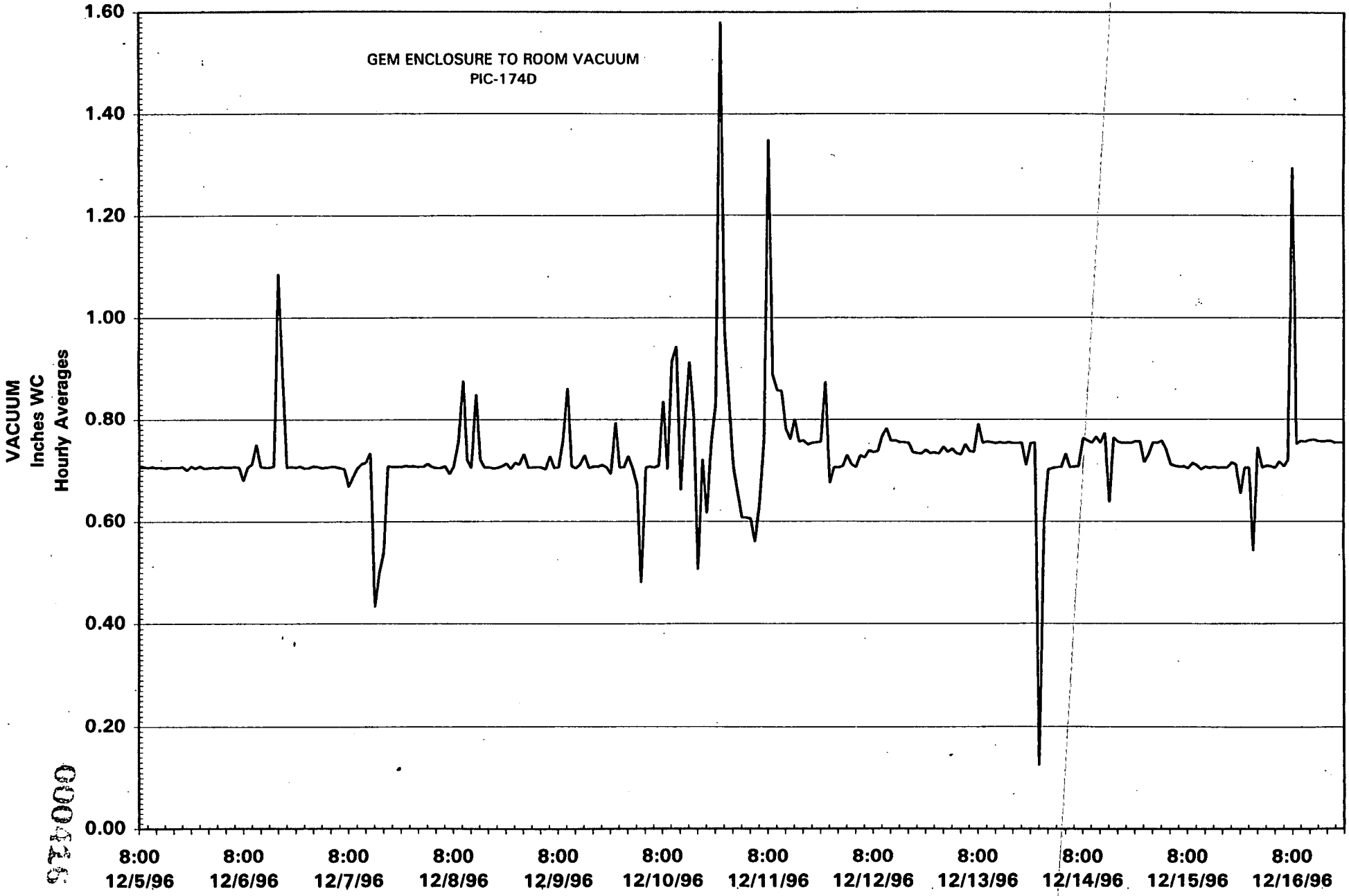
SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 9

VHP 1/9/97

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES									
READINGS		GEM HOPPER	GOB CUTTER	GOB CUTTER TEMP	GOB CUTTER	GOB ROLLER	CONVEYOR SPEED	GEM ENCLOSURE TO ROOM VACUUM	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/5/96	8:00	59.66	123.66	OUT OF SERVICE	0.07	0.29	37.18	0.71	11.48	55.05	56.65
12/5/96	9:00	60.08	129.70		2.17	2.40	37.19	0.71	11.50	56.62	58.67
12/5/96	10:00	60.96	141.82		7.01	7.16	37.20	0.71	11.53	58.25	60.36
12/5/96	11:00	62.13	127.25		0.07	0.27	37.19	0.71	11.52	59.72	61.37
12/5/96	12:00	63.21	125.62		0.07	0.27	37.24	0.71	11.51	61.08	62.71
12/5/96	13:00	64.03	124.52		0.07	0.27	37.20	0.71	11.56	62.04	63.64
12/5/96	14:00	64.04	123.23		0.07	0.27	37.17	0.71	11.52	60.32	62.07
12/5/96	15:00	64.03	122.79		0.07	0.27	37.17	0.71	11.52	59.20	60.92
12/5/96	16:00	63.97	123.10		0.07	0.27	37.20	0.71	11.49	59.23	60.93
12/5/96	17:00	63.98	123.22		0.07	0.27	37.17	0.71	11.45	60.83	62.34
12/5/96	18:00	63.92	124.59		0.07	0.27	37.23	0.71	11.48	61.31	62.87
12/5/96	19:00	63.84	133.35		0.07	0.27	37.17	0.70	11.48	59.74	61.45
12/5/96	20:00	63.57	157.27		0.07	0.29	37.23	0.71	11.49	59.10	61.11
12/5/96	21:00	63.78	177.92		0.40	0.62	37.21	0.70	11.48	59.55	63.67
12/5/96	22:00	63.66	143.53		0.07	0.26	37.26	0.71	11.45	58.00	60.06
12/5/96	23:00	63.37	178.04		1.09	4.90	37.13	0.70	11.46	58.36	62.44
12/6/96	0:00	63.62	201.64		10.14	10.23	37.16	0.71	11.50	58.77	63.64
12/6/96	1:00	64.41	185.48		21.65	22.09	37.19	0.71	11.51	58.12	61.09
12/6/96	2:00	64.10	162.53		21.94	22.06	37.21	0.71	11.45	57.41	60.02
12/6/96	3:00	63.42	143.96		22.05	21.99	37.24	0.71	11.39	56.93	59.15
12/6/96	4:00	62.65	130.70		21.82	22.08	37.21	0.71	11.44	55.89	57.87
12/6/96	5:00	61.87	126.75		20.20	20.25	37.23	0.71	11.44	55.48	57.41
12/6/96	6:00	61.10	124.60		0.07	0.30	37.21	0.71	11.43	54.49	56.31
12/6/96	7:00	60.51	117.35		0.07	0.30	37.23	0.71	11.42	53.88	55.63
12/6/96	8:00	60.28	110.70		0.08	0.30	37.24	0.68	11.41	54.59	56.16
12/6/96	9:00	60.37	113.07		0.07	0.30	37.19	0.71	11.40	55.69	57.19
12/6/96	10:00	60.83	109.44		0.08	0.30	37.22	0.71	11.41	57.11	58.48
12/6/96	11:00	84.17	174.35		12.69	12.98	37.19	0.75	11.43	59.83	66.20
12/6/96	12:00	69.19	154.07		21.82	22.03	37.26	0.71	11.44	59.81	61.84
12/6/96	13:00	65.91	140.03		22.05	22.05	37.24	0.71	11.45	60.39	62.73
12/6/96	14:00	83.65	210.70		14.34	22.24	37.21	0.71	11.45	62.87	69.98
12/6/96	15:00	74.92	157.53		8.07	22.07	37.20	0.71	11.48	62.54	66.00
12/6/96	16:00	87.99	339.16		11.86	22.09	37.20	1.09	11.52	64.95	72.87
12/6/96	17:00	75.85	320.33		0.08	17.01	31.32	0.88	11.53	64.15	71.94
12/6/96	18:00	72.82	187.50		17.19	22.05	13.30	0.71	11.46	61.71	65.75
12/6/96	19:00	97.64	169.86		18.16	18.02	37.17	0.71	11.43	59.20	63.78
12/6/96	20:00	96.52	146.47		0.07	0.29	37.21	0.71	11.45	58.08	60.36
12/6/96	21:00	109.23	180.44		7.33	7.34	37.19	0.71	11.47	59.04	63.66
12/6/96	22:00	93.58	166.70		3.36	3.56	37.25	0.70	11.49	59.45	62.66
12/6/96	23:00	82.84	182.50		2.62	2.85	37.20	0.71	11.45	61.69	65.18
12/7/96	0:00	76.89	145.34		0.07	0.30	37.15	0.71	11.47	61.57	63.59
12/7/96	1:00	73.63	195.30		6.83	7.18	37.21	0.71	11.45	61.91	65.80
12/7/96	2:00	71.34	172.54		0.07	0.30	37.24	0.71	11.48	61.20	63.58
12/7/96	3:00	69.12	129.94		0.08	0.30	37.23	0.71	11.46	59.55	61.49
12/7/96	4:00	67.69	122.91		0.08	0.30	37.19	0.71	11.44	58.53	60.32
12/7/96	5:00	66.96	121.58		0.07	0.30	37.22	0.71	11.43	58.27	60.03
12/7/96	6:00	68.86	237.00		5.44	5.81	37.21	0.71	11.48	59.05	63.81
12/7/96	7:00	67.39	151.37		0.07	0.30	37.20	0.70	11.47	57.78	60.02
12/7/96	8:00	68.59	248.90		0.14	0.33	33.65	0.67	11.49	58.80	65.02
12/7/96	9:00	70.83	216.33		0.08	0.27	37.20	0.69	11.41	58.94	62.89
12/7/96	10:00	68.00	263.86		5.26	7.58	37.20	0.70	11.45	61.16	67.63
12/7/96	11:00	67.98	189.73		0.08	0.30	37.17	0.71	11.51	61.79	65.48
12/7/96	12:00	72.25	326.31		0.07	0.30	37.21	0.72	11.55	65.64	73.79
12/7/96	13:00	75.25	201.89		0.07	5.88	37.16	0.73	11.50	65.97	69.15
12/7/96	14:00	73.71	181.20		0.08	10.27	37.15	0.43	11.50	67.79	72.07
12/7/96	15:00	73.70	206.87		0.07	6.26	37.26	0.50	11.51	68.35	72.92
12/7/96	16:00	73.85	181.41		0.07	0.30	37.22	0.54	11.53	66.58	69.13
12/7/96	17:00	83.63	224.92		3.76	14.89	33.81	0.71	11.46	66.87	72.78
12/7/96	18:00	74.70	169.26		2.78	16.07	37.18	0.71	11.64	60.24	62.79
12/7/96	19:00	72.01	201.17		9.54	16.06	37.24	0.71	11.60	56.85	62.96
12/7/96	20:00	70.09	170.83		10.92	16.06	37.28	0.71	11.79	53.54	56.35
12/7/96	21:00	68.20	160.22		12.83	16.07	37.20	0.71	11.79	53.14	55.51
12/7/96	22:00	66.50	149.36		16.17	16.07	37.22	0.71	11.80	51.38	58.63
12/7/96	23:00	65.37	205.60		17.99	16.06	37.21	0.71	11.76	51.14	56.91
12/8/96	0:00	65.49	167.90		12.30	16.12	37.20	0.71	11.81	49.16	51.85
12/8/96	1:00	63.33	149.37		11.84	16.07	37.20	0.71	11.81	48.85	51.91
12/8/96	2:00	62.29	185.03		12.06	16.09	37.24	0.71	11.76	49.08	53.16

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		GEM HOPPER	GOB CUTTER	GOB CUTTER TEMP	GOB CUTTER	GOB ROLLER	CONVEYOR SPEED	GEM ENCLOSURE TO ROOM VACUUM	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/8/96	3:00	61.40	140.04		12.94	16.08	37.19	0.71	11.86	47.78	49.96
12/8/96	4:00	60.63	133.00		10.40	16.08	37.15	0.71	11.83	47.56	49.56
12/8/96	5:00	59.78	129.84		14.42	16.09	37.22	0.71	11.94	46.64	48.54
12/8/96	6:00	59.17	133.49		12.19	16.11	37.21	0.71	11.78	49.81	51.68
12/8/96	7:00	62.49	260.74		13.72	14.16	37.24	0.69	11.57	53.89	61.43
12/8/96	8:00	61.28	172.94		9.26	16.06	37.19	0.71	11.66	54.13	56.71
12/8/96	9:00	67.10	177.78		4.93	16.08	37.23	0.76	11.63	55.24	59.33
12/8/96	10:00	74.11	261.96		2.87	15.95	37.20	0.88	11.63	54.82	61.39
12/8/96	11:00	64.72	185.36		0.08	16.07	37.29	0.72	11.77	52.28	56.49
12/8/96	12:00	63.10	161.08		0.08	16.07	37.20	0.71	11.81	51.75	54.03
12/8/96	13:00	61.82	152.32		0.07	16.07	37.19	0.85	11.81	51.23	53.35
12/8/96	14:00	67.66	212.22		0.98	14.50	37.22	0.72	11.82	51.46	57.42
12/8/96	15:00	75.26	218.06		2.22	13.71	37.22	0.71	11.76	52.29	57.73
12/8/96	16:00	68.61	192.26		0.07	0.30	37.20	0.71	11.75	51.37	54.70
12/8/96	17:00	63.62	149.62		0.07	0.31	37.27	0.70	11.81	51.36	53.49
12/8/96	18:00	62.78	179.85		1.98	3.64	37.21	0.71	11.64	52.82	56.55
12/8/96	19:00	63.14	173.09		3.91	6.77	37.29	0.71	11.63	52.99	58.40
12/8/96	20:00	64.72	171.46		0.70	3.46	37.23	0.71	11.75	52.46	55.25
12/8/96	21:00	63.79	151.17		0.07	0.30	37.23	0.70	11.86	49.09	51.36
12/8/96	22:00	63.53	146.72		0.07	0.30	37.17	0.71	11.83	47.87	50.06
12/8/96	23:00	63.57	143.87		0.07	0.30	37.17	0.71	11.82	48.54	50.56
12/9/96	0:00	67.43	145.69		0.07	0.30	37.20	0.73	11.77	50.41	52.62
12/9/96	1:00	67.48	151.18		0.07	0.30	37.16	0.71	11.90	51.10	53.29
12/9/96	2:00	68.19	151.48		0.07	0.30	37.21	0.71	11.99	50.38	52.59
12/9/96	3:00	68.10	148.79		0.07	0.30	37.24	0.71	12.00	50.19	52.41
12/9/96	4:00	69.55	170.44		1.61	3.29	36.76	0.71	12.04	50.42	54.97
12/9/96	5:00	73.84	193.66		1.34	3.55	37.23	0.70	12.09	51.65	55.80
12/9/96	6:00	70.08	197.34		2.11	5.10	37.22	0.73	12.04	50.60	54.55
12/9/96	7:00	69.72	177.18		0.74	2.55	37.18	0.71	12.16	51.48	55.16
12/9/96	8:00	70.75	206.73		3.11	7.55	37.18	0.71	12.07	52.70	59.23
12/9/96	9:00	69.50	166.80		0.08	0.30	37.23	0.76	12.27	50.95	53.65
12/9/96	10:00	69.06	175.86		0.07	0.30	37.23	0.86	12.22	51.20	54.29
12/9/96	11:00	78.32	191.21		1.77	6.96	37.23	0.71	12.05	54.86	61.23
12/9/96	12:00	82.00	200.93		0.26	1.88	37.22	0.70	12.20	55.15	58.82
12/9/96	13:00	73.15	194.44		0.70	3.87	37.20	0.71	12.11	54.04	58.95
12/9/96	14:00	71.48	199.81		0.22	1.60	37.14	0.73	12.17	55.16	59.04
12/9/96	15:00	70.01	167.91		0.07	0.29	37.14	0.71	12.28	54.23	56.91
12/9/96	16:00	69.24	158.87		0.07	0.29	37.16	0.71	12.19	54.04	56.54
12/9/96	17:00	68.86	152.21		0.07	0.29	37.21	0.71	12.21	53.47	55.89
12/9/96	18:00	68.76	143.80		0.07	0.29	37.20	0.71	12.29	52.00	54.29
12/9/96	19:00	70.61	195.74		2.52	13.66	33.49	0.71	12.48	52.70	59.13
12/9/96	20:00	72.87	188.45		0.14	0.74	37.20	0.69	12.68	53.93	57.54
12/9/96	21:00	69.67	156.43		0.07	0.27	37.20	0.79	12.67	53.23	55.92
12/9/96	22:00	68.64	150.04		0.07	0.27	37.19	0.71	12.70	52.38	54.54
12/9/96	23:00	68.19	147.53		0.07	0.27	37.22	0.71	12.70	52.41	54.29
12/10/96	0:00	70.17	154.23		0.82	3.54	37.21	0.73	12.59	52.81	55.75
12/10/96	1:00	68.44	165.45		1.58	7.51	37.23	0.70	12.59	53.16	56.36
12/10/96	2:00	65.20	154.71		0.08	0.29	37.16	0.67	12.63	53.53	55.99
12/10/96	3:00	66.00	118.54		0.12	0.33	37.19	0.48	12.47	53.17	55.30
12/10/96	4:00	66.25	147.23		0.07	0.29	37.18	0.71	12.75	53.23	55.35
12/10/96	5:00	64.41	149.52		0.07	0.29	37.21	0.71	12.72	54.77	56.82
12/10/96	6:00	64.92	159.40		0.07	0.29	37.23	0.71	12.66	55.25	57.46
12/10/96	7:00	65.80	158.77		0.07	0.29	37.19	0.71	12.68	57.21	59.12
12/10/96	8:00	66.41	155.45		0.07	1.71	37.22	0.84	12.65	58.78	60.67
12/10/96	9:00	79.19	162.15		0.67	7.41	37.19	0.70	12.55	60.23	63.08
12/10/96	10:00	81.19	181.44		0.07	0.29	37.19	0.91	12.58	62.70	64.80
12/10/96	11:00	71.72	159.16		0.07	1.70	37.20	0.94	12.51	65.47	67.19
12/10/96	12:00	77.93	132.92		0.08	0.75	37.23	0.66	12.34	69.37	71.21
12/10/96	13:00	76.74	163.05		0.76	2.52	37.15	0.79	12.38	70.59	72.34
12/10/96	14:00	73.49	166.21		0.05	0.29	37.17	0.91	12.37	73.13	74.72
12/10/96	15:00	73.74	167.34		0.05	0.29	37.19	0.81	12.30	74.97	76.68
12/10/96	16:00	81.11	164.55		0.06	0.30	37.22	0.51	12.29	75.35	77.75
12/10/96	17:00	84.81	189.95		0.08	4.55	37.23	0.72	12.36	74.43	76.58
12/10/96	18:00	85.35	203.13		0.08	7.70	37.23	0.62	12.30	74.36	79.14
12/10/96	19:00	83.37	187.08		0.07	4.36	37.20	0.76	12.55	73.08	75.92
12/10/96	20:00	79.43	189.46		0.07	0.30	37.19	0.83	12.57	71.47	74.08
12/10/96	21:00	78.43	454.63		0.07	0.30	37.25	1.58	12.42	74.43	81.91

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM

CAMPAIGN 4 SERIES A GLASS

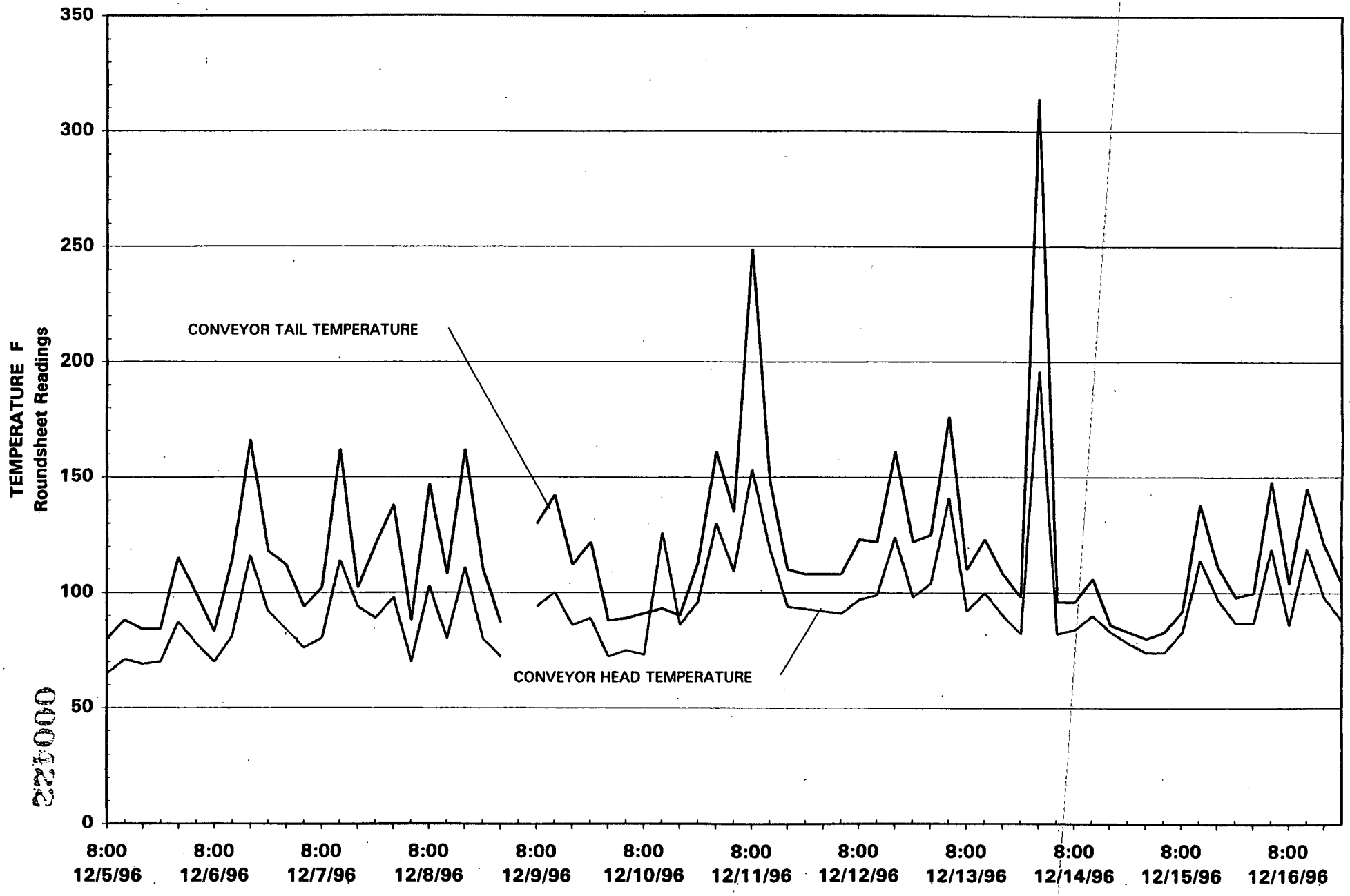
		HOURLY AVERAGES									
READINGS		GEM HOPPER	GOB CUTTER	GOB CUTTER TEMP	GOB CUTTER	GOB ROLLER	CONVEYOR SPEED	GEM ENCLOSURE TO ROOM VACUUM	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/10/96	22:00	78.57	309.69		0.07	2.45	37.28	0.97	12.40	75.06	81.36
12/10/96	23:00	79.72	319.27		0.08	0.30	37.21	0.84	12.52	75.15	81.38
12/11/96	0:00	77.14	227.50		0.08	0.30	37.27	0.71	12.70	72.90	76.89
12/11/96	1:00	92.92	229.23		0.07	0.81	37.24	0.66	12.77	72.56	77.54
12/11/96	2:00	77.41	212.61		0.07	0.86	37.24	0.61	12.92	73.91	77.26
12/11/96	3:00	73.05	211.83		0.08	3.94	37.18	0.61	13.03	74.55	78.87
12/11/96	4:00	69.07	232.62		0.08	9.07	37.22	0.61	13.20	74.79	79.65
12/11/96	5:00	66.78	192.96		0.07	9.05	37.21	0.56	13.26	73.98	76.48
12/11/96	6:00	65.69	161.71		0.07	9.08	37.20	0.63	13.30	73.91	75.58
12/11/96	7:00	64.69	154.38		0.08	5.15	27.92	0.76	13.34	74.36	76.00
12/11/96	8:00	66.18	403.50		0.08	1.62	37.21	1.35	13.38	76.76	84.08
12/11/96	9:00	69.22	390.38		0.07	0.30	37.18	0.89	12.32	78.45	83.69
12/11/96	10:00	71.57	337.26		0.08	0.30	37.21	0.86	12.31	79.65	85.57
12/11/96	11:00	73.98	267.09		0.08	1.61	37.20	0.86	12.25	80.72	85.60
12/11/96	12:00	75.21	245.34		0.08	3.97	37.21	0.78	12.36	80.68	85.22
12/11/96	13:00	76.71	213.34		0.08	0.32	37.17	0.76	12.35	80.74	83.82
12/11/96	14:00	79.15	228.52		0.07	3.41	37.21	0.80	12.27	81.66	86.92
12/11/96	15:00	79.08	181.78		0.08	0.30	37.20	0.76	12.39	80.83	83.09
12/11/96	16:00	79.49	230.36		0.08	3.71	37.18	0.76	12.20	82.29	87.24
12/11/96	17:00	79.28	191.89		0.07	0.30	37.16	0.75	12.35	81.17	83.46
12/11/96	18:00	78.76	176.35		0.07	0.30	37.21	0.75	12.35	80.05	82.15
12/11/96	19:00	77.72	169.99		0.07	0.30	37.23	0.76	12.38	77.34	79.42
12/11/96	20:00	76.37	190.10		0.07	0.30	37.21	0.76	12.44	75.10	77.27
12/11/96	21:00	75.36	331.10		0.08	4.65	37.15	0.87	12.40	75.04	81.36
12/11/96	22:00	74.20	208.36		0.08	0.37	37.25	0.68	12.58	74.01	77.11
12/11/96	23:00	72.59	172.42		0.07	0.30	37.19	0.71	12.75	71.27	73.63
12/12/96	0:00	71.74	163.51		0.08	3.00	37.18	0.71	12.68	70.19	72.24
12/12/96	1:00	70.91	193.57		0.07	15.03	37.13	0.71	12.80	69.14	73.60
12/12/96	2:00	72.25	218.27		0.07	15.18	37.21	0.73	12.82	68.85	72.86
12/12/96	3:00	70.77	169.88		0.07	15.16	37.18	0.71	12.95	66.98	69.34
12/12/96	4:00	69.52	161.05		0.07	15.11	37.16	0.71	12.96	66.07	68.20
12/12/96	5:00	71.37	213.97		0.07	9.46	37.20	0.73	12.84	66.58	71.78
12/12/96	6:00	69.88	166.28		0.07	0.29	37.20	0.73	13.05	64.51	66.75
12/12/96	7:00	69.34	195.34		0.07	6.08	37.22	0.74	13.03	63.24	67.50
12/12/96	8:00	69.82	202.33		0.08	6.78	37.21	0.74	12.97	64.21	68.77
12/12/96	9:00	94.36	205.58		0.07	23.54	37.22	0.74	13.06	63.28	68.19
12/12/96	10:00	82.29	164.12		0.07	23.70	37.17	0.77	13.23	61.20	63.52
12/12/96	11:00	88.40	214.77		0.07	23.74	37.18	0.78	13.06	64.77	68.99
12/12/96	12:00	95.66	194.19		0.08	23.84	37.25	0.76	12.96	67.68	70.44
12/12/96	13:00	81.30	186.26		0.07	23.86	37.14	0.76	12.98	68.85	71.05
12/12/96	14:00	77.09	263.07		0.07	23.79	37.22	0.76	12.68	71.05	77.97
12/12/96	15:00	74.07	212.97		0.07	24.04	37.17	0.76	12.94	69.72	72.80
12/12/96	16:00	69.35	237.42		0.07	23.93	37.25	0.75	12.88	68.59	73.91
12/12/96	17:00	70.44	224.68		0.07	23.89	37.17	0.74	13.05	66.19	71.00
12/12/96	18:00	72.80	228.28		0.07	23.91	37.15	0.73	12.95	65.50	70.69
12/12/96	19:00	73.76	205.43		0.07	23.92	37.23	0.73	13.16	63.87	67.19
12/12/96	20:00	72.69	186.74		0.07	23.80	37.23	0.74	12.99	63.95	69.42
12/12/96	21:00	71.43	215.86		0.07	23.86	37.26	0.73	13.06	63.80	68.37
12/12/96	22:00	69.56	206.32		0.08	23.64	37.24	0.74	13.03	63.38	68.70
12/12/96	23:00	69.43	187.64		0.08	23.78	37.18	0.73	13.14	62.25	65.14
12/13/96	0:00	68.88	152.55		0.07	23.80	37.26	0.75	13.17	61.53	63.75
12/13/96	1:00	68.90	205.97		0.08	23.71	37.23	0.74	13.07	62.61	68.08
12/13/96	2:00	68.92	169.28		0.07	21.59	37.22	0.74	13.17	60.94	63.50
12/13/96	3:00	78.02	219.44		0.07	24.13	37.22	0.73	13.06	61.20	66.22
12/13/96	4:00	71.62	158.31		0.07	24.29	37.21	0.73	13.16	60.19	63.29
12/13/96	5:00	69.93	144.58		0.07	24.20	37.15	0.75	13.16	59.33	61.73
12/13/96	6:00	92.73	259.72		0.07	24.08	37.24	0.74	13.11	60.31	66.23
12/13/96	7:00	75.45	188.66		0.07	24.19	37.18	0.74	13.20	58.86	61.77
12/13/96	8:00	71.21	221.87		0.07	24.10	37.18	0.79	13.12	59.52	64.63
12/13/96	9:00	69.64	187.89		0.08	24.10	37.23	0.75	13.21	59.36	62.27
12/13/96	10:00	68.81	201.03		0.07	24.05	37.17	0.76	13.12	60.02	64.68
12/13/96	11:00	68.64	180.19		0.07	24.08	37.25	0.76	13.18	59.42	62.90
12/13/96	12:00	78.67	212.56		0.07	23.57	37.21	0.75	13.05	60.72	66.63
12/13/96	13:00	81.50	211.03		0.08	23.68	37.14	0.76	13.08	61.56	66.69
12/13/96	14:00	72.10	250.80		0.07	23.57	37.27	0.75	13.07	61.74	65.61
12/13/96	15:00	70.10	182.26		0.07	23.68	37.23	0.76	13.05	62.41	64.89
12/13/96	16:00	69.36	151.94		0.07	23.66	37.19	0.75	13.09	62.73	64.70

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY AVERAGES									
READINGS		GEM	GOB	GOB	GOB	GOB	CONVEYOR	GEM	CLCW	CLCW	CLCW
		HOPPER	CUTTER	CUTTER	CUTTER	ROLLER	SPEED	ENCLOSURE	DIVERTERS	DIVERTERS	DIVERTERS
				TEMP				TO ROOM	& CONVEYOR	& CONVEYOR	& CONVEYOR
								VACUUM	SUPPLY	SUPPLY	RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/13/96	17:00	68.68	140.06		0.07	23.61	37.22	0.75	13.19	61.52	63.63
12/13/96	18:00	67.86	133.55		0.07	23.51	37.21	0.75	13.25	58.92	61.06
12/13/96	19:00	68.10	122.11		0.07	0.29	37.22	0.71	13.30	56.63	58.72
12/13/96	20:00	66.46	123.75		0.07	0.29	37.23	0.75	13.34	55.70	57.89
12/13/96	21:00	65.09	120.60		0.07	0.29	37.25	0.75	13.27	55.12	57.10
12/13/96	22:00	78.52	148.92		0.08	5.74	36.48	0.13	13.29	54.74	58.73
12/13/96	23:00	74.00	471.51		0.08	0.31	37.23	0.60	13.16	54.67	62.93
12/14/96	0:00	68.43	633.46		0.07	0.30	37.19	0.70	13.20	55.50	65.36
12/14/96	1:00	65.98	251.64		0.08	0.30	37.18	0.70	13.40	52.90	56.89
12/14/96	2:00	64.53	185.97		0.07	0.30	37.23	0.71	13.30	52.66	56.02
12/14/96	3:00	63.42	141.24		0.07	0.30	37.21	0.71	13.35	52.16	54.68
12/14/96	4:00	62.86	119.18		0.08	0.30	37.24	0.73	13.40	52.01	54.10
12/14/96	5:00	62.27	108.32		0.08	0.30	37.23	0.71	13.53	51.24	53.22
12/14/96	6:00	61.85	119.85		0.08	0.30	37.16	0.71	13.44	51.10	53.82
12/14/96	7:00	61.56	111.18		0.07	0.30	37.23	0.71	13.44	51.08	53.33
12/14/96	8:00	62.08	210.71		0.09	23.08	37.15	0.76	13.36	51.52	56.25
12/14/96	9:00	63.16	164.00		0.08	10.58	37.14	0.76	13.38	53.08	55.48
12/14/96	10:00	63.67	204.79		0.08	0.29	37.26	0.75	13.22	57.28	60.04
12/14/96	11:00	65.38	249.32		0.07	0.29	37.21	0.77	13.14	61.19	64.95
12/14/96	12:00	66.78	154.61		0.06	0.29	37.23	0.75	13.09	62.63	64.48
12/14/96	13:00	67.90	169.57		0.06	0.29	37.22	0.77	13.11	64.61	67.11
12/14/96	14:00	68.88	131.91		0.07	0.29	37.16	0.64	13.04	65.88	67.42
12/14/96	15:00	69.57	137.77		0.07	0.29	37.19	0.76	13.02	66.74	68.11
12/14/96	16:00	70.80	137.53		0.07	0.29	37.19	0.76	13.05	66.95	68.30
12/14/96	17:00	70.34	134.47		0.06	0.29	37.26	0.75	13.07	65.22	66.65
12/14/96	18:00	69.25	130.40		0.06	0.29	37.20	0.75	13.07	62.78	64.15
12/14/96	19:00	68.58	127.71		0.06	0.29	37.23	0.75	13.17	62.56	63.86
12/14/96	20:00	67.99	128.09		0.07	0.29	37.20	0.76	13.24	61.92	63.32
12/14/96	21:00	67.37	127.75		0.08	0.29	37.23	0.76	13.15	60.46	61.93
12/14/96	22:00	66.62	125.07		0.07	0.29	37.14	0.72	13.19	59.25	60.57
12/14/96	23:00	65.91	121.41		0.07	0.29	37.26	0.73	13.31	58.41	59.70
12/15/96	0:00	65.22	118.33		0.07	0.29	37.22	0.76	13.09	58.39	59.54
12/15/96	1:00	64.68	117.68		0.07	0.29	37.23	0.75	12.92	58.40	59.64
12/15/96	2:00	64.27	133.68		0.08	0.29	37.20	0.76	12.88	58.17	59.52
12/15/96	3:00	64.06	123.07		0.07	0.29	37.20	0.74	12.92	57.59	58.92
12/15/96	4:00	63.93	130.49		0.08	0.29	37.19	0.71	12.94	57.37	58.96
12/15/96	5:00	63.92	155.92		0.08	0.29	37.26	0.71	12.88	57.31	60.15
12/15/96	6:00	64.06	152.19		0.07	0.30	37.22	0.71	12.95	56.60	58.81
12/15/96	7:00	63.51	157.27		0.07	10.35	37.28	0.71	12.98	55.67	59.06
12/15/96	8:00	63.71	241.10		0.08	6.53	37.16	0.70	12.75	57.44	62.67
12/15/96	9:00	66.32	176.72		0.08	5.40	37.20	0.71	12.78	58.56	61.90
12/15/96	10:00	66.51	218.67		0.08	22.18	37.26	0.71	12.45	62.76	67.50
12/15/96	11:00	67.11	251.34		0.07	10.53	37.20	0.70	12.75	66.21	72.30
12/15/96	12:00	67.44	178.38		0.08	0.29	37.20	0.71	12.88	67.12	69.87
12/15/96	13:00	70.08	203.92		0.08	0.72	37.23	0.71	12.73	69.57	73.74
12/15/96	14:00	70.56	296.05		0.07	0.30	37.27	0.71	12.63	71.57	75.59
12/15/96	15:00	71.11	157.74		0.07	0.30	37.22	0.71	12.79	72.71	74.75
12/15/96	16:00	71.24	134.66		0.07	0.30	37.20	0.71	12.78	72.75	74.41
12/15/96	17:00	70.96	124.66		0.07	0.30	37.22	0.71	12.85	71.69	73.24
12/15/96	18:00	71.41	122.46		0.07	0.30	37.24	0.72	12.88	69.82	71.41
12/15/96	19:00	71.80	138.68		0.07	0.30	37.21	0.71	12.89	69.04	70.51
12/15/96	20:00	72.16	135.32		0.08	3.35	37.17	0.65	12.99	69.14	70.70
12/15/96	21:00	71.96	144.23		0.07	0.29	37.20	0.71	12.98	68.52	70.05
12/15/96	22:00	71.57	149.09		0.08	0.29	37.21	0.71	12.98	67.57	69.24
12/15/96	23:00	71.61	144.41		0.07	0.29	37.29	0.54	12.92	66.83	68.70
12/16/96	0:00	75.95	198.01		0.07	6.11	37.21	0.75	13.11	63.64	67.45
12/16/96	1:00	69.46	150.18		0.07	0.30	37.24	0.71	13.15	61.40	63.43
12/16/96	2:00	66.33	143.59		0.08	0.30	37.22	0.71	13.17	59.60	61.53
12/16/96	3:00	64.36	166.18		0.09	6.93	37.20	0.71	13.10	58.76	62.90
12/16/96	4:00	63.20	147.94		0.24	16.04	37.28	0.71	13.25	56.60	59.10
12/16/96	5:00	61.94	199.72		0.08	4.56	37.19	0.72	13.19	55.74	60.72
12/16/96	6:00	60.67	151.22		0.09	0.30	37.17	0.71	13.36	53.86	56.08
12/16/96	7:00	60.45	187.09		0.14	16.48	37.26	0.72	13.21	54.62	58.84
12/16/96	8:00	62.01	176.36		0.08	0.62	113.09	1.29	13.32	53.90	56.58
12/16/96	9:00	66.15	201.73		0.08	7.41	43.16	0.75	13.22	56.65	61.34
12/16/96	10:00	65.60	165.84		0.06	3.61	37.26	0.76	13.31	56.48	58.96
12/16/96	11:00	67.00	277.39		0.07	10.72	37.17	0.76	12.99	58.63	66.41

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM											
CAMPAIGN 4 SERIES A GLASS											
		HOURLY AVERAGES									
READINGS		GEM HOPPER	GOB CUTTER	GOB CUTTER TEMP	GOB CUTTER	GOB ROLLER	CONVEYOR SPEED	GEM ENCLOSURE TO ROOM VACUUM	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/16/96	12:00	67.19	173.83		0.07	0.29	37.23	0.76	13.29	56.81	59.29
12/16/96	13:00	65.81	159.09		0.06	0.29	37.25	0.76	13.26	57.31	59.30
12/16/96	14:00	64.95	173.36		0.06	1.61	37.25	0.76	13.23	58.16	61.14
12/16/96	15:00	66.30	209.96		0.07	10.09	37.21	0.76	13.19	59.41	63.82
12/16/96	16:00	66.58	171.91		0.08	20.15	37.23	0.76	13.26	60.07	62.36
12/16/96	17:00	67.18	202.39		0.07	20.00	37.19	0.76	13.19	61.56	65.29
12/16/96	18:00	67.94	172.23		0.07	17.09	37.27	0.75	13.25	60.67	63.27
12/16/96	19:00	68.10	161.85		0.08	0.30	37.22	0.75	13.28	60.88	63.19
12/16/96	20:00	67.95	156.88		0.08	0.30	37.21	0.75	13.27	60.84	63.03

000121

CAMPA[illegible]4
SERIES A GLASS
GEM MACHINE SYSTEM

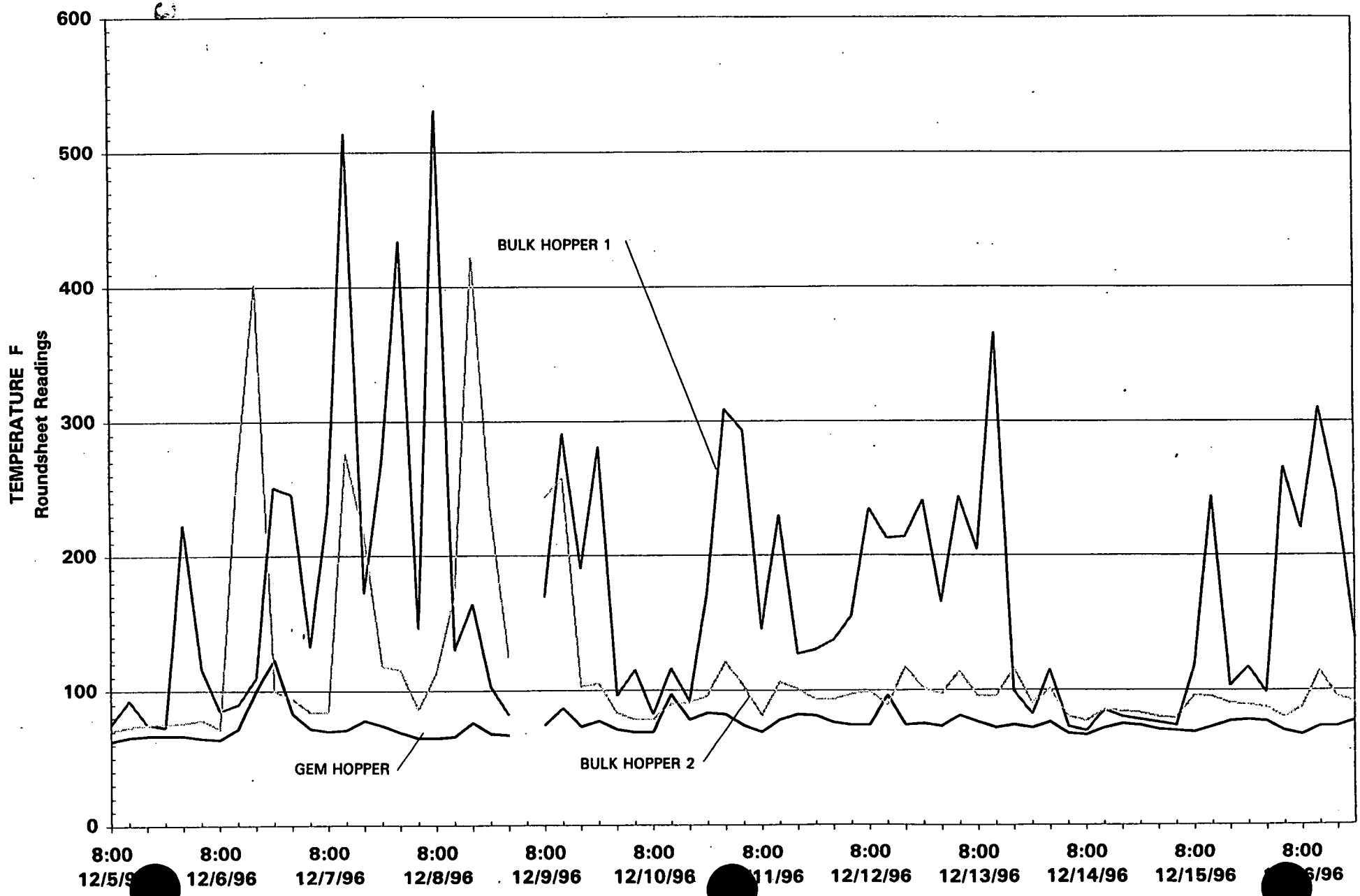


C4GEMMCH.XLS Chart 10

VHP 1/9/97

000422

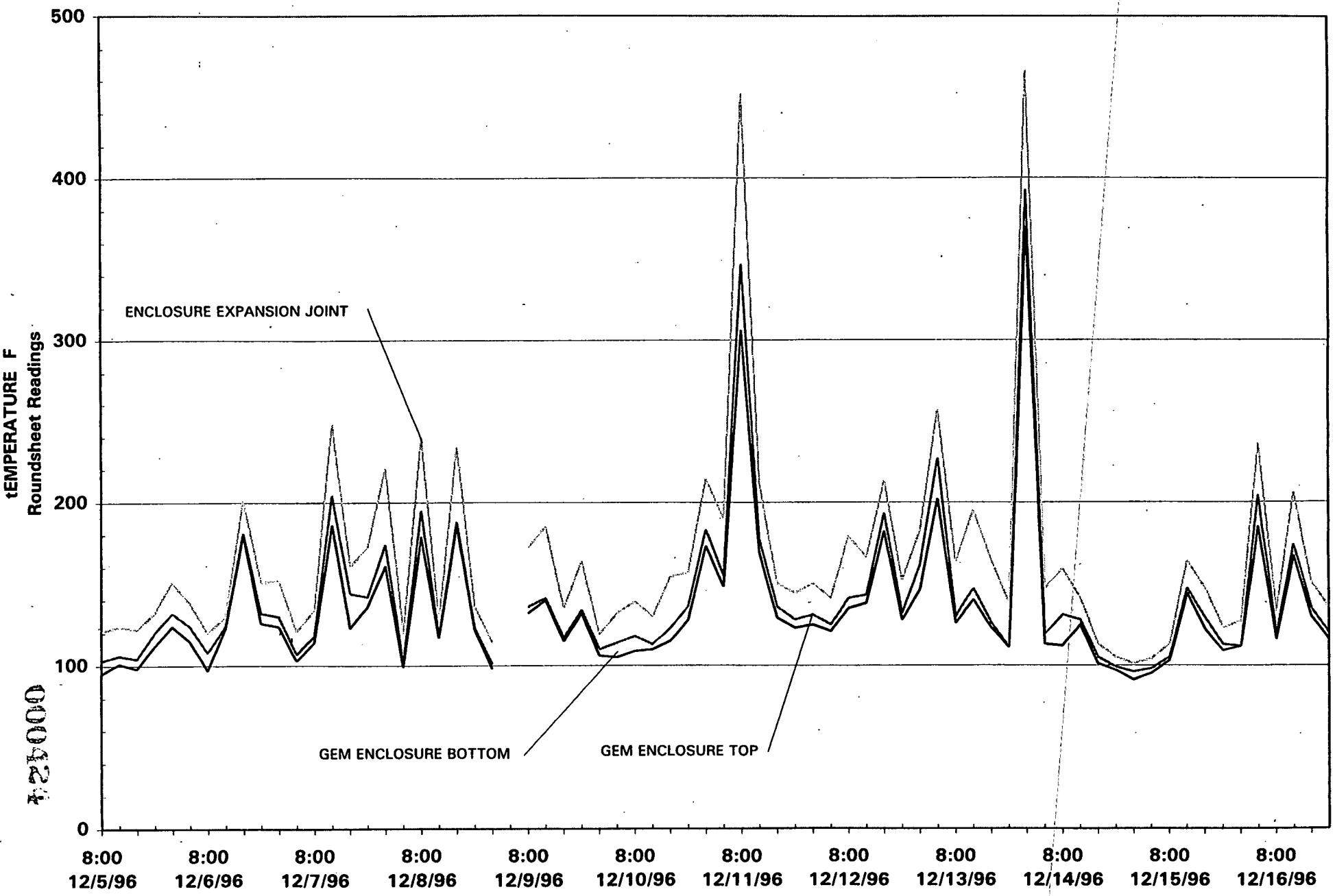
CAMPAIGN 4
SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 11

VHF 1/9/97

CAMPA[illegible]4
SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 12

VHP 1/9/97

000424

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM

CAMPAIGN 4 SERIES A GLASS

		ROUNDSHEET READINGS							
READINGS		CONVEYOR TAIL TEMP	CONVEYOR HEAD TEMP	GEM HOPPER TEMP	BULK HOPPER #1 TEMP	BULK HOPPER #2 TEMP	GEM ENCLOSURE BOTTOM TEMP	GEM ENCLOSURE TOP TEMP	ENCLOSURE EXPANSION JOINT TEMP
DATE	HOUR	F	F	F	F	F	F	F	F
12/5/96	8:00	80	65	63	75	71	95	103	121
12/5/96	12:00	88	71	66	93	73	101	106	124
12/5/96	16:00	84	69	67	75	75	98	104	122
12/5/96	20:00	84	70	67	73	75	112	120	132
12/6/96	0:00	115	87	67	223	76	124	132	151
12/6/96	4:00	100	78	65	116	78	115	124	138
12/6/96	8:00	83	70	64	85	72	97	108	120
12/6/96	12:00	114	81	72	90	261	123	124	130
12/6/96	16:00	166	116	100	109	402	180	181	201
12/6/96	20:00	118	92	123	251	100	126	132	151
12/7/96	0:00	112	84	83	246	94	124	130	152
12/7/96	4:00	94	76	72	132	84	103	107	121
12/7/96	8:00	102	80	70	234	84	114	118	134
12/7/96	12:00	162	114	71	514	276	186	204	248
12/7/96	16:00	102	94	78	172	215	123	144	161
12/7/96	20:00	121	89	74	269	118	136	142	172
12/8/96	0:00	138	98	69	434	115	161	174	221
12/8/96	4:00	88	70	65	146	86	99	101	120
12/8/96	8:00	147	103	65	531	113	179	195	240
12/8/96	12:00	108	80	66	130	169	117	118	127
12/8/96	16:00	162	111	76	164	422	186	188	234
12/8/96	20:00	110	80	68	103	235	122	123	136
12/9/96	0:00	87	72	67	82	124	98	101	114
12/9/96	4:00								
12/9/96	8:00	130	94	74	169	243	132	136	172
12/9/96	12:00	142	100	87	291	258	140	141	185
12/9/96	16:00	112	86	73	190	103	115	117	135
12/9/96	20:00	122	89	77	281	105	132	134	164
12/10/96	0:00	88	72	71	96	83	106	110	119
12/10/96	4:00	89	75	69	115	78	105	114	132
12/10/96	8:00	91	73	69	82	78	109	118	139
12/10/96	12:00	93	126	97	116	90	110	113	130
12/10/96	16:00	90	86	78	92	91	115	123	154
12/10/96	20:00	113	96	83	172	96	128	136	157
12/11/96	0:00	161	130	82	309	121	173	183	214
12/11/96	4:00	135	109	74	293	103	148	155	190
12/11/96	8:00	249	153	69	145	81	306	347	452
12/11/96	12:00	148	119	78	230	106	169	177	212
12/11/96	16:00	110	94	82	127	101	129	136	150
12/11/96	20:00	108	93	81	130	93	123	128	144
12/12/96	0:00	108	92	76	137	93	125	131	150
12/12/96	4:00	108	91	74	155	97	121	125	141
12/12/96	8:00	123	97	74	235	99	135	141	179
12/12/96	12:00	122	99	96	213	89	138	143	166
12/12/96	16:00	161	124	74	214	117	182	193	213
12/12/96	20:00	122	98	75	241	101	128	132	152
12/13/96	0:00	125	104	73	165	97	146	161	182
12/13/96	4:00	176	141	81	244	114	202	227	257
12/13/96	8:00	110	92	76	204	95	126	130	163
12/13/96	12:00	123	100	72	366	95	140	147	195
12/13/96	16:00	108	90	74	99	116	123	126	164
12/13/96	20:00	98	82	72	82	90	111	111	138
12/14/96	0:00	314	196	76	115	101	370	393	467
12/14/96	4:00	96	82	68	73	80	113	119	147

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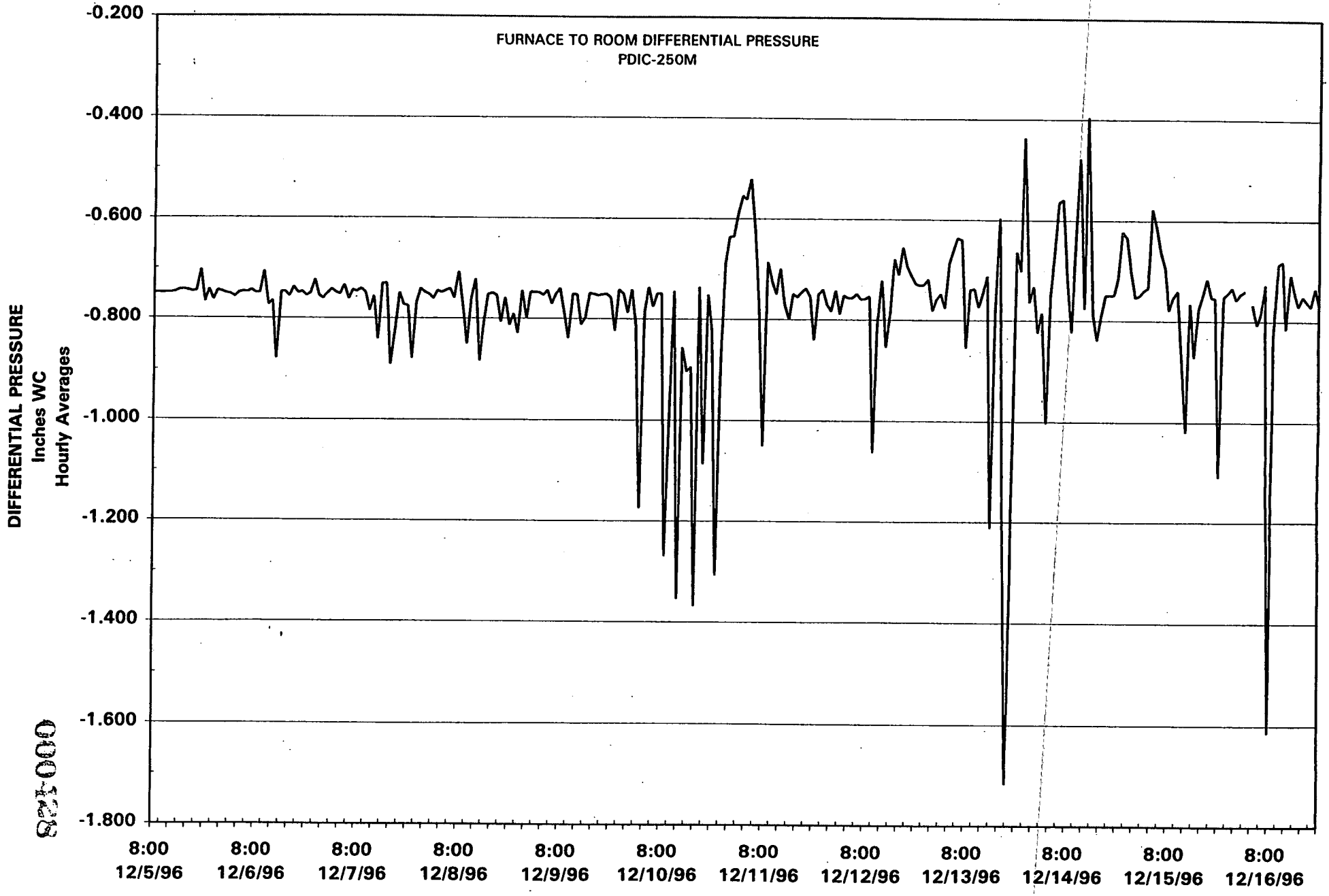
VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM									
CAMPAIGN 4 SERIES A GLASS									
		ROUNDSHEET READINGS							
READINGS		CONVEYOR TAIL TEMP	CONVEYOR HEAD TEMP	GEM HOPPER TEMP	BULK HOPPER #1 TEMP	BULK HOPPER #2 TEMP	GEM ENCLOSURE BOTTOM TEMP	GEM ENCLOSURE TOP TEMP	ENCLOSURE EXPANSION JOINT TEMP
DATE	HOUR	F	F	F	F	F	F	F	F
12/14/96	8:00	96	84	67	70	77	112	131	159
12/14/96	12:00	106	90	72	85	85	125	128	141
12/14/96	16:00	86	83	75	80	84	101	105	113
12/14/96	20:00	83	78	74	78	83	97	99	105
12/15/96	0:00	80	74	71	76	80	91	96	101
12/15/96	4:00	83	74	70	74	79	95	98	104
12/15/96	8:00	92	83	69	117	96	103	105	113
12/15/96	12:00	138	114	73	244	95	144	147	164
12/15/96	16:00	111	97	77	103	90	122	129	147
12/15/96	20:00	98	87	78	117	89	109	113	123
12/16/96	0:00	100	87	77	98	87	112	112	127
12/16/96	4:00	148	119	70	266	80	185	204	236
12/16/96	8:00	104	86	67	220	87	116	119	133
12/16/96	12:00	145	119	73	310	114	167	174	206
12/16/96	16:00	121	98	73	247	95	130	135	151
12/16/96	20:00	104	88	77	138	91	116	120	135

000426

FURNACE OFFGAS SYSTEM

CAMPAIGN 4
SERIES A GLASS
FURNACE OFFGAS SYSTEM

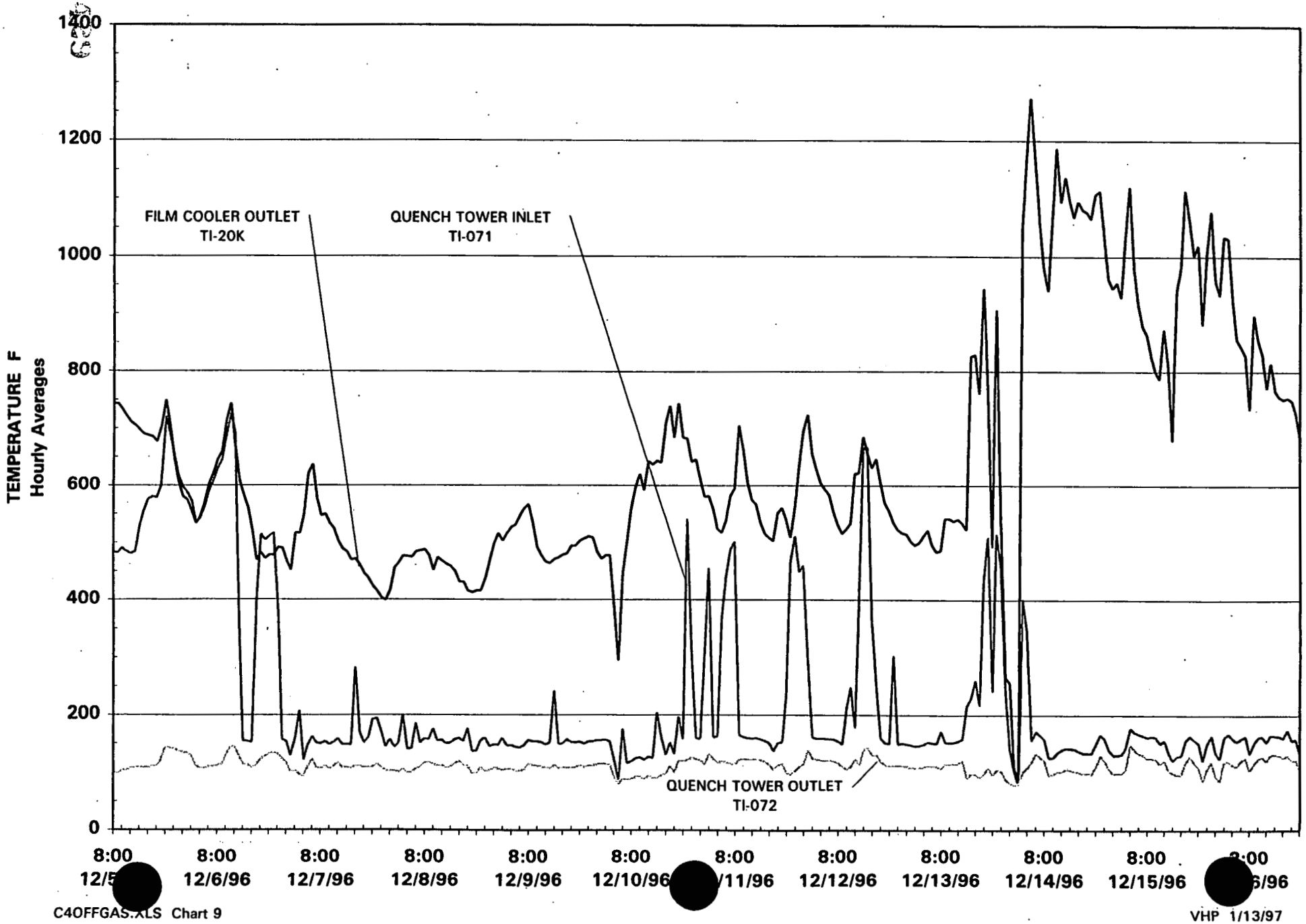


C4OFFGAS.XLS Chart 8

VHP 1/13/97

000128

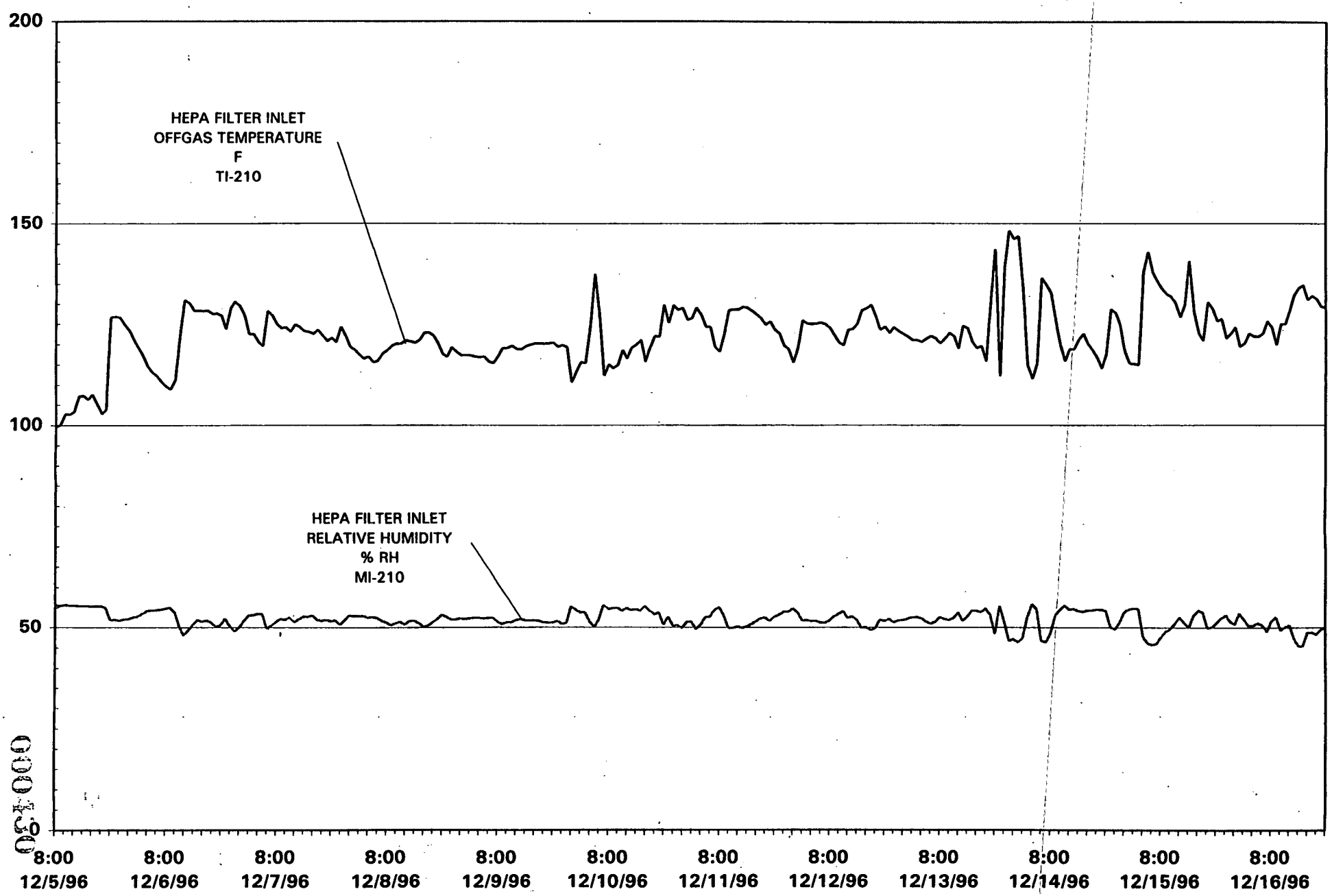
CAMPAIGN 4
SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 9

VHP 1/13/97

CAMPAIGN 4
SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 21

VHP 1/14/97

000430

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/5/96	8:00	-0.750	744.00	483.13	98.13	OUT OF SERVICE	99.74	55.64
12/5/96	9:00	-0.749	743.43	481.58	98.94		100.10	55.45
12/5/96	10:00	-0.750	733.08	490.27	103.12		102.86	55.64
12/5/96	11:00	-0.749	720.87	484.45	104.95		102.73	55.55
12/5/96	12:00	-0.749	710.60	480.43	107.46		103.40	55.47
12/5/96	13:00	-0.748	704.80	483.49	108.32		107.20	55.40
12/5/96	14:00	-0.744	696.90	528.66	108.74		107.30	55.39
12/5/96	15:00	-0.743	689.92	555.33	109.38		106.41	55.37
12/5/96	16:00	-0.745	687.52	575.72	109.27		107.60	55.28
12/5/96	17:00	-0.747	684.91	580.25	110.46		105.09	55.33
12/5/96	18:00	-0.746	677.09	578.62	110.69		102.84	55.35
12/5/96	19:00	-0.704	702.31	599.80	120.54		103.84	54.96
12/5/96	20:00	-0.767	749.61	720.14	143.10		126.62	51.84
12/5/96	21:00	-0.743	700.47	688.52	141.60		126.80	51.98
12/5/96	22:00	-0.763	648.05	653.13	141.82		126.60	51.76
12/5/96	23:00	-0.745	606.94	616.54	136.67		124.78	52.03
12/6/96	0:00	-0.747	580.23	597.14	134.50		123.43	52.16
12/6/96	1:00	-0.750	575.06	587.44	133.27		121.14	52.59
12/6/96	2:00	-0.752	555.69	572.79	128.97		119.18	52.74
12/6/96	3:00	-0.757	533.45	536.21	112.26		117.09	53.49
12/6/96	4:00	-0.749	546.01	543.28	108.52		114.62	54.14
12/6/96	5:00	-0.747	569.55	562.44	108.22		113.13	54.27
12/6/96	6:00	-0.748	601.57	589.66	109.91		112.27	54.29
12/6/96	7:00	-0.744	621.54	608.63	110.68		110.74	54.47
12/6/96	8:00	-0.749	645.80	630.77	113.13		109.65	54.67
12/6/96	9:00	-0.749	659.23	645.13	113.80		108.96	54.89
12/6/96	10:00	-0.707	711.86	688.02	128.89		111.15	53.87
12/6/96	11:00	-0.773	743.89	725.09	142.45		122.24	50.26
12/6/96	12:00	-0.765	669.09	690.02	144.13		130.94	47.91
12/6/96	13:00	-0.879	610.81	353.12	128.95		130.27	49.27
12/6/96	14:00	-0.748	583.55	154.35	115.50		128.36	50.67
12/6/96	15:00	-0.747	560.76	154.01	113.94		128.33	51.90
12/6/96	16:00	-0.756	521.27	152.14	109.26		128.22	51.51
12/6/96	17:00	-0.738	469.33	400.65	112.73		128.37	51.80
12/6/96	18:00	-0.749	481.75	514.32	123.26		127.53	51.21
12/6/96	19:00	-0.747	472.06	504.14	127.63		127.63	50.22
12/6/96	20:00	-0.755	478.30	511.01	132.14		127.11	50.52
12/6/96	21:00	-0.750	477.73	517.51	133.96		123.78	52.28
12/6/96	22:00	-0.724	491.10	387.79	132.24		128.93	50.38
12/6/96	23:00	-0.755	489.52	157.74	124.59		130.59	49.10
12/7/96	0:00	-0.760	467.41	153.20	117.38		129.49	49.79
12/7/96	1:00	-0.750	452.11	129.49	101.34		127.15	51.56
12/7/96	2:00	-0.742	517.37	157.66	103.47		122.56	52.89
12/7/96	3:00	-0.748	516.71	207.61	96.48		122.57	53.04

000532

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/7/96	4:00	-0.752	548.58	122.06	93.42		120.65	53.36
12/7/96	5:00	-0.734	621.43	146.47	110.50		119.60	53.37
12/7/96	6:00	-0.761	636.90	161.91	123.42		128.21	49.89
12/7/96	7:00	-0.744	577.86	150.92	109.08		127.15	50.46
12/7/96	8:00	-0.746	547.24	149.34	106.86		125.00	51.45
12/7/96	9:00	-0.741	549.62	152.97	111.20		124.01	52.14
12/7/96	10:00	-0.749	533.16	148.18	107.30		124.26	51.98
12/7/96	11:00	-0.784	524.46	151.81	110.94		123.15	52.47
12/7/96	12:00	-0.756	501.81	157.88	117.79		124.91	51.39
12/7/96	13:00	-0.841	489.02	148.12	108.61		124.35	52.06
12/7/96	14:00	-0.731	483.54	148.00	108.78		123.28	52.65
12/7/96	15:00	-0.730	469.62	147.54	107.61		123.06	52.68
12/7/96	16:00	-0.890	471.92	283.02	111.35		122.63	52.91
12/7/96	17:00	-0.826	460.70	169.14	111.49		123.59	51.94
12/7/96	18:00	-0.749	446.40	150.60	109.03		122.22	51.73
12/7/96	19:00	-0.772	437.38	159.24	109.24		120.89	51.88
12/7/96	20:00	-0.775	424.35	192.42	110.14		121.58	51.59
12/7/96	21:00	-0.878	414.72	194.12	114.52		120.59	51.78
12/7/96	22:00	-0.769	403.75	169.79	108.00		124.33	50.79
12/7/96	23:00	-0.741	399.48	144.30	103.47		122.02	51.81
12/8/96	0:00	-0.748	416.63	156.49	102.10		119.52	52.89
12/8/96	1:00	-0.752	455.97	143.54	103.45		118.68	52.74
12/8/96	2:00	-0.760	464.36	150.45	100.24		117.51	52.78
12/8/96	3:00	-0.745	476.60	200.82	105.93		116.47	52.79
12/8/96	4:00	-0.748	475.91	140.68	100.60		117.06	52.42
12/8/96	5:00	-0.744	474.83	141.72	100.52		115.65	52.55
12/8/96	6:00	-0.741	483.95	185.50	106.22		115.93	52.33
12/8/96	7:00	-0.759	485.76	151.03	109.08		117.67	51.65
12/8/96	8:00	-0.707	487.28	157.58	116.58		118.52	51.22
12/8/96	9:00	-0.777	476.95	156.93	117.19		119.75	50.58
12/8/96	10:00	-0.850	451.56	175.10	114.07		120.20	51.02
12/8/96	11:00	-0.760	473.71	154.48	111.60		120.19	51.40
12/8/96	12:00	-0.722	467.64	155.23	112.24		120.91	50.77
12/8/96	13:00	-0.883	462.34	149.89	109.08		120.79	51.59
12/8/96	14:00	-0.807	458.33	151.09	110.49		120.45	51.63
12/8/96	15:00	-0.752	449.62	156.55	115.46		121.04	51.06
12/8/96	16:00	-0.749	430.87	159.25	120.06		122.88	50.24
12/8/96	17:00	-0.754	430.84	153.54	112.91		122.97	50.45
12/8/96	18:00	-0.807	414.90	175.77	111.10		122.25	51.18
12/8/96	19:00	-0.759	412.66	137.19	99.04		120.35	52.07
12/8/96	20:00	-0.813	415.47	137.95	99.53		117.67	53.14
12/8/96	21:00	-0.791	415.67	155.49	108.23		116.94	52.65
12/8/96	22:00	-0.828	436.73	159.38	102.77		119.24	51.97
12/8/96	23:00	-0.745	468.05	145.76	104.23		118.18	51.97

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/9/96	0:00	-0.799	497.55	148.32	107.47		117.34	52.26
12/9/96	1:00	-0.747	515.38	148.14	107.03		117.34	52.10
12/9/96	2:00	-0.747	502.99	158.26	104.73		117.32	52.24
12/9/96	3:00	-0.748	516.47	146.70	105.82		116.98	52.42
12/9/96	4:00	-0.753	526.47	147.34	106.45		116.81	52.35
12/9/96	5:00	-0.744	530.52	144.40	103.83		116.99	52.24
12/9/96	6:00	-0.770	547.37	143.19	102.39		115.74	52.37
12/9/96	7:00	-0.751	559.91	147.31	105.65		115.40	52.43
12/9/96	8:00	-0.740	566.40	155.87	114.66		116.94	51.43
12/9/96	9:00	-0.790	534.01	153.92	112.75		118.99	50.82
12/9/96	10:00	-0.838	490.91	153.76	111.45		119.07	51.22
12/9/96	11:00	-0.751	476.98	152.15	110.10		119.62	51.26
12/9/96	12:00	-0.752	466.55	148.85	108.29		118.86	51.82
12/9/96	13:00	-0.811	464.32	151.47	106.80		118.70	52.10
12/9/96	14:00	-0.798	470.92	242.67	112.64		119.52	51.81
12/9/96	15:00	-0.749	473.66	149.55	108.10		119.91	51.80
12/9/96	16:00	-0.751	478.34	150.52	108.63		120.19	51.75
12/9/96	17:00	-0.753	480.60	157.07	108.89		120.22	51.66
12/9/96	18:00	-0.752	494.09	152.50	109.45		120.15	51.27
12/9/96	19:00	-0.750	494.08	152.48	109.84		120.28	51.22
12/9/96	20:00	-0.758	503.00	153.27	112.13		120.43	51.22
12/9/96	21:00	-0.823	507.22	149.86	109.60		119.42	51.63
12/9/96	22:00	-0.742	510.71	153.70	112.14		119.79	50.89
12/9/96	23:00	-0.750	508.52	154.27	112.17		119.26	51.10
12/10/96	0:00	-0.787	483.79	156.02	114.55		110.66	55.12
12/10/96	1:00	-0.742	471.66	156.23	115.29		113.27	54.33
12/10/96	2:00	-0.815	477.88	156.73	114.52		115.53	53.70
12/10/96	3:00	-1.175	477.83	153.77	114.63		115.40	53.74
12/10/96	4:00	-0.785	389.27	122.37	93.54		124.61	51.36
12/10/96	5:00	-0.737	294.47	87.25	79.68		137.41	50.07
12/10/96	6:00	-0.775	444.42	174.91	88.08		127.55	51.98
12/10/96	7:00	-0.749	500.66	116.25	88.03		112.32	55.51
12/10/96	8:00	-0.749	561.09	119.88	88.69		114.92	54.52
12/10/96	9:00	-1.270	597.74	124.71	91.97		114.10	54.71
12/10/96	10:00	-0.992	619.73	126.26	92.97		114.81	54.78
12/10/96	11:00	-0.745	591.88	122.49	88.83		118.47	54.06
12/10/96	12:00	-1.355	641.98	127.66	93.66		116.45	54.78
12/10/96	13:00	-0.856	636.58	125.64	91.03		119.09	54.22
12/10/96	14:00	-0.902	643.13	204.05	90.36		119.93	54.44
12/10/96	15:00	-0.894	640.01	161.88	95.16		121.04	54.05
12/10/96	16:00	-1.369	709.76	131.16	97.36		115.74	55.23
12/10/96	17:00	-0.736	738.47	151.92	112.34		119.14	54.10
12/10/96	18:00	-1.087	684.67	132.46	99.60		122.04	53.16
12/10/96	19:00	-0.752	743.29	196.61	121.87		121.82	53.55

000192

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/10/96	20:00	-0.827	684.21	158.18	120.56		129.69	50.69
12/10/96	21:00	-1.309	682.60	541.00	122.54		125.27	52.60
12/10/96	22:00	-0.900	641.66	315.26	126.67		129.58	50.41
12/10/96	23:00	-0.689	645.16	160.37	123.57		128.57	50.53
12/11/96	0:00	-0.636	611.47	158.39	121.65		128.98	49.84
12/11/96	1:00	-0.635	580.76	301.62	115.83		126.03	51.41
12/11/96	2:00	-0.587	581.75	455.16	132.65		126.41	51.37
12/11/96	3:00	-0.554	558.66	161.06	124.93		129.02	49.64
12/11/96	4:00	-0.560	523.83	164.23	118.02		127.35	50.58
12/11/96	5:00	-0.522	517.28	366.64	120.88		124.35	52.55
12/11/96	6:00	-0.625	538.42	438.26	119.31		124.28	52.57
12/11/96	7:00	-0.780	582.14	487.36	116.02		119.40	54.23
12/11/96	8:00	-1.050	594.78	500.92	115.69		118.21	54.99
12/11/96	9:00	-0.686	704.86	166.56	122.42		122.53	52.85
12/11/96	10:00	-0.724	663.24	162.01	125.36		128.42	49.88
12/11/96	11:00	-0.749	605.07	160.22	124.10		128.64	49.97
12/11/96	12:00	-0.699	575.30	159.38	123.61		128.57	50.23
12/11/96	13:00	-0.770	567.18	160.33	123.99		129.16	49.93
12/11/96	14:00	-0.800	535.28	157.91	122.48		129.03	50.26
12/11/96	15:00	-0.749	515.40	155.11	119.57		128.26	50.80
12/11/96	16:00	-0.755	508.22	151.08	114.74		127.36	51.54
12/11/96	17:00	-0.745	502.53	138.27	105.75		126.45	52.21
12/11/96	18:00	-0.738	551.30	151.55	113.69		124.90	52.42
12/11/96	19:00	-0.754	560.46	152.98	115.83		125.59	51.61
12/11/96	20:00	-0.840	540.43	235.13	99.64		123.59	52.63
12/11/96	21:00	-0.749	508.84	464.35	97.16		122.69	53.05
12/11/96	22:00	-0.740	561.09	511.02	103.68		119.69	53.83
12/11/96	23:00	-0.770	635.22	448.90	110.46		118.72	53.92
12/12/96	0:00	-0.783	696.19	459.27	114.83		115.43	54.65
12/12/96	1:00	-0.742	723.47	297.58	139.90		118.94	53.78
12/12/96	2:00	-0.788	654.79	160.57	125.27		125.86	51.72
12/12/96	3:00	-0.752	628.73	159.01	122.92		125.16	51.80
12/12/96	4:00	-0.756	605.01	158.98	122.35		125.08	51.54
12/12/96	5:00	-0.756	593.04	158.47	121.59		125.14	51.58
12/12/96	6:00	-0.748	583.52	157.88	121.14		125.39	51.21
12/12/96	7:00	-0.759	553.63	157.11	119.82		125.00	51.18
12/12/96	8:00	-0.758	531.10	154.09	116.38		124.12	51.67
12/12/96	9:00	-0.753	515.43	149.21	110.47		122.18	52.72
12/12/96	10:00	-1.062	523.78	208.52	105.98		120.45	53.38
12/12/96	11:00	-0.805	533.66	248.21	109.94		119.78	54.01
12/12/96	12:00	-0.722	620.74	177.38	124.02		123.56	52.39
12/12/96	13:00	-0.853	622.55	399.92	112.88		123.77	52.74
12/12/96	14:00	-0.786	685.08	664.76	139.86		125.12	51.83
12/12/96	15:00	-0.679	655.50	666.61	143.46		128.35	49.96

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/12/96	16:00	-0.710	630.97	362.65	130.51		128.89	50.03
12/12/96	17:00	-0.656	646.01	250.08	130.84		129.66	49.48
12/12/96	18:00	-0.693	606.19	158.60	118.86		126.94	49.73
12/12/96	19:00	-0.711	569.53	151.37	113.58		123.63	51.94
12/12/96	20:00	-0.728	554.98	150.05	111.81		124.41	51.61
12/12/96	21:00	-0.731	534.40	302.95	112.01		122.87	52.12
12/12/96	22:00	-0.730	522.96	149.73	111.64		124.25	51.32
12/12/96	23:00	-0.719	516.56	150.72	111.81		123.28	51.73
12/13/96	0:00	-0.781	514.92	149.15	110.26		122.56	51.87
12/13/96	1:00	-0.758	502.75	148.06	109.30		121.94	52.15
12/13/96	2:00	-0.748	495.25	146.22	108.29		121.09	52.51
12/13/96	3:00	-0.776	499.03	146.81	108.56		121.02	52.56
12/13/96	4:00	-0.687	511.85	149.27	110.19		120.64	52.28
12/13/96	5:00	-0.659	521.43	153.18	112.41		121.40	51.51
12/13/96	6:00	-0.636	495.16	151.42	111.17		122.03	50.93
12/13/96	7:00	-0.640	483.33	150.48	110.29		121.49	51.43
12/13/96	8:00	-0.854	485.60	171.05	107.80		120.27	52.59
12/13/96	9:00	-0.739	541.75	152.12	114.11		121.35	52.15
12/13/96	10:00	-0.738	541.94	151.85	114.29		122.85	51.88
12/13/96	11:00	-0.773	537.36	152.74	114.93		122.00	52.43
12/13/96	12:00	-0.746	540.75	154.53	115.94		118.98	53.77
12/13/96	13:00	-0.712	533.67	158.58	120.85		124.56	51.70
12/13/96	14:00	-1.212	522.23	214.66	89.87		124.01	52.75
12/13/96	15:00	-0.777	826.64	228.82	97.82		120.64	54.23
12/13/96	16:00	-0.596	829.66	260.37	97.10		119.04	54.19
12/13/96	17:00	-1.317	761.28	216.21	91.41		119.57	53.92
12/13/96	18:00	-1.717	945.13	430.88	98.42		115.83	54.75
12/13/96	19:00	-1.130	761.72	509.48	109.05		130.44	53.16
12/13/96	20:00	-0.664	491.99	240.48	95.26		143.60	48.40
12/13/96	21:00	-0.701	907.01	514.73	105.53		112.16	55.29
12/13/96	22:00	-0.437	537.15	457.82	102.39		139.14	51.50
12/13/96	23:00	-0.763	266.16	237.89	88.01		148.14	46.73
12/14/96	0:00	-0.733	255.65	142.62	81.41		146.29	47.08
12/14/96	1:00	-0.824	105.78	102.48	78.91		146.83	46.38
12/14/96	2:00	-0.785	93.11	78.84	80.60		133.35	47.43
12/14/96	3:00	-1.003	1049.46	401.70	101.57		114.86	52.38
12/14/96	4:00	-0.752	1162.24	347.07	108.86		111.47	55.64
12/14/96	5:00	-0.665	1274.06	156.32	118.38		115.20	54.50
12/14/96	6:00	-0.565	1172.29	171.46	133.40		136.49	46.77
12/14/96	7:00	-0.560	1059.11	165.61	127.53		134.71	46.30
12/14/96	8:00	-0.723	978.33	157.98	121.72		132.69	48.47
12/14/96	9:00	-0.822	941.02	125.88	95.37		125.75	52.98
12/14/96	10:00	-0.636	1071.16	127.19	97.34		119.87	54.26
12/14/96	11:00	-0.477	1187.53	134.96	101.90		115.85	55.33

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM								
CAMPAIGN 4 SERIES A GLASS								
HOURLY AVERAGES								
READINGS		FURNACE TO	FILM	QUENCH	QUENCH	DESICCANT	HEPA	HEPA FILTER
		ROOM	COOLER	TOWER	TOWER	TOWER	FILTER	OFFGAS INLET
		DIFF PRESS	OFFGAS	OFFGAS	OFFGAS	OFFGAS	OFFGAS	RELATIVE
			OUTLET	INLET	OUTLET	INLET	INLET	HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/14/96	12:00	-0.776	1094.12	139.58	100.80		118.81	54.40
12/14/96	13:00	-0.396	1137.28	142.80	107.23		118.78	54.54
12/14/96	14:00	-0.788	1095.65	141.85	104.75		121.16	54.09
12/14/96	15:00	-0.838	1067.98	141.42	101.79		122.58	53.90
12/14/96	16:00	-0.790	1095.14	137.42	100.89		120.05	54.16
12/14/96	17:00	-0.750	1081.34	134.26	98.04		118.53	54.24
12/14/96	18:00	-0.749	1076.93	134.54	98.07		116.65	54.40
12/14/96	19:00	-0.749	1065.88	134.53	97.93		114.05	54.42
12/14/96	20:00	-0.713	1107.13	149.21	111.28		117.35	54.01
12/14/96	21:00	-0.623	1114.13	166.33	130.26		128.65	50.06
12/14/96	22:00	-0.634	1038.44	159.13	122.03		127.67	49.61
12/14/96	23:00	-0.704	962.13	140.47	107.43		124.49	51.44
12/15/96	0:00	-0.753	944.87	130.82	98.91		118.27	53.85
12/15/96	1:00	-0.750	954.93	131.46	98.54		115.24	54.43
12/15/96	2:00	-0.740	928.94	132.44	98.65		115.11	54.70
12/15/96	3:00	-0.734	1031.60	143.56	105.32		114.88	54.56
12/15/96	4:00	-0.578	1120.89	177.24	147.49		137.79	47.67
12/15/96	5:00	-0.612	977.03	171.14	139.57		142.97	45.97
12/15/96	6:00	-0.663	915.39	167.59	133.73		137.83	45.65
12/15/96	7:00	-0.695	879.28	164.96	131.41		135.78	45.87
12/15/96	8:00	-0.778	864.06	161.92	125.55		133.90	47.62
12/15/96	9:00	-0.754	826.71	163.38	125.81		132.44	49.00
12/15/96	10:00	-0.741	801.29	162.28	124.67		131.81	49.55
12/15/96	11:00	-0.870	786.11	150.61	115.84		130.10	51.13
12/15/96	12:00	-1.020	873.31	155.56	121.41		126.68	52.47
12/15/96	13:00	-0.766	813.29	135.66	105.17		129.78	51.19
12/15/96	14:00	-0.871	678.79	121.89	99.41		140.67	50.04
12/15/96	15:00	-0.779	940.83	129.74	96.99		127.84	52.93
12/15/96	16:00	-0.749	982.38	131.06	96.84		122.64	54.19
12/15/96	17:00	-0.717	1114.72	156.32	118.00		121.00	53.65
12/15/96	18:00	-0.753	1061.76	163.90	129.13		130.30	49.81
12/15/96	19:00	-0.755	1001.98	156.84	118.03		128.75	50.19
12/15/96	20:00	-1.109	1019.32	150.30	109.41		125.76	51.17
12/15/96	21:00	-0.752	881.93	121.92	86.90		126.21	52.26
12/15/96	22:00	-0.744	1002.14	150.57	105.26		121.51	52.97
12/15/96	23:00	-0.734	1077.96	164.17	119.13		122.60	51.42
12/16/96	0:00	-0.758	958.31	134.82	94.41		124.10	50.90
12/16/96	1:00	-0.746	933.28	125.09	85.88		119.43	53.45
12/16/96	2:00	-0.740	1034.55	162.38	118.90		120.29	51.86
12/16/96	3:00		1031.55	167.63	119.78		122.60	50.45
12/16/96	4:00	-0.767	925.19	158.82	114.13		121.98	50.49
12/16/96	5:00	-0.807	855.51	154.50	111.15		121.87	51.04
12/16/96	6:00	-0.784	842.47	159.38	121.60		122.60	50.63
12/16/96	7:00	-0.728	827.37	162.89	125.99		125.69	48.98

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM								
CAMPAIGN 4 SERIES A GLASS								
HOURLY AVERAGES								
READINGS		FURNACE TO	FILM	QUENCH	QUENCH	DESICCANT	HEPA	HEPA FILTER
		ROOM	COOLER	TOWER	TOWER	TOWER	FILTER	OFFGAS INLET
		DIFF PRESS	OFFGAS	OFFGAS	OFFGAS	OFFGAS	OFFGAS	RELATIVE
			OUTLET	INLET	OUTLET	INLET	INLET	HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In-WC	F	F	F	F	F	% RH
12/16/96	8:00	-1.614	733.53	134.02	103.81		124.16	51.56
12/16/96	9:00	-0.830	897.69	150.69	114.99		119.91	52.48
12/16/96	10:00	-0.687	853.85	161.35	124.72		125.04	49.29
12/16/96	11:00	-0.682	827.36	163.08	127.66		125.05	50.12
12/16/96	12:00	-0.815	770.91	152.99	120.51		128.43	50.53
12/16/96	13:00	-0.709	815.22	164.92	132.08		132.23	47.21
12/16/96	14:00	-0.745	766.34	164.11	131.67		134.03	45.34
12/16/96	15:00	-0.770	755.61	163.44	130.94		134.69	45.37
12/16/96	16:00	-0.751	751.41	159.84	125.93		131.03	48.72
12/16/96	17:00	-0.762	754.21	174.16	130.31		132.03	48.79
12/16/96	18:00	-0.771	748.99	156.02	122.21		131.27	48.31
12/16/96	19:00	-0.735	725.07	157.59	122.32		129.31	49.46
12/16/96	20:00	-0.767	683.30	133.98	106.15		129.09	49.98

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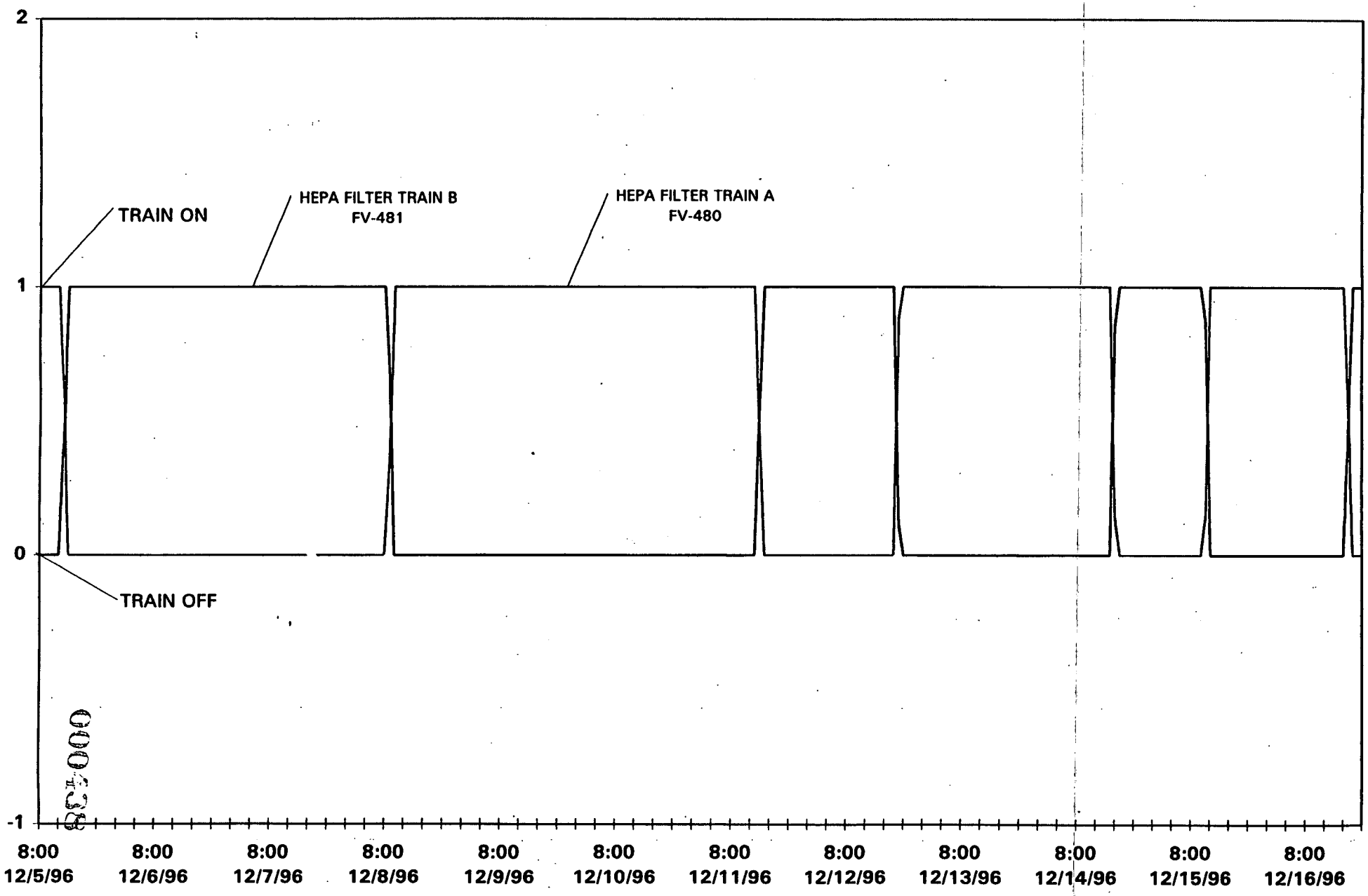
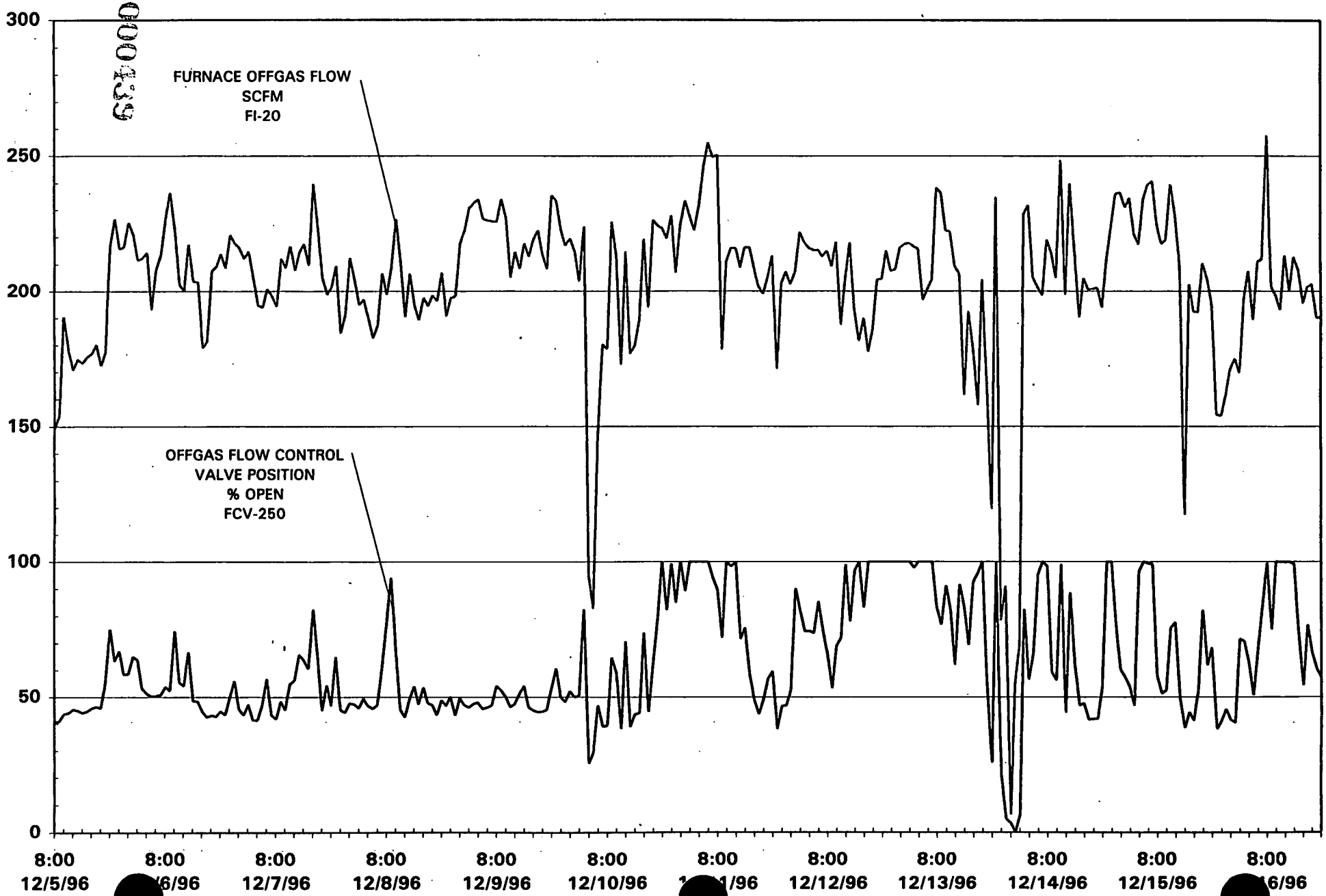
CAMPAIGN 4
SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 10

VHP 1/13/97

CAMPAIGN 4
SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 11

VHP 1/13/97

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES					
READINGS		HEPA FILTER TRAIN A	HEPA FILTER TRAIN B	HEPA FILTERS DIFF PRESS	OFFGAS FLOW CONTROL VALVE POSITION	FLOW TO STACK	TOTAL STACK FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/5/96	8:00	0.00	1.00	0.18	40.81	149.25	8615.08
12/5/96	9:00	0.00	1.00	0.19	40.79	153.91	8522.42
12/5/96	10:00	0.00	1.00	0.23	43.73	190.43	8511.08
12/5/96	11:00	0.00	1.00	0.25	44.13	178.07	8378.25
12/5/96	12:00	0.00	1.00	0.27	45.44	170.74	8372.92
12/5/96	13:00	0.42	0.60	0.48	45.04	174.77	8370.33
12/5/96	14:00	1.00	0.00	0.82	44.20	173.30	8353.08
12/5/96	15:00	1.00	0.00	0.87	44.70	175.63	8353.50
12/5/96	16:00	1.00	0.00	0.93	45.86	176.70	8357.50
12/5/96	17:00	1.00	0.00	0.97	46.48	180.17	8285.33
12/5/96	18:00	1.00	0.00	1.00	45.95	172.47	8314.33
12/5/96	19:00	1.00	0.00	1.01	54.84	177.20	8333.83
12/5/96	20:00	1.00	0.00	1.02	74.97	216.80	8370.67
12/5/96	21:00	1.00	0.00	1.07	63.38	226.78	8336.92
12/5/96	22:00	1.00	0.00	1.12	67.09	215.83	8494.08
12/5/96	23:00	1.00	0.00	1.11	58.50	216.32	8498.25
12/6/96	0:00	1.00	0.00	1.13	58.65	225.41	8490.76
12/6/96	1:00	1.00	0.00	1.17	64.99	220.90	8431.00
12/6/96	2:00	1.00	0.00	1.18	63.77	211.60	8418.83
12/6/96	3:00	1.00	0.00	1.14	53.11	212.10	8458.75
12/6/96	4:00	1.00	0.00	1.11	51.22	214.38	8498.50
12/6/96	5:00	1.00	0.00	1.10	50.25	193.22	8490.58
12/6/96	6:00	1.00	0.00	1.11	50.46	208.05	8508.50
12/6/96	7:00	1.00	0.00	1.12	50.83	213.57	8495.58
12/6/96	8:00	1.00	0.00	1.18	53.89	227.26	8491.83
12/6/96	9:00	1.00	0.00	1.21	52.27	236.46	8467.58
12/6/96	10:00	1.00	0.00	1.26	74.30	222.87	8407.92
12/6/96	11:00	1.00	0.00	1.17	55.53	202.66	8204.92
12/6/96	12:00	1.00	0.00	1.16	54.16	199.98	8443.92
12/6/96	13:00	1.00	0.00	1.19	66.80	217.30	8511.67
12/6/96	14:00	1.00	0.00	1.12	48.64	203.77	8504.79
12/6/96	15:00	1.00	0.00	1.11	48.37	203.49	8485.25
12/6/96	16:00	1.00	0.00	0.98	44.77	179.12	8271.17
12/6/96	17:00	1.00	0.00	0.96	42.44	181.35	8206.50
12/6/96	18:00	1.00	0.00	1.06	43.14	207.73	8316.36
12/6/96	19:00	1.00	0.00	1.06	42.72	209.18	8408.67
12/6/96	20:00	1.00	0.00	1.11	44.64	213.73	8475.50
12/6/96	21:00	1.00	0.00	1.05	43.35	208.69	8499.58
12/6/96	22:00	1.00	0.00	1.16	49.95	220.71	8490.67
12/6/96	23:00	1.00	0.00	1.19	56.02	217.87	8460.92
12/7/96	0:00	1.00	0.00	1.09	45.48	216.19	8392.92
12/7/96	1:00	1.00	0.00	1.05	43.27	212.05	8415.92
12/7/96	2:00	1.00	0.00	1.05	47.21	214.71	8443.58
12/7/96	3:00	1.00	0.00	0.98	41.42	204.99	8511.25

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
		HOURLY AVERAGES					
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/7/96	4:00	1.00	0.00	0.96	41.30	194.72	8521.58
12/7/96	5:00	1.00	0.00	0.97	47.12	193.95	8485.50
12/7/96	6:00	1.00	0.00	1.13	56.76	200.75	8416.27
12/7/96	7:00	1.00	0.00	1.03	43.25	198.26	8424.42
12/7/96	8:00	1.00	0.00	0.98	41.73	194.34	8458.67
12/7/96	9:00	1.00	0.00	1.08	48.35	212.01	8470.85
12/7/96	10:00	1.00	0.00	1.08	45.26	208.78	8463.90
12/7/96	11:00	1.00	0.00	1.12	54.89	216.67	8438.08
12/7/96	12:00	1.00	0.00	1.16	56.33	207.80	8312.83
12/7/96	13:00	1.00	0.00	1.19	65.71	214.34	8178.92
12/7/96	14:00	1.00	0.00	1.20	63.66	217.57	8142.92
12/7/96	15:00	1.00	0.00	1.16	60.58	209.64	8226.27
12/7/96	16:00	1.00	0.00	1.31	82.31	239.62	8268.42
12/7/96	17:00	1.00		1.20	65.31	223.37	8251.63
12/7/96	18:00	1.00	0.00	1.10	44.97	204.87	8356.61
12/7/96	19:00	1.00	0.00	1.15	54.37	198.80	8508.31
12/7/96	20:00	1.00	0.00	1.12	46.83	201.60	8470.67
12/7/96	21:00	1.00	0.00	1.21	64.74	209.34	8581.08
12/7/96	22:00	1.00	0.00	1.11	45.14	184.45	8708.83
12/7/96	23:00	1.00	0.00	1.12	44.29	191.40	8842.58
12/8/96	0:00	1.00	0.00	1.21	47.73	212.22	8402.54
12/8/96	1:00	1.00	0.00	1.18	47.35	204.54	8437.42
12/8/96	2:00	1.00	0.00	1.17	45.93	195.00	8393.08
12/8/96	3:00	1.00	0.00	1.20	49.40	196.89	8443.25
12/8/96	4:00	1.00	0.00	1.18	46.78	190.21	8611.58
12/8/96	5:00	1.00	0.00	1.15	45.66	182.63	8390.17
12/8/96	6:00	1.00	0.00	1.16	47.11	187.25	8315.58
12/8/96	7:00	1.00	0.00	1.25	60.43	206.64	8419.42
12/8/96	8:00	1.00	0.00	1.26	77.43	198.77	8350.17
12/8/96	9:00	0.67	0.33	0.94	93.95	209.16	8358.58
12/8/96	10:00	0.00	1.00	0.23	67.69	226.69	8340.08
12/8/96	11:00	0.00	1.00	0.20	45.39	211.02	8377.33
12/8/96	12:00	0.00	1.00	0.18	42.42	190.44	8334.42
12/8/96	13:00	0.00	1.00	0.21	49.16	206.53	8501.42
12/8/96	14:00	0.00	1.00	0.21	53.86	195.05	8496.36
12/8/96	15:00	0.00	1.00	0.21	47.40	189.18	8499.17
12/8/96	16:00	0.00	1.00	0.22	53.41	197.42	8349.92
12/8/96	17:00	0.00	1.00	0.21	47.78	194.43	8519.25
12/8/96	18:00	0.00	1.00	0.21	47.04	198.42	8392.75
12/8/96	19:00	0.00	1.00	0.19	43.28	196.43	8318.58
12/8/96	20:00	0.00	1.00	0.20	48.78	206.85	8167.42
12/8/96	21:00	0.00	1.00	0.19	46.79	190.64	8270.67
12/8/96	22:00	0.00	1.00	0.20	50.07	197.46	8332.83
12/8/96	23:00	0.00	1.00	0.19	43.18	198.11	8486.50

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
		HOURLY AVERAGES					
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/9/96	0:00	0.00	1.00	0.22	49.52	217.69	8312.17
12/9/96	1:00	0.00	1.00	0.21	47.03	222.35	8364.75
12/9/96	2:00	0.00	1.00	0.21	46.16	230.62	8418.00
12/9/96	3:00	0.00	1.00	0.22	47.55	232.69	8171.42
12/9/96	4:00	0.00	1.00	0.22	47.99	233.74	7938.08
12/9/96	5:00	0.00	1.00	0.21	45.59	226.82	7971.17
12/9/96	6:00	0.00	1.00	0.20	46.14	226.28	7901.55
12/9/96	7:00	0.00	1.00	0.21	46.95	225.89	7951.20
12/9/96	8:00	0.00	1.00	0.22	54.07	225.76	7946.08
12/9/96	9:00	0.00	1.00	0.22	52.46	233.86	8103.75
12/9/96	10:00	0.00	1.00	0.22	50.21	226.91	8053.50
12/9/96	11:00	0.00	1.00	0.21	46.32	205.21	8445.00
12/9/96	12:00	0.00	1.00	0.22	47.46	214.41	8429.58
12/9/96	13:00	0.00	1.00	0.21	51.21	208.36	8464.58
12/9/96	14:00	0.00	1.00	0.23	54.05	217.75	8522.08
12/9/96	15:00	0.00	1.00	0.22	46.16	212.76	8476.92
12/9/96	16:00	0.00	1.00	0.21	45.04	219.00	8483.92
12/9/96	17:00	0.00	1.00	0.21	44.32	222.42	8416.58
12/9/96	18:00	0.00	1.00	0.20	44.54	213.44	8458.67
12/9/96	19:00	0.00	1.00	0.20	45.23	208.26	8480.58
12/9/96	20:00	0.00	1.00	0.22	53.02	235.25	8176.25
12/9/96	21:00	0.00	1.00	0.23	60.49	233.26	7939.17
12/9/96	22:00	0.00	1.00	0.22	49.99	222.52	7988.17
12/9/96	23:00	0.00	1.00	0.21	48.18	217.00	8023.67
12/10/96	0:00	0.00	1.00	0.20	52.04	219.56	8002.08
12/10/96	1:00	0.00	1.00	0.21	50.09	214.58	8015.00
12/10/96	2:00	0.00	1.00	0.20	50.51	203.65	7495.75
12/10/96	3:00	0.00	1.00	0.23	82.37	223.78	7657.75
12/10/96	4:00	0.00	1.00	0.06	25.51	95.04	7996.50
12/10/96	5:00	0.00	1.00	0.04	29.39	82.74	8043.64
12/10/96	6:00	0.00	1.00	0.15	46.79	146.64	7975.92
12/10/96	7:00	0.00	1.00	0.17	39.09	180.25	7932.67
12/10/96	8:00	0.00	1.00	0.17	39.35	178.58	7982.50
12/10/96	9:00	0.00	1.00	0.22	64.45	225.64	7950.17
12/10/96	10:00	0.00	1.00	0.23	59.06	212.96	8030.92
12/10/96	11:00	0.00	1.00	0.17	38.16	172.68	7950.17
12/10/96	12:00	0.00	1.00	0.24	70.51	214.62	7723.42
12/10/96	13:00	0.00	1.00	0.18	38.95	176.84	7774.24
12/10/96	14:00	0.00	1.00	0.19	43.52	179.77	7677.08
12/10/96	15:00	0.00	1.00	0.21	43.92	189.30	7534.42
12/10/96	16:00	0.00	1.00	0.26	73.60	219.37	7493.50
12/10/96	17:00	0.00	1.00	0.21	44.54	198.94	7525.75
12/10/96	18:00	0.00	1.00	0.25	62.70	226.41	7480.67
12/10/96	19:00	0.00	1.00	0.25	78.89	224.28	7546.42

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
		HOURLY AVERAGES					
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/10/96	20:00	0.00	1.00	0.28	100.00	223.30	7802.25
12/10/96	21:00	0.00	1.00	0.28	82.31	219.67	7927.00
12/10/96	22:00	0.00	1.00	0.29	99.17	227.96	7776.25
12/10/96	23:00	0.00	1.00	0.25	84.89	207.06	7584.75
12/11/96	0:00	0.00	1.00	0.28	100.00	224.91	7599.42
12/11/96	1:00	0.00	1.00	0.28	89.25	233.24	7649.92
12/11/96	2:00	0.00	1.00	0.29	100.00	227.89	7362.08
12/11/96	3:00	0.00	1.00	0.28	100.00	222.60	7587.67
12/11/96	4:00	0.00	1.00	0.30	100.00	231.43	7779.00
12/11/96	5:00	0.00	1.00	0.32	100.00	246.07	7884.08
12/11/96	6:00	0.00	1.00	0.33	100.00	254.74	7961.67
12/11/96	7:00	0.00	1.00	0.33	94.32	249.63	7955.50
12/11/96	8:00	0.00	1.00	0.33	89.69	250.23	7810.17
12/11/96	9:00	0.00	1.00	0.27	72.03	178.33	7556.42
12/11/96	10:00	0.00	1.00	0.30	99.90	210.88	7486.75
12/11/96	11:00	0.00	1.00	0.31	98.42	215.86	7193.46
12/11/96	12:00	0.00	1.00	0.32	99.77	216.02	7285.17
12/11/96	13:00	0.00	1.00	0.31	71.58	208.87	7283.58
12/11/96	14:00	0.53	0.47	0.83	75.49	216.25	7266.83
12/11/96	15:00	1.00	0.00	1.31	58.35	216.22	7399.92
12/11/96	16:00	1.00	0.00	1.25	48.81	208.69	7760.92
12/11/96	17:00	1.00	0.00	1.20	43.61	201.75	7790.08
12/11/96	18:00	1.00	0.00	1.20	49.05	199.05	7780.33
12/11/96	19:00	1.00	0.00	1.25	56.84	205.04	7663.75
12/11/96	20:00	1.00	0.00	1.27	59.56	213.07	7947.63
12/11/96	21:00	1.00	0.00	0.99	38.19	171.03	7906.00
12/11/96	22:00	1.00	0.00	1.19	46.66	202.92	8042.33
12/11/96	23:00	1.00	0.00	1.23	46.92	207.35	8152.83
12/12/96	0:00	1.00	0.00	1.21	52.45	202.63	8181.25
12/12/96	1:00	1.00	0.00	1.26	89.98	207.19	8208.08
12/12/96	2:00	1.00	0.00	1.30	81.72	221.86	8212.17
12/12/96	3:00	1.00	0.00	1.27	74.31	218.22	8323.83
12/12/96	4:00	1.00	0.00	1.25	74.39	216.07	8369.75
12/12/96	5:00	1.00	0.00	1.24	73.67	215.14	8356.42
12/12/96	6:00	1.00	0.00	1.25	85.25	215.25	8407.08
12/12/96	7:00	1.00	0.00	1.24	74.66	212.90	8428.83
12/12/96	8:00	1.00	0.00	1.24	65.98	214.82	8356.17
12/12/96	9:00	1.00	0.00	1.19	53.26	209.37	8325.50
12/12/96	10:00	1.00	0.00	1.27	69.01	218.19	7526.33
12/12/96	11:00	1.00	0.00	1.09	71.94	187.59	8552.50
12/12/96	12:00	1.00	0.00	1.22	98.91	204.46	8415.25
12/12/96	13:00	1.00	0.00	1.28	77.87	217.97	8384.83
12/12/96	14:00	1.00	0.00	1.17	96.66	192.90	8281.25
12/12/96	15:00	1.00	0.00	1.12	99.86	181.58	8162.25

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES					
READINGS		HEPA FILTER TRAIN A	HEPA FILTER TRAIN B	HEPA FILTERS DIFF PRESS	OFFGAS FLOW CONTROL VALVE POSITION	FLOW TO STACK	TOTAL STACK FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/12/96	16:00	1.00	0.00	1.13	83.17	189.95	8292.58
12/12/96	17:00	1.00	0.00	1.08	100.00	177.67	8218.50
12/12/96	18:00	1.00	0.00	1.08	100.00	185.65	8198.42
12/12/96	19:00	0.12	0.88	0.39	100.00	204.29	8073.00
12/12/96	20:00	0.00	1.00	0.29	100.00	204.66	8225.08
12/12/96	21:00	0.00	1.00	0.31	100.00	214.92	8209.20
12/12/96	22:00	0.00	1.00	0.30	100.00	207.67	8234.50
12/12/96	23:00	0.00	1.00	0.30	100.00	208.18	8184.17
12/13/96	0:00	0.00	1.00	0.30	100.00	216.02	8228.33
12/13/96	1:00	0.00	1.00	0.31	100.00	217.47	8268.50
12/13/96	2:00	0.00	1.00	0.31	100.00	217.81	8098.00
12/13/96	3:00	0.00	1.00	0.31	97.83	216.59	7709.00
12/13/96	4:00	0.00	1.00	0.30	100.00	215.62	7608.17
12/13/96	5:00	0.00	1.00	0.29	100.00	196.79	7771.50
12/13/96	6:00	0.00	1.00	0.29	100.00	200.72	7895.83
12/13/96	7:00	0.00	1.00	0.29	100.00	204.30	7848.67
12/13/96	8:00	0.00	1.00	0.35	83.28	238.13	8074.83
12/13/96	9:00	0.00	1.00	0.35	76.81	236.25	8020.17
12/13/96	10:00	0.00	1.00	0.36	91.05	222.44	7855.50
12/13/96	11:00	0.00	1.00	0.35	82.39	222.31	7839.92
12/13/96	12:00	0.00	1.00	0.34	61.97	209.47	7803.00
12/13/96	13:00	0.00	1.00	0.35	91.56	206.67	7768.31
12/13/96	14:00	0.00	1.00	0.28	83.03	161.48	8134.83
12/13/96	15:00	0.00	1.00	0.33	69.38	192.45	7761.17
12/13/96	16:00	0.00	1.00	0.32	92.40	179.05	7728.17
12/13/96	17:00	0.00	1.00	0.28	95.90	157.77	8182.92
12/13/96	18:00	0.00	1.00	0.33	100.00	204.31	8329.75
12/13/96	19:00	0.00	1.00	0.20	55.00	165.41	8205.92
12/13/96	20:00	0.00	1.00	0.10	25.69	119.58	8080.92
12/13/96	21:00	0.00	1.00	0.41	100.00	234.64	8199.42
12/13/96	22:00	0.00	1.00	0.05	21.67	78.28	7945.25
12/13/96	23:00	0.00	1.00	-0.04	5.00	91.03	8030.08
12/14/96	0:00	0.00	1.00	-0.05	3.33	6.77	8129.83
12/14/96	1:00	0.00	1.00	-0.05	0.00	54.74	8193.17
12/14/96	2:00	0.00	1.00	-0.06	6.67	68.95	8254.17
12/14/96	3:00	0.00	1.00	0.36	82.40	228.56	8155.69
12/14/96	4:00	0.00	1.00	0.42	56.50	231.75	8086.67
12/14/96	5:00	0.00	1.00	0.38	65.95	205.18	7996.25
12/14/96	6:00	0.00	1.00	0.29	95.46	201.54	7973.50
12/14/96	7:00	0.00	1.00	0.27	100.00	198.42	8009.17
12/14/96	8:00	0.00	1.00	0.29	98.41	219.02	8073.58
12/14/96	9:00	0.00	1.00	0.30	59.25	214.09	8182.92
12/14/96	10:00	0.00	1.00	0.34	56.20	205.02	7960.33
12/14/96	11:00	0.00	1.00	0.50	99.05	248.55	7741.25

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
		HOURLY AVERAGES					
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/14/96	12:00	0.00	1.00	0.42	44.11	198.59	7815.50
12/14/96	13:00	0.00	1.00	0.56	88.52	239.84	7741.58
12/14/96	14:00	0.00	1.00	0.52	62.11	215.29	8047.17
12/14/96	15:00	0.00	1.00	0.48	46.92	190.40	7990.00
12/14/96	16:00	0.85	0.15	1.12	47.61	204.84	7810.83
12/14/96	17:00	1.00	0.00	1.18	41.67	200.67	7842.25
12/14/96	18:00	1.00	0.00	1.19	41.80	200.80	7852.00
12/14/96	19:00	1.00	0.00	1.20	41.98	201.26	7984.33
12/14/96	20:00	1.00	0.00	1.20	53.70	193.91	7933.42
12/14/96	21:00	1.00	0.00	1.33	99.95	211.42	7975.83
12/14/96	22:00	1.00	0.00	1.39	100.00	224.33	8075.67
12/14/96	23:00	1.00	0.00	1.44	77.12	235.96	8114.75
12/15/96	0:00	1.00	0.00	1.42	60.21	236.41	8241.17
12/15/96	1:00	1.00	0.00	1.39	57.19	231.00	8177.08
12/15/96	2:00	1.00	0.00	1.40	53.59	234.30	8041.42
12/15/96	3:00	1.00	0.00	1.33	46.80	221.38	8029.83
12/15/96	4:00	1.00	0.00	1.32	96.46	217.27	8004.58
12/15/96	5:00	1.00	0.00	1.22	100.00	233.75	8080.33
12/15/96	6:00	1.00	0.00	1.06	99.33	239.42	8073.92
12/15/96	7:00	1.00	0.00	1.10	99.16	240.74	8173.02
12/15/96	8:00	1.00	0.00	1.04	57.46	224.49	8123.33
12/15/96	9:00	1.00	0.00	1.03	51.50	217.45	7935.67
12/15/96	10:00	1.00	0.00	1.09	52.59	218.91	7907.12
12/15/96	11:00	0.87	0.15	1.16	75.64	239.36	7884.92
12/15/96	12:00	0.00	1.00	0.48	77.45	228.47	7838.42
12/15/96	13:00	0.00	1.00	0.45	49.63	209.73	7565.50
12/15/96	14:00	0.00	1.00	0.23	38.54	117.36	7722.08
12/15/96	15:00	0.00	1.00	0.44	44.16	202.45	7511.50
12/15/96	16:00	0.00	1.00	0.44	41.30	192.30	7506.10
12/15/96	17:00	0.00	1.00	0.47	52.55	192.21	7525.11
12/15/96	18:00	0.00	1.00	0.50	82.02	210.32	7334.67
12/15/96	19:00	0.00	1.00	0.48	61.81	204.52	7725.67
12/15/96	20:00	0.00	1.00	0.46	68.25	195.25	7705.08
12/15/96	21:00	0.00	1.00	0.36	38.13	154.28	7597.42
12/15/96	22:00	0.00	1.00	0.37	41.25	153.87	7596.33
12/15/96	23:00	0.00	1.00	0.41	45.45	161.11	7575.25
12/16/96	0:00	0.00	1.00	0.41	41.59	170.85	7707.33
12/16/96	1:00	0.00	1.00	0.42	40.53	174.81	7823.58
12/16/96	2:00	0.00	1.00	0.43	71.54	169.49	7857.80
12/16/96	3:00	0.00	1.00	0.51	70.76	196.94	7875.17
12/16/96	4:00	0.00	1.00	0.53	63.01	207.49	7948.05
12/16/96	5:00	0.00	1.00	0.47	50.66	189.45	8049.92
12/16/96	6:00	0.00	1.00	0.55	68.43	210.87	8138.92
12/16/96	7:00	0.00	1.00	0.55	83.50	211.88	8113.58

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
		HOURLY AVERAGES					
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/16/96	8:00	0.00	1.00	0.66	99.37	257.44	8610.67
12/16/96	9:00	0.00	1.00	0.53	75.17	201.56	8072.42
12/16/96	10:00	0.00	1.00	0.54	100.00	198.44	7957.50
12/16/96	11:00	0.00	1.00	0.52	100.00	193.07	7888.42
12/16/96	12:00	0.00	1.00	0.54	99.84	213.14	8085.42
12/16/96	13:00	0.00	1.00	0.52	99.94	200.13	8046.17
12/16/96	14:00	0.00	1.00	0.54	99.02	212.59	7987.20
12/16/96	15:00	0.00	1.00	0.54	73.30	208.09	7931.33
12/16/96	16:00	0.00	1.00	0.51	54.38	195.47	7925.09
12/16/96	17:00	0.40	0.62	0.81	76.55	201.43	7927.75
12/16/96	18:00	1.00	0.00	1.27	66.41	202.60	7885.00
12/16/96	19:00	1.00	0.00	1.23	60.52	190.19	7875.25
12/16/96	20:00	1.00	0.00	1.24	57.24	190.43	7900.25

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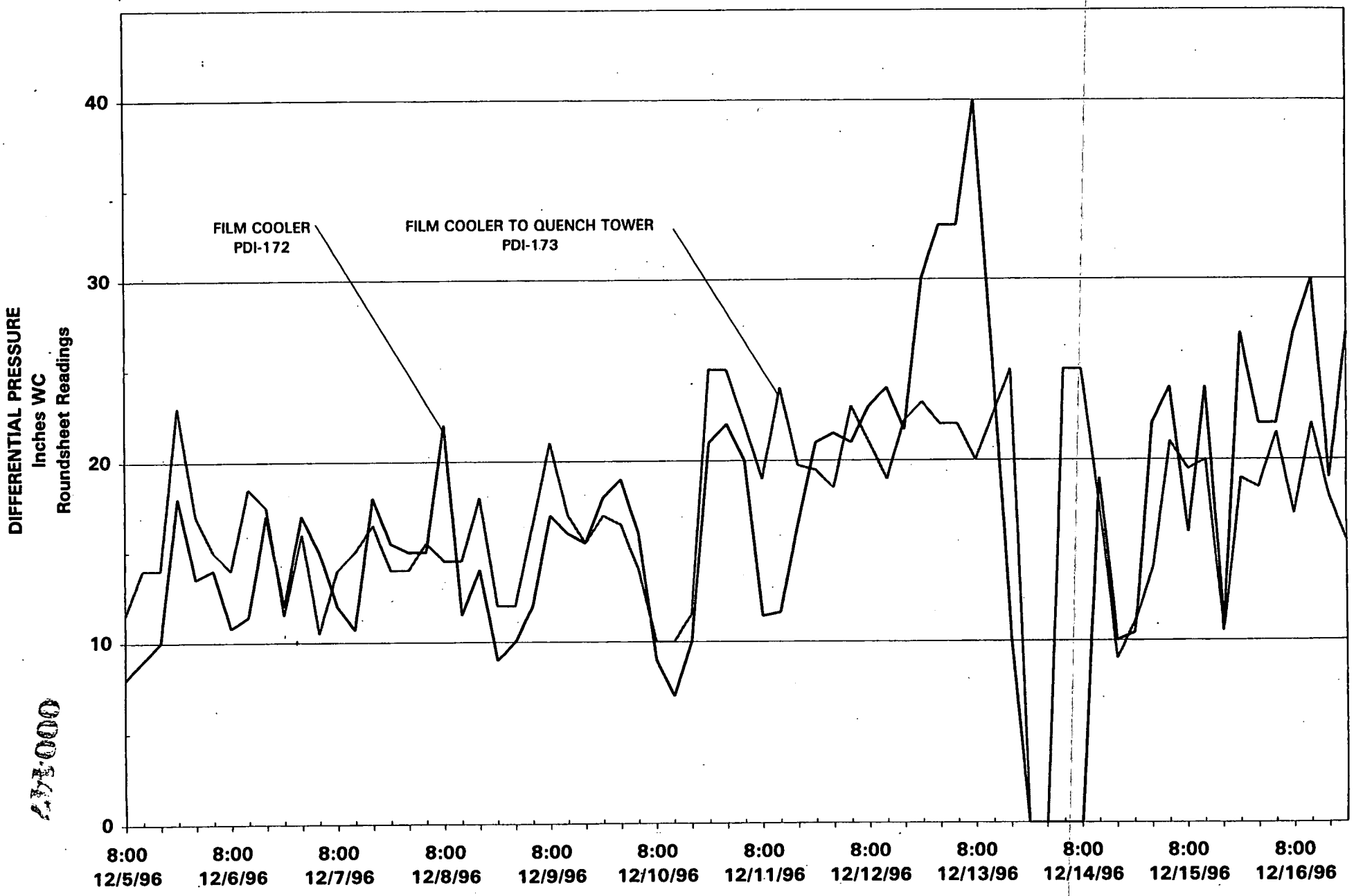
CAMPA[illegible]4
SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 12

VHP 1/20/97

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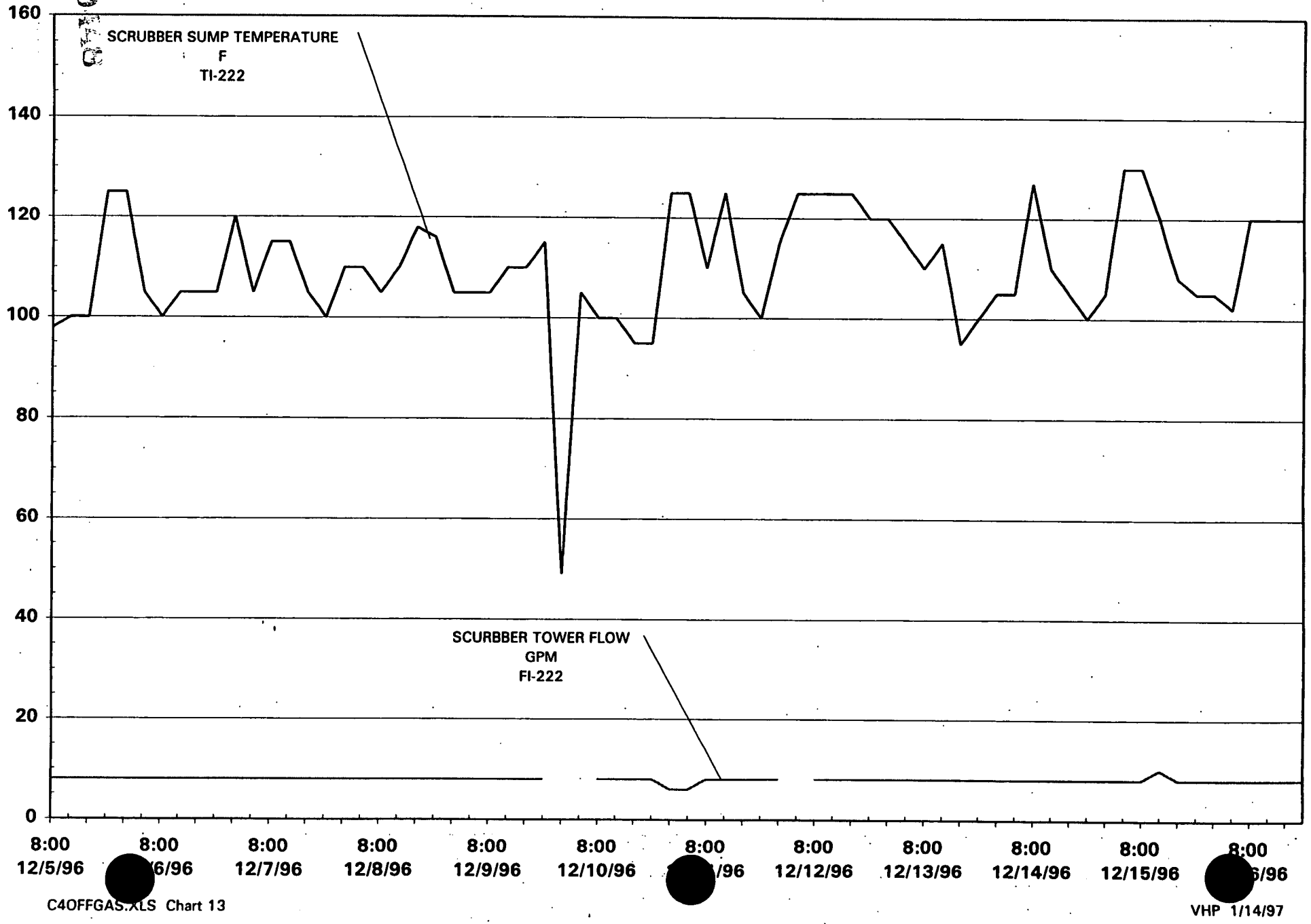
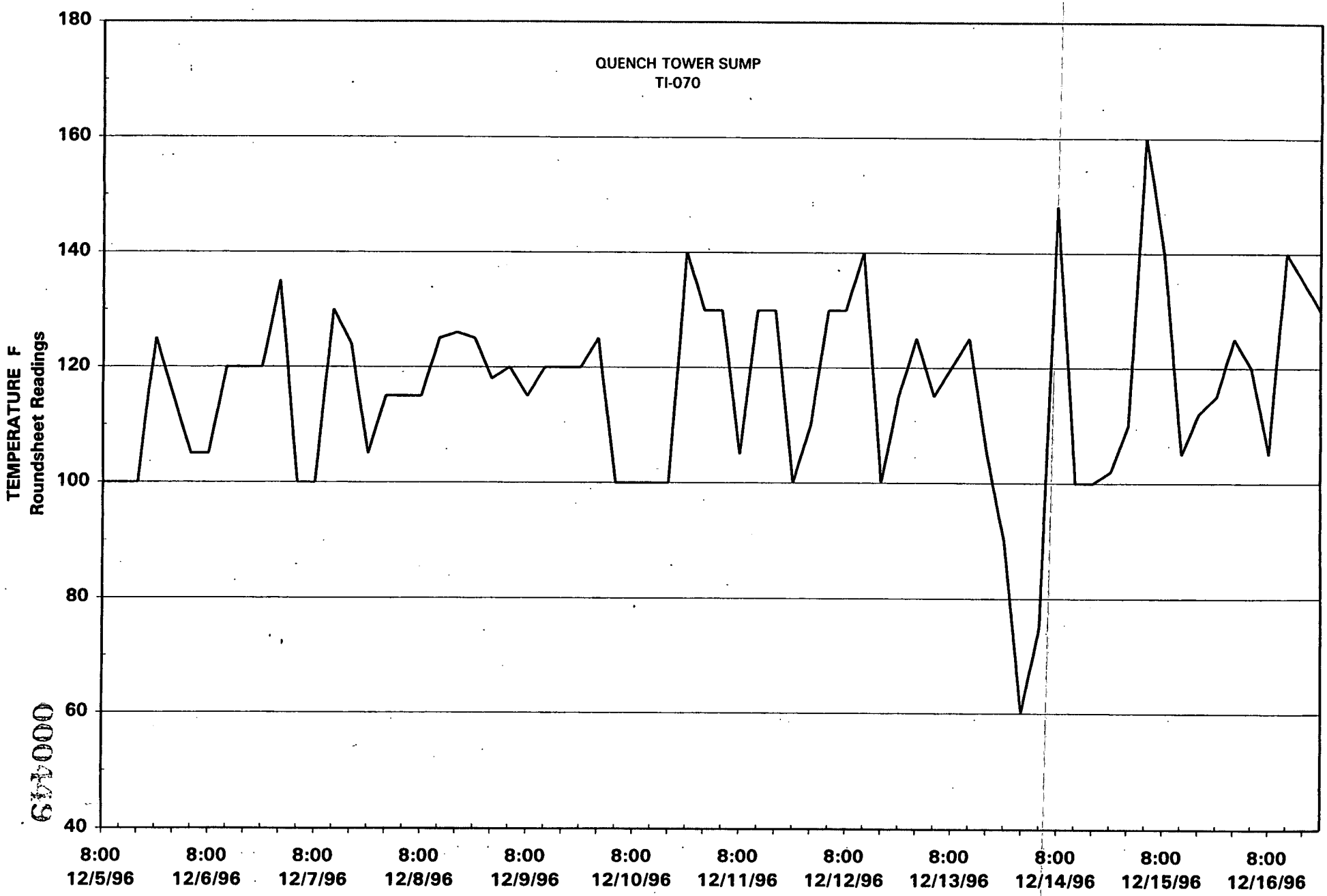
CAMPAIGN 4
SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 13

VHP 1/14/97

CAMPAIGN 4
SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 14

VHP 1/14/97

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VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 SERIES A GLASS

ROUNDSHEET DATA

READINGS		FILM COOLER DIFF PRESS	FILM COOLER TO QT DIFF PRESS	QUENCH TOWER SUMP TEMP	SCRUBBER TOWER VACUUM	SCRUBBER SUMP TEMP	SCRUBBER TOWER FLOW	DESICCANT TOWER INTERNAL TEMP	DESICCANT TOWER VACUUM
		PDI-172	PDI-173	TI-070	PI-222	TI-222	FI-222	TI-210	PI-210
DATE	HOUR	In WC	In WC	F	In WC	F	GPM	F	In WC
12/5/96	8:00	8.0	11.5	100	0.0	98	8	OUT OF SERVICE	OUT OF SERVICE
12/5/96	12:00	9.0	14.0	100	0.0	100	8		
12/5/96	16:00	10.0	14.0	100	0.0	100	8		
12/5/96	20:00	18.0	23.0	125	2.0	125	8		
12/6/96	0:00	13.5	17.0	115	1.5	125	8		
12/6/96	4:00	14.0	15.0	105	1.5	105	8		
12/6/96	8:00	10.8	14.0	105	1.5	100	8		
12/6/96	12:00	11.4	18.5	120	2.0	105	8		
12/6/96	16:00	17.0	17.5	120	2.0	105	8		
12/6/96	20:00	12.0	11.5	120	1.0	105	8		
12/7/96	0:00	17.0	16.0	135	2.0	120	8		
12/7/96	4:00	15.0	10.5	100	1.0	105	8		
12/7/96	8:00	12.0	14.0	100	0.4	115	8		
12/7/96	12:00	10.7	15.0	130	2.2	115	8		
12/7/96	16:00	18.0	16.5	124	2.2	105	8		
12/7/96	20:00	15.5	14.0	105	0.0	100	8		
12/8/96	0:00	15.0	14.0	115	1.0	110	8		
12/8/96	4:00	15.0	15.5	115	1.0	110	8		
12/8/96	8:00	22.0	14.5	115	1.9	105	8		
12/8/96	12:00	11.5	14.5	125	0.2	110	8		
12/8/96	16:00	14.0	18.0	126	0.2	118	8		
12/8/96	20:00	9.0	12.0	125	0.2	116	8		
12/9/96	0:00	10.0	12.0	118	0.2	105	8		
12/9/96	4:00	12.0	16.5	120		105	8		
12/9/96	8:00	17.0	21.0	115	0.2	105	8		
12/9/96	12:00	16.0	17.0	120	0.1	110	8		
12/9/96	16:00	15.5	15.5	120	0.2	110	8		
12/9/96	20:00	18.0	17.0	120	0.1	115	8		
12/10/96	0:00	19.0	16.5	125	1.0	49			
12/10/96	4:00	16.0	14.0	100		105			
12/10/96	8:00	9.0	10.0	100	1.0	100	8		
12/10/96	12:00	7.0	10.0	100	0.6	100	8		
12/10/96	16:00	10.0	11.5	100	0.6	95	8		
12/10/96	20:00	21.0	25.0	140	0.6	95	8		
12/11/96	0:00	22.0	25.0	130	4.0	125	6		
12/11/96	4:00	20.0	22.0	130	3.0	125	6		
12/11/96	8:00	11.4	19.0	105	2.5	110	8		
12/11/96	12:00	11.6	24.0	130	2.5	125	8		
12/11/96	16:00	16.5	19.8	130	2.5	105	8		
12/11/96	20:00	21.0	19.5	100	2.5	100	8		
12/12/96	0:00	21.5	18.5	110	2.3	115	8		
12/12/96	4:00	21.0	23.0	130	2.5	125			
12/12/96	8:00	23.0	21.0	130	2.0	125	8		
12/12/96	12:00	24.0	19.0	140		125	8		
12/12/96	16:00	21.7	22.2	100		125	8		
12/12/96	20:00	30.0	23.2	115		120	8		
12/13/96	0:00	33.0	22.0	125	3.0	120	8		
12/13/96	4:00	33.0	22.0	115	2.5	115	8		
12/13/96	8:00	40.0	20.0	120	2.5	110	8		
12/13/96	12:00	25.5	22.5	125	2.2	115	8		
12/13/96	16:00	10.0	25.0	105	2.0	95	8		
12/13/96	20:00	0.0	0.0	90	0.0	100	8		
12/14/96	0:00	0.0	0.0	60		105	8		

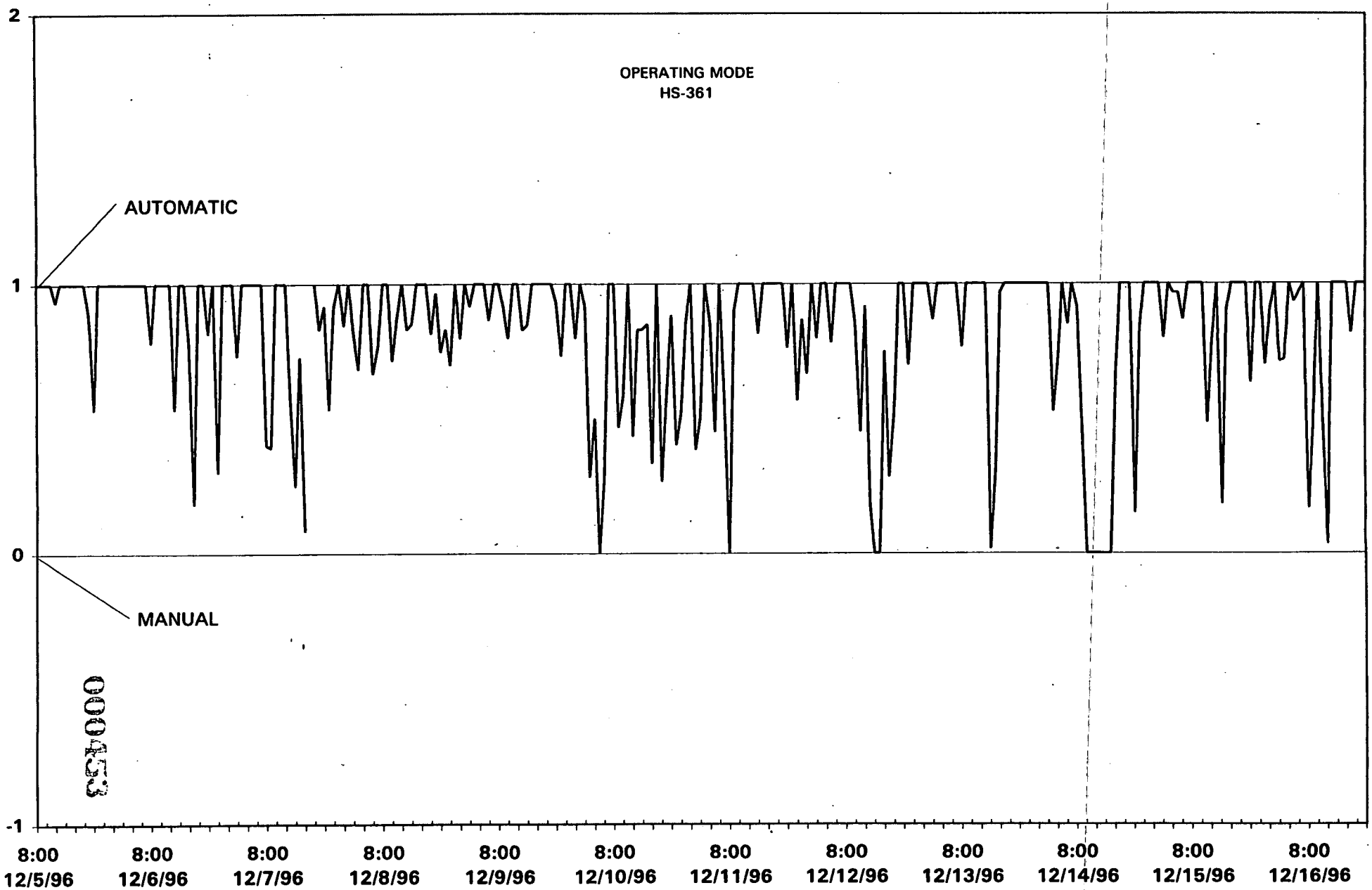
000450

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM									
CAMPAIGN 4 SERIES A GLASS									
		ROUNDSHEET DATA							
READINGS		FILM COOLER DIFF PRESS	FILM COOLER TO QT DIFF PRESS	QUENCH TOWER SUMP TEMP	SCRUBBER TOWER VACUUM	SCRUBBER SUMP TEMP	SCRUBBER TOWER FLOW	DESICCANT TOWER INTERNAL TEMP	DESICCANT TOWER VACUUM
		PDI-172	PDI-173	TI-070	PI-222	TI-222	FI-222	TI-210	PI-210
DATE	HOUR	In WC	In WC	F	In WC	F	GPM	F	In WC
12/14/96	4:00	0.0	25.0	75	0.4	105	8		
12/14/96	8:00	0.0	25.0	148	1.5	127	8		
12/14/96	12:00	19.0	17.5	100	0.0	110	8		
12/14/96	16:00	10.0	9.0	100	0.0	105	8		
12/14/96	20:00	10.4	11.0	102	0.0	100	8		
12/15/96	0:00	22.0	14.0	110	1.1	105	8		
12/15/96	4:00	24.0	21.0	160	2.1	130	8		
12/15/96	8:00	16.0	19.5	140	1.1	130	8		
12/15/96	12:00	24.0	20.0	105	2.0	120	10		
12/15/96	16:00	11.0	10.5	112	1.0	108	8		
12/15/96	20:00	27.0	19.0	115	2.0	105	8		
12/16/96	0:00	22	18.5	125	1.5	105	8		
12/16/96	4:00	22	21.5	120	0.5	102	8		
12/16/96	8:00	27	17	105	0.5	120	8		
12/16/96	12:00	30	22	140	1.5	120	8		
12/16/96	16:00	19	18	135	1.9	120	8		
12/16/96	20:00	27	15.5	130	2.1	120	8		

000451

EMERGENCY OFFGAS SYSTEM

CAMPA[illegible]4
SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS Chart 8

VHP 1/29/97

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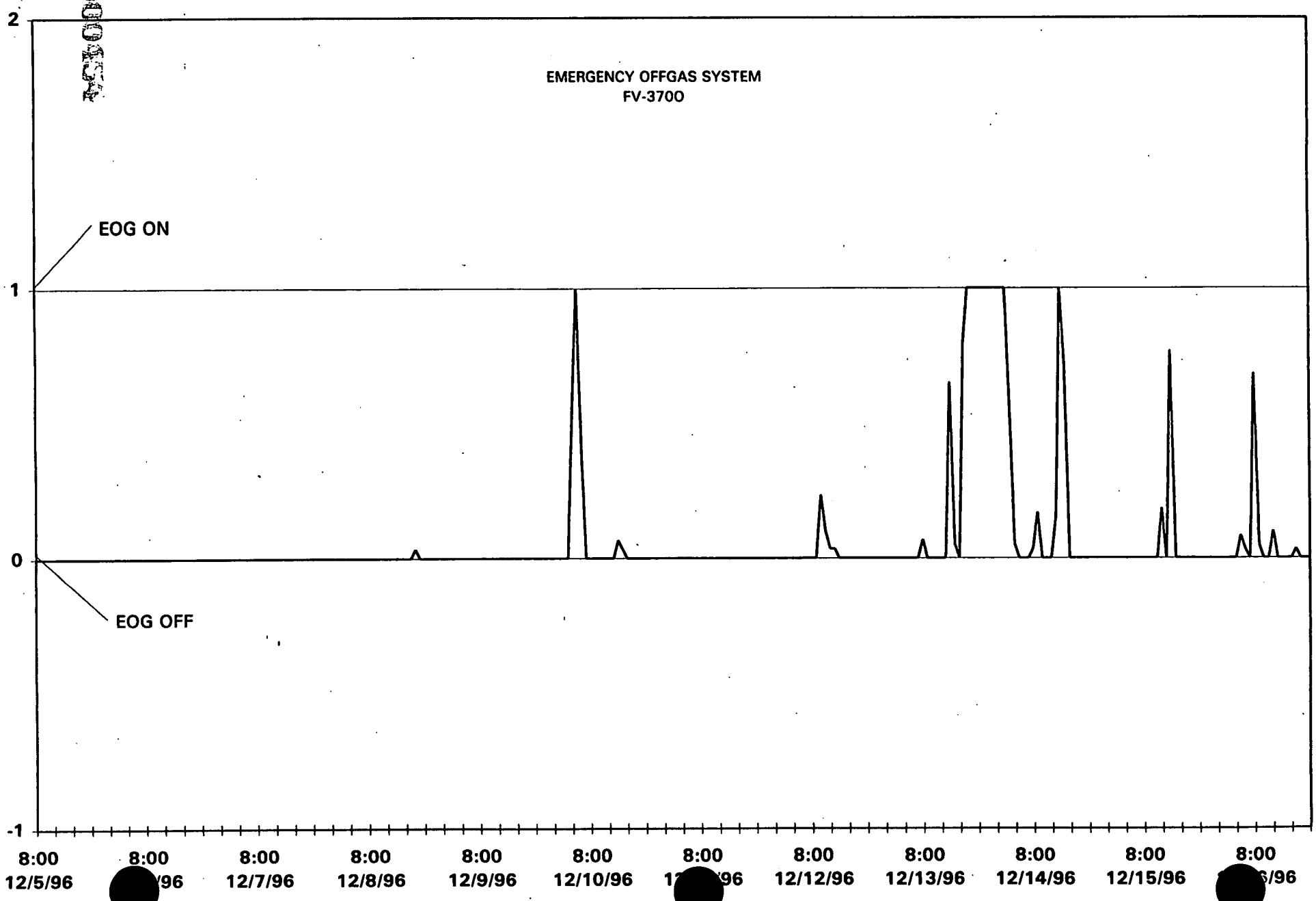
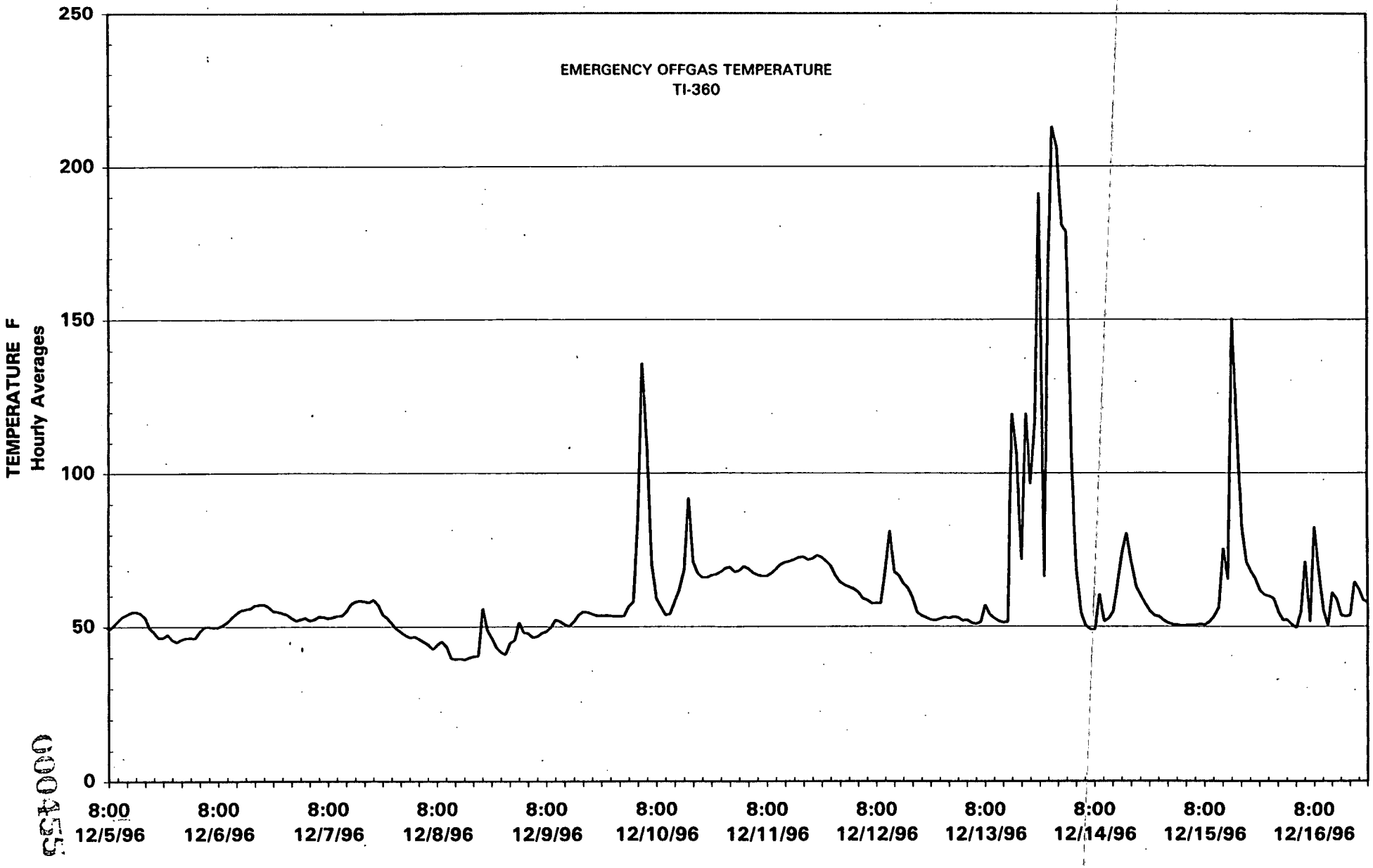
CAMPAIGN 4
SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS Chart 4

VHP 1/14/97

CAMPA[illegible]4
SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS Chart 5

VHP 1/14/97

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/5/96	8:00	1.00	0.0	49.17	8615.08	0.2	0.0
12/5/96	9:00	1.00	0.0	50.23	8522.42		
12/5/96	10:00	1.00	0.0	51.76	8511.08		
12/5/96	11:00	1.00	0.0	53.29	8378.25		
12/5/96	12:00	0.93	0.0	54.03	8372.92	0.2	0.0
12/5/96	13:00	1.00	0.0	54.76	8370.33		
12/5/96	14:00	1.00	0.0	54.90	8353.08		
12/5/96	15:00	1.00	0.0	54.35	8353.50		
12/5/96	16:00	1.00	0.0	53.10	8357.50	0.3	0.0
12/5/96	17:00	1.00	0.0	49.50	8285.33		
12/5/96	18:00	1.00	0.0	48.26	8314.33		
12/5/96	19:00	0.88	0.0	46.40	8333.83		
12/5/96	20:00	0.53	0.0	46.51	8370.67	0.2	0.0
12/5/96	21:00	1.00	0.0	47.54	8336.92		
12/5/96	22:00	1.00	0.0	45.81	8494.08		
12/5/96	23:00	1.00	0.0	45.09	8498.25		
12/6/96	0:00	1.00	0.0	45.95	8490.76	0.2	0.0
12/6/96	1:00	1.00	0.0	46.38	8431.00		
12/6/96	2:00	1.00	0.0	46.45	8418.83		
12/6/96	3:00	1.00	0.0	46.31	8458.75		
12/6/96	4:00	1.00	0.0	48.32	8498.50	0.2	0.0
12/6/96	5:00	1.00	0.0	49.88	8490.58		
12/6/96	6:00	1.00	0.0	49.93	8508.50		
12/6/96	7:00	1.00	0.0	49.72	8495.58		
12/6/96	8:00	0.78	0.0	49.79	8491.83	0.2	0.0
12/6/96	9:00	1.00	0.0	50.46	8467.58		
12/6/96	10:00	1.00	0.0	51.52	8407.92		
12/6/96	11:00	1.00	0.0	52.94	8204.92		
12/6/96	12:00	1.00	0.0	54.30	8443.92	0.2	0.0
12/6/96	13:00	0.53	0.0	55.37	8511.67		
12/6/96	14:00	1.00	0.0	55.66	8504.79		
12/6/96	15:00	1.00	0.0	55.92	8485.25		
12/6/96	16:00	0.77	0.0	56.86	8271.17	0.2	0.0
12/6/96	17:00	0.18	0.0	57.14	8206.50		
12/6/96	18:00	1.00	0.0	57.16	8316.36		
12/6/96	19:00	1.00	0.0	56.43	8408.67		
12/6/96	20:00	0.82	0.0	55.04	8475.50	0.2	0.0
12/6/96	21:00	1.00	0.0	54.84	8499.58		
12/6/96	22:00	0.30	0.0	54.38	8490.67		
12/6/96	23:00	1.00	0.0	53.95	8460.92		
12/7/96	0:00	1.00	0.0	52.83	8392.92	0.3	0.0
12/7/96	1:00	1.00	0.0	52.03	8415.92		
12/7/96	2:00	0.73	0.0	52.48	8443.58		
12/7/96	3:00	1.00	0.0	52.85	8511.25		
12/7/96	4:00	1.00	0.0	51.98	8521.58	0.3	0.0
12/7/96	5:00	1.00	0.0	52.47	8485.50		
12/7/96	6:00	1.00	0.0	53.30	8416.27		
12/7/96	7:00	1.00	0.0	53.14	8424.42		
12/7/96	8:00	0.40	0.0	52.74	8458.67	0.3	0.0
12/7/96	9:00	0.39	0.0	53.06	8470.85		

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VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/7/96	10:00	1.00	0.0	53.49	8463.90		
12/7/96	11:00	1.00	0.0	53.57	8438.08		
12/7/96	12:00	1.00	0.0	54.94	8312.83	0.3	0.0
12/7/96	13:00	0.57	0.0	57.28	8178.92		
12/7/96	14:00	0.25	0.0	58.03	8142.92		
12/7/96	15:00	0.73	0.0	58.32	8226.27		
12/7/96	16:00	0.08	0.0	58.10	8268.42	0.2	0.1
12/7/96	17:00		0.0	57.78	8251.63		
12/7/96	18:00	1.00	0.0	58.60	8356.61		
12/7/96	19:00	0.83	0.0	57.00	8508.31		
12/7/96	20:00	0.92	0.0	53.89	8470.67	0.1	0.0
12/7/96	21:00	0.53	0.0	52.78	8581.08		
12/7/96	22:00	0.92	0.0	50.98	8708.83		
12/7/96	23:00	1.00	0.0	49.25	8842.58		
12/8/96	0:00	0.85	0.0	48.23	8402.54	0.3	0.0
12/8/96	1:00	1.00	0.0	47.13	8437.42		
12/8/96	2:00	0.82	0.0	46.43	8393.08		
12/8/96	3:00	0.68	0.0	46.68	8443.25		
12/8/96	4:00	1.00	0.0	45.87	8611.58	0.3	0.0
12/8/96	5:00	1.00	0.0	44.96	8390.17		
12/8/96	6:00	0.67	0.0	44.08	8315.58		
12/8/96	7:00	0.77	0.0	42.66	8419.42		
12/8/96	8:00	1.00	0.0	44.12	8350.17	0.3	0.0
12/8/96	9:00	1.00	0.0	45.07	8358.58		
12/8/96	10:00	0.72	0.0	43.49	8340.08		
12/8/96	11:00	0.88	0.0	39.69	8377.33		
12/8/96	12:00	1.00	0.0	39.31	8334.42	0.3	0.0
12/8/96	13:00	0.83	0.0	39.48	8501.42		
12/8/96	14:00	0.86	0.0	39.21	8496.36		
12/8/96	15:00	1.00	0.0	39.83	8499.17		
12/8/96	16:00	1.00	0.0	40.23	8349.92	0.2	0.0
12/8/96	17:00	1.00	0.0	40.39	8519.25		
12/8/96	18:00	0.82	0.0	55.81	8392.75		
12/8/96	19:00	0.97	0.0	48.96	8318.58		
12/8/96	20:00	0.75	0.0	46.13	8167.42	0.3	0.1
12/8/96	21:00	0.83	0.0	43.19	8270.67		
12/8/96	22:00	0.70	0.0	41.63	8332.83		
12/8/96	23:00	1.00	0.0	40.92	8486.50		
12/9/96	0:00	0.80	0.0	44.52	8312.17	0.1	0.0
12/9/96	1:00	1.00	0.0	45.53	8364.75		
12/9/96	2:00	0.92	0.0	51.35	8418.00		
12/9/96	3:00	1.00	0.0	48.18	8171.42		
12/9/96	4:00	1.00	0.0	47.87	7938.08	0.2	0.0
12/9/96	5:00	1.00	0.0	46.44	7971.17		
12/9/96	6:00	0.87	0.0	46.83	7901.55		
12/9/96	7:00	1.00	0.0	47.91	7951.20		
12/9/96	8:00	1.00	0.0	48.43	7946.08	0.0	0.0
12/9/96	9:00	0.92	0.0	49.85	8103.75		
12/9/96	10:00	0.80	0.0	52.20	8053.50		
12/9/96	11:00	1.00	0.0	51.74	8445.00		

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/9/96	12:00	1.00	0.0	50.71	8429.58	0.0	0.0
12/9/96	13:00	0.83	0.0	50.13	8464.58		
12/9/96	14:00	0.85	0.0	51.72	8522.08		
12/9/96	15:00	1.00	0.0	53.65	8476.92		
12/9/96	16:00	1.00	0.0	54.77	8483.92	0.0	0.0
12/9/96	17:00	1.00	0.0	54.51	8416.58		
12/9/96	18:00	1.00	0.0	53.98	8458.67		
12/9/96	19:00	1.00	0.0	53.50	8480.58		
12/9/96	20:00	0.93	0.0	53.47	8176.25	0.0	0.0
12/9/96	21:00	0.73	0.0	53.57	7939.17		
12/9/96	22:00	1.00	0.0	53.43	7988.17		
12/9/96	23:00	1.00	0.0	53.27	8023.67		
12/10/96	0:00	0.80	0.0	53.25	8002.08	0.3	0.0
12/10/96	1:00	1.00	0.0	53.44	8015.00		
12/10/96	2:00	0.92	0.0	56.52	7495.75		
12/10/96	3:00	0.28	0.0	57.99	7657.75		
12/10/96	4:00	0.50	0.5	84.95	7996.50	0.3	0.0
12/10/96	5:00	0.00	1.0	135.88	8043.64		
12/10/96	6:00	0.27	0.4	108.67	7975.92		
12/10/96	7:00	1.00	0.0	70.03	7932.67		
12/10/96	8:00	1.00	0.0	59.22	7982.50	0.3	0.0
12/10/96	9:00	0.47	0.0	56.40	7950.17		
12/10/96	10:00	0.58	0.0	53.75	8030.92		
12/10/96	11:00	1.00	0.0	54.08	7950.17		
12/10/96	12:00	0.43	0.0	57.99	7723.42	0.3	0.0
12/10/96	13:00	0.83	0.0	61.80	7774.24		
12/10/96	14:00	0.83	0.1	68.34	7677.08		
12/10/96	15:00	0.85	0.0	91.99	7534.42		
12/10/96	16:00	0.33	0.0	71.03	7493.50	0.1	0.0
12/10/96	17:00	1.00	0.0	67.22	7525.75		
12/10/96	18:00	0.27	0.0	65.88	7480.67		
12/10/96	19:00	0.58	0.0	65.85	7546.42		
12/10/96	20:00	0.88	0.0	66.62	7802.25	0.1	0.0
12/10/96	21:00	0.40	0.0	66.90	7927.00		
12/10/96	22:00	0.52	0.0	67.74	7776.25		
12/10/96	23:00	0.85	0.0	68.94	7584.75		
12/11/96	0:00	1.00	0.0	69.24	7599.42	0.3	0.0
12/11/96	1:00	0.38	0.0	67.75	7649.92		
12/11/96	2:00	0.50	0.0	68.17	7362.08		
12/11/96	3:00	1.00	0.0	69.45	7587.67		
12/11/96	4:00	0.85	0.0	68.82	7779.00	0.3	0.0
12/11/96	5:00	0.45	0.0	67.48	7884.08		
12/11/96	6:00	1.00	0.0	66.75	7961.67		
12/11/96	7:00	0.57	0.0	66.38	7955.50		
12/11/96	8:00	0.00	0.0	66.40	7810.17	0.2	0.0
12/11/96	9:00	0.90	0.0	67.33	7556.42		
12/11/96	10:00	1.00	0.0	68.63	7486.75		
12/11/96	11:00	1.00	0.0	70.10	7193.46		
12/11/96	12:00	1.00	0.0	70.81	7285.17	0.2	0.0
12/11/96	13:00	1.00	0.0	71.17	7283.58		

000458

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/11/96	14:00	0.82	0.0	71.76	7266.83		
12/11/96	15:00	1.00	0.0	72.53	7399.92		
12/11/96	16:00	1.00	0.0	72.68	7760.92	0.2	0.0
12/11/96	17:00	1.00	0.0	71.67	7790.08		
12/11/96	18:00	1.00	0.0	72.04	7780.33		
12/11/96	19:00	1.00	0.0	73.17	7663.75		
12/11/96	20:00	0.76	0.0	72.52	7947.63	0.2	0.0
12/11/96	21:00	1.00	0.0	71.15	7906.00		
12/11/96	22:00	0.57	0.0	69.73	8042.33		
12/11/96	23:00	0.87	0.0	66.48	8152.83		
12/12/96	0:00	0.67	0.0	64.36	8181.25	0.2	0.0
12/12/96	1:00	1.00	0.0	63.31	8208.08		
12/12/96	2:00	0.80	0.0	62.65	8212.17		
12/12/96	3:00	1.00	0.0	62.11	8323.83		
12/12/96	4:00	1.00	0.0	61.08	8369.75	0.2	0.0
12/12/96	5:00	0.78	0.0	59.07	8356.42		
12/12/96	6:00	1.00	0.0	58.56	8407.08		
12/12/96	7:00	1.00	0.0	57.47	8428.83		
12/12/96	8:00	1.00	0.0	57.56	8356.17	0.2	0.0
12/12/96	9:00	1.00	0.0	57.47	8325.50		
12/12/96	10:00	0.85	0.2	68.56	7526.33		
12/12/96	11:00	0.45	0.1	81.13	8552.50		
12/12/96	12:00	0.92	0.0	67.67	8415.25	0.2	0.0
12/12/96	13:00	0.18	0.0	66.59	8384.83		
12/12/96	14:00	0.00	0.0	63.82	8281.25		
12/12/96	15:00	0.00	0.0	62.17	8162.25		
12/12/96	16:00	0.75	0.0	59.12	8292.58	0.2	0.0
12/12/96	17:00	0.28	0.0	54.57	8218.50		
12/12/96	18:00	0.53	0.0	53.60	8198.42		
12/12/96	19:00	1.00	0.0	52.91	8073.00		
12/12/96	20:00	1.00	0.0	52.26	8225.08	0.2	0.0
12/12/96	21:00	0.70	0.0	51.98	8209.20		
12/12/96	22:00	1.00	0.0	52.54	8234.50		
12/12/96	23:00	1.00	0.0	53.08	8184.17		
12/13/96	0:00	1.00	0.0	52.74	8228.33	0.2	0.0
12/13/96	1:00	1.00	0.0	53.18	8268.50		
12/13/96	2:00	0.87	0.0	53.00	8098.00		
12/13/96	3:00	1.00	0.0	51.93	7709.00		
12/13/96	4:00	1.00	0.0	52.14	7608.17	0.2	0.0
12/13/96	5:00	1.00	0.0	51.19	7771.50		
12/13/96	6:00	1.00	0.0	50.85	7895.83		
12/13/96	7:00	1.00	0.0	51.50	7848.67		
12/13/96	8:00	0.77	0.1	56.80	8074.83	0.2	0.0
12/13/96	9:00	1.00	0.0	53.90	8020.17		
12/13/96	10:00	1.00	0.0	52.72	7855.50		
12/13/96	11:00	1.00	0.0	51.76	7839.92		
12/13/96	12:00	1.00	0.0	51.34	7803.00	0.2	0.0
12/13/96	13:00	1.00	0.0	51.58	7768.31		
12/13/96	14:00	0.02	0.7	119.45	8134.83		
12/13/96	15:00	0.32	0.1	105.99	7761.17		

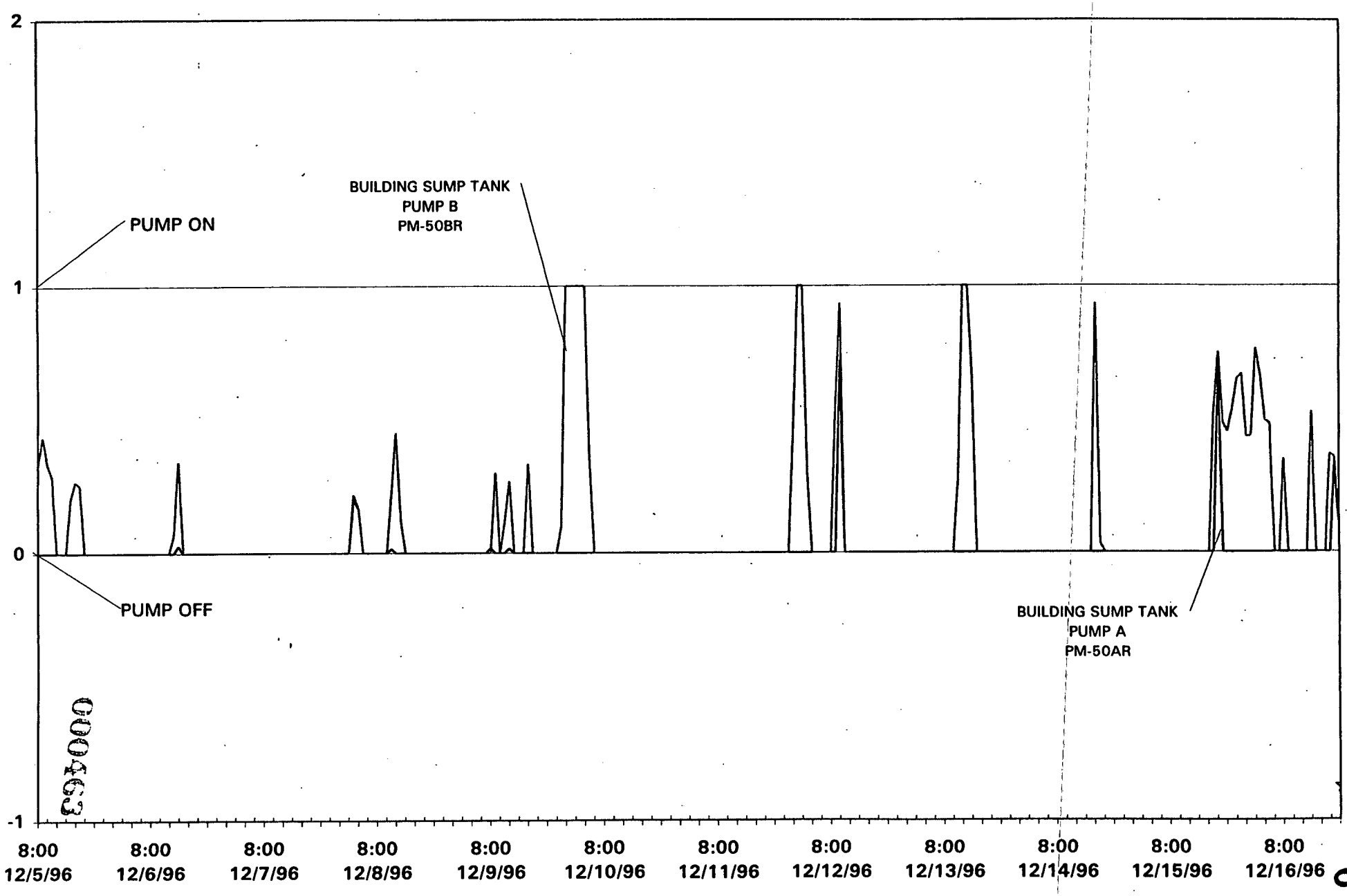
VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/13/96	16:00	0.97	0.0	71.66	7728.17	0.2	0.0
12/13/96	17:00	1.00	0.8	119.45	8182.92		
12/13/96	18:00	1.00	1.0	96.37	8329.75		
12/13/96	19:00	1.00	1.0	117.01	8205.92		
12/13/96	20:00	1.00	1.0	191.21	8080.92	4.0	0.2
12/13/96	21:00	1.00	1.0	65.99	8199.42		
12/13/96	22:00	1.00	1.0	163.78	7945.25		
12/13/96	23:00	1.00	1.0	212.84	8030.08		
12/14/96	0:00	1.00	1.0	206.52	8129.83	6.4	0.4
12/14/96	1:00	1.00	1.0	180.84	8193.17		
12/14/96	2:00	1.00	1.0	178.57	8254.17		
12/14/96	3:00	0.53	0.6	105.93	8155.69		
12/14/96	4:00	0.72	0.1	68.52	8086.67	0.2	0.0
12/14/96	5:00	1.00	0.0	54.54	7996.25		
12/14/96	6:00	0.85	0.0	50.36	7973.50		
12/14/96	7:00	1.00	0.0	49.13	8009.17		
12/14/96	8:00	0.92	0.0	49.05	8073.58	0.2	0.0
12/14/96	9:00	0.45	0.2	60.31	8182.92		
12/14/96	10:00	0.00	0.0	51.71	7960.33		
12/14/96	11:00	0.00	0.0	52.69	7741.25		
12/14/96	12:00	0.00	0.0	54.72	7815.50	0.2	0.0
12/14/96	13:00	0.00	0.2	63.99	7741.58		
12/14/96	14:00	0.00	1.0	74.01	8047.17		
12/14/96	15:00	0.00	0.7	80.39	7990.00		
12/14/96	16:00	0.67	0.0	70.37	7810.83	0.2	0.0
12/14/96	17:00	1.00	0.0	62.92	7842.25		
12/14/96	18:00	1.00	0.0	59.76	7852.00		
12/14/96	19:00	1.00	0.0	57.11	7984.33		
12/14/96	20:00	0.15	0.0	54.88	7933.42	0.2	0.0
12/14/96	21:00	0.83	0.0	53.60	7975.83		
12/14/96	22:00	1.00	0.0	53.24	8075.67		
12/14/96	23:00	1.00	0.0	52.05	8114.75		
12/15/96	0:00	1.00	0.0	51.22	8241.17	0.0	0.0
12/15/96	1:00	1.00	0.0	50.71	8177.08		
12/15/96	2:00	0.80	0.0	50.63	8041.42		
12/15/96	3:00	1.00	0.0	50.22	8029.83		
12/15/96	4:00	0.97	0.0	50.49	8004.58	0.0	0.0
12/15/96	5:00	0.97	0.0	50.42	8080.33		
12/15/96	6:00	0.87	0.0	50.64	8073.92		
12/15/96	7:00	1.00	0.0	50.85	8173.02		
12/15/96	8:00	1.00	0.0	50.70	8123.33	0.2	0.0
12/15/96	9:00	1.00	0.0	51.69	7935.67		
12/15/96	10:00	1.00	0.0	53.45	7907.12		
12/15/96	11:00	0.48	0.0	56.02	7884.92		
12/15/96	12:00	0.78	0.2	75.40	7838.42	0.5	0.5
12/15/96	13:00	1.00	0.0	65.25	7565.50		
12/15/96	14:00	0.18	0.8	150.34	7722.08		
12/15/96	15:00	0.90	0.0	116.45	7511.50		
12/15/96	16:00	1.00	0.0	82.97	7506.10	0.2	0.0
12/15/96	17:00	1.00	0.0	71.01	7525.11		

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/15/96	18:00	1.00	0.0	67.84	7334.67		
12/15/96	19:00	1.00	0.0	65.44	7725.67		
12/15/96	20:00	0.63	0.0	61.67	7705.08	0.2	0.0
12/15/96	21:00	1.00	0.0	60.24	7597.42		
12/15/96	22:00	1.00	0.0	59.78	7596.33		
12/15/96	23:00	0.70	0.0	59.03	7575.25		
12/16/96	0:00	0.90	0.0	54.57	7707.33	0.0	0.2
12/16/96	1:00	1.00	0.0	52.05	7823.58		
12/16/96	2:00	0.71	0.0	52.10	7857.80		
12/16/96	3:00	0.72	0.0	50.58	7875.17		
12/16/96	4:00	1.00	0.0	49.66	7948.05	0.0	0.2
12/16/96	5:00	0.93	0.1	54.53	8049.92		
12/16/96	6:00	0.97	0.0	71.12	8138.92		
12/16/96	7:00	1.00	0.0	51.53	8113.58		
12/16/96	8:00	0.17	0.7	82.42	8610.67	0.6	0.6
12/16/96	9:00	0.47	0.1	67.67	8072.42		
12/16/96	10:00	1.00	0.0	54.88	7957.50		
12/16/96	11:00	0.53	0.0	50.39	7888.42		
12/16/96	12:00	0.03	0.1	60.87	8085.42	0.3	0.0
12/16/96	13:00	1.00	0.0	58.75	8046.17		
12/16/96	14:00	1.00	0.0	53.51	7987.20		
12/16/96	15:00	1.00	0.0	53.20	7931.33		
12/16/96	16:00	1.00	0.0	53.53	7925.09	0.2	0.0
12/16/96	17:00	0.82	0.0	64.30	7927.75		
12/16/96	18:00	1.00	0.0	61.98	7885.00		
12/16/96	19:00	1.00	0.0	58.45	7875.25		
12/16/96	20:00	1.00	0.0	57.68	7900.25	0.2	0.0

000461

RECYCLE WATER SYSTEM

CASMPA 4
SERIES A GLASS
RECYCLE WATER SYSTEM



000463

C4RCYWTR.XLS Chart 3

VHP 3/12/97

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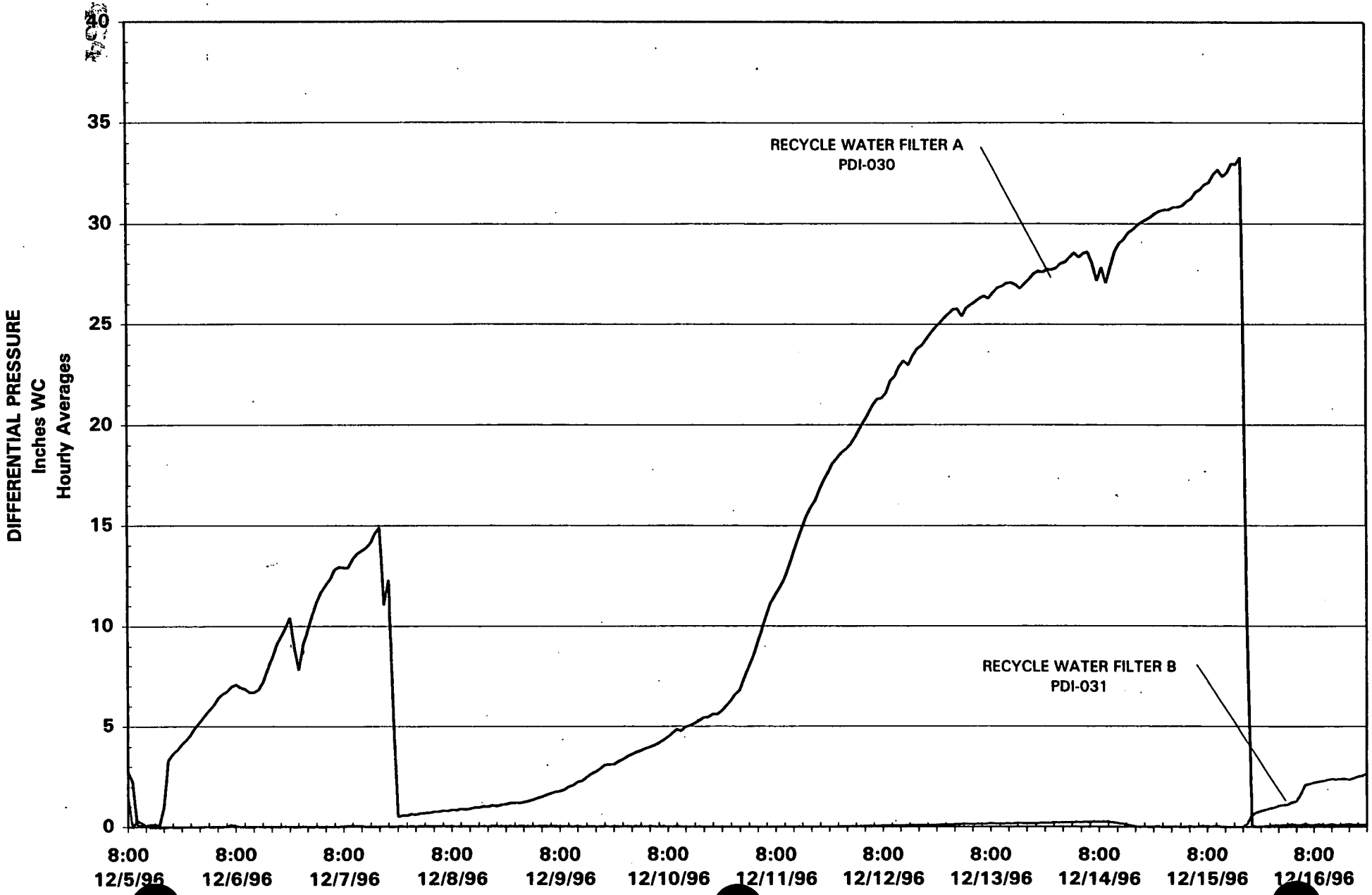
CAMPAIGN 4
SERIES A GLASS
RECYCLE WATER SYSTEM



C4RCYWTRIALS Chart 4

VHP 1/15/97

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/5/96	8:00	0.0	0.3	2.739	1.440
12/5/96	9:00	0.0	0.4	2.250	-0.049
12/5/96	10:00	0.0	0.3	0.100	0.307
12/5/96	11:00	0.0	0.3	0.072	0.194
12/5/96	12:00	0.0	0.0	0.063	0.056
12/5/96	13:00	0.0	0.0	0.101	-0.032
12/5/96	14:00	0.0	0.0	0.101	-0.039
12/5/96	15:00	0.0	0.2	0.075	-0.049
12/5/96	16:00	0.0	0.3	0.990	-0.044
12/5/96	17:00	0.0	0.3	3.309	-0.010
12/5/96	18:00	0.0	0.0	3.622	-0.027
12/5/96	19:00	0.0	0.0	3.841	-0.032
12/5/96	20:00	0.0	0.0	4.110	-0.004
12/5/96	21:00	0.0	0.0	4.334	-0.016
12/5/96	22:00	0.0	0.0	4.603	-0.016
12/5/96	23:00	0.0	0.0	4.944	0.003
12/6/96	0:00	0.0	0.0	5.200	-0.018
12/6/96	1:00	0.0	0.0	5.526	-0.005
12/6/96	2:00	0.0	0.0	5.811	-0.004
12/6/96	3:00	0.0	0.0	6.047	-0.019
12/6/96	4:00	0.0	0.0	6.394	0.001
12/6/96	5:00	0.0	0.0	6.599	-0.010
12/6/96	6:00	0.0	0.0	6.744	0.021
12/6/96	7:00	0.0	0.0	6.972	0.099
12/6/96	8:00	0.0	0.0	7.072	0.050
12/6/96	9:00	0.0	0.0	6.931	-0.006
12/6/96	10:00	0.0	0.0	6.861	-0.007
12/6/96	11:00	0.0	0.0	6.692	-0.018
12/6/96	12:00	0.0	0.0	6.706	-0.014
12/6/96	13:00	0.0	0.1	6.845	0.012
12/6/96	14:00	0.0	0.3	7.211	-0.008
12/6/96	15:00	0.0	0.0	7.817	-0.014
12/6/96	16:00	0.0	0.0	8.384	-0.014
12/6/96	17:00	0.0	0.0	9.068	-0.010
12/6/96	18:00	0.0	0.0	9.494	-0.008
12/6/96	19:00	0.0	0.0	9.887	0.011
12/6/96	20:00	0.0	0.0	10.437	0.004
12/6/96	21:00	0.0	0.0	8.839	-0.010
12/6/96	22:00	0.0	0.0	7.805	-0.010
12/6/96	23:00	0.0	0.0	9.112	0.010
12/7/96	0:00	0.0	0.0	9.785	0.004
12/7/96	1:00	0.0	0.0	10.528	-0.010
12/7/96	2:00	0.0	0.0	11.179	-0.010
12/7/96	3:00	0.0	0.0	11.679	-0.007

000465

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/7/96	4:00	0.0	0.0	12.049	0.015
12/7/96	5:00	0.0	0.0	12.352	0.004
12/7/96	6:00	0.0	0.0	12.812	-0.008
12/7/96	7:00	0.0	0.0	12.927	-0.003
12/7/96	8:00	0.0	0.0	12.907	0.018
12/7/96	9:00	0.0	0.0	12.892	0.047
12/7/96	10:00	0.0	0.0	13.304	0.052
12/7/96	11:00	0.0	0.0	13.596	0.051
12/7/96	12:00	0.0	0.0	13.744	0.031
12/7/96	13:00	0.0	0.0	13.886	-0.007
12/7/96	14:00	0.0	0.0	14.142	-0.010
12/7/96	15:00	0.0	0.0	14.589	-0.006
12/7/96	16:00	0.0	0.0	14.897	-0.004
12/7/96	17:00	0.0	0.0	11.059	-0.004
12/7/96	18:00	0.0	0.0	12.298	-0.005
12/7/96	19:00	0.0	0.0	5.445	-0.006
12/7/96	20:00	0.0	0.0	0.513	0.014
12/7/96	21:00	0.0	0.0	0.563	0.013
12/7/96	22:00	0.0	0.0	0.565	-0.001
12/7/96	23:00	0.0	0.0	0.635	0.022
12/8/96	0:00	0.0	0.0	0.609	0.003
12/8/96	1:00	0.0	0.0	0.666	0.019
12/8/96	2:00	0.0	0.0	0.687	0.012
12/8/96	3:00	0.2	0.2	0.708	0.012
12/8/96	4:00	0.2	0.2	0.752	0.017
12/8/96	5:00	0.0	0.0	0.761	0.012
12/8/96	6:00	0.0	0.0	0.802	0.016
12/8/96	7:00	0.0	0.0	0.794	0.006
12/8/96	8:00	0.0	0.0	0.853	0.022
12/8/96	9:00	0.0	0.0	0.826	0.000
12/8/96	10:00	0.0	0.0	0.895	0.025
12/8/96	11:00	0.0	0.2	0.867	0.007
12/8/96	12:00	0.0	0.5	0.908	0.013
12/8/96	13:00	0.0	0.1	0.962	0.017
12/8/96	14:00	0.0	0.0	0.962	0.005
12/8/96	15:00	0.0	0.0	1.031	0.028
12/8/96	16:00	0.0	0.0	1.013	0.002
12/8/96	17:00	0.0	0.0	1.082	0.029
12/8/96	18:00	0.0	0.0	1.047	0.006
12/8/96	19:00	0.0	0.0	1.105	0.024
12/8/96	20:00	0.0	0.0	1.138	0.010
12/8/96	21:00	0.0	0.0	1.194	0.020
12/8/96	22:00	0.0	0.0	1.204	0.015
12/8/96	23:00	0.0	0.0	1.200	0.018

000466

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/9/96	0:00	0.0	0.0	1.242	0.019
12/9/96	1:00	0.0	0.0	1.300	0.018
12/9/96	2:00	0.0	0.0	1.354	0.017
12/9/96	3:00	0.0	0.0	1.428	0.021
12/9/96	4:00	0.0	0.0	1.505	0.019
12/9/96	5:00	0.0	0.0	1.595	0.022
12/9/96	6:00	0.0	0.0	1.668	0.020
12/9/96	7:00	0.0	0.0	1.745	0.023
12/9/96	8:00	0.0	0.0	1.788	0.021
12/9/96	9:00	0.0	0.3	1.850	0.016
12/9/96	10:00	0.0	0.0	1.999	0.024
12/9/96	11:00	0.0	0.1	2.077	0.004
12/9/96	12:00	0.0	0.3	2.250	0.033
12/9/96	13:00	0.0	0.0	2.311	0.004
12/9/96	14:00	0.0	0.0	2.475	0.011
12/9/96	15:00	0.0	0.0	2.657	0.025
12/9/96	16:00	0.0	0.3	2.767	0.001
12/9/96	17:00	0.0	0.0	2.909	0.006
12/9/96	18:00	0.0	0.0	3.086	0.024
12/9/96	19:00	0.0	0.0	3.116	0.004
12/9/96	20:00	0.0	0.0	3.117	0.025
12/9/96	21:00	0.0	0.0	3.255	0.008
12/9/96	22:00	0.0	0.0	3.353	0.005
12/9/96	23:00	0.0	0.1	3.504	0.027
12/10/96	0:00	0.0	1.0	3.605	0.000
12/10/96	1:00	0.0	1.0	3.694	0.022
12/10/96	2:00	0.0	1.0	3.774	0.009
12/10/96	3:00	0.0	1.0	3.872	0.001
12/10/96	4:00	0.0	1.0	3.955	0.027
12/10/96	5:00	0.0	0.4	4.045	0.004
12/10/96	6:00	0.0	0.0	4.159	0.014
12/10/96	7:00	0.0	0.0	4.293	0.019
12/10/96	8:00	0.0	0.0	4.466	0.002
12/10/96	9:00	0.0	0.0	4.643	0.005
12/10/96	10:00	0.0	0.0	4.844	0.029
12/10/96	11:00	0.0	0.0	4.772	0.004
12/10/96	12:00	0.0	0.0	4.961	-0.001
12/10/96	13:00	0.0	0.0	5.042	0.002
12/10/96	14:00	0.0	0.0	5.162	0.004
12/10/96	15:00	0.0	0.0	5.295	0.006
12/10/96	16:00	0.0	0.0	5.448	0.005
12/10/96	17:00	0.0	0.0	5.466	0.003
12/10/96	18:00	0.0	0.0	5.618	0.000
12/10/96	19:00	0.0	0.0	5.597	0.001

000467

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/10/96	20:00	0.0	0.0	5.772	0.001
12/10/96	21:00	0.0	0.0	6.008	0.002
12/10/96	22:00	0.0	0.0	6.271	0.004
12/10/96	23:00	0.0	0.0	6.591	0.003
12/11/96	0:00	0.0	0.0	6.795	0.003
12/11/96	1:00	0.0	0.0	7.402	0.003
12/11/96	2:00	0.0	0.0	7.934	0.003
12/11/96	3:00	0.0	0.0	8.432	0.005
12/11/96	4:00	0.0	0.0	9.109	0.003
12/11/96	5:00	0.0	0.0	9.799	0.002
12/11/96	6:00	0.0	0.0	10.516	0.002
12/11/96	7:00	0.0	0.0	11.161	0.003
12/11/96	8:00	0.0	0.0	11.554	0.004
12/11/96	9:00	0.0	0.0	11.918	0.007
12/11/96	10:00	0.0	0.0	12.307	0.005
12/11/96	11:00	0.0	0.0	12.867	0.004
12/11/96	12:00	0.0	0.0	13.533	0.005
12/11/96	13:00	0.0	0.0	14.208	0.006
12/11/96	14:00	0.0	0.0	14.814	0.001
12/11/96	15:00	0.0	0.0	15.398	0.001
12/11/96	16:00	0.0	0.0	15.886	0.001
12/11/96	17:00	0.0	0.0	16.214	0.000
12/11/96	18:00	0.0	0.0	16.766	0.000
12/11/96	19:00	0.0	0.0	17.242	0.000
12/11/96	20:00	0.0	0.0	17.654	0.002
12/11/96	21:00	0.0	0.0	18.080	0.005
12/11/96	22:00	0.0	0.0	18.342	0.011
12/11/96	23:00	0.0	0.0	18.615	0.012
12/12/96	0:00	0.0	0.5	18.794	0.017
12/12/96	1:00	0.0	1.0	19.030	0.023
12/12/96	2:00	0.0	1.0	19.392	0.027
12/12/96	3:00	0.0	0.3	19.793	0.034
12/12/96	4:00	0.0	0.0	20.164	0.036
12/12/96	5:00	0.0	0.0	20.524	0.040
12/12/96	6:00	0.0	0.0	20.953	0.044
12/12/96	7:00	0.0	0.0	21.270	0.048
12/12/96	8:00	0.0	0.0	21.314	0.054
12/12/96	9:00	0.0	0.5	21.584	0.054
12/12/96	10:00	0.7	0.9	22.199	0.057
12/12/96	11:00	0.0	0.0	22.438	0.062
12/12/96	12:00	0.0	0.0	22.940	0.062
12/12/96	13:00	0.0	0.0	23.216	0.067
12/12/96	14:00	0.0	0.0	23.000	0.066
12/12/96	15:00	0.0	0.0	23.474	0.066

000468

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/12/96	16:00	0.0	0.0	23.818	0.068
12/12/96	17:00	0.0	0.0	23.962	0.079
12/12/96	18:00	0.0	0.0	24.273	0.084
12/12/96	19:00	0.0	0.0	24.565	0.090
12/12/96	20:00	0.0	0.0	24.827	0.093
12/12/96	21:00	0.0	0.0	25.044	0.100
12/12/96	22:00	0.0	0.0	25.300	0.101
12/12/96	23:00	0.0	0.0	25.502	0.107
12/13/96	0:00	0.0	0.0	25.722	0.112
12/13/96	1:00	0.0	0.0	25.764	0.115
12/13/96	2:00	0.0	0.0	25.384	0.146
12/13/96	3:00	0.0	0.0	25.812	0.141
12/13/96	4:00	0.0	0.0	25.970	0.129
12/13/96	5:00	0.0	0.0	26.116	0.131
12/13/96	6:00	0.0	0.0	26.298	0.138
12/13/96	7:00	0.0	0.0	26.399	0.144
12/13/96	8:00	0.0	0.0	26.281	0.167
12/13/96	9:00	0.0	0.0	26.576	0.157
12/13/96	10:00	0.0	0.0	26.826	0.150
12/13/96	11:00	0.0	0.3	26.908	0.154
12/13/96	12:00	0.0	1.0	27.055	0.159
12/13/96	13:00	0.0	1.0	27.079	0.164
12/13/96	14:00	0.0	0.7	26.986	0.192
12/13/96	15:00	0.0	0.0	26.782	0.169
12/13/96	16:00	0.0	0.0	27.021	0.154
12/13/96	17:00	0.0	0.0	27.247	0.156
12/13/96	18:00	0.0	0.0	27.538	0.162
12/13/96	19:00	0.0	0.0	27.644	0.192
12/13/96	20:00	0.0	0.0	27.614	0.189
12/13/96	21:00	0.0	0.0	27.728	0.184
12/13/96	22:00	0.0	0.0	27.732	0.216
12/13/96	23:00	0.0	0.0	27.791	0.200
12/14/96	0:00	0.0	0.0	28.030	0.218
12/14/96	1:00	0.0	0.0	28.099	0.220
12/14/96	2:00	0.0	0.0	28.339	0.218
12/14/96	3:00	0.0	0.0	28.561	0.242
12/14/96	4:00	0.0	0.0	28.344	0.229
12/14/96	5:00	0.0	0.0	28.533	0.254
12/14/96	6:00	0.0	0.0	28.601	0.238
12/14/96	7:00	0.0	0.0	28.025	0.260
12/14/96	8:00	0.0	0.0	27.169	0.246
12/14/96	9:00	0.0	0.0	27.824	0.263
12/14/96	10:00	0.0	0.0	27.072	0.246
12/14/96	11:00	0.0	0.0	27.884	0.217

000469

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/14/96	12:00	0.0	0.0	28.656	0.184
12/14/96	13:00	0.0	0.0	29.042	0.152
12/14/96	14:00	0.0	0.0	29.220	0.108
12/14/96	15:00	0.0	0.0	29.552	0.061
12/14/96	16:00	0.0	0.9	29.715	0.017
12/14/96	17:00	0.0	0.0	29.924	-0.006
12/14/96	18:00	0.0	0.0	30.080	-0.007
12/14/96	19:00	0.0	0.0	30.204	-0.008
12/14/96	20:00	0.0	0.0	30.330	0.001
12/14/96	21:00	0.0	0.0	30.494	0.019
12/14/96	22:00	0.0	0.0	30.610	-0.006
12/14/96	23:00	0.0	0.0	30.665	-0.009
12/15/96	0:00	0.0	0.0	30.672	0.005
12/15/96	1:00	0.0	0.0	30.810	0.008
12/15/96	2:00	0.0	0.0	30.818	-0.007
12/15/96	3:00	0.0	0.0	30.890	-0.003
12/15/96	4:00	0.0	0.0	31.086	0.023
12/15/96	5:00	0.0	0.0	31.232	-0.002
12/15/96	6:00	0.0	0.0	31.571	-0.004
12/15/96	7:00	0.0	0.0	31.695	0.040
12/15/96	8:00	0.0	0.0	31.938	0.027
12/15/96	9:00	0.0	0.0	32.049	0.017
12/15/96	10:00	0.0	0.0	32.444	0.038
12/15/96	11:00	0.0	0.0	32.673	0.013
12/15/96	12:00	0.0	0.0	32.339	-0.011
12/15/96	13:00	0.0	0.0	32.523	-0.010
12/15/96	14:00	0.0	0.0	32.962	-0.010
12/15/96	15:00	0.0	0.0	32.936	-0.007
12/15/96	16:00	0.0	0.0	33.258	-0.008
12/15/96	17:00	0.0	0.5	11.462	0.163
12/15/96	18:00	0.7	0.8	0.062	0.578
12/15/96	19:00	0.0	0.5	0.001	0.712
12/15/96	20:00	0.0	0.5	0.019	0.794
12/15/96	21:00	0.0	0.5	0.037	0.847
12/15/96	22:00	0.0	0.7	0.050	0.916
12/15/96	23:00	0.0	0.7	0.058	0.963
12/16/96	0:00	0.0	0.4	0.061	1.055
12/16/96	1:00	0.0	0.4	0.062	1.095
12/16/96	2:00	0.0	0.8	0.094	1.120
12/16/96	3:00	0.0	0.7	0.111	1.228
12/16/96	4:00	0.0	0.5	0.075	1.281
12/16/96	5:00	0.0	0.5	0.084	1.647
12/16/96	6:00	0.0	0.0	0.133	2.087
12/16/96	7:00	0.0	0.0	0.072	2.153

000170

VITRIFICATION PILOT PLANT RECYCLE WATER SYSTEM					
CAMPAIGN 4 SERIES A GLASS					
		HOURLY AVERAGES			
READINGS		BUILDING	BUILDING	WASTE	WASTE
		SUMP TANK	SUMP TANK	RECYCLE	RECYCLE
		PUMP A	PUMP B	WATER	WATER
		PM-50AR	PM-50BR	FILTER A	FILTER B
		0.0> ON <1.0	0.0> ON <1.0	PDI-030	PDI-031
DATE	HOUR	OFF = 0.0	OFF = 0.0	In WC	In WC
12/16/96	8:00	0.0	0.4	0.080	2.219
12/16/96	9:00	0.0	0.0	0.112	2.264
12/16/96	10:00	0.0	0.0	0.077	2.301
12/16/96	11:00	0.0	0.0	0.081	2.347
12/16/96	12:00	0.0	0.0	0.119	2.393
12/16/96	13:00	0.0	0.0	0.075	2.379
12/16/96	14:00	0.0	0.5	0.074	2.403
12/16/96	15:00	0.0	0.0	0.099	2.394
12/16/96	16:00	0.0	0.0	0.121	2.366
12/16/96	17:00	0.0	0.0	0.082	2.436
12/16/96	18:00	0.0	0.4	0.075	2.515
12/16/96	19:00	0.3	0.4	0.078	2.561
12/16/96	20:00	0.1	0.1	0.080	2.651

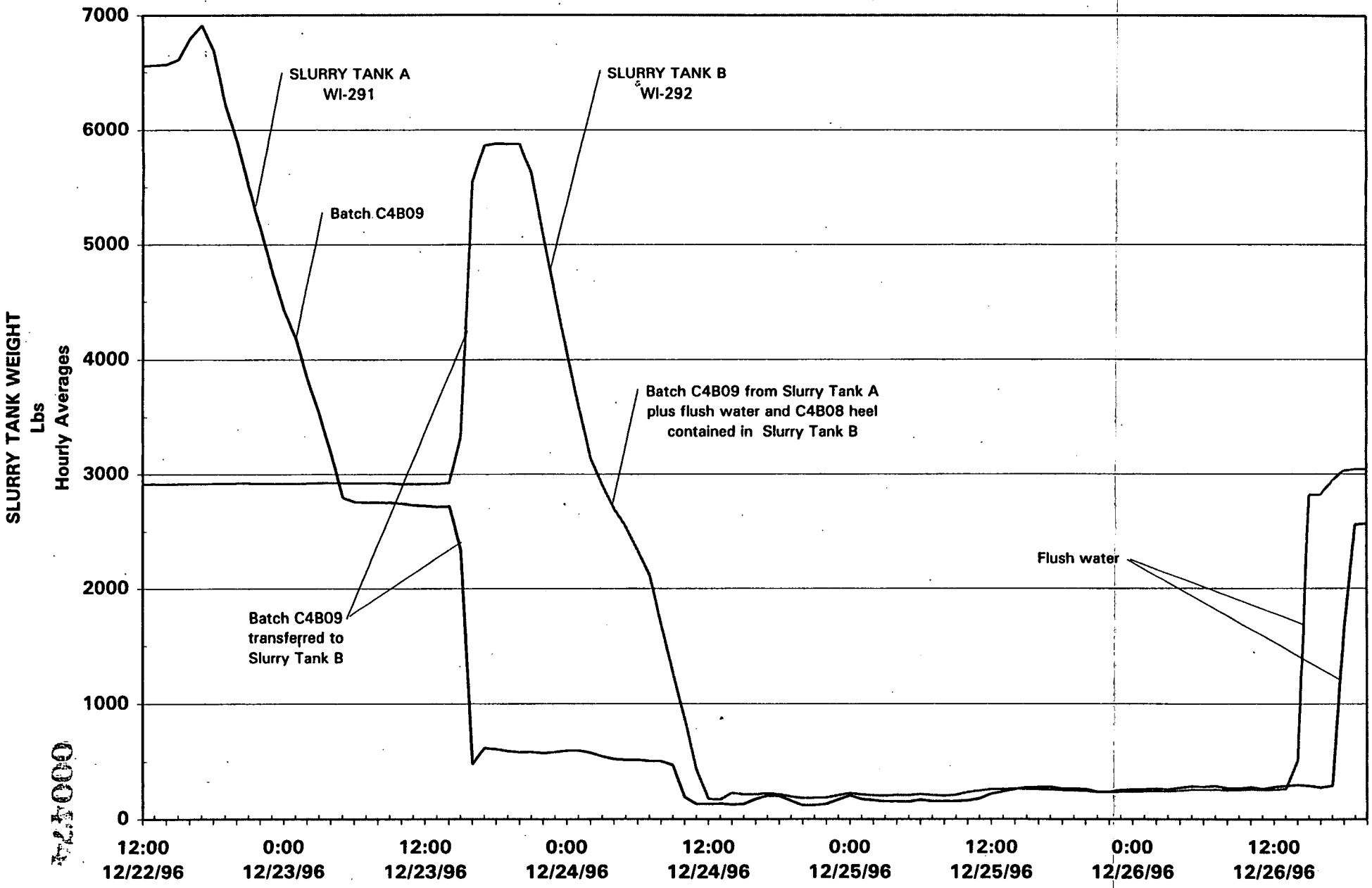
000471

Appendix C3

Transition to Low Temperature Series A Glass

FEED PREPARATION SYSTEM

CAMPA[illegible]4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FEED PREPARATION SYSTEM



C4FDPRP.XLS Chart 5

VHP 2/13/97

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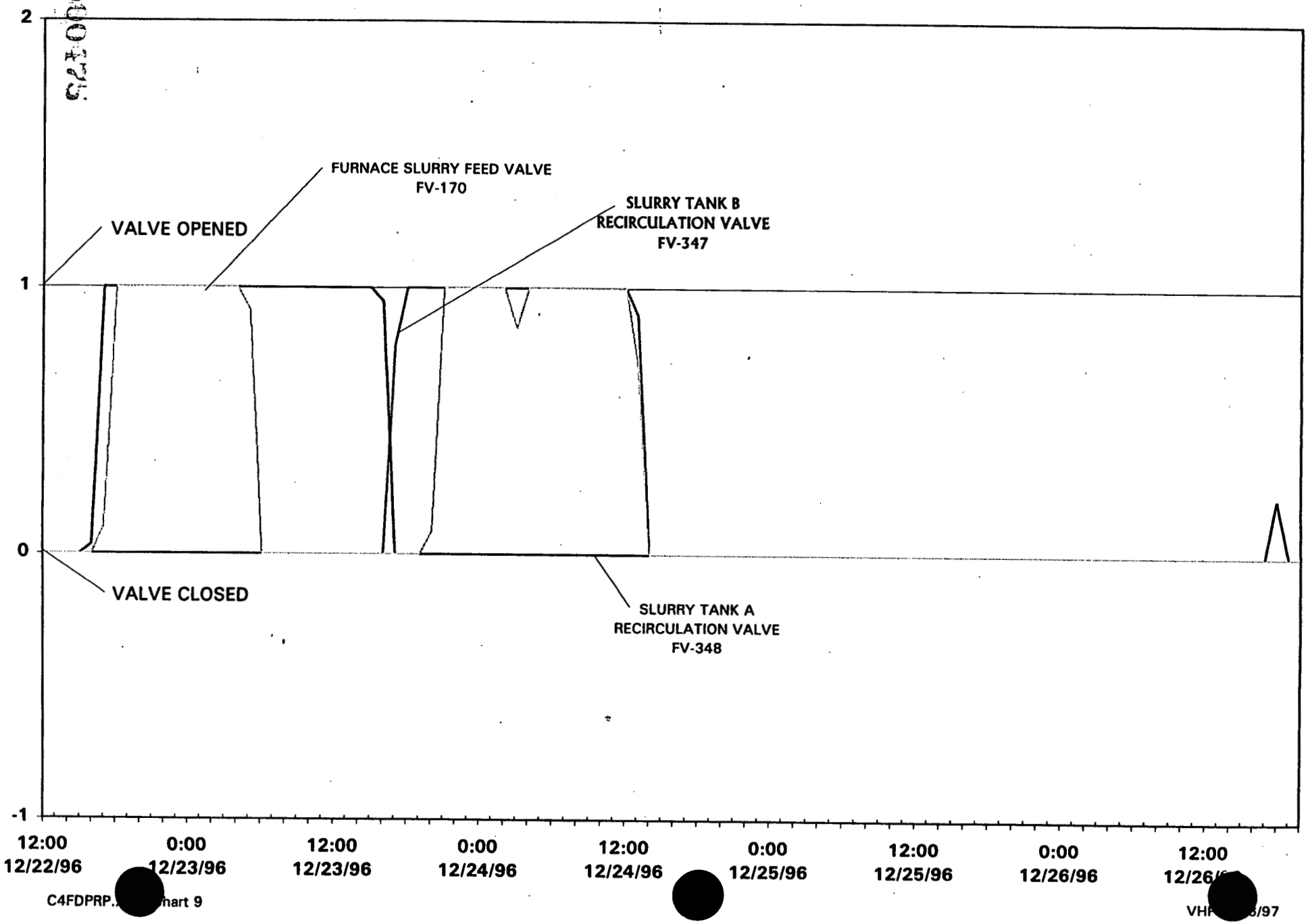
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FEED PREPARATION SYSTEM



C4FDPRP.[illegible]hart 9

VH[illegible]/97

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM

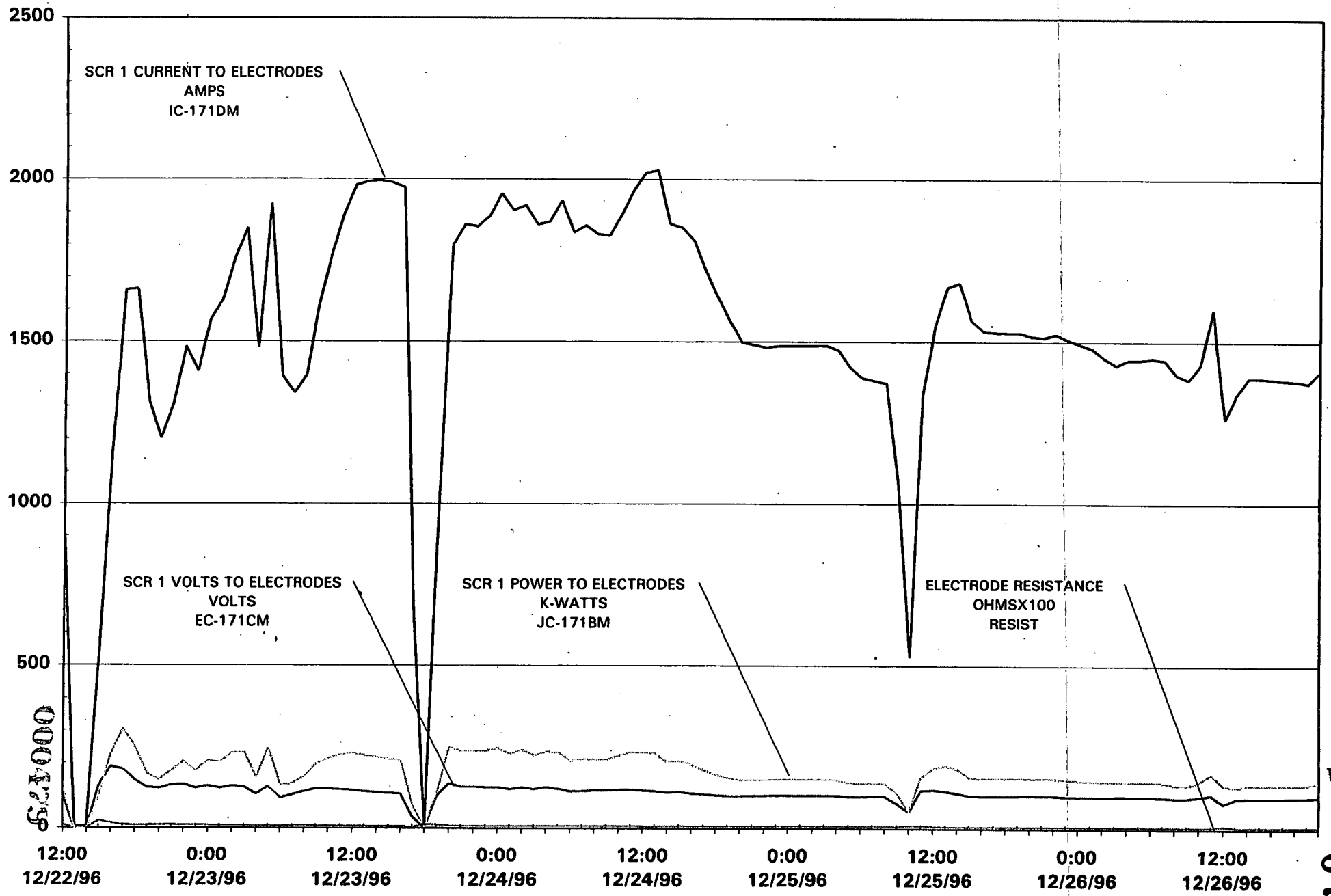
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY RECIRC VALVE	AGITATOR	WEIGHT	SLURRY RECIRC VALVE	AGITATOR	RECIRC FLOW	SLURRY FEED VALVE	SLURRY FEED PUMP RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/22/96	12:00	6559.58	0.0	1.0	2912.50	0.0	1.0	0.00	0.0	0.03
12/22/96	13:00	6565.33	0.0	1.0	2914.38	0.0	1.0	0.00	0.0	0.03
12/22/96	14:00	6573.38	0.0	1.0	2912.88	0.0	1.0	0.00	0.0	0.04
12/22/96	15:00	6615.13	0.0	1.0	2914.83	0.0	1.0	0.00	0.0	0.03
12/22/96	16:00	6799.62	0.0	1.0	2915.72	0.0	1.0	0.00	0.0	0.04
12/22/96	17:00	6919.42	1.0	1.0	2916.79	0.0	1.0	32.28	0.1	3.96
12/22/96	18:00	6690.33	1.0	1.0	2917.67	0.0	1.0	32.35	1.0	267.35
12/22/96	19:00	6210.79	1.0	1.0	2917.63	0.0	1.0	27.03	1.0	247.73
12/22/96	20:00	5889.96	1.0	1.0	2920.30	0.0	1.0	25.55	1.0	162.27
12/22/96	21:00	5508.88	1.0	1.0	2919.54	0.0	1.0	25.31	1.0	211.55
12/22/96	22:00	5142.42	1.0	1.0	2918.33	0.0	1.0	25.05	1.0	210.34
12/22/96	23:00	4780.42	1.0	1.0	2918.46	0.0	1.0	24.89	1.0	210.32
12/23/96	0:00	4434.79	1.0	1.0	2917.29	0.0	1.0	24.46	1.0	160.49
12/23/96	1:00	4192.54	1.0	1.0	2917.42	0.0	1.0	24.21	1.0	188.96
12/23/96	2:00	3836.88	1.0	1.0	2920.75	0.0	1.0	23.87	1.0	186.17
12/23/96	3:00	3527.92	1.0	1.0	2922.29	0.0	1.0	24.45	1.0	174.82
12/23/96	4:00	3190.58	1.0	1.0	2923.42	0.0	1.0	44.54	1.0	204.41
12/23/96	5:00	2792.96	1.0	1.0	2923.00	0.0	1.0	50.79	0.9	150.35
12/23/96	6:00	2756.67	1.0	1.0	2920.25	0.0	1.0	51.00	0.0	0.03
12/23/96	7:00	2752.67	1.0	1.0	2920.96	0.0	1.0	51.00	0.0	0.03
12/23/96	8:00	2750.93	1.0	1.0	2921.53	0.0	1.0	51.00	0.0	0.04
12/23/96	9:00	2751.13	1.0	1.0	2921.88	0.0	1.0	51.00	0.0	0.03
12/23/96	10:00	2742.16	1.0	1.0	2915.13	0.0	1.0	51.00	0.0	0.03
12/23/96	11:00	2728.83	1.0	1.0	2914.75	0.0	1.0	48.79	0.0	0.03
12/23/96	12:00	2721.75	1.0	1.0	2914.25	0.0	1.0	48.24	0.0	0.05
12/23/96	13:00	2714.63	1.0	1.0	2916.75	0.0	1.0	50.97	0.0	0.03
12/23/96	14:00	2719.21	1.0	1.0	2922.64	0.0	1.0	51.00	0.0	0.03
12/23/96	15:00	2334.71	1.0	0.9	3328.63	0.0	1.0	43.59	0.0	0.03
12/23/96	16:00	477.33	0.9	0.0	5542.97	0.0	1.0	23.35	0.0	0.04
12/23/96	17:00	620.54	0.0	0.0	5859.71	0.8	1.0	33.92	0.0	0.05
12/23/96	18:00	611.13	0.0	0.0	5876.50	1.0	1.0	51.00	0.0	0.04
12/23/96	19:00	592.38	0.0	0.0	5873.46	1.0	1.0	51.00	0.0	0.04
12/23/96	20:00	583.38	0.0	0.0	5872.04	1.0	1.0	51.00	0.1	9.38
12/23/96	21:00	584.08	0.0	0.0	5616.00	1.0	1.0	51.00	1.0	311.20
12/23/96	22:00	574.38	0.0	0.0	5069.63	1.0	1.0	51.00	1.0	304.33
12/23/96	23:00	584.54	0.0	0.0	4548.83	1.0	1.0	50.33	1.0	310.43
12/24/96	0:00	596.00	0.0	0.0	4052.33	1.0	1.0	48.72	1.0	300.39
12/24/96	1:00	598.92	0.0	0.0	3587.96	1.0	1.0	47.40	1.0	234.64
12/24/96	2:00	579.04	0.0	0.0	3143.79	1.0	1.0	45.24	1.0	306.54
12/24/96	3:00	544.92	0.0	0.0	2901.42	1.0	1.0	11.88	0.9	230.37
12/24/96	4:00	523.63	0.0	0.0	2693.96	1.0	1.0	36.91	1.0	327.89
12/24/96	5:00	515.04	0.0	0.0	2538.96	1.0	1.0	38.55	1.0	256.32
12/24/96	6:00	514.58	0.0	0.0	2327.96	1.0	1.0	33.23	1.0	250.03
12/24/96	7:00	505.83	0.0	0.0	2119.13	1.0	1.0	49.62	1.0	250.61
12/24/96	8:00	503.38	0.0	0.0	1687.21	1.0	1.0	51.00	1.0	230.82
12/24/96	9:00	470.29	0.0	0.0	1265.92	1.0	1.0	51.00	1.0	209.50
12/24/96	10:00	190.67	0.0	0.0	871.63	1.0	1.0	51.00	1.0	237.66
12/24/96	11:00	132.42	0.0	0.0	433.50	1.0	1.0	50.38	1.0	237.10
12/24/96	12:00	132.83	0.0	0.0	175.83	1.0	1.0	26.40	1.0	225.92
12/24/96	13:00	136.25	0.0	0.0	170.83	0.9	1.0	24.86	0.7	162.70
12/24/96	14:00	127.75	0.0	0.0	226.17	0.0	1.0	0.00	0.0	0.03
12/24/96	15:00	132.50	0.0	0.0	214.08	0.0	1.0	0.00	0.0	0.04
12/24/96	16:00	173.71	0.0	0.0	214.83	0.0	1.0	0.00	0.0	0.05
12/24/96	17:00	201.58	0.0	0.0	221.33	0.0	1.0	0.00	0.0	0.03
12/24/96	18:00	199.28	0.0	0.0	213.98	0.0	1.0	-0.01	0.0	0.04
12/24/96	19:00	160.88	0.0	0.0	195.04	0.0	1.0	0.00	0.0	0.04

VITRIFICATION PILOT PLANT FEED PREPARATION SYSTEM										
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS										
		HOURLY AVERAGES								
READINGS		SLURRY TANK A			SLURRY TANK B			SLURRY	FURNACE	FURNACE
		WEIGHT	SLURRY	AGITATOR	WEIGHT	SLURRY	AGITATOR	RECIRC	SLURRY	SLURRY
			RECIRC			RECIRC		FLOW	FEED VALVE	FEED PUMP
			VALVE			VALVE				RATE
		WI-291	FV-348	AG05AR	WI-292	FV-347	AG05BR	FI-170	FV-170	SIC-173M
			OPENED = 1.0	ON = 1.0		OPENED = 1.0	ON = 1.0		OPENED = 1	
DATE	HOUR	LBS	CLOSED = 0.0	OFF = 0.0	LBS	CLOSED = 0.0	OFF = 0.0	GPM	CLOSED = 0	RPM
12/24/96	20:00	121.50	0.0	0.0	182.33	0.0	1.0	0.00	0.0	0.04
12/24/96	21:00	123.21	0.0	0.0	184.63	0.0	1.0	0.00	0.0	0.04
12/24/96	22:00	133.42	0.0	0.0	186.83	0.0	1.0	0.00	0.0	0.05
12/24/96	23:00	170.08	0.0	0.0	206.83	0.0	1.0	0.00	0.0	0.04
12/25/96	0:00	203.63	0.0	0.0	222.92	0.0	1.0	-0.01	0.0	0.05
12/25/96	1:00	174.42	0.0	0.0	211.25	0.0	1.0	0.00	0.0	0.04
12/25/96	2:00	164.33	0.0	0.0	206.50	0.0	1.0	0.00	0.0	0.04
12/25/96	3:00	154.46	0.0	0.0	201.38	0.0	1.0	0.00	0.0	0.04
12/25/96	4:00	155.42	0.0	0.0	208.13	0.0	1.0	0.00	0.0	0.04
12/25/96	5:00	152.25	0.0	0.0	205.54	0.0	1.0	0.00	0.0	0.05
12/25/96	6:00	167.46	0.0	0.0	215.17	0.0	1.0	-0.01	0.0	0.04
12/25/96	7:00	156.79	0.0	0.0	208.42	0.0	1.0	0.00	0.0	0.04
12/25/96	8:00	155.79	0.0	0.0	202.25	0.0	1.0	0.00	0.0	0.04
12/25/96	9:00	157.96	0.0	0.0	210.04	0.0	1.0	-0.01	0.0	0.04
12/25/96	10:00	162.88	0.0	0.0	233.79	0.0	1.0	-0.01	0.0	0.05
12/25/96	11:00	177.88	0.0	0.0	248.63	0.0	1.0	0.00	0.0	0.03
12/25/96	12:00	220.17	0.0	0.0	259.38	0.0	1.0	-0.01	0.0	0.03
12/25/96	13:00	240.04	0.0	0.0	261.21	0.0	1.0	0.00	0.0	0.04
12/25/96	14:00	261.88	0.0	0.0	265.88	0.0	1.0	0.00	0.0	0.04
12/25/96	15:00	275.96	0.0	0.0	260.38	0.0	1.0	0.00	0.0	0.03
12/25/96	16:00	278.79	0.0	0.0	260.00	0.0	1.0	0.00	0.0	0.05
12/25/96	17:00	281.42	0.0	0.0	258.29	0.0	1.0	0.00	0.0	0.04
12/25/96	18:00	266.46	0.0	0.0	251.79	0.0	1.0	0.00	0.0	0.02
12/25/96	19:00	266.13	0.0	0.0	249.79	0.0	1.0	-0.01	0.0	0.05
12/25/96	20:00	260.88	0.0	0.0	245.25	0.0	1.0	-0.01	0.0	0.03
12/25/96	21:00	238.13	0.0	0.0	236.46	0.0	1.0	0.00	0.0	0.04
12/25/96	22:00	236.38	0.0	0.0	233.83	0.0	1.0	0.00	0.0	0.04
12/25/96	23:00	253.29	0.0	0.0	238.46	0.0	1.0	0.00	0.0	0.03
12/26/96	0:00	257.79	0.0	0.0	240.58	0.0	1.0	0.00	0.0	0.04
12/26/96	1:00	258.83	0.0	0.0	241.46	0.0	1.0	0.00	0.0	0.04
12/26/96	2:00	264.63	0.0	0.0	244.96	0.0	1.0	0.00	0.0	0.05
12/26/96	3:00	257.83	0.0	0.0	241.63	0.0	1.0	-0.01	0.0	0.04
12/26/96	4:00	273.64	0.0	0.0	248.52	0.0	1.0	0.00	0.0	0.05
12/26/96	5:00	284.33	0.0	0.0	256.38	0.0	1.0	-0.01	0.0	0.04
12/26/96	6:00	281.63	0.0	0.0	255.75	0.0	1.0	-0.01	0.0	0.03
12/26/96	7:00	288.96	0.0	0.0	258.04	0.0	1.0	-0.01	0.0	0.05
12/26/96	8:00	269.79	0.0	0.0	250.79	0.0	1.0	0.00	0.0	0.05
12/26/96	9:00	267.63	0.0	0.0	252.46	0.0	1.0	0.00	0.0	0.04
12/26/96	10:00	280.00	0.0	0.0	262.08	0.0	1.0	-0.01	0.0	0.05
12/26/96	11:00	264.08	0.0	0.0	253.46	0.0	1.0	0.00	0.0	0.03
12/26/96	12:00	280.42	0.0	0.0	258.25	0.0	1.0	0.00	0.0	0.04
12/26/96	13:00	292.21	0.0	0.0	264.63	0.0	1.0	0.00	0.0	0.04
12/26/96	14:00	298.42	0.0	0.0	508.54	0.0	1.0	0.00	0.0	0.03
12/26/96	15:00	291.63	0.0	0.0	2818.79	0.0	1.0	0.00	0.0	0.04
12/26/96	16:00	277.71	0.0	0.0	2818.83	0.0	1.0	-0.01	0.0	0.04
12/26/96	17:00	293.81	0.0	0.0	2942.54	0.0	1.0	0.00	0.0	0.03
12/26/96	18:00	1642.00	0.2	0.5	3029.00	0.0	1.0	0.00	0.0	0.04
12/26/96	19:00	2557.20	0.0	1.0	3043.48	0.0	1.0	0.00	0.0	0.04
12/26/96	20:00	2566.67	0.0	1.0	3044.83	0.0	1.0	0.00	0.0	0.04

FURNACE SYSTEM

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE SYSTEM



C4FURN.XLS Chart 29

VHP 1/8/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERAURE SERIES A GLASS

		HOURLY AVERAGES						
READINGS		ELECTRODE CURRENT	CURRENT CONTROLLER SET POINT	ELECTRODE VOLTAGE	VOLTAGE CONTROLLER SET POINT	ELECTRODE POWER	POWER CONTROLLER SET POINT	ELECTRODE RESISTANCE
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/22/96	12:00	916.93	36.00	100.87	454.80	119.01	118.44	10.41
12/22/96	13:00	6.15	36.00	-0.01	454.80	1.99	0.00	-0.10
12/22/96	14:00	6.35	36.00	-0.01	454.80	2.00	0.00	-0.07
12/22/96	15:00	556.28	36.00	127.40	454.80	96.11	96.92	23.45
12/22/96	16:00	1174.32	36.00	188.00	454.80	226.54	226.66	16.25
12/22/96	17:00	1659.08	36.00	180.80	454.80	305.07	304.88	11.01
12/22/96	18:00	1662.48	36.00	146.91	454.80	251.89	251.20	8.84
12/22/96	19:00	1313.48	36.00	124.56	454.80	166.06	165.68	9.49
12/22/96	20:00	1201.40	36.00	122.40	454.80	148.82	148.80	10.19
12/22/96	21:00	1306.05	36.00	131.90	454.80	175.44	175.36	10.11
12/22/96	22:00	1483.95	36.00	134.50	454.80	204.72	204.44	9.07
12/22/96	23:00	1408.33	36.00	122.14	454.80	174.48	174.40	8.67
12/23/96	0:00	1567.93	36.00	128.94	454.80	206.45	206.52	8.23
12/23/96	1:00	1627.65	36.00	122.05	454.80	202.69	202.64	7.51
12/23/96	2:00	1758.90	36.00	128.74	454.80	231.14	230.16	7.33
12/23/96	3:00	1849.60	36.00	125.31	454.80	234.39	234.76	6.78
12/23/96	4:00	1481.10	36.00	102.67	454.80	154.14	154.44	6.93
12/23/96	5:00	1924.60	36.00	127.35	454.80	247.47	247.24	6.61
12/23/96	6:00	1394.18	36.00	92.26	454.80	132.21	130.52	6.65
12/23/96	7:00	1340.85	36.00	101.40	454.80	137.06	137.12	7.57
12/23/96	8:00	1394.92	36.00	111.54	454.80	157.30	157.83	8.00
12/23/96	9:00	1612.53	36.00	120.93	454.80	197.94	197.84	7.51
12/23/96	10:00	1765.04	36.00	120.06	454.80	214.36	214.33	6.80
12/23/96	11:00	1894.40	36.00	118.73	454.80	226.97	226.88	6.27
12/23/96	12:00	1981.53	36.00	115.97	454.80	231.21	230.96	5.85
12/23/96	13:00	1992.68	36.00	111.76	454.80	223.66	223.68	5.61
12/23/96	14:00	1996.14	36.00	108.89	454.80	218.29	218.09	5.45
12/23/96	15:00	1989.25	36.00	106.53	454.80	212.80	212.88	5.36
12/23/96	16:00	1974.57	36.00	105.27	454.80	208.92	208.80	5.33
12/23/96	17:00	664.10	36.00	34.89	454.80	70.84	66.12	1.84
12/23/96	18:00	10.40	36.00	1.56	454.80	2.21	0.52	12.11
12/23/96	19:00	972.83	36.00	97.87	454.80	103.64	104.16	10.20
12/23/96	20:00	1798.75	36.00	137.18	454.80	250.38	250.00	7.69
12/23/96	21:00	1861.95	36.00	126.88	454.80	237.51	237.60	6.81
12/23/96	22:00	1854.70	36.00	127.18	454.80	237.52	237.60	6.86
12/23/96	23:00	1886.93	36.00	125.65	454.80	238.93	238.80	6.66
12/24/96	0:00	1955.50	36.00	125.51	454.80	247.05	247.20	6.42
12/24/96	1:00	1905.13	36.00	119.51	454.80	228.35	228.12	6.27
12/24/96	2:00	1921.15	36.00	125.13	454.80	241.98	242.16	6.52
12/24/96	3:00	1861.98	36.00	119.38	454.80	223.57	223.32	6.42
12/24/96	4:00	1869.95	36.00	125.17	454.80	235.41	236.04	6.70
12/24/96	5:00	1937.05	36.00	120.09	454.80	233.52	233.04	6.20
12/24/96	6:00	1837.75	36.00	112.23	454.80	206.66	206.60	6.11
12/24/96	7:00	1858.85	36.00	113.53	454.80	211.09	211.00	6.11
12/24/96	8:00	1832.40	36.00	115.17	454.80	211.25	211.20	6.28
12/24/96	9:00	1828.18	36.00	115.30	454.80	211.52	211.52	6.31
12/24/96	10:00	1893.28	36.00	116.83	454.80	222.45	222.48	6.17
12/24/96	11:00	1968.41	36.00	117.91	454.80	233.02	232.80	5.99
12/24/96	12:00	2021.83	36.00	115.26	454.80	233.03	232.80	5.70
12/24/96	13:00	2028.58	36.00	113.09	454.80	229.59	229.44	5.57
12/24/96	14:00	1863.68	36.00	109.44	454.80	203.91	204.00	5.87

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERAURE SERIES A GLASS

		HOURLY AVERAGES						
READINGS		ELECTRODE CURRENT	CURRENT CONTROLLER SET POINT	ELECTRODE VOLTAGE	VOLTAGE CONTROLLER SET POINT	ELECTRODE POWER	POWER CONTROLLER SET POINT	ELECTRODE RESISTANCE
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/24/96	15:00	1853.40	36.00	111.44	454.80	207.13	207.04	6.01
12/24/96	16:00	1812.60	36.00	107.38	454.80	195.22	196.08	5.93
12/24/96	17:00	1717.80	36.00	104.07	454.80	178.42	178.40	6.06
12/24/96	18:00	1637.67	36.00	101.39	454.80	165.54	165.52	6.19
12/24/96	19:00	1564.38	36.00	99.37	454.80	155.22	155.20	6.35
12/24/96	20:00	1497.93	36.00	99.37	454.80	148.86	148.80	6.64
12/24/96	21:00	1491.35	36.00	100.07	454.80	148.86	148.80	6.71
12/24/96	22:00	1484.00	36.00	100.95	454.80	149.59	149.60	6.80
12/24/96	23:00	1488.08	36.00	101.74	454.80	151.24	151.20	6.84
12/25/96	0:00	1488.75	36.00	101.82	454.80	151.24	151.20	6.85
12/25/96	1:00	1488.65	36.00	101.70	454.80	151.14	151.20	6.83
12/25/96	2:00	1488.98	36.00	101.62	454.80	151.24	151.20	6.82
12/25/96	3:00	1489.35	36.00	101.54	454.80	151.36	150.96	6.81
12/25/96	4:00	1475.70	36.00	100.86	454.80	149.08	148.80	6.83
12/25/96	5:00	1419.70	36.00	98.38	454.80	139.89	139.96	6.93
12/25/96	6:00	1389.10	36.00	98.48	454.80	136.82	136.80	7.09
12/25/96	7:00	1380.28	36.00	99.25	454.80	136.83	136.80	7.19
12/25/96	8:00	1371.63	36.00	99.83	454.80	136.82	136.80	7.28
12/25/96	9:00	1059.03	36.00	76.77	454.80	109.23	108.40	6.56
12/25/96	10:00	527.20	36.00	53.23	454.80	53.26	52.80	9.57
12/25/96	11:00	1338.18	36.00	116.61	454.80	156.86	157.00	8.73
12/25/96	12:00	1547.08	36.00	118.41	454.80	184.58	184.60	7.66
12/25/96	13:00	1669.43	36.00	114.84	454.80	192.37	192.00	6.88
12/25/96	14:00	1682.45	36.00	108.99	454.80	183.67	183.60	6.48
12/25/96	15:00	1566.68	36.00	101.43	454.80	157.81	157.88	6.48
12/25/96	16:00	1532.23	36.00	100.98	454.80	153.51	153.60	6.59
12/25/96	17:00	1528.60	36.00	101.18	454.80	153.52	153.60	6.63
12/25/96	18:00	1528.23	36.00	101.23	454.80	153.54	153.60	6.63
12/25/96	19:00	1528.20	36.00	101.34	454.80	153.46	153.60	6.63
12/25/96	20:00	1517.48	36.00	101.99	454.80	153.52	153.60	6.72
12/25/96	21:00	1513.63	36.00	102.13	454.80	153.50	153.60	6.75
12/25/96	22:00	1523.20	36.00	101.34	454.80	153.48	153.60	6.66
12/25/96	23:00	1506.95	36.00	99.55	454.80	149.36	149.36	6.61
12/26/96	0:00	1493.20	36.00	99.15	454.80	147.47	147.36	6.64
12/26/96	1:00	1480.88	36.00	99.34	454.80	146.55	146.40	6.71
12/26/96	2:00	1450.93	36.00	98.94	454.80	143.14	143.00	6.82
12/26/96	3:00	1427.90	36.00	99.78	454.80	142.59	142.68	6.98
12/26/96	4:00	1444.77	36.00	100.36	454.80	144.08	144.00	6.95
12/26/96	5:00	1445.18	36.00	100.33	454.80	144.14	144.00	6.94
12/26/96	6:00	1448.88	36.00	99.69	454.80	144.21	144.00	6.88
12/26/96	7:00	1444.15	36.00	98.44	454.80	141.88	141.92	6.81
12/26/96	8:00	1398.65	36.00	96.32	454.80	134.44	134.40	6.89
12/26/96	9:00	1382.90	36.00	96.30	454.80	132.94	133.04	6.96
12/26/96	10:00	1431.48	36.00	100.27	454.80	144.13	144.20	7.01
12/26/96	11:00	1598.18	36.00	105.57	454.80	168.97	168.72	6.61
12/26/96	12:00	1260.80	36.00	79.46	454.80	132.64	178.96	9.95
12/26/96	13:00	1339.48	36.00	94.43	454.80	128.48	130.84	7.07
12/26/96	14:00	1388.78	36.00	96.69	454.80	134.46	134.40	6.96
12/26/96	15:00	1388.15	36.00	96.72	454.80	134.40	134.40	6.97
12/26/96	16:00	1384.93	36.00	96.92	454.80	134.36	134.40	7.00
12/26/96	17:00	1381.47	36.00	97.05	454.80	134.36	134.40	7.03

VITRIFICATION PILOT PLANT FURNACE SYSTEM								
CAMPAIGN 4 TRANSITION TO LOW TEMPERAURE SERIES A GLASS								
		HOURLY AVERAGES						
READINGS		ELECTRODE	CURRENT	ELECTRODE	VOLTAGE	ELECTRODE	POWER	ELECTRODE
		CURRENT	CONTROLLER	VOLTAGE	CONTROLLER	POWER	CONTROLLER	RESISTANCE
			SET POINT		SET POINT		SET POINT	
		IC-171DM	IC-171DSP	EC-171CM	EC-171SP	JC-171BM	JC-171BSP	RESIST
DATE	HOUR	AMPS	AMPS	VOLTS	VOLTS	K-WATTS	K-WATTS	OHMS*(100)
12/26/96	18:00	1379.75	36.00	97.25	454.80	134.40	134.40	7.05
12/26/96	19:00	1373.36	36.00	98.42	454.80	135.40	135.38	7.16
12/26/96	20:00	1410.60	36.00	99.65	454.80	141.35	141.60	7.06

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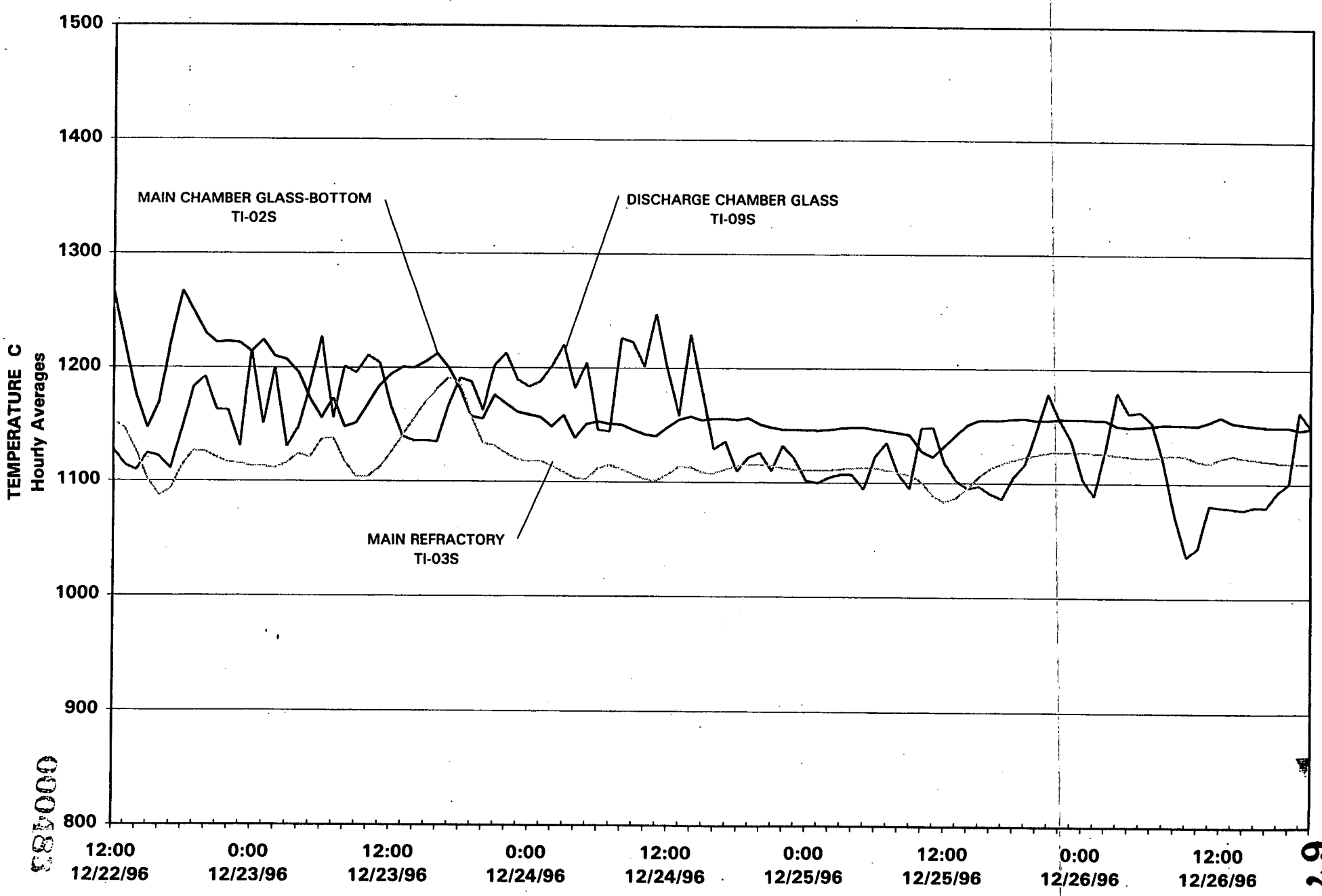
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE SYSTEM



C4FURN.XLS Chart 30

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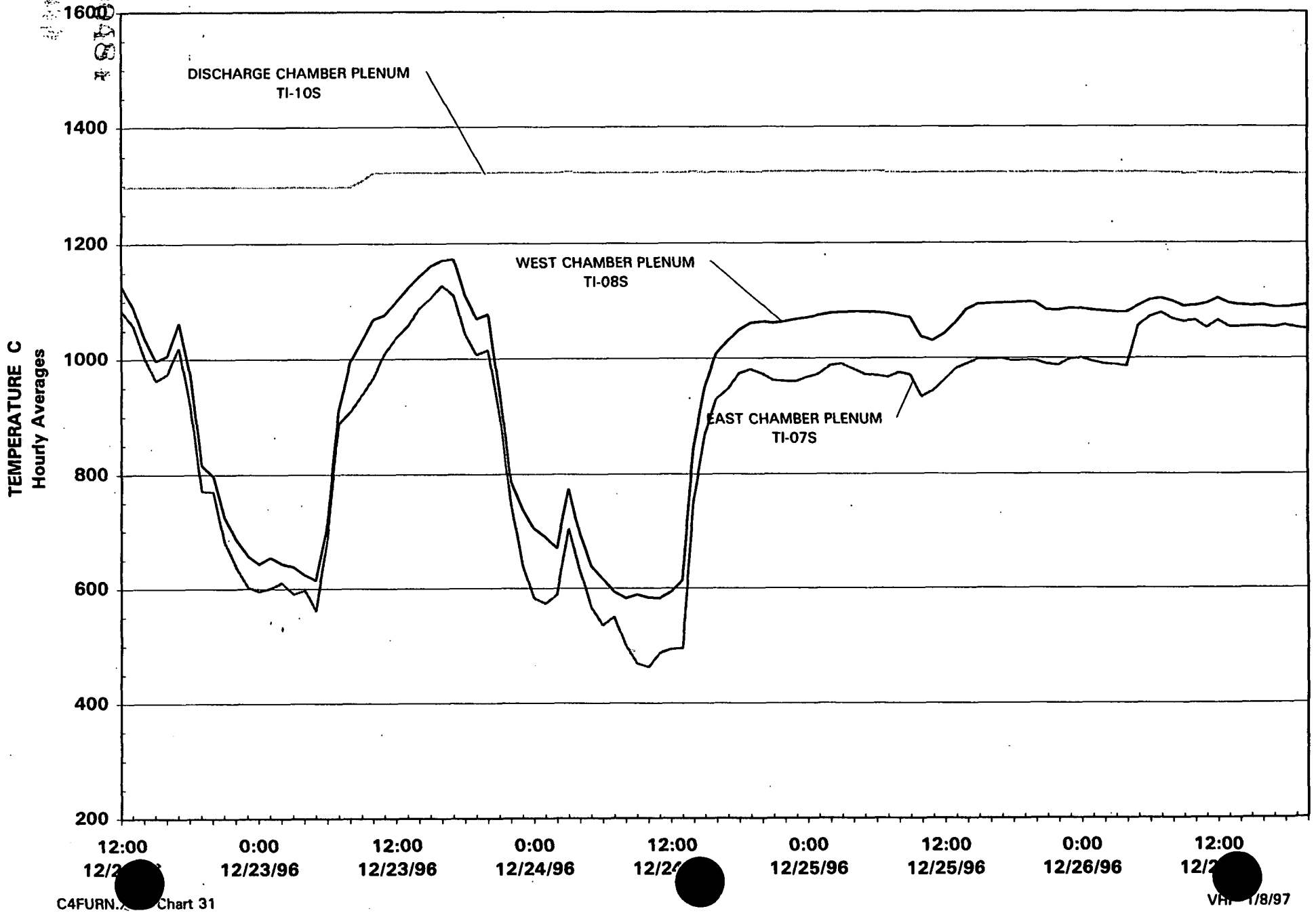
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE SYSTM



C4FURN. Chart 31

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VITRIFICATION PILOT PLA[illegible]URNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

READINGS		HOURLY AVERAGES										
		MAIN CHAMBER GLASS TOP	MAIN CHAMBER GLASS BOTTOM	WEST CHAMBER GLASS	WEST CHAMBER IR GLASS	EAST CHAMBER GLASS	EAST CHAMBER IR GLASS	DISCH CHAMBER GLASS	WEST CHAMBER PLENUM	EAST CHAMBER PLENUM	DISCH CHAMBER PLENUM	MAIN REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/22/96	12:00	OUT OF SERVICE	1265.37	OUT OF SERVICE	OUT OF SERVICE	OUT OF SERVICE	OUT OF SERVIC	1127.47	1127.79	1085.06	1297.38	1152.26
12/22/96	13:00		1218.53					1114.06	1089.64	1057.76	1297.10	1145.99
12/22/96	14:00		1174.47					1109.60	1035.97	1002.29	1297.02	1126.03
12/22/96	15:00		1146.64					1124.24	997.41	962.71	1296.87	1101.56
12/22/96	16:00		1169.40					1121.63	1006.48	974.05	1297.08	1087.25
12/22/96	17:00		1223.24					1110.97	1062.88	1019.87	1297.19	1093.43
12/22/96	18:00		1266.36					1145.63	973.73	922.25	1297.44	1113.41
12/22/96	19:00		1248.67					1182.42	816.59	771.37	1297.42	1126.73
12/22/96	20:00		1229.69					1191.62	798.10	769.77	1297.28	1125.69
12/22/96	21:00		1221.47					1162.80	724.62	680.85	1297.01	1120.64
12/22/96	22:00		1222.27					1162.40	685.25	638.23	1296.92	1116.27
12/22/96	23:00		1221.26					1130.39	657.42	602.73	1296.61	1115.52
12/23/96	0:00		1213.73					1215.12	643.14	595.51	1296.75	1113.19
12/23/96	1:00		1223.61					1150.54	654.32	601.13	1296.66	1113.05
12/23/96	2:00		1209.77					1199.98	643.54	610.09	1297.07	1111.52
12/23/96	3:00		1206.84					1130.15	638.41	590.60	1297.05	1115.81
12/23/96	4:00		1195.89					1147.16	624.47	597.51	1297.13	1123.93
12/23/96	5:00		1172.52					1183.38	614.30	561.15	1297.03	1120.86
12/23/96	6:00		1155.73					1226.52	713.75	691.00	1297.31	1136.89
12/23/96	7:00		1173.08					1155.90	911.60	887.78	1297.26	1137.95
12/23/96	8:00		1147.81					1200.97	994.25	907.76	1296.91	1117.60
12/23/96	9:00		1151.17					1195.37	1031.07	936.50	1307.38	1103.74
12/23/96	10:00		1167.93					1210.44	1069.15	966.53	1320.83	1103.92
12/23/96	11:00		1183.58					1204.57	1076.42	1008.95	1322.62	1111.74
12/23/96	12:00		1193.82					1165.73	1098.73	1036.71	1322.19	1124.69
12/23/96	13:00		1200.54					1139.78	1122.62	1057.25	1322.19	1139.74
12/23/96	14:00		1199.95					1135.48	1143.02	1086.39	1322.28	1155.50
12/23/96	15:00		1205.34					1135.97	1161.03	1104.97	1322.23	1169.94
12/23/96	16:00		1212.21					1134.52	1171.16	1127.67	1322.13	1180.89
12/23/96	17:00		1199.61					1167.79	1173.15	1110.18	1321.98	1191.07
12/23/96	18:00		1180.72					1190.46	1110.55	1043.06	1321.99	1185.35
12/23/96	19:00		1157.18					1187.30	1069.54	1006.90	1322.17	1156.78
12/23/96	20:00		1155.18					1162.45	1077.24	1015.13	1322.37	1133.67
12/23/96	21:00		1175.97					1202.35	942.48	906.64	1322.38	1131.43
12/23/96	22:00		1168.44					1212.53	787.05	750.23	1322.35	1125.04
12/23/96	23:00		1161.15					1189.35	738.96	640.95	1322.27	1119.50
12/24/96	0:00		1158.87					1183.33	703.81	582.77	1322.28	1117.84
12/24/96	1:00		1156.74					1187.65	689.20	573.60	1322.41	1118.44
12/24/96	2:00		1148.36					1201.83	669.32	589.07	1322.02	1113.68
12/24/96	3:00		1158.80					1220.09	773.86	703.17	1322.95	1108.46
12/24/96	4:00		1138.37					1182.04	694.12	631.60	1322.29	1103.30
12/24/96	5:00		1150.64					1204.51	639.12	566.49	1322.55	1102.38
12/24/96	6:00		1152.94					1145.73	616.76	536.41	1322.54	1112.02
12/24/96	7:00		1150.89					1144.15	593.26	549.82	1322.32	1114.60
12/24/96	8:00		1150.23					1225.74	582.55	500.79	1322.54	1111.23
12/24/96	9:00		1145.79					1222.44	588.88	470.11	1322.44	1106.77
12/24/96	10:00		1141.67					1201.46	583.43	462.95	1322.15	1102.63
12/24/96	11:00		1140.07					1246.84	582.60	488.58	1322.90	1101.33
12/24/96	12:00		1147.89					1198.97	593.82	494.94	1322.20	1106.48

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY AVERAGES										
READINGS		MAIN CHAMBER	MAIN CHAMBER	WEST CHAMBER	WEST CHAMBER	EAST CHAMBER	EAST CHAMBER	DISCH CHAMBER	WEST CHAMBER	EAST CHAMBER	DISCH CHAMBER	MAIN
		GLASS TOP	GLASS BOTTOM	GLASS	IR GLASS	GLASS	IR GLASS	GLASS	PLENUM	PLENUM	PLENUM	REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/24/96	13:00		1154.78					1158.22	613.85	496.21	1322.18	1113.40
12/24/96	14:00		1157.57					1229.00	844.21	749.66	1323.22	1113.05
12/24/96	15:00		1154.31					1179.99	949.59	866.73	1322.56	1108.25
12/24/96	16:00		1155.56					1128.87	1007.72	928.72	1322.58	1107.76
12/24/96	17:00		1155.85					1135.39	1029.88	945.79	1322.74	1111.26
12/24/96	18:00		1154.78					1109.68	1049.52	973.15	1322.58	1114.10
12/24/96	19:00		1156.45					1121.78	1061.71	980.39	1322.69	1115.51
12/24/96	20:00		1150.96					1125.98	1064.26	973.36	1322.90	1115.63
12/24/96	21:00		1148.12					1110.15	1061.91	961.99	1322.94	1114.44
12/24/96	22:00		1146.53					1131.94	1064.69	960.44	1323.08	1112.49
12/24/96	23:00		1146.53					1120.98	1068.36	959.89	1323.19	1111.30
12/25/96	0:00		1145.86					1102.03	1071.05	967.71	1323.24	1110.65
12/25/96	1:00		1145.45					1099.86	1074.80	972.63	1323.14	1110.52
12/25/96	2:00		1146.27					1104.43	1078.59	987.45	1323.10	1111.08
12/25/96	3:00		1147.56					1107.14	1079.80	990.34	1323.13	1111.73
12/25/96	4:00		1148.32					1107.07	1080.45	980.81	1323.19	1112.47
12/25/96	5:00		1148.40					1094.49	1081.03	972.35	1323.16	1113.19
12/25/96	6:00		1146.58					1122.66	1079.70	970.36	1322.97	1112.45
12/25/96	7:00		1145.10					1134.89	1078.31	967.09	1322.79	1110.82
12/25/96	8:00		1143.55					1107.76	1074.43	974.98	1322.44	1108.64
12/25/96	9:00		1141.91					1095.05	1071.02	970.89	1322.13	1106.65
12/25/96	10:00		1127.65					1147.77	1037.64	932.71	1321.67	1101.14
12/25/96	11:00		1122.64					1148.38	1030.50	942.73	1321.95	1088.31
12/25/96	12:00		1132.25					1117.27	1043.21	961.68	1321.78	1083.32
12/25/96	13:00		1141.66					1102.34	1062.24	981.86	1321.97	1086.84
12/25/96	14:00		1150.74					1095.22	1084.55	989.58	1322.21	1095.46
12/25/96	15:00		1154.86					1097.18	1093.42	998.61	1322.23	1105.36
12/25/96	16:00		1155.10					1090.51	1094.49	998.11	1322.26	1112.45
12/25/96	17:00		1155.11					1086.16	1095.61	999.21	1322.27	1116.77
12/25/96	18:00		1156.01					1105.34	1095.95	995.43	1322.27	1120.05
12/25/96	19:00		1156.48					1116.10	1097.50	996.58	1322.27	1122.57
12/25/96	20:00		1154.79					1145.56	1096.18	996.00	1322.26	1124.69
12/25/96	21:00		1154.89					1178.06	1083.73	989.92	1322.27	1126.57
12/25/96	22:00		1155.80					1155.50	1083.05	987.54	1321.84	1126.99
12/25/96	23:00		1156.06					1137.14	1086.33	998.37	1321.70	1127.05
12/26/96	0:00		1155.97					1103.41	1085.53	1000.04	1321.99	1126.82
12/26/96	1:00		1155.29					1088.95	1083.05	994.25	1322.20	1126.37
12/26/96	2:00		1155.01					1129.02	1081.37	989.84	1322.20	1125.64
12/26/96	3:00		1150.02					1179.68	1079.88	988.44	1322.14	1124.62
12/26/96	4:00		1148.99					1161.44	1079.76	985.84	1321.95	1123.37
12/26/96	5:00		1149.24					1162.53	1089.68	1056.57	1321.73	1122.26
12/26/96	6:00		1150.34					1153.64	1100.64	1071.93	1321.32	1122.13
12/26/96	7:00		1151.47					1117.76	1103.44	1078.71	1320.95	1123.66
12/26/96	8:00		1151.41					1070.33	1098.14	1068.16	1320.07	1124.93
12/26/96	9:00		1150.98					1036.17	1089.34	1063.53	1319.82	1123.54
12/26/96	10:00		1150.61					1043.89	1089.99	1065.57	1319.84	1119.49
12/26/96	11:00		1153.95					1080.74	1093.82	1053.24	1320.13	1118.02
12/26/96	12:00		1158.32					1079.36	1103.60	1065.91	1319.71	1121.88
12/26/96	13:00		1153.26					1078.38	1094.65	1054.96	1319.86	1124.47

VITRIFICATION PILOT PL[illegible]URNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY AVERAGES										
READINGS		MAIN CHAMBER	MAIN CHAMBER	WEST CHAMBER	WEST CHAMBER	EAST CHAMBER	EAST CHAMBER	DISCH CHAMBER	WEST CHAMBER	EAST CHAMBER	DISCH CHAMBER	MAIN
		GLASS TOP	GLASS BOTTOM	GLASS	IR GLASS	GLASS	IR GLASS	GLASS	PLENUM	PLENUM	PLENUM	REFRACTORY
		TI-4S	TI-2S	TI-5S	TI-IRW	TI-6S	TI-IRE	TI-9S	TI-7S	TI-8S	TI-10S	TI-3S
DATE	HOUR	C	C	C	C	C	C	C	C	C	C	C
12/26/96	14:00		1151.79					1077.03	1091.81	1054.57	1319.87	1122.40
12/26/96	15:00		1150.74					1080.04	1090.09	1055.75	1319.86	1121.25
12/26/96	16:00		1149.72					1079.43	1091.63	1056.31	1319.92	1119.76
12/26/96	17:00		1149.73					1092.66	1088.18	1054.29	1319.85	1118.67
12/26/96	18:00		1149.43					1100.03	1088.15	1058.02	1320.03	1117.86
12/26/96	19:00		1147.06					1163.02	1089.96	1053.46	1319.33	1117.72
12/26/96	20:00		1148.47					1148.73	1092.00	1051.27	1319.61	1117.76

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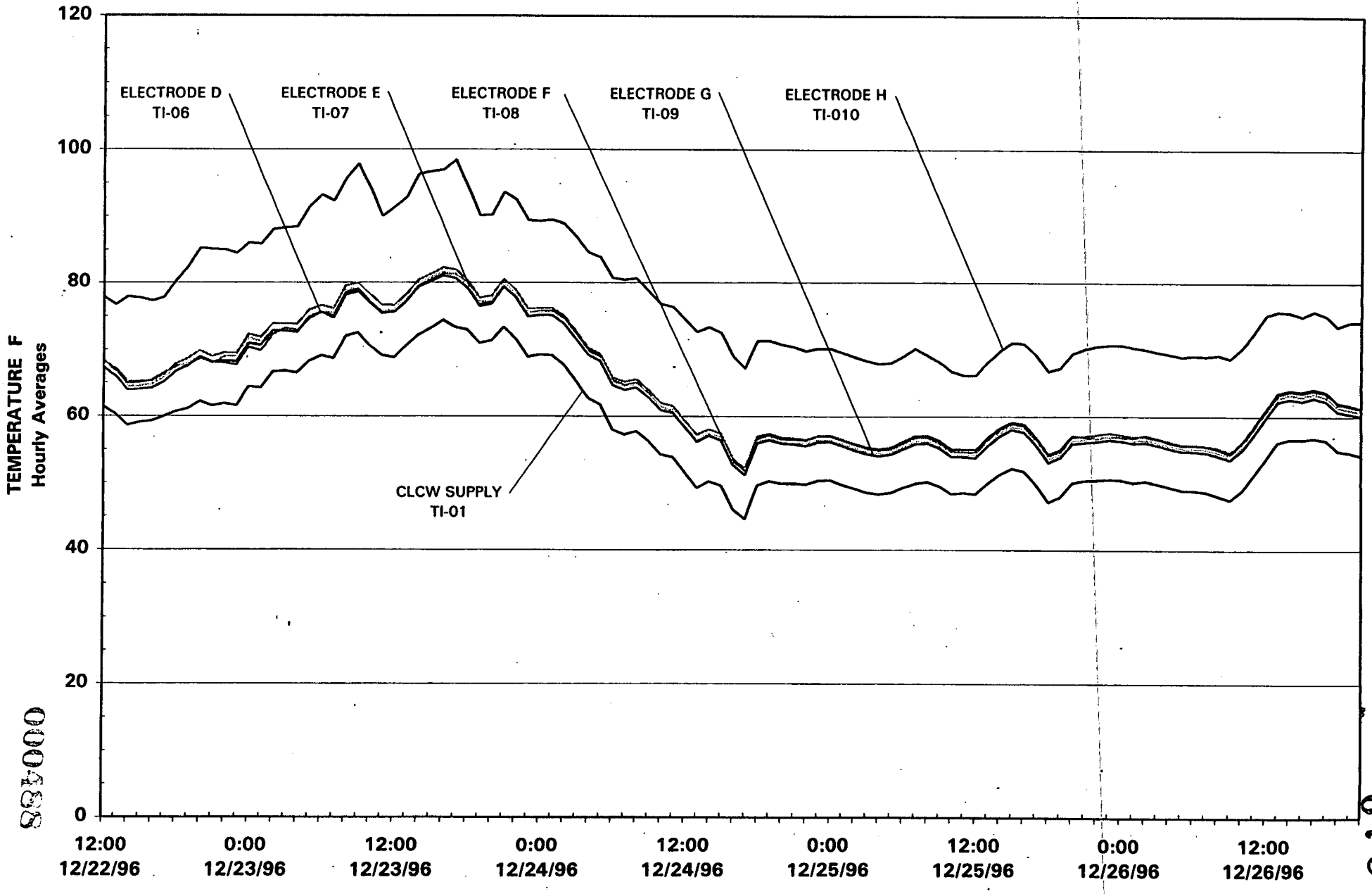
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE SYSTEM
EAST ELECTRODE CLCW RETURN



C4FURN.XLS Chart 32

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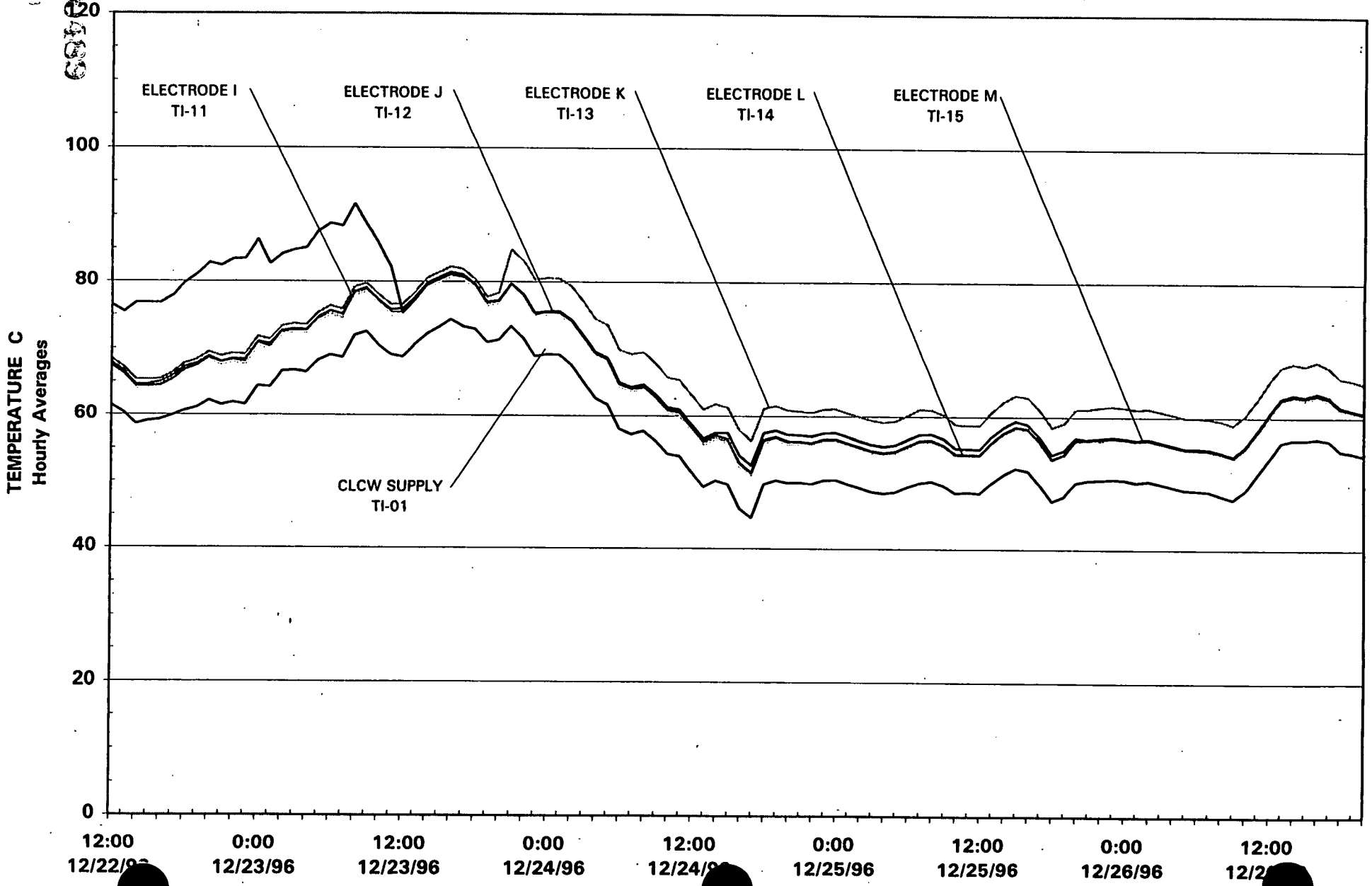
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE SYSTEM
WEST ELECTRODE CLCW RETURN



C4FURN.[illegible] Chart 33

VH[illegible]/8/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/22/96	12:00	61.47	68.32	67.65	68.24	67.24	77.79	67.81	67.32	68.39	67.46	76.49
12/22/96	13:00	60.35	66.86	66.51	67.02	65.97	76.67	66.63	66.08	67.17	66.30	75.47
12/22/96	14:00	58.62	64.95	64.49	65.14	63.93	77.87	64.53	63.98	65.29	64.38	76.86
12/22/96	15:00	59.07	65.09	64.50	65.17	64.00	77.67	64.57	64.03	65.30	64.32	76.82
12/22/96	16:00	59.28	65.31	64.74	65.30	64.18	77.22	64.94	64.38	65.41	64.44	76.82
12/22/96	17:00	59.94	66.38	65.76	66.20	65.07	77.72	65.89	65.45	66.35	65.36	77.88
12/22/96	18:00	60.67	67.46	67.16	67.77	66.69	80.31	67.23	66.72	67.70	66.81	79.81
12/22/96	19:00	61.15	67.59	67.92	68.63	67.49	82.50	67.68	67.32	68.27	67.46	81.11
12/22/96	20:00	62.24	68.63	68.75	69.82	68.82	85.26	68.78	68.35	69.42	68.63	82.81
12/22/96	21:00	61.56	68.01	67.85	68.91	68.05	85.09	67.96	67.57	68.81	67.95	82.43
12/22/96	22:00	61.93	67.96	68.90	69.51	68.26	85.04	68.30	67.96	69.23	68.39	83.36
12/22/96	23:00	61.61	67.68	68.91	69.40	68.15	84.47	68.04	67.65	69.04	68.29	83.44
12/23/96	0:00	64.41	70.35	71.72	72.26	70.93	86.04	70.87	70.43	71.79	71.02	86.34
12/23/96	1:00	64.22	69.80	71.22	71.84	70.69	85.87	70.37	70.03	71.38	70.66	82.71
12/23/96	2:00	66.60	72.29	72.71	73.87	72.81	87.99	72.44	72.18	73.34	72.64	84.18
12/23/96	3:00	66.75	73.14	72.93	73.83	72.78	88.26	72.59	72.47	73.70	72.90	84.78
12/23/96	4:00	66.47	72.85	72.72	73.73	72.59	88.38	72.56	72.42	73.54	72.77	85.11
12/23/96	5:00	68.23	74.57	74.91	75.88	74.72	91.42	74.43	74.23	75.39	74.71	87.53
12/23/96	6:00	69.03	75.65	75.69	76.53	75.53	93.18	75.13	75.07	76.40	75.64	88.72
12/23/96	7:00	68.63	74.67	75.42	76.13	74.98	92.30	74.55	74.58	75.86	75.10	88.35
12/23/96	8:00	71.99	78.06	78.86	79.52	78.45	95.68	78.01	78.00	79.22	78.49	91.67
12/23/96	9:00	72.53	78.60	79.10	79.93	78.94	97.82	78.66	78.60	79.75	79.04	88.62
12/23/96	10:00	70.54	76.91	77.10	78.13	76.94	94.11	76.84	76.84	78.03	77.21	85.67
12/23/96	11:00	69.08	75.38	75.67	76.64	75.45	90.01	75.43	75.31	76.61	75.82	82.21
12/23/96	12:00	68.74	75.64	75.95	76.62	75.60	91.39	75.47	75.24	76.66	75.95	75.37
12/23/96	13:00	70.65	77.42	77.65	78.20	77.20	92.89	77.13	76.96	78.33	77.58	77.30
12/23/96	14:00	72.20	79.66	79.85	80.40	79.34	96.38	79.26	79.10	80.56	79.74	79.55
12/23/96	15:00	73.21	80.48	80.72	81.32	80.14	96.72	80.15	79.99	81.43	80.61	80.49
12/23/96	16:00	74.36	81.45	81.62	82.27	81.07	97.00	81.08	80.83	82.28	81.44	81.37
12/23/96	17:00	73.34	81.26	81.26	81.97	80.67	98.42	80.74	80.41	81.91	81.08	81.00
12/23/96	18:00	72.94	79.90	79.76	80.36	79.18	94.43	79.53	79.17	80.38	79.57	79.63
12/23/96	19:00	70.97	76.79	77.01	77.67	76.48	90.12	76.86	76.49	77.72	76.87	76.96
12/23/96	20:00	71.34	77.16	77.31	77.99	76.82	90.19	77.14	76.88	78.39	77.19	77.21
12/23/96	21:00	73.36	79.41	79.92	80.48	79.33	93.60	79.52	79.38	84.87	79.73	79.72
12/23/96	22:00	71.62	77.82	78.29	78.89	77.77	92.51	77.89	77.73	83.25	78.09	78.14
12/23/96	23:00	68.88	75.38	75.39	76.08	74.90	89.39	75.14	74.91	80.35	75.33	75.34
12/24/96	0:00	69.20	75.74	75.60	76.21	75.14	89.30	75.38	75.22	80.59	75.54	75.62
12/24/96	1:00	69.11	75.78	75.62	76.19	75.11	89.46	75.27	75.12	80.53	75.50	75.62
12/24/96	2:00	67.66	74.58	74.39	74.96	73.84	88.88	74.08	73.86	79.39	74.28	74.38
12/24/96	3:00	65.17	72.31	72.07	72.70	71.55	86.95	71.70	71.52	77.09	71.93	72.06
12/24/96	4:00	62.69	69.80	69.52	70.18	69.12	84.59	69.18	69.01	74.51	69.42	69.57
12/24/96	5:00	61.72	68.97	68.65	69.30	68.24	83.85	68.21	68.11	73.55	68.47	68.66
12/24/96	6:00	57.99	65.38	65.08	65.77	64.68	80.74	64.50	64.48	69.92	64.84	65.03
12/24/96	7:00	57.22	64.65	64.50	65.15	63.99	80.46	63.87	63.78	69.26	64.19	64.34
12/24/96	8:00	57.70	64.97	64.88	65.50	64.34	80.67	64.18	64.02	69.54	64.48	64.72

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/24/96	9:00	56.29	63.41	63.33	63.94	62.83	78.74	62.54	62.52	67.85	62.91	63.28
12/24/96	10:00	54.30	61.37	61.33	62.01	60.91	76.82	60.60	60.58	65.79	60.99	61.32
12/24/96	11:00	53.94	60.91	60.94	61.56	60.51	76.38	60.18	60.19	65.40	60.57	60.95
12/24/96	12:00	51.58	58.38	58.69	59.35	58.34	74.51	57.90	57.90	63.16	58.32	58.68
12/24/96	13:00	49.26	56.23	56.52	57.16	56.14	72.68	55.71	55.68	60.98	56.16	56.58
12/24/96	14:00	50.23	57.34	57.33	58.02	57.06	73.39	56.62	56.56	61.84	57.06	57.42
12/24/96	15:00	49.63	56.69	56.67	57.36	56.37	72.59	56.04	55.97	61.27	56.49	57.46
12/24/96	16:00	46.01	53.24	53.00	53.68	52.68	69.02	52.58	52.45	57.78	52.92	53.99
12/24/96	17:00	44.61	51.80	51.40	52.09	51.19	67.15	51.18	51.09	56.26	51.47	52.57
12/24/96	18:00	49.68	56.65	56.27	56.94	55.98	71.25	56.07	55.96	61.12	56.38	57.43
12/24/96	19:00	50.28	57.17	56.70	57.34	56.43	71.30	56.59	56.44	61.58	56.87	57.82
12/24/96	20:00	49.91	56.61	56.17	56.81	55.94	70.75	55.99	55.85	60.89	56.22	57.22
12/24/96	21:00	49.94	56.52	56.09	56.70	55.81	70.35	56.00	55.86	60.76	56.16	57.14
12/24/96	22:00	49.79	56.41	55.87	56.46	55.57	69.76	55.84	55.68	60.58	55.97	56.96
12/24/96	23:00	50.34	57.00	56.39	57.00	56.10	70.13	56.38	56.21	61.06	56.48	57.47
12/25/96	0:00	50.41	57.06	56.44	57.02	56.18	70.14	56.47	56.28	61.13	56.53	57.52
12/25/96	1:00	49.73	56.44	55.84	56.39	55.57	69.46	55.84	55.63	60.53	55.93	56.89
12/25/96	2:00	49.18	55.88	55.26	55.80	54.96	68.87	55.31	55.04	59.98	55.37	56.29
12/25/96	3:00	48.58	55.37	54.66	55.24	54.36	68.29	54.76	54.50	59.46	54.81	55.76
12/25/96	4:00	48.34	55.13	54.42	54.92	54.06	67.84	54.50	54.26	59.11	54.54	55.46
12/25/96	5:00	48.53	55.33	54.56	55.14	54.31	67.97	54.70	54.44	59.31	54.72	55.69
12/25/96	6:00	49.31	56.19	55.40	55.95	55.14	68.94	55.49	55.33	60.17	55.52	56.50
12/25/96	7:00	49.94	57.02	56.19	56.80	55.88	70.13	56.30	56.10	61.10	56.31	57.26
12/25/96	8:00	50.21	57.09	56.26	56.84	56.00	69.12	56.41	56.20	61.02	56.37	57.34
12/25/96	9:00	49.58	56.38	55.53	56.10	55.28	68.10	55.67	55.49	60.29	55.68	56.61
12/25/96	10:00	48.41	55.11	54.29	54.81	53.98	66.76	54.40	54.16	58.83	54.35	55.26
12/25/96	11:00	48.54	55.09	54.23	54.72	53.92	66.18	54.29	54.15	58.68	54.23	55.17
12/25/96	12:00	48.36	55.04	54.14	54.65	53.79	66.18	54.31	54.12	58.70	54.22	55.11
12/25/96	13:00	49.98	56.79	55.98	56.50	55.60	68.08	56.14	55.86	60.70	56.07	56.96
12/25/96	14:00	51.30	58.20	57.45	57.96	57.04	69.77	57.56	57.32	62.26	57.52	58.42
12/25/96	15:00	52.23	59.07	58.41	58.87	58.03	71.03	58.50	58.25	63.28	58.46	59.37
12/25/96	16:00	51.83	58.82	58.12	58.60	57.66	70.92	58.20	57.94	62.97	58.20	58.86
12/25/96	17:00	49.80	56.91	56.16	56.72	55.74	69.18	56.29	56.01	61.09	56.29	56.91
12/25/96	18:00	47.18	54.30	53.51	54.11	53.12	66.77	53.68	53.39	58.42	53.64	54.28
12/25/96	19:00	47.96	55.02	54.26	54.79	53.85	67.24	54.36	54.11	59.09	54.35	54.99
12/25/96	20:00	50.10	57.12	56.37	56.93	55.99	69.40	56.46	56.24	61.14	56.46	56.80
12/25/96	21:00	50.44	56.97	56.54	57.06	56.13	70.09	56.46	56.38	61.21	56.61	56.54
12/25/96	22:00	50.51	56.75	56.81	57.28	56.28	70.51	56.43	56.49	61.46	56.76	56.65
12/25/96	23:00	50.63	56.96	56.96	57.54	56.56	70.69	56.75	56.65	61.64	56.94	56.85
12/26/96	0:00	50.53	56.93	56.77	57.30	56.37	70.70	56.72	56.49	61.45	56.75	56.70
12/26/96	1:00	50.15	56.89	56.41	56.99	56.07	70.35	56.50	56.23	61.20	56.48	56.45
12/26/96	2:00	50.36	57.15	56.52	57.03	56.15	70.07	56.65	56.38	61.27	56.65	56.57
12/26/96	3:00	49.95	56.72	56.11	56.62	55.74	69.65	56.20	55.96	60.85	56.17	56.12
12/26/96	4:00	49.48	56.16	55.60	56.28	55.24	69.30	55.69	55.48	60.43	55.74	55.68
12/26/96	5:00	48.99	55.74	55.23	55.82	54.82	68.92	55.25	55.06	59.96	55.26	55.28

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY AVERAGES										
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM										
		CLCW	D	E	F	G	H	I	J	K	L	M
		SUPPLY	COOLING WATER RETURN									
		TI-001	TI-006	TI-007	TI-008	TI-009	TI-010	TI-011	TI-012	TI-013	TI-014	TI-015
DATE	HOUR	F	F	F	F	F	F	F	F	F	F	F
12/26/96	6:00	48.91	55.71	55.17	55.75	54.78	69.11	55.24	54.95	59.93	55.17	55.28
12/26/96	7:00	48.73	55.57	55.05	55.59	54.60	68.99	55.11	54.79	59.82	55.04	55.13
12/26/96	8:00	48.13	55.15	54.63	55.27	54.14	69.18	54.68	54.42	59.48	54.67	54.69
12/26/96	9:00	47.55	54.41	53.97	54.61	53.59	68.65	54.14	53.78	58.87	54.05	54.07
12/26/96	10:00	48.93	56.07	55.36	55.93	54.94	70.24	55.51	55.16	60.24	55.41	55.41
12/26/96	11:00	51.31	58.44	57.78	58.25	57.27	72.45	57.89	57.48	62.63	57.83	57.78
12/26/96	12:00	53.77	61.06	60.39	60.86	59.83	75.23	60.53	60.05	65.32	60.45	60.42
12/26/96	13:00	56.17	63.51	62.84	63.31	62.27	75.74	62.96	62.50	67.61	62.87	62.81
12/26/96	14:00	56.62	63.94	63.34	63.75	62.71	75.60	63.46	62.98	68.15	63.38	63.29
12/26/96	15:00	56.59	63.74	63.05	63.59	62.37	75.05	63.25	62.77	67.81	63.12	63.12
12/26/96	16:00	56.79	64.17	63.53	63.91	62.88	75.83	63.72	63.19	68.40	63.52	63.48
12/26/96	17:00	56.47	63.72	63.02	63.57	62.37	75.14	63.19	62.68	67.58	63.05	63.00
12/26/96	18:00	54.93	62.11	61.43	61.95	60.78	73.47	61.61	61.13	65.92	61.46	61.45
12/26/96	19:00	54.66	61.77	61.05	61.60	60.44	74.16	61.15	60.80	65.58	61.06	61.05
12/26/96	20:00	54.20	61.22	60.69	61.15	60.09	74.17	60.73	60.34	65.05	60.65	60.65

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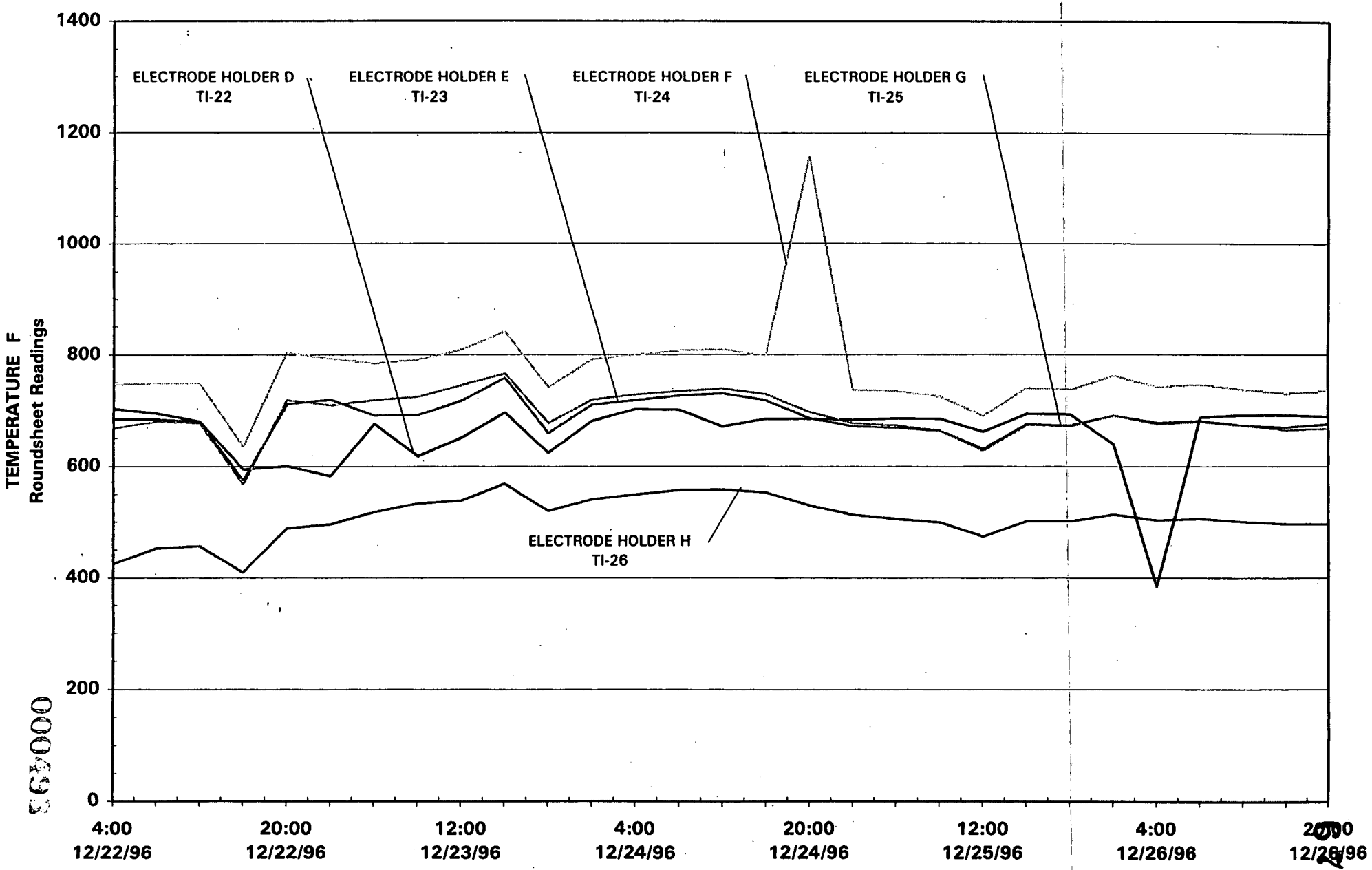
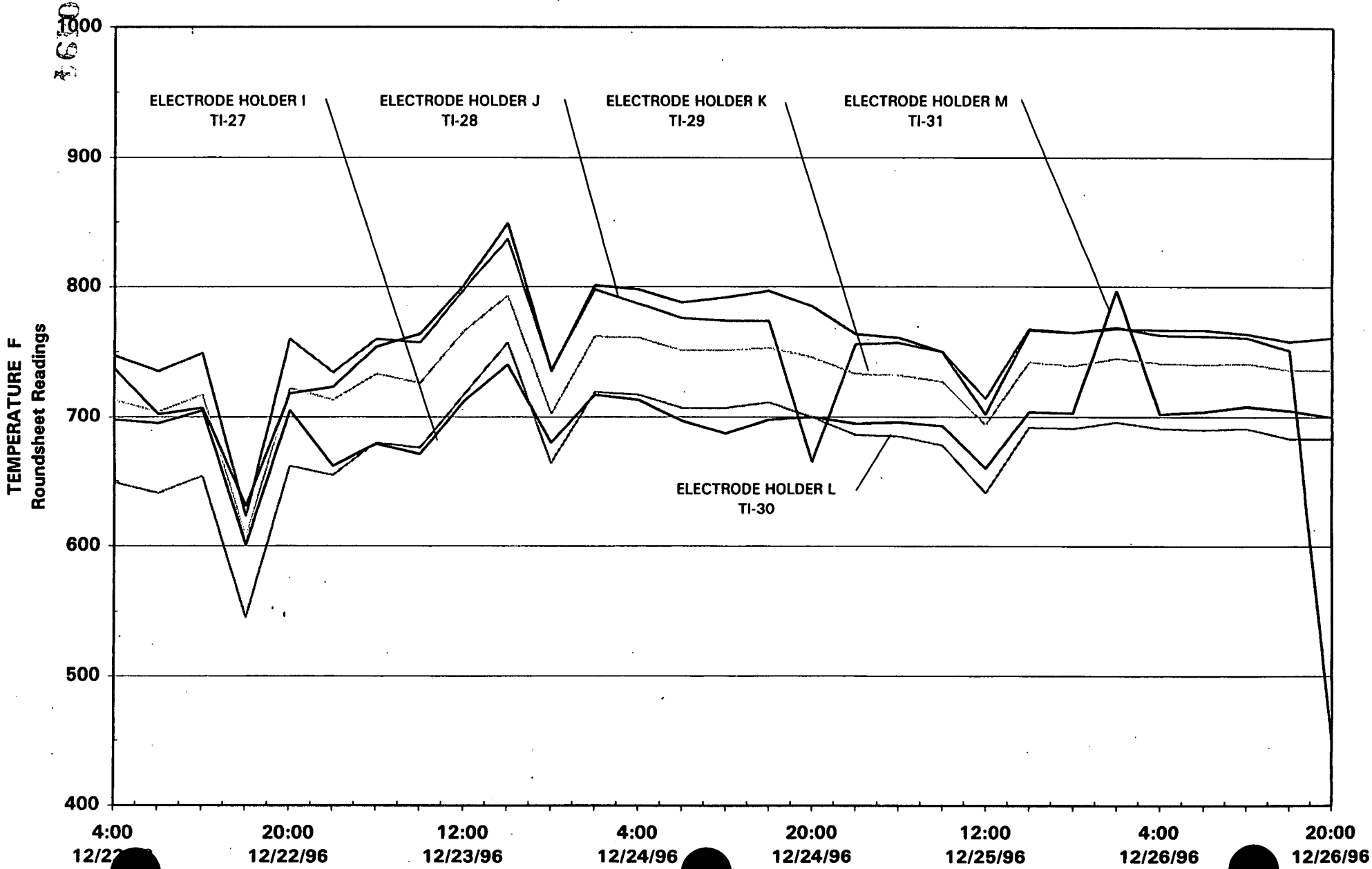
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE SYSTEM
EAST ELECTRODE HOLDER TEMPERATURES



C4FURN.XLS Chart 34

VHP 1/8/97

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE SYSTEM
WEST ELECTRODE HOLDER TEMPERATURES



C4FURN.XLS Chart 35

VHF 1/8/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE HOLDER TEMPERATURES									
		D	E	F	G	H	I	J	K	L	M
		TI-022	TI-023	TI-024	TI-025	TI-026	TI-027	TI-028	TI-029	TI-030	TI-031
DATE	HOUR	F	F	F	F	F	F	F	F	F	F
12/22/96	4:00	703	684	746	668	425	698	747	713	649	737
12/22/96	8:00	695	684	748	680	453	695	735	704	641	702
12/22/96	12:00	680	680	748	677	457	705	749	717	654	707
12/22/96	16:00	595	575	635	568	410	601	623	606	545	631
12/22/96	20:00	601	711	804	718	489	705	760	722	662	718
12/23/96	0:00	583	719	793	709	496	662	734	713	655	723
12/23/96	4:00	676	691	784	718	518	679	760	733	680	754
12/23/96	8:00	618	692	791	724	534	671	757	726	676	764
12/23/96	12:00	651	717	809	745	539	712	798	766	717	801
12/23/96	16:00	696	758	841	766	569	740	837	793	757	849
12/23/96	20:00	624	659	741	677	520	680	736	702	664	735
12/24/96	0:00	681	710	791	719	541	717	798	762	719	801
12/24/96	4:00	702	718	800	728	550	713	787	761	717	798
12/24/96	8:00	701	726	807	734	558	697	776	751	707	788
12/24/96	12:00	671	730	810	739	559	687	774	751	707	792
12/24/96	16:00	685	718	797	729	554	698	774	753	711	797
12/24/96	20:00	685	686	1157	697	530	700	665	746	700	785
12/25/96	0:00	683	672	737	677	513	695	756	733	686	764
12/25/96	4:00	686	669	734	673	506	696	757	732	685	761
12/25/96	8:00	685	664	725	664	500	693	750	727	678	750
12/25/96	12:00	662	631	690	628	474	660	714	694	641	702
12/25/96	16:00	694	675	740	674	502	704	768	742	692	767
12/25/96	20:00	693	673	737	672	502	703	765	739	691	765
12/26/96	0:00	639	691	762	691	514	797	768	745	696	769
12/26/96	4:00	384	678	742	676	504	702	767	741	691	763
12/26/96	8:00	688	681	746	680	507	704	767	740	690	762
12/26/96	12:00	692	673	737	673	501	708	764	741	691	761
12/26/96	16:00	692	670	730	665	497	705	758	736	683	751
12/26/96	20:00	689	676	735	668	497	700	761	736	683	450

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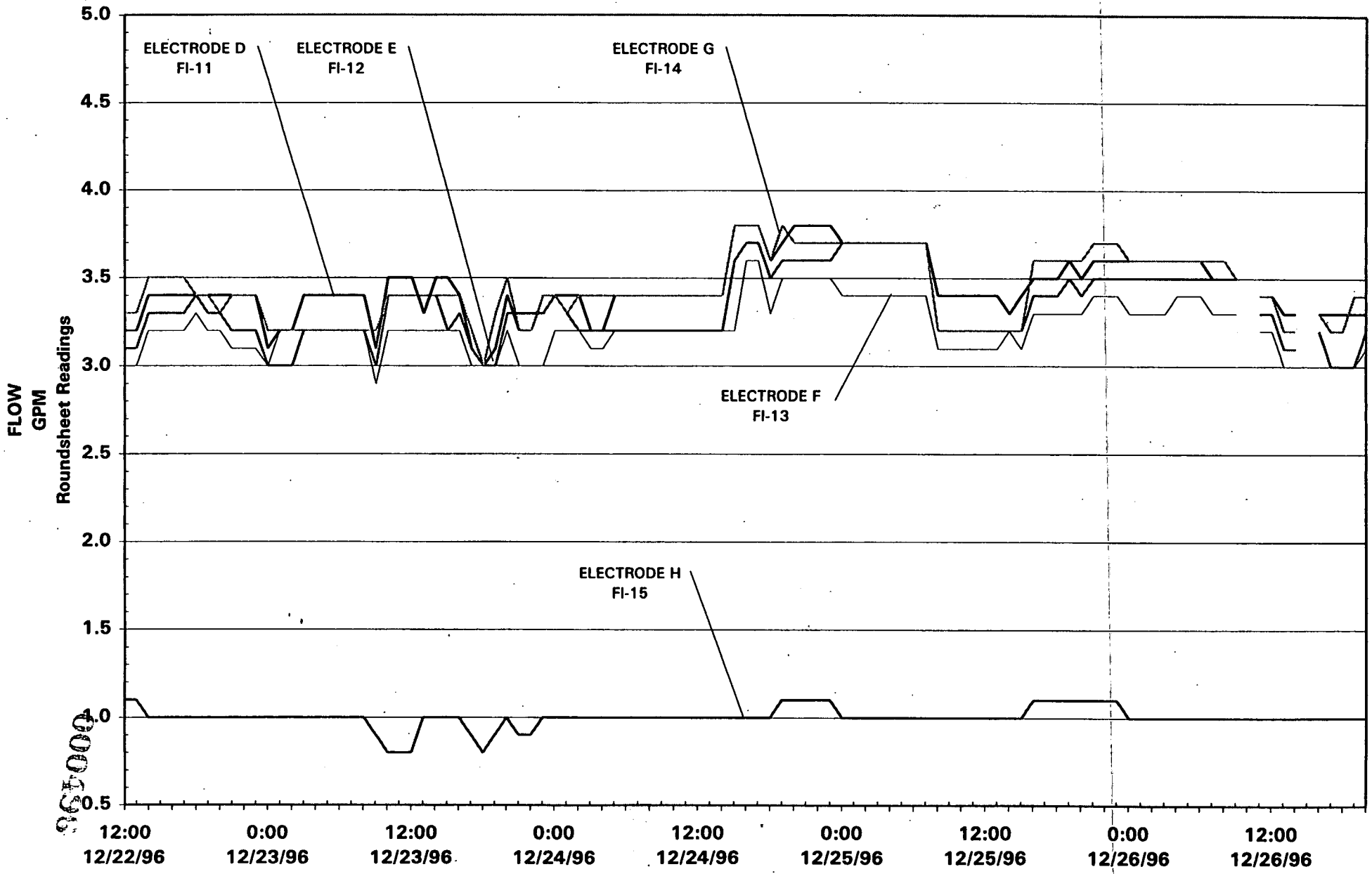
CAMPA[illegible]4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNCAE SYSTEM
EAST ELECTRODE CLCW SUPPLY



C4FURN.XLS Chart 20

VHP 1/20/97

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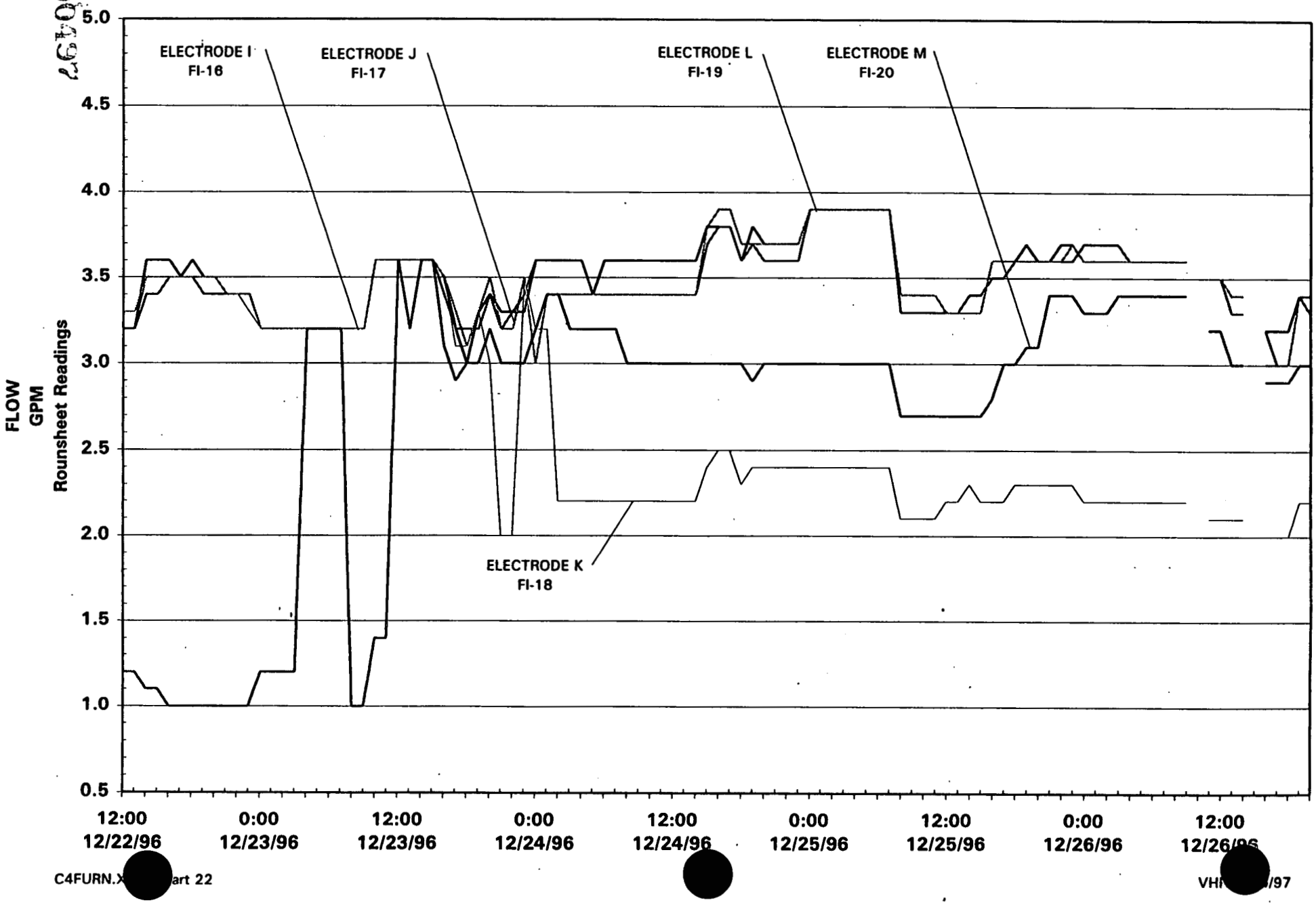
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE SYSTEM
WEST ELECTRODE CLCW SUPPLY



C4FURN.X[redacted]art 22

VH[redacted]/97

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VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

HOURLY READINGS ROUNDSHEETS

READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/22/96	12:00	3.2	3.1	3.0	3.3	1.1	3.2	3.2	3.2	3.3	1.2
12/22/96	13:00	3.2	3.1	3.0	3.3	1.1	3.2	3.2	3.2	3.3	1.2
12/22/96	14:00	3.4	3.3	3.2	3.5	1.0	3.6	3.4	3.5	3.5	1.1
12/22/96	15:00	3.4	3.3	3.2	3.5	1.0	3.6	3.4	3.5	3.5	1.1
12/22/96	16:00	3.4	3.3	3.2	3.5	1.0	3.6	3.5	3.5	3.5	1.0
12/22/96	17:00	3.4	3.3	3.2	3.5	1.0	3.5	3.5	3.5	3.5	1.0
12/22/96	18:00	3.4	3.4	3.3	3.4	1.0	3.6	3.5	3.5	3.5	1.0
12/22/96	19:00	3.4	3.3	3.2	3.4	1.0	3.5	3.4	3.4	3.5	1.0
12/22/96	20:00	3.4	3.3	3.2	3.3	1.0	3.5	3.4	3.4	3.5	1.0
12/22/96	21:00	3.4	3.2	3.1	3.4	1.0	3.4	3.4	3.4	3.4	1.0
12/22/96	22:00	3.4	3.2	3.1	3.4	1.0	3.4	3.4	3.4	3.4	1.0
12/22/96	23:00	3.4	3.2	3.1	3.4	1.0	3.4	3.4	3.3	3.4	1.0
12/23/96	0:00	3.1	3.0	3.0	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/23/96	1:00	3.2	3.0	3.2	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/23/96	2:00	3.2	3.0	3.2	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/23/96	3:00	3.4	3.2	3.2	3.2	1.0	3.2	3.2	3.2	3.2	1.2
12/23/96	4:00	3.4	3.2	3.2	3.2	1.0	3.2	3.2	3.2	3.2	3.2
12/23/96	5:00	3.4	3.2	3.2	3.2	1.0	3.2	3.2	3.2	3.2	3.2
12/23/96	6:00	3.4	3.2	3.2	3.2	1.0	3.2	3.2	3.2	3.2	3.2
12/23/96	7:00	3.4	3.2	3.2	3.2	1.0	3.2	3.2	3.2	3.2	3.2
12/23/96	8:00	3.4	3.2	3.2	3.2	1.0	3.2	3.2	3.2	3.2	1.0
12/23/96	9:00	3.1	3.0	2.9	3.2	0.9	3.2	3.2	3.2	3.2	1.0
12/23/96	10:00	3.5	3.4	3.2	3.4	0.8	3.6	3.6	3.6	3.6	1.4
12/23/96	11:00	3.5	3.4	3.2	3.4	0.8	3.6	3.6	3.6	3.6	1.4
12/23/96	12:00	3.5	3.4	3.2	3.4	0.8	3.6	3.6	3.6	3.6	3.6
12/23/96	13:00	3.3	3.4	3.2	3.4	1.0	3.6	3.6	3.6	3.6	3.2
12/23/96	14:00	3.5	3.4	3.2	3.4	1.0	3.6	3.6	3.6	3.6	3.6
12/23/96	15:00	3.5	3.2	3.2	3.4	1.0	3.6	3.6	3.6	3.6	3.6
12/23/96	16:00	3.4	3.3	3.2	3.4	1.0	3.5	3.4	3.5	3.5	3.1
12/23/96	17:00	3.1	3.1	3.0	3.2	0.9	3.2	3.2	3.1	3.3	2.9
12/23/96	18:00	3.0	3.0	3.0	3.0	0.8	3.0	3.2	3.1	3.1	3.0
12/23/96	19:00	3.1	3.0	3.0	3.3	0.9	3.3	3.2	3.3	3.3	3.0
12/23/96	20:00	3.4	3.3	3.2	3.5	1.0	3.4	3.4	3.0	3.5	3.2
12/23/96	21:00	3.2	3.3	3.0	3.2	0.9	3.3	3.2	2.0	3.2	3.0
12/23/96	22:00	3.2	3.3	3.0	3.2	0.9	3.3	3.3	2.0	3.2	3.0
12/23/96	23:00	3.4	3.3	3.0	3.4	1.0	3.3	3.4	3.5	3.5	3.0
12/24/96	0:00	3.4	3.4	3.2	3.4	1.0	3.6	3.6	3.2	3.0	3.2
12/24/96	1:00	3.4	3.3	3.2	3.3	1.0	3.6	3.6	3.2	3.4	3.4
12/24/96	2:00	3.4	3.2	3.2	3.4	1.0	3.6	3.6	2.2	3.4	3.4
12/24/96	3:00	3.2	3.2	3.1	3.4	1.0	3.6	3.6	2.2	3.4	3.2
12/24/96	4:00	3.2	3.2	3.1	3.4	1.0	3.6	3.6	2.2	3.4	3.2
12/24/96	5:00	3.4	3.2	3.2	3.4	1.0	3.4	3.4	2.2	3.4	3.2
12/24/96	6:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.2
12/24/96	7:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.2
12/24/96	8:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.0

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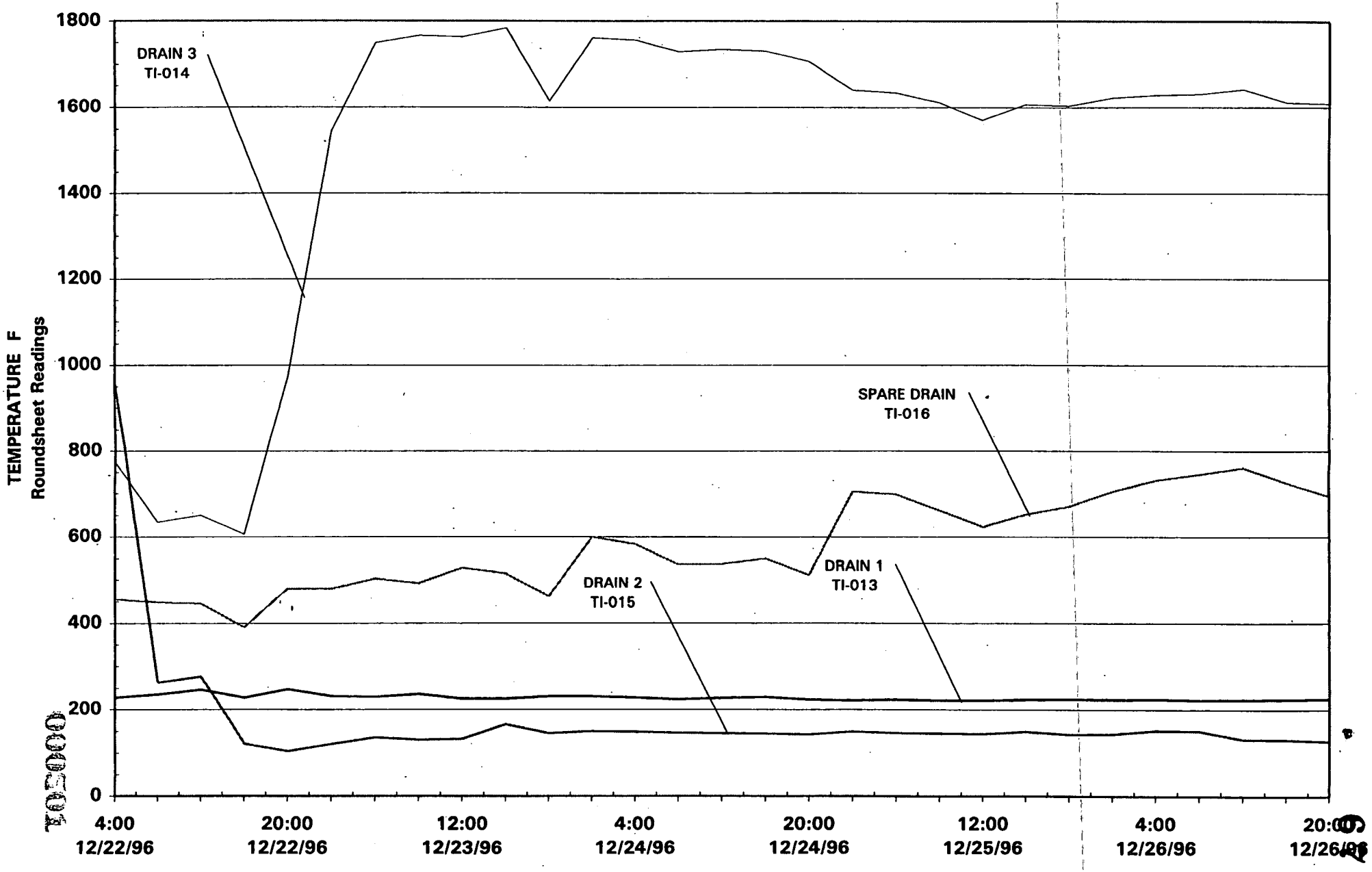
VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/24/96	9:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.0
12/24/96	10:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.0
12/24/96	11:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.0
12/24/96	12:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.0
12/24/96	13:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.0
12/24/96	14:00	3.4	3.2	3.2	3.4	1.0	3.6	3.4	2.2	3.4	3.0
12/24/96	15:00	3.8	3.6	3.2	3.8	1.0	3.8	3.7	2.4	3.8	3.0
12/24/96	16:00	3.8	3.7	3.6	3.8	1.0	3.8	3.8	2.5	3.9	3.0
12/24/96	17:00	3.8	3.7	3.6	3.8	1.0	3.8	3.8	2.5	3.9	3.0
12/24/96	18:00	3.6	3.5	3.3	3.6	1.0	3.6	3.6	2.3	3.7	3.0
12/24/96	19:00	3.7	3.6	3.5	3.8	1.1	3.8	3.7	2.4	3.7	2.9
12/24/96	20:00	3.8	3.6	3.5	3.7	1.1	3.7	3.6	2.4	3.7	3.0
12/24/96	21:00	3.8	3.6	3.5	3.7	1.1	3.7	3.6	2.4	3.7	3.0
12/24/96	22:00	3.8	3.6	3.5	3.7	1.1	3.7	3.6	2.4	3.7	3.0
12/24/96	23:00	3.8	3.6	3.5	3.7	1.1	3.7	3.6	2.4	3.7	3.0
12/25/96	0:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	1:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	2:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	3:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	4:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	5:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	6:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	7:00	3.7	3.7	3.4	3.7	1.0	3.9	3.9	2.4	3.9	3.0
12/25/96	8:00	3.4	3.2	3.1	3.2	1.0	3.3	3.3	2.1	3.4	2.7
12/25/96	9:00	3.4	3.2	3.1	3.2	1.0	3.3	3.3	2.1	3.4	2.7
12/25/96	10:00	3.4	3.2	3.1	3.2	1.0	3.3	3.3	2.1	3.4	2.7
12/25/96	11:00	3.4	3.2	3.1	3.2	1.0	3.3	3.3	2.1	3.4	2.7
12/25/96	12:00	3.4	3.2	3.1	3.2	1.0	3.3	3.3	2.2	3.3	2.7
12/25/96	13:00	3.4	3.2	3.1	3.2	1.0	3.3	3.3	2.2	3.3	2.7
12/25/96	14:00	3.3	3.2	3.2	3.2	1.0	3.3	3.4	2.3	3.3	2.7
12/25/96	15:00	3.4	3.2	3.1	3.2	1.0	3.3	3.4	2.2	3.3	2.7
12/25/96	16:00	3.5	3.4	3.3	3.6	1.1	3.6	3.5	2.2	3.6	2.8
12/25/96	17:00	3.5	3.4	3.3	3.6	1.1	3.6	3.5	2.2	3.6	3.0
12/25/96	18:00	3.5	3.4	3.3	3.6	1.1	3.6	3.6	2.3	3.6	3.0
12/25/96	19:00	3.6	3.5	3.3	3.6	1.1	3.7	3.6	2.3	3.6	3.1
12/25/96	20:00	3.5	3.4	3.3	3.6	1.1	3.6	3.6	2.3	3.6	3.1
12/25/96	21:00	3.6	3.5	3.4	3.7	1.1	3.6	3.6	2.3	3.6	3.4
12/25/96	22:00	3.6	3.5	3.4	3.7	1.1	3.7	3.6	2.3	3.6	3.4
12/25/96	23:00	3.6	3.5	3.4	3.7	1.1	3.7	3.6	2.3	3.7	3.4
12/26/96	0:00	3.6	3.5	3.3	3.6	1.0	3.6	3.7	2.2	3.6	3.3
12/26/96	1:00	3.6	3.5	3.3	3.6	1.0	3.6	3.7	2.2	3.6	3.3
12/26/96	2:00	3.6	3.5	3.3	3.6	1.0	3.6	3.7	2.2	3.6	3.3
12/26/96	3:00	3.6	3.5	3.3	3.6	1.0	3.6	3.7	2.2	3.6	3.4
12/26/96	4:00	3.6	3.5	3.4	3.6	1.0	3.6	3.6	2.2	3.6	3.4
12/26/96	5:00	3.6	3.5	3.4	3.6	1.0	3.6	3.6	2.2	3.6	3.4

VITRIFICATION PILOT PLANT FURNACE SYSTEM											
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS											
		HOURLY READINGS ROUNDSHEETS									
READINGS		ELECTRODE CLOSED LOOP COOLING WATER SYSTEM									
		D	E	F	G	H	I	J	K	L	M
		COOLING WATER SUPPLY									
		FI-011	FI-012	FI-013	FI-014	FI-015	FI-016	FI-017	FI-018	FI-019	FI-020
DATE	HOUR	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM
12/26/96	6:00	3.6	3.5	3.4	3.6	1.0	3.6	3.6	2.2	3.6	3.4
12/26/96	7:00	3.5	3.5	3.3	3.6	1.0	3.6	3.6	2.2	3.6	3.4
12/26/96	8:00	3.5	3.5	3.3	3.6	1.0	3.6	3.6	2.2	3.6	3.4
12/26/96	9:00	3.5	3.5	3.3	3.5	1.0	3.6	3.6	2.2	3.6	3.4
12/26/96	10:00					1.0					
12/26/96	11:00	3.4	3.3	3.2	3.4	1.0	3.5	3.5	2.1	3.5	3.2
12/26/96	12:00	3.4	3.3	3.2	3.4	1.0	3.5	3.5	2.1	3.5	3.2
12/26/96	13:00	3.3	3.1	3.0	3.2	1.0	3.3	3.3	2.1	3.4	3.0
12/26/96	14:00	3.3	3.1	3.0	3.2	1.0	3.3	3.3	2.1	3.4	3.0
12/26/96	15:00					1.0					
12/26/96	16:00	3.3	3.2	3.0	3.3	1.0	3.2	3.2	2.0	3.0	2.9
12/26/96	17:00	3.3	3.0	3.0	3.2	1.0	3.2	3.0	2.0	3.0	2.9
12/26/96	18:00	3.3	3.0	3.0	3.2	1.0	3.2	3.0	2.0	3.0	2.9
12/26/96	19:00	3.3	3.0	3.0	3.4	1.0	3.4	3.4	2.2	3.4	3.0
12/26/96	20:00	3.3	3.2	3.1	3.4	1.0	3.4	3.3	2.2	3.4	3.0

000500

CAMPA[illegible]4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE SYSTEM
MELTER DRAINS



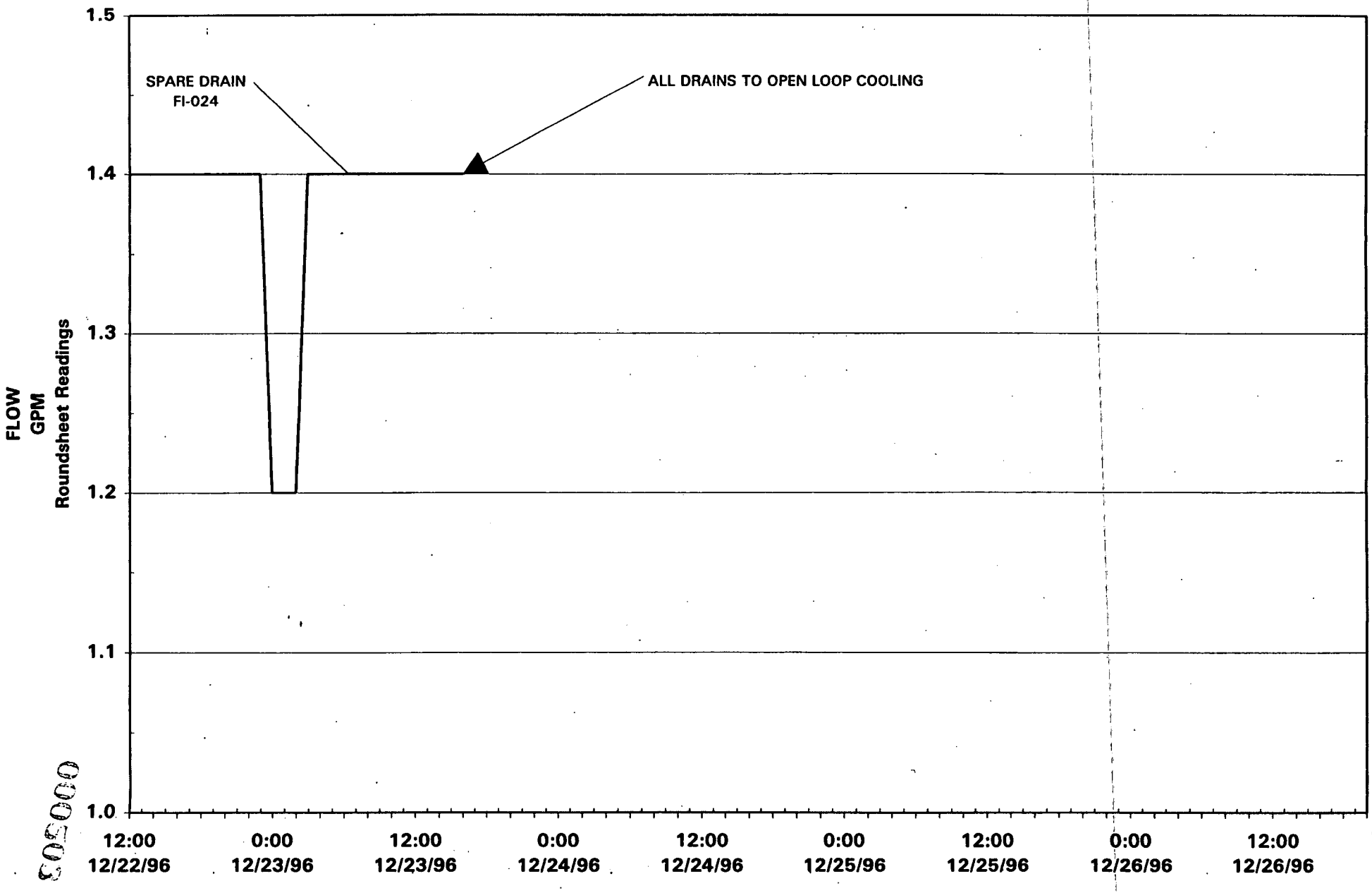
C4FURN.XLS Chart 24

VHP 1/20/97

VITRIFICATION PILOT PLANT FURNACE SYSTEM					
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS					
MELTER BOTTOM DRAINS					
READINGS		ROUNDSHEET READINGS			
		SURFACE TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		TI-013	TI-015	TI-014	TI-016
DATE	HOUR	F	F	F	F
12/22/96	4:00	227	959	774	455
12/22/96	8:00	235	263	635	448
12/22/96	12:00	246	277	651	445
12/22/96	16:00	227	122	606	391
12/22/96	20:00	247	104	975	480
12/23/96	0:00	231	121	1545	480
12/23/96	4:00	229	136	1748	503
12/23/96	8:00	236	131	1765	493
12/23/96	12:00	225	133	1762	528
12/23/96	16:00	225	166	1783	515
12/23/96	20:00	231	146	1614	462
12/24/96	0:00	231	151	1760	600
12/24/96	4:00	228	150	1755	584
12/24/96	8:00	224	147	1729	536
12/24/96	12:00	227	146	1735	537
12/24/96	16:00	229	145	1731	550
12/24/96	20:00	223	143	1706	512
12/25/96	0:00	221	150	1640	705
12/25/96	4:00	223	146	1634	699
12/25/96	8:00	221	145	1612	661
12/25/96	12:00	221	144	1569	623
12/25/96	16:00	223	149	1607	652
12/25/96	20:00	224	143	1604	671
12/26/96	0:00	223	144	1623	706
12/26/96	4:00	224	152	1629	732
12/26/96	8:00	222	151	1632	746
12/26/96	12:00	223	132	1643	761
12/26/96	16:00	224	131	1612	726
12/26/96	20:00	225	127	1609	694

000502

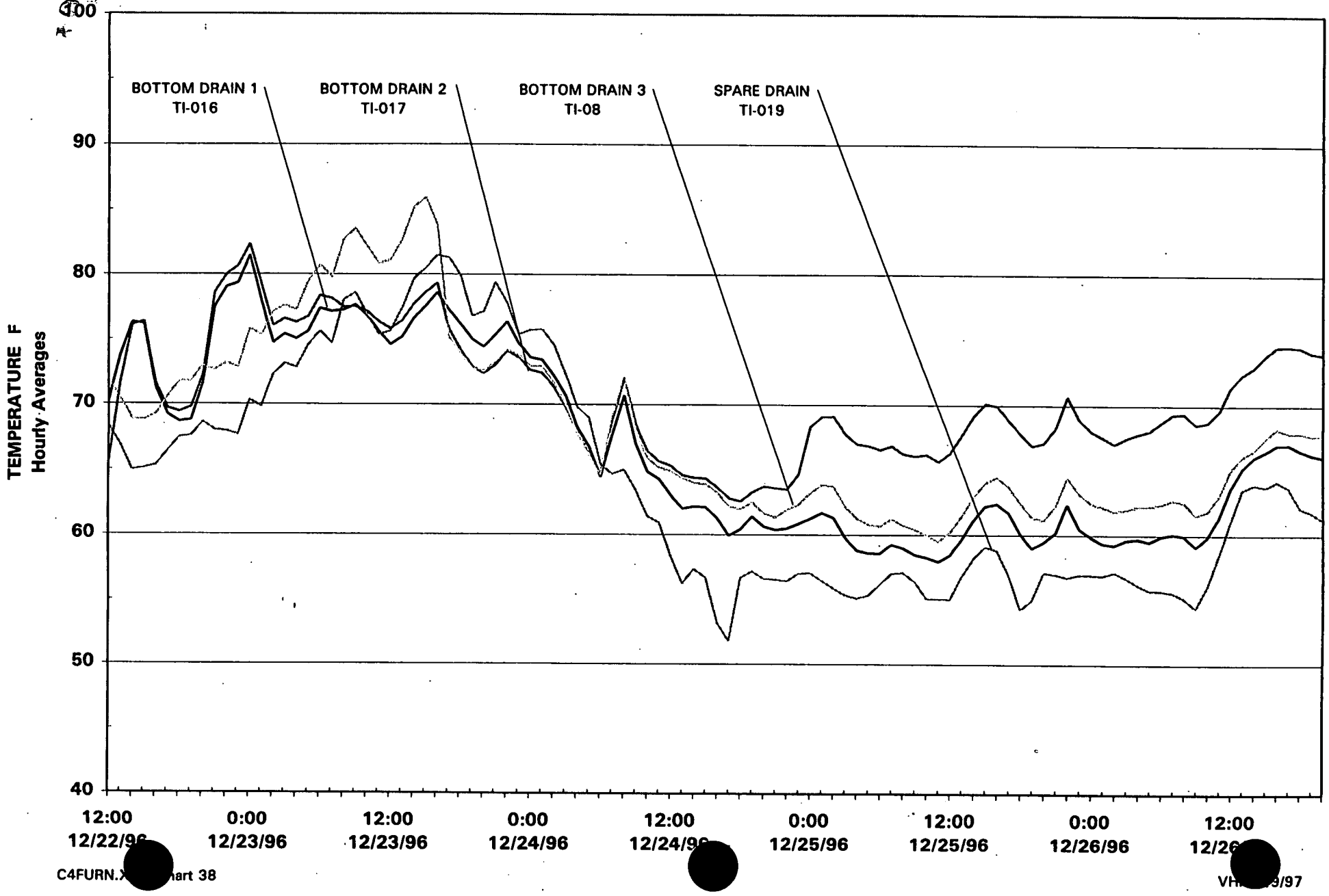
CAMPA[illegible] 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE SYSTEM
BOTTOM DRAIN CLCW FLOW



C4FURN.XLS Chart 37

VHP 1/9/97

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE SYSTEM
BOTTOM DRAIN CW DISCHARGE



VITRIFICATION PILOT PLANT FURNACE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CW DISCHARGE TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/22/96	12:00	OPEN LOOP COOLING	OPEN LOOP COOLING	3.5	1.4	70.27	65.63	71.92	68.32
12/22/96	13:00			OPEN LOOP COOLING	1.4	73.74	71.70	70.45	66.86
12/22/96	14:00				1.4	76.32	76.14	68.86	64.95
12/22/96	15:00				1.4	76.21	76.36	68.81	65.09
12/22/96	16:00				1.4	71.21	71.50	69.23	65.31
12/22/96	17:00				1.4	69.22	69.69	70.60	66.38
12/22/96	18:00				1.4	68.67	69.43	71.74	67.46
12/22/96	19:00				1.4	68.79	69.78	71.80	67.59
12/22/96	20:00				1.4	71.63	72.19	72.97	68.63
12/22/96	21:00				1.4	77.50	78.61	72.65	68.01
12/22/96	22:00				1.4	79.04	79.99	73.20	67.96
12/22/96	23:00				1.4	79.34	80.64	72.86	67.68
12/23/96	0:00				1.2	81.44	82.33	75.83	70.35
12/23/96	1:00				1.2	77.96	79.20	75.33	69.80
12/23/96	2:00				1.2	74.72	76.05	77.13	72.29
12/23/96	3:00				1.4	75.41	76.59	77.61	73.14
12/23/96	4:00				1.4	75.03	76.31	77.27	72.85
12/23/96	5:00				1.4	75.63	76.75	79.51	74.57
12/23/96	6:00				1.4	77.39	78.38	80.73	75.65
12/23/96	7:00				1.4	77.14	78.15	79.77	74.67
12/23/96	8:00				1.4	77.26	77.49	82.73	78.06
12/23/96	9:00				1.4	77.66	77.54	83.52	78.60
12/23/96	10:00				1.4	76.83	77.14	82.12	76.91
12/23/96	11:00				1.4	75.62	76.37	80.81	75.38
12/23/96	12:00				1.4	74.59	75.80	81.10	75.64
12/23/96	13:00				1.4	75.19	76.43	82.68	77.42
12/23/96	14:00				1.4	76.62	77.73	85.18	79.66
12/23/96	15:00				1.4	77.56	78.62	85.91	80.48
12/23/96	16:00				1.4	78.60	79.31	83.78	81.45
12/23/96	17:00				OPEN LOOP COOLING	77.26	75.80	75.24	81.26
12/23/96	18:00					76.20	74.17	73.96	79.90
12/23/96	19:00					75.01	72.90	72.80	76.79
12/23/96	20:00					74.41	72.38	72.53	77.16
12/23/96	21:00					75.34	73.02	73.23	79.41
12/23/96	22:00					76.38	74.12	74.19	77.82
12/23/96	23:00					74.68	73.61	73.77	75.38
12/24/96	0:00					73.61	72.64	72.92	75.74
12/24/96	1:00					73.43	72.41	72.92	75.78
12/24/96	2:00					72.19	71.32	71.59	74.58
12/24/96	3:00					70.71	69.85	69.93	72.31
12/24/96	4:00					68.26	67.91	67.89	69.80
12/24/96	5:00					66.76	66.18	66.14	68.97
12/24/96	6:00					64.42	64.61	64.55	65.38
12/24/96	7:00					67.67	68.83	68.94	64.65
12/24/96	8:00					70.69	72.02	72.10	64.97
12/24/96	9:00					66.99	68.47	68.13	63.41
12/24/96	10:00					64.82	66.40	65.83	61.37
12/24/96	11:00					64.28	65.62	65.16	60.91
12/24/96	12:00					63.05	65.30	64.87	58.38
12/24/96	13:00					62.01	64.57	64.35	56.23
12/24/96	14:00					62.16	64.38	64.00	57.34
12/24/96	15:00					62.11	64.32	63.88	56.69
12/24/96	16:00					61.23	63.64	63.25	53.24
12/24/96	17:00					59.95	62.82	62.18	51.80
12/24/96	18:00					60.42	62.59	61.95	56.65
12/24/96	19:00					61.38	63.27	62.51	57.17
12/24/96	20:00					60.62	63.73	61.64	56.61
12/24/96	21:00					60.38	63.59	61.32	56.52
12/24/96	22:00					60.47	63.49	61.89	56.41
12/24/96	23:00					60.84	64.67	62.33	57.00
12/25/96	0:00					61.23	68.27	63.19	57.06
12/25/96	1:00					61.67	69.09	63.86	56.44
12/25/96	2:00					61.30	69.11	63.74	55.88
12/25/96	3:00					59.83	67.75	62.20	55.37
12/25/96	4:00					58.80	66.98	61.25	55.13
12/25/96	5:00					58.60	66.83	60.79	55.33
12/25/96	6:00					58.58	66.55	60.66	56.19
12/25/96	7:00					59.27	66.83	61.22	57.02
12/25/96	8:00					58.98	66.24	60.72	57.09
12/25/96	9:00					58.48	66.05	60.41	56.38
12/25/96	10:00					58.27	66.17	59.98	55.11
12/25/96	11:00					57.94	65.63	59.51	55.09
12/25/96	12:00					58.47	66.29	60.19	55.04

VITRIFICATION PILOT PLANT FURNACE SYSTEM									
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS									
		MELTER BOTTOM DRAINS							
READINGS		ROUNDSHEET READINGS				HOURLY AVERAGES			
		CLCW FLOW				CW DISCHARGE TEMPERATURE			
		DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN	DRAIN #1	DRAIN #2	DRAIN #3	SPARE DRAIN
		FI-021	FI-022	FI-023	FI-024	TI-016	TI-017	TI-018	TI-019
DATE	HOUR	GPM	GPM	GPM	GPM	F	F	F	F
12/25/96	13:00					59.68	67.66	61.44	56.79
12/25/96	14:00					61.12	69.16	62.91	58.20
12/25/96	15:00					62.22	70.13	64.02	59.07
12/25/96	16:00					62.41	69.94	64.44	58.82
12/25/96	17:00					61.73	68.85	63.75	56.91
12/25/96	18:00					60.08	67.79	62.48	54.30
12/25/96	19:00					58.98	66.86	61.38	55.02
12/25/96	20:00					59.49	67.09	61.13	57.12
12/25/96	21:00					60.18	68.26	62.24	56.97
12/25/96	22:00					62.35	70.67	64.43	56.75
12/25/96	23:00					60.50	68.89	63.21	56.96
12/26/96	0:00					59.86	68.01	62.45	56.93
12/26/96	1:00					59.39	67.51	62.19	56.89
12/26/96	2:00					59.24	67.01	61.84	57.15
12/26/96	3:00					59.65	67.45	61.99	56.72
12/26/96	4:00					59.72	67.77	62.22	56.16
12/26/96	5:00					59.52	68.01	62.25	55.74
12/26/96	6:00					59.92	68.68	62.37	55.71
12/26/96	7:00					60.09	69.31	62.71	55.57
12/26/96	8:00					59.96	69.37	62.53	55.15
12/26/96	9:00					59.12	68.53	61.54	54.41
12/26/96	10:00					59.86	68.71	61.83	56.07
12/26/96	11:00					61.35	69.56	63.03	58.44
12/26/96	12:00					63.64	71.40	65.00	61.06
12/26/96	13:00					65.11	72.36	66.04	63.51
12/26/96	14:00					66.02	72.92	66.55	63.94
12/26/96	15:00					66.44	73.84	67.46	63.74
12/26/96	16:00					66.96	74.52	68.22	64.17
12/26/96	17:00					66.99	74.54	67.88	63.72
12/26/96	18:00					66.55	74.48	67.88	62.11
12/26/96	19:00					66.21	74.08	67.68	61.77
12/26/96	20:00					66.03	73.94	67.63	61.22

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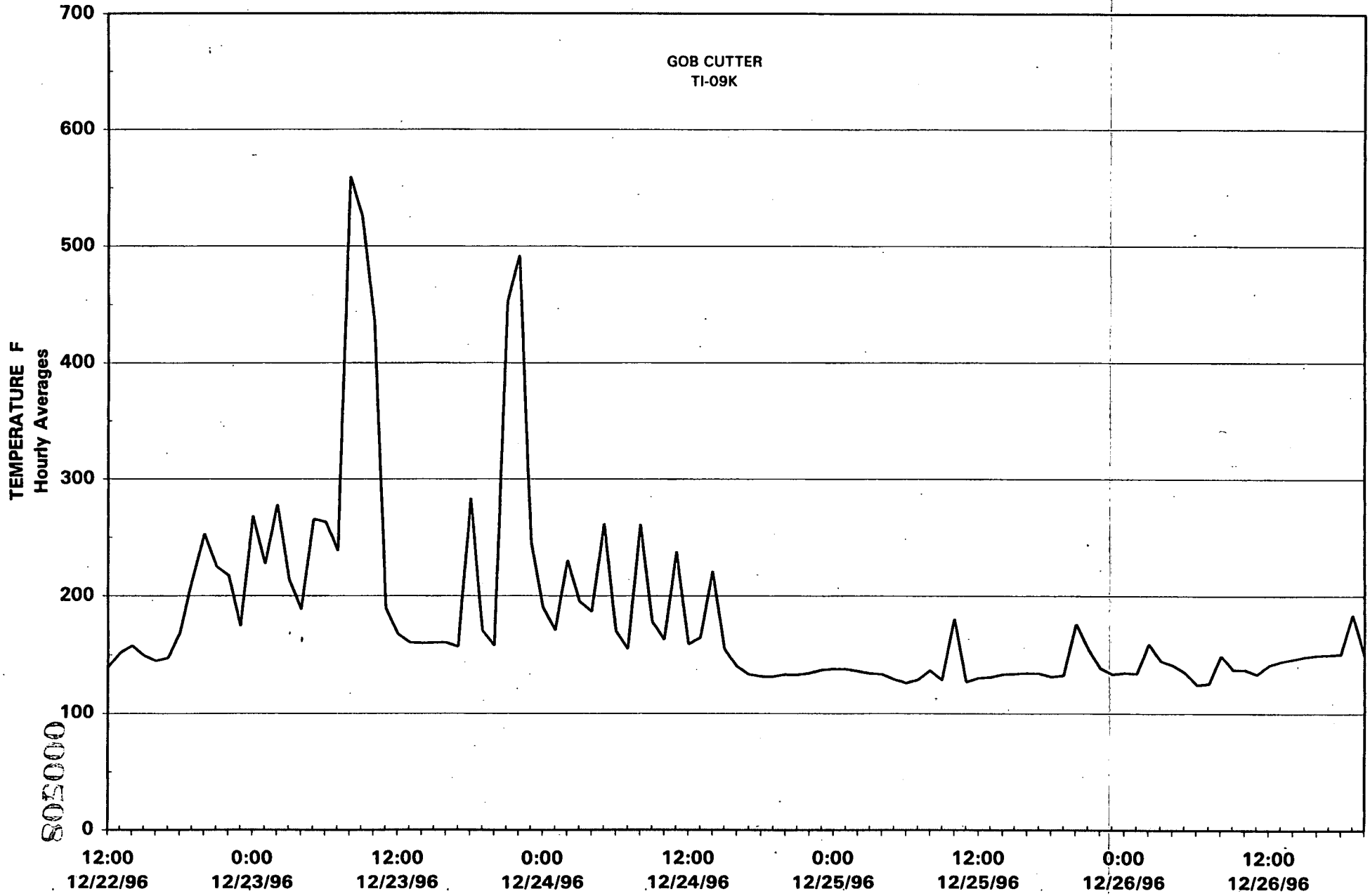
GEM MACHINE SYSTEM

CAMPA[illegible]4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 13

VHP 1/9/97

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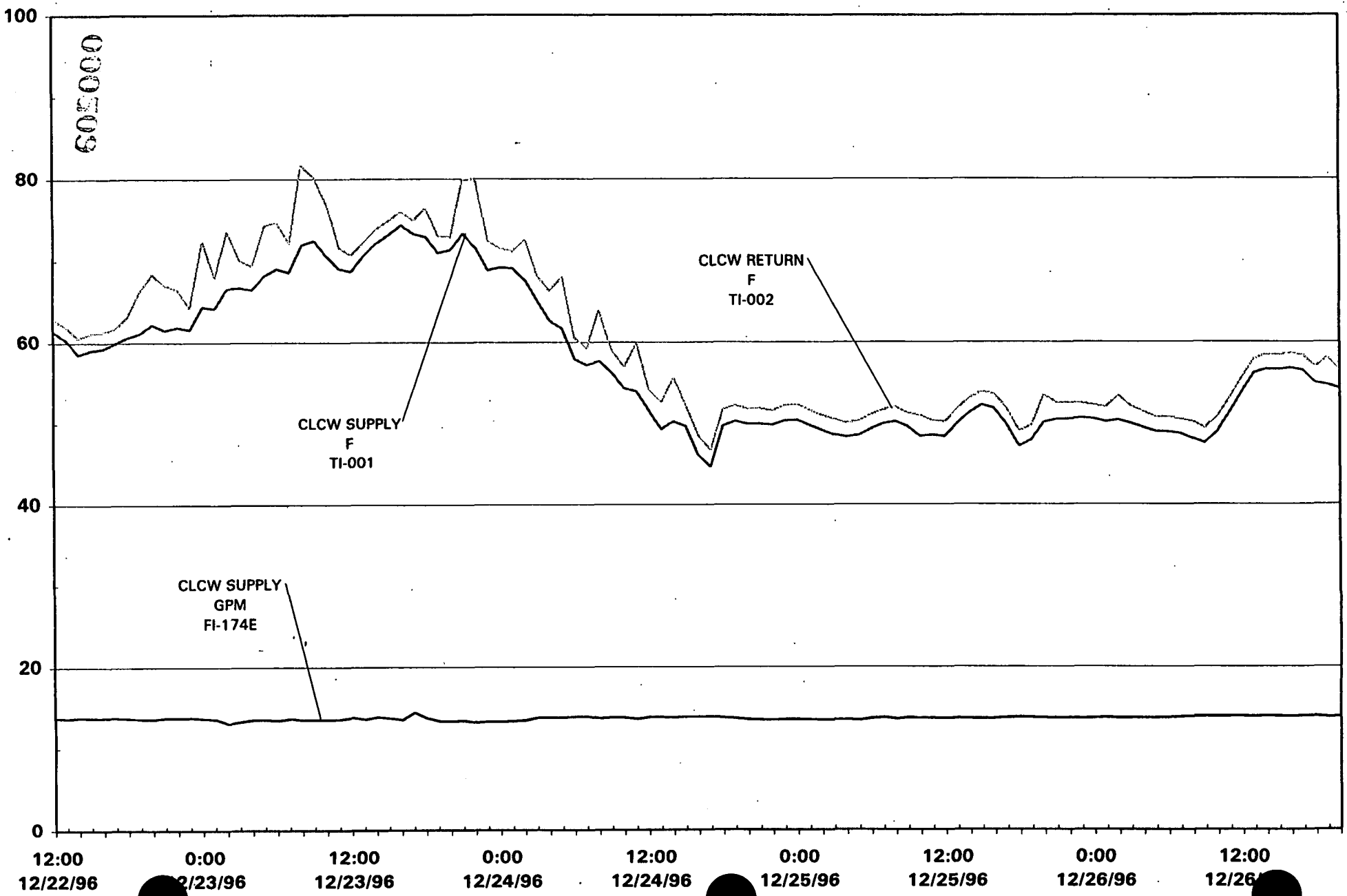
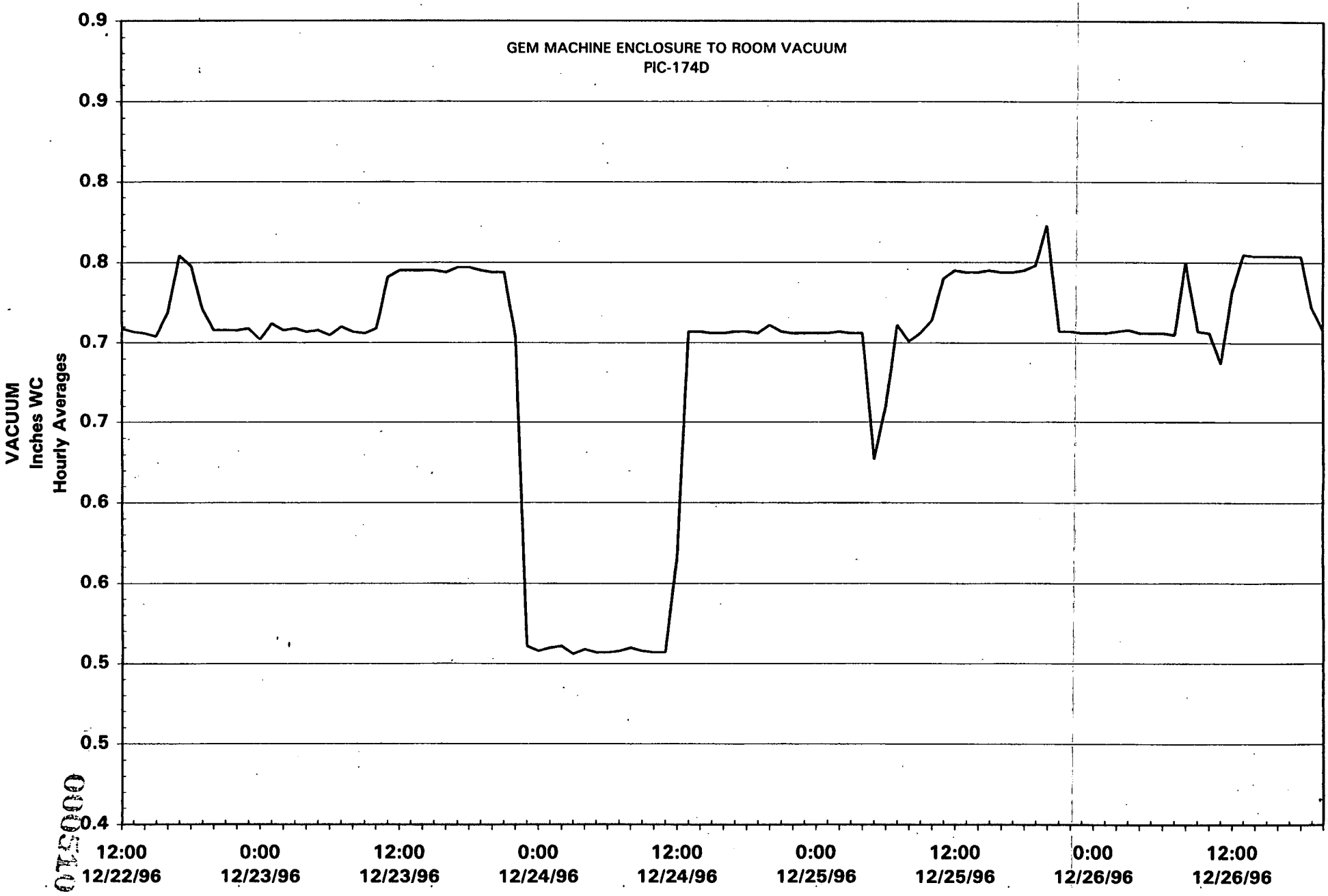
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
GEM MACHINE SYSTEM



CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 15

VHP 1/9/97

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VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

READINGS		HOURLY AVERAGES									
		GEM HOPPER	GOB CUTTER	GOB CUTTER TEMP	GOB CUTTER	GOB ROLLER	CONVEYOR SPEED	GEM ENCLOSURE TO ROOM VACUUM	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/22/96	12:00	51.13	139.37	OUT OF SERVICE	0.07	0.29	37.23	0.71	13.79	61.47	62.89
12/22/96	13:00	53.18	151.51		0.08	0.29	37.17	0.71	13.71	60.35	62.07
12/22/96	14:00	55.71	157.78		0.07	0.29	37.19	0.71	13.82	58.62	60.62
12/22/96	15:00	60.03	149.12		0.07	0.29	37.26	0.70	13.78	59.07	61.10
12/22/96	16:00	62.84	144.66		0.08	0.29	37.22	0.72	13.79	59.28	61.34
12/22/96	17:00	64.16	147.24		0.07	0.29	37.19	0.75	13.80	59.94	61.75
12/22/96	18:00	65.46	168.44		0.07	0.29	37.23	0.75	13.75	60.67	63.14
12/22/96	19:00	67.68	213.49		0.08	5.64	37.19	0.72	13.65	61.15	66.25
12/22/96	20:00	65.92	253.20		0.07	0.60	37.17	0.71	13.65	62.24	68.42
12/22/96	21:00	64.03	225.03		0.07	0.28	37.25	0.71	13.79	61.56	67.04
12/22/96	22:00	61.75	217.61		0.08	0.27	37.21	0.71	13.77	61.93	66.47
12/22/96	23:00	60.72	174.18		0.08	0.27	37.25	0.71	13.81	61.61	64.25
12/23/96	0:00	65.07	268.41		0.07	18.97	37.21	0.70	13.71	64.41	72.46
12/23/96	1:00	68.21	227.44		0.08	7.05	37.22	0.71	13.61	64.22	67.98
12/23/96	2:00	84.78	278.00		0.07	13.71	37.19	0.71	13.09	66.60	73.57
12/23/96	3:00	73.68	213.82		0.07	1.62	37.27	0.71	13.33	66.75	70.07
12/23/96	4:00	72.68	188.74		0.08	0.29	37.27	0.71	13.54	66.47	69.36
12/23/96	5:00	73.21	265.86		0.08	0.29	37.26	0.71	13.54	68.23	74.33
12/23/96	6:00	102.54	263.38		0.08	17.84	37.26	0.71	13.48	69.03	74.71
12/23/96	7:00	77.67	238.80		0.07	11.45	37.22	0.71	13.68	68.63	72.15
12/23/96	8:00	76.12	559.03		0.07	0.29	37.15	0.71	13.53	71.99	81.71
12/23/96	9:00	74.48	525.68		0.07	0.29	37.23	0.71	13.53	72.53	80.22
12/23/96	10:00	73.12	434.35		0.07	0.29	37.21	0.71	13.53	70.54	77.07
12/23/96	11:00	72.06	190.04		0.07	0.29	37.19	0.74	13.59	69.08	71.61
12/23/96	12:00	69.89	167.46		0.07	0.29	37.18	0.75	13.81	68.74	70.68
12/23/96	13:00	69.08	160.41		0.08	0.29	37.22	0.75	13.58	70.65	72.34
12/23/96	14:00	69.10	159.88		0.07	0.29	37.18	0.75	13.86	72.20	73.87
12/23/96	15:00	69.68	160.35		0.07	0.29	37.23	0.75	13.71	73.21	74.86
12/23/96	16:00	70.31	160.26		0.08	0.29	37.16	0.74	13.53	74.36	76.02
12/23/96	17:00	70.31	156.99		0.07	0.29	37.18	0.75	14.43	73.34	74.95
12/23/96	18:00	70.10	283.41		0.08	0.29	37.23	0.75	13.74	72.94	76.46
12/23/96	19:00	69.44	170.27		0.08	0.29	37.21	0.75	13.37	70.97	73.03
12/23/96	20:00	68.66	157.73		0.07	0.29	37.20	0.74	13.32	71.34	72.95
12/23/96	21:00	68.47	452.45		0.07	0.29	37.24	0.74	13.40	73.36	79.89
12/23/96	22:00	68.83	491.85		0.08	0.29	37.17	0.70	13.18	71.62	80.00
12/23/96	23:00	68.45	246.02		0.07	0.29	37.23	0.51	13.31	68.88	72.46
12/24/96	0:00	68.10	190.31		0.08	0.29	37.24	0.51	13.28	69.20	71.52
12/24/96	1:00	67.84	170.67		0.08	0.29	37.22	0.51	13.33	69.11	71.18
12/24/96	2:00	67.55	230.08		0.08	6.42	37.19	0.51	13.43	67.66	72.63
12/24/96	3:00	66.27	195.20		0.08	0.27	37.21	0.51	13.73	65.17	68.21
12/24/96	4:00	66.80	186.64		0.08	2.90	37.24	0.51	13.74	62.69	66.27
12/24/96	5:00	78.89	261.87		0.09	20.06	37.22	0.51	13.77	61.72	68.11
12/24/96	6:00	65.59	169.89		0.09	19.11	37.22	0.51	13.86	57.99	60.56
12/24/96	7:00	60.14	155.12		0.07	2.33	37.22	0.51	13.86	57.22	59.26
12/24/96	8:00	71.83	261.24		0.08	7.38	37.26	0.51	13.67	57.70	63.92
12/24/96	9:00	65.91	177.99		0.07	0.29	37.21	0.51	13.78	56.29	59.04
12/24/96	10:00	63.88	162.77		0.08	1.92	37.26	0.51	13.75	54.30	57.00
12/24/96	11:00	67.34	237.77		0.07	7.42	37.22	0.51	13.58	53.94	59.91
12/24/96	12:00	62.87	159.11		0.07	0.29	37.15	0.57	13.80	51.58	54.08
12/24/96	13:00	62.69	164.35		0.08	4.82	37.23	0.71	13.80	49.26	52.57
12/24/96	14:00	76.09	220.99		0.06	4.44	37.07	0.71	13.77	50.23	55.62
12/24/96	15:00	65.96	155.16		0.06	0.29	37.16	0.71	13.86	49.63	52.18
12/24/96	16:00	63.32	140.29		0.06	0.29	37.23	0.71	13.86	46.01	48.48
12/24/96	17:00	62.22	133.55		0.06	0.29	37.22	0.71	13.89	44.61	46.69
12/24/96	18:00	61.42	131.81		0.06	0.29	37.23	0.71	13.75	49.68	51.71
12/24/96	19:00	61.14	131.47		0.06	0.29	37.26	0.71	13.66	50.28	52.19
12/24/96	20:00	61.06	133.22		0.06	0.29	37.22	0.71	13.53	49.91	51.79
12/24/96	21:00	61.00	133.06		0.06	0.29	37.20	0.71	13.49	49.94	51.81
12/24/96	22:00	61.02	134.46		0.06	0.29	37.27	0.71	13.48	49.79	51.59
12/24/96	23:00	61.04	136.93		0.06	0.29	37.21	0.71	13.52	50.34	52.21
12/25/96	0:00	61.11	137.93		0.06	0.29	37.21	0.71	13.54	50.41	52.31
12/25/96	1:00	61.35	137.82		0.06	0.29	37.19	0.71	13.50	49.73	51.60
12/25/96	2:00	60.99	136.26		0.06	0.29	37.19	0.71	13.45	49.18	50.99
12/25/96	3:00	59.58	134.29		0.06	0.29	37.22	0.71	13.47	48.58	50.50
12/25/96	4:00	58.52	133.69		0.06	0.29	37.21	0.71	13.50	48.34	50.05
12/25/96	5:00	57.79	129.37		0.06	0.30	37.22	0.63	13.42	48.53	50.31
12/25/96	6:00	57.78	126.26		0.06	1.26	37.19	0.66	13.62	49.31	51.08

VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		HOURLY AVERAGES									
READINGS		GEM HOPPER	GOB CUTTER	GOB CUTTER TEMP	GOB CUTTER	GOB ROLLER	CONVEYOR SPEED	GEM ENCLOSURE TO ROOM VACUUM	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR SUPPLY	CLCW DIVERTERS & CONVEYOR RETURN
		TI-3K	TI-9K	IR	SIC-174BM	SIC-174AM	SIC-174CM	PIC-174D	FI-174E	TI-001	TI-002
DATE	HOUR	F	F	F	RPM	RPM	RPM	In WC	GPM	F	F
12/25/96	7:00	57.65	128.72		0.06	0.29	37.18	0.71	13.71	49.94	51.65
12/25/96	8:00	57.08	136.72		0.06	0.30	37.20	0.70	13.56	50.21	51.98
12/25/96	9:00	56.62	128.64		0.06	0.29	37.24	0.71	13.68	49.58	51.23
12/25/96	10:00	57.42	180.51		0.07	0.29	37.16	0.71	13.63	48.41	50.96
12/25/96	11:00	58.42	127.03		0.07	0.29	37.18	0.74	13.63	48.54	50.31
12/25/96	12:00	58.09	130.31		0.08	0.29	37.25	0.75	13.62	48.36	50.16
12/25/96	13:00	58.82	131.19		0.07	0.29	37.20	0.74	13.66	49.98	51.78
12/25/96	14:00	59.59	133.44		0.06	0.30	37.23	0.74	13.63	51.30	53.07
12/25/96	15:00	60.32	134.12		0.06	0.29	37.15	0.75	13.60	52.23	53.88
12/25/96	16:00	60.62	134.65		0.06	0.29	37.18	0.74	13.64	51.83	53.58
12/25/96	17:00	60.33	134.19		0.06	0.29	37.24	0.74	13.70	49.80	51.80
12/25/96	18:00	59.67	131.57		0.06	0.29	37.17	0.75	13.77	47.18	49.05
12/25/96	19:00	58.93	132.67		0.07	0.29	37.24	0.75	13.70	47.96	49.72
12/25/96	20:00	58.54	176.31		0.08	3.25	37.18	0.77	13.69	50.10	53.45
12/25/96	21:00	57.43	155.21		0.07	0.29	37.19	0.71	13.66	50.44	52.54
12/25/96	22:00	57.13	138.76		0.07	0.29	37.19	0.71	13.70	50.51	52.51
12/25/96	23:00	57.42	133.58		0.07	0.29	37.28	0.71	13.61	50.63	52.44
12/26/96	0:00	57.30	134.89		0.07	0.29	37.15	0.71	13.67	50.53	52.24
12/26/96	1:00	57.12	134.34		0.07	0.29	37.17	0.71	13.73	50.15	51.97
12/26/96	2:00	61.26	159.36		0.07	11.70	37.20	0.71	13.65	50.36	53.35
12/26/96	3:00	60.60	144.90		0.08	27.14	37.22	0.71	13.68	49.95	52.09
12/26/96	4:00	58.51	141.17		0.08	4.24	37.20	0.71	13.68	49.48	51.45
12/26/96	5:00	58.30	135.27		0.07	0.29	37.21	0.71	13.72	48.99	50.78
12/26/96	6:00	58.43	124.89		0.07	0.29	37.19	0.71	13.74	48.91	50.78
12/26/96	7:00	58.65	125.87		0.07	0.29	37.25	0.71	13.80	48.73	50.48
12/26/96	8:00	58.61	149.61		0.07	0.29	37.14	0.75	13.86	48.13	50.18
12/26/96	9:00	58.40	137.37		0.07	0.29	37.23	0.71	13.89	47.55	49.41
12/26/96	10:00	59.14	137.32		0.07	0.29	37.23	0.71	13.84	48.93	50.73
12/26/96	11:00	60.39	133.68		0.07	2.32	37.22	0.69	13.88	51.31	53.06
12/26/96	12:00	61.56	141.29		0.07	0.29	37.17	0.73	13.89	53.77	55.55
12/26/96	13:00	62.59	144.55		0.07	0.29	37.25	0.76	13.86	56.17	57.89
12/26/96	14:00	63.44	146.75		0.07	0.29	37.22	0.75	13.89	56.62	58.47
12/26/96	15:00	64.24	148.74		0.07	0.29	37.26	0.75	13.86	56.59	58.41
12/26/96	16:00	64.86	150.16		0.07	0.29	37.21	0.75	13.83	56.79	58.61
12/26/96	17:00	65.17	150.60		0.07	0.29	37.24	0.75	13.88	56.47	58.36
12/26/96	18:00	65.26	151.23		0.07	0.29	37.21	0.75	13.88	54.93	56.90
12/26/96	19:00	65.59	183.98		0.08	14.75	34.71	0.72	13.77	54.66	58.10
12/26/96	20:00	65.61	150.05		0.09	0.29	36.74	0.71	13.82	54.20	56.50

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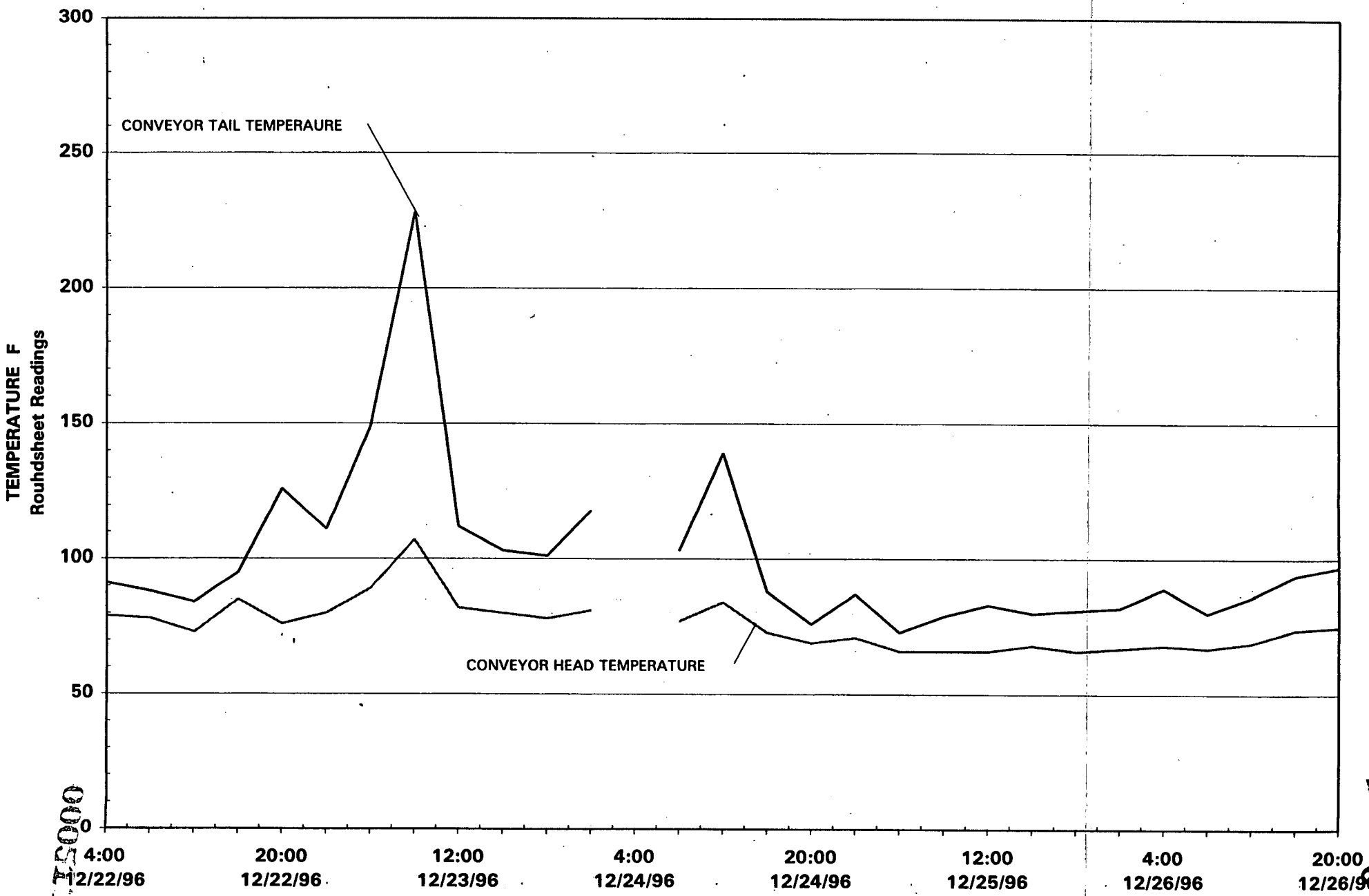
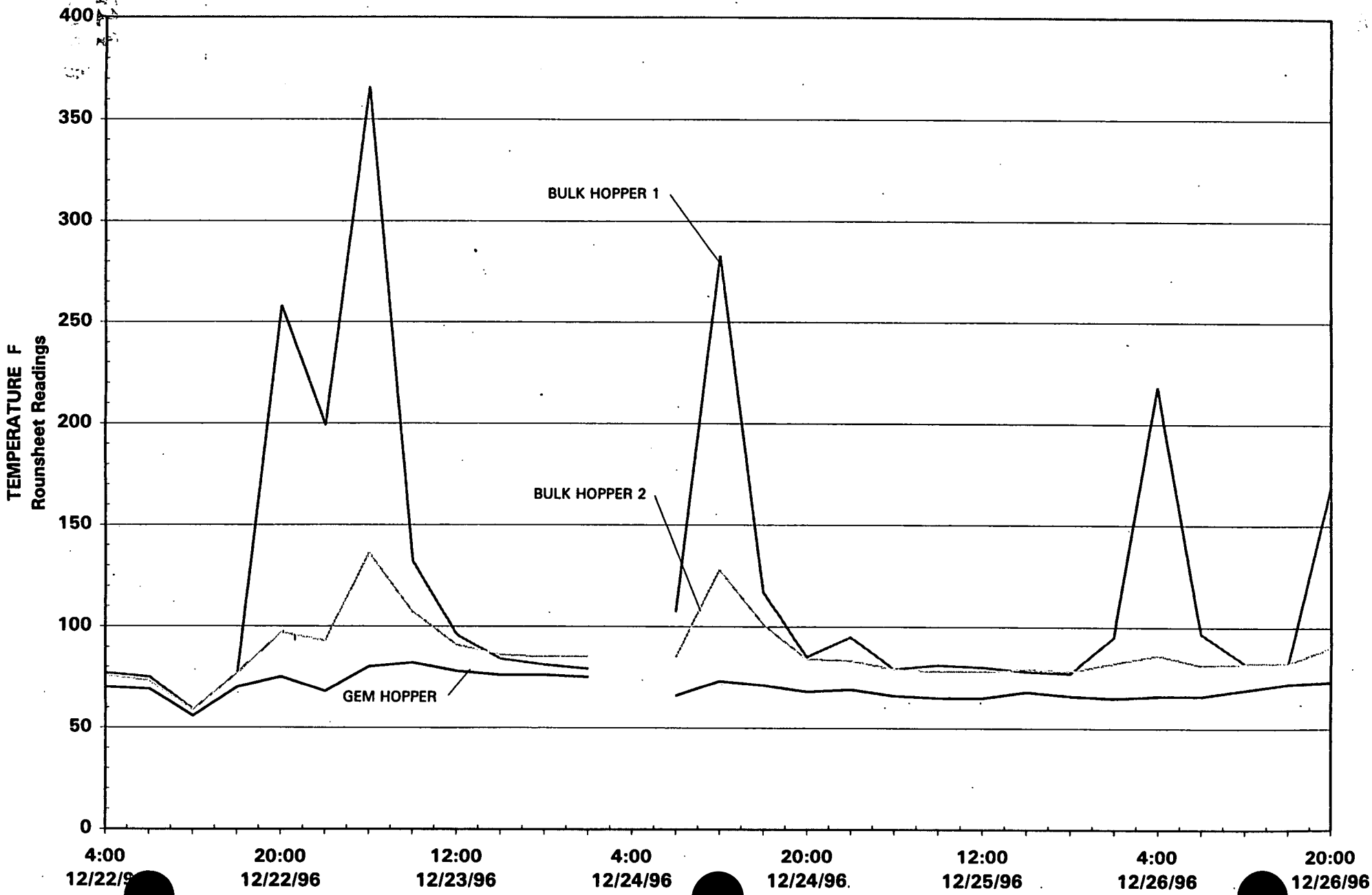
CAMPA[illegible]4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 16

VHP 1/9/97

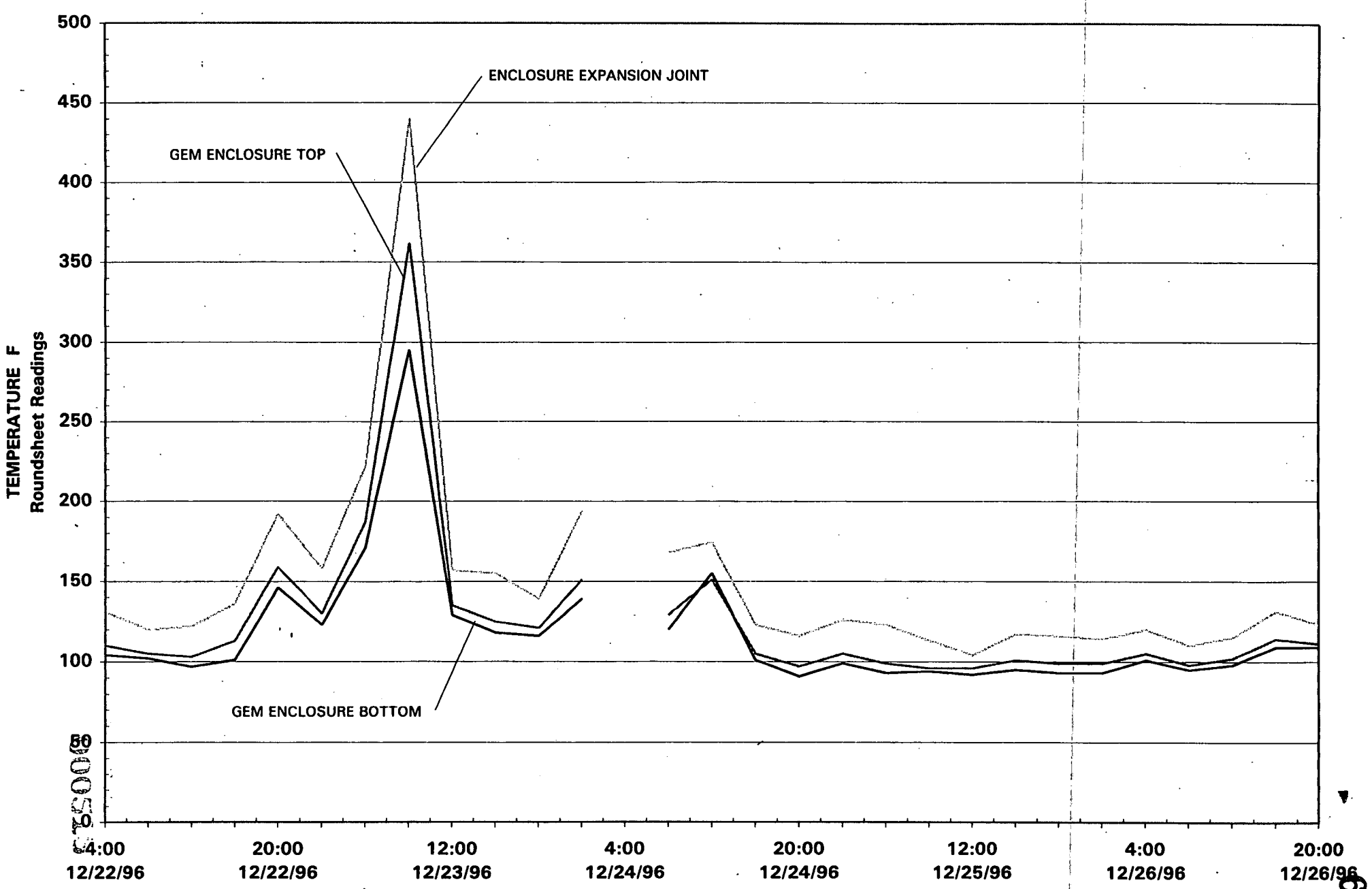
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCHARTS Chart 17

VHF 1/9/97

CAMPA[illegible]4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
GEM MACHINE SYSTEM



C4GEMMCH.XLS Chart 18

VHP 1/9/97

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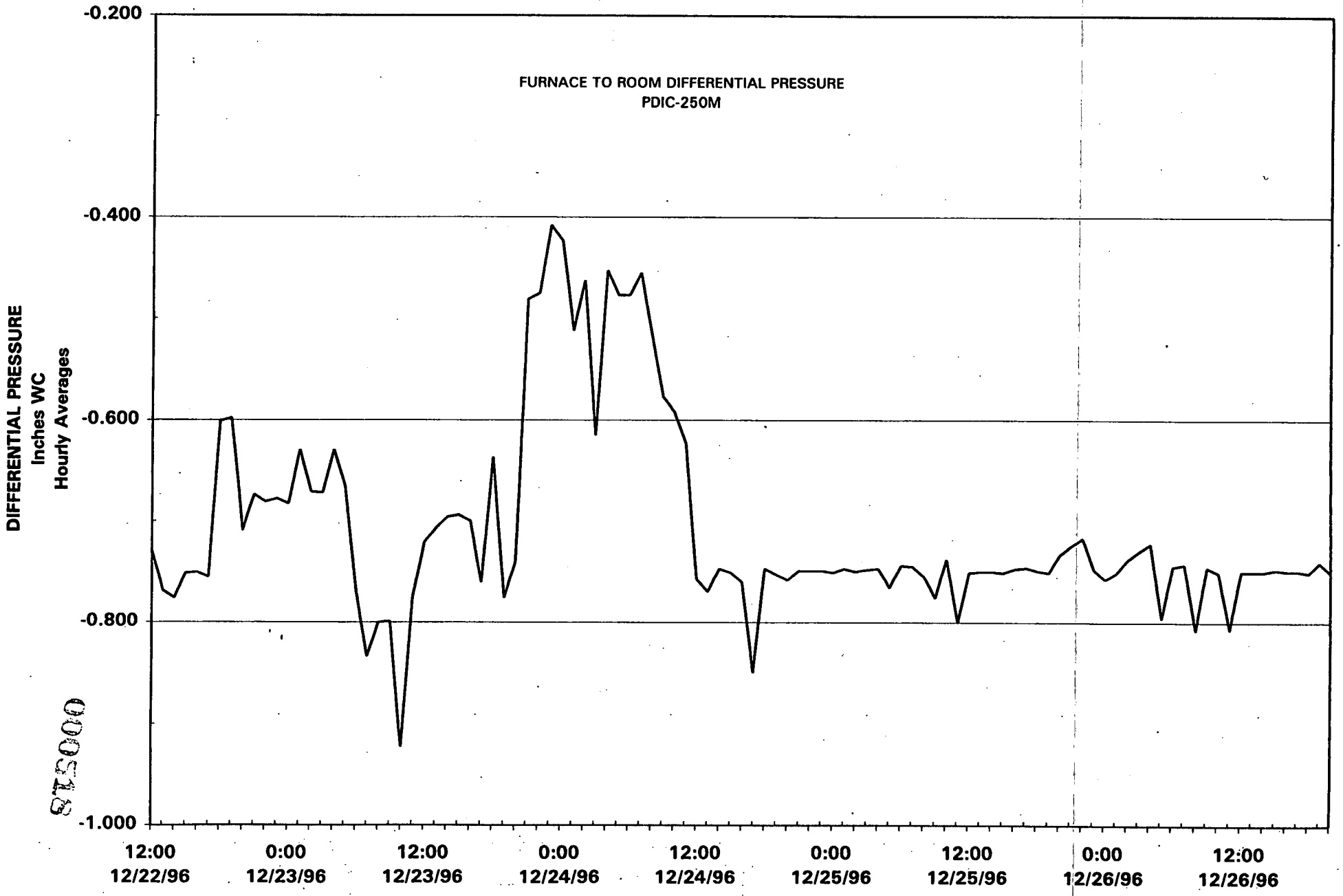
VITRIFICATION PILOT PLANT GEM MACHINE SYSTEM									
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS									
		ROUNDSHEET READINGS							
READINGS		CONVEYOR TAIL TEMP	CONVEYOR HEAD TEMP	GEM HOPPER TEMP	BULK HOPPER #1 TEMP	BULK HOPPER #2 TEMP	GEM ENCLOSURE BOTTOM TEMP	GEM ENCLOSURE TOP TEMP	ENCLOSURE EXPANSION JOINT TEMP
DATE	HOUR	F	F	F	F	F	F	F	F
12/22/96	4:00	91	79	70	77	76	104	110	131
12/22/96	8:00	88	78	69	75	73	102	105	120
12/22/96	12:00	84	73	56	59	59	97	103	122
12/22/96	16:00	95	85	70	77	77	101	113	136
12/22/96	20:00	126	76	75	258	97	146	159	192
12/23/96	0:00	111	80	68	199	93	123	130	158
12/23/96	4:00	149	89	80	366	136	171	187	222
12/23/96	8:00	228	107	82	132	107	295	362	440
12/23/96	12:00	112	82	78	96	91	129	135	157
12/23/96	16:00	103	80	76	84	86	118	125	155
12/23/96	20:00	101	78	76	81	85	116	121	139
12/24/96	0:00	118	81	75	79	85	139	151	194
12/24/96	4:00								
12/24/96	8:00	103	77	66	107	85	120	129	168
12/24/96	12:00	139	84	73	283	128	155	151	174
12/24/96	16:00	88	73	71	117	101	101	105	123
12/24/96	20:00	76	69	68	85	84	91	97	116
12/25/96	0:00	87	71	69	95	83	99	105	126
12/25/96	4:00	73	66	66	79	79	93	99	123
12/25/96	8:00	79	66	65	81	78	94	96	113
12/25/96	12:00	83	66	65	80	78	92	96	104
12/25/96	16:00	80	68	68	78	79	95	101	117
12/25/96	20:00	81	66	66	77	78	93	99	116
12/26/96	0:00	82	67	65	95	82	93	99	114
12/26/96	4:00	89	68	66	218	86	101	105	120
12/26/96	8:00	80	67	66	97	81	95	98	110
12/26/96	12:00	86	69	69	82	82	98	102	115
12/26/96	16:00	94	74	72	82	82	109	114	131
12/26/96	20:00	97	75	73	169	90	109	111	123

000516

FURNACE OFFGAS SYSTEM

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE OFFGAS SYSTEM



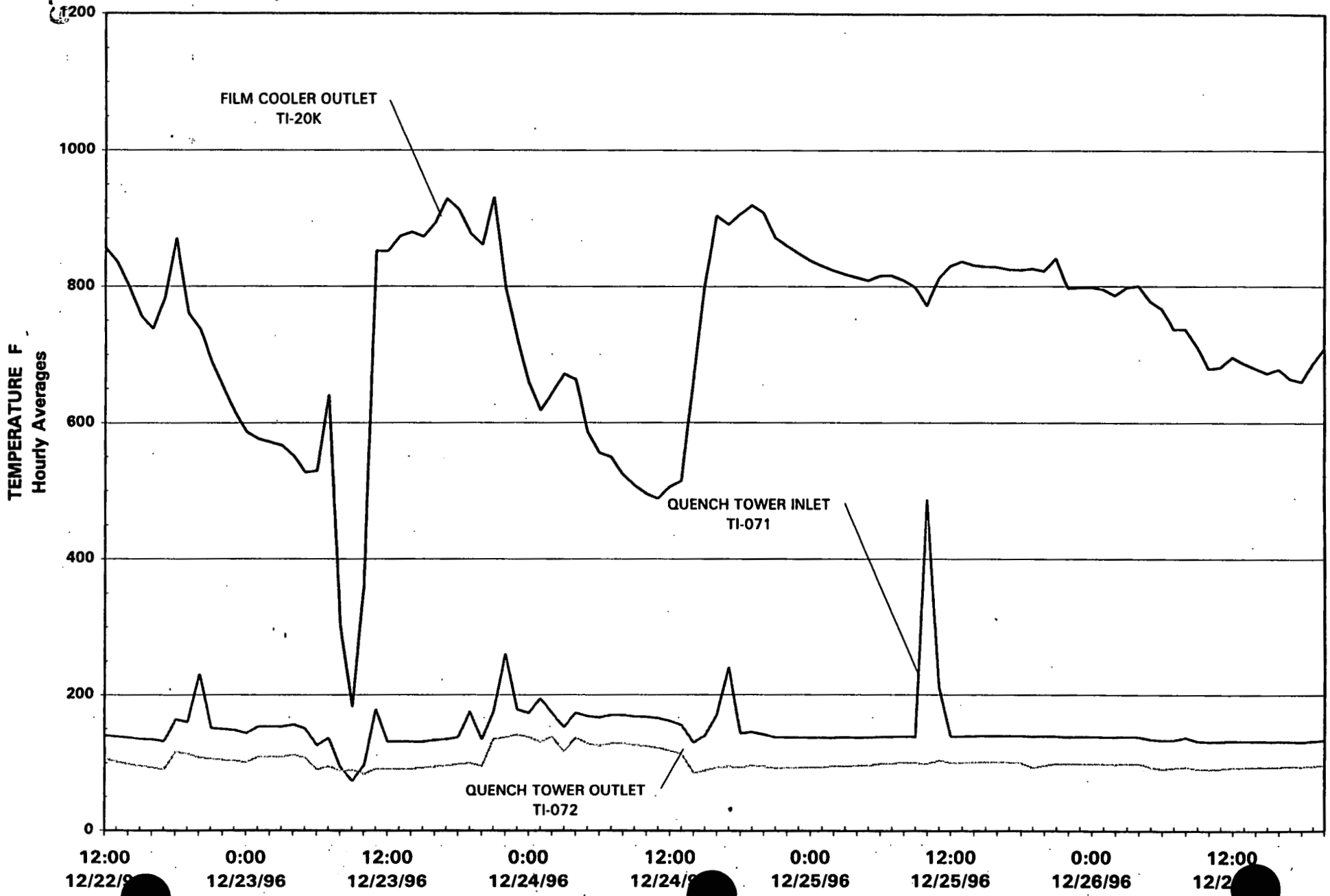
C4OFFGAS.XLS Chart 15

VHP 1/14/97

000518

673

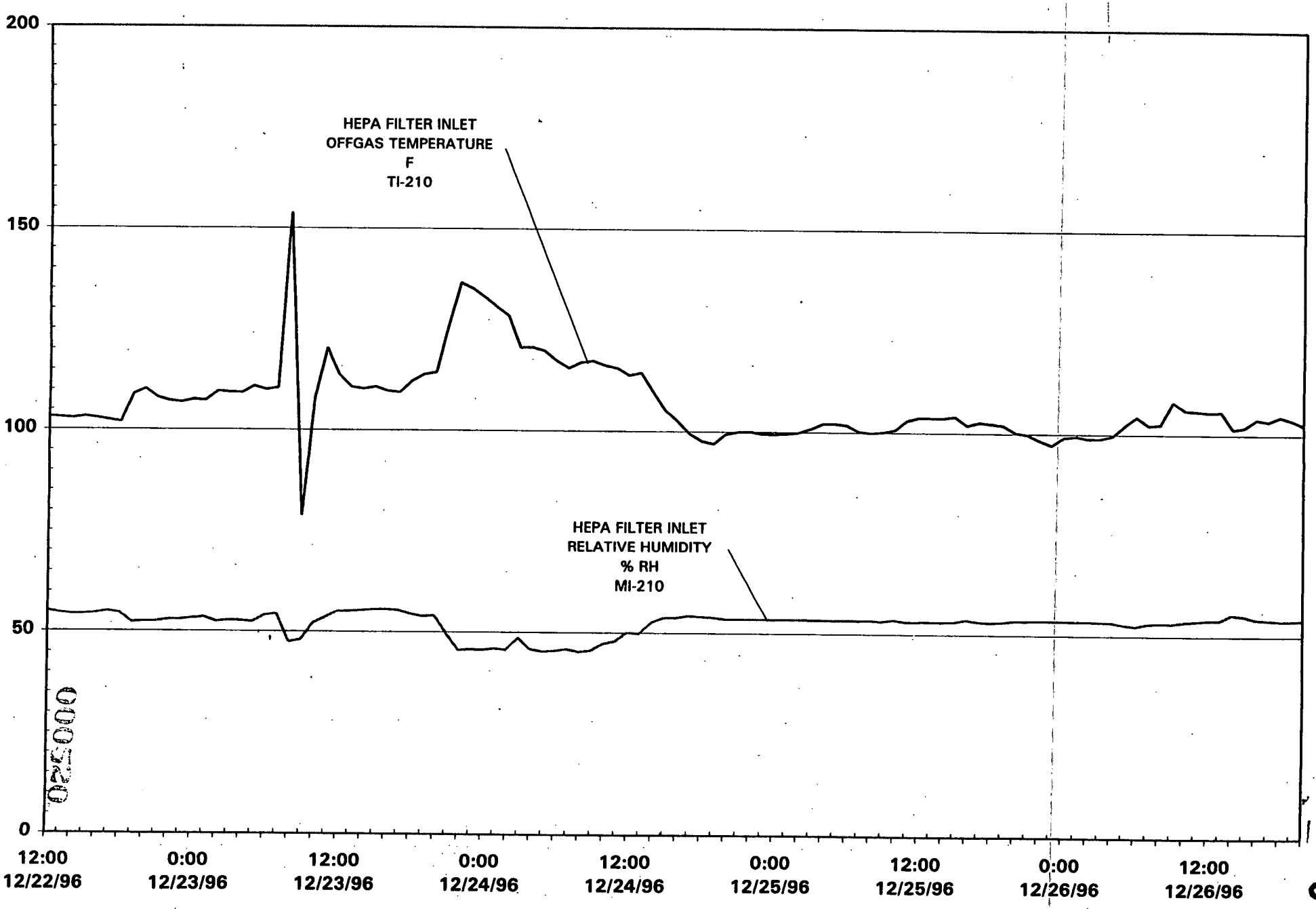
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS Chart 16

VHP 1/14/97

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 22

VHP 1/14/97

025000

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/22/96	12:00	-0.730	856.45	140.77	106.62	OUT OF SERVICE	103.17	55.01
12/22/96	13:00	-0.769	835.72	139.05	102.05		103.00	54.44
12/22/96	14:00	-0.776	800.23	137.31	98.60		102.80	54.15
12/22/96	15:00	-0.752	756.62	135.17	95.38		103.20	54.13
12/22/96	16:00	-0.751	738.09	134.52	93.60		102.83	54.40
12/22/96	17:00	-0.756	781.69	131.54	89.67		102.33	54.89
12/22/96	18:00	-0.601	870.89	163.16	116.21		101.92	54.48
12/22/96	19:00	-0.598	760.46	159.82	113.39		108.86	52.19
12/22/96	20:00	-0.709	738.24	230.63	108.22		110.16	52.40
12/22/96	21:00	-0.674	689.65	151.26	105.82		108.02	52.37
12/22/96	22:00	-0.681	650.70	149.73	104.60		107.21	52.84
12/22/96	23:00	-0.678	615.52	148.25	103.52		106.84	52.89
12/23/96	0:00	-0.683	585.72	143.44	100.66		107.53	53.14
12/23/96	1:00	-0.630	576.07	153.13	109.00		107.31	53.44
12/23/96	2:00	-0.671	571.18	153.35	109.26		109.63	52.37
12/23/96	3:00	-0.672	566.32	153.09	109.12		109.37	52.66
12/23/96	4:00	-0.630	551.50	155.91	111.73		109.27	52.62
12/23/96	5:00	-0.666	527.07	150.33	107.95		110.92	52.34
12/23/96	6:00	-0.769	529.46	125.53	89.96		110.08	53.92
12/23/96	7:00	-0.834	640.60	135.96	94.40		110.56	54.28
12/23/96	8:00	-0.800	300.83	93.62	88.37		153.69	47.49
12/23/96	9:00	-0.799	181.98	73.14	89.06		78.71	48.04
12/23/96	10:00	-0.923	361.98	95.60	83.52		107.78	52.09
12/23/96	11:00	-0.775	851.98	178.06	91.06		120.35	53.53
12/23/96	12:00	-0.721	852.14	130.74	90.90		113.84	54.98
12/23/96	13:00	-0.707	874.08	131.26	91.27		110.85	55.14
12/23/96	14:00	-0.696	880.19	130.77	91.33		110.37	55.28
12/23/96	15:00	-0.694	873.45	130.99	92.07		110.87	55.55
12/23/96	16:00	-0.700	894.00	133.06	94.06		109.86	55.62
12/23/96	17:00	-0.761	929.13	134.47	95.36		109.50	55.40
12/23/96	18:00	-0.637	913.25	137.34	97.99		112.29	54.45
12/23/96	19:00	-0.776	878.15	174.82	99.92		113.96	53.89
12/23/96	20:00	-0.741	861.35	134.26	95.30		114.45	54.05
12/23/96	21:00	-0.481	931.20	174.15	134.60		125.67	49.67
12/23/96	22:00	-0.475	798.32	260.56	137.05		136.55	45.66
12/23/96	23:00	-0.408	722.09	178.08	141.45		135.18	45.81
12/24/96	0:00	-0.423	658.52	172.92	137.61		133.04	45.70
12/24/96	1:00	-0.512	618.46	194.29	130.57		130.65	46.01
12/24/96	2:00	-0.463	643.98	172.96	138.34		128.39	45.77
12/24/96	3:00	-0.615	671.37	152.48	116.73		120.63	48.62
12/24/96	4:00	-0.453	663.90	173.19	136.82		120.67	45.92
12/24/96	5:00	-0.477	586.29	168.40	128.48		119.84	45.37
12/24/96	6:00	-0.477	556.08	166.52	125.22		117.47	45.55
12/24/96	7:00	-0.455	549.63	169.98	128.51		115.75	46.00

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VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS INLET RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/24/96	8:00	-0.519	524.39	169.87	128.89		117.07	45.29
12/24/96	9:00	-0.577	507.85	167.93	126.15		117.47	45.63
12/24/96	10:00	-0.592	496.15	167.41	124.85		116.41	47.31
12/24/96	11:00	-0.623	488.84	165.44	122.47		115.78	47.97
12/24/96	12:00	-0.758	505.79	161.45	117.71		114.01	50.05
12/24/96	13:00	-0.770	514.61	155.26	113.12		114.63	49.84
12/24/96	14:00	-0.747	661.10	129.85	85.14		109.83	52.65
12/24/96	15:00	-0.751	802.04	140.09	88.71		105.24	53.78
12/24/96	16:00	-0.761	903.94	170.44	92.64		102.67	53.83
12/24/96	17:00	-0.850	891.21	240.67	94.66		99.50	54.33
12/24/96	18:00	-0.747	906.31	143.38	93.24		97.69	54.11
12/24/96	19:00	-0.753	919.24	145.03	95.86		97.07	53.93
12/24/96	20:00	-0.759	908.57	141.69	94.61		99.38	53.54
12/24/96	21:00	-0.749	871.41	137.60	92.17		100.01	53.54
12/24/96	22:00	-0.749	860.00	137.44	92.84		100.09	53.56
12/24/96	23:00	-0.749	848.72	137.23	92.99		99.52	53.56
12/25/96	0:00	-0.751	838.17	137.02	93.14		99.44	53.49
12/25/96	1:00	-0.747	830.54	137.19	93.78		99.60	53.53
12/25/96	2:00	-0.750	823.62	137.17	94.39		99.97	53.54
12/25/96	3:00	-0.748	817.85	137.26	94.88		100.91	53.48
12/25/96	4:00	-0.747	813.42	137.13	95.36		102.18	53.44
12/25/96	5:00	-0.766	809.02	137.48	96.25		102.21	53.38
12/25/96	6:00	-0.744	815.68	138.05	98.07		101.87	53.41
12/25/96	7:00	-0.745	816.15	138.30	99.03		100.25	53.38
12/25/96	8:00	-0.755	809.41	138.67	100.07		99.94	53.43
12/25/96	9:00	-0.776	798.97	138.39	99.75		100.19	53.23
12/25/96	10:00	-0.738	771.38	486.96	98.88		100.70	53.58
12/25/96	11:00	-0.800	811.62	210.85	103.79		103.07	53.14
12/25/96	12:00	-0.751	830.00	138.78	99.81		103.74	53.14
12/25/96	13:00	-0.750	836.89	139.20	100.39		103.72	53.21
12/25/96	14:00	-0.750	831.33	139.68	100.85		103.71	53.17
12/25/96	15:00	-0.751	829.59	140.03	101.15		104.01	53.19
12/25/96	16:00	-0.747	828.66	139.93	101.53		101.97	53.75
12/25/96	17:00	-0.746	825.33	139.92	100.51		102.71	53.32
12/25/96	18:00	-0.749	824.37	139.96	99.77		102.41	53.11
12/25/96	19:00	-0.751	826.24	138.94	92.76		102.03	53.27
12/25/96	20:00	-0.733	822.99	139.63	96.32		100.26	53.57
12/25/96	21:00	-0.725	841.45	139.30	98.94		99.78	53.61
12/25/96	22:00	-0.717	797.08	138.07	98.72		98.34	53.72
12/25/96	23:00	-0.748	797.96	138.56	98.97		97.20	53.65
12/26/96	0:00	-0.758	798.84	138.62	98.57		99.10	53.66
12/26/96	1:00	-0.751	795.51	138.46	98.10		99.46	53.56
12/26/96	2:00	-0.738	786.61	138.19	97.69		98.87	53.57
12/26/96	3:00	-0.730	798.07	138.63	98.97		98.93	53.47

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

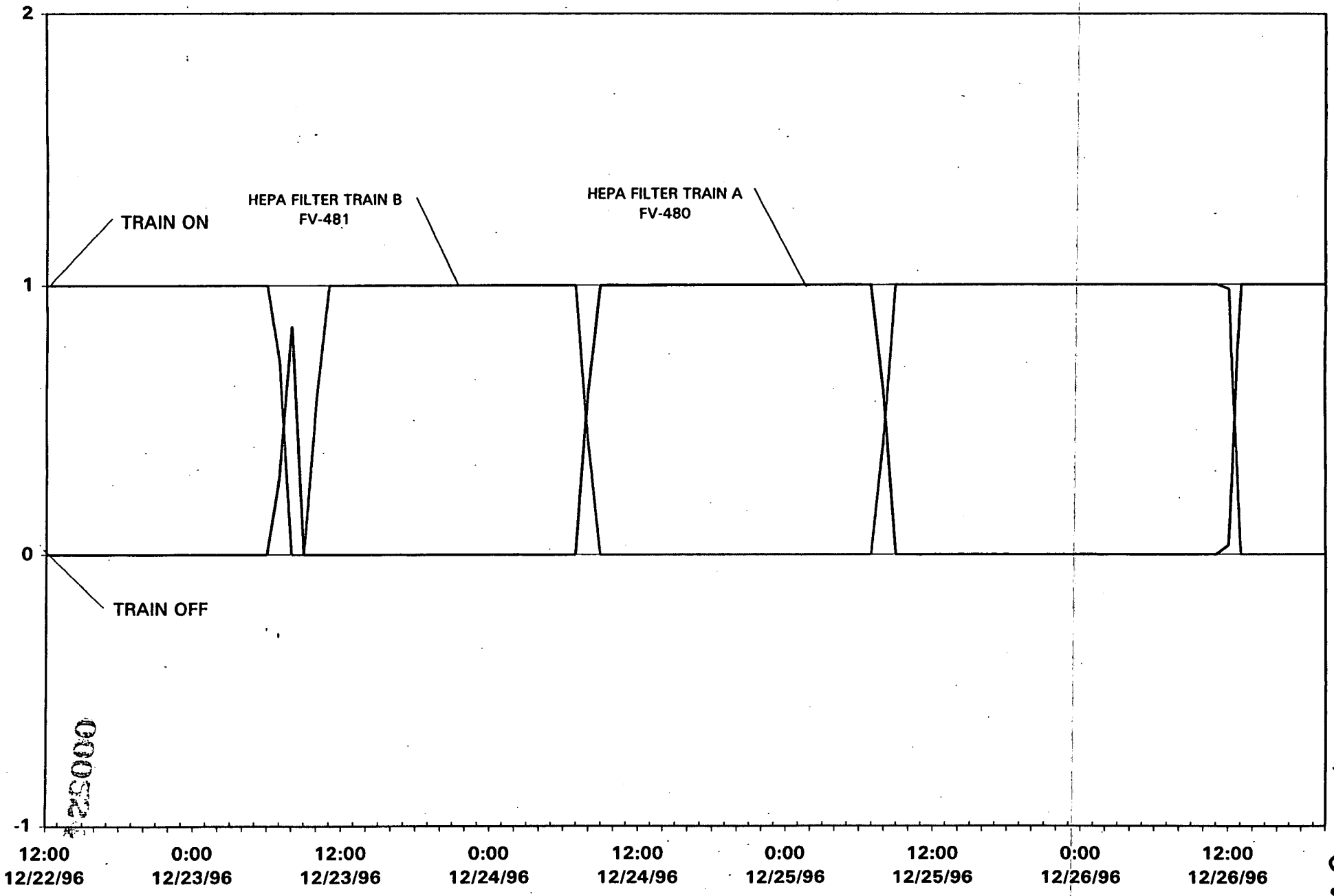
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

HOURLY AVERAGES

READINGS		FURNACE TO ROOM DIFF PRESS	FILM COOLER OFFGAS OUTLET	QUENCH TOWER OFFGAS INLET	QUENCH TOWER OFFGAS OUTLET	DESICCANT TOWER OFFGAS INLET	HEPA FILTER OFFGAS INLET	HEPA FILTER OFFGAS RELATIVE HUMIDITY
		PDIC-250M	TI-20K	TI-071	TI-072	TI-420	TI-210	MI-210
DATE	HOUR	In WC	F	F	F	F	F	% RH
12/26/96	4:00	-0.723	800.57	138.26	98.88		99.65	53.43
12/26/96	5:00	-0.796	777.77	134.82	93.57		102.18	52.81
12/26/96	6:00	-0.745	766.80	133.51	91.02		104.30	52.43
12/26/96	7:00	-0.743	737.51	133.77	92.85		102.31	53.09
12/26/96	8:00	-0.808	737.83	137.43	94.21		102.51	53.29
12/26/96	9:00	-0.746	712.17	132.19	90.91		108.11	53.14
12/26/96	10:00	-0.751	679.52	131.06	90.42		106.05	53.58
12/26/96	11:00	-0.807	681.47	131.55	91.66		105.82	53.84
12/26/96	12:00	-0.750	695.90	132.43	92.81		105.56	54.01
12/26/96	13:00	-0.750	687.06	132.00	92.99		105.72	54.10
12/26/96	14:00	-0.750	680.11	132.03	93.77		101.48	55.43
12/26/96	15:00	-0.748	672.62	131.85	94.22		101.93	55.10
12/26/96	16:00	-0.749	678.52	131.81	94.17		103.85	54.37
12/26/96	17:00	-0.749	664.55	131.44	94.67		103.39	54.14
12/26/96	18:00	-0.751	660.44	130.72	94.10		104.52	53.97
12/26/96	19:00	-0.741	687.93	132.28	95.32		103.69	53.99
12/26/96	20:00	-0.751	708.79	133.51	96.46		102.39	54.07

000523

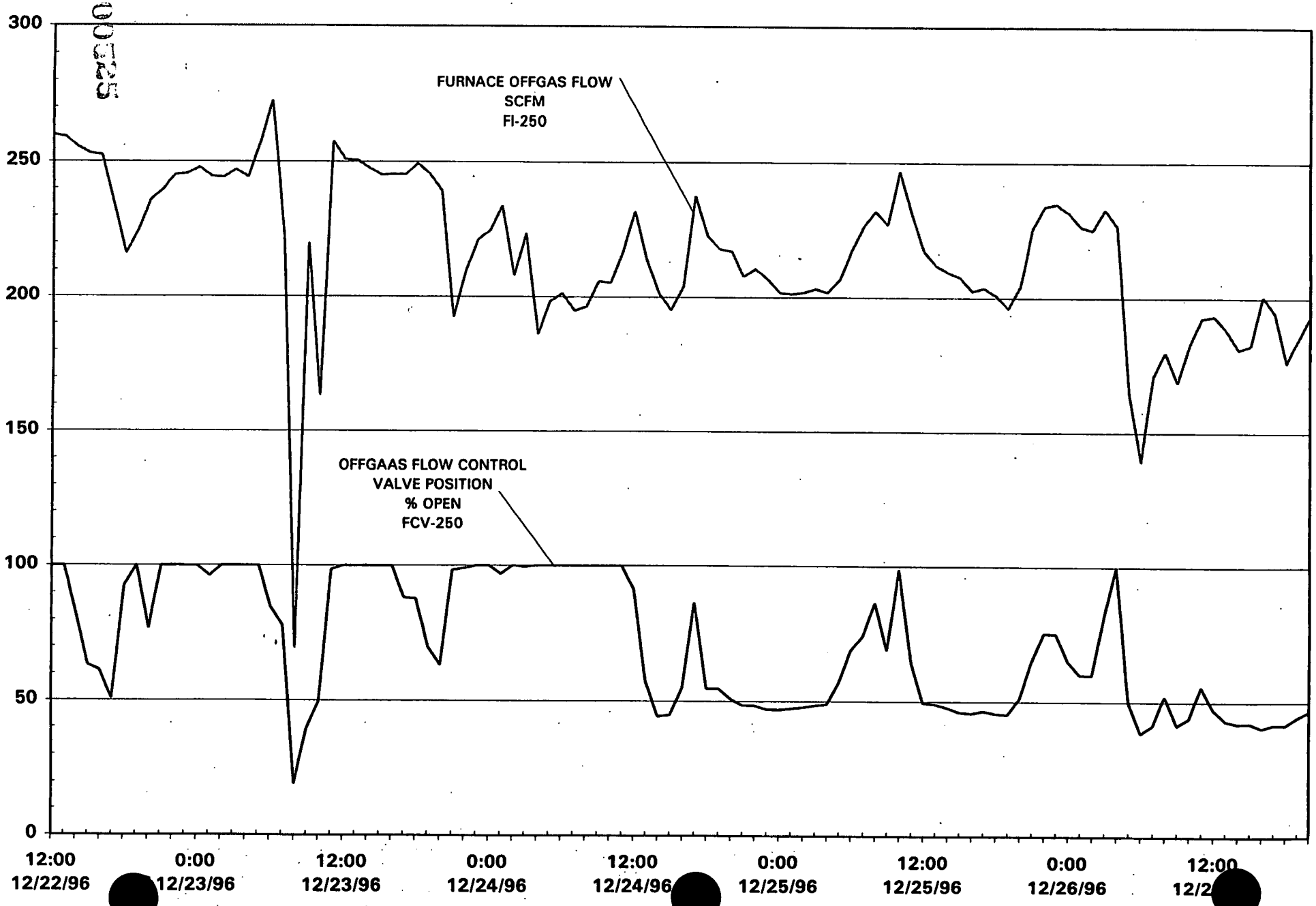
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 17

VHP 1/14/97

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 18

VHP 1/14/97

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

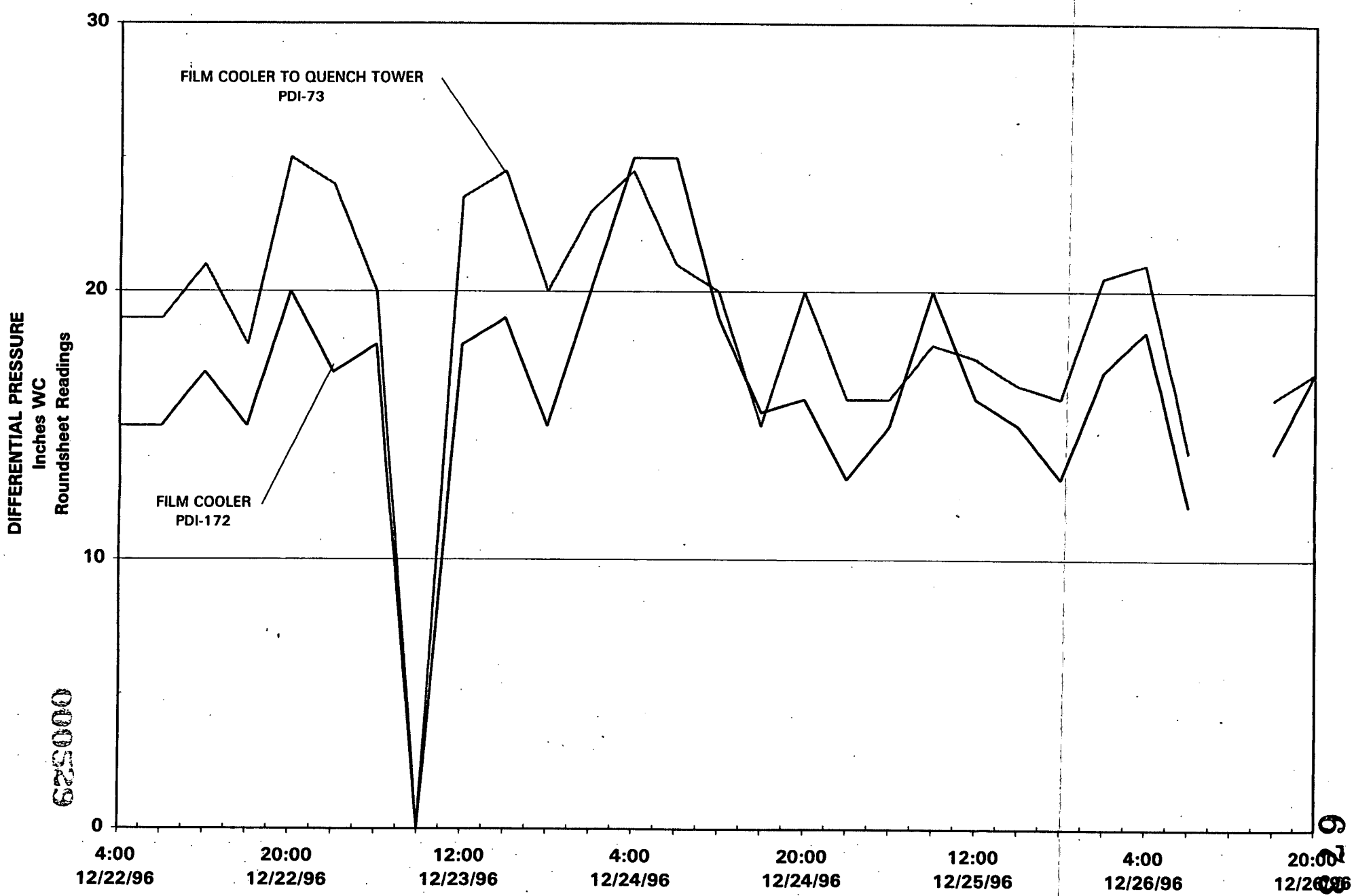
CAMPAIGN 4 SERIES A GLASS

		HOURLY AVERAGES					
READINGS		HEPA FILTER TRAIN A	HEPA FILTER TRAIN B	HEPA FILTERS DIFF PRESS	OFFGAS FLOW CONTROL VALVE POSITION	FLOW TO STACK	TOTAL STACK FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/22/96	12:00	0.00	1.00	1.76	100.00	259.88	7474.25
12/22/96	13:00	0.00	1.00	1.77	100.00	259.11	7302.08
12/22/96	14:00	0.00	1.00	1.63	82.25	255.25	7187.00
12/22/96	15:00	0.00	1.00	1.65	63.01	252.98	7814.58
12/22/96	16:00	0.00	1.00	1.69	61.05	252.30	8387.03
12/22/96	17:00	0.00	1.00	1.53	50.61	234.11	8493.17
12/22/96	18:00	0.00	1.00	1.45	92.54	216.12	8448.33
12/22/96	19:00	0.00	1.00	1.55	100.00	224.59	8443.67
12/22/96	20:00	0.00	1.00	1.60	76.52	235.73	7622.03
12/22/96	21:00	0.00	1.00	1.66	100.00	239.53	7045.92
12/22/96	22:00	0.00	1.00	1.68	100.00	245.08	6947.08
12/22/96	23:00	0.00	1.00	1.69	99.98	245.54	6938.42
12/23/96	0:00	0.00	1.00	1.74	99.89	247.91	7006.75
12/23/96	1:00	0.00	1.00	1.73	96.06	244.52	7443.33
12/23/96	2:00	0.00	1.00	1.77	100.00	244.07	7605.75
12/23/96	3:00	0.00	1.00	1.83	100.00	247.04	7217.67
12/23/96	4:00	0.00	1.00	1.86	100.00	244.29	7658.75
12/23/96	5:00	0.00	1.00	2.01	99.99	257.15	7590.33
12/23/96	6:00	0.00	1.00	2.13	84.49	272.35	7371.92
12/23/96	7:00	0.28	0.72	1.75	77.87	222.28	7551.25
12/23/96	8:00	0.85	0.00	-0.05	18.98	69.17	7743.73
12/23/96	9:00	0.00	0.00	0.76	39.37	219.90	7948.17
12/23/96	10:00	0.00	0.58	0.02	49.49	163.23	7949.32
12/23/96	11:00	0.00	1.00	0.22	98.43	257.40	7699.83
12/23/96	12:00	0.00	1.00	0.22	100.00	250.83	7702.42
12/23/96	13:00	0.00	1.00	0.23	100.00	250.51	7710.50
12/23/96	14:00	0.00	1.00	0.25	100.00	247.65	7737.96
12/23/96	15:00	0.00	1.00	0.27	100.00	245.04	7477.42
12/23/96	16:00	0.00	1.00	0.29	100.00	245.32	7413.45
12/23/96	17:00	0.00	1.00	0.33	88.13	245.25	7364.50
12/23/96	18:00	0.00	1.00	0.36	87.66	249.39	7395.75
12/23/96	19:00	0.00	1.00	0.37	69.82	245.48	7746.50
12/23/96	20:00	0.00	1.00	0.37	63.04	239.14	7773.08
12/23/96	21:00	0.00	1.00	0.28	98.31	192.35	7593.17
12/23/96	22:00	0.00	1.00	0.29	99.01	209.75	7514.58
12/23/96	23:00	0.00	1.00	0.30	100.00	221.26	7646.08
12/24/96	0:00	0.00	1.00	0.31	100.00	224.73	7735.75
12/24/96	1:00	0.00	1.00	0.33	96.91	233.65	7841.00
12/24/96	2:00	0.00	1.00	0.31	100.00	208.01	7771.67
12/24/96	3:00	0.00	1.00	0.35	99.60	223.56	7903.58
12/24/96	4:00	0.00	1.00	0.30	100.00	186.01	8035.00
12/24/96	5:00	0.00	1.00	0.32	100.00	198.30	8084.25
12/24/96	6:00	0.00	1.00	0.33	100.00	201.31	8089.58
12/24/96	7:00	0.00	1.00	0.32	100.00	194.82	7528.42

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
		HOURLY AVERAGES					
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/24/96	8:00	0.60	0.42	0.23	100.00	196.25	7659.75
12/24/96	9:00	1.00	0.00	0.19	100.00	205.89	7957.25
12/24/96	10:00	1.00	0.00	0.19	100.00	205.33	8079.00
12/24/96	11:00	1.00	0.00	0.20	100.00	216.96	8105.85
12/24/96	12:00	1.00	0.00	0.22	91.58	231.89	8110.25
12/24/96	13:00	1.00	0.00	0.20	57.03	213.69	8033.33
12/24/96	14:00	1.00	0.00	0.19	44.14	201.56	7979.00
12/24/96	15:00	1.00	0.00	0.19	44.72	195.11	8019.50
12/24/96	16:00	1.00	0.00	0.22	54.82	203.85	8040.08
12/24/96	17:00	1.00	0.00	0.29	86.35	237.48	8074.92
12/24/96	18:00	1.00	0.00	0.30	54.60	222.81	8029.15
12/24/96	19:00	1.00	0.00	0.35	54.65	218.05	8029.42
12/24/96	20:00	1.00	0.00	0.39	50.87	217.18	8022.42
12/24/96	21:00	1.00	0.00	0.42	48.50	207.93	8131.25
12/24/96	22:00	1.00	0.00	0.44	48.31	210.71	8116.50
12/24/96	23:00	1.00	0.00	0.45	46.90	206.88	8087.42
12/25/96	0:00	1.00	0.00	0.48	46.75	201.81	8047.17
12/25/96	1:00	1.00	0.00	0.51	47.19	201.26	8026.92
12/25/96	2:00	1.00	0.00	0.54	47.66	201.85	8134.50
12/25/96	3:00	1.00	0.00	0.57	48.37	203.20	8234.33
12/25/96	4:00	1.00	0.00	0.61	48.83	201.86	8235.08
12/25/96	5:00	1.00	0.00	0.66	56.67	206.57	8164.92
12/25/96	6:00	1.00	0.00	0.79	68.68	217.50	8230.08
12/25/96	7:00	1.00	0.00	0.88	74.23	226.43	8272.67
12/25/96	8:00	0.60	0.42	0.70	86.46	232.12	8364.92
12/25/96	9:00	0.00	1.00	0.38	68.91	227.02	8461.92
12/25/96	10:00	0.00	1.00	0.42	98.87	246.85	8468.17
12/25/96	11:00	0.00	1.00	0.40	64.42	231.05	8246.00
12/25/96	12:00	0.00	1.00	0.38	49.47	217.35	8228.50
12/25/96	13:00	0.00	1.00	0.39	49.03	212.11	8198.67
12/25/96	14:00	0.00	1.00	0.39	47.69	209.62	8125.75
12/25/96	15:00	0.00	1.00	0.40	46.06	207.70	8090.58
12/25/96	16:00	0.00	1.00	0.41	45.62	202.54	8091.33
12/25/96	17:00	0.00	1.00	0.42	46.46	203.68	8135.08
12/25/96	18:00	0.00	1.00	0.43	45.54	200.80	8177.75
12/25/96	19:00	0.00	1.00	0.44	45.10	195.92	8259.17
12/25/96	20:00	0.00	1.00	0.47	51.20	204.36	8286.75
12/25/96	21:00	0.00	1.00	0.55	64.84	225.48	8145.58
12/25/96	22:00	0.00	1.00	0.60	75.41	234.04	8193.50
12/25/96	23:00	0.00	1.00	0.63	75.23	234.94	8361.50
12/26/96	0:00	0.00	1.00	0.66	65.04	231.81	8431.42
12/26/96	1:00	0.00	1.00	0.68	60.04	226.41	8398.00
12/26/96	2:00	0.00	1.00	0.70	59.87	225.24	8356.08
12/26/96	3:00	0.00	1.00	0.76	82.21	233.01	8357.08

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM							
CAMPAIGN 4 SERIES A GLASS							
		HOURLY AVERAGES					
READINGS		HEPA FILTER	HEPA FILTER	HEPA	OFFGAS	FLOW	TOTAL
		TRAIN A	TRAIN B	FILTERS	FLOW CONTROL	TO	STACK
				DIFF PRESS	VALVE POSITION	STACK	FLOW
		FV-480	FV-481				
		ON LINE = 1.0	ON LINE = 1.0	PDI-480	FCV-250	FI-250	FI-251
DATE	HOUR	OFF LINE = 0.0	OFF LINE = 0.0	In WC	% OPEN	SCFM	SCFM
12/26/96	4:00	0.00	1.00	0.77	99.60	226.76	8353.46
12/26/96	5:00	0.00	1.00	0.60	50.04	165.14	8289.92
12/26/96	6:00	0.00	1.00	0.55	38.42	139.05	8194.67
12/26/96	7:00	0.00	1.00	0.67	41.44	171.14	8239.42
12/26/96	8:00	0.00	1.00	0.74	52.05	179.81	8260.50
12/26/96	9:00	0.00	1.00	0.73	41.42	168.66	8239.75
12/26/96	10:00	0.00	1.00	0.82	44.03	182.93	8193.33
12/26/96	11:00	0.00	1.00	0.90	55.72	192.44	8126.42
12/26/96	12:00	0.03	0.98	0.95	47.19	193.20	8012.75
12/26/96	13:00	1.00	0.00	0.76	43.14	188.03	8005.92
12/26/96	14:00	1.00	0.00	0.74	42.07	180.96	8002.50
12/26/96	15:00	1.00	0.00	0.76	42.33	182.51	8045.25
12/26/96	16:00	1.00	0.00	0.72	40.56	200.59	8502.00
12/26/96	17:00	1.00	0.00	0.77	41.74	194.44	8221.64
12/26/96	18:00	1.00	0.00	0.76	41.64	176.18	7945.33
12/26/96	19:00	1.00	0.00	0.80	44.44	184.88	7873.39
12/26/96	20:00	1.00	0.00	0.84	46.62	193.05	7937.08

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS FURNACE OFFGAS SYSTEM



C4OFFGAS.XLS Chart 18

VHP 1/14/97

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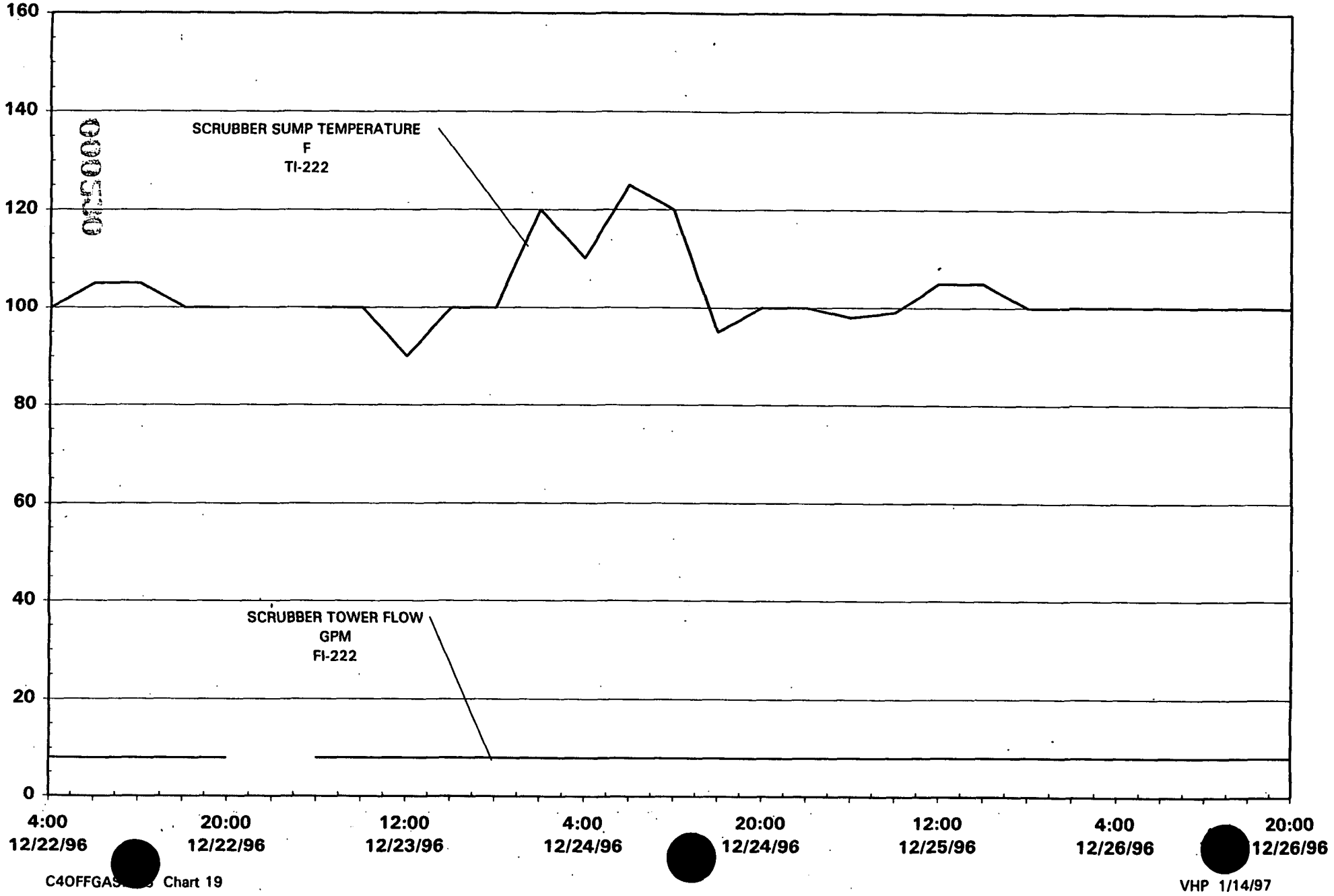
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
FURNACE OFFGAS SYSTEM



C4OFFGAS Chart 19

VHP 1/14/97

VITRIFICATION PILOT PLANT FURNACE OFFGAS SYSTEM

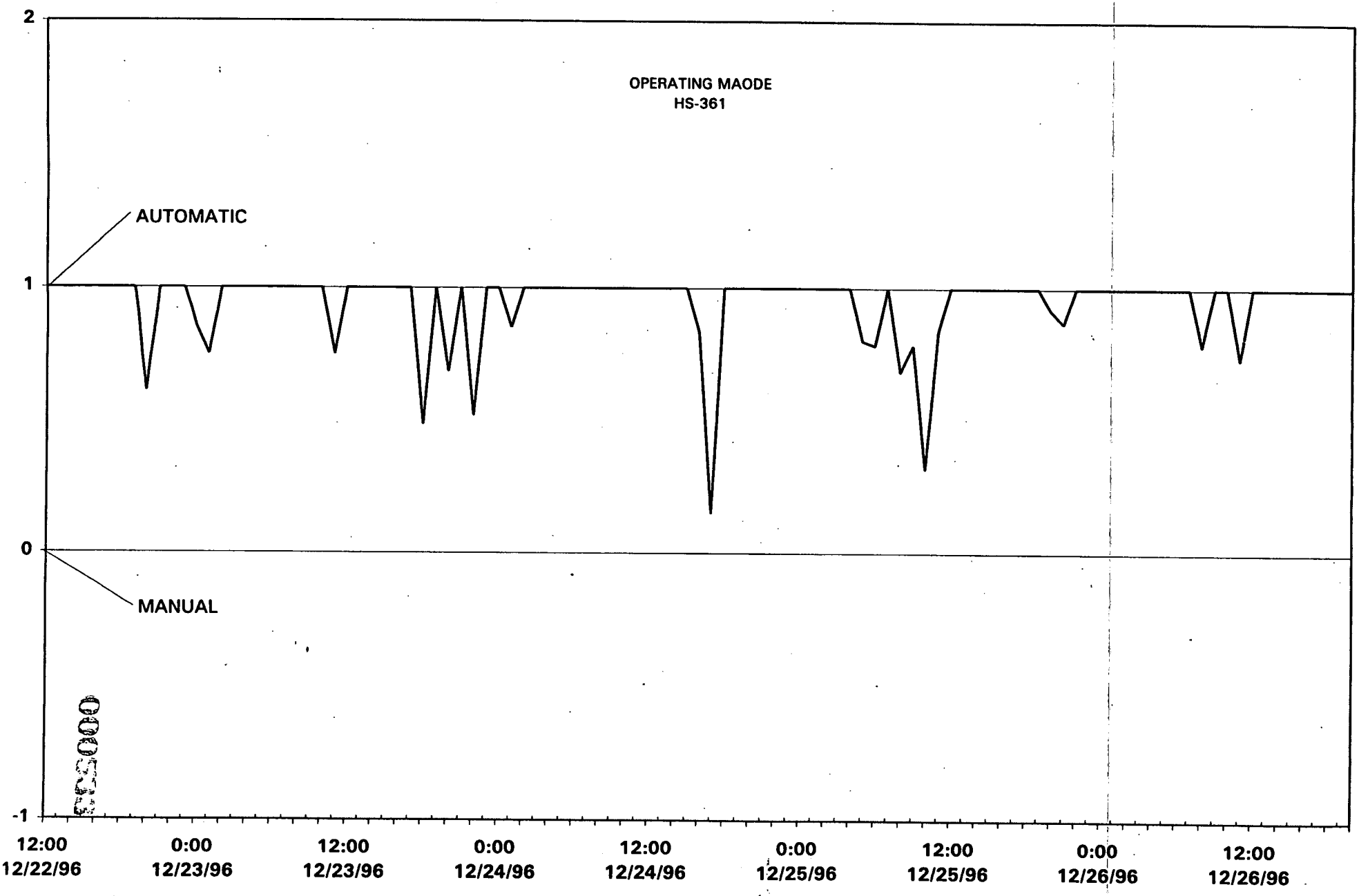
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

		ROUNDSHEET DATA							
READINGS		FILM COOLER DIFF PRESS	FILM COOLER TO QT DIFF PRESS	QUENCH TOWER SUMP TEMP	SCRUBBER TOWER VACUUM	SCRUBBER SUMP TEMP	SCRUBBER TOWER FLOW	DESICCANT TOWER INTERNAL TEMP	DESICCANT TOWER VACUUM
		PDI-172	PDI-173	TI-070	PI-222	TI-222	FI-222	TI-210	PI-210
DATE	HOUR	In WC	In WC	F	In WC	F	GPM	F	In WC
12/22/96	4:00	15.0	19.0	110	1.5	100	8	OUT OF SERVICE	OUT OF SERVICE
12/22/96	8:00	15.0	19.0	115	1.3	105	8		
12/22/96	12:00	17.0	21.0	115	1.8	105	8		
12/22/96	16:00	15.0	18.0	100	1.8	100	8		
12/22/96	20:00	20.0	25.0	100		100	8		
12/23/96	0:00	17.0	24.0						
12/23/96	4:00	18.0	20.0	100		100	8		
12/23/96	8:00	0.0	0.0	60		100	8		
12/23/96	12:00	18.0	23.5	100	2.0	90	8		
12/23/96	16:00	19.0	24.5	105	2.0	100	8		
12/23/96	20:00	15.0	20.0	100	2.0	100	8		
12/24/96	0:00	20.0	23.0	100	2.0	120	8		
12/24/96	4:00	25.0	24.5	100	2.0	110	8		
12/24/96	8:00	25.0	21.0	140	1.9	125	8		
12/24/96	12:00	19.0	20.0	130	1.4	120	8		
12/24/96	16:00	15.5	15.0	95	0.0	95	8		
12/24/96	20:00	16.0	20.0	105	0.0	100	8		
12/25/96	0:00	13.0	16.0	105	0.0	100	8		
12/25/96	4:00	15.0	16.0	100	0.0	98	8		
12/25/96	8:00	20.0	18.0	110	0.0	99	8		
12/25/96	12:00	16.0	17.5	110	0.0	105	8		
12/25/96	16:00	15.0	16.5	110	0.0	105	8		
12/25/96	20:00	13.0	16.0	105	0.0	100	8		
12/26/96	0:00	17.0	20.5	101	0.0	100	8		
12/26/96	4:00	18.5	21.0	101	0.0	100	8		
12/26/96	8:00	12.0	14.0	101	0.0	100	8		
12/26/96	12:00			100	0.6	100	8		
12/26/96	16:00	14.0	16.0	100	0.0	100	8		
12/26/96	20:00	17.0	17.0	100	0.0	100	8		

000531

EMERGENCY OFFGAS SYSTEM

CAMPA 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS Chart 9

VHP 1/29/97

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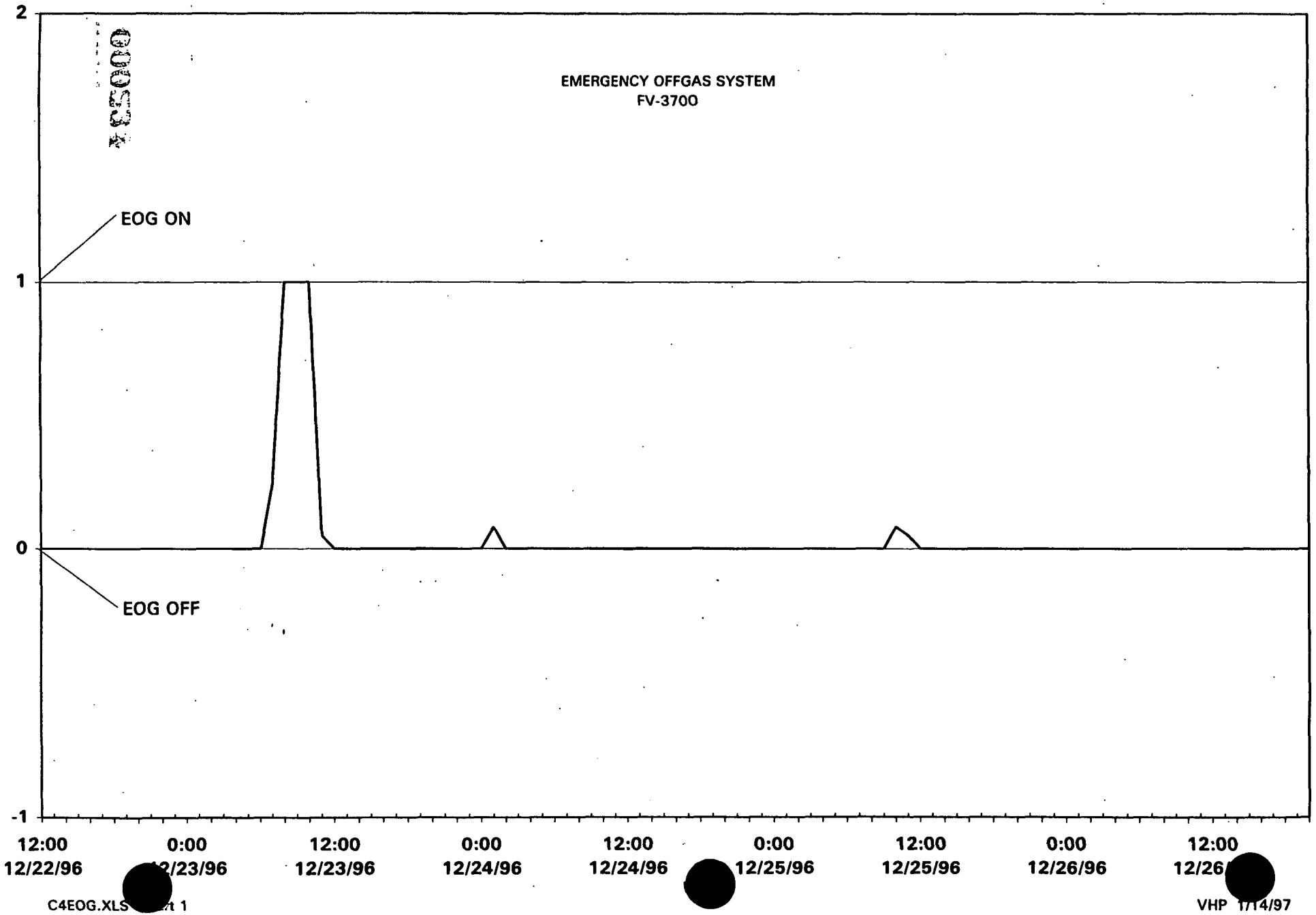
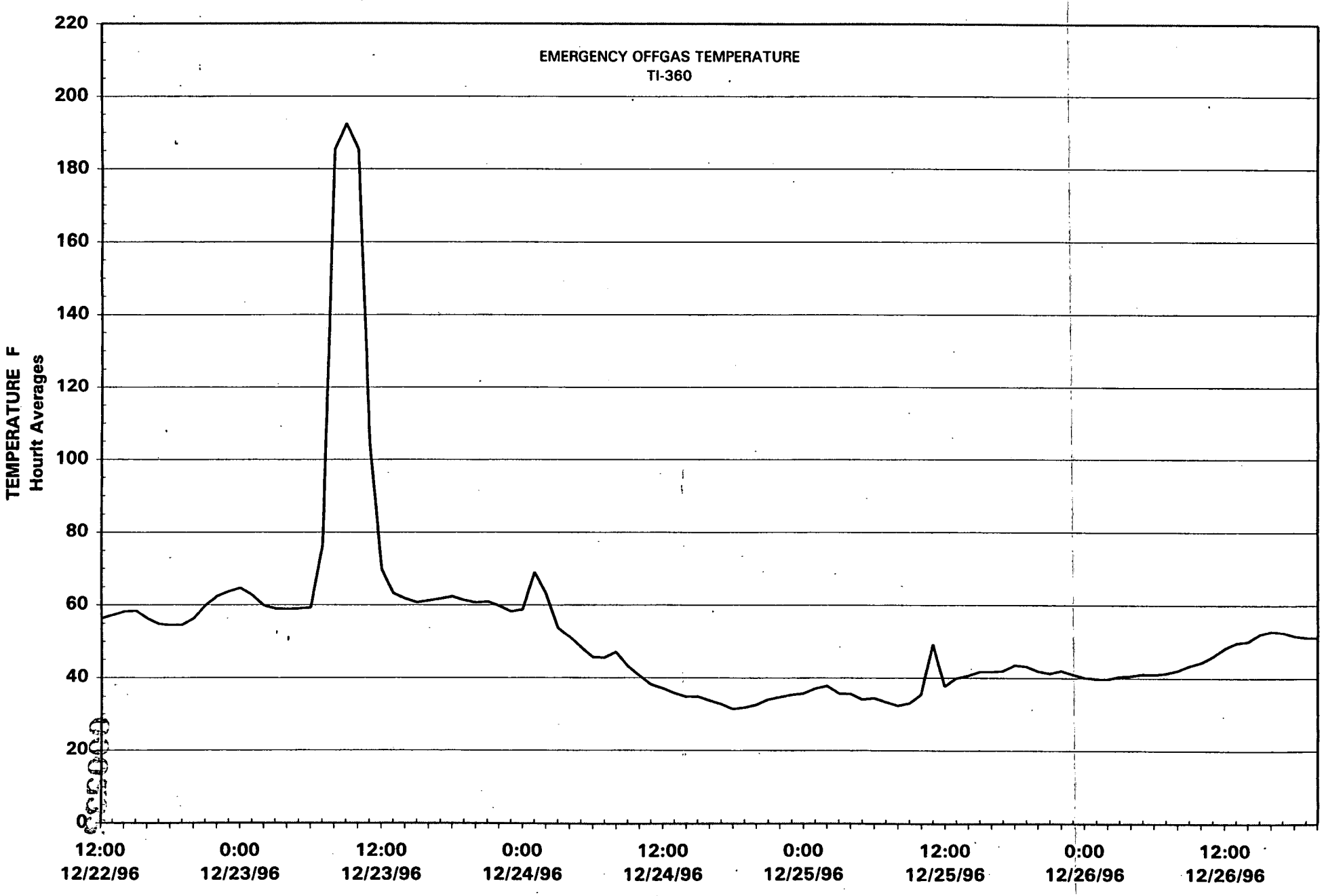
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS [redacted] t 1

VHP 1/14/97

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
EMERGENCY OFFGAS SYSTEM



C4EOG.XLS Chart 6

VHP 1/14/97

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM

CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS

			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/22/96	12:00	1.00	0.0	56.34	7474.25	0.3	0.0
12/22/96	13:00	1.00	0.0	57.25	7302.08		
12/22/96	14:00	1.00	0.0	58.22	7187.00		
12/22/96	15:00	1.00	0.0	58.41	7814.58		
12/22/96	16:00	1.00	0.0	56.29	8387.03	0.2	0.0
12/22/96	17:00	1.00	0.0	54.81	8493.17		
12/22/96	18:00	1.00	0.0	54.53	8448.33		
12/22/96	19:00	1.00	0.0	54.64	8443.67		
12/22/96	20:00	0.61	0.0	56.32	7622.03	0.2	0.0
12/22/96	21:00	1.00	0.0	59.89	7045.92		
12/22/96	22:00	1.00	0.0	62.29	6947.08		
12/22/96	23:00	1.00	0.0	63.63	6938.42		
12/23/96	0:00	0.85	0.0	64.63	7006.75		
12/23/96	1:00	0.75	0.0	62.66	7443.33		
12/23/96	2:00	1.00	0.0	59.86	7605.75		
12/23/96	3:00	1.00	0.0	59.04	7217.67		
12/23/96	4:00	1.00	0.0	58.92	7658.75	0.2	0.0
12/23/96	5:00	1.00	0.0	59.02	7590.33		
12/23/96	6:00	1.00	0.0	59.31	7371.92		
12/23/96	7:00	1.00	0.3	76.31	7551.25		
12/23/96	8:00	1.00	1.0	185.10	7743.73	0.4	0.4
12/23/96	9:00	1.00	1.0	192.42	7948.17		
12/23/96	10:00	1.00	1.0	185.29	7949.32		
12/23/96	11:00	0.75	0.1	104.74	7699.83		
12/23/96	12:00	1.00	0.0	69.79	7702.42	0.2	0.0
12/23/96	13:00	1.00	0.0	63.19	7710.50		
12/23/96	14:00	1.00	0.0	61.76	7737.96		
12/23/96	15:00	1.00	0.0	60.77	7477.42		
12/23/96	16:00	1.00	0.0	61.21	7413.45	0.4	0.0
12/23/96	17:00	1.00	0.0	61.76	7364.50		
12/23/96	18:00	0.48	0.0	62.31	7395.75		
12/23/96	19:00	1.00	0.0	61.33	7746.50		
12/23/96	20:00	0.68	0.0	60.70	7773.08	0.2	0.0
12/23/96	21:00	1.00	0.0	60.95	7593.17		
12/23/96	22:00	0.52	0.0	59.77	7514.58	-	
12/23/96	23:00	1.00	0.0	58.25	7646.08		
12/24/96	0:00	1.00	0.0	58.79	7735.75	0.2	0.0
12/24/96	1:00	0.85	0.1	68.91	7841.00		
12/24/96	2:00	1.00	0.0	63.06	7771.67		
12/24/96	3:00	1.00	0.0	53.82	7903.58		
12/24/96	4:00	1.00	0.0	51.38	8035.00	0.1	0.2
12/24/96	5:00	1.00	0.0	48.34	8084.25		
12/24/96	6:00	1.00	0.0	45.78	8089.58		
12/24/96	7:00	1.00	0.0	45.56	7528.42		
12/24/96	8:00	1.00	0.0	47.08	7659.75	0.0	0.0
12/24/96	9:00	1.00	0.0	43.33	7957.25		

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VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/24/96	10:00	1.00	0.0	40.64	8079.00		
12/24/96	11:00	1.00	0.0	38.27	8105.85		
12/24/96	12:00	1.00	0.0	37.26	8110.25	0.0	0.0
12/24/96	13:00	1.00	0.0	35.91	8033.33		
12/24/96	14:00	1.00	0.0	34.86	7979.00		
12/24/96	15:00	1.00	0.0	34.95	8019.50		
12/24/96	16:00	0.83	0.0	33.86	8040.08	0.2	0.0
12/24/96	17:00	0.15	0.0	32.82	8074.92		
12/24/96	18:00	1.00	0.0	31.46	8029.15		
12/24/96	19:00	1.00	0.0	31.90	8029.42		
12/24/96	20:00	1.00	0.0	32.64	8022.42	0.2	0.0
12/24/96	21:00	1.00	0.0	34.17	8131.25		
12/24/96	22:00	1.00	0.0	34.81	8116.50		
12/24/96	23:00	1.00	0.0	35.48	8087.42		
12/25/96	0:00	1.00	0.0	35.87	8047.17	0.2	0.0
12/25/96	1:00	1.00	0.0	37.21	8026.92		
12/25/96	2:00	1.00	0.0	37.97	8134.50		
12/25/96	3:00	1.00	0.0	35.85	8234.33		
12/25/96	4:00	1.00	0.0	35.71	8235.08	0.2	0.0
12/25/96	5:00	0.80	0.0	34.15	8164.92		
12/25/96	6:00	0.78	0.0	34.48	8230.08		
12/25/96	7:00	1.00	0.0	33.41	8272.67		
12/25/96	8:00	0.68	0.0	32.45	8364.92	0.2	0.0
12/25/96	9:00	0.78	0.0	33.07	8461.92		
12/25/96	10:00	0.32	0.1	35.48	8468.17		
12/25/96	11:00	0.83	0.1	49.17	8246.00		
12/25/96	12:00	1.00	0.0	37.86	8228.50	0.2	0.0
12/25/96	13:00	1.00	0.0	39.90	8198.67		
12/25/96	14:00	1.00	0.0	40.61	8125.75		
12/25/96	15:00	1.00	0.0	41.68	8090.58		
12/25/96	16:00	1.00	0.0	41.72	8091.33	0.2	0.0
12/25/96	17:00	1.00	0.0	41.94	8135.08		
12/25/96	18:00	1.00	0.0	43.59	8177.75		
12/25/96	19:00	1.00	0.0	43.22	8259.17		
12/25/96	20:00	0.92	0.0	41.91	8286.75	- 0.2	0.0
12/25/96	21:00	0.87	0.0	41.27	8145.58		
12/25/96	22:00	1.00	0.0	42.03	8193.50		
12/25/96	23:00	1.00	0.0	40.96	8361.50		
12/26/96	0:00	1.00	0.0	40.15	8431.42	0.2	0.0
12/26/96	1:00	1.00	0.0	39.85	8398.00		
12/26/96	2:00	1.00	0.0	39.76	8356.08		
12/26/96	3:00	1.00	0.0	40.42	8357.08		
12/26/96	4:00	1.00	0.0	40.59	8353.46	0.2	0.0
12/26/96	5:00	1.00	0.0	41.09	8289.92		
12/26/96	6:00	1.00	0.0	41.00	8194.67		
12/26/96	7:00	1.00	0.0	41.32	8239.42		

VITRIFICATION PILOT PLANT EMERGENCY OFFGAS SYSTEM							
CAMPAIGN 4 TRANSITION TO LOW TEMPERATURE SERIES A GLASS							
			HOURLY AVERAGES			ROUNDSHEET READINGS	
READINGS		EOG	EMERGENCY	EOG	TOTAL	EOG	EOG
		OPERATING MODE	OFFGAS	TEMPERATURE	STACK	PREFILTER	HEPA FILTER
		MANUAL or AUTO	SYSTEM		FLOW	DIFFERENTIAL	DIFFERENTIAL
		HS-361	FV-370			PRESSURE	PRESSURE
		0.0>AUTO<1.0	ON = 1.0	TI-360	FI-251	PDI-370A	PDI-370
DATE	HOUR	MANUAL = 0.0	OFF = 0.0	F	SCFM	In WC	In WC
12/26/96	8:00	0.78	0.0	42.12	8260.50	0.2	0.0
12/26/96	9:00	1.00	0.0	43.44	8239.75		
12/26/96	10:00	1.00	0.0	44.40	8193.33		
12/26/96	11:00	0.73	0.0	46.10	8126.42		
12/26/96	12:00	1.00	0.0	48.30	8012.75	0.2	0.0
12/26/96	13:00	1.00	0.0	49.68	8005.92		
12/26/96	14:00	1.00	0.0	50.13	8002.50		
12/26/96	15:00	1.00	0.0	52.08	8045.25		
12/26/96	16:00	1.00	0.0	52.88	8502.00	0.2	0.0
12/26/96	17:00	1.00	0.0	52.54	8221.64		
12/26/96	18:00	1.00	0.0	51.63	7945.33		
12/26/96	19:00	1.00	0.0	51.17	7873.39		
12/26/96	20:00	1.00	0.0	51.04	7937.08	0.2	0.0

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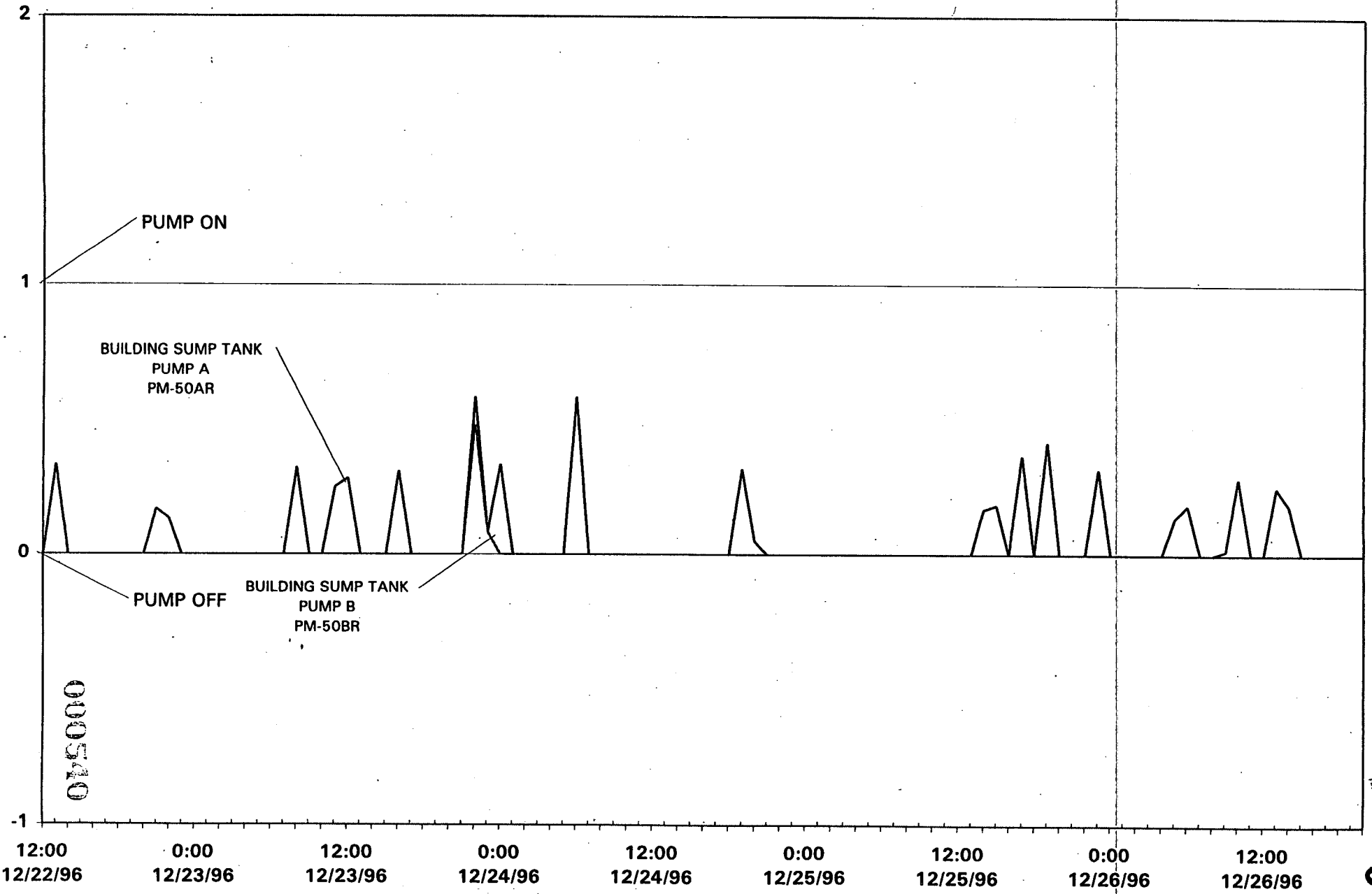
RECYCLE WATER SYSTEM

CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS RECYCLE WATER SYSTEM



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C4RCYWTR.XLS Chart 5

VHP 3/12/97

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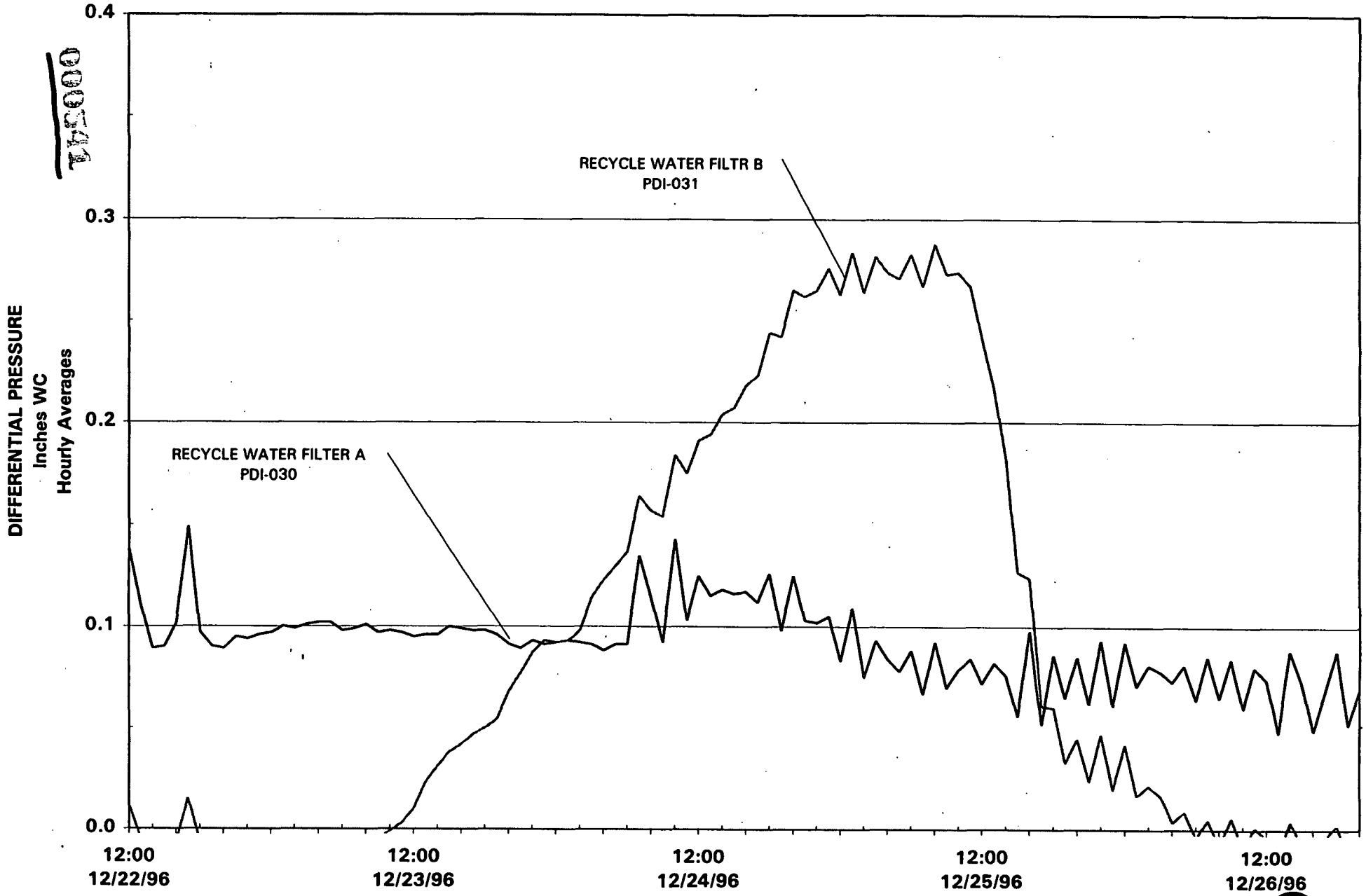
CAMPAIGN 4
TRANSITION TO LOW TEMPERATURE SERIES A GLASS
RECYCLE WATER SYSTEM



C4RCYWT Chart 6

VHP /97

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