Keywords: HWVP, IDMS, DWPF,
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INTEGRATED DWPF MELTER SYSTEM (IDMS) CAMPAIGN REPORT

HANFORD WASTE VITRIFICATION PLANT (HWVP) PROCESS DEMONSTRATION (U)

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ABSTRACT

Vitrification facilities are being developed worldwide to convert high-level nuclear waste to a durable glass form for permanent disposal. Facilities in the United States include the Department of Energy's Defense Waste Processing Facility (DWPF) at the Savannah River Site, the Hanford Waste Vitrification Plant (HWVP) at the Hanford Site and the West Valley Demonstration Project (WVDP) at West Valley, NY. At each of these sites, highly radioactive defense waste will be vitrified to a stable borosilicate glass. The DWPF and WVDP are near physical completion while the HWVP is in the design phase.

The Integrated DWPF Melter System (IDMS) is a vitrification test facility at the Savannah River Technology Center (SRTC). It was designed and constructed to provide an engineering-scale representation of the DWPF melter and its associated feed preparation and off-gas treatment systems. Because of the similarities of the DWPF and HWVP processes, the IDMS facility has also been used to characterize the processing behavior of a reference NCAW simulant. The demonstration was undertaken specifically to determine material balances, to characterize the evolution of offgas products (especially hydrogen), to determine the effects of noble metals, and to obtain general HWVP design data. The campaign was conducted from November, 1991 to February, 1992.

CONTENTS

	Page
CONTENTS	i
LIST OF FIGURES	v
LIST OF TABLES	xiii
ACRONYMS	xvii
SUMMARY/RECOMMENDATIONS	1
CAMPAIGN OVERVIEW	9
SYSTEM DESCRIPTION	11
Feed Preparation System	11
Process Vessel Vent System	14
Feed Delivery System	17
Melter System	18
Melter Offgas System	24
Process Analyzers	29
RAW MATERIALS	33
Sludge	33
Formic Acid	38
Recycle Waste Stream	38
Frit	41
LABORATORY-SCALE EXPERIMENTATION	43
Run #1	43
Run #2	45
HWVP1 BATCH HISTORY	51
Sludge Make-up	51
Formic Acid Addition	65

CONTENTS

	Page
RWS Cycle	70
FRIT Cycle	73
Melter Operation	78
HWVP2 BATCH HISTORY	83
Sludge Make-up	83
Formic Acid Addition	97
RWS Cycle	100
FRIT Cycle	103
Melter Operation	105
FEED PREPARATION	108
Material Balances	108
Major Components	108
Minor Components	108
Trace Components	109
Noble Metals	109
Anions	109
Offgas Products	114
Hydrogen Evolution	114
Ammonia / Ammonium Production	116
N _y O _x Production / Nitrogen Balance	121
CO _x Production / Carbon Balance	127
Formic Acid Consumption	133
HWVP1	133
HWVP2	137

CONTENTS

	Page
MELTER SYSTEM	143
Material Balances	143
Major Components	143
Minor Components	149
Trace Components	149
Melter Offgas System	153
Nitrogen Balance	153
Carbon Balance	154
Offgas System Deposits	155
NOBLE METALS IN THE MELTER SYSTEM	163
Size, Distribution, and Chemical Form	163
Melter Feed Slurry	164
Melter Cold Cap	164
Glass Product	165
Melter Floor	175
Methods for Noble Metals Analysis	196
Noble Metals Material Balance	196
Effects on the Melter Operation	211
GLASS PRODUCT QUALITY	221
REDOX of the Glass Product	221
Applicability of the PCCS	223
Viscosity of the Glass Product	224
Product Consistency Test	225
Experimental Method	225
Test Results and Discussion	226

CONTENTS

	Page
INTEGRATED SYSTEM PERFORMANCE	235
Sludge/Slurry Rheological Measurements	235
Use of DWPF Analytical Methods	235
PERTINENT HWVP DESIGN DATA	241
QUALITY ASSURANCE	249
ACKNOWLEDGMENTS	251
REFERENCES	253
APPENDICES	257
APPENDIX A: Campaign Sample Log	
APPENDIX B: Analytical Flowsheets	
APPENDIX C: Analytical Results	
APPENDIX D: Material Balance Tables	
APPENDIX E: Sludge Make-up Procedure	

LIST OF FIGURES

	Page
1 IDMS Process Schematic	12
2 IDMS SRAT/SME	13
3 IDMS SRAT/SME Condenser	15
4 Formic Acid Vent Condenser	16
5 IDMS Melter Feed Tube	18
6 Cross-Sectional View of the IDMS Melter	20
7 Geometric Comparison of the IDMS and DWPf/HWVP Melters	21
8 Lab Scale Run #1 Offgas Products	46
9 Lab Scale Run #1 pH Profile	46
10 Lab Scale Run #2 Offgas Products	49
11 Lab Scale Run #2 pH Profile	49
12 HWVP1 Chronological Timeline (07-NOV-91)	52
13 HWVP1 Chronological Timeline (11-NOV-91)	53
14 HWVP1 Chronological Timeline (12-NOV-91)	54
15 HWVP1 Chronological Timeline (13-NOV-91)	55
16 HWVP1 Chronological Timeline (14-NOV-91)	56
17 HWVP1 Chronological Timeline (15-NOV-91)	57
18 HWVP1 Chronological Timeline (18-NOV-91)	58
19 HWVP1 Chronological Timeline (19-NOV-91)	59
20 HWVP1 Plots of SRAT/SME Temperature (top) and SRAT/SME Volume (bottom)	60
21 HWVP1 Plots of Total Offgas Flow (top), SRAT/SME air purge (middle), and SRAT/SME vapor space pressure (bottom)	61
22 HWVP1 Plots of Hydrogen, H ₂ , (top) and Carbon Dioxide, CO ₂ , (bottom)	62

LIST OF FIGURES

	Page
23 HWVP1 Plots of Nitrogen Oxide, NO, (top), Nitrogen Dioxide, NO ₂ , (middle), and Nitrous Oxide, N ₂ O, (bottom)	63
24 HWVP1 Plots of Oxygen, O ₂ , (top), Nitrogen, N ₂ , (middle), and (N ₂ :O ₂) Molar Ratio (bottom)	64
25 HWVP1 SRAT Temperature - Formic Cycle	69
26 HWVP1 Formic Acid Addition Rate	69
27 Location of Feed Line Blockages During HWVP1	79
28 Feedrate Profile for HWVP1 Melter Feeding	79
29 HWVP1 Feed Loop Recirculation Rate (gpm)	80
30 HWVP1 Melter Feed Pump Output (%)	80
31 HWVP1 Melter Feed Tank Level (%)	81
32 HWVP2 Chronological Timeline (05-DEC-91)	84
33 HWVP2 Chronological Timeline (08-DEC-91)	85
34 HWVP2 Chronological Timeline (09-DEC-91)	86
35 HWVP2 Chronological Timeline (10-DEC-91)	87
36 HWVP2 Chronological Timeline (11-DEC-91)	88
37 HWVP2 Chronological Timeline (12-DEC-91)	89
38 HWVP2 Plots of SRAT/SME Temperature (top) and SRAT/SME Volume (bottom)	90
39 HWVP2 Plots of Total Offgas Flow (top), SRAT/SME air purge (middle), and SRAT/SME vapor space pressure (bottom)	91
40 HWVP2 Plots of Hydrogen, H ₂ , (top) and Carbon Dioxide, CO ₂ , (bottom)	92
41 HWVP2 Plots of Nitrogen Oxide, NO, (top), Nitrogen Dioxide, NO ₂ , (middle), and Nitrous Oxide, N ₂ O, (bottom)	93
42 HWVP2 Plots of Oxygen, O ₂ , (top), Nitrogen, N ₂ , (middle), and (N ₂ :O ₂) Molar Ratio (bottom)	94

LIST OF FIGURES

	Page
43 HWVP2 SRAT Temperature - Formic Cycle	98
44 HWVP2 Formic Acid Addition Rate	98
45 Feedrate Profile for HWVP2 Melter Feeding	105
46 HWVP2 Feed Loop Recirculation Rate (gpm)	106
47 HWVP2 Melter Feed Tank Level (%)	106
48 HWVP1 Hydrogen Generation - Formic Cycle	115
49 HWVP2 Hydrogen Generation - Formic Cycle	116
50 HWVP1 Nitrogen Oxides - Formic Cycle	122
51 HWVP2 Nitrogen Oxides - Formic Cycle	124
52 HWVP1 Carbon Dioxide - Formic Cycle	128
53 HWVP2 Carbon Dioxide - Formic Cycle	130
54 Plot of the pH of the HWVP1 SRAT Contents during the formic acid addition/digestion period	134
55 Plot of the formate, nitrate, and nitrite concentrations for the HWVP1 formic acid addition/digestion period	134
56 Plot of the carbon content of the HWVP1 SRAT contents during the formic acid addition/digestion period	135
57 Plot of the solubility of selected components in the HWVP1 SRAT during the formic acid addition/digestion period	135
58 Plot of the solubility of selected components in the HWVP1 SRAT during the formic acid addition/digestion period	136
59 Plot of the pH of the HWVP2 SRAT material during the formic acid addition period	138
60 Plot of the carbon content of the HWVP2 SRAT contents during the formic acid addition period	139

LIST OF FIGURES

	Page
61 Plot of the solubility of selected components in the HWVP2 SRAT during the formic acid addition period	139
62 Plots of HWVP1 and HWVP2 Glass Component versus total glass production (a) Aluminum (b) Barium (c) Boron/Potassium and (d) Cadmium	144
63 Plots of HWVP1 and HWVP2 Glass Component versus total glass production (a) Calcium (b) Chromium (c) Copper and (d) Iron	145
64 Plots of HWVP1 and HWVP2 Glass Component versus total glass production (a) Lead (b) Lithium (c) Magnesium and (d) Manganese	146
65 Plots of HWVP1 and HWVP2 Glass Component versus total glass production (a) Molybdenum (b) Neodymium (c) Silicon and (d) Titanium	147
66 Plots of HWVP1 and HWVP2 Glass Component versus total glass production (a) Zinc (b) Nickel (c) Sodium and (d) Zirconium	148
67 Offgas Deposit Sampling Point	156
68 Melter Offgas Header Deposits	157
69 SEM Micrograph (2000X) showing a typical IDMS offgas deposit prior to the HWVP Demonstration (I-OGDP-4178)	159
70 SEM Micrographs (top 50X, bottom 500X) showing a typical IDMS offgas deposit after feeding the HWVP1 material (H-OGDP-0297)	160
71 SEM Micrograph (1000X) showing a typical IDMS offgas deposit after feeding the HWVP2 material (H-OGDP-0397)	161
72 SEM Micrograph (15X) showing a sample of the HWVP1 Melter Cold Cap (H-COLD-0238)	165
73 SEM Micrograph (3000X) - glass sample HWVP1 material (H-GLAS-0162)	166
74 SEM Micrograph (1500X) - glass sample HWVP1 material (H-GLAS-0162)	167

LIST OF FIGURES

	Page
75 SEM Micrograph (100X and 1000X) - glass sample HWVP1 material (H-GLAS-0264)	168
76 SEM Micrograph (3000X) - glass sample HWVP1 material (H-GLAS-0294)	169
77 SEM Micrograph (2000X) - glass sample HWVP2 material (H-GLAS-0334)	170
78 SEM Micrograph (750X) - glass sample HWVP2 material (H-GLAS-0334)	171
79 SEM Micrograph (500X) - glass sample HWVP2 material (H-GLAS-0421)	172
80 SEM Micrograph (750X) - glass sample HWVP2 material (H-GLAS-0446)	173
81 SEM Micrograph (2000X) - glass sample HWVP2 material (H-GLAS-0446)	174
82 Top View of IDMS Melter	177
83 SEM Micrograph (500X) - melter bottom sample taken 8/23/91 (I-MELT-4312)	178
84 SEM Micrograph (100X) - melter bottom sample taken 10/15/91 (I-MELT-4790)	179
85 SEM Micrograph (200X) - melter bottom sample taken 10/15/91 (I-MELT-4790)	180
86 SEM Micrograph (2000X) - melter bottom sample taken 10/15/91 (I-MELT-4790)	181
87 SEM Micrograph - melter bottom sample taken 12/4/91 (H-MELT-0330)	182
88 SEM Micrograph - melter bottom sample taken 12/18/91 (H-MELT-0329)	183
89 SEM Micrograph - melter bottom sample taken 12/18/92 (H-MELT-0329)	184
90 SEM Micrograph - melter bottom sample taken 3/6/92 (I-MELT-5219)	185
91 SEM Micrograph - melter bottom sample taken 3/6/92 (I-MELT-5219)	186

LIST OF FIGURES

	Page
92 SEM Micrograph - melter bottom sample taken 3/6/92 (I-MELT-5219)	187
93 SEM Micrograph - melter bottom sample taken 3/27/92 (I-MELT-5242)	188
94 SEM Micrograph - melter bottom sample taken 3/27/92 (I-MELT-5242)	189
95 SEM Micrograph - melter bottom sample taken 3/27/92 (I-MELT-5242)	190
96 SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270)	191
97 SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270)	192
98 SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270)	193
99 SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270)	194
100 Plots of (a) Ru vs lbs of Glass, (b) Ru vs Production Time, (c) Rh vs lbs of Glass, and (d) Rh vs Production Time	198
101 Plots of (a) Pd vs lbs of Glass, (b) Pd vs Production Time, (c) Te vs lbs of Glass, and (d) Te vs Production Time	199
102 Plots of (a) Ag vs lbs of Glass, (b) Ag vs Production Time, and (c) Se vs lbs of Glass	200
103 Plots of (a) Al vs Production Time, (b) Cd vs Production Time, (c) Mn vs Production Time	201
104 Plot of Overall HWVP1 Ru Mass Balance	203
105 Plot of Overall HWVP1 Pd Mass Balance	203
106 Plot of Overall HWVP1 Rh Mass Balance	203
107 Plot of Overall HWVP1 Te Mass Balance	204
108 Plot of Overall HWVP1 Ag Mass Balance	204
109 Plot of Overall HWVP2 Ru Mass Balance	206

LIST OF FIGURES

	Page
110 Plot of Overall HWVP2 Pd Mass Balance	206
111 Plot of Overall HWVP2 Rh Mass Balance	206
112 Plot of Overall HWVP2 Te Mass Balance	207
113 Plot of Overall HWVP2 Ag Mass Balance	207
114 Plot of Glass Production vs Production Time	208
115 Plot of Ru Mass Balance vs Production Time	208
116 Plot of Pd Mass Balance vs Production Time	209
117 Plot of Rh Mass Balance vs Production Time	209
118 Plot of Te Mass Balance vs Production Time	210
119 Plot of Ag Mass Balance vs Production Time	210
120 AB/CD Resistance Ratio and Apparent Resistance for long-term melter operation	212
121 AB and CD Electrode Temperatures for long-term melter operation	213
122 Electrode Current and Voltage for long-term melter operation	214
123 Electrode Power and Glass Pool Temperature for long-term melter operation	215
124 HWVP1 and HWVP2 Melter Operation - Upper and Lower Glass Pool Resistances x Upper and Lower Glass Pool Temperature	216
125 HWVP1 and HWVP2 Glass Pool Resistance*Temperature Ratio During Periods of Feeding and Idling	216
126 HWVP1 and HWVP2 Top and Bottom Glass Pool Temperatures	217
127 Upper and Lower Electrode Current during HWVP1 and HWVP2	217
128 Upper and Lower Electrode Voltage during HWVP1 and HWVP2	218
129 Electrode Temperatures during HWVP1 and HWVP2	218

LIST OF FIGURES

	Page
130 Lid Heater Currents during HWVP1 and HWVP2	219
131 Melter Plenum Temperature During Periods of Feeding and Idling during HWVP1 and HWVP2	219
132 Melt Viscosity versus Melt Temperature	224
133 Internal Consistency of PCT Data	227
134 HAAKE Rotovisco (RV3) Rheometer	236

LIST OF TABLES

	Page
1 IDMS/DWPF/HWVP Melter Comparison	19
2 IDMS Process Analyzers - Feed Preparation	30
3 IDMS Process Analyzers - Melter System	31
4 Composition of the Mixed Hydroxide Slurry	34
5 Primary Chemicals - Nitrates/Nitrites (grams)	35
6 Primary Chemicals - Oxides/Hydroxides (grams)	35
7 Primary Chemicals - Salts/Others (grams)	36
8 Secondary Trim Chemicals (grams)	37
9 Ruthenium Conversion Procedure	37
10 Formic Acid Concentrations for Each Run	38
11 Trim Chemicals Used for Make-up of the RWS	39
12 Zeolite and Diatomaceous Earth Comp (wt%)	39
13 Recycle Waste Stream (RWS)	40
14 IDMS/HWVP Frit Composition	41
15 Summary of IDMS/HWVP Frit Characterization	42
16 Lab Scale Run #1 Sludge Composition	44
17 Calculated Formic Acid Requirement Run #1	45
18 Lab Scale Run #2 Sludge Composition	47
19 Calculated Formic Acid Requirement Run #2	48
20 HWVP1 Waste Sludge Simulant (elem/oxides)	66
21 HWVP1 Waste Sludge Simulant (wet chem)	67
22 Calculated Formic Acid Requirement for HWVP1	68
23 Sludge after formic acid add'n and digestion	70
24 HWVP1 SME after RWS addition (before conc'n)	71
25 HWVP1 SME after RWS addition (after conc'n)	71

LIST OF TABLES

	Page
26 HWVP2 SME Composition after RWS Addition	72
27 HWVP1 SME Composition after FRIT Cycle	74
28 HWVP1 SME Composition after FRIT Cycle	75
29 HWVP1 SME Composition after NaNO ₃ Addition	76
30 HWVP1 SME Composition after NaNO ₃ Addition	77
31 HWVP2 Waste Sludge Composition	95
32 HWVP2 Waste Sludge Composition	96
33 Calculated Formic Acid Requirement for HWVP2	97
34 HWVP2 SRAT Composition after Formic Digestion	99
35 HWVP2 SME after RWS add'n - unconc'd	101
36 HWVP2 SME after RWS add'n - conc'd	101
37 HWVP2 SME Composition after RWS Cycle	102
38 HWVP2 SME Composition after FRIT Cycle	103
39 HWVP2 SME Composition after FRIT Cycle	104
40 Feed Preparation Material Balance - Major Components	110
41 Feed Preparation Material Balance - Minor Components	111
42 Feed Preparation Material Balance - Trace Components	112
43 Feed Preparation Material Balance - Noble Metals and Anions.....	113
44 Ammonium Data - HWVP1	118
45 Ammonium Data - HWVP2	120
46 HWVP1 Feed Preparation Nitrogen Balance	123
47 HWVP2 Feed Preparation Nitrogen Balance	126
48 HWVP1 Feed Preparation Carbon Balance	129
49 HWVP2 Feed Preparation Carbon Balance	131

LIST OF TABLES

	Page
50 Modified Formic Acid Requirement for HWVP1	141
51 Modified Formic Acid Requirement for HWVP2	142
52 Melter Material Balance - Major Components	150
53 Melter Material Balance - Minor Components	151
54 Melter Material Balance - Trace Components	152
55 Typical Operating Conditions of the IDMS Melter Offgas System	155
56 Chemical Composition of the Offgas Deposits	158
57 Noble Metals in German, SRS, and Hanford Wastes	162
58 Analysis of IDMS Melter Floor Samples	176
59 HWVP1 Noble Metal Material Balance - Melter	201
60 HWVP2 Noble Metal Material Balance - Melter	204
61 $\text{Fe}(2+)/\Sigma\text{Fe}(\text{total})$ for HWVP1 and HWVP2 Glasses	221
62 PCT Multielement Standard Analysis	228
63 PCT Analysis of ARM glass and Blank	229
64 PCT Leachate Concentrations for HWVP1 Glass	230
65 PCT Leachate Concentrations for HWVP2 Glass	231
66 PCT Normalized Release Rates for HWVP1 Glass	232
67 PCT Normalized Release Rates for HWVP2 Glass	233
68 HWVP1 Rheology Measurements	237
69 HWVP2 Rheology Measurements	238

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LIST OF ACRONYMS

AA:	Atomic Absorption
ADS:	Analytical Development Section of SRTC
BDL:	Below Detection Limit
CPC:	Chemical Processing Cell
DWPF:	Defense Waste Processing Facility
DWPT:	Defense Waste Processing Technology Section of SRTC
EDX:	Energy Dispersive X-Ray
FAVC:	Formic Acid Vent Condenser
GC:	Gas Chromatograph
HEME:	High Efficiency Mist Eliminator
HEPA:	High Efficiency Particulate Air filter
HTC:	Heat Transfer Coefficient
HWVP1:	First Run of the HWVP Process Demonstration
HWVP2:	Second Run of the HWVP Process Demonstration
HWVP:	Hanford Waste Vitrification Plant
IC:	Ion Chromatography
ICP:	Inductively Coupled Plasma
ICP-AES:	Inductively Coupled Plasma - Atomic Emission Spectroscopy
ICP-MS:	Inductively Coupled Plasma - Mass Spectrometry
IDMS:	Integrated DWPF Melter System
INE/KfK:	Institute für Nuklear Entsorgungstechnik at Kernforschungszentrum Karlsruhe
IXS:	Ion Exchange System
LEL:	Lower Explosive Limit
LIMS:	Laboratory Information Management System
ME:	Mist Eliminator
MFT:	Melter Feed Tank
MOC:	Minimum Oxygen for Combustion
NCAW:	Neutralized Current Acid Waste
OGCT:	Off Gas Condensate Tank
PCCS:	Product Composition Control System
PCT:	Product Consistency Test
PLC:	Programmable Logic Controller
PNL:	Battelle Pacific Northwest Laboratory
PVVS:	Process Vessel Vent System
RWS:	Recycle Waste Stream
SAS:	Steam Atomized Scrubber
SCR:	Silicon Controlled Rectifier
SEM:	Scanning Electron Microscopy/Microscope
SME:	Slurry Mix Evaporator
SRAT:	Sludge Receipt and Adjustment Tank
SRL:	Savannah River Laboratory (now SRTC)
SRS:	Savannah River Site
SRTC:	1) Savannah River Technology Center, 2) a process sample name (SRAT after Trim Chemicals added)
TEM:	Transmission Electron Microscopy/Microscope
TIC:	Total Inorganic Carbon
TOC:	Total Organic Carbon
TC:	Total Carbon
WHC:	Westinghouse Hanford Company
WSRC:	Westinghouse Savannah River Company
WVDP:	West Valley Demonstration Project
WWPT:	Waste Water Pump Tank
XRD:	X-Ray Diffraction
XRF:	X-Ray Fluorescence

NOTE TO READERS:

The following is a summary of conventions used in the presentation of data for this report:

- Analytical results for various process samples will consistently list concentrations of elements in wt%. Unless otherwise noted, this implies wt% of that element with respect to the total solids (soluble and insoluble) in liquid samples and the total sample weight for solid samples.
- At times, the oxide composition of a sample is reported. These oxide composition were obtained by assuming an oxide form of each measured element and converting the measured elemental composition (on a calcine solids basis) to that oxide by multiplying by the appropriate gravimetric/oxide factor. This method is flawed in that it neglects the contribution of halides and sulfates; but, it is a reasonable approximation of the actual composition.
- All pH measurements, unless otherwise noted, were taken at room temperature ($\approx 25^{\circ}\text{C}$).
- For the most part, process data are presented in the units in which they are reported or measured.
- Any data which has been "corrected" is indicated. If no indication is shown, the reader can assume that the values are "as measured" or "as reported". Samples are only corrected if the analysis of standard samples indicates that the analysis is significantly biased. Correction factors (bias corrections) are obtained from the analysis of standard samples which have been prepared (dissolved) and analyzed on the same day as the process sample to be corrected.
- Time is normally reported according to a 24 hour clock (military time).

SUMMARY/RECOMMENDATIONS

The Integrated DWPF Melter System (IDMS) is a pilot-scale vitrification test facility at the Savannah River Technology Center (SRTC). The IDMS has been used to characterize the operating behavior of the Defense Waste Processing Facility (DWPF).

Two runs designed to characterize the processing behavior of Hanford Neutralized Current Acid Waste (NCAW) were conducted in the IDMS. Specific objectives, as defined in the Technical Task Plan, are as follows:

Feed Preparation System:

- Determine the noble metals material balance around the HWVP Feed Preparation System.
- Determine the material balance (for all other components) around the HWVP Feed Preparation System.
- Characterize the evolution of hydrogen in the HWVP Feed Preparation System.
- Characterize the N_yO_x production in the HWVP Feed Preparation System.
- Characterize the offgas products in the HWVP Feed Preparation System.
- Characterize the consumption of formic acid.

Melter System:

- Demonstrate the long term effects of noble metals on melter operating performance.
- Demonstrate the noble metals material balance around the HWVP Melter System.
- Determine the material balance (for all other compounds) around the HWVP Melter System.
- Determine the size, distribution, and chemical form of noble metals in the HWVP glass product.
- Characterize the reduction/oxidation behavior of the HWVP glass.
- Characterize the offgas products of the HWVP Melter System.

Integrated System:

- Compare the operational behavior of the HWVP feed simulant to that of other feed simulants (DWPF) used in the IDMS.

- Characterize the effects of the Recycle Waste Stream (RWS) addition to the HWVP SME.
- Evaluate the use of the DWPF analytical methods on the HWVP process samples.
- Evaluate the use of the SRL Product Composition Control System (PCCS) on the HWVP process.
- Obtain pertinent HWVP design information when able.

The runs were conducted between November, 1991 and February, 1992. Approximately 7950 lbs of simulated waste glass were produced during the two run campaign.

Several raw materials were necessary for the two run campaign. These included a waste sludge simulant, a Recycle Waste Stream (RWS) simulant, 90wt% formic acid, and a borosilicate glass frit. Both runs contained reference amounts of noble metals. These materials were combined to form the feed slurry which was fed to the melter. The components were combined to form a glass which is approximately 28% waste oxides, 4% RWS oxides, and 68% frit oxides.

Prior to starting the pilot-scale operations, two lab-scale (2 liter) operations were conducted in order to estimate the amount of hydrogen which could be expected in the large scale equipment and to gauge the effectiveness of the IDMS hydrogen purge control system.

The first IDMS operation, referred to as HWVP1, was begun on November 7, 1991 with the transfer of mixed hydroxide slurry to the IDMS SRAT/SME vessel. Thirty-eight gallons of formic acid were added to the low nitrite ($\approx 0.1M$) waste sludge simulant. SRTC methods for determining the formic acid requirement predicted a requirement of 30 gallons. However, on the advice of PNL, an additional 8 gallons were added to ensure the initiation of hydrogen evolution. The formic acid was added at approximately 0.2 gpm which is a scaled equivalent to one-half the HWVP reference addition rate.

After addition of the formic acid, Recycle Waste Stream, and Frit, the resulting HWVP1 SME product was sampled and analyzed in order to determine its acceptability. The SME product was low in alkali oxide (specifically Na_2O since this was the "low nitrite" run) and high in silica (SiO_2) and was predicted to

have a melt viscosity which exceeded the processable limit (100 poise at 1150°C). The SME composition was adjusted by the addition of NaNO_3 .

Pumping of the HWVP1 melter feed slurry was difficult and the 0.25" feed line (just before the feed tube but after the strainer) was prone to blockages during the feeding cycle. The rheological properties of the feed material deteriorated with time.

The processing of the second run, HWVP2, was begun on December 5, 1991 with the transfer of the mixed hydroxide slurry to the IDMS SRAT/SME. Fifty-six gallons of formic acid were added to the waste sludge simulant which contained the reference concentration of nitrite (≈ 0.4 M). The formic acid was initially added at the equivalent reference addition rate, 0.4 gpm. This addition rate resulted in offgas "spikes" which caused pressure excursions in the SRAT/SME vapor space. These pressurizations resulted in numerous automatic process shut downs. A leak in the formic acid delivery system caused a 2-3 hour interruption in the formic acid addition. After repair of the leak, the formic acid was reinitiated at 0.3 gpm with much more stable results.

Recommendation: The HWVP should consider the effects of the formic acid addition rate (including offgas surges which can lead to vessel over-pressurization, foaming and high Vessel Vent System temperatures) in future design and research activities.

After the addition of formic acid was completed, the vessel contents were quickly taken to boiling resulting in severe foaming and solids carryover. Note that an antifoam agent (DOW CORNING #544) was regularly added throughout both HWVP1 and HWVP2 feed preparation cycles.

Recommendation: The HWVP should approach boiling very cautiously during feed preparation operations to reduce the possibility of foaming and unnecessary solids carryover. Further, regular addition of an antifoam agent is essential to reduce the potential for foaming.

After addition of the formic acid, Recycle Waste Stream, and Frit, the resulting HWVP1 SME product was sampled and analyzed in order to determine its acceptability. The SME product was very close to the target composition and was thus assumed to be processable.

Processing of the HWVP2 melter feed was extremely difficult. The feed rate of the melter feed slurry was very erratic. Two dilutions (with water) were necessary to continue processing. The rheological properties of this material were much worse than any slurry that had been previously processed in the IDMS facility. One obvious difference in the HWVP runs from previous IDMS runs done in support of the DWPF was the composition of the borosilicate glass frit. The frit used during the HWVP demonstrations has a low durability relative to the FRIT-202 used in DWPF tests. In an aqueous solution, the boron and lithium may leach from the frit matrix leaving the SiO_2 present as a silica gel. This would adversely affect the rheological properties of the feed slurry and would be worsened by the noble metal induced pH drift.

Recommendation: The rheology of the NCAW melter feed slurry may be a severe problem for the operation of the HWVP facility. It is recommended that further tests be conducted to fully characterize this behavior. These tests should include, but not be limited to, consideration of an alternate acid for feed preparation processing and use of a more durable frit composition.

Material balances for the major and minor components of the feed preparation processing were quite good. Material balances for the trace elements and noble metals were not as good, emphasizing the difficulty in analytically verifying the composition of these compounds.

Hydrogen was measured during the formic acid cycle for both the HWVP1 and HWVP2 runs. As expected, based on previous IDMS runs, the low nitrite HWVP1 material produced the peak hydrogen evolution rate. The maximum hydrogen was $1.7\text{E-}4$ pph H_2 per pound of waste oxides for HWVP1 and about 30 times lower for HWVP2. In each run, the peak hydrogen was measured at the onset of boiling at the start of the digestion period. The DWPF

design basis (for radioactive operations) is $1.8\text{E-}4$ pph H_2 per pound of waste oxides.

Ammonia generation was estimated by the analysis of ammonium in the SRAT contents and SRAT condenser condensates. A significant amount of ammonia was generated in both runs. However, as with the hydrogen, the ammonia generation was highest in HWVP1. Any ammonia which is not scrubbed in the SRAT condenser may react with residual nitric acid in the Process Vessel Vent System to form ammonium nitrate (NH_4NO_3) deposits. This material is potentially explosive.

Recommendation: Additional demonstrations using HWVP simulants which include noble metals should be conducted to better understand and quantify ammonia evolution.

Other offgases measured during the formic acid cycle of the two runs included carbon dioxide and the nitrogen oxides (NO , NO_2 , and N_2O). The evolution rates of these gases are very dependent upon the addition rate of the formic acid. The total amount of gas evolved is dependent upon the initial concentration of nitrite, carbonate, and MnO_2 in the waste sludge simulant.

Formic acid is added to the NCAW waste sludge in order to adjust the rheological properties for easier pumping and to sufficiently reduce Mn(IV) to Mn(II) to decrease the potential for foaming in the melter. The HWVP has not currently accepted a method for determination of the amount of formic acid required during feed preparation during plant operation.

Recommendation: WHC should adapt a method for determining the required formic acid which includes consideration for the varying concentration of formic acid consumers in the feed preparation process. These should include, but not be limited to, free hydroxide, nitrite, carbonate, MnO_2 , Cd(OH)_2 , and Ni(OH)_2 .

As with the feed preparation system, material balances for the major and minor components of the melter processing were adequate. Material balances for the trace elements were not as good, emphasizing the difficulty in analytically verifying the composition of these compounds. One interesting observation was that the amount of Cr exiting the melter with the glass was

consistently higher than the amount added with the melter feed. While this is most likely the result of the flushing of Cr-rich spinels which have accumulated on the IDMS melter floor, it may also be an indication of the deterioration of the Cr-containing Monofrax K-3 refractory and/or Inconel-690 electrodes.

Analysis of offgas deposits and offgas condensates suggest little or no volatility of cadmium. Some cadmium was measured in the offgas deposits but is more likely the result of entrainment rather than volatility. Ruthenium measured in the offgas deposits, however, suggest a limited amount of Ru may have exited the melter as the gaseous RuO_4 . However, most of this Ru was present in the offgas deposits as entrained RuO_2 -spinel particles and was not present in sufficient quantities ($\approx 1\%$ of total Ru) to affect the overall ruthenium balance in the melter system.

Analysis of the glass product via Scanning Electron Microscopy (SEM) revealed scattered individual and clustered RuO_2 as the principle melt insoluble. Ru/Rh alloys and palladium tellurides were also observed in the glass product. The particles were usually 10 - 100 micron.

Samples taken at the center of the melter and at the face of the lower electrode closest to the riser throat suggest a non-uniform layer of noble metals (mainly RuO_2) and Ni/Fe/Cr spinel on the melter floor. Analysis of these samples revealed a higher concentration of Ru in the samples taken from the outside edges of the melt pool (at the face of one of the electrodes). This suggests that the convective currents in the melter tend to "push" the RuO_2 from the center of the melter (where it enters) to the outside edges.

Material balances of the melter operation for both HWVP1 and HWVP2, coupled with analyses of melter floor samples, suggest that the noble metals are deposited in the following relative quantities: $\text{Ru} \gg \text{Rh} > \text{Pd} > \text{Ag}$. Material balances, using several analytical techniques, suggest that the noble metals are retained in the following amounts: Ruthenium: 10 - 40%, Rhodium: 10 - 15%, Palladium: 5 - 15%, and Silver: 0 - 10% (as a percentage of the total fed to the melter).

Plots of noble metal concentrations in the glass product versus production time and total glass production revealed that there was significant noble metal settling during periods of prolonged idling (when the melter was not being slurry fed). It is assumed that, once feeding has ceased, the insulating cold cap is melted and the convective currents significantly decrease and are no longer able to keep the melt insoluble noble metals suspended.

Just prior to starting the HWVP Process Demonstration, a change in the electrical properties of the IDMS melter was noted. The apparent resistance encountered by the lower set of electrodes (C-D) decreased relative to that encountered by the upper set of electrodes (A-B). This operating parameter was monitored by the upper-to-lower resistance ratio (AB/CD). This ratio continued to increase and stabilized midway through the test.

The glass produced during the two run campaign was quite oxidized (*i.e.* $\text{Fe}^{2+}/\Sigma\text{Fe}_{\text{total}} \ll 0.1$). No evidence of foaming in the melter was observed. The design melt rate of 8 lb/hr/ft² was met during periods of continuous feeding at an average rate of 25 lbs oxides/hr. However, during most of the melter operation, especially with the HWVP2 material, the melt rate was limited by the difficulty of feeding the slurry to the melter and not by the capacity of the melter.

Selected glass samples from both HWVP1 and HWVP2 were leached according to the Product Consistency Test (PCT). The results revealed that, while the estimated release of the NCAW glass was higher than Savannah River glass compositions, it does meet the current acceptance criteria for canistered waste glass forms (the glass must have a release rate which is better than the 131 Stage 2 glass that was qualified in the DWPF Environmental Assessment).

CAMPAIGN OVERVIEW

Vitrification facilities are being developed worldwide to convert high-level nuclear waste to a durable glass form for permanent disposal. Facilities in the United States include the Department of Energy's Defense Waste Processing Facility (DWPF) at the Savannah River Site, the Hanford Waste Vitrification Plant (HWVP) at the Hanford Site, and the West Valley Demonstration Project (WVDP) at West Valley, NY. At each of these sites, highly radioactive defense waste will be vitrified to a stable borosilicate glass. The DWPF and WVDP are near physical completion while the HWVP is in the design phase.

Since the fall of 1988 the Savannah River Technology Center (SRTC), has operated the Integrated DWPF Melter System (IDMS). The IDMS is a vitrification test facility which was designed and constructed to provide an engineering-scale representation of the DWPF melter and its associated feed preparation and off-gas treatment systems. The system has been used extensively in the characterization of the operating behavior of the DWPF.¹⁻⁵

Because of the similarities of the DWPF and HWVP processes, the IDMS facility has also been used to characterize the processing of one type of Hanford High Level Waste (NCAW). In order to perform this characterization, the IDMS was operated batch-style for two feed preparation (SRAT/SME) cycles. These runs were conducted between November, 1991 and February, 1992 and are referred to as HWVP1 and HWVP2.

The campaign was undertaken specifically to determine material balances, to characterize the evolution of offgas products (especially hydrogen), to determine the effects of noble metals, and to obtain general HWVP design data.⁶

SYSTEM AND EQUIPMENT DESCRIPTION

The IDMS feed preparation, process vessel vent, feed delivery, melter, and melter off-gas systems are located in Building 672-T at the TNX Area of the Savannah River Site. A flowsheet of the entire process is shown in Figure 1.

FEED PREPARATION SYSTEM

The feed preparation system consists of a Sludge Receipt and Adjustment Tank / Slurry Mix Evaporator (SRAT/SME), a SRAT/SME Condenser, and a Waste Water Pump Tank (WWPT). Individual components of the feed preparation system are as follows:

SRAT/SME

The SRAT/SME shown in Figure 2 is a 2000-gallon dished-head Hastelloy C-276 tank with separate internal Hastelloy steam and cooling water coils. The tank is vented to the Process Vessel Vent System (PVVS), which will be discussed in a later section. The IDMS SRAT/SME is approximately 1/5-scale compared (volumetrically) to the DWPF and HWVP SRAT and SME vessels.

The IDMS SRAT/SME agitation system is similar to that of the DWPF. The IDMS SRAT/SME has a 25-horsepower Hastelloy C-276 agitator which operates over a 42-125 rpm range while the DWPF canyon vessels use a 100-horsepower Hastelloy C-276 agitator which operates with fixed speeds of 65 and 130 rpm. Both the IDMS SRAT/SME and the DWPF agitation systems are comprised of upper and lower impellers. The upper impeller of the DWPF agitators has three blades of a hydrofoil design while the upper impeller of the IDMS agitator is a four blade pitched design. The lower (for both the IDMS and the DWPF) is a four blade flat impeller that acts as a sweeper to keep solids from depositing on the bottom of the tank. The IDMS impellers have a 30-inch diameter while the DWPF impeller diameter is 36 inches. During the HWVP testing, the SRAT/SME agitator was operated at a speed such the shear rate matched that of the DWPF SRAT and SME vessels. The shear rate is defined as:

$$s.r. = \frac{\text{Agitator tip speed (ft/sec)}}{\text{Distance from tip to vessel (ft)}}$$

This corresponded to a tip speed of 10.21 ft/sec (78 rpm).

Figure 2. IDMS SRAT/SME

SRAT/SME Condenser

The SRAT/SME Condenser shown in Figure 3 is a single-pass Hastelloy C-276 shell-and-tube heat exchanger. The condenser is insulated, and uses cooling water from the 672-T cooling tower.

Waste Water Pump Tank

The WWPT is a 125-gallon dished-head Hastelloy C-276 tank. All condensate from the SRAT/SME and melter operations are collected in this tank before exiting the facility to be processed in the TNX water treatment systems.

Sludge Receipt Tank

The simulated sludge used in the IDMS is vendor-supplied and is delivered to TNX via tank truck. The sludge is stored in the 10,000-gallon Sludge Receipt Tank (SRT). This tank is agitated and has a steam heating coil to prevent freezing of the tank contents.

Formic Acid Pump

The formic acid pump is a metering pump capable of pumping up to 0.5 gpm.

Frit Slurry Makeup Tank

The Frit Slurry Makeup Tank (FSMT) is the same tank that was previously used for experimentation in the Full Scale SRAT/SME facility. The FSMT is a 3,000-gallon stainless steel tank with a 5-hP agitator.

PROCESS VESSEL VENT SYSTEM

The PVVS serves the SRAT/SME, the Waste Water Pump Tank, and the Melter Feed Tank. Forced air purges are provided on all three tanks, with the air addition flow rates set to maintain the hydrogen concentration to below 60% of its Lower Explosive Limit (LEL). The PVVS consists of the following equipment:

Figure 3. IDMS SRAT/SME Condenser

Formic Acid Vent Condenser

The Formic Acid Vent Condenser (FAVC) shown in Figure 4 is a stainless steel single-pass shell-and-tube heat exchanger with a built-in glass fiber mist eliminator (HEME). Chilled water is used to lower the process vapor temperature to 10°C.

Figure 4. Formic Acid Vent Condenser

FEED DELIVERY SYSTEM

The Melter Feed Tank (MFT) is the only IDMS vessel that operates as a batch-in/continuous-out process. It is a 1500 gallon dished-head Hastelloy C-276 tank with an internal Hastelloy C-276 cooling coil used to prevent overheating of the tank contents. The tank contents are agitated continuously to prevent solids from settling in the tank bottom. Agitation is accomplished via a 15-hp variable speed agitator. The IDMS MFT agitation system is the same as the IDMS SRAT/SME agitator except that the MFT impeller diameter is 24 inches compared to 30 inches for the SRAT/SME. During the HWVP testing, the MFT agitator was operated at a speed such the shear rate matched that of the DWPF MFT. The shear rate is defined as:

$$s.r. = \frac{\text{Agitator tip speed (ft/sec)}}{\text{Distance from tip to vessel (ft)}}$$

This corresponded to a tip speed of 9.08 ft/sec (87 rpm).

A recirculation loop feed system similar to that used in the DWPF is used in the IDMS. The slurry is recirculated through a two-inch pipe using a veinless centrifugal pump. The loop pressure is adjusted using a venturi-type restrictor at the return to the tank. The loop pressure forces the slurry through a strainer, a 3-way valve, and 50 feet of 0.25-inch ID piping to the melter feed tube. The strainer is a plate with nine 0.082" diameter holes which have a combined cross-sectional area equal to that of the feed line. The flow rate to the melter is measured via a magnetic flow device and is controlled by varying the pump speed.

The feed tube (see Figure 5) extends through the melter lid past the lid heaters and discharges the slurry one foot above the melt pool. Slurry is fed through the innermost pipe of the feed tube which has an ID of 0.18-inch. The slurry feed pipe temperature is maintained at 30-40°C by a cooling water jacket that extends all the way to the feed discharge. Water cooling helps prevent slurry drying and pluggage in the feed tube.

Process water is piped into the feed line at the three-way valve. This allows water flushing both forward to the feed nozzle and back through the strainer and recirculation loop.

The feed nozzle is flushed with water prior to feeding in order to cool the feed tube at the entrance of the melter to prevent a line plug. The entire system, including the recirculation line and feed tube, is flushed each time the melter feed pump is stopped.

Figure 5. IDMS Melter Feed Tube

MELTER SYSTEM

The IDMS Melter shell design is basically the same as that of the DWPF Scale Glass Melter (SGM). An additional 12 inches of Monofrax K-3 was added to the lower interior walls of the melt tank to reduce its diameter from 48 inches to 24 inches. This gives a melt pool surface area which is approximately $1/9^{\text{th}}$ that of the DWPF Melter. Melt rate is directly proportional to the surface area. Therefore, the IDMS Melter can be slurry-fed to

produce glass at 25 lb/hr, as compared to 228 lb/hr for the DWPF Melter. Table 1 gives a comparison of the two melters and Figure 6 shows a cross-sectional view of the melter and Figure 7 shows a geometric comparison of the IDMS melter with the DWPF/HWVP melter.

Table 1. IDMS/DWPF/HWVP Melter Comparison

<u>Parameter</u>	<u>IDMS Melter</u>	<u>DWPF/HWVP Melter</u>
Melt surface area	3 ft ² (0.29 m ²)	28 ft ² (2.61 m ²)
Melt volume	18 ft ³ (0.20 m ³)	87.6 ft ³ (2.48 m ³)
Centerline depth	27 in (69 cm)	37 in (95 cm)
Glass content (max)	1063 lbs (482 kg)	13,136 lbs (5956 kg)
Production rate	24 lb/hr (11 kg/hr)	228 lb/hr (103 kg/hr)
Melt rate	8 lb/hr/ft ²	8 lb/hr/ft ²

The melter vessel is lined with K-3 refractory to provide containment of the molten glass. The entire shell is water-cooled to freeze any glass that may penetrate between the refractory blocks before it reaches the shell. Two pairs of diametrically opposed Inconel™ 690 electrodes provide about 35 kW of power to maintain the glass temperature between 1100°C and 1150°C. These electrodes heat the glass by passing an electric current through it, a process called joule heating. The A and C electrode stems are water-cooled, and the B and D stems are air-cooled to freeze any glass that could potentially leak out where the stems penetrate the refractory. Air (instead of water) is used on the B and D electrode stems to reduce heat loss in the unheated riser throat region. Each electrode pair (A-B and C-D) is controlled separately to permit diversion of power to the lower or upper melt pool.

Power supplies for the electrodes can provide up to 300 V single phase, but under normal conditions only 53 V single phase will be required. Power to the electrodes is controlled by silicon controlled rectifiers (SCR's) on the primary side of the power supply transformers. Due to the high current (approximately 400 amps), water-cooled cables deliver the power to the electrodes from the secondary side of the transformer.

Two horizontally-entering Inconel™ 690 lid heaters, each made of two elements, provide an additional 60 kW of heat to vaporize

water from the slurry feed, melt and the glass, and combust any organics in the feed. These heaters are also the primary source of heat during melter startup.

Figure 6. Cross-Sectional View of the IDMS Melter

Figure 7. Geometric Comparison of the IDMS and DWPF/HWVP Melters

The lid heaters are maintained at 950°C by passing current through the tubes. The power supplies provide up to 8000 amps on the secondary side. Power to the lid heaters is controlled by SCR's on the primary side of the power supply transformers. Due to the very high amperage, the two transformers are water-cooled and located adjacent to the lid heaters so that a direct connection from the transformer to the lid heaters can be made. The surface temperature of the heaters is limited to 950°C because of thermal creep considerations.

Glass flows from the melter up through a heated riser channel and then down a heated pour spout channel into a canister which holds up to 200 lbs of glass. The riser is a 2-inch diameter Inconel™ 690 pipe surrounded by a serpentine Inconel 690™ heater. The heater is isolated from the Inconel™ pipe and housing with ceramics. The heater is used to maintain the glass in the channel at 1100°C.

The pour spout heater is constructed similarly to the riser heater. It is used to keep the glass above 1050°C to keep it free flowing. Power to the riser and pour spout heaters is controlled by SCR's on the primary side of the power supply transformers.

Pouring is initiated by creating a vacuum at the canister relative to the melter vapor space. A flexible set of stainless steel bellows provides a vacuum seal between the melter and the canister during pouring. These canisters are 31 inches tall and 10 inches in diameter. Although the slurry is fed continuously to the melter, glass is poured in batches. This is due to the fact that the minimum acceptable pour rate to prevent wavering of the pour stream (about 60 lb/hr) is higher than the melt rate of 25 lb/hr for the IDMS Melter.

A radiation level detector is provided as the primary means to determine the glass level in the canister. A sealed cesium-137 source is positioned in front of the canister, and a radiation detector is positioned behind the canister. The detector is calibrated such that the amount of radiation transmitted through the canister corresponds to a canister level.

The melter cannot be completely drained by using the normal vacuum pouring procedure. Therefore, a non-prototypic dump

valve is located at the bottom of the melter. It is comprised of three heater zones which keep the glass fluid during draining. The uppermost zone (Zone 1) is always energized, while Zones 2 and 3 are only energized during draining.

The melter top head components consist of a feed tube, a borescope, a melt pool thermowell, a vapor space thermowell, a level probe, an off-gas film cooler, and a melter vent line. Descriptions of the film cooler and the melter vent line are in the off-gas description section, while a discussion of the feed tube can be found in the feed system description section.

The borescope is used for continuous visual monitoring of the cold cap, including the recording of any unusual occurrences. The borescope is the same one that was used in the Scale Glass Melter. It is a long Inconel tube with an eyepiece and nine optical lenses. The inner lenses relay the image being observed from the viewing head to the attached camera. The borescope is cooled with air, and the outer lens in the melter vapor space is periodically cleaned with steam. Loss of the cooling air would result in the melting of the copper lens spacers and some of the lens.

The melt and vapor space thermowells are hollow Inconel™ 690 chambers (3-inch O.D. and 1-inch I.D.) with type B thermocouples located inside the respective chambers. The vapor space thermowell extends into the melter vapor space to a point 5.6 inches above the glass pool melt line (overflow level). Three thermocouples, located 3.6 inches above the end of the vapor space thermowell, are used to measure the vapor space temperature. It should be noted that the vapor space temperature is not directly controlled from these thermocouples. The lid heaters have thermocouples which measure their skin temperatures. By controlling these skin temperatures, the vapor space temperature is indirectly controlled.

The melt pool thermowell extends into the glass pool to within 2.5 inches of the melter floor. Three thermocouples which are used to control the lower glass pool temperature (via the C-D electrodes) are located at the very end of the thermowell. Three other thermocouples are located 12 inches above the lower glass pool thermocouples. These are used to control the upper glass pool temperature via the A-B electrodes. For each

electrode pair, a control thermocouple is chosen to be used by the PID cascade controllers.

MELTER OFFGAS SYSTEM

The IDMS Melter Off-Gas System is a scaled simulation of the DWPF system. It was designed for an off-gas flow rate of 350 lb/hr entering the SAS's, compared with 1900 lb/hr for the DWPF. The off-gas consists of steam, non-condensable gases from sludge decomposition and volatilization, air from inleakage and purges, mercury vapor, and particulate matter from entrainment. The purposes of the off-gas system are to maintain a negative pressure in the melter plenum, to provide adequate combustion in the melter vapor space, ensure ventilation and treatment of the reaction gases and steam released from the melter, and provide melter pour spout vacuum to initiate and control glass pouring. Since there are no radionuclides present in the IDMS, the demand on the IDMS off-gas system is less than for the DWPF off-gas system. However, to enable adequate evaluation of the processing efficiency, mechanical reliability, corrosion, and fouling of filters, demister pads, and heat exchange surfaces, all of the DWPF processing steps are incorporated into the IDMS. Unlike the DWPF, the IDMS does not have a redundant backup system. Instead, it has a bypass system which can be used if the primary system is not operative.

The melter off-gas is normally processed through the primary off-gas system. This system cools the off-gas, condenses most of the water and mercury vapor, and removes the particulates in a series of scrubbers and filters. It consists of the following equipment: an Off-Gas Film Cooler (OGFC) to reduce deposits at the entrance to the off-gas system; a film cooler brush to clean the film cooler; a Quencher (ejector venturi) to cool the off-gas and remove large particulate; an Off-Gas Condensate Tank (OGCT); a two-stage Steam Atomized Scrubber (SAS) to remove submicron particulates; a Mist Eliminator and a High Efficiency Mist Eliminator (HEME) to remove fine mists and particulates; a High Efficiency Particulate Air filter (HEPA) with a preheater; and a blower with a steam jet back-up. A bypass system, which is driven by a steam jet, is used on the melter vent line to the seal pot to insure a negative melter pressure when the primary system is not operating. It is also equipped with a brush to clean deposits from the section of the line adjacent to the

melter. A water-driven spout jet pulls a vacuum on the melter pour spout to control glass pouring.

Individual equipment components, listed in sequence of flow through the treatment line, consist of the following:

Off-Gas Film Cooler

The Off-Gas Film Cooler (OGFC) is mounted in the melter offgas exhaust nozzle. It is a slotted pipe assembly through which cooling air and steam are injected, reducing the temperature of the off-gases and the potential for hard glassy deposit pluggage. The injected air forms a cool boundary layer along the pipe wall, preventing particles from reaching and bonding with the wall. The OGFC operates in a temperature control mode (a constant flow of air with the steam flow varying to control off-gas temperature).

The IDMS OGFC is a prototypical design of the DWPF OGFC, consisting of nine slots inclined at 10° to the vertical. Seven slots are equally spaced with 0.09-inch openings. The remaining two slots are wider, 0.15-inch and 0.16-inch, and are positioned at the film cooler entrance to increase air flow and reduce deposits in this more critical region. All exposed surfaces are constructed of Inconel™ 690, while the remainder is 304 stainless steel.

Quencher

The Quencher is an ejector-venturi gas scrubber which reduces the gas temperature below the dew point to disengage most of the water vapor from the non-condensables and allow semi-volatile particles to coalesce. The Quencher is also necessary for maintaining a negative pressure in the melter. The quenching is accomplished using recirculated condensate at 40°C, pumped from the Off-Gas Condensate Tank (OGCT). This motive fluid is propelled through the venturi's 1-inch OD inlet which leads to the nine 0.31-inch OD holes and exits through the 6-inch OD outlet. This is a scaled-down version of the DWPF Quencher.

A two-phase line connects the Quencher to the OGCT. In this horizontal pipe, liquid and gas flow concurrently. This type of

concurrent flow has been classified as either stratified, wave, or slug, depending on the quencher water flow rate.

At low liquid flow rates, a stratified flow pattern is observed, in which the liquid flows along the bottom of the pipe and the gas flows over a smooth liquid-gas interface. At higher flow rates, the flow pattern passes through a stage of wave flow which is similar to stratified flow, except that the interface has waves traveling in the direction of flow. At high flow rates, the phenomena of slug flow occurs which is when a wave is picked up periodically by the rapidly moving gas to form a frothy slug which passes along the pipe at a greater velocity than the average liquid velocity. This type of flow is undesirable because the slugs can cause severe vibrations in the pipelines from their impact against pipe bends.

Off-Gas Condensate Tank

The Off-Gas Condensate Tank (OGCT) collects the aqueous effluent from the Quencher, Steam Atomized Scrubbers, Off-Gas Condenser, HEME, and the Melter Spout Jet. The effluent is recycled to the Quencher as the coolant, to the SASes as the scrubbing agent, and to the Melter Spout Jet as the motive fluid. The process heat absorbed by the circulating water is removed by a heat exchanger between the OGCT and the Quencher. Liquid effluent from the OGCT will be purged and sent to the Waste Water Pump Tank (WWPT).

Steam Atomized Scrubbers

The two-stage Steam Atomized Scrubbers (SAS) remove submicron and micron-sized particulates from the melter off-gas. Recirculated condensate is directed into the wake region of an expanding supersonic steam jet, producing tiny water droplets which will contact and capture particles in the entering off-gas. These droplets are accelerated in the mixing tube where turbulence is sufficient to promote coalescence, but low enough so as not to cause significant re-entrainment of the liquid. The droplets are separated from the vapor in a cyclone separator. The SAS technology was developed and patented by the Lone Star Steel Company, which refers to the equipment as Hydro-Sonic Scrubbers.

Off-Gas Condenser

The Off-Gas Condenser is a shell-and-tube heat exchanger that separates the condensables from the off-gas stream and removes virtually all of the elemental mercury (from DWPF feeds only, there is no mercury in the HWVP feed simulants). The separated condensables in the off-gas stream are drained to the Off-Gas Condensate Tank. The Condenser also condenses the steam from the SAS units, reducing the load on the exhausted. The cooling medium used is 25% ethylene glycol which is regulated to the condenser to maintain the off-gas at 10°C.

The off-gas enters at the top of the condenser and flows through 45 0.75-inch OD tubes. The tubes are each 84 inches long and are arranged on a one-inch triangular pitch. The effluent vapor and condensed gases exit at the bottom of the condenser through separate pipes. The vapor continues on to the Mist Eliminator and the condensables are drained to the Off-Gas Condensate Tank. The cooling medium enters the shell side of the 10.75-inch OD shell and flows upward around 25 segmental baffles.

Mist Eliminator

The Mist Eliminator (ME) consists of a 27-cm diameter by 15.2-cm thick York demister with top and bottom grids. An atomized water spray wets the surface intermittently, similar to the HEME operation. The Mist Eliminator separates any suspended liquid droplets from non-condensable gases.

High Efficiency Mist Eliminator

The High Efficiency Mist Eliminator (HEME) consists of a densely-packed Fiberglass filter element wetted continuously with an atomized water spray. It traps particulates and flushes soluble materials to the condensate tank.

The IDMS HEME shares three basic characteristics with the DWPF HEME, including similar pad construction, face velocity, and liquid loading. It consists of one 24-inch diameter by 51-inch long filter element. The off-gas flows from the inside of the element to the outside. There is a coarse 0.5-inch layer of 30-micron glass fiber on the face followed by a 2.5-inch layer of fine 8-micron glass fiber packed at 11 lbs/ft². The latter

layer has been shown to act as a prefilter and extend the life of the HEME filter.

The HEME element was designed to operate at a 5 fpm superficial face velocity. Air-atomized water is injected into the entering off-gas stream at a rate of 50 milligrams per actual cubic foot of off-gas. At 500 lb/hr of off-gas flow, the water flow is 0.08 gal/hr. The lowest available water spray nozzle flow is 0.36 gal/hr. Therefore an intermittent spray is used.

Heater/High Efficiency Particulate Air Filter

The Heater raises the off-gas temperature 10°C above its dew point. This prevents condensation which could cause a large pressure drop across the High Efficiency Particulate Air (HEPA) Filters. Two HEPA filters in parallel serve as the final treatment step before the off-gas is released to the environment via the stack. However, only one HEPA filter is valved in at a time. The filters remove the remaining submicron sized particles from the off-gas. The filter element area is 12 x 12 x 5.875 inches.

Exhauster

The Exhauster maintains a negative pressure throughout the Melter/Off-Gas System. It is a variable speed, positive-displacement device which draws the melter off-gas through the off-gas system. An isolation valve, connected to the OGCT-to-SAS line, is provided for exhauster restart protection during startup and switchover; mechanical damage will occur if the exhauster is operated with insufficient air flow. The exhauster speed is varied to control the pressure in the OGCT at about -6 inches of water. The two-lobe rotary exhauster, which is directly coupled to a 7.5-hp motor, discharges, at constant speed, a relatively constant volume of air under variable pressure conditions.

A steam jet vacuum pump is used as an emergency back-up to the blower. This unit has a 2.5-inch suction opening designed to handle a process load of 500 lb/hr while utilizing 52 lb/hr of steam. It ensures primary off-gas system operation in the event of blower failure for any reason.

Melter Spout Jet

The Melter Spout Jet is used to initiate and control glass pouring by creating a vacuum in the pour spout relative to the melter plenum. It is an ejector-venturi gas scrubber with a 2-inch OD inlet and a 3-inch OD outlet. The motive fluid is recirculated condensate from the OGCT, which is maintained at 40°C. It is propelled through the venturi's nine 5/16-inch OD holes at a fixed rate of either 15 gpm for idle (non-pouring) conditions or 35 gpm for glass pouring. Vacuum control air is bleed into the vacuum line via 754PV to control the pressure to +3"wc in idle, and from -5 to -14"wc during glass pouring.

Bypass Off-Gas System

The Bypass System is intended to operate only when feed to the Melter is discontinued. It is used when the primary system is not operative. This auxiliary steam jet blower is unique to the IDMS and is not included in the DWPF design. This steam jet insures that a negative pressure is maintained in the Melter in the event that the Off-Gas System is out of service for any reason. The unit has a 1.5-inch suction opening designed to handle a process load of 165 lb/hr while utilizing 58 lb/hr of steam.

PROCESS ANALYZERS

The IDMS facility is equipped to measure the gaseous composition of several vapor streams. The on-line analyzer capabilities for the IDMS Feed Preparation System are summarized in Table 2 while those of the Melter System are summarized in Table 3. Note that the approximate accuracy for each gas measured is shown as $\pm$ volumetric percent.

The data from the Mass Spectrometer and Gas Chromatographs is sent to a Math CoProcessor which takes other system information (stream flowrates, etc.) and determines the operating percentage of the Lower Explosive Limit (LEL). This information is then sent to the IDMS Programmable Logic Controller (PLC) which will automatically interlock the process operation if the system exceeds 60% of the LEL. All data is displayed to the Control Room Operator on the Operator Interface System or VANTAGE™. All data is archived on VANTAGE™ for future use.

Table 2. IDMS On-Line Analyzer Capabilities - Feed Preparation

Analyzer	Location	Gas Meas'd	Normal Range (%)	Analyzer Range (%)	Minimum Detection Limit (%)	Approx Accuracy
Mass Spectrometer	FAVC exit	H ₂	0 - 4	0 - 100	0.05	± 0.10
		NO	0 - 10	0 - 100	0.02	± 0.30
		NO ₂	0 - 20	0 - 100	0.05	± 0.30
		O ₂	0 - 21	0 - 100	0.02	± 0.30
		CO ₂	0 - 40	0 - 100	0.20 ^a	± 0.30
			0 - 40	0 - 100	0.50 ^b	± 0.30
		N ₂	50 - 78	0 - 100	0.02	± 0.30
		Ar	0 - 1	0 - 100	0.02	± 0.10
		benzene	0 - 0.3	0 - 100	0.02	± 0.05
		N ₂ O	0 - 6	0 - 100	0.04 ^c	± 0.30
			0 - 6	0 - 100	0.67 ^d	± 0.30
			0 - 6	0 - 100	1.35 ^e	± 0.30
		water ^f	0 - 2	0 - 100	-	-
Gas Chromatographs	FAVC exit ^g	H ₂	0 - 4	0 - 5	0.001	± 0.005
		NO	0 - 10	0 - 20	0.500	± 0.30
		O ₂	0 - 21	0 - 25	0.100	± 0.30
		CO ₂	0 - 40	0 - 50	0.500	± 0.30
		N ₂	50 - 78	0 - 80	0.100	± 0.30
		benzene	0 - 0.3	0 - 0.3	0.010	± 0.005
		N ₂ O	0 - 6	0 - 10	0.001	± 0.30
Siemens Oxymat 5F Oxygen Analyzer	SRAT Cond exit ^h	O ₂	0 - 21	0 - 100	0.10	± 0.10

a 0.20% when N₂O is not measured

b 0.50% when N₂O is measured

c at 1% CO₂

d at 20% CO₂

e at 40% CO₂

f not calibrated but detected

g it is possible that the GC'S could be connected to the Melter and/or the HEPA exit locations

h the presence of NO_x causes errors in the measured concentration (can be approximately corrected)

Table 3. IDMS On-Line Analyzer Capabilities - Melter System

Analyzer	Location	Gas Meas'd	Normal Range (%)	Analyzer Range (%)	Minimum Detection Limit (%)	Approx Accuracy
Mass Spectrometer	Melter Exit ^a	H ₂	unknown	0 - 100	0.05	± 0.10
	HEPA Exit ^a	NO	0.1 - 0.3	0 - 100	0.02	± 0.30
		NO ₂	0.01 - 0.05	0 - 100	0.05	± 0.30
		O ₂	19 - 21	0 - 100	0.02	± 0.30
		CO ₂	0.5 - 2.5	0 - 100	0.20	± 0.30
		N ₂	76 - 78	0 - 100	0.02	± 0.30
		Ar	0.8 - 1.0	0 - 100	0.02	± 0.10
		SO ₂	unknown	0 - 100	0.02	± 0.10
Monitro Labs 8840HL	Melter exit ^b	NO	0.1 - 0.3	0 - 0.04	0.002	± 0.005
Chemiluminescent	OGCT exit ^b	NO ₂	0.01 - 0.05	0 - 10	0.002	± 0.005
NOx Analyzer	HEPA exit ^c					
Siemens Oxymat 5E	Melter exit ^{b,d}	O ₂	0 - 1.1	0 - 100	0.10	± 0.10
Oxygen Analyzer	OGCT exit ^{b,d}					
Siemens Ultramat 22	Melter exit ^{b,d}	CO	0 - 0.002	0 - 0.001	0.0002	± 0.0001
CO/CO ₂ Analyzer	OGCT exit ^{b,d}	CO ₂	0 - 0.05	0 - 0.05	0.0005	± 0.001

a dry basis (water removed by condensation)

b Melter exit and OGCT exit samples are analyzed after a 20:1 dilution with dry nitrogen

c HEPA exit sample analyzed after variable dilution by dry nitrogen

d wet basis

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RAW MATERIALS

Several raw materials were required during the IDMS HWVP Process Demonstration. A waste sludge simulant, a Recycle Waste Stream simulant, formic acid, and frit were required to complete this demonstration. Note that the three streams were blended in the following approximate proportions:

28% waste oxides
4% RWS oxides
68% frit oxides

A description of each material is provided below:

SLUDGE

The waste sludge used during the IDMS HWVP Process Demonstration was a simulation of the 1991 Revision of the Hanford Neutralized Current Acid Waste (NCAW '91)⁷. The sludge simulation was made in the following steps:

- (1) An outside vendor prepared a Mixed Hydroxide Slurry containing precipitated Fe, Zr, Ni, Mn, and Al. This sludge was then shipped to SRTC and stored in the Slurry Receipt Tank (SRT) at TNX.
- (2) A portion of this Mixed Hydroxide Slurry was then transferred to the IDMS SRAT/SME where the "primary trim chemicals" were added. Primary trim chemicals include all those necessary except the noble metal and cadmium compounds.
- (3) The "secondary trim chemicals" are added. Secondary trim chemicals are defined as the noble metal and cadmium compounds.

Vendor Mixed Hydroxide Slurry Make-up

The Mixed Hydroxide Slurry was prepared (by Optima Chemicals, Inc.) according to the procedure given in Appendix E. The basic procedure is as follows:

- (1) The hydroxides of Fe, Zr, Ni, and hydrated manganese dioxide are precipitated from nitrate feedstocks.

- (2) The solution is washed to remove the excess nitrate and sodium. The resultant is then sampled.
- (3) In a separate vessel, the hydroxide of Al is precipitated from a nitrate feedstock.
- (4) The aluminum solution is washed to remove the excess nitrate and sodium. The resultant is then sampled.
- (5) The two solutions are blended, sampled, and shipped upon acceptance.

The analyzed compositions of the Zr/Fe/Mn slurry, the $\text{Al}(\text{OH})_2$ slurry, and the Mixed Hydroxide Slurry are given in Table 4.

Table 4. Composition of the Mixed Hydroxide Slurry

Component	Units	Zr/Fe/Mn Slurry	$\text{Al}(\text{OH})_2$ Slurry	Mixed OH Slurry
Ni	wt%	3.22	0.51	2.70
Mn	wt%	2.75	0.33	2.40
Fe	wt%	34.13	5.21	37.30
Mg	wt%	0.16	0.11	0.20
Al	wt%	0.00	33.43	6.80
Zr	wt%	18.79	2.68	15.80
Na	wt%	1.89	0.16	1.50
$\text{NO}_3(-)$	Molar	0.06	0.02	0.04
$\text{SO}_4(2-)$	Molar	0.00	0.00	0.00
wt% solids	wt%	16.21	10.74	8.23
wt% oxides	wt%	8.91	ND	6.46
density	g/ml	1.08	1.03	1.07
pH		11.37	7.51	10.42
solids conc.	g/liter	174.93	110.95	88.30
oxides conc.	g/liter	96.18	ND	69.30

ND = Not Determined

Primary Chemical Addition

The primary chemicals are comprised of all of the necessary trim chemicals except the noble metals and cadmium. The primary chemicals and the amounts added (in grams) with each run are listed in Tables 5 - 7.

Table 5. Primary Chemicals - Nitrates/Nitrites (grams)

<u>Chemical Name</u>	<u>Formula</u>	<u>HWVP1</u>	<u>HWVP2</u>
Chromium Nitrate	$\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	8463.4	8463.0
Cesium Nitrate	CsNO_3	5100.0	5101.0
Potassium Nitrate	KNO_3	2591.3	2591.0
Sodium Nitrite	NaNO_2	33950.0	147944.0
Sodium Nitrate	NaNO_3	26750.0	26750.0
Lead Nitrate	$\text{Pb}(\text{NO}_3)_2$	5962.0	5962.0
Rubidium Nitrate	RbNO_3	476.0	476.0
Samarium Nitrate	$\text{Sm}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$	930.0	930.0
Praseodymium Nitrate	$\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$	2482.0	2482.0
Zinc Nitrate	$\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	7506.0	7506.0
Yttrium Nitrate	$\text{Y}(\text{NO}_3)_3 \cdot 4\text{H}_2\text{O}$	1510.0	1510.0

Table 6. Primary Chemicals - Oxides/Hydroxides (grams)

<u>Chemical Name</u>	<u>Formula</u>	<u>HWVP1</u>	<u>HWVP2</u>
Barium Hydroxide	$\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$	2219.0	2219.2
Selenium Dioxide	SeO_2	97.0	97.0
Calcium Hydroxide	$\text{Ca}(\text{OH})_2$	6414.0	6414.5
Cerium Hydroxide	$\text{Ce}(\text{OH})_4$	4778.0	4778.2
Germanium Oxide	GeO_2	1.0	1.0
Lanthanum Oxide	La_2O_3	8029.0	4015.0
Magnesium Hydroxide	$\text{Mg}(\text{OH})_2$	3239.0	3239.7
Niobium Oxide	Nb_2O_5	141.0	71.0
Neodymium Oxide	Nd_2O_3	42850.0	21425.0
Silicon Dioxide	SiO_2	24767.0	23387.0
Tin Oxide	SnO	65.0	65.0
Strontium Carbonate	SrCO_3	1038.0	1038.0
Tantalum Oxide	Ta_2O_5	41.0	21.0
Tellurium Oxide	TeO_2	610.0	610.0
Titanium Oxide	TiO_2	1510.0	1510.0
Molybdenum Oxide	MoO_3	3434.0	3434.0

Table 7. Primary Chemicals - Salts/Others (grams)

<u>Chemical Name</u>	<u>Formula</u>	<u>HWVP1</u>	<u>HWVP2</u>
Boric Acid	H ₂ BO ₃	63.0	63.0
Lithium Chloride	LiCl	1.2	1.2
Sodium Chloride	NaCl	3047.0	3047.7
Sodium Carbonate	Na ₂ CO ₃	51022.0	51022.0
Sodium Oxalate	Na ₂ C ₂ O ₄	9161.0	3444.0
Sodium Fluoride	NaF	1318.0	1318.0
Sodium Iodide	NaI	30 mg	30 mg
Sodium Phosphate	Na ₃ PO ₄	831.0	831.0
Sodium Sulfate	Na ₂ SO ₄	4436.0	4436.0
Copper Sulfate	CuSO ₄ •5H ₂ O	4728.0	4728.0

Secondary Chemical Addition

The secondary chemicals are defined as the noble metal and cadmium compounds. The noble metal compounds were added separately so that a process samples of "no noble metal" sludge could be taken. These samples were used as analytical blanks during noble metal analyses. The cadmium addition was deferred because of the health risks associated with the handling of this material. The secondary chemicals and the amounts added with each run are shown in Table 8.

The ruthenium was purchased as ruthenium chloride (RuCl₃) and converted to nitrosylruthenium hydroxide (RuNO(OH)₃) prior to addition to the SRAT. The procedure for this conversion was developed by R. M. Wallace and D. T Hobbs of the Savannah River Technology Center and is shown in Table 9. While the procedure may not produce a pure nitrosylruthenium form, it does result in a product which has undergone similar treatment as actual waste. The other noble metals were added individually to the SRAT as nitrate solutions.

Table 8. Secondary Trim Chemicals (grams)

<u>Chemical Name</u>	<u>Formula</u>	<u>HWVP1</u>	<u>HWVP2</u>
Silver Nitrate	AgNO ₃	1078.3	1078.0
Rhodium Nitrate sol'n	Rh(NO ₃) ₃ *	10482.5	10482.3
Palladium Nitrate sol'n	Pd(NO ₃) ₂ **	7334.0	7334.0
Cadmium Hydroxide	Cd(OH) ₂	21178.0	21178.0
Ruthenium Chloride	RuCl ₃ †	4445.0	4445.0

* solution is 4.933 wt% Rh

** solution is 8.769 wt% Pd

† salt is 42 wt% Ru; RuCl₃ is converted to a nitrosyl ruthenium form prior to addition to the SRAT

Table 9. Ruthenium Conversion Procedure

Step	Description
1	Weigh out 2222.5 g RuCl ₃
2	Add RuCl ₃ to 8.9 liters of 1M HCl
3	Bring to boil and reflux
4	Weigh out 2217 g of NaNO ₂
5	Add to boiling mixture over 1 hr period
6	Cool to 80°C
7	Weigh out 3683 g NaNO ₂
8	Add NaNO ₂ to mixture over 3 hr period
9	Measure 1561 ml of concentrated HNO ₃
10	Add HNO ₃ slowly
11	Bring to boil and reflux for four hours
12	Cool to 80°C
13	Add 5 liters of simulated sludge
14	Add 1770 g of NaOH pellets while agitating
15	Cool to room temperature and transfer to a carboy
16	Repeat the above procedure
17	Combine the two product carboys

FORMIC ACID

The formic acid during this demonstration was industrial grade at approximately 90 wt%. The acid was sampled prior to the run in order to verify the concentration. The results are given in Table 10.

Table 10. Formic Acid Concentrations for Each Run

<u>Conc'n</u>	<u>HWVP1</u>	<u>HWVP2</u>
Molarity	23.64	22.45
Wt %	90.7 %	86.1 %

RECYCLE WASTE STREAM (RWS)

The HWVP Recycle Waste Stream (RWS) is composed of spent zeolite and diatomaceous earth, spent decon frit, and concentrated evaporator and melter offgas condensates. In normal HWVP operations, the RWS will be pH adjusted to ≈ 7 by the addition of NaOH prior to its addition to the SME material.

The RWS for the IDMS HWVP Process Demonstration was made-up as a slurry in the IDMS Frit Slurry Make-up Tank (FSMT). The trim chemicals which were used to make-up this material are shown in Table 11. Note that no formic acid was included in the make-up of the RWS for either run (as is normally done in PNL bench-scale tests) since the Task Technical Plan specified that the TOC content of the RWS be from sodium oxalate. However, no sodium oxalate (or sodium phosphate) was available for the make-up of the RWS in the second run (HWVP2). The zeolite used was Union Carbide Ionsieve IE-96 which was specially ground to -125 mesh. The diatomaceous earth mixture was Manville Standard Super-Cel™. The cadmium hydroxide content of the RWS was slurried with water and added directly to the SRAT since the FSMT is outside the IDMS containment.

Table 11. Trim Chemicals Used for Make-up of the RWS (grams)

<u>Chemical Name</u>	<u>Formula</u>	<u>HWVP1</u>	<u>HWVP2</u>
Sodium Nitrate	NaNO ₃	46267.0	46267.7
Manganese Dioxide	MnO ₂	503.0	500.0
Sodium Chloride	NaCl	60.0	60.0
Sodium Phosphate	Na ₃ PO ₄	7766.0	0.0 *
Sodium Oxalate	Na ₂ C ₂ O ₄	6332.2	0.0 *
Cadmium Hydroxide**	Cd(OH) ₂	1920.0	1920.0
Diatomaceous Earth	†	18144.0	18144.0
Zeolite	††	8392.0	8392.0

* no sodium phosphate or oxalate was available for the second run.

** the cadmium hydroxide was slurried with water in plastic carboys and added directly to the SRAT rather than to the FSMT.

† Manville Standard Super-CelTM

†† Union Carbide Ionsieve IE-96 (-125 mesh)

The composition of the zeolite and diatomaceous earth mixture are shown in Table 12.

Table 12. Zeolite and Diatomaceous Earth Comp (wt%)

<u>Chemical Name</u>	<u>Formula</u>	<u>Zeolite*</u>	<u>Dia. Earth†</u>
Aluminum Oxide	Al ₂ O ₃	17.17	3.66
Calcium Oxide	CaO	0.81	0.46
Ferrous Oxide	Fe ₂ O ₃	3.83	1.25
Potassium Oxide	K ₂ O	0.46	0.51
Magnesium Oxide	MgO	0.75	0.56
Sodium Oxide	Na ₂ O	8.28	0.57
Phosphorus Oxide	P ₂ O ₅	-	0.23
Silicon Oxide	SiO ₂	68.23	92.58
Titanium Oxide	TiO ₂	0.47	0.18

* Union Carbide Ionsieve IE-96 (-125 mesh)

† Manville Standard Super-CelTM

The composition of the Recycle Waste Stream (RWS) for HWVP1 (the stream was not sampled during HWVP2) is shown in Table 13. The pH of this material is quite high at 9.72. As stated above, the HWVP intends to adjust the pH of the material to ≈ 7 by the addition of NaOH, since the Chemical Cell and Melter Offgas condensates will be quite acidic. This material was not neutralized because the pH was not known until the material was already transferred into the SRAT/SME. And, as stated above, no formic acid was added to the slurry since it was requested that the TOC content of the RWS be added as sodium oxalate.

Table 13. Recycle Waste Stream (RWS)

Chemical Name	Formula	wt%*	wt%**
Aluminum Oxide	Al ₂ O ₃	2.82	4.33
Barium Oxide	BaO	0.01	0.02
Calcium Oxide	CaO	0.32	0.5
Ferrous Oxide	Fe ₂ O ₃	0.9	1.39
Potassium Oxide	K ₂ O	0.67	1.04
Magnesium Oxide	MgO	0.36	0.56
Manganese Oxide	MnO	0.08	0.13
Sodium Oxide	Na ₂ O	24.95	38.34
Phosphorus Oxide	P ₂ O ₅	0.54	0.83
Silicon Oxide	SiO ₂	29.83	45.84
Titanium Oxide	TiO ₂	0.09	0.14
Zinc Oxide	ZnO	0.18	0.28
Nitrate	NO ₃ -	0.76 Molar	
Oxalate	C ₂ O ₄ ²⁻	0.12 Molar	
Chloride	Cl-	0.09 Molar	
	wt% solids	13.49 wt%	
	solids conc.	145.7 g solids/liter	
	wt% oxides	8.78 wt%	
	oxides conc.	94.8 g oxides/liter	
	pH	9.72	

* dried solids basis

** oxides basis

FRIT

The frit used during these demonstrations was obtained from a lot purchased (via PO #144127) and specified by Battelle Pacific Northwest Laboratory (PNL). A one-liter sample of the frit was taken and separated into eight representative samples using a rotary riffler. These samples, along with eight samples of an SRL standard frit (FRIT-202), were submitted for analytical verification. The results obtained from the standard were used to bias correct the analytical results for the PNL Frit. The results for these analyses are shown in Tables 14 and 15.

Table 14. IDMS/HWVP Frit Composition*

<u>Major Oxides</u>	<u>Comp (wt%)</u>	<u>Spec (wt%)</u>
SiO ₂	73.135	72.260
B ₂ O ₃	18.902	20.450
Li ₂ O	6.972	7.290
<u>Minor Oxides</u>	<u>Comp (wt%)</u>	
Na ₂ O	0.359	
CaO	0.088	
Fe ₂ O ₃	0.039	
TiO ₂	0.103	
ZrO ₂	0.039	
Al ₂ O ₃	0.189	
BaO	0.016	
K ₂ O	0.031	
ZnO	0.078	
Total Oxides	99.950 %	

*Values are corrected, see Table 15.

Table 15. Summary of IDMS/HWVP Frit Characterization

Analysis/Prep	Oxide	SRTC Standard Frit			IDMS/HWVP Frit	
		Measured	Expected	Corr'n	Measured	Corrected
AA/MW	Na ₂ O	5.004	5.9	1.179	0.209	0.246
	K ₂ O	0.074	0.19	2.555	0.012	0.031
ICP/MW	CaO	0.098	0.12	1.219	0.072	0.088
	Cr ₂ O ₃	<0.010	0	-	<0.010	<0.010
	CuO	<0.010	0	-	<0.010	<0.010
	Fe ₂ O ₃	0.035	0.03	0.861	0.042	0.036
	MgO	1.908	2	1.048	<0.010	<0.010
	MnO	0.001	0	-	<0.010	<0.010
	NiO	<0.010	0	-	<0.010	<0.010
	Na ₂ O	6.124	5.9	0.967	0.371	0.359
	TiO ₂	0.111	0.11	0.992	0.105	0.104
	ZnO	0.015	0	-	0.078	0.078
	ZrO ₂	0.031	0.02	0.644	0.059	0.038
ICP/Na ₂ O ₂	Al ₂ O ₃	0.646	0.4	0.619	0.306	0.189
	BaO	0.039	0.04	1.027	0.015	0.016
	B ₂ O ₃	8.266	7.7	0.932	20.292	18.902
	Fe ₂ O ₃	0.09	0.03	0.334	0.126	0.042
	Li ₂ O	7.322	6.7	0.915	7.619	6.972
	MgO	2.027	2	0.986	<0.010	<0.010
	SiO ₂	78.083	76.6	0.981	74.55	73.135
	TiO ₂	0.117	0.11	0.94	0.108	0.102

LAB SCALE EXPERIMENTATION

Because the amount of hydrogen evolved may be significantly influenced by the amount of available catalyst, and, the NCAW'91 simulant contains a significant increase in rhodium over SRS waste types (0.064 wt% Rh in NCAW'91 vs 0.038 wt% Rh in SRS HM), there was concern that the hydrogen concentration control systems in the IDMS may not be adequate. SRTC has obtained very good correlation between laboratory-scale SRAT operations and those in the IDMS facility. Therefore, prior to starting the large scale (IDMS) process demonstration, two runs were conducted in a laboratory-scale SRAT/SME at SRTC. Additionally, the make-up of the small-scale sludge provided an opportunity to "test" the simulant recipe before using it in the large-scale equipment. Note, however, that these runs were performed only to gauge the expected offgas generation in the IDMS facility and was not intended to provide design data.

Both of the experiments were conducted in the 2-liter SRAT/SME which is located in the DWPT Engineering Laboratory in Building 677-T at TNX. The experiments were conducted by C. W. Hsu of the Savannah River Technology Center. The experiments were defined as "scoping studies" and therefore a rigorous Quality Assurance plan was not followed. However, good laboratory practices were followed throughout the experimentation.

RUN #1

The composition of the sludge material used in the Lab Scale Run #1 is shown in Table 16. Sodium nitrite was added for a NO_2^- concentration of 0.1 M. Sodium hydroxide was added to bring the sodium up to the nominal concentration and the noble metals were added at their nominal NCAW'91 concentration. In the Run #1 Lab Scale demonstration 70 ml of $\approx 90\text{wt}\%$ formic acid was added to the 2 liter batch of sludge. The calculated formic acid requirement is shown in Table 17.

Table 16. Lab Scale Run #1 Sludge Composition

Element	Oxide or Component	Elemental (wt%)	Oxide (wt%)
P	P2O5	0.13	0.39
Zn	ZnO	0.21	0.35
Pb	PbO2	1.01	1.50
Ni	NiO	1.72	2.82
B	B2O3	0.08	0.35
Mn	MnO2	1.43	2.92
Fe	Fe2O3	18.97	34.88
Cr	Cr2O3	0.17	0.32
Mg	MgO	0.31	0.67
Al	Al2O3	4.09	9.93
Si	SiO2	1.71	4.71
Ca	CaO	0.64	1.14
Cu	CuO	0.20	0.32
Ti	TiO2	0.25	0.54
Zr	ZrO2	9.38	16.29
Sr	SrO	0.14	0.22
Nd	Nd2O3	4.93	7.39
Ba	BaO	0.15	0.22
Na	Na2O	8.68	15.05
	NO3 (-)	7453 mg/l	0.12 Molar
	SO4 (2-)	896 mg/l	0.01 Molar
	TIC	2202 mg/l	
	TOC	150 mg/l	
	wt% solids	12.24 wt%	
	wt% oxides	9.64 wt%	
	density	1.10 g/ml	
	pH	12.36	
	solids conc.	134.64 g/liter	
	oxides conc.	106.04 g/liter	

Table 17. Calculated Formic Acid Requirement Run #1

<u>Reactant</u>	<u>Amount</u>	<u>Units</u>	<u>gmoles reactant*</u>	<u>gmoles HCOOH req'd</u>
hydroxide	0.246	Molar	0.49	0.49
carbonate	0.171	Molar	0.34	0.68
nitrite	0.10	Molar	0.20	0.15
MnO ₂	1.43	wt% Mn	0.07	0.11
Ni(OH) ₂	1.72	wt% Ni	0.08	0.05
Total gmoles HCOOH required				1.48
Total volume of 90 wt% HCOOH required (@ 110%)				68.6 ml

* 2 liters of sludge @ 134.6 g solids per liter of sludge

Approximately 70 ml of the 90 wt% formic acid was metered into the Run#1 sludge material. The resulting offgas products are shown in Figure 8 and the pH curve is shown in Figure 9. The offgas curves shown in Figure 8 are somewhat similar to those seen in IDMS HWVP1 (described in a later section). Volumetrically, there was more NO present than N₂O and the hydrogen did not start production until the NO₂⁻ had been almost completely destroyed. The peak hydrogen observed was ≈ 0.0002 mol/min/2L sludge.

RUN #2

The composition of the sludge material used in the Lab Scale Run #2 is shown in Table 18. As in Run #1, sodium nitrite was added for a NO₂⁻ concentration of 0.1 M and sodium hydroxide was added to bring the sodium concentration to the nominal NCAW level. The noble metals were added at their nominal NCAW'91 concentration. In the Run #2 Lab Scale demonstration 100 ml of ≈90wt% formic acid was added to the 2.6 liter batch of sludge. This included a 25% increase over that which was predicted by the SRTC formic acid requirement calculation. This excess was added to gauge the effect of excess acid on the offgas products, especially hydrogen. The calculated formic acid requirement is shown in Table 19.

Figures 8 and 9. Figure 8 (top) shows the offgas products during Lab Scale Run #1. Figure 9 (bottom) shows the pH profile (@ $\approx 95^{\circ}\text{C}$) in relation to the formic acid addition period.

Table 18. Lab Scale Run #2 Sludge Composition

Element	Oxide or Component	Elemental (wt%)	Oxide (wt%)
P	P2O5	0.16	0.48
Zn	ZnO	0.20	0.33
Pb	PbO2	0.96	1.45
Ni	NiO	1.65	2.74
B	B2O3	0.08	0.33
Mn	MnO2	1.36	2.81
Fe	Fe2O3	18.50	34.50
Cr	Cr2O3	0.17	0.33
Mg	MgO	0.32	0.69
Al	Al2O3	4.08	10.06
Si	SiO2	1.72	4.80
Ca	CaO	0.62	1.14
Cu	CuO	0.19	0.31
Ti	TiO2	0.27	0.59
Zr	ZrO2	8.71	15.36
Sr	SrO	0.13	0.20
Nd	Nd2O3	5.36	8.16
Ba	BaO	0.16	0.23
Na	Na2O	8.81	15.50
	NO3 (-)	7538 mg/l	0.12 Molar
	SO4 (2-)	907 mg/l	0.01 Molar
	TIC	1889 mg/l	
	TOC	329 mg/l	
	wt% solids	12.24 wt%	
	wt% oxides	9.59 wt%	
	density	1.11 g/ml	
	pH	12.35	
	solids conc.	135.86 g/liter	
	oxides conc.	106.45 g/liter	

Table 19. Calculated Formic Acid Requirement Run #2

<u>Reactant</u>	<u>Amount</u>	<u>Units</u>	<u>gmoles reactant*</u>	<u>gmoles HCOOH req'd</u>
hydroxide	0.25	Molar	0.65	0.65
carbonate	0.14	Molar	0.35	0.71
nitrite	0.10	Molar	0.26	0.20
MnO ₂	1.43	wt% Mn	0.08	0.13
Ni(OH) ₂	1.60	wt% Ni	0.09	0.05
Total gmoles HCOOH required				1.74
Total volume of 90 wt% HCOOH req'd (@ 110%)				80.6 ml
Total volume of 90 wt% HCOOH req'd (@ 25% xs)				100.7 ml

* 2.6 liters of sludge @ 135.9 g solids per liter of sludge

Approximately 100 ml of the 90 wt% formic acid was metered into the Run#2 sludge material. The resulting offgas products are shown in Figure 10 and the pH curve is shown in Figure 11. The offgas curves shown in Figure 10 are very similar to those seen in the Run#1 plot. The peak evolution of most of the offgas products were about the same as Run#1 except hydrogen which is about 3.5X that of Run#1. The peak hydrogen observed was ≈ 0.0007 mol/min/2L sludge.

Figures 10 and 11. Figure 10 (top) shows the offgas products during Lab Scale Run #2. Figure 11 (bottom) shows the pH profile (@ $\approx 95^{\circ}\text{C}$) in relation to the formic acid addition period.

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HWVP1 BATCH HISTORY

HWVP1 was started on 11/7/91 with the transfer of mixed hydroxide slurry and finished on 12/15/91 when the last canister of glass was poured. Chronological timelines for the feed preparation portion of this run and graphical representation for essential processing data are provided in Figures 12 - 24. The chronological timelines are depicted in military time and were constructed via the use of archived processing data, the control room operator's logbook, and the technical engineer's logbook. The timelines reveal at what times the SRAT/SME condensate was returned to the vessel (REFLUX) and when the condensate was removed (CONCENTRATION). The timelines also provide explanation for any unusual event such as an unscheduled shut-down. Essential data which is shown in graphical format include the SRAT/SME temperature, volume, and vapor space pressure. Major offgas reaction products, as well as oxygen and nitrogen, are also provided for the entire feed preparation cycle. Additionally, a written summary of each operation is also provided.

SLUDGE MAKE-UP

The first step in the preparation of the melter feed simulant is the make-up of the simulated waste sludge. The waste sludge simulant for the HWVP1 run was started by transferring approximately 1200 gallons of the mixed hydroxide slurry from the TNX Slurry Receipt Tank (SRT) to the IDMS SRAT/SME. This operation was completed on November 7, 1991. The SRAT/SME contents were then sampled and the primary trim chemicals were added (as specified in the earlier section). The tank contents were again sampled and analyzed in order to determine the formic acid requirement.

Meetings with visiting observers (including personnel from Westinghouse Hanford Company, Pacific Northwest Laboratory, Fluor-Daniel, and The Institute für Nuklear Entsorgungstechnik (INE) Kernforschungszentrum Karlsruhe) were held on the morning of November 11, 1991. This provided an opportunity to brief these observers on testing objectives, schedule, etc. and to allow for last minute facility preparations.

Run: HWVP1 / Feed Preparation
Date: 07-NOV-91

Operation Log:

03:00 - 04:00 Mixed Hydroxide Slurry is transferred from the TNX SRT to the IDMS SRAT/SME

05:00 - 07:15 Primary Trim Chemicals are added to the IDMS SRAT/SME

Nov 07 - 11, 1991 Analytical measurements of the sludge, facility modifications, etc.

Figure 12. HWVP1 Chronological Timeline (07-NOV-91)

Figure 13. HWVP1 Chronological Timeline (11-NOV-91)

Operation Log:

00:00 - 08:00 Sludge was maintained at approximately 95°C overnight, problems during the night with 217FT
 08:00 - 10:00 Total offgas flow measurement device (217FT) was replaced
 10:00 - 10:38 Heat-up to 93°C
 10:38 - 13:55 Formic acid addition
 11:00 - 12:30 SRAT condensate valving in 'concentration' mode
 11:35 Hydrogen first measured
 14:30 - 15:51 Slow heat-up of the SRAT contents
 16:00 - 22:45 Formic acid digestion period

Figure 14. HWVP1 Chronological Timeline (12-NOV-91)

Run: HWVP1 / Feed Preparation
Date: 13-NOV-91

Operation Log:

00:00 - 12:00 Steam OFF, SRAT contents cooling down
 08:00 - 12:00 Replacing ultrafilter (part of the waste water treatment system) to enable concentration
 12:00 - 13:30 Heat-up to boiling
 13:30 - 19:40 SRAT contents boiling in concentration mode
 19:40 Maximum concentration permissible (wrt tank level) attained, steam is discontinued, condensate valving automatically switches to reflux mode
 19:40 - 23:30 Steam to SRAT is on and off, temperature varies from 75°C to 98°C
 21:40 Recycle Waste Stream (RWS) added to the SRAT/SME vessel
 23:30 - 24:00 Valving back in concentration mode, SRAT/SME contents at boiling

Figure 15. HWVP1 Chronological Timeline (13-NOV-91)

Run: HWVP1 / Feed Preparation
Date: 14-NOV-91

Operation Log:

00:00 - 04:00 Continue concentration of the SME after RWS addition
 04:00 - 06:00 Switched to reflux mode due to problems with the waste water ultrafiltration system
 06:00 - 09:00 Continue concentration of the SME after RWS addition
 09:00 - 12:00 After SME/RWS concentration was completed the slurry was cooled and held at 85 - 95°C
 09:00 - 11:30 Make-up of the Frit-Water slurry; addition of 3 gal of formic acid, water, and frit to the FSMT
 11:30 Addition of the first frit slurry mixture to the SRAT/SME vessel
 12:00 - 22:45 Concentration of the SME slurry
 22:45 Addition of the second frit slurry mixture to the SRAT/SME vessel
 22:45 - 23:30 SME contents cooled due to the addition of frit slurry and problems getting steam to reinitiate
 23:30 - 24:00 Continue concentration of the SME slurry

Figure 16. HWVP1 Chronological Timeline (14-NOV-91)

Run: HWVP1 / Feed Preparation

Date: 15-NOV-91 (Friday)

Operation Log:

00:00 - 08:45 Continue concentration of the SME after second frit slurry addition

08:45 Addition of third (and final) frit slurry

08:45 - 09:45 SME contents cooled to below boiling due to addition of third frit slurry

09:45 - 16:00 Concentration of the SME after third frit slurry addition

16:00 - 24:00 Steam is discontinued and the SME contents are cooled to 30°C and held over the weekend

Figure 17. HWVP1 Chronological Timeline (15-NOV-91)

Operation Log:

00:00 - 07:35 SME contents cool, steam is off

07:35 - 13:25 Steam is initiated to the SRAT/SME, material is concentrated and sampled for solids content

13:25 - 24:00 Material is cooled and held overnight awaiting solids analysis

Figure 18. HWVP1 Chronological Timeline (18-NOV-91)

Run: HWVP1 / Feed Preparation

Date: 19-NOV-91 (Tuesday)

Operation Log:

00:00 - 07:20 SME contents cool, steam is off

07:20 - 13:40 Steam is initiated to the SRAT/SME, material is concentrated as much as possible (to volume of 50%)

13:25 - 24:00 Material is cooled and held

NOTE: Material was held in the SRAT/SME while reviewing the chemical analysis and crucible test results.

On 26-NOV-91 (@ 12:45) 300 lbs of sodium nitrate (NaNO_3) is added to the SME product. On 29-NOV-91, the first transfer of SME material from the SRAT/SME to the Melter Feed Tank (MFT) was made.

Figure 19. HWVP1 Chronological Timeline (19-NOV-91)

Figure 20. HWVP1 Plots of SRAT/SME Temperature (top) and SRAT/SME Volume (bottom)

Figure 21. HWVP1 Plots of Total Offgas Flow (top), SRAT/SME air purge (middle), and SRAT/SME vapor space pressure (bottom)

Figure 22. HWVP1 Plots of Hydrogen, H₂ (top), and Carbon Dioxide, CO₂ (bottom)

Figure 23. HWVP1 Plots of Nitrogen Oxide, NO (top), Nitrogen Dioxide, NO₂ (middle), and Nitrous Oxide, N₂O (bottom)

Figure 24. HWVP1 Plots of Oxygen, O₂ (top), Nitrogen, N₂ (middle), and N₂:O₂ Molar Ratio (bottom)

The secondary trim chemicals (cadmium, noble metals) were added on the evening of November 11, 1991. The tank contents were again sampled; however, the sample results suggest that these samples were taken incorrectly (there was no increase in the cadmium content). The composition of the HWVP1 waste sludge simulant as compared to the desired NCAW'91 composition is shown in Table 20 (elemental and oxides) and Table 21 (wet chemistry). Note that the elemental data was taken from a SRAT sample that was taken approximately 50 minutes into the formic acid addition. This was so that the cadmium and noble metals could be included in the results. However, the wet chemistry results are reported from samples taken before secondary chemical addition. One should note that the neodymium and lanthanum oxides in the sludge are much higher than the NCAW'91 specification. This is due to an error in the sludge make-up procedure. This error was corrected prior to the sludge make-up of the second run. The sodium value is significantly lower than the NCAW'91 expected value because HWVP1 was a "low nitrite" run. The analysis also revealed higher than expected SiO_2 values suggesting the presence of residual melter feed in the SRAT/SME tank. Material balances suggest that this melter feed heel was approximately 80 gallons. (Note that this heel would have been from the IDMS PX1 run, which was a PUREX type waste simulant containing noble metals but no mercury).

Once all chemicals had been added and sampled, the tank contents were heated to 95°C and held in reflux mode overnight.

FORMIC ACID ADDITION

The second step in the preparation of the melter feed simulant is chemical adjustment of the sludge material via the addition of formic acid. In the HWVP process, formic acid is added to the sludge in order to adjust the rheological properties of the material and to sufficiently reduce Mn(IV) to Mn(II) to decrease the potential for foaming in the melter. The "Formic Cycle" consists of the addition of 90 wt% formic acid followed by a period of boiling (digestion). It is during these periods of the operation that the majority of the offgas products are released. It is also usually during this phase of the operation that the peak evolution for all offgas products (except possibly ammonia) is observed.

Table 20. HWVP1 Waste Sludge Simulant (oxides/elem)

Component	Oxide	Elemental	Oxide	NCAW'91
		wt%	wt%	Oxide wt%
Potassium	K ₂ O	0.20	0.29	0.20
Cesium	Cs ₂ O	1.09	1.39	0.61
Aluminum	Al ₂ O ₃	3.88	8.80	9.22
Barium	BaO	0.16	0.22	0.18
Boron	B ₂ O ₃	0.04	0.14	0.01
Cadmium	CdO	2.58	3.53	3.08
Calcium	CaO	0.74	1.24	0.80
Cerium	CeO ₂	0.46	0.69	0.66
Chromium	Cr ₂ O ₃	0.16	0.28	0.27
Copper	CuO	0.21	0.32	0.25
Germanium	GeO ₂	BDL	BDL	<0.01
Iron	Fe ₂ O ₃	16.64	28.56	28.80
Lanthanum	La ₂ O ₃	0.79	1.10	0.67
Lead	PbO	0.61	0.79	0.71
Lithium	Li ₂ O	0.04	0.09	<0.01
Magnesium	MgO	0.30	0.59	0.37
Manganese	MnO ₂	1.44	2.23	2.18
Molybdenum	MoO ₃	0.34	0.61	0.57
Neodymium	Nd ₂ O ₃	5.63	7.90	3.55
Nickel	NiO	1.50	2.28	2.34
Niobium	Nb ₂ O ₅	BDL	BDL	0.01
Palladium	PdO	0.04	0.06	0.12
Phosphorus	P ₂ O ₅	0.15	0.42	0.89
Praseodymium	Pr ₂ O ₃	0.25	0.35	0.16
Rhodium	Rh ₂ O ₃	0.04	0.06	0.11
Rubidium	Rb ₂ O ₃	BDL	BDL	0.06
Ruthenium	Ru ₂ O ₃	0.28	0.41	0.39
Samarium	Sm ₂ O ₃	0.13	0.19	0.08
Selenium	SeO ₂	0.02	0.04	0.02
Silicon	SiO ₂	3.87	9.95	4.10
Silver	Ag ₂ O	0.12	0.16	0.12
Sodium (ICP)	Na ₂ O	7.21	11.69	21.80
Strontium	SrO	0.10	0.15	0.12
Tantalum	Ta ₂ O ₅	BDL	BDL	<0.01
Tellurium	TeO ₂	NA	NA	0.10
Tin	SnO	0.01	0.01	0.01
Titanium	TiO ₂	0.17	0.35	0.66
Yttrium	Y ₂ O ₃	0.06	0.09	0.08
Zinc	ZnO	0.26	0.39	0.34
Zirconium	ZrO ₂	9.04	14.66	15.40

NA = Not Available

BDL = Below Detection Limit

Table 21. HWVP1 Waste Sludge Simulant (wet chem) - Prior to addition of the secondary trim chemicals

Formate	HCOO(-)	BDL mg/l	BDL Molar
Nitrate	NO3(-)	9220 mg/l	0.15 Molar
Nitrite	NO2(-)	3782 mg/l	0.08 Molar
Oxalate	C2O4(2-)	ND mg/l	ND Molar
Sulfate	SO4(2-)	1124 mg/l	0.02 Molar
Ammonium	NH4(+)	BDL mg/l	BDL Molar
Chloride	Cl(-)	372 mg/l	0.01 Molar
Fluoride	F(-)	79 mg/l	<0.01 Molar
pH		8.37	
wt% solids		11.6 wt%	125.63 g solids/liter
wt% oxides		8.71 wt%	94.33 g oxides/liter
density		1.08 g/ml	
TIC		3673 mg/l	
TOC		0 mg/l	

Note: The nominal concentration of NCAW sludge to the HWVP SRAT should be 100-150 g WO/L. This material is, therefore, somewhat dilute. However, the IDMS liquid effluent ultrafilter was performing very poorly and needed to be replaced. And, the formic acid addition was already delayed by one day and there were numerous observers including personnel from WHC, PNL, Fluor-Daniel, and KfK. Because formating the somewhat dilute sludge did not present any obviously negative impacts to the test objectives, it was decided to proceed. Note also that after addition of the secondary trim chemicals (noble metals and cadmium compounds) the concentration increased to ≈ 106 g WO/L.

The Formic Cycle for HWVP1 was conducted on November 12-13, 1991. Thirty-eight (38) gallons of 90.7 wt% formic acid were added to the HWVP1 alkaline sludge at approximately 0.2 gpm. This addition rate would scale to approximately 1.0 gpm in the HWVP facility, one-half the anticipated rate. Based upon operational experience in the IDMS facility, SRTC has recommended to the DWPF that the formic acid addition rate be adjusted from 2.0 gpm to 1.0 gpm. This lower addition rate helps to prevent offgas surges which can lead to vessel over-pressurization and foaming (CO₂) and high PVVS temperatures (NO $\rightarrow$ NO₂). The amount of formic acid used during HWVP1 was determined by applying the SRTC method⁸ and adding an "excess" amount of formic acid (per WHC and PNL guidance). This "excess" amount was added on the advice of PNL who, based on bench-scale experimentation, considered the SRTC amount to be insufficient

to initiate hydrogen evolution. A summary of the formic acid requirement for HWVP1 is shown in Table 22. Further, a complete analysis of the consumption of formic acid is provided in a later section.

Table 22. Calculated Formic Acid Requirement for HWVP1

<u>Reactant</u>	<u>Amount</u>	<u>Units</u>	<u>gmoles reactant*</u>	<u>gmoles HCOOH req'd</u>
hydroxide	0.1	Molar	507.2	507.2
carbonate	0.125	Molar	634.0	1268.0
nitrite	0.10	Molar	507.2	380.4
MnO ₂	1.4	wt% Mn	163.3	245.0
Ni(OH) ₂	1.5	wt% Ni	163.8	98.2

Total gmoles HCOOH required	2498.8
Total gallons of 90 wt% HCOOH required (@ 100%)	27.9 gal
Total gallons of 90 wt% HCOOH required (@ 110%)	30.7 gal
WHC/PNL recommended "excess ($\approx$ 25%) "	38.0 gal

* 5072 liters (1340 gallons) of sludge @ 124.3 g solids per liter of sludge

The waste sludge simulant was heated to approximately 93°C before the addition of the formic acid. As one can see in the chronological timelines, the condensate valving switched from reflux to concentration during the addition but was returned to reflux before the completion of the addition. Once the formic acid was completely added, the SRAT contents were slowly heated to boiling and held at boiling during the digestion period. Figure 25 shows the temperature profile of the IDMS SRAT/SME during the HWVP1 Formic Cycle. The figure also identifies heat-up, acid addition, and digestion periods. Note that dips in the SRAT temperature are periods of sampling where the vessel contents are lowered to 95°C, sampled and quickly reheated. Figure 26 shows the flowrate of the formic acid during the addition period.

After completion of the formic acid digestion period the vessel contents were cooled and held overnight to allow for a next-morning replacement of the liquid effluent ultrafilter. Once this was accomplished, the SRAT contents were heated and boiled in concentration mode until the minimum tank level ($\approx$ 1100 gallons) was attained. The condensate valving was then switched to reflux mode in preparation for the receipt of the Recycle Waste Stream (RWS).

Figure 25. HWVP1 SRAT Temperature - Formic Cycle

Figure 26. HWVP1 Formic Acid Addition Rate

Table 23. Sludge after formic acid add'n and digestion

Formate	HCOO(-)	17398 mg/l	0.39 Molar
Nitrate	NO3(-)	8585 mg/l	0.02 Molar
Nitrite	NO2(-)	BDL mg/l	BDL Molar
Oxalate	C2O4(2-)	ND mg/l	ND Molar
Sulfate	SO4(2-)	778 mg/l	0.01 Molar
Ammonium	NH4(+)	380 mg/l	0.02 Molar
Chloride	Cl(-)	ND mg/l	ND Molar
Fluoride	F(-)	ND mg/l	ND Molar
pH		7.7	
wt% solids		12.74 wt%	139.89 g solids/liter
wt% oxides		9.7 wt%	106.55 g oxides/liter
density		1.1 g/ml	
TIC		1352 mg/l	
TOC		5231 mg/l	

RWS CYCLE

The RWS Cycle consists of the make-up of the Recycle Waste Stream (RWS), addition of the RWS to the formatted waste sludge, and concentration of the mixture. The HWVP1 RWS was made-up in the Frit Slurry Make-up Tank (FSMT) by the addition of the RWS trim chemicals as described in the earlier "Raw Materials" section with approximately 200 gallons of water. The material was sampled and then immediately transferred to the IDMS SRAT/SME. The SRAT/SME contents were then sampled, concentrated, and resampled. Note that the cadmium content of the HWVP Recycle Waste Stream was added directly to the SRAT/SME instead of through the FSMT. The RWS Cycle for HWVP1 was conducted on November 13 - 14, 1991.

The composition of the HWVP1 RWS was shown earlier in Table 13. The composition of the resulting SRAT/SME mixture is shown in Tables 24 - 26.

Table 24. HWVP1 SME after RWS addition (before conc'n)

Formate	HCOO(-)	17351 mg/l	0.39 Molar
Nitrate	NO3(-)	13916 mg/l	0.22 Molar
Nitrite	NO2(-)	BDL mg/l	BDL Molar
Oxalate	C2O4(2-)	407 mg/l	<0.01 Molar
Sulfate	SO4(2-)	886 mg/l	0.01 Molar
Ammonium	NH4(+)	457 mg/l	0.03 Molar
Chloride	Cl(-)	915 mg/l	0.03 Molar
Fluoride	F(-)	20 mg/l	<0.01 Molar
pH		8.36	
wt% solids		13.61 wt%	150.46 g solids/liter
wt% oxides		10.18 wt%	112.51 g oxides/liter
density		1.11 g/ml	
TIC		1709 mg/l	
TOC		4794 mg/l	

Table 25. HWVP1 SME after RWS addition (after conc'n)

Formate	HCOO(-)	16543 mg/l	0.37 Molar
Nitrate	NO3(-)	14582 mg/l	0.24 Molar
Nitrite	NO2(-)	BDL mg/l	BDL Molar
Oxalate	C2O4(2-)	ND mg/l	ND Molar
Sulfate	SO4(2-)	1090 mg/l	0.02 Molar
Ammonium	NH4(+)	410 mg/l	0.02 Molar
Chloride	Cl(-)	ND mg/l	ND Molar
Fluoride	F(-)	ND mg/l	ND Molar
pH		8.77	
wt% solids		15.34 wt%	171.58 g solids/liter
wt% oxides		11.36 wt%	127.06 g oxides/liter
density		1.1 g/ml	
TIC		2051 mg/l	
TOC		4979 mg/l	

Table 26. HWVP1 SME Composition after RWS Addition

Component	Oxide	Elemental wt%	Oxide wt%
Potassium	K ₂ O	0.16	0.26
Cesium	Cs ₂ O	2.93	4.33
Aluminum	Al ₂ O ₃	3.06	8.07
Barium	BaO	0.12	0.19
Boron	B ₂ O ₃	0.01	0.05
Cadmium	CdO	2.27	3.62
Calcium	CaO	0.69	1.34
Cerium	CeO ₂	0.31	0.53
Chromium	Cr ₂ O ₃	0.12	0.25
Copper	CuO	0.16	0.28
Germanium	GeO ₂	BDL	BDL
Iron	Fe ₂ O ₃	12.79	25.53
Lanthanum	La ₂ O ₃	0.66	1.07
Lead	PbO	0.47	0.70
Lithium	Li ₂ O	0.02	0.05
Magnesium	MgO	0.16	0.37
Manganese	MnO	1.18	2.13
Molybdenum	MoO ₃	0.25	0.53
Neodymium	Nd ₂ O ₃	4.42	7.22
Nickel	NiO	1.23	2.18
Niobium	Nb ₂ O ₅	BDL	BDL
Palladium	PdO	BDL	BDL
Phosphorus	P ₂ O ₅	0.20	0.63
Praseodymium	Pr ₂ O ₃	0.12	0.20
Rhodium	Rh ₂ O ₃	BDL	BDL
Rubidium	Rb ₂ O ₃	BDL	BDL
Ruthenium	Ru ₂ O ₃	0.24	0.41
Samarium	Sm ₂ O ₃	0.03	0.05
Selenium	SeO ₂	BDL	BDL
Silicon	SiO ₂	2.62	7.82
Silver	Ag ₂ O	0.09	0.14
Sodium	Na ₂ O	9.21	17.35
Strontium	SrO	0.09	0.14
Tantalum	Ta ₂ O ₅	BDL	BDL
Tellurium	TeO ₂	0.09	0.16
Tin	SnO	0.01	0.02
Titanium	TiO ₂	0.14	0.33
Yttrium	Y ₂ O ₃	0.04	0.07
Zinc	ZnO	0.22	0.39
Zirconium	ZrO ₂	7.21	13.58

FRIT CYCLE

Frit Make-up and Addition

The FRIT Cycle consists of the make-up of the frit-water slurry, addition of the frit slurry to the SME vessel, and concentration of the mixture. The HWVP1 frit slurry was made-up in the Frit Slurry Make-up Tank (FSMT) by the mixing of 3200 lbs of the borosilicate glass frit described in the earlier "Raw Materials" section with approximately 400 gallons of water. (This is the amount of frit which was specified based on target feed compositions.⁶) Approximately 3 gallons of 90 wt% formic acid were also added to the frit-water mixture. Since the FSMT was originally used with the SRTC Full-Scale SRAT/SME, it is oversized and not optimal for use with the IDMS SRAT/SME. Because of this, it is difficult to keep any type of frit suspended. However, as compared to SRS FRIT-202, the frit used in these tests was even more difficult to keep suspended. In order to pump all of the frit to the SRAT/SME, a water lance was used to move frit which had accumulated on the dished bottom of the tank.

The frit slurry was transferred to the IDMS SRAT/SME in three additions. After each addition, the SRAT/SME contents were concentrated to create space in the vessel for subsequent frit slurry additions. Once all of the frit was added, the SRAT/SME was sampled for process control purposes. The SME product was then concentrated over the next few days while awaiting the analytical results of the dilute sample. Once the final concentration was completed, the vessel was resampled. The composition of the HWVP1 SME product is shown in Tables 27 and 28.

Table 27. HWVP1 SME Composition after FRIT Cycle*

Formate	HCOO(-)	14125 mg/l	0.31 Molar
Nitrate	NO3(-)	11565 mg/l	0.19 Molar
Nitrite	NO2(-)	BDL mg/l	BDL Molar
Oxalate	C2O4(2-)	1029 mg/l	0.01 Molar
Sulfate	SO4(2-)	1106 mg/l	0.02 Molar
Ammonium	NH4(+)	<1 mg/l	<0.01 Molar
Chloride	Cl(-)	797 mg/l	0.02 Molar
Fluoride	F(-)	39 mg/l	<0.01 Molar
pH		9.69	
wt% solids		30.96 wt%	390.10 g solids/liter
wt% oxides		20.96 wt%	350.15 g oxides/liter
density		1.26 g/ml	
TIC		2054 mg/l	
TOC		3696 mg/l	

Note: This analysis is of the SME product before final concentration. A sample (H-SMCO-0099) was taken after the final concentration was completed in order to measure the oxide loading of the SME. However, this sample, for unknown reason, was never submitted to the laboratory.

Because the resulting SME product was much lower in soda (Na_2O) and higher in silica (SiO_2) than the predicted NCAW'91 glass, it was suspected that the viscosity of the resulting melt would be above the prescribed upper limit (100 poise @ 1150°C). SRTC has developed a property-to-composition correlation for predicting the melt viscosity⁹ of SRS waste glass compositions. However, this correlation does not include the contribution of zirconium which will act similarly to aluminum to increase the viscosity of the molten melt.¹⁰ In order to test the pourability of the molten material before feeding it to the melter, a small sample was vitrified in a small, sealed crucible. The molten glass was visibly more difficult to pour as compared to previous IDMS melter feeds. The test was repeated in a large, unsealed crucible with essentially the same result. Further, a "melt tilt" test was done where a glass button made from the HWVP1 melter feed was heated to 820-840°C along with reference glasses on a tilted metal plate. The HWVP1 glass was obviously more viscous than an 80 poise reference glass (IDMS BL2).

Table 28. HWVP1 SME Composition after FRIT Cycle

Component	Oxide	Elemental wt%	Meas'd Oxide wt%	Corr'd* Oxide wt%	NCAW'91 Oxide wt%
Potassium	K ₂ O	0.14	0.17	0.16	0.07
Cesium	Cs ₂ O	0.73	0.77	0.16	0.17
Aluminum	Al ₂ O ₃	1.54	2.92	2.92	2.75
Barium	BaO	0.06	0.07	0.07	0.05
Boron	B ₂ O ₃	4.78	15.39	13.70	13.91
Cadmium	CdO	0.96	1.10	1.10	1.00
Calcium	CaO	0.30	0.42	0.42	0.24
Cerium	CeO ₂	0.17	0.21	0.21	0.18
Chromium	Cr ₂ O ₃	0.06	0.08	0.11	0.08
Copper	CuO	0.10	0.13	0.11	0.07
Germanium	GeO ₂	BDL	BDL	BDL	<0.01
Iron	Fe ₂ O ₃	6.68	9.55	8.85	8.12
Lanthanum	La ₂ O ₃	0.24	0.29	0.29	0.19
Lead	PbO	0.16	0.18	0.18	0.18
Lithium	Li ₂ O	2.87	6.18	5.33	4.96
Magnesium	MgO	0.05	0.08	0.08	0.12
Manganese	MnO	0.51	0.81	0.81	0.65
Molybdenum	MoO ₃	0.10	0.14	0.15	0.16
Neodymium	Nd ₂ O ₃	1.66	1.94	1.94	1.00
Nickel	NiO	0.55	0.70	0.70	0.66
Niobium	Nb ₂ O ₅	BDL	BDL	BDL	<0.01
Palladium	PdO	0.04	0.05	0.05	0.03
Phosphorus	P ₂ O ₅	0.02	0.05	0.05	0.38
Praseodymium	Pr ₂ O ₃	0.09	0.11	0.11	0.04
Rhodium	Rh ₂ O ₃	0.04	0.05	0.05	0.03
Rubidium	Rb ₂ O ₃	BDL	BDL	0.02	0.02
Ruthenium	Ru ₂ O ₃	0.11	0.14	0.14	0.11
Samarium	Sm ₂ O ₃	0.06	0.07	0.07	0.02
Selenium	SeO ₂	0.02	0.03	0.03	<0.01
Silicon	SiO ₂	29.37	62.83	54.66	52.04
Silver	Ag ₂ O	0.04	0.05	0.05	0.03
Sodium	Na ₂ O	4.79	6.46	5.45	7.83
Strontium	SrO	0.02	0.03	0.03	0.03
Tantalum	Ta ₂ O ₅	BDL	BDL	BDL	<0.01
Tellurium	TeO ₂	ND	ND	ND	0.03
Tin	SnO	0.06	0.07	0.00	<0.01
Titanium	TiO ₂	0.09	0.16	0.16	0.19
Yttrium	Y ₂ O ₃	0.01	0.02	0.02	0.02
Zinc	ZnO	0.13	0.16	0.15	0.10
Zirconium	ZrO ₂	3.13	4.23	4.23	4.31

* Values were corrected using correction factors obtained by analyzing a standard glass (which was dissolved and analyzed on the same day as the process sample).

HWVP1 SME Remediation

Based on the aforementioned empirical tests, it was decided to reduce the melt viscosity by increasing the alkali content of the melter feed. This was done with the addition of 300 lbs of NaNO_3 which was added in order to raise the sodium content to the nominal NCAW'91 melter feed concentration. The resulting modified SME product is shown in Tables 29 and 30. The final SME volume was 1104 gallons.

Table 29. HWVP1 SME Composition after NaNO_3 Addition

Formate	$\text{HCOO}(-)$	16092 mg/l	0.36 Molar
Nitrate	$\text{NO}_3(-)$	33639 mg/l	0.54 Molar
Nitrite	$\text{NO}_2(-)$	BDL mg/l	BDL Molar
Oxalate	$\text{C}_2\text{O}_4(2-)$	1130 mg/l	0.01 Molar
Sulfate	$\text{SO}_4(2-)$	1438 mg/l	0.02 Molar
Ammonium	$\text{NH}_4(+)$	BDL mg/l	BDL Molar
Chloride	$\text{Cl}(-)$	797 mg/l	0.02 Molar
Fluoride	$\text{F}(-)$	39 mg/l	<0.01 Molar
pH		9.69	
wt% solids		37.14 wt%	493.96 g solids/liter
wt% oxides		34.25 wt%	455.53 g oxides/liter
density		1.33 g/ml	
TIC		2735 mg/l	
TOC		4158 mg/l	

Table 30. HWVP1 SME Composition after NaNO₃ Addition

Component	Oxide	Elemental	Meas'd	Corr'd	NCAW'91
		wt%	Oxide wt%	Oxide wt%	Oxide wt%
Potassium	K ₂ O	0.14	0.18	0.18	0.07
Cesium	Cs ₂ O	0.73	0.84	0.17	0.17
Aluminum	Al ₂ O ₃	1.33	2.74	2.74	2.75
Barium	BaO	0.05	0.05	0.05	0.05
Boron	B ₂ O ₃	3.98	13.94	12.98	13.91
Cadmium	CdO	0.79	0.98	0.98	1.00
Calcium	CaO	0.23	0.36	0.36	0.24
Cerium	CeO ₂	0.21	0.27	0.27	0.18
Chromium	Cr ₂ O ₃	0.06	0.09	0.12	0.08
Copper	CuO	0.07	0.09	0.08	0.07
Germanium	GeO ₂	BDL	BDL	BDL	<0.01
Iron	Fe ₂ O ₃	4.88	7.59	7.11	8.12
Lanthanum	La ₂ O ₃	0.20	0.26	0.26	0.19
Lead	PbO	0.13	0.15	0.15	0.18
Lithium	Li ₂ O	2.31	5.41	4.81	4.96
Magnesium	MgO	0.08	0.15	0.15	0.12
Manganese	MnO	0.43	0.60	0.60	0.65
Molybdenum	MoO ₃	0.11	0.18	0.19	0.16
Neodymium	Nd ₂ O ₃	1.81	2.30	2.30	1.00
Nickel	NiO	0.43	0.59	0.59	0.66
Niobium	Nb ₂ O ₅	BDL	BDL	BDL	<0.01
Palladium	PdO	0.07	0.09	0.09	0.03
Phosphorus	P ₂ O ₅	0.06	0.16	0.16	0.38
Praseodymium	Pr ₂ O ₃	0.15	0.19	0.19	0.04
Rhodium	Rh ₂ O ₃	0.04	0.05	0.05	0.03
Rubidium	Rb ₂ O ₃	BDL	BDL	BDL	0.02
Ruthenium	Ru ₂ O ₃	0.13	0.17	0.17	0.11
Samarium	Sm ₂ O ₃	0.10	0.12	0.02	0.02
Selenium	SeO ₂	0.03	0.05	0.05	<0.01
Silicon	SiO ₂	21.23	49.45	49.45	52.04
Silver	Ag ₂ O	0.04	0.04	0.04	0.03
Sodium	Na ₂ O	4.97	8.77	7.90	7.83
Strontium	SrO	0.02	0.02	0.02	0.03
Tantalum	Ta ₂ O ₅	BDL	BDL	BDL	<0.01
Tellurium	TeO ₂	ND	ND	ND	0.03
Tin	SnO	0.02	0.02	0.02	<0.01
Titanium	TiO ₂	0.09	0.15	0.15	0.19
Yttrium	Y ₂ O ₃	0.02	0.03	0.03	0.02
Zinc	ZnO	0.11	0.16	0.15	0.10
Zirconium	ZrO ₂	2.55	3.75	3.75	4.31

MELTER OPERATION

Approximately 490 gallons of the HWVP1 SME product was transferred from the IDMS SRAT/SME to the IDMS MFT on 11/29/91. This is referred to as "Transfer #1". There was a heel in the MFT of 300 gallons. This heel was SRS PUREX type melter feed (from the IDMS PX1 run) which contained noble metals but no mercury. Initially, there were considerable difficulties in feeding the HWVP1 material. The feed pump was consistently operating at 100% output and, as a result, over-heating and shutting OFF. Initially, it was suspected that the rheological properties of the HWVP1 feed material were significantly different from previous IDMS melter feeds. The size of the venturi-type line restrictor was varied in an effort to make the material easier to feed. However, after several days of feeding (at 100% feed pump output), a restriction, which had formed during the just completed feeding of SRS PUREX slurry, was found in the feed line just before the entrance of the feed tube (see Figure 27). This was the first occurrence of a restriction in this location (although the 0.25" IDMS feed tube has been prone to pluggages throughout the IDMS melter operation). The restriction consisted of feed material which had accumulated in the line eventually causing a blockage. This was not the result of a particle of material lodging in the feed line as this material had been passed through the feed line strainer prior to this point. Once the restriction was removed, the material was pumped much easier. However, restrictions of this type reoccurred throughout the feeding of the HWVP1 melter feed slurry.

Figure 27. Location of feed line blockages during HWVP1

The second transfer consisting of approximately 375 gallons of the HWVP1 feed material from the SRAT/SME to the MFT was completed on December 5, 1991. A total of 3390 lbs of glass was poured during the processing of the HWVP1 material. A feedrate profile for the HWVP1 feeding is shown in Figure 28.

Figure 28. Feedrate profile for HWVP1

Figure 29. Melter feed loop recirculation rate (gpm)

Figure 30. Melter feed pump output (%)

Figure 31. Melter Feed Tank level (%)

Additional melter operational parameters are given in a later section (NOBLE METALS IN THE MELTER SYSTEM - Effects on the Melter Operation).

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HWVP2 BATCH HISTORY

HWVP2 was started on 12/5/91 with the transfer of mixed hydroxide slurry and finished on 2/4/92 when the last canister of glass was poured. Chronological timelines for the feed preparation portion of this run and graphical representation for essential processing data are provided in Figures 32 - 42. As with those of HWVP1, the chronological timelines are depicted in military time and were constructed via the use of archived processing data, the control room operator's logbook, and the technical engineer's logbook. The timelines reveal the times when the SRAT/SME condensate was returned to the vessel (REFLUX) and when the condensate was removed (CONCENTRATION). The timelines also provide explanation for any unusual event such as an unscheduled shut-down. Essential data which is shown in graphical format include the SRAT/SME temperature, volume, and vapor space pressure. Major offgas reaction products, as well as oxygen and nitrogen, are also provided for the entire feed preparation cycle. Additionally, a written summary of each operation is also provided.

SLUDGE MAKE-UP

The make-up of the waste sludge simulant for the HWVP2 run was started with the transfer of approximately 1200 gallons of the mixed hydroxide slurry from the TNX Slurry Receipt Tank (SRT) to the IDMS SRAT/SME. This operation was completed on December 5, 1991. The SRAT/SME contents were then sampled and the primary trim chemicals were added (as specified in an earlier section). The tank contents were again sampled and analyzed. On 12/8/91, the SRAT contents were heated and concentrated to make room for IDMS building sump decant (essentially water). The secondary trim chemicals (cadmium, noble metals) and building sump decant were added on December 9, 1991 and the tank contents were again sampled. The composition of the HWVP2 waste sludge simulant as compared to the desired NCAW'91 composition is shown in Table 31 (wet chemistry) and Table 32 (elemental and oxides). It is obvious from the sludge analysis that there was a considerable heel remaining in the SRAT/SME from the previous run. This heel is estimated to be approximately 250 gallons. The Si, B, and Li are all considerably higher than the NCAW'91 desired content indicating the presence of frit in the solution.

Run: HWVP2 / Feed Preparation

Date: 05-DEC-91

Operation Log:

11:30 - 12:00 Transfer (#2) of HWVP1 SME Product from the SRAT/SME to the MFT

13:00 - 13:30 Limited internal inspection of the IDMS SRAT/SME vessel (Note: This inspection was made by viewing the inside of the vessel through a conservation vent and only a small portion of the vessel was viewed).

21:00 - 23:00 Addition of the Primary Trim Chemicals

After addition of the primary trim chemicals the analytical verification of the sludge was started; there was no activity in the SRAT/SME until 12/08/91.

Figure 32. HWVP2 Chronological Timeline (05-DEC-91)

Run: HWVP2 / Feed Preparation

Date: 08-DEC-91

Operation Log:

16:30 - 17:45 Steam is initiated to the SRAT, the contents are heated in reflux mode

17:45 - 24:00 SRAT contents are boiled in concentration mode

Figure 33. HWVP2 Chronological Timeline (08-DEC-91)

Run: HWVP2 / Feed Preparation

Date: 09-DEC-91

Operation Log:

00:00 - 03:00 SRAT contents boiling in concentration mode
 03:00 - 03:15 Secondary Trim Chemicals added
 03:30 - 03:45 IDMS building sump decant added to the SRAT/SME
 03:45 - 07:00 SRAT contents boiling in concentration mode
 07:00 - 13:00 SRAT contents held at 93 °C awaiting the addition of formic acid
 08:50 SRAT contents are sampled
 13:05 - 14:40 Formic acid addition (approximately 30 of 56 gallons added), rate was approximately 0.4 gpm
 14:40 - 17:30 Leak detected in the formic acid delivery system, addition stopped to repair leak
 17:30 - 19:40 Formic acid addition is restarted
 19:40 - 24:00 Formic acid digestion ... switched back and forth from concentration due to foaming and plugging of down stream filters.

Figure 34. HWVP2 Chronological Timeline (09-DEC-91)

Run: HWVP2 / Feed Preparation

Date: 10-DEC-91

Operation Log:

00:00 - 01:00 SRAT/SME contents boiling in concentration mode (formic acid digestion period)
 01:00 - 04:00 SRAT/SME contents boiling; switched to reflux mode due to ultrafilter problems (acid digestion)
 04:00 - 10:45 SRAT/SME contents cooled and held while ultrafilters are backflushed
 10:45 - 15:40 SRAT/SME contents are heated and held at approximately 80°C
 15:40 - 15:54 IDMS building sump decant is added to the SRAT/SME
 15:54 - 16:15 SRAT/SME contents are heated up to boiling (in reflux mode)
 16:15 - 23:17 SRAT/SME contents boiling in concentration mode
 23:17 - 23:20 Begin addition of the Recycle Waste Stream (RWS)
 23:20 - 24:00 SRAT/SME contents boiling in concentration mode

Figure 35. HWVP2 Chronological Timeline (10-DEC-91)

Run: HWVP2 / Feed Preparation
Date: 11-DEC-91

Operation Log:

00:00 - 04:57 SRAT/SME contents boiling in concentration mode (RWS Concentration period)
 04:57 - 07:00 SRAT/SME contents boiling in reflux while preparing for make-up of frit slurry
 06:00 - 07:00 Make-up of the frit slurry in the Frit Slurry Make-up Tank (FSMT)
 07:00 - 07:15 First addition of frit slurry to the SRAT/SME
 08:20 - 18:25 SRAT/SME contents boiling in concentration mode (FRIT Concentration)
 18:25 - 18:40 Second frit slurry addition to the SRAT/SME (in reflux mode)
 18:40 - 19:30 SRAT/SME contents heating up to boiling in reflux mode
 19:30 - 24:00 SRAT/SME contents boiling in concentration mode

Figure 36. HWVP2 Chronological Timeline (11-DEC-91)

Run: HWVP2 / Feed Preparation

Date: 12-DEC-91

Operation Log:

00:00 - 00:15 SRAT/SME contents boiling in concentration mode
00:15 - 08:00 Steam to SRAT/SME is shut OFF and vessel contents are cooled (valving in reflux mode)
08:00 - 09:30 Steam to the SRAT/SME is initiated and the contents are heated in reflux mode
09:30 - 15:30 SRAT/SME contents boiling in concentration mode
15:30 - 16:30 Steam to SRAT/SME is discontinued and the vessel contents are cooled (valving in conc'n mode)
16:30 - 24:00 SRAT/SME contents continue to cool and valving is switched to reflux mode

Figure 37. HWVP2 Chronological Timeline (12-DEC-91)

Figure 38. HWVP2 Plots of SRAT/SME Temperature (top) and SRAT/SME Volume (bottom)

Figure 39. HWVP2 Plots of Total Offgas Flow (top), SRAT/SME air purge (middle), and SRAT/SME vapor space pressure (bottom)

Figure 40. HWVP2 Plots of Hydrogen, H₂ (top) and Carbon Dioxide, CO₂ (bottom)

Figure 41. HWVP2 Plots of Nitrogen Oxide, NO, (top), Nitrogen Dioxide, NO₂, (middle), and Nitrous Oxide, N₂O, (bottom)

Figure 42. HWVP2 Plots of Oxygen, O₂, (top), Nitrogen, N₂, (middle), and (N₂:O₂) Molar Ratio (bottom)

Table 31. HWVP2 Waste Sludge Composition

Formate	HCOO(-)	2154 mg/l	0.05 Molar
Nitrate	NO3(-)	17316 mg/l	0.28 Molar
Nitrite	NO2(-)	18514 mg/l	0.40 Molar
Oxalate	C2O4(2-)	1048 mg/l	0.01 Molar
Sulfate	SO4(2-)	1631 mg/l	0.03 Molar
Ammonium	NH4(+)	BDL mg/l	BDL Molar
Chloride	Cl(-)	843 mg/l	0.02 Molar
Fluoride	F(-)	95 mg/l	0.01 Molar
pH		10.50	
wt% solids		18.78 wt%	219.73 g solids/liter
wt% oxides		17.03 wt%	199.25 g oxides/liter
density		1.17 g/ml	
TIC		2143 mg/l	
TOC		1351 mg/l	

One can see by the presence of the formate and the increased nitrate further evidence of the presence of a HWVP1 SME heel at the start of the HWVP2 operation. Note also that the sludge simulant is much more concentrated (at ≈ 200 gWO/L) than the HWVP1 initial SRAT material. It is not known what effect, if any, this had on the ultimate rheological properties of the HWVP2 SME product.

Table 32. HWVP2 Waste Sludge Simulant

Component	Oxide	NCAW'91		
		Elem wt%	Oxide wt%	Oxide wt%
Potassium	K ₂ O	0.10	0.16	0.20
Cesium	Cs ₂ O	0.25	0.35	0.61
Aluminum	Al ₂ O ₃	2.57	6.32	9.22
Barium	BaO	0.11	0.15	0.18
Boron	B ₂ O ₃	1.07	4.50	0.01
Cadmium	CdO	1.65	2.45	3.08
Calcium	CaO	0.53	0.97	0.80
Cerium	CeO ₂	0.30	0.48	0.66
Chromium	Cr ₂ O ₃	0.11	0.20	0.27
Copper	CuO	0.13	0.22	0.25
Germanium	GeO ₂	BDL	BDL	<0.01
Iron	Fe ₂ O ₃	11.13	20.73	28.80
Lanthanum	La ₂ O ₃	0.26	0.40	0.67
Lead	PbO	0.43	0.60	0.71
Lithium	Li ₂ O	0.67	1.87	<0.01
Magnesium	MgO	0.20	0.43	0.37
Manganese	MnO ₂	0.90	1.51	2.18
Molybdenum	MoO ₃	0.18	0.35	0.57
Neodymium	Nd ₂ O ₃	2.26	3.45	3.55
Nickel	NiO	1.03	1.71	2.34
Niobium	Nb ₂ O ₅	BDL	BDL	0.01
Palladium	PdO	0.05	0.07	0.12
Phosphorus	P ₂ O ₅	0.09	0.26	0.89
Praseodymium	Pr ₂ O ₃	0.10	0.16	0.16
Rhodium	Rh ₂ O ₃	0.04	0.06	0.11
Rubidium	Rb ₂ O ₃	BDL	BDL	0.06
Ruthenium	Ru ₂ O ₃	0.26	0.42	0.39
Samarium	Sm ₂ O ₃	0.04	0.06	0.08
Selenium	SeO ₂	BDL	BDL	0.02
Silicon	SiO ₂	9.12	25.42	4.10
Silver	Ag ₂ O	0.10	0.14	0.12
Sodium (ICP)	Na ₂ O	8.92	15.68	21.80
Strontium	SrO	0.07	0.11	0.12
Tantalum	Ta ₂ O ₅	0.02	0.03	<0.01
Tellurium	TeO ₂	0.14	NA	0.10
Tin	SnO	0.01	0.02	0.01
Titanium	TiO ₂	0.11	0.25	0.66
Yttrium	Y ₂ O ₃	0.04	0.06	0.08
Zinc	ZnO	0.18	0.30	0.34
Zirconium	ZrO ₂	5.77	10.14	15.40

FORMIC ACID ADDITION

After adding the secondary trim chemicals and sump decant and then sampling, the SRAT contents were held at 93°C (in reflux mode) awaiting the addition of the formic acid. Fifty-six (56) gallons of 86.1 wt% formic acid were added to the HWVP2 alkaline sludge. The determination for this amount is shown in Table 33.

Table 33. Calculated Formic Acid Requirement for HWVP2

<u>Reactant</u>	<u>Amount</u>	<u>Units</u>	<u>gmoles reactant*</u>	<u>gmoles HCOOH req'd</u>
hydroxide	0.1	Molar	580.6	580.6
carbonate	0.171	Molar	990.0	1980.9
nitrite	0.37	Molar	2145.4	1609.0
MnO ₂	0.9	wt% Mn	184.5	276.7
Ni(OH) ₂	1.1	wt% Ni	196.9	118.2
Total gmoles HCOOH required				4565
Total gallons of 90 wt% HCOOH required (@ 100%)				51.0 gal
Total gallons of 90 wt% HCOOH required (@ 110%)				56.1 gal

* 5806 liters (1534 gallons) of sludge @ 186.4 g solids per liter of sludge

The formic acid was added at an initial flowrate of 0.4 gpm. The increased acid addition flowrate (from 0.2 gpm during HWVP1) caused offgas surges which lead to over-pressurization in the SRAT/SME vapor space. When the SRAT/SME vapor space pressure exceeded 2"H₂O (vacuum), the control system automatically discontinued the addition of formic acid, turned OFF the steam, and initiated water to the vessel cooling coils. This happened numerous times during the first acid addition period (a leak in the formic acid delivery system forced an interruption in the acid addition). After this interruption, the formic acid addition was resumed at a flow rate of 0.3 gpm with much more stable results. Figure 43 shows the temperature profile of the IDMS SRAT/SME during the HWVP2 Formic Cycle. Figure 44 shows the flowrate of the formic acid during the two addition periods. The figure shows that during the first addition period the addition was stopped several times (due to high pressure in the SRAT vapor space).

Figure 43. HWVP2 SRAT Temperature - Formic Cycle

Figure 44. HWVP2 Formic Acid Addition Rate

RECOMMENDATION: The HWVP should consider the effects of the formic acid addition rate (including offgas surges which can lead to vessel over-pressurization, foaming and high Vessel Vent System temperatures) in future design and research activities.

The exact consequences of these numerous short interruptions and the one very long shutdown are not known. It is possible that slightly less formic acid was added than the flow totalizer indicated. However, as will be shown later in this report (in the section "Formic Acid Consumption"), the pH, soluble cations, and carbon species hardly changed during the long maintenance outage. And, since this was a "high nitrite" run, very little hydrogen was expected. So, it is speculated that these outages had very little effect on the final outcome of the task objectives.

Table 34. HWVP2 SRAT Composition after Formic Digestion

Formate	HCOO(-)	33619 mg/l	0.75 Molar
Nitrate	NO3(-)	22232 mg/l	0.36 Molar
Nitrite	NO2(-)	15 mg/l	<0.01 Molar
Oxalate	C2O4(2-)	ND mg/l	ND Molar
Sulfate	SO4(2-)	1866 mg/l	0.03 Molar
Ammonium	NH4(+)	42 mg/l	<0.01 Molar
Chloride	Cl(-)	1500 mg/l	0.04 Molar
Fluoride	F(-)	98 mg/l	0.01 Molar
pH		9.27	
wt% solids		21.11 wt%	252.63 g solids/liter
wt% oxides		18.68 wt%	223.60 g oxides/liter
density		1.20 g/ml	
TIC		2524 mg/l	
TOC		8866 mg/l	

In HWVP1, it was requested by visiting personnel, that initiation of boiling, at the start of digestion, be done slowly; and, this was done. However, for HWVP2, it was requested that boiling be attained very quickly. As can be seen in Figure 43, boiling was attained quite quickly relative to that of HWVP1. However, because of this, there was severe

foaming and solids carryover. This solids carryover then plugged the downstream ultrafilter.

Recommendation: The HWVP should approach boiling very cautiously during feed preparation operations to reduce the possibility of foaming and unnecessary solids carryover. Further, regular addition of an antifoam agent is essential to reduce the potential for foaming.

Because of this filter pluggage, part of the formic acid digestion was conducted in reflux mode. After completion of the digestion period, the SRAT contents were cooled to allow for the backflushing of the ultrafilters. Once this is completed the SRAT contents were reheated and held at $\approx 80^{\circ}\text{C}$ while IDMS building sump decant was added. This material was then concentrated before the addition of the Recycle Waste Stream.

RWS CYCLE

The RWS Cycle consists of the make-up of the Recycle Waste Stream (RWS), addition of the RWS to the formatted waste sludge, and concentration of the mixture. The HWVP2 RWS was made-up in the Frit Slurry Make-up Tank (FSMT) by the addition of the RWS trim chemicals as described in the earlier "Raw Materials" section with approximately 200 gallons of water. The material was then immediately transferred to the IDMS SRAT/SME. The SRAT/SME contents were then sampled, concentrated, and resampled. Note that the cadmium content of the HWVP Recycle Waste Stream was added directly to the SRAT/SME instead of through the FSMT. Note also that no sodium phosphate or sodium oxalate were available for the RWS make-up of this run. The RWS Cycle for HWVP2 was conducted on 12/11/91.

The composition of the resulting SRAT/SME mixture is shown in Tables 35 - 37.

Table 35. HWVP2 SME after RWS add'n - unconc'd

Formate	HCOO(-)	27831 mg/l	0.62 Molar
Nitrate	NO3(-)	23534 mg/l	0.38 Molar
Nitrite	NO2(-)	15 mg/l	<0.01 Molar
Oxalate	C2O4(2-)	ND mg/l	ND Molar
Sulfate	SO4(2-)	1594 mg/l	0.02 Molar
Ammonium	NH4(+)	62 mg/l	<0.01 Molar
Chloride	Cl(-)	1300 mg/l	0.04 Molar
Fluoride	F(-)	93 mg/l	<0.01 Molar
pH		9.36	
wt% solids		20.67 wt%	245.40 g solids/liter
wt% oxides		18.44 wt%	218.98 g oxides/liter
density		1.19 g/ml	
TIC		2694 mg/l	
TOC		7874 mg/l	

Table 36. HWVP2 SME after RWS add'n - conc'd

Formate	HCOO(-)	31200 mg/l	0.69 Molar
Nitrate	NO3(-)	29117 mg/l	0.47 Molar
Nitrite	NO2(-)	22 mg/l	<0.01 Molar
Oxalate	C2O4(2-)	ND mg/l	ND Molar
Sulfate	SO4(2-)	1898 mg/l	0.03 Molar
Ammonium	NH4(+)	21 mg/l	0.01 Molar
Chloride	Cl(-)	1300 mg/l	0.04 Molar
Fluoride	F(-)	93 mg/l	<0.01 Molar
pH		9.53	
wt% solids		21.92 wt%	259.97 g solids/liter
wt% oxides		19.78 wt%	234.53 g oxides/liter
density		1.19 g/ml	
TIC		2651 mg/l	
TOC		8055 mg/l	

Table 37. HWVP2 SME Composition after RWS Cycle

Component	Oxide	Elem wt%	Oxide wt%
Potassium	K ₂ O	0.11	0.17
Cesium	Cs ₂ O	0.30	0.42
Aluminum	Al ₂ O ₃	2.52	6.22
Barium	BaO	0.10	0.15
Boron	B ₂ O ₃	1.08	4.54
Cadmium	CdO	1.70	2.52
Calcium	CaO	0.53	0.96
Cerium	CeO ₂	0.27	0.43
Chromium	Cr ₂ O ₃	0.11	0.20
Copper	CuO	0.12	0.20
Germanium	GeO ₂	BDL	BDL
Iron	Fe ₂ O ₃	10.54	19.68
Lanthanum	La ₂ O ₃	0.22	0.34
Lead	PbO	0.38	0.53
Lithium	Li ₂ O	0.69	1.93
Magnesium	MgO	0.19	0.41
Manganese	MnO ₂	0.85	1.43
Molybdenum	MoO ₃	0.20	0.40
Neodymium	Nd ₂ O ₃	2.17	3.31
Nickel	NiO	1.01	1.67
Niobium	Nb ₂ O ₅	BDL	BDL
Palladium	PdO	0.03	0.05
Phosphorus	P ₂ O ₅	0.02	0.07
Praseodymium	Pr ₂ O ₃	0.06	0.09
Rhodium	Rh ₂ O ₃	0.02	0.03
Rubidium	Rb ₂ O ₃	BDL	BDL
Ruthenium	Ru ₂ O ₃	0.26	0.42
Samarium	Sm ₂ O ₃	BDL	BDL
Selenium	SeO ₂	BDL	BDL
Silicon	SiO ₂	8.98	25.09
Silver	Ag ₂ O	0.10	0.14
Sodium (ICP)	Na ₂ O	10.32	18.19
Strontium	SrO	0.07	0.10
Tantalum	Ta ₂ O ₅	BDL	BDL
Tellurium	TeO ₂	NA	NA
Tin	SnO	BDL	BDL
Titanium	TiO ₂	0.11	0.24
Yttrium	Y ₂ O ₃	0.04	0.06
Zinc	ZnO	0.16	0.27
Zirconium	ZrO ₂	5.53	9.75

FRIT CYCLE

Frit Make-up and Addition

The FRIT Cycle consists of the make-up of the frit-water slurry, addition of the frit slurry to the SME vessel, and concentration of the mixture. The HWVP2 frit slurry was made-up in the Frit Slurry Make-up Tank (FSMT) by the mixing of 3200 lbs of the borosilicate glass frit described in the earlier "Raw Materials" section with approximately 400 gallons of water. Approximately 3 gallons of 90 wt% formic acid were also added to the frit-water mixture. The frit slurry was then transferred to the IDMS SRAT/SME in 2 separate additions with the blended material concentrated between addition. The final resulting mixture was then sampled, concentrated, and resampled. The composition of the HWVP2 SME product is shown in Table 38 (wet chemistry) and Table 39 (elemental and oxides). The final volume of the SME was 1050 gallons.

Table 38. HWVP2 SME Composition after FRIT Cycle

Formate	HCOO(-)	20845 mg/l	0.46 Molar
Nitrate	NO3(-)	21111 mg/l	0.34 Molar
Nitrite	NO2(-)	BDL mg/l	BDL Molar
Oxalate	C2O4(2-)	789 mg/l	0.01 Molar
Sulfate	SO4(2-)	1476 mg/l	0.02 Molar
Ammonium	NH4(+)	BDL mg/l	BDL Molar
Chloride	Cl(-)	1200 mg/l	0.03 Molar
Fluoride	F(-)	100 mg/l	0.01 Molar
pH		10.03	
wt% solids		37.92 wt%	500.54 g solids/liter
wt% oxides		36.85 wt%	2486.42 g oxides/liter
density		1.32 g/ml	
TIC		3029 mg/l	
TOC		5324 mg/l	

Table 39. HWVP2 SME Composition after FRIT Cycle

NCAW'91				
		Elem	Oxide	Oxide
Component	Oxide	wt%	wt%	wt%
Potassium	K2O	0.08	0.09	0.07
Cesium	Cs2O	0.10	0.11	0.17
Aluminum	Al2O3	1.36	2.68	2.75
Barium	BaO	0.05	0.06	0.05
Boron	B2O3	3.99	13.43	13.91
Cadmium	CdO	0.80	0.95	1.00
Calcium	CaO	0.27	0.39	0.24
Cerium	CeO2	0.11	0.14	0.18
Chromium	Cr2O3	0.05	0.08	0.08
Copper	CuO	0.07	0.09	0.07
Germanium	GeO2	0.02	0.03	<0.01
Iron	Fe2O3	5.08	7.59	8.12
Lanthanum	La2O3	0.12	0.15	0.19
Lead	PbO	0.18	0.20	0.18
Lithium	Li2O	2.29	5.15	4.96
Magnesium	MgO	0.10	0.18	0.12
Manganese	MnO2	0.41	0.55	0.65
Molybdenum	MoO3	0.11	0.17	0.16
Neodymium	Nd2O3	0.88	1.08	1.00
Nickel	NiO	0.45	0.60	0.66
Niobium	Nb2O5	BDL	BDL	<0.01
Palladium	PdO	0.01	0.01	0.03
Phosphorus	P2O5	0.03	0.07	0.38
Praseodymium	Pr2O3	0.04	0.05	0.04
Rhodium	Rh2O3	0.01	0.01	0.03
Rubidium	Rb2O3	BDL	BDL	0.02
Ruthenium	Ru2O3	0.04	0.05	0.11
Samarium	Sm2O3	0.02	0.02	0.02
Selenium	SeO2	BDL	BDL	<0.01
Silicon	SiO2	24.00	53.63	52.04
Silver	Ag2O	0.04	0.05	0.03
Sodium (ICP)	Na2O	5.79	8.16	7.83
Strontium	SrO	0.03	0.04	0.03
Tantalum	Ta2O5	0.01	0.02	<0.01
Tellurium	TeO2	NA	NA	0.03
Tin	SnO	0.01	0.02	<0.01
Titanium	TiO2	0.09	0.16	0.19
Yttrium	Y2O3	0.02	0.02	0.02
Zinc	ZnO	0.10	0.13	0.10
Zirconium	ZrO2	2.66	3.75	4.31

The material was quite close in composition to the NCAW'91 target composition and was therefore assumed to be processable (with respect to viscosity and liquidus) in the IDMS melter. The material was then transferred to the Melter Feed Tank.

MELTER OPERATION

Approximately 550 gallons of the HWVP2 SME product was transferred from the IDMS SRAT/SME to the IDMS MFT on 1/3/92. This is referred to as "Transfer #1". A second transfer of approximately 500 gallons ("Transfer #2") was made on 1/10/92. A total of 4561 lbs* of glass was poured during the processing of the HWVP2 material. A feedrate profile for the HWVP1 feeding is shown in Figure 45.

Figure 45. Feed rate profile for HWVP2 melter feeding

* NOTE: A total of 3390 lbs of glass was poured during HWVP1 and a total of 4561 lbs of glass was poured during HWVP2. The glass assigned to HWVP1 includes a heel left in the MFT from a prior IDMS run (PX1). The glass assigned to HWVP2 includes a heel left in the MFT from HWVP1. A heel was left in the MFT after HWVP2 operations (approximately 300 gallons).

Figure 46. Feed loop recirculation rate (gpm)

Figure 47. Melter Feed Tank level (%)

Processing of the HWVP2 melter feed was extremely difficult. As can be seen in Figure 45, the feed rate of the melter feed slurry was very erratic. The rheological properties of this material were much worse than any slurry which had been previously processed in the IDMS facility. Two dilutions (with water) were necessary to continue processing. The first dilution consisted of 50 gallons of water with an approximate 40 gallons of flush water (total dilution of 90 gallons). The second dilution was approximately 35 gallons.

One obvious difference in the HWVP runs from previous IDMS runs done in support of the DWPF was the composition of the borosilicate glass frit. The frit used during the HWVP demonstrations has a low durability relative to the FRIT-202 used in DWPF tests¹¹. In an aqueous solution, the boron and lithium may leach from the frit matrix leaving the SiO₂ present as a silica gel. This would adversely affect the rheological properties of the feed slurry and would be worsened by the noble metal induced pH drift.

Recommendation: The rheology of the NCAW melter feed slurry may be a severe problem for the operation of the HWVP facility. It is recommended that further tests be conducted to fully characterize this behavior. These tests should include, but not be limited to, consideration of an alternate acid for feed preparation processing and use of a more durable frit composition.

The average feed rate and melt rate were calculated for a period of continuous feeding during HWVP2. The results are as follows:

Avg feed rate (lb oxides/hr)	25.39 (HWVP2)	25.0 (target)
Avg melt rate (lb/hr/ft ²)	8.09 (HWVP2)	8.0 (target)

As seen the average rates were very close for the target values. However, during most of the feeding of the HWVP material, and especially the HWVP2 material, the melt rate was limited by the difficulty of feeding the slurry to the melter and not by the capacity of the melter. There were no problems noted which can be associated with feed buildup on the cold cap or foaming

Additional melter operational parameters are given in a later section (NOBLE METALS IN THE MELTER SYSTEM - Effects on the Melter Operation).

FEED PREPARATION

MATERIAL BALANCES

Material balances for the Feed Preparation System (i.e. the SRAT/SME) were performed for all elements and anions, and for carbon and nitrogen. The carbon and nitrogen balances are summarized in a later section. The material balances are broken down into major, minor, and trace elemental components. Additionally the anionic components are handled separately as are the noble metals. More detailed material balance tables are given in Appendix D. These tables show the composition of each of the major streams (as measured and as predicted).

Major Components

Major components are those which are present in the SME product in concentrations greater than 0.5 wt%. Table 40 shows the results of the material balances for the major components for both HWVP1 and HWVP2. The results show that most of the components which are added to form the SME product are accounted for, analytically, in the SME product within $\pm 10\%$.

Minor Components

Minor components are those which are present in the SME product in concentrations of 0.1 - 0.5 wt%. Table 41 shows the results of the material balances for the minor components for both HWVP1 and HWVP2. The results show that most of the components which are added to form the SME product are accounted for, analytically, in the SME product within $\pm 15\%$.

Trace Components

Trace components are those which are present in the SME product in concentrations less than 0.1 wt%. Table 42 shows the results of the material balances for the trace components for both HWVP1 and HWVP2. The results are quite scattered and emphasize the difficulty of analytically determining quantities of components this low. Some analytes (yttrium and strontium, esp.), however, did give favorable results.

Noble Metals

Reliable analyses of the noble metals in the waste sludge simulant, melter feed slurry, and glass are hindered by a number of problems. The effectiveness of dissolution procedures is highly dependent upon the chemical form of the noble metals. Dissolution of the sludge in hot aqua regia and subsequent analysis via ICP-AES or ICP-MS has proven to be a somewhat effective means of measuring these elements.¹¹ This is the method used for these material balances. Further discussion on the analysis of noble metals is given in a later section. Table 43 shows the results of the material balances for the noble metals for both HWVP1 and HWVP2. The material balances for these components were not good. Ruthenium and silver were accounted for within $\pm 30\%$, while rhodium and palladium were $\pm 90\%$ and $\pm 60\%$ respectively.

Anions

Measurements of the anions were performed using Ion Chromatography (IC). Anions such as formate (HCOO^-), nitrate (NO_3^-), nitrite (NO_2^-), and oxalate ($\text{C}_2\text{O}_4^{2-}$) are included in the carbon and nitrogen balances summarized in a later section. Table 43 shows the results of the material balances for the anions for both HWVP1 and HWVP2. Chloride and sulfate were generally within $\pm 20\%$ of that expected while fluoride, which is present in much smaller quantities was not as good. No reliable phosphate or iodide analyses were obtained.

Table 40. Feed Preparation Material Balances - Major Components

	Mixed OH- Slurry (Analytical)	SRAT Heel (Calculated)	Primary Trims (Weighed)	Secondary Trims (Weighed)	RWS (Weighed)	FRIT (Weighed)	Predicted SME Comp (Calculated)	Analyzed SME Comp (Analytical)	% Acct'd for in SME (Calculated)	% from Predicted
HWVP1										
Major (lbs)										
Al	60.14	3.45	0.00	0.00	2.59	3.39	69.57	68.37	98.27	-1.7
B	0.00	1.23	0.03	0.00	0.00	187.84	189.10	188.76	99.82	-0.2
Cd	0.00	0.00	0.00	35.84	1.73	0.00	37.57	37.97	101.07	1.1
Fe	262.98	6.66	0.00	0.00	0.85	0.86	271.35	274.28	101.08	1.1
Li	0.00	0.55	0.00	0.00	0.00	103.62	104.17	109.89	105.49	5.5
Mn	21.17	1.46	0.00	0.00	0.70	0.00	23.33	22.69	97.24	-2.8
Na	13.41	4.63	104.79	13.13	33.74	7.17	176.86	179.45	101.46	1.5
Nd	0.00	0.00	80.99	0.00	0.00	0.00	80.99	70.90	87.54	-12.5
Ni	23.45	0.99	0.00	0.00	0.00	0.00	24.44	24.44	99.98	0.0
Si	3.82	16.51	25.52	0.00	23.21	1093.95	1163.02	1132.55	97.38	-2.6
Zr	139.44	0.00	0.00	0.00	0.00	0.93	140.37	138.66	98.78	-1.2
HWVP2										
Major (lbs)										
Al	59.93	0.77	0.00	0.00	2.59	3.39	66.68	69.43	104.13	4.1
B	0.00	26.48	0.03	0.00	0.00	187.84	214.35	204.18	95.26	-4.7
Cd	0.00	6.71	0.00	35.84	1.73	0.00	44.28	41.01	92.62	-7.4
Fe	263.30	6.54	0.00	0.00	0.85	0.86	271.55	260.17	95.81	-4.2
Li	0.00	16.17	0.00	0.00	0.00	103.62	119.79	117.17	97.82	-2.2
Mn	21.22	0.80	0.00	0.00	0.70	0.00	22.71	20.97	92.31	-7.7
Na	15.70	4.30	183.93	13.13	28.95	8.51	254.52	262.56	103.16	3.2
Nd	0.00	4.68	40.50	0.00	0.00	0.00	45.18	41.42	91.68	-8.3
Ni	23.46	1.68	0.00	0.00	0.00	0.00	25.14	23.14	92.02	-8.0
Si	3.45	159.01	22.91	0.00	23.21	1093.95	1302.54	1228.17	94.29	-5.7
Zr	139.90	1.58	0.00	0.00	0.00	0.00	141.47	136.19	96.26	-3.7

Table 41. Feed Preparation Material Balance - Minor Components

	Mixed OH- Slurry (Analytical)	SRAT Heel (Calculated)	Primary Trims (Weighed)	Secondary Trims (Weighed)	RWS (Weighed)	FRIT (Weighed)	Predicted SME Comp (Calculated)	Analyzed SME Comp (Analytical)	% Acct'd for in SME (Calculated)	% from Predicted
HWVP1										
Minor (lbs)										
Ca	4.10	1.09	7.65	0.00	0.24	2.02	15.10	13.41	88.82	-11.2
Ce	0.00	0.00	7.09	0.00	0.00	0.00	7.09	7.49	105.63	5.6
Cs	0.00	0.00	7.67	0.00	0.00	0.00	7.67	6.65	86.74	-13.3
La	0.00	0.00	15.09	0.00	0.00	0.00	15.09	10.81	71.62	-28.4
Mg	2.71	0.00	2.98	0.00	0.22	0.00	5.91	5.54	93.82	-6.2
Mo	0.00	0.00	5.05	0.00	0.00	0.00	5.05	4.96	98.30	-1.7
K	0.69	1.66	2.21	0.00	0.49	0.83	5.88	5.76	97.93	-2.1
Pb	0.00	0.00	8.22	0.00	0.00	0.00	8.22	8.99	109.33	9.3
Ti	0.00	0.00	2.00	0.00	0.10	1.98	4.08	4.14	101.51	1.5
HWVP2										
Minor (lbs)										
Ca	4.03	1.37	7.65	0.00	0.24	2.02	15.31	13.58	88.72	-11.3
Ce	0.00	0.00	7.09	0.00	0.00	0.00	7.09	4.62	65.15	-34.8
Cs	0.00	0.00	7.67	0.00	0.00	0.00	7.67	5.12	66.73	-33.3
La	0.00	0.00	7.55	0.00	0.00	0.00	7.55	3.33	44.11	-55.9
Mg	1.50	0.00	2.98	0.00	0.22	0.00	4.70	4.74	100.99	1.0
Mo	0.00	0.00	5.05	0.00	0.00	0.00	5.05	5.47	108.43	8.4
K	0.69	0.00	2.21	0.00	0.49	0.83	4.22	3.87	91.81	-8.2
Pb	0.00	0.00	8.22	0.00	0.00	0.00	8.22	9.14	111.21	11.2
Ti	0.00	0.00	2.00	0.00	0.10	1.98	4.08	4.66	114.27	14.3

Table 42. Feed Preparation Material Balances - Trace Components

	Mixed OH-Slurry (Analytical)	SRAT Heel (Calculated)	Primary Trims (Weighed)	Secondary Trims (Weighed)	RWS (Weighed)	FRIT (Weighed)	Predicted SME Comp (Calculated)	Analyzed SME Comp (Analytical)	% Acct'd for in SME (Calculated)	% from Predicted
HWVP1										
Trace (lbs)										
P	0.00	0.00	0.35	0.00	0.04	0.00	0.39	0.89	229.38	129.4
Sn	0.00	0.00	0.13	0.00	0.00	0.00	0.13	0.35	277.78	177.8
Zn	0.00	0.00	3.64	0.00	0.00	0.00	3.64	5.32	146.31	46.3
Ge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	BDL	BDL	BDL
Ta	0.00	0.00	0.07	0.00	0.00	0.00	0.07	BDL	BDL	BDL
Cr	0.00	0.00	2.43	0.00	0.00	0.00	2.43	3.54	145.98	46.0
Nb	0.00	0.00	0.17	0.00	0.00	0.00	0.17	BDL	BDL	BDL
Cu	0.00	0.00	2.65	0.00	0.00	0.00	2.65	3.54	133.43	33.4
Y	0.00	0.00	0.86	0.00	0.00	0.00	0.86	0.84	97.33	-2.7
Sr	0.00	0.00	1.36	0.00	0.00	0.00	1.36	1.46	107.51	7.5
Pr	0.00	0.00	1.77	0.00	0.00	0.00	1.77	4.17	235.33	135.3
Sm	0.00	0.00	0.69	0.00	0.00	0.00	0.69	2.57	370.32	270.3
Ba	0.00	0.00	2.13	0.00	0.00	0.45	2.58	2.73	105.92	5.9
Rb	0.00	0.00	0.61	0.00	0.00	0.00	0.61	BDL	BDL	BDL
HWVP2										
Trace (lbs)										
P	0.00	0.00	0.35	0.00	0.04	0.00	0.39	1.44	370.92	270.9
Sn	0.00	0.00	0.13	0.00	0.00	0.00	0.13	0.71	562.32	462.3
Zn	0.00	0.00	3.64	0.00	0.00	0.00	3.64	5.04	138.52	38.5
Ge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	BDL	BDL	BDL
Ta	0.00	0.00	0.04	0.00	0.00	0.00	0.04	BDL	BDL	BDL
Cr	0.00	0.00	2.42	0.00	0.00	0.00	2.42	2.80	115.50	15.5
Nb	0.00	0.00	0.08	0.00	0.00	0.00	0.08	BDL	BDL	BDL
Cu	0.00	0.00	2.65	0.00	0.00	0.00	2.65	3.50	131.98	32.0
Y	0.00	0.00	0.86	0.00	0.00	0.00	0.86	0.78	90.21	-9.8
Sr	0.00	0.00	1.36	0.00	0.00	0.00	1.36	1.47	108.20	8.2
Pr	0.00	0.00	1.77	0.00	0.00	0.00	1.77	1.44	81.48	-18.5
Sm	0.00	0.00	0.69	0.00	0.00	0.00	0.69	6.75	973.28	873.3
Ba	0.00	0.00	2.13	0.00	0.00	0.45	2.58	NA	NA	NA
Rb	0.00	0.00	0.61	0.00	0.00	0.00	0.61	0.51	84.16	-15.8

Table 43. Feed Preparation Material Balances - Noble Metals and Anions

	Sludge Before Transfe (Analytical)	SRAT Heel (2-1)	Trim Chemicals (Weighed)	NM/Cd Added (Weighed)	Recycle Waste Stream (Weighed)	FRIT (Weighed)	Calc'd Comp after FRIT (10+12)	After Frit Add'n (Analytical)	% Acct'd for in SME (14/13)	% from Predicted
HWVP1										
NM's etc. (lbs)										
Ru	0.00	0.00	0.00	4.12	0.00	0.00	4.12	5.43	131.97	32.0
Pd	0.00	0.00	0.00	1.42	0.00	0.00	1.42	2.09	147.41	47.4
Rh	0.00	0.00	0.00	1.14	0.00	0.00	1.14	2.02	177.39	77.4
Ag	0.00	0.00	0.00	1.51	0.00	0.00	1.51	2.08	137.63	37.6
Te	0.00	0.00	0.18	0.00	0.00	0.00	0.18	BDL		
Se	0.00	0.00	0.15	0.00	0.00	0.00	0.15	BDL		
HWVP1										
Anions (lbs)										
Cl	0.30	0.51	4.08	7.08	0.08	0.00	12.05	10.09	83.73	-16.3
F	0.06	0.02	1.31	0.00	0.00	0.00	1.39	0.49	35.54	-64.5
SO4	3.74	0.00	9.73	0.00	0.00	3.94	17.41	14.03	80.60	-19.4
HWVP2										
NM's etc. (lbs)										
Ru	0.00	0.00	0.00	4.12	0.00	0.00	4.12	3.58	87.01	-13.0
Pd	0.00	0.00	0.00	1.42	0.00	0.00	1.42	0.60	41.91	-58.1
Rh	0.00	0.00	0.00	1.14	0.00	0.00	1.14	0.12	10.10	-89.9
Ag	0.00	0.00	0.00	1.51	0.00	0.00	1.51	1.98	131.12	31.1
Te	0.00	0.00	0.18	0.00	0.00	0.00	0.18	BDL		
Se	0.00	0.00	0.15	0.00	0.00	0.00	0.15	BDL		
HWVP2										
Anions (lbs)										
Cl	0.30	0.00	4.08	7.08	0.08	0.00	11.54	14.00	121.31	21.3
F	0.06	0.00	1.31	0.00	0.00	0.00	1.37	1.17	85.16	-14.8
SO4	3.74	0.00	9.73	0.00	0.00	3.94	17.41	17.14	98.44	-1.6

OFFGAS PRODUCTS

Hydrogen

Hydrogen is evolved during the Formic Cycle by the decomposition of formic acid as follows:

This reaction is catalytically promoted to a small degree by some transition metals (e.g. Cu, Fe) and to a greater degree by the noble metals.

Extensive testing has been undertaken at SRTC (large scale and lab scale)¹² and at Battelle PNL (lab scale)¹³ in order to characterize the evolution of hydrogen during the formic acid treatment of Savannah River and Hanford waste sludges. The knowledge base to date can be summarized as follows:

- The relative catalytic activity of the fission product noble metals is Rh >> Ru >> Pd.
- The rate of reaction is highly dependent upon the temperature of the vessel contents.
- The amount of the nitrite (NO₂⁻) ion present in the sludge affects the induction period for initiation of hydrogen evolution.
- The amount of hydrogen is dependent on the amount of "excess" formic acid added to the sludge material.

Figure 48 shows the evolution profile of hydrogen during the HWVP1 Formic Cycle. As can be seen in this plot, the maximum hydrogen occurred once the SRAT contents were heated to boiling. The generation then starts an exponential decay with time. This is consistent with hydrogen profiles observed in previous IDMS runs made in support of the DWPF¹².

Max H ₂ (HWVP1)	= 0.21 pph H ₂ (0.79 gmol/min)
Max H ₂ Production	= 1.7E-4 (pph H ₂)/(lb sludge oxides)
DWPF Design Basis*	= 1.8E-4 (pph H ₂)/(lb sludge oxides)

• Radioactive Operations

Figure 48. HWVP1 Hydrogen Generation - Formic Cycle

Figure 49 shows the evolution profile of hydrogen during the HWVP2 Formic Cycle. The peak hydrogen generation was again at the point at which the SRAT contents were heated to boiling. However, the maximum hydrogen generation for HWVP2 was approximately 30 times smaller than that of HWVP1. There are several things which contribute to this difference:

- The amount of nitrite in the HWVP2 waste sludge simulant was approximately 4X that of the HWVP1 material.
- The formic acid requirement for each run was determined based on correlations which were developed by SRTC using DWPF waste simulants. However, in HWVP1, an additional 25% formic acid (≈ 8 gallons) was added in order to ensure that hydrogen evolution would be initiated.

- The time between the start of formic acid addition and the initiation of the digestion was 5 hrs for HWVP1 and 7 hrs for HWVP2.

Figure 49. HWVP2 Hydrogen Generation - Formic Cycle

Ammonia Production

Ammonia (NH_3) was formed during the feed preparation cycles of both HWVP1 and HWVP2. The exact mechanism for the formation of NH_3 is not known. However, there are a few observations which can be noted:

- The amount of NH_3 generated seems to be associated with the amount of hydrogen which is evolved.
- The amount of NH_3 generated seems to be associated with the amount of the nitrate (NO_3^-) ion present in the waste sludge.

In a slightly acidic sludge material the ammonia will exist as the ammonium cation

and will be retained in the sludge material. But, as the pH of the sludge material increases, the above reaction is reversed and ammonia gas is evolved. The gas is partially scrubbed in the SRAT/SME Condenser and exits with the condensate. The ammonia which is not scrubbed in the SRAT/SME Condenser may then react with residual nitric acid (from the scrubbing of NO_2 earlier in the process) in the Process Vessel Vent System (PVVS) header. The product of this reaction, ammonium nitrate (NH_4NO_3), is a potentially explosive compound.

The ammonia generation for HWVP1 is summarized in Table 44. It can be seen in this table that no ammonia was produced until the digestion portion of the formic cycle (the same as the hydrogen). The amount of ammonium ion in the sludge increased to a what appears to be a steady state value of approximately 106 gmoles. The presence of the ammonium ion in the condensate reveals that, as the SRAT contents pH increases, ammonia gas is released and is then scrubbed in the SRAT/SME condenser. Note that the condensate was returned to the SRAT/SME vessel (reflux) during the HWVP1 formic cycle and so the majority of ammonia gas which is evolved from the SRAT is then returned with the condensate recycle. The addition of the Recycle Waste Stream provides an additional source of nitrate (NO_3^-) to the SRAT/SME. Initially, after the addition of the RWS, the ammonium in the SRAT/SME increases. Since the pH of the SRAT/SME contents continued to rise, ammonia gas continued to exit the SRAT/SME. However, since the contents were being concentrated, the scrubbed ammonia is removed from the feed preparation system with the condensate. This is even more obvious in the frit cycle where the ammonia is generated and completely removed from the SRAT/SME contents. At the end of the SME concentration step, the ammonium concentration in the SRAT/SME was <1 ppm.

Table 44. Ammonium Data - HWVP1

Time* (hrs)	NH4+ (mg/l) SRAT/SME	NH4+ (gmol) SRAT/SME	NH4+ (mg/l) Condensate	NH4+ (gmol/hr) Condensate	sludge pH (lab)	condensate pH (lab)
2.0	197	55.7	34	0.43	6.60	8.15
2.5	-	-	50	0.63		7.36
3.0	-	-	64	0.81		8.27
3.5	-	-	53	0.67		8.98
4.0	357	100.3	83	1.05	7.06	9.09
4.5	-	-	98	1.24		8.69
5.0	-	-	80	1.01		9.32
5.5	-	-	116	1.42		9.37
6.0	383	106.6	150	1.89	7.40	9.01
6.5	-	-	127	1.60		9.60
7.0	-	-	187	2.36		9.38
7.5	-	-	285	3.59		9.17
8.0	381	106.1	-	-	7.69	-
* time into formic digestion						
Time*	NH4+ (mg/l) SRAT/SME	NH4+ (gmol) SRAT/SME	NH4+ (mg/l) Condensate	NH4+ (gmol/hr) Condensate	sludge pH (lab)	condensate pH (lab)
Start	360	128.0	-	-	8.35	-
@ 1 hr	-	-	609	3.53	-	10.04
End	411	102.2	-	-	8.76	-
* at the beginning, after 1 hr, after 2 hrs, and at the end of RWS concentration						
Time*	NH4+ (mg/l) SRAT/SME	NH4+ (gmol) SRAT/SME	NH4+ (mg/l) Condensate	NH4+ (gmol/hr) Condensate	sludge pH (lab)	condensate pH (lab)
1.0	-	-	4141	26.10	-	10.26
2.0	-	-	3086	19.45	-	10.34
3.0	-	-	2449	15.44	-	10.28
4.0	-	-	2010	12.67	-	10.20
End	0	0.0	-	-	9.51	-
* time into SME concentration						

The ammonia generation behavior in HWVP2 was very similar to that in HWVP1. However, as with the hydrogen generation, the ammonia generated in HWVP2 was considerably less than that of HWVP1. Table 45 summarizes the ammonia generation and scrubbing for HWVP2. Unlike HWVP1, the condensate during the HWVP2 formic digestion period, was not returned to the SRAT (some was at the end of the digestion period). As happened in HWVP1, the addition of the RWS resulted in an increase in the amount of ammonium ion in the SRAT/SME. And, as in HWVP1, the total quantity of ammonium in the SRAT/SME was reduced as the pH of the slurry rose, releasing ammonia gas. Some of this ammonia is then scrubbed in the SRAT/SME condenser and removed with the condensate. This continued in the Frit cycle and at the end of the SME processing there was only 15 ppm NH_4^+ still present in the SME product.

As mentioned earlier, ammonia which is not scrubbed in the SRAT/SME condenser can then react with residual nitric acid in the Process Vessel Vent System (PVVS) header. The product of this reaction, ammonium nitrate (NH_4NO_3), is a potentially explosive material. Tests conducted in the IDMS facility for the DWPF¹⁴ suggest that, of the total ammonia released from the SRAT/SME, approximately 83% is stripped in the SRAT/SME condenser, the amount reaching the inlet of the FAVC was approximately 13%, with the remaining 4% assumed to have deposited in the PVVS header between the SRAT/SME condenser and the FAVC.

Recommendation: Additional demonstrations using HWVP simulants which include noble metals should be conducted to better understand and quantify ammonia evolution.

Table 45. Ammonium Data - HWVP2

Time* (hrs)	NH4+ (mg/l) SRAT/SME	NH4+ (gmol) SRAT/SME	NH4+ (mg/l) Condensate	NH4+ (gmol/hr) Condensate	sludge pH (lab)	condensate pH (lab)
0.5	-	-	0	0.00	-	1.27
1.0	-	-	0	0.00	-	4.14
1.5	-	-	11	0.08	-	6.40
2.0	-	-	18	0.14	-	7.28
2.5	-	-	28	0.21	-	8.84
3.0	-	-	57	0.43	-	8.80
3.5	0	0	-	-	8.45	-
4.0	-	-	409	3.09	-	9.23
4.5	-	-	542	4.10	-	9.40
5.0	-	-	635	4.80	-	9.49
5.5	-	-	508	3.84	-	9.97
6.0	40	10.58	842	6.37	9.27	9.52
* time into formic acid digestion						
Time*	NH4+ (mg/l) SRAT/SME	NH4+ (gmol) SRAT/SME	NH4+ (mg/l) Condensate	NH4+ (gmol/hr) Condensate	sludge pH (lab)	condensate pH (lab)
Start	62	17.6	-	-	9.36	-
@ 1 hr	-	-	890	6.73	-	9.78
@ 2 hr	-	-	861	6.51	-	9.71
End	22	5.9	-	-	9.52	-
* at the beginning, after 1 hr, after 2 hrs, and at the end of RWS concentration						
Time*	NH4+ (mg/l) SRAT/SME	NH4+ (gmol) SRAT/SME	NH4+ (mg/l) Condensate	NH4+ (gmol/hr) Condensate	sludge pH (lab)	condensate pH (lab)
1.0	-	-	835	6.31	-	9.95
2.0	-	-	748	5.66	-	9.87
3.0	-	-	676	5.11	-	9.55
4.0	-	-	646	4.87	-	9.82
End	15	4.4	-	-	10.00	-
* time into SME concentration						

N_yO_x Production / Nitrogen Balance

The chemistry associated with nitrogen species in the simulated waste sludge is very complex. Offgas products, including NO, NO₂, N₂O and possibly N₂, are produced by a variety of possible reactions including:

In the SRAT:

In the gas phase:

In the SRAT Condenser:

In the SRAT Condenser (or SRAT if in reflux):

In the SRAT:

Figure 50 shows the evolution of NO, NO₂, and N₂O during the Formic Cycle of HWVP1.

Figure 50. HWVP1 Nitrogen Oxides - Formic Cycle

As shown in Figure 50, the nitrogen oxides were almost completely evolved by the end of the formic acid addition period. NO_2 , which is the oxidation product of NO , was the most abundant nitrogen oxide measured (volumetrically). However, since the initial nitrite concentration was relatively low ($\approx 0.1\text{M}$), the nitrogen oxides emitted during the HWVP1 run were all correspondingly low.

Max NO_2 (HWVP1) = 4.0 pph NO_2 (0.66 gmol/min)

Max NO (HWVP1) = 2.4 pph NO (0.60 gmol/min)

Max N_2O (HWVP1) = 1.8 pph N_2O (0.31 gmol/min)

Table 46 shows the Nitrogen Balance for the HWVP1 Formic Cycle. As shown in the table, the nitrogen species can be accounted for to within 82.6 %. The "missing" nitrogen may be the result of

Table 46. HWVP1 Feed Preparation Nitrogen Balance

Sample ID	Liquid Phase				Gas Phase						
	NO3(-) (gmol)	NO2(-) (gmol)	NH4(+) (gmol)	N (in tank) (gmol)	NO (gmol)	NO (% of total)	NO2 (gmol)	NO2 (% of total)	N2O (gmol)	N2O (% of total)	N (out) (gmol)
During Formic Add'n											
SRDF-0016	755.37	417.62	0.00	1172.99	0.00	0.00	0.00	0.00	8.04	100.00	16.08
SRDF-0018	762.66	418.39	0.00	1181.05	0.00	0.00	0.00	0.00	8.04	100.00	16.08
SRDF-0020	791.17	407.57	0.00	1198.74	0.15	0.88	0.00	0.00	8.45	99.12	17.05
SRDF-0022	756.84	376.87	0.00	1133.71	1.51	6.96	0.00	0.00	10.10	93.04	21.71
SRDF-0024	781.66	363.84	0.00	1145.50	3.78	13.86	0.00	0.00	11.75	86.14	27.28
SRDF-0026	773.23	293.51	0.00	1066.74	7.11	20.47	0.00	0.00	13.81	79.53	34.73
SRDF-0028	770.69	276.17	0.00	1046.86	11.79	26.45	0.00	0.00	16.39	73.55	44.57
SRDF-0030	774.62	210.03	0.00	984.65	17.24	31.02	0.00	0.00	19.17	68.98	55.58
SRDF-0032	753.89	194.57	0.00	948.46	22.98	34.30	0.10	0.15	21.96	65.55	67.00
SRDF-0034	767.57	126.55	0.00	894.12	28.88	35.37	2.66	3.26	25.05	61.37	81.64
SRDF-0037	749.80	68.79	0.00	818.59	34.32	34.67	8.38	8.47	28.14	56.86	98.98
SRDF-0038	791.99	29.37	0.00	821.36	39.01	33.90	14.20	12.34	30.93	53.76	115.07
SRDF-0040	770.77	5.63	0.00	776.40	43.24	33.30	19.82	15.26	33.40	51.44	129.86
SRDF-0042	759.79	0.00	0.00	759.79	45.66	32.38	24.65	17.48	35.36	50.15	141.03
SRDF-0044	762.90	0.00	0.00	762.90	46.57	31.99	26.23	18.02	36.39	49.99	145.58
During Formic Digest											
SRDF-0049	750.78	0.00	55.59	806.37	46.87	31.42	26.23	17.58	38.04	51.00	149.18
SRDF-0057	742.42	0.00	100.18	842.60	46.87	31.20	26.23	17.46	38.56	51.34	150.22
SRDF-0065	717.53	0.00	106.55	824.08	46.87	31.03	26.23	17.37	38.97	51.60	151.04
SRFO-0071	712.12	0.00	105.99	818.11	46.87	31.03	26.23	17.37	38.97	51.60	151.04
Balance											

N (initial) 1172.99 gmol

N (out) 151.04 gmol

N (remaining) 818.11 gmol

Balance 82.62 %

analytical errors, NO_2 scrubbed at the SRAT condenser or FAVC, nitric acid/nitrate salt accumulation in the Process Vessel Vent System piping, ammonia which is not scrubbed at the SRAT condenser, and unaccounted for nitrogen gas as a reaction product.

On a molar basis, N_2O accounted for approximately 52% of the total nitrogen moles produced, while NO and NO_2 accounted for 31% and 17% respectively.

Figure 51 shows the evolution of NO , NO_2 , and N_2O during the Formic Cycle of HWVP2.

Figure 51. HWVP2 Nitrogen Oxides - Formic Cycle

The peak amounts of each of the nitrogen oxides are considerably more than those observed in HWVP1. This can be accounted for by the fact that the initial nitrite concentration of HWVP2 was approximately 4X that of HWVP1. The peak NO_x is also dependent

upon the rate of formic acid addition. The initial formic acid addition rate was approximately 2X that of HWVP1.

Max NO₂ (HWVP2) = 13.5 pph NO₂ (2.22 gmol/min)

Max NO (HWVP2) = 3.5 pph NO (0.88 gmol/min)

Max N₂O (HWVP2) = 19.5 pph N₂O (3.35 gmol/min)

Table 47 shows the Nitrogen Balance for the HWVP2 Formic Cycle. As shown in the table, the nitrogen species can be accounted for to within 92.4 %. The "missing" nitrogen can be accounted for in the same ways as HWVP1 (see above).

On a molar basis, N₂O accounts for approximately 74% of the total nitrogen moles produced, while NO and NO₂ account for 8% and 18% respectively.

Table 47. HWVP2 Feed Preparation Nitrogen Balance

Sample ID	Liquid Phase				Gas Phase						
	NO3(-) (gmol)	NO2(-) (gmol)	NH4(+) (gmol)	N (in tank) (gmol)	NO (gmol)	NO (% of total)	NO2 (gmol)	NO2 (% of total)	N2O (gmol)	N2O (% of total)	N (out) (gmol)
During Formic Add'n											
SRNM-0170	1447.30	2078.00	0.00	3525.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SRDF-0172	1456.61	2077.11	0.00	3533.72	0.00	0.00	0.00	0.00	1.03	100.00	2.06
SRDF-0174	1486.85	2111.55	0.00	3598.40	0.00	0.00	0.00	0.00	1.75	100.00	3.50
SRDF-0176	1410.70	1978.03	0.00	3388.73	0.15	2.45	0.00	0.00	2.99	97.55	6.13
SRDF-0178	1457.27	1944.59	0.00	3401.86	2.27	15.49	0.00	0.00	6.19	84.51	14.65
SRDF-0180	1351.36	1790.41	0.00	3141.77	6.20	19.27	0.00	0.00	12.99	80.73	32.18
SRDF-0182	1401.39	1716.54	0.00	3117.93	11.04	18.98	1.77	3.04	22.68	77.98	58.17
SRDF-0184	1511.58	1627.01	0.00	3138.59	17.39	17.62	5.42	5.49	37.94	76.89	98.69
SRDF-0186	1412.35	1488.38	0.00	2900.73	25.10	15.60	15.38	9.56	60.20	74.84	160.88
SRDF-0188	1467.16	1346.64	0.00	2813.80	32.96	13.58	34.51	14.22	87.63	72.20	242.73
SRDF-0190	1475.07	1163.80	0.00	2638.87	38.56	11.94	50.88	15.76	116.70	72.30	322.84
SRDF-0192	1537.62	1112.04	0.00	2649.66	41.43	11.13	56.31	15.13	137.21	73.74	372.16
SRDF-0194	1491.14	1010.51	0.00	2501.65	43.70	10.35	60.45	14.32	158.97	75.33	422.09
SRDF-0198	1609.81	882.85	0.00	2492.66	53.22	8.35	73.46	11.52	255.46	80.13	637.60
SRDF-0200	1534.30	710.86	0.00	2245.16	59.27	8.79	76.03	11.27	269.68	79.95	674.66
SRDF-0202	1629.83	646.13	0.00	2275.96	65.32	9.04	84.01	11.62	286.69	79.34	722.71
SRDF-0204	1623.16	543.43	0.00	2166.59	71.37	9.13	99.00	12.66	305.66	78.20	781.69
SRDF-0206	1641.28	245.37	0.00	1886.65	76.81	9.08	119.02	14.07	324.94	76.84	845.71
SRDF-0208	1802.08	585.37	0.00	2387.45	81.80	9.00	139.83	15.39	343.60	75.61	908.83
SRDF-0210	1559.79	449.14	0.00	2008.93	85.58	8.86	155.70	16.13	362.05	75.01	965.38
SRDF-0212	1596.72	232.51	0.00	1829.23	89.51	8.84	167.34	16.52	378.03	74.64	1012.91
SRDF-0213	1529.36	343.05	0.00	1872.41	93.89	8.83	178.97	16.82	395.45	74.35	1063.76
During Formic Digest											
SRDF-00221	1586.68	2.61	0.00	1589.29	125.19	8.21	272.55	17.88	563.49	73.91	1524.72
SRDF-00227	1718.72	1.57	10.68	1730.97	125.19	8.20	272.55	17.85	564.73	73.96	1527.20
Balance											

N (initial) 3525.30 gmol
 N (out) 1527.20 gmol
 N (remaining) 1730.97 gmol
 Balance 92.42 %

CO₂ Production / Carbon Balance

Carbon dioxide is evolved during the Formic Cycle via several possible reactions as listed below:

Neutralization Reactions:

REDOX Reactions:

Catalytic Reactions:

other catalytic reaction ???

Figure 52 shows the CO₂ evolution during the Formic Cycle of HWVP1.

The first peak (@ about 3 hrs) is most likely due to the neutralization of the carbonates present in the waste sludge simulant. The second peak (@ about 5 hrs) is most likely associated with the decomposition of the nitrite ion as it corresponds with peaks of nitrogen oxides (as just discussed in the previous section). The remaining CO₂ is evolved via a combination of the reduction of Mn(IV) to Mn(II), decomposition of formic acid, and the release of dissolved CO₂ upon heating the vessel contents to boiling.

Figure 52. HWVP1 Carbon Dioxide - Formic Cycle

$$\text{Max CO}_2 \text{ (HWVP1)} = 48.0 \text{ pph CO}_2 \text{ (8.23 gmol/min)}$$

Table 48 shows the Carbon Balance for the HWVP1 Formic Cycle. As shown in the table, the carbon species can be accounted for to within 85.9 %. The "missing" carbon is most likely the result of analytical errors, especially with the carbonate analysis (measured as Total Inorganic Carbon, TIC). There was no measurable production of carbon monoxide, CO, during the HWVP1 Formic Cycle.

Table 48. HWVP1 Feed Preparation Carbon Balance

Sample ID	Liquid Phase				Gas Phase		
	CO ₃ (2-) (gmol)	HCOO(-) (gmol)	C ₂ O ₄ (2-) (gmol)	C (in tank) (gmol)	CO (gmol)	CO ₂ (gmol)	C (out) (gmol)
During Formic Add'n							
SRDF-0016	550.28	757.76	62.63	1433.30	0.00	46.60	46.60
SRDF-0018	548.58	830.77	62.63	1504.61	0.00	88.45	88.45
SRDF-0020	508.79	1102.77	62.63	1736.82	0.00	165.98	165.98
SRDF-0022	485.09	1111.38	62.63	1721.73	0.00	256.18	256.18
SRDF-0024	470.27	1288.37	62.63	1883.90	0.00	321.85	321.85
SRDF-0026	457.15	1510.10	62.63	2092.51	0.00	387.10	387.10
SRDF-0028	427.95	1513.42	62.63	2066.63	0.00	456.38	456.38
SRDF-0030	376.73	1708.85	62.63	2210.84	0.00	526.69	526.69
SRDF-0032	430.49	1681.57	62.63	2237.32	0.00	595.14	595.14
SRDF-0034	408.90	1918.17	62.63	2452.33	0.00	669.88	669.88
SRDF-0037	389.00	1843.20	62.63	2357.46	0.00	743.69	743.69
SRDF-0038	466.04	2187.84	62.63	2779.14	0.00	810.70	810.70
SRDF-0040	398.32	2214.52	62.63	2738.10	0.00	874.62	874.62
SRDF-0042	455.88	2366.44	62.63	2947.58	0.00	925.13	925.13
SRDF-0044	474.08	2413.14	62.23	3011.68	0.00	961.11	961.11
During Formic Digest							
SRDF-0049	617.58	2310.63	62.63	3053.47	0.00	1371.00	1371.00
SRDF-0057	494.83	2277.45	62.23	2896.74	0.00	1476.15	1476.15
SRDF-0065	486.98	2215.52	61.74	2825.98	0.00	1546.25	1546.25
SRFO-0071	486.98	2215.52	61.74	2825.98	0.00	1546.25	1546.25
Balance							

C (initial) 1433.30 gmol
 C (out) 1546.25 gmol
 C (in) 3655.15 gmol
 C (remaining) 2825.98 gmol
 Balance 85.92 %

Figure 53 shows the CO₂ evolution during the Formic Cycle of HWVP2.

Figure 53. HWVP2 Carbon Dioxide - Formic Cycle

The peak CO₂ generation was again early in the acid addition indicating it was associated with the neutralization of carbonates. However, the maximum CO₂ generation for HWVP2 was approximately double that of HWVP1.

$$\text{Max CO}_2 \text{ (HWVP2)} = 88.0 \text{ pph CO}_2 \text{ (15.12 gmol/min)}$$

There are several things which contribute to this difference:

- The amount of nitrite in the HWVP2 waste sludge simulant was approximately 4X that of the HWVP1 material. CO₂ is a reaction product of the destruction of NO₂⁻ with formic acid.

- During the first addition period of HWVP2 (when the peak CO_2 occurred), the formic acid addition flowrate was approximately twice that of HWVP1.
- The amount carbonate in the HWVP2 sludge simulant was greater than that of the HWVP1 sludge.

Table 49 shows the Carbon Balance for the HWVP2 Formic Cycle. As shown in the table, the carbon species can be accounted for to within 111.2 %. The "extra" carbon is very likely the result of analytical errors, especially with the carbonate analysis which seems very inconsistent for this run. As in HWVP1, there was no measurable production of carbon monoxide, CO , during the HWVP2 Formic Cycle.

Table 49. HWVP2 Feed Preparation Carbon Balance

Sample ID	Liquid Phase				Gas Phase		
	CO ₃ (2-) (gmol)	HCOO(-) (gmol)	C ₂ O ₄ (2-) (gmol)	C (in tank) (gmol)	CO (gmol)	CO ₂ (gmol)	C (out) (gmol)
During Formic Add'n							
SRNM-0170	981.50	271.65	59.69	1372.53	0.00	0.00	0.00
SRDF-0172	852.05	527.10	63.00	1505.15	0.00	25.15	25.15
SRDF-0174	899.32	636.65	63.00	1661.97	0.00	31.03	31.03
SRDF-0176	958.08	692.91	63.00	1776.99	0.00	58.14	58.14
SRDF-0178	904.85	1204.78	63.00	2235.63	0.00	117.11	117.11
SRDF-0180	819.26	1222.73	63.00	2167.99	0.00	211.44	211.44
SRDF-0182	783.92	1468.29	63.00	2378.21	0.00	322.98	322.98
SRDF-0184	845.66	1955.70	63.00	2927.36	0.00	441.95	441.95
SRDF-0186	856.73	1731.78	63.00	2714.51	0.00	584.42	584.42
SRDF-0188	929.55	1955.20	63.00	3010.75	0.00	712.25	712.25
SRDF-0190	920.61	2515.56	63.00	3562.17	0.00	814.93	814.93
SRDF-0192	1015.14	2797.23	63.00	3938.37	0.00	851.42	851.42
SRDF-0194	1032.60	2850.40	63.00	4009.00	0.00	909.26	909.26
SRDF-0198	957.14	3308.12	66.27	4397.80	0.00	1232.96	1232.96
SRDF-0200	910.12	3131.37	66.27	4174.03	0.00	1341.10	1341.10
SRDF-0202	998.80	3673.71	66.27	4805.05	0.00	1440.69	1440.69
SRDF-0204	1017.16	3753.95	66.27	4903.65	0.00	1540.58	1540.58
SRDF-0206	1300.23	3952.16	66.27	5384.93	0.00	1641.92	1641.92
SRDF-0208	1198.56	4032.07	66.27	5363.17	0.00	1736.35	1736.35
SRDF-0210	895.00	4089.63	66.27	5117.17	0.00	1791.71	1791.71
SRDF-0212	924.00	4236.59	66.27	5293.13	0.00	1842.43	1842.43
SRDF-0213	1054.34	4230.74	66.27	5417.62	0.00	1919.33	1919.33
During Formic Digest							
SRDF-00221	942.98	3783.83	59.27	4845.35	0.00	2518.91	2518.91
SRDF-00227	1059.93	3917.48	10.68	4998.77	0.00	2744.78	2744.78
Balance							

C (initial) 1372.53 gmol

C (out) 2744.78 gmol

C (in) 5589.54 gmol

C (remaining) 4998.77 gmol

Balance 111.22 %

FORMIC ACID CONSUMPTION

The consumption of formic acid can be characterized through the analysis of the liquid and offgas samples. The general order of the competing reactions and the "completeness" of the REDOX and dissolution reactions can be determined by interpreting the order of offgas products, depletion of specific anions, and solubility of certain metals. In general the formic acid reactions can be grouped into one of four categories:

Neutralization Reactions (free hydroxides and carbonates):

Reduction/Oxidation Reactions:

Dissolution Reactions (insoluble hydroxides):

Catalytic Reactions:

HWVP1

Figures 54 - 58 show plots of the HWVP1 SRAT components which are affected by the addition of formic acid. Note that 38 gallons of formic acid were added to the HWVP1 waste simulant containing 0.1M NO_2^- . This included an extra 8 gallons above that recommended by the SRTC formic acid requirement calculation.

Figure 54. Plot of the pH of the HWVP1 SRAT contents during the formic acid addition/digestion period.

Figure 55. Plot of the formate, nitrate, and nitrite concentrations for the HWVP1 formic acid addition and digestion period.

Figure 56. Plot of the carbon content of the HWVP1 SRAT contents during the formic acid addition/digestion period.

Figure 57. Plot of the solubility of selected components in the HWVP1 SRAT during the formic acid addition/digestion period.

Figure 58. Plot of the solubility of selected components in the HWVP1 SRAT during the formic acid addition/digestion period.

Figure 54 shows the "real time" pH (taken at 95°C within a few minutes of sampling the tank) in contrast with the lab pH (taken at 25°C several days after sampling the tank). The pH of the material continues to drop until the end of formic acid addition period. The pH then drifts back up during the formic acid digestion period. Figure 55 shows the concentration of the formate, nitrate, and nitrite anions during the formic acid addition/digestion period. The nitrite reduction starts at about half way through the formic acid addition and, for this low nitrite run, is completely consumed just at the end of the formic acid addition. Note that this is the point where hydrogen evolution begins. The nitrate concentration changes very little through this time period. A slight drop in concentration during the formic acid digestion period is probably due in some way to the production of ammonia. The formate concentration increases with the addition of formic acid and then declines with the catalyzed decomposition (to hydrogen and carbon dioxide) and other REDOX reactions. Figure 56 shows the carbon content of the SRAT sludge during the formic acid addition/digestion period. As the formic acid, an organic material, is added to the SRAT the organic carbon content

increases accordingly. Note that this curve is very similar to the formate curve just discussed. Formates and oxalates should be the only organics present during this stage of processing. The interesting curve is that of the inorganic carbon. In the formic acid requirement calculation, the carbonates are assumed to be neutralized 100%, in which case the TIC value would go to 0 mg/l. As can be seen in the plot, the TIC value decreases steadily, remains constant for a period, and then increases during the formic acid digestion period. Figures 57 - 58 show the solubilities for various components during the formic acid addition/digestion period. From these plots it can be estimated that 85 - 95 % of the carbonates (Na, Sr, Ca, Y) were neutralized at the end of the formic acid addition. The solubilities of these components immediately declined with the end of formic acid addition and the rise in solution pH. REDOX reactions involving manganese and molybdenum were completed at 50% (the target) and 100%. Dissolution reactions for the metal hydroxides were 100% for $\text{Mg}(\text{OH})_2$, 40% for $\text{Cd}(\text{OH})_2$, and 15% for $\text{Ni}(\text{OH})_2$ and $\text{Zn}(\text{OH})_2$ which are not shown. However, the solubilities of these components decreased with rising pH. It should be noted that $\text{Mg}(\text{OH})_2$, $\text{Cd}(\text{OH})_2$, and MoO_3 were not considered in the formic acid requirement. The contribution of MoO_3 is not significant while the contributions of the $\text{Cd}(\text{OH})_2$ and $\text{Mg}(\text{OH})_2$ are greater than that of $\text{Ni}(\text{OH})_2$ which is considered in the SRTC formic requirement calculation.

HWVP2

Figures 59 - 61 show plots of the HWVP2 SRAT components which are affected by the addition of formic acid. Note that 56 gallons of formic acid were added to the HWVP1 waste simulant containing 0.4M NO_2^- . This did not include any formic acid above that recommended by the SRTC formic acid requirement calculation. Figure 59 shows the plot of the real time pH (at 95°C) and the lab pH (at 25°C) for the formic acid addition only (there was not sufficient data from the formic acid digestion period to plot). The pH profile is very similar to that of the HWVP1 run except the pH of the material did not drop as low. Though it is not shown in this plot, the pH of the material rose significantly during the formic acid digestion period (to a lab measured pH of 9.3).

Figure 59. Plot of the pH of the HWVP2 SRAT material during the formic acid addition period.

Figure 60 shows the carbon content of the HWVP2 SRAT material during the formic acid addition period. As expected the TOC value increased with the addition of the formic acid. However, the inorganic carbon (TIC) value hardly changes the entire acid addition period. This, coupled with the fact that calcium (shown in Figure 61) and strontium (not shown) are solubilized to 30% and 5% respectively, suggests that very little of the carbonate in the HWVP2 waste sludge simulant was neutralized. Figure 35 shows the solubility of manganese and calcium. Mn(IV) reduction was only 20% complete in HWVP2 as opposed to the targeted value of 50% which was accomplished in HWVP1.

Figure 60. Plot of the carbon content of the HWVP2 SRAT contents during the formic acid addition period.

Figure 61. Plot of the solubility of selected components in the HWVP2 SRAT during the formic acid addition period.

All of this data suggests that an insufficient quantity of formic acid was added to the HWVP2 waste sludge simulant. This can be explained by the fact that the SRTC calculation for formic acid addition assumes that all of the NO_2^- will be consumed via a combination of the following reactions:

and

The first reaction requires 0.67 moles of formic acid per mole of nitrite while the second reaction requires 1.5 moles of formic acid per mole of nitrite. When formulating the SRTC formic acid calculational basis, C. W. Hsu assumed the first reaction was the predominant of the two competing reactions and recommended that 0.75 mole of formic acid be added for every mole of nitrite.⁸ This assumption has been adequate for Savannah River waste types but does not appear to be correct for the NCAW simulant. If the first reaction was predominant, there would have been a measurable increase in the nitrate concentration after the formic acid digestion period (especially in the case of the high nitrite HWVP2). However, there was no increase in the nitrate concentration during the HWVP1 or HWVP2 runs. Also, unlike Savannah River waste sludges, N_2O is a major offgas product. So the following reaction must also be considered:

In this case, 2 moles of formic acid are required for every mole of nitrite. Since N_2O accounted for $\approx 50\%$ of the nitrogen moles emitted in HWVP1 and $\approx 75\%$ of the nitrogen moles emitted in HWVP2, this reaction is the major consumer of formic acid. If the contributions of $\text{Mg}(\text{OH})_2$ (at 100% complete) and $\text{Cd}(\text{OH})_2$ (at 40% complete) are considered in the formic acid requirement calculation, and if a $\text{N}_2\text{O}/\text{NO}$ reaction split is assumed, a modified formic acid requirement can be calculated. Table 50 shows the modified formic acid requirement for HWVP1.

Table 50. Modified Formic Acid Requirement for HWVP1

<u>Reactant</u>	<u>Amount</u>	<u>Units</u>	<u>gmoles reactant*</u>	<u>gmoles HCOOH req'd</u>
hydroxide	0.1	Molar	507.2	507.2
carbonate	0.125	Molar	634.0	1268.0
NO ₂ ⁻ (NO)	0.05	Molar	253.6	380.4
NO ₂ ⁻ (N ₂ O)	0.05	Molar	253.6	507.2
MnO ₂	1.4	wt% Mn	163.3	245.0
Ni(OH) ₂	1.5	wt% Ni	163.8	49.1
Cd(OH) ₂	2.7	wt% Cd	155.3	124.3
Mg(OH) ₂	0.3	wt% Mg	79.1	158.2
Total gmoles HCOOH required				3112.5
Total gallons of 90 wt% HCOOH required (@ 100%)				34.8 gal
Total gallons of 90 wt% HCOOH required (@ 110%)				38.2 gal

* 5072 liters (1340 gallons) of sludge @ 124.3 g solids
per liter of sludge

The modified calculation predicts 38 gallons, the exact amount added during HWVP1. Note that the calculation assumes Ni is 15% solubilized as opposed to 30% in the earlier calculation. The nitrite is assumed to be decomposed 50% to NO and 50% to N₂O.

The modified calculation for HWVP2 is shown in Table 51. In this case, the nitrite is assumed to be decomposed 75% to N₂O and 25% to NO₂.

This modified calculation supports the process and analytical data that suggest that an insufficient amount of formic acid was added in HWVP2. According to this modified calculation, 86 gallons of formic acid would have been required in HWVP2 while only 56 gallons were added. It is not known how this additional acid would have affected the hydrogen, ammonia, or CO₂ generations for this run. It is also not known to what extent this may have affected the final melter feed rheology.

Table 51. Modified Formic Acid Requirement for HWVP2

<u>Reactant</u>	<u>Amount</u>	<u>Units</u>	<u>gmoles reactant*</u>	<u>gmoles HCOOH req'd</u>
hydroxide	0.1	Molar	580.6	580.6
carbonate	0.171	Molar	990.0	1980.9
NO ₂ ⁻ (NO)	0.093	Molar	537.1	805.6
NO ₂ ⁻ (N ₂ O)	0.278	Molar	1611.2	3222.4
MnO ₂	0.9	wt% Mn	184.5	276.7
Ni(OH) ₂	1.1	wt% Ni	196.9	59.1
Cd(OH) ₂	1.7	wt% Cd	158.8	127.0
Mg(OH) ₂	0.2	wt% Mg	89.0	178.0

Total gmoles HCOOH required	7032.3
Total gallons of 90 wt% HCOOH required (@ 100%)	78.5 gal
Total gallons of 90 wt% HCOOH required (@ 110%)	86.4 gal

* 5806 liters (1534 gallons) of sludge @ 186.4 g solids per liter of sludge

RECOMMENDATION: WHC should adapt a method for determining the required formic acid which includes consideration for the varying concentration of formic acid consumers in the feed preparation process. These should include, but not be limited to, free hydroxide, nitrite, carbonate, MnO₂, Cd(OH)₂, and Ni(OH)₂.

MELTER SYSTEM

MATERIAL BALANCES

A material balance around the Melter System was performed for all elements and anions, and for carbon and nitrogen. The carbon and nitrogen balances are summarized in a later section. The material balances are broken down into major, minor, and trace elemental components (material balances for the noble metals are given in a later section). Two dissolution procedures were used for preparing the glass and slurry samples for analysis: the sodium peroxide fusion (Na_2O_2) and the microwave acid dissolution (MW acid). Plots of each glass component versus cumulative glass production are shown in Figures 62 - 66. The results from both procedures are shown. Components such as cadmium (which was not present in the initial material in the melter) and zirconium show a Continuous Stirred Tank Reactor (CSTR) response. Using these components it is estimated that it took 2 - 3 melter turnovers (at 900 lbs per melt volume) to reach a steady state composition.

Major Components

Major components are those which are present in the glass product in concentrations greater than 0.5 wt%. Table 52 shows the results of the material balances for the major components for both HWVP1 and HWVP2. The results show that most of the major components in the melter feed are accounted for in the glass product within $\pm 10\%$. The mass balances for cadmium usually indicated that the cadmium in the melter feed was accounted for in the glass $+10\%$. This would indicate that there is very little loss of cadmium through volatility or entrainment in the melter offgas system. The silicon balance for HWVP2 are not good (-20%). This is the result of poor analytical results for the Si in the HWVP2 glass.

Figure 62. Plots of HWVP1 and HWVP2 Glass Components versus total glass production, (a) Aluminum, (b) Barium, (c) Boron/Potassium, and (d) Cadmium

Figure 63. Plots of HWVP1 and HWVP2 Glass Components versus total glass production, (a) Calcium, (b) Chromium, (c) Copper, and (d) Iron

Figure 64. Plots of HWVP1 and HWVP2 Glass Components versus total glass production, (a) Lead, (b) Lithium, (c) Magnesium, and (d) Manganese

Figure 65. Plots of HWVP1 and HWVP2 Glass Components versus total glass production, (a) Molybdenum, (b) Neodymium, (c) Silicon, and (d) Titanium

Figure 66: Plots of HWVP1 and HWVP2 Glass Components versus total glass production, (a) Zinc, (b) Nickel, (c) Sodium, and (d) Zirconium

Minor Components

Minor components are those which are present in the glass product in concentrations of 0.1 - 0.5 wt%. Table 53 shows the results of the material balances for the minor components for both HWVP1 and HWVP2. The results show that most of the minor components in the melter feed are accounted for in the glass product within ± 15 -20%.

Trace Components

Trace components are those which are present in the SME product in concentrations less than 0.1 wt%. Table 54 shows the results of the material balances for the trace components for both HWVP1 and HWVP2. The results are quite scattered and emphasize the difficulty of analytically determining quantities of components this low.

An interesting result is that of chromium. The Cr in the glass product is 60 - 230 % higher in the glass product than in the melter feed. There are several sources for this extra Cr in the glass product. It may possibly be a product of the deterioration of the Cr-containing Monofrax K-3 refractory ($\approx 27\%$ Cr_2O_3) and/or Inconel-690 electrodes ($\approx 15\%$ Cr). However, the more likely source of the excess Cr is from the flushing of Cr-spinels which had accumulated on the melter floor during previous IDMS melter operations. Plots of the Cr (and also of the other major spinel components, Fe, Ni, and Mn) show a sharp rise at the beginning of glass production for HWVP2. This is consistent with data which will be presented later which shows that the spinel components on the melter floor decreased at the end of the HWVP2 feeding. The exact mechanism of this flushing is not known.

Table 52. Melter Material Balance - Major Components

	Melter Feed wt% elem (Na ₂ O ₂)	HWVP1 Glass wt% (Na ₂ O ₂)	% accounted for in Glass (Na ₂ O ₂)	± %		Melter Feed wt% elem (MW acid)	HWVP1 Glass wt% (MW acid)	% accounted for in Glass (MW acid)	± %
HWVP1 Major									
Al	1.621	1.525	94.1	-5.9		1.575	1.520	96.5	-3.5
B	3.599	3.690	102.5	2.5		ND	ND	NA	NA
Cd	0.581	0.612	105.3	5.3		0.557	0.623	111.9	11.9
Fe	5.285	5.780	109.4	9.4		5.400	5.365	99.3	-0.7
Li	2.433	2.405	98.9	-1.1		2.504	2.298	91.8	-8.2
Mn	0.919	0.857	93.2	-6.8		0.897	0.851	94.9	-5.1
Nd	1.329	1.256	94.5	-5.5		ND	ND	NA	NA
Si	22.515	22.175	98.5	-1.5		ND	ND	NA	NA
Zr	1.966	2.185	111.2	11.2		ND	ND	NA	NA
Ni	ND	ND	NA	NA		0.635	0.661	104.2	4.2
Na	ND	ND	NA	NA		6.552	5.830	89.0	-11.0
HWVP2 Major									
Al	1.179	1.452	123.2	23.2		1.342	1.393	103.8	3.8
B	4.003	4.008	100.1	0.1		0.000		NA	NA
Cd	0.703	0.772	109.7	9.7		0.719	0.796	110.7	10.7
Fe	4.812	5.282	109.8	9.8		4.877	5.487	112.5	12.5
Li	2.325	2.354	101.3	1.3		2.347	2.302	98.1	-1.9
Mn	0.520	0.578	111.2	11.2		0.492	0.573	116.5	16.5
Nd	0.744	1.071	144.0	44.0		ND	ND	NA	NA
Si	23.066	18.412	79.8	-20.2		ND	ND	NA	NA
Zr	2.397	2.612	108.9	8.9		ND	ND	NA	NA
Ni	ND	ND	NA	NA		0.475	0.597	125.6	25.6
Na	ND	ND	NA	NA		5.902	5.697	96.5	-3.5

Table 53. Melter Material Balance - Minor Components

	Melter Feed wt% elem (Na ₂ O ₂)	HWVP1 Glass wt% (Na ₂ O ₂)	% accounted for in Glass (Na ₂ O ₂)	± %		Melter Feed wt% elem (MW acid)	HWVP1 Glass wt% (MW acid)	% accounted for in Glass (MW acid)	± %
HWVP1 Minor									
Ca	0.598	0.537	89.9	-10.1		0.437	0.423	96.6	-3.4
Ce	ND	ND	NA	NA		ND	ND	NA	NA
La	ND	ND	NA	NA		ND	ND	NA	NA
Pb	0.226	0.194	85.8	-14.2		0.147	0.164	111.1	11.1
Mg	NA	NA	NA	NA		0.382	0.337	88.4	-11.6
Ti	0.139	0.112	80.2	-19.8		0.134	0.114	85.3	-14.7
Mo	0.096	0.072	75.2	-24.8		0.073	0.082	111.7	11.7
HWVP2 Minor									
Ca	0.398	0.437	109.9	9.9		0.294	0.285	97.1	-2.9
Ce	ND	ND	NA	NA		ND	ND	NA	NA
La	ND	ND	NA	NA		ND	ND	NA	NA
Pb	0.144	0.180	125.3	25.3		0.158	0.154	97.6	-2.4
Mg	NA	NA	NA	NA		0.173	0.125	72.2	-27.8
Ti	0.088	0.095	107.4	7.4		0.094	0.093	98.9	-1.1
Mo	0.063	0.107	169.8	69.8		0.101	0.084	83.3	-16.7

Table 54. Melter Material Balance - Trace Components

	Melter Feed wt% elem (Na ₂ O ₂)	HWVP1 Glass wt% (Na ₂ O ₂)	% accounted for in Glass (Na ₂ O ₂)	± %		Melter Feed wt% elem (MW acid)	HWVP1 Glass wt% (MW acid)	% accounted for in Glass (MW acid)	± %
HWVP1 Trace									
Ba	0.084	0.079	93.4	-6.6		0.065	0.067	102.5	2.5
Cr	0.090	0.142	158.5	58.5		0.079	0.104	130.4	30.4
Cu	0.126	0.116	92.1	-7.9		0.113	0.101	89.2	-10.8
P	0.055	0.024	43.2	-56.8		0.093	0.034	36.3	-63.7
Pr	0.105	0.020	19.2	-80.8		ND	ND	NA	NA
Sm	0.068	0.011	16.7	-83.3		ND	ND	NA	NA
Sr	0.036	0.034	95.3	-4.7		0.020	0.025	124.3	24.3
Te	NA	NA	NA	NA		NA	NA	NA	NA
Y	0.014	0.011	77.5	-22.5		0.004	0.007	155.3	55.3
Zn	0.157	0.133	84.7	-15.3		0.112	0.108	95.9	-4.1
HWVP2 Trace									
Ba	0.053	0.060	114.2	14.2		0.045	0.058	129.9	29.9
Cr	0.041	0.138	332.6	232.6		0.059	0.125	213.5	113.5
Cu	0.106	0.076	71.5	-28.5		0.069	0.069	99.9	-0.1
P	NA	NA	NA	NA		0.028	0.015	53.9	-46.1
Pr	NA	NA	NA	NA		NA	NA	NA	NA
Sm	NA	NA	NA	NA		NA	NA	NA	NA
Sr	0.033	0.036	110.6	10.6		NA	NA	NA	NA
Te	NA	NA	NA	NA		NA	NA	NA	NA
Y	NA	NA	NA	NA		NA	NA	NA	NA
Zn	0.169	0.126	74.4	-25.6		0.095	0.100	105.8	5.8

MELTER OFFGAS SYSTEM

Nitrogen Balance

Measurements of the melter offgas were taken during the HWVP2 melter feeding operation. However, after analyzing the archived data, it is concluded that the NO/NO₂/NO_x values are not correct. The NO_x analyzer used to measure the melter offgas has been proven to be somewhat unreliable in the past. However, based on past SRTC melter operations (SGM, IDMS), the following reactions can be assumed to have taken place:

The relative amounts of NO, NO₂, and N₂ emitted from the melter would be dependent upon the composition of the melter feed, the amount of air inleakage into the melter plenum, and the temperature of the melter vapor space. In the IDMS melter, most of the nitrogen enters the quencher as N₂ and NO₂. A considerable amount of the NO₂ is then scrubbed in the quencher/OGCT by the following reaction:

and the nitrous acid is converted to nitric acid by:

It is assumed that the nitrogen species would behave similarly in the HWVP Submerged Bed Scrubber (SBS).

Carbon Balance

While the measurements of the NO_x emissions were not reliable, the measurements of the CO_x melter emissions were quite good. Measurements were taken of CO₂ and CO over a several hour period of continuous feeding. The vitrification reactions which may contribute to the CO_x emissions from the melter are as follows:

The results of the carbon balance were very good. 101% of the total carbon feed to the melter during the measurement time period was accounted for in the CO_x measurements. CO₂ accounted for 96% of the CO_x measured with the remaining being CO. This is very consistent with data for previous IDMS runs.² At high melter plenum temperatures, the IDMS melter has a very high combustion efficiency.

Offgas System Deposits

The formation of deposits in the melter offgas line has been a problem common to all slurry-fed melters. Deposits found in the offgas header of the Scale Glass Melter (SGM) and IDMS melter have been identified as mixtures of alkali-rich chlorides, sulfates, borates, and fluorides with entrained Fe_2O_3 , spinels, and frit particles.¹⁵ Table 55 shows the typical operating conditions of the melter offgas system.

Table 55. Typical Operating Conditions of the IDMS Melter Offgas System

<u>Parameter</u>	<u>Condition</u>
Plenum temperature	800-900°C
Offgas line temperature	275-350°C
Total offgas flow	300-350 lbs/hr
Film Cooler Air	120 lbs/hr
Film Cooler Steam	0 lbs/hr

The offgas system was cleaned and sampled prior to starting the HWVP Process Demonstration (8/7/91). It was sampled again after processing the HWVP1 melter feed slurry (12/17/91), and again after processing the HWVP2 feed material (1/28/92). Figure 67 shows the point in the offgas header where the samples were taken. Figure 68 shows a photo of the deposited material. The samples were analyzed for chemical composition and submitted for analysis by Scanning Electron Microscope/Energy Dispersive X-Ray (SEM/EDX). The chemical composition of the samples is shown in Table 56. The analysis revealed that the offgas deposits associated with the NCAW'91 melter feed material are very similar to those seen previously in the IDMS melter. The most notable exceptions are in the increase in the amount of B, Zr, and Li in the HWVP offgas deposits. These components are present in the HWVP NCAW melter feed in higher concentrations than in SRS melter feeds and are thus entrained to a greater extent. Also notable are the concentrations of Cd and Ru.

The cadmium concentration in the offgas deposits increases from none before the HWVP runs to $\approx 1\%$ after the processing of the second batch of HWVP feed material. While this may be the result of some volatility, it is more likely due to entrainment

and overall accounts for very little of the total cadmium in the system.

The Ru in the offgas deposits increased from <1% before the HWVP runs to >5% after HWVP1 to $\approx$ 3% at the end of HWVP2 melter feeding. In very oxidizing conditions RuO_2 can be oxidized to RuO_4 , a toxic gas. RuO_4 , however, is very unstable and would convert back to RuO_2 once it exits the melter and enters the cooler offgas line. It would then deposit in the offgas header as RuO_2 . However, the Ru in the offgas deposits was mostly associated with entrained spinels, the other noble metals, and tellurium; and so, like the cadmium, was more likely the result of entrainment rather than volatilization. Overall, the amount of Ru present in the offgas samples accounted for < 1% of the total Ru fed to the melter. (Note that the DWPF curie balance assumed that 1% of the Ru entering the melter would exit as the gaseous RuO_4 and immediately be converted to particulate RuO_2).

Figure 67. Offgas Deposit Sampling Point

Figure 68. Melter Offgas Header Deposits

Table 56. Chemical Composition of the Offgas Deposits

Component	Before ¹ HWVP1 wt%	After ² HWVP1 wt%	After ³ HWVP2 wt%
K	6.71	NA	3.19
Na(AA)	12.61	NA	12.40
Na(ICP)	14.10	11.77	14.97
CS	1.52	NA	0.92
P	0.09	0.05	0.04
Zn	0.09	0.13	0.13
Cd	0.00	0.58	0.95
Pb	0.29	0.42	0.43
Ni	1.08	1.28	1.82
Ru	0.87	5.17	2.93
B	0.60	2.69	3.43
Mn	2.02	1.65	0.89
Fe	8.70	8.40	5.77
Cr	1.34	0.83	1.15
Mg	0.15	0.18	0.09
Mo	0.00	0.12	0.33
Al	1.29	1.77	1.07
Si	2.96	5.35	3.36
Ca	0.75	0.80	0.51
Cu	0.24	0.29	0.26
Ag	NA	0.07	0.39
Ti	0.08	0.13	0.09
Zr	0.07	1.66	1.84
Sr	0.08	0.06	0.03
Nd	0.25	1.40	0.53
Ba	0.08	0.12	0.07
Li	0.87	1.94	2.14
F(-)	0.10	0.00	0.10
Cl(-)	14.35	8.93	9.86
SO4(2-)	16.90	12.42	17.35

1 sample taken on 8/7/91 (I-OGDP-4177)

2 sample taken on 12/17/91 (H-OGDP-0297)

3 sample taken on 1/28/92 (H-OGDP-0397)

NA = Not Available (not done)

Figure 69 shows the morphology of typical IDMS offgas deposit prior to the processing of Hanford NCAW material. This material has been identified as alkali-rich halides, sulfates, borates, and fluorides with entrained Fe_2O_3 , spinels, and frit particles. The chemical composition of this material is shown in Column 1 of Table 56.

Figure 69. SEM Micrograph (2000X) showing a typical IDMS offgas deposit prior to the HWVP Demonstration (I-OGDP-4178).

Figure 70 show SEM Micrographs of offgas deposits which were removed after the feeding of the HWVP1 Melter Feed. The top view is shown at 50X and the bottom is shown at 500X. The material is very similar to the deposited material prior to the HWVP runs. The chemical composition of this material is shown in Column 2 of Table 56.

Figure 71 shows SEM Micrographs of offgas deposits which were removed after the feeding of the HWVP2 Melter Feed. An accompanying EDX spectra shows the typical deposit matrix, mostly alkali-rich chlorides, sulfates, and entrained (Ni,Fe,Cr) spinel. Another spectra shows that the obvious mass in the center of the photo is a complex mixture of entrained frit and

spinel, alkali-rich sulfates, and an aggregate/alloy of Ru/Rh/Te. In another micrograph, a small amount ($< 10\mu\text{m}$) of a Cd compound was found in association with Ru and Te. However, this was the only occurrence of cadmium seen in any of the offgas deposit samples. The chemical composition of the bulk material is given in Column 3 of Table 55.

Figure 70. SEM Micrographs (top 50X, bottom 500X) showing a typical IDMS offgas deposit after feeding the HWVP1 material (H-OGDP-0297).

Figure 71. SEM Micrograph (1000X) showing a typical IDMS offgas deposit after feeding the HWVP2 material. (H-OGDP-0397)

NOBLE METALS IN THE MELTER SYSTEM

Vitrification facilities worldwide have experienced operational difficulties which can be linked to noble metal deposition on the melter floor. In each of these facilities, the electrical resistivity of the glass decreased in time, especially during idling periods. In many cases, the electrical characteristics were distorted to the point that melting could not continue. Concerns (in the U.S.) were first raised with the failure of the German PAMELA melter in Mol, Belgium. Table 57 shows a comparison of noble metals concentrations for selected German, Savannah River, and Hanford wastes.

Table 57. Noble Metals in German, SRS, and Hanford Wastes

<u>Component</u>	PAMELA	SRS/DWPF	HWVP
	<u>LEWC/WAK</u>	<u>HM/BLEND</u>	<u>NCAW'91</u>
Ru	1000/5100	830/350	870
Pd	/3000	310/160	300
Rh	/1400	150/ 68	240
Ag		<u>20/ 77</u>	<u>320</u>
Total	1360*/9500	1310/655	1730

Values in ppm elemental projected in the glass product

* This is the product of 1000 ppm Ru and 360 ppm of "other" noble metals. This value (1360 ppm) resulted in PAMELA failure.

The HWVP will utilize a DWPF-type melter which has a design basis lifetime of two years. It is not known how the processing of noble metals and their possible deposition will influence the effective lifetime of the melter. The IDMS melter, which is of the DWPF design, has been exposed to the processing of noble metals during testing done in support of the DWPF.

SIZE, DISTRIBUTION, AND CHEMICAL FORM

The rate of accumulation or the settling velocity is a function of the size, distribution, and chemical form of the noble metal or noble metal agglomerate in the glass. Samples were taken from various points in the melter system in order to understand

how the size, distribution, and chemical form of the noble metals are affected by the processing steps.

Melter Feed Slurry

The size, distribution, and chemical form of the noble metals in the melter feed are affected by a combination of the upstream processing steps (specifically the addition of a reductant, formic acid), and the way in which the material is physically treated in the MFT. The size and distribution of the noble metals is affected by the shearing actions of the vessel agitator and the melter feed pump.

Samples of the melter feed slurry were filtered to remove soluble salts and dried. The dried solids were then examined under a Scanning Electron Microscope (SEM). No noble metal compounds, alloys, or aggregates could be found in the HWVP1 melter feed (H-MFTR-0102). A very small aggregate of Ru/Pd/Ag was seen in the HWVP2 melter feed (H-MFTR-0299). This is consistent with previous DWPF-type melter feeds which have been processed in the IDMS. Noble metals are rarely seen in these melter feed samples. It is suspected that the particles are small and sufficiently dispersed such that they are not easily found by standard microscopy.

Melter Cold Cap

During the continuous feeding of the simulant slurry, a "cold cap" region forms on the surface of the molten glass. It is in this area that almost all reduction-oxidation reactions occur and gaseous vitrification products are evolved.

After material has been feed to the melter to form a cold cap which sufficiently covers the molten glass, a dip sample of the cold cap region can be obtained. A cold cap sample was obtained during the feeding of the HWVP1 melter feed slurry. A typical SEM micrograph of this sample (H-COLD-0238) is shown in Figure 72. This micrograph shows the "gas bubbles" of this partially vitrified sample. Samples of previous IDMS cold cap material revealed that the noble metals are preferentially located within these vitrified gas bubbles. The HWVP1 cold cap sample did not display this same phenomenon. In fact, no noble metals were found in the cold cap sample. However, since only

one sample was examined, very little can be said about the NCAW cold cap behavior.

Figure 72. SEM Micrograph (15X) showing a sample of the HWVP1 Melter Cold Cap (H-COLD-0238).

Glass Product

Glass samples from selected canisters were sampled and submitted for SEM/EDX analysis. Typical SEM micrographs of these samples are shown in Figures 73 - 81. In Figure 73, a Cu-Ni phase or alloy is shown (at 3000X). This was the only occurrence of this type of material seen in any of the glasses observed. Figure 74 shows a typical RuO_2 cluster (at 1500X). These types of individual and clustered RuO_2 clusters are very common in the glass product and are similar to those seen in previous IDMS/DWPF glasses¹⁶ and is somewhat similar to that seen in German waste glass simulants.¹⁷ Figure 75 shows a 100X view of a HWVP1 glass sample showing scattered individual and clustered RuO_2 crystals. Figure 75 also shows a 1000X view of one of those clusters. Figure 76 again shows a view (at 3000X) of the typical RuO_2 formations. Figure 77 shows a cluster of $(\text{Na},\text{K})\text{Cl}$ salt formations at 2000X. While the formation of halide salts

which will have an affinity for cesium is a serious matter, these salts may also have been condensed in the pour spout region and picked up on the glass while pouring. Figure 78 shows the (Ni,Mn)(Fe,Cr) spinels which are very common in the simulated DWPF and HWVP glasses. The spinels shown in Figure 78 have apparently been formed by heterogeneous nucleation on a Rh (or RhO_2) particle. This is very common, especially with RuO_2 .¹⁸ Figure 79 shows a RuO_2 cluster adjacent to a cluster of KCl salts (at 500X). Figure 80 shows a rather large ($>15\mu\text{m}$) spinel in a HWVP2 glass sample. Figure 81 shows (at 2000X) an individual spherically shaped Pd-Te alloy.

Figure 73. SEM Micrograph (3000X) - glass sample HWVP1 material (H-GLAS-0162).

EDS ANALYSIS: ELECTRON MICROANALYSIS (EDS) OF THE SAMPLE
 SAMPLE ID: H-GLAS-0162 DATE: 04/03/92
 ANALYST: J. L. HARRIS

Figure 74. SEM Micrograph (1500X) - glass sample HWVP1 material (H-GLAS-0162).

Figure 75. SEM Micrograph (100X and 1000X) - glass sample HWVP1 material (H-GLAS-0264).

EDS ANALYSIS OF H-GLAS-0294 (H-GLAS-0294) DATE 04-05-92 10:23
C 1.45% O 1.00% N 0.00% A 0.00% P 0.00% E 0.00%

Figure 76. SEM Micrograph (3000X)- glass sample HWVP1 material (H-GLAS-0294).

SEM SRTC-AOS 772-A C-108.112
 Cursor: 0.000keV = 0

WED 30-MAY-92 14:25

NaCl-KCl salts

Figure 77. SEM Micrograph (2000X) - glass sample HWVP2 material (H-GLAS-0334).

Figure 78. SEM Micrograph (750X) - glass sample HWVP2 material (H-GLAS-0334).

Figure 79. SEM Micrograph (500X) - glass sample HWVP2 material (H-GLAS-0421).

Figure 80. SEM Micrograph (750X) - glass sample HWVP2 material (H-GLAS-0446).

SEM SPTC/ADS 773-A C-108,112 SUN 10-MAY-92 08:39
Cursor: 0.000keV = 0

Figure 81. SEM Micrograph (2000X) - glass sample HWVP2 material (H-GLAS-0446).

Melter Floor

Since the introduction of noble metals in the IDMS melter, samples of the melter floor have been taken on a regular basis. The samples are taken using a "grain thief" type sampling device. The samples are normally taken through the feedtube port but have also been taken from the borescope port (See Figure 82).

Melter floor samples (actually at about 3-5 cm above the floor) were first taken approximately 2 months after introduction of noble metals to the IDMS melter (in late 1990). At that point there was no evidence of the presence of any noble metal deposition or crystalline formations. Another sample of the melter floor (again at about 3-5 cm) was taken approximately 5 months after the initial floor sample. This sample revealed RuO_2 needles approximately 5 to 15 μm long. These needles were present, for the most part, in 20 to 40 μm clusters. There was no evidence of any Pd, Rh, Ag, Se or Te. Approximately 13 months after the introduction of the noble metals, a third sample of the melter floor was taken. This sample (I-MELT-4312, shown in Figure 83) revealed a significant increase in the amount of RuO_2 from the earlier samples. There was also evidence of Pd deposition. Since there was a considerable amount of deposited RuO_2 in this sample compared to previous samples, the frequency of melter floor sampling was increased and another sample was taken on 10/15/91. This sample (I-MELT-4790) was just before the start of the feeding of the HWVP1 feed slurry. Micrographs of this sample revealed a dense layer of melt insolubles, mainly RuO_2 and $(\text{Ni}, \text{Mn})(\text{Fe}, \text{Cr})$ spinels (Figures 84 and 85). This sample also revealed the first evidence of Rh deposition on the melter floor (Figure 86). Another sample was then taken on 12/4/91 which was during the feeding of the HWVP1 melter feed slurry. This sample (H-MELT-0330, shown in Figure 87) again revealed significant RuO_2 and spinel accumulation and also individual Pd. After the completion of the feeding of the HWVP1 melter feed, a sample was again taken of the melter floor (on 12/18/91). This sample (H-MELT-0329), as before, revealed dense RuO_2 /spinel accumulation and scattered Rh accumulation (Figures 88 and 89).

A melter floor sample was taken after completion of the feeding of the HWVP2 material. This sample (I-MELT-4804) was chemically

analyzed but not examined by the microscope. The chemical analysis (Table 58) revealed that the Ru, Rh, and spinel components (Cr, Mn, and Fe) had all decreased. This supports the "spinel flushing" which was discussed in an earlier section. Another sample (I-MELT-5219) was taken on 3/6/92 and is shown in Figures 90 - 92. This sample is the first taken through the borescope port. The sampling point was just at the face the bottom electrode which is closest to the riser throat entrance. The SEM examination revealed that, like I-MELT-4804, there was much less of an accumulation of spinels than that of previous samples. Figure 90 shows the normal RuO_2 clusters, Rh-nucleated Cr/Ni/Fe spinel, and an elongated formation of ruthenium disulfide, RuS_2 , a compound which decomposes at temperatures $> 1000^\circ\text{C}$. Figure 91 shows a relatively large mass of metallic palladium. Figure 92 shows the presence of rhodium in this sample. Another floor sample (I-MELT-5242) was then taken from the center of the melter (feed tube port) on 3/27/92. This sample, shown in Figures 93 - 95, revealed large masses of deposited material. The next sample (I-MELT-5270) was taken from the borescope port of the melter on 4/20/92. This sample showed a dense accumulation of noble metals and spinels. The analysis of this sample, as shown in Table 58, confirmed the increase in spinel components (especially Cr). Representative micrographs are shown in Figures 96 - 99.

Table 58 shows the amounts (in wt%) of selected components in each melter floor sample (analyses by ICP-AES/Sodium Peroxide Fusion-HCl uptake). These results suggest a non-uniform layer of noble metals (mainly RuO_2) and Ni/Fe/Cr spinel on the melter floor. The samples which have been shaded are those which have been taken from the borescope port. Analysis of these samples revealed a higher concentration of Ru in the samples taken from the outside edges of the melt pool (at the face of one of the electrodes). This suggests that the convective currents in the melter tend to "push" the RuO_2 from the center of the melter (where it enters) to the outside edges. These convective currents may also be responsible for the apparent flushing of crystalline spinels from the melter.

IDMS 1/10 Scale Glass Melter

Figure 82. Top View of the IDMS Melter

SCANNED FROM THE BOTTOM OF MELT C-412 MON 26-AUG-91 12:51
CUT OFF 0.000eV = 0

Figure 83. SEM Micrograph (500X) - melter bottom sample taken 8/23/91 (I-MELT-4312).

Figure 84. SEM Micrograph (100X) - melter bottom sample taken 10/15/91 (I-MELT-4790).

EDS ANALYSIS ELECTRON MICROSCOPE PH. C-112 RUN 02-442-32 10/11
 Current: 0.00000000

Figure 85. SEM Micrograph (200X) - melter bottom sample taken 10/15/91 (I-MELT-4790).

Figure 86. SEM Micrograph (2000X) - melter bottom sample taken 10/15/91 (I-MELT-4790).

Figure 87. SEM Micrograph - melter bottom sample taken 12/4/91 (H-MELT-0330).

SPRINTING ELECTRON MICROSCOPE SPL C-112 TLE 04-FEB-92 13:04
 Cursor: 0 200keV = 3

0.000 VFE = 4026 10 340
 10 10165 H-MELT-03290 PHOTO-0516 SPOT-1

Rhodium

Figure 88. SEM Micrograph - melter bottom sample taken 12/18/91 (H-MELT-0329).

Dense accumulation of
noble metals and spinel

Figure 89. SEM Micrograph - melter bottom sample taken
12/18/92 (H-MELT-0329).

Figure 90. SEM Micrograph - melter bottom sample taken 3/6/92 (I-MELT-5219).

SCANNING ELECTRON MICROSCOPE SFL C-112 TUE 10-MAR-92 08:00
Cursor: 0.000keV = 0

Figure 91. SEM Micrograph - melter bottom sample taken 3/6/92 (I-MELT-5219).

SCANNING ELECTRON MICROSCOPE V41 C-112 TUE 10-MAR-92 03:14
Current: 0.000keV = 0

Figure 92. SEM Micrograph - melter bottom sample taken 3/6/92 (I-MELT-5219).

Figure 93. SEM Micrograph - melter bottom sample taken 3/27/92 (I-MELT-5242).

Figure 94. SEM Micrograph - melter bottom sample taken 3/27/92 (I-MELT-5242).

Figure 95. SEM Micrograph - melter bottom sample taken 3/27/92 (I-MELT-5242).

Figure 96. SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270).

Figure 97. SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270).

Figure 98. SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270).

Figure 99. SEM Micrograph - melter bottom sample taken 4/20/92 (I-MELT-5270).

Table 58. Analysis of IDMS Melter Floor Samples

Component	PUREX Glass	1 Before HWVP1	2 During HWVP1	3 After HWVP1	4 After HWVP2	5 After HWVP2	6 After HWVP2	7 After HWVP2	NCAW'91 Glass
Ru	-	4.68	0.42	6.20	2.02	9.67	5.53	12.60	0.06
Rh	-	0.41	0.03	0.30	0.02	0.27	NA	0.18	0.03
Pd	-	0.07	0.02	0.01	0.33	0.08	NA	0.09	0.03
Si	19.06	16.46	16.47	15.35	17.62	18.00	15.23	14.39	20.22
Fe	7.17	8.89	11.08	9.00	3.30	4.78	4.39	4.36	5.40
Cr	0.17	0.82	3.19	3.40	0.48	0.49	NA	1.83	0.11
Mn	2.66	2.45	2.52	1.23	0.35	0.46	NA	0.73	0.52
Cd	0.00	0.00	0.20	0.44	NA	0.55	NA	NA	0.75
Zr	0.09	0.04	0.63	1.33	2.77	2.11	NA	1.74	2.57

1 sample taken 10/15/91 from the feed tube port (I-MELT-4790)

2 sample taken 12/4/91 from the feed tube port (H-MELT-0330)

3 sample taken 12/18/91 from the feed tube port (H-MELT-0330)

4 sample taken 2/18/92 from the feed tube port (I-MELT-4804)

5 sample taken 3/6/92 from the borescope port (I-MELT-5219)

6 sample taken 3/27/92 from the feed tube port (I-MELT-5242)

7 sample taken 4/20/92 from the borescope port (I-MELT-5270)

METHODS FOR NOBLE METALS ANALYSIS

In order to complete a meaningful material balance of the noble metals in the melter system (i.e. in order to determine the extent of deposition), accurate analytical measures of the noble metals must be made in the glass product and melter feed slurry.

Initial SRTC Evaluation

Several glasses, including samples from IDMS BL2, HWVP1, melter floor, etc. were analyzed by several methods in order to make an initial method-to-method comparison. All of these measurements were conducted at the SRTC. These measurements are as follows:

1. ICP-AES (Aqua Regia Dissolution)
2. ICP-AES (Na₂O₂ Fusion/HCl Dissolution)
3. ICP-AES (Microwave Acid Dissolution)
4. ICP-MS (Aqua Regia Dissolution)
5. XRF (X-Ray Florescence)

The results revealed that, while ICP-AES and ICP-MS are both excellent analytical tools, their effectiveness is highly dependent upon the type of sample preparation used. The aqua regia and microwave acid procedures proved to be ineffective in the dissolution of the noble metals (especially RuO₂), spinels, SiO₂, and ZrO₂. The sodium peroxide fusion procedure is a very aggressive method and proved to be adequate for getting all components into solution. The results of the ICP-AES (Na₂O₂/HCl prep) determinations agreed quite well with those obtained by XRF. However, in order to get usable results, one must analyze a matrix-matched noble metal blank along with the samples of interest. The blank results are then be used to correct the raw results from the process samples.

NOBLE METALS MATERIAL BALANCE

In an effort to determine the extent of noble metal deposition, material balances were performed for both melter feeding operations of the HWVP Process Demonstration. The melter feed and glasses were measured by XRF, ICP-AES (by SRTC), and ICP-AES (by Monarch Analytical Laboratories, Inc.).

Monarch Analytical Laboratories, Inc. measured the Ru, Rh, and Pd by ICP-AES. The analytical solutions were prepared by dissolving the glass matrix in aqua regia and separating the Ru, Rh, and Pd by carrier precipitation with copper as the insoluble sulfides. The separated sulfides were then fused with sodium peroxide in zirconium crucibles and dissolved in hydrochloric acid. The resulting solution contains all of the platinum metals but is free of the matrix elements. The solution for tellurium analysis is prepared similarly with excess selenium being used as precipitating agent. Plots of the Monarch analyses versus cumulative glass production and versus production time are given in Figures 100 - 102. Plots of other analytes versus production time (for comparison) are given in Figure 103. In plots of noble metal concentration versus cumulative glass production, the analyses appear to be quite scattered. However, when one examines the analyses plotted versus production, it is obvious that the noble metal concentrations (especially those of Ru and Rh) decreased significantly during prolonged periods of idling. There is not enough data in this analysis group alone to determine a complete accumulation rate versus idling time profile. However, when this data is combined with other noble metal data which have been obtained from previous and subsequent runs in support of the DWPF, this accumulation rate versus idling time profile should be available.

Figure 100. Plots of (a) Ru vs lbs of glass, (b) Ru vs Production Time, hrs, (c) Rh vs lbs of glass, and (d) Rh vs Production Time, hrs.

Figure 101. Plots of (a) Pd vs lbs of glass, (b) Pd vs Production Time, hrs, (c) Te vs lbs of glass, and (d) Te vs Production Time, hrs.

Figure 102. Plots of (a) Ag vs lbs of glass, (b) Ag vs Production Time, hrs, (c) Se vs lbs of glass, and (d) Cr vs Production Time, hrs.

Figure 103. Plots of (a) Al vs Production Time, hrs, (b) Cd vs Production Time, hrs, (c) Mn vs Production Time, hrs, and (d) Ni vs Production Time, hrs.

HWVP1

Samples of the HWVP1 melter feed material and glass product were analyzed for noble metals (and tellurium) were analyzed by ICP-AES (from a sodium peroxide fusion sample preparation), XRF, and by an independent laboratory (Monarch Analytical Laboratories). The percent of each analyte accounted for in the glass product while the melter was at steady state (after 2 - 3 melter turnovers) is shown in Table 59. Any unaccounted for amount can be assumed to have accumulated on the floor of the melter.

Table 59. HWVP1 Melter Steady State Material Balance

	ICP-AES*	XRF	Monarch**
Ruthenium	88.9 ± 12%	61.5 ± 7%	86.9 ± 9%
Rhodium	90.5 ± 5%	84.4 ± 3%	84.9 ± 5%
Palladium	84.9 ± 18%	92.6 ± 2%	96.6 ± 5%
Silver	92.7 ± 3%	94.7 ± 5%	91.5 ± 2%
Tellurium	ND	ND	77.0 ± 8 %

* Na₂O₂/HCl prep

** Monarch Analytical Laboratories

ND = not done

Using the Monarch analyses of the melter feed and each of the glass canisters produced, plots of the overall mass balance for each of the noble metals were constructed. These are shown for HWVP1 in Figures 104 - 108.

Figure 104. Plot of Overall HWVP1 Ru Mass Balance

Figure 105. Plot of Overall HWVP1 Pd Mass Balance

Figure 106. Plot of Overall HWVP1 Rh Mass Balance

Figure 107. Plot of Overall HWVP1 Te Mass Balance

Figure 108. Plot of Overall HWVP1 Ag Mass Balance

HWVP2

As with the HWVP1 mass balance, samples of the HWVP2 melter feed material and glass product were analyzed for noble metals (and tellurium). However, the samples were only analyzed by XRF and by an independent laboratory (Monarch Analytical Laboratories). The percent of each analyte accounted for in the HWVP2 steady state glass product is shown in Table 60. Any unaccounted for amount can be assumed to have accumulated on the floor of the melter.

Table 60. HWVP2 Melter Steady State Material Balance

	ICP-AES*	XRF	Monarch**
Ruthenium	ND	72.3 $\pm$ 12%	87.3 $\pm$ 8%
Rhodium	ND	87.1 $\pm$ 6%	90.8 $\pm$ 12%
Palladium	ND	88.8 $\pm$ 5%	108.1 $\pm$ 5%
Silver	ND	99.1 $\pm$ 4%	102.5 $\pm$ 5%
Tellurium	ND	97.5 $\pm$ 5%	91.5 $\pm$ 9%

* No ICP determinations were made for HWVP2

** Monarch Analytical Laboratories

ND = not done

The overall material balances for each analyte, as in HWVP1, are shown in Figures 109 - 113.

Figure 109. Plot of Overall HWVP2 Ru Mass Balance

Figure 110. Plot of Overall HWVP2 Pd Mass Balance

Figure 111. Plot of Overall HWVP2 Rh Mass Balance

Figure 112. Plot of Overall HWVP2 Te Mass Balance

Figure 113. Plot of Overall HWVP2 Ag Mass Balance

Plots of glass production and analyte concentration versus production time are shown in Figures 114 - 119.

Figure 114. Plot of Glass Production vs Production Time

Figure 115. Overall Ru Mass Balance vs Production Time

Figure 116. Overall Pd Mass Balance vs Production Time

Figure 117. Overall Rh Mass Balance vs Production Time

Figure 118. Overall Te Mass Balance vs Production Time

Figure 119. Overall Ag Mass Balance vs Production Time

In each case the tendency is for the noble metals to be retained in the following relative amounts: $Ru \gg Rh > Pd > Ag$. Any unaccounted for silver can be explained by the large increase in concentration from DWPF concentrations (initially present in the melter) to the HWVP glass. Also, some silver was present in the melter offgas condensate as insoluble silver halides.

EFFECT ON THE MELTER SYSTEM

The electrical properties of the IDMS melter have been monitored since the start of its operation. There had been no significant change in these properties until just before the beginning of the feeding of the HWVP1 slurry. At this point, the apparent resistance encountered by the lower set of electrodes (C-D) decreased relative to that encountered by the upper set of electrodes (A-B). This operating parameter was monitored by the upper-to-lower resistance ratio (AB/CD). This ratio continued to increase throughout the first part of the test and then stabilized at the higher value (See Figure 120). The apparent resistance (in ohms) of the upper and lower glass pool are also shown in Figure 120.

Another change in the melter operation which was noted was a rise in the temperatures of the lower electrodes (as measured by a thermocouple from the inside stem). This rise began just at the end of the feeding of the HWVP2 melter feed slurry. This, as well as the temperatures of the upper electrodes is shown in Figure 121. Other melter operating parameters of interest which are included are the electrode current (amps) and voltage (volts) shown in Figure 122, and the electrode power (kW) and glass pool temperature shown in Figure 123. While the data in Figures 120 - 123 are melter operating data over a long time period, similar data for short term melter operation (only during the HWVP tests) are shown in Figures 124 - 131.

Figure 124 shows the upper and lower melt resistances which have been multiplied by the upper and lower melt pool temperatures. Figure 125 shows the corresponding upper-to-lower ratio and also displays melter feeding rate. This ratio does seem to increase slightly during periods of idling (which corresponds to concentrations plots showing significant settling of the noble metals during prolonged idling periods). Figure 126 shows the upper and lower melt pool temperatures. Figure 127 shows the short term electrode current measurements while Figure 128 shows the corresponding voltage. Figure 129 shows the electrode temperatures during this time period. Figure 130 shows the lid heaters current measurements, while Figure 131 shows the melter vapor space (plenum) temperature during the HWVP1 and HWVP2 operations.

Figure 120. AB/CD Resistance Ratio and Apparent Resistance

Figure 121. AB and CD Electrode Temperatures

Figure 122. Electrode Current and Voltage

Figure 123. Electrode Power and Glass Pool Temperature

Figure 124. HWVP1 and HWVP2 Melter Operation - Upper and Lower Glass Pool Resistances x Upper and Lower Glass Pool Temperature

Figure 125. HWVP1 and HWVP2 Glass Pool (Resistance-times-Temperature) Ratio During Periods of Feeding and Idling.

Figure 126. HWVP1 and HWVP2 Top and Bottom Glass Pool Temperatures.

Figure 127. Upper and Lower Electrode Current during HWVP1 and HWVP2.

Figure 128. Upper and Lower Electrode Voltage during HWVP1 and HWVP2.

Figure 129. Electrode Temperatures during HWVP1 and HWVP2.

Figure 130. Lid Heater Currents during HWVP1 and HWVP2.

Figure 131. Melter Plenum Temperature During Periods of Feeding and Idling during HWVP1 and HWVP2.

GLASS PRODUCT QUALITY

REDOX OF THE GLASS PRODUCT

The reduction-oxidation (REDOX) potential of the glass melt is a property which must be controlled. An overly reducing glass melt may result in the formation of metal and metal sulfide deposits in the melter. On the other hand, there have been concerns that an overly oxidizing melt may result in increased ruthenium volatility and/or foaming in the melter.

There are several factors that affect the REDOX potential of the glass product. In general, there must be a "balance" of available reducing agents (mainly the formate ion) with the available oxidizing agents (mainly the nitrate ion and oxygen in the melter plenum).

The ratio of ferric iron (Fe^{2+}) in the glass to that of the total iron in the glass (or sometimes to the ferrous iron (Fe^{3+})) has been the most commonly used measure of the REDOX potential of defense waste glass melts. The Savannah River Technology Center has recommended that the DWPF be operated such that

$$\frac{\text{Fe}^{2+}}{\text{Fe}_{\text{total}}} < 0.33$$

A lower limit, originally imposed to prevent melter foaming, has been dropped due to the fact that no evidence of melter foaming has been observed in any melter (SGM, IDMS, etc.) when the chemical processing of the waste sludge included the addition of formic acid.

Pacific Northwest Laboratory has recommended that the HWVP be operated such that

$$0.005 < \frac{\text{Fe}^{2+}}{\text{Fe}_{\text{total}}} < 0.23$$

Measurements taken of the melter feed slurry from both HWVP1 and HWVP2 predicted a glass product REDOX of $\text{Fe}^{2+}/\sum \text{Fe}_{\text{total}} \lll 0.1$. The $\text{Fe}^{2+}/\sum \text{Fe}_{\text{total}}$ of the glass was consistently $\lll 0.1$. There was no evidence of foaming in the melter (via the internal foam

detector or otherwise) during the two run campaign. Actual measurements are shown in Table 61. The average value for HWVP1 glasses was 0.019 ± 0.01 while that of the HWVP2 glasses was 0.034 ± 0.018 .

Table 61. $\text{Fe}(2+)/\Sigma\text{Fe}(\text{total})$ in IDMS HWVP Glasses

SAMPLE NO HWVP1	$\text{Fe}(2+)/\Sigma\text{Fe}(\text{total})$	SAMPLE NO HWVP2	$\text{Fe}(2+)/\Sigma\text{Fe}(\text{total})$
H-GLAS-0113	0.015	H-GLAS-0317	0.024
H-GLAS-0118	0.015	H-GLAS-0311	0.023
H-GLAS-0131	0.009	H-GLAS-0310	0.021
H-GLAS-0134	0.027	H-GLAS-0323	0.023
H-GLAS-0140	0.008	H-GLAS-0336	0.022
H-GLAS-0143	0.014	H-GLAS-0348	0.012
H-GLAS-0149	0.010	H-GLAS-0351	0.012
H-GLAS-0155	0.023	H-GLAS-0352	0.025
H-GLAS-0162	0.021	H-GLAS-0358	0.032
H-GLAS-0244	0.039	H-GLAS-0361	0.048
H-GLAS-0246	0.015	H-GLAS-0378	0.029
H-GLAS-0250	0.041	H-GLAS-0374	0.059
H-GLAS-0254	0.018	H-GLAS-0384	0.038
H-GLAS-0260	0.032	H-GLAS-0387	0.017
H-GLAS-0265	0.022	H-GLAS-0388	0.041
H-GLAS-0278	0.003	H-GLAS-0393	0.022
H-GLAS-0275	0.016	H-GLAS-0406	0.046
H-GLAS-0287	0.021	H-GLAS-0412	0.025
H-GLAS-0293	0.021	H-GLAS-0422	0.076
		H-GLAS-0429	0.054
HWVP1 Average	0.019	H-GLAS-0432	0.061
Stan Dev	0.010	H-GLAS-0438	0.018
%RSD	51.11	H-GLAS-0448	0.018
		H-GLAS-0451	0.012
		H-GLAS-0461	0.053
		H-GLAS-0468	0.067
		H-GLAS-0479	0.035
		H-GLAS-0487	0.036
		H-GLAS-0491	0.026
		HWVP2 Average	0.034
		Stan Dev	0.018
		%RSD	52.09

APPLICABILITY OF THE PCCS

The Product Composition Control System (PCCS) is a statistical-based software package which has been developed by the Savannah River Technology Center for the control of the DWPF process. The software is highly dependent upon glass property-to-composition correlations which have been developed by SRTC for DWPF glass matrices. It is not known how well these correlations predict the properties of the HWVP NCAW glass product. Components such as zirconium will greatly affect the viscosity of the molten melt and the durability of the glass product. However, the PCCS was applied (without modification) during the HWVP Demonstration in order to determine its applicability. The melter feed blending portion of the PCCS is the only part of the software which can be practically applied in the IDMS. The PCCS will calculate the optimum blend of frit, sludge waste, and PHA waste during DWPF operations by minimizing the amount of frit necessary while still maintaining a glass product composition which meets all product processability and acceptability criteria. By substituting the composition of the RWS for that of the PHA, the blending operation for the HWVP process is very similar. When this was done, the PCCS predicted an optimum blend which was very close to that which was actually used (i.e. 28 wt% sludge oxides, 4 wt% RWS oxides, and 68 wt% frit oxides).

VISCOSITY OF THE GLASS PRODUCT

Selected glass samples from the IDMS HWVP Process Demonstration were sent to Sharp Shurtz Laboratories for measurement of high temperature viscosity. A plot of the data is shown in Figure 132. The acceptance criteria for processability in the DWPF melter is that the viscosity of the glass be greater than 20 poise but less than 100 poise at 1150°C. Low melt viscosities can lead to refractory leakage, increased refractory corrosion, and increased volatility. High melt viscosities lead to reduced heat transfer between the cold cap and the molten glass which reduces the melt rate. High viscosity melts may also be difficult to pour. As can be seen from Figure 73, each of the HWVP Process Demonstration glass samples meets this criteria.

Figure 132. Melt Viscosity versus Melt Temperature

PRODUCT CONSISTENCY TEST (PCT)

The current Waste Acceptance Preliminary Specification (WAPS) requires that vitrified waste producers demonstrate control of the consistency of the final waste form using the Product Consistency Test. The SRTC-developed PCT is a crushed glass durability test which can be used to rapidly, reliably, and remotely test glass during production. It is a glass dominated test and is sensitive to glass composition and homogeneity. The current acceptance criteria is that it must have a release rate which is better than the 131 Stage 2 glass which has been qualified in the DWPF Environmental Assessment (EA).

The durability of the glasses produced during the IDMS HWVP Process Demonstration was evaluated by leaching selected samples of the canistered glass product according the SRTC-developed Product Consistency Test.¹⁹ Fourteen glass samples (seven each from HWVP1 and HWVP2) were run in triplicate. Along with these glasses, a standard glass (ARM-1) was also leached for comparison.

PCT Experimental Method

The glass samples were examined by X-Ray Diffraction (XRD) analysis to determine if any crystallization/devitrification had occurred during processing. The durability of the glasses was studied using Version 3.0 of the PCT.¹⁹ In the PCT protocol, crushed glass of 100-200 mesh is immersed in ASTM Type-I water for 7 days at 90°C. The volume of the solution (V) is 10 ml per gram of glass. After 7 days, the leachates are filtered to remove colloids and/or particulates. The pH of the leachate is measured and the solution is analyzed for elemental content. A standard glass (ARM-1) is used as a control to eliminate long term bias in the experimental analysis and in the analytical data. Triplicate analyses and triplicate glass standards were run simultaneously. A multielement solution standard was used to ensure that instrumental drift did not significantly bias the short term analysis of the leachates.

The leachate concentrations are reported as normalized elemental mass losses, NC_i , released from the glass in grams per liter of leachant where the release concentrations are normalized by the weight fraction of that element present in the glass. The

normalized mass loss of a glass component, NL_i , is a function of (1) the mass fraction of that element in the glass, (2) the exposed surface area of the glass, and (3) the leachate volume, as given below:

$$NL_i = \frac{C_i}{F_i (SA/V)}$$

where

NL_i = normalized elemental mass loss (g_{glass}/m^2)
 C_i = mass of element "i" in the solution (g_i/m^3)
 F_i = fraction of elemental "i" in the glass (g_i/g_{glass})
 SA = specimen surface area (m^2)
 V = solution volume (m^3)

The above equation provides leachate concentrations in grams of glass per m^2 of glass surface area exposed. Since the SA/V term is constant during the PCT analyses, the alternative expression given below can also be used.

$$NC_i = \frac{C_i}{F_i}$$

The units of NC_i are grams of glass per liter of leachate.

The elemental compositions of the glasses were obtained using DWPF prototypic dissolution and analytical techniques. All determinations, except cesium and potassium, were made by Inductively Coupled Plasma optical spectroscopy.

Test Results and Discussion

The XRD scans indicated that there was a small amount of crystallinity in the glass. These crystalline structures were identified as trevorite (nickel-iron spinel, $NiFe_2O_4$) and ruthenium dioxide (RuO_2). However, this crystallinity was <1% and should not affect the test results.

Boron and lithium releases from glass are considered to be the most accurate indicators of the durability of the glass matrix as these elements are leached from the glass faster than the other components. Additionally, boron releases are considered

to be the best indicator of glass durability because boron does not saturate in the leachate and does not participate in precipitation reactions caused by solution supersaturation.²⁰ As in internal check for consistency, the releases of selected elements were plotted versus that of boron. This is to ensure that other leachable components are leached the same trend as boron (i.e. if a glass releases a great deal of boron, it should also release a great deal of lithium. These plots are shown in Figure 133.

Figure 133. Internal Consistency of PCT data

During analysis of the elemental content of the leachate a multielement standard was used to ensure that instrumental drift did not affect the results. The elemental analysis of the leachates took 3 days to complete. Each day the multielement standard was run before the leachates and after every 3 to 5 samples. The solution standards were always within $\pm 5\%$ of the standard value. The data is provided in Table 62.

A standard glass, MCC's Approved Reference Material (ARM-1), was leached along with the process glass samples. The releases of selected components were, in most all cases, exactly within the expected range of concentrations. The analysis of two blanks (ASTM Type-I water with no glass) showed only an insignificant offset in the silicon value. This data is provided in Table 63.

The PCT leachate concentrations for HWVP1 glass are shown in Table 64. The PCT leachate concentrations for HWVP2 glass are shown in Table 65. The normalized release rates for HWVP1 glasses is shown in Table 65. The normalized release rates for HWVP2 glasses is shown in Table 67. In each case the normalized release rate was better than that of the DWPF EA glass and would, therefore, be acceptable as a canistered vitrified waste form.

Table 62. Multielement Standard Analysis

Element	Concentration of Multielement Standard (ppm)	Day 1 Standard Ck Before PCT analysis	Day 1 Standard Ck After 2 Blks and 3 ARMs	Day 1 Standard Ck After 5 glasses	Day 1 Standard Ck After 4 glasses	Day 1 Average	Day 1 % error
Zn	5.00	4.89	4.91	4.91	4.98	4.92	-1.6 %
B	5.00	5.01	5.09	5.15	5.04	5.07	1.4 %
Mn	5.00	4.95	4.98	4.92	4.97	4.95	-0.9 %
Fe	5.00	5.00	5.02	4.96	5.01	4.99	-0.1 %
Cr	5.00	4.91	4.96	4.95	4.98	4.95	-1.0 %
Mg	5.00	4.95	4.90	4.94	4.97	4.94	-1.2 %
Ca	5.00	4.82	4.83	4.88	4.95	4.87	-2.6 %
Ti	5.00	4.97	5.02	4.94	4.94	4.97	-0.7 %
Ba	5.00	ND	5.04	4.91	4.96	4.97	-0.6 %
Na	5.00	4.86	4.82	4.91	4.85	4.86	-2.8 %
Si	5.00	5.00	4.91	4.80	ND	4.90	-1.9 %

Element	Concentration of Multielement Standard (ppm)	Day 2 Standard Ck Before PCT analysis	Day 2 Standard Ck After 3 glasses	Day 2 Standard Ck After 4 glasses	Day 2 Standard Ck After 5 glasses	Day 2 Standard Ck After 5 glasses	Day 2 Standard Ck After 5 glasses	Day 2 Average	Day 2 % error
Zn	5.00	4.95	4.97	4.99	5.02	4.98	5.02	4.99	-0.2 %
B	5.00	4.96	5.05	5.50	5.00	5.32	5.35	5.20	4.0 %
Mn	5.00	5.08	5.10	5.10	5.13	5.15	5.14	5.12	2.3 %
Fe	5.00	5.04	5.07	5.08	5.11	5.11	5.10	5.09	1.7 %
Cr	5.00	5.00	4.98	5.00	5.00	5.00	4.96	4.99	-0.3 %
Mg	5.00	5.03	5.05	5.08	5.09	5.08	5.04	5.06	1.2 %
Ca	5.00	5.02	5.01	5.01	5.04	5.05	5.07	5.03	0.7 %
Ti	5.00	5.05	5.10	5.05	5.12	5.09	5.11	5.09	1.7 %
Ba	5.00	5.04	5.04	5.04	5.08	5.07	5.06	5.06	1.1 %
Na	5.00	4.94	4.87	4.89	4.91	4.90	4.96	4.91	-1.7 %
Si	5.00	4.91	ND	4.87	4.80	4.77	4.77	4.83	-3.5 %

Element	Concentration of Multielement Standard (ppm)	Day 3 Standard Ck Before PCT analysis	Day 3 Standard Ck After 5 glasses	Day 3 Average	Day 3 % error
Zn	5.00	4.94	4.97	4.96	-0.9 %
B	5.00	4.99	5.09	5.04	0.8 %
Mn	5.00	5.07	5.12	5.09	1.8 %
Fe	5.00	5.02	5.08	5.05	1.0 %
Cr	5.00	4.99	5.00	5.00	0.0 %
Mg	5.00	5.08	5.06	5.07	1.3 %
Ca	5.00	5.03	5.04	5.03	0.7 %
Ti	5.00	5.02	5.12	5.07	1.4 %
Ba	5.00	5.02	5.06	5.04	0.9 %
Na	5.00	4.99	4.95	4.97	-0.6 %
Si	5.00	4.77	4.83	4.80	-4.1 %

Table 63. PCT Analysis of ARM* glass and Blank**

Element	Expected (mg/l)	ARM1 (mg/l)	ARM2 (mg/l)	ARM3 (mg/l)	Blk 1 (mg/l)	Blk 2 (mg/l)
B	16 to 19	18.81	21.56	17.78	<0.01	<0.01
Si	55 to 60	61.16	64.30	58.71	0.31	0.23
Na	35 to 40	38.40	41.86	36.23	ND	ND
Li	12 to 15	14.22	15.37	13.40	<0.01	<0.01
Al	4 to 5	4.77	4.18	4.49	<0.01	<0.01
Fe	0.00	0.00	0.00	0.00	<0.01	<0.01
Mn	0.00	0.00	0.00	0.00	<0.01	<0.01
Mg	0.00	0.00	0.00	0.00	<0.01	<0.01
Ni	0.00	0.00	0.00	0.00	<0.01	<0.01
Ca	0.08	0.01	0.00	0.00	<0.01	<0.01
pH		10.03	9.97	9.87		

* MCC Aproved Reference Material (ARM)

** ASTM Type I Water (no glass)

Table 64. PCT Leachate Concentrations for HWVP1 Glass

HANFORD GLASS IDENTIFICATION	pH	B In leachate (ppm)	Mo In leachate (ppm)	Na In leachate (ppm)	Li In leachate (ppm)	Si In leachate (ppm)	B In glass (wt%)	Mo In glass (wt%)	Na In glass (wt%)	Li In glass (wt%)	Si In glass (wt%)
H-GLAS-0112-1	9.85	20.82	0.05	52.40	16.65	102.14	2.50	0.03	7.05	2.28	21.19
H-GLAS-0112-2	9.83	21.17	0.07	52.93	16.62	101.78	2.50	0.03	7.05	2.28	21.19
H-GLAS-0112-3	9.80	21.05	0.08	53.07	16.70	103.42	2.50	0.03	7.05	2.28	21.19
AVERAGE	9.83	21.01	0.07	52.80	16.66	102.45	2.50	0.03	7.05	2.28	21.19
H-GLAS-0130-1	9.65	31.98	0.33	63.33	21.43	116.96	2.78	0.04	6.80	2.30	20.92
H-GLAS-0130-2	9.63	31.75	0.34	60.76	21.08	115.69	2.78	0.04	6.80	2.30	20.92
H-GLAS-0130-3	9.61	31.46	0.36	60.66	20.92	116.38	2.78	0.04	6.80	2.30	20.92
AVERAGE	9.63	31.73	0.34	61.58	21.14	116.34	2.78	0.04	6.80	2.30	20.92
H-GLAS-0162-1	9.39	69.00	1.32	83.84	35.41	157.64	3.44	0.08	5.89	2.35	21.09
H-GLAS-0162-2	9.76	69.25	1.32	83.17	35.59	156.70	3.44	0.08	5.89	2.35	21.09
H-GLAS-0162-3	9.92	64.06	1.23	78.67	33.34	151.33	3.44	0.08	5.89	2.35	21.09
AVERAGE	9.69	67.44	1.29	81.89	34.78	155.22	3.44	0.08	5.89	2.35	21.09
H-GLAS-0244-1	9.87	69.22	1.38	84.04	37.28	155.83	3.41	0.08	5.89	2.26	20.17
H-GLAS-0244-2	9.92	83.92	1.66	100.42	44.20	173.44	3.41	0.08	5.89	2.26	20.17
H-GLAS-0244-3	9.88	88.07	1.74	104.15	46.24	175.72	3.41	0.08	5.89	2.26	20.17
AVERAGE	9.89	80.40	1.59	96.20	42.57	168.33	3.41	0.08	5.89	2.26	20.17
H-GLAS-0254-1	9.77	NA	NA	NA	NA	NA	3.58	0.08	6.13	2.33	21.06
H-GLAS-0254-2	9.78	78.55	1.59	87.78	40.64	162.73	3.58	0.08	6.13	2.33	21.06
H-GLAS-0254-3	9.81	70.58	1.42	79.55	36.85	153.46	3.58	0.08	6.13	2.33	21.06
AVERAGE	9.79	74.57	1.50	83.66	38.74	158.10	3.58	0.08	6.13	2.33	21.06
H-GLAS-0278-1	9.75	60.34	1.23	67.21	31.23	146.05	3.63	0.08	5.81	2.36	21.28
H-GLAS-0278-2	9.90	96.16	2.00	102.52	48.05	178.16	3.63	0.08	5.81	2.36	21.28
H-GLAS-0278-3	9.82	91.16	1.90	96.77	46.13	170.43	3.63	0.08	5.81	2.36	21.28
AVERAGE	9.82	82.55	1.71	88.83	41.80	164.88	3.63	0.08	5.81	2.36	21.28
H-GLAS-0293-1	9.81	100.57	2.17	104.27	49.68	174.88	3.68	0.08	5.80	2.37	21.44
H-GLAS-0293-2	9.86	111.07	2.37	114.12	54.33	184.12	3.68	0.08	5.80	2.37	21.44
H-GLAS-0293-3	9.84	105.27	2.26	109.75	52.02	181.09	3.68	0.08	5.80	2.37	21.44
AVERAGE	9.84	105.64	2.27	109.38	52.01	180.03	3.68	0.08	5.80	2.37	21.44

Table 65. PCT Leachate Concentrations for HWVP2 Glass

HANFORD GLASS IDENTIFICATION	pH	B In leachate (ppm)	Mo In leachate (ppm)	Na In leachate (ppm)	Li In leachate (ppm)	Si In leachate (ppm)	B In glass (wt%)	Mo In glass (wt%)	Na In glass (wt%)	Li In glass (wt%)	Si In glass (wt%)
H-GLAS-0308-1	9.76	78.53	1.76	80.36	38.76	147.56	3.79	0.05	5.70	2.31	22.30
H-GLAS-0308-2	9.79	74.97	1.77	80.88	39.33	146.59	3.79	0.05	5.70	2.31	22.30
H-GLAS-0308-3	9.64	68.19	1.61	74.31	35.74	138.03	3.79	0.05	5.70	2.31	22.30
AVERAGE	9.73	73.90	1.71	78.52	37.94	144.06	3.79	0.05	5.70	2.31	22.30
H-GLAS-0334-1	9.75	94.61	2.37	97.83	47.85	159.02	3.93	0.11	5.81	2.30	22.01
H-GLAS-0334-2	9.77	91.19	2.28	95.07	46.41	157.31	3.93	0.11	5.81	2.30	22.01
H-GLAS-0334-3	9.76	83.37	2.09	87.01	42.84	149.38	3.93	0.11	5.81	2.30	22.01
AVERAGE	9.76	89.72	2.24	93.30	45.70	155.24	3.93	0.11	5.81	2.30	22.01
H-GLAS-0352-1	9.72	110.45	2.78	108.58	54.88	169.87	3.94	0.10	5.80	2.37	18.30
H-GLAS-0352-2	9.61	92.35	2.31	91.53	46.29	152.37	3.94	0.10	5.80	2.37	18.30
H-GLAS-0352-3	9.52	100.33	2.50	98.84	49.94	162.48	3.94	0.10	5.80	2.37	18.30
AVERAGE	9.62	101.04	2.53	99.65	50.37	161.57	3.94	0.10	5.80	2.37	18.30
H-GLAS-0387-1	9.65	101.74	2.46	90.14	50.48	158.24	3.90	0.10	5.48	2.39	20.22
H-GLAS-0387-2	9.66	101.71	2.46	90.84	50.01	160.35	3.90	0.10	5.48	2.39	20.22
H-GLAS-0387-3	9.71	96.96	2.35	86.92	48.27	157.81	3.90	0.10	5.48	2.39	20.22
AVERAGE	9.67	100.14	2.42	89.30	49.58	158.80	3.90	0.10	5.48	2.39	20.22
H-GLAS-0421-1	9.66	100.73	2.53	90.17	49.34	157.36	4.01	0.12	5.61	2.41	18.47
H-GLAS-0421-2	9.59	78.01	1.93	70.33	39.76	136.16	4.01	0.12	5.61	2.41	18.47
H-GLAS-0421-3	9.62	88.76	NA	81.52	46.00	145.17	4.01	0.12	5.61	2.41	18.47
AVERAGE	9.62	89.17	2.23	80.67	45.03	146.23	4.01	0.12	5.61	2.41	18.47
H-GLAS-0446-1	9.67	87.30		78.72	45.44	142.29	4.04	0.11	5.57	2.41	18.27
H-GLAS-0446-2	9.69	91.38	2.19	78.12	44.77	149.99	4.04	0.11	5.57	2.41	18.27
H-GLAS-0446-3	9.67	84.45	2.02	72.85	41.57	143.11	4.04	0.11	5.57	2.41	18.27
AVERAGE	9.68	87.71	2.10	76.56	43.92	145.13	4.04	0.11	5.57	2.41	18.27
H-GLAS-0466-1	9.69	104.99	2.57	94.54	50.23	149.01	4.11	0.11	5.90	2.44	17.76
H-GLAS-0466-2	9.62	117.24	2.89	103.86	55.46	162.61	4.11	0.11	5.90	2.44	17.76
H-GLAS-0466-3	9.75	NA	NA	NA	NA	NA	4.11	0.11	5.90	2.44	17.76
AVERAGE	9.69	111.12	2.73	99.20	52.85	155.81	4.11	0.11	5.90	2.44	17.76

Table 66. PCT Normalized Release Rates for HWVP1 Glass

HANFORD GLASS IDENTIFICATION	pH	NL(B) (g/m ²)	NL(Mo) (g/m ²)	NL(Na) (g/m ²)	NL(LI) (g/m ²)	NL(SI) (g/m ²)	NC(B) (g/l)	NC(Mo) (g/l)	NC(Na) (g/l)	NC(LI) (g/l)	NC(SI) (g/l)
H-GLAS-0112-1	9.85	42.63	10.03	38.03	37.31	24.66	0.83	0.20	0.74	0.73	0.48
H-GLAS-0112-2	9.83	43.36	14.53	38.42	37.23	24.57	0.85	0.28	0.75	0.73	0.48
H-GLAS-0112-3	9.80	43.10	16.78	38.52	37.43	24.97	0.84	0.33	0.75	0.73	0.49
AVERAGE	9.83	43.03	13.78	38.32	37.32	24.73	0.84	0.27	0.75	0.73	0.48
H-GLAS-0130-1	9.65	58.85	43.02	47.62	47.75	28.59	1.15	0.84	0.93	0.93	0.56
H-GLAS-0130-2	9.63	58.42	43.94	45.69	46.95	28.28	1.14	0.86	0.89	0.92	0.55
H-GLAS-0130-3	9.61	57.88	47.09	45.62	46.62	28.45	1.13	0.92	0.89	0.91	0.56
AVERAGE	9.63	58.38	44.68	46.31	47.11	28.44	1.14	0.87	0.91	0.92	0.56
H-GLAS-0162-1	9.39	102.48	90.09	72.81	77.03	38.24	2.00	1.76	1.42	1.51	0.75
H-GLAS-0162-2	9.76	102.86	90.09	72.23	77.44	38.01	2.01	1.76	1.41	1.51	0.74
H-GLAS-0162-3	9.92	95.15	83.82	68.32	72.54	36.71	1.86	1.64	1.34	1.42	0.72
AVERAGE	9.69	100.16	88.00	71.12	75.67	37.65	1.96	1.72	1.39	1.48	0.74
H-GLAS-0244-1	9.87	103.96	87.98	72.98	84.55	39.53	2.03	1.72	1.43	1.65	0.77
H-GLAS-0244-2	9.92	126.03	106.33	87.21	100.27	43.99	2.46	2.08	1.70	1.96	0.86
H-GLAS-0244-3	9.88	132.25	111.32	90.45	104.89	44.57	2.59	2.18	1.77	2.05	0.87
AVERAGE	9.89	120.75	101.88	83.55	96.57	42.70	2.36	1.99	1.63	1.89	0.83
H-GLAS-0254-1	9.77										
H-GLAS-0254-2	9.78	112.33	105.69	73.21	89.11	39.52	2.20	2.07	1.43	1.74	0.77
H-GLAS-0254-3	9.81	100.93	94.06	66.35	80.79	37.27	1.97	1.84	1.30	1.58	0.73
AVERAGE	9.79	106.63	99.88	69.78	84.95	38.39	2.08	1.95	1.36	1.66	0.75
H-GLAS-0278-1	9.75	85.06	79.70	59.18	67.58	35.11	1.66	1.56	1.16	1.32	0.69
H-GLAS-0278-2	9.90	135.53	129.75	90.27	103.96	42.83	2.65	2.54	1.76	2.03	0.84
H-GLAS-0278-3	9.82	128.48	123.28	85.21	99.80	40.98	2.51	2.41	1.67	1.95	0.80
AVERAGE	9.82	116.36	110.91	78.22	90.45	39.64	2.27	2.17	1.53	1.77	0.77
H-GLAS-0293-1	9.81	139.87	138.55	91.97	107.13	41.72	2.73	2.71	1.80	2.09	0.82
H-GLAS-0293-2	9.86	154.47	151.41	100.66	117.15	43.92	3.02	2.96	1.97	2.29	0.86
H-GLAS-0293-3	9.84	146.40	144.69	96.81	112.17	43.20	2.86	2.83	1.89	2.19	0.84
AVERAGE	9.84	146.91	144.88	96.48	112.15	42.94	2.87	2.83	1.89	2.19	0.84

Table 67. PCT Normalized Release Rates for HWVP2 Glass

HANFORD GLASS IDENTIFICATION	pH	NL(B) (g/m2)	NL(Mo) (g/m2)	NL(Na) (g/m2)	NL(Li) (g/m2)	NL(Si) (g/m2)	NC(B) (g/l)	NC(Mo) (g/l)	NC(Na) (g/l)	NC(Li) (g/l)	NC(Si) (g/l)
H-GLAS-0308-1	9.76	105.92	173.13	72.09	85.89	33.85	2.07	3.38	1.41	1.68	0.66
H-GLAS-0308-2	9.79	101.13	173.72	72.56	87.16	33.63	1.98	3.40	1.42	1.70	0.66
H-GLAS-0308-3	9.64	91.98	157.98	66.66	79.22	31.66	1.80	3.09	1.30	1.55	0.62
AVERAGE	9.73	99.68	168.27	70.44	84.09	33.05	1.95	3.29	1.38	1.64	0.65
H-GLAS-0334-1	9.75	123.29	114.22	86.13	106.55	36.95	2.41	2.23	1.68	2.08	0.72
H-GLAS-0334-2	9.77	118.84	109.97	83.70	103.34	36.56	2.32	2.15	1.64	2.02	0.71
H-GLAS-0334-3	9.76	108.64	100.66	76.60	95.41	34.71	2.12	1.97	1.50	1.87	0.68
AVERAGE	9.76	116.93	108.29	82.14	101.77	36.07	2.29	2.12	1.61	1.99	0.71
H-GLAS-0352-1	9.72	143.28	138.16	95.74	118.53	47.47	2.80	2.70	1.87	2.32	0.93
H-GLAS-0352-2	9.61	119.80	114.62	80.71	100.00	42.58	2.34	2.24	1.58	1.95	0.83
H-GLAS-0352-3	9.52	130.15	124.25	87.15	107.88	45.41	2.54	2.43	1.70	2.11	0.89
AVERAGE	9.62	131.08	125.68	87.87	108.80	45.15	2.56	2.46	1.72	2.13	0.88
H-GLAS-0387-1	9.65	133.44	132.56	84.09	108.26	40.02	2.61	2.59	1.64	2.12	0.78
H-GLAS-0387-2	9.66	133.40	132.51	84.74	107.25	40.56	2.61	2.59	1.66	2.10	0.79
H-GLAS-0387-3	9.71	127.17	126.48	81.09	103.52	39.92	2.49	2.47	1.59	2.02	0.78
AVERAGE	9.67	131.34	130.52	83.31	106.34	40.17	2.57	2.55	1.63	2.08	0.79
H-GLAS-0421-1	9.66	128.36	112.31	82.17	104.93	43.59	2.51	2.20	1.61	2.05	0.85
H-GLAS-0421-2	9.59	99.41	85.76	64.09	84.56	37.72	1.94	1.68	1.25	1.65	0.74
H-GLAS-0421-3	9.62	113.11	NA	74.29	97.84	40.21	2.21	NA	1.45	1.91	0.79
AVERAGE	9.62	113.63	99.03	73.52	95.77	40.51	2.22	1.94	1.44	1.87	0.79
H-GLAS-0446-1	9.67	110.42	100.00	72.32	96.60	39.83	2.16	0.00	1.41	1.89	0.78
H-GLAS-0446-2	9.69	115.58	100.74	71.76	95.17	41.98	2.26	1.97	1.40	1.86	0.82
H-GLAS-0446-3	9.67	106.81	93.22	66.93	88.37	40.06	2.09	1.82	1.31	1.73	0.78
AVERAGE	9.68	110.94	96.98	70.34	93.38	40.62	2.17	1.90	1.38	1.83	0.79
H-GLAS-0466-1	9.69	130.76	119.55	82.03	105.48	42.92	2.56	2.34	1.60	2.06	0.84
H-GLAS-0466-2	9.62	146.02	134.29	90.12	116.46	46.84	2.85	2.63	1.76	2.28	0.92
H-GLAS-0466-3	9.75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AVERAGE	9.69	138.39	126.92	86.08	110.97	44.88	2.71	2.48	1.68	2.17	0.88

INTEGRATED SYSTEM PERFORMANCE

SLUDGE/SLURRY RHEOLOGICAL MEASUREMENTS

Measurements of the rheological characteristics of the HWVP sludges and slurries were made for each type of material during processing. The measurements were made using a HAAKE RV 3 (Rotovisco) rheometer. A schematic of the RV 3 setup is shown in Figure 134. The rheological properties of the sludges and slurries (as measured) are given in Tables 68 and 69. Also included are measures of pH, solids and oxides content, inorganic carbon content, and the specific gravity.

NOTE: The rheological measurements were performed on a HAAKE Rotovisco RV3 rheometer. This instrument is quite old and sometimes unreliable. The data provided in Tables 67 and 68 seem to be biased high. While this data has been checked and re-checked and appears to have been obtained correctly, it should be used with caution.

USE OF DWPF ANALYTICAL METHODS

All process samples were analyzed via standard DWPF analytical methods. A truly statistical evaluation of the effectiveness of these methods cannot be accomplished as this was not within the scope of these tests. However, general observations can be made. Each of the standard analytical methods are discussed below with general observations given for each.

DWPF Analytical Methods - Elemental (Cations)

Glass and sludge are dissolved by several methods to yield solutions suitable for elemental analyses. Results of independent dissolutions are assessed separately to provide a useful cross-check for most elemental determinations. The solutions are analyzed for elemental content using Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES) and Atomic Absorption Spectroscopy (AA). Three types of DWPF dissolution procedures were used during the HWVP Process Demonstration. Each of the dissolution methods and their relative merits are discussed below. Further, an evaluation of each with the NCAW materials is given. Soluble cations in sludge are measured by analyzing the undiluted filtrate by ICP-AES.

HAAKE Rotovisco (RV3) Rheometer

Table 68 HWVP1 Rheology Measurements

Sample ID	Sample Date	Description	Rheogram Date	pH (@25 C)	Solids (g/liter)	Oxides (g/liter)	specific gravity	TIC (mg/liter)	yield stress (dynes/cm^2)	consistency (cP)
SRNM-0015A	11/11/91	HWVP1 alkaline sludge	12/12/91	11.68	154.6	124.4	1.10	1670	285	46
SRDF-0016	11/12/91	HWVP1 sludge during formic add'n	12/9/91	8.37	125.3	94.1	1.08	1300	113	26
SRDF-0020	11/12/91	HWVP1 sludge during formic add'n	12/5/91	7.54	135.1	102.5	1.10	1202	83	26
SRDF-0024	11/12/91	HWVP1 sludge during formic add'n	12/9/91	7.16	134.6	102.0	1.10	1111	86	33
SRDF-0028	11/12/91	HWVP1 sludge during formic add'n	12/9/91	6.91	140.5	109.8	1.11	1011	135	20
SRDF-0032	11/12/91	HWVP1 sludge during formic add'n	12/10/91	7.02	138.5	107.1	1.10	1017	154	19
SRDF-0036	11/12/91	HWVP1 sludge during formic add'n	12/10/91	7.02	137.1	95.9	1.09	974	135	20
SRDF-0040	11/12/91	HWVP1 sludge during formic add'n	12/10/91	6.36	137.1	102.3	1.10	941	113	14
SRDF-0044	11/12/91	HWVP1 sludge during formic add'n	12/10/91	5.80	129.8	96.6	1.03	1120	98	34
SRDF-0050B	11/12/91	HWVP1 sludge during formic add'n	12/11/91	6.75	134.2	104.8	1.10	1478	120	20
SRDF-0058A	11/12/91	HWVP1 sludge during formic add'n	12/11/91	7.07	137.0	103.7	1.10	1344	113	26
SRFO-0066	11/12/91	HWVP1 sludge after formic digestion	12/10/91	7.46	138.8	102.2	1.10	1226	120	37
SRFO-0071	11/12/91	HWVP1 sludge after formic digestion	12/10/91	7.69	142.5	108.8	1.10	1271	135	20
SMRW-0082A	11/12/91	HWVP1 SME after RWS add'n	12/12/91	8.32	150.5	112.7	1.11	1734	161	13
SMRW-0083A	11/13/91	HWVP1 SME after RWS add'n	12/12/91	8.40	151.5	114.8	1.11	1723	139	21
SMCO-0098B	11/15/91	HWVP1 SME Product	12/11/91	--	--	--	--	--	146	27
SMCO-0100B	11/26/91	HWVP1 SME Product	12/4/91	--	--	--	--	--	353	83
MFTR-0120B	12/1/91	HWVP1 Melter Feed	12/4/91	--	--	--	--	--	291	94
MFTR-0127	12/6/91	HWVP1 Melter Feed	1/14/92	9.53	476.4	446.3	1.27	3043	159	51
MFTR-0146	12/7/91	HWVP1 Melter Feed	1/14/92	9.48	466.9	451.4	1.29	2566	206	59
MFTR-0157	12/8/91	HWVP1 Melter Feed	1/8/92	9.59	474.1	449.2	1.32	2917	371	102
MFTR-0267	12/13/91	HWVP1 Melter Feed	1/9/92	9.48	472.1	461.8	1.31	3314	941	93
MFTR-0290B	12/15/91	HWVP1 Melter Feed	1/14/92	--	--	--	--	--	405	49
MFTH-0298B	1/3/92	MFT heel before HWVP2 M.F. transfer	1/13/92	9.64	469.4	450.4	1.28	3023	825	29

Table 69. HWVP2 Rheology Measurements

Sample ID	Sample Date	Description	Rheogram Date	pH (@25 C)	Solids (g/liter)	Oxides (g/liter)	specific gravity	TIC (mg/liter)	yield stress (dynes/cm^2)	consistency (cP)
SRTC-0126A	12/6/91	HWVP2 alkaline sludge	12/11/91	10.24	219.7	190.8	1.17	2179	152	36
SRDF-0190	12/9/91	HWVP2 sludge during formic add'n	1/16/92	8.27	225.7	195.5	1.15	2162	114	25
SRDF-0196	12/9/91	HWVP2 sludge during formic add'n	1/15/92	8.32	224.7	196.5	1.16	2592	68	23
SRDF-0198	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.82	230.6	201.4	1.17	2137	--	--
SRDF-0200	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.92	234.0	205.8	1.17	2032	73	21
SRDF-0202	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.79	229.8	200.5	1.17	2230	64	27
SRDF-0204	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.69	225.4	198.0	1.16	2271	83	14
SRDF-0206	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.74	225.9	200.1	1.17	2903	38	34
SRDF-0208	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.66	226.9	198.5	1.17	2676	41	19
SRDF-0210	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.66	234.8	201.0	1.17	2000	39	16
SRDF-0212	12/9/91	HWVP2 sludge during formic add'n	1/16/92	7.57	201.8	239.5	1.17	2065	34	17
SRDF-0213	12/9/91	HWVP2 sludge during formic add'n	1/15/92	7.55	248.2	204.0	1.17	2176	30	20
SRDF-0221	12/9/91	HWVP2 sludge during formic add'n	1/16/92	8.45	201.9	232.3	1.18	2354	92	18
SRFO-0227	12/10/91	HWVP2 sludge after formic digestion	1/13/92	9.27	224.8	253.9	1.20	2646	86	23
SMRW-0231A	12/11/91	HWVP2 SME after RWS add'n	1/16/92	9.52	227.9	257.6	1.18	2774	15	9
SMCO-0241A	12/12/91	HWVP2 SME Product	1/8/92	10.04	491.9	476.3	1.31	3472	703	198
SMCO-0242C	12/12/91	HWVP2 SME Product	1/9/92	10.02	514.2	498.6	1.34	3689	911	100
MFTR-0299	1/3/92	HWVP2 Melter Feed	1/13/92	9.64	548.9	534.3	1.34	4214	825	29
MFTR-0300	1/8/92	HWVP2 Melter Feed	1/16/92	9.64	--	--	--	--	773	21
MFTR-0339	1/11/92	HWVP2 Melter Feed after dilution #1	1/22/92	9.49	510.6	500.2	1.33	4271	1238	238
MFTR-0357	1/20/92	HWVP2 Melter Feed after dilution #1	1/23/92	9.67	534.2	510.2	1.35	4389	2097	848
MFTR-0366	1/21/92	HWVP2 Melter Feed after dilution #2	1/23/92	9.71	480.5	441.2	1.28	4243	788	312
MFTR-0381	1/21/92	HWVP2 Melter Feed after dilution #2	1/22/92	9.69	462.0	419.6	1.24	4398	947	57

Sodium Peroxide Fusion Dissolution

A sodium peroxide fusion effectively dissolves both sludge and glass. About 0.25 g of finely crushed sample is heated with 2.5 g of sodium peroxide in a covered nickel or zirconium crucible for 10 minutes at 700°C. Deionized water and concentrated hydrochloric acid are added to dissolve the mixture after fluxing. The major disadvantage of this method is that it cannot be used to determine sodium or the crucible material (Ni or Zr). The method also results in a relatively high concentration of dissolved solids and acid that can affect nebulizer performance in ICP-AES and AA determinations. In the HWVP samples, measurements of Ca seemed to be biased high with this method while those of Zn and Pb were quite erratic.

Microwave-Acid Dissolution

A microwave oven dissolution procedure is used to dissolve glass for elemental analysis. A mixture of 0.25 g of finely crushed glass and 5 ml each of concentrated HF and HNO₃ are heated at 40% microwave power for 12 minutes. After cooling, 40 ml of a 0.6 M boric acid solution is added to complex the fluoride ion. The final step is addition of 5 ml of concentrated HCl and heating at 40% microwave power for 5 minutes. The solution is diluted and then analyzed using ICP-AES and AA techniques. This method yields solutions that can be analyzed for all the components of interest in SRS glass except boron and silicon. Boron determinations are precluded by the addition of boric acid. Silicon can be accurately determined from this solution only if the ICP-AES torch and spray chamber assembly are fabricated of silicon-free materials. The SRL/TNX assembly is quartz, which can be attacked by free fluoride. Thus, silicon is obtained from the sodium peroxide fusion.

Analyses of rare earth elements (Nd, Sm, Pr, etc.) are not good by this method because of the tendency for these elements to form fluoride precipitates.

Aqua Regia Dissolution

For this dissolution method, 0.2 g of dried sludge or finely crushed glass is heated with 12 ml of aqua regia for two hours at 110°C in a sealed reaction vessel. The reaction vessel is

commercially available Teflon container especially designed for high pressure digestions. A conventional drying oven is used to heat the mixture. Microwave heating cannot be used because it may result in sample loss due to excessive pressure buildup in the container. The aqua regia dissolution method is effective for dissolving SRS sludge for subsequent analyses and measurement of nearly all major elements in SRS waste. However, silicon content cannot be determined from the dissolved solution as the dissolution of silicon is incomplete in aqua regia. Additionally, refractory components such as zirconia (ZrO_2), spinels (Fe, Cr, Ni crystals), and ruthenium dioxide (RuO_2) may not be completely dissolved in the aqua regia solution.

Ionic Analyses

Species such as nitrates, nitrites, formates, *etc.* were measured via Ion Chromatography (IC). These components are measured by first diluting the sample and then filtering the diluted solution. The halides were obtained by first fusing the material with sodium peroxide (as described earlier) followed by a deionized water uptake. This material is then filtered and measured by IC. This method proved to be biased very high due to some sort of zirconium interference. Halide measurements with this method have been quite good with DWPF simulants. However, the DWPF simulants have contained very small quantities of Zr. Additionally, the Zr in the DWPF simulations was added as ZrO_2 which does not seem to affect the measurement. For material balances, selected samples were reanalyzed measuring free halides in the sample by the method described for nitrates, *etc.*

PERTINENT HWVP DESIGN DATA**Tank Periphery Solids Buildup**

Experiences in the operation of the IDMS facility suggest that buildup of solids on the walls of processing vessels will take place under the same conditions that promote coil fouling (Item 1.3b). However, since this material is not "baked" onto the vessel wall, as with the steam coils, it is normally sufficiently removed with a water rinse and agitation. SRL recommends that this be examined in the Full Scale Vessel testing at PNL.

Tank agitator/coil erosion data

No data concerning SRAT/SME vessel agitator or heating/cooling coil erosion was obtained during the IDMS HWVP Process Demonstration. SRL recommends that this be examined in the Full Scale Vessel testing at PNL.

Condenser shell side pressure drop

No data concerning SRAT/SME condenser shell side (cooling water) pressure drop was obtained during the IDMS HWVP Process Demonstration. If this is required design data, SRL recommends that this be examined in the Full Scale Vessel testing at PNL.

Noncondensable effects on condenser performance

The Heat Transfer Coefficient (HTC) for the SRAT/SME condenser has been monitored throughout the operation of the IDMS facility. The HTC for the SRAT/SME condenser is calculated as follows:

$$U = Q / (A \Delta T_{LM})$$

$$\text{and } Q = m C_p \Delta T$$

where U = Heat Transfer Coefficient (BTU/hr-ft²-°F)
 Q = condenser heat load (BTU/hr)
 A = condenser heat transfer area (124.8 ft²)
 C_p = heat capacity of water (1.0 BTU/(lb-°F))
 ΔT_{LM} = log mean temperature difference (°F)
 ΔT = cooling water temperature rise (°F)
 m = flow rate of cooling water (lbs/hr)

where the ΔT_{LM} is calculated as follows:

$$\Delta T_{LM} = (\Delta T_2 - \Delta T_1) / (\ln(\Delta T_2 / \Delta T_1))$$

where ΔT_2 = hot side temperature difference (°F)
 and ΔT_1 = cold side temperature difference (°F)

The IDMS SRAT/SME Condenser has consistently met or exceeded the design Heat Transfer Coefficient. The HTC has declined during the course of the IDMS facility operation due to fouling by heavy organic material from the PHA material. More data is available on request.

Coil heat transfer coefficients

SRAT/SME Steam Coil

The Heat Transfer Coefficient (HTC) for the SRAT/SME steam coil has been monitored throughout the operation of the IDMS facility. The HTC for the SRAT/SME steam coil is calculated as follows:

$$U = Q/[A(T_h - T_c)]$$

$$\text{and } Q = mH_{\text{cond}}$$

where U = Heat Transfer Coefficient (BTU/hr-ft²-°F)

Q = coil heat load (BTU/hr)

A = coil heat transfer area (67.25 ft²)

m = steam flow (lbs/hr)

T_h = condensation temperature (°F)

T_c = average temperature of vessel contents (°F)

H_{cond} = enthalpy of condensation (BTU/lb)

where T_h and H_{cond} are calculated as follows[ref]:

$$T_h = 177.81 + 2.892(P) - 0.0194(P^2) + 0.000055(P^3)$$

$$H_{\text{cond}} = 992.89 - 1.867(P) + 0.0115(P^2) - 0.000033(P^3)$$

where P = steam chest pressure (psia)

The IDMS SRAT/SME steam coil has usually met or exceeded the design Heat Transfer Coefficient. The HTC has been a good indication of coil fouling (as in IDMS BL2 Operations⁴). More data is available on request.

SRAT/SME Cooling Coil

The Heat Transfer Coefficient (HTC) for the SRAT/SME cooling water coil has been monitored throughout the operation of the IDMS facility. The HTC for the SRAT/SME cooling water coil is calculated as follows:

$$U = Q/[A(T_h - T_c)]$$

$$\text{and } Q = mC_p\Delta T$$

where

U	= Heat Transfer Coefficient (BTU/hr-ft ² -°F)
Q	= coil cooling load (BTU/hr)
A	= coil heat transfer area (71.4 ft ²)
m	= cooling water flow (lbs/hr)
C _p	= heat capacity of water (1.0 BTU/(lb-°F))
T _h	= average temperature of vessel contents (°F)
T _c	= average cooling water temperature (°F)
ΔT	= cooling water temperature rise (°F)

Shown below are data taken at various times during the operation of the IDMS facility (before and during the HWVP Process Demonstrations). The data includes the above variables and is given for cooldown periods.

SRAT/SME Cooling Coil Heat Transfer Data
(see equations above for units)

Cooling Water Flow (m)	SRAT Temp (T _h)	Cooling Water Temp (T _c)	Heat Load (Q)	HTC (U)
13260	212	94.6	1019150	185.8
13260	208	94.6	978351	178.8
13260	205	96.4	829070	150.5
13260	201	91.7	813399	144.9
13260	198	92.5	777077	143.9
13260	194	92.8	750444	144.4
13260	176	93.2	619139	146.0
13260	158	93.0	481301	143.7
13260	140	91.5	357375	142.9
13260	122	89.2	245632	145.1
13260	104	85.6	139327	148.6
13260	86	78.5	64545	172.4

Clean water for coil cleaning

For situations where slurry material has dried onto the surface of the heating and/or cooling coils, water has proven to be an adequate cleaning solution. However, if an alkaline material containing frit is boiled, as was done in the IDMS BLEND 2 (BL2) operation, sodium/calcium-silicates can form on the surface of the steam coils. In the case of IDMS BL2, the silicate gel-like material could not be removed from the vessel coils using only clean water. The steam coil deposits were analyzed and determined to be a sodium/calcium-silicate gel-like material which was not enriched in sludge, frit, phosphate, nor noble metals.

The BL2 SRAT/SME was drained, the agitator, and the vessel interior was inspected. The steam and cooling water coils and the sides of the tank were first cleaned with air and water streams. A 2% oxalic acid solution was then added, refluxed for three hours, and then concentrated to 4% oxalic acid. The solution was drained and the vessel inspected. The coils and tank walls were again flushed with water to remove any residual

solids. Visually the vessel was very clean. Nitric acid ($\approx 2M$) was added and refluxed for two hours in order to remove any residual mercury. After refluxing, the acid was drained and about 1000 gallons of clean water were added to the SRAT/SME. Analysis of this water showed <10 mg/L of residual mercury.

Melter feed loop pressure drop and cross flow strainer performance

Summary of Feed System Pressure Measurements

<u>Condition</u>	<u>Recir Line Press (psig)</u>	<u>Feed Line Press (psig)</u>
Normal	10 - 20	3 - 8
HWVP #1	30	12
HWVP #2	40	20
HWVP #2'	25	10
'after dilution		

Foaming and carryover / Anti-foam agent

Extensive foaming studies were conducted as part of the SRL Full-Scale SRAT/SME testing. Several anti-foam agents were tested with Dow Corning Anti-Foam #544 being recommended for use in the DWPF. This antifoam has also been used during IDMS operations including the HWVP Process Demonstration. During the HWVP testing, anti-foam was added every 12 - 16 hours at a concentration of 100 ppm. Only once was any significant solids carryover observed during the processing of the simulated HWVP waste material. This foaming/carryover was the result of quickly heating to boiling after the completion of the formic acid addition for HWVP2.

Recommendation: The HWVP should approach boiling very cautiously during feed preparation operations to reduce the possibility of foaming and unnecessary solids carryover. Further, regular addition of an antifoam agent is essential to reduce the potential for foaming.

Pump impeller erosion

The melter feed pump used in the IDMS facility is not prototypic of that which will be used in either the DWPF or the HWVP melter feed delivery systems. Therefore no pump impeller wear data was obtained during the IDMS HWVP Process Demonstration.

Pressure drop in frit slurry lines

No data concerning the pressure drop in frit slurry lines was obtained during the IDMS HWVP Process Demonstration.

Homogeneity testing

Homogeneity testing was not a specific objective of the IDMS HWVP Process Demonstration. The IDMS is not the appropriate place to conduct such tests since its tanks are scaled volumetrically (not geometrically) and do not have the prototypic sampling system. Extensive vessel homogeneity testing has been conducted in the SRL Full-Scale SRAT/SME.

Melter preloading and startup

The preloading and startup of the IDMS melter has been documented in a previous report. Further, SRL has recommended a similar procedure for the startup of the DWPF Melter.

Film cooler pressure drop

<u>Process Measurement</u>	<u>HWVP1</u>	<u>HWVP2</u>
Time period	Dec 12, 1991	Jan 20-21, 1992
Total offgas flow	350 lbs/hr	350 lbs/hr
OGFC air flow	125 lbs/hr	125 lbs/hr
Offgas temp (after OGFC)	230°C	285°C
OGFC ΔP	0.8 inwc	0.4 inwc
Melter-to-quencher ΔP^*	4.0 inwc	6.0 inwc
Melter feed rate	6.0 gal/hr	7.0 gal/hr
Melt pool (top) temp	1150°C	1135°C
Melter plenum temp	740°C	770°C
Melter plenum pressure	-6.0 inwc	-6.0 inwc

* approximately 10 ft from melter exit to quencher

Offgas system upset pressure/temperature data

No experiments specifically designed to evaluate the effects of upsets/surges on the Melter Offgas System were conducted during the IDMS HWVP Process Demonstration. Such data has been obtained, however, during previous IDMS/DWPF campaigns with a summary report pending. The usefulness of this data must be considered since the IDMS Melter Offgas System does not have a Submerged Bed Scrubber (SBS), as is planned for the HWVP, but, rather contains a Quencher and OffGas Condensate Tank (OGCT).

Air in-leakage through fittings

The fittings in the IDMS facility are not prototypic (not Hanford connectors) and therefore no data was obtained during the IDMS HWVP Process Demonstration.

QUALITY ASSURANCE

This task has been completed in accordance with "DWPT Technical Task Plan: Hanford Waste Vitrification Plant (HWVP) Process Demonstration (U)" - WSRC-TR-91-0441 (July 15, 1991).⁶

The task was controlled in accordance with "Task QA Plan for the HWVP Process Demonstration" - WSRC-TR-91-0521 (September 6, 1991).²¹

The data for this task is recorded in the registered SRTC laboratory notebook, WSRC-NB-91-0117.

The accuracy of analytical results performed by the DWPT Analytical Laboratory (at TNX) were controlled by bracketing the analytical results with check standards which were controlled to within 5% (except liquid chromatography results) of their nominal values. The liquid chromatography results were controlled via check standards that were controlled to within 10% of their nominal values.

The rheological measurements were performed on a HAAKE Rotovisco RV3 rheometer. This instrument is quite old and sometimes unreliable. The data provided in Tables 65 and 66 seems to be biased high. While this data has been checked and re-checked and appears to have been obtained correctly, it should be used with caution.

The results from SRNM-0014 and SRNM-0015 indicate that the samples may have been taken incorrectly. The results should be used with caution.

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Special recognition is as follows:

General technical oversight of the facility operation during the campaign was done by Don Miller, Mike Smith, Jack Zamecnik, Jim Ritter, and Nick Hutson.

Operation of the facility was conducted and supervised by the TNX Operations Section (TOS) of the SRTC. General maintenance of the facility, including calibration of the M&TE instrumentation, was conducted by the TOS Works Engineering Group.

Feed preparation and melter offgas measurements were conducted by Jack Zamecnik, Jim Ritter, and Francis Williams all of SRTC/DWPT.

The small scale experiments were conducted by Grace Hsu with the assistance of Irene Reamer both of SRTC/DWPT.

Mike Summer, Jack Durden, and Dan Steedley, all of SRTC/ADS, conducted the SEM/EDX analyses.

XRF/XRD analyses were performed by Art Jurgensen, SRTC/ADS.

The leaching of the glass product via the Product Consistency Test was performed by David Best and Chris Beam, both of SRTC/DWPT.

Two university students, participating in the Cooperative Education Program at the Savannah River Site assisted with completion of various parts of this report. These students are James Jerkins of the University of Alabama and Brent Good of Purdue University.

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Harold Rhoad, SRTC/DWPT, conducted the procedure for preparation of the nitrosyl-ruthenium solution.

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And finally, a very special thanks is offered to the members of the DWPT Analytical Laboratory who made an extra effort to handle the enormous number of samples and analytical requests during this campaign. In each case, the results were timely and rarely questioned.

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APPENDICES

- A: Sample Log
- B: Analytical Flowsheets
- C: Analytical Results
- D: Material Balance Tables
- E: Mixed Hydroxide Slurry Makeup Procedure

Appendix A:

Sample Log

SAMPLE ID	Date	Time	RPT #	TNX	Comment
AFFS - 0001	9/30/91	12:30	4	BASLUDGE	OH slurry / submitted as I-AFFS-4442
AFFS - 0002	9/30/91	12:30	4	BASLUDGE	AI slurry / submitted as I-AFFS-4443
AFFS - 0003	10/11/91	08:45	2	BASLUDGE	Mixed OH slurry / submitted as I-AFFS-4530
SPEC - 0004	10/15/91	11:30	1	BASLUDGE	Small scale sludge #1 (no NO2- or noble metals) I-4580
SPEC - 0005	10/15/91	11:30	1	BASLUDGE	Small scale sludge #2 (no NO2- or noble metals) I-4581
SRTF - 0006	11/7/91	15:00	4	BASLUDGE	Slurry Receipt Tank (SRT) before run
SRAT - 0007	11/7/91	04:25	2	BASLUDGE	SRAT contents - after Mixed OH slurry transfer (HWVP1)
SRTC - 0008	11/7/91	08:35	2	BASLUDGE	SRAT contents - after primary trim chemical add'n (HWVP1)
SRTC - 0009	11/7/91	08:35	2	BASLUDGE	SRAT contents - after primary trim chemical add'n (HWVP1)
FRIT - 0010	11/11/91	19:00	4	FRIT	Hanford glass frit
FRIT - 0011	11/11/91	19:00	4	FRIT	Hanford glass frit
FRIT - 0012	11/11/91	19:00	4	FRIT	SRL standard frit (202)
FRIT - 0013	11/9/91	19:00	4	FRIT	SRL standard frit (202)
SRNM - 0014	11/11/91	20:30	2	BASLUDGE	SRAT contents - after secondary trim chemical add'n (HWVP1)
SRNM - 0015	11/11/91	20:30	2	BASLUDGE	SRAT contents - after secondary trim chemical add'n (HWVP1)
SRDF - 0016	11/12/91	11:30	1	ACSLUDGE	SRAT contents - 50 minutes into formic addition (HWVP1)
SRDF - 0017	11/12/91	11:30	1		SRAT contents - 50 minutes into formic addition (HWVP1)
SRDF - 0018	11/12/91	11:40	1	ACSLUDGE	SRAT contents - 60 minutes into formic addition (HWVP1)
SRDF - 0019	11/12/91	11:40	1		SRAT contents - 60 minutes into formic addition (HWVP1)
SRDF - 0020	11/12/91	11:50	1	ACSLUDGE	SRAT contents - 70 minutes into formic addition (HWVP1)
SRDF - 0021	11/12/91	11:50	1		SRAT contents - 70 minutes into formic addition (HWVP1)
SRDF - 0022	11/12/91	12:00	1	ACSLUDGE	SRAT contents - 80 minutes into formic addition (HWVP1)
SRDF - 0023	11/12/91	12:00	1		SRAT contents - 80 minutes into formic addition (HWVP1)
SRDF - 0024	11/12/91	12:10	1	ACSLUDGE	SRAT contents - 90 minutes into formic addition (HWVP1)
SRDF - 0025	11/12/91	12:10	1		SRAT contents - 90 minutes into formic addition (HWVP1)
SRDF - 0026	11/12/91	12:20	1	ACSLUDGE	SRAT contents - 100 minutes into formic addition (HWVP1)
SRDF - 0027	11/12/91	12:20	1		SRAT contents - 100 minutes into formic addition (HWVP1)
SRDF - 0028	11/12/91	12:30	1	ACSLUDGE	SRAT contents - 110 minutes into formic addition (HWVP1)
SRDF - 0029	11/12/91	12:30	1		SRAT contents - 110 minutes into formic addition (HWVP1)
SRDF - 0030	11/12/91	12:40	1	ACSLUDGE	SRAT contents - 120 minutes into formic addition (HWVP1)
SRDF - 0031	11/12/91	12:40	1		SRAT contents - 120 minutes into formic addition (HWVP1)
SRDF - 0032	11/12/91	12:50	1	ACSLUDGE	SRAT contents - 130 minutes into formic addition (HWVP1)
SRDF - 0033	11/12/91	12:50	1		SRAT contents - 130 minutes into formic addition (HWVP1)

SAMPLE ID	Date	Time	RPT #	TNX		Comment
SRDF - 0034	11/12/91	13:00	1	ACSLUDGE		SRAT contents - 140 minutes into formic addition (HWVP1)
SRDF - 0035	11/12/91	13:00	1	ACSLUDGE		SRAT contents - 140 minutes into formic addition (HWVP1)
SRDF - 0036	11/12/91	13:10	1	ACSLUDGE		SRAT contents - 150 minutes into formic addition (HWVP1)
SRDF - 0037	11/12/91	13:10	1	ACSLUDGE		SRAT contents - 150 minutes into formic addition (HWVP1)
SRDF - 0038	11/12/91	13:20	1	ACSLUDGE		SRAT contents - 160 minutes into formic addition (HWVP1)
SRDF - 0039	11/12/91	13:20	1			SRAT contents - 160 minutes into formic addition (HWVP1)
SRDF - 0040	11/12/91	13:30	1	ACSLUDGE		SRAT contents - 170 minutes into formic addition (HWVP1)
SRDF - 0041	11/12/91	13:30	1			SRAT contents - 170 minutes into formic addition (HWVP1)
SRDF - 0042	11/12/91	13:40	1	ACSLUDGE		SRAT contents - 180 minutes into formic addition (HWVP1)
SRDF - 0043	11/12/91	13:40	1			SRAT contents - 180 minutes into formic addition (HWVP1)
SRDF - 0044	11/12/91	13:50	1	ACSLUDGE		SRAT contents - 190 minutes into formic addition (HWVP1)
SRDF - 0045	11/12/91	13:50	1			SRAT contents - 190 minutes into formic addition (HWVP1)
FORM - 0046	11/12/91	14:15	1	FORMIC		HWVP1 Formic Acid
SCFO - 0047	11/12/91	17:00	1	SRACOND		SRAT Condensate - 2 hrs into digestion (HWVP1)
SCFO - 0048	11/12/91	17:00	1	SRACOND		SRAT Condensate - 2 hrs into digestion (HWVP1)
SRDF - 0049	11/12/91	17:00	2	ACSLUDGE		SRAT contents - 2 hrs into digestion (HWVP1)
SRDF - 0050	11/12/91	17:00	2	ACSLUDGE		SRAT contents - 2 hrs into digestion (HWVP1)
SCFO - 0051	11/12/91	17:30	1	SRACOND		SRAT Condensate - 2 1/2 hrs into digestion (HWVP1)
SCFO - 0052	11/12/91	18:00	1	SRACOND		SRAT Condensate - 3 hrs into digestion (HWVP1)
SCFO - 0053	11/12/91	18:00	1	SRACOND		SRAT Condensate - 3 hrs into digestion (HWVP1)
SCFO - 0054	11/12/91	18:30	1	SRACOND		SRAT Condensate - 3 1/2 hrs into digestion (HWVP1)
SCFO - 0055	11/12/91	19:00	1	SRACOND		SRAT Condensate - 4 hrs into digestion (HWVP1)
SCFO - 0056	11/12/91	19:00	1	SRACOND		SRAT Condensate - 4 hrs into digestion (HWVP1)
SRDF - 0057	11/12/91	19:00	2	ACSLUDGE		SRAT contents - 4 hrs into digestion (HWVP1)
SRDF - 0058	11/12/91	19:00	2	ACSLUDGE		SRAT contents - 4 hrs into digestion (HWVP1)
SCFO - 0059	11/12/91	19:30	1	SRACOND		SRAT Condensate - 4 1/2 hrs into digestion (HWVP1)
SCFO - 0060	11/12/91	20:00	1	SRACOND		SRAT Condensate - 5 hrs into digestion (HWVP1)
SCFO - 0061	11/12/91	20:00	1	SRACOND		SRAT Condensate - 5 hrs into digestion (HWVP1)
SCFO - 0062	11/12/91	20:30	1	SRACOND		SRAT Condensate - 5 1/2 hrs into digestion (HWVP1)
SCFO - 0063	11/12/91	21:00	1	SRACOND		SRAT Condensate - 6 hrs into digestion (HWVP1)
SCFO - 0064	11/12/91	21:00	1	SRACOND		SRAT Condensate - 6 hrs into digestion (HWVP1)
SRDF - 0065	11/12/91	21:00	1	ACSLUDGE		SRAT contents - 6 hrs into digestion (HWVP1)
SRDF - 0066	11/12/91	21:00	1	ACSLUDGE		SRAT contents - 6 hrs into digestion (HWVP1)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
SCFO - 0067	11/12/91	21:30	1	SRACOND	SRAT Condensate - 6 1/2 hrs into digestion (HWVP1)
SCFO - 0068	11/12/91	22:00	1	SRACOND	SRAT Condensate - 7 hrs into digestion (HWVP1)
SCFO - 0069	11/12/91	22:00	1	SRACOND	SRAT Condensate - 7 hrs into digestion (HWVP1)
SCFO - 0070	11/12/91	22:30	1	SRACOND	SRAT Condensate - 7 1/2 hrs into digestion (HWVP1)
SRFO - 0071	11/12/91	22:45	1	ACSLUDGE	SRAT contents - 7 3/4 hrs into digestion (HWVP1)
SRFO - 0072	11/12/91	22:45	1	ACSLUDGE	SRAT contents - 7 3/4 hrs into digestion (HWVP1)
IMPI - 0073	11/13/91	10:00	1	IC/ICP	Impinger to trap ammonia (HWVP1)
IMPI - 0074	11/13/91	10:00	1	IC/ICP	Impinger to trap ammonia (HWVP1)
IMPI - 0075	11/13/91	10:00	1	IC/ICP	Impinger to trap ammonia (HWVP1)
IMPI - 0076	11/13/91	10:00	1	IC/ICP	Impinger to trap ammonia (HWVP1)
IMPI - 0077	11/13/91	10:00	1	IC/ICP	Impinger to trap ammonia (HWVP1)
IMPI - 0078	11/13/91	10:00	1	IC/ICP	Impinger to trap ammonia (HWVP1)
IMPI - 0079	11/13/91	10:00	1	IC/ICP	Impinger to trap ammonia (HWVP1)
RWSS - 0080	11/13/91	21:55	4	RWSS	HWVP1 Recycle Waste Stream (RWS)
RWSS - 0081	11/13/91	21:55	4	RWSS	HWVP1 Recycle Waste Stream (RWS)
SMRW - 0082	11/13/91	22:55	2	ACSLUDGE	SME contents - after RWS addition (HWVP1)
SMRW - 0083	11/13/91	22:55	2	ACSLUDGE	SME contents - after RWS addition (HWVP1)
SCRW - 0084	11/14/91	00:40	1	SRCOOND	SME Condensate - 1 hr into RWS concentration (HWVP1)
SCRW - 0085	11/14/91	01:40	1	SRCOOND	SME Condensate - 2 hrs into RWS concentration (HWVP1)
SMRW - 0086	11/14/91	09:15	1	ACSLUDGE	SME contents - after RWS concentration (HWVP1)
SMRW - 0087	11/14/91	09:15	1	ACSLUDGE	SME contents - after RWS concentration (HWVP1)
SCSM - 0088	11/14/91	13:30	1	SRCOOND	SME Condensate - 1 hr into frit concentration (HWVP1)
SCSM - 0089	11/14/91	13:30	1	SRCOOND	SME Condensate - 1 hr into frit concentration (HWVP1)
SCSM - 0090	11/14/91	14:30	1	SRCOOND	SME Condensate - 2 hrs into frit concentration (HWVP1)
SCSM - 0091	11/14/91	14:30	1	SRCOOND	SME Condensate - 2 hrs into frit concentration (HWVP1)
SCSM - 0092	11/14/91	15:30	1	SRCOOND	SME Condensate - 3 hrs into frit concentration (HWVP1)
SCSM - 0093	11/14/91	15:30	1	SRCOOND	SME Condensate - 3 hrs into frit concentration (HWVP1)
SCSM - 0094	11/14/91	16:30	1	SRCOOND	SME Condensate - 4 hrs into frit concentration (HWVP1)
SCSM - 0095	11/14/91	16:30	1	SRCOOND	SME Condensate - 4 hrs into frit concentration (HWVP1)
GLAS - 0096	11/15/91	09:00	2	GLASS	NCAW / PNL GLASS STANDARD (HW39-4)
SMCO - 0097	11/15/91	09:40	4	SLGLAS/SLUR	SME PRODUCT (HWVP1)
SMCO - 0098	11/15/91	09:40	4	SLGLAS/SLUR	SME PRODUCT (HWVP1)
SMCO - 0099	11/19/91	13:58	1	SOLIDS	SME PRODUCT (HWVP1)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
SMCO - 0100	11/26/91	13:30	2	SLGLAS/SLUR	SME PRODUCT (HWVP1) - after addition of NaNO3
MFTH - 0101	11/29/91	14:20	2	SLGLAS/SLUR	MFT Høel before HWVP1 Transfer #1
MFTR - 0102	11/29/91	14:20	4	SLGLAS/SLUR	MFT Contents after transfer #1 (HWVP1)
MFTR - 0103	11/29/91	14:20	1	ACSLUDGE	MFT Contents after transfer #1 (HWVP1)
MFTR - 0104	11/29/91	14:20	1		MFT sample dried (> 100 g) and archived
MFTR - 0105	11/30/91	03:00	2	SLURRY	HWVP1 MFT Contents
OGCT - 0106	11/30/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0107	11/30/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
OGCT - 0108	11/30/91	15:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0109	11/30/91	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
OGCT - 0110	11/30/91	21:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0111	11/30/91	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0112	11/30/91	21:00	1	GLASS	HWVP 1 GLASS (Canister #403)
GLAS - 0113	11/30/91	21:00	1	NOBLE	HWVP 1 GLASS (Canister #403)
GLAS - 0114	11/30/91	21:00	1	CORNING	HWVP 1 GLASS (Canister #403)
OGCT - 0115	12/1/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0116	12/1/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0117	12/1/91	03:00	1	GLASS	HWVP 1 GLASS (Canister #468)
GLAS - 0118	12/1/91	03:00	1	NOBLE	HWVP 1 GLASS (Canister #468)
GLAS - 0119	12/1/91	03:00	1	CORNING	HWVP 1 GLASS (Canister #468)
MFTR - 0120	12/1/91	16:40	2	SLURRY	HWVP1 MFT Contents
MFTR - 0121	12/3/91	12:25	2	SLURRY	HWVP1 MFT Contents
MFTR - 0122	12/3/91	15:00	2	SLURRY	HWVP1 MFT Contents
OGCT - 0123	12/3/91	15:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0124	12/3/91	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
SRAT - 0125	12/3/91	16:15	2	BASLUDGE	SRAT contents - after Mixed OH slurry transfer (HWVP2)
SRTC - 0126	12/6/91	16:50	2	BASLUDGE	SRAT contents - after primary trim chemical add'n (HWVP2)
MFTR - 0127	12/6/91	15:00	2	SLURRY	HWVP1 MFT Contents
OGCT - 0128	12/6/91	15:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0129	12/6/91	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0130	12/6/91	18:43	1	GLASS	HWVP 1 GLASS (Canister #491)
GLAS - 0131	12/6/91	18:43	1	NOBLE	HWVP 1 GLASS (Canister #491)
GLAS - 0132	12/6/91	18:43	1	CORNING	HWVP 1 GLASS (Canister #491)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
GLAS - 0133	12/6/91	18:43	1	GLASS	HWVP 1 GLASS (Canister #496)
GLAS - 0134	12/6/91	18:43	1	NOBLE	HWVP 1 GLASS (Canister #496)
GLAS - 0135	12/6/91	18:43	1	CORNING	HWVP 1 GLASS (Canister #496)
OGCT - 0136	12/6/91	21:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0137	12/6/91	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0138	12/7/91	03:00	1	GLASS	HWVP 1 GLASS (Canister #469)
GLAS - 0139	12/7/91	03:00	1	NOBLE	HWVP 1 GLASS (Canister #469)
GLAS - 0140	12/7/91	03:00	1	CORNING	HWVP 1 GLASS (Canister #469)
OGCT - 0141	12/7/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0142	12/7/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0143	12/7/91	07:10	1	GLASS	HWVP 1 GLASS (Canister #407)
GLAS - 0144	12/7/91	07:10	1	NOBLE	HWVP 1 GLASS (Canister #407)
GLAS - 0145	12/7/91	07:10	1	CORNING	HWVP 1 GLASS (Canister #407)
MFTR - 0146	12/7/91	09:00	2	SLURRY	HWVP1 MFT Contents
OGCT - 0147	12/7/91	09:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0148	12/7/91	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0149	12/7/91	18:15	1	GLASS	HWVP 1 GLASS (Canister #405)
GLAS - 0150	12/7/91	18:15	1	NOBLE	HWVP 1 GLASS (Canister #405)
GLAS - 0151	12/7/91	18:15	1	CORNING	HWVP 1 GLASS (Canister #405)
OGCT - 0152	12/8/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0153	12/8/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0154	12/8/91	07:15	1	GLASS	HWVP 1 GLASS (Canister #482)
GLAS - 0155	12/8/91	07:15	1	NOBLE	HWVP 1 GLASS (Canister #482)
GLAS - 0156	12/8/91	07:15	1	CORNING	HWVP 1 GLASS (Canister #482)
MFTR - 0157	12/8/91	09:00	2	SLURRY	HWVP1 MFT Contents
OGCT - 0158	12/8/91	09:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0159	12/8/91	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
OGCT - 0160	12/8/91	15:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0161	12/8/91	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0162	12/8/91	19:10	1	GLASS	HWVP 1 GLASS (Canister #493)
GLAS - 0163	12/8/91	19:10	1	NOBLE	HWVP 1 GLASS (Canister #493)
GLAS - 0164	12/8/91	19:10	1	CORNING	HWVP 1 GLASS (Canister #493)
OGCT - 0165	12/8/91	21:00	1	CONDEN	OGCT contents - side tap (HWVP1)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
OGCB - 0166	12/8/91	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
OGCT - 0167	12/9/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0168	12/9/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
SRNM - 0169	12/9/91	08:50	2	BASLUDGE	SRAT contents - after secondary trim chemical add'n (HWVP2)
SRNM - 0170	12/9/91	08:50	2	BASLUDGE	SRAT contents - after secondary trim chemical add'n (HWVP2)
FORM - 0171	12/9/91	12:50	1	FORMIC	HWVP2 Formic Acid
SRDF - 0172	12/9/91	13:15	1	ACSLUDGE	SRAT contents - 10 minutes into formic addition (HWVP2)
SRDF - 0173	12/9/91	13:15	1	ACSLUDGE	SRAT contents - 10 minutes into formic addition (HWVP2)
SRDF - 0174	12/9/91	13:25	1	ACSLUDGE	SRAT contents - 20 minutes into formic addition (HWVP2)
SRDF - 0175	12/9/91	13:25	1	ACSLUDGE	SRAT contents - 20 minutes into formic addition (HWVP2)
SRDF - 0176	12/9/91	13:35	1	ACSLUDGE	SRAT contents - 30 minutes into formic addition (HWVP2)
SRDF - 0177	12/9/91	13:35	1	ACSLUDGE	SRAT contents - 30 minutes into formic addition (HWVP2)
SRDF - 0178	12/9/91	13:45	1	ACSLUDGE	SRAT contents - 40 minutes into formic addition (HWVP2)
SRDF - 0179	12/9/91	13:45	1	ACSLUDGE	SRAT contents - 40 minutes into formic addition (HWVP2)
SRDF - 0180	12/9/91	13:55	1	ACSLUDGE	SRAT contents - 50 minutes into formic addition (HWVP2)
SRDF - 0181	12/9/91	13:55	1	ACSLUDGE	SRAT contents - 50 minutes into formic addition (HWVP2)
SRDF - 0182	12/9/91	14:05	1	ACSLUDGE	SRAT contents - 60 minutes into formic addition (HWVP2)
SRDF - 0183	12/9/91	14:05	1	ACSLUDGE	SRAT contents - 60 minutes into formic addition (HWVP2)
SRDF - 0184	12/9/91	14:15	1	ACSLUDGE	SRAT contents - 70 minutes into formic addition (HWVP2)
SRDF - 0185	12/9/91	14:15	1	ACSLUDGE	SRAT contents - 70 minutes into formic addition (HWVP2)
SRDF - 0186	12/9/91	14:25	1	ACSLUDGE	SRAT contents - 80 minutes into formic addition (HWVP2)
SRDF - 0187	12/9/91	14:25	1	ACSLUDGE	SRAT contents - 80 minutes into formic addition (HWVP2)
SRDF - 0188	12/9/91	14:35	1	ACSLUDGE	SRAT contents - 90 minutes into formic addition (HWVP2)
SRDF - 0189	12/9/91	14:35	1	ACSLUDGE	SRAT contents - 90 minutes into formic addition (HWVP2)
SRDF - 0190	12/9/91	14:45	1	ACSLUDGE	SRAT contents - 100 minutes into formic addition (HWVP2)
SRDF - 0191	12/9/91	14:45	1	ACSLUDGE	SRAT contents - 100 minutes into formic addition (HWVP2)
SRDF - 0192	12/9/91	14:55	1	ACSLUDGE	SRAT contents - 110 minutes into formic addition (HWVP2)
SRDF - 0193	12/9/91	14:55	1	ACSLUDGE	SRAT contents - 110 minutes into formic addition (HWVP2)
SRDF - 0194	12/9/91	15:05	1	ACSLUDGE	SRAT contents - 120 minutes into formic addition (HWVP2)
SRDF - 0195	12/9/91	15:05	1	ACSLUDGE	SRAT contents - 120 minutes into formic addition (HWVP2)
SCFO - 0196	12/9/91	17:40	1	SPACOND	SRAT Condensate - Half way through formic addition (HWVP2)
SRDF - 0197	12/9/91	18:00	1	ACSLUDGE	SRAT contents - 130 minutes into formic addition (HWVP2)
SRDF - 0198	12/9/91	18:00	1	ACSLUDGE	SRAT contents - 130 minutes into formic addition (HWVP2)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
SRDF - 0199	12/9/91	18:10	1	ACSLUDGE	SRAT contents - 140 minutes into formic addition (HWVP2)
SRDF - 0200	12/9/91	18:10	1	ACSLUDGE	SRAT contents - 140 minutes into formic addition (HWVP2)
SRDF - 0201	12/9/91	18:20	1	ACSLUDGE	SRAT contents - 150 minutes into formic addition (HWVP2)
SRDF - 0202	12/9/91	18:20	1	ACSLUDGE	SRAT contents - 150 minutes into formic addition (HWVP2)
SRDF - 0203	12/9/91	18:30	1	ACSLUDGE	SRAT contents - 160 minutes into formic addition (HWVP2)
SRDF - 0204	12/9/91	18:30	1	ACSLUDGE	SRAT contents - 160 minutes into formic addition (HWVP2)
SRDF - 0205	12/9/91	18:40	1	ACSLUDGE	SRAT contents - 170 minutes into formic addition (HWVP2)
SRDF - 0206	12/9/91	18:40	1	ACSLUDGE	SRAT contents - 170 minutes into formic addition (HWVP2)
SRDF - 0207	12/9/91	18:50	1	ACSLUDGE	SRAT contents - 180 minutes into formic addition (HWVP2)
SRDF - 0208	12/9/91	18:50	1	ACSLUDGE	SRAT contents - 180 minutes into formic addition (HWVP2)
SRDF - 0209	12/9/91	19:00	1	ACSLUDGE	SRAT contents - 190 minutes into formic addition (HWVP2)
SRDF - 0210	12/9/91	19:00	1	ACSLUDGE	SRAT contents - 190 minutes into formic addition (HWVP2)
SRDF - 0211	12/9/91	19:10	1	ACSLUDGE	SRAT contents - 200 minutes into formic addition (HWVP2)
SRDF - 0212	12/9/91	19:10	1	ACSLUDGE	SRAT contents - 200 minutes into formic addition (HWVP2)
SRDF - 0213	12/9/91	19:20	1	ACSLUDGE	SRAT contents - 210 minutes into formic addition (HWVP2)
SCFO - 0214	12/9/91	19:40	1	SRACOND	SRAT Condensate - at the completion formic addition (HWVP2)
SCFO - 0215	12/9/91	20:30	1	SRACOND	SRAT Condensate - at 1/2 hr into formic digestion (HWVP2)
SCFO - 0216	12/9/91	21:00	1	SRACOND	SRAT Condensate - at 1 hr into formic digestion (HWVP2)
SCFO - 0217	12/9/91	21:30	1	SRACOND	SRAT Condensate - at 1 1/2 hr into formic digestion (HWVP2)
SCFO - 0218	12/9/91	22:00	1	SRACOND	SRAT Condensate - at 2 hrs into formic digestion (HWVP2)
SCFO - 0219	12/9/91	22:30	1	SRACOND	SRAT Condensate - at 2 1/2 hrs into formic digestion (HWVP2)
SCFO - 0220	12/9/91	23:00	1	SRACOND	SRAT Condensate - at 3 hrs into formic digestion (HWVP2)
SRDF - 0221	12/9/91	23:30	2	ACSLUDGE	SRAT contents - at 3 1/2 hrs into formic digestion (HWVP2)
SCFO - 0222	12/10/91	00:00	1	SRACOND	SRAT Condensate - at 4 hrs into formic digestion (HWVP2)
SCFO - 0223	12/10/91	00:30	1	SRACOND	SRAT Condensate - at 4 1/2 hrs into formic digestion (HWVP2)
SCFO - 0224	12/10/91	01:00	1	SRACOND	SRAT Condensate - at 5 hrs into formic digestion (HWVP2)
SCFO - 0225	12/10/91	01:30	1	SRACOND	SRAT Condensate - at 5 1/2 hr into formic digestion (HWVP2)
SCFO - 0226	12/10/91	02:00	1	SRACOND	SRAT Condensate - at 6 hrs into formic digestion (HWVP2)
SRFO - 0227	12/10/91	22:50	2	ACSLUDGE	SRAT contents - at completion of digestion (HWVP2)
SMRW - 0228	12/11/91	00:22	2	ACSLUDGE	SME contents - after RWS addition (HWVP2)
SCRW - 0229	12/11/91	01:00	1	SRACOND	SME Condensate - 1 hr into RWS concentration (HWVP1)
SCRW - 0230	12/11/91	02:00	1	SRACOND	SME Condensate - 2 hrs into RWS concentration (HWVP1)
SMRW - 0231	12/11/91	07:00	1	ACSLUDGE	SME contents - after RWS concentration (HWVP2)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
SMRW - 0232	12/11/91	07:05	1	ACSLUDGE	SME contents - after RWS concentration (HWVP2)
SCSM - 0233	12/11/91	10:00	1	SRACOND	SME Condensate - 1 hr into frit concentration (HWVP2)
SCSM - 0234	12/11/91	01:00	1	SRACOND	SME Condensate - 1 hr into frit concentration (HWVP2)
SCSM - 0235	12/11/91	11:00	1	SRACOND	SME Condensate - 2 hrs into frit concentration (HWVP2)
SCSM - 0236	12/11/91	11:00	1	SRACOND	SME Condensate - 2 hrs into frit concentration (HWVP2)
SCSM - 0237	12/11/91	12:00	1	SRACOND	SME Condensate - 3 hrs into frit concentration (HWVP2)
SCSM - 0238	12/11/91	12:00	1	SRACOND	SME Condensate - 3 hrs into frit concentration (HWVP2)
SCSM - 0239	12/11/91	13:00	1	SRACOND	SME Condensate - 4 hrs into frit concentration (HWVP2)
SCSM - 0240	12/11/91	13:00	1	SRACOND	SME Condensate - 4 hrs into frit concentration (HWVP2)
SMCO - 0241	12/12/91	00:30	4	SLGLAS/SLUR	SME PRODUCT (HWVP2)
SMCO - 0242	12/12/91	00:30	4	SLGLAS/SLUR	SME PRODUCT (HWVP2)
GLAS - 0243	12/12/91	01:10	1	NOBLE	HWVP 1 GLASS (Canister #499)
GLAS - 0244	12/12/91	01:10	1	GLASS	HWVP 1 GLASS (Canister #499)
GLAS - 0245	12/12/91	01:10	1	CORNING	HWVP 1 GLASS (Canister #499)
GLAS - 0246	12/12/91	01:15	1	GLASS	HWVP 1 GLASS (Canister #68)
GLAS - 0247	12/12/91	01:15	1	NOBLE	HWVP 1 GLASS (Canister #68)
GLAS - 0248	12/12/91	01:15	1	CORNING	HWVP 1 GLASS (Canister #68)
GLAS - 0249	12/12/91	11:00	1	GLASS	HWVP 1 GLASS (Canister #488)
GLAS - 0250	12/12/91	11:00	1	NOBLE	HWVP 1 GLASS (Canister #488)
GLAS - 0251	12/12/91	11:00	1	CORNING	HWVP 1 GLASS (Canister #488)
GLAS - 0252	12/12/91	13:30	2	GLASS	NCAW / PNL GLASS STANDARD (HW39-4)
GLAS - 0253	12/12/91	16:00	1	SLURRY	HWVP1 MFT Contents
GLAS - 0254	12/12/91	18:30	1	GLASS	HWVP 1 GLASS (Canister #65)
GLAS - 0255	12/12/91	18:30	1	NOBLE	HWVP 1 GLASS (Canister #65)
GLAS - 0256	12/12/91	18:30	1	CORNING	HWVP 1 GLASS (Canister #65)
GLAS - 0257	12/12/91	21:00	1	CONDEN	OGCT contents - side tap (HWVP1)
GLAS - 0258	12/12/91	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0259	12/12/91	23:30	1	GLASS	HWVP 1 GLASS (Canister #480)
GLAS - 0260	12/12/91	23:30	1	NOBLE	HWVP 1 GLASS (Canister #480)
GLAS - 0261	12/12/91	23:30	1	CORNING	HWVP 1 GLASS (Canister #480)
OGCT - 0262	12/13/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OHCB - 0263	12/13/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0264	12/13/91	09:00	1	GLASS	HWVP 1 GLASS (Canister #69)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
GLAS - 0265	12/13/91	09:00	1	NOBLE	HWVP 1 GLASS (Canister #69)
GLAS - 0266	12/13/91	09:00	1	CORNING	HWVP 1 GLASS (Canister #69)
MFTR - 0267	12/13/91	09:00	2	SLURRY	HWVP1 MFT Contents
OGCT - 0268	12/13/91	09:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0269	12/13/91	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
OGCT - 0270	12/14/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0271	12/14/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
OGCT - 0272	12/14/91	09:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0273	12/14/91	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0274	12/14/91	10:30	1	GLASS	HWVP 1 GLASS (Canister #67)
GLAS - 0275	12/14/91	10:30	1	NOBLE	HWVP 1 GLASS (Canister #67)
GLAS - 0276	12/14/91	10:30	1	CORNING	HWVP 1 GLASS (Canister #67)
GLAS - 0277	12/14/91	11:00	1	GLASS	HWVP 1 GLASS (Canister #72)
GLAS - 0278	12/14/91	11:00	1	NOBLE	HWVP 1 GLASS (Canister #72)
GLAS - 0279	12/14/91	11:00	1	CORNING	HWVP 1 GLASS (Canister #72)
OGCT - 0280	12/14/91	15:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0281	12/14/91	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
MFTR - 0282	12/14/91	15:45	2	SLURRY	HWVP1 MFT Contents
OGCT - 0283	12/14/91	21:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0284	12/14/91	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
OGCT - 0285	12/15/91	03:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0286	12/15/91	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0287	12/15/91	04:00	1	GLASS	HWVP 1 GLASS (Canister #?)
GLAS - 0288	12/15/91	04:00	1	NOBLE	HWVP 1 GLASS (Canister #?)
GLAS - 0289	12/15/91	04:00	1	CORNING	HWVP 1 GLASS (Canister #?)
MFTR - 0290	12/15/91	09:00	2	SLURRY	HWVP1 MFT Contents
OGCT - 0291	12/15/91	09:00	1	CONDEN	OGCT contents - side tap (HWVP1)
OGCB - 0292	12/15/91	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP1)
GLAS - 0293	12/15/91	09:15	1	GLASS	HWVP 1 GLASS (Canister #70)
GLAS - 0294	12/15/91	09:15	1	NOBLE	HWVP 1 GLASS (Canister #70)
GLAS - 0295	12/15/91	09:15	1	CORNING	HWVP 1 GLASS (Canister #70)
OGDP - 0296	12/17/91	14:00	1	OGDEP	OFFGAS DEPOSIT FROM INSPECTION PORT
ODGP - 0297	12/17/91	14:00	1	SEM	OFFGAS DEPOSIT FROM INSPECTION PORT

SAMPLE ID	Date	Time	RPT #	TNX	Comment
MFTH - 0298	1/3/92	12:38	2	SLGLAS/SLUR	MFT Heel before HWVP2 Transfer #1
MFTR - 0299	1/3/92	14:00	4	SLGLAS/SLUR	MFT Contents after transfer #1 (HWVP2)
MFTR - 0300	1/3/92	14:00	1	ACSLUDGE	MFT Contents after transfer #1 (HWVP2)
MFTR - 0301	1/3/92	14:00	1	NOBLE	MFT sample dried (> 100 g) and archived
SPEC - 0302	1/7/92	09:15	1	SOLIDS	MFT Contents after transfer #1 (HWVP2)
OGCT - 0303	1/7/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0304	1/7/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0305	1/7/92	21:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0306	1/8/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0307	1/8/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0308	1/8/92	06:00	1	GLASS	HWVP 2 GLASS (Canister #75)
GLAS - 0309	1/8/92	06:00	1	NOBLE	HWVP 2 GLASS (Canister #75)
GLAS - 0310	1/8/92	06:00	1	CORNING	HWVP 2 GLASS (Canister #75)
GLAS - 0311	1/8/92	06:00	1	GLASS	HWVP 2 GLASS (Canister #78)
GLAS - 0312	1/8/92	06:00	1	NOBLE	HWVP 2 GLASS (Canister #78)
GLAS - 0313	1/8/92	06:00	1	CORNING	HWVP 2 GLASS (Canister #78)
OGCT - 0314	1/8/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0315	1/8/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0316	1/7/92	02:30	1	NOBLE	HWVP 2 GLASS (Canister #?)
GLAS - 0317	1/7/92	02:30	1	CORNING	HWVP 2 GLASS (Canister #?)
GLAS - 0318	1/7/92	02:30	1	GLASS	HWVP 2 GLASS (Canister #?)
OGCT - 0319	1/6/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0320	1/6/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0321	1/7/92	02:30	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0322	1/7/92	02:30	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0323	1/8/92	13:30	1	GLASS	HWVP 2 GLASS (Canister #74)
GLAS - 0324	1/8/92	13:30	1	NOBLE	HWVP 2 GLASS (Canister #74)
GLAS - 0325	1/8/92	13:30	1	CORNING	HWVP 2 GLASS (Canister #74)
OGCT - 0326	1/8/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0327	1/8/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
COLD - 0328	1/8/92	15:30	1	-	HWVP1 Cold Cap sample - taken 12/4/91
MELT - 0329	1/8/92	15:30	1	-	Melter floor sample - taken 12/18/91
MELT - 0330	1/8/92	15:30	1	-	Melter floor sample - taken 12/4/91

SAMPLE ID	Date	Time	RPT #	TNX	Comment
MFTR - 0331	1/8/92	16:15	1	SLURRY	HWVP2 MFT Contents
OGCT - 0332	1/8/92	24:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0333	1/8/92	24:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0334	1/9/92	00:45	1	GLASS	HWVP 2 GLASS (Canister #73)
GLAS - 0335	1/9/92	00:45	1	NOBLE	HWVP 2 GLASS (Canister #73)
GLAS - 0336	1/9/92	00:45	1	CORNING	HWVP 2 GLASS (Canister #73)
OGCT - 0337	1/9/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0338	1/9/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0339	1/9/92	09:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0340	1/9/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0341	1/9/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0342	1/11/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0343	1/11/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0344	1/11/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0345	1/11/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0346	1/11/92	03:10	1	GLASS	HWVP 2 GLASS (Canister #64)
GLAS - 0347	1/11/92	03:10	1	NOBLE	HWVP 2 GLASS (Canister #64)
GLAS - 0348	1/11/92	03:10	1	CORNING	HWVP 2 GLASS (Canister #64)
GLAS - 0349	1/11/92	03:10	1	GLASS	HWVP 2 GLASS (Canister #79)
GLAS - 0350	1/11/92	03:10	1	NOBLE	HWVP 2 GLASS (Canister #79)
GLAS - 0351	1/11/92	03:10	1	CORNING	HWVP 2 GLASS (Canister #79)
GLAS - 0352	1/11/92	03:15	1	GLASS	HWVP 2 GLASS (Canister #77)
GLAS - 0353	1/11/92	03:15	1	NOBLE	HWVP 2 GLASS (Canister #77)
GLAS - 0354	1/11/92	03:15	1	CORNING	HWVP 2 GLASS (Canister #77)
OGCT - 0355	1/11/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0356	1/11/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0357	1/11/92	09:00	2	SLURRY	HWVP2 MFT Contents
GLAS - 0358	1/11/92	11:00	1	GLASS	HWVP 2 GLASS (Canister #81)
GLAS - 0359	1/11/92	11:00	1	NOBLE	HWVP 2 GLASS (Canister #81)
GLAS - 0360	1/11/92	11:00	1	CORNING	HWVP 2 GLASS (Canister #81)
GLAS - 0361	1/11/92	13:00	1	GLASS	HWVP 2 GLASS (Canister #82)
GLAS - 0362	1/11/92	13:00	1	NOBLE	HWVP 2 GLASS (Canister #82)
GLAS - 0363	1/11/92	13:00	1	CORNING	HWVP 2 GLASS (Canister #82)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
OGCT - 0364	1/11/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0365	1/11/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0366	1/20/92	18:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0367	1/20/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0368	1/20/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0369	1/20/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0370	1/20/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0371	1/21/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0372	1/21/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0373	1/21/92	06:15	1	GLASS	HWVP 2 GLASS (Canister #83)
GLAS - 0374	1/21/92	06:15	1	NOBLE	HWVP 2 GLASS (Canister #83)
GLAS - 0375	1/21/92	06:15	1	CORNING	HWVP 2 GLASS (Canister #83)
GLAS - 0376	1/21/92	06:45	1	GLASS	HWVP 2 GLASS (Canister #80)
GLAS - 0377	1/21/92	06:45	1	NOBLE	HWVP 2 GLASS (Canister #80)
GLAS - 0378	1/21/92	06:45	1	CORNING	HWVP 2 GLASS (Canister #80)
OGCT - 0379	1/21/92	09:00	1	COND	OGCT contents - side tap (HWVP2)
OGCB - 0380	1/21/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0381	1/21/92	09:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0382	1/21/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0383	1/21/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0384	1/21/92	16:00	1	GLASS	HWVP 2 GLASS (Canister #90)
GLAS - 0385	1/21/92	16:00	1	NOBLE	HWVP 2 GLASS (Canister #90)
GLAS - 0386	1/21/92	16:00	1	CORNING	HWVP 2 GLASS (Canister #90)
GLAS - 0387	1/21/92	19:00	1	GLASS	HWVP 2 GLASS (Canister #86)
GLAS - 0388	1/21/92	19:00	1	NOBLE	HWVP 2 GLASS (Canister #86)
GLAS - 0389	1/21/92	19:00	1	CORNING	HWVP 2 GLASS (Canister #86)
OGCT - 0390	1/21/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0391	1/21/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0392	1/2/04	09:00	1	GLASS	HWVP 2 GLASS (Canister #76)
GLAS - 0393	1/2/04	09:00	1	NOBLE	HWVP 2 GLASS (Canister #76)
GLAS - 0394	1/2/04	09:00	1	CORNING	HWVP 2 GLASS (Canister #76)
OGCT - 0395	1/2/04	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0396	1/25/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
OGDP - 0397	1/2/04	11:15	1	OGDEP	Offgas header deposit
MFTR - 0398	1/2/04	10:45	2	MFTR	HWVP2 MFT Contents
OGCT - 0399	1/29/92	10:45	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0400	1/29/92	10:45	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0401	1/29/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0402	1/29/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0403	1/29/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0404	1/29/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0405	1/30/92	00:30	1	GLASS	HWVP 2 GLASS (Canister #89)
GLAS - 0406	1/30/92	00:30	1	NOBLE	HWVP 2 GLASS (Canister #89)
GLAS - 0407	1/30/92	00:30	1	CORNING	HWVP 2 GLASS (Canister #89)
OGCT - 0408	1/30/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0409	1/30/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0410	1/30/92	16:40	1	GLASS	HWVP 2 GLASS (Canister #88)
GLAS - 0411	1/30/92	16:40	1	NOBLE	HWVP 2 GLASS (Canister #88)
GLAS - 0412	1/30/92	16:40	1	CORNING	HWVP 2 GLASS (Canister #88)
OGCT - 0413	1/30/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0414	1/30/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0415	1/30/92	21:00	1	SLURRY	HWVP2 MFT Contents
OGCT - 0416	1/2/04	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0417	1/31/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0418	1/31/92	09:00	1	SLURRY	HWVP2 MFT Contents
OGCT - 0419	1/31/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0420	1/31/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0421	1/31/92	14:30	1	GLASS	HWVP 2 GLASS (Canister #??)
GLAS - 0422	1/31/92	14:30	1	NOBLE	HWVP 2 GLASS (Canister #??)
GLAS - 0423	1/31/92	14:30	1	CORNING	HWVP 2 GLASS (Canister #??)
OGCT - 0424	1/31/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0425	1/31/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0426	1/31/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0427	1/31/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0428	1/31/92	20:30	1	GLASS	HWVP 2 GLASS (Canister #84)
GLAS - 0429	1/31/92	20:30	1	NOBLE	HWVP 2 GLASS (Canister #84)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
GLAS - 0430	1/31/92	20:30	1	CORNING	HWVP 2 GLASS (Canister #84)
GLAS - 0431	1/31/92	20:40	1	GLASS	HWVP 2 GLASS (Canister #204)
GLAS - 0432	1/31/92	20:40	1	NOBLE	HWVP 2 GLASS (Canister #204)
GLAS - 0433	1/31/92	20:40	1	CORNING	HWVP 2 GLASS (Canister #204)
OGCT - 0434	2/1/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0435	2/1/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0436	2/1/92	06:25	1	GLASS	HWVP 2 GLASS (Canister #188)
GLAS - 0437	2/1/92	06:25	1	NOBLE	HWVP 2 GLASS (Canister #188)
GLAS - 0438	2/1/92	06:25	1	CORNING	HWVP 2 GLASS (Canister #188)
MFTR - 0439	2/1/92	09:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0440	2/1/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0441	2/1/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0442	2/1/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0443	2/1/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0444	2/1/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0445	2/1/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0446	2/1/92	22:00	1	GLASS	HWVP 2 GLASS (Canister #190)
GLAS - 0447	2/1/92	22:00	1	NOBLE	HWVP 2 GLASS (Canister #190)
GLAS - 0448	2/1/92	22:00	1	CORNING	HWVP 2 GLASS (Canister #190)
GLAS - 0449	2/1/92	22:30	1	GLASS	HWVP 2 GLASS (Canister #184)
GLAS - 0450	2/1/92	22:30	1	NOBLE	HWVP 2 GLASS (Canister #184)
GLAS - 0451	2/2/92	22:30	1	CORNING	HWVP 2 GLASS (Canister #184)
OGCT - 0452	2/2/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0453	2/2/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0454	2/2/92	09:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0455	2/2/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0456	2/2/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0457	2/2/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0458	2/2/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0459	2/2/92	16:20	1	GLASS	HWVP 2 GLASS (Canister #220)
GLAS - 0460	2/2/92	16:20	1	NOBLE	HWVP 2 GLASS (Canister #220)
GLAS - 0461	2/2/92	16:20	1	CORNING	HWVP 2 GLASS (Canister #220)
OGCT - 0462	2/2/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
OGCB - 0463	2/2/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0464	2/3/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0465	2/3/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0466	2/3/92	06:10	1	GLASS	HWVP 2 GLASS (Canister #23)
GLAS - 0467	2/3/92	06:10	1	NOBLE	HWVP 2 GLASS (Canister #23)
GLAS - 0468	2/3/92	06:10	1	CORNING	HWVP 2 GLASS (Canister #23)
MFTR - 0469	2/3/92	09:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0470	2/3/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0471	2/3/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0472	2/3/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0473	2/3/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0474	2/3/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0475	2/3/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
OGCT - 0476	2/4/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0477	2/4/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0478	2/4/92	03:00	1	GLASS	HWVP 2 GLASS (Canister #230)
GLAS - 0479	2/4/92	03:00	1	NOBLE	HWVP 2 GLASS (Canister #230)
GLAS - 0480	2/4/92	03:00	1	CORNING	HWVP 2 GLASS (Canister #230)
OGCT - 0481	2/4/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0482	2/4/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
MFTR - 0483	2/4/92	09:00	2	SLURRY	HWVP2 MFT Contents
OGCT - 0484	2/4/92	15:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0485	2/4/92	15:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0486	2/4/92	15:00	1	GLASS	HWVP 2 GLASS (Canister #191)
GLAS - 0487	2/4/92	15:00	1	NOBLE	HWVP 2 GLASS (Canister #191)
GLAS - 0488	2/4/92	15:00	1	CORNING	HWVP 2 GLASS (Canister #191)
OGCT - 0489	2/4/92	21:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0490	2/4/92	21:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0491	2/4/92	22:00	1	GLASS	HWVP 2 GLASS (Canister #197)
GLAS - 0492	2/4/92	22:00	1	NOBLE	HWVP 2 GLASS (Canister #197)
GLAS - 0493	2/4/92	22:00	1	CORNING	HWVP 2 GLASS (Canister #197)
OGCT - 0494	2/5/92	03:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0495	2/5/92	03:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)

SAMPLE ID	Date	Time	RPT #	TNX	Comment
OGCT - 0496	2/5/92	09:00	1	CONDEN	OGCT contents - side tap (HWVP2)
OGCB - 0497	2/5/92	09:00	1	CONDEN	OGCT contents - bottom tap (HWVP2)
GLAS - 0498	2/11/92	14:00	1	GLASS	Standard glass (PNL HW39-4)
GLAS - 0499	2/12/92	10:00	1	REDOX	HWVP1 (H-GLAS-0246) Fe(II)/Fe(total) measurement
GLAS - 0500	2/12/92	10:00	1	REDOX	HWVP2 (H-GLAS-0387) Fe(II)/Fe(total) measurement
GLAS - 0501	2/12/92	14:00	1	GLASS	SRL noble metal blank glass
GLAS - 0502	2/12/92	14:00	1	GLASS	PNL noble metal blank glass (from K Wiemers)
MFTR - 0503	2/12/92	14:00	1	SLGLASS & AR	PNL noble metal reference slurry (from K Wiemers)
GLAS - 0504	3/30/92	14:00	-	-	HWVP (NCAW) noble metal blank glass for round robin
GLAS - 0505	4/1/92	13:00	-	-	Standard glass for interlab round robin (PNL HW39-4)
SPEC - 0506	4/22/92	08:00	1	CONDEN	Condensate / cadmium - noble metal blank
- 0507	6/17/92	08:00	1	GLASS	PNL Glass Standard
- 0508	6/19/92	09:30	-	-	PNL Glass Standard sent to Monarch

Appendix B:
Analytical Flowsheets

CONDEN

Melter off-gas condensate
Hazards: pH 1-4

Filtrate

As received

IC

COOH
NO2
NO3
PO4
SO4
Cl
F
NH4

pH
total acid (titration)

ICP

Ag, Al, B, Ba, Ca,
Cd, Ce, Cr, Cu,
Fe, La, Li, Mg,
Mn, Mo, Na, Nb,
Nd, Ni, Pb, Pd,
Pr, Rb, Rh, Ru,
Se, Si, Sm, Sn,
Sr, Ta, Ti, Y, Zn,
Zr

FORMIC
FORM

Formic acid (raw material)
Hazards: pH<3, formic acid

As received

formic acid (titration to endpoint)

SLURRY

Slurry
Hazards: pH 5-8

Na₂O₂/H₂O uptake
(dried sludge)

IC
Cl
F

Rheogram

As received

IC
COOH
NO₂
NO₃
PO₄
SO₄
oxalate

total solids
calcine
density
pH
TOC, TIC, TC

SRACOND

SRAT off-gas condensate
Hazards: pH 1-8

Filtrate

As received

IC

COOH
NO₂
NO₃
PO₄
SO₄
Cl
F
NH₄

pH
total acid (titration)

ICP

Ag, Al, B, Ba, Ca,
Cr, Cu, Fe, Li,
Mg, Mn, Na, Nd,
Ni, Pb, Pd, Rh,
Ru, Si, Sr, Ti, Zn,
Cd, Ce, Ge, La,
Mo, Nb, Pr, Rb,
Se, Sm, Sn, Ta,
Te, Y

Appendix C:

Selected
Analytical Results

Analytical Results:

HWVP1 sludge through
formic acid digestion

SAMPLE ID		SRTF 0006	SRTF 0006	SRTF 0006	SRTF 0006	SRAT 0007	SRAT 0007	SRTC 0008	SRTC 0008	SRTC 0009	SRTC 0009
ANALYTICAL CODE(S)		BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE
DATE		11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91
ANALYSIS # OF total COMPONENT	Units	1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2
IC (Filtrate)											
FORMATE (COOH(1-))	MG/L	<1	<1	<1	<1	322	315	125	126	120	125
NITRATE (NO3(1-))	MG/L	2088	2261	2207	2281	2401	2409	7909	8248	8171	8263
NITRITE (NO2(1-))	MG/L	56	58	59	58	103	98	3976	4188	4141	4233
OXALATE (C2O4(2-))	MG/L	<1	<1	<1	<1	<1	<1	1067	1095	1077	1091
PHOSPHATE (PO4(3-))	MG/L	<1	<1	<1	<1	<1	<1	<9	<1	<1	<1
SULFATE (SO4(2-))	MG/L	360	371	374	373	357	349	1256	1336	1317	1325
AMMONIUM (NH4(1+))	MG/L	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
IC (Na2O2/H2O)											
CHLORIDE (CL(1-))	MG/L										
FLUORIDE (F(1-))	MG/L										
Wet Chemistry											
PH	PH	10.42	10.42	10.42	10.42	10.18	10.18	11.03	11.03	11.01	11.01
TOTAL WT % SOLIDS	WT %	8.23	8.12	8.34	8.24	8.24	7.98	11.59	11.51	11.47	11.61
EQUIV PT	MOLE/LITER	0.003 TO PH 7	0.003 TO PH 7	0.003 TO PH 7	0.003 TO PH 7	0.004 TO PH 7	0.004 TO PH 7	0.132 TO PH 7	0.131 TO PH 7	0.138 TO PH 7	0.138 TO PH 7
RHEOGRAM DONE (Y/N)	DD-MON-YY	Y 7-NOV-91	Y 8-NOV-91	Y 8-NOV-91	Y 8-NOV-91	Y 7-NOV-91	Y 7-NOV-91	Y 7-NOV-91	Y 7-NOV-91	Y 7-NOV-91	Y 7-NOV-91
CALCINED % SOLIDS	WT %	6.47	6.49	6.48	6.40	6.37	6.34	9.02	8.89	8.95	8.95
DENSITY	G/ML	1.07	1.07	1.07	1.07	1.06	1.06	1.09	1.09	1.09	1.09
Carbon Analysis											
TOTAL CARBON	PPM	424	405	401	389	672	671	1959	1908	1892	1883
TOTAL INORGANIC CARBON	PPM	323	314	318	299	369	404	1472	1466	1533	1494
TOTAL ORGANIC CARBON	PPM	101	91	83	90	303	267	487	442	359	389
AA (Na2O2/HCl)											
SILICON (SI)	WT %	3.200	3.400	3.300	3.200	2.200	2.400	3.200	3.200	3.200	3.400
AA (Aqua Regia)	Aqua Regia										
SODIUM (NA)	WT %	1.207	1.267	1.278	1.272	1.700	1.433	5.754	5.889	6.316	5.630
POTASSIUM (K)	WT %	0.080	0.070	0.100	0.060	0.250	0.230	0.300	0.290	0.300	0.260
AE (Aqua Regia)											
CESIUM (CS)	WT %	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.000	1.000	1.000	1.000
ICP (Na2O2/HCl)											
ALUMINUM (AL)	WT %	6.887	6.795	6.681	6.639	6.469	6.591	4.040	4.080	3.810	4.080
BARIUM (BA)	WT %	0.007	0.006	0.005	0.005	0.026	0.021	0.170	0.172	0.162	0.174
BORON (B)	WT %	<0.01	<0.01	<0.01	<0.01	0.171	0.158	0.070	0.066	0.090	0.082
CADMIUM (CD)	WT %	0.010	0.006	0.001	0.007	0.004	0.003	0.002	0.002	0.002	0.002
CALCIUM (CA)	WT %	0.514	0.514	0.496	0.488	0.601	0.590	0.952	0.954	0.922	0.980
CERIUM (CE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.346	0.352	0.358	0.364
CHROMIUM (CR)	WT %	<0.01	<0.01	<0.01	<0.01	0.029	0.021	0.178	0.182	0.180	0.182
COPPER (CU)	WT %	<0.01	<0.01	0.120	<0.01	0.141	0.039	0.204	0.206	0.196	0.210
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	0.061	0.044	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	30.380	30.360	29.860	29.830	27.470	28.060	17.180	17.360	17.260	17.320
LANTHANUM (LA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.590	0.548	0.718	0.714
LEAD (PB)	WT %	<0.01	<0.01	<0.01	<0.01	0.061	0.029	0.628	0.638	0.594	0.648
LITHIUM (LI)	WT %	<0.01	<0.01	<0.01	<0.01	0.110	0.098	0.054	0.054	0.072	0.078
MAGNESIUM (MG)	WT %	0.078	0.059	0.037	0.038	0.274	0.209	0.274	0.276	0.282	0.296
MANGANESE (MN)	WT %	2.451	2.432	2.420	2.408	2.309	2.374	1.434	1.450	1.456	1.460
MOLYBDENUM (MO)	WT %	<0.01	<0.01	<0.01	<0.01	0.037	0.010	0.250	0.232	0.324	0.218
NEODYMIUM (ND)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5.340	5.520	4.970	5.700
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	0.017	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PHOSPHOROUS (P)	WT %	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.116	0.122	0.160	0.160

SAMPLE ID		SRTF 0006	SRTF 0006	SRTF 0006	SRTF 0006	SRAT 0007	SRAT 0007	SRTC 0008	SRTC 0008	SRTC 0009	SRTC 0009
ANALYTICAL CODE(S)		BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE
DATE		11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91	11/7/91
ANALYSIS # OF total COMPONENT	Units	1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2
ICP (Na2O2/HCl) cont'd											
RHODIUM (RH)	WT %	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	<0.01	0.062	0.024
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	0.069	0.037	0.018	<0.01	0.006	0.010
SILICON (SI)	WT %	0.465	0.465	0.407	0.440	2.080	2.070	3.280	3.260	3.260	3.610
SILVER (AG)	WT %	0.048	0.044	0.042	0.039	0.066	0.055	NR	NR	NR	NR
STRONTIUM (SR)	WT %	0.012	0.011	0.011	0.011	0.016	0.015	0.110	0.114	0.120	0.116
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	0.049	0.011	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.190	0.170	0.168	0.172	0.246	0.224	3.040	3.080	3.050	3.080
TIN (SN)	WT %	0.014	0.006	0.007	0.004	0.031	0.023	0.026	0.026	0.030	0.050
TITANIUM (TI)	WT %	0.037	0.039	0.036	0.035	0.065	0.061	0.160	0.160	0.080	0.160
YTTRIUM (Y)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.062	0.062	0.060	0.064
ZINC (ZN)	WT %	0.081	0.056	0.100	0.061	0.073	0.070	0.224	0.226	0.212	0.228
ZIRCONIUM (ZR)	WT %	16.480	16.300	16.080	16.100	14.530	14.960	8.490	8.280	8.180	8.220
ICP (Aqua Regia)											
ALUMINUM (AL)	WT %	6.715	6.895	6.774	7.004	6.531	6.366	3.956	3.869	3.674	4.023
BARIUM (BA)	WT %	0.020	0.020	0.020	0.018	0.030	0.030	0.158	0.154	0.147	0.163
BORON (B)	WT %	0.037	0.033	0.031	0.029	0.086	0.088	0.024	0.024	0.026	0.029
CADMIUM (CD)	WT %	0.005	0.005	0.005	0.005	0.005	0.005	0.003	0.003	0.003	0.004
CALCIUM (CA)	WT %	0.413	0.442	0.415	0.424	0.469	0.459	0.784	0.762	0.736	0.844
CERIUM (CE)	WT %	0.097	0.084	0.076	<0.01	0.093	0.100	0.513	0.517	0.537	0.640
CHROMIUM (CR)	WT %	0.022	0.022	0.021	0.018	0.020	0.019	0.173	0.167	0.166	0.177
COPPER (CU)	WT %	0.026	0.026	0.022	0.019	0.043	0.042	0.209	0.203	0.197	0.219
GERMANIUM (GE)	WT %	0.129	0.121	0.117	0.101	0.112	0.106	0.033	0.028	0.030	0.045
IRON (FE)	WT %	28.670	29.360	29.180	30.190	27.210	27.330	16.480	15.720	14.930	16.300
LANTHANUM (LA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.960	0.943	0.876	0.993
LEAD (PB)	WT %	0.065	0.074	0.066	0.055	0.078	0.077	0.609	0.607	0.588	0.641
LITHIUM (LI)	WT %	<0.01	<0.01	<0.01	<0.01	0.009	0.008	<0.01	<0.01	<0.01	<0.01
MAGNESIUM (MG)	WT %	0.299	0.322	0.316	0.288	0.296	0.298	0.320	0.304	0.310	0.357
MANGANESE (MN)	WT %	2.308	2.360	2.343	2.423	2.285	2.271	1.370	1.331	1.275	1.390
MOLYBDENUM (MO)	WT %	0.055	0.056	0.052	0.044	0.052	0.053	0.325	0.331	0.354	0.316
NEODYMIUM (ND)	WT %	0.140	0.139	0.118	<0.01	0.255	0.255	5.387	5.246	5.198	5.679
NICKEL (NI)	WT %	2.615	2.683	2.565	2.740	2.517	2.472	1.491	1.445	1.387	1.506
NIOBIUM (NB)	WT %	0.037	0.036	0.034	0.021	0.036	0.037	0.008	0.008	0.012	0.020
PALLADIUM (PD)	WT %	0.105	0.089	0.063	0.013	0.076	0.073	0.022	0.027	0.039	0.076
PHOSPHOROUS (P)	WT %	0.084	0.090	0.086	0.076	0.083	0.088	0.050	0.057	0.056	0.059
PRASEODYMIUM (PR)	WT %	0.105	0.092	0.078	<0.01	0.098	0.105	0.334	0.323	0.332	0.432
RHODIUM (RH)	WT %	0.072	0.068	0.054	0.003	0.066	0.073	0.015	0.022	0.036	0.066
RUBIDIUM (RB)	WT %	0.113	0.148	0.071	<0.01	0.193	0.195	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.250	0.254	0.249	0.247	0.244	0.245	0.119	0.110	0.113	0.134
SAMARIUM (SA)	WT %	0.096	0.100	0.064	<0.01	0.100	0.087	0.211	0.229	0.245	0.316
SELENIUM (SE)	WT %	0.087	0.088	0.090	0.078	0.078	0.083	0.011	0.017	0.029	0.031
SILVER (AG)	WT %	0.085	0.087	0.085	0.082	0.079	0.079	0.044	0.042	0.042	0.049
SODIUM (NA)	WT %	1.641	1.801	1.821	1.838	2.262	1.968	7.371	7.559	7.796	7.052
STRONTIUM (SR)	WT %	0.010	0.010	0.010	0.010	0.013	0.012	0.103	0.100	0.094	0.104
TANTALUM (TA)	WT %	0.063	0.071	0.058	0.049	0.058	0.061	0.015	0.018	0.020	0.033
TELLURIUM (TE)	WT %	0.255	0.265	0.265	0.265	0.255	0.249	0.211	0.206	0.210	0.237
TIN (SN)	WT %	0.036	0.039	0.036	0.035	0.034	0.032	0.017	0.017	0.024	0.025
TITANIUM (TI)	WT %	0.059	0.061	0.059	0.058	0.069	0.067	0.130	0.120	0.110	0.130

[illegible]

SAMPLE ID		SRNM 0014	SRNM 0014	SRNM 0015	SRNM 0015	SRDF 0016	SRDF 0018	SRDF 0020	SRDF 0022	SRDF 0024	SRDF 0026	SRDF 0028
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/11/91	11/11/91	11/11/91	11/11/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total COMPONENT	Units	1 of 2	2 of 2	1 of 2	2 of 2	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)												
FORMATE (COOH(1-))	MG/L	99	93	96	99	6165	6759	8972	9042	10482	12286	12313
NITRATE (NO3(1-))	MG/L	7667	7691	7414	7704	9220	9309	9657	9238	9541	9438	9407
NITRITE (NO2(1-))	MG/L	3751	3811	3603	3769	3782	3789	3691	3413	3295	2658	2501
OXALATE (C2O4(2-))	MG/L	1087	1003	1102	1135	ND	ND	ND	ND	ND	ND	ND
PHOSPHATE (PO4(3-))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<25
SULFATE (SO4(2-))	MG/L	1201	1178	1190	1213	1124	1140	954	907	760	616	570
AMMONIUM (NH4(1+))	MG/L	NR	NR	NR	NR	<1	<1	<1	<1	<1	<1	<1
IC (Na2O2/H2O)												
CHLORIDE (CL(1-))	MG/L											
FLUORIDE (F(1-))	MG/L											
Wet Chemistry												
PH	PH	11.77	11.77	11.68	11.68	8.37	8.13	7.54	7.40	7.16	6.96	6.91
TOTAL WT % SOLIDS	WT %	14.03	13.92	14.05	16.03	11.60	12.14	12.28	12.27	12.24	12.13	12.66
EQUIV PT	MOLE/LITER	088 TO PH7	088 TO PH7	083 TO PH7	083 TO PH7	002 TO PH7	002 TO PH7	0009 TO PH7	0010 TO PH7	0014 TO PH7	0013 TO PH7	0015 TO PH7
RHEOGRAM DONE (Y/N)	DD-MON-YY	11-12-91	11-12-91	12-12-91	12-12-91	09-12-91	11-12-91	05-12-91	10-12-91	09-12-91	09-12-91	09-12-91
CALCINED % SOLIDS	WT %	11.16	11.20	11.31	11.18	8.71	9.39	9.32	9.37	9.27	9.23	9.89
DENSITY	G/ML	1.12	1.11	1.10	1.10	1.08	1.08	1.10	1.10	1.10	1.10	1.11
Carbon Analysis												
TOTAL CARBON	PPM	2256	2011	2111	2116	3637	3834	4225	4297	4592	5022	5174
TOTAL INORGANIC CARBON	PPM	1686	1591	1670	1727	1300	1296	1202	1146	1111	1080	1011
TOTAL ORGANIC CARBON	PPM	570	420	441	389	2337	2538	3023	3151	3482	3942	4163
AA (Na2O2/HCl)												
SILICON (SI)	WT %	3.400	3.400	3.600	3.600	2.900	2.600	2.900	2.800	2.600	2.500	3.000
AA (Aqua Regia)	Aqua Regia											
SODIUM (NA)	WT %	5.417	5.440	5.715	5.700	6.367	5.926	5.998	5.966	6.072	5.867	5.907
POTASSIUM (K)	WT %	0.180	0.190	0.210	0.190	0.200	0.190	0.190	0.190	0.230	0.230	0.200
AE (Aqua Regia)	Aqua Regia											
CESIUM (CS)	WT %	1.330	1.115	1.380	1.362	1.092	1.203	1.343	1.426	1.434	1.629	1.150
ICP (Na2O2/HCl)												
ALUMINUM (AL)	WT %	4.252	4.521	4.701	4.762	3.869	3.562	3.830	3.736	3.759	3.713	4.072
BARIUM (BA)	WT %	0.182	0.193	0.201	0.200	0.161	0.148	0.158	0.154	0.157	0.156	0.167
BORON (B)	WT %	0.067	0.062	0.065	0.070	0.036	0.065	0.039	0.035	0.026	0.024	0.081
CADMIUM (CD)	WT %	0.004	0.003	0.003	0.004	2.435	2.195	2.459	2.440	2.438	2.370	2.412
CALCIUM (CA)	WT %	1.603	1.691	1.748	1.742	1.422	0.804	1.400	1.423	1.383	1.384	1.452
CERIUM (CE)	WT %	0.388	0.404	0.389	0.417	0.253	0.550	0.185	0.188	0.215	0.254	0.742
CHROMIUM (CR)	WT %	0.180	0.196	0.202	0.203	0.150	0.172	0.156	0.152	0.155	0.150	0.180
COPPER (CU)	WT %	0.235	0.240	0.252	0.252	0.203	0.197	0.194	0.187	0.190	0.199	0.228
GERMANIUM (GE)	WT %	0.010	<0.01	<0.01	<0.01	<0.01	0.101	<0.01	<0.01	<0.01	<0.01	0.151
IRON (FE)	WT %	18.750	20.100	20.840	20.840	16.820	14.700	16.710	16.401	16.630	16.230	16.710
LANTHANUM (LA)	WT %	0.853	0.853	0.854	0.792	0.802	0.810	0.619	0.625	0.642	0.757	0.927
LEAD (PB)	WT %	0.701	0.731	0.767	0.767	0.557	0.613	0.631	0.571	0.595	0.571	0.709
LITHIUM (LI)	WT %	0.058	0.054	0.063	0.064	0.036	0.036	0.040	0.031	0.026	0.030	0.073
MAGNESIUM (MG)	WT %	0.331	0.342	0.364	0.374	0.216	0.335	0.194	0.215	0.218	0.200	0.429
MANGANESE (MN)	WT %	1.622	1.679	1.759	1.774	1.409	1.276	1.438	1.365	1.381	1.382	1.364
MOLYBDENUM (MO)	WT %	0.278	0.304	0.295	0.299	0.329	0.357	0.330	0.323	0.338	0.325	0.408
NEODYMIUM (ND)	WT %	5.906	6.288	6.530	6.553	5.381	5.420	5.238	5.096	5.305	5.237	5.786
NIOBIUM (NB)	WT %	0.007	<0.01	0.009	0.007	<0.01	0.030	<0.01	<0.01	<0.01	<0.01	0.059
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	0.190	<0.01	<0.01	<0.01	<0.01	0.257
PHOSPHOROUS (P)	WT %	0.058	0.048	0.054	0.056	0.027	0.085	0.032	0.022	0.030	0.032	0.087
PRASEODYMIUM (PR)	WT %	0.164	0.155	0.149	0.150	0.051	0.404	<0.01	<0.01	0.045	0.106	0.579

SAMPLE ID		SRNM 0014	SRNM 0014	SRNM 0015	SRNM 0015	SRDF 0016	SRDF 0018	SRDF 0020	SRDF 0022	SRDF 0024	SRDF 0026	SRDF 0028
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/11/91	11/11/91	11/11/91	11/11/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total COMPONENT	Units	1 of 2	2 of 2	1 of 2	2 of 2	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
ICP (Na2O2/HCl) cont'd												
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	0.134	<0.01	<0.01	<0.01	0.167	0.187
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.338
RUTHENIUM (RU)	WT %	0.088	0.096	0.101	0.099	0.226	0.378	0.120	0.211	0.251	0.183	0.346
SAMARIUM (SA)	WT %	0.051	0.072	0.047	0.058	<0.01	0.306	<0.01	<0.01	<0.01	0.033	0.502
SELENIUM (SE)	WT %	0.019	0.020	0.019	0.021	<0.01	0.094	<0.01	<0.01	0.001	<0.01	0.118
SILICON (SI)	WT %	3.085	3.097	3.445	3.500	3.872	1.955	3.291	3.031	2.672	2.606	2.975
SILVER (AG)	WT %	0.035	0.037	0.038	0.039	0.112	0.124	0.107	0.106	0.107	0.111	0.142
STRONTIUM (SR)	WT %	0.127	0.141	0.141	0.136	0.105	0.093	0.105	0.101	0.099	0.102	0.099
TANTALUM (TA)	WT %	0.021	0.013	0.021	0.027	<0.01	0.051	0.007	<0.01	<0.01	<0.01	0.066
TELLURIUM (TE)	WT %	0.194	0.216	0.224	0.205	0.135	0.227	0.175	0.181	0.176	0.144	0.262
TIN (SN)	WT %	0.027	0.028	0.027	0.029	0.001	0.030	0.015	0.013	0.017	0.014	0.043
TITANIUM (TI)	WT %	0.201	0.218	0.220	0.232	0.173	0.180	0.174	0.163	0.168	0.180	0.184
YTTRIUM (Y)	WT %	0.066	0.069	0.072	0.072	0.054	0.059	0.051	0.052	0.052	0.063	0.064
ZINC (ZN)	WT %	0.453	0.356	0.416	0.423	0.285	0.292	0.349	0.273	0.279	0.308	0.276
ZIRCONIUM (ZR)	WT %	9.916	10.600	11.020	10.980	8.846	7.839	8.779	8.613	8.620	8.787	8.693
ICP (Aqua Regia)												
ALUMINUM (AL)	WT %	4.348	4.410	4.301	4.031	3.892	4.011	3.656	3.780	3.623	3.654	3.888
BARIUM (BA)	WT %	0.181	0.181	0.179	0.163	0.162	0.162	0.151	0.156	0.150	0.152	0.163
BORON (B)	WT %	<0.01	<0.01	<0.01	<0.01	<0.010	0.006	0.006	0.007	0.005	0.001	<0.010
CADMIUM (CD)	WT %	0.003	0.002	0.002	0.001	2.724	2.694	2.503	2.655	2.493	2.569	2.579
CALCIUM (CA)	WT %	0.827	0.832	0.821	0.776	0.739	0.743	0.696	0.710	0.691	0.714	0.684
CERIUM (CE)	WT %	0.460	0.497	0.523	0.494	0.464	0.402	0.395	0.408	0.349	0.389	0.463
CHROMIUM (CR)	WT %	0.181	0.189	0.186	0.170	0.166	0.170	0.158	0.162	0.157	0.158	0.165
COPPER (CU)	WT %	0.243	0.243	0.240	0.221	0.218	0.223	0.204	0.209	0.202	0.205	0.225
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
IRON (FE)	WT %	18.260	18.660	17.950	17.170	16.458	16.770	15.410	15.890	15.360	15.710	16.392
LANTHANUM (LA)	WT %	0.935	0.920	0.935	0.820	0.768	0.812	0.801	0.724	0.743	0.723	0.817
LEAD (PB)	WT %	0.720	0.741	0.730	0.671	0.662	0.677	0.607	0.638	0.606	0.626	0.658
LITHIUM (LI)	WT %	<0.01	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
MAGNESIUM (MG)	WT %	0.316	0.323	0.343	0.276	0.295	0.272	0.271	0.268	0.268	0.284	0.236
MANGANESE (MN)	WT %	1.622	1.641	1.593	1.515	1.466	1.480	1.378	1.431	1.379	1.390	1.440
MOLYBDENUM (MO)	WT %	0.253	0.267	0.287	0.274	0.343	0.335	0.332	0.340	0.332	0.337	0.352
NEODYMIUM (ND)	WT %	6.813	6.890	6.709	6.159	5.873	5.958	5.501	5.753	5.488	5.578	5.822
NICKEL (NI)	WT %	1.679	1.686	1.651	1.572	1.497	1.553	1.425	1.478	1.422	1.430	1.490
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	0.041	0.038	0.037	0.019	0.013	0.025	0.050
PHOSPHOROUS (P)	WT %	0.198	0.227	0.173	0.214	0.151	0.158	0.228	0.120	0.156	0.172	0.154
PRASEODYMIUM (PR)	WT %	0.189	0.217	0.269	0.230	0.250	0.198	0.188	0.203	0.158	0.179	0.250
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	0.044	0.026	0.016	0.020	0.002	0.012	0.032
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
RUTHENIUM (RU)	WT %	0.098	0.098	0.107	0.089	0.328	0.371	0.338	0.351	0.332	0.341	0.327
SAMARIUM (SA)	WT %	0.081	0.092	0.162	0.121	0.134	0.096	0.079	0.091	0.072	0.090	0.119
SELENIUM (SE)	WT %	<0.01	<0.01	0.016	<0.01	0.022	0.004	0.022	0.013	0.013	0.017	<0.010
SILVER (AG)	WT %	0.037	0.040	0.041	0.033	0.130	0.133	0.124	0.126	0.121	0.125	0.130
SODIUM (NA)	WT %	6.214	6.581	6.794	6.411	7.213	6.827	8.040	7.998	8.745	9.596	8.800
STRONTIUM (SR)	WT %	0.116	0.119	0.143	0.108	0.103	0.101	0.093	0.097	0.093	0.098	0.100
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.010	0.005	<0.01	<0.01	<0.01	<0.01	<0.010
TELLURIUM (TE)	WT %	0.215	0.211	0.221	0.200	0.231	0.212	0.198	0.199	0.198	0.198	0.226
TIN (SN)	WT %	0.017	0.016	0.019	0.010	0.019	0.013	0.017	0.013	0.014	0.013	0.014
TITANIUM (TI)	WT %	0.039	0.100	0.040	0.037	0.038	0.036	0.033	0.038	0.033	0.033	0.045

SAMPLE ID		SRNM 0014	SRNM 0014	SRNM 0015	SRNM 0015	SRDF 0016	SRDF 0018	SRDF 0020	SRDF 0022	SRDF 0024	SRDF 0026	SRDF 0028
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/11/91	11/11/91	11/11/91	11/11/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total		1 of 2	2 of 2	1 of 2	2 of 2	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units											
ICP (Aqua Regia) cont'd												
YTTRIUM (Y)	WT %	0.064	0.066	0.065	0.059	0.058	0.060	0.054	0.056	0.053	0.055	0.059
ZINC (ZN)	WT %	0.264	0.268	0.262	0.245	0.239	0.241	0.222	0.234	0.223	0.226	0.239
ZIRCONIUM (ZR)	WT %	10.170	10.280	9.743	9.565	9.242	9.284	8.413	8.837	8.538	8.485	9.142
ICP (Filtrate)												
ALUMINUM (AL)	PPM	156.600	154.800	133.900	132.900	4.628	1.724	<0.01	<0.01	<0.01	<0.01	<0.01
BARIUM (BA)	PPM	0.054	0.065	0.067	0.066	0.513	0.372	0.583	0.729	0.843	0.907	0.843
BORON (B)	PPM	11.180	10.760	11.270	11.190	5.537	4.700	6.058	7.205	6.388	6.984	6.910
CADMIUM (CD)	PPM	0.039	0.029	0.029	0.030	13.460	22.540	258.100	397.300	646.400	988.000	1018.000
CALCIUM (CA)	PPM	5.557	6.114	6.244	6.305	27.990	26.380	179.900	217.300	264.200	316.700	324.200
CERIUM (CE)	PPM	0.249	0.429	0.363	0.504	0.312	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	4.784	4.678	4.741	4.678	21.130	15.730	<0.01	<0.01	<0.01	0.155	<0.01
COPPER (CU)	PPM	0.306	0.270	0.298	0.295	0.199	<0.01	<0.01	<0.01	<0.01	0.165	<0.01
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.243	<0.01
IRON (FE)	PPM	0.212	0.164	0.169	0.189	0.104	<0.01	<0.01	<0.01	<0.01	0.143	<0.01
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.220	<0.01
LEAD (PB)	PPM	0.350	0.430	0.353	0.266	0.173	<0.01	<0.01	<0.01	<0.01	0.295	<0.01
LITHIUM (LI)	PPM	0.312	0.292	0.400	0.395	1.732	1.529	1.873	1.937	2.004	2.306	2.010
MAGNESIUM (MG)	PPM	0.834	0.568	0.589	0.705	104.340	140.300	226.100	237.700	245.400	259.600	253.000
MANGANESE (MN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.062	35.270	61.460	128.200	277.200	318.800
MOLYBDENUM (MO)	PPM	482.900	463.200	472.110	467.700	215.620	155.100	26.260	16.140	6.811	3.250	2.061
NEODYMIUM (ND)	PPM	0.203	0.256	0.219	0.283	0.143	<0.01	<0.01	<0.01	<0.01	7.012	2.718
NICKEL (NI)	PPM	0.056	0.024	0.056	0.046	0.524	0.371	2.524	4.041	8.187	20.280	25.340
NIOBIUM (NB)	PPM	0.089	0.109	0.103	0.154	0.090	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	0.233	0.262	0.325	0.456	38.730	39.440	4.591	2.405	0.118	0.726	<0.01
PHOSPHOROUS (P)	PPM	2.399	2.108	2.095	2.132	1.210	3.587	1.699	1.623	2.672	9.282	5.875
PRASEODYMIUM (PR)	PPM	0.135	0.394	0.156	0.153	0.036	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	1.688	1.530	1.786	1.729	4.045	1.863	0.547	<0.01	<0.01	0.275	<0.01
RUBIDIUM (RB)	PPM	51.860	50.290	48.490	49.900	51.140	49.500	47.260	46.570	46.570	49.480	34.200
RUTHENIUM (RU)	PPM	0.190	0.201	0.139	0.267	1.607	1.635	4.111	5.157	6.349	9.264	9.454
SAMARIUM (SM)	PPM	0.123	0.122	0.058	0.352	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	11.510	10.970	10.860	10.550	0.881	<0.01	0.226	0.239	0.214	0.862	<0.01
SILICON (SI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	8.395	5.613	3.904	3.098	0.223	2.218
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	10144.000	10316.000	10123.000	10259.000	11780.000	11194.000	11351.000	11532.000	11413.000	11391.000	11260.000
STRONTIUM (SR)	PPM	0.026	0.027	0.027	0.030	0.377	0.534	3.206	10.640	31.110	56.830	60.310
TANTALUM (TA)	PPM	0.477	0.323	0.286	0.503	0.483	<0.01	<0.01	<0.01	<0.01	0.840	<0.01
TELLURIUM (TE)	PPM	1.428	1.508	1.270	1.329	0.157	<0.01	0.400	0.836	1.422	2.523	1.607
TIN (SN)	PPM	0.172	0.142	0.178	0.144	0.036	<0.01	<0.01	0.006	<0.01	0.024	<0.01
TITANIUM (TI)	PPM	0.016	0.024	0.031	0.039	0.034	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	0.026	0.023	0.020	0.027	0.020	<0.01	<0.01	<0.01	<0.01	0.076	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.206	0.370	0.821	2.113	2.730
ZIRCONIUM (ZR)	PPM	0.030	0.023	0.017	0.031	0.052	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SRDF 0030	SRDF 0032	SRDF 0034	SRDF 0035	SRDF 0036	SRDF 0037	SRDF 0038	SRDF 0040	SRDF 0042	SRDF 0044
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total COMPONENT	Units	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)											
FORMATE (COOH[1-])	MG/L	13903	13681	15606	14789	14996	15922	17800	18017	19253	19633
NITRATE (NO3[1-])	MG/L	9455	9202	9369	9140	8894	9152	9667	9408	9274	9312
NITRITE (NO2[1-])	MG/L	1902	1762	1146	1198	1041	623	266	51	<1	<1
OXALATE (C2O4[2-])	MG/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	541	519	495	496	441	454	454	443	310	314
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
IC (Na2O2/H2O)											
CHLORIDE (CL[1-])	MG/L										
FLUORIDE (F[1-])	MG/L										
Wet Chemistry											
PH	PH	6.84	7.02	7.08	7.11	7.02	6.91	6.74	6.36	5.94	5.80
TOTAL WT % SOLIDS	WT %	11.93	12.59	12.34	12.57	12.58	12.19	11.95	12.46	12.40	12.60
EQUIV PT	MOLE/LITER	.0016 TO PH7	.002 TO PH7	.003 TO PH7	.002 TO PH7	.003 TO PH7	.003 TO PH7	.003 TO PH7	.004 TO PH7	.008 TO PH7	.009 TO PH7
RHEOGRAM DONE (Y/N)	DD-MON-YY	09-12-91	10-12-91	10-12-91	09-12-91	10-12-91	10-12-91	09-12-91	10-12-91	10-12-91	10-12-91
CALCINED % SOLIDS	WT %	9.16	9.74	9.33	9.69	8.80	9.40	9.36	9.30	9.35	9.38
DENSITY	G/ML	1.10	1.10	1.10	1.10	1.09	1.09	1.10	1.10	1.10	1.03
Carbon Analysis											
TOTAL CARBON	PPM	5520	5792	5923	5958	6230	6294	6589	6781	7099	7610
TOTAL INORGANIC CARBON	PPM	890	1017	966	1069	974	919	1101	941	1077	1120
TOTAL ORGANIC CARBON	PPM	4630	4775	4957	4889	5256	5375	5488	5840	6022	6490
AA (Na2O2/HCl)											
SILICON (SI)	WT %	2.400	2.300	2.400	2.800	2.300	2.300	2.300	2.400	2.300	2.300
AA (Aqua Regia)	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia
SODIUM (NA)	WT %	5.941	6.991	6.383	5.533	6.420	5.448	6.706	6.555	6.141	6.391
POTASSIUM (K)	WT %	0.240	0.180	0.180	0.140	0.150	0.140	0.160	0.160	0.150	0.150
AE (Aqua Regia)	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia
CESIUM (CS)	WT %	1.502	3.000	3.300	2.900	3.000	2.700	2.600	3.300	3.000	3.000
ICP (Na2O2/HCl)											
ALUMINUM (AL)	WT %	3.861	2.986	3.131	3.396	3.194	3.280	3.361	3.176	3.127	3.330
BARIUM (BA)	WT %	0.158	0.125	0.132	0.142	0.133	0.137	0.141	0.132	0.132	0.139
BORON (B)	WT %	0.069	<0.01	0.001	0.007	<0.010	<0.01	<0.01	0.002	0.003	0.001
CADMIUM (CD)	WT %	2.437	2.101	2.141	2.164	2.104	2.142	2.185	2.001	2.018	1.856
CALCIUM (CA)	WT %	1.460	0.742	0.746	0.733	0.756	0.736	0.758	0.706	0.719	0.671
CERIUM (CE)	WT %	0.713	<0.01	<0.01	0.013	0.020	<0.01	0.016	<0.01	0.048	0.002
CHROMIUM (CR)	WT %	0.175	0.124	0.133	0.143	0.134	0.141	0.141	0.135	0.131	0.139
COPPER (CU)	WT %	0.232	0.168	0.174	0.186	0.167	0.169	0.178	0.169	0.185	0.173
GERMANIUM (GE)	WT %	0.147	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	15.850	13.110	13.930	14.940	13.868	14.360	14.790	14.070	13.660	14.600
LANTHANUM (LA)	WT %	0.984	0.191	0.288	0.303	0.345	0.286	0.436	0.300	0.404	0.363
LEAD (PB)	WT %	0.671	0.460	0.501	0.532	0.489	0.502	0.507	0.491	0.479	0.509
LITHIUM (LI)	WT %	0.058	<0.01	<0.01	0.017	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
MAGNESIUM (MG)	WT %	0.477	0.081	0.078	0.073	0.083	0.081	0.075	0.063	0.089	0.050
MANGANESE (MN)	WT %	1.341	1.202	1.233	1.230	1.247	1.187	1.191	1.138	1.135	1.036
MOLYBDENUM (MO)	WT %	0.390	0.243	0.260	0.284	0.268	0.272	0.284	0.264	0.258	0.275
NEODYMIUM (ND)	WT %	5.506	4.439	4.717	5.142	4.726	4.928	5.056	4.700	4.656	4.821
NIوبيUM (NB)	WT %	0.051	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	0.262	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	WT %	0.098	ND	ND	0.078	ND	ND	0.060	ND	ND	0.048
PRASEODYMIUM (PR)	WT %	0.603	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SRDF 0030	SRDF 0032	SRDF 0034	SRDF 0035	SRDF 0036	SRDF 0037	SRDF 0038	SRDF 0040	SRDF 0042	SRDF 0044
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total COMPONENT	Units	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
ICP (Na2O2/HCl) cont'd											
RHODIUM (RH)	WT %	0.206	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	0.622	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.292	0.214	0.232	0.255	0.226	0.241	0.255	0.233	0.240	0.253
SAMARIUM (SA)	WT %	0.495	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	0.110	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	2.342	2.287	2.379	2.700	2.242	2.257	2.326	2.285	2.169	2.270
SILVER (AG)	WT %	0.136	0.086	0.094	0.104	0.096	0.099	0.102	0.095	0.094	0.100
STRONTIUM (SR)	WT %	0.102	0.086	0.085	0.082	0.085	0.085	0.087	0.080	0.086	0.078
TANTALUM (TA)	WT %	0.100	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.245	0.102	0.111	0.141	0.117	0.123	0.123	0.124	0.110	0.116
TIN (SN)	WT %	0.051	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	WT %	0.178	0.147	0.160	0.167	0.156	0.162	0.166	0.166	0.154	0.167
YTTRIUM (Y)	WT %	0.062	0.040	0.042	0.046	0.043	0.044	0.045	0.042	0.041	0.043
ZINC (ZN)	WT %	0.292	0.239	0.288	0.267	0.324	0.291	0.267	0.319	0.258	0.291
ZIRCONIUM (ZR)	WT %	8.275	7.579	7.980	8.623	8.049	8.286	8.524	8.031	7.924	8.447
ICP (Aqua Regia)											
ALUMINUM (AL)	WT %	3.585	3.696	3.639	3.901	3.784	3.761	3.860	3.732	3.903	3.697
BARIUM (BA)	WT %	0.148	0.153	0.156	0.164	0.157	0.154	0.161	0.157	0.160	0.156
BORON (B)	WT %	0.007	<0.01	<0.010	<0.010	0.005	0.008	0.020	<0.01	0.006	<0.010
CADMIUM (CD)	WT %	2.567	2.574	2.444	2.476	2.407	2.337	2.466	2.315	2.156	2.106
CALCIUM (CA)	WT %	0.722	0.707	0.638	0.656	0.649	0.622	0.687	0.616	0.589	0.562
CERIUM (CE)	WT %	0.394	0.384	0.405	0.479	0.401	0.404	0.401	0.390	0.455	0.410
CHROMIUM (CR)	WT %	0.155	0.158	0.162	0.171	0.162	0.162	0.184	0.162	0.166	0.164
COPPER (CU)	WT %	0.201	0.213	0.213	0.225	0.215	0.211	0.217	0.206	0.213	0.209
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.010	0.004	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
IRON (FE)	WT %	15.180	15.840	15.840	16.716	16.150	15.980	16.870	15.890	16.430	15.790
LANTHANUM (LA)	WT %	0.728	0.756	0.761	0.751	0.751	0.828	0.765	0.758	0.840	0.728
LEAD (PB)	WT %	0.594	0.643	0.639	0.674	0.647	0.623	0.653	0.621	0.645	0.642
LITHIUM (LI)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
MAGNESIUM (MG)	WT %	0.299	0.263	0.249	0.241	0.226	0.227	0.341	0.217	0.225	0.220
MANGANESE (MN)	WT %	1.410	1.426	1.304	1.365	1.332	1.237	1.377	1.215	1.142	1.111
MOLYBDENUM (MO)	WT %	0.326	0.337	0.342	0.361	0.345	0.344	0.374	0.337	0.354	0.343
NEODYMIUM (ND)	WT %	5.406	5.634	5.639	5.904	5.735	5.680	5.896	5.582	5.791	5.453
NICKEL (NI)	WT %	1.392	1.464	1.439	1.499	1.465	1.465	1.515	1.428	1.451	1.385
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
PALLADIUM (PD)	WT %	0.025	0.017	0.067	0.060	0.018	0.044	0.046	0.020	0.039	0.055
PHOSPHOROUS (P)	WT %	0.181	0.187	0.132	0.111	0.130	0.166	0.228	0.160	0.070	0.142
PRASEODYMIUM (PR)	WT %	0.187	0.167	0.226	0.244	0.190	0.218	0.208	0.180	0.190	0.219
RHODIUM (RH)	WT %	0.024	0.006	0.043	0.049	0.012	0.035	0.008	0.005	0.025	0.044
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
RUTHENIUM (RU)	WT %	0.332	353	0.331	0.333	0.356	0.351	0.388	0.348	0.364	0.318
SAMARIUM (SA)	WT %	0.692	67	0.127	0.138	0.093	0.100	0.097	0.072	0.109	0.127
SELENIUM (SE)	WT %	0.012	0.017	0.016	0.016	0.009	0.002	0.010	0.007	<0.01	0.010
SILVER (AG)	WT %	0.124	0.127	0.127	0.134	0.130	0.130	0.134	0.128	0.136	0.128
SODIUM (NA)	WT %	9.451	8.170	7.448	6.644	7.604	6.579	8.089	7.762	7.448	7.345
STRONTIUM (SR)	WT %	0.101	0.098	0.088	0.090	0.089	0.086	0.096	0.086	0.085	0.082
TANTALUM (TA)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
TELLURIUM (TE)	WT %	0.187	0.189	0.225	0.244	0.213	0.209	0.189	0.193	0.211	0.208
TIN (SN)	WT %	0.010	0.017	0.015	0.021	0.013	0.014	0.012	0.015	0.017	0.017
TITANIUM (TI)	WT %	0.031	0.034	0.036	0.039	0.037	0.037	0.042	0.033	0.038	0.120

SAMPLE ID		SRDF 0030	SRDF 0032	SRDF 0034	SRDF 0035	SRDF 0036	SRDF 0037	SRDF 0038	SRDF 0040	SRDF 0042	SRDF 0044
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units										
ICP (Aqua Regia) cont'd											
YTTRIUM (Y)	WT %	0.054	0.055	0.056	0.059	0.057	0.056	0.057	0.054	0.056	0.055
ZINC (ZN)	WT %	0.220	0.231	0.230	0.243	0.231	0.228	0.236	0.227	0.229	0.220
ZIRCONIUM (ZR)	WT %	8.333	8.640	8.757	9.224	8.858	8.773	9.021	8.735	8.995	8.779
ICP (Filtrate)											
ALUMINUM (AL)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.630	<0.01	1.797	3.300
BARIUM (BA)	PPM	0.988	1.028	1.103	1.090	1.108	1.132	1.438	1.452	1.986	2.159
BORON (B)	PPM	7.723	7.489	8.086	8.149	8.151	8.292	9.371	9.540	12.660	13.570
CADMIUM (CD)	PPM	1105.000	1105.400	1049.000	1106.000	1049.000	1049.000	1106.000	1049.000	1095.000	1095.000
CALCIUM (CA)	PPM	383.200	391.900	449.400	432.000	461.800	480.500	533.400	580.100	668.900	681.600
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.240	14.200
CHROMIUM (CR)	PPM	0.282	0.280	0.090	0.349	0.103	0.154	0.568	0.381	0.994	1.294
COPPER (CU)	PPM	0.423	0.471	0.446	0.649	0.533	0.678	1.162	2.725	14.030	20.500
GERMANIUM (GE)	PPM	0.876	0.754	<0.01	0.707	<0.01	<0.01	0.941	<0.01	1.562	1.939
IRON (FE)	PPM	0.237	0.268	0.135	0.333	0.152	0.153	0.502	0.413	0.903	1.232
LANTHANUM (LA)	PPM	6.376	7.439	6.646	11.020	8.351	12.380	32.050	41.750	173.600	248.700
LEAD (PB)	PPM	0.254	0.532	0.061	0.853	0.138	0.107	2.031	1.714	6.890	10.240
LITHIUM (LI)	PPM	2.517	2.555	2.272	2.606	2.307	2.288	2.839	2.578	3.205	3.256
MAGNESIUM (MG)	PPM	266.000	265.600	266.800	271.900	270.100	268.400	280.200	279.400	311.600	308.100
MANGANESE (MN)	PPM	468.000	500.400	652.900	615.300	690.100	699.300	704.900	699.800	719.400	719.400
MOLYBDENUM (MO)	PPM	2.220	2.198	1.334	2.158	1.425	1.430	2.290	1.658	2.328	2.255
NEODYMIUM (ND)	PPM	17.260	20.960	34.310	29.030	37.320	46.200	84.090	133.700	530.400	792.800
NICKEL (NI)	PPM	44.580	48.130	73.690	64.580	78.820	91.650	118.400	157.000	237.400	263.900
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.575	0.946
PALLADIUM (PD)	PPM	0.277	0.169	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.513	2.680
PHOSPHOROUS (P)	PPM	14.730	15.880	12.020	18.850	12.700	13.900	28.870	20.560	23.960	24.620
PRASEODYMIUM (PR)	PPM	<0.01	0.01	<0.01	0.631	<0.01	<0.01	3.375	0.515	35.270	53.530
RHODIUM (RH)	PPM	0.335	0.285	<0.01	0.250	<0.01	<0.01	1.525	<0.01	1.942	3.248
RUBIDIUM (RB)	PPM	47.870	51.280	35.010	49.840	33.360	29.590	51.370	32.350		
RUTHENIUM (RU)	PPM	11.640	11.710	8.590	10.800	8.086	6.238	6.269	3.817	5.664	7.517
SAMARIUM (SM)	PPM	0.045	<0.01	<0.01	0.754	<0.01	<0.01	3.594	0.137	26.850	39.500
SELENIUM (SE)	PPM	1.360	1.469	0.912	2.003	1.022	1.255	3.157	2.223	5.043	5.482
SILICON (SI)	PPM	0.676	1.291	2.005	0.363	1.824	1.791	0.346	1.806	2.639	3.720
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.255	0.338
SODIUM (NA)	PPM	11326.000	11303.000	11385.000	11334.000	11399.000	11229.000	11273.000	11282.000	11894.000	11762.000
STRONTIUM (SR)	PPM	73.640	74.650	83.350	80.190	84.940	84.760	87.270	89.170	97.390	97.060
TANTALUM (TA)	PPM	1.235	1.395	0.669	1.534	0.748	0.648	2.173	1.188	3.594	4.027
TELLURIUM (TE)	PPM	3.587	3.626	3.023	3.796	3.209	3.227	5.334	4.397	9.252	10.910
TIN (SN)	PPM	0.034	0.042	<0.01	0.155	<0.01	<0.01	0.229	<0.01	0.707	1.041
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.092	0.193
YTTRIUM (Y)	PPM	0.221	0.273	0.388	0.388	0.435	0.565	1.157	1.748	7.880	11.930
ZINC (ZN)	PPM	4.828	5.289	8.970	7.363	9.484	11.360	15.760	22.430	48.540	60.690
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.050	0.090

SAMPLE ID		SRDF 0049	SRDF 0049	SRDF 0050	SRDF 0050	SRDF 0057	SRDF 0057	SRDF 0058	SRDF 0058	SRFO 0065	SRFO 0066	SRFO 0071	SRFO 0072
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE,	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total COMPONENT		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 1	1 OF 1	1 OF 1
	Units												
IC (Filtrate)													
FORMATE (COOH[1-])	MG/L	18799	18697	18080	18386	18526	20305	18930	18269	18284	18258	18020	16776
NITRATE (NO3[1-])	MG/L	9164	9124	8868	9226	9062	9884	8922	9024	8884	8839	8817	8353
NITRITE (NO2[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
OXALATE (C2O4[2-])	MG/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	367	374	415	405	682	733	604	598	740	750	790	766
AMMONIUM (NH4[1+])	MG/L	197	190	240	237	355	357	314	357	383	343	381	378
IC (Na2O2/H2O)													
CHLORIDE (CL[1-])	MG/L												
FLUORIDE (F[1-])	MG/L												
Wet Chemistry													
PH	PH	6.60	6.60	6.75	6.75	7.06	7.06	7.07	7.07	7.40	7.46	7.69	7.70
TOTAL WT % SOLIDS	WT %	12.85	12.78	12.39	12.20	12.60	12.55	12.45	12.40	12.69	12.62	12.95	12.52
EQUIV PT	MOLE/LITER	0.020 TO PH 7	0.021 TO PH 7	0.017 TO PH 7	0.017 TO PH 7	0.007 TO PH 7	0.007 TO PH 7	0.008 TO PH 7	0.008 TO PH 7	0.004 TO PH 7	0.003 TO PH 7	0.002 TO PH 7	0.002 TO PH 7
RHEOGRAM DONE (Y/N)	DD-MON-YY	12-12-91	12-12-91	11-12-91	11-12-91	11-12-91	11-12-91	11-12-91	11-12-91	10-12-91	10-12-91	10-12-91	10-12-91
CALCINED % SOLIDS	WT %	9.81	9.85	9.67	9.53	9.42	9.43	9.43	9.30	9.30	9.29	9.89	9.51
DENSITY	G/ML	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Carbon Analysis													
TOTAL CARBON	PPM	7013	6999	6945	6930	6769	6941	6884	6910	6737	6733	6582	6582
TOTAL INORGANIC CARBON	PPM	1459	1450	1304	1478	1169	1217	1344	1218	1167	1226	1271	1432
TOTAL ORGANIC CARBON	PPM	5554	5549	5641	5452	5600	5724	5540	5692	5570	5507	5311	5150
AA (Na2O2/HCl)													
SILICON (SI)	WT %	2.600	2.400	2.600	2.700	2.500	2.300	2.400	2.400	2.800	2.700	2.600	2.600
AA (Aqua Regia)													
SODIUM (NA)	WT %	6.287	6.740	6.679	7.154	7.026	7.063	7.640	7.540	6.444	6.430	6.697	6.844
POTASSIUM (K)	WT %	0.150	0.150	0.160	0.160	0.160	0.160	0.150	0.150	0.160	0.150	0.150	0.160
AE (Aqua Regia)		Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia	Aqua Regia
CESIUM (CS)	WT %	3.100	3.000	2.900	2.800	3.000	3.000	2.900	2.900	2.800	3.000	2.900	3.100
ICP (Na2O2/HCl)													
ALUMINUM (AL)	WT %	3.178	3.167	3.146	3.211	3.153	3.081	3.129	3.144	3.129	3.061	3.004	3.118
BARIUM (BA)	WT %	0.132	0.132	0.132	0.135	0.133	0.128	0.129	0.132	0.130	0.128	0.126	0.131
BORON (B)	WT %	0.013	0.006	0.015	0.019	0.015	0.005	0.003	<0.01	0.014	0.004	0.011	0.005
CADMIUM (CD)	WT %	2.125	2.134	2.222	2.229	2.161	2.153	2.183	2.145	2.137	2.141	2.138	2.206
CALCIUM (CA)	WT %	0.742	0.746	0.788	0.768	0.772	0.762	0.756	0.755	0.742	0.753	0.763	0.782
CERIUM (CE)	WT %	0.052	0.025	0.056	0.045	0.087	0.042	<0.01	0.018	<0.01	<0.01	<0.01	0.002
CHROMIUM (CR)	WT %	0.133	0.133	0.130	0.135	0.132	0.128	0.130	0.128	0.131	0.126	0.130	0.130
COPPER (CU)	WT %	0.169	0.231	0.165	0.168	0.174	0.173	0.169	0.175	0.165	0.174	0.162	0.169
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	13.830	13.670	13.670	13.967	13.560	13.410	13.580	13.760	13.660	13.460	13.230	13.760
LANTHANUM (LA)	WT %	0.299	0.225	0.531	0.446	0.545	0.541	0.302	0.251	0.338	0.255	0.262	0.294
LEAD (PB)	WT %	0.493	0.499	0.477	0.495	0.491	0.459	0.475	0.491	0.487	0.470	0.467	0.462
LITHIUM (LI)	WT %	0.022	0.010	0.022	0.029	0.012	0.009	<0.01	<0.01	0.024	0.010	0.022	<0.01
MAGNESIUM (MG)	WT %	0.109	0.085	0.117	0.121	0.130	0.115	0.112	0.097	0.105	0.074	0.102	0.099
MANGANESE (MN)	WT %	1.175	1.221	1.259	1.231	1.220	1.201	1.260	1.199	1.203	1.204	1.198	1.224
MOLYBDENUM (MO)	WT %	0.265	0.265	0.258	0.267	0.266	0.256	0.251	0.260	0.258	0.248	0.243	0.252
NEODYMIUM (ND)	WT %	4.722	4.661	4.685	4.832	4.724	4.632	4.594	4.655	4.644	4.519	4.461	4.703
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	WT %	ND	ND	<0.01	ND	<0.01	<0.01	ND	ND	ND	0.007	0.044	ND
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SRDF 0049	SRDF 0049	SRDF 0050	SRDF 0050	SRDF 0057	SRDF 0057	SRDF 0058	SRDF 0058	SRFO 0065	SRFO 0066	SRFO 0071	SRFO 0072
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units												
ICP (Na2O2/HCl) cont'd													
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.248	0.236	0.245	0.242	0.243	0.235	0.242	0.239	0.236	0.229	0.228	0.223
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	2.678	2.334	3.170	3.133	3.768	3.298	2.208	2.184	2.500	2.273	2.514	2.439
SILVER (AG)	WT %	0.095	0.096	0.093	0.096	0.095	0.093	0.092	0.094	0.093	0.090	0.089	0.094
STRONTIUM (SR)	WT %	0.088	0.087	0.093	0.092	0.091	0.090	0.090	0.090	0.090	0.088	0.089	0.092
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.124	0.123	0.100	0.105	0.133	0.124	0.128	0.119	0.096	0.105	0.101	0.106
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	WT %	0.160	0.160	0.154	0.156	0.154	0.150	0.160	0.153	0.157	0.151	0.146	0.153
YTTRIUM (Y)	WT %	0.043	0.042	0.042	0.043	0.043	0.041	0.041	0.042	0.041	0.040	0.039	0.042
ZINC (ZN)	WT %	0.243	0.287	0.243	0.247	0.259	0.229	0.315	0.237	0.273	0.238	0.244	0.232
ZIRCONIUM (ZR)	WT %	8.037	7.956	7.906	8.044	7.921	7.801	7.782	7.942	7.902	7.780	7.585	7.952
ICP (Aqua Regia)													
ALUMINUM (AL)	WT %	3.673	3.773	3.747	6.334	3.725	3.638	3.408	3.578	3.809	3.296	3.555	3.452
BARIUM (BA)	WT %	0.151	0.155	0.157	0.151	0.153	0.149	0.140	0.149	0.156	0.137	0.148	0.147
BORON (B)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	0.001	0.006	0.006	0.002	0.005	0.009	<0.010
CADMIUM (CD)	WT %	2.447	2.488	2.394	2.528	2.524	2.576	2.332	2.415	2.460	2.187	2.423	2.445
CALCIUM (CA)	WT %	0.654	0.685	0.657	0.686	0.695	0.714	0.667	0.663	0.652	0.594	0.664	0.682
CERIUM (CE)	WT %	0.377	0.395	0.410	0.414	0.372	0.352	0.367	0.415	0.411	0.387	0.454	0.397
CHROMIUM (CR)	WT %	0.156	0.161	0.161	0.158	0.159	0.154	0.146	0.154	0.159	0.141	0.155	0.155
COPPER (CU)	WT %	0.199	0.209	0.211	0.203	0.207	0.200	0.192	0.202	0.209	0.185	0.199	0.203
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
IRON (FE)	WT %	15.540	15.870	15.980	15.540	15.700	15.320	14.330	15.070	15.840	13.970	15.110	14.762
LANTHANUM (LA)	WT %	0.679	0.753	0.753	0.727	0.758	0.762	0.690	0.795	0.773	0.773	0.872	0.723
LEAD (PB)	WT %	0.617	0.626	0.633	0.618	0.618	0.605	0.585	0.611	0.626	0.557	0.612	0.603
LITHIUM (LI)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
MAGNESIUM (MG)	WT %	0.235	0.255	0.236	0.257	0.250	0.267	0.266	0.258	0.243	0.233	0.280	0.283
MANGANESE (MN)	WT %	1.291	1.349	1.311	1.363	1.368	1.410	1.303	1.314	1.311	1.186	1.317	1.328
MOLYBDENUM (MO)	WT %	0.328	0.340	0.340	0.332	0.332	0.328	0.313	0.329	0.343	0.302	0.330	0.324
NEODYMIUM (ND)	WT %	5.549	5.594	5.677	5.529	5.637	5.437	5.135	5.426	5.698	5.001	5.418	5.256
NICKEL (NI)	WT %	1.415	1.452	1.446	1.427	1.448	1.409	1.316	1.380	1.460	1.272	1.387	1.350
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
PALLADIUM (PD)	WT %	0.007	0.013	0.014	0.018	0.008	0.001	0.022	0.028	0.016	0.028	0.039	0.069
PHOSPHOROUS (P)	WT %	0.204	0.250	0.226	0.067	0.172	0.127	0.197	0.236	0.129	0.0203	0.126	0.243
PRASEODYMIUM (PR)	WT %	0.158	0.616	0.165	0.166	0.162	0.131	0.148	0.183	0.174	0.169	0.219	0.217
RHODIUM (RH)	WT %	<0.01	0.013	0.013	0.001	0.002	<0.01	0.014	0.025	0.014	0.022	0.039	0.038
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010
RUTHENIUM (RU)	WT %	0.341	0.347	0.344	0.331	0.349	0.337	0.329	0.339	0.348	0.313	0.350	0.305
SAMARIUM (SA)	WT %	0.053	0.001	0.063	0.066	0.057	0.047	0.070	0.097	0.066	0.086	0.122	0.110
SELENIUM (SE)	WT %	0.006	0.012	0.007	<0.01	<0.01	0.002	0.001	0.005	<0.01	0.007	0.012	0.020
SILVER (AG)	WT %	0.124	0.128	0.129	0.124	0.126	0.121	0.117	0.124	0.128	0.115	0.124	0.121
SODIUM (NA)	WT %	7.593	7.883	8.042	8.423	8.300	8.901	8.721	8.264	7.614	7.435	7.940	8.225
STRONTIUM (SR)	WT %	0.095	0.099	0.097	0.098	0.100	0.100	0.094	0.095	0.098	0.088	0.095	0.096
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.007	<0.010
TELLURIUM (TE)	WT %	0.186	0.202	0.204	0.202	0.194	0.192	0.187	0.187	0.200	0.174	0.203	0.210
TIN (SN)	WT %	0.016	0.010	0.011	0.013	0.014	0.015	0.011	0.013	0.013	0.011	0.016	0.017
TITANIUM (TI)	WT %	0.032	0.033	0.061	0.100	0.030	0.031	0.029	0.040	0.035	0.033	0.044	0.122

SAMPLE ID		SRDF 0049	SRDF 0049	SRDF 0050	SRDF 0050	SRDF 0057	SRDF 0057	SRDF 0058	SRDF 0058	SRFO 0065	SRFO 0066	SRFO 0071	SRFO 0072
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total COMPONENT		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 1	1 OF 1	1 OF 1
Units													
ICP (Aqua Regia) cont'd													
YTTRIUM (Y)	WT %	0.054	0.055	0.056	0.053	0.055	0.053	0.050	0.053	0.056	0.050	0.054	0.052
ZINC (ZN)	WT %	0.224	0.229	0.231	0.224	0.230	0.221	0.208	0.217	0.230	0.200	0.217	0.216
ZIRCONIUM (ZR)	WT %	8.564	8.722	8.772	8.532	8.527	8.406	7.893	8.378	8.701	7.680	8.292	8.292
ICP (Filtrate)													
ALUMINUM (AL)	PPM	2.002	1.678	0.810	0.685	1.029	1.033	0.791	0.687	<0.01	<0.01	<0.01	<0.01
BARIUM (BA)	PPM	0.598	0.568	0.502	0.495	0.440	0.444	0.446	0.448	0.371	0.375	0.334	0.336
BORON (B)	PPM	6.805	6.419	5.764	5.713	4.555	4.614	4.547	4.598	4.178	4.100	3.444	3.713
CADMIUM (CD)	PPM	1095.000	1095.000	1095.000	1095.000	918.200	934.500	925.900	942.800	710.500	683.900	476.400	476.000
CALCIUM (CA)	PPM	671.600	638.800	632.700	632.600	557.300	571.200	562.100	572.300	544.700	538.300	517.300	519.300
CERIUM (CE)	PPM	<0.01	<0.01	1.060	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.220
CHROMIUM (CR)	PPM	0.800	0.760	0.644	0.649	0.566	0.568	0.539	0.569	0.415	0.343	0.247	0.215
COPPER (CU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GERMANIUM (GE)	PPM	1.387	0.953	0.791	0.754	0.744	0.246	0.842	0.233	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	1.054	0.952	0.790	0.728	0.567	0.565	0.532	0.552	0.371	0.349	0.264	0.253
LANTHANUM (LA)	PPM	2.087	1.188	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	0.828	0.830	0.527	0.502	0.379	0.412	0.502	0.480	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	3.703	3.454	3.494	3.501	3.558	3.602	3.532	3.596	3.716	3.712	3.887	3.931
MAGNESIUM (MG)	PPM	3.114	295.400	298.200	300.100	292.000	292.200	286.900	291.300	299.200	298.100	296.400	296.100
MANGANESE (MN)	PPM	7.190	719.100	719.200	719.200	720.200	719.500	719.200	719.200	719.300	719.200	699.900	690.000
MOLYBDENUM (MO)	PPM	2.119	1.929	1.850	1.812	1.561	1.639	1.540	1.750	1.356	1.201	4.021	4.599
NEODYMIUM (ND)	PPM	9.584	8.100	4.372	5.746	0.435	0.549	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	40.650	38.410	23.230	24.090	6.567	6.671	6.499	6.711	3.280	2.295	1.344	1.390
NIOBIUM (NB)	PPM	2.360	0.155	<0.01	<0.01	<0.01	0.073	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	0.831	0.490	<0.01	<0.01	0.038	0.060	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	22.580	21.510	20.790	20.890	18.210	17.900	17.670	18.550	16.330	16.230	13.620	13.670
PRASEODYMIUM (PR)	PPM	2.057	1.530	<0.01	<0.01	0.162	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	0.867	0.732	<0.01	<0.01	<0.01	0.151	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RUTHENIUM (RU)	PPM	4.589	4.475	3.994	3.981	3.620	3.558	3.514	3.726	2.993	2.868	2.456	2.325
SAMARIUM (SM)	PPM	4.340	3.887	2.212	2.302	2.072	2.266	1.794	1.561	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	4.098	4.311	3.765	3.539	3.366	3.206	3.206	3.326	2.181	2.218	1.609	1.742
SILICON (SI)	PPM	6.156	3.536	0.513	0.231	1.702	1.120	0.857	0.301	<0.01	<0.01	<0.01	<0.01
SILVER (AG)	PPM	0.232	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	11654.000	11156.000	11293.000	11370.000	10988.000	11196.000	10985.000	11168.000	11749.000	11811.000	11968.000	12081.000
STRONTIUM (SR)	PPM	69.890	66.240	62.950	63.020	44.710	45.650	45.250	45.920	39.290	38.490	32.930	32.720
TANTALUM (TA)	PPM	2.312	2.247	1.824	1.727	1.311	1.430	1.315	1.246	0.618	0.614	0.311	0.307
TELLURIUM (TE)	PPM	5.348	5.152	4.690	4.327	3.195	3.201	2.986	3.029	1.909	1.767	1.237	1.115
TIN (SN)	PPM	0.221	0.199	0.104	0.147	0.053	0.192	0.133	0.137	0.060	0.090	0.013	<0.01
TITANIUM (TI)	PPM	0.048	0.043	<0.01	<0.01	<0.029	0.016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	0.196	0.174	0.083	0.122	0.150	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	3.614	3.254	2.435	2.696	0.887	0.901	0.820	0.900	0.460	0.408	0.186	0.200
ZIRCONIUM (ZR)	PPM	0.086	0.063	<0.01	<0.01	0.032	0.012	0.022	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results:

HWVP1 SRAT Condensate

SAMPLE ID		SCFO 0047	SCFO 0048	SCFO 0051	SCFO 0052	SCFO 0053	SCFO 0054	SCFO 0055	SCFO 0056	SCFO 0059	SCFO 0060	SCFO 0061
ANALYTICAL CODE(S)		SFCOCD	SFCOCD	SFCOCD	SFCOCD	SFCOCD	SFCOCD	SFCOCD	SFCOCD	SFCOCD	SFCOCD	SFCOCD
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91
ANALYSIS # OF total COMPONENT	Units	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FLUORIDE (F[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FORMATE (COOH[1-])	MG/L	35	35	26	20	20	15	15	15	10	11	12
NITRATE (NO3[1-])	MG/L	2	2	2	2	2	1	<1	<1	<1	<1	<1
NITRITE (NO2[1-])	MG/L	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PHOSPHATE (PO4[3-])	MG/L	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1	1	1	<1	<1	1	<1	<1	<1	<1	<1
AMMONIUM (NH4[1+])	MG/L	34	34	50	64	66	53	83	83	98	80	81
Wet Chemistry												
PH	PH	8.15	8.08	7.36	8.27	8.32	8.98	9.09	9.09	8.69	9.32	9.39
EQUIV PT	MOLE/LITER	ND	ND	ND	ND	ND	ND	.003 TO PH7	.002 TO PH7	ND	.002 TO PH7	.002 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BARIUM (BA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BORON (B)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CADMIUM (CD)	PPM	1.387	<0.01	0.026	0.302	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CALCIUM (CA)	PPM	1.183	1.335	1.257	1.545	1.815	1.184	1.308	1.430	1.650	1.044	1.173
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MAGNESIUM (MG)	PPM	0.029	0.350	<0.01	0.394	0.465	0.307	0.335	0.377	0.352	0.217	0.292
MANGANESE (MN)	PPM	0.740	<0.01	<0.01	0.052	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MOLYBDENUM (MO)	PPM	<0.01	0.032	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.841	0.543	1.359	0.383	0.566	0.469	0.558	0.585	0.482	0.477	0.592
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	<0.01	<0.01	0.195	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	16.180	0.843	12.260	1.178	1.020	1.045	0.701	0.686	0.674	0.527	0.519
STRONTIUM (SR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TIN (SN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SCFO 0062	SCFO 0063	SCFO 0064	SCFO 0067	SCFO 0068	SCFO 0069	SCFO 0070	SCRW 0084	SCRW 0085	SCSM 0088	SCSM 0089
ANALYTICAL CODE(S)		SCFO0062	SCFO0063	SCFO0064	SCFO0067	SCFO0068	SCFO0069	SCFO0070	SCRW0084	SCRW0085	SCSM0088	SCSM0089
DATE		11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/12/91	11/14/91	11/14/91	11/14/91	11/14/91
ANALYSIS # OF total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units											
IC (Filtrate)												
CHLORIDE (CL(1-))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FLUORIDE (F(1-))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
FORMATE (COOH(1-))	MG/L	8	6	6	5	4	4	4	<1	<1	<1	<1
NITRATE (NO3(1-))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRITE (NO2(1-))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PHOSPHATE (PO4(3-))	MG/L	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4(2-))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1
AMMONIUM (NH4(1+))	MG/L	116	147	150	127	187	189	285	609	871	4141	4103
Wet Chemistry												
PH	PH	9.37	9.01	9.01	9.60	9.38	9.44	9.17	10.04	9.82	10.26	10.26
EQUIV PT	MOLE/LITER	.007 TO PH7	.004 TO PH7	.004 TO PH7	.010 TO PH7	.011 TO PH7	.012 TO PH7	.010 TO PH7	.030 TO PH7	.037 TO PH7	.19 TO PH7	.17 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.025
BARIUM (BA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BORON (B)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.015	2.037
CADMIUM (CD)	PPM	0.156	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.010
CALCIUM (CA)	PPM	1.228	2.200	2.102	1.157	1.363	0.990	2.175	1.883	2.354	2.150	1.989
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.594	0.634
CHROMIUM (CR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	0.024
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MAGNESIUM (MG)	PPM	0.030	0.474	0.445	0.231	0.015	0.210	0.156	0.328	0.385	0.511	0.494
MANGANESE (MN)	PPM	0.035	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MOLYBDENUM (MO)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.023
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014
NIوبيUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.021
PHOSPHOROUS (P)	PPM	0.163	0.689	0.619	0.530	0.116	0.500	0.200	0.668	0.744	0.775	0.670
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.151
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.019
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.208	0.566
RUTHENIUM (RU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.031	0.049
SELENIUM (SE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.081	0.147
SILICON (SI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	19.600	<0.01
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	1.028	0.584	0.570	0.482	0.719	0.482	0.646	<0.01	<0.01	<0.01	<0.01
STRONTIUM (SR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TIN (SN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.047	0.040
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SCSM 0090	SCSM 0091	SCSM 0092	SCSM 0093	SCSM 0094	SCSM 0095
ANALYTICAL CODE(S)		SACOND	SACOND	SACOND	SACOND	SACOND	SACOND
DATE		11/14/91	11/14/91	11/14/91	11/14/91	11/14/91	11/14/91
ANALYSIS # OF total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)	Units						
CHLORIDE (CL[1-])	MG/L	<1	<1	<1	<1	<1	<1
FLUORIDE (F[1-])	MG/L	<1	<1	<1	<1	<1	<1
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	<1	<1	<1	<1	<1	<1
NITRITE (NO2[1-])	MG/L	<1	<1	<1	<1	<1	<1
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1	1	1	<1	<1	1
AMMONIUM (NH4[1+])	MG/L	3086	3072	2318	2449	2010	1860
Wet Chemistry							
PH		10.34	10.35	10.29	10.28	10.20	10.20
EQUIV PT	MOLE/LITER	.14 TO PH7	.14 TO PH7	.108 TO PH7	.11 TO PH7	.088 TO PH7	.092 TO PH7
ICP (Filtrate)							
ALUMINUM (AL)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BARIUM (BA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BORON (B)	PPM	1.993	2.020	2.175	2.145	2.196	2.210
CADMIUM (CD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CALCIUM (CA)	PPM	2.413	2.005	2.128	1.885	2.282	2.349
CERIUM (CE)	PPM	0.186	0.208	0.065	0.282	0.223	0.200
CHROMIUM (CR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MAGNESIUM (MG)	PPM	0.440	0.370	0.362	0.351	0.434	0.470
MANGANESE (MN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MOLYBDENUM (MO)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.802	0.810	0.684	0.736	0.696	0.756
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	PPM	10.160	10.790	4.003	4.502	2.157	2.188
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
STRONTIUM (SR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TIN (SN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results:

HWVP1 Recycle Waste Stream

SAMPLE ID		RWSS 0080	RWSS 0080	RWSS 0080	RWSS 0080	RWSS 0081	RWSS 0081	RWSS 0081	RWSS 0081
ANALYTICAL CODE(S)		RWS	RWS	RWS	RWS	RWS	RWS	RWS	RWS
DATE		11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91
ANALYSIS # OF total COMPONENT	Units	1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
IC (Filtrate)									
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	46116	45637	46033	46535	47529	47802	48772	47482
NITRITE (NO2[1-])	MG/L	<8	<8	<8	<8	<8	<8	<8	<9
OXALATE (C2O4[2-])	MG/L	9883	9825	10905	10249	12856	9944	11312	10881
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	<219	<175	<169	<177	<187	<198	<209	<179
IC (Na2O2/H2O)									
CHLORIDE (CL[1-])	MG/L								
FLUORIDE (F[1-])	MG/L								
Wet Chemistry									
PH	PH	9.68	9.68	9.68	9.68	9.76	9.76	9.76	9.76
TOTAL WT % SOLIDS	WT %	13.30	13.53	13.57	13.36	13.53	13.55	13.49	13.61
EQUIV PT	MOLE/LITER	.0008 TO PH7	.0008 TO PH7	.0008 TO PH7	.0008 TO PH7	.001 TO PH7	.001 TO PH7	.001 TO PH7	.001 TO PH7
CALCINED % SOLIDS	WT %	8.80	8.59	8.64	8.85	8.81	8.78	8.80	8.96
DENSITY	G/ML	1.08	1.08	1.08	1.08	1.09	1.09	1.09	1.09
Carbon Analysis									
TOTAL CARBON	PPM	2158	2097	2116	1976	2143	1985	2054	2062
TOTAL INORGANIC CARBON	PPM	100	97	88	81	114	86	91	146
TOTAL ORGANIC CARBON	PPM	2058	2000	2028	1895	2029	1899	1963	1916
AA (Na2O2/HCl)									
SILICON (SI)	WT %	13.300	13.500	13.400	14.100	13.200	14.800	15.000	14.400
AA (Aqua Regia)									
SODIUM (NA)	WT %	15.950	16.093	15.909	16.486	16.717	16.314	16.651	15.989
POTASSIUM (K)	WT %	0.530	0.640	0.530	0.530	0.550	0.580	0.570	0.560
AE (Aqua Regia)									
CESIUM (CS)	WT %	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
ICP (Na2O2/HCl)									
ALUMINUM (AL)	WT %	1.417	1.500	1.457	1.562	1.431	1.515	1.557	1.487
BARIUM (BA)	WT %	0.012	0.013	0.012	0.013	0.013	0.014	0.013	0.014
BORON (B)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	0.001	0.001	<0.010
CADMIUM (CD)	WT %	<0.010	0.002	0.002	0.002	0.003	0.001	0.003	0.002
CALCIUM (CA)	WT %	0.284	0.289	0.287	0.293	0.284	0.299	0.302	0.294
CERIUM (CE)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
CHROMIUM (CR)	WT %	<0.010	0.006	0.003	0.009	0.004	0.003	0.005	0.002
COPPER (CU)	WT %	<0.010	<0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010
GERMANIUM (GE)	WT %	0.041	0.034	0.037	0.082	0.054	0.045	0.015	0.027
IRON (FE)	WT %	0.635	0.676	0.629	0.722	0.626	0.657	0.714	0.649
LANTHANUM (LA)	WT %	0.049	0.096	0.071	0.096	0.027	0.067	0.056	0.044
LEAD (PB)	WT %	0.040	0.042	0.052	0.054	0.036	0.025	0.037	0.037
LITHIUM (LI)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
MAGNESIUM (MG)	WT %	0.233	0.241	0.230	0.252	0.244	0.235	0.240	0.241

SAMPLE ID		RWSS 0080	RWSS 0080	RWSS 0080	RWSS 0080	RWSS 0081	RWSS 0081	RWSS 0081	RWSS 0081
ANALYTICAL CODE(S)		RWS	RWS	RWS	RWS	RWS	RWS	RWS	RWS
DATE		11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91
ANALYSIS # OF total		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units								
ICP (Na2O2/HCl) cont'd									
MANGANESE (MN)	WT %	0.091	0.111	0.091	0.136	0.072	0.043	0.112	0.068
MOLYBDENUM (MO)	WT %	<0.010	0.010	0.006	0.010	0.007	0.003	0.009	0.004
NEODYMIUM (ND)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
NIOBIUM (NB)	WT %	<0.010	<0.010	<0.010	0.003	0.002	<0.010	<0.010	<0.010
PALLADIUM (PD)	WT %	0.032	0.035	0.013	0.036	0.030	0.002	0.008	0.023
PHOSPHOROUS (P)	WT %	1.035	0.507	0.378	0.342	0.323	0.328	0.273	0.208
PRASEODYMIUM (PR)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
RHODIUM (RH)	WT %	<0.010	0.014	<0.010	0.015	0.004	<0.010	0.015	<0.010
RUBIDIUM (RB)	WT %	<0.010	0.044	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
RUTHENIUM (RU)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
SAMARIUM (SA)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
SELENIUM (SE)	WT %	0.014	0.026	0.035	0.032	0.026	0.015	0.043	0.026
SILICON (SI)	WT %	13.984	14.131	13.730	13.933	13.464	14.122	14.154	13.784
SILVER (AG)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
STRONTIUM (SR)	WT %	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
TANTALUM (TA)	WT %	0.021	0.024	0.019	0.026	0.022	0.015	0.023	0.014
TELLURIUM (TE)	WT %	0.034	0.006	0.047	0.046	0.036	0.025	0.036	0.025
TIN (SN)	WT %	0.007	0.012	0.010	0.014	0.018	0.014	0.006	0.010
TITANIUM (TI)	WT %	0.060	0.066	0.058	0.070	0.050	0.055	0.065	0.053
YTTRIUM (Y)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
ZINC (ZN)	WT %	0.132	0.170	0.137	0.187	0.171	0.071	0.171	0.117
ZIRCONIUM (ZR)	WT %	<0.010	0.010	0.004	<0.010	0.010	0.004	0.014	0.012
ICP (Aqua Regia)									
CADMIUM (CD)	WT %	0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CALCIUM (CA)	WT %	0.170	0.171	0.171	0.168	0.165	0.181	0.176	0.169
CHROMIUM (CR)	WT %	0.002	0.003	0.002	0.002	0.004	0.003	0.003	0.002
COPPER (CU)	WT %	0.001	<0.01	<0.01	<0.01	<0.01	0.001	<0.01	<0.01
IRON (FE)	WT %	0.602	0.591	0.580	0.573	0.613	0.621	0.619	0.599
MAGNESIUM (MG)	WT %	0.194	0.193	0.192	0.189	0.194	0.206	0.201	0.196
MANGANESE (MN)	WT %	0.013	0.014	0.013	0.013	0.007	0.019	0.018	0.014
NEODYMIUM (ND)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	WT %	0.006	0.006	0.004	0.004	0.007	0.007	0.003	0.005
PHOSPHOROUS (P)	WT %	0.065	0.052	0.051	0.052	0.047	0.043	0.042	0.044
SODIUM (NA)	WT %	18.240	18.350	18.200	18.650	19.080		18.720	18.120
TITANIUM (TI)	WT %	0.049	0.050	0.050	0.051	0.049	0.054	0.052	0.052
ZINC (ZN)	WT %	0.011	0.010	0.007	0.007	0.013	0.010	0.007	0.007
ZIRCONIUM (ZR)	WT %	0.023	0.003	0.008	0.003	0.007	0.009	0.005	0.005

SAMPLE ID		RWSS 0080	RWSS 0080	RWSS 0080	RWSS 0080	RWSS 0081	RWSS 0081	RWSS 0081	RWSS 0081
ANALYTICAL CODE(S)		RWS	RWS	RWS	RWS	RWS	RWS	RWS	RWS
DATE		11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91	11/13/91
ANALYSIS # OF total		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units								
ICP (Filtrate)									
ALUMINUM (AL)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BARIUM (BA)	PPM	2.279	2.213	2.380	2.364	2.453	2.460	2.488	2.480
BORON (B)	PPM	5.102	5.082	5.378	5.323	5.147	5.406	5.477	5.436
CADMIUM (CD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CALCIUM (CA)	PPM	0.452	0.408	0.440	0.498	0.354	0.353	0.340	0.349
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LANTHANUM LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	1.358	1.219	1.345	1.345	0.923	0.932	0.945	0.936
MAGNESIUM (MG)	PPM	<0.01	26.600	27.940	27.520	28.870	29.680	29.690	29.690
MANGANESE (MN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MOLYBDENUM (MO)	PPM	26.810	0.139	0.131	0.145	0.089	0.083	0.080	0.083
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.906	0.935	0.864	0.635	2.087	2.357	2.315	2.580
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	PPM	6.550	6.326	6.812	6.748	7.860	7.953	8.065	7.933
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	8966.000	8735.000	8694.000	8750.000	10224.000	10093.000	9951.000	9942.000
STRONTIUM (SR)	PPM	0.148	0.141	0.152	0.151	0.151	0.154	0.152	0.152
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TIN (SN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	0.069	0.072	0.077	0.076	0.059	0.064	0.068	0.067
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results:

HWVP1 SME-RWS

SAMPLE ID		SMRW 0082	SMRW 0082	SMRW 0083	SMRW 0083	SMRW 0086	SMRW 0087
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/13/91	11/13/91	11/13/91	11/13/91	11/14/91	11/14/91
ANALYSIS # OF total COMPONENT	Units	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 1
IC (Filtrate)							
FORMATE (COOH[1-])	MG/L	17323	17806	16916	17359	15865	17220
NITRATE (NO3[1-])	MG/L	14014	14138	13683	13827	14078	15086
NITRITE (NO2[1-])	MG/L	<1	<1	<1	<1	<1	<1
OXALATE (C2O4[2-])	MG/L	414	406	400	409	ND	<1
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	888	907	868	882	1044	1135
AMMONIUM (NH4[1+])	MG/L	441	458	469	460	411	408
IC (Na2O2/H2O)							
CHLORIDE (CL[1-])	MG/L						
FLUORIDE (F[1-])	MG/L						
Wet Chemistry							
PH	PH	8.32	8.32	8.40	8.40	8.76	8.77
TOTAL WT % SOLIDS	WT %	13.56	13.67	13.65	13.55	15.29	15.39
EQUIV PT	MOLE/LITER	0.001 TO PH7	.001 TO PH7	.002 TO PH7	.002 TO PH7	.0008 TO PH7	0.002 TO PH7
RHEOGRAM DONE (Y/N)	DD-MON-YY	12-12-91	12-12-91	12-12-91	12-12-914	11-12-91	11-12-91
CALCINED % SOLIDS	WT %	10.15	9.72	10.34	10.49	11.03	11.69
DENSITY	G/ML	1.11	1.11	1.11	1.10	1.12	1.12
Carbon Analysis							
TOTAL CARBON	PPM	6499	6416	6548	6546	7088	6972
TOTAL INORGANIC CARBON	PPM	1734	1600	1723	1777	1992	2110
TOTAL ORGANIC CARBON	PPM	4765	4816	4825	4769	5096	4862
AA (Na2O2/HCl)							
SILICON (SI)	WT %	2.400	2.400	2.600	2.700	2.300	2.300
AA (Aqua Regia)							
SODIUM (NA)	WT %	0.160	0.160	0.150	0.150	0.160	0.160
POTASSIUM (K)	WT %	7.622	7.738	7.820	7.825	7.745	7.852
AE (Aqua Regia)							
CESIUM (CS)	WT %	3.000	2.900	2.900	2.900	2.800	3.000

SAMPLE ID		SMRW 0082	SMRW 0082	SMRW 0083	SMRW 0083	SMRW 0086	SMRW 0087
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/13/91	11/13/91	11/13/91	11/13/91	11/14/91	11/14/91
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 1
COMPONENT	Units						
ICP (Na2O2/HCl)							
ALUMINUM (AL)	WT %	2.903	2.945	2.871	2.928	2.813	2.786
BARIUM (BA)	WT %	0.119	0.120	0.117	0.119	0.114	0.115
BORON (B)	WT %	0.008	0.009	0.014	<0.010	0.010	0.018
CADMIUM (CD)	WT %	2.164	2.186	2.170	2.156	2.090	2.116
CALCIUM (CA)	WT %	0.730	0.741	0.730	0.743	0.710	0.711
CERIUM (CE)	WT %	0.023	0.002	<0.010	0.037	<0.01	<0.01
CHROMIUM (CR)	WT %	0.113	0.112	0.122	0.115	0.109	0.107
COPPER (CU)	WT %	0.155	0.144	0.147	0.160	0.140	0.138
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
IRON (FE)	WT %	12.250	12.340	12.120	12.385	11.940	11.940
LANTHANUM (LA)	WT %	0.467	0.408	0.272	0.425	0.308	0.253
LEAD (PB)	WT %	0.429	0.426	0.425	0.422	0.388	0.389
LITHIUM (LI)	WT %	0.020	0.018	0.019	0.014	0.018	0.034
MAGNESIUM (MG)	WT %	0.101	0.099	0.100	0.111	0.102	0.089
MANGANESE (MN)	WT %	1.155	1.139	1.165	1.154	1.112	1.123
MOLYBDENUM (MO)	WT %	0.224	0.224	0.219	0.233	0.219	0.212
NEODYMIUM (ND)	WT %	4.195	4.172	4.091	4.187	3.976	3.965
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
PHOSPHOROUS (P)	WT %	0.023	0.015	ND	ND	ND	0.026
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
RHODIUM (RH)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.199	0.203	0.182	0.196	0.189	0.185
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
SILICON (SI)	WT %	4.116	3.984	3.673	3.491	3.173	3.599
SILVER (AG)	WT %	0.083	0.083	0.079	0.086	0.078	0.075
STRONTIUM (SR)	WT %	0.084	0.084	0.084	0.085	0.081	0.082
TANTALUM (TA)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
TELLURIUM (TE)	WT %	0.103	0.092	0.085	0.091	0.093	0.095
TIN (SN)	WT %	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01
TITANIUM (TI)	WT %	0.144	0.141	0.141	0.146	0.137	0.134
YTTRIUM (Y)	WT %	0.037	0.036	0.036	0.038	0.035	0.034
ZINC (ZN)	WT %	0.256	0.230	0.258	0.239	0.227	0.201
ZIRCONIUM (ZR)	WT %	7.077	7.161	7.017	7.132	6.779	6.804

SAMPLE ID		SMRW 0082	SMRW 0082	SMRW 0083	SMRW 0083	SMRW 0086	SMRW 0087
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/13/91	11/13/91	11/13/91	11/13/91	11/14/91	11/14/91
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 1
COMPONENT	Units						
ICP (Aqua Regia)							
ALUMINUM (AL)	WT %	3.220	3.134	3.406	3.282	3.166	3.023
BARIUM (BA)	WT %	0.130	0.127	0.137	0.133	0.128	0.124
BORON (B)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CADMIUM (CD)	WT %	2.368	2.345	2.519	2.472	2.318	2.250
CALCIUM (CA)	WT %	0.615	0.606	0.643	0.634	0.594	0.583
CERIUM (CE)	WT %	0.299	0.293	0.335	0.311	0.289	0.275
CHROMIUM (CR)	WT %	0.131	0.129	0.141	0.136	0.128	0.127
COPPER (CU)	WT %	0.175	0.172	0.185	0.178	0.167	0.166
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	13.300	13.020	14.130	13.650	13.130	12.700
LANTHANUM (LA)	WT %	0.605	0.634	0.733	0.644	0.578	0.601
LEAD (PB)	WT %	0.511	0.500	0.546	0.537	0.510	0.480
LITHIUM (LI)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MAGNESIUM (MG)	WT %	0.236	0.221	0.251	0.248	0.211	0.212
MANGANESE (MN)	WT %	1.211	1.186	1.275	1.264	1.205	1.170
MOLYBDENUM (MO)	WT %	0.283	0.280	0.299	0.289	0.276	0.266
NEODYMIUM (ND)	WT %	4.702	4.596	5.008	4.835	4.606	4.464
NICKEL (NI)	WT %	1.219	1.197	1.282	1.245	1.187	1.162
NIObIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	0.008	<0.01	<0.01
PHOSPHOROUS (P)	WT %	0.172	0.148	0.269	0.205	0.181	0.165
PRASEODYMIUM (PR)	WT %	0.121	0.114	0.132	0.113	0.088	0.095
RHODIUM (RH)	WT %	0.002	<0.01	0.012	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.286	0.281	0.307	0.296	0.279	0.269
SAMARIUM (SA)	WT %	0.020	0.029	0.044	0.041	0.019	0.033
SELENIUM (SE)	WT %	0.001	0.002	<0.01	0.004	<0.01	<0.01
SILICON (SI)	WT %	0.211	0.227	0.220	0.218	0.234	0.252
SILVER (AG)	WT %	0.107	0.105	0.113	0.107	0.102	0.099
SODIUM (NA)	WT %	9.329	9.168	9.123	10.030	9.433	9.272
STRONTIUM (SR)	WT %	0.086	0.085	0.091	0.089	0.085	0.082
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.171	0.158	0.168	0.168	0.161	0.156
TIN (SN)	WT %	0.013	0.012	0.014	0.007	0.008	0.009
TITANIUM (TI)	WT %	0.029	0.034	0.032	0.030	0.028	0.032
YTTRIUM (Y)	WT %	0.046	0.045	0.048	0.047	0.045	0.043
ZINC (ZN)	WT %	0.194	0.191	0.203	0.198	0.190	0.183
ZIRCONIUM (ZR)	WT %	7.244	7.125	7.702	7.515	7.155	6.883

SAMPLE ID		SMRW 0082	SMRW 0082	SMRW 0083	SMRW 0083	SMRW 0086	SMRW 0087
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		11/13/91	11/13/91	11/13/91	11/13/91	11/14/91	11/14/91
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 1
COMPONENT	Units						
ICP (Filtrate)							
ALUMINUM (AL)	PPM	<0.01	<0.01	<0.01	<0.01	0.493	0.480
BARIUM (BA)	PPM	0.342	0.346	0.354	0.346	0.252	0.248
BORON (B)	PPM	2.315	2.324	2.330	2.269	2.535	2.702
CADMIUM (CD)	PPM	32.740	32.710	32.710	32.320	1.513	1.495
CALCIUM (CA)	PPM	82.660	82.200	80.720	80.680	30.480	29.430
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	0.049	0.150	0.073	0.122	0.900	0.425
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	0.012	0.014	0.014	0.013	<0.01	<0.01
LANTHANUM LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	6.127	6.074	6.023	6.032	8.003	8.000
MAGNESIUM (MG)	PPM	188.800	186.600	185.000	184.500	74.760	74.540
MANGANESE (MN)	PPM	65.560	65.450	65.200	65.090	3.824	3.866
MOLYBDENUM (MO)	PPM	15.570	15.420	15.370	15.430	48.610	48.320
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	0.070	0.077	0.083	0.085	<0.01	<0.01
NIObIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	2.260	2.131	2.100	2.223	1.746	1.820
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	72.100	72.270	72.770	72.460	81.710	81.490
RUTHENIUM (RU)	PPM	1.372	1.405	1.409	1.413	0.938	0.910
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	0.072	0.071	0.066	0.073	<0.01	<0.01
SILICON (SI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	8501.000	8426.000	8381.000	8302.000	8643.000	8582.000
STRONTIUM (SR)	PPM	12.990	12.820	12.740	12.580	5.332	5.336
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TIN (SN)	PPM	<0.01	<0.01	<0.01	0.012	<0.01	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SMCO 0097	SMCO 0097	SMCO 0097	SMCO 0097	SMCO 0098	SMCO 0098	SMCO 0098	SMCO 0098	SMCO 0100	SMCO 0100
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/26/91	11/26/91
ANALYSIS # OF total COMPONENT		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 2	2 OF 2
IC (Filtrate)	Units										
FORMATE (COOH[1-])	MG/L	14027	13989	14626	13619	13997	14585	14237	13923	15272	16912
NITRATE (NO3[1-])	MG/L	11549	11445	11847	11201	11502	11776	11714	11485	32079	35198
NITRITE (NO2[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	33	34
OXALATE (C2O4[2-])	MG/L	1022	1040	1043	1008	1014	1033	1046	1023	1089	1171
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1086	1120	1127	1081	1100	1109	1112	1111	1380	1495
IC (vit/Na2O2/H2O)											
CHLORIDE (CL[1-])	MG/L										
FLUORIDE (F[1-])	MG/L										
PHOSPHATE (PO4[3-])	MG/L	<91	<561	<21	<1	<207	<129	<68	<7		<1
SULFATE (SO4[2-])	MG/L	3686	4093	3679	3763	3803	3556	3669	3564		4374
Wet Chemistry											
PH	PH	9.68	9.68	9.68	9.68	9.70	9.70	9.70	9.70	9.69	9.69
TOTAL WT % SOLIDS	WT %	31.02	30.77	30.76	31.07	31.04	30.81	31.05	31.14	39.54	39.58
RHEOGRAM DONE (Y/N)	DD-MON-YY	11-12-91	11-12-91	11-12-91	11-12-91	11-12-91	11-12-91	11-12-91	11-12-91	Y 04-12-92	Y 04-12-92
CALCINED % SOLIDS	WT %	27.72	27.84	27.81	27.80	27.80	27.89	27.77	27.66	34.25	34.25
DENSITY	G/^L	1.25	1.25	1.25	1.25	1.27	1.27	1.27	1.27	1.33	1.33
Carbon Analysis											
TOTAL CARBON	PPM	5454	5487	5754	5605	5881	5636	6073	6106	2640	2829
TOTAL INORGANIC CARBON	PPM	1744	1850	1979	1545	2254	2142	2528	2390	4094	4221
TOTAL ORGANIC CARBON	PPM	3710	3637	3776	4060	3627	3494	3545	3716	6734	7050
AA (vit/Na2O2/HCl)											
SILICON (SI)	WT %	25.100	25.100	25.000	25.600	25.000	24.900	23.800	24.800		23.600
AA (vit/Microwave)											
SODIUM (NA)	WT %	3.159	3.075	3.064	3.130	3.066	3.083	3.041	2.969		4.770
POTASSIUM (K)	WT %	0.130	0.130	0.150	0.130	0.130	0.130	0.130	0.170		0.180
AE (vit/Microwave)											
CESIUM (CS)	WT %	0.698	0.746	0.749	0.788	0.739	0.644	0.745	0.696		0.100
Colorimetry											
Fe(II)/Fe(total)	ratio	0.013	0.014	0.022	0.011	0.004	0.011	0.003	0.008		0.011
ICP (vit/Na2O2/HCl)											
ALUMINUM (AL)	WT %	1.614	1.549	1.582	1.531	1.483	1.542	1.520	1.523		1.384
BARIUM (BA)	WT %	0.062	0.061	0.062	0.062	0.060	0.062	0.061	0.063		0.056
BORON (B)	WT %	4.735	4.729	4.696	4.830	4.806	4.831	4.812	4.790		3.978
CADMIUM (CD)	WT %	0.959	0.952	0.965	0.983	0.961	0.977	0.968	0.953		0.827</

SAMPLE ID		SMCO 0097	SMCO 0097	SMCO 0097	SMCO 0097	SMCO 0098	SMCO 0098	SMCO 0098	SMCO 0098	SMCO 0100	SMCO 0100
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/26/91	11/26/91
ANALYSIS # OF total		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 2	2 OF 2
COMPONENT	Units										
ICP (vit/Na2O2/HCl) cont'd											
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.149
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.096
SILICON (SI)	WT %	28.950	29.020	29.680	29.370	29.580	29.250	29.280	29.810		21.230
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.019
TIN (SN)	WT %	0.001	0.094	0.161	0.143	0.012	0.042	0.004	0.005		0.019
TITANIUM (TI)	WT %	0.122	0.086	0.091	0.091	0.088	0.090	0.093	0.092		0.089
YTTRIUM (Y)	WT %	0.013	0.012	0.012	0.013	0.013	0.014	0.014	0.012		0.019
ZIRCONIUM (ZR)	WT %	3.108	3.098	3.120	3.185	3.081	3.158	3.167	3.118		2.640
ICP (Aqua Regia)											
ALUMINUM (AL)	WT %	1.194	1.355	1.355	1.188	1.098	1.097	1.322	1.299		
BARIUM (BA)	WT %	0.053	0.056	0.056	0.054	0.055	0.054	0.053	0.055		
BORON (B)	WT %	2.958	2.796	3.024	3.088	3.023	2.925	3.059	2.942		
CADMIUM (CD)	WT %	0.840	0.870	0.868	0.849	0.873	0.864	0.846	0.844		
CALCIUM (CA)	WT %	0.260	0.270	0.260	0.260	0.260	0.260	0.260	0.260		
CERIUM (CE)	WT %	0.179	0.174	0.161	0.143	0.192	0.178	0.174	0.151		
CHROMIUM (CR)	WT %	0.048	0.053	0.052	0.049	0.051	0.051	0.050	0.050		
COPPER (CU)	WT %	0.084	0.085	0.087	0.091	0.088	0.088	0.084	0.086		
GERMANIUM (GE)	WT %	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010		
IRON (FE)	WT %	5.002	5.270	5.246	5.105	5.213	5.135	5.073	5.041		
LANTHANUM (LA)	WT %	0.290	0.242	0.279	0.211	0.222	0.261	0.248	0.201		
LEAD (PB)	WT %	0.194	0.207	0.211	0.205	0.200	0.210	0.205	0.195		
LITHIUM (LI)	WT %	2.158	2.043	2.143	2.162	2.149	2.046	2.156	2.121		
MAGNESIUM (MG)	WT %	0.110	0.126	0.129	0.118	0.127	0.127	0.132	0.129		
MANGANESE (MN)	WT %	0.421	0.440	0.444	0.438	0.441	0.440	0.430	0.436		
MOLYBDENUM (MO)	WT %	0.113	0.113	0.115	0.113	0.114	0.107	0.115	0.109		
NEODYMIUM (ND)	WT %	1.615	1.717	1.698	1.616	1.682	1.666	1.659	1.642		
NICKEL (NI)	WT %	0.454	0.468	0.464	0.453	0.467	0.455	0.452	0.451		
NIوبيUM (NB)	WT %	0.003	0.008	0.006	0.003	0.007	0.009	0.007	0.008		
PALLADIUM (PD)	WT %	0.031	0.042	0.043	0.030	0.042	0.047	0.051	0.053		0.062
PHOSPHOROUS (P)	WT %	0.016	0.021	0.018	0.028	0.017	0.024	0.025	0.022		
PRASEODYMIUM (PR)	WT %	0.093	0.103	0.092	0.077	0.106	0.090	0.098	0.091		
RHODIUM (RH)	WT %	0.041	0.044	0.035	0.029	0.046	0.039	0.034	0.060		0.050
RUBIDIUM (RB)	WT %	<0.01	0.025	0.002	<0.010	<0.010	0.052	<0.010	<0.010		
RUTHENIUM (RU)	WT %	0.097	0.109	0.112	0.105	0.116	0.116	0.113	0.113		0.122
SAMARIUM (SA)	WT %	0.066	0.059	0.063	0.024	0.064	0.073	0.073	0.039		
SELENIUM (SE)	WT %	0.016	0.021	0.021	0.018	0.023	0.023	0.027	0.020		0.028
SILICON (SI)	WT %	0.934	0.720	0.554	0.457	0.420	0.397	0.335	0.328		
SILVER (AG)	WT %	0.041	0.043	0.042	0.041	0.042	0.043	0.043	0.042		0.041
SODIUM (NA)	WT %	3.455	3.175	3.246	3.343	3.309	2.942	3.284	3.041		
STRONTIUM (SR)	WT %	0.032	0.034	0.033	0.033	0.033	0.033	0.033	0.033		
TANTALUM (TA)	WT %	0.009	0.003	0.008	0.006	0.011	0.007	0.002	0.013		
TELLURIUM (TE)	WT %	0.042	0.056	0.052	0.052	0.055	0.058	0.057	0.048		0.076
TIN (SN)	WT %	0.008	0.008	0.007	0.008	0.007	0.009	0.008	0.009		

SAMPLE ID		SMCO 0097	SMCO 0097	SMCO 0097	SMCO 0097	SMCO 0098	SMCO 0098	SMCO 0098	SMCO 0098	SMCO 0100	SMCO 0100
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/15/91	11/26/91	11/26/91
ANALYSIS # OF total		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 2	2 OF 2
COMPONENT	Units										
ICP (Aqua Regia) cont'd											
TITANIUM (TI)	WT %	0.029	0.032	0.031	0.030	0.030	0.031	0.032	0.032		
YTTRIUM (Y)	WT %	0.019	0.020	0.019	0.019	0.020	0.019	0.019	0.019		
ZINC (ZN)	WT %	0.107	0.107	0.110	0.110	0.109	0.108	0.106	0.109		
ZIRCONIUM (ZR)	WT %	2.429	2.596	2.510	2.566	2.461	2.492	2.519	2.447		
ICP (vit/Microwave)											
CADMIUM (CD)	WT %	0.971	0.976	0.954	0.995	0.967	0.990	0.989	0.960		0.753
CALCIUM (CA)	WT %	0.279	0.277	0.415	0.280	0.293	0.290	0.299	0.275		0.234
CHROMIUM (CR)	WT %	0.055	0.054	0.053	0.051	0.061	0.065	0.065	0.053		0.051
COPPER (CU)	WT %	0.105	0.092	0.136	0.085	0.096	0.109	0.109	0.087		0.063
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
IRON (FE)	WT %	6.540	6.537	6.602	6.714	6.470	6.612	6.604	6.431		4.803
LEAD (PB)	WT %	0.137	0.133	0.185	0.153	0.178	0.189	0.194	0.100		0.129
MAGNESIUM (MG)	WT %	0.035	0.018	0.008	<0.01	0.081	0.083	0.078	0.030		0.082
MANGANESE (MN)	WT %	0.508	0.507	0.535	0.516	0.501	0.509	0.511	0.509		0.414
MOLYBDENUM (MO)	WT %	0.103	0.101	0.094	0.096	0.120	0.119	1.659	0.089		0.099
NICKEL (NI)	WT %	0.560	0.549	0.561	0.559	0.556	0.557	0.558	0.518		0.429
PHOSPHOROUS (P)	WT %	0.023	0.005	<0.01	0.019	0.022	0.051	0.024	<0.01		0.061
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
SODIUM (NA)	WT %	4.756	4.786	4.893	4.943	4.904	5.060	4.655	4.341		5.968
STRONTIUM (SR)	WT %	0.020	0.020	0.021		0.022	0.022	0.028	0.022		0.016
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	0.002	0.011	<0.01	<0.01		<0.01
TELLURIUM (TE)	WT %										0.045
TIN (SN)	WT %	0.001	<0.01	<0.01	0.021	0.017	0.062	0.020	0.002		<0.01
TITANIUM (TI)	WT %	0.089	0.089	0.103	0.089	0.094	0.094	0.095	0.084		0.081
YTTRIUM (Y)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
ZINC (ZN)	WT %	0.123	0.123	0.125	0.125	0.125	0.126	0.127	0.134		0.094

Analytical Results:

HWVP1 Melter Feed

SAMPLE ID		MFTH 0101	MFTH 0101	MFTR 0102	MFTR 0102	MFTR 0102	MFTR 0102
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		11/29/91	11/29/91	11/29/91	11/29/91	11/29/91	11/29/91
ANALYSIS # OF total COMPONENT	Units	1 OF 2	2 OF 2	1 OF 4	2 OF 4	3 OF 4	4 OF 4
IC (Filtrate)							
FORMATE (COOH[1-])	MG/L	15173	14744	15442	13219	15454	14302
NITRATE (NO3[1-])	MG/L	20436	19953	30201	25966	30277	28211
NITRITE (NO2[1-])	MG/L	<13	<12	<29	<24	<29	<27
OXALATE (C2O4[2-])	MG/L	38	35	941	816	945	908
PHOSPHATE (PO4[3-])	MG/L	<23	<1	<13	<32	<16	<10
SULFATE (SO4[2-])	MG/L	1281	1237	1508	1310	1536	1453
IC (Na2O2/H2O)							
CHLORIDE (CL[1-])	MG/L						
FLUORIDE (F[1-])	MG/L						
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	4590	4413	4034	4620	3967	4715
Wet Chemistry							
PH	PH	8.54	8.54	9.50	9.51	9.51	9.51
TOTAL WT % SOLIDS	WT %	39.63	40.22	36.56	36.85	36.97	36.75
RHEOGRAM DONE (Y/N)	DD-MON-YY	04-12-91	04-12-91	05-12-91	05-12-91	05-DEC-91	05-DEC-91
CALCINED % SOLIDS	WT %	37.51	37.51	34.41	34.45	34.10	34.27
DENSITY	G/ML	1.29	1.29	1.28	1.30	1.28	1.29
Carbon Analysis							
TOTAL CARBON	PPM	8273	7810	7048	6927	6904	7043
TOTAL INORGANIC CARBON	PPM	2697	2441	2570	2634	2502	2483
TOTAL ORGANIC CARBON	PPM	5576	5369	4478	4293	4402	4560
AA (vit/Na2O2/HCl)							
SILICON (SI)	WT %	25.200	25.000	26.100	25.800	25.700	25.900
AA (vit/Microwave)							
SODIUM (NA)	WT %	5.203	5.156	4.781	4.807	4.774	4.876
POTASSIUM (K)	WT %	1.410	1.390	1.390	0.650	0.620	0.620
AE (vit/Microwave)							
CESIUM (CS)	WT %	0.100	0.100	<0.10	0.100	0.100	0.100
Colorimetry							
Fe(II)/Fe(total)	RATIO	0.008	0.007	0.009	0.007	0.008	0.008

SAMPLE ID		MFTH 0101	MFTH 0101	MFTR 0102	MFTR 0102	MFTR 0102	MFTR 0102
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		11/29/91	11/29/91	11/29/91	11/29/91	11/29/91	11/29/91
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units						
ICP (vit/Na2O2/HCl)							
ALUMINUM (AL)	WT %	1.944	1.888	1.476	1.528	1.495	1.534
BARIUM (BA)	WT %	0.129	0.127	0.077	0.081	0.077	0.080
BORON (B)	WT %	2.178	2.106	3.291	3.395	3.326	3.405
CADMIUM (CD)	WT %	0.021	0.005	0.540	0.544	0.533	0.550
CALCIUM (CA)	WT %	0.910	0.890	0.555	0.562	0.551	0.561
CERIUM (CE)	WT %	0.008	<0.01	0.120	0.104	0.177	0.170
CHROMIUM (CR)	WT %	0.125	0.124	0.089	0.084	0.081	0.081
COPPER (CU)	WT %	0.228	0.217	0.116	0.121	0.116	0.118
GERMANIUM (GE)	WT %	0.047	0.055	0.025	0.022	0.040	0.050
IRON (FE)	WT %	5.385	5.523	4.593	5.123	4.918	5.071
LANTHANUM (LA)	WT %	<0.01	<0.01	0.073	<0.01	<0.01	<0.01
LEAD (PB)	WT %	0.246	0.217	0.212	0.210	0.219	0.201
LITHIUM (LI)	WT %	2.188	2.272	2.240	2.310	2.232	2.287
MAGNESIUM (MG)	WT %	0.959	0.957	0.402	0.431	0.425	0.420
MANGANESE (MN)	WT %	1.757	1.733	0.843	0.889	0.834	0.862
MOLYBDENUM (MO)	WT %	0.025	0.019	0.088	0.083	0.094	0.094
NEODYMIUM (ND)	WT %	0.117	0.105	1.203	1.191	1.277	1.282
NIOBIUM (NB)	WT %	0.009	0.006	0.011	0.007	0.015	0.009
PALLADIUM (PD)	WT %	0.047	0.055	0.054	0.058	0.090	0.082
PHOSPHOROUS (P)	WT %	0.065	0.061	0.038	0.049	0.060	0.058
PRASEODYMIUM (PR)	WT %	0.025	0.019	0.086	0.056	0.133	0.116
RHODIUM (RH)	WT %	0.042	0.033	0.040	0.032	0.058	0.062
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	0.038	0.148
RUTHENIUM (RU)	WT %	0.124	0.108	0.126	0.118	0.135	0.117
SAMARIUM (SA)	WT %	<0.01	<0.01	0.050	0.019	0.115	0.069
SELENIUM (SE)	WT %	0.052	0.040	0.051	0.036	0.050	0.041
SILICON (SI)	WT %	21.860	21.560	20.500	21.380	20.870	21.190
SILVER (AG)	WT %	<0.01	<0.01	0.025	0.026	0.029	0.028
STRONTIUM (SR)	WT %	0.027	0.025	0.033	0.033	0.033	0.034
TANTALUM (TA)	WT %	0.042	0.021	0.029	0.034	0.023	0.032
TELLURIUM (TE)	WT %	0.060	0.050	0.063	0.083	0.074	0.063
TIN (SN)	WT %	0.042	0.051	0.011	0.230	0.017	0.019
TITANIUM (TI)	WT %	0.234	0.221	0.125	0.134	0.126	0.134
YTTRIUM (Y)	WT %	0.001	<0.01	0.013	0.012	0.014	0.015
ZINC (ZN)	WT %	0.195	0.160	0.160	0.145	0.139	0.143
ZIRCONIUM (ZR)	WT %	1.382	1.440	1.789	1.865	1.816	1.859

SAMPLE ID		MFTH 0101	MFTH 0101	MFTR 0102	MFTR 0102	MFTR 0102	MFTR 0102
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		11/29/91	11/29/91	11/29/91	11/29/91	11/29/91	11/29/91
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units						
ICP (Aqua Regia)							
PALLADIUM (PD)	WT %	0.067	0.062	0.052	0.065	0.052	0.060
RHODIUM (RH)	WT %	0.038	0.030	0.034	0.039	0.031	0.042
RUTHENIUM (RU)	WT %	0.097	0.100	0.107	0.116	0.087	0.105
SELENIUM (SE)	WT %	0.032	0.036	0.031	0.028	0.033	0.024
SILVER (AG)	WT %	<0.01	<0.01	0.026	0.028	0.022	0.028
TELLURIUM (TE)	WT %	0.033	0.032	0.062	0.055	0.061	0.061
ICP (Microwave)							
ALUMINIUM (AL)	WT %	1.854	1.868	1.460	1.479	1.460	1.473
BARIUM (BA)	WT %	0.126	0.129	0.067	0.060	0.058	0.059
CADMIUM (CD)	WT %	0.017	<0.01	0.517	0.513	0.522	0.525
CALCIUM (CA)	WT %	0.752	0.762	0.408	0.417	0.401	0.405
CERIUM (CE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	WT %	0.117	0.115	0.077	0.074	0.072	0.073
COPPER (CU)	WT %	0.214	0.211	0.104	0.108	0.105	0.106
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	5.226	5.204	5.006	5.081	5.000	5.045
LANTHANUM (LA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	WT %	0.186	0.190	0.147	0.135	0.135	0.132
LITHIUM (LI)	WT %	2.327	2.328	2.333	2.352	2.314	2.338
MAGNESIUM (MG)	WT %	0.888	0.911	0.350	0.369	0.351	0.353
MANGANESE (MN)	WT %	1.664	1.678	0.826	0.859	0.828	0.831
MOLYBDENUM (MO)	WT %	<0.01	<0.01	0.068	0.068	0.068	0.069
NEODYMIUM (ND)	WT %	<0.01	<0.01	0.299	<0.01	<0.01	<0.01
NICKEL (NI)	WT %	0.884	0.894	0.589	0.598	0.587	0.592
NIObIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	WT %	0.106	0.129	0.100	0.088	0.071	0.086
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.026	0.028	0.026	0.018	0.019	0.019
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	20.520	20.890	18.820	20.150	20.190	19.930
SILVER (AG)	WT %	<0.01	<0.01	0.021	0.021	0.021	0.021
SODIUM (NA)	WT %	6.713	6.695	6.184	6.176	6.041	6.025
STRONTIUM (SR)	WT %	0.021	0.021	0.022	0.018	0.017	0.018
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.024	0.023	0.035	0.034	0.033	0.034
TIN (SN)	WT %	0.035	0.044	0.015	<0.01	0.054	<0.01
TITANIUM (TI)	WT %	0.224	0.219	0.124	0.128	0.123	0.125
YTTRIUM (Y)	WT %	<0.01	<0.01	0.004	<0.01	<0.01	<0.01
ZINC (ZN)	WT %	0.126	0.128	0.104	0.105	0.104	0.105
ZIRCONIUM (ZR)	WT %	1.480	1.511	1.789	1.809	1.768	1.788

SAMPLE ID		MFTR 0105	MFTR 0105	MFT 0120	MFT 0120	MFTR 0121	MFTR 0121	MFTR 0122	MFTR 0122	MFTR 0127
ANALYTICAL CODE(S)		SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY
DATE		11/30/91	11/30/91	12/1/91	12/1/91	12/3/91	12/3/91	12/3/91	12/3/91	12/6/91
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2
COMPONENT	Units									
IC (Filtrate)										
FORMATE (COOH[1-])	MG/L	14382	15027	15018	14969	15285	14907	14210	14803	15176
NITRATE (NO3[1-])	MG/L	28250	29617	30206	30321	30307	30280	27889	29617	32430
NITRITE (NO2[1-])	MG/L	<27	<28	<30	<30	29	29	30	27	28
OXALATE (C2O4[2-])	MG/L	897	941	944	958	987	952	867	923	1071
PHOSPHATE (PO4[3-])	MG/L	<8	<15	<12	<1	<8	<6	<35	<8	<37
SULFATE (SO4[2-])	MG/L	1419	1479	1512	1540	1481	1442	1341	1419	1435
IC (Na2O2/H2O)										
CHLORIDE (CL[1-])	MG/L									
FLUORIDE (F[1-])	MG/L									
PHOSPHATE (PO4[3-])	MG/L									
SULFATE (SO4[2-])	MG/L									
Wet Chemistry										
PH	PH	9.49	9.49	9.50	9.50	9.43	9.43	9.50	9.50	9.53
TOTAL WT % SOLIDS	WT %	38.49	38.75	37.29	37.19	37.65	37.95	37.98	37.75	37.51
RHEOGRAM DONE (Y/N)	DD-MON-YY	05-DEC-91	05-DEC-91	04-DEC-91	04-DEC-91	11-12-91	11-12-91	11-12-91	11-12-91	14-01-92
CALCINED % SOLIDS	WT %	34.76	34.95	34.64	34.55	35.41	35.08	35.36	35.36	35.14
DENSITY	G/ML	1.27	1.27	1.28	1.30	1.29	1.30	1.28	1.28	1.27
Carbon Analysis										
TOTAL CARBON	PPM	7044	7067	7174	7327	7332	7258	7133	7400	7295
TOTAL INORGANIC CARBON	PPM	2361	2407	2514	3030	2467	2480	2564	2700	3043
TOTAL ORGANIC CARBON	PPM	4683	4660	4660	4297	4865	4779	4569	4700	4252

SAMPLE ID		MFTR 0127	MFTR 0146	MFTR 0146	MFTR 0157	MFTR 0157	MFTR 0267	MFTR 0267
ANALYTICAL CODE(S)		SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY
DATE		12/6/91	12/7/91	12/7/91	12/8/91	12/8/91	12/13/91	12/13/91
ANALYSIS # OF total COMPONENT	Units	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2
IC (Filtrate)								
FORMATE (COOH[1-])	MG/L	15613	14859	15582	15197	14433	14937	14517
NITRATE (NO3[1-])	MG/L	32167	31585	32904	33065	32233	32152	30135
NITRITE (NO2[1-])	MG/L	29	28	29	28	<28	26	25
OXALATE (C2O4[2-])	MC	1044	1036	1068	786	763	1217	1180
PHOSPHATE (PO4[3-])	MG/L	<13	<10	<9	<14	<12	<23	<24
SULFATE (SO4[2-])	MG/L	1417	1425	1463	1530	1507	1455	1396
IC (Na2O2/H2O)								
CHLORIDE (CL[1-])	MG/L							
FLUORIDE (F[1-])	MG/L							
PHOSPHATE (PO4[3-])	MG/L							
SULFATE (SO4[2-])	MG/L							
Wet Chemistry								
PH	PH	9.53	9.48	9.48	9.59	9.59	9.48	9.48
TOTAL WT % SOLIDS	WT %	37.07	36.19	36.05	35.92	35.35	36.10	36.04
RHEOGRAM DONE (Y/N)	DD-MON-YY	14-01-92	14-01-92	14-01-92	8-1-92	8-1-92	09-01-92	09-01-92
CALCINED % SOLIDS	WT %	35.01	34.99	35.00	34.03	34.07	34.79	35.25
DENSITY	G/ML	1.29	1.29	1.29	1.32	1.30	1.32	1.31
Carbon Analysis								
TOTAL CARBON	PPM	7181	6612	6804	6994	6694	7049	7140
TOTAL INORGANIC CARBON	PPM	2720	2566	2446	2917	2603	2672	3314
TOTAL ORGANIC CARBON	PPM	4461	4046	4358	4077	4091	4377	3826

Analytical Results:

HWVP1 Offgas Condensate

SAMPLE ID		OGCT 0106	OGCB 0107	OGCT 0108	OGCB 0109	OGCT 0110	OGCB 0111	OGCT 0115	OGCB 0116	OGCT 0123	OGCB 0124	OGCT 0128
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		11/30/91	11/30/91	11/30/91	11/30/91	11/30/91	11/30/91	12/1/91	12/1/91	12/3/91	12/3/91	12/6/91
ANALYSIS # OF total COMPONENT	Units	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	235	232	234	222	204	208	211	207	249	243	275
FLUORIDE (F[1-])	MG/L	28	28	28	27	26	25	26	26	32	32	36
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	818	832	834	827	923	939	928	923	1301	1289	1318
NITRITE (NO2[1-])	MG/L	8	9	8	10	13	14	14	15	10	10	11
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	37	37	36	36	13	33	33	33	58	58	73
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH		2.00	2.03	2.06	2.07	2.05	2.05	2.06	2.06	1.89	1.86	1.91
TOT ACID (EQ PT)	MOLE/LITER	0.020 TO PH 7	0.018 TO PH 7	0.021 TO PH 7	0.020 TO PH 7	0.023 TO PH 7	0.023 TO PH 7	0.022 TO PH 7	0.023 TO PH 7	.028 TO PH 7	.031 TO PH 7	.028 TO PH 7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	2.719	2.348	2.417	2.366	2.255	2.344	2.228	2.244	2.444	2.484	3.880
BARIUM (BA)	PPM	0.238	0.215	0.223	0.217	0.202	0.195	0.202	0.201	0.213	0.217	0.284
BORON (B)	PPM	25.410	24.210	23.420	23.980	25.280	22.220	25.200	24.200	25.870	25.810	29.010
CADMIUM (CD)	PPM	0.238	0.233	0.280	0.322	0.551	0.519	0.551	0.550	0.821	0.831	1.160
CALCIUM (CA)	PPM	4.459	3.806	3.937	4.057	3.946	3.464	3.717	3.983	3.674	3.548	3.969
CERIUM (CE)	PPM	<0.01	0.080	0.081	0.085	0.151	<0.01	<0.01	0.135	0.161	0.120	<0.01
CHROMIUM (CR)	PPM	2.557	2.330	2.921	3.087	1.995	1.793	1.998	1.988	2.318	2.455	3.177
COPPER (CU)	PPM	4.570	4.175	4.133	3.962	3.571	3.299	3.550	3.531	3.759	3.828	4.501
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.030	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	4.716	4.538	4.865	19.070	4.138	4.089	4.151	4.362	4.375	4.564	7.370
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	2.644	2.449	2.427	2.382	2.215	1.959	2.108	2.082	2.183	2.187	2.642
LITHIUM (LI)	PPM	3.986	3.671	3.677	3.753	3.848	3.605	3.818	3.832	4.564	4.638	6.230
MAGNESIUM (MG)	PPM	0.664	0.610	0.648	0.678	0.603	0.692	0.576	0.694	0.722	0.692	0.645
MANGANESE (MN)	PPM	2.285	2.037	2.050	2.067	1.725	1.577	1.737	1.723	1.660	1.711	2.674
MOLYBDENUM (MO)	PPM	0.518	0.322	2.097	2.549	0.288	0.336	0.296	0.303	0.513	0.589	1.167
NEODYMIUM (ND)	PPM	0.234	0.106	0.146	0.238	0.464	0.845	0.451	0.485	0.644	0.644	0.918
NICKEL (NI)	PPM	1.577	1.342	3.154	5.641	1.008	0.990	1.015	1.060	1.044	1.232	2.094
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.028	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	1.476	2.491	1.804	2.076	2.094	0.990	2.028	1.875	1.238	1.201	0.311
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	1.380	1.277	1.297	1.371	1.250	1.181	1.246	1.218	1.499	1.516	2.121
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	0.969	0.931	0.922	0.932	1.024	0.946	1.021	0.996	1.081	1.079	1.137
SILICON (SI)	PPM	4.370	4.015	4.342	4.391	4.812	4.466	4.784	4.813	5.650	5.729	8.421
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	73.420	66.730	66.920	65.640	59.760	55.110	59.910	59.700	65.940	66.900	79.380
STRONTIUM (SR)	PPM	0.061	0.055	0.056	0.057	0.057	0.053	0.056	0.057	0.057	0.057	0.093
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.008	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	0.597	0.558	0.582	0.560	0.509	0.619	0.513	0.526	0.775	0.747	1.186
TIN (SN)	PPM	0.080	0.077	0.086	0.065	0.062	0.064	0.066	0.057	0.069	0.067	0.063
TITANIUM (TI)	PPM	0.175	0.158	0.157	0.152	0.147	0.140	0.144	0.146	0.150	0.148	0.200
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	0.387	0.377	0.356	0.362	0.314	0.290	0.314	0.313	0.326	0.332	0.422
ZIRCONIUM (ZR)	PPM	0.567	0.569	0.589	0.755	1.211	1.128	1.216	1.120	1.478	1.508	2.110

SAMPLE ID		OGCB 0129	OGCT 0136	OGCB 0137	OGCT 0141	OGCB 0142	OGCT 0147	OGCB 0148	OGCT 0152	OGCB 0153	OGCT 0158	OGCB 0159
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		12/6/91	12/9/91	12/6/91	12/7/91	12/7/91	12/7/91	12/7/91	12/8/91	12/8/91	12/8/91	12/8/91
ANALYSIS # OF total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)	Units											
CHLORIDE (CL[1-])	MG/L	277	212	256	237	245	233	213	218	206	215	199
FLUORIDE (F[1-])	MG/L	36	35	34	32	32	31	28	25	27	27	27
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1366	1281	1277	1296	1310	1372	1408	1482	1419	1431	1416
NITRITE (NO2[1-])	MG/L	12	13	14	23	21	23	1	2	2	2	2
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	2	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	73	71	73	69	68	66	60	47	46	46	47
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	2.00	1.88	2.00	2.00	1.89	2.11	2.09	1.94	1.90	1.93	197.00
TOT ACID (EQ PT)	MOLE/LITER	0.031 TO PH 7	.027 TO PH 7	0.030 TO PH 7	0.030 TO PH 7	.028 TO PH 7	0.031 TO PH 7	0.031 TO PH 7	.029 TO PH 7	.033 TO PH 7	0.034 TO PH 7	0.034 TO PH 7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	3.650	3.476	3.395	3.439	3.404	3.483	3.469	3.458	3.629	3.546	3.284
BARIUM (BA)	PPM	0.290	0.278	0.281	0.270	0.270	0.267	0.265	0.256	0.264	0.254	0.246
BORON (B)	PPM	26.480	29.960	30.040	31.240	31.260	32.000	32.410	32.800	31.800	33.340	34.990
CADMIUM (CD)	PPM	1.184	1.238	1.247	1.332	1.344	1.403	1.423	1.562	1.631	1.723	1.659
CALCIUM (CA)	PPM	4.398	3.928	3.821	4.088	3.856	4.348	4.164	3.579	3.975	4.132	3.942
CERIUM (CE)	PPM	0.327	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.170	0.166	<0.01
CHROMIUM (CR)	PPM	3.286	3.033	2.883	2.654	2.653	2.660	2.470	2.791	2.451	2.314	2.341
COPPER (CU)	PPM	0.203	4.333	4.381	4.068	4.118	3.913	3.852	3.775	3.832	3.751	3.695
GERMANIUM (GE)	PPM	0.099	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	<0.01
IRON (FE)	PPM	6.630	6.524	6.866	6.859	6.550	6.670	7.066	6.694	7.021	6.526	6.835
LANTHANUM (LA)	PPM	0.279	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	2.711	2.509	2.507	2.363	2.334	2.248	2.208	2.177	2.300	2.197	2.109
LITHIUM (LI)	PPM	6.037	6.255	6.342	6.183	6.240	6.299	6.359	6.212	6.069	6.041	6.148
MAGNESIUM (MG)	PPM	1.021	0.620	0.560	0.649	0.589	0.720	0.693	0.640	0.937	0.984	0.688
MANGANESE (MN)	PPM	2.318	2.306	2.313	2.169	2.178	2.085	2.060	1.970	1.966	1.860	1.878
MOLYBDENUM (MO)	PPM	1.181	1.306	0.668	0.556	0.556	1.113	0.565	2.002	0.765	0.686	0.725
NEODYMIUM (ND)	PPM	1.940	1.114	1.057	1.262	1.244	1.280	1.324	1.496	2.236	2.337	1.486
NICKEL (NI)	PPM	2.975	2.101	1.509	1.321	1.309	1.790	1.312	2.514	1.470	1.245	1.310
NIObIUM (NB)	PPM	0.038	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	0.056	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.024	0.029	<0.01
PHOSPHOROUS (P)	PPM	0.856	0.363	0.325	0.408	0.388	0.465	0.430	0.373	0.687	0.732	0.454
PRASEODYMIUM (PR)	PPM	0.342	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.126	0.148	<0.01
RHODIUM (RH)	PPM	0.129	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	0.011	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	2.208	2.047	2.020	1.963	1.941	1.838	1.823	1.922	2.035	2.065	1.964
SAMARIUM (SM)	PPM	0.291	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.071	0.096	<0.01
SELENIUM (SE)	PPM	1.293	1.092	1.067	1.039	1.008	0.953	0.970	1.212	1.292	1.398	1.238
SILICON (SI)	PPM	7.784	8.324	8.316	8.794	8.715	9.357	9.384	9.555	9.464	9.484	9.390
SILVER (AG)	PPM	0.056	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.027	0.028	<0.01
SODIUM (NA)	PPM	72.640	76.780	77.080	72.790	73.630	76.330	82.570	67.550	65.530	63.210	66.070
STRONTIUM (SR)	PPM	0.095	0.092	0.093	0.093	0.092	0.093	0.092	0.087	0.090	0.090	0.087
TANTALUM (TA)	PPM	0.075	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.032	0.026	<0.01
TELLURIUM (TE)	PPM	1.282	1.148	1.126	1.055	1.057	1.044	1.033	1.047	1.166	1.154	1.057
TIN (SN)	PPM	0.108	0.061	0.057	0.044	0.046	0.041	0.043	0.044	0.072	0.088	0.034
TITANIUM (TI)	PPM	0.203	0.178	0.177	0.175	0.173	0.169	0.168	0.165	0.187	0.184	0.159
YTTRIUM (Y)	PPM	0.021	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.023	0.023	<0.01
ZINC (ZN)	PPM	0.404	0.392	0.395	0.377	0.377	0.369	0.361	0.369	0.373	0.367	0.354
ZIRCONIUM (ZR)	PPM	2.074	2.396	2.455	2.674	2.704	2.881	2.896	3.006	3.024	3.130	3.139

SAMPLE ID		OGCT 0160	OGCB 0161	OGCT 0165	OGCB 0166	OGCT 0167	OGCB 0168	OGCT 0257	OGCB 0258	OGCT 0262	OGCB 0263	OGCT 0268
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		12/8/91	12/8/91	12/8/91	12/8/91	12/9/91	12/9/91	12/12/91	12/12/91	12/13/91	12/13/91	12/13/91
ANALYSIS # OF total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)	Units											
CHLORIDE (CL[1-])	MG/L	190	217	192	185	182	176	165	163	157	153	158
FLUORIDE (F[1-])	MG/L	25	26	24	24	22	22	22	24	22	22	13
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1357	1440	1339	1316	1456	1459	1808	2107	2015	1975	2027
NITRITE (NO2[1-])	MG/L	2	2	2	2	1	2	3	3	3	3	2
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	45	46	41	40	38	37	48	56	52	52	23
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.99	1.97	2.01	2.03	2.05	2.05	2.24	2.10	2.08	2.09	2.06
TOT ACID (EQ PT)	MOLE/LITER	0.033 TO PH 7	.029 TO PH7	.027 TO PH7	0.031 TO PH 7	0.033 TO PH 7	0.033 TO PH 7	0.034 TO PH 7	0.039 TO PH 7	0.037 TO PH 7	0.037 TO PH 7	0.037 TO PH 7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	3.494	3.326	3.391	3.421	3.353	3.055	3.060	3.176	2.757	2.776	2.544
BARIUM (BA)	PPM	0.242	0.249	0.234	0.236	0.228	0.223	0.213	0.221	0.201	0.203	0.171
BORON (B)	PPM	31.850	35.090	31.670	31.640	32.050	34.690	35.430	32.750	36.180	36.460	31.260
CADMIUM (CD)	PPM	1.697	1.675	1.657	1.667	1.666	1.617	1.809	1.955	1.879	1.894	1.726
CALCIUM (CA)	PPM	3.815	3.984	3.395	3.592	3.569	3.508	3.979	3.931	4.043	3.745	1.449
CERIUM (CE)	PPM	0.408	<0.01	0.436	0.454	0.435	<0.01	<0.01	0.448	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	2.172	2.344	2.001	2.050	1.855	1.876	3.675	1.960	1.931	1.839	1.613
COPPER (CU)	PPM	3.403	3.634	3.288	3.283	3.104	3.173	3.568	3.737	3.756	3.777	3.320
GERMANIUM (GE)	PPM	0.126	~ 01	0.082	0.129	0.140	<0.01	<0.01	0.140	<0.01	<0.01	<0.01
IRON (FE)	PPM	6.291	7.050	6.193	6.879	6.146	6.617	6.720	6.411	6.020	6.549	5.816
LANTHANUM (LA)	PPM	0.315	<0.01	0.420	0.408	0.415	<0.01	<0.01	0.420	<0.01	<0.01	<0.01
LEAD (PB)	PPM	2.064	2.089	1.977	1.997	1.857	1.757	1.680	1.809	1.578	1.600	1.467
LITHIUM (LI)	PPM	5.658	6.097	5.462	5.509	5.324	5.610	5.848	5.486	5.590	5.574	4.786
MAGNESIUM (MG)	PPM	0.997	0.709	0.904	0.962	0.964	0.611	0.681	1.094	0.729	0.687	0.322
MANGANESE (MN)	PPM	1.733	1.924	1.666	1.667	1.580	1.631	1.521	1.379	1.329	1.365	1.288
MOLYBDENUM (MO)	PPM	0.865	0.896	0.713	0.877	0.686	0.619	7.518	1.011	1.238	0.800	1.094
NEODYMIUM (ND)	PPM	2.551	1.555	2.614	2.622	2.653	1.658	1.503	2.563	1.456	1.514	1.595
NICKEL (NI)	PPM	1.374	1.472	1.143	1.413	1.100	1.081	7.247	1.427	1.468	1.237	1.330
NIObIUM (NB)	PPM	0.036	<0.01	0.038	0.041	0.041	<0.01	<0.01	0.045	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	0.153	<0.01	0.178	0.166	0.175	<0.01	<0.01	0.202	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.605	0.417	0.694	0.640	0.663	0.318	0.450	0.543	0.404	0.445	0.404
PRASEODYMIUM (PR)	PPM	0.392	<0.01	0.411	0.416	0.424	<0.01	<0.01	0.440	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	0.127	<0.01	0.133	0.152	0.142	<0.01	<0.01	0.164	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	1.976	1.938	1.877	1.893	1.830	1.680	1.757	1.964	1.743	1.747	1.554
SAMARIUM (SM)	PPM	0.302	<0.01	0.344	0.344	0.362	<0.01	<0.01	0.376	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	1.313	1.204	1.250	1.287	1.205	1.015	1.091	1.349	1.055	1.079	0.887
SILICON (SI)	PPM	9.176	9.614	8.894	9.042	9.045	9.482	10.210	8.957	9.076	9.141	7.418
SILVER (AG)	PPM	0.041	<0.01	0.043	0.042	0.043	<0.01	<0.01	0.048	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	55.770	64.970	52.450	53.030	49.750	55.160	60.460	48.670	51.330	51.500	43.920
STRONTIUM (SR)	PPM	0.087	0.089	0.084	0.084	0.083	0.082	0.077	0.075	0.071	0.071	0.055
TANTALUM (TA)	PPM	0.079	<0.01	0.071	0.071	0.060	<0.01	<0.01	0.093	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	1.108	1.004	1.053	1.054	1.104	0.856	0.990	1.251	1.052	1.058	0.756
TIN (SN)	PPM	0.082	0.035	0.081	0.086	0.073	0.028	0.040	0.107	0.044	0.043	0.051
TITANIUM (TI)	PPM	0.182	0.160	0.180	0.180	0.176	0.147	0.129	0.159	0.120	0.122	0.119
YTTRIUM (Y)	PPM	0.030	<0.01	0.029	0.030	0.030	<0.01	<0.01	0.030	<0.01	<0.01	0.012
ZINC (ZN)	PPM	0.344	0.357	0.333	0.336	0.321	0.316	0.360	0.352	0.344	0.345	0.321
ZIRCONIUM (ZR)	PPM	3.136	3.244	3.159	3.153	3.201	3.348	3.198	2.999	3.113	3.125	2.888

SAMPLE ID		OGCB 0269	OGCT 0270	OGCB 0271	OGCT 0272	OGCB 0273	OGCT 0280	OGCB 0281	OGCT 0283	OGCB 0284	OGCT 0285	OGCB 0286
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		12/13/91	12/14/91	12/14/91	12/14/91	12/14/91	12/14/91	12/14/91	12/14/91	12/14/91	12/15/91	12/15/91
ANALYSIS # OF total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)	Units											
CHLORIDE (CL[1-])	MG/L	141	144	129	128	121	125	126	127	119	108	109
FLUORIDE (F[1-])	MG/L	18	16	18	17	16	17	16	15	16	14	14
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1944	1962	1865	1800	1800	1720	1732	1734	1682	1662	1671
NITRITE (NO2[1-])	MG/L	4	2	4	4	4	4	4	2	4	6	6
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	32	29	31	29	28	28	28	26	27	24	24
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.84	2.08	1.88	1.86	1.89	1.93	1.94	2.08	1.94	1.95	1.97
TOT ACID (EQ PT)	MOLE/LITER	.036 TO PH7	0.035 TO PH 7	.035 TO PH7	.034 TO PH7	.035 TO PH7	.031 TO PH7	.031 TO PH7	0.03 TO PH 7	.031 TO PH7	.031 TO PH7	.031 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	2.609	2.816	2.461	2.681	2.356	2.407	2.397	2.626	2.652	2.138	2.192
BARIUM (BA)	PPM	0.189	0.187	0.203	0.180	0.174	0.170	0.174	0.175	0.187	0.152	0.156
BORON (B)	PPM	36.320	31.650	36.210	33.080	34.700	36.200	35.260	34.090	34.580	39.450	35.260
CADMIUM (CD)	PPM	1.825	1.819	1.835	1.851	1.763	1.846	1.815	1.892	1.907	1.738	1.736
CALCIUM (CA)	PPM	3.398	3.399	3.193	3.460	4.002	3.383	3.099	3.093	2.918	2.832	2.679
CERIUM (CE)	PPM	<0.01	0.566	<0.01	0.142	<0.01	<0.01	<0.01	0.142	0.124	<0.01	<0.01
CHROMIUM (CR)	PPM	1.689	1.513	1.741	1.486	1.459	1.428	1.430	1.373	1.478	1.211	1.407
COPPER (CU)	PPM	3.642	3.507	3.765	3.529	3.519	3.385	3.408	3.277	3.332	3.050	3.129
GERMANIUM (GE)	PPM	<0.01	0.142	<0.01	0.013	<0.01	<0.01	<0.01	0.013	0.008	<0.01	<0.01
IRON (FE)	PPM	7.841	5.420	6.305	5.530	5.820	5.571	6.217	5.476	6.085	5.053	5.775
LANTHANUM (LA)	PPM	<0.01	0.446	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	1.484	1.483	1.470	1.415	1.305	1.256	1.288	1.361	1.379	1.133	1.158
LITHIUM (LI)	PPM	5.250	4.739	5.552	4.794	4.968	5.285	5.100	4.811	4.811	4.587	4.600
MAGNESIUM (MG)	PPM	0.643	0.998	0.505	0.907	0.690	0.570	0.515	0.792	0.779	0.478	0.455
MANGANESE (MN)	PPM	1.290	1.157	1.394	1.150	1.147	1.153	1.165	1.105	1.135	1.013	1.075
MOLYBDENUM (MO)	PPM	0.778	0.732	0.935	0.692	0.659	0.714	0.667	0.714	0.810	0.579	0.637
NEODYMIUM (ND)	PPM	1.455	2.574	1.450	2.194	1.369	1.400	1.443	2.221	2.238	1.283	1.324
NICKEL (NI)	PPM	1.200	1.039	1.639	1.006	1.020	1.004	0.955	0.950	1.006	0.812	0.986
NIObIUM (NB)	PPM	<0.01	0.053	<0.01	<0.01	<0.01	<0.01	<0.01	0.004	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	0.232	<0.01	0.015	<0.01	<0.01	<0.01	0.016	0.025	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.430	0.586	0.337	0.672	0.380	0.414	0.295	0.718	0.756	0.415	0.488
PRASEODYMIUM (PR)	PPM	<0.01	0.511	<0.01	0.113	<0.01	<0.01	<0.01	0.115	0.090	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	0.195	<0.01	0.023	<0.01	<0.01	<0.01	0.024	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	1.677	1.695	1.584	1.632	1.477	1.441	1.430	1.557	1.593	1.301	1.357
SAMARIUM (SM)	PPM	<0.01	0.451	<0.01	0.097	<0.01	<0.01	<0.01	0.060	0.057	<0.01	<0.01
SELENIUM (SE)	PPM	0.963	1.181	0.978	1.139	0.970	1.000	0.959	1.186	1.182	0.897	0.909
SILICON (SI)	PPM	8.740	8.165	8.673	8.330	8.255	8.508	8.460	8.342	8.469	7.662	7.745
SILVER (AG)	PPM	<0.01	0.044	<0.01	0.023	<0.01	<0.01	<0.01	0.023	0.026	<0.01	<0.01
SODIUM (NA)	PPM	46.680	38.870	70.820	40.810	43.020	58.690	43.500	38.720	38.890	36.990	37.080
STRONTIUM (SR)	PPM	0.067	0.067	0.068	0.066	0.066	0.065	0.065	0.065	0.065	0.058	0.058
TANTALUM (TA)	PPM	<0.01	0.108	<0.01	0.027	<0.01	<0.01	<0.01	0.013	0.012	<0.01	<0.01
TELLURIUM (TE)	PPM	0.963	1.063	0.887	0.951	0.824	0.815	0.820	0.925	0.924	0.719	0.741
TIN (SN)	PPM	0.039	0.092	0.040	0.064	0.020	0.020	0.017	0.069	0.074	0.021	0.016
TITANIUM (TI)	PPM	0.117	0.143	0.114	0.131	0.105	0.107	0.109	0.131	0.135	0.096	0.098
YTTRIUM (Y)	PPM	<0.01	0.030	<0.01	0.023	<0.01	<0.01	<0.01	0.023	0.024	<0.01	<0.01
ZINC (ZN)	PPM	0.335	0.330	0.353	0.333	0.329	0.325	0.325	0.325	0.329	0.300	0.301
ZIRCONIUM (ZR)	PPM	3.057	2.883	3.128	3.004	2.985	3.100	3.169	3.066	3.176	2.899	2.964

SAMPLE ID		OGCT 0291	OGCB 0292
ANALYTICAL CODE(S)		CONDEN	CONDEN
DATE		12/15/91	12/15/91
ANALYSIS # OF total		1 OF 1	1 OF 1
COMPONENT	Units		
IC (Filtrate)			
CHLORIDE (CL[1-])	MG/L	103	104
FLUORIDE (F[1-])	MG/L	14	13
FORMATE (COOH[1-])	MG/L	<1	<1
NITRATE (NO3[1-])	MG/L	1664	1714
NITRITE (NO2[1-])	MG/L	5	2
PHOSPHATE (PO4[3-])	MG/L	<1	<1
SULFATE (SO4[2-])	MG/L	23	23
AMMONIUM (NH4[1+])	MG/L	<1	<1
Wet Chemistry			
PH	PH	1.94	2.08
TOT ACID (EQ PT)	MOLE/LITER	.030 TO PH7	0.031 TO PH 7
ICP (Filtrate)			
ALUMINUM (AL)	PPM	2.049	2.391
BARIUM (BA)	PPM	0.145	0.160
BORON (B)	PPM	34.660	32.460
CADMIUM (CD)	PPM	1.664	1.721
CALCIUM (CA)	PPM	2.707	2.913
CERUM (CE)	PPM	<0.01	0.116
CHROMIUM (CR)	PPM	1.147	1.610
COPPER (CU)	PPM	3.002	3.011
GERMANIUM (GE)	PPM	<0.01	<0.01
IRON (FE)	PPM	4.902	17.100
LANTHANUM (LA)	PPM	<0.01	<0.01
LEAD (PB)	PPM	1.051	1.175
LITHIUM (LI)	PPM	4.341	4.341
MAGNESIUM (MG)	PPM	0.449	0.751
MANGANESE (MN)	PPM	0.974	1.079
MOLYBDENUM (MO)	PPM	0.567	2.169
NEODYMIUM (ND)	PPM	1.199	2.046
NICKEL (NI)	PPM	0.790	2.505
NIOBIUM (NB)	PPM	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	0.018
PHOSPHOROUS (P)	PPM	0.481	0.704
PRASEODYMIUM (PR)	PPM	<0.01	0.129
RHODIUM (RH)	PPM	<0.01	0.013
RUBIDIUM (RB)	PPM	<0.01	<0.01
RUTHENIUM (RU)	PPM	1.270	1.439
SAMARIUM (SM)	PPM	<0.01	0.062
SELENIUM (SE)	PPM	0.869	1.017
SILICON (SI)	PPM	7.416	7.645
SILVER (AG)	PPM	<0.01	<0.01
SODIUM (NA)	PPM	34.570	35.630
STRONTIUM (SR)	PPM	0.056	0.060
TANTALUM (TA)	PPM	<0.01	0.030
TELLURIUM (TE)	PPM	0.687	0.781
TIN (SN)	PPM	0.014	0.047
TITANIUM (TI)	PPM	0.093	0.120
YTTRIUM (Y)	PPM	<0.01	0.021
ZINC (ZN)	PPM	0.292	0.317
ZIRCONIUM (ZR)	PPM	2.820	2.842

Analytical Results:

HWVP2 Sludge through
Formic Digestion

SAMPLE ID		SRAT 0125	SRAT 0125	SRTC 0126	SRTC 0126	SRNM 0169	SRNM 0169	SRNM 0170	SRNM 0170	SRDF 0172	SRDF 0174	SRDF 0176
ANALYTICAL CODE(S)		BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/5/91	12/5/91	12/6/91	12/6/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91
ANALYSIS # OF total COMPONENT	Units	1 of 2	2 of 2	1 of 2	2 of 2	1 of 2	2 of 2	1 of 2	2 of 2	1 of 1	1 of 1	1 of 1
IC (Filtrate)												
FORMATE (COOH[1-])	MG/L	14687	15172	2539	2517	1995	2093	2197	2331	4263	5149	5604
NITRATE (NO3[1-])	MG/L	29838	31012	13331	13562	16642	16565	17561	18495	17674	18041	17117
NITRITE (NO2[1-])	MG/L	27	28	16984	16588	17780	17662	18712	19903	18699	19009	17807
OXALATE (C2O4[2-])	MG/L	1154	1219	489	472	1012	1031	1028	1119	NR	NR	NR
PHOSPHATE (PO4[3-])	MG/L	46	18	16	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1337	1385	1514	1494	1525	1596	1684	1719	1618	1632	1603
AMMONIUM (NH4[1+])	MG/L	NR	NR	NR	NR	NR	NR	NR	NR	<1	<1	<1
IC (Na2O2/H2O)												
CHLORIDE (CL[1-])	MG/L											
FLUORIDE (F[1-])	MG/L											
Wet Chemistry												
PH	PH	9.64	9.64	10.24	10.24	10.86	10.36	10.38	10.38	9.76	9.55	9.53
CALCINED % SOLIDS	WT %	21.25	20.92	16.31	16.37	19.20	18.69	18.80	18.43	19.14	18.73	18.95
TOT BASE (EQ PT)	MOLE/LITER	.37 TO PH7	.37 TO PH7	.21 TO PH7	.21 TO PH7	0.220 TO PH 7	0.219 TO PH 7	0.221 TO PH 7	0.219 TO PH 7	0.17 TO PH 7	0.16 TO PH 7	0.15 TO PH 7
RHEOGRAM DONE (Y/N)	DD-MON-YY	11-12-91	11-12-91	11-12-91	11-12-91	Y 20/01/92	Y 20/01/92	Y 20/01/92	Y 20/01/92	Y 17/01/92	Y 17/01/92	Y 20/01/92
TOTAL WT % SOLIDS	WT %	25.00	25.07	13.07	13.47	17.32	17.43	16.75	16.63	17.19	16.69	16.71
DENSITY	G/ML	1.20	1.20	1.17	1.14	1.17	1.16	1.17	1.18	1.14	1.17	1.18
Carbon Analysis												
TOTAL CARBON	PPM	6781	6970	3393	3326	3215	3228	4019	3513	3902	4069	4664
TOTAL INORGANIC CARBON	PPM	2714	2821	2179	1915	2073	2049	2305	2145	2001	2112	2250
TOTAL ORGANIC CARBON	PPM	4067	4149	1214	1411	1142	1179	1714	1368	1901	1957	2414
AA (Na2O2/HCl)												
SILICON (SI)	WT %	19.200	18.500	10.400	10.800	9.100	9.700	10.200	10.600	10.800	10.100	10.300
AA (Aqua Regia)												
SODIUM (NA)	WT %	4.870	4.581	8.030	6.879	5.537	6.463	5.718	5.846	5.868	6.055	4.736
POTASSIUM (K)	WT %	0.090	0.080	0.100	0.110	0.090	0.100	0.090	0.130		0.090	0.080
AE (Aqua Regia)												
CESIUM (CS)	WT %	0.100	0.100	ND	ND	0.200	0.300	0.200	0.300	0.200	0.200	0.200
ICP (Na2O2/HCl)												
ALUMINUM (AL)	WT %	0.619	0.627	2.337	2.442	2.359	2.271	2.610	2.587	2.574	2.543	2.490
BARIUM (BA)	WT %	0.026	0.026	0.096	0.100	0.096	0.093	0.107	0.107	0.105	0.104	0.103
BORON (B)	WT %	1.997	2.025	1.250	1.223	1.313	1.152	1.292	1.287	1.266	1.249	1.236
CADMIUM (CD)	WT %	0.479	0.479	0.268	0.273	1.567	1.535	1.598	1.603	1.633	1.602	1.574
CALCIUM (CA)	WT %	0.205	0.204	0.573	0.580	0.571	0.551	0.631	0.650	0.631	0.619	<0.01
CERIUM (CE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.311	0.265	0.256	0.214	0.216
CHROMIUM (CR)	WT %	0.016	0.017	0.092	0.091	0.081	0.080	0.110	0.111	0.108	0.107	0.106
COPPER (CU)	WT %	0.019	0.018	0.105	0.110	0.110	0.100	0.138	0.166	0.138	0.142	0.079
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	3.006	3.033	10.860	11.150	10.870	10.550	10.890	10.970	10.790	10.680	10.660
LANTHANUM (LA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.358	0.388	0.360	0.232	0.248
LEAD (PB)	WT %	0.052	0.055	0.348	0.338	0.296	0.277	0.390	0.385	0.381	0.365	0.370
LITHIUM (LI)	WT %	1.308	1.352	0.704	0.708	0.636	0.665	0.705	0.680	0.687	0.667	0.668
MAGNESIUM (MG)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.181	0.158	0.168	0.167	0.139
MANGANESE (MN)	WT %	0.264	0.262	0.895	0.915	0.891	0.855	0.898	0.892	0.892	0.857	0.872
MOLYBDENUM (MO)	WT %	0.029	0.031	0.172	0.154	0.117	0.132	0.194	0.184	0.186	0.193	0.188
NEODYMIUM (ND)	WT %	0.649	0.665	1.546	1.655	1.626	1.536	2.217	2.205	2.175	2.108	2.062
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	0.009	0.017	<0.01	0.162
PHOSPHOROUS (P)	WT %	<0.01	<0.01	0.178	<0.01	0.149	0.067	0.084	0.053	0.092	0.091	0.078
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.121	0.102	0.071	0.062	0.063

SAMPLE ID		SRAT 0125	SRAT 0125	SRTC 0126	SRTC 0126	SRNM 0169	SRNM 0169	SRNM 0170	SRNM 0170	SRDF 0172	SRDF 0174	SRDF 0176
ANALYTICAL CODE(S)		BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/5/91	12/5/91	12/6/91	12/6/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91
ANALYSIS # OF total		1 of 2	2 of 2	1 of 2	2 of 2	1 of 2	2 of 2	1 of 2	2 of 2	1 of 1	1 of 1	1 of 1
COMPONENT	Units											
ICP (Na2O2/HCl) cont'd												
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.049	0.032	0.016	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	<0.01	<0.01	0.075	0.024	0.140	0.130	0.234	0.236	0.240	0.238	0.214
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.057	0.046	0.023	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	9.398	9.344	7.840	7.923	9.083	9.081	9.141	9.172	9.030	8.864	0.611
SILVER (AG)	WT %	<0.01	<0.01	<0.01	<0.01	0.049	0.045	0.083	0.083	0.080	0.079	0.079
STRONTIUM (SR)	WT %	0.021	0.021	0.068	0.070	0.070	0.063	0.071	0.071	0.069	0.071	0.069
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.019	0.020	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	<0.01	<0.01	0.092	0.057	0.150	0.140	0.150	0.140	0.140	0.130	0.110
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012	0.016	0.016	0.012	0.014
TITANIUM (TI)	WT %	0.035	0.036	0.106	0.112	0.102	0.099	0.126	0.125	0.126	0.119	0.121
YTTRIUM (Y)	WT %	<0.01	<0.01	0.027	0.027	0.026	0.024	0.040	0.039	0.038	0.038	0.037
ZINC (ZN)	WT %	0.074	0.067	0.191	0.182	0.220	0.186	0.223	0.193	0.217	0.171	0.203
ZIRCONIUM (ZR)	WT %	1.572	1.592	5.738	5.949	5.705	5.521	5.717	5.731	5.645	5.627	5.587
ICP (Aqua Regia)												
ALUMINUM (AL)	WT %	0.998	1.120	2.731	2.812	2.667	2.549	2.711	2.775	2.616	2.625	2.625
BARIUM (BA)	WT %	0.045	0.047	0.111	0.114	0.111	0.104	0.111	0.114	0.108	0.108	0.108
BORON (B)	WT %	2.467	2.648	1.026	1.009	0.859	0.909	0.874	0.892	0.869	0.887	0.923
CADMIUM (CD)	WT %	0.764	0.808	0.295	0.305	1.751	1.645	1.726	1.764	1.732	1.727	1.708
CALCIUM (CA)	WT %	0.211	0.228	0.526	0.541	0.535	0.502	0.539	0.552	0.520	0.528	0.526
CERIUM (CE)	WT %	<0.01	<0.01	0.247	0.266	0.298	0.282	0.310	0.318	0.313	0.280	0.281
CHROMIUM (CR)	WT %	0.033	0.036	0.117	0.117	0.118	0.111	0.118	0.122	0.113	0.114	0.114
COPPER (CU)	WT %	0.040	0.043	0.138	0.140	0.136	0.130	0.138	0.141	0.134	0.135	0.134
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	4.747	5.004	11.810	12.070	11.530	10.840	11.610	11.760	11.210	11.280	11.350
LANTHANUM (LA)	WT %	<0.01	<0.01	0.125	0.190	0.243	0.270	0.247	0.295	0.221	0.248	0.257
LEAD (PB)	WT %	0.129	0.134	0.418	0.419	0.440	0.406	0.435	0.435	0.417	0.414	0.423
LITHIUM (LI)	WT %	1.859	1.975	0.680	0.658	0.622	0.702	0.640	0.682	0.621	0.640	0.663
MAGNESIUM (MG)	WT %	<0.01	<0.01	0.173	0.172	0.204	0.194	0.196	0.198	0.198	0.193	0.197
MANGANESE (MN)	WT %	0.404	0.422	0.956	0.978	0.919	0.864	0.925	0.943	0.895	0.906	0.906
MOLYBDENUM (MO)	WT %	0.067	0.071	0.221	0.188	0.190	0.221	0.197	0.201	0.189	0.203	0.225
NEODYMIUM (ND)	WT %	1.341	1.431	2.206	2.276	2.278	2.130	2.282	2.360	2.228	2.227	2.231
NICKEL (NI)	WT %	0.408	0.436	1.053	1.085	1.042	0.978	1.040	1.064	1.013	1.012	1.019
NIوبيUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	0.038	0.050	0.042	0.058	0.034	0.041	0.045
PHOSPHOROUS (P)	WT %	<0.01	<0.01	<0.01	<0.01	0.028	0.064	0.352	0.022	0.016	0.023	0.021
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	0.045	0.050	0.104	0.095	0.098	0.115	0.105	0.095	0.086
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	0.030	0.040	0.039	0.047	0.029	0.029	0.041
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.041	0.038	0.080	0.079	0.258	0.256	0.264	0.263	0.252	0.262	0.260
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01	0.037	0.042	0.037	0.036	0.028	0.023	0.026
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	1.159	0.359	0.597	0.567	1.305	0.863	1.265	0.564	0.618	0.983	0.957
SILVER (AG)	WT %	0.017	0.018	0.031	0.033	0.101	0.097	0.103	0.103	0.098	0.100	0.100
SODIUM (NA)	WT %	4.906	5.025	9.261	8.080	8.414	9.574	8.758	8.918	8.330	8.992	9.670
STRONTIUM (SR)	WT %	0.030	0.031	0.070	0.079	0.070	0.064	0.067	0.074	0.075	0.070	0.071
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	<0.01	<0.01	0.129	0.128	0.142	0.136	0.141	0.149	0.122	0.129	0.133
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SRAT 0125	SRAT 0125	SRTC 0126	SRTC 0126	SRNM 0169	SRNM 0169	SRNM 0170	SRNM 0170	SRDF 0172	SRDF 0174	SRDF 0176
ANALYTICAL CODE(S)		BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	BASLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/5/91	12/5/91	12/6/91	12/6/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91
ANALYSIS # OF total COMPONENT	Units	1 of 2	2 of 2	1 of 2	2 of 2	1 of 2	2 of 2	1 of 2	2 of 2	1 of 1	1 of 1	1 of 1
ICP (Aqua Regia) cont'd												
TITANIUM (TI)	WT %	0.023	0.015	0.045	0.047	0.062	0.028	0.075	0.037	0.028	0.036	0.029
YTTRIUM (Y)	WT %	0.010	0.010	0.039	0.040	0.040	0.038	0.040	0.041	0.039	0.039	0.039
ZINC (ZN)	WT %	0.081	0.085	0.161	0.168	0.159	0.149	0.161	0.165	0.154	0.155	0.155
ZIRCONIUM (ZR)	WT %	2.304	2.488	6.142	6.231	5.980	5.585	5.991	5.899	5.814	5.806	5.829
ICP (Filtrate)												
ALUMINUM (AL)	PPM	2.850	2.963	7.114	7.016	2.292	2.224	18.940	19.380	12.360	11.660	11.150
BARIUM (BA)	PPM	0.275	0.271	0.348	0.350	0.013	0.013	0.153	0.142	0.177	0.194	0.211
BORON (B)	PPM	419.100	419.200	419.100	420.000	138.000	138.300	390.400	390.400	390.400	390.400	390.400
CADMIUM (CD)	PPM	0.033	0.030	<0.01	<0.01	0.106	0.115	0.884	0.919	1.227	1.195	1.127
CALCIUM (CA)	PPM	5.469	5.245	12.320	12.330	0.434	0.395	4.000	4.075	3.437	3.501	2.885
CERIUM (CE)	PPM	0.400	0.342	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	<0.01	<0.01	3.107	3.111	0.012	0.010	0.211	0.220	0.038	0.035	0.037
COPPER (CU)	PPM	0.615	0.595	0.174	0.175	0.024	0.026	0.237	0.237	0.245	0.255	0.264
GERMANIUM (GE)	PPM	0.060	<0.01	<0.01	<0.01	0.040	0.037	0.083	0.016	0.014	<0.01	<0.01
IRON (FE)	PPM	0.040	0.033	0.088	0.090	0.017	0.019	0.133	0.136	0.131	0.129	0.122
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	0.038	0.048	0.032	0.027	0.010	0.006	0.073	0.042	0.092	0.122	0.151
LITHIUM (LI)	PPM	1954.000	1985.000	912.600	913.000	133.700	135.500	1154.000	1185.000	1210.000	1206.000	1180.000
MAGNESIUM (MG)	PPM	0.739	0.768	0.688	0.695	0.112	0.123	0.769	0.774	1.259	1.598	1.727
MANGANESE (MN)	PPM	0.018	0.015	<0.01	<0.01	0.007	0.007	0.063	0.065	0.035	0.030	0.038
MOLYBDENUM (MO)	PPM	164.000	171.300	367.300	367.400	55.920	56.520	444.500	462.500	464.400	465.100	448.300
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	<0.01	<0.01	<0.01	<0.01	0.004	0.009	0.041	0.030	0.075	0.130	0.160
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	0.007	<0.01	0.038	<0.01	2.366	1.972	2.280
PHOSPHOROUS (P)	PPM	12.240	12.980	5.113	5.119	0.856	0.838	5.663	5.873	5.673	5.457	5.232
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	0.361	0.357	1.051	1.055	0.923	0.943	7.927	8.021	8.883	10.150	10.290
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	0.316	0.330	0.017	0.014	1.548	1.571	12.070	12.490	16.800	19.370	19.970
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	0.284	0.230	6.502	6.491	1.130	1.104	9.013	9.481	7.703	6.835	6.000
SILICON (SI)	PPM	126.800	125.600	3.149	3.211	0.532	0.551	3.256	3.415	3.418	3.449	3.422
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	6781.000	7032.000	8246.000	8247.000	2034.000	2050.000	8329.000	8329.000	8331.000	8331.000	8330.000
STRONTIUM (SR)	PPM	0.242	0.242	0.106	0.110	<0.01	<0.01	0.027	0.027	0.046	0.057	0.065
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	0.017	0.024	0.085	0.066	0.045	0.028	0.021
TELLURIUM (TE)	PPM	2.740	3.272	0.727	0.733	0.152	0.164	1.004	1.000	0.926	0.968	0.947
TIN (SN)	PPM	0.068	0.064	0.030	0.027	0.028	0.016	0.083	0.080	0.083	0.090	0.080
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	0.058	0.060	0.004	<0.01	0.039	0.038	0.043	0.034	0.029
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	0.092	0.090	0.015	0.015	0.125	0.124	2.379	3.555	4.007

SAMPLE ID		SRDF 0178	SRDF 0180	SRDF 0182	SRDF 0184	SRDF 0186	SRDF 0188	SRDF 0190	SRDF 0192	SRDF 0194	SRDF 0196	SRDF 0198
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91
ANALYSIS # OF total		1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1
COMPONENT	Units											
IC (Filtrate)												
FORMATE (COOH(1-))	MG/L	10035	9889	11875	15817	14006	15813	20345	22623	23053	22999	25436
NITRATE (NO3(1-))	MG/L	17682	16397	17004	18341	17137	17802	17898	18657	18093	17024	18570
NITRITE (NO2(1-))	MG/L	17506	16118	15453	14647	13399	12123	10477	10011	9097	7810	7556
OXALATE (C2O4(2-))	MG/L	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PHOSPHATE (PO4(3-))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4(2-))	MG/L	1563	1423	1503	1577	1482	1489	1486	1602	1572	1467	1584
AMMONIUM (NH4(1+))	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
IC (Na2O2/H2O)												
CHLORIDE (CL(1-))	MG/L											
FLUORIDE (F(1-))	MG/L											
Wet Chemistry												
PH	PH	8.92	8.8	8.72	8.51	8.62	8.63	8.27	7.96	7.85	8.32	7.82
CALCINED % SOLIDS	WT %	18.44	18.57	19.01	18.62	19.30	19.60	17.00	16.85	17.46	16.94	17.21
TOT BASE (EQ PT)	MOLE/LITER	0.095 TO PH 7	0.08	0.06 TO PH 7	0.05 TO PH 7	0.06 TO PH 7	0.06 TO PH 7	0.09 TO PH 7	0.08 TO PH 7	0.08 TO PH 7		0.07 TO PH 7
RHEOGRAM DONE (Y/N)	DD-MON-YY	Y 20/01/92	Y 20/01/92	Y 20/01/92	Y 17/01/92	Y 17/01/92	Y 20/01/92	16-01-92	Y 20/01/92	Y 17/01/92	15-01-92	15-01-92
TOTAL WT % SOLIDS	WT %	16.76	16.75	17.15	17.26	17.48	17.46	19.63	19.14	19.38	19.37	19.71
DENSITY	G/ML	1.17	1.17	1.17	1.18	1.17	1.18	1.15	1.16	1.16	1.16	1.17
Carbon Analysis												
TOTAL CARBON	PPM	5767	5451	5844	7441	7380	8305	8343	9205	9235	9384	9673
TOTAL INORGANIC CARBON	PPM	2125	1924	1841	1986	2012	2183	2162	2384	2425	2592	2137
TOTAL ORGANIC CARBON	PPM	3642	3527	4003	5455	5368	6122	6181	6821	6810	6792	7536
AA (Na2O2/HCl)												
SILICON (SI)	WT %	9.000	10.600	9.800	11.700	11.100	11.700	11.600	11.400	11.900	11.100	12.500
AA (Aqua Regia)												
SODIUM (NA)	WT %	5.792	7.120	7.039	6.825	7.042	7.277	7.427	6.917	7.153	6.761	7.684
POTASSIUM (K)	WT %	0.090	0.100	0.100	0.110	0.100	0.110	0.140	0.130	0.110	0.130	0.140
AE (Aqua Regia)												
CESIUM (CS)	WT %	0.300	0.300	0.200	0.200	0.200	0.300	0.200	0.300	0.300	0.200	0.300
ICP (Na2O2/HCl)												
ALUMINUM (AL)	WT %	2.363	2.648	2.388	2.611	2.529	2.289	2.395	2.376	2.336	2.287	2.372
BARIUM (BA)	WT %	0.097	0.108	0.097	0.105	0.103	0.091	0.095	0.094	0.094	0.091	0.094
BORON (B)	WT %	1.236	1.232	1.220	1.268	1.256	1.807	1.420	1.364	1.589	1.409	1.529
CADMIUM (CD)	WT %	1.481	1.646	1.518	1.627	1.564	1.575	1.628	1.615	1.580	1.559	1.610
CALCIUM (CA)	WT %	0.598	0.646	0.589	0.632	0.614	0.569	0.595	0.583	0.585	0.566	0.575
CERIUM (CE)	WT %	0.195	0.252	0.255	0.296	0.295	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	WT %	0.100	0.112	0.102	0.110	0.108	0.085	0.090	0.086	0.088	0.083	0.087
COPPER (CU)	WT %	0.159	0.136	0.121	0.128	0.131	0.110	0.121	0.112	0.109	0.115	0.116
GERMANIUM (GE)	WT %	<0.01	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	10.100	11.100	10.020	10.760	10.500	10.030	10.640	10.520	10.340	10.200	10.410
LANTHANUM (LA)	WT %	0.194	0.132	0.182	0.126	0.178	0.181	0.146	0.140	0.150	0.083	0.230
LEAD (PB)	WT %	0.355	0.393	0.346	0.379	0.374	0.310	0.327	0.322	0.326	0.301	0.320
LITHIUM (LI)	WT %	0.707	0.617	0.697	0.623	0.661	0.693	0.655	0.656	0.656	0.669	0.653
MAGNESIUM (MG)	WT %	0.146	0.175	0.177	0.161	0.165	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MANGANESE (MN)	WT %	0.813	0.903	0.816	0.881	0.857	0.851	0.893	0.860	0.864	0.842	0.864
MOLYBDENUM (MO)	WT %	0.215	0.166	0.208	0.169	0.196	0.153	0.148	0.156	0.154	0.165	0.162
NEODYMIUM (ND)	WT %	1.978	2.199	1.972	2.142	2.113	1.565	1.695	1.709	1.647	1.585	1.642
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	0.002	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	0.025	0.038	0.044	0.043	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	WT %	0.084	0.059	0.067	0.091	0.103	<0.01	0.013	0.019	0.036	0.011	0.052
PRASEODYMIUM (PR)	WT %	0.053	0.049	0.086	0.134	0.134	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SRDF 0178	SRDF 0180	SRDF 0182	SRDF 0184	SRDF 0186	SRDF 0188	SRDF 0190	SRDF 0192	SRDF 0194	SRDF 0196	SRDF 0198
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91
ANALYSIS # OF total		1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1
COMPONENT	Units											
ICP (Na2O2/HCl) cont'd												
RHODIUM (RH)	WT %	<0.01	<0.01	0.025	0.032	0.044	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.212	0.232	0.222	0.233	0.228	0.010	<0.01	<0.01	<0.01	<0.01	<0.01
SAMARIUM (SA)	WT %	<0.01	0.024	0.044	0.069	0.062	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	8.042	9.224	8.514	9.998	9.018	8.518	8.452	8.207	8.461	7.980	8.871
SILVER (AG)	WT %	0.075	0.084	0.077	0.082	0.083	0.056	0.061	0.062	0.060	0.059	0.061
STRONTIUM (SR)	WT %	0.064	0.070	0.064	0.065	0.064	0.061	0.066	0.065	0.064	0.063	0.063
TANTALUM (TA)	WT %	<0.01	0.013	0.016	0.019	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.120	0.140	0.120	0.130	0.150	0.044	0.058	0.046	0.055	0.047	0.075
TIN (SN)	WT %	0.013	0.014	0.017	0.022	0.016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	WT %	0.111	0.126	0.116	0.126	0.121	0.099	0.107	0.101	0.104	0.099	0.105
YTTRIUM (Y)	WT %	0.035	0.039	0.035	0.039	0.038	0.025	0.027	0.026	0.026	0.025	0.026
ZINC (ZN)	WT %	0.170	0.213	0.180	0.194	0.180	0.193	0.214	0.186	0.193	0.170	0.195
ZIRCONIUM (ZR)	WT %	5.323	5.782	5.238	5.628	5.505	5.418	5.723	5.642	5.565	5.494	5.642
ICP (Aqua Regia)												
ALUMINUM (AL)	WT %	2.543	2.635	2.535	2.787	2.546	2.543	2.581	2.694	2.659	2.511	2.635
BARIUM (BA)	WT %	0.105	0.108	0.105	0.114	0.106	0.105	0.108	0.111	0.110	0.104	0.108
BORON (B)	WT %	0.915	0.887	0.886	0.884	0.908	0.924	0.890	0.925	0.915	0.892	0.929
CADMIUM (CD)	WT %	1.665	1.723	1.674	1.833	1.708	1.708	1.692	1.784	1.733	1.650	1.714
CALCIUM (CA)	WT %	0.508	0.528	0.511	0.554	0.519	0.516	0.524	0.543	0.530	0.502	0.516
CERIUM (CE)	WT %	0.265	0.298	0.277	0.299	0.277	0.282	0.294	0.277	0.302	0.266	0.270
CHROMIUM (CR)	WT %	0.111	0.116	0.110	0.120	0.111	0.111	0.115	0.117	0.116	0.110	0.113
COPPER (CU)	WT %	0.130	0.135	0.129	0.141	0.131	0.130	0.133	0.138	0.137	0.130	0.134
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	10.960	11.340	10.930	11.880	11.050	10.850	11.220	11.610	11.510	10.870	11.210
LANTHANUM (LA)	WT %	0.252	0.271	0.227	0.220	0.214	0.241	0.269	0.221	0.256	0.267	0.231
LEAD (PB)	WT %	0.412	0.425	0.404	0.441	0.410	0.399	0.413	0.432	0.422	0.399	0.414
LITHIUM (LI)	WT %	0.673	0.632	0.637	0.565	0.628	0.638	0.598	0.624	0.637	0.634	0.651
MAGNESIUM (MG)	WT %	0.188	0.197	0.184	0.197	0.186	0.186	0.187	0.180	0.180	0.168	0.179
MANGANESE (MN)	WT %	0.880	0.907	0.872	0.961	0.891	0.885	0.904	0.929	0.914	0.867	0.898
MOLYBDENUM (MO)	WT %	0.228	0.209	0.207	0.172	0.206	0.206	0.198	0.219	0.224	0.219	0.228
NEODYMIUM (ND)	WT %	2.151	2.244	2.149	2.333	2.152	2.121	2.218	2.269	2.266	2.120	2.187
NICKEL (NI)	WT %	0.982	1.027	0.977	1.070	0.996	0.980	1.007	1.039	1.038	0.981	1.011
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	0.038	0.037	0.028	0.043	0.032	0.038	0.046	0.032	0.041	0.036	0.029
PHOSPHOROUS (P)	WT %	0.016	0.031	0.018	0.020	0.026	0.019	0.026	0.026	0.023	<0.01	0.018
PRASEODYMIUM (PR)	WT %	0.091	0.101	0.078	0.100	0.075	0.069	0.098	0.067	0.079	0.063	0.076
RHODIUM (RH)	WT %	0.035	0.034	0.032	0.023	0.030	0.030	0.032	0.030	0.039	0.031	0.028
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1/11	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.252	0.257	0.248	0.261	0.243	0.250	0.246	0.263	0.259	0.248	0.256
SAMARIUM (SA)	WT %	0.026	0.26	0.026	0.044	<0.01	<0.01	0.032	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	0.743	0.617	0.716	0.795	1.041	1.539	1.060	0.952	1.004	0.987	0.804
SILVER (AG)	WT %	0.095	0.100	0.095	0.104	0.096	0.097	0.099	0.102	0.102	0.095	0.098
SODIUM (NA)	WT %	10.190	8.989	9.156	7.090	8.682	8.509	8.263	8.642	9.007	8.928	8.865
STRONTIUM (SR)	WT %	0.063	0.077	0.073	0.067	0.069	0.065	0.068	0.069	0.068	0.064	0.066
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.122	0.130	0.136	0.138	0.121	0.133	0.137	0.135	0.140	0.131	0.127
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SRDF 0178	SRDF 0180	SRDF 0182	SRDF 0184	SRDF 0186	SRDF 0188	SRDF 0190	SRDF 0192	SRDF 0194	SRDF 0196	SRDF 0198
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91
ANALYSIS # OF total		1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1
COMPONENT	Units											
ICP (Aqua Regia) cont'd												
TITANIUM (TI)	WT %	0.026	0.029	0.028	0.028	0.026	0.091	0.026	0.031	0.028	0.028	0.031
YTTRIUM (Y)	WT %	0.037	0.040	0.038	0.041	0.038	0.038	0.039	0.040	0.040	0.037	0.038
ZINC (ZN)	WT %	0.150	0.156	0.151	0.164	0.153	0.151	0.154	0.159	0.157	0.149	0.155
ZIRCONIUM (ZR)	WT %	5.610	5.793	5.656	6.084	5.694	5.629	5.723	5.984	5.913	5.579	5.728
ICP (Filtrate)												
ALUMINUM (AL)	PPM	8.879	8.800	7.982	6.540	6.377	5.411	6.421	5.375	4.107	3.295	2.501
BARIUM (BA)	PPM	0.526	0.507	0.428	0.305	0.381	0.401	0.330	0.058	0.081	0.208	0.355
BORON (B)	PPM	390.500	872.600	872.600	880.900	945.100	944.300	954.300	1058.000	1101.000	1126.000	1150.000
CADMIUM (CD)	PPM	3.517	4.072	8.322	33.870	38.200	34.810	8.127	45.160	101.900	206.000	320.500
CALCIUM (CA)	PPM	1.951	2.646	4.149	11.530	13.160	22.220	14.090	41.180	73.870	116.500	160.800
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	0.055	0.061	0.089	0.117	0.114	0.068	0.031	0.061	0.085	0.098	0.121
COPPER (CU)	PPM	0.767	0.895	0.985	0.937	0.842	0.440	0.290	0.397	0.402	0.401	0.473
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.254	0.033	<0.01	0.236
IRON (FE)	PPM	0.119	0.124	0.127	0.125	0.124	0.113	0.094	0.101	0.081	0.118	0.143
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	0.419	0.459	0.605	0.727	0.720	0.725	0.477	0.391	0.398	0.331	0.517
LITHIUM (LI)	PPM	1209.000	1373.000	1378.000	1361.000	1400.000	1412.000	1432.000	1293.000	1329.000	1332.000	1341.000
MAGNESIUM (MG)	PPM	9.934	23.470	98.340	177.600	186.600	191.100	126.700	149.500	166.900	179.300	189.300
MANGANESE (MN)	PPM	0.277	0.691	4.405	24.460	26.120	26.660	7.989	40.790	73.110	112.300	163.300
MOLYBDENUM (MO)	PPM	435.000	434.300	405.500	337.000	330.500	293.200	344.400	291.600	231.300	191.800	152.100
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	3.281	4.046	6.377	6.103	6.155	5.536	1.236	3.502	5.113	6.887	9.844
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	4.228	4.953	6.754	6.893	7.310	7.092	0.035	0.318	1.393	1.592	1.814
PHOSPHOROUS (P)	PPM	5.125	5.204	5.304	4.499	4.576	4.141	4.353	2.418	1.859	2.176	2.357
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	13.550	13.750	14.090	13.720	13.710	12.890	17.900	14.860	12.810	11.120	9.804
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	37.220	35.580	36.360	36.920
RUTHENIUM (RU)	PPM	32.230	34.740	42.360	52.900	53.850	59.610	43.570	60.950	68.190	77.720	85.660
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	1.801	1.609	1.086	0.808	0.749	0.669	0.785	0.646	0.773	0.785	1.192
SILICON (SI)	PPM	3.952	4.045	4.119	4.495	4.511	4.515	4.013	6.324	6.532	6.541	6.773
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	8329.000	8331.000	8330.000	8332.000	8332.000	8332.000	8333.000	20668.000	20681.000	20521.000	20513.000
STRONTIUM (SR)	PPM	0.363	0.454	0.885	4.911	5.285	7.690	5.777	12.210	16.440	20.970	25.040
TANTALUM (TA)	PPM	0.023	<0.01	0.015	0.033	0.036	<0.01	<0.01	0.132	0.323	0.276	0.523
TELLURIUM (TE)	PPM	0.916	0.908	0.791	0.741	0.739	0.615	0.655	0.977	0.724	1.348	1.437
TIN (SN)	PPM	0.089	0.095	0.102	0.104	0.090	0.090	0.089	0.096	0.149	0.165	0.092
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	0.033	0.045	0.084	0.170	0.170	0.123	0.046	0.196	0.331	0.499	0.783
ZIRCONIUM (ZR)	PPM	5.465	4.620	1.560	0.294	0.228	0.212	0.337	0.074	0.049	0.043	0.046

SAMPLE ID		SRDF 0200	SRDF 0202	SRDF 0204	SRDF 0206	SRDF 0208	SRDF 0210	SRDF 0212	SRDF 0213	SRDF 0221	SRDF 0221	SRFO 0227	SRFO 0227
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/10/91	12/10/91
ANALYSIS # OF total COMPONENT	Units	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 2	2 of 2	1 of 2	2 of 2
IC (Filtrate)													
FORMATE (COOH[1-])	MG/L	24077	28247	28864	30388	31087	31445	32575	33871	32530	33535	33679	33558
NITRATE (NO3[1-])	MG/L	17699	18801	18724	18933	20788	17993	18419	17642	20465	21383	22168	22295
NITRITE (NO2[1-])	MG/L	6084	5530	4651	2100	5010	3844	1990	2936	25	25	15	15
OXALATE (C2O4[2-])	MG/L	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<11	<1
SULFATE (SO4[2-])	MG/L	1483	1553	1547	1531	1659	1479	1444	1472	1593	1669	1840	1891
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	7	40	43
IC (Na2O2/H2O)													
CHLORIDE (CL[1-])	MG/L												
FLUORIDE (F[1-])	MG/L												
Wet Chemistry													
PH	PH	7.92	7.79	7.69	7.74	7.66	7.66	7.57	7.55	8.45	8.45	9.27	9.27
CALCINED % SOLIDS	WT %	17.59	17.14	17.07	17.10	16.97	17.18	20.47	17.44	19.69	19.58	21.16	21.05
TOT BASE (EQ PT)	MOLE/LITER	0.07 TO PH 7	0.066 TO PH 7	0.06 TO PH 7	0.06 TO PH 7	0.06 TO PH 7	0.06 TO PH 7	0.05 TO PH 7	0.05 TO PH 7	0.11 TO PH 7	0.11 TO PH 7	0.18 TO PH 7	0.18 TO PH 7
RHEOGRAM DONE (Y/N)	DD-MON-YY	15-01-92	15-01-92	15-01-92	15-01-92	15-01-92	15-01-92	16-01-92	15-01-92	16-01-92	16-01-92	13-10-92	13-01-92
TOTAL WT % SOLIDS	WT %	20.00	19.64	19.43	19.31	19.39	20.07	17.25	21.21	17.11	17.15	18.73	18.63
DENSITY	G/MIL	1.17	1.17	1.16	1.17	1.17	1.17	1.17	1.17	1.18	1.19	1.20	1.20
Carbon Analysis													
TOTAL CARBON	PPM	9765	10053	10107	10603	10566	10476	11158	11239	11196	11509	11456	11323
TOTAL INORGANIC CARBON	PPM	2032	2230	2271	2903	2676	2000	2065	2176	2354	2218	2646	2401
TOTAL ORGANIC CARBON	PPM	7733	7823	7836	7700	7890	8476	9093	9063	8842	9291	8810	8922
AA (Na2O2/HCl)													
SILICON (SI)	WT %	12.200	12.300	11.800	10.800	12.500	11.600	13.000	12.100	10.500	11.600	10.200	11.000
AA (Aqua Regia)													
SODIUM (NA)	WT %	6.695	6.943	7.846	6.717	6.828	7.343	8.571	6.766	7.617	8.511	8.074	7.453
POTASSIUM (K)	WT %	0.130	0.110	0.110	0.100	0.100	0.110	0.110	0.110	0.110	0.110	0.110	0.100
AE (Aqua Regia)													
CESIUM (CS)	WT %	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
ICP (Na2O2/HCl)													
ALUMINUM (AL)	WT %	2.367	2.251	2.416	2.223	2.489	2.290	2.332	2.443	2.394	2.605	2.278	2.588
BARIUM (BA)	WT %	0.091	0.088	0.097	0.088	0.097	0.093	0.096	0.100	0.098	0.106	0.094	0.106
BORON (B)	WT %	1.481	1.370	1.323	1.292	1.282	1.257	1.149	1.132	1.120	1.259	1.146	1.127
CADMIUM (CD)	WT %	1.590	1.530	1.638	1.559	1.634	1.505	1.470	1.525	1.502	1.637	1.471	1.662
CALCIUM (CA)	WT %	0.576	0.557	0.585	0.572	0.580	0.556	0.707	0.594	0.608	0.649	0.578	0.660
CERIUM (CE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.190	0.203	0.168	0.164	0.164	0.180
CHROMIUM (CR)	WT %	0.087	0.081	0.090	0.081	0.093	0.084	0.102	0.107	0.104	0.113	0.102	0.114
COPPER (CU)	WT %	0.105	0.100	0.114	0.109	0.113	0.108	0.133	0.129	0.117	0.130	0.113	0.131
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	10.330	9.890	10.650	9.928	10.870	10.200	9.923	10.380	10.050	11.090	9.770	11.100
LANTHANUM (LA)	WT %	0.200	0.068	0.155	0.036	0.027	0.114	0.177	0.232	0.265	0.181	0.152	0.233
LEAD (PB)	WT %	0.306	0.304	0.329	0.307	0.341	0.307	0.352	0.380	0.365	0.402	0.354	0.396
LITHIUM (LI)	WT %	0.655	0.699	0.636	0.697	0.622	0.655	0.667	0.635	0.702	0.784	0.780	0.629
MAGNESIUM (MG)	WT %	<0.01	<0.01	<0.01	0.002	<0.01	<0.01	0.132	0.157	0.162	0.175	0.136	0.158
MANGANESE (MN)	WT %	0.835	0.810	0.860	0.816	0.873	0.830	0.784	0.815	0.823	0.903	0.794	0.896
MOLYBDENUM (MO)	WT %	0.165	0.162	0.168	0.168	0.171	0.166	0.207	0.213	0.214	0.237	0.233	0.184
NEODYMIUM (ND)	WT %	1.445	1.498	1.718	1.547	1.750	1.629	1.887	1.972	1.912	2.112	1.813	2.088
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.015	0.017	<0.01	<0.01	<0.01	0.020
PHOSPHOROUS (P)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	0.030	<0.01	<0.01	0.014	<0.01	<0.01	<0.01
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.180	0.010	0.027	<0.01	<0.01	<0.01

SAMPLE ID		SRDF 0200	SRDF 0202	SRDF 0204	SRDF 0206	SRDF 0208	SRDF 0210	SRDF 0212	SRDF 0213	SRDF 0221	SRDF 0221	SRFO 0227	SRFO 0227
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/10/91	12/10/91
ANALYSIS # OF total		1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 2	2 of 2	1 of 2	2 of 2
COMPONENT	Units												
ICP (Na2O2/HCl) cont'd													
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.023	0.010	<0.01	0.019	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.213	0.231	0.219	0.248	0.215	0.249
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	8.766	8.847	8.569	7.618	8.858	8.127	8.930	8.985	7.901	8.695	7.528	8.641
SILVER (AG)	WT %	0.059	0.054	0.063	0.055	0.062	0.060	0.085	0.089	0.085	0.093	0.083	0.093
STRONTIUM (SR)	WT %	0.063	0.063	0.065	0.064	0.065	0.063	0.066	0.064	0.067	0.073	0.064	0.072
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.050	0.058	0.073	0.048	0.077	0.050	0.104	0.118	0.099	0.129	0.098	0.113
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	WT %	0.100	0.095	0.106	0.097	0.108	0.101	0.110	0.118	0.113	0.123	0.108	0.123
YTTRIUM (Y)	WT %	0.025	0.023	0.027	0.024	0.027	0.025	0.034	0.035	0.034	0.038	0.033	0.036
ZINC (ZN)	WT %	0.163	0.171	0.174	0.160	0.178	0.181	0.174	0.178	0.177	0.198	0.171	0.178
ZIRCONIUM (ZR)	WT %	5.599	5.361	5.756	5.365	5.846	5.490	5.357	5.581	5.433	5.941	5.234	5.942
ICP (Aqua Regia)													
ALUMINUM (AL)	WT %	2.537	2.609	2.661	2.685	2.982	2.830	2.595	2.860	2.986	2.814	2.720	2.855
BARIUM (BA)	WT %	0.107	0.107	0.112	0.111	0.122	0.116	0.106	0.117	0.122	0.116	0.111	0.117
BORON (B)	WT %	0.900	0.933	0.900	0.996	0.995	0.971	1.004	0.940	1.007	1.004	1.027	0.952
CADMIUM (CD)	WT %	1.694	1.714	1.807	1.788	1.931	1.791	1.698	1.785	1.958	1.837	1.759	1.863
CALCIUM (CA)	WT %	0.511	0.507	0.526	0.535	0.568	0.535	0.513	0.529	0.595	0.559	0.544	0.574
CERIUM (CE)	WT %	0.267	0.280	0.285	0.229	0.250	0.220	0.222	0.231	0.280	0.255	0.250	0.278
CHROMIUM (CR)	WT %	0.114	0.113	0.119	0.115	0.126	0.122	0.110	0.122	0.130	0.121	0.117	0.123
COPPER (CU)	WT %	0.134	0.133	0.139	0.135	0.151	0.143	0.130	0.145	0.151	0.142	0.137	0.144
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	11.250	11.080	11.820	11.600	12.820	12.230	11.090	12.260	12.890	12.120	11.720	12.300
LANTHANUM (LA)	WT %	0.185	0.194	0.229	0.186	0.194	0.210	0.141	0.228	0.245	0.195	0.247	0.262
LEAD (PB)	WT %	0.418	0.414	0.433	0.413	0.467	0.449	0.405	0.450	0.478	0.441	0.429	0.459
LITHIUM (LI)	WT %	0.619	0.652	0.605	0.699	0.657	0.649	0.722	0.638	0.653	0.689	0.753	0.636
MAGNESIUM (MG)	WT %	0.177	0.166	0.171	0.171	0.162	0.164	0.160	0.171	0.210	0.182	0.199	0.196
MANGANESE (MN)	WT %	0.892	0.885	0.923	0.932	1.002	0.950	0.882	0.939	1.018	0.964	0.926	0.974
MOLYBDENUM (MO)	WT %	0.223	0.230	0.236	0.240	0.248	0.247	0.234	0.249	0.230	0.233	0.252	0.210
NEODYMIUM (ND)	WT %	2.147	2.148	2.297	2.201	2.446	2.318	2.094	2.321	2.482	2.339	2.262	2.366
NICKEL (NI)	WT %	1.008	0.999	1.061	1.040	1.145	1.095	0.995	1.097	1.151	1.085	1.050	1.110
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	0.032	0.037	0.041	<0.01	0.010	<0.01	<0.01	0.024	0.035	0.019	0.023	0.034
PHOSPHOROUS (P)	WT %	0.019	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	0.015	0.016	<0.01
PRASEODYMIUM (PR)	WT %	0.073	0.067	0.109	<0.01	<0.01	0.019	<0.01	0.027	0.072	0.056	0.059	0.074
RHODIUM (RH)	WT %	0.026	0.027	0.031	<0.01	<0.01	<0.01	<0.01	<0.01	0.021	0.021	0.019	0.025
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	3.245	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.248	0.254	0.255	0.260	0.272	0.255	0.240	0.270	0.296	0.268	0.265	0.275
SAMARIUM (SA)	WT %	0.014	0.015	0.019	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	0.948	0.626	0.834	0.498	0.496	0.517	0.383	0.368	0.379	0.581	0.510	0.367
SILVER (AG)	WT %	0.097	0.097	0.105	0.100	0.110	0.103	0.094	0.092	0.112	0.104	0.101	0.098
SODIUM (NA)	WT %	8.310	8.804	8.235	10.020	8.910	9.017	9.978	8.856	8.925	9.471	11.000	8.781
STRONTIUM (SR)	WT %	0.065	0.066	0.068	0.071	0.073	0.069	0.067	0.070	0.077	0.074	0.073	0.076
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.126	0.122	0.132	0.136	0.143	0.136	0.128	0.141	0.151	0.132	0.133	0.139
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SRDF 0200	SRDF 0202	SRDF 0204	SRDF 0206	SRDF 0208	SRDF 0210	SRDF 0212	SRDF 0213	SRDF 0221	SRDF 0221	SRFO 0227	SRFO 0227
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/10/91	12/10/91
ANALYSIS # OF total		1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 1	1 of 2	2 of 2	1 of 2	2 of 2
COMPONENT	Units												
ICP (Aqua Regia) cont'd													
TITANIUM (TI)	WT %	0.027	0.028	0.028	0.028	0.030	0.030	0.026	0.029	0.032	0.028	0.027	0.028
YTTRIUM (Y)	WT %	0.038	0.038	0.040	0.039	0.045	0.041	0.037	0.041	0.044	0.041	0.040	0.042
ZINC (ZN)	WT %	0.155	0.155	0.160	0.166	0.177	0.169	0.152	0.169	0.178	0.165	0.159	0.168
ZIRCONIUM (ZR)	WT %	5.694	5.709	6.001	5.967	6.569	6.244	5.774	6.188	6.451	6.245	6.002	6.049
ICP (Filtrate)													
ALUMINUM (AL)	PPM	1.878	1.476	0.978	2.356	1.625	1.497	1.495	1.549	4.587	4.821	10.010	9.794
BARIUM (BA)	PPM	0.364	0.343	0.397	0.359	0.342	0.410	0.436	0.438	0.336	0.331	0.359	0.358
BORON (B)	PPM	1174.000	1171.000	1087.000	1120.000	1134.000	1149.000	1167.000	1167.000	950.100	952.000	1118.000	1114.000
CADMIUM (CD)	PPM	455.100	539.000	571.400	398.700	433.800	516.600	602.390	631.300	3.158	3.139	0.136	0.147
CALCIUM (CA)	PPM	212.700	244.500	261.200	235.600	247.100	275.200	304.900	311.000	61.860	62.570	3.596	5.349
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	0.178	0.184	0.103	0.159	0.176	0.225	0.291	0.299	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	0.655	0.755	0.659	0.363	0.488	0.751	0.991	1.044	0.220	0.230	0.782	0.573
GERMANIUM (GE)	PPM	0.072	0.430	0.272	0.668	0.033	0.651	0.862	0.689	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	0.179	0.205	0.130	0.178	0.190	0.233	0.266	0.261	<0.01	<0.01	<0.01	<0.01
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	0.375	0.321	0.349	0.269	0.325	0.288	0.426	0.381	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	1355.000	1331.000	1334.000	1369.000	1361.000	1344.000	1347.000	1353.000	1461.000	1459.000	1654.000	1643.000
MAGNESIUM (MG)	PPM	199.400	201.000	204.200	204.200	205.200	207.700	211.900	214.000	102.800	102.200	6.740	6.314
MANGANESE (MN)	PPM	226.000	269.100	297.500	224.900	256.700	319.200	384.900	398.000	11.600	11.690	0.733	0.709
MOLYBDENUM (MO)	PPM	116.600	94.550	91.760	139.900	113.700	84.000	73.030	70.900	341.600	343.500	563.700	562.000
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	13.880	16.650	17.140	10.280	13.130	18.340	22.720	23.280	<0.01	<0.01	0.071	0.087
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	1.916	1.503	0.283	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	2.488	2.953	2.814	2.427	2.669	3.037	3.479	3.470	1.377	1.239	2.605	2.242
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	8.458	7.724	7.710	10.480	9.897	8.297	7.784	7.634	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	36.120	34.330	36.120	37.630	36.140	38.590	38.150	38.660	37.510	39.260	50.300	48.100
RUTHENIUM (RU)	PPM	92.830	95.910	95.520	84.260	85.640	86.840	81.520	81.400	<0.01	<0.01	<0.01	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	1.250	1.145	1.436	1.273	1.354	1.610	1.947	1.970	<0.01	<0.01	0.153	<0.01
SILICON (SI)	PPM	7.187	7.062	6.899	6.011	6.287	6.463	6.866	7.209	4.944	4.848	4.452	6.214
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	20545.000	20291.000	20262.000	20644.000	20435.000	20090.000	20068.000	20001.000	23591.000	23569.000	27018.000	26880.000
STRONTIUM (SR)	PPM	28.700	30.730	32.110	30.190	30.560	33.230	36.030	36.830	13.340	13.360	2.366	2.399
TANTALUM (TA)	PPM	0.726	0.588	0.710	0.666	0.713	0.826	1.132	0.941	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	1.698	1.998	2.133	1.667	1.692	1.953	2.267	2.298	<0.01	<0.01	0.223	0.022
TIN (SN)	PPM	0.175	0.096	0.093	0.208	0.190	0.152	0.198	0.210	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	1.225	1.584	1.585	0.808	1.109	1.712	2.312	2.454	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	0.057	0.071	0.052	0.030	0.039	0.069	0.047	0.053	<0.01	<0.01	0.655	0.596

Analytical Results:

HWVP2 SRAT Condensate

SAMPLE ID		SCFO 0196	SCFO 0214	SCFO 0215	SCFO 0216	SCFO 0217	SCFO 0218	SCFO 0219	SCFO 0220
ANALYTICAL CODE(S)		SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND
DATE		12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91	12/9/91
ANALYSIS # OF total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units								
IC (Filtrate)									
CHLORIDE (CL[1-])	MG/L	<1	<1	709	1	<1	<1	<1	<1
FLUORIDE (F[1-])	MG/L	1	<1	<20	<1	<1	<1	<1	<1
FORMATE (COOH[1-])	MG/L	92	3092	18078	33	17	10	8	6
NITRATE (NO3[1-])	MG/L	258	19495	9986	22	6	3	4	3
NITRITE (NO2[1-])	MG/L	<1	44	798	15	10	3	1	<1
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	2	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	7	61	796	2	1	1	1	1
AMMONIUM (NH4[1+])	MG/L	7	<1	<1	<1	11	18	28	57
Wet Chemistry									
PH	PH	2.52	1.27	7.38	4.14	6.40	7.28	8.84	8.80
EQUIV PT	MOLE/LITER	0.008 TO PH 7	.39 TO PH7	.002 TO PH7	.002 TO PH7	.001 TO PH7	.001 TO PH7	N.D.	.003 TO PH7
ICP (Filtrate)									
ALUMINUM (AL)	PPM	0.129	1.257	2.242	0.142	<0.01	<0.01	<0.01	<0.01
BARIUM (BA)	PPM	0.008	0.020	0.422	0.154	<0.01	<0.01	<0.01	<0.01
BORON (B)	PPM	2.474	3.139	690.900	2.776	1.779	1.513	1.781	1.258
CADMIUM (CD)	PPM	0.016	1.254	168.800	1.398	0.023	<0.01	<0.01	<0.01
CALCIUM (CA)	PPM	3.672	2.531	176.200	1.980	1.215	0.920	<0.01	1.017
CERIUM (CE)	PPM	1.199	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	<0.01	0.023	0.091	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	0.010	0.070	<0.01	0.034	<0.01	<0.01	<0.01	<0.01
GERMANIUM (GE)	PPM	<0.01	<0.01	0.379	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	0.301	2.872	0.109	<0.01	<0.01	<0.01	<0.01	0.024
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	<0.01	0.030	<0.01	0.021	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	0.093	0.084	800.400	0.813	0.296	0.120	0.148	0.158
MAGNESIUM (MG)	PPM	0.345	0.396	119.000	0.407	0.251	0.180	0.150	0.224
MANGANESE (MN)	PPM	0.309	0.573	160.800	0.657	0.067	<0.01	<0.01	<0.01
MOLYBDENUM (MO)	PPM	0.015	<0.01	118.500	<0.01	0.115	0.054	0.071	0.081
NEODYMIUM (ND)	PPM	1.209	<0.01	<0.01	0.200	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	0.064	0.389	3.699	0.063	<0.01	<0.01	<0.01	<0.01
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.124	0.229	2.045	0.162	0.199	0.186	0.192	0.176
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	1.813	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	19.820	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	<0.01	<0.01	2.165	<0.01	<0.01	<0.01	<0.01	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	<0.01	<0.01	1.099	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	PPM	<0.01	<0.01	4.213	<0.01	<0.01	<0.01	0.724	<0.01
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	7.409	<0.01	12671.000	12.920	3.452	<0.01	0.147	0.319
STRONTIUM (SR)	PPM	0.061	0.020	21.240	0.084	0.012	<0.01	<0.01	<0.01
TANTALUM (TA)	PPM	<0.01	<0.01	0.307	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	1.076	<0.01	<0.01	<0.01	<0.01	<0.01
TIN (SN)	PPM	<0.01	<0.01	0.159	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	0.016	0.066	0.313	0.046	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

SAMPLE ID		SCFO 0222	SCFO 0223	SCFO 0224	SCFO 0225	SCFO 0226	SCRW 0229	SCRW 0230	SCSM 0233
ANALYTICAL CODE(S)		SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND
DATE		12/10/91	12/10/91	12/10/91	12/10/91	12/10/91	12/11/91	12/11/91	12/11/91
ANALYSIS # OF total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
	Units								
IC (Filtrate)									
CHLORIDE (CL[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
FLUORIDE (F[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
FORMATE (COOH[1-])	MG/L	2	1	1	2	2	<1	<1	<1
NITRATE (NO3[1-])	MG/L	2	1	1	1	2	<1	<1	<1
NITRITE (NO2[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1	<1	<1	<1	1	<1	<1	<1
AMMONIUM (NH4[1+])	MG/L	409	542	835	508	842	890	861	835
Wet Chemistry									
PH	PH	9.23	9.40	9.49	9.97	9.52	9.78	9.71	9.95
EQUIV PT	MOLE/LITER	.03 TO PH7	.04 TO PH7	.04 TO PH7	0.039 TO PH 7	0.05	0.06 TO PH 7	0.05 TO PH 7	0.052 TO PH 7
ICP (Filtrate)									
ALUMINUM (AL)	PPM	<0.01	<0.01	<0.01	0.034	<0.01	0.151	0.123	<0.01
BARIUM (BA)	PPM	<0.01	<0.01	<0.01	<0.01	0.014	<0.01	<0.01	<0.01
BORON (B)	PPM	0.752	0.603	0.470	0.578	0.603	0.670	0.646	1.481
CADMIUM (CD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CALCIUM (CA)	PPM	1.491	1.364	1.352	1.052	1.306	2.091	1.893	1.982
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	0.021	0.079	0.287	0.273	<0.01
CHROMIUM (CR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.012	0.013	<0.01
COPPER (CU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.020	0.018	<0.01
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.103	0.068	<0.01
IRON (FE)	PPM	<0.01	<0.01	<0.01	0.044	<0.01	0.021	0.021	<0.01
LANTHANUM LA)	PPM	<0.01	<0.01	0.095	0.220	0.273	0.083	<0.01	<0.01
LEAD (PB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.048	0.032	<0.01
LITHIUM (LI)	PPM	0.037	0.033	0.035	0.054	0.059	0.013	<0.01	0.250
MAGNESIUM (MG)	PPM	0.268	0.250	0.273	0.261	0.284	0.535	0.484	0.130
MANGANESE (MN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MOLYBDENUM (MO)	PPM	0.056	0.051	0.038	0.054	0.071	0.045	0.043	<0.01
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	0.071	0.124	0.331	0.270	<0.01
NICKEL (NI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.028	0.026	<0.01
NIObIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.034	0.031	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	0.020	0.168	0.168	<0.01
PHOSPHOROUS (P)	PPM	0.203	0.190	0.165	0.158	<0.01	0.466	0.525	0.132
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	0.060	0.112	0.317	0.298	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.109	0.103	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	0.195	0.078	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.055	0.053	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	0.019	0.076	0.276	0.234	<0.01
SELENIUM (SE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.082	0.107	<0.01
SILICON (SI)	PPM	<0.01	<0.01	<0.01	<0.01	1.311	<0.01	<0.01	<0.01
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.506	<0.01	45.640
STRONTIUM (SR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.010	<0.01	<0.01
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.068	0.051	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.109	0.084	<0.01
TIN (SN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.019	0.034	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.012	0.010	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.006	<0.01	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	0.014	<0.01

SAMPLE ID		SCSM 0234	SCSM 0235	SCSM 0236	SCSM 0237	SCSM 0238	SCSM 0239	SCSM 0240
ANALYTICAL CODE(S)		SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND	SRACOND
DATE		12/11/91	12/11/91	12/11/91	12/11/91	12/11/91	12/11/91	12/11/91
ANALYSIS # OF total COMPONENT	Units	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)								
CHLORIDE (CL[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1
FLUORIDE (F[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1
NITRITE (NO2[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1	<1	<1	<1	<1	<1	<1
AMMONIUM (NH4[1+])	MG/L	835	748	695	676	723	569	646
Wet Chemistry								
PH	PH	9.97	9.87	9.64	9.55	9.85	9.82	9.82
EQUIV PT	MOLE/LITER	0.05 TO PH 7	0.04 TO PH 7	0.05 TO PH 7	0.044 TO PH 7	0.05 TO PH 7	0.04 TO PH 7	0.044 TO PH 7
ICP (Filtrate)								
ALUMINUM (AL)	PPM	<0.01	<0.01	0.060	0.024	<0.01	<0.01	<0.01
BARIUM (BA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BORON (B)	PPM	0.830	1.020	0.981	0.799	0.902	1.032	0.869
CADMIUM (CD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CALCIUM (CA)	PPM	1.793	1.721	1.799	1.660	1.713	1.625	1.644
CERIUM (CE)	PPM	<0.01	<0.01	0.101	0.036	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01
LANTHANUM LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	PPM	0.080	0.161	0.060	0.014	<0.01	0.158	0.029
MAGNESIUM (MG)	PPM	0.102	0.075	0.439	0.380	0.113	0.065	0.062
MANGANESE (MN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MOLYBDENUM (MO)	PPM	<0.01	<0.01	0.071	0.015	<0.01	<0.01	<0.01
NEODYMIUM (ND)	PPM	<0.01	<0.01	0.119	0.043	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	<0.01	<0.01	0.015	<0.01	<0.01	<0.01	<0.01
NIOBIUM (NB)	PPM	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	0.072	0.042	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.135	0.106	0.442	0.396	0.151	0.124	0.087
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	0.111	0.077	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	0.061	0.024	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	<0.01	<0.01	0.040	0.022	<0.01	<0.01	<0.01
SAMARIUM (SM)	PPM	<0.01	<0.01	0.074	0.030	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	<0.01	<0.01	0.027	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	4.400	11.760	48.630	26.740	0.051	10.160	1.530
STRONTIUM (SR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TANTALUM (TA)	PPM	<0.01	<0.01	0.023	0.027	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	<0.01	<0.01	0.047	0.043	<0.01	<0.01	<0.01
TIN (SN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results:

HWVP2 SME-RWS

SAMPLE ID		SMRW 0228	SMRW 0228	SMRW 0231	SMRW 0231
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/11/91	12/11/91	12/11/91	12/11/91
ANALYSIS # OF total		1 of 2	2 of 2	1 of 2	2 of 2
COMPONENT	Units				
FORMATE (COOH[1-])	MG/L	27748	27914	31624	30775
NITRATE (NO3[1-])	MG/L	23605	23462	29422	28811
NITRITE (NO2[1-])	MG/L	14	15	24	20
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1604	1583	1919	1876
AMMONIUM (NH4[1+])	MG/L	62	62	22	20
IC (Na2O2/H2O)					
CHLORIDE (CL[1-])	MG/L				
FLUORIDE (F[1-])	MG/L				
Wet Chemistry					
PH	PH	9.36	9.36	9.52	9.53
CALCINED % SOLIDS	WT %	20.42	20.91	21.83	22.01
TOT BASE (EQ PT)	MOLE/LITER	0.20 TO PH 7	0.20 TO PH 7	0.27 TO PH 7	0.26 TO PH 7
RHEOGRAM DONE (Y/N)	DD-MON-YY	16-01-92	16-01-92	16-01-92	Y 20/01/92
TOTAL WT % SOLIDS	WT %	18.36	18.52	19.31	20.24
DENSITY	G/ML	1.19	1.18	1.18	1.19
Carbon Analysis					
TOTAL CARBON	PPM	10524	10611	10832	10579
TOTAL INORGANIC CARBON	PPM	2660	2728	2774	2528
TOTAL ORGANIC CARBON	PPM	7864	7883	8058	8051
AA (Na2O2/HCl)					
SILICON (SI)	WT %	12.200	11.700	11.600	12.000
AA (Aqua Regia)					
SODIUM (NA)	WT %	8.571	8.511	8.074	7.453
POTASSIUM (K)	WT %	0.110	0.110	0.110	0.100
AE (Aqua Regia)					
CESIUM (CS)	WT %	0.300	0.300	0.300	0.200

SAMPLE ID	SMRW 0228	SMRW 0228	SMRW 0228	SMRW 0231	SMRW 0231
ANALYTICAL CODE(S)	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE	12/11/91	12/11/91	12/11/91	12/11/91	12/11/91
ANALYSIS # OF total	1 of 2	2 of 2	1 of 2	2 of 2	2 of 2
COMPONENT	Units				
ICP (Na2O2/HCl)					
ALUMINUM (AL)	WT %	2.431	2.328	2.345	2.404
BARIUM (BA)	WT %	0.097	0.093	0.094	0.096
BORON (B)	WT %	1.117	1.212	1.094	1.093
CADMIUM (CD)	WT %	1.612	1.532	1.584	1.602
CALCIUM (CA)	WT %	0.605	0.590	0.594	0.604
CERIUM (CE)	WT %	0.149	0.141	0.150	0.146
CHROMIUM (CR)	WT %	0.104	0.098	0.099	0.101
COPPER (CU)	WT %	0.117	0.111	0.110	0.115
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	10.130	9.616	9.740	9.966
LANTHANUM (LA)	WT %	0.155	0.100	0.180	0.190
LEAD (PB)	WT %	0.353	0.342	0.345	0.365
LITHIUM (LI)	WT %	0.644	0.701	0.673	0.657
MAGNESIUM (MG)	WT %	0.170	0.145	0.145	0.162
MANGANESE (MN)	WT %	0.820	0.783	0.797	0.825
MOLYBDENUM (MO)	WT %	0.173	0.191	0.194	0.177
NEODYMIUM (ND)	WT %	1.898	1.769	1.792	1.862
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	0.011
PHOSPHOROUS (P)	WT %	<0.01	<0.01	<0.01	0.021
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	0.012
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.219	0.221	0.206	0.212
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	9.232	8.735	8.696	8.930
SILVER (AG)	WT %	0.085	0.080	0.079	0.085
STRONTIUM (SR)	WT %	0.066	0.063	0.064	0.066
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.129	0.100	0.118	0.096
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	WT %	0.115	0.109	0.112	0.114
YTTRIUM (Y)	WT %	0.034	0.032	0.032	0.033
ZINC (ZN)	WT %	0.172	0.173	0.169	0.166
ZIRCONIUM (ZR)	WT %	5.424	5.142	5.174	5.286

SAMPLE ID	SMRW 0228	SMRW 0228	SMRW 0231	SMRW 0231
ANALYTICAL CODE(S)	ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE	12/11/91	12/11/91	12/11/91	12/11/91
ANALYSIS # OF total	1 of 2	2 of 2	1 of 2	2 of 2
COMPONENT	Units			
ICP (Aqua Regia)				
ALUMINIUM (AL)	WT %	2.715	2.604	2.664
BARIUM (BA)	WT %	0.109	0.104	0.108
BORON (B)	WT %	0.984	1.004	0.995
CADMIUM (CD)	WT %	1.864	1.778	1.880
CALCIUM (CA)	WT %	0.537	0.515	0.533
CERIUM (CE)	WT %	0.289	0.250	0.263
CHROMIUM (CR)	WT %	0.116	0.110	0.112
COPPER (CU)	WT %	0.134	0.129	0.131
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01
IRON (FE)	WT %	11.440	10.990	11.150
LANTHANUM (LA)	WT %	0.239	0.202	0.232
LEAD (PB)	WT %	0.420	0.394	0.410
LITHIUM (LI)	WT %	0.676	0.725	0.704
MAGNESIUM (MG)	WT %	0.189	0.189	0.198
MANGANESE (MN)	WT %	0.922	0.878	0.906
MOLYBDENUM (MO)	WT %	0.220	0.234	0.223
NEODYMIUM (ND)	WT %	2.207	2.128	2.177
NICKEL (NI)	WT %	1.027	0.983	1.007
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	0.031	0.034	0.035
PHOSPHOROUS (P)	WT %	0.024	0.022	0.035
PRASEODYMIUM (PR)	WT %	0.077	0.045	0.058
RHODIUM (RH)	WT %	0.022	0.016	0.026
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.263	0.254	0.261
SAMARIUM (SA)	WT %	<0.01	<0.01	0.015
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01
SILICON (SI)	WT %	0.380	0.369	0.373
SILVER (AG)	WT %	0.099	0.095	0.097
SODIUM (NA)	WT %	9.926	10.720	10.320
STRONTIUM (SR)	WT %	0.070	0.067	0.068
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.139	0.131	0.132
TIN (SN)	WT %	<0.01	<0.01	<0.01
TITANIUM (TI)	WT %	0.029	0.029	0.030
YTRIUM (Y)	WT %	0.039	0.037	0.039
ZINC (ZN)	WT %	0.15~	0.151	0.152
ZIRCONIUM (ZR)	WT %	5.894	5.674	5.671
				5.705

SAMPLE ID		SMRW 0228	SMRW 0228	SMRW 0231	SMRW 0231
ANALYTICAL CODE(S)		ACSLUDGE	ACSLUDGE	ACSLUDGE	ACSLUDGE
DATE		12/11/91	12/11/91	12/11/91	12/11/91
ANALYSIS # OF total		1 of 2	2 of 2	1 of 2	2 of 2
COMPONENT	Units				
ICP (Filtrate)					
ALUMINUM (AL)	PPM	10.430	10.130	8.330	10.120
BARIUM (BA)	PPM	0.516	0.492	0.505	0.573
BORON (B)	PPM	1072.000	1050.000	390.200	1190.000
CADMIUM (CD)	PPM	0.197	0.184	0.125	0.138
CALCIUM (CA)	PPM	5.661	5.308	3.434	4.610
CERIUM (CE)	PPM	0.518	1.139	<0.01	<0.01
CHROMIUM (CR)	PPM	0.056	0.066	0.036	<0.01
COPPER (CU)	PPM	0.721	0.744	0.545	0.520
GERMANIUM (GE)	PPM	<0.01	0.516	<0.01	<0.01
IRON (FE)	PPM	0.190	0.197	0.133	<0.01
LANTHANUM LA)	PPM	2.052	1.243	<0.01	<0.01
LEAD (PB)	PPM	<0.01	0.036	<0.01	<0.01
LITHIUM (LI)	PPM	1494.000	1462.000	1299.000	1610.000
MAGNESIUM (MG)	PPM	7.222	7.180	1.778	1.212
MANGANESE (MN)	PPM	0.557	0.563	0.245	0.283
MOLYBDENUM (MO)	PPM	505.700	491.300	409.300	567.000
NEODYMIUM (ND)	PPM	0.473	0.649	<0.01	<0.01
NICKEL (NI)	PPM	0.335	0.292	0.107	<0.01
NIOBIUM (NB)	PPM	0.110	0.062	<0.01	<0.01
PALLADIUM (PD)	PPM	0.157	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	3.583	3.533	5.739	2.481
PRASEODYMIUM (PR)	PPM	0.714	0.641	<0.01	<0.01
RHODIUM (RH)	PPM	2.018	2.201	1.443	<0.01
RUBIDIUM (RB)	PPM	53.090	50.490	<0.01	45.670
RUTHENIUM (RU)	PPM	1.439	1.478	0.774	<0.01
SAMARIUM (SM)	PPM	0.491	0.550	<0.01	<0.01
SELENIUM (SE)	PPM	0.832	0.692	0.375	0.221
SILICON (SI)	PPM	2.774	2.441	3.568	4.928
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	PPM	26473.000	24903.000	8329.000	28958.000
STRONTIUM (SR)	PPM	2.231	2.123	1.299	1.737
TANTALUM (TA)	PPM	0.275	0.142	0.048	<0.01
TELLURIUM (TE)	PPM	1.214	0.995	0.756	0.431
TIN (SN)	PPM	0.149	0.075	0.071	<0.01
TITANIUM (TI)	PPM	0.039	0.026	<0.01	<0.01
YTTRIUM (Y)	PPM	0.019	0.023	0.011	<0.01
ZINC (ZN)	PPM	<0.01	<0.01	0.010	<0.01
ZIRCONIUM (ZR)	PPM	0.619	0.611	0.641	0.662

Analytical Results:

HWVP2 SME-FRIT

SAMPLE ID		SMCO 0241	SMCO 0241	SMCO 0241	SMCO 0241	SMCO 0242	SMCO 0242	SMCO 0242	SMCO 0242
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91
ANALYSIS # of total		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units								
IC (FILTRATE)									
FORMATE (COOH[1-])	MG/L	22178	19873	20529	22479	18566	21564	20027	21545
NITRATE (NO3[1-])	MG/L	22553	20028	20729	22406	18772	21995	20459	21942
NITRITE (NO2[1-])	MG/L	<10	<9	<10	<10	<7	<9	<9	<9
OXALATE (C2O4[2-])	MG/L	990	846	793	914	707	550	674	835
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<20	<1	<1	<1
SULFATE (SO4[2-])	MG/L	1642	1483	1378	1543	1315	1508	1414	1521
IC (Na2O2/H2O)									
CHLORIDE (CL[1-])	MG/L								
FLUORIDE (F[1-])	MG/L								
IC (vit/Na2O2/H2O)									
CHLORIDE (CL[1-])	MG/L								
FLUORIDE (F[1-])	MG/L								
PHOSPHATE (PO4[3-])	MG/L	<30	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	3779	3863	3700	4420	3726	4107	3875	3700
Wet Chemistry									
PH	PH	10.04	10.04	10.04	10.04	10.02	10.02	10.02	10.02
TOTAL WT % SOLIDS	WT %	37.55	37.59	37.46	37.72	38.47	38.21	38.37	37.97
RHEOGRAM DONE (Y/N)	DD-MON-YY	08-01-91	08-01-91	08-01-91	08-01-91	09-01-91	09-01-91	09-01-91	09-01-91
CALCINED % SOLIDS	WT %	36.36	36.51	36.49	36.62	37.24	37.21	37.21	37.17
DENSITY	G/ML	1.31	1.32	1.31	1.33	1.32	1.30	1.34	1.34
Carbon Analysis									
TOTAL CARBON	PPM	9003	8012	8213	8172	8536	8436	8481	7976
TOTAL INORGANIC CARBON	PPM	3472	2492	2853	2587	3337	2626	3689	3179
TOTAL ORGANIC CARBON	PPM	5531	5520	5360	5585	5199	5810	4792	4797
AA (vit/Na2O2/HCl)									
SILICON (SI)	WT %	25.300	25.300	25.000	25.600	21.600	21.700	21.400	21.500
AA (Microwave)									
SODIUM (NA)	WT %	4.593	4.514	4.356	4.534	4.263	4.284	4.253	4.110
POTASSIUM (K)	WT %	0.080	0.080	0.070	0.080	0.070	0.070	0.080	0.070
AE (vit/Microwave)									
CESIUM (CS)	WT %	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Colorimetry									
FE(II)/FE(TOT)	RATIO	0.009	0.008	0.008	0.009	0.011	0.008	0.009	0.009

SAMPLE ID		SMCO 0241	SMCO 0241	SMCO 0241	SMCO 0241	SMCO 0242	SMCO 0242	SMCO 0242	SMCO 0242
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91
ANALYSIS # of total COMPONENT		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
	Units								
ICP (vit/Na2O2/HCl)									
ALUMINUM (AL)	WT %	1.376	1.385	1.383	1.398	1.390	1.347	1.375	1.381
BARIUM (BA)	WT %	0.053	0.054	0.053	0.054	0.053	0.052	0.053	0.052
BORON (B)	WT %	3.922	3.975	3.990	4.026	4.021	3.995	4.002	4.028
CADMIUM (CD)	WT %	0.809	0.815	0.813	0.820	0.799	0.786	0.802	0.797
CERIUM (CE)	WT %	0.069	0.042	0.069	0.091	0.090	0.071	0.091	0.076
GERMANIUM (GE)	WT %	0.007	<0.01	0.006	0.014	0.006	0.031	0.040	0.046
IRON (FE)	WT %	5.155	5.217	5.200	5.220	5.135	5.155	5.091	5.092
LANTHANUM (LA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LITHIUM (LI)	WT %	2.326	2.329	2.316	2.338	2.354	2.322	2.335	2.331
MAGNESIUM (MG)	WT %	0.073	0.082	0.091	0.073	0.087	0.085	0.090	0.090
MOLYBDENUM (MO)	WT %	0.107	0.106	0.104	0.109	0.109	0.107	0.108	0.107
NEODYMIUM (ND)	WT %	0.956	0.950	0.953	0.978	0.968	0.946	0.958	0.980
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	0.012	0.030	0.025	0.038	0.009
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.032	0.043	0.031	0.035	0.045	0.043	0.031	0.035
SILICON (SI)	WT %	23.910	24.040	24.030	23.910	24.150	24.130	23.840	23.980
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	0.013	0.016	0.008	0.023	0.005
TIN (SN)	WT %	0.017	0.009	0.012	0.026	0.016	0.012	0.012	0.014
TITANIUM (TI)	WT %	0.092	0.093	0.095	0.095	0.095	0.096	0.095	0.095
YTTRIUM (Y)	WT %	0.016	0.016	0.016	0.017	0.017	0.016	0.016	0.017
ZIRCONIUM (ZR)	WT %	2.672	2.708	2.688	2.701	2.648	2.602	2.619	2.642

SAMPLE ID		SMCO 0241	SMCO 0241	SMCO 0241	SMCO 0241	SMCO 0242	SMCO 0242	SMCO 0242	SMCO 0242
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91	12/12/91
ANALYSIS # of total		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units								
ICP (Aqua Regia)									
PALLADIUM (PD)	WT %	<0.01	0.028	0.004	0.006	0.008	0.004	0.012	<0.01
RHODIUM (RH)	WT %	<0.01	0.001	<0.01	0.003	<0.01	<0.01	<0.01	0.001
RUTHENIUM (RU)	WT %	0.047	0.066	0.066	0.062	0.056	0.072	0.062	0.067
SELENIUM (SE)	WT %	<0.01	<0.01	0.004	0.002	<0.01	0.007	0.006	<0.01
SILVER (AG)	WT %	0.031	0.037	0.036	0.035	0.033	0.035	0.035	0.035
TELLURIUM (TE)	WT %	0.067	0.098	0.089	0.096	0.088	0.095	0.091	0.102
ICP (Microwave)									
ALUMINUM (AL)	WT %	1.334	1.349	1.347	1.341	1.316	1.317	1.338	1.312
BARIUM (BA)	WT %	0.054	0.054	0.053	0.051	0.051	0.049	0.044	0.045
CADMIUM (CD)	WT %	0.801	0.808	0.806	0.799	0.786	0.783	0.793	0.786
CALCIUM (CA)	WT %	0.268	0.270	0.269	0.266	0.264	0.261	0.260	0.257
CERIUM (CE)	WT %	0.133	0.135	0.126	0.114	0.122	0.081	0.030	0.050
CHROMIUM (CR)	WT %	0.054	0.057	0.056	0.055	0.054	0.054	0.053	0.053
COPPER (CU)	WT %	0.065	0.066	0.066	0.067	0.072	0.071	0.072	0.070
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	5.023	5.084	5.048	5.012	4.925	4.930	4.986	4.934
LANTHANUM (LA)	WT %	0.151	0.147	0.132	0.133	0.135	0.098	0.045	0.054
LEAD (PB)	WT %	0.186	0.185	0.185	0.180	0.181	0.173	0.161	0.164
LITHIUM (LI)	WT %	2.225	2.250	2.229	2.226	2.265	2.263	2.280	2.240
MAGNESIUM (MG)	WT %	0.100	0.105	0.104	0.102	0.102	0.101	0.103	0.101
MANGANESE (MN)	WT %	0.409	0.415	0.412	0.411	0.406	0.403	0.412	0.403
MOLYBDENUM (MO)	WT %	0.107	0.108	0.107	0.108	0.105	0.106	0.106	0.105
NEODYMIUM (ND)	WT %	0.962	0.951	0.899	0.824	0.875	0.654	0.354	0.437
NICKEL (NI)	WT %	0.452	0.459	0.456	0.457	0.444	0.446	0.451	0.443
NIوبيUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	0.010	0.010	0.011	0.011	<0.01	0.012
PHOSPHOROUS (P)	WT %	0.034	0.032	0.028	0.031	0.030	0.029	0.029	0.029
PRASEODYMIUM (PR)	WT %	0.047	0.048	0.045	0.040	0.044	0.026	<0.01	0.010
RHODIUM (RH)	WT %	0.010	0.011	0.010	0.010	0.012	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.095	0.095	0.094	0.087	0.094	0.077	0.053	0.061
SAMARIUM (SA)	WT %	0.018	0.017	0.016	0.017	0.018	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILVER (AG)	WT %	0.042	0.042	0.041	0.041	0.041	0.041	0.041	0.040
SODIUM (NA)	WT %	5.813	5.830	5.850	5.822	5.690	5.767	5.771	5.618
STRONTIUM (SR)	WT %	0.031	0.031	0.030	0.029	0.030	0.027	0.023	0.024
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.068	0.071	0.071	0.069	0.070	0.067	0.065	0.066
TIN (SN)	WT %	0.010	<0.01	<0.01	0.026	0.010	<0.01	0.012	0.010
TITANIUM (TI)	WT %	0.088	0.088	0.088	0.087	0.087	0.087	0.088	0.087
YTTRIUM (Y)	WT %	0.017	0.016	0.015	0.014	0.015	0.012	<0.01	<0.01
ZINC (ZN)	WT %	0.097	0.097	0.097	0.097	0.099	0.101	0.101	0.099
ZIRCONIUM (ZR)	WT %	2.682	2.713	2.695	2.675	2.637	2.595	2.625	2.583

Analytical Results:

HWVP2 Melter Feed

SAMPLE ID		MFTH 0298	MFTH 0298	MFTR 0299	MFTR 0299	MFTR 0299	MFTR 0299
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		1/3/92	1/3/92	1/3/92	1/3/92	1/3/92	1/3/92
ANALYSIS # OF total COMPONENT	Units	1 OF 2	2 OF 2	1 OF 4	2 OF 4	3 OF 4	4 OF 4
IC (FILTRATE)							
FORMATE (COOH[1-])	MG/L	16010	14907	17505	17567	17718	17091
NITRATE (NO3[1-])	MG/L	35535	33469	30780	31460	31130	30386
NITRITE (NO2[1-])	MG/L	<35	<33	<13	<13	<13	<14
OXALATE (C2O4[2-])	MG/L	1341	1299	1260	1286	1304	1321
PHOSPHATE (PO4[3-])	MG/L	<16	<12	<14	<14	<40	<19
SULFATE (SO4[2-])	MG/L	1690	1617	1902	1899	1920	1929
IC (Na2O2/H2O)							
CHLORIDE (CL[1-])	MG/L						
FLUORIDE (F[1-])	MG/L						
Wet Chemistry	p						
PH	PH	9.64	9.64	9.64	9.64	9.64	9.64
TOTAL WT % SOLIDS	WT %	36.67	36.50	40.96	40.56	40.77	40.73
RHEOGRAM DONE (Y/N)	DD-MON-YY	13-01-92	13-01-92	13-01-92	13-01-92	13-01-92	13-01-92
CALCINED% SOLIDS	WT %	35.19	35.14	39.87	39.80	39.79	39.75
DENSITY	G/ML	1.28	1.29	1.34	1.31	1.31	1.31
Carbon Analysis							
TOTAL CARBON	PPM	7431	7052	8581	8416	8374	8607
TOTAL INORGANIC CARBON	PPM	3023	2726	4214	4081	4113	4336
TOTAL ORGANIC CARBON	PPM	4408	4326	4367	4335	4261	4271
IC (vit/Na2O2/H2O)							
CHLORIDE (CL[1-])	MG/L						
FLUORIDE (F[1-])	MG/L						
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	3943	4159	4525	4530	4780	5013
AA (vit/Na2O2/HCl)							
SILICON (SI)	WT %	24.400	24.600	25.000	25.700	25.200	25.400
AA (vit/Microwave)							
SODIUM (NA)	WT %	4.969	5.018	4.699	4.619	4.694	4.641
POTASSIUM (K)	WT %	0.390	0.390	0.200	0.200	0.200	0.200
AE (vit/Microwave)							
CESIUM (CS)	WT %	0.100	0.100	0.100	0.100	0.100	0.100
Colorimetry							
FE(II)/FE(TOT)	NONE	0.023	0.023	0.021	0.021	0.023	0.018

SAMPLE ID		MFTH 0298	MFTH 0298	MFTR 0299	MFTR 0299	MFTR 0299	MFTR 0299
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		1/3/92	1/3/92	1/3/92	1/3/92	1/3/92	1/3/92
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units						
ALUMINUM (AL)	WT %	1.179	1.169	1.077	1.113	1.141	1.157
BARIUM (BA)	WT %	0.059	0.058	0.049	0.050	0.050	0.051
BORON (B)	WT %	3.595	3.508	3.799	3.802	3.819	3.824
CADMIUM (CD)	WT %	0.579	0.132	0.660	0.668	0.674	0.677
CALCIUM (CA)	WT %	0.456	0.448	0.376	0.378	0.381	0.379
CERIUM (CE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	WT %	0.050	0.051	0.037	0.040	0.040	0.041
COPPER (CU)	WT %	0.118	0.102	0.096	0.087	0.138	0.084
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	4.742	4.592	4.518	4.579	4.562	4.664
LANTHANUM (LA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	WT %	0.135	0.132	0.127	0.141	0.130	0.149
LITHIUM (LI)	WT %	2.230	2.193	2.200	2.207	2.220	2.226
MAGNESIUM (MG)	WT %	0.111	0.108	0.023	0.033	0.036	0.035
MANGANESE (MN)	WT %	0.713	0.699	0.498	0.497	0.489	0.496
MOLYBDENUM (MO)	WT %	0.044	0.043	0.055	0.059	0.061	0.065
NEODYMIUM (ND)	WT %	0.909	0.921	0.667	0.705	0.698	0.763
NIOBIUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	WT %	0.233	0.066	0.040	0.016	<0.01	<0.01
PRASEODYMIUM (PR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.021	0.030	0.035	0.043	0.042	0.049
SAMARIUM (SA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	21.950	21.930	22.060	21.800	22.110	21.870
SILVER (AG)	WT %	<0.01	<0.01	<0.01	0.019	0.018	0.020
STRONTIUM (SR)	WT %	0.031	0.030	0.031	0.031	0.031	0.031
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TITANIUM (TI)	WT %	0.102	0.092	0.080	0.084	0.088	0.085
YTTRIUM (Y)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	WT %	0.212	0.213	0.172	0.169	0.146	0.158
ZIRCONIUM (ZR)	WT %	1.904	1.861	2.257	2.285	2.279	2.309

SAMPLE ID		MFTH 0298	MFTH 0298	MFTR 0299	MFTR 0299	MFTR 0299	MFTR 0299
ANALYTICAL CODE(S)		SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR	SLGLAS/SLUR
DATE		1/3/92	1/3/92	1/3/92	1/3/92	1/3/92	1/3/92
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units						
ICP (Aqua Regia)							
PALLADIUM (PD)	WT %	0.030	0.024	0.031	0.031	0.028	0.029
RHODIUM (RH)	WT %	0.022	0.021	0.025	0.026	0.024	0.024
RUTHENIUM (RU)	WT %	0.092	0.090	0.098	0.106	0.099	0.097
SELENIUM (SE)	WT %	0.010	0.010	0.010	0.009	0.010	0.010
SILVER (AG)	WT %	0.026	0.025	0.032	0.036	0.033	0.032
TELLURIUM (TE)	WT %	0.053	0.051	0.060	0.064	0.062	0.059
ICP (vit/Microwave)							
ALUMINUM (AL)	WT %	1.360	1.366	1.295	1.249	1.289	1.279
BARIUM (BA)	WT %	0.061	0.046	0.046	0.038	0.048	0.038
CADMIUM (CD)	WT %	0.582	0.587	0.693	0.670	0.686	0.690
CALCIUM (CA)	WT %	0.361	0.354	0.284	0.269	0.288	0.277
CERIUM (CE)	WT %	0.092	<0.01	0.046	<0.01	0.071	<0.01
CHROMIUM (CR)	WT %	0.067	0.069	0.057	0.055	0.055	0.056
COPPER (CU)	WT %	0.088	0.089	0.068	0.063	0.067	0.065
GERMANIUM (GE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	4.704	4.788	4.688	4.550	4.646	4.687
LANTHANUM (LA)	WT %	0.175	<0.01	0.066	<0.01	0.098	<0.01
LEAD (PB)	WT %	0.172	0.142	0.156	0.130	0.178	0.137
LITHIUM (LI)	WT %	2.241	2.306	2.258	2.181	2.251	2.247
MAGNESIUM (MG)	WT %	0.285	0.293	0.167	0.160	0.165	0.167
MANGANESE (MN)	WT %	0.643	0.653	0.476	0.456	0.470	0.471
MOLYBDENUM (MO)	WT %	0.088	0.089	0.097	0.094	0.097	0.096
NEODYMIUM (ND)	WT %	1.054	0.070	0.506	0.110	0.635	0.074
NICKEL (NI)	WT %	0.528	0.535	0.459	0.441	0.454	0.456
NIوبيUM (NB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	WT %	0.030	0.029	0.025	0.024	0.031	0.026
PRASEODYMIUM (PR)	WT %	0.047	<0.01	<0.01	<0.01	0.019	<0.01
RHODIUM (RH)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	WT %	0.072	0.037	0.062	0.037	0.072	0.038
SAMARIUM (SA)	WT %	0.025	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILVER (AG)	WT %	0.027	0.027	0.036	0.034	0.037	0.036
SODIUM (NA)	WT %	5.981	6.134	5.695	5.531	5.622	5.628
STRONTIUM (SR)	WT %	0.027	<0.01	0.022	<0.01	0.024	0.016
TANTALUM (TA)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	WT %	0.054	0.054	0.059	0.059	0.062	0.059
TIN (SN)	WT %	<0.01	<0.01	<0.01	<0.01	0.102	0.028
TITANIUM (TI)	WT %	0.099	0.100	0.091	0.087	0.090	0.090
YTTRIUM (Y)	WT %	0.011	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	WT %	0.098	0.098	0.092	0.089	0.090	0.089
ZIRCONIUM (ZR)	WT %	1.925	1.908	2.323	2.225	2.362	2.308

SAMPLE ID		MFTR 0305	MFTR 0305	MFTR 0331	MFTR 0331	MFTR 0339	MFTR 0339	MFTR 0357	MFTR 0357	MFTR 0366	MFTR 0366
ANALYTICAL CODE(S)		SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY
DATE		1/7/92	1/7/92	1/8/92	1/8/92	1/9/92	1/9/92	1/11/92	1/11/92	1/20/92	1/20/92
ANALYSIS # OF total COMPONENT	Units	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2
IC (FILTRATE)											
FORMATE (COOH{1-})	MG/L	11604	12421	13537	13356	12325	12906	14016	14515	10819	11139
NITRATE (NO3{1-})	MG/L	27519	29114	27961	27458	25482	26630	24264	25089	21550	22142
NITRITE (NO2{1-})	MG/L	<15	<16	<14	<14	<13	<13	<7	<7	<9	<10
OXALATE (C2O4{2-})	MG/L	934	969	1197	1212	1106	1162	1003	1030	915	934
PHOSPHATE (PO4{3-})	MG/L	<36	<17	<31	<1	<1	<1	<46	<14	<17	<10
SULFATE (SO4{2-})	MG/L	1512	1594	1647	1660	1522	1597	1599	1565	1494	1484
IC (Na2O2/H2O)											
CHLORIDE (CL{1-})	MG/L										
FLUORIDE (F{1-})	MG/L										
Wet Chemistry											
PH	PH	8.45	9.61	9.65	9.63	9.49	9.51	9.67	9.65	9.71	9.70
TOTAL WT % SOLIDS	WT %	38.81	39.23	37.91	38.17	38.39	38.54	39.57	39.05	37.54	36.95
RHEOGRAM DONE (Y/N)	DD-MON-YY	Y 17/01/92	Y 17/01/92	23-01-92	23-01-92	22-01-92	22-01-92	Y 23-01-92	Y 23-01-92	Y 23-01-92	Y 23-01-92
CALCINED % SOLIDS	WT %	37.00	37.15	37.53	37.72	37.61	37.46	37.79	38.25	34.47	34.34
DENSITY	G/ML	1.30	1.27	1.33	1.31	1.33	1.32	1.35	1.35	1.28	1.29
Carbon Analysis											
TOTAL CARBON	PPM	7318	7308	7724	7383	7470	7149	7962	7599	7734	7930
TOTAL INORGANIC CARBON	PPM	3995	3918	4168	4101	4271	3819	4389	4239	4243	4503
TOTAL ORGANIC CARBON	PPM	3323	3390	3556	3282	3199	3330	3573	3360	3491	3427

SAMPLE ID		MFTR 0381	MFTR 0381	MFTR 0398	MFTR 0398	MFTR 0415	MFTR 0418	MFTR 0418	MFTR 0439	MFTR 0439	MFTR 0454
ANALYTICAL CODE(S)		SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY	SLURRY
DATE		1/21/92	1/21/92	1/29/92	1/29/92	1/30/92	1/30/92	1/31/92	2/1/92	2/1/92	2/2/92
ANALYSIS # OF total		1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 1	1 OF 2	2 OF 2	1 OF 2	2 OF 2	1 OF 2
COMPONENT	Units										
IC (FILTRATE)											
FORMATE (COOH[1-])	MG/L	10673	11030	9111	9267	8184	7757	8366	7647	7696	6203
NITRATE (NO3[1-])	MG/L	21662	22395	21622	21924	20267	19688	20801	19454	19066	14272
NITRITE (NO2[1-])	MG/L	<9	<9	<11	<11	<9	<9	<9	<9	<9	60
OXALATE (C2O4[2-])	MG/L	1002	1033	1105	1024	838	832	892	821	824	786
PHOSPHATE (PO4[3-])	MG/L	<31	<30	<33	<35	<36	<12	<17	<14	<1	<4
SULFATE (SO4[2-])	MG/L	1339	1401	1582	1522	1396	1343	1490	1301	1276	972
IC (Na2O2/H2O)											
CHLORIDE (CL[1-])	MG/L										
FLUORIDE (F[1-])	MG/L										
Wet Chemistry											
PH	PH	9.69	9.69	9.62	9.62	9.60	9.60	9.60	9.70	9.70	9.86
TOTAL WT % SOLIDS	WT %	37.26	37.10	39.31	38.74	38.11	38.06	37.68	38.59	38.14	27.21
RHEOGRAM DONE (Y/N)	DD-MON-YY	Y22-01-92	Y 22-01-92	Y 31-01-92	Y 31-01-92	Y 31-01-92	Y 31-01-92	Y 31-01-92	32478.00	32478.00	32478.00
CALCINED % SOLIDS	WT %	33.84	33.72	34.76	36.25	35.04	35.93	36.05	35.65	35.68	23.55
DENSITY	G/ML	1.24	1.27	1.30	1.28	1.28	1.31	1.32	1.32	1.31	1.17
Carbon Analysis											
TOTAL CARBON	PPM	7658	7544	7925	8012	7811	7910	8034	9944	8795	6666
TOTAL INORGANIC CARBON	PPM	4398	4336	4282	4683	4655	4712	4987	5250	5011	3426
TOTAL ORGANIC CARBON	PPM	3260	3208	3643	3329	3156	3198	3047	4694	3784	3240

SAMPLE ID		MFTR 0454	MFTR 0469	MFTR 0469	MFTR 0483	MFTR 0483
ANALYTICAL CODE(S)		SLURRY	SLURRY	SLURRY	SLURRY	SLURRY
DATE		2/2/92	2/3/92	2/3/92	2/4/92	2/4/92
ANALYSIS # OF total		2 OF 2	1 OF 2	2 OF 2	1 OF 2	2 OF 2
COMPONENT	Units					
IC (FILTRATE)						
FORMATE (COOH[1-])	MG/L	6323	6114	5931	5757	6178
NITRATE (NO3[1-])	MG/L	14845	15574	14072	13448	14028
NITRITE (NO2[1-])	MG/L	62	66	63	62	64
OXALATE (C2O4[2-])	MG/L	809	1124	1080	1007	649
PHOSPHATE (PO4[3-])	MG/L	<4	<32	<11	<8	<8
SULFATE (SO4[2-])	MG/L	988	1014	987	967	917
IC (Na2O2/H2O)						
CHLORIDE (CL[1-])	MG/L					
FLUORIDE (F[1-])	MG/L					
Wet Chemistry						
PH	PH	9.86	9.81	9.81	9.87	9.87
TOTAL WT % SOLIDS	WT %	27.02	26.57	26.80	34.67	34.19
RHEOGRAM DONE (Y/N)	DD-MON-YY	32478.00	12-02-92	12-02-92	12-02-92	12-02-92
CALCINED % SOLIDS	WT %	23.36	22.78	22.92	30.64	30.02
DENSITY	G/ML	1.19	1.16	1.17	1.30	1.29
Carbon Analysis						
TOTAL CARBON	PPM	6466	6119	6038	5799	5984
TOTAL INORGANIC CARBON	PPM	3416	3036	3078	3072	3248
TOTAL ORGANIC CARBON	PPM	3050	3083	2960	2727	2736

Analytical Results:

HWVP2 Melter Offgas Condensate

SAMPLE ID		OGCT 0319	OGCB 0320	OGCT 0321	OGCB 0322	OGCT 0303	OGCB 0304	OGCT 0306	OGCB 0307	OGCT 0314	OGCB 0315	OGCT 0326
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		1/6/92	1/6/92	1/7/92	1/7/92	1/7/92	1/7/92	1/8/92	1/8/92	1/8/92	1/8/92	1/8/92
ANALYSIS # of total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units											
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	342	357	323	322	295	283	247	257	207	208	193
FLUORIDE (F[1-])	MG/L	52	54	49	50	43	40	36	38	37	37	35
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	2997	3065	2764	2794	2585	2445	2220	2330	2189	2189	2006
NITRITE (NO2[1-])	MG/L	15	16	19	19	13	12	21	15	21	22	26
PHOSPHATE (PO4[3-])	MG/L	<2	<1	<1	<1	<1	<1	<1	<1	5	<1	<1
SULFATE (SO4[2-])	MG/L	205	246	241	251	100	96	86	89	101	111	102
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.80	1.85	1.90	1.80	1.86	1.88	1.89	1.90	1.89	1.89	1.89
TOT ACID (EQ PT)	MOLE/LITER	.06 TO PH 7	.057 TO PH 7	.053 TO PH 7	.052 TO PH 7	.05 TO PH 7	.047 TO PH 7	0.041 TO PH 7	.045 TO PH 7	.038 TO PH 7	.039 TO PH 7	.036 TO PH 7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	3.264	3.347	3.127	3.106	2.992	2.910	2.618	2.729	2.500	2.464	2.318
BARIUM (BA)	PPM	0.237	0.238	0.220	0.221	0.212	0.208	0.192	0.197	0.174	0.172	0.160
BORON (B)	PPM	53.890	53.130	50.920	50.840	49.210	47.660	44.710	45.890	42.290	42.300	40.130
CADMIUM (CD)	PPM	6.040	6.045	5.609	5.591	5.289	5.078	4.814	4.787	4.215	4.169	3.861
CALCIUM (CA)	PPM	4.248	4.306	4.093	4.060	4.090	3.422	3.253	3.257	2.987	3.793	3.658
CERIUM (CE)	PPM	0.092	0.409	0.302	0.339	0.013	0.017	0.042	0.032	0.301	0.322	0.407
CHROMIUM (CR)	PPM	5.309	5.141	4.779	4.727	5.374	5.250	4.190	4.300	3.473	3.466	3.151
COPPER (CU)	PPM	12.830	12.790	11.870	11.790	11.360	10.860	9.962	10.440	8.966	8.955	8.159
GERMANIUM (GE)	PPM	0.014	0.118	0.110	0.127	<0.01	0.078	0.041	<0.01	0.097	0.096	0.117
IRON (FE)	PPM	8.505	9.092	7.988	8.447	8.033	30.860	16.600	7.179	6.243	6.462	5.771
LANTHANUM (LA)	PPM	0.230	0.431	0.355	0.276	0.199	0.227	0.112	0.178	0.345	0.379	0.339
LEAD (PB)	PPM	3.513	3.513	3.261	3.261	3.022	2.948	2.660	2.787	2.447	2.428	2.227
LITHIUM (LI)	PPM	12.330	12.310	11.210	11.150	10.840	10.300	9.341	9.689	8.306	8.249	7.569
MAGNESIUM (MG)	PPM	1.358	1.506	1.389	1.376	1.267	1.167	1.080	1.111	1.100	1.226	1.206
MANGANESE (MN)	PPM	1.674	1.662	1.512	1.513	1.530	1.646	1.401	1.351	1.133	1.131	1.037
MOLYBDENUM (MO)	PPM	3.406	3.434	3.236	3.083	6.036	5.591	3.206	3.208	2.176	2.275	2.067
NEODYMIUM (ND)	PPM	2.185	2.200	2.185	2.249	1.950	1.846	1.708	1.795	1.861	1.852	1.826
NICKEL (NI)	PPM	4.111	4.216	3.803	3.753	5.890	7.322	4.245	3.719	2.794	2.808	2.548
NIObIUM (NB)	PPM	<0.01	0.031	0.021	0.019	<0.01	<0.01	<0.01	<0.01	0.022	0.027	0.032
PALLADIUM (PD)	PPM	<0.01	0.178	0.098	0.106	<0.01	<0.01	<0.01	<0.01	0.130	0.133	0.142
PHOSPHOROUS (P)	PPM	0.346	0.358	0.399	0.370	0.399	0.407	0.308	0.313	0.414	0.405	0.381
PRASEODYMIUM (PR)	PPM	0.034	0.132	0.245	0.296	<0.01	<0.01	0.010	0.017	0.294	0.316	0.385
RHODIUM (RH)	PPM	0.011	0.166	0.101	0.121	<0.01	0.016	<0.01	<0.01	0.126	0.123	0.150
RUBIDIUM (RB)	PPM	0.032	0.045	0.317	0.545	<0.01	<0.01	<0.01	<0.01	0.482	0.673	0.554
RUTHENIUM (RU)	PPM	4.040	3.984	3.684	3.690	3.507	3.529	3.128	3.235	2.778	2.774	2.560
SAMARIUM (SM)	PPM	<0.01	0.049	0.176	0.215	<0.01	<0.01	<0.01	<0.01	0.212	0.228	0.315
SELENIUM (SE)	PPM	2.387	2.379	2.224	2.229	2.100	1.940	1.773	1.886	1.697	1.674	1.538
SILICON (SI)	PPM	9.694	9.785	8.882	8.951	9.116	8.258	7.329	7.767	6.819	6.739	6.148
SILVER (AG)	PPM	0.047	0.064	0.059	0.060	0.043	0.045	0.038	0.041	0.058	0.061	0.066
SODIUM (NA)	PPM	101.700	101.400	92.600	92.730	90.050	85.670	77.660	80.410	69.390	68.520	63.040
STRONTIUM (SR)	PPM	0.066	0.065	0.062	0.062	0.061	0.059	0.055	0.056	0.050	0.051	0.049
TANTALUM (TA)	PPM	<0.01	0.078	0.065	0.065	<0.01	<0.01	0.010	<0.01	0.048	0.064	0.056
TELLURIUM (TE)	PPM	4.021	4.044	3.687	3.695	3.467	3.303	3.008	3.175	2.735	2.744	2.487
TIN (SN)	PPM	0.280	0.288	0.261	0.265	0.246	0.236	0.213	0.230	0.210	0.204	0.191
TITANIUM (TI)	PPM	0.154	0.159	0.147	0.149	0.138	0.132	0.119	0.125	0.116	0.116	0.111
YTTRIUM (Y)	PPM	0.020	0.026	0.024	0.025	0.018	0.018	0.017	0.017	0.021	0.021	0.022
ZINC (ZN)	PPM	1.007	1.015	0.940	0.933	0.900	0.894	0.802	0.882	0.718	0.713	0.653
ZIRCONIUM (ZR)	PPM	3.147	3.077	2.976	2.971	2.978	2.822	2.624	2.717	2.472	2.459	2.338

SAMPLE ID		OGCB 0327	OGCT 0332	OGCB 0333	OGCT 0337	OGCB 0338	OGCT 0340	OGCB 0341	OGCT 0342	OGCB 0343	OGCT 0344	OGCB 0345
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		1/8/92	1/8/92	1/8/92	1/9/92	1/9/92	1/9/92	1/9/92	1/11/92	1/11/92	1/11/92	1/11/92
ANALYSIS # of total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)	Units											
CHLORIDE (CL[1-])	MG/L	196	170	176	172	170	161	161	167	166	159	161
FLUORIDE (F[1-])	MG/L	35	27	27	24	25	23	22	29	30	30	28
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	2001	1779	1817	1687	1727	1704	1703	1804	1784	1768	1720
NITRITE (NO2[1-])	MG/L	26	13	16	14	14	19	21	7	7	7	7
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<7
SULFATE (SO4[2-])	MG/L	106	62	63	56	57	52	51	90	93	96	76
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.92	1.97	1.95	1.94	1.94	1.93	1.91	1.93	1.88	1.94	1.87
TOT ACID (EQ PT)	MOLE/LITER	.035 TO PH 7	.034 TO PH 7	.034 TO PH 7	0.033 TO PH 7	.033 TO PH 7	.033 TO PH 7	.032 TO PH 7	.033 TO PH 7	.033 TO PH 7	.0312 TO PH 7	.032 TO PH 7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	2.320	2.107	2.025	1.940	1.938	1.888	1.912	2.152	2.130	1.847	1.841
BARIUM (BA)	PPM	0.159	0.151	0.151	0.141	0.142	0.139	0.138	0.139	0.140	0.131	0.132
BORON (B)	PPM	39.400	39.260	38.580	36.720	37.280	36.870	36.920	37.290	37.530	36.370	36.290
CADMIUM (CD)	PPM	3.798	3.545	3.527	3.370	3.384	3.340	3.328	3.315	3.290	3.112	3.115
CALCIUM (CA)	PPM	3.776	3.734	3.899	3.530	3.386	3.455	3.300	3.435	3.634	3.170	3.216
CERIUM (CE)	PPM	0.427	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.349	0.382	<0.01	<0.01
CHROMIUM (CR)	PPM	3.114	3.070	3.167	3.251	3.123	2.860	2.939	2.921	2.468	2.381	2.417
COPPER (CU)	PPM	8.060	7.852	7.897	7.291	7.454	6.911	6.717	6.230	6.157	6.082	6.076
GERMANIUM (GE)	PPM	0.052	0.024	<0.01	<0.01	<0.01	<0.01	<0.01	0.120	0.084	<0.01	<0.01
IRON (FE)	PPM	5.981	5.561	6.347	17.830	5.273	4.956	15.660	4.973	4.811	4.687	4.709
LANTHANUM (LA)	PPM	0.328	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.261	0.270	<0.01	<0.01
LEAD (PB)	PPM	2.185	2.036	2.031	1.885	1.876	1.824	1.810	1.812	1.781	1.640	1.647
LITHIUM (LI)	PPM	7.443	7.219	7.371	6.957	6.951	6.644	6.588	6.132	6.064	6.072	6.104
MAGNESIUM (MG)	PPM	1.200	1.041	0.979	0.944	0.909	0.933	0.907	1.155	1.210	0.865	0.869
MANGANESE (MN)	PPM	1.026	1.009	1.035	1.034	0.954	0.891	0.942	0.794	0.780	0.771	0.770
MOLYBDENUM (MO)	PPM	2.024	2.206	2.482	3.197	2.793	2.244	2.497	3.272	1.628	1.536	1.647
NEODYMIUM (ND)	PPM	1.828	1.337	1.018	0.886	0.929	0.877	0.885	1.566	1.562	0.842	0.859
NICKEL (NI)	PPM	2.559	2.746	2.999	3.776	3.147	2.604	3.150	3.342	1.923	1.869	1.932
NIOBIUM (NB)	PPM	0.029	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.028	0.026	<0.01	<0.01
PALLADIUM (PD)	PPM	0.181	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.138	0.132	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.409	0.347	0.320	0.236	0.291	0.317	0.266	0.353	0.349	0.247	0.270
PRASEODYMIUM (PR)	PPM	0.386	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.319	0.347	<0.01	<0.01
RHODIUM (RH)	PPM	0.165	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.138	0.131	<0.01	<0.01
RUBIDIUM (RB)	PPM	0.596	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.396	0.542	<0.01	<0.01
RUTHENIUM (RU)	PPM	2.529	2.420	2.370	2.321	2.241	2.139	2.197	2.089	2.081	1.920	1.946
SAMARIUM (SM)	PPM	0.320	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.246	0.261	<0.01	<0.01
SELENIUM (SE)	PPM	1.558	1.438	1.381	1.390	1.363	1.402	1.399	1.529	1.150	1.374	1.350
SILICON (SI)	PPM	6.059	5.453	5.497	5.201	5.263	4.979	4.883	5.890	5.706	4.855	4.860
SILVER (AG)	PPM	0.069	0.035	0.022	0.028	0.023	<0.01	<0.01	0.056	0.058	<0.01	<0.01
SODIUM (NA)	PPM	62.190	60.320	64.850	60.950	60.470	58.350	57.890	53.580	53.170	53.850	53.380
STRONTIUM (SR)	PPM	0.049	0.049	0.049	0.047	0.046	0.045	0.044	0.045	0.046	0.044	0.044
TANTALUM (TA)	PPM	0.054	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.053	0.064	<0.01	<0.01
TELLURIUM (TE)	PPM	2.430	2.350	2.336	2.268	2.284	2.314	2.296	2.345	2.311	2.155	2.168
TIN (SN)	PPM	0.196	0.181	0.163	0.125	0.144	0.128	0.129	0.129	0.136	0.106	0.108
TITANIUM (TI)	PPM	0.110	0.097	0.090	0.081	0.081	0.076	0.077	0.090	0.091	0.070	0.072
YTTRIUM (Y)	PPM	0.022	0.013	<0.01	<0.01	<0.01	<0.01	<0.01	0.021	0.021	<0.01	<0.01
ZINC (ZN)	PPM	0.671	0.629	0.633	0.596	0.589	0.550	0.548	0.512	0.515	0.486	0.491
ZIRCONIUM (ZR)	PPM	2.315	2.335	2.327	2.174	2.205	2.133	2.130	2.215	2.244	2.245	2.261

SAMPLE ID		OGCT 0355	OGCB 0356	OGCT 0364	OGCB 0365	OGCT 0367	OGCB 0368	OGCT 0369	OGCB 0370	OGCT 0371	OGCB 0372	OGCT 0379
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		1/11/92	1/11/92	1/11/92	1/11/92	1/20/92	1/20/92	1/20/92	1/20/92	1/21/92	1/21/92	1/21/92
ANALYSIS # of total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units											
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	152	148	138	137	180	183	177	174	165	162	143
FLUORIDE (F[1-])	MG/L	27	28	26	26	35	36	35	35	33	32	22
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1686	1670	1623	1624	1749	1769	1680	1694	1588	1540	1464
NITRITE (NO2[1-])	MG/L	8	8	8	8	9	<9	14	14	21	20	29
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<5	<1	<1	<1	<1	<6	<1
SULFATE (SO4[2-])	MG/L	80	83	79	82	95	104	103	102	96	88	50
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.97	1.91	1.89	1.83	1.92	1.82	1.95	1.93	1.96	1.92	1.90
TOT ACID (EQ PT)	MOLE/LITER	.031 TO PH 7	.031 TO PH 7	.03 TO PH 7	.03 TO PH 7	0.033 TO PH 7	0.034 TO PH 7	0.033 TO PH 7	0.033 TO PH 7	0.031 TO PH 7	0.030 TO PH 7	0.030 TO PH 7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	1.826	1.812	1.806	1.806	2.219	2.226	2.003	2.008	1.876	1.860	1.719
BARIUM (BA)	PPM	0.128	0.127	0.124	0.124	0.159	0.162	0.149	0.162	0.140	0.141	0.130
BORON (B)	PPM	36.070	35.970	35.100	35.030	40.990	41.610	41.930	41.869	41.725	41.333	41.527
CADMIUM (CD)	PPM	2.996	2.983	2.777	2.798	3.657	3.685	3.524	3.490	3.285	3.267	3.035
CALCIUM (CA)	PPM	3.141	2.948	2.933	3.041	3.508	3.477	3.194	3.355	3.299	3.294	3.438
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	2.337	2.248	2.079	2.072	3.030	3.052	2.862	2.853	2.648	2.682	2.464
COPPER (CU)	PPM	5.771	5.692	5.287	5.289	7.276	7.327	6.882	6.919	6.488	6.520	6.065
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	4.642	5.332	4.554	5.446	5.467	6.966	5.210	5.769	4.921	5.223	4.629
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	1.552	1.518	1.422	1.437	1.918	1.909	1.802	1.741	1.628	1.631	1.485
LITHIUM (LI)	PPM	5.827	5.807	5.489	5.452	7.518	7.539	7.115	7.173	6.732	6.745	6.245
MAGNESIUM (MG)	PPM	0.843	0.788	0.784	0.813	0.926	0.909	0.837	0.781	0.739	0.717	0.728
MANGANESE (MN)	PPM	0.740	0.742	0.701	0.705	0.991	1.045	0.936	0.950	0.880	0.902	0.815
MOLYBDENUM (MO)	PPM	1.791	1.537	1.470	1.393	1.947	2.062	1.830	1.840	1.689	1.728	1.613
NEODYMIUM (ND)	PPM	0.860	0.868	0.865	0.851	0.931	0.887	0.570	0.557	0.420	0.397	0.252
NICKEL (NI)	PPM	2.035	1.912	1.703	1.698	2.270	2.621	2.145	2.172	1.994	2.035	1.917
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.266	0.264	0.247	0.240	0.312	0.278	0.283	0.267	0.287	0.255	0.309
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	1.821	1.808	1.673	1.669	2.397	2.439	2.299	2.265	2.124	2.137	1.999
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	1.285	1.282	1.170	1.170	1.809	1.821	1.773	1.690	1.598	1.550	1.478
SILICON (SI)	PPM	4.823	4.719	4.740	4.693	3.913	3.932	3.653	3.755	3.445	3.489	3.270
SILVER (AG)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.020	<0.020	<0.01
SODIUM (NA)	PPM	50.730	50.290	47.550	47.220	64.280	64.190	60.650	60.527	57.068	56.935	52.769
STRONTIUM (SR)	PPM	0.044	0.043	0.043	0.043	0.058	0.059	0.054	0.055	0.052	0.052	0.050
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	2.018	2.032	1.841	1.826	2.654	2.637	2.512	2.465	2.306	2.298	2.093
TIN (SN)	PPM	0.095	0.097	0.076	0.085	0.099	0.097	0.093	0.086	0.071	0.065	0.055
TITANIUM (TI)	PPM	0.068	0.069	0.067	0.067	0.079	0.079	0.064	0.065	0.059	0.059	0.050
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	0.468	0.460	0.434	0.435	0.610	0.617	0.579	0.581	0.544	0.547	0.508
ZIRCONIUM (ZR)	PPM	2.306	2.320	2.371	2.352	2.528	2.562	2.427	2.533	2.358	2.389	2.286

SAMPLE ID		OGCB 0380	OGCT 0382	OGCB 0383	OGCT 0390	OGCB 0391	OGCT 0395	OGCB 0396	OGCT 0399	OGCB 0400	OGCT 0401	OGCB 0402
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		1/21/92	1/21/92	1/21/92	1/21/92	1/21/92	1/25/92	1/25/92	1/29/92	1/29/92	1/29/92	1/29/92
ANALYSIS # of total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
Units												
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	142	144	146	141	144	165	165	200	202	192	191
FLUORIDE (F[1-])	MG/L	22	31	31	28	28	25	26	28	28	27	26
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1482	1308	1412	1368	1484	1425	1430	1762	1762	1658	1645
NITRITE (NO2[1-])	MG/L	28	21	21	21	21	5	5	5	5	11	12
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<5	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	49	87	86	77	81	60	60	76	77	72	72
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.83	1.94	1.91	1.98	1.89	1.90	1.93	1.78	1.84	1.86	1.99
TOT ACID (EQ PT)	MOLE/LITER	0.030 TO PH 7	0.030 TO PH 7	0.030 TO PH 7	0.028 TO PH 7	0.029 TO PH 7	.034 TO PH7	.033 TO PH7	.037 TO PH7	.039 TO PH7	.038 TO PH7	.036 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	1.728	2.034	2.060	1.922	1.952	1.904	1.882	2.223	2.256	2.101	2.044
BARIUM (BA)	PPM	0.132	0.138	0.139	0.132	0.134	0.147	0.148	0.178	0.195	0.166	0.166
BORON (B)	PPM	41.634	40.690	40.530	40.380	40.740	41.551	41.191	43.342	44.330	42.402	42.483
CADMIUM (CD)	PPM	3.042	2.954	2.965	2.789	2.807	3.225	3.202	4.109	4.150	3.941	3.825
CALCIUM (CA)	PPM	3.277	3.590	3.235	2.946	3.218	3.195	3.134	4.273	4.102	3.974	3.846
CERIUM (CE)	PPM	<0.01	0.164	0.195	0.148	0.077	0.074	0.018	0.089	0.087	<0.01	<0.01
CHROMIUM (CR)	PPM	2.476	2.309	2.339	2.137	2.178	2.548	2.567	3.263	3.285	3.088	3.061
COPPER (CU)	PPM	6.099	5.583	5.663	5.306	5.311	6.074	6.109	7.367	7.399	7.010	6.993
GERMANIUM (GE)	PPM	<0.01	0.060	0.064	0.078	0.090	0.227	0.282	0.024	0.101	0.082	<0.01
IRON (FE)	PPM	5.129	4.442	4.912	4.249	4.353	4.277	4.876	4.590	5.097	4.399	4.590
LANTHANUM (LA)	PPM	<0.01	0.254	0.200	0.042	0.099	0.030	<0.01	0.122	0.131	<0.01	<0.01
LEAD (PB)	PPM	1.494	1.448	1.468	1.349	1.381	1.514	1.489	1.876	1.916	1.800	1.749
LITHIUM (LI)	PPM	6.318	5.908	5.897	5.531	5.561	6.733	6.770	8.104	8.154	7.638	7.660
MAGNESIUM (MG)	PPM	0.675	1.023	0.972	0.862	0.953	0.903	0.863	1.204	1.157	1.127	1.040
MANGANESE (MN)	PPM	0.840	0.765	0.776	0.728	0.740	0.738	0.801	0.804	0.880	0.790	0.814
MOLYBDENUM (MO)	PPM	1.619	1.548	1.656	1.503	1.550	1.719	1.739	1.958	1.981	1.946	1.925
NEODYMIUM (ND)	PPM	0.278	1.239	1.293	1.237	1.087	1.057	1.028	1.103	1.136	0.897	0.871
NICKEL (NI)	PPM	1.934	1.806	1.896	1.731	1.754	1.822	1.998	2.049	2.109	1.910	1.903
NIObIUM (NB)	PPM	<0.01	0.010	0.015	0.012	0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	0.056	0.074	0.064	0.077	0.102	<0.01	0.033	0.041	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.267	0.381	0.329	0.337	0.342	0.250	0.248	0.289	0.297	0.269	0.272
PRASEODYMIUM (PR)	PPM	<0.01	0.057	0.106	0.114	<0.01	0.005	<0.01	0.046	0.078	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	0.047	0.051	0.054	0.060	0.099	<0.01	0.018	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	0.283	0.283	0.214	0.259	<0.01	<0.01	0.131	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	2.016	2.006	2.033	1.925	1.936	2.226	2.154	2.807	2.780	2.665	2.592
SAMARIUM (SM)	PPM	<0.01	0.078	0.129	0.103	<0.01	0.038	<0.01	<0.01	0.011	<0.01	<0.01
SELENIUM (SE)	PPM	1.469	1.606	1.653	1.531	1.506	1.925	1.858	2.471	2.471	2.312	2.245
SILICON (SI)	PPM	3.297	2.675	2.762	2.504	2.587	2.929	2.949	5.119	5.370	4.658	4.701
SILVER (AG)	PPM	<0.02	0.049	0.049	0.048	0.050	0.059	0.044	0.043	0.044	0.037	0.031
SODIUM (NA)	PPM	52.675	47.830	48.350	44.860	45.360	50.933	51.079	63.347	63.847	53.398	59.197
STRONTIUM (SR)	PPM	0.050	0.053	0.052	0.049	0.055	0.049	0.050	0.059	0.060	0.056	0.055
TANTALUM (TA)	PPM	<0.01	0.039	0.047	0.044	0.030	0.279	0.036	0.026	0.024	0.034	<0.01
TELLURIUM (TE)	PPM	2.077	2.108	2.130	1.961	2.003	2.218	2.218	3.129	3.152	2.905	2.881
TIN (SN)	PPM	0.055	0.101	0.097	0.098	0.095	0.113	0.108	0.145	0.153	0.142	0.130
TITANIUM (TI)	PPM	0.051	0.079	0.081	0.077	0.080	0.078	0.067	0.075	0.080	0.071	0.069
YTTRIUM (Y)	PPM	<0.01	0.017	0.017	0.016	0.017	0.036	0.014	0.014	0.015	0.012	0.010
ZINC (ZN)	PPM	0.515	0.488	0.490	0.459	0.464	0.531	0.551	0.604	0.614	0.571	0.572
ZIRCONIUM (ZR)	PPM	2.321	2.126	2.144	2.093	2.117	2.028	1.907	2.041	2.285	2.029	2.059

SAMPLE ID		OGCT 0403	OGCB 0404	OGCT 0408	OGCB 0409	OGCT 0413	OGCB 0414	OGCT 0416	OGCB 0417	OGCT 0419	OGCB 0420	OGCT 0424
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		1/29/92	1/29/92	1/30/92	1/30/92	1/30/92	1/30/92	1/31/92	1/31/92	1/31/92	1/31/92	1/31/92
ANALYSIS # of total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units											
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	179	180	167	168	150	152	138	137	123	125	113
FLUORIDE (F[1-])	MG/L	25	25	23	24	31	30	29	28	26	27	16
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1523	1541	1415	1400	1345	1343	1184	1127	1024	1101	1096
NITRITE (NO2[1-])	MG/L	17	17	19	19	12	12	19	19	32	31	4
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	200	<1	<5	<1	<1
SULFATE (SO4[2-])	MG/L	66	66	62	62	95	96	90	78	71	82	42
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.97	2.00	1.92	2.01	1.82	1.85	1.90	1.93	1.97	1.98	2.01
TOT ACID (EQ PT)	MOLE/LITER	.038 TO PH7	.036 TO PH7	.034 TO PH7	.034 TO PH7	.030 TO PH7	.030 TO PH7	.027 TO PH7	.027 TO PH7	.026 TO PH7	.025 TO PH7	.024 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	1.931	1.863	1.839	1.833	1.881	1.889	1.723	1.732	1.590	1.796	1.601
BARIUM (BA)	PPM	0.153	0.157	0.145	0.148	0.137	0.136	0.124	0.122	0.111	0.116	0.109
BORON (B)	PPM	42.343	41.303	41.975	42.252	38.841	38.484	37.534	37.755	36.201	37.031	36.265
CADMIUM (CD)	PPM	3.652	3.547	3.456	3.466	3.331	3.301	3.030	3.045	2.759	2.931	2.630
CALCIUM (CA)	PPM	3.508	3.566	3.492	3.398	1.607	1.506	1.344	1.377	1.213	1.509	1.152
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.130
CHROMIUM (CR)	PPM	2.816	2.744	2.665	2.681	2.549	2.480	2.194	2.222	1.981	2.307	1.848
COPPER (CU)	PPM	6.558	6.373	6.206	6.218	5.737	5.717	5.152	5.189	4.716	5.034	4.361
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	0.046	0.031	0.047	0.027	0.030	0.064	<0.01
IRON (FE)	PPM	4.201	4.229	4.064	4.209	3.926	6.354	3.550	4.658	3.318	7.516	3.199
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	1.619	1.594	1.538	1.556	1.463	1.448	1.322	1.347	1.210	1.280	1.171
LITHIUM (LI)	PPM	7.187	6.941	6.800	6.830	6.281	6.227	5.624	5.661	5.158	5.392	4.721
MAGNESIUM (MG)	PPM	0.909	0.916	0.883	0.876	0.543	0.536	0.488	0.498	0.424	0.499	0.432
MANGANESE (MN)	PPM	0.751	0.758	0.721	0.725	0.680	0.682	0.603	0.612	0.552	0.664	0.543
MOLYBDENUM (MO)	PPM	1.662	1.614	1.578	1.602	2.106	1.723	1.530	1.591	1.383	1.992	1.307
NEODYMIUM (ND)	PPM	0.750	0.730	0.690	0.680	0.867	0.852	0.750	0.783	0.678	0.803	0.809
NICKEL (NI)	PPM	1.753	1.734	1.653	1.670	1.855	1.600	1.375	1.472	1.243	1.870	1.184
NIObIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.311	0.312	0.330	0.334	0.121	0.106	0.119	0.147	0.128	0.154	0.161
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.055
RUTHENIUM (RU)	PPM	2.454	2.377	2.363	2.359	2.204	2.210	2.031	2.063	1.884	2.005	1.885
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	2.160	2.062	2.020	1.998	1.920	1.902	1.774	1.789	1.566	1.652	1.648
SILICON (SI)	PPM	4.521	4.506	4.308	4.357	4.762	4.652	4.119	4.112	3.708	3.722	4.094
SILVER (AG)	PPM	0.027	0.028	0.026	0.025	0.031	0.032	0.029	0.031	0.025	0.028	0.028
SODIUM (NA)	PPM	55.278	53.423	52.246	52.604	49.418	49.354	44.360	44.366	40.430	42.509	35.947
STRONTIUM (SR)	PPM	0.052	0.052	0.052	0.051	0.041	0.041	0.038	0.038	0.035	0.038	0.033
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.010	<0.01	0.018	0.060
TELLURIUM (TE)	PPM	2.656	2.606	2.478	2.543	2.391	2.403	2.131	2.183	1.957	2.062	1.760
TIN (SN)	PPM	0.118	0.111	0.114	0.116	0.119	0.121	0.120	0.112	0.097	0.112	0.130
TITANIUM (TI)	PPM	0.063	0.061	0.060	0.062	0.060	0.059	0.054	0.055	0.050	0.057	0.051
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	0.010	0.010	0.010	0.010	<0.01	0.010	0.010
ZINC (ZN)	PPM	0.550	0.528	0.511	0.512	0.494	0.482	0.431	0.438	0.396	0.948	0.374
ZIRCONIUM (ZR)	PPM	2.014	1.952	2.000	2.001	1.948	1.966	1.827	1.831	1.735	1.838	1.690

SAMPLE ID		OGCB 0425	OGCT 0426	OGCB 0427	OGCT 0434	OGCB 0435	OGCT 0440	OGCB 0441	OGCT 0442	OGCB 0443	OGCT 0444	OGCB 0445
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		1/31/92	1/31/92	1/31/92	2/1/92	2/1/92	2/1/92	2/1/92	2/1/92	2/1/92	2/1/92	2/1/92
ANALYSIS # of total COMPONENT	Units	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	111	100	102	95	95	88	84	78	77	75	74
FLUORIDE (F[1-])	MG/L	16	15	14	13	14	13	13	12	12	11	11
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1097	1032	1029	963	962	953	946	929	939	931	932
NITRITE (NO2[1-])	MG/L	8	4	4	4	4	4	5	5	5	5	5
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	42	38	39	35	36	32	31	29	28	27	27
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	2.03	1.90	2.09	2.05	1.86	2.08	2.09	1.92	1.93	1.96	1.98
TOT ACID (EQ PT)	MOLE/LITER	.024 TO PH7	.025 TO PH7	.025 TO PH7	.024 TO PH7	.024 TO PH7	.023 TO PH7	.023 TO PH7	.023 TO PH7	.023 TO PH7	.023 TO PH7	.023 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	1.554	1.359	1.327	1.253	1.226	1.081	1.113	1.087	0.949	0.897	0.867
BARIUM (BA)	PPM	0.108	0.093	0.092	0.084	0.081	0.075	0.074	0.067	0.058	0.054	0.051
BORON (B)	PPM	36.234	33.683	33.123	32.924	32.473	31.134	32.437	31.098	31.182	31.857	30.918
CADMIUM (CD)	PPM	2.607	2.313	2.290	2.122	2.144	1.958	1.971	1.895	1.901	1.785	1.693
CALCIUM (CA)	PPM	1.172	0.969	0.956	0.880	0.869	0.769	0.763	0.725	0.690	0.647	0.620
CERIUM (CE)	PPM	0.096	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	1.829	1.634	1.626	1.461	1.500	1.337	1.336	1.247	1.248	1.211	1.182
COPPER (CU)	PPM	4.390	4.024	4.115	3.718	3.738	3.449	3.388	3.203	3.247	2.938	2.956
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	3.349	3.320	2.932	2.715	3.148	2.498	2.706	2.416	2.679	2.377	2.610
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	1.076	1.040	0.982	0.850	0.932	0.706	0.711	0.693	0.832	0.569	0.391
LITHIUM (LI)	PPM	4.746	4.268	4.345	3.870	4.053	3.654	3.590	3.356	3.400	3.226	3.234
MAGNESIUM (MG)	PPM	0.430	0.309	0.322	0.303	0.281	0.194	0.223	0.221	0.057	0.035	0.025
MANGANESE (MN)	PPM	0.543	0.480	0.465	0.432	0.437	0.402	0.407	0.376	0.370	0.366	0.366
MOLYBDENUM (MO)	PPM	1.320	1.152	1.116	1.060	1.062	1.137	0.985	0.886	0.889	1.037	0.908
NEODYMIUM (ND)	PPM	0.626	0.502	0.506	0.473	0.165	0.125	0.285	0.151	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	1.227	1.035	1.042	0.910	0.978	0.879	0.824	0.803	0.794	0.907	0.737
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.166	0.100	0.028	0.100	0.183	0.078	0.117	0.045	<0.01	0.050	<0.01
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	0.069	<0.01	0.059	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	1.854	1.566	1.584	1.457	1.500	1.213	1.296	1.285	1.098	1.055	0.975
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	1.626	1.340	1.379	1.274	1.247	1.005	1.066	1.022	1.027	0.901	0.862
SILICON (SI)	PPM	3.889	3.317	3.171	2.894	2.969	2.674	2.727	2.661	2.527	2.409	2.440
SILVER (AG)	PPM	0.033	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
SODIUM (NA)	PPM	36.142	31.702	32.812	28.885	29.999	27.264	27.001	24.868	25.344	22.891	23.360
STRONTIUM (SR)	PPM	0.033	0.029	0.029	0.028	0.028	0.025	0.025	0.023	0.021	0.020	0.020
TANTALUM (TA)	PPM	0.079	0.017	0.088	0.031	<0.01	0.041	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	1.923	1.523	1.568	1.460	1.430	1.250	1.372	1.172	1.256	1.028	1.012
TIN (SN)	PPM	0.188	0.119	0.144	0.109	0.174	0.079	0.126	0.099	0.107	0.102	0.040
TITANIUM (TI)	PPM	0.052	0.037	0.037	0.037	0.038	0.030	0.033	0.029	0.017	0.016	0.014
YTTRIUM (Y)	PPM	0.014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	0.382	0.325	0.324	0.304	0.294	0.271	0.270	0.252	0.260	0.253	0.240
ZIRCONIUM (ZR)	PPM	1.699	1.610	1.648	1.540	1.538	1.454	1.515	1.422	1.400	1.404	1.344

SAMPLE ID		OGCT 0452	OGCB 0453	OGCT 0455	OGCB 0456	OGCT 0457	OGCB 0458	OGCT 0462	OGCB 0463	OGCT 0464	OGCB 0465	OGCT 0470
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		2/2/92	2/2/92	2/2/92	2/2/92	2/2/92	2/2/92	2/2/92	2/2/92	2/3/92	2/3/92	2/3/92
ANALYSIS # of total COMPONENT		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
IC (Filtrate)	Units											
CHLORIDE (CL[1-])	MG/L	69	69	69	71	72	72	71	74	74	73	79
FLUORIDE (F[1-])	MG/L	11	10	11	12	12	12	12	12	12	12	13
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	1007	1013	1007	1035	1007	978	933	947	905	894	891
NITRITE (NO2[1-])	MG/L	5	5	6	5	5	5	4	5	5	5	5
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	185	<1	<1
SULFATE (SO4[2-])	MG/L	25	25	24	25	47	24	23	24	23	23	24
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	1.99	2.01	1.88	1.90	1.95	1.95	2.00	2.02	1.99	1.98	2.01
TOT ACID (EQ PT)	MOLE/LITER	.024 TO PH7	.025 TO PH7	.020 TO PH7	.020 TO PH7	.019 TO PH7	.019 TO PH7	.018 TO PH7	.019 TO PH7	.020 TO PH7	.020 TO PH7	.020 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	0.956	0.926	1.150	1.105	1.210	1.202	1.316	1.273	1.364	1.429	1.609
BARIUM (BA)	PPM	0.054	0.052	0.060	0.060	0.064	0.062	0.066	0.064	0.068	0.070	0.076
BORON (B)	PPM	31.436	31.871	33.926	32.182	33.647	32.950	33.741	33.439	33.407	35.541	36.098
CADMIUM (CD)	PPM	1.696	1.747	1.904	1.871	1.876	1.814	1.883	1.893	1.957	1.990	2.071
CALCIUM (CA)	PPM	0.626	0.611	0.659	0.650	0.629	0.602	0.627	0.601	0.606	0.623	0.646
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	1.037	1.071	1.027	0.995	0.952	0.945	1.005	1.104	0.953	0.885	0.875
COPPER (CU)	PPM	2.821	2.846	2.724	2.688	2.449	2.432	2.398	2.398	2.351	2.252	2.166
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	PPM	2.527	2.924	3.192	3.290	3.334	3.572	3.601	3.870	3.864	4.270	4.304
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	0.562	0.333	0.357	0.409	0.365	0.259	0.399	0.280	0.454	0.244	0.365
LITHIUM (LI)	PPM	3.122	3.187	3.520	3.447	3.531	3.487	3.590	3.685	3.867	3.839	4.171
MAGNESIUM (MG)	PPM	0.073	0.010	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MANGANESE (MN)	PPM	0.362	0.378	0.416	0.413	0.435	0.435	0.449	0.446	0.464	0.480	0.508
MOLYBDENUM (MO)	PPM	0.818	0.720	0.728	0.696	0.763	0.665	1.072	1.607	0.976	0.797	0.810
NEODYMIUM (ND)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	PPM	0.630	0.604	0.512	0.526	0.536	0.462	0.704	0.983	0.609	0.441	0.422
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	0.883	0.840	0.702	0.734	0.570	0.630	0.619	0.622	0.711	0.596	0.547
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	0.807	0.758	0.769	0.791	0.763	0.741	0.741	0.730	0.774	0.774	0.895
SILICON (SI)	PPM	2.845	2.828	3.736	3.640	4.037	4.139	4.483	4.351	4.848	5.027	5.713
SILVER (AG)	PPM	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
SODIUM (NA)	PPM	22.781	22.481	24.022	23.254	23.400	22.865	23.747	23.934	23.810	23.440	23.823
STRONTIUM (SR)	PPM	0.023	0.023	0.029	0.028	0.032	0.031	0.035	0.034	0.039	0.041	0.045
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TELLURIUM (TE)	PPM	0.942	0.968	0.958	0.844	0.857	0.752	0.788	0.729	0.691	0.695	0.623
TIN (SN)	PPM	0.020	0.026	<0.01	0.023	0.059	0.039	<0.01	<0.01	0.030	<0.01	<0.01
TITANIUM (TI)	PPM	0.010	0.010	0.017	0.022	0.025	0.021	0.024	0.021	0.025	0.034	0.033
YTTRIUM (Y)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC (ZN)	PPM	0.239	0.235	0.240	0.229	0.227	0.230	0.216	0.224	0.217	0.223	0.222
ZIRCONIUM (ZR)	PPM	1.692	1.715	2.230	2.209	2.405	2.472	2.676	2.709	3.026	3.059	3.462

SAMPLE ID		OGCB 0471	OGCT 0472	OGCB 0473	OGCT 0474	OGCB 0475	OGCT 0476	OGCB 0477	OGCT 0481	OGCB 0482	OGCT 0484	OGCB 0485
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		2/3/92	2/3/92	2/3/92	2/3/92	2/3/92	2/4/92	2/4/92	2/4/92	2/4/92	2/4/92	2/4/92
ANALYSIS # of total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units											
IC (Filtrate)												
CHLORIDE (CL[1-])	MG/L	79	84	82	87	86	90	91	104	108	110	109
FLUORIDE (F[1-])	MG/L	13	14	14	14	14	15	14	24	25	27	27
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	889	1002	1000	1048	1060	1038	1035	1008	1031	968	968
NITRITE (NO2[1-])	MG/L	6	5	6	6	6	7	7	8	8	8	8
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	80	280	98	<8	<1	<1	<1
SULFATE (SO4[2-])	MG/L	24	26	26	26	26	26	26	47	57	68	59
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Wet Chemistry												
PH	PH	2.03	2.04	2.03	2.04	2.03	2.02	1.99	1.95	1.99	2.04	2.07
TOT ACID (EQ PT)	MOLE/LITER	.019 TO PH7	.021 TO PH7	.022 TO PH7	.022 TO PH7	.023 TO PH7	.023 TO PH7	.023 TO PH7	.019 TO PH7	.020 TO PH7	.019 TO PH7	.020 TO PH7
ICP (Filtrate)												
ALUMINUM (AL)	PPM	1.593	2.173	2.152	2.279	2.188	2.277	2.292	2.702	2.745	2.728	2.683
BARIUM (BA)	PPM	0.078	0.121	0.116	0.121	0.117	0.121	0.118	0.132	0.137	0.134	0.135
BORON (B)	PPM	36.292	39.371	38.620	40.796	41.230	43.298	43.647	41.312	42.252	43.969	42.563
CADMIUM (CD)	PPM	2.089	2.423	2.381	2.446	2.429	2.470	2.582	2.803	2.742	2.757	2.780
CALCIUM (CA)	PPM	0.658	0.916	0.897	0.955	0.897	0.889	0.889	1.018	1.004	0.991	1.002
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	0.861	0.995	0.995	0.970	0.985	0.951	0.990	0.922	0.948	0.916	0.916
COPPER (CU)	PPM	2.200	2.352	2.358	2.310	2.287	2.209	2.238	2.153	2.163	2.108	2.075
GERMANIUM (GE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.046	<0.01	0.062	0.176
IRON (FE)	PPM	4.896	4.978	5.276	5.164	5.463	5.343	5.669	5.552	6.176	5.822	5.987
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	0.283	0.440	0.744	0.654	0.518	0.391	0.567	0.718	0.837	0.510	0.737
LITHIUM (LI)	PPM	4.050	4.767	4.738	4.957	4.947	5.116	5.229	5.151	5.161	5.178	5.109
MAGNESIUM (MG)	PPM	<0.01	0.145	0.173	0.145	0.089	0.044	<0.01	0.383	0.389	0.369	0.384
MANGANESE (MN)	PPM	0.513	0.593	0.587	0.607	0.607	0.620	0.634	0.644	0.653	0.669	0.653
MOLYBDENUM (MO)	PPM	0.745	0.931	0.959	0.939	1.018	0.903	1.028	1.100	1.158	1.093	1.110
NEODYMIUM (ND)	PPM	0.123	1.370	1.292	1.297	1.131	0.996	0.988	2.191	2.166	2.150	2.136
NICKEL (NI)	PPM	0.361	0.517	0.551	0.517	0.523	0.420	0.523	0.428	0.530	0.476	0.462
NIObIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.036	0.049	0.016	0.011
PHOSPHOROUS (P)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.096	0.239	0.124	0.096
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.123	<0.01	<0.01
RUTHENIUM (RU)	PPM	0.533	0.989	1.054	0.934	0.989	0.845	0.828	1.345	1.486	1.290	1.328
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	<0.01	<0.01
SELENIUM (SE)	PPM	0.851	1.177	1.152	1.120	1.171	1.241	1.215	1.403	1.469	1.454	1.418
SILICON (SI)	PPM	5.759	7.202	7.092	7.677	7.435	8.040	8.094	8.549	8.540	8.585	8.485
SILVER (AG)	PPM	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.039	0.039	0.030	0.034
SODIUM (NA)	PPM	24.681	27.261	27.243	28.063	27.983	29.094	29.253	29.135	29.588	29.536	29.434
STRONTIUM (SR)	PPM	0.047	0.060	0.059	0.060	0.061	0.066	0.065	0.070	0.069	0.070	0.070
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.115	0.010	<0.01	<0.01
TELLURIUM (TE)	PPM	0.647	0.816	0.761	0.750	0.751	0.656	0.782	1.001	0.909	0.896	0.930
TIN (SN)	PPM	<0.01	0.013	0.020	0.040	<0.01	0.010	<0.01	<0.01	0.030	0.114	<0.01
TITANIUM (TI)	PPM	0.033	0.077	0.076	0.077	0.071	0.071	0.071	0.098	0.098	0.097	0.098
YTTRIUM (Y)	PPM	<0.01	0.020	0.018	0.016	0.012	<0.01	<0.01	0.033	0.029	0.029	0.027
ZINC (ZN)	PPM	0.224	0.272	0.257	0.262	0.254	0.250	0.265	0.266	0.262	0.263	0.260
ZIRCONIUM (ZR)	PPM	3.554	4.164	4.120	4.394	4.348	4.590	4.658	4.769	4.800	4.948	4.890

SAMPLE ID		OGCT 0489	OGCB 0490	OGCT 0494	OGCB 0495	OGCT 0496	OGCT 0497
ANALYTICAL CODE(S)		CONDEN	CONDEN	CONDEN	CONDEN	CONDEN	CONDEN
DATE		2/4/92	2/4/92	2/5/92	2/5/92	2/5/92	2/5/92
ANALYSIS # of total		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1
COMPONENT	Units						
IC (Filtrate)							
CHLORIDE (CL[1-])	MG/L	111	116	115	120	121	128
FLUORIDE (F[1-])	MG/L	27	28	29	30	30	31
FORMATE (COOH[1-])	MG/L	<1	<1	<1	<1	<1	<1
NITRATE (NO3[1-])	MG/L	955	923	924	883	890	862
NITRITE (NO2[1-])	MG/L	8	8	8	9	10	11
PHOSPHATE (PO4[3-])	MG/L	<1	<8	<1	<1	<1	<1
SULFATE (SO4[2-])	MG/L	59	50	55	58	56	61
AMMONIUM (NH4[1+])	MG/L	<1	<1	<1	<1	<1	<1
Wet Chemistry							
PH	PH	2.09	2.09	2.12	2.14	2.15	2.16
TOT ACID (EQ PT)	MOLE/LITER	.019 TO PH7	.019 TO PH7	.019 TO PH7	.019 TO PH7	.018 TO PH7	.018 TO PH7
ICP (Filtrate)							
ALUMINUM (AL)	PPM	2.708	2.644	2.654	2.598	2.631	2.590
BARIUM (BA)	PPM	0.131	0.133	0.132	0.126	0.126	0.119
BORON (B)	PPM	42.850	44.064	44.347	44.349	45.681	46.605
CADMIUM (CD)	PPM	2.746	2.779	2.731	2.729	2.769	2.749
CALCIUM (CA)	PPM	1.002	0.952	0.964	0.927	0.942	0.957
CERIUM (CE)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM (CR)	PPM	1.016	0.909	1.007	0.880	1.011	1.044
COPPER (CU)	PPM	2.071	2.011	1.977	1.906	1.921	1.872
GERMANIUM (GE)	PPM	0.152	0.168	0.050	<0.01	<0.01	0.043
IRON (FE)	PPM	5.683	7.210	5.867	6.069	5.712	18.933
LANTHANUM (LA)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LEAD (PB)	PPM	0.648	0.645	0.606	0.560	0.687	0.783
LITHIUM (LI)	PPM	5.155	5.197	5.118	5.069	5.046	5.126
MAGNESIUM (MG)	PPM	0.309	0.316	0.295	0.301	0.255	0.237
MANGANESE (MN)	PPM	0.656	0.666	0.670	0.641	0.656	0.737
MOLYBDENUM (MO)	PPM	1.608	1.216	1.568	1.181	1.716	1.788
NEODYMIUM (ND)	PPM	2.032	1.914	1.875	1.840	1.809	1.559
NICKEL (NI)	PPM	0.746	0.465	0.732	0.387	0.766	0.917
NIOBIUM (NB)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PALLADIUM (PD)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PHOSPHOROUS (P)	PPM	0.117	<0.01	<0.01	0.024	<0.01	<0.01
PRASEODYMIUM (PR)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RHODIUM (RH)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
RUBIDIUM (RB)	PPM	0.134	<0.01	<0.01	<0.01	<0.01	<0.01
RUTHENIUM (RU)	PPM	1.320	1.341	1.140	1.273	1.204	1.371
SAMARIUM (SM)	PPM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM (SE)	PPM	1.476	1.389	1.381	1.396	1.476	1.484
SILICON (SI)	PPM	8.574	8.562	8.543	8.365	8.637	8.301
SILVER (AG)	PPM	0.033	0.025	0.028	0.031	0.029	0.021
SODIUM (NA)	PPM	29.269	29.903	29.475	29.499	29.330	29.891
STRONTIUM (SR)	PPM	0.070	0.070	0.069	0.069	0.069	0.069
TANTALUM (TA)	PPM	<0.01	<0.01	<0.01	0.038	<0.01	<0.01
TELLURIUM (TE)	PPM	0.919	0.878	0.964	0.872	0.868	0.859
TIN (SN)	PPM	<0.01	0.053	0.019	0.137	0.018	0.072
TITANIUM (TI)	PPM	0.097	0.095	0.090	0.092	0.092	0.089
YTTRIUM (Y)	PPM	0.025	0.024	0.023	0.022	0.022	0.019
ZINC (ZN)	PPM	0.260	0.261	0.255	0.248	0.247	0.262
ZIRCONIUM (ZR)	PPM	4.933	4.976	4.901	4.895	4.987	4.833

Analytical Results:

FRIT Analyses

SAMPLE ID		FRIT-0010	FRIT-0010	FRIT-0010	FRIT-0010	FRIT-0011	FRIT-0011	FRIT-0011	FRIT-0011
ANALYTICAL CODE(S)		FRIT	FRIT	FRIT	FRIT	FRIT	FRIT	FRIT	FRIT
DATE		11/11/91	11/11/91	11/11/91	11/11/91	11/11/91	11/11/91	11/11/91	11/11/91
ANALYSIS # OF total COMPONENT		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
IC (Na2O2/H2O)	Units								
CHLORIDE (CL[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
FLUORIDE (F[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
PHOSPHATE (PO4[3-])	MG/L	<1	<1	<1	<1	<1	<466	<1	<1
SULFATE (SO4[2-])	MG/L	1261	1253	985	1112	3096	1126	1245	1388
AA (Na2O2/HCl)									
SILICON (SI)	WT %	32.460	31.880	32.930	32.190	28.420	30.080	29.080	29.210
ICP (Na2O2/HCl)									
ALUMINUM (AL)	WT %	0.175	0.170	0.178	0.178	0.141	0.151	0.150	0.153
BARIUM (BA)	WT %	0.014	0.012	0.017	0.016	0.012	0.012	0.012	0.014
BORON (B)	WT %	6.258	6.227	6.169	6.345	6.372	6.344	6.353	6.350
IRON (FE)	WT %	0.069	0.086	0.069	0.137	0.031	0.131	0.104	0.079
LITHIUM (LI)	WT %	3.522	3.491	3.508	3.535	3.569	3.567	3.542	3.578
MAGNESIUM (MG)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICON (SI)	WT %	34.650	34.570	34.560	34.870	34.920	35.270	34.820	35.120
TITANIUM (TI)	WT %	0.066	0.063	0.066	0.068	0.063	0.064	0.064	0.064
ICP (Microwave)									
CALCIUM (CA)	WT %	0.052	0.051	0.050	0.051	0.051	0.052	0.052	0.052
CHROMIUM (CR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	0.031	0.028	0.026	0.027	0.031	0.037	0.031	0.025
MAGNESIUM (MG)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MANGANESE (MN)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	WT %	0.301	0.294	0.272	0.247	0.278	0.277	0.271	0.259
TITANIUM (TI)	WT %	0.062	0.062	0.061	0.063	0.064	0.063	0.064	<0.01
ZINC (ZN)	WT %	0.065	0.062	0.061	0.062	0.063	0.063	0.063	0.063
ZIRCONIUM (ZR)	WT %	0.047	0.042	0.041	0.042	0.050	0.044	0.043	0.043
AA (Microwave)									
SODIUM (NA)	WT %	0.160	0.156	0.153	0.158	0.156	0.153	0.149	0.153
POTASSIUM (K)	WT %	0.013	0.010	0.010	0.010	0.012	0.009	0.009	0.009

SAMPLE ID		FRIT-0012	FRIT-0012	FRIT-0012	FRIT-0012	FRIT-0013	FRIT-0013	FRIT-0013	FRIT-0013
ANALYTICAL CODE(S)		FRIT	FRIT	FRIT	FRIT	FRIT	FRIT	FRIT	FRIT
DATE		11/11/91	11/11/91	11/11/91	11/11/91	11/11/91	11/11/91	11/11/91	11/11/91
ANALYSIS # OF total		1 OF 4	2 OF 4	3 OF 4	4 OF 4	1 OF 4	2 OF 4	3 OF 4	4 OF 4
COMPONENT	Units								
IC (Na2O2/H2O)									
CHLORIDE (CL[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
FLUORIDE (F[1-])	MG/L	<1	<1	<1	<1	<1	<1	<1	<1
PHOSPHATE (PO4[3-])	MG/L	<1	<504	<841	<546	<1054	<1	<184	<1
SULFATE (SO4[2-])	MG/L	1182	1694	1757	2200	2797	1013	1310	1509
AA (Na2O2/HCl)									
SILICON (SI)	WT %	29.940	30.580	30.810	31.850	28.840	30.310	31.920	32.100
ICP (Na2O2/HCl)									
ALUMINUM (AL)	WT %	0.337	0.332	0.321	0.321	0.359	0.358	0.363	0.346
BARIUM (BA)	WT %	0.033	0.034	0.037	0.036	0.034	0.035	0.035	0.035
BORON (B)	WT %	2.579	2.582	2.602	2.566	2.578	2.552	2.532	2.547
IRON (FE)	WT %	0.068	0.092	0.080	0.116	0.029	0.039	0.039	0.039
LITHIUM (LI)	WT %	3.370	3.464	3.480	3.412	3.409	3.338	3.381	3.354
MAGNESIUM (MG)	WT %	1.216	1.230	1.218	1.216	1.239	1.218	1.227	1.218
SILICON (SI)	WT %	35.960	37.180	37.310	36.960	35.460	36.010	37.020	36.090
TITANIUM (TI)	WT %	0.069	0.070	0.070	0.070	0.071	0.070	0.071	0.070
ICP (Microwave)									
CALCIUM (CA)	WT %	0.079	0.079	0.082	0.080	0.083	0.058	0.049	0.053
CHROMIUM (CR)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
COPPER (CU)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
IRON (FE)	WT %	0.029	0.038	0.028	0.026	0.028	0.016	0.012	0.018
MAGNESIUM (MG)	WT %	1.178	1.169	1.188	1.201	1.243	1.067	1.072	1.088
MANGANESE (MN)	WT %	0.001	0.001	0.001	0.001	<0.01	<0.01	<0.01	<0.01
NICKEL (NI)	WT %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SODIUM (NA)	WT %	4.411	4.500	4.589	4.565	4.526	4.470	4.608	4.555
TITANIUM (TI)	WT %	0.069	0.070	0.072	0.074	0.071	0.059	0.057	0.060
ZINC (ZN)	WT %	0.012	0.012	0.012	0.011	0.012	<0.01	<0.01	<0.01
ZIRCONIUM (ZR)	WT %	0.024	0.021	0.023	0.025	0.022	<0.01	<0.01	<0.01
AA (Microwave)									
SODIUM (NA)	WT %	3.794	3.859	3.823	3.836	3.576	3.633	3.637	3.540
POTASSIUM (K)	WT %	0.065	0.061	0.061	0.061	0.066	0.060	0.060	0.060

Appendix D:
Material Balance Tables

HWVP1 Feed Preparation Material Balance Table

	1	2	3	4	5	6	7
	Sludge Before Transfer (Analytical)	Transfer of Sludge (Analytical)	SRAT Heel (2-1)	Trim Chemicals (Weighed)	Calc'd Comp after Trims (2+4)	Sludge after Trim Chem Add'n (Analytical)	NM/Cd Added (Weighed)
WT%SOLIDS	8.23	8.11				11.55	
DENSITY (g/mL)	1.07	1.14				1.14	
VOLUME (gal)	1200.00	1270.08	70.08			1298.00	
Major (lbs)							
Al	60.14	63.59	3.45	0.00	63.59	56.04	0.00
B	0.00	1.23	1.23	0.03	1.26	0.73	0.00
Cd	0.00	0.00	0.00	0.00	0.00	0.04	35.84
Fe	262.98	269.64	6.66	0.00	269.64	235.58	0.00
Li	0.00	0.55	0.55	0.00	0.55	0.53	0.00
Mn	21.17	22.63	1.46	0.00	22.63	19.85	0.00
Na	13.41	18.04	4.63	104.79	122.82	105.85	13.13
Nd	0.00	0.00	0.00	80.99	80.99	76.50	0.00
Ni	23.45	24.44	0.99	0.00	24.44	21.29	0.00
Si	3.82	20.33	16.51	25.52	45.86	47.67	0.00
Zr	139.44	139.32	0.00	0.00	139.32	117.13	0.00
Minor (lbs)							
Ca	4.10	5.19	1.09	7.65	12.84	12.32	0.00
Ce	0.00	0.00	0.00	7.09	7.09	6.45	0.00
Cs	0.00	0.00	0.00	7.67	7.67	14.22	0.00
La	0.00	0.00	0.00	15.09	15.09	11.27	0.00
Mg	2.71	2.64	0.00	2.98	5.61	4.30	0.00
Mo	0.00	0.00	0.00	5.05	5.05	4.18	0.00
K	0.69	2.35	1.66	2.21	4.56	4.09	0.00
Pb	0.00	0.00	0.00	8.22	8.22	8.80	0.00
Ti	0.00	0.00	0.00	2.00	2.00	1.87	0.00

HWVP1 Feed Preparation Material Balance Table

	1	2	3	4	5	6	7
	Sludge Before Transfer (Analytical)	Transfer of Sludge (Analytical)	SRAT Heel (2-1)	Trim Chemicals (Weighed)	Calc'd Comp after Trims (2+4)	Sludge after Trim Chem Add'n (Analytical)	NM/Cd Added (Weighed)
WT% SOLIDS	8.23	8.11				11.55	
DENSITY (g/mL)	1.07	1.14				1.14	
VOLUME (gal)	1200.00	1270.08				1298.00	
Trace (lbs)							
P	0.00	0.00	0.00	0.35	0.35	0.79	0.00
Sn	0.00	0.00	0.00	0.13	0.13	0.38	0.00
Zn	0.00	0.00	0.00	3.64	3.64	3.08	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.14	0.00
Ta	0.00	0.00	0.00	0.07	0.07	0.22	0.00
Cr	0.00	0.00	0.00	2.43	2.43	2.50	0.00
Nb	0.00	0.00	0.00	0.17	0.17	0.16	0.00
Cu	0.00	0.00	0.00	2.65	2.65	2.92	0.00
Y	0.00	0.00	0.00	0.86	0.86	0.87	0.00
Sr	0.00	0.00	0.00	1.36	1.36	1.53	0.00
Pr	0.00	0.00	0.00	1.77	1.77	2.27	0.00
Sm	0.00	0.00	0.00	0.69	0.69	1.97	0.00
Ba	0.00	0.00	0.00	2.13	2.13	2.31	0.00
Rb	0.00	0.00	0.00	0.61	0.61	0.14	0.00
NM's etc (lbs)							
Ru	0.00	0.00	0.00	0.00	0.00	0.00	4.12
Pd	0.00	0.00	0.00	0.00	0.00	0.00	1.42
Rh	0.00	0.00	0.00	0.00	0.00	0.00	1.14
Ag	0.00	0.00	0.00	0.00	0.00	0.00	1.51
Te	0.00	0.00	0.00	0.00	0.00	0.00	0.18
Se	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Anions (lbs)							
Cl	0.30	0.81	0.51	4.08	4.89	4.07	7.08
F	0.06	0.08	0.02	1.31	1.39	1.22	0.00
SO4	3.74	3.74	0.00	9.73	13.47	14.17	0.00
PO4	0.00	0.00	0.00		0.00	0.00	0.00

HWVP1 Feed Preparation Material Balance Table

	8	9	10	11	12	13	14
	After NM/Cd and Formic Add'n (Analytical)	Recycle Waste Stream (Weighed)	Cal'd RWS Addition (8+9)	After RWS Add'n (Analytical)	FRIT (Weighed)	Calc'd Comp after FRIT (10+12)	After Frit Add'n (Analytical)
WT%SOLIDS	12.74			14.22			30.96
DENSITY (g/mL)	1.16			1.19			1.26
VOLUME (gal)	1323.70			1182.00			1516.60
Major (lbs)							
Al	53.33	2.59	66.18	49.81	3.39	69.57	68.37
B	0.14	0.00	1.26	0.17	187.84	189.10	188.76
Cd	37.42	1.73	37.57	36.73	0.00	37.57	37.97
Fe	230.97	0.85	270.49	208.87	0.86	271.35	274.28
Li	0.21	0.00	0.55	0.23	103.62	104.17	109.89
Mn	20.58	0.70	23.33	19.30	0.00	23.33	22.69
Na	131.32	33.74	169.69	143.12	7.17	176.86	179.45
Nd	80.58	0.00	80.99	71.50	0.00	80.99	70.90
Ni	21.93	0.00	24.44	19.78	0.00	24.44	24.44
Si	40.24	23.21	69.07	52.87	1093.95	1163.02	1132.55
Zr	130.47	0.00	139.32	116.09	0.93	140.25	138.66
Minor (lbs)							
Ca	11.74	0.24	13.08	10.86	2.02	15.10	13.41
Ce	6.91	0.00	7.09	4.82	0.00	7.09	7.49
Cs	48.74	0.00	7.67	46.66	0.00	7.67	6.65
La	12.96	0.00	15.09	9.63	0.00	15.09	10.81
Mg	4.57	0.22	5.83	3.52	0.00	5.83	5.54
Mo	4.67	0.00	5.05	4.12	0.00	5.05	4.96
K	2.52	0.49	5.05	2.67	0.83	5.88	5.76
Pb	8.71	0.00	8.22	7.48	0.00	8.22	8.99
Ti	1.89	0.10	2.09	2.28	1.98	4.08	4.14

HWVP1 Feed Preparation Material Balance Table

	8	9	10	11	12	13	14
	After NM/Cd and Formic Add'n (Analytical)	Recycle Waste Stream (Weighed)	Cal'd RWS Addition (8+9)	After RWS Add'n (Analytical)	FRIT (Weighed)	Calc'd Comp after FRIT (10+12)	After Frit Add'n (Analytical)
WT% SOLIDS	12.74			14.22			30.96
DENSITY (g/mL)	1.16			1.19			1.26
VOLUME (gal)	1323.70			1182.00			1516.60
Trace (lbs)							
P	2.24	0.04	0.39	3.02	0.00	0.39	0.89
Sn	0.22	0.00	0.13	0.15	0.00	0.13	0.35
Zn	3.69	0.00	3.64	3.47	0.00	3.64	5.32
Ge	0.16	0.00	0.00	0.17	0.00	0.00	BDL
Ta	0.15	0.00	0.07	0.17	0.00	0.07	BDL
Cr	2.30	0.00	2.43	1.97	0.00	2.43	3.54
Nb	0.16	0.00	0.17	0.17	0.00	0.17	BDL
Cu	2.98	0.00	2.65	2.56	0.00	2.65	3.54
Y	0.76	0.00	0.86	0.67	0.00	0.86	0.84
Sr	1.51	0.00	1.36	1.38	0.00	1.36	1.46
Pr	3.54	0.00	1.77	1.47	0.00	1.77	4.17
Sm	1.88	0.00	0.69	0.32	0.00	0.69	2.57
Ba	2.24	0.00	2.13	2.02	0.45	2.58	2.73
Rb	0.16	0.00	0.61	0.17	0.00	0.61	BDL
NM's etc. (lbs)							
Ru	3.79	0.00	4.12	2.97	0.00	4.12	5.43
Pd	0.49	0.00	1.42	0.00	0.00	1.42	2.09
Rh	0.35	0.00	1.14	0.00	0.00	1.14	2.02
Ag	1.39	0.00	1.51	1.08	0.00	1.51	2.08
Te	0.00	0.00	0.18	0.00	0.00	0.18	NA
Se	0.18	0.00	0.15	0.00	0.00	0.15	NA
Anions (lbs)							
Cl	NA	0.08	12.05	9.03	0.00	12.05	10.09
F	NA	0.00	1.39	0.20	0.00	1.39	0.49
SO4	8.71	0.00	13.47	10.30	3.94	17.41	14.03
PO4	0.01	0.00	0	0.00	0.00	0.00	0.00

	1	2	3	4	5	6	7
	Sludge Before Transfer (Analytical)	Transfer of Sludge (Analytical)	SRAT Heel (2-1)	Trim Chemicals (Weighed)	Calc'd Comp after Trims (1+4)	Sludge after Trim Chem Add'n (Analytical)	NM/Cd Added (Weighed)
WT% SOLIDS	8.23					16.94	
DENSITY (g/mL)	1.07					1.02	
VOLUME (gal)	1200.00					1636.00	
Major (lbs)							
Al	59.93		0.77	0.00	59.93	60.69	0.00
B	0.00		26.48	0.03	0.03	26.51	0.00
Cd	0.00		6.71	0.00	0.00	6.71	35.84
Fe	263.30		6.54	0.00	263.30	269.84	0.00
Li	0.00		16.17	0.00	0.00	16.17	0.00
Mn	21.22		0.80	0.00	21.22	22.02	0.00
Na	15.70		4.30	183.93	199.63	203.93	13.13
Nd	0.00		4.68	40.50	40.50	45.18	0.00
Ni	23.46		1.68	0.00	23.46	25.14	0.00
Si	3.45		159.01	22.91	26.36	185.38	0.00
Zr	139.90		1.58	0.00	139.90	141.47	0.00
Minor (lbs)							
Ca	4.03		1.37	7.65	11.68	13.05	0.00
Ce	0.00		0.00	7.09	7.09	3.13	0.00
Cs	0.00		0.00	7.67	7.67	7.06	0.00
La	0.00		0.00	7.55	7.55	1.97	0.00
Mg	1.50		0.00	2.98	4.48	2.15	0.00
Mo	0.00		0.00	5.05	5.05	4.32	0.00
K	0.69		0.00	2.21	2.90	2.47	0.00
Pb	0.00		0.00	8.22	8.22	8.96	0.00
Ti	0.00		0.00	2.00	2.00	1.82	0.00

	1	2	3	4	5	6	7
	Sludge Before Transfer (Analytical)	Transfer of Sludge (Analytical)	SRAT Heel (2-1)	Trim Chemicals (Weighed)	Calc'd Comp after Trims (1+4)	Sludge after Trim Chem Add'n (Analytical)	NM/Cd Added (Weighed)
WT% SOLIDS	8.23					16.94	
DENSITY (g/mL)	1.07					1.02	
VOLUME (gal)	1200.00					1636.00	
Trace (lbs)							
P	0.00		0.00	0.35	0.35	1.22	0.00
Sn	0.00		0.00	0.13	0.13	0.24	0.00
Zn	0.00		0.00	3.64	3.64	4.13	0.00
Ge	0.00		0.00	0.00	0.00	0.24	0.00
Ta	0.00		0.00	0.04	0.04	0.24	0.00
Cr	0.00		0.00	2.42	2.42	2.45	0.00
Nb	0.00		0.00	0.08	0.08	0.24	0.00
Cu	0.00		0.00	2.65	2.65	2.90	0.00
Y	0.00		0.00	0.86	0.86	0.78	0.00
Sr	0.00		0.00	1.36	1.36	1.69	0.00
Pr	0.00		0.00	1.77	1.77	0.68	0.00
Sm	0.00		0.00	0.69	0.69	0.24	0.00
Ba	0.00		0.00	2.13	2.13	2.48	0.00
Rb	0.00		0.00	0.61	0.61	0.24	0.00
NM's etc. (lbs)							
Ru	0.00		0.00	0.00	0.00	0.00	4.12
Pd	0.00		0.00	0.00	0.00	0.00	1.42
Rh	0.00		0.00	0.00	0.00	0.00	1.14
Ag	0.00		0.00	0.00	0.00	0.00	1.51
Te	0.00		0.00	0.18	0.18		0.00
Se	0.00		0.00	0.15	0.15		0.00
Anions (lbs)							
Cl	0.30		0.00	4.08	4.38	6.39	7.08
F	0.06		0.00	1.31	1.37	1.38	0.00
SO4	3.74		0.00	9.73	13.47	20.53	0.00

	8	9	15	16	21	22	23	28	29		
	Cal'd Comp After NM/Cd (2+4+7)	After NM/Cd Addition (Analytical)	After Formic Addition (Analytical)	Recycle Waste Stream (Weighed)	Calc'd Comp After RWS (8+16)	After RWS Addition (Analytical)	FRIT (Weighed)	Calc'd Comp After FRIT (21+23)	AFTER FRIT ADDITION MEASURED	% Acct'd for in SME (14/13)	% from Target
WT% SOLIDS		21.15	23.21			22.01					
DENSITY (g/mL)		1.07	1.10			1.10			1.30		
VOLUME (gal)		1350.24	1181.60			1280.00			1398.10		
Major (lbs)											
Al	59.93	65.44	65.41	2.59	62.52	65.53	3.39	66.68	69.43	104.13	4.1
B	0.03	27.35	26.64	0.00	0.03	26.61	187.84	214.35	204.18	95.26	-4.7
Cd	35.84	42.05	42.32	1.73	37.57	45.00	0.00	44.28	41.01	92.62	-7.4
Fe	263.30	283.79	281.24	0.85	264.14	273.04	0.86	271.55	260.17	95.81	-4.2
Li	0.00	17.00	17.53	0.00	0.00	17.21	103.62	119.79	117.17	97.82	-2.2
Mn	21.22	22.91	22.49	0.70	21.91	22.36	0.00	22.71	20.97	92.31	-7.7
Na	212.76	227.39	247.86	28.95	241.71	241.49	8.51	254.52	262.56	103.16	3.2
Nd	40.50	53.03	53.43	0.00	40.50	51.99	0.00	45.18	41.42	91.68	-8.3
Ni	23.46	26.29	27.07	0.00	23.46	25.86	0.00	25.14	23.14	92.02	-8.0
Si	26.36	232.57	202.60	23.21	49.57	230.94	1093.95	1302.54	1228.17	94.29	-5.7
Zr	139.90	147.05	145.52	0.00	139.90	142.12	0.93	142.40	136.19	95.64	-4.4
Minor (lbs)											
Ca	11.68	14.44	14.76	0.24	11.92	14.68	2.02	13.94	13.58	97.46	-2.5
Ce	7.09	5.75	5.46	0.00	7.09	5.56	0.00	7.09	4.62	65.15	-34.8
Cs	7.67	6.38	7.52	0.00	7.67	5.17	0.00	7.67	5.12	66.73	-33.3
La	7.55	5.81	5.60	0.00	7.55	5.46	0.00	7.55	3.33	44.11	-55.9
Mg	4.48	3.67	4.32	0.22	4.70	4.67	0.00	4.70	4.74	100.99	1.0
Mo	5.05	4.58	5.51	0.00	5.05	4.89	0.00	5.05	5.47	108.43	8.4
K	2.90	2.61	2.76	0.49	3.39	2.59	0.83	4.22	3.87	91.81	-8.2
Pb	8.22	9.77	10.26	0.00	8.22	10.05	0.00	8.22	9.14	111.21	11.2
Ti	2.00	2.08	1.79	0.10	2.09	1.86	1.98	4.08	4.66	114.27	14.3

	8	9	15	16	21	22	23	28	29		
	Cal'd Comp After NM/Cd (2+4+7)	After NM/Cd Addition (Analytical)	After Formic Addition (Analytical)	Recyclo Waste Stream (Weighed)	Calc'd Comp After RWS (8+16)	After RWS Addition (Analytical)	FRIT (Weighed)	Calc'd Comp After FRIT (21+23)	AFTER FRIT ADDITION MEASURED	% Acct'd for in SME (14/13)	
WT% SOLIDS		21.15	23.21			22.01			38.00		
DENSITY (g/mL)		1.07	1.10			1.10			1.30		
VOLUME (gal)		1350.24	1181.60			1280.00			1398.10		
Trace (lbs)											
P	0.35	2.61	0.29	0.04	0.39	0.57	0.00	0.39	1.44	370.92	270.9
Sn	0.13	0.28	0.25	0.00	0.13	0.26	0.00	0.13	0.71	562.32	462.3
Zn	3.64	4.64	4.24	0.00	3.64	4.15	0.00	3.64	5.04	138.52	38.5
Ce	0.00	0.26	0.25	0.00	0.00	0.26	0.00	0.00	0.67	33626.56	33526.6
Ta	0.04	0.32	0.25	0.00	0.04	0.26	0.00	0.04	0.58	1538.97	1439.0
Cr	2.42	2.71	2.86	0.00	2.42	2.75	0.00	2.42	2.80	115.50	15.5
Nb	0.08	0.26	0.25	0.00	0.08	0.26	0.00	0.08	0.51	609.18	509.2
Cu	2.65	3.38	3.29	0.00	2.65	3.19	0.00	2.65	3.50	131.98	32.0
Y	0.86	0.92	0.95	0.00	0.86	0.92	0.00	0.86	0.78	90.21	-9.8
Sr	1.36	1.75	1.79	0.00	1.36	1.73	0.00	1.36	1.47	108.20	8.2
Pr	1.77	2.09	0.96	0.00	1.77	1.10	0.00	1.77	1.44	81.48	-18.5
Sm	0.69	0.88	0.25	0.00	0.69	0.26	0.00	0.69	6.75	973.28	873.3
Ba	2.13	2.69	2.68	0.00	2.13	2.64	0.45	2.58	10.98	425.76	325.8
Pb	0.61	0.26	0.25	0.00	0.61	0.26	0.00	0.61	0.51	84.16	-15.8
NM's etc. (lbs)											
Ru	4.12	5.18		0.00	4.12 #		0.00	4.12	3.58	87.01	-13.0
Pd	1.42	1.10		0.00	1.42 #		0.00	1.42	0.60	41.91	-58.1
Rh	1.14	0.92		0.00	1.14 #		0.00	1.14	0.12	10.10	-89.9
Ag	1.51	1.96		0.00	1.51 #		0.00	1.51	1.98	131.12	31.1
Te	0.18			0.00	0.18 #		0.00	0.18		0.00	-100.0
Se	0.15			0.00	0.15 #		0.00	0.15		0.00	-100.0
Anions (lbs)											
Cl	11.46	9.50	14.79	0.08	11.54	13.89	0.00	11.54	14.00	121.31	21.3
F	1.37	1.07	0.97	0.00	1.37	0.99	0.00	1.37	1.17	85.16	-14.8
SO4	13.47	18.38	18.39	0.00 #	13.47	20.04	3.94	17.41	17.14	98.44	-1.6

Appendix E:

Mixed Hydroxide Slurry
Make-up Procedure

SPECIFICATION AND PROCEDURE FOR THE PREPARATION OF THE MIXED HYDROXIDE SLURRY FOR THE IDMS HWVP DEMONSTRATION

The steps to be followed in the preparation of this mixed hydroxide slurry will include: dissolution of nitrate feedstocks, neutralization using sodium hydroxide, separation of precipitated solids, several washing steps to remove excess sodium and nitrate, sampling, and ultimate shipment of the material.

This procedure will result in the manufacture of approximately 3000 gal of an 8 wt% solids slurry. Part I provides the preparation procedure and Part II provides the specification and analytical requirements of the preparation. The following schematic outlines the preparation steps.

Modifications to procedures presented in Part I and methods for adjustment of materials that do not meet specifications listed in Part II must be reviewed and approved by the technical representative, Nick Hutson (803 725-6042) of the Savannah River Laboratory (SRL).

PART I: PREPARATION PROCEDURE

The vessels used in this procedure (Tank 1 and Tank 2) are assumed to be continuously agitated with cooling capabilities. During the makeup procedure the slurry temperatures should be maintained below 40°C to control exothermic reactions during the neutralization steps. The capacity of the tanks used will determine the number of washing steps required to remove excess sodium nitrate and sodium hydroxide. Therefore, the production time should be adjusted accordingly in the delivery time estimate.

The specific values for the quantities of chemicals used in the preparation of the slurry are listed in Table 1.

Step 1: Preparation of Mn, Fe, Zr, and Ni slurry

- A. Charge Tank 1 with [A] gallons of water.
- B. Add [B] lbs of 50 wt% manganese nitrate $\{\text{Mn}(\text{NO}_3)_2\}$ solution. Adjust the temperature to 35°C to 40°C. Stir the solution continuously.
- C. In a separate vessel, blend [C] lbs of potassium permanganate $\{\text{KMnO}_4\}$ with [D] gallons of water. Agitate the solution. Adjust the temperature to 35°C to 40°C when the permanganate has dissolved.

- D. Pump the permanganate solution (prepared in step C) into the manganese nitrate (prepared in step B) at a rate of 2.0 - 3.0 gallons per minute with constant agitation. Maintain slurry temperature between 35°C to 40°C.
- E. With continued agitation, add [E] gallons of water, [F] lbs of ferric nitrate nanohydrate $\{\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}\}$, [G] lbs of zirconium nitrate pentahydrate $\{\text{Zr}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}\}$, [H] lbs of nickel nitrate hexahydrate $\{\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}\}$.
- F. Agitate until the nitrates are completely dissolved.
- G. In a separate vessel, add [I] lbs of 50 wt% sodium hydroxide solution to [J] gallons of water.
- H. Stirring constantly, add the sodium hydroxide solution slowly to the solution in Tank 1 until the pH is in the range of 12 to 12.5. Provide cooling during neutralization to maintain the temperature of the slurry below 40°C.
- I. After a pH of 12 is reached continue to agitate the slurry for 1 hour.
- J. Perform solids separation: SOLIDS CONCENTRATION MUST BE MAINTAINED BELOW 30 WT% DURING SEPARATION PROCESS.
- K. Perform water wash/solids separation sequence to maintain sodium and nitrate specification presented in Part II of this procedure.
- L. Agitate the contents in Tank 1 and obtain a representative sample for analysis. Submit the sample to the SRL technical for determination of the sodium, nitrate, and cation concentrations.

Step 2: Preparation of Al Slurry

- A. Charge to Tank 2 about [K] gal of water.
- B. While agitating, add [L] lbs of aluminum nitrate nanohydrate $\{\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}\}$.
- C. Agitate until the nitrate is completely dissolved.
- D. In a separate vessel add [M] lbs of a 50 wt% sodium hydroxide solution to about [N] gal of water.
- E. With continued agitation, add the sodium hydroxide solution slowly to the solution in Tank 2 until the solution pH is in the range of 10 to 10.5. Provide cooling necessary during neutralization to maintain the temperature of the slurry below 40°C.

- F. After a pH of 10 is reached, continue to stir solution for 1 hr.
- G. Perform solids separation: SOLIDS CONCENTRATION MUST BE MAINTAINED BELOW 30 WT% DURING SEPARATION PROCESS.
- H. Perform water wash/solids separation sequence to maintain sodium and nitrate specification presented in Part 2 of this procedure.
- I. Agitate the contents in Tank 2 and obtain a representative sample for analysis. Submit the sample to the SRL technical representative for determination of the sodium, nitrate, and cation concentrations.

Step 3: Blending and Final Adjustment

- A. Transfer [0] lbs of aluminum (Al) from Tank 2 to Tank 1.
- B. Agitate the slurry in Tank 1 and obtain a representative sample for analysis. Submit the sample to the SRL technical representative for determination of the wt% total solids and sodium, nitrate, and cation concentrations.
- C. Adjust the composition of the product to meet the specifications in Part II. This may require additional washing steps to meet the sodium and nitrate concentration limits. Any adjustments to the Al, Fe, Mn, Ni and/or Zr concentrations must be approved by the SRL technical representative.
- D. Analytical verification and concurrence from SRL's technical representative must be received before the material may be shipped to TNX. Once the product specifications have been approved, the material can be shipped to TNX by tanker.

Table 1
Slurry Preparation Procedure Components

	<u>Component</u>	<u>Units</u>	<u>Amount</u>
[A]	Dilution Water	gals	292
[B]	50 wt% Mn(NO ₃) ₂	lbs	183
[C]	KMnO ₄	lbs	40
[D]	Dilution Water	gals	297
[E]	Dilution Water	gals	876
[F]	Fe(NO ₃) ₃ ·9H ₂ O	lbs	3699
[G]	Zr(NO ₃) ₄ ·5H ₂ O	lbs	1424
[H]	Ni(NO ₃) ₂ ·6H ₂ O	lbs	243
[I]	50 wt% NaOH	lbs	3684
[J]	Dilution Water	gals	134
[K]	Dilution Water	gals	71
[L]	Al(NO ₃) ₃ ·9H ₂ O	lbs	1805
[M]	50 wt% NaOH	lbs	1210
[N]	Dilution Water	gals	44
[O]	Aluminum	lbs	130

PART II: SPECIFICATION OF ANALYTICAL REQUIREMENTS

The product must meet the specifications listed below.

1.	Solids wt%	8 ± 2 wt%
2.	Total iron {Fe} delivered	535 ± 5%
3.	Total zirconium {r} delivered	303 lbs ± 5%
4.	Total aluminum {Al} delivered	130 lbs ± 5%
5.	Total nickel {Ni} delivered	49 lbs ± 5%
6.	Total manganese {Mn} delivered	37 lbs ± 5%
7.	Total sodium {Na} delivered	< 51 lbs
8.	Total nitrate {NO ₃ -}	< 127 lbs
9.	Total calcium	< 6 lbs
10.	Anions in the dried solids sample	
	Chloride	< 253 ppm
	Fluoride	< 25 ppm
	Sulfate	< 127 ppm
11.	Total other impurities	< 13 lbs

12. Feedstock chemicals used are to be technical grade quality.
13. At the suppliers discretion, solutions of the nitrate chemicals or species having different waters of hydration can be used as starting material in place of the materials identified in Part I.