23.304

Gas Suspension Absorption (GSA) Demonstration Plant Air Toxics Characterization

Final Report
Appendices

Prepared for

Frank Hsu

AirPol Inc.
32 Henry Street
Teterborough, New Jersey 07608

by

Energy and Environmental Research Corporation
18 Mason
Irvine, California 92718

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NOTICE

This document is a draft. It has not been formally released by AirPol Inc. It should not, at this stage, be construed to represent actual results. It is being circulated for comments on its technical merit and policy implications.

ABSTRACT

This report summarizes results of a project to characterize air toxic emissions of selected hazardous air pollutants (HAPs) from the AirPol Gas Suspension Absorption SO_2 control technology. This project was sponsored by the U.S. Department of Energy (DOE), AirPol Inc., and the Tennessee Valley Authority (TVA). The GSA process utilizes a semi-dry lime scrubber for SO_2 and HCl removal. Most of the solids in the GSA reactor are removed from the flue gas and recycled into the reactor. The flue gas from the GSA reactor/cyclone is passed through a dust collector for final particulate control. AirPol demonstrated the process in a 10 MW pilot-scale plant utilizing a slipstream from a coal-fired utility boiler. The pilot plant consisted of the GSA reactor/cyclone, an ESP, and a small, 1 MW equivalent pulsed jet baghouse.

The 10 MW pilot-plant was tested in September and October, 1993 at the TVA National Center for Emissions Research located in West Paducah Kentucky. The test program included evaluation of two process configurations:

Series. The baghouse was operated in series with the ESP, i.e., the flue gas from the GA reactor/cyclone passed first through the ESP and then the fabric filter;

Parallel. The baghouse was operated in parallel with the ESP, meaning that 15-16 percent of the flue gas leaving the GSA reactor/cyclone was introduced to the fabric filter; thus, both the ESP inlet stream and the fabric baghouse stream contained equivalent concentrations of all flue gas constituents;

Two test conditions were evaluated in each configuration: baseline, with no lime introduction to the system; and demonstration, with lime injection into the GSA.

Three test runs were performed under each condition. Samples for key gaseous, liquid and solid streams were collected and analyzed for each run. The HAPs measured included 13 trace metals, HCl, and HF. This report presents all field data and laboratory analysis results. Mass balances, removal efficiencies, and emission factors for HAPs also are presented.

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ABBREVIATIONS AND SYMBOLS

acf actual cubic foot
acfm actual cubic feet per minute
acm actual cubic meter
APCD air pollution control device
APCL Applied Physics and Chemistry Laboratory
As arsenic
ASTM American Society for Testing and Materials
aq aqueous
Ba barium
Be beryllium
BI fabric filter inlet flue gas sampling location
BO fabric filter outlet flue gas sampling location
BP baseline parallel configuration
BS baseline series configuration
Btu British thermal unit
Ca calcium
$Ca(OH)_2$ calcium hydroxide (also lime or hydrated lime)
Ca/S calcium to sulfur molar ratio
$CaSO_3$ calcium sulfite
$CaSO_4$ calcium sulfate
$CaCl_2$ calcium chloride
Cd cadmium
CAAA Clean Air Act Amendments of 1990
CC confidence coefficient
CEMS continuous emissions monitoring system
CI confidence interval
Cl chloride
Co cobalt
CO_2 carbon dioxide
Cr chromium
CTT clean coal technology
CTE Commercial Testing and Engineering Company
CV-AAS cold vapor atomic absorption spectroscopy
DA-AAS direct aspiration-atomic absorption spectroscopy
DOE Department of Energy
DP demonstration parallel configuration
DS demonstration series configuration
dscf dry standard cubic foot (20°C, 760 mm Hg)
dscm dry standard cubic meter (20°C, 760 mm Hg)
EER Energy and Environmental Research Corporation
EI ESP inlet flue gas sampling location
EO ESP outlet flue gas sampling location
EPA United States Environmental Protection Agency
EPRI Electric Power Research Institute
ESP electrostatic precipitator
F fluoride
FB field blank
F_d dry F factor
FF fabric filter (also baghouse)

ABBREVIATIONS AND SYMBOLS
(continued)

ft foot
ft^2 square foot
g gram
GCVw gross calorific value (Btu/lb)
GF-AAS graphite furnace atomic absorption spectroscopy
GI GSA inlet flue gas sampling location
gr grain
GS Greenburg-Smith
GSA gas suspension absorption
HAP hazardous air pollutant
HCl hydrogen chloride
HF hydrogen fluoride
Hg mercury
HPLC high performance liquid chromatography
H_2O water
H_2O_2 hydrogen peroxide
HNO_3 nitric acid
IC ion chromatograph
ICAP inductively coupled argon plasma
in inch
K 1,000,000 Btu/MBtu
Kc 1.53 scf/lb%
kg kilo grams
Khd 3.64 scf/lb%
Kn 0.14 scf/lb%
Ko 0.46 scf/lb%
Ks 0.57 scf/lb%
lb pound
m meter
m^2 square meter
MBC mass balance closure
MDL method detection limit
mg milligram
Mg manganese
min minute
MJ megajoule
ml milliliter
MMBtu million British thermal units
Mn manganese
Mod modified stem
MS matrix spike
MSD matrix spike duplicate
MW megawatt
MWe megawatt (electric)
N/A not applicable
NCER National Center for Emission Research
ND not detected
NDIR non-dispersive infrared absorption spectroscopy

ABBREVIATIONS AND SYMBOLS
(continued)

NDM maximum not detected
NDUV nin-dispersive ultraviolet absorption spectroscopy
Ncm normal cubic meter (0°C, 760 mm Hg)
Ncfm normal cubic foot per minute (0°C, 760 mm Hg)
Ni nickel
Nm^3 normal cubic meter (0°C, 760 mm Hg)
NOx oxides of nitrogen
NPL National Priorities List
O_2 oxygen
Pb lead
PEA performance evaluation audit
PM particulate matter
ppm part per million by volume
PQL practical quantitation limit
QA quality assurance
QC quality control
QA/QC quality assurance/quality control
QAPP quality assurance project plan
RPD relative percent difference
Sb antimony
scfm standard cubic foot per minute (20°C, 760 mm Hg)
Se selenium
sec second
SO_2 sulfur dioxide
SO_3 sulfur trioxide
SS4 coal process stream
SS5 GSA cyclone solids process stream
SS7 lime slurry process stream
SS9A ESP field 1 process stream
SS9B ESP fields 2-4 process stream
SS11 fabric filter ash process stream
SS13 fly-ash reinjection process stream
SS14 trim water process stream
TC thermocouple
TSA technical system audit
TVA Tennessee Valley Authority
UARG Utility Air Regulatory Group
V vanadium
-- not determined
°C degrees centigrade
°F degrees Farenheit

SI CONVERSION FACTORS

	English (US)	X	Factor	=	SI
Area:	1 ft^2	x	9.29×10^{-2}	=	m^2
	1 in^2	x	6.45	=	cm^2
Flow Rate	1 gal/min	x	6.31×10^{-5}	=	m^3/s
	1 gal/min	x	6.31×10^{-2}	=	L/s
Length:	1 ft	x	0.30	=	m
	1 in	x	2.54	=	cm
	1 yd	x	0.91	=	m
Mass:	1 lb	x	4.54×10^{2}	=	g
	1 lb	x	0.454	=	kg
	1 gr	x	0.065	=	g
Volume:	1 ft^3	x	28.3	=	L
	1 ft^3	x	0.0283	=	m^3
	1 gal	x	3.78	=	L
	1 gal	x	3.78×10^{-3}	=	m^3
Temperature	°F + 32	x	1.8		°C
	°R	x	0.556	=	K

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APPENDIX A—PROCESS OPERATION

This appendix presents detailed process operation data summarized in the main volume. The following four tables present average data during each test run. Subsequent pages present selected data at intervals during each run.

DATE TEST RUN		Parameter I.D. Code	Target	DEMONSTRATION SERIES 9/22/93 R2-HCL	9/23/93 R3-HCL	9/23/93 R4-HCL	9/21/93 R1-M	9/22/93 R2-M	9/23/93 R3-M	Avg.	CI
SO2 Removal Rate	%	SO2_RET	90	87.9	87.3	88.0	87.4	90.8	86.0	87.9	0.16
Gas Flow Venturi Inlet	Ncfm	SFG_IVEN	20000	20011	19969	20006	20000	20002	20004	19999	1.54
GSA Inlet Temp.	deg F		320	295	290	293	295	299	292	294	0.32
Venturi Inlet Gas Temp.	deg F	TD_IVEN		289	284	287	290	294	286	288	0.36
E.S.P. Outlet Gas Temp.	deg F	TD_EPO		146	145	146	147	147	145	146	0.09
Trim Water Flow Rate	GPM	GPM_TRW		5.64	5.45	5.29	5.87	5.33	5.06	5.44	0.03
Lime Slurry Flow Rate	GPM	GPM_LS		4.36	4.44	4.53	4.08	4.86	4.59	4.48	0.03
Flyash Reinjection	lb/min	LBM_FA	6.8	7.31	7.31	7.40	7.29	7.40	7.27	7.33	0.01
Approach to Adiabatic	deg F	ASAT_DO	12	12.0	12.0	12.1	13.2	12.0	12.0	12.2	0.05
GSA delta P.	in H2O	DP_RVES		0.18	0.18	0.16	0.18	0.19	0.13	0.17	0.00
ESP delta P.	in H2O	DP_ESP		1.55	1.56	2.16	1.74	1.75	1.83	1.76	0.02
ESP Outlet Opacity	%	OPACITY		1.52	1.75	1.62	2.18	2.01	2.19	1.88	0.03
Recycle Flow Rate	lb/min	LBM_REC	2500	2556	2458	2776	2771	2550	2697	2635	13.6
Recycle Ratio	lb/lb Ca	REC_RAT		257	260	287	295	197	177	245	4.94
Unit Load	MW	BOIL_LD		148	147	146	146	147	147	147	0.06
GSA In. Venturi SO2	ppm	SO2_IVEN		1809	1583	1772	1745	1786	1790	1748	8.60
GSA In. PH. SO2	ppm	SO2_PHX		1693	1568	1647	1631	1704	1664	1651	5.07
GSA Inlet O2	%	O2_IVEN		6.30	6.52	7.02	6.62	6.21	6.29	6.49	0.03
ESP Inlet SO2	ppm	SO2_EPI		233	209	199	207	178	235	210	2.23
ESP Inlet O2	%	O2_EPI		7.24	6.29	6.84	6.94	6.55	6.81	6.78	0.03
ESP Outlet SO2	ppm	SO2_EPO		176	170	171	173	136	198	171	2.05
ESP Outlet O2	%	O2_EPO		7.70	7.37	7.78	7.46	7.14	7.31	7.46	0.02
Baghouse Inlet SO2	ppm	SO2_PJI		176	170	171	173	136	198	171	2.05
Baghouse Inlet O2	%	O2_PJI		7.26	7.37	7.78	7.46	7.14	7.31	7.39	0.02
Baghouse Outlet SO2	ppm	SO2_PJO		165	175	158	153	129	179	160	1.85
Baghouse Outlet O2	%	O2_PJO		8.21	7.84	8.04	7.84	7.55	7.91	7.90	0.02

DATE TEST RUN		Parameter I.D. Code	Target	BASELINE SERIES 9/28/93 R2-HCL	9/28/93 R3-HCL	9/29/93 R4-HCL	9/28/93 R2-M	9/29/93 R3-M	9/29/93 R4-M	Avg	CI
SO2 Removal Rate	%	SO2_RET		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Gas Flow Venturi Inlet	Ncfm	SFG_IVEN	20000	20003	20000	20001	20002	20000	19998	20001	0.18
GSA Inlet Temp.	deg F	N/A	270	288	295	291	291	284	288	290	0.38
Venturi Inlet Gas Temp.	deg F	TD_IVEN		282	290	284	291	279	281	285	0.51
E.S.P. Outlet Gas Temp.	deg F	TD_EPO		255	257	157	256	255	256	239	4.15
Trim Water Flow Rate	GPM	GPM_TRW		0	0	0	0	0	0	0	0.00
Lime Slurry Flow Rate	GPM	GPM_LS		0	0	0	0	0	0	0	0.00
Flyash Reinjection	lb/min	LBM_FA	6.4	6.83	6.81	6.72	6.70	6.73	6.61	6.73	0.01
Approach to Adiabatic	deg F	ASAT_DO		131	132	132	132	131	132	132	0.05
GSA delta P.	in H2O	DP_RVES		-0.03	-0.02	0.00	-0.02	-0.03	-0.03	-0.02	0.00
ESP delta P.	in H2O	DP_ESP		1.42	1.71	1.53	1.56	1.45	1.65	1.55	0.01
ESP Outlet Opacity	%	OPACITY		0.80	0.86	0.85	1.16	0.62	0.52	0.80	0.02
Recycle Flow Rate	lb/min	LBM_REC		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Recycle Ratio	lb/lb Ca	REC_RAT		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Unit Load	MW	BOIL_LD		147	149	148	148	148	147	148	0.08
GSA In. Venturi SO2	ppm	SO2_IVEN		1828	1829	1818	1797	1862	1815	1825	2.23
GSA In. PH. SO2	ppm	SO2_PHX		1734	1738	1729	1712	1767	1725	1734	1.89
GSA Inlet O2	%	O2_IVEN		6.66	6.46	6.54	6.41	6.56	6.71	6.56	0.01
ESP Inlet SO2	ppm	SO2_EPI		1554	1554	1545	1528	1577	1535	1549	1.77
ESP Inlet O2	%	O2_EPI		7.26	7.00	7.06	7.22	7.08	7.23	7.14	0.01
ESP Outlet SO2	ppm	SO2_EPO		1589	1580	1573	1554	1605	1564	1577	1.88
ESP Outlet O2	%	O2_EPO		8.06	7.95	8.02	8.12	8.05	8.21	8.07	0.01
Baghouse Inlet SO2	ppm	SO2_PJI		1589	1580	1573	1554	1605	1564	1577	1.88
Baghouse Inlet O2	%	O2_PJI		8.06	7.95	8.02	8.12	8.05	8.21	8.07	0.01
Baghouse Outlet SO2	ppm	SO2_PJO		1474	1419	1460	1432	1483	1441	1451	2.58
Baghouse Outlet O2	%	O2_PJO		7.95	8.35	8.35	8.34	8.35	8.36	8.28	0.02

DATE TEST RUN		Parameter I.D. Code	Target	DEMONSTRATION PARALLEL 10/13/93 R1-HCL	10/14/93 R2-HCL	10/15/93 R3-HCL	10/14/93 R1-M	10/15/93 R2-M	10/15/93 R3-M	Average	CI
SO2 Removal Rate	%	SO2_RET	90	91.1	91.4	91.4	91.5	91.5	91.6	91.4	0.02
Gas Flow Venturi Inlet	Ncfm	SFG_IVEN	20000	20010	19996	19995	19998	20004	20003	20001	0.59
GSA Inlet Temp.	deg F	N/A	320	291	301	302	284	296	292	294	0.70
Venturi Inlet Gas Temp.	deg F	TD_IVEN		284	295	298	288	293	298	293	0.58
E.S.P. Outlet Gas Temp.	deg F	TD_EPO		146	147	148	146	147	148	147	0.09
Trim Water Flow Rate	GPM	GPM_TRW		3.84	4.25	4.46	4.56	4.57	4.26	4.32	0.03
Lime Slurry Flow Rate	GPM	GPM_LS		4.65	5.72	5.72	5.47	5.50	5.86	5.49	0.04
Flyash Reinjection	lb/min	LBM_FA	6.8	7.14	7.22	7.32	7.28	7.33	7.38	7.28	0.01
Approach to Adiabatic	deg F	ASAT_DO	12	12.0	13.8	12.0	12.0	12.0	12.4	12.4	0.07
GSA delta P.	in H2O	DP_RVES		0.17	0.19	0.19	0.18	0.19	0.19	0.19	0.00
ESP delta P.	in H2O	DP_ESP		1.62	1.58	1.65	1.46	1.56	1.59	1.58	0.01
ESP Outlet Opacity	%	OPACITY		0.71	1.24	1.87	1.65	1.67	1.50	1.44	0.04
Recycle Flow Rate	lb/min	LBM_REC	2500	2544	2438	2410	2395	2423	2386	2433	5.93
Recycle Ratio	lb/lb Ca	REC_RAT		241	201	198	204	213	193	208	1.79
Unit Load	MW	BOIL_LD		124	149	149	147	148	149	145	1.02
GSA In. Venturi SO2	ppm	SO2_IVEN		1721	1822	1820	1867	1808	1853	1834	5.25
GSA In. PH. SO2	ppm	SO2_PHX		1662	1759	1774	1798	1754	1791	1775	5.05
GSA In. Venturi O2	%	O2_IVEN		6.94	6.35	5.91	6.15	6.11	5.81	6.07	0.04
ESP Inlet SO2	ppm	SO2_EPI		134	160	168	163	155	155	160	1.21
ESP Inlet O2	%	O2_EPI		7.45	6.83	6.36	6.71	6.65	6.34	6.58	0.04
ESP Outlet SO2	ppm	SO2_EPO		124	128	130	129	126	128	128	0.21
ESP Outlet O2	%	O2_EPO		7.91	7.34	6.98	7.21	7.16	6.94	7.13	0.04
Baghouse Inlet SO2	ppm	SO2_PJI		134	160	168	163	155	155	160	1.21
Baghouse Inlet O2	%	O2_PJI		7.91	7.34	N/A	7.21	7.16	6.94	5.73	0.31
Baghouse Outlet SO2	ppm	SO2_PJO		52.0	52.0	65.3	54.0	49.5	36.2	51	0.96
Baghouse Outlet O2	%	O2_PJO		7.74	7.15	6.61	6.95	7.12	6.71	6.91	0.04

DATE TEST RUN		Parameter I.D. Code	Target	BASELINE PARALLEL 10/21/93 R2-HCL	10/21/93 R3-HCL	10/22/93 R4-HCL	10/21/93 R2-M	10/22/93 R3-M	10/22/93 R4-M	Average	CI
SO2 Removal Rate	%	SO2_RET		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Gas Flow Venturi Inlet	Ncfm	SFG_IVEN	20000	20010	20004	19996	19985	19989	20004	19998	1.00
GSA Inlet Temp.	deg F	N/A	270	292	294	288				291	0.31
Venturi Inlet Gas Temp.	deg F	TD_IVEN		289	288	281	284	276	285	284	0.49
E.S.P. Outlet Gas Temp.	deg F	TD_EPO		242	242	253	241	252	253	247	0.62
Trim Water Flow Rate	GPM	GPM_TRW		0	0	0	0	0	0	0	0.00
Lime Slurry Flow Rate	GPM	GPM_LS		0	0	0	0	0	0	0	0.00
Flyash Reinjection	lb/min	LBM_FA	6.4	6.87	6.95	6.78	7.15	6.77	6.68	6.87	0.02
Approach to Adiabatic	deg F	ASAT_DO		133	133	131	132	130	131	132	0.12
GSA delta P.	in H2O	DP_RVES		-0.04	-0.05	-0.04	-0.05	-0.05	-0.04	-0.05	0.00
ESP delta P.	in H2O	DP_ESP		1.53	1.47	1.50	1.45	1.46	1.56	1.50	0.00
ESP Outlet Opacity	%	OPACITY		2.66	2.82	2.97	2.78	2.89	3.19	2.89	0.02
Recycle Flow Rate	lb/min	LBM_REC		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Recycle Ratio	lb/lb Ca	REC_RAT		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Unit Load	MW	BOIL_LD		150	149	149	148	140	149	147	0.38
GSA In. Venturi SO2	ppm	SO2_IVEN		1781	1811	1805	1801	1796	1811	1805	1.16
GSA In. PH. SO2	ppm	SO2_PHX		1736	1760	1720	1743	1734	1695	1730	2.27
GSA In. Venturi O2	%	O2_IVEN		6.77	6.43	6.11	6.53	6.30	6.30	6.33	0.02
ESP Inlet SO2	ppm	SO2_EPI		1548	1577	1618	1566	1653	1611	1605	3.97
ESP Inlet O2	%	O2_EPI		7.31	7.04	6.78	7.22	6.66	6.81	6.90	0.03
ESP Outlet SO2	ppm	SO2_EPO		1559	1581	1547	1572	1536	1549	1557	1.74
ESP Outlet O2	%	O2_EPO		8.01	7.73	7.49	7.89	7.68	7.50	7.66	0.02
Baghouse Inlet SO2	ppm	SO2_PJI		1548	1577	1618	1566	1653	1611	1605	3.97
Baghouse Inlet O2	%	O2_PJI		8.01	7.73	7.44	7.89	7.68	7.50	7.65	0.02
Baghouse Outlet SO2	ppm	SO2_PJO		1519	1535	1571	1531	1564	1554	1551	2.12
Baghouse Outlet O2	%	O2_PJO		8.42	8.27	7.75	8.33	8.00	7.85	8.04	0.03

		DEMONSTRATION SERIES						
DATE		22-Sep-03	23-Sep-03	23-Sep-03	21-Sep-03		23-Sep-03	
TEST RUN		R2-HCL	R3-HCL	R4-HCL	R1-M	R2-M	R3-M	Average
SO2 Removal Rate	%	87.86	87.34	87.97	87.40	90.79	86.04	87.90
Inlet O2	%	6.30	6.52	7.02	6.62	6.21	6.29	6.49
Outlet O2	%	7.26	7.37	7.78	7.46	7.14	7.31	7.39
Gas Flow	scfm	20011	19969	20006	20000	20002	20004	19999
Inlet Gas Temp.	deg F	289	284	287	290	294	286	288
Outlet Gas Temp.	deg F	146	145	146	147	147	145	146
Approach to Adiabatic	deg F	11.98	12.00	12.06	13.22	12.00	11.99	12.21
GSA delta P.	in H2O	0.18	0.18	0.16	0.18	0.19	0.13	0.17
ESP delta P.	in H2O	1.55	1.56	2.16	1.74	1.75	1.83	1.76
ESP Outlet Opacity	%	1.52	1.75	1.62	2.18	2.01	2.19	1.88
Recycle Ratio	MW	256.70	260.30	286.50	295.00	147.44	176.60	237.09
Unit Load	MW	147.60	146.60	145.90	146.47	147.00	147.00	146.76
		BASELINE SERIES						
DATE		28-Sep-03	28-Sep-03	29-Sep-03	28-Sep-03	29-Sep-03	29-Sep-03	
TEST RUN		R2-HCL	R3-HCL	R4-HCL	R2-M	R3-M	R4-M	Average
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.66	6.46	6.54	6.69	6.56	6.67	6.60
Outlet O2	%	8.08	7.95	8.02	8.12	8.05	8.18	8.07
Gas Flow	scfm	20003	20000	20001	20002	20000	19998	20001
Inlet Gas Temp.	deg F	282	290	284	291	279	281	285
Outlet Gas Temp.	deg F	255	257	157	256	255	256	239
Approach to Adiabatic	deg F	130.70	132.27	131.75	131.63	131.33	131.58	131.54
GSA delta P.	in H2O	-0.03	-0.02	0.00	-0.02	-0.03	-0.03	-0.02
ESP delta P.	in H2O	1.42	1.71	1.53	1.56	1.45	1.65	1.55
ESP Outlet Opacity	%	0.80	0.86	0.85	1.16	0.62	0.52	0.80
Recycle Ratio	MW	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	146.70	148.94	147.78	147.87	148.04	147.12	147.74
		DEMONSTRATION PARALLEL						
DATE		13-Oct-03	14-Oct-03	15-Oct-03	14-Oct-03	15-Oct-03	15-Oct-03	
TEST RUN		R2-HCL	R3-HCL	R4-HCL	R1-M	R2-M	R3-M	Average
SO2 Removal Rate	%	91.10	91.42	91.38	91.49	91.50	91.57	91.41
Inlet O2	%	6.95	6.35	5.91	6.15	6.12	5.81	6.22
Outlet O2	%	7.91	7.34	6.98	7.21	7.17	6.94	7.26
Gas Flow	scfm	20010	19996	19995	19998	20004	20003	20001
Inlet Gas Temp.	deg F	284	295	298	288	293	298	293
Outlet Gas Temp.	deg F	146	147	148	146	147	148	147
Approach to Adiabatic	deg F	12.03	13.81	12.04	12.00	12.00	12.36	12.37
GSA delta P.	in H2O	0.17	0.19	0.19	0.18	0.19	0.19	0.19
ESP delta P.	in H2O	1.62	1.58	1.65	1.46	1.56	1.59	1.58
ESP Outlet Opacity	%	0.71	1.24	1.87	1.65	1.67	1.50	1.44
Recycle Ratio	MW	241.17	201.38	197.67	203.94	212.56	193.12	208.307
Unit Load	MW	124.27	148.92	149.27	147.21	148.20	149.19	144.51
		BASELINE PARALLEL						
DATE		21-Oct-03	21-Oct-03	22-Oct-03	21-Oct-03	22-Oct-03	22-Oct-03	
TEST RUN		R2-HCL	R3-HCL	R4-HCL	R2-M	R3-M	R4-M	Average
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.77	6.43	6.11	6.53	6.29	6.30	6.41
Outlet O2	%	8.21	8.00	7.44	8.11	7.68	7.50	7.82
Gas Flow	scfm	20010	20004	19996	19985	19989	20004	19998
Inlet Gas Temp.	deg F	289	288	281	284	276	285	284
Outlet Gas Temp.	deg F	242	242	253	241	252	253	247
Approach to Adiabatic	deg F	133.06	133.02	131.18	132.01	130.20	130.65	131.69
GSA delta P.	in H2O	-0.04	-0.05	-0.04	-0.05	-0.05	-0.04	-0.06
ESP delta P.	in H2O	1.53	1.47	1.50	1.45	1.46	1.56	1.50
ESP Outlet Opacity	%	2.66	2.82		2.78	2.89	3.19	2.87
Recycle Ratio	MW	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	150.28	148.62	148.62	148.15	140.03	148.57	147.38

Process Data Summary
Demonstration Series
Metals Test Run #1

Date:	SEPT 21 1993												
Test Run:	AP-DS-R1-M												
Time:		13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45
SO2 Removal Rate	%	87.7	87.7	88	87.7	88.2	87.9	87	87.3	87.4	87	86.9	86.2
Inlet O2	%	6.76	6.75	6.77	6.69	6.61	6.57	6.58	6.68	6.65	6.63	6.64	6.67
Outlet O2	%	7.57	7.56	7.55	7.49	7.45	7.43	7.43	7.42	7.53	7.4	7.44	7.51
Gas Flow	scfm	19993	20008	20009	20003	20000	20000	19996	20004	19988	19994	19995	20004
Inlet Gas Temp.	deg F	288	288	288	289	289	289	289	289	289	289	290	290
Outlet Gas Temp.	deg F	146	146	146	147	147	147	147	147	147	147	147	147
Approach to Adiabati	deg F	12.97	13.02	13	13	13	13.02	13	12.95	13.02	13.9	13.97	13
GSA delta P.	in H2O	0.18	0.18	0.18	0.19	0.18	-0.05	0.19	0.18	0.19	0.19	0.19	0.19
ESP delta P.	in H2O	1.69	1.67	1.63	1.67	1.7	1.56	1.59	1.63	1.67	1.7	1.73	1.74
ESP Outlet Opacity	%	1.84	2.1	1.76	1.58	1.89	1.8	1.76	1.5	2.61	2.21	2.48	2.43
Recycle Ratio	%	294.8	293.7	293.3	291	288.1	287.3	292.8	295.6	296.4	298.2	298.1	304.5
Unit Load	MW	146.7	146.7	147	146.7	146.6	146	145.7	145.7	145.8	145.9	146.1	146.3

Date:	SEPT 21 1993											
Test Run:	AP-DS-R1-M											
Time:		16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	Average
SO2 Removal Rate	%	85.9	87.1	87.7	87.9	87.9	87.9	87.9	86.3	87.6	87.7	87.40
Inlet O2	%	6.66	6.62	6.6	6.57	6.56	6.54	6.55	6.48	6.52	6.5	6.62
Outlet O2	%	7.5	7.44	7.44	7.44	7.47	7.4	7.38	7.44	7.36	7.37	7.46
Gas Flow	scfm	20002	20004	19996	20010	19979	19997	20010	20001	20006	20000	20000
Inlet Gas Temp.	deg F	290	291	291	291	291	291	291	291	291	292	290
Outlet Gas Temp.	deg F	147	147	147	147	147	147	147	147	147	147	147
Approach to Adiabati	deg F	13.97	13.95	13.03	13.97	13.05	13	12.97	13.1	12.9	13.05	13.22
GSA delta P.	in H2O	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18
ESP delta P.	in H2O	1.75	1.81	1.8	1.79	1.84	1.82	1.89	1.9	1.9	1.89	1.74
ESP Outlet Opacity	%	3.71	4.34	3.37	2.13	2.03	1.79	1.87	1.5	1.69	1.56	2.18
Recycle Ratio	%	301.3	294.5	293.6	292.4	295.7	293.8	295	296.9	297.2	295.4	294.982
Unit Load	MW	146.5	146.6	146.5	146.5	146.5	146.6	146.9	146.9	147	147.2	191.93

Process Data Summary
Demonstration Series
Metals Test Run #2

Date:	Sept 22,1993												
Test Run:	DS-R2-M												
Time:		12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15
SO2 Removal Rate	%	91.7	91.8	91.6	91.4	91.3	91.5	91.7	92	92.5	91.7	92.4	91.2
Inlet O2	%	6.21	6.25	6.27	6.20	6.08	6.02	6.1	6.06	6.12	6.25	6.15	6.46
Outlet O2	%	7.11	7.16	7.19	7.07	7.09	6.96	7.05	7.01	7.07	7.21	7.13	7.32
Gas Flow	scfm	20003	19991	20013	20000	20011	19980	20012	19991	19995	20007	20014	19977
Inlet Gas Temp.	deg F	291	292	293	294	295	297	298	298	298	295	294	292
Outlet Gas Temp.	deg F	146	146	146	146	146	147	147	147	147	147	147	147
Approach to Adiabati	deg F	12.02	12.02	11.97	12.02	12.05	11.89	12.02	11.97	12	12.15	11.82	12.07
GSA delta P.	in H2O	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
ESP delta P.	in H2O	1.69	1.69	1.65	1.73	1.91	1.76	1.7	1.72	1.74	1.86	1.85	1.68
ESP Outlet Opacity	%	1.66	1.4	1.64	1.55	1.87	1.67	2.3	1.75	1.95	1.92	2.03	1.73
Unit Load	MW	147.6	147.6	147.9	147.9	147.6	147.6	147.6	147.5	147.9	147.2	147.4	146.5

Date:	Sept 22,1993										
Test Run:	DS-R2-M										
Time:		15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	Average
SO2 Removal Rate	%	91.3	90 5	88.7	89.4	89.2	89.3	89.4	89.2	88.8	90.75
Inlet O2	%	6.28	6.34	6.37	6.38	6.3	6.26	6.18	6.13	6.1	6.21
Outlet O2	%	7.24	7.22	7.25	7.34	7.17	7.2	7.1	7.09	7.05	7.14
Gas Flow	scfm	20018	19998	19994	20013	20007	20011	20000	20002	20004	20002
Inlet Gas Temp.	deg F	292	292	292	293	293	293	294	293	293	294
Outlet Gas Temp.	deg F	147	147	147	147	147	147	147	147	147	147
Approach to Adiabati	deg F	12.17	11.77	11.95	12	11.96	12	12	12.03	12.13	12.00
GSA delta P.	in H2O	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.19
ESP delta P.	in H2O	1.73	1.86	1.77	1.68	1.7	1.73	1.81	1.7	1.71	1.75
ESP Outlet Opacity	%	2.28	1.9	2.02	3.94	3.03	2.09	1.84	1.7	1.88	2.01
Recycle Ratio	%	147.1	147.2	147.3	147.3	147.4	147.3	147.4	147.4	147.5	147.44
Unit Load	MW	147.3	147	147	147.2	147.4	147.1	146.7	146.5	146.8	147.00

Process Data Summary
Demonstration Series
Metals Test Run #3

Date:	Sept 23,1993												
Test Run:	DS-R3-M												
Time:		12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30
SO2 Removal Rate	%	86.7	87.2	87.7	88.8	87.9	87.7	88	86.1	88	86.5	85.7	85.4
Inlet O2	%	6.29	6.36	6.24	6.32	6.38	6.37	6.36	6.35	6.31	6.28	6.28	6.22
Outlet O2	%	7.31	7.35	7.28	7.30	7.35	7.36	7.36	7.4	7.31	7.27	7.32	7.24
Gas Flow	scfm	19998	20008	20006	20003	19997	20085	20010	19988	20008	19995	20002	20008
Inlet Gas Temp.	deg F	283	284	284	284	284	285	285	286	286	286	286	287
Outlet Gas Temp.	deg F	144	144	144	144	144	144	144	145	145	145	145	145
Approach to Adiabati	deg F	12.17	11.95	12.02	11.92	12.05	12	11.92	12.11	12.04	11.89	11.94	11.96
GSA delta P.	in H2O	0.16	0.11	0.14	0.14	0.11	0.11	0.16	0.1	0.07	0.09	0.13	0.17
ESP delta P.	in H2O	1.5	1.53	1.57	1.63	1.61	1.64	1.6	1.57	1.52	1.57	1.62	1.64
ESP Outlet Opacity	%	2.44	2.88	2.14	3.05	1.93	1.99	2.24	2.23	2	2.17	1.72	1.82
Recycle Ratio	%	281.1	282.4	277.3	266.7	281.8	278	271.8	282.1	304.7	297.6	276.4	270
Unit Load	MW	146.7	146.8	146.9	146.8	146.8	147.1	147.5	147.1	146.7	147	147	147.2

Date:	Sept 23,1993												
Test Run:	DS-R3-M												
Time:		15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	Average
SO2 Removal Rate	%	84.4	84.9	84.4	85.1	84.8	84.2	85.2	84.9	84.1	85.2	86	85.351
Inlet O2	%	6.2	6.16	6.15	6.14	6.14	6.05	6.18	6.23	6.26	6.44	6.91	6.29
Outlet O2	%	7.26	7.21	7.22	7.17	7.16	7.18	7.19	7.31	7.32	7.45	7.76	7.31
Gas Flow	scfm	19999	19997	20000	19995	20003	20012	19998	19981	20005	19994	19996	20004
Inlet Gas Temp.	deg F	286	286	286	286	286	287	287	286	286	287	288	286
Outlet Gas Temp.	deg F	145	145	145	145	145	146	146	146	146	146	146	145
Approach to Adiabati	deg F	11.96	11.88	12.16	11.86	11.97	12.14	11.84	11.96	11.98	12.11	11.85	11.99
GSA delta P.	in H2O	0.12	0.11	0.13	0.13	0.16	0.18	0.14	0.14	0.14	0.16	0.19	0.13
ESP delta P.	in H2O	1.74	1.9	1.95	1.96	2.05	2.17	2.29	2.33	2.3	2.21	2.11	1.83
ESP Outlet Opacity	%	2.01	1.92	3.78	2.61	2.07	1.87	1.63	1.72	1.51	3.12	1.61	2.19
Recycle Ratio	%	267.5	266.9	266.6	265.5	264.8	272.5	273.1	275.2	274.4	277.1	287.3	276.557
Unit Load	MW	147.3	147	147	147.2	147.4	147.1	146.7	146.5	146.8	146.2	147.2	146.96

Process Data Summary
Demonstration Series
HCl Test Run #2

Date:	SEPT 22 1993								Average
Test Run:	AP-DS-R2-HCL								
Time:		08:30	08:45	09:00	09:15	09:30	09:45	10:00	
SO2 Removal Rate	%	87.9	87.7	87.3	88.3	88.2	87.1	88.5	87.86
Inlet O2	%	6.25	6.40	6.33	6.33	6.27	6.29	6.25	6.30
Outlet O2	%	7.19	7.38	7.28	7.26	7.22	7.30	7.20	7.26
Gas Flow	scfm	20098	19992	19990	20000	20006	19998	19995	20011
Inlet Gas Temp.	deg F	289	289	289	289	289	290	290	289
Outlet Gas Temp.	deg F	146	146	146	146	146	146	146	146
Approach to Adiabat	deg F	12	11.95	12.17	12	11.86	11.97	11.92	11.98
GSA delta P.	in H2O	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
ESP delta P.	in H2O	1.58	1.53	1.54	1.47	1.54	1.54	1.67	1.55
ESP Outlet Opacity	%	2.17	1.4	1.4	1.26	1.45	1.38	1.57	1.52
Recycle Ratio	%	254.9	257.4	256.5	255.7	256.8	258.4	257.1	256.69
Unit Load	MW	147.5	147.3	147.8	147.6	147.7	147.8	147.7	147.63

Process Data Summary
Demonstration Series
HCl Test Run #3

Date:	Sept 23,1993								
Test Run:	DS-R3-HCl								
Time:		09:45	10:00	10:15	10:30	10:45	11:00	11:15	Average
SO2 Removal Rate	%	86.9	87.1	87.8	87.5	87.4	87.4	87.3	87.3429
Inlet O2	%	6.63	6.46	6.54	6.41	6.52	6.54	6.56	6.52
Outlet O2	%	6.85	7.42	7.51	7.41	7.42	7.49	7.50	7.37
Gas Flow	scfm	19884	19898	19994	20010	20000	19996	20001	19969
Inlet Gas Temp.	deg F	283	283	284	285	285	285	285	284
Outlet Gas Temp.	deg F	145	145	145	145	145	145	144	145
Approach to Adiabat	deg F	11.92	12.12	11.89	12.07	12.15	12.06	11.81	12.00
GSA delta P.	in H2O	0.19	0.19	0.19	0.18	0.18	0.17	0.18	0.18
ESP delta P.	in H2O	1.52	1.6	1.54	1.56	1.6	1.59	1.54	1.56
ESP Outlet Opacity	%	1.65	1.58	1.51	1.44	2.85	1.72	1.5	1.75
Recycle Ratio	%	259.9	259.1	260.4	255.7	258.1	262.5	266.4	260.3
Unit Load	MW	145.9	146.3	146.4	147	146.3	147.2	147.2	146.61

Process Data Summary
Demonstration Series
HCl Test Run #4

Date:	Sept 23,1993							
Test Run:	DS-R4-HCl							
Time:		18:45	19:00	19:15	19:30	19:45	20:00	Average
SO2 Removal Rate	%	87.3	87.8	88	87.9	88.3	88.5	87.5667
Inlet O2	%	6.94	7.01	7.04	7.06	7.05	6.99	7.02
Outlet O2	%	7.74	7.77	7.84	7.74	7.82	7.77	7.78
Gas Flow	scfm	19999	20006	20011	20005	19998	20016	20006
Inlet Gas Temp.	deg F	288	288	287	287	286	285	287
Outlet Gas Temp.	deg F	146	146	146	145	145	145	146
Approach to Adiabat	deg F	12.21	12.09	11.97	12.04	12.01	12.04	12.06
GSA delta P.	in H2O	0.13	0.16	0.19	0.13	0.18	0.18	0.16
ESP delta P.	in H2O	2.13	2.13	2.19	2.13	2.14	2.22	2.16
ESP Outlet Opacity	%	1.48	1.92	1.55	1.6	1.52	1.67	1.62
Recycle Ratio	%	284.2	288.1	286.7	288.5	286.8	284.8	286.517
Unit Load	MW	147.2	146.8	146.4	145.8	145.2	144.2	145.93

Process Data Summary
Demonstration Parallel
Metals Test Run #1

Date:	Oct 14,1993																	
Test Run:	DP-R1 -M																	
Time:		08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45
SO2 Removal Rate	%	90 3	92.4	91.7	90.5	92.4	91 4	91 2	91.3	91.8	91.8	91	91.8	91.7	91	91.7	91.6	91.5
Inlet O2	%	6 08	6 07	6.06	6.02	6.05	6.19	6 21	6 08	6.06	6 11	6.1	6.14	6.18	6.17	6.13	6.18	6.15
Outlet O2	%	7 26	7.17	7.16	7.15	7.13	7.24	7.28	7.14	7.19	7 19	7.21	7.36	7.2	7.23	7.18	7.15	7.16
Gas Flow	scfm	20011	19999	20003	20013	20000	19992	20009	20007	20021	20010	20003	19988	20003	20008	19999	19998	19992
Inlet Gas Temp.	deg F	281	281	281	282	282	282	283	284	285	286	287	288	289	289	288	288	288
Outlet Gas Temp.	deg F	147	147	147	147	146	146	146	146	146	146	146	146	146	146	146	146	146
Approach to Adiabn	deg F	11 4	12.45	12.07	11.72	12.27	11.94	11 89	11.91	12.07	12.17	11.69	12.11	12.04	11.82	12 14	11.94	12.02
GSA delta P.	in H2O	0 17	0 17	0.16	0.17	0.18	0 18	0 18	0.18	0.18	0 18	0.18	0.19	0.19	0.18	0.19	0.19	0.19
ESP delta P.	in H2O	1 42	1.27	1.35	1.44	1.4	1.36	1.36	1.32	1.43	1.44	1.43	1.47	1.42	1.43	1.54	1.46	1.44
ESP Outlet Opacity	%	1.39	1.14	0.87	1.05	0.94	1.31	1.34	1.78	2.3	2.2	1.89	1.78	1.46	1.53	2.04	1.66	2.02
Recycle Ratio	%	223 4	222 4	252.4	220.8	230.9	219 3	203.7	195	193.2	210.5	191.8	194.7	220.1	203	204.6	210.6	208.1
Unit Load	MW	147 1	146.9	147	147	147.4	147 6	148.3	148.1	147.8	147.8	148.2	148.5	148.7	148.8	148.7	148.6	148.6

Date:	Oct15,1993																			
Test Run:	DP-R1-M																			
Time:		13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	Average
SO2 Removal Rate	%	91 5	91.3	91.5	92	91.6	91.4	91.3	92	91.4	91.5	91.8	90.7	91.3	91.8	91.5	91.5	91.3	91.6	[illegible]
Inlet O2	%	6 15	6.11	6.12	6.08	6.11	6.09	6.14	6.09	6.11	6 14	6.61	6.05	6.06	6.28	6.31	6.28	6.36	6.34	[illegible]
Outlet O2	%	7 15	7.07	7.11	7.11	7.15	7.16	7.13	7.12	7.15	7.19	7.61	7.19	7.12	7.26	7.28	7.33	7.33	7.36	[illegible]
Gas Flow	scfm	20003	20010	20002	19990	19991	19991	19994	19994	19994	19985	20055	19935	19978	19994	19995	19989	19993	19985	[illegible]
Inlet Gas Temp.	deg F	288	288	289	289	289	290	290	291	291	292	294	294	293	292	292	292	294	295	[illegible]
Outlet Gas Temp.	deg F	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	[illegible]
Approach to Adiabn	deg F	11.97	11.93	11.99	12.1	11.99	11.94	11.92	12.22	11.94	12.02	12.36	11.57	11.97	12.2	12.05	11.95	12.05	12.02	[illegible]
GSA delta P.	in H2O	0 19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0 19	0.19	0.18	0.19	0.19	0.19	0.19	0.19	0.19	[illegible]
ESP delta P.	in H2O	1 48	1.46	1.46	1.43	1.48	1.48	1.45	1.48	1.49	1.52	1.51	1.54	1.55	1.5	1.51	1.52	1.56	1.57	[illegible]
ESP Outlet Opacity	%	1 63	1.6	1.88	1.38	1.5	1.45	1.46	1.38	2.21	2 17	1.82	1.41	1.61	2.49	2.39	1.66	1.55	1.34	[illegible]
Recycle Ratio	%	204 1	203.9	186.7	196.5	202.9	197.8	184	190.9	196.1	192.2	205.6	208.3	181.4	188.9	195.4	195.1	196.7	200.9	[illegible]
Unit Load	MW	148.1	147.5	147.4	147.5	147.7	148	148.3	148.3	148 4	148.6	131.3	135	146.3	148.1	148.6	149	149.2	149.9	[illegible]

Process Data Summary
Demonstration Parallel
Metals Test Run #2

Date:	Oct 15,1993														
Test Run:	DP-R2-M														
Time:		08:30	08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45
SO2 Removal Rate	%	96.4	92.7	90.4	90.9	91.1	91	91.2	91.1	91	92.1	90.6	91.2	92.1	91.1
Inlet O2	%	6.33	6.35	6.24	6.19	6.29	6.16	6.16	6.16	6.2	6.18	6.18	6.28	6.23	6.08
Outlet O2	%	7.48	7.50	7.29	7.32	7.39	7.26	7.22	7.27	7.31	7.3	7.26	7.22	7.23	7.06
Gas Flow	scfm	19946	20011	20022	19976	20011	20034	19997	20010	20016	20014	20014	20009	19984	19996
Inlet Gas Temp.	deg F	284	285	286	288	289	289	290	290	291	291	291	291	291	293
Outlet Gas Temp.	deg F	146	146	146	146	146	146	146	146	146	147	146	146	147	147
Approach to Adiabati	deg F	12	13.04	11.55	11.73	12	11.95	11.97	12.08	11.8	12.45	11.54	12	12.23	11.88
GSA delta P.	in H2O	0.18	0.34	0.22	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.18	0.18	0.18
ESP delta P.	in H2O	1.4	1.43	1.29	1.43	1.5	1.46	1.48	1.46	1.47	1.44	1.45	1.46	1.58	1.64
ESP Outlet Opacity	%	1.87	1.94	1.91	1.72	1.4	1.57	1.42	1.08	1.28	1.2	1.28	1.19	1.73	1.86
Recycle Ratio	%	190.2	280.7	259.3	237.8	228.6	229	224.6	215.6	201.9	215.7	217.7	192.4	222.1	217.5
Unit Load	MW	148.4	147.8	146.6	146.7	147.1	147.4	147.4	147.8	148.3	148.3	148.3	148.6	148.7	148.8

Date:	Oct15,1993															
Test Run:	DP-R2-M															
Time:		12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	Average
SO2 Removal Rate	%	91	91.2	92.2	90.9	91.2	91.7	91.3	91.3	91.6	91.5	91.1	91.2	91.5	91.3	[illegible]
Inlet O2	%	6.11	6.14	6	5.94	6.06	6	6.05	6.06	6	5.99	5.98	5.99	5.98	5.99	6.12
Outlet O2	%	7.06	7.1	7.04	7.03	7.1	7	7.12	7.1	7.04	7.04	7	6.98	7	7.01	7.17
Gas Flow	scfm	19999	20002	20039	19987	20008	20000	20009	20015	19998	20012	20006	19998	20000	19994	[illegible]
Inlet Gas Temp.	deg F	293	294	295	295	296	297	297	297	298	298	298	299	299	299	293
Outlet Gas Temp.	deg F	146	146	146	147	147	147	147	147	147	147	147	147	147	147	147
Approach to Adiabati	deg F	11.8	12.13	12.1	11.7	12.15	11.88	11.95	12.13	11.95	12	11.9	12.05	11.98	11.94	[illegible]
GSA delta P.	in H2O	0.18	0.18	0.18	0.18	0.19	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	[illegible]
ESP delta P.	in H2O	2.02	2.01	1.81	1.58	1.57	1.61	1.56	1.55	1.57	1.59	1.6	1.57	1.61	1.62	[illegible]
ESP Outlet Opacity	%	2.31	2.41	2.29	1.79	1.89	1.62	1.73	1.41	1.63	1.63	2.09	1.43	1.62	1.54	[illegible]
Recycle Ratio	%	203.8	190.4	209.2	205.9	190.5	202.1	197.5	201.3	204.5	206.6	206.5	195.3	204.2	200.7	[illegible]
Unit Load	MW	148.7	149	149.1	148.7	148.6	147.5	147.9	148.2	148.4	148.4	148.5	148.7	148.8	148.9	[illegible]

Process Data Summary
Demonstration Parallel
Metals Test Run #3

Date:	Oct15,1993											
Test Run:	DP-R3-M											
Time:		19:00	19:15	19:30	19:45	20:00	20:15	20:30	20:45	21:00	21:15	21:30
SO2 Removal Rate	%	91.5	91.5	91.5	91.7	91.4	91.5	92.1	91.3	91.5	91.6	91.7
Inlet O2	%	5.82	5.67	5.64	5.68	5.66	5.69	5.64	5.66	5.71	5.75	5.79
Outlet O2	%	6.88	6.77	6.81	6.81	6.82	6.96	6.82	6.86	6.88	6.96	6.85
Gas Flow	scfm	20008	19990	20005	20001	20011	20000	19985	19993	19997	19996	20016
Inlet Gas Temp.	deg F	298	298	298	299	299	299	299	299	299	299	299
Outlet Gas Temp.	deg F	148	148	148	148	148	148	148	148	148	148	148
Approach to Adiabati	deg F	11.96	11.9	12.06	12.06	11.98	11.96	12.19	11.91	12.03	12.18	11.88
GSA delta P.	in H2O	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
ESP delta P.	in H2O	1.58	1.56	1.59	1.59	1.68	1.69	1.66	1.66	1.61	1.67	1.74
ESP Outlet Opacity	%	1.48	1.32	1.54	1.45	1.69	1.78	1.86	1.71	1.53	1.57	2
Recycle Ratio	%	194.1	191.7	188.1	190.3	188.1	186	191.7	195	187.6	186.6	191
Unit Load	MW	149.4	149.1	149	149.1	149	148.9	149.2	149.1	149.3	149.2	149.2

Date:	Oct15,1993									
Test Run:	DP-R3-M									
Time:		21:45	22:00	22:15	22:30	22:45	23:00	23:15	23:30	Average
SO2 Removal Rate	%	91.4	91.8	90.9	91.8	91.4	89.7	93.8	91.7	91.57
Inlet O2	%	5.76	5.93	5.99	6	5.99	6.01	6.05	6.02	5.81
Outlet O2	%	6.93	7.07	7.08	7.08	7.1	7.08	7.09	7.1	6.94
Gas Flow	scfm	19990	19996	20018	20007	20019	20005	20005	20022	20003
Inlet Gas Temp.	deg F	299	298	297	297	297	297	296	295	298
Outlet Gas Temp.	deg F	148	148	148	148	148	149	150	149	148
Approach to Adiabati	deg F	12.06	12.01	11.91	12.01	12.01	16.34	14.38	11.93	12.36
GSA delta P.	in H2O	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.34	0.19
ESP delta P.	in H2O	1.56	1.53	1.52	1.53	1.53	1.52	1.53	1.54	1.59
ESP Outlet Opacity	%	1.25	1.25	2.03	1.24	1.15	1.26	1.09	1.27	1.58
Recycle Ratio	%	188.9	195.1	195.1	195.2	196.4	158.2	177.1	273.1	193.12
Unit Load	MW	149.2	149.6	149.9	149.9	149.9	149.8	147.1	148.8	149.19

Process Data Summary
Demonstration Parallel
HCl Test Run #1

Date:	Oct 13,1993								Average
Test Run:	DP-R1 -HCl								
Time:		08:45	09:00	09:15	09:30	09:45	10:00	10:15	
SO2 Removal Rate	%	93.7	90.8	90.8	90.6	90.8	90.5	90.5	91.16
Inlet O2	%	6.37	6.93	7.03	6.84	7.07	7.16	7.23	6.95
Outlet O2	%	7.46	7.92	8.09	7.79	7.97	8.03	8.10	7.91
Gas Flow	scfm	19979	20077	20016	19995	20007	19990	20004	20010
Inlet Gas Temp.	deg F	285	284	287	286	284	283	282	284
Outlet Gas Temp.	deg F	146	146	146	146	146	146	146	146
Approach to Adiabat	deg F	12.45	12.05	11.62	12.1	12	12	12.02	12.03
GSA delta P.	in H2O	0.19	0.18	0.17	0.16	0.16	0.17	0.17	0.17
ESP delta P.	in H2O	1.59	1.79	1.78	1.57	1.46	1.52	1.6	1.62
ESP Outlet Opacity	%	0.98	0.87	0.81	0.65	0.57	0.61	0.5	0.71
Recycle Ratio	%	221.5	245.6	242.5	232.3	235.5	255	255.8	244.17
Unit Load	MW	148.6	136	122	117.2	115.4	115	115.7	124.77

Process Data Summary
Demonstration Parallel
HCl Test Run #2

Date:	Oct14,1993						
Test Run:	DP-R2-hcl						
Time:		17:45	18:00	18:15	18:30	18:45	Average
SO2 Removal Rate	%	90.6	91.3	90.5	92	92.7	91.43
Inlet O2	%	6.34	6.28	6.23	6.44	6.44	6.35
Outlet O2	%	7.36	7.29	7.23	7.37	7.44	7.34
Gas Flow	scfm	20002	19978	19999	20004	19998	19996
Inlet Gas Temp.	deg F	295	295	297	296	294	295
Outlet Gas Temp.	deg F	146	146	148	149	148	147
Approach to Adiabat	deg F	11.86	11.97	16.89	15.88	12.45	13.81
GSA delta P.	in H2O	0.19	0.19	0.19	0.18	0.18	0.19
ESP delta P.	in H2O	1.58	1.57	1.56	1.61	1.57	1.58
ESP Outlet Opacity	%	1.21	1.36	1.22	1.3	1.09	1.20
Recycle Ratio	%	211.2	194.6	181.3	164.9	254.9	201.58
Unit Load	MW	149.7	149.7	149	148.1	148.1	148.92

Process Data Summary
Demonstration Parallel
HCl Test Run #3

Date:	Oct 15,1993							
Test Run:	DP-R3-hcl							
Time:		16:00	16:15	16:30	16:45	17:00	17:15	Average
SO2 Removal Rate	%	91.2	91.6	91.4	91.3	91.5	91.3	91.38
Inlet O2	%	5.93	5.84	5.88	5.95	5.91	5.93	5.91
Outlet O2	%	6.96	6.96	6.93	6.99	7.00	7.04	6.98
Gas Flow	scfm	19997	20016	20001	19989	19980	19989	19995
Inlet Gas Temp.	deg F	300	298	297	297	298	298	298
Outlet Gas Temp.	deg F	148	147	148	148	148	148	148
Approach to Adiabat	deg F	12.05	12.1	12.05	11.78	12.04	12.2	12.04
GSA delta P.	in H2O	0.19	0.19	0.18	0.19	0.19	0.19	0.19
ESP delta P.	in H2O	1.61	1.6	1.63	1.66	1.68	1.7	1.65
ESP Outlet Opacity	%	1.55	2.31	2.54	1.75	1.49	1.55	1.87
Recycle Ratio	%	200.6	202.1	202.4	194.3	193.7	192.9	197.67
Unit Load	MW	149.5	149.4	148.8	149.1	149.4	149.4	149.27

Process Data Summary
Baseline Parallel
Metals Test Run #2

Date:	OCT 21 1993												
Test Run:	AP-BP-R2-M												
Time:		08:15	08:30	08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00
SO2 Removal Rate	%												
Inlet O2	%	6.46	6.56	6.56	6.67	6.54	6.52	6.45	6.49	6.39	6.42	6.4	6.41
Outlet O2	%	8.32	8.43	8.18	8.26	8.11	8.14	8.13	8.02	7.95	8.08	8.08	7.97
Gas Flow	scfm	20104	20018	19988	19997	20005	19999	20014	20002	20007	20020	20018	20004
Inlet Gas Temp.	deg F	280	280	281	282	284	283	283	283	284	285	285	284
Outlet Gas Temp.	deg F	237	238	238	239	239	240	240	240	242	241	241	241
Approach to Adiabati	deg F	127.8	127.39	130.47	131.15	132.31	132.64	131.4	131.25	131.86	133.05	133.15	133.07
GSA delta P.	in H2O	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
ESP delta P.	in H2O	1.56	1.52	1.45	1.43	1.35	1.42	1.44	1.43	1.48	1.45	1.47	1.37
ESP Outlet Opacity	%	3.63	3.87	2.65	2.63	2.46	2.51	2.64	2.6	2.5	2.47	2.54	3.06
Recycle ratio %													
Unit Load	MW	145.8	147	147.5	147.9	148.2	148.6	147.6	147.4	147.6	147.9	148.1	147.9

Date:	OCT 21 1993								
Test Run:	AP-BP-R2-M								
Time:		11:15	11:30	11:45	12:00	12:15	12:30	12:45	Average
SO2 Removal Rate	%								
Inlet O2	%	6.49	6.56	6.49	6.64	6.69	6.64	6.69	6.53
Outlet O2	%	7.93	8.15	7.95	8.09	8.16	8.09	8.06	8.11
Gas Flow	scfm	19997	19513	20005	20004	20009	20011	19998	19985
Inlet Gas Temp.	deg F	284	285	285	286	287	286	287	284
Outlet Gas Temp.	deg F	242	242	243	243	242	243	242	241
Approach to Adiabati	deg F	132.99	132.56	135.57	132.77	132.92	132.92	132.94	132.91
GSA delta P.	in H2O	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
ESP delta P.	in H2O	1.44	1.5	1.42	1.46	1.41	1.45	1.45	1.45
ESP Outlet Opacity	%	2.67	2.85	2.87	2.82	2.72	2.75	2.5	2.78
Recycle Ratio	%								
Unit Load	MW	148.1	148.6	148.9	149.6	149.5	149.3	149.4	148.15

Process Data Summary
Baseline Parallel
Metals Test Run #3

Date:	OCT 22 1993												
Test Run:	AP-BP-R3-M												
Time:		8:30	08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15
SO2 Removal Rate	%	6.38	6.37	6.40	6.47	6.41	6.23	6.29	6.26	6.29	6.28	6.71	6.05
Inlet O2	%	7.75	7.74	7.68	7.79	7.81	7.61	7.6	7.63	7.59	7.59	7.55	7.87
Outlet O2	%	19919	19981	19993	19981	19992	19989	19988	19971	19991	19985	19997	20045
Gas Flow	scfm	273	274	274	275	275	274	273	273	273	273	274	276
Inlet Gas Temp.	deg F	251	251	251	251	251	251	251	251	251	251	251	252
Outlet Gas Temp.	deg F	129.87	129.25	129.61	129.01	128.7	129.13	129.64	130.09	130.24	130.29	130.42	130.65
Approach to Adiabati	deg F	-0.06	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.06	-0.05	-0.05	-0.05	-0.05
GSA delta P.	in H2O	1.4	1.33	1.37	1.44	1.41	1.39	1.43	1.52	1.45	1.48	1.4	1.55
ESP delta P.	in H2O	3.22	3.01	2.73	2.77	2.73	2.68	2.68	3.03	2.84	2.84	2.88	2.88
ESP Outlet Opacity	%												
Recycle Ratio	%	147.3	147.6	147.3	147.3	147.2	147.9	148	147.6	147.5	147.8	147.9	135.5
Unit Load	MW												

Date:	OCT 22 1993							
Test Run:	AP-BP-R3-M							
Time:		11:30	11:45	12:00	12:15	12:30	12:45	Average
SO2 Removal Rate	%	6.47	6.66	5.7	6.08	6.01	6.09	6.29
Inlet O2	%	7.76	7.86	7.91	7.44	7.48	7.49	7.68
Outlet O2	%	19926	20017	20032	19999	19994	20001	19989
Gas Flow	scfm	279	282	283	281	280	279	276
Inlet Gas Temp.	deg F	252	252	252	253	253	253	253
Outlet Gas Temp.	deg F	130.75	130.88	131.13	131.28	131.28	131.4	130.20
Approach to Adiabati	deg F	-0.05	-0.05	-0.05	-0.05	-0.04	-0.04	-0.05
GSA delta P.	in H2O	1.53	1.54	1.54	1.52	1.52	1.54	1.46
ESP delta P.	in H2O	3.02	3.07	3	2.9	3.01	2.8	2.89
ESP Outlet Opacity	%							
Recycle Ratio	%	136.8	133.3	126.1	122.3	121.5	121.6	140.03
Unit Load	MW							

Process Data Summary
Baseline Parallel
Metals Test Run #4

Date:	OCT 22 1993												
Test Run:	AP-BP-R4-M												
Time:		15:30	15:45	16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15
SO2 Removal Rate	%												
Inlet O2	%	6.27	6.28	6.38	6.31	6.26	6.36	6.31	6.32	6.27	6.32	6.32	6.16
Outlet O2	%	7.50	7.48	7.59	7.54	7.48	7.52	7.49	7.49	7.47	7.53	7.46	7.39
Gas Flow	scfm	20001	19980	20005	20025	20008	20001	20001	19996	20013	20005	20010	20006
Inlet Gas Temp.	deg F	283	284	285	285	285	285	285	285	285	286	286	286
Outlet Gas Temp.	deg F	253	253	253	253	253	253	253	253	253	253	253	253
Approach to Adiabati	deg F	130.62	130.6	130.27	129.74	129.94	129.89	130.57	130.72	130.77	130.8	130.9	131
GSA delta P.	in H2O	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
ESP delta P.	in H2O	1.56	1.55	1.59	1.59	1.65	1.61	1.62	1.64	1.55	1.52	1.55	1.57
ESP Outlet Opacity	%	3.08	3.38	3.17	3.58	3.68	3.38	3.1	3.13	3.18	3.01	2.99	3.12
Recycle Ratio	%												
Unit Load	MW	148.9	149.3	148.9	148.5	149.4	149.1	149.7	149.3	149.8	149.3	148.7	148.1

Date:	OCT 22 1993							
Test Run:	AP-BP-R4-M							
Time:		18:30	18:45	19:00	19:15	19:30	19:45	Average
SO2 Removal Rate	%							
Inlet O2	%	6.18	6.21	6.12	6.27	6.61	6.49	6.30
Outlet O2	%	7.41	7.44	7.39	7.47	7.76	7.63	7.50
Gas Flow	scfm	20007	19993	20007	19981	20013	20017	20004
Inlet Gas Temp.	deg F	285	286	287	287	287	286	285
Outlet Gas Temp.	deg F	253	253	253	253	253	253	253
Approach to Adiabati	deg F	131.05	131.08	130.95	130.95	130.9	130.88	130.65
GSA delta P.	in H2O	-0.04	-0.05	-0.05	-0.04	-0.05	-0.04	-0.04
ESP delta P.	in H2O	1.51	1.48	1.48	1.51	1.55	1.49	1.56
ESP Outlet Opacity	%	3.1	3.13	3.01	3.24	2.95	3.19	3.19
Recycle Ratio	%							
Unit Load	MW	147.9	147.8	148.2	148	147	146.4	148.57

Process Data Summary
Baseline Parallel
HCl Test Run #2

Date:	OCT 21 1993							
Test Run:	BP-R2-HCL							
Time:		13:15	13:30	13:45	14:00	14:15	14:30	Average
SO2 Removal Rate	%							
Inlet O2	%	6.76	6.73	6.73	6.83	6.83	6.73	6.77
Outlet O2	%	8.19	8.19	8.16	8.31	8.24	8.19	8.21
Gas Flow	scfm	20004	20008	20020	20017	19996	20014	20010
Inlet Gas Temp.	deg F	288	288	289	290	290	291	289
Outlet Gas Temp.	deg F	242	242.5	242	241.5	241.5	241.5	242
Approach to Adiabat	deg F	132.94	132.92	133	133.12	133.2	133.15	133.06
GSA delta P.	in H2O	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
ESP delta P.	in H2O	1.48	1.46	1.47	1.71	1.55	1.49	1.53
ESP Outlet Opacity	%	2.67	2.57	2.64	2.76	2.56	2.75	2.66
Recycle Ratio	%							
Unit Load	MW	150	150.1	150.4	150.4	150.3	150.5	150.28

Process Data Summary
Baseline Parallel
HCl Test Run #3

Date:	OCT 21 1993							
Test Run:	*BP-R3-HCL*							
Time:		15:45	16:00	16:15	16:30	16:45	17:00	Average
SO2 Removal Rate	%							
Inlet O2	%	6.52	6.58	6.45	6.39	6.33	6.33	6.43
Outlet O2	%	8.00	8.14	8.05	8.00	7.92	7.87	8.00
Gas Flow	scfm	19999	20012	20005	19992	20008	20006	20004
Inlet Gas Temp.	deg F	289	289	288	288	287	287	288
Outlet Gas Temp.	deg F	242	242.5	242	241.5	241.5	241.5	242
Approach to Adiabat	deg F	132.92	133.05	133.02	133.1	133.07	132.97	133.02
GSA delta P.	in H2O	-0.04	-0.05	-0.05	-0.05	-0.05	-0.04	-0.05
ESP delta P.	in H2O	1.49	1.44	1.47	1.48	1.45	1.51	1.47
ESP Outlet Opacity	%	2.63	2.67	2.86	3.23	2.8	2.7	2.82
Recycle Ratio	%							
Unit Load	MW	150.3	149.7	148.4	142.8	150.6	149.9	148.62

Process Data Summary
Baseline Parallel
HCl Test Run #4

Date:	OCTOBER 22 1993							
Test Run:	BP-R4-HCL							
Time:		13:15	13:30	13:45	14:00	14:15	14:30	Average
SO2 Removal Rate	%							6.11
Inlet O2	%	6.12	5.86	5.95	6.15	6.33	6.24	7.44
Outlet O2	%	7.50	7.39	7.48	7.23	7.53	7.49	19996
Gas Flow	scfm	20008	19996	20013	19943	20014	20000	281
Inlet Gas Temp.	deg F	279	280	282	282	282	282	253
Outlet Gas Temp.	deg F	253	253	253	253	253	253	131.18
Approach to Adiabat	deg F	131.33	131.46	131.53	130.95	130.9	130.9	-0.04
GSA delta P.	in H2O	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	1.50
ESP delta P.	in H2O	1.46	1.44	1.39	1.5	1.61	1.6	
ESP Outlet Opacity	%							
Recycle Ratio	MW							
Unit Load	MW	150.3	149.7	148.4	142.8	150.6	149.9	148.62

Process Data Summary
Baseline Series
Metals Test Run #2

Date:	Sept 28, 1993											
Test Run:	BS-R2-M											
Time:		11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	13:00	13:30	13:45
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.72	6.79	6.74	6.73	6.72	6.74	6.75	6.75	6.7	6.73	6.68
Outlet O2	%	8.15	8.22	8.18	8.17	8.13	8.18	8.19	8.11	8.08	8.16	8.15
Gas Flow	scfm	20002	20003	20007	19996	19996	20001	20022	19986	20015	20012	20002
Inlet Gas Temp.	deg F	282	282	282	283	383	284	284	285	285	286	286
Outlet Gas Temp.	deg F	255	255	255	255	255	256	255	256	256	256	256
Approach to Adiabati	deg F	130.81	130.81	130.64	130.74	131.14	131.27	131.29	131.29	131.17	131.72	131.82
GSA delta P.	in H2O	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02
ESP delta P.	in H2O	1.47	1.5	1.53	1.52	1.53	1.55	1.56	1.54	1.58	1.51	1.56
ESP Outlet Opacity	%	1.65	0.48	0.77	0.57	1.05	0.73	1.72	0.98	0.96	0.84	0.86
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	146.7	146.8	146.9	147.1	147.2	147.3	147.6	147.7	147.7	148	148.3

Date:	Sept 28, 1993												
Test Run:	BS-R2-M												
Time:		14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	Average
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.71	6.57	6.64	6.59	6.66	6.65	6.69	6.65	6.69	6.65	6.58	6.69
Outlet O2	%	8.13	8.05	8.13	8.08	8.1	8.07	8.11	8.07	8.11	8.02	8.01	8.12
Gas Flow	scfm	20019	19973	20014	20001	20027	20001	19995	19982	20009	19999	19990	20002
Inlet Gas Temp.	deg F	287	289	290	291	291	290	290	290	291	291	290	291
Outlet Gas Temp.	deg F	256	257	256	256	256	257	257	257	257	257	257	256
Approach to Adiabati	deg F	131.92	132.15	131.42	131.72	131.9	132.35	132.3	132.35	132.33	132.33	132.28	131.63
GSA delta P.	in H2O	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
ESP delta P.	in H2O	1.55	1.58	1.59	1.6	1.634	1.61	1.6	1.56	1.6	1.56	1.57	1.56
ESP Outlet Opacity	%	1.18	1.15	1.24	1	1.55	1.01	1.27	0.98	1.31	2.56	1.65	1.16
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	148.4	148.1	147.5	147.5	148	148.3	148.5	148.6	148.9	149.1	148.9	147.87

Process Data Summary
Baseline Series
Metals Test Run #3

Date:	Sept 29, 1993												
Test Run:	BS-R3-M												
Time:		09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.57	6.57	6.44	6.46	6.50	6.50	6.61	6.61	6.58	6.6	6.59	6.61
Outlet O2	%	8.07	8.16	7.97	7.95	7.99	8.00	8.07	8.11	8.1	8.13	8.06	8.05
Gas Flow	scfm	19988	20032	19993	20003	19980	19996	20010	19988	20011	19993	20009	19980
Inlet Gas Temp.	deg F	277	277	277	277	278	278	278	278	278	279	279	279
Outlet Gas Temp.	deg F	255	255	255	255	255	254	255	255	255	255	255	255
Approach to Adiabati	deg F	131.22	131.17	131.17	131.27	130.84	130.1	130.76	130.66	130.91	131.11	131.67	131.64
GSA delta P.	in H2O	-0.04	-0.04	-0.04	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
ESP delta P.	in H2O	1.4	1.42	1.37	1.33	1.48	1.48	1.44	1.46	1.41	1.47	1.42	1.44
ESP Outlet Opacity	%	0.76	0.41	0.52	0.42	0.49	0.25	0.64	0.53	0.6	0.45	0.6	0.75
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	146.9	147.1	147.1	147.2	147.3	147.7	147.7	148	148	148	148.1	148.2

Date:	Sept 29, 1993										
Test Run:	BS-R3-M										
Time:		12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	Average
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.61	6.59	6.57	6.58	6.58	6.57	6.58	6.55	6.56	6.56
Outlet O2	%	8.05	8.06	8.03	8.04	8.03	8	8.05	8.03	8.01	8.05
Gas Flow	scfm	20000	19995	20007	20004	19999	19999	20002	20010	20000	20000
Inlet Gas Temp.	deg F	280	280	280	281	281	281	281	282	282	279
Outlet Gas Temp.	deg F	255	255	256	256	256	256	256	256	256	255
Approach to Adiabati	deg F	131.64	131.67	131.82	131.75	131.64	131.7	131.72	131.77	131.64	131.33
GSA delta P.	in H2O	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
ESP delta P.	in H2O	1.45	1.48	1.47	1.47	1.45	1.48	1.47	1.49	1.49	1.45
ESP Outlet Opacity	%	0.94	0.72	0.86	0.54	0.79	0.87	0.64	0.59	0.68	0.62
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	148.3	148.4	148.7	148.4	148.6	148.7	148.7	148.8	148.9	148.04

Process Data Summary
Baseline Series
Metals Test Run #4

Date:	Sept 29, 1993										
Test Run:	BS-R4-M										
Time:		16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	18:45	19:00
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.70	6.69	6.67	6.65	6.63	6.61	6.64	6.66	6.7	6.78
Outlet O2	%	8.16	8.16	8.18	8.18	8.13	8.16	8.17	8.17	8.25	8.22
Gas Flow	scfm	20002	19981	20014	19975	20025	20000	19997	19999	19994	19989
Inlet Gas Temp.	deg F	281	281	281	281	281	281	282	282	282	282
Outlet Gas Temp.	deg F	256	256	256	256	256	256	256	256	256	256
Approach to Adiabat	deg F	131.95	132.05	132.15	130.61	131.42	131.42	131.82	131.8	131.39	131.17
GSA delta P.	in H2O	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
ESP delta P.	in H2O	1.64	1.62	1.68	1.71	1.69	1.66	1.64	1.64	1.63	1.6
ESP Outlet Opacity	%	0.53	0.55	0.36	0.54	0.45	0.58	0.44	0.75	0.49	0.54
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	146.5	146.7	146.9	147	146.9	147.1	147.2	147.4	147.6	147.9

Date:	Sept 29, 1993									
Test Run:	BS-R4-M									
Time:		19:15	19:30	19:45	20:00	20:15	20:30	20:45	21:00	Average
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.75	6.76	6.77	6.76	6.69	6.71	6.75	6.79	6.67
Outlet O2	%	8.26	8.23	8.29	8.24	8.22	8.22	8.22	8.27	8.18
Gas Flow	scfm	20010	19992	20002	19975	20016	19997	20009	19984	19998
Inlet Gas Temp.	deg F	282	282	282	282	281	281	281	281	281
Outlet Gas Temp.	deg F	256	256	256	256	256	256	256	256	256
Approach to Adiabat	deg F	130.64	130.81	131.04	131.14	131.49	131.62	131.49	131.42	131.58
GSA delta P.	in H2O	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
ESP delta P.	in H2O	1.59	1.58	1.57	1.56	1.53	1.57	1.48	1.49	1.65
ESP Outlet Opacity	%	0.31	0.48	0.53	0.55	0.35	0.65	0.38	1.27	0.52
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	147.9	148.1	148.2	149	148.1	148	148.1	148.1	147.12

Process Data Summary
Baseline Series
HCl Test Run #2

Date:	Sept 28, 1993									
Test Run:	BS-R2-HCl									
Time:		08:45	09:00	09:15	09:30	09:45	10:00	10:15	10:30	Average
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.65	6.63	6.64	6.55	6.73	6.71	6.70	6.69	6.66
Outlet O2	%	8.05	8.04	8.02	7.99	8.19	8.16	8.06	8.10	8.08
Gas Flow	scfm	20026	19988	19999	19972	20034	20001	20002	19999	20003
Inlet Gas Temp.	deg F	280	281	281	282	283	284	283	282	282
Outlet Gas Temp.	deg F	255	255	255	255	255	255	255	255	255
Approach to Adiabat	deg F	130.74	130.48	130.56	130.58	130.94	130.66	130.76	130.86	130.70
GSA delta P.	in H2O	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
ESP delta P.	in H2O	1.42	1.39	1.39	1.38	1.36	1.48	1.47	1.48	1.42
ESP Outlet Opacity	%	0.87	0.79	0.64	0.69	0.57	0.8	1.31	0.7	0.80
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	146.8	147.1	147.2	147.2	147.1	146	146.1	146.2	146.71

Process Data Summary
Baseline Series
HCl Test Run #3

Date:	Sept 28, 1993								
Test Run:	BS-R3-HCL								
Time:		16:30	16:45	17:00	17:15	17:30	17:45	18:00	AVERAGE
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.58	6.65	6.52	6.40	6.37	6.38	6.34	6.46
Outlet O2	%	8.01	8.10	8.03	7.90	7.88	7.88	7.83	7.95
Gas Flow	scfm	19990	19994	20011	20003	20001	20008	19991	20000
Inlet Gas Temp.	deg F	290	290	290	290	290	290	290	290
Outlet Gas Temp.	deg F	257	257	257	257	257	257	257	257
Approach to Adiabat	deg F	132.4	131.9	132.28	132.33	132.45	132.15	132.38	132.27
GSA delta P.	in H2O	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
ESP delta P.	in H2O	1.57	1.71	1.67	1.71	1.7	1.69	1.9	1.71
ESP Outlet Opacity	%	1.65	0.83	0.82	0.53	0.65	0.64	0.92	0.86
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	148.9	149.1	149	149	149	148.8	148.8	148.94

Process Data Summary
Baseline Series
HCl Test Run #4

Date:	September 29, 1993							
Test Run:	BS-R4-HCL							
Time:		14:30	14:45	15:00	15:15	15:30	15:45	Average
SO2 Removal Rate	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inlet O2	%	6.53	6.55	6.43	6.63	6.58	6.53	6.54
Outlet O2	%	8.00	8.02	7.95	8.11	8.02	8.00	8.02
Gas Flow	scfm	19997	20006	20008	19983	20011	20003	20001
Inlet Gas Temp.	deg F	282	282	283	286	286	286	284
Outlet Gas Temp.	deg F	256	256	256	257	257	257	257
Approach to Adiabat	deg F	131.42	131.62	131.97	131.92	131.72	131.87	131.75
GSA delta P.	in H2O	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
ESP delta P.	in H2O	1.51	1.52	1.56	1.52	1.55	1.52	1.53
ESP Outlet Opacity	%	1.03	0.59	0.88	0.93	0.98	0.69	0.85
Recycle Ratio	%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unit Load	MW	148.9	148.9	149.1	147.8	146.2	145.8	147.78

APPENDIX B—DETAILED RESULTS

This appendix presents detailed results of all characterization measurements. It is organized into the following sub-appendices:

B-1 Series Configuration, Demonstration Tests: Results
B-2 Parallel Configuration, Demonstration Tests: Results
B-3 Series Configuration, BaselineTests: Results
B-4 Parallel Configuration, Baseline Tests: Results

In each sub-appendix, flue gas trace metals measurements are presented at each location, followed by HCl measurements. The results of solids and liquids measurements are provided at the end of each sub-appendix.

Appendix B-1—Series Configuration, Demonstration Tests: Results

EPA METHOD 29. MULTIPLE METALS
LOCATION: GSA Inlet
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-GI

DATE: 8/1/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	9/21/93	9/22/93	9/23/93
RUN NUMBER	-	-	1	2	3
ROUND STACK, DIAMETER	ds	inches	40	40	40
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234
AVERAGE STACK TEMPERATURE	Fs	°F	295	299	292
AVERAGE METER TEMPERATURE	Fm	°F	99.2	100	91
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	29.85	29.78
STACK STATIC PRESSURE	Pg	in. H20	-18	-18	-18
AVG. DELTA H	dH	in. H20	1.802	1.98	1.86
AVG. VELOCITY HEAD	dP	in. H20	0.929	0.95	0.9
PITOT COEFFICIENT	Cp	-	0.829	0.829	0.829
GAS SAMPLE VOLUME	Vm	ft^3	113.8	119.42	114.83
METER CALIBRATION FACTOR	Y	-	1.017	1.017	1.017
TOTAL SAMPLING TIME	min	minutes	160	160	160
STACK GAS OXYGEN CONTENT	Co2,m	%	6.62	6.21	6.29
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.38	11.79	11.71
IMPINGER GAIN	Ww	grams	206.2	221.9	244.1

LAB ANALYSIS RESULTS							AVERAGE
ANTIMONY		µg	4.385	3.085	ND	0.34	2.55
ARSENIC		µg	437.70	472.70		570.12	493.51
BARIUM		µg	282.65	257.65		838.65	459.65
CADMIUM		µg	16.90	17.00		22.50	18.80
CHROMIUM		µg	891.70	879.70		978.70	916.70
COBALT		µg	123.20	113.20		148.20	128.20
LEAD		µg	225.50	202.80		343.70	257.33
MANGANESE		µg	885.00	883.00		1295.00	1021.00
MERCURY		µg	1.30	3.12		5.60	3.34
SELENIUM		µg	200.00	206.07		284.07	230.04
VANADIUM		µg	2030.00	1979.00		2329.00	2112.67
PARTICULATE		mg	7270	8300		8840	8137

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA Inlet
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-GI

DATE: 8/1/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	9/21/93	9/22/93	9/23/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.727	8.727	8.727	8.727	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	755.0	759.0	752.0	755.3	8.7
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	559.2	560.0	551.0	556.7	12.4
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	109.43	114.75	111.85	112.01	6.63
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	9.706	10.445	11.490	10.547	2.227
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0815	0.0834	0.0932	0.0860	0.0155
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.09	30.13	30.13	30.12	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.10	29.12	29.00	29.07	0.17
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.52	28.53	28.46	28.50	0.09
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	65.16	66.03	64.19	65.12	2.29
vm = 0.3048 * vs	vsm	m/s	19.86	20.12	19.56	19.85	0.70
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	acf/min	34115	34571	33608	34098	1197
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	46778	47204	46001	46661	1515
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	20878	21008	20344	20743	874
Qsdm = Qsd/35.32	Qsdm	dscm/min	591.1	594.8	576.0	587.3	24.8
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	44358	44707	43280	44115	1848
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	95.8	99.8	100.4	98.7	6.3

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA Inlet
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-GI

DATE: 8/1/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA	flag	DATA	flag	AVERAGE	CI
TEST DATE	-	-		9/21/93		9/22/93		9/23/93			
RUN NUMBER	-	-		1		2		3			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm		1.7737		1.1567		ND 0.1315		0.9987	2.0608
ARSENIC		µg/dscm		177.0		177.2		220.5		191.6	62.2
BARIUM		µg/dscm		114.3		96.6		324.4		178.4	314.8
CADMIUM		µg/dscm		6.837		6.374		8.703		7.305	3.062
CHROMIUM		µg/dscm		360.7		329.8		378.5		356.4	61.2
COBALT		µg/dscm		49.83		42.44		57.32		49.87	18.48
LEAD		µg/dscm		91.2		76.0		132.9		100.1	73.2
MANGANESE		µg/dscm		358.0		331.1		500.9		396.6	226.7
MERCURY		µg/dscm		0.526		1.170		2.166		1.287	2.053
SELENIUM		µg/dscm		80.90		77.26		109.87		89.34	44.39
VANADIUM		µg/dscm		821.1		742.0		900.8		821.3	197.3
PARTICULATE		mg/dscm		2941		3112		3419		3157	602

MASS FLOW RATE											
ANTIMONY		mg/hr		50.18		33.88		ND 3.71		28.64	58.58
ARSENIC		mg/hr		5009		5191		6220		5473	1622
BARIUM		mg/hr		3235		2829		9150		5071	8789
CADMIUM		mg/hr		193.5		186.7		245.5		208.5	79.9
CHROMIUM		mg/hr		10205		9660		10678		10181	1265
COBALT		mg/hr		1410		1243		1617		1423	465
LEAD		mg/hr		2581		2227		3750		2852	1980
MANGANESE		mg/hr		10128		9686		14128		11318	6071
MERCURY		mg/hr		14.88		34.26		61.10		36.75	57.66
SELENIUM		mg/hr		2289		2263		3099		2550	1181
VANADIUM		mg/hr		23232		21732		25409		23458	4594
PARTICULATE		kg/hr		83.20		91.14		96.44		90.26	16.56

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP Inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R2to4-M-EI

DATE: 8/1/94
OPERATOR: JOHN JACKSON
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	9/22/93	9/23/93	9/23/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches	39.5	39.5	39.5
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.227	0.227	0.196
AVERAGE STACK TEMPERATURE	Fs	°F	143	143	144
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.85	29.78	29.78
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30
AVG. DELTA H	dH	in. H20	2.12	1.83	1.41
AVG. VELOCITY HEAD	dP	in. H20	0.82	0.705	0.987
PITOT COEFFICIENT	Cp	-	0.84	0.84	0.84
GAS SAMPLE VOLUME	Vm	ft^3	42	36.7	32.44
METER CALIBRATION FACTOR	Y	-	2 0.97	0.981	0.981
TOTAL SAMPLING TIME	min	minutes	60	60	60
STACK GAS OXYGEN CONTENT	Co2,m	%	6.94	6.55	6.81
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.06	11.45	11.19
IMPINGER GAIN	Ww	grams	138.9	135.2	121.5

LAB ANALYSIS RESULTS									AVERAGE
ANTIMONY		µg	2	1.985	ND	0.34	ND	0.34	0.78
ARSENIC		µg	2	85.50		109.00		155.00	116.50
BARIUM		µg	2	1144.65		1524.65		883.00	1184.10
CADMIUM		µg	2	5.80		9.60		6.00	7.13
CHROMIUM		µg	2	416.70		550.70		418.70	462.03
COBALT		µg	2	59.20		82.20		68.20	69.87
LEAD		µg	2	146.00		158.00		121.00	141.67
MANGANESE		µg	2	553.00		794.00		737.00	694.67
MERCURY		µg	2	0.34		1.82		1.24	1.13
SELENIUM		µg	2	198.00		161.00		105.00	154.67
VANADIUM		µg	2	639.00		792.00		558.00	663.00
PARTICULATE		mg	2	9160		9950		9260	9457

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP Inlet
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R2to4-M-EI

DATE: 8/1/94
OPERATOR: JOHN JACKSON
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	9/22/93	9/23/93	9/23/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04047	0.04047	0.03017	0.03704	0.01477
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.510	8.510	8.510	8.510	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	603.0	603.0	604.0	603.3	1.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	41.47	36.54	32.26	36.76	11.45
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	6.538	6.364	5.719	6.207	1.072
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1362	0.1483	0.1506	0.1450	0.0192
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.05	30.09	30.06	30.07	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.41	28.30	28.25	28.32	0.20
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.64	27.57	27.57	27.60	0.10
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	56.98	53.00	62.83	57.60	12.27
vm = 0.3048 * vs	vsm	m/s	17.37	16.16	19.15	17.56	3.74
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	29095	27063	32078	29412	6267
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	47267	43690	51603	47520	9844
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dsct/min	20325	18592	21943	20287	4164
Qsdm = Qsd/35.32	Qsdm	dscm/min	575.4	526.4	621.3	574.4	117.9
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	43127	39512	46586	43075	8787
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	103.0	99.2	99.6	100.6	5.2

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP Inlet
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R2to4-M-EI

DATE: 8/1/94
OPERATOR: JOHN JACKSON
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA	flag	DATA	flag	AVERAGE	CI
TEST DATE	–	–		9/22/93		9/23/93		9/23/93			
RUN NUMBER	-	-		2		3		4			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	2	2.1672	ND	0.4099	ND	0.4728		0.8695	2.4767
ARSENIC		µg/dscm	2	93.3		131.4		215.5		146.8	155.3
BARIUM		µg/dscm	2	1250		1838		1228		1439	860
CADMIUM		µg/dscm	2	6.332		11.573		8.343		8.750	6.569
CHROMIUM		µg/dscm	2	455.0		663.9		582.2		567.0	261.6
COBALT		µg/dscm	2	64.63		99.10		94.83		86.19	46.67
LEAD		µg/dscm	2	159.4		190.5		168.2		172.7	39.8
MANGANESE		µg/dscm	2	603.8		957.2		1024.8		861.9	561.7
MERCURY		µg/dscm	2	0.371		2.194		1.724		1.430	2.351
SELENIUM		µg/dscm	2	216.2		194.1		146.0		185.4	89.1
VANADIUM		µg/dscm	2	697.7		954.8		775.9		809.4	327.5
PARTICULATE		mg/dscm	2	10001		11995		12876		11624	3659

MASS FLOW RATE											
ANTIMONY		mg/hr	2	58.36	ND	10.38	ND	13.87		23.49	66.45
ARSENIC		mg/hr	2	2514		3327		6324		4055	4985
BARIUM		mg/hr	2	33651		46538		36025		38738	17038
CADMIUM		mg/hr	2	170.5		293.0		244.8		236.1	153.3
CHROMIUM		mg/hr	2	12251		16809		17082		15381	6743
COBALT		mg/hr	2	1740		2509		2782		2344	1342
LEAD		mg/hr	2	4292		4823		4937		4684	854
MANGANESE		mg/hr	2	16258		24236		30069		23521	17225
MERCURY		mg/hr	2	10.00		55.55		50.59		38.71	62.09
SELENIUM		mg/hr	2	5821		4914		4284		5006	1920
VANADIUM		mg/hr	2	18786		24175		22766		21909	6943
PARTICULATE		kg/hr	2	269.3		303.7		377.8		316.9	137.7

EPA METHOD 26A: HCL and HF
LOCATION: ESP Inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-HCL-EI

DATE: 8/1/94
OPERATOR: JOHN JACKSON
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			9/21/93	9/22/93	9/23/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.03976	0.03976	0.03976	0.03976	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.510	8.510	8.510	8.510	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	598.0	605.0	605.0	602.7	10.0
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	526.3	520.0	520.0	522.1	9.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	40.43	38.35	42.17	40.32	4.76
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	6.293	6.190	7.155	6.546	1.316
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1347	0.1390	0.1450	0.1396	0.0129
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.01	30.07	30.06	30.05	0.07
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.39	28.39	28.31	28.36	0.12
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.63	27.64	27.57	27.62	0.09
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	62.31	58.91	60.80	60.68	4.24
vm = 0.3048 * vs	vsm	m/s	18.99	17.96	18.53	18.49	1.29
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	31817	30080	31045	30981	2162
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	52079	48674	49971	50241	4268
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	22443	20876	21339	21553	2000
Qsdm = Qsd/35.32	Qsdm	dscm/min	635.4	591.0	604.2	610.2	56.6
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	47565	44323	45299	45729	4132
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	92.6	94.4	101.5	96.2	11.8
HCl concentration, dry		mg/dscm	2 ND 0.00889	ND 0.00919	ND 0.00882	ND 0.00897	0.00048
HCl concentration, dry @ 3% O2		mg/dscm	2 ND 0.01165	ND 0.01166	ND 0.01123	ND 0.01151	0.00061
HCl concentration, dry @ 3% O2		ppmv	2 ND 0.00769	ND 0.00769	ND 0.00741	ND 0.00760	0.00040
HCl mass flow rate		mg/hr	2 ND 339	ND 326	ND 320	ND 328	24.6
HF concentration, dry		mg/dscm	2 ND 0.02277	ND 0.02352	ND 0.02337	ND 0.02322	0.00099
HF concentration, dry @ 3% O2		mg/dscm	2 ND 0.02983	ND 0.02984	ND 0.02975	ND 0.02981	0.00012
HF concentration, dry @ 3% O2		ppmv	2 ND 0.03587	ND 0.03587	ND 0.03577	ND 0.03583	0.00014
HF mass flow rate		mg/hr	2 ND 868	ND 834	ND 847	ND 850	42.5

EPA METHOD 26A: HCL and HF
LOCATION: ESP outlet
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DS-R1-HCL-EO

DATE: 8/1/94
OPERATOR: BARRY BOULIANE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			9/21/93			
RUN NUMBER	-	-	1			
ROUND STACK, DIAMETER	ds	inches				
RECTANGULAR STACK, LENGTH	L	inches	29.5			
WIDTH	W	inches	29.5			
NOZZLE DIAMETER	dn	inches	0.234			
AVERAGE STACK TEMPERATURE	Fs	°F	147			
AVERAGE METER TEMPERATURE	Fm	°F	60			
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84			
STACK STATIC PRESSURE	Pg	in. H20	-25			
AVG. DELTA H	dH	in. H20	1.488			
AVG. VELOCITY HEAD	dP	in. H20	0.928			
PITOT COEFFICIENT	Cp	-	0.84			
GAS SAMPLE VOLUME	Vm	ft^3	44.7			
METER CALIBRATION FACTOR	Y	-	0.989			
TOTAL SAMPLING TIME	min	minutes	60			
STACK GAS OXYGEN CONTENT	Co2,m	%	7.7			
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.3			
IMPINGER GAIN	Ww	grams	142.4			
LAB ANALYSIS RESULTS			RUN 1			AVERAGE
CHLORIDE		mg	ND 0.0103			ND 0.0103
FLUORIDE		mg	ND 0.02575			ND 0.02575

EPA METHOD 26A: HCL and HF
LOCATION: ESP outlet
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DS-R1-HCL-EO

DATE: 8/1/94
OPERATOR: BARRY BOULIANE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			9/21/93				
RUN NUMBER	-	-	1				
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301			0.04301	na
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000			0.000	na
= L * W/144 (RECTANGULAR)			6.043			6.043	na
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	607.0			607.0	na
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0			520.0	na
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	44.91			44.91	na
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	6.703			6.703	na
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1299			0.1299	na
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.96			29.96	na
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.40			28.40	na
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.00			28.00	na
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	60.43			60.43	na
vm = 0.3048 * vs	vsm	m/s	18.42			18.42	na
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	21914			21914	na
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	35819			35819	na
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	15517			15517	na
Qsdm = Qsd/35.32	Qsdm	dscm/min	439.3			439.3	na
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	32826			32826	na
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	97.7			97.7	na
HCl concentration, dry		mg/dscm	ND 0.00833			ND 0.00833	na
HCl concentration, dry @ 3% O2		mg/dscm	ND 0.01129			ND 0.01129	na
HCl concentration, dry @ 3% O2		ppmv	ND 0.00745			ND 0.00745	na
HCl mass flow rate		mg/hr	ND 219.5			ND 219.5	na
HF concentration, dry		mg/dscm	ND 0.02132			ND 0.02132	na
HF concentration, dry @ 3% O2		mg/dscm	ND 0.02891			ND 0.02891	na
HF concentration, dry @ 3% O2		ppmv	ND 0.03476			ND 0.03476	na
HF mass flow rate		mg/hr	ND 562.0			ND 562.0	na

EPA METHOD 26A: HCL and HF
LOCATION: Baghouse inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DS-R2to4-HCL-BI

DATE: 8/1/94
OPERATOR: JOE REPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			9/22/93	9/23/93	9/23/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches				
RECTANGULAR STACK, LENGTH	L	inches	15.5	15.5	15.5	
WIDTH	W	inches	15.5	15.5	15.5	
NOZZLE DIAMETER	dn	inches	0.236	0.236	0.236	
AVERAGE STACK TEMPERATURE	Fs	°F	141	142	144	
AVERAGE METER TEMPERATURE	Fm	°F	74	76.9	78.4	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.85	29.78	29.78	
STACK STATIC PRESSURE	Pg	in. H20	-29.75	-29.75	-29.75	
AVG. DELTA H	dH	in. H20	1.274	1.432	1.348	
AVG. VELOCITY HEAD	dP	in. H20	0.526	0.6	0.587	
PITOT COEFFICIENT	Cp	-	0.82	0.82	0.82	
GAS SAMPLE VOLUME	Vm	ft^3	35.9	38.5	37.48	
METER CALIBRATION FACTOR	Y	-	0.993	0.993	0.993	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	7.26	7.37	7.78	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.74	10.63	10.22	
IMPINGER GAIN	Ww	grams	90.2	156.4	127.1	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	ND 0.00672	ND 0.01034	ND 0.00976	ND 0.0096067
FLUORIDE		mg	ND 0.0218	ND 0.0285	ND 0.0244	ND 0.0249

EPA METHOD 26A: HCL and HF
LOCATION: Baghouse inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DS-R2to4-HCL-BI

DATE: 8/1/94
OPERATOR: JOE REPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC *
TEST DATE			9/22/93	9/23/93	9/23/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04374	0.04374	0.04374	0.04374	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			1.668	1.668	1.668	1.668	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	601.0	602.0	604.0	602.3	3.8
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	534.0	536.9	538.4	536.4	5.6
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	35.26	37.54	36.43	36.41	2.83
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	4.246	7.362	5.983	5.863	3.879
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1075	0.1640	0.1410	0.1375	0.0706
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	30.01	30.00	29.95	29.98	0.08
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.72	28.03	28.26	28.34	0.87
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.66	27.59	27.59	27.62	0.10
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	44.22	47.91	47.27	46.47	4.89
vm = 0.3048 * vs	vsm	m/s	13.48	14.60	14.41	14.16	1.49
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	4427	4796	4732	4651	490
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7300	7686	7621	7535	514
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3208	3242	3275	3242	84
Qsdm = Qsd/35.32	Qsdm	dscm/min	90.8	91.8	92.7	91.8	2.4
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	6798	6867	6927	6864	159
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	100.7	106.0	101.9	102.8	7.0
HCl concentration, dry		mg/dscm	ND 0.00898	ND 0.01000	ND 0.00973	ND 0.00957	0.00131
HCl concentration, dry @ 3% O2		mg/dscm	ND 0.01179	ND 0.01324	ND 0.01327	ND 0.01277	0.00211
HCl concentration, dry @ 3% O2		ppmv	ND 0.00778	ND 0.00873	ND 0.00876	ND 0.00842	0.00139
HCl mass flow rate		mg/hr	ND 48.95	ND 55.09	ND 54.13	ND 52.72	8.22
HF concentration, dry		mg/dscm	ND 0.02299	ND 0.02824	ND 0.02491	ND 0.02538	0.00659
HF concentration, dry @ 3% O2		mg/dscm	ND 0.03017	ND 0.03736	ND 0.03398	ND 0.03384	0.00893
HF concentration, dry @ 3% O2		ppmv	ND 0.03627	ND 0.04491	ND 0.04085	ND 0.04068	0.01073
HF mass flow rate		mg/hr	ND 125.3	ND 155.5	ND 138.6	ND 139.8	37.6

EPA METHOD 26A: HCL and HF
LOCATION: Baghouse outlet
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-HCL-BO

DATE: 9/13/93
OPERATOR: BARRY BOULIANE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			9/21/93	9/22/93	9/23/93	
RUN NUMBER	-	-	1	2	3	
ROUND STACK, DIAMETER	ds	inches				
RECTANGULAR STACK, LENGTH	L	inches	18.5	18.5	18.5	
WIDTH	W	inches	18.5	18.5	18.5	
NOZZLE DIAMETER	dn	inches	0.29	0.29	0.29	
AVERAGE STACK TEMPERATURE	Fs	°F	143	147	144	
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	29.85	29.78	
STACK STATIC PRESSURE	Pg	in. H20	-30.25	-30.25	-30.25	
AVG. DELTA H	dH	in. H20	0.97	0.438	1.207	
AVG. VELOCITY HEAD	dP	in. H20	0.344	0.441	0.415	
PITOT COEFFICIENT	Cp	-	0.78	0.78	0.78	
GAS SAMPLE VOLUME	Vm	ft^3	37.9	42.6	42.71	
METER CALIBRATION FACTOR	Y	-	1.009	1.009	1.009	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	8.21	7.84	8.04	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	9.79	10.16	9.96	
IMPINGER GAIN	Ww	grams	118.3	134.3	140.1	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	ND 0.00876	ND 0.0103	ND 0.01056	ND 0.0098733
FLUORIDE		mg	ND 0.0219	ND 0.02575	ND 0.0264	ND 0.0246833

EPA METHOD 26A: HCL and HF
LOCATION: Baghouse outlet
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-HCL-BO

DATE: 9/13/93
OPERATOR: BARRY BOULIANE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	DATA CC
TEST DATE			9/21/93	9/22/93	9/23/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.06605	0.06605	0.06605	0.06605	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			2.377	2.377	2.377	2.377	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	603.0	607.0	604.0	604.7	5.2
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	38.80	43.57	43.66	42.01	6.91
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	5.568	6.322	6.595	6.161	1.320
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1255	0.1267	0.1312	0.1278	0.0075
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.89	29.94	29.92	29.92	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.40	28.43	28.35	28.39	0.09
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.62	27.63	27.56	27.60	0.09
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	34.29	38.93	37.77	37.00	6.00
vm = 0.3048 * vs	vsm	m/s	10.45	11.87	11.51	11.28	1.83
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	4890	5552	5386	5276	855
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7935	8960	8691	8529	1320
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3455	3892	3766	3704	560
Qsdm = Qsd/35.32	Qsdm	dscm/min	97.8	110.2	106.6	104.9	15.8
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	7294	8230	7956	7826	1196
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	97.0	96.7	100.2	98.0	4.7
HCl concentration, dry		mg/dscm	ND 0.00820	ND 0.00859	ND 0.00878	ND 0.00852	0.00074
HCl concentration, dry @ 3% O2		mg/dscm	ND 0.01157	ND 0.01177	ND 0.01223	ND 0.01185	0.00084
HCl concentration, dry @ 3% O2		ppmv	ND 0.00763	ND 0.00777	ND 0.00807	ND 0.00782	0.00055
HCl mass flow rate		mg/hr	ND 48.122406	ND 56.771576	ND 56.193467	ND 53.695817	12.012676
HF concentration, dry		mg/dscm	ND 0.02099	ND 0.02198	ND 0.02249	ND 0.02182	0.00189
HF concentration, dry @ 3% O2		mg/dscm	ND 0.02961	ND 0.03012	ND 0.03130	ND 0.03034	0.00215
HF concentration, dry @ 3% O2		ppmv	ND 0.03559	ND 0.03621	ND 0.03763	ND 0.03648	0.00259
HF mass flow rate		mg/hr	ND 123.2	ND 145.3	ND 143.9	ND 137.5	30.8

METALS AND CHLORIDE ANALYSIS

DATE: 8/10/94
PLANT: National Center for Emissions Research
OPERATOR: DAVE LADD
CITY: West Paducah, KY
ENTERED BY: JENNY PONT
RUN #: AP-DS-R1to3-M-SS4
CHECKED BY: DESIREE JONES

DATA ENTRY	SYMBOL	UNITS	DATA
RUN NUMBER	-	-	COMPOSITE OF 1-3
STREAM FLOW		kg/hr	
TOTAL SAMPLING TIME	min	minutes	240
TOTAL STREAM MASS	Ww	grams	
METALS CATCH			
ANTIMONY		µg/g	ND 0.55
ARSENIC		µg/g	4.6
BARIUM		µg/g	623
BERYLLIUM		µg/g	1.1
CADMIUM		µg/g	0.1
CHROMIUM		µg/g	17
COBALT		µg/g	3.7
LEAD		µg/g	5.5
MANGANESE		µg/g	33
MERCURY(1)		µg/g	0.07
MERCURY		µg/g	0.06
NICKEL		µg/g	7
SELENIUM		µg/g	2.7
VANADIUM		µg/g	29
CHLORIDE		Wt. %	0.02
MOISTURE		%	8.42

METALS AND CHLORIDE ANALYSIS
LOCATION: GSA Solids (5)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-SS5

DATE: 9/13/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA		DATA		DATA				
TEST DATE				9/21/94		9/22/94		9/23/94			
RUN NUMBER	-	-		1		2		3			
STREAM FLOW		kg/hr	*	335.23		460.5		432.4			
LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	0.08	ND	0.08	ND	0.08	ND	0.08	0.00
ARSENIC		mg/kg		22.30		14.90		19.30		18.83	9.25
BARIUM		mg/kg		75.30		57.00		59.30		63.87	24.76
CADMIUM		mg/kg		0.330	ND	0.004	ND	0.004		0.111	0.47
CHROMIUM		mg/kg		15.40		15.90		14.80		15.37	1.37
COBALT		mg/kg		1.96		1.80		3.43		2.40	2.23
LEAD		mg/kg		1.84		0.56		0.41		0.94	1.95
MANGANESE		mg/kg		62.80		90.50		83.40		78.90	35.74
MERCURY		mg/kg	ND	0.100	ND	0.100	ND	0.100	ND	0.100	0.00
SELENIUM		mg/kg	ND	0.10	ND	0.10	ND	0.10	ND	0.100	0.00
VANADIUM		mg/kg		18.40		19.60		20.70		19.57	2.86
CHLORINE		mg/kg		91.00		98.00		120.00		103.00	37.59
MASS FLOW RATE											
ANTIMONY		mg/hr	ND	26.8	ND	36.8	ND	34.6	ND	32.75	13.1
ARSENIC		mg/hr		7475.6		6861.5		8345.5		7560.86	1852.6
BARIUM		mg/hr		25242.8		26248.5		25641.9		25711.08	1258.1
CADMIUM		mg/hr		110.6	ND	1.8	ND	1.7		37.471	156.1
CHROMIUM		mg/hr		5162.5		7322.0		6399.7		6294.72	2691.8
COBALT		mg/hr		657.1		828.9		1483.2		989.71	1082.9
LEAD		mg/hr		616.8		257.9		177.3		350.66	581.3
MANGANESE		mg/hr		21052.4		41675.3		36063.0		32930.23	26488.9
MERCURY		mg/hr	ND	33.5	ND	46.1	ND	43.2	ND	40.938	16.3
SELENIUM		mg/hr	ND	33.5	ND	46.1	ND	43.2	ND	40.938	16.3
VANADIUM		mg/hr		6168.2		9025.8		8950.9		8048.31	4046.1
CHLORINE		mg/hr		30505.9		45129.0		51889.2		42508.0	27153.6

*Ash flow calculated using Run 4 ESP inlet particulate data.

METALS AND CHLORIDE ANALYSIS
LOCATION: Lime slurry (SS7)
PLANT: National Center for Emissions Research/AirPol Den
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-SS7

DATE: 8/4/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: JON KAWAGUCHI

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	-	-	9/21/93	9/22/93	9/23/93
RUN NUMBER			1	2	3
SLURRY FLOW		L/hr	926.56	990.16	1008.32
SLURRY DENSITY(a)		kg/L	1.14	1.14	1.14

LAB ANALYSIS:			1	2	3	AVERAGE	CI
ANTIMONY		mg/kg	(b) ND 0.08	(b) ND 0.08	(b) ND 0.08	(b) ND 0.08	0.00
ARSENIC		mg/kg	(b) 0.96	(b) 0.96	(b) 0.96	(b) 0.96	0.00
BARIUM		mg/kg	(b) 1.43	(b) 1.43	(b) 1.43	(b) 1.43	0.00
BERYLLIUM		mg/kg	(b) ND 0.02	(b) ND 0.02	(b) ND 0.02	(b) ND 0.02	0.00
CADMIUM		mg/kg	(b) 0.011	(b) 0.011	(b) 0.011	(b) 0.01	0.00
CHROMIUM		mg/kg	(b) 4.51	(b) 4.51	(b) 4.51	(b) 4.51	0.00
COBALT		mg/kg	(b) ND 0.35	(b) ND 0.35	(b) ND 0.35	(b) ND 0.35	0.00
LEAD		mg/kg	(b) ND 0.035	(b) ND 0.035	(b) ND 0.035	(b) ND 0.04	0.00
MANGANESE		mg/kg	(b) 4.67	(b) 4.67	(b) 4.67	(b) 4.67	0.00
MERCURY		mg/kg	(b) ND 0.10	(b) ND 0.10	(b) ND 0.10	(b) ND 0.10	0.00
NICKEL		mg/kg	(b) 0.75	(b) 0.75	(b) 0.75	(b) 0.75	0.00
SELENIUM		mg/kg	(b) 1.45	(b) 1.45	(b) 1.45	(b) 1.45	0.00
VANADIUM		mg/kg	(b) 2.25	(b) 2.25	(b) 2.25	(b) 2.25	0.00
CHLORIDE		mg/kg	26.00	26.00	26.00	26.00	0.00
MOISTURE		%	69.90	71.90	71.90	71.23	2.87

CALCULATED DATA						AVERAGE	CI
STREAM FLOW		kg/hr	1056	1129	1149	1112	121.59
MASS FLOW RATES:							
ANTIMONY		mg/hr	(b) ND 84.50	(b) ND 90.30	(b) ND 91.96	(b) ND 88.92	9.73
ARSENIC		mg/hr	(b) 1014.0	(b) 1083.6	(b) 1103.5	1067.05	116.73
BARIUM		mg/hr	(b) 1510.5	(b) 1614.2	(b) 1643.8	1589.47	173.88
BERYLLIUM		mg/hr	(b) ND 15.84	(b) ND 16.93	(b) ND 17.24	(b) ND 16.67	1.82
CADMIUM		mg/hr	(b) 11.62	(b) 12.42	(b) 12.64	(b) 12.23	1.34
CHROMIUM		mg/hr	(b) 4763.8	(b) 5090.8	(b) 5184.2	(b) 5012.93	548.38
COBALT		mg/hr	(b) ND 369.7	(b) ND 395.1	(b) ND 402.3	(b) ND 389.03	42.56
LEAD		mg/hr	(b) ND 36.97	(b) ND 39.51	(b) ND 40.23	(b) ND 38.90	4.26
MANGANESE		mg/hr	(b) 4932.8	(b) 5271.4	(b) 5368.1	(b) 5190.78	567.84
MERCURY		mg/hr	(b) ND 105.6	(b) ND 112.9	(b) ND 114.9	(b) ND 111.15	12.16
NICKEL		mg/hr	(b) 792.2	(b) 846.6	(b) 862.1	(b) 833.64	91.19
SELENIUM			(b) 1531.6	(b) 1636.7	(b) 1666.8	(b) 1611.70	176.31
VANADIUM			(b) 2376.6	(b) 2539.8	(b) 2586.3	(b) 2500.91	273.58
CHLORIDE		mg/L	27463.2	29348.3	29886.6	28899.4	3161.40

(a) Determined by TVA/NCER.
(b) Analysis based on single archive sample (Run 1, 9/21/93). Same analysis applied to all test runs.

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, field 1 (9A)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1lo3-M-SS9A

DATE: 9/13/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS		DATA		DATA		DATA			
TEST DATE				9/21/94		9/22/94		9/23/94			
RUN NUMBER	-	-		1		2		3			
STREAM FLOW		kg/hr	*	339.36		243.04		273.22			
LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	10	ND	10	ND	10	ND	10.00	0.00
ARSENIC		mg/kg		17.00		14.00		15.00		15.33	3.79
BARIUM		mg/kg		53.00		63.00	ND	3.10		39.18	79.72
CADMIUM		mg/kg		0.600		1.000		0.900		0.833	0.52
CHROMIUM		mg/kg		19.00		26.00		33.00		26.00	17.39
COBALT		mg/kg	ND	0.65	ND	0.65		4.00		1.55	4.81
LEAD		mg/kg		4.00		8.00		6.00		6.00	4.97
MANGANESE		mg/kg		29.00		24.00		24.00		25.67	7.17
MERCURY		mg/kg	ND	0.030	ND	0.030	ND	0.030	ND	0.030	0.00
SELENIUM		mg/kg	ND	0.11	ND	0.11		3.00		1.037	4.15
VANADIUM		mg/kg	ND	1.70		57.00		55.00		37.62	77.92
CHLORINE		mg/kg		820.00		1100.00		1100.00		1006.67	401.61
MASS FLOW RATE											
ANTIMONY		mg/hr	ND	3393.6	ND	2430.4	ND	2732.2	ND	2852.07	1223.9
ARSENIC		mg/hr		5769.1		3402.6		4098.3		4423.33	3021.7
BARIUM		mg/hr		17986.1		15311.5	ND	847.0		11240.36	22907.3
CADMIUM		mg/hr		203.6		243.0		245.9		230.851	58.7
CHROMIUM		mg/hr		6447.8		6319.0		9016.3		7261.05	3779.7
COBALT		mg/hr	ND	220.6	ND	158.0		1092.9		427.39	1298.4
LEAD		mg/hr		1357.4		1944.3		1639.3		1647.03	729.2
MANGANESE		mg/hr		9841.4		5833.0		6557.3		7410.56	5306.9
MERCURY		mg/hr	ND	10.2	ND	7.3	ND	8.2	ND	8.556	3.7
SELENIUM		mg/hr	ND	37.3	ND	26.7		819.7		283.897	1129.8
VANADIUM		mg/hr	ND	576.9		13853.3		15027.1		9722.95	19937.9
CHLORINE		mg/hr		278275.2		267344.0		300542.0		282053.7	42031.2

*Ash flow calculated using make-up ESP inlet particulate data from 9/23/93 (Run 4).

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, fields 2-4 (9B)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-SS9B

DATE: 9/13/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: Matt Gardner

DATA ENTRY	SYMBOL	UNITS	DATA		DATA		DATA				
TEST DATE				9/21/93		9/22/93		9/23/93			
RUN NUMBER	-	-		1		2		3			
STREAM FLOW		kg/hr	*	40.66		29.12		32.74			
LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	10	ND	10	ND	10	ND	10.00	0.00
ARSENIC		mg/kg		12.00		5.00		16.00		11.00	13.83
BARIUM		mg/kg		69.00		39.00		39.00		49.00	43.03
CADMIUM		mg/kg	ND	0.300		0.700		0.500		0.450	0.50
CHROMIUM		mg/kg		13.00		12.00		31.00		18.67	26.56
COBALT		mg/kg	ND	0.65	ND	0.65		3.00	NDM	2.00	3.37
LEAD		mg/kg		8.00	ND	2.30		5.00		4.72	7.08
MANGANESE		mg/kg		18.00		16.00		26.00		20.00	13.15
MERCURY		mg/kg	ND	0.030	ND	0.030	ND	0.030	ND	0.030	0.00
SELENIUM		mg/kg	ND	0.11	ND	0.11	ND	0.11	ND	0.110	0.00
VANADIUM		mg/kg	ND	1.70	ND	1.70	ND	1.70	ND	1.70	0.00
CHLORINE		mg/kg		780.00		780.00		890.00		816.67	157.78
MASS FLOW RATE											
ANTIMONY		mg/hr	ND	406.6	ND	291.2	ND	327.4	ND	341.73	146.6
ARSENIC		mg/hr		487.9		145.6		523.8		385.79	518.7
BARIUM		mg/hr		2805.5		1135.7		1276.9		1739.36	2300.6
CADMIUM		mg/hr	ND	12.2		20.4		16.4		14.284	10.2
CHROMIUM		mg/hr		528.6		349.4		1014.9		630.99	855.5
COBALT		mg/hr	ND	26.4	ND	18.9		98.2	NDM	26.43	108.8
LEAD		mg/hr		325.3	ND	67.0		163.7		174.16	324.2
MANGANESE		mg/hr		731.9		465.9		851.2		683.01	490.0
MERCURY		mg/hr	ND	1.2	ND	0.9	ND	1.0	ND	1.025	0.4
SELENIUM		mg/hr	ND	4.5	ND	3.2	ND	3.6	ND	3.759	1.6
VANADIUM		mg/hr	ND	69.1	ND	49.5	ND	55.7	ND	58.09	24.9
CHLORINE		mg/hr		31714.8		22713.6		29138.6		27855.7	11516.7

*Ash flow calculated using ESP inlet particulate data from 9/23/94 (Run 4).

METALS AND CHLORIDE ANALYSIS
LOCATION: Baghouse hopper ash (11)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-SS11

DATE: 9/13/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			9/21/93	9/22/93	9/23/93
RUN NUMBER	-	-	1	2	3
STREAM FLOW		kg/hr	0.3151	0.0859	0.1726

LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	10	ND	10	ND	10	ND	10.00	0.00
ARSENIC		mg/kg		15		54		24		31.00	50.73
BARIUM		mg/kg		36		63		37		45.33	38.03
CADMIUM		mg/kg		26.8		25		17.6		23.13	12.11
CHROMIUM		mg/kg		49		34		30		37.67	24.88
COBALT		mg/kg		5		4		5		4.67	1.43
LEAD		mg/kg		14		17		13		14.67	5.17
MANGANESE		mg/kg		97		93		136		108.67	59.02
MERCURY		mg/kg		1		0.6		1.4		1.000	0.99
SELENIUM		mg/kg	ND	0.11	ND	0.11	ND	0.11	ND	0.110	0.00
VANADIUM		mg/kg	ND	1.7		59		71		43.62	92.01
CHLORINE		mg/kg		520		470		130		373.33	527.20

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	3.151	ND	0.859	ND	1.726	ND	1.912	2.875038
ARSENIC		mg/hr		4.7265		4.6386		4.1424		4.5025	0.782411
BARIUM		mg/hr		11.3436		5.4117		6.3862		7.71383333	7.902702
CADMIUM		mg/hr		8.44468		2.1475		3.03776		4.54331333	8.466323
CHROMIUM		mg/hr		15.4399		2.9206		5.178		7.84616667	16.5768
COBALT		mg/hr		1.5755		0.3436		0.863		0.92736667	1.536482
LEAD		mg/hr		4.4114		1.4603		2.2438		2.70516667	3.797782
MANGANESE		mg/hr		30.5647		7.9887		23.4736		20.6756667	28.68203
MERCURY		mg/hr		0.3151		0.05154		0.24164		0.20276	0.337904
SELENIUM		mg/hr	ND	0.034661	ND	0.009449	ND	0.018986	ND	0.021032	0.031625
VANADIUM		mg/hr	ND	0.53567		5.0681		12.2546		5.86351167	14.68081
CHLORINE		mg/hr		163.852		40.373		22.438		75.5543333	191.2743

METALS AND CHLORIDE ANALYSIS
LOCATION: Reinjected fly ash (13)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-SS13

DATE: 8/4/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			9/22/93	9/23/94	9/23/94
RUN NUMBER	-	-	1	2	3
STREAM FLOW		kg/hr	198.4	201.4	197.86

METALS CATCH						AVERAGE	CI
ANTIMONY		mg/kg	ND 0.08	ND 0.08	ND 0.08	ND 0.08	0.00
ARSENIC		mg/kg	51.80	112.00	25.20	63.00	110.48
BARIUM		mg/kg	118.30	175.90	138.70	144.30	72.56
CADMIUM		mg/kg	0.280	0.367	0.239	0.295	0.16
CHROMIUM		mg/kg	15.70	20.00	17.50	17.73	5.36
COBALT		mg/kg	4.22	4.94	4.85	4.67	0.97
LEAD		mg/kg	18.10	26.90	12.50	19.17	18.03
MANGANESE		mg/kg	57.00	76.70	116.10	83.27	74.76
MERCURY		mg/kg	ND 0.10	ND 0.10	ND 0.10	ND 0.10	0.00
SELENIUM		mg/kg	1.70	3.26	2.04	2.33	2.04
VANADIUM		mg/kg	21.30	30.40	29.60	27.10	12.52
CHLORINE		mg/kg	ND 0.02	ND 0.02	4.00	1.34	5.71

METALS MASS FLOW RATE			1	2	3	AVERAGE	CI
ANTIMONY		mg/hr	ND 15.9	ND 16.1	ND 15.8	ND 15.94	0.4
ARSENIC		mg/hr	10277.1	22556.8	4986.1	12606.66	22393.9
BARIUM		mg/hr	23470.7	35426.3	27443.2	28780.05	15126.8
CADMIUM		mg/hr	55.6	73.9	47.3	58.92	33.9
CHROMIUM		mg/hr	3114.9	4028.0	3462.6	3535.14	1145.0
COBALT		mg/hr	837.2	994.9	959.6	930.60	205.6
LEAD		mg/hr	3591.0	5417.7	2473.3	3827.32	3692.6
MANGANESE		mg/hr	11308.8	15447.4	22971.5	16575.91	14689.2
MERCURY		mg/hr	ND 19.8	ND 20.1	ND 19.8	ND 19.92	0.5
SELENIUM		mg/hr	337.3	656.6	403.6	465.83	418.6
VANADIUM		mg/hr	4225.9	6122.6	5856.7	5401.71	2551.2
CHLORINE		mg/hr	ND 4.0	ND 4.0	791.4	265.1	1129.5

METALS AND CHLORIDE ANALYSIS
LOCATION: Trim water (14)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-SS14

DATE: 8/10/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			9/21/93	9/22/93	9/23/93
RUN NUMBER	-	-	1	2	3
STREAM FLOW		L/hr	1333.1	1210.44	1199.09
WATER DENSITY		kg/L	1	1	1

LABORATORY ANALYSIS RESULTS						AVERAGE		CI
ANTIMONY		mg/kg	* ND 0.002	* ND 0.002	ND 0.002	ND 0.002		0.00
ARSENIC		mg/kg	* ND 0.001	* ND 0.001	ND 0.001	ND 0.001		0.00
BARIUM		mg/kg	* 0.039	* 0.039	0.039	0.039		0.00
CADMIUM		mg/kg	* ND 0.0007	* ND 0.0007	ND 0.0007	ND 0.0007		0.00
CHROMIUM		mg/kg	* ND 0.009	* ND 0.009	ND 0.009	ND 0.009		0.00
COBALT		mg/kg	* ND 0.007	* ND 0.007	ND 0.007	ND 0.007		0.00
LEAD		mg/kg	* ND 0.001	* ND 0.001	ND 0.001	ND 0.001		0.00
MANGANESE		mg/kg	* ND 0.001	* ND 0.001	ND 0.001	ND 0.001		0.00
MERCURY		mg/kg	* ND 0.0002	* ND 0.0002	ND 0.0002	ND 0.0002		0.00
SELENIUM		mg/kg	* ND 0.001	* ND 0.001	ND 0.001	ND 0.001		0.00
VANADIUM		mg/kg	* ND 0.005	* ND 0.005	ND 0.005	ND 0.005		0.00
CHLORINE		mg/kg	81.00	63.00	67.00	70.33		23.48

MASS FLOW RATE								
STREAM FLOW		kg/hr	1333.1	1210.44	1199.09			
ANTIMONY		mg/hr	ND 2.7	ND 2.4	ND 2.4	ND 2.50		0.4
ARSENIC		mg/hr	ND 1.3	ND 1.2	ND 1.2	ND 1.25		0.2
BARIUM		mg/hr	52.0	47.2	46.8	48.65		7.2
CADMIUM		mg/hr	ND 0.9	ND 0.8	ND 0.8	ND 0.873		0.1
CHROMIUM		mg/hr	ND 12.0	ND 10.9	ND 10.8	ND 11.23		1.7
COBALT		mg/hr	ND 9.3	ND 8.5	ND 8.4	ND 8.73		1.3
LEAD		mg/hr	ND 1.3	ND 1.2	ND 1.2	ND 1.25		0.2
MANGANESE		mg/hr	ND 1.3	ND 1.2	ND 1.2	ND 1.25		0.2
MERCURY		mg/hr	ND 0.3	ND 0.2	ND 0.2	ND 0.250		0.0
SELENIUM		mg/hr	ND 1.3	ND 1.2	ND 1.2	ND 1.248		0.2
VANADIUM		mg/hr	ND 6.7	ND 6.1	ND 6.0	ND 6.24		0.9
CHLORINE		mg/hr	107981.1	76257.7	80339.0	88192.6		42875.7

* Analysis based on single archive sample (Run 3, 9/23/93). Same analysis applied to all other test runs.

Appendix B-2—Parallel Configuration, Demonstration Tests: Results

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE ALAIMO

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	10/14/93	10/15/93	10/15/93
RUN NUMBER	-	-	1	2	3
ROUND STACK, DIAMETER	ds	inches	40	40	40
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234
AVERAGE STACK TEMPERATURE	Fs	°F	284	296	292
AVERAGE METER TEMPERATURE	Fm	°F	73	79	91
BAROMETRIC PRESSURE	Pbar	in. Hg	29.88	29.82	29.78
STACK STATIC PRESSURE	Pg	in. H20	-18	-18	-18
AVG. DELTA H	dH	in. H20	1.79	1.92	1.86
AVG. VELOCITY HEAD	dP	in. H20	0.888	0.95	0.9
PITOT COEFFICIENT	Cp	-	0.829	0.829	0.829
GAS SAMPLE VOLUME	Vm	ft^3	111.8	115.15	114.83
METER CALIBRATION FACTOR	Y	-	1.017	1.017	1.017
TOTAL SAMPLING TIME	min	minutes	160	160	160
STACK GAS OXYGEN CONTENT	Co2,m	%	6.15	6.11	5.81
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.85	11.89	12.19
IMPINGER GAIN	Ww	grams	197.8	213	244.1

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY		µg	13.685	16.585	19.29	16.52
ARSENIC		µg	739.06	842.06	688.50	756.54
BARIUM		µg	233.65	132.65	139.65	168.65
CADMIUM		µg	16.90	17.10	18.80	17.60
CHROMIUM		µg	1062.70	939.70	796.70	933.03
COBALT		µg	172.20	189.20	177.20	179.53
LEAD		µg	295.05	411.05	332.05	346.05
MANGANESE		µg	1161.00	538.40	518.40	739.27
MERCURY		µg	10.02	4.92	1.42	5.45
SELENIUM		µg	25.97	ND 0.26	58.37	28.15
VANADIUM		µg	2259.00	1599.00	1209.00	1689.00
PARTICULATE		mg	9190	8920	9120	9077

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE ALAIMO

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/14/93	10/15/93	10/15/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.727	8.727	8.727	8.727	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	744.0	756.0	752.0	750.7	15.2
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	533.0	539.0	551.0	541.0	22.8
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	112.93	114.83	111.85	113.20	3.75
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	9.310	10.026	11.490	10.275	2.760
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0762	0.0803	0.0932	0.0832	0.0220
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.14	30.15	30.18	30.16	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.22	29.17	29.05	29.15	0.22
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.56	28.50	28.46	28.50	0.13
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	63.07	65.87	64.13	64.36	3.52
vm = 0.3048 * vs	vsm	m/s	19.22	20.08	19.55	19.62	1.07
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	33021	34492	33578	33697	1845
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	46195	47313	46043	46517	1723
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	20655	21093	20326	20691	956
Qsdm = Qsd/35.32	Qsdm	dscm/min	584.8	597.2	575.5	585.8	27.1
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	43966	44905	43324	44065	1976
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.9	99.5	100.5	100.0	1.3

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE ALAIMO

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag	DATA flag	DATA flag	AVERAGE flag	CI
TEST DATE	-	-	10/14/93	10/15/93	10/15/93		
RUN NUMBER	-	-	1	2	3		
CONCENTRATION @ 3% O2							
ANTIMONY		µg/dscm	5.1925	6.1723	7.2218	6.1955	2.5211
ARSENIC		µg/dscm	280.4238	313.3806	257.8265	283.8770	69.4063
BARIUM		µg/dscm	88.655	49.367	52.296	63.439	54.373
CADMIUM		µg/dscm	6.4124	6.3639	7.0401	6.6055	0.9371
CHROMIUM		µg/dscm	403.224	349.718	298.345	350.429	130.286
COBALT		µg/dscm	65.338	70.413	66.357	67.369	6.669
LEAD		µg/dscm	111.9506	152.9750	124.3435	129.7564	52.2730
MANGANESE		µg/dscm	440.52	200.37	194.13	278.34	349.02
MERCURY		µg/dscm	3.8019	1.8310	0.5318	2.0549	4.0906
SELENIUM		µg/dscm	9.85	ND 0.10	21.86	10.59	27.08
VANADIUM		µg/dscm	857.139	595.083	452.741	634.988	509.615
PARTICULATE		mg/dscm	3486.99	3319.66	3415.22	3407.29	208.55

MASS FLOW RATE							
ANTIMONY		mg/hr	150.129	182.735	210.211	181.025	74.722
ARSENIC		mg/hr	8107.731	9277.870	7504.804	8296.802	2239.698
BARIUM		mg/hr	2563.22	1461.55	1522.22	1848.99	1538.50
CADMIUM		mg/hr	185.399	188.409	204.924	192.911	26.116
CHROMIUM		mg/hr	11658.17	10353.67	8684.21	10232.02	3703.42
COBALT		mg/hr	1889.09	2084.62	1931.52	1968.41	255.52
LEAD		mg/hr	3236.763	4528.942	3619.387	3795.030	1648.990
MANGANESE		mg/hr	12736.55	5932.12	5650.68	8106.45	9967.80
MERCURY		mg/hr	109.923	54.209	15.478	59.870	117.946
SELENIUM		mg/hr	284.84	ND 2.86	636.19	307.49	788.27
VANADIUM		mg/hr	24781.97	17617.88	13178.37	18526.08	14545.48
PARTICULATE		kg/hr	100.8173	98.2811	99.4100	99.5028	3.1567

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1Io3-M-EI

DATE: 8/10/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	-	-	10/14/93	10/15/93	10/15/93
RUN NUMBER	-	-	1	2	3
ROUND STACK, DIAMETER	ds	inches	39.5	39.5	39.5
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.196	0.196	0.196
AVERAGE STACK TEMPERATURE	Fs	°F	140	146	148
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.88	29.82	29.82
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30
AVG. DELTA H	dH	in. H20	1.32	1.39	1.38
AVG. VELOCITY HEAD	dP	in. H20	0.967	0.985	1.02
PITOT COEFFICIENT	Cp	-	0.84	0.84	0.84
GAS SAMPLE VOLUME	Vm	ft^3	66.72	40.6	37.2
METER CALIBRATION FACTOR	Y	-	0.981	0.981	0.981
TOTAL SAMPLING TIME	min	minutes	120	72	72
STACK GAS OXYGEN CONTENT	Co2,m	%	6.71	6.65	6.34
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.29	11.35	11.66
IMPINGER GAIN	Ww	grams	301.2	128	136

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY	µg	*	7.985	14.485	20.79	17.64
ARSENIC	µg	*	112.06	317.06	365.06	341.06
BARIUM	µg	*	327.65	948.65	2514.65	1731.65
CADMIUM	µg	*	7.40	7.80	9.60	8.70
CHROMIUM	µg	*	84.70	373.70	536.00	454.85
COBALT	µg	*	13.20	85.20	95.20	90.20
LEAD	µg	*	3.90	196.05	256.05	226.05
MANGANESE	µg	*	67.60	409.40	495.00	452.20
MERCURY	µg	*	0.82	1.92	3.92	2.92
SELENIUM	µg	*	ND 0.26	ND 0.26	ND 0.26	ND 0.26
VANADIUM	µg	*	127.00	825.00	971.00	898.00
PARTICULATE	mg	*	2591	11000	13800	12400

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* Acetone rinse sample destroyed in shipment.
** *Run 1 data excluded from average and confidence index calculation.*

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1Io3-M-EI

DATE: 8/10/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: MATT GARDNER

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA		AVERAGE	DATA
TEST DATE	-	-	10/14/93	10/15/93	10/15/93			
RUN NUMBER	-	-	1	2	3			
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.03017	0.03017	0.03017	**	0.03017	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.510	8.510	8.510	**	8.510	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	**	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	600.0	606.0	608.0	**	607.0	37.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	**	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	66.56	40.43	37.04	**	38.73	145.13
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	14.177	6.025	6.402	**	6.213	41.347
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1756	0.1297	0.1474	**	0.1385	0.2080
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	30.07	30.08	30.12	**	30.10	0.21
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	27.95	28.51	28.33	**	28.42	2.57
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.67	27.61	27.61	**	27.61	0.31
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	62.19	62.52	63.93	**	63.23	8.32
vm = 0.3048 * vs	vsm	m/s	18.96	19.06	19.49	**	19.27	2.53
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	31754	31924	32644	**	32284	4246
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	51074	51747	52404	**	52075	5974
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	21299	22333	22300	**	22316	5281
Qsdm = Qsd/35.32	Qsdm	dscm/min	603.0	632.3	631.4	**	631.8	149.5
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	45236	47444	47432	**	47438	11422
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	105.8	102.1	93.7	**	97.9	55.6

* Acetone rinse sample destroyed in shipment.
** Run 1 data excluded from average and confidence index calculation.

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R11a3-M-EI

DATE: 8/10/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: MATT GARDNER

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA	flag	DATA	flag	AVERAGE	DATA
TEST DATE	–	–		10/14/93		10/15/93		10/15/93			
RUN NUMBER	-	-		1		2		3			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	*	5.3436	*	15.8917	*	24.3584	**	20.1251	85.5898
ARSENIC		µg/dscm	*	74.9911	*	347.8512	*	427.8224	**	387.8368	1662.0834
BARIUM		µg/dscm	*	219.265	*	1040.778	*	2946.977	**	1993.878	12572.358
CADMIUM		µg/dscm	*	4.9521	*	8.5575	*	11.2505	**	9.9040	28.3925
CHROMIUM		µg/dscm	*	56.682	*	409.992	*	628.151	**	519.071	2591.003
COBALT		µg/dscm	*	8.834	*	93.474	*	111.567	**	102.521	492.724
LEAD		µg/dscm	*	2.6099	*	215.0860	*	300.0675	**	257.5768	1376.5598
MANGANESE		µg/dscm	*	45.24	*	449.16	*	580.10	**	514.63	2504.88
MERCURY		µg/dscm	*	0.5487	*	2.1065	*	4.5939	**	3.3502	18.3313
SELENIUM		µg/dscm	*	ND 0.17	*	ND 0.29	*	ND 0.30	**	ND 0.29	0.63
VANADIUM		µg/dscm	*	84.989	*	905.120	*	1137.938	**	1021.529	4969.329
PARTICULATE		mg/dscm	*	1733.91	*	12068.26	*	16172.54	**	14120.40	66844.32
MASS FLOW RATE											
ANTIMONY		mg/hr	*	153.266	*	479.964	*	750.563	**	615.264	2687.150
ARSENIC		mg/hr	*	2150.907	*	10505.858	*	13182.612	**	11844.235	51699.100
BARIUM		mg/hr	*	6288.99	*	31433.74	*	90806.05	**	61119.893	389911.73
CADMIUM		mg/hr	*	142.037	*	258.455	*	346.664	**	302.559	922.139
CHROMIUM		mg/hr	*	1625.75	*	12382.64	*	19355.39	**	15869.016	80248.40
COBALT		mg/hr	*	253.36	*	2823.12	*	3437.75	**	3130.436	15177.21
LEAD		mg/hr	*	74.858	*	6496.064	*	9246.064	**	7871.064	42285.316
MANGANESE		mg/hr	*	1297.53	*	13565.57	*	17874.85	**	15720.208	77277.32
MERCURY		mg/hr	*	15.739	*	63.620	*	141.554	**	102.587	570.543
SELENIUM		mg/hr	*	ND 4.99	*	ND 8.62	*	ND 9.39	**	ND 9.002	21.10
VANADIUM		mg/hr	*	2437.67	*	27336.57	*	35063.60	**	31200.082	153181.23
PARTICULATE		kg/hr	*	49.7323	*	364.4876	*	498.3292	**	431.4084	2069.1141

* Acetone rinse sample destroyed in shipment.
** Run 1 data excluded from average and confidence index calculation.

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	10/15/93	10/15/93	
RUN NUMBER	-	-	2	3	
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	29.5	29.5	
WIDTH	W	inches	29.5	29.5	
NOZZLE DIAMETER	dn	inches	0.234	0.234	
AVERAGE STACK TEMPERATURE	Fs	°F	146	147	
AVERAGE METER TEMPERATURE	Fm	°F	60	60	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.82	29.88	
STACK STATIC PRESSURE	Pg	in. H20	-25	-25	
AVG. DELTA H	dH	in. H20	1.293	1.34	
AVG. VELOCITY HEAD	dP	in. H20	0.896	0.91	
PITOT COEFFICIENT	Cp	-	0.84	0.84	
GAS SAMPLE VOLUME	Vm	ft^3	176.08	179.2	
METER CALIBRATION FACTOR	Y	-	1.009	1.009	
TOTAL SAMPLING TIME	min	minutes	240	240	
STACK GAS OXYGEN CONTENT	Co2,m	%	7.16	6.94	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.84	11.06	
IMPINGER GAIN	Ww	grams	574.9	587.6	

LAB ANALYSIS RESULTS								AVERAGE	
ANTIMONY		µg	ND	0.34	ND	0.34		ND	0.34
ARSENIC		µg		149.06		1.76			75.41
BARIUM		µg		486.65		31.65			259.15
CADMIUM		µg		3.80		0.80			2.30
CHROMIUM		µg		208.70	ND	10.80			107.05
COBALT		µg		46.20	ND	4.80			24.30
LEAD		µg		137.05		1.95			69.50
MANGANESE		µg		267.00		13.40			140.20
MERCURY		µg		6.92		6.94			6.93
SELENIUM		µg	ND	0.26	ND	0.26		ND	0.26
VANADIUM		µg		441.00	ND	36.00			229.50
PARTICULATE		mg		2650		45			1347

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/15/93	10/15/93			
RUN NUMBER	-	-	2	3			
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301		0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000		0.000	0.000
= L * W/144 (RECTANGULAR)			6.043	6.043		6.043	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	606.0	607.0		606.5	6.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0		520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	180.30	183.88		182.09	22.77
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	27.061	27.658		27.359	3.798
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1305	0.1307		0.1306	0.0016
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.02	30.05		30.03	0.17
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.45	28.47		28.46	0.13
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.98	28.04		28.01	0.38
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	59.30	59.73		59.52	2.71
vm = 0.3048 * vs	vsm	m/s	18.08	18.21		18.14	0.82
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	21504	21659		21581	981
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	35243	35538		35391	1877
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	15230	15342		15286	715
Qsdm = Qsd/35.32	Qsdm	dscm/min	431.2	434.4		432.8	20.2
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	32288	32555		32422	1698
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.9	101.1		100.5	7.9

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA		flag	AVERAGE	CI
TEST DATE	–	–		10/15/93		10/15/93				
RUN NUMBER	-	-		2		3				
CONCENTRATION @ 3% O2										
ANTIMONY		µg/dscm	ND	0.0867	ND	0.0837		ND	0.0852	0.0193
ARSENIC		µg/dscm		38.0311		0.4334			19.2322	238.8583
BARIUM		µg/dscm		124.164		7.793			65.978	739.302
CADMIUM		µg/dscm		0.9704		0.1978			0.5841	4.9082
CHROMIUM		µg/dscm		53.248	ND	2.659			27.289	321.388
COBALT		µg/dscm		11.787	ND	1.182			6.189	67.377
LEAD		µg/dscm		34.9661		0.4794			17.7227	219.0939
MANGANESE		µg/dscm		68.12		3.30			35.71	411.82
MERCURY		µg/dscm		1.7656		1.7088			1.7372	0.3607
SELENIUM		µg/dscm	ND	0.07	ND	0.06		ND	0.07	0.01
VANADIUM		µg/dscm		112.516	ND	8.864			58.474	658.504
PARTICULATE		mg/dscm		676.12		11.06			343.59	4225.15

MASS FLOW RATE										
ANTIMONY		mg/hr	ND	1.723	ND	1.702		ND	1.712	0.134
ARSENIC		mg/hr		755.259		8.808			382.033	4742.198
BARIUM		mg/hr		2465.76		158.40			1312.08	14658.67
CADMIUM		mg/hr		19.272		4.021			11.646	96.885
CHROMIUM		mg/hr		1057.44	ND	54.05			542.23	6374.55
COBALT		mg/hr		234.09	ND	24.02			123.05	1334.53
LEAD		mg/hr		694.391		9.744			352.068	4349.560
MANGANESE		mg/hr		1352.84		67.06			709.95	8168.52
MERCURY		mg/hr		35.062		34.733			34.898	2.091
SELENIUM		mg/hr	ND	1.32	ND	1.30		ND	1.31	0.10
VANADIUM		mg/hr		2234.46	ND	180.17			1162.27	13050.91
PARTICULATE		kg/hr		13.4270		0.2247			6.8259	83.8744

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse Inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	10/14/93	10/15/93	10/15/93
RUN NUMBER	-	-	1	2	3
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	15.5	15.5	15.5
WIDTH	W	inches	15.5	15.5	15.5
NOZZLE DIAMETER	dn	inches	0.235	0.227	0.227
AVERAGE STACK TEMPERATURE	Fs	°F	137	136	137
AVERAGE METER TEMPERATURE	Fm	°F	77.3	78	75
BAROMETRIC PRESSURE	Pbar	in. Hg	29.88	29.82	29.82
STACK STATIC PRESSURE	Pg	in. H20	-29.75	-29.75	-29.75
AVG. DELTA H	dH	in. H20	1.355	1.09	1.23
AVG. VELOCITY HEAD	dP	in. H20	0.612	0.572	0.64
PITOT COEFFICIENT	Cp	-	0.82	0.82	0.82
GAS SAMPLE VOLUME	Vm	ft^3	119.51	54.39	42.43
METER CALIBRATION FACTOR	Y	-	0.993	0.993	0.993
TOTAL SAMPLING TIME	min	minutes	192	96	72
STACK GAS OXYGEN CONTENT	Co2,m	%	7.21	7.16	6.94
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.79	10.84	11.06
IMPINGER GAIN	Ww	grams	364.3	176.2	142.3

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY		µg	29.785	19.185	11.69	20.22
ARSENIC		µg	274.06	356.06	243.06	291.06
BARIUM		µg	1484.65	529.65	940.65	984.98
CADMIUM		µg	2.70	4.30	3.80	3.60
CHROMIUM		µg	381.70	261.70	262.70	302.03
COBALT		µg	80.70	50.40	61.20	64.10
LEAD		µg	60.85	100.05	135.47	98.79
MANGANESE		µg	499.40	284.40	401.00	394.93
MERCURY		µg	5.32	1.74	1.74	2.93
SELENIUM		µg	ND 0.26	ND 0.26	ND 0.26	ND 0.26
VANADIUM		µg	714.00	652.00	573.00	646.33
PARTICULATE		mg	16300	13400	9290	12997

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse Inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/14/93	10/15/93	10/15/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04337	0.04047	0.04047	0.04144	0.00416
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			1.668	1.668	1.668	1.668	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	597.0	596.0	597.0	596.7	1.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	537.3	538.0	535.0	536.8	3.9
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	116.81	52.95	41.55	70.44	100.76
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	17.148	8.294	6.698	10.713	13.985
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1280	0.1354	0.1388	0.1341	0.0137
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.01	30.02	30.05	30.03	0.04
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.48	28.39	28.37	28.41	0.14
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.69	27.63	27.63	27.65	0.09
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	47.72	46.21	48.94	47.62	3.39
vm = 0.3048 * vs	vsm	m/s	14.54	14.08	14.92	14.51	1.03
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	4777	4626	4899	4767	340
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7871	7596	8026	7831	540
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3408	3271	3444	3374	227
Qsdm = Qsd/35.32	Qsdm	dscm/min	96.5	92.6	97.5	95.5	6.4
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	7224	6934	7309	7156	488
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	98.9	100.1	99.5	99.5	1.5

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse Inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA	flag	DATA	flag	AVERAGE	CI
TEST DATE	–	–		10/14/93		10/15/93		10/15/93			
RUN NUMBER	-	-		1		2		3			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm		11.7729		16.6674		12.7322		13.7242	6.4435
ARSENIC		µg/dscm		108.3257		309.3351		264.8433		227.5014	262.2950
BARIUM		µg/dscm		586.827		460.145		1024.952		690.641	736.281
CADMIUM		µg/dscm		1.0686		3.7388		4.1444		2.9839	4.1515
CHROMIUM		µg/dscm		150.872		227.358		286.243		221.491	168.628
COBALT		µg/dscm		31.898		43.786		66.685		47.456	43.927
LEAD		µg/dscm		24.0505		86.9181		147.6109		86.1932	153.4908
MANGANESE		µg/dscm		197.39		247.08		436.94		293.80	314.08
MERCURY		µg/dscm		2.1028		1.5117		1.8959		1.8368	0.7452
SELENIUM		µg/dscm	ND	0.10	ND	0.23	ND	0.28	ND	0.20	0.23
VANADIUM		µg/dscm		282.218		566.440		624.353		491.003	454.926
PARTICULATE		mg/dscm		6442.78		11641.55		10122.58		9402.30	6641.09

MASS FLOW RATE											
ANTIMONY		mg/hr		52.129		71.088		58.101		60.439	24.081
ARSENIC		mg/hr		479.653		1319.340		1208.571		1002.521	1133.335
BARIUM		mg/hr		2598.40		1962.56		4677.21		3079.39	3527.27
CADMIUM		mg/hr		4.732		15.946		18.912		13.197	18.581
CHROMIUM		mg/hr		668.04		969.70		1306.23		981.32	793.13
COBALT		mg/hr		141.24		186.75		304.31		210.77	209.04
LEAD		mg/hr		106.493		370.713		673.599		383.602	704.988
MANGANESE		mg/hr		874.04		1053.81		1993.90		1307.25	1494.11
MERCURY		mg/hr		9.311		6.447		8.652		8.137	3.726
SELENIUM		mg/hr	ND	0.46	ND	0.96	ND	1.29	ND	0.90	1.05
VANADIUM		mg/hr		1249.62		2415.91		2849.14		2171.56	2055.24
PARTICULATE		kg/hr		28.5278		49.6522		46.1928		41.4576	28.1483

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	--	--	10/14/93	10/15/93	10/15/93
RUN NUMBER	-	-	1	2	3
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	18.5	18.5	18.5
WIDTH	W	inches	18.5	18.5	18.5
NOZZLE DIAMETER	dn	inches	0.296	0.296	0.296
AVERAGE STACK TEMPERATURE	Fs	°F	143	144	143
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.88	29.82	29.88
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30
AVG. DELTA H	dH	in. H20	1.254	1.538	1.48
AVG. VELOCITY HEAD	dP	in. H20	0.388	0.419	0.4
PITOT COEFFICIENT	Cp	-	0.78	0.78	0.78
GAS SAMPLE VOLUME	Vm	ft^3	173.15	178.51	178.96
METER CALIBRATION FACTOR	Y	-	1.009	0.989	0.989
TOTAL SAMPLING TIME	min	minutes	240	240	240
STACK GAS OXYGEN CONTENT	Co2,m	%	6.95	7.12	6.71
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	12.05	11.88	12.29
IMPINGER GAIN	Ww	grams	538.7	561.4	578

LAB ANALYSIS RESULTS									AVERAGE	
ANTIMONY		µg	ND	0.34	ND	0.34	ND	0.34	ND	0.34
ARSENIC		µg	ND	0.24	ND	0.24		1.16		0.47
BARIUM		µg	ND	18.60	ND	18.60	ND	18.60	ND	18.60
CADMIUM		µg		8.80		7.30		6.00		7.37
CHROMIUM		µg	ND	10.80	ND	10.80	ND	10.80	ND	10.80
COBALT		µg	ND	4.80	ND	4.80	ND	4.80	ND	4.80
LEAD		µg		4.30		3.70		1.65		3.22
MANGANESE		µg		18.00		43.00		22.40		27.80
MERCURY		µg		3.68		6.48		1.88		4.01
SELENIUM		µg	ND	0.26	ND	0.26	ND	0.26	ND	0.26
VANADIUM		µg	ND	36.00	ND	36.00	ND	36.00	ND	36.00
PARTICULATE		mg		27		17		34		26

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F), Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/14/93	10/15/93	10/15/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.06881	0.06881	0.06881	0.06881	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			2.377	2.377	2.377	2.377	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	603.0	604.0	603.0	603.3	1.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	177.63	179.27	180.06	178.99	3.07
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	25.357	26.425	27.206	26.329	2.307
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1249	0.1285	0.1313	0.1282	0.0079
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	30.21	30.19	30.23	30.21	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.68	28.62	28.63	28.64	0.08
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.67	27.61	27.67	27.65	0.09
STACK GAS VELOCITY vs = 85.49 Cp [sqrt[(dP*Ts) /(Ps*Mw)]]	vs	ft/s	36.20	37.73	36.79	36.91	1.92
vm = 0.3048 * vs	vsm	m/s	11.03	11.50	11.21	11.25	0.58
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	acf/min	5163	5381	5247	5264	274
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	8478	8783	8600	8620	383
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3658	3782	3690	3710	161
Qsdm = Qsd/35.32	Qsdm	dscm/min	103.6	107.1	104.5	105.0	4.5
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	7802	8062	7879	7914	332
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	100.7	98.3	101.2	100.0	3.9

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag		DATA flag		DATA flag		AVERAGE flag		CI
TEST DATE	-	-		10/14/93		10/15/93		10/15/93			
RUN NUMBER	-	-		1		2		3			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	ND	0.0867	ND	0.0870	ND	0.0841	ND	0.0859	0.0040
ARSENIC		µg/dscm	ND	0.0612	ND	0.0614		0.2870		0.1161	0.3237
BARIUM		µg/dscm	ND	4.744	ND	4.759	ND	4.601	ND	4.701	0.216
CADMIUM		µg/dscm		2.2446		1.8678		1.4843		1.8655	0.9444
CHROMIUM		µg/dscm	ND	2.755	ND	2.763	ND	2.672	ND	2.730	0.126
COBALT		µg/dscm	ND	1.224	ND	1.228	ND	1.187	ND	1.213	0.056
LEAD		µg/dscm		1.0968		0.9467		0.4074		0.8170	0.9006
MANGANESE		µg/dscm		4.59		11.00		5.54		7.04	8.60
MERCURY		µg/dscm		0.9386		1.6579		0.4651		1.0206	1.4922
SELENIUM		µg/dscm	ND	0.07	ND	0.07	ND	0.06	ND	0.07	0.00
VANADIUM		µg/dscm	ND	9.182	ND	9.211	ND	8.906	ND	9.100	0.419
PARTICULATE		mg/dscm		6.76		4.35		8.36		6.49	5.02

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	0.420	ND	0.430	ND	0.418	ND	0.423	0.016
ARSENIC		mg/hr	ND	0.296	ND	0.304		1.426		0.575	1.615
BARIUM		mg/hr	ND	22.97	ND	23.54	ND	22.86	ND	23.13	0.90
CADMIUM		mg/hr		10.868		9.238		7.376		9.161	4.342
CHROMIUM		mg/hr	ND	13.34	ND	13.67	ND	13.28	ND	13.43	0.52
COBALT		mg/hr	ND	5.93	ND	6.07	ND	5.90	ND	5.97	0.23
LEAD		mg/hr		5.311		4.682		2.025		4.006	4.334
MANGANESE		mg/hr		22.23		54.42		27.54		34.73	42.87
MERCURY		mg/hr		4.545		8.200		2.311		5.019	7.386
SELENIUM		mg/hr	ND	0.32	ND	0.33	ND	0.32	ND	0.32	0.01
VANADIUM		mg/hr	ND	44.46	ND	45.56	ND	44.25	ND	44.76	1.74
PARTICULATE		kg/hr		0.0327		0.0215		0.0416		0.0319	0.0249

EPA METHOD 26A: HCL and HF
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-HCL-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			10/13/93	10/14/93	10/15/93	
RUN NUMBER	-	-	1	2	3	
ROUND STACK, DIAMETER	ds	inches	40	40	40	
RECTANGULAR STACK, LENGTH	L	inches				
WIDTH	W	inches				
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234	
AVERAGE STACK TEMPERATURE	Fs	°F	291	301	302	
AVERAGE METER TEMPERATURE	Fm	°F	69.3	81.3	90	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.77	29.88	29.88	
STACK STATIC PRESSURE	Pg	in. H20	-18	-18	-18	
AVG. DELTA H	dH	in. H20	1.757	1.758	1.71	
AVG. VELOCITY HEAD	dP	in. H20	0.888	0.881	0.84	
PITOT COEFFICIENT	Cp	-	0.829	0.829	0.829	
GAS SAMPLE VOLUME	Vm	ft^3	41.25	41.74	41.45	
METER CALIBRATION FACTOR	Y	-	1.017	1.017	1.017	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	6.94	6.35	5.91	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.06	11.65	12.09	
IMPINGER GAIN	Ww	grams	74.4	79.1	81	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	16	23	25	21.333333
FLUORIDE		mg	0.83	0.4	4.5	1.91

EPA METHOD 26A: HCL and HF
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-HCL-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/13/93	10/14/93	10/15/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.727	8.727	8.727	8.727	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	751.0	761.0	762.0	758.0	15.1
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	529.3	541.3	550.0	540.2	25.8
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	41.80	41.51	40.57	41.29	1.60
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	3.502	3.723	3.813	3.679	0.397
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0773	0.0823	0.0859	0.0818	0.0107
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.05	30.12	30.17	30.11	0.15
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.12	29.12	29.13	29.12	0.01
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.45	28.56	28.56	28.52	0.16
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	63.59	63.64	62.17	63.13	2.07
vm = 0.3048 * vs	vsm	m/s	19.38	19.40	18.95	19.24	0.63
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	33298	33319	32554	33057	1083
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	45811	45420	44325	45185	1913
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	20529	20240	19671	20147	1084
Qsdm = Qsd/35.32	Qsdm	dscm/min	581.2	573.0	556.9	570.4	30.7
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	43560	43049	41913	42841	2095
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.2	99.9	100.5	99.9	1.6
HCl concentration, dry		mg/dscm	13.90165	20.12268	22.38214	18.80216	10.91061
HCl concentration, dry @ 3% O2		mg/dscm	17.82518	24.75574	26.72718	23.10270	11.61566
HCl concentration, dry @ 3% O2		ppmv	11.76364	16.33743	17.63847	15.24651	7.66570
HCl mass flow rate		mg/hr	484796	691877	747943	641539	344347.4
HF concentration, dry		mg/dscm	0.73844	0.35835	4.12541	1.74074	5.15231
HF concentration, dry @ 3% O2		mg/dscm	0.94686	0.44086	4.92628	2.10466	6.10315
HF concentration, dry @ 3% O2		ppmv	1.13826	0.52998	5.92212	2.53012	7.33689
HF mass flow rate		mg/hr	25752	12321	137859	58644	171245.1

EPA METHOD 26A: HCL and HF
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R2-3-HCL-EI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			10/14/93	10/15/93		
RUN NUMBER	-	-	2	3		
ROUND STACK, DIAMETER	ds	inches	39.5	39.5		
RECTANGULAR STACK, LENGTH	L	inches				
WIDTH	W	inches				
NOZZLE DIAMETER	dn	inches	0.227	0.227		
AVERAGE STACK TEMPERATURE	Fs	°F	147	147.1		
AVERAGE METER TEMPERATURE	Fm	°F	60	60		
BAROMETRIC PRESSURE	Pbar	in. Hg	29.88	29.82		
STACK STATIC PRESSURE	Pg	in. H20	-30	-30		
AVG. DELTA H	dH	in. H20	1.636	1.71		
AVG. VELOCITY HEAD	dP	in. H20	0.666	0.7		
PITOT COEFFICIENT	Cp	-	0.84	0.84		
GAS SAMPLE VOLUME	Vm	ft^3	37.07	37.73		
METER CALIBRATION FACTOR	Y	-	0.981	0.981		
TOTAL SAMPLING TIME	min	minutes	60	60		
STACK GAS OXYGEN CONTENT	Co2,m	%	6.83	6.36		
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.17	11.64		
IMPINGER GAIN	Ww	grams	124	126.1		
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	ND 0.01	ND 0.01		ND 0.01
FLUORIDE		mg	ND 0.03	ND 0.03		ND 0.03

EPA METHOD 26A: HCL and HF
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R2-3-HCL-EI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/14/93	10/15/93			
RUN NUMBER	-	-	2	3			
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04047	0.04047		0.04047	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.510	8.510		8.510	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000		0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	607.0	607.1		607.1	0.6
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0		520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	37.01	37.60		37.30	3.75
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	5.837	5.936		5.886	0.628
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1362	0.1363		0.1363	0.0007
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.06	30.12		30.09	0.36
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.42	28.46		28.44	0.30
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.67	27.61		27.64	0.38
STACK GAS VELOCITY vs = 85.49 Cp [sqrt[(dP*Ts) /(Ps*Mw)]]	vs	f/s	51.49	52.80		52.14	8.36
vm = 0.3048 * vs	vsm	m/s	15.69	16.09		15.89	2.55
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	26289	26960		26625	4267
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	42489	43545		43017	6712
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	18262	18683		18472	2671
Qsdm = Qsd/35.32	Qsdm	dscm/min	517.1	529.0		523.0	75.6
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	38768	39735		39252	6144
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	102.3	101.6		102.0	4.5
HCl concentration, dry		mg/dscm	ND 0.00981	ND 0.00966		ND 0.00974	0.00098
HCl concentration, dry @ 3% O2		mg/dscm	ND 0.01249	ND 0.01189		ND 0.01219	0.00377
HCl concentration, dry @ 3% O2		ppmv	ND 0.00824	ND 0.00785		ND 0.00804	0.00249
HCl mass flow rate		mg/hr	ND 304	ND 307		ND 306	13.5
HF concentration, dry		mg/dscm	ND 0.03015	ND 0.02967		ND 0.02991	0.00301
HF concentration, dry @ 3% O2		mg/dscm	ND 0.03835	ND 0.03653		ND 0.03744	0.01158
HF concentration, dry @ 3% O2		ppmv	ND 0.04611	ND 0.04392		ND 0.04501	0.01392
HF mass flow rate		mg/hr	ND 935	ND 942		ND 939	41.4

EPA METHOD 26A: HCL and HF
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R3-HCL-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			10/15/93			
RUN NUMBER	-	-	3			
ROUND STACK, DIAMETER	ds	inches	29.5			
RECTANGULAR STACK, LENGTH	L	inches				
WIDTH	W	inches				
NOZZLE DIAMETER	dn	inches	0.227			
AVERAGE STACK TEMPERATURE	Fs	°F	147			
AVERAGE METER TEMPERATURE	Fm	°F	60			
BAROMETRIC PRESSURE	Pbar	in. Hg	29.88			
STACK STATIC PRESSURE	Pg	in. H20	-25			
AVG. DELTA H	dH	in. H20	1.15			
AVG. VELOCITY HEAD	dP	in. H20	0.9			
PITOT COEFFICIENT	Cp	-	0.8399			
GAS SAMPLE VOLUME	Vm	ft^3	41.49			
METER CALIBRATION FACTOR	Y	-	1.009			
TOTAL SAMPLING TIME	min	minutes	60			
STACK GAS OXYGEN CONTENT	Co2,m	%	6.98			
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.02			
IMPINGER GAIN	Ww	grams	143.4			
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	0.52			0.52
FLUORIDE		mg	ND 0.03			ND 0.03

EPA METHOD 26A: HCL and HF
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R3-HCL-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/15/93				
RUN NUMBER	-	-	3				
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04047			0.04047	na
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	4.746			4.746	na
= L * W/144 (RECTANGULAR)			0.000			0.000	na
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	607.0			607.0	na
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0			520.0	na
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	42.55			42.55	na
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	6.750			6.750	na
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1369			0.1369	na
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.04			30.04	na
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.39			28.39	na
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.04			28.04	na
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	59.48			59.48	na
vm = 0.3048 * vs	vsm	m/s	18.13			18.13	na
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	16938			16938	na
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	27717			27717	na
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dsct/min	11914			11914	na
Qsdm = Qsd/35.32	Qsdm	dscm/min	337.3			337.3	na
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	25276			25276	na
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	100.6			100.6	na
HCl concentration, dry		mg/dscm	0.44383			0.44383	na
HCl concentration, dry @ 3% O2		mg/dscm	0.57072			0.57072	na
HCl concentration, dry @ 3% O2		ppmv	0.37665			0.37665	na
HCl mass flow rate		mg/hr	8982			8982	na
HF concentration, dry		mg/dscm	ND 0.02622			ND 0.02622	na
HF concentration, dry @ 3% O2		mg/dscm	ND 0.03372			ND 0.03372	na
HF concentration, dry @ 3% O2		ppmv	ND 0.04053			ND 0.04053	na
HF mass flow rate		mg/hr	ND 531			ND 531	na

EPA METHOD 26A: HCL and HF
LOCATION: FF inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-HCL-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA		DATA		DATA			
TEST DATE			10/13/93		10/14/93		10/15/93			
RUN NUMBER	-	-	1		2		3			
ROUND STACK, DIAMETER	ds	inches								
RECTANGULAR STACK, LENGTH	L	inches	15.5		15.5					
WIDTH	W	inches	15.5		15.5					
NOZZLE DIAMETER	dn	inches	0.229		0.229					
AVERAGE STACK TEMPERATURE	Fs	°F	137		141					
AVERAGE METER TEMPERATURE	Fm	°F	60.9		82.58					
BAROMETRIC PRESSURE	Pbar	in. Hg	29.77		29.88					
STACK STATIC PRESSURE	Pg	in. H20	-29.75		-29.75					
AVG. DELTA H	dH	in. H20	1.144		1.169					
AVG. VELOCITY HEAD	dP	in. H20	0.582		0.578					
PITOT COEFFICIENT	Cp	-	0.82		0.82					
GAS SAMPLE VOLUME	Vm	ft^3	33.65		34.99					
METER CALIBRATION FACTOR	Y	-	0.993		0.993					
TOTAL SAMPLING TIME	min	minutes	60		60					
STACK GAS OXYGEN CONTENT	Co2,m	%	7.91		7.34					
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.09		10.66					
IMPINGER GAIN	Ww	grams	96.9		116					
LAB ANALYSIS RESULTS									AVERAGE	
CHLORIDE		mg	ND	0.01	ND	0.01			ND	0.01
FLUORIDE		mg	ND	0.02	ND	0.03			ND	0.025

EPA METHOD 26A: HCL and HF
LOCATION: FF inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-HCL-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/13/93	10/14/93			
RUN NUMBER	-	-	1	2			
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04119	0.04119		0.04119	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000		0.000	0.000
= L * W/144 (RECTANGULAR)			1.668	1.668		1.668	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	597.0	601.0		599.0	25.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.9	542.6		531.7	137.7
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	33.78	33.85		33.82	0.43
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	4.561	5.460		5.011	5.712
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1190	0.1389		0.1289	0.1267
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.93	30.00		29.97	0.43
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.51	28.33		28.42	1.14
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.58	27.69		27.64	0.70
STACK GAS VELOCITY vs = 85.49 Cp [sqrt((dP*Ts) /(Ps*Mw)]]	vs	ft/s	46.60	46.65		46.62	0.31
vm = 0.3048 * vs	vsm	m/s	14.20	14.22		14.21	0.09
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	4664	4669		4667	31
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7665	7604		7635	385
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3349	3268		3309	516
Qsdm = Qsd/35.32	Qsdm	dscm/min	94.8	92.5		93.7	14.6
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	7079	6924		7002	990
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	98.1	100.7		99.4	16.8
HCl concentration, dry		mg/dscm	ND 0.01075	ND 0.01073		ND 0.01074	0.00014
HCl concentration, dry @ 3% O2		mg/dscm	ND 0.01482	ND 0.01416		ND 0.01449	0.00414
HCl concentration, dry @ 3% O2		ppmv	ND 0.00978	ND 0.00935		ND 0.00956	0.00273
HCl mass flow rate		mg/hr	ND 61	ND 60		ND 60	10.2
HF concentration, dry		mg/dscm	ND 0.02202	ND 0.03296		ND 0.02749	0.06952
HF concentration, dry @ 3% O2		mg/dscm	ND 0.03034	ND 0.04351		ND 0.03693	0.08367
HF concentration, dry @ 3% O2		ppmv	ND 0.03647	ND 0.05231		ND 0.04439	0.10058
HF mass flow rate		mg/hr	ND 125	ND 183		ND 154	366.7

EPA METHOD 26A: HCL and HF
LOCATION: FF outlet (10)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-HCL-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

DATA ENTRY	SYMBOL	UNITS	DATA		DATA		DATA			
TEST DATE			10/13/93		10/14/93		10/15/93			
RUN NUMBER	-	-	1		2		3			
ROUND STACK, DIAMETER	ds	inches								
RECTANGULAR STACK, LENGTH	L	inches	18.5		18.5		18.5			
WIDTH	W	inches	18.5		18.5		18.5			
NOZZLE DIAMETER	dn	inches	0.295		0.295		0.295			
AVERAGE STACK TEMPERATURE	Fs	°F	139		144		144			
AVERAGE METER TEMPERATURE	Fm	°F	60		60		60			
BAROMETRIC PRESSURE	Pbar	in. Hg	29.77		29.88		29.88			
STACK STATIC PRESSURE	Pg	in. H20	-30		-30		-30			
AVG. DELTA H	dH	in. H20	1.373		1.617		1.6			
AVG. VELOCITY HEAD	dP	in. H20	0.434		0.446		0.44			
PITOT COEFFICIENT	Cp	-	0.78		0.78		0.78			
GAS SAMPLE VOLUME	Vm	ft^3	45.45		46.64		46.44			
METER CALIBRATION FACTOR	Y	-	1.009		0.989		0.989			
TOTAL SAMPLING TIME	min	minutes	60		60		60			
STACK GAS OXYGEN CONTENT	Co2,m	%	7.74		7.15		6.61			
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.26		10.85		11.39			
IMPINGER GAIN	Ww	grams	128.8		144.5		148.9			
LAB ANALYSIS RESULTS									AVERAGE	
CHLORIDE		mg	ND	0.01	ND	0.01	ND	0.01	ND	0.01
FLUORIDE		mg	ND	0.03	ND	0.03	ND	0.03		0.02

EPA METHOD 26A: HCL and HF
LOCATION: FF outlet (10)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-HCL-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: VINCE

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/13/93	10/14/93	10/15/93		
RUN NUMBER	-	-	1	2	3		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.06835	0.06835	0.06835	0.06835	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			2.377	2.377	2.377	2.377	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	599.0	604.0	604.0	602.3	7.2
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	46.47	46.94	46.74	46.72	0.59
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	6.063	6.802	7.009	6.624	1.236
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.1154	0.1266	0.1304	0.1241	0.0193
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.95	30.02	30.09	30.02	0.17
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.57	28.50	28.51	28.53	0.10
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.56	27.67	27.67	27.64	0.16
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	38.31	38.97	38.70	38.66	0.82
vm = 0.3048 * vs	vsm	m/s	11.68	11.88	11.80	11.78	0.25
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	5463	5557	5519	5513	117
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	8961	9053	8993	9002	116
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3923	3923	3879	3908	63
Qsdm = Qsd/35.32	Qsdm	dscm/min	111.1	111.1	109.8	110.7	1.8
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	8298	8318	8241	8286	98
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	98.9	99.9	100.6	99.8	2.1
HCl concentration, dry		mg/dscm	ND 0.00782	ND 0.00774	ND 0.00777	ND 0.00777	0.00010
HCl concentration, dry @ 3% O2		mg/dscm	ND 0.01063	ND 0.01007	ND 0.00973	ND 0.01015	0.00113
HCl concentration, dry @ 3% O2		ppmv	ND 0.00702	ND 0.00665	ND 0.00642	ND 0.00670	0.00074
HCl mass flow rate		mg/hr	ND 52	ND 52	ND 51	ND 52	1.1
HF concentration, dry		mg/dscm	ND 0.02401	ND 0.02377	ND 0.02387	0.01594	0.00030
HF concentration, dry @ 3% O2		mg/dscm	ND 0.03266	ND 0.03094	ND 0.02990	0.02103	0.00346
HF concentration, dry @ 3% O2		ppmv	ND 0.03926	ND 0.03720	ND 0.03595	0.02528	0.00416
HF mass flow rate		mg/hr	ND 160	ND 158	ND 157	106	3.4

METALS AND CHLORIDE ANALYSIS

PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-SS4

DATE: 8/10/94
OPERATOR: DAVE LADD
ENTERED BY: JENNY PONT
CHECKED BY: DESIREE JONES

DATA ENTRY	SYMBOL	UNITS	DATA
RUN NUMBER	-	-	COMPOSITE OF 1-3
STREAM FLOW		kg/hr	
TOTAL SAMPLING TIME	min	minutes	240
TOTAL STREAM MASS	Ww	grams	
METALS CATCH			
ANTIMONY		µg/g	ND 0.55
ARSENIC		µg/g	5.5
BARIUM		µg/g	64
BERYLLIUM		µg/g	1.1
CADMIUM		µg/g	ND 0.046
CHROMIUM		µg/g	17.5
COBALT		µg/g	4.6
LEAD		µg/g	5.5
MANGANESE		µg/g	24
MERCURY(1)		µg/g	0.06
MERCURY		µg/g	0.07
SELENIUM		µg/g	12
VANADIUM		µg/g	1.8
			48
CHLORIDE		Wt. %	0.018
MOISTURE		%	7.87

METALS AND CHLORIDE ANALYSIS
LOCATION: GSA absorber/cyclone solids (5)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R11o3-M-SS5

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS		DATA		DATA		DATA			
TEST DATE				10/13/93		10/14/93		10/15/93			
RUN NUMBER	-	-		1		2		3			
STREAM FLOW		kg/hr	*	329.05		403.86		582.45			
LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	0.08	ND	0.08	ND	0.08	ND	0.08	0.00
ARSENIC		mg/kg		16.60		13.90		20.60		17.03	8.37
BARIUM		mg/kg		55.30		51.60		41.60		49.50	17.61
CADMIUM		mg/kg	ND	0.004		0.222		0.322		0.182	0.40
CHROMIUM		mg/kg		16.50		15.60		15.20		15.77	1.65
COBALT		mg/kg		3.16		2.40		2.34		2.63	1.14
LEAD		mg/kg	ND	0.04		0.22		0.53		0.26	0.62
MANGANESE		mg/kg		68.40		61.20		51.20		60.27	21.46
MERCURY		mg/kg	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.00
SELENIUM		mg/kg	ND	0.10	ND	0.10	ND	0.10	ND	0.100	0.00
VANADIUM		mg/kg		23.60		24.40		20.00		22.67	5.82
CHLORINE		mg/kg		92.00		100.00		210.00		134.00	163.82
MASS FLOW RATE											
ANTIMONY		mg/hr	ND	26.3	ND	32.3	ND	46.6	ND	35.08	25.9
ARSENIC		mg/hr		5462.2		5613.7		11998.5		7691.45	9268.5
BARIUM		mg/hr		18196.5		20839.2		24229.9		21088.52	7513.7
CADMIUM		mg/hr	ND	1.3		89.7		187.5		92.621	231.4
CHROMIUM		mg/hr		5429.3		6300.2		8853.2		6860.93	4420.9
COBALT		mg/hr		1039.8		969.3		1362.9		1124.00	521.5
LEAD		mg/hr	ND	11.5		88.8		308.7		134.44	383.0
MANGANESE		mg/hr		22507.0		24716.2		29821.4		25681.56	9320.1
MERCURY		mg/hr	ND	32.9	ND	40.4	ND	58.2	ND	43.845	32.3
SELENIUM		mg/hr	ND	32.9	ND	40.4	ND	58.2	ND	43.845	32.3
VANADIUM		mg/hr		7765.6		9854.2		11649.0		9756.25	4828.5
CHLORINE		mg/hr		30272.6		40386.0		122314.5		64324.4	125396.6

*Ash flow calculated using Run 3 particulate data for GSA inlet and ESP inlet (10/15/93).

METALS AND CHLORIDE ANALYSIS
LOCATION: Lime slurry (SS7)
PLANT: National Center for Emissions Research/AirPol Den
CITY: West Paducah, KY
RUN #: AP-DS-R1to3-M-SS7

DATE: 8/10/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			10/13/93	10/14/93	10/15/93
RUN NUMBER	-	-	1	2	3
SLURRY FLOW		L/hr	1242.2	1249	1330.8
SLURRY DENSITY(a)		kg/L	1.14	1.14	1.14

LAB ANALYSIS:			1	2	3	AVERAGE	CI
ANTIMONY		mg/kg	(b) ND 0.08	(b) ND 0.08	(b) ND 0.08	(b) ND 0.08	0.00
ARSENIC		mg/kg	(b) 0.54	(b) 0.54	(b) 0.54	(b) 0.54	0.00
BARIUM		mg/kg	(b) 1.38	(b) 1.38	(b) 1.38	(b) 1.38	0.00
BERYLLIUM		mg/kg	(b) ND 0.02	(b) ND 0.02	(b) ND 0.02	(b) ND 0.02	0.00
CADMIUM		mg/kg	(b) 0.018	(b) 0.018	(b) 0.018	(b) 0.02	0.00
CHROMIUM		mg/kg	(b) 3.70	(b) 3.70	(b) 3.70	(b) 3.70	0.00
COBALT		mg/kg	(b) ND 0.35	(b) ND 0.35	(b) ND 0.35	(b) ND 0.35	0.00
LEAD		mg/kg	(b) ND 0.035	(b) ND 0.035	(b) ND 0.035	(b) ND 0.04	0.00
MANGANESE		mg/kg	(b) 5.44	(b) 5.44	(b) 5.44	(b) 5.44	0.00
MERCURY		mg/kg	(b) ND 0.10	(b) ND 0.10	(b) ND 0.10	(b) ND 0.10	0.00
NICKEL		mg/kg	(b) 0.96	(b) 0.96	(b) 0.96	(b) 0.96	0.00
SELENIUM		mg/kg	(b) 1.01	(b) 1.01	(b) 1.01	(b) 1.01	0.00
VANADIUM		mg/kg	(b) 2.21	(b) 2.21	(b) 2.21	(b) 2.21	0.00
CHLORIDE		mg/kg	28.00	28.00	28.00	28.00	0.00
MOISTURE		%	70.80	70.90	64.90	68.87	8.54

CALCULATED DATA						AVERAGE	CI
STREAM FLOW		kg/hr	1416	1424	1517	1452	139.65
MASS FLOW RATES:							
ANTIMONY		mg/hr	(b) ND 113.29	(b) ND 113.91	(b) ND 121.37	(b) ND 116.19	11.17
ARSENIC		mg/hr	(b) 764.7	(b) 768.9	(b) 819.2	(b) 784.27	75.41
BARIUM		mg/hr	(b) 1954.2	(b) 1964.9	(b) 2093.6	(b) 2004.26	192.71
BERYLLIUM		mg/hr	(b) ND 21.24	(b) ND 21.36	(b) ND 22.76	(b) ND 21.79	2.09
CADMIUM		mg/hr	(b) 25.49	(b) 25.63	(b) 27.31	(b) 26.14	2.51
CHROMIUM		mg/hr	(b) 5239.6	(b) 5268.3	(b) 5613.3	(b) 5373.73	516.69
COBALT		mg/hr	(b) ND 495.6	(b) ND 498.4	(b) ND 531.0	(b) ND 508.33	48.88
LEAD		mg/hr	(b) ND 49.56	(b) ND 49.84	(b) ND 53.10	(b) ND 50.83	4.89
MANGANESE		mg/hr	(b) 7703.6	(b) 7745.8	(b) 8253.1	(b) 7900.84	759.68
MERCURY		mg/hr	(b) ND 141.6	(b) ND 142.4	(b) ND 151.7	(b) ND 145.24	13.96
NICKEL		mg/hr	(b) 1359.5	(b) 1366.9	(b) 1456.4	(b) 1394.27	134.06
SELENIUM			(b) 1430.3	(b) 1438.1	(b) 1532.3	(b) 1466.88	141.04
VANADIUM			(b) 3129.6	(b) 3146.7	(b) 3352.8	(b) 3209.72	308.62
CHLORIDE		mg/L	39651.0	39868.1	42479.1	40666.1	3910.10

(a) Determined by TVA/NCER.
(b) Analysis based on single archive sample (Run 1, 10/13/93). Same analysis applied to all test runs.

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, field 1 (9A)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-SS9A

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			10/13/93	10/14/93	10/15/93
RUN NUMBER	-	-	1	2	3
STREAM FLOW		kg/hr	* 403.99	** 355.91	271.01

LABORATORY ANALYSIS RESULTS						AVERAGE	CI
ANTIMONY		mg/kg	ND 10	ND 10	ND 10	ND 10.00	0.00
ARSENIC		mg/kg	51.00	55.00	51.00	52.33	5.74
BARIUM		mg/kg	91.00	84.00	57.00	77.33	44.60
CADMIUM		mg/kg	1.200	0.900	1.200	1.100	0.43
CHROMIUM		mg/kg	23.00	21.00	18.00	20.67	6.25
COBALT		mg/kg	19.00	16.00	13.00	16.00	7.45
LEAD		mg/kg	ND 2.30	ND 2.30	5.00	2.43	3.87
MANGANESE		mg/kg	2.30	17.00	12.00	10.43	18.57
MERCURY		mg/kg	ND 0.030	ND 0.030	ND 0.030	ND 0.030	0.00
SELENIUM		mg/kg	ND 0.11	ND 0.11	ND 0.11	ND 0.110	0.00
VANADIUM		mg/kg	65.00	ND 1.70	ND 1.70	22.233	90.79
CHLORINE		mg/kg	730.00	780.00	850.00	786.67	149.75

MASS FLOW RATE							
ANTIMONY		mg/hr	ND 4039.9	ND 3559.1	ND 2710.1	ND 3436.37	1672.8
ARSENIC		mg/hr	20603.5	19575.1	13821.5	18000.02	9080.4
BARIUM		mg/hr	36763.1	29896.4	15447.6	27369.03	27030.1
CADMIUM		mg/hr	484.8	320.3	325.2	376.773	232.5
CHROMIUM		mg/hr	9291.8	7474.1	4878.2	7214.69	5510.8
COBALT		mg/hr	7675.8	5694.6	3523.1	5631.17	5160.1
LEAD		mg/hr	ND 929.2	ND 818.6	1355.1	742.98	703.7
MANGANESE		mg/hr	929.2	6050.5	3252.1	3410.59	6370.6
MERCURY		mg/hr	ND 12.1	ND 10.7	ND 8.1	ND 10.309	5.0
SELENIUM		mg/hr	ND 44.4	ND 39.2	ND 29.8	ND 37.800	18.4
VANADIUM		mg/hr	26259.4	ND 605.0	ND 460.7	8930.744	36900.8
CHLORINE		mg/hr	294912.7	277609.8	230358.5	267627.0	83013.8

*Ash flow calculated using Run 3 particulate data at ESP inlet and baghouse inlet(10/15/93), Run 2 particulate data at ESP outlet (10/15/93).
**Ash flow calculated using average of Run 1 and Run 2 particulate data at ESP outlet since no tests were performed on 10/14/93 at that location, and average of Runs 2 and 3 particulate data at ESP inlet due to lost acetone rinse for Run 1.

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, fields 2-4 (9B)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-SS9B

DATE: 8/7/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS		DATA		DATA		DATA
TEST DATE				10/13/93		10/14/93		10/15/93
RUN NUMBER	-	-		1		2		3
STREAM FLOW		kg/hr	*	48.406	**	42.645		32.472

LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	10	ND	10	ND	10	ND	10.00	0.00
ARSENIC		mg/kg		41.00		38.00		45.00		41.33	8.72
BARIUM		mg/kg		94.00		67.00		72.00		77.67	35.69
CADMIUM		mg/kg		0.800		1.600		0.900		1.100	1.08
CHROMIUM		mg/kg		32.00		24.00		28.00		28.00	9.94
COBALT		mg/kg		17.00		16.00		14.00		15.67	3.79
LEAD		mg/kg	ND	2.30		6.00		6.00		4.38	5.31
MANGANESE		mg/kg		28.00		22.00		17.00		22.33	13.68
MERCURY		mg/kg	ND	0.030	ND	0.030	ND	0.030	ND	0.030	0.00
SELENIUM		mg/kg	ND	0.11	ND	0.11	ND	0.11	ND	0.110	0.00
VANADIUM		mg/kg		56.00	ND	1.70	ND	1.70		19.233	77.88
CHLORINE		mg/kg		770.00		730.00		850.00		783.33	151.80

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	484.1	ND	426.5	ND	324.7	ND	411.74	200.4
ARSENIC		mg/hr		1984.6		1620.5		1461.2		1688.80	666.6
BARIUM		mg/hr		4550.2		2857.2		2338.0		3248.45	2873.9
CADMIUM		mg/hr		38.7		68.2		29.2		45.394	50.5
CHROMIUM		mg/hr		1549.0		1023.5		909.2		1160.56	847.7
COBALT		mg/hr		822.9		682.3		454.6		653.28	461.7
LEAD		mg/hr	ND	111.3		255.9		194.8		168.79	180.3
MANGANESE		mg/hr		1355.4		938.2		552.0		948.53	996.1
MERCURY		mg/hr	ND	1.5	ND	1.3	ND	1.0	ND	1.235	0.6
SELENIUM		mg/hr	ND	5.3	ND	4.7	ND	3.6	ND	4.529	2.2
VANADIUM		mg/hr		2710.7	ND	72.5	ND	55.2		924.862	3796.6
CHLORINE		mg/hr		37272.6		31130.9		27601.2		32001.6	12158.7

*Ash flow calculated using Run 3 particulate data at ESP inlet and baghouse inlet(10/15/93), Run 2 particulate data at ESP outlet (10/15/93).
**Ash flow calculated using average of Run 1 and Run 2 particulate data at ESP outlet since no tests were performed on 10/14/93 at that location, and average of Runs 2 and 3 particulate data at ESP inlet due to lost acetone rinse for Run 1.

METALS AND CHLORIDE ANALYSIS
LOCATION: Baghouse hopper ash (11)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to2-M-SS11

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA		
TEST DATE			10/13/93	10/14/94	10/15/94		
RUN NUMBER	-	-	1	2	3		
STREAM FLOW		kg/hr	* 47.439	30.169	51.187		
LABORATORY ANALYSIS RESULTS						AVERAGE	CI
ANTIMONY		mg/kg	ND 10	ND 10	ND 10	ND 10.00	0.00
ARSENIC		mg/kg	59.00	53.00	56.00	56.00	7.45
BARIUM		mg/kg	83.00	63.00	73.00	73.00	24.84
CADMIUM		mg/kg	1.200	0.800	1.000	1.000	0.50
CHROMIUM		mg/kg	22.00	25.00	23.50	23.50	3.73
COBALT		mg/kg	15.00	15.00	15.00	15.00	0.00
LEAD		mg/kg	ND 2.30	ND 2.30	ND 2.30	ND 2.30	0.00
MANGANESE		mg/kg	26.00	19.00	22.50	22.50	8.70
MERCURY		mg/kg	ND 0.030	ND 0.030	ND 0.030	ND 0.030	0.00
SELENIUM		mg/kg	ND 0.11	ND 0.11	ND 0.11	ND 0.110	0.00
VANADIUM		mg/kg	ND 1.70	53.00	26.93	26.925	63.73
CHLORINE		mg/kg	-	720.00	-	720.00	na
MASS FLOW RATE							
ANTIMONY		mg/hr	ND 474.4	ND 301.7	ND 511.9	ND 429.32	278.5
ARSENIC		mg/hr	2798.9	1599.0	2866.5	2421.44	1771.6
BARIUM		mg/hr	3937.4	1900.6	3736.7	3191.58	2788.6
CADMIUM		mg/hr	56.9	24.1	51.2	44.083	43.5
CHROMIUM		mg/hr	1043.7	754.2	1202.9	1000.26	565.1
COBALT		mg/hr	711.6	452.5	767.8	643.98	417.8
LEAD		mg/hr	ND 109.1	ND 69.4	ND 117.7	ND 98.74	64.1
MANGANESE		mg/hr	1233.4	573.2	1151.7	986.11	894.1
MERCURY		mg/hr	ND 1.4	ND 0.9	ND 1.5	ND 1.288	0.8
SELENIUM		mg/hr	ND 5.2	ND 3.3	ND 5.6	ND 4.722	3.1
VANADIUM		mg/hr	ND 80.6	1599.0	1378.2	1005.830	2038.0
CHLORINE		mg/hr	-	21721.7	-	21721.7	na

*Ash flow calculated using baghouse inlet and outlet flue gas particulate data from 10/15/93.
**No metals analysis available. Estimated value using average of Runs 1 and 2 concentrations.

METALS AND CHLORIDE ANALYSIS
LOCATION: Reinjected fly ash (13)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R1to3-M-SS13

DATE: 8/4/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			10/13/93	10/14/93	10/15/93
RUN NUMBER	-	-	1	2	3
STREAM FLOW		kg/hr	194.3	198.13	199.49

LABORATORY ANALYSIS RESULTS								AVERAGE		CI
ANTIMONY		mg/kg	ND 0.08	ND 0.08	ND 0.08	ND	0.08		0.00
ARSENIC		mg/kg	33.80	30.60	54.40		39.60		32.09
BARIUM		mg/kg	113.50	124.20	146.10		127.93		41.28
CADMIUM		mg/kg	0.295	0.297	0.405		0.332		0.16
CHROMIUM		mg/kg	22.00	32.30	30.00		28.10		13.43
COBALT		mg/kg	6.02	6.02	7.60		6.55		2.27
LEAD		mg/kg	10.80	9.96	18.70		13.15		11.98
MANGANESE		mg/kg	75.70	89.10	78.30		81.03		17.65
MERCURY		mg/kg	ND 0.100	ND 0.100	ND 0.100	ND	0.100		0.00
SELENIUM		mg/kg	2.73	4.11	3.46		3.433		1.72
VANADIUM		mg/kg	32.00	47.50	47.70		42.40		22.38
CHLORINE		mg/kg	3.10	3.30	3.30		3.23		0.29

MASS FLOW RATE									
ANTIMONY		mg/hr	ND 15.5	ND 15.9	ND 16.0	ND	15.78		0.5
ARSENIC		mg/hr	6567.3	6062.8	10852.3		7827.46		6538.0
BARIUM		mg/hr	22053.1	24607.7	29145.5		25268.76		8924.1
CADMIUM		mg/hr	57.3	58.8	80.8		65.652		32.6
CHROMIUM		mg/hr	4274.6	6399.6	5984.7		5552.97		2798.3
COBALT		mg/hr	1169.7	1192.7	1516.1		1292.85		481.2
LEAD		mg/hr	2098.4	1973.4	3730.5		2600.76		2435.5
MANGANESE		mg/hr	14708.5	17653.4	15620.1		15993.99		3745.4
MERCURY		mg/hr	ND 19.4	ND 19.8	ND 19.9	ND	19.731		0.7
SELENIUM		mg/hr	530.4	814.3	690.2		678.330		353.6
VANADIUM		mg/hr	6217.6	9411.2	9515.7		8381.48		4657.4
CHLORINE		mg/hr	602.3	653.8	658.3		638.2		77.3

METALS AND CHLORIDE ANALYSIS
LOCATION: Trim water (14)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-DP-R11o3-M-SS14

DATE: 8/10/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			10/13/93	10/14/93	10/15/93
RUN NUMBER	-	-	1	2	3
STREAM FLOW		L/hr	1033.73	1036	965.72
WATER DENSITY		kg/L	1	1	1

LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	* ND	0.002	* ND	0.002	* ND	0.002	ND	0.002	0.00
ARSENIC		mg/kg	* ND	0.001	* ND	0.001	* ND	0.001	ND	0.001	0.00
BARIUM		mg/kg	*	0.039	*	0.039	*	0.039		0.039	0.00
CADMIUM		mg/kg	* ND	0.0007	* ND	0.0007	* ND	0.0007	ND	0.0007	0.00
CHROMIUM		mg/kg	* ND	0.009	* ND	0.009	* ND	0.009	ND	0.009	0.00
COBALT		mg/kg	* ND	0.007	* ND	0.007	* ND	0.007	ND	0.007	0.00
LEAD		mg/kg	* ND	0.001	* ND	0.001	* ND	0.001	ND	0.001	0.00
MANGANESE		mg/kg	* ND	0.001	* ND	0.001	* ND	0.001	ND	0.001	0.00
MERCURY		mg/kg	* ND	0.0002	* ND	0.0002	* ND	0.0002	ND	0.0002	0.00
SELENIUM		mg/kg	* ND	0.001	* ND	0.001	* ND	0.001	ND	0.001	0.00
VANADIUM		mg/kg	* ND	0.005	* ND	0.005	* ND	0.005	ND	0.005	0.00
CHLORINE		mg/kg		240.00		87.00		60.00		129.00	241.16

MASS FLOW RATE											
STREAM FLOW		kg/hr		1033.73		1036		965.72			
ANTIMONY		mg/hr	ND	2.1	ND	2.1	ND	1.9	ND	2.02	0.2
ARSENIC		mg/hr	ND	1.0	ND	1.0	ND	1.0	ND	1.01	0.1
BARIUM		mg/hr		40.3		40.4		37.7		39.46	3.9
CADMIUM		mg/hr	ND	0.7	ND	0.7	ND	0.7	ND	0.708	0.1
CHROMIUM		mg/hr	ND	9.3	ND	9.3	ND	8.7	ND	9.11	0.9
COBALT		mg/hr	ND	7.2	ND	7.3	ND	6.8	ND	7.08	0.7
LEAD		mg/hr	ND	1.0	ND	1.0	ND	1.0	ND	1.01	0.1
MANGANESE		mg/hr	ND	1.0	ND	1.0	ND	1.0	ND	1.01	0.1
MERCURY		mg/hr	ND	0.2	ND	0.2	ND	0.2	ND	0.202	0.0
SELENIUM		mg/hr	ND	1.0	ND	1.0	ND	1.0	ND	1.012	0.1
VANADIUM		mg/hr	ND	5.2	ND	5.2	ND	4.8	ND	5.06	0.5
CHLORINE		mg/hr		248095.2		90132.0		57943.2		132056.8	252838.2

* Analysis based on single archive sample (Run 3, 9/23/93). Same analysis applied to all other test runs.

Appendix B-3—Series Configuration, BaselineTests: Results

EPA METHOD 29. MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-GI

DATE: 8/9/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: Glenn England

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	9/28/93	9/29/93	9/29/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches	40	40	40
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234
AVERAGE STACK TEMPERATURE	Fs	°F	291	284	288
AVERAGE METER TEMPERATURE	Fm	°F	86	75	80
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	30.03	30.03
STACK STATIC PRESSURE	Pg	in. H20	-18	-18	-18
AVG. DELTA H	dH	in. H20	1.9	1.26	1.34
AVG. VELOCITY HEAD	dP	in. H20	0.91	0.874	0.874
PITOT COEFFICIENT	Cp	-	0.829	0.829	0.829
GAS SAMPLE VOLUME	Vm	ft^3	114.77	94.05	96.35
METER CALIBRATION FACTOR	Y	-	1.017	1.017	1.017
TOTAL SAMPLING TIME	min	minutes	160	160	160
STACK GAS OXYGEN CONTENT	Co2,m	%	6.41	6.56	6.71
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.59	11.44	11.29
IMPINGER GAIN	Ww	grams	202.7	174.1	169.6

LAB ANALYSIS RESULTS							AVERAGE
ANTIMONY		µg	ND 0.34	ND 0.34	3.39		1.24
ARSENIC		µg	438.60	491.06	497.06		475.57
BARIUM		µg	595.65	2044.65	2584.65		1741.65
CADMIUM		µg	15.30	18.40	19.00		17.57
CHROMIUM		µg	783.70	1062.70	1422.70		1089.70
COBALT		µg	107.20	145.20	176.20		142.87
LEAD		µg	186.70	348.90	429.60		321.73
MANGANESE		µg	1259.60	2110.40	1933.30		1767.77
MERCURY		µg	2.80	6.22	4.52		4.51
SELENIUM		µg	322.07	356.00	290.07		322.71
VANADIUM		µg	1589.00	2239.00	2599.00		2142.33
PARTICULATE		mg	7420	10900	11300		9873

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-GI

DATE: 8/9/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: Glenn England

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	-	-	9/28/93	9/29/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.727	8.727	8.727	8.727	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	751.0	744.0	748.0	747.7	8.7
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	546.0	535.0	540.0	540.3	13.7
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	113.05	95.00	96.44	101.50	24.93
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	9.541	8.195	7.983	8.573	2.099
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0778	0.0794	0.0764	0.0779	0.0037
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.11	30.09	30.07	30.09	0.04
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.17	29.13	29.15	29.15	0.04
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.52	28.71	28.71	28.64	0.27
STACK GAS VELOCITY vs = 85.49 Cp (sqrt[(dP*Ts) /(Ps*Mw)])	vs	ft/s	64.24	62.49	62.64	63.12	2.41
vm = 0.3048 * vs	vsm	m/s	19.58	19.05	19.09	19.24	0.73
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	acf/min	33636	32721	32798	33052	1260
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	46473	45883	45775	46044	934
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	20777	20502	20506	20595	390
Qsdm = Qsd/35.32	Qsdm	dscm/min	588.2	580.5	580.6	583.1	11.1
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	44179	43570	43553	43768	886
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.4	84.7	85.9	90.0	20.3

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-GI

DATE: 8/9/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: Glenn England

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag	DATA flag	DATA flag	AVERAGE flag	CI
TEST DATE	-	-	9/28/93	9/29/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
CONCENTRATION @ 3% O2							
ANTIMONY		µg/dscm	ND 0.1312	1 ND 0.14664	1 1.485173	0.5414	1.9311
ARSENIC		µg/dscm	169.2265	1 211.791	1 218.0856	199.7010	66.0306
BARIUM		µg/dscm	229.822	1 881.8443	1 1134.018	748.561	1159.194
CADMIUM		µg/dscm	5.9032	1 7.93731	1 8.337807	7.3928	3.2431
CHROMIUM		µg/dscm	302.378	1 458.3356	1 624.2112	461.641	399.835
COBALT		µg/dscm	41.361	1 62.62382	1 77.30795	60.431	44.900
LEAD		µg/dscm	72.0351	1 150.4783	1 188.4875	137.0003	147.5315
MANGANESE		µg/dscm	486.00	1 910.2018	1 848.2375	748.15	569.24
MERCURY		µg/dscm	1.0803	2.885854	2.08762	2.0179	2.2478
SELENIUM		µg/dscm	124.26	165.171	133.9702	141.13	53.10
VANADIUM		µg/dscm	613.089	1 965.6662	1 1140.314	906.356	667.218
PARTICULATE		mg/dscm	2862.88	1 4669.07	1 4851.55	4127.84	2730.97

MASS FLOW RATE							
ANTIMONY		mg/hr	ND 3.748	1 ND 4.091	1 41.014	14.978	53.207
ARSENIC		mg/hr	4834.894	1 5909.303	1 6022.506	5588.901	1628.329
BARIUM		mg/hr	6566.13	1 24604.85	1 31316.28	20829.08	31799.02
CADMIUM		mg/hr	168.659	1 221.463	1 230.251	206.791	82.764
CHROMIUM		mg/hr	8639.09	1 12788.29	1 17237.80	12888.39	10683.21
COBALT		mg/hr	1181.72	1 1747.30	1 2134.88	1687.97	1190.86
LEAD		mg/hr	2058.082	1 4198.582	1 5205.143	3820.602	3992.874
MANGANESE		mg/hr	13885.16	1 25396.07	1 23424.36	20901.86	15293.81
MERCURY		mg/hr	30.866	80.520	57.650	56.345	61.743
SELENIUM		mg/hr	3550.27	4608.53	3699.63	3952.81	1422.93
VANADIUM		mg/hr	17516.29	1 26943.61	1 31490.15	25316.68	17707.31
PARTICULATE		kg/hr	81.7941	1 130.2745	1 133.9771	115.3486	72.3388

(1) Results corrected for low isokinetic rate caused by partially blocked pitot: (C)corrected = C x (1 + I/100)/2 where C = concentration and I = isokinetic rate, %.

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-EI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	8/28/93	8/29/93	8/29/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches	39.5	39.5	39.5
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.196	0.196	0.196
AVERAGE STACK TEMPERATURE	Fs	°F	272	272	273
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	30.03	30.03
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30
AVG. DELTA H	dH	in. H20	1.34	1.31	1.19
AVG. VELOCITY HEAD	dP	in. H20	1.08	1.07	0.97
PITOT COEFFICIENT	Cp	-	0.84	0.84	0.84
GAS SAMPLE VOLUME	Vm	ft^3	65.77	65.47	62.69
METER CALIBRATION FACTOR	Y	-	0.981	0.981	0.981
TOTAL SAMPLING TIME	min	minutes	120	120	120
STACK GAS OXYGEN CONTENT	Co2,m	%	7.22	7.08	7.23
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.78	10.92	10.77
IMPINGER GAIN	Ww	grams	114.8	109.6	109.2

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY		µg	2.785	6.185	3.09	4.02
ARSENIC		µg	450.06	365.06	378.06	397.73
BARIUM		µg	2444.65	1744.65	1584.65	1924.65
CADMIUM		µg	13.30	11.90	12.30	12.50
CHROMIUM		µg	996.70	843.70	929.70	923.37
COBALT		µg	169.20	173.20	161.20	167.87
LEAD		µg	376.50	302.90	307.10	328.83
MANGANESE		µg	1299.00	1023.00	1189.00	1170.33
MERCURY		µg	3.82	2.52	2.24	2.86
SELENIUM		µg	150.07	142.07	143.07	145.07
VANADIUM		µg	1769.00	1349.00	1349.00	1489.00
PARTICULATE		mg	6690	3160	6090	5313

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-EI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	8/28/93	8/29/93	8/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.03017	0.03017	0.03017	0.03017	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.510	8.510	8.510	8.510	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	732.0	732.0	733.0	732.3	1.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	65.53	65.64	62.83	64.67	3.95
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	5.404	5.159	5.140	5.234	0.365
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0762	0.0729	0.0756	0.0749	0.0044
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.01	30.03	30.01	30.02	0.03
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.10	29.15	29.10	29.12	0.08
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.63	27.82	27.82	27.76	0.27
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	71.20	70.56	67.29	69.69	5.22
vm = 0.3048 * vs	vsm	m/s	21.70	21.51	20.51	21.24	1.59
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	36356	36029	34357	35581	2664
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	49821	49807	47350	48993	3534
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	22366	22398	21266	22010	1602
Qsdm = Qsd/35.32	Qsdm	dscm/min	633.3	634.1	602.1	623.2	45.3
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	47407	47500	45072	46660	3417
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.2	99.2	100.0	99.5	1.2

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-EI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag	DATA flag	DATA flag	AVERAGE flag	CI
TEST DATE	–	–	8/28/93	8/29/93	8/29/93		
RUN NUMBER	-	-	2	3	4		
CONCENTRATION @ 3% O2							
ANTIMONY		µg/dscm	1.9637	4.3095	2.2702	2.8478	3.1679
ARSENIC		µg/dscm	317.3310	254.3632	278.2028	283.2990	78.9815
BARIUM		µg/dscm	1723.689	1215.621	1166.096	1368.468	766.728
CADMIUM		µg/dscm	9.3776	8.2916	9.0538	8.9077	1.3852
CHROMIUM		µg/dscm	702.759	587.866	684.138	658.254	153.197
COBALT		µg/dscm	119.301	120.681	118.622	119.534	2.606
LEAD		µg/dscm	265.4649	211.0519	225.9855	234.1674	69.8449
MANGANESE		µg/dscm	915.91	712.80	874.95	834.55	266.85
MERCURY		µg/dscm	2.6934	1.7559	1.6483	2.0325	1.4281
SELENIUM		µg/dscm	105.81	98.99	105.28	103.36	9.43
VANADIUM		µg/dscm	1247.297	939.944	992.688	1059.976	408.311
PARTICULATE		mg/dscm	4717.03	2201.80	4481.45	3800.09	3451.16

MASS FLOW RATE							
ANTIMONY		mg/hr	57.020	126.597	62.631	82.082	96.025
ARSENIC		mg/hr	9214.528	7472.163	7675.238	8120.643	2366.973
BARIUM		mg/hr	50051.76	35710.04	32171.00	39310.93	23523.32
CADMIUM		mg/hr	272.304	243.573	249.781	255.219	37.558
CHROMIUM		mg/hr	20406.43	17269.12	18874.44	18850.00	3897.43
COBALT		mg/hr	3464.20	3545.11	3272.62	3427.31	347.66
LEAD		mg/hr	7708.461	6199.852	6234.634	6714.316	2139.339
MANGANESE		mg/hr	26595.72	20939.09	24138.65	23891.15	7046.65
MERCURY		mg/hr	78.211	51.580	45.476	58.422	43.245
SELENIUM		mg/hr	3072.43	2907.83	2904.45	2961.57	238.55
VANADIUM		mg/hr	36218.50	27611.76	27386.91	30405.72	12509.31
PARTICULATE		kg/hr	136.9711	64.6799	123.6370	108.4293	95.5731

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	9/28/93	9/29/93	9/29/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	29.5	29.5	29.5
WIDTH	W	inches	29.5	29.5	29.5
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234
AVERAGE STACK TEMPERATURE	Fs	°F	257	257	258
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	30.03	30.03
STACK STATIC PRESSURE	Pg	in. H20	-25	-25	-25
AVG. DELTA H	dH	in. H20	1.57	1.605	1.612
AVG. VELOCITY HEAD	dP	in. H20	1.06	1.038	1.04
PITOT COEFFICIENT	Cp	-	0.84	0.84	0.84
GAS SAMPLE VOLUME	Vm	ft^3	183.53	185.98	185.28
METER CALIBRATION FACTOR	Y	-	0.989	0.989	0.989
TOTAL SAMPLING TIME	min	minutes	240	240	240
STACK GAS OXYGEN CONTENT	Co2,m	%	8.12	8.05	8.21
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	9.88	9.95	9.79
IMPINGER GAIN	Ww	grams	302.1	298.1	297.2

LAB ANALYSIS RESULTS									AVERAGE	
ANTIMONY		µg	ND	0.34	ND	0.34	ND	0.34	ND	0.34
ARSENIC		µg		42.36		22.56		15.56		26.83
BARIUM		µg		94.65		109.65		95.65		99.98
CADMIUM		µg		1.20		1.10		0.50		0.94
CHROMIUM		µg		34.70		6.80		51.70		31.07
COBALT		µg		5.90		6.40		5.50		5.93
LEAD		µg		7.85		8.60		21.00		12.48
MANGANESE		µg		37.70		44.40		46.70		42.93
MERCURY		µg		1.82		1.24		1.92		1.66
SELENIUM		µg		104.07		224.00		204.00		177.36
VANADIUM		µg		79.00	ND	36.00	ND	36.00		38.33
PARTICULATE		mg		174		180		163		172

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA *Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg*	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	9/28/93	9/29/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			6.043	6.043	6.043	6.043	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	717.0	717.0	718.0	717.3	1.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	184.45	188.11	187.41	186.66	4.83
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	14.220	14.032	13.989	14.080	0.305
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0716	0.0694	0.0695	0.0702	0.0031
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.91	29.91	29.89	29.90	0.02
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.05	29.09	29.07	29.07	0.04
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.00	28.19	28.19	28.13	0.27
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	69.41	68.41	68.55	68.79	1.34
vm = 0.3048 * vs	vsm	m/s	21.16	20.85	20.89	20.97	0.41
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	acf/min	25168	24807	24856	24944	486
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	35624	35392	35391	35469	334
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	16098	16012	16020	16043	118
Qsdm = Qsd/35.32	Qsdm	dscm/min	455.8	453.3	453.6	454.2	3.3
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	33997	33825	33821	33881	250
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	96.6	99.1	98.7	98.1	3.3

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-EO

DATE: 8/2/94
OPERATOR: BARRY BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag		DATA flag		DATA flag		AVERAGE flag		CI
TEST DATE	–	–		9/28/93		9/29/93		9/29/93			
RUN NUMBER	-	-		2		3		4			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	ND	0.0912	ND	0.0889	ND	0.0904	ND	0.0901	0.0028
ARSENIC		µg/dscm		11.3580		5.8989		4.1354		7.1307	9.3550
BARIUM		µg/dscm		25.379		28.671		25.421		26.490	4.692
CADMIUM		µg/dscm		0.3227		0.2885		0.1338		0.2483	0.2500
CHROMIUM		µg/dscm		9.304		1.778		13.740		8.274	15.023
COBALT		µg/dscm		1.582		1.673		1.462		1.572	0.264
LEAD		µg/dscm		2.1040		2.2487		5.5811		3.3113	4.8869
MANGANESE		µg/dscm		10.11		11.61		12.41		11.38	2.90
MERCURY		µg/dscm		0.4880		0.3242		0.5103		0.4408	0.2524
SELENIUM		µg/dscm		27.90		58.57		54.22		46.90	41.22
VANADIUM		µg/dscm		21.182	ND	9.413	ND	9.568		10.224	16.771
PARTICULATE		mg/dscm		46.65		47.07		43.32		45.68	5.10

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	1.780	ND	1.736	ND	1.743	ND	1.753	0.058
ARSENIC		mg/hr		221.753		115.182		79.784		138.906	183.588
BARIUM		mg/hr		495.49		559.83		490.45		515.25	96.10
CADMIUM		mg/hr		6.300		5.634		2.582		4.839	4.926
CHROMIUM		mg/hr		181.65		34.72		265.09		160.49	289.76
COBALT		mg/hr		30.89		32.68		28.20		30.59	5.59
LEAD		mg/hr		41.079		43.908		107.678		64.221	93.562
MANGANESE		mg/hr		197.36		226.69		239.45		221.17	53.62
MERCURY		mg/hr		9.528		6.331		9.845		8.568	4.829
SELENIUM		mg/hr		544.78		1143.65		1046.01		911.48	798.23
VANADIUM		mg/hr		413.56	ND	183.80	ND	184.59		199.25	328.99
PARTICULATE		kg/hr		0.9109		0.9190		0.8358		0.8886	0.1140

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY'HOWE
CHECKED BY: GREG ROONEY

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	9/28/93	9/29/93	9/29/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	15.5	15.5	15.5
WIDTH	W	inches	15.5	15.5	15.5
NOZZLE DIAMETER	dn	inches	0.235	0.235	0.235
AVERAGE STACK TEMPERATURE	Fs	°F	242	243	244
AVERAGE METER TEMPERATURE	Fm	°F	82.7	70.5	75.2
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	30.03	30.03
STACK STATIC PRESSURE	Pg	in. H20	-29.75	-29.75	-29.75
AVG. DELTA H	dH	in. H20	0.951	0.907	0.97
AVG. VELOCITY HEAD	dP	in. H20	0.488	0.437	0.463
PITOT COEFFICIENT	Cp	-	0.82	0.82	0.82
GAS SAMPLE VOLUME	Vm	ft^3	100.83	97.51	101.19
METER CALIBRATION FACTOR	Y	-	0.993	0.993	0.993
TOTAL SAMPLING TIME	min	minutes	192	192	192
STACK GAS OXYGEN CONTENT	Co2,m	%	8.12	8.05	8.21
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	9.88	9.95	9.79
IMPINGER GAIN	Ww	grams	156.5	153.6	156.3

LAB ANALYSIS RESULTS									AVERAGE	
ANTIMONY		µg	ND	0.34	ND	0.34	ND	0.34	ND	0.34
ARSENIC		µg		8.46		5.56		7.06		7.03
BARIUM		µg		86.65		68.65		76.65		77.32
CADMIUM		µg		0.90		0.60		0.90		0.80
CHROMIUM		µg		34.70		31.70		42.70		36.37
COBALT		µg		6.50		9.10		6.20		7.27
LEAD		µg		6.45		5.05		7.85		6.45
MANGANESE		µg		36.00		23.40		31.90		30.43
MERCURY		µg	ND	0.12		0.44	ND	0.12		0.19
SELENIUM		µg		21.20		18.40		25.20		21.60
VANADIUM		µg	ND	36.00	ND	36.00	ND	36.00	ND	36.00
PARTICULATE		mg		117		62		121		100

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	9/28/93	9/29/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04337	0.04337	0.04337	0.04337	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			1.668	1.668	1.668	1.668	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	702.0	703.0	704.0	703.0	2.5
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	542.7	530.5	535.2	536.1	15.3
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	97.34	96.90	99.69	97.98	3.73
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	7.366	7.230	7.357	7.318	0.189
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0704	0.0694	0.0687	0.0695	0.0020
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.91	29.91	29.89	29.90	0.02
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.07	29.09	29.08	29.08	0.02
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.65	27.84	27.84	27.78	0.27
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	45.76	43.18	44.48	44.47	3.22
vm = 0.3048 * vs	vsm	m/s	13.95	13.16	13.56	13.56	0.98
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	4581	4322	4453	4452	322
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	6544	6211	6388	6381	413
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dsct/min	2959	2810	2893	2887	186
Qsdm = Qsd/35.32	Qsdm	dscm/min	83.8	79.6	81.9	81.8	5.3
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	6250	5936	6107	6098	390
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	94.9	99.5	99.4	98.0	6.5

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA	flag	DATA	flag	AVERAGE	CI
TEST DATE	–	–		9/28/93		9/29/93		9/29/93			
RUN NUMBER	-	-		2		3		4			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	ND	0.1727	ND	0.1726	ND	0.1699	ND	0.1717	0.0040
ARSENIC		µg/dscm		4.2983		2.8222		3.5273		3.5493	1.8341
BARIUM		µg/dscm		44.025		34.846		38.295		39.055	11.518
CADMIUM		µg/dscm		0.4590		0.3063		0.4514		0.4056	0.2138
CHROMIUM		µg/dscm		17.630		16.091		21.333		18.351	6.695
COBALT		µg/dscm		3.302		4.619		3.096		3.673	2.051
LEAD		µg/dscm		3.2756		2.5618		3.9205		3.2526	1.6884
MANGANESE		µg/dscm		18.29		11.88		15.94		15.37	8.06
MERCURY		µg/dscm	ND	0.0610		0.2233	ND	0.0600		0.0946	0.2336
SELENIUM		µg/dscm		10.77		9.34		12.59		10.90	4.05
VANADIUM		µg/dscm	ND	18.291	ND	18.273	ND	17.986	ND	18.183	0.425
PARTICULATE		mg/dscm		59.44		31.32		60.45		50.41	41.08

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	0.620	ND	0.591	ND	0.592	ND	0.601	0.041
ARSENIC		mg/hr		15.428		9.671		12.289		12.463	7.161
BARIUM		mg/hr		158.02		119.41		133.42		136.95	48.55
CADMIUM		mg/hr		1.648		1.050		1.573		1.423	0.809
CHROMIUM		mg/hr		63.28		55.14		74.33		64.25	23.92
COBALT		mg/hr		11.85		15.83		10.79		12.82	6.60
LEAD		mg/hr		11.757		8.779		13.659		11.398	6.111
MANGANESE		mg/hr		65.65		40.70		55.53		53.96	31.17
MERCURY		mg/hr	ND	0.219		0.765	ND	0.209		0.326	0.791
SELENIUM		mg/hr		38.66		32.00		43.86		38.18	14.77
VANADIUM		mg/hr	ND	65.65	ND	62.62	ND	62.66	ND	63.64	4.32
PARTICULATE		kg/hr		0.2134		0.1073		0.2106		0.1771	0.1502

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	9/28/93	9/29/93	9/29/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	18.5	18.5	18.5
WIDTH	W	inches	18.5	18.5	18.5
NOZZLE DIAMETER	dn	inches	0.29	0.29	0.296
AVERAGE STACK TEMPERATURE	Fs	°F	238	234	235
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	30.03	30.03
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30
AVG. DELTA H	dH	in. H20	0.955	0.999	1.159
AVG. VELOCITY HEAD	dP	in. H20	0.329	0.329	0.331
PITOT COEFFICIENT	Cp	-	0.78	0.78	0.78
GAS SAMPLE VOLUME	Vm	ft^3	185.85	185.96	155.22
METER CALIBRATION FACTOR	Y	-	1.009	1.009	1.009
TOTAL SAMPLING TIME	min	minutes	300	300	240
STACK GAS OXYGEN CONTENT	Co2,m	%	8.34	8.35	8.36
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	9.66	9.65	9.64
IMPINGER GAIN	Ww	grams	292.3	283.9	239.2

LAB ANALYSIS RESULTS									AVERAGE	
ANTIMONY		µg	ND	0.34	ND	0.34	ND	0.34	ND	0.34
ARSENIC		µg	ND	0.24	ND	0.24		0.66		0.30
BARIUM		µg	ND	18.60	ND	18.60	ND	18.60	ND	18.60
CADMIUM		µg		1.50		2.60		2.60		2.24
CHROMIUM		µg	ND	10.80	ND	10.80	ND	10.80	ND	10.80
COBALT		µg	ND	4.80	ND	4.80	ND	4.80	ND	4.80
LEAD		µg		3.10		3.40		2.40		2.97
MANGANESE		µg		17.00		7.40		8.00		10.80
MERCURY		µg		0.24		1.22		0.24		0.57
SELENIUM		µg		2.70		8.10		6.10		5.63
VANADIUM		µg	ND	36.00	ND	36.00	ND	36.00	ND	36.00
PARTICULATE		mg		27		57		45		43

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	9/28/93	9/29/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.06605	0.06605	0.06881	0.06697	0.00396
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			2.377	2.377	2.377	2.377	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	698.0	694.0	695.0	695.7	5.2
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	190.27	191.61	160.00	180.63	44.41
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	13.759	13.363	11.259	12.794	3.338
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0674	0.0652	0.0657	0.0661	0.0029
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.88	29.88	29.88	29.88	0.00
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.08	29.10	29.10	29.09	0.03
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.63	27.82	27.82	27.76	0.27
STACK GAS VELOCITY vs = 85.49 Cp (sqrt[(dP*Ts) /(Ps*Mw)])	vs	ft/s	35.65	35.41	35.55	35.53	0.30
vm = 0.3048 * vs	vsm	m/s	10.87	10.79	10.83	10.83	0.09
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	5083	5049	5069	5067	43
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7300	7350	7366	7339	85
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3311	3338	3344	3331	45
Qsdm = Qsd/35.32	Qsdm	dscm/min	93.7	94.5	94.7	94.3	1.3
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	6986	7044	7056	7029	93
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.3	99.2	99.2	99.2	0.2

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA	flag	DATA	flag	AVERAGE	CI
TEST DATE	–	–		9/28/93		9/29/93		9/29/93			
RUN NUMBER	-	-		2		3		4			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	ND	0.0899	ND	0.0894	ND	0.1071	ND	0.0955	0.0251
ARSENIC		µg/dscm	ND	0.0635	ND	0.0631		0.2079		0.0904	0.2075
BARIUM		µg/dscm	ND	4.919	ND	4.889	ND	5.859	ND	5.222	1.371
CADMIUM		µg/dscm		0.3976		0.6843		0.8201		0.6340	0.5358
CHROMIUM		µg/dscm	ND	2.856	ND	2.839	ND	3.402	ND	3.032	0.796
COBALT		µg/dscm	ND	1.270	ND	1.262	ND	1.512	ND	1.348	0.354
LEAD		µg/dscm		0.8199		0.8936		0.7560		0.8232	0.1711
MANGANESE		µg/dscm		4.50		1.94		2.52		2.99	3.32
MERCURY		µg/dscm		0.0635		0.3207		0.0756		0.1532	0.3605
SELENIUM		µg/dscm		0.71		2.13		1.92		1.59	1.90
VANADIUM		µg/dscm	ND	9.521	ND	9.462	ND	11.341	ND	10.108	2.653
PARTICULATE		mg/dscm		7.17		14.88		14.11		12.05	10.55

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	0.355	ND	0.355	ND	0.426	ND	0.379	0.102
ARSENIC		mg/hr	ND	0.250	ND	0.251		0.828		0.359	0.827
BARIUM		mg/hr	ND	19.41	ND	19.44	ND	23.32	ND	20.72	5.59
CADMIUM		mg/hr		1.569		2.721		3.264		2.518	2.150
CHROMIUM		mg/hr	ND	11.27	ND	11.29	ND	13.54	ND	12.03	3.24
COBALT		mg/hr	ND	5.01	ND	5.02	ND	6.02	ND	5.35	1.44
LEAD		mg/hr		3.236		3.553		3.009		3.266	0.679
MANGANESE		mg/hr		17.74		7.73		10.03		11.84	13.03
MERCURY		mg/hr		0.250		1.275		0.301		0.609	1.435
SELENIUM		mg/hr		2.82		8.46		7.65		6.31	7.58
VANADIUM		mg/hr	ND	37.57	ND	37.62	ND	45.14	ND	40.11	10.81
PARTICULATE		kg/hr		0.0283		0.0591		0.0562		0.0479	0.0423

EPA METHOD 26A: HCL and HF
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R1to3-HCL-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			9/28/93	9/28/9.	9/29/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches	40	40	40	
RECTANGULAR STACK, LENGTH	L	inches				
WIDTH	W	inches				
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234	
AVERAGE STACK TEMPERATURE	Fs	°F	288	295	291	
AVERAGE METER TEMPERATURE	Fm	°F	70.6	85.5	78.7	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	29.84	30.03	
STACK STATIC PRESSURE	Pg	in. H20	-18	-18	-18	
AVG. DELTA H	dH	in. H20	1.904	1.751	1.21	
AVG. VELOCITY HEAD	dP	in. H20	0.955	0.862	0.6	
PITOT COEFFICIENT	Cp	-	0.829	0.829	0.829	
GAS SAMPLE VOLUME	Vm	ft^3	42.94	41.79	34.68	
METER CALIBRATION FACTOR	Y	-	1.017	1.017	1.017	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	6.66	6.46	6.54	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.34	11.54	11.46	
IMPINGER GAIN	Ww	grams	81.4	65.7	70.7	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	17	19	17	17.666667
FLUORIDE		mg	1.9	3.5	2.9	2.7666667

EPA METHOD 26A: HCL and HF
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R1to3-HCL-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			9/28/93	9/28/9.	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.727	8.727	8.727	8.727	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	748.0	755.0	751.0	751.3	8.7
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	530.6	545.5	538.7	538.3	18.5
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	43.53	41.19	34.78	39.83	11.24
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	3.831	3.092	3.328	3.417	0.938
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0809	0.0698	0.0873	0.0794	0.0220
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	30.08	30.10	30.10	30.09	0.03
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.10	29.26	29.04	29.13	0.28
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.52	28.52	28.71	28.58	0.27
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	65.75	62.59	52.11	60.15	17.75
vm = 0.3048 * vs	vsm	m/s	20.04	19.08	15.88	18.33	5.41
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	34427	32773	27282	31494	9292
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	47651	45182	37778	43537	12764
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	21279	20310	16790	19460	5869
Qsdm = Qsd/35.32	Qsdm	dscm/min	602.5	575.0	475.4	551.0	166.2
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	45203	43180	35683	41355	12460
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.6	98.8	100.9	99.8	2.7
HCl concentration, dry		mg/dscm	14.18568	16.75464	17.75025	16.23019	4.56930
HCl concentration, dry @ 3% O2		mg/dscm	17.83172	20.76926	22.12601	20.24233	5.45337
HCl concentration, dry @ 3% O2		ppmv	11.76796	13.70657	14.60195	13.35883	3.59892
HCl mass flow rate		mg/hr	512784	578077	506263	532375	98661.4
HF concentration, dry		mg/dscm	1.62348	3.16040	3.10061	2.62816	2.16285
HF concentration, dry @ 3% O2		mg/dscm	2.04076	3.91768	3.86496	3.27446	2.65513
HF concentration, dry @ 3% O2		ppmv	2.45329	4.70963	4.64626	3.93639	3.19186
HF mass flow rate		mg/hr	58686	109042	88434	85387	62893.4

EPA METHOD 26A: HCL and HF
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-HCL-EI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY:

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			9/28/93	9/28/93	9/29/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches	39.5	39.5	39.5	
RECTANGULAR STACK, LENGTH	L	inches				
WIDTH	W	inches				
NOZZLE DIAMETER	dn	inches	0.227	0.227	0.227	
AVERAGE STACK TEMPERATURE	Fs	°F	273	273	274	
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	29.84	30.03	
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30	
AVG. DELTA H	dH	in. H20	1.755	1.666	2.1	
AVG. VELOCITY HEAD	dP	in. H20	0.816	0.774	0.973	
PITOT COEFFICIENT	Cp	-	0.84	0.84	0.84	
GAS SAMPLE VOLUME	Vm	ft^3	39.23	37.83	41.85	
METER CALIBRATION FACTOR	Y	-	0.981	0.981	0.981	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	7.26	6.98	7.06	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.74	11.02	10.94	
IMPINGER GAIN	Ww	grams	72.5	73.7	79	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	18	17	22	19
FLUORIDE		mg	2.3	3	5.3	3.5333333

EPA METHOD 26A: HCL and HF
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R21o4-HCL-EI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY:

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			9/28/93	9/28/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04047	0.04047	0.04047	0.04047	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.510	8.510	8.510	8.510	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	733.0	733.0	734.0	733.3	1.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	39.13	37.72	42.04	39.63	5.47
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	3.413	3.469	3.719	3.533	0.404
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0802	0.0842	0.0813	0.0819	0.0052
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	30.01	30.04	30.03	30.03	0.04
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.05	29.03	29.05	29.04	0.03
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.63	27.63	27.82	27.70	0.27
STACK GAS VELOCITY vs = 85.49 Cp [sqrt[(dP*Ts) /(Ps*Mw)]]	vs	ft/s	61.99	60.39	67.50	63.29	9.26
vm = 0.3048 * vs	vsm	m/s	18.89	18.41	20.57	19.29	2.82
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	31652	30836	34463	32317	4727
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	43237	42097	47351	44228	6866
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	19361	18780	21172	19771	3100
Qsdm = Qsd/35.32	Qsdm	dscm/min	548.2	531.7	599.4	559.8	87.8
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	41030	39843	44904	41925	6576
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	102.0	101.4	100.2	101.2	2.2
HCl concentration, dry		mg/dscm	16.70954	16.36883	19.00761	17.36199	3.56576
HCl concentration, dry @ 3% O2		mg/dscm	21.92820	21.04900	24.58355	22.52025	4.57155
HCl concentration, dry @ 3% O2		ppmv	14.47141	13.89118	16.22379	14.86213	3.01697
HCl mass flow rate		mg/hr	549566	522199	683631	585132	214631.0
HF concentration, dry		mg/dscm	2.18632	2.95790	4.68893	3.27771	3.18391
HF concentration, dry @ 3% O2		mg/dscm	2.86914	3.80362	6.06444	4.24573	4.08150
HF concentration, dry @ 3% O2		ppmv	3.44913	4.57251	7.29036	5.10400	4.90657
HF mass flow rate		mg/hr	71906	94363	168643	111637	125779.6

EPA METHOD 26A: HCL and HF
LOCATION: FF inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-HCL-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			9/28/93	9/28/93	9/29/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches				
RECTANGULAR STACK, LENGTH	L	inches	15.5	15.5	15.5	
WIDTH	W	inches	15.5	15.5	15.5	
NOZZLE DIAMETER	dn	inches	0.229	0.229	0.229	
AVERAGE STACK TEMPERATURE	Fs	°F	236	252	249	
AVERAGE METER TEMPERATURE	Fm	°F	65.8	82.8	71.5	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	29.84	30.03	
STACK STATIC PRESSURE	Pg	in. H20	-29.75	-29.75	-29.75	
AVG. DELTA H	dH	in. H20	0.756	0.901	0.841	
AVG. VELOCITY HEAD	dP	in. H20	0.446	0.48	0.456	
PITOT COEFFICIENT	Cp	-	0.82	0.82	0.82	
GAS SAMPLE VOLUME	Vm	ft^3	41.11	41.24	34.25	
METER CALIBRATION FACTOR	Y	-	0.993	0.993	0.993	
TOTAL SAMPLING TIME	min	minutes	90	80	70	
STACK GAS OXYGEN CONTENT	Co2,m	%	8.06	7.95	8.02	
STACK GAS CARBON DIOXIDE CONTENT	Coo2,m	%	9.94	10.05	9.98	
IMPINGER GAIN	Ww	grams	70.9	64.3	59.3	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	15	21	14	16.666667
FLUORIDE		mg	2.1	4.9	1.7	2.9

EPA METHOD 26A: HCL and HF
LOCATION: FF inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R21o4-HCL-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			9/28/93	9/28/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04119	0.04119	0.04119	0.04119	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			1.668	1.668	1.668	1.668	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	696.0	712.0	709.0	705.7	21.1
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	525.8	542.8	531.5	533.4	21.5
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	40.94	39.80	33.97	38.24	9.30
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	3.337	3.027	2.791	3.052	0.680
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0754	0.0707	0.0759	0.0740	0.0072
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.91	29.93	29.92	29.92	0.02
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.01	29.08	29.01	29.04	0.10
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.65	27.65	27.84	27.72	0.27
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	43.60	45.70	44.35	44.55	2.64
vm = 0.3048 * vs	vsm	m/s	13.29	13.93	13.52	13.58	0.80
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	4365	4575	4440	4460	264
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	6277	6446	6310	6344	222
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	2829	2913	2842	2861	112
Qsdm = Qsd/35.32	Qsdm	dscm/min	80.1	82.5	80.5	81.0	3.2
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	5975	6155	6004	6045	240
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	93.8	99.7	99.6	97.7	8.3
HCl concentration, dry		mg/dscm	13.30628	19.16364	14.96999	15.81330	7.49865
HCl concentration, dry @ 3% O2		mg/dscm	18.55004	26.48874	20.80457	21.94778	10.16333
HCl concentration, dry @ 3% O2		ppmv	12.24201	17.48111	13.72987	14.48433	6.70724
HCl mass flow rate		mg/hr	63938	94817	72269	77008	39689.0
HF concentration, dry		mg/dscm	1.90756	4.57876	1.86138	2.78257	3.86494
HF concentration, dry @ 3% O2		mg/dscm	2.65929	6.32894	2.58686	3.85836	5.31621
HF concentration, dry @ 3% O2		ppmv	3.19686	7.60833	3.10979	4.63833	6.39088
HF mass flow rate		mg/hr	9166	22655	8986	13602	19477.4

EPA METHOD 26A: HCL and HF
LOCATION: FF outlet (10)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-HCL-BO

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			9/28/93	9/28/93	9/29/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches				
RECTANGULAR STACK, LENGTH	L	inches	18.5	18.5	18.5	
WIDTH	W	inches	18.5	18.5	18.5	
NOZZLE DIAMETER	dn	inches	0.29	0.29	0.29	
AVERAGE STACK TEMPERATURE	Fs	°F	232	238	238	
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60	
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	29.84	30.03	
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30	
AVG. DELTA H	dH	in. H20	1.1	1.158	1.206	
AVG. VELOCITY HEAD	dP	in. H20	0.389	0.373	0.382	
PITOT COEFFICIENT	Cp	-	0.78	0.78	0.78	
GAS SAMPLE VOLUME	Vm	ft^3	40.48	39.59	40.18	
METER CALIBRATION FACTOR	Y	-	1.009	1.009	1.009	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	7.95	8.35	8.35	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.05	9.65	9.65	
IMPINGER GAIN	Ww	grams	68.2	62.9	67.1	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	20	19	21	20
FLUORIDE		mg	4.6	3.4	5.4	4.4666667

EPA METHOD 26A: HCL and HF
LOCATION: FF outlet (10)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-HCL-BO

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: GREG ROONEY

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			9/28/93	9/28/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.06605	0.06605	0.06605	0.06605	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			2.377	2.377	2.377	2.377	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	692.0	698.0	698.0	696.0	8.6
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	41.46	40.55	41.42	41.14	1.27
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	3.210	2.961	3.158	3.110	0.327
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0719	0.0680	0.0708	0.0703	0.0049
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.93	29.88	29.88	29.89	0.07
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.07	29.07	29.04	29.06	0.05
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.63	27.63	27.82	27.70	0.27
STACK GAS VELOCITY vs = 85.49 Cp [sqrt[(dP*Ts) /(Ps*Mw)]]	vs	ft/s	38.60	37.96	38.31	38.29	0.79
vm = 0.3048 * vs	vsm	m/s	11.77	11.57	11.68	11.67	0.24
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	5505	5414	5463	5460	113
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7971	7772	7888	7877	248
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3599	3523	3569	3564	95
Qsdm = Qsd/35.32	Qsdm	dscm/min	101.9	99.8	101.1	100.9	2.7
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	7606	7434	7531	7524	214
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.5	99.4	100.3	99.7	1.1
HCl concentration, dry		mg/dscm	17.52169	17.01738	18.41333	17.65080	1.75611
HCl concentration, dry @ 3% O2		mg/dscm	24.21917	24.27180	26.26283	24.91794	2.89429
HCl concentration, dry @ 3% O2		ppmv	15.98332	16.01806	17.33203	16.44447	1.91007
HCl mass flow rate		mg/hr	107124	101856	111644	106875	12169.1
HF concentration, dry		mg/dscm	4.12664	3.11825	4.84842	4.03110	2.15896
HF concentration, dry @ 3% O2		mg/dscm	5.70401	4.44755	6.91527	5.68894	3.06550
HF concentration, dry @ 3% O2		ppmv	6.85707	5.34661	8.31318	6.83895	3.68519
HF mass flow rate		mg/hr	25229	18664	29397	24430	13442.4

METALS AND CHLORIDE ANALYSIS

PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BS-R1to3-M-SS4

DATE: 8/10/93
OPERATOR: DAVE LADD
ENTERED BY: JENNY PONT
CHECKED BY: DESIREE JONES

DATA ENTRY	SYMBOL	UNITS	DATA
RUN NUMBER	-	-	COMPOSITE OF 1-3
STREAM FLOW		kg/hr	
TOTAL SAMPLING TIME	min	minutes	240
TOTAL STREAM MASS	Ww	grams	

METALS CATCH			
ANTIMONY		µg/g	ND 0.54
ARSENIC		µg/g	3.6
BARIUM		µg/g	117
BERYLLIUM		µg/g	0.63
CADMIUM		µg/g	0.045
CHROMIUM		µg/g	14.5
COBALT		µg/g	3.6
LEAD		µg/g	4.5
MANGANESE		µg/g	17
MERCURY(1)		µg/g	0.08
MERCURY		µg/g	0.07
NICKEL		µg/g	9
SELENIUM		µg/g	0.89
VANADIUM		µg/g	26

CHLORIDE		Wt. %	0.02

MOISTURE		%	9.68

METALS AND CHLORIDE ANALYSIS
LOCATION: GSA Hopper (5)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R1,R2,R4-M-SS5

DATE: 9/10/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS		DATA		DATA		DATA			
TEST DATE				9/27/93		9/28/93		9/29/93			
RUN NUMBER	-	-		1		2		4			
STREAM FLOW		kg/hr	*	193.5		127.2		245.5			
LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	**	ND 0.08		ND 0.08		ND 0.08		ND 0.08	0.00
ARSENIC		mg/kg	**	16.35		16.50		16.20		16.35	0.37
BARIUM		mg/kg	**	82.70		86.40		79.00		82.70	9.19
CADMIUM		mg/kg	**	ND 0.004		ND 0.004		ND 0.004		ND 0.00	0.00
CHROMIUM		mg/kg	**	27.20		27.60		26.80		27.20	0.99
COBALT		mg/kg	**	4.33		4.37		4.29		4.33	0.10
LEAD		mg/kg	**	1.89		1.81		1.96		1.89	0.19
MANGANESE		mg/kg	**	141.40		145.40		137.40		141.40	9.94
MERCURY		mg/kg	**	ND 0.100		ND 0.100		ND 0.100		ND 0.100	0.00
SELENIUM		mg/kg	**	7.55		6.50		8.60		7.550	2.61
VANADIUM		mg/kg	**	37.55		36.60		38.50		37.55	2.36
CHLORINE		mg/kg	**	4.50		4.30		4.70		4.50	0.50
MASS FLOW RATE											
ANTIMONY		mg/hr		ND 15.48		ND 10.18		ND 19.64		ND 15.10	11.8
ARSENIC		mg/hr		3163.73		2098.80		3977.10		3079.88	2340.1
BARIUM		mg/hr		16002.45		10990.08		19394.50		15462.34	10504.2
CADMIUM		mg/hr		ND 0.77		ND 0.51		ND 0.98		ND 0.75	0.6
CHROMIUM		mg/hr		5263.20		3510.72		6579.40		5117.77	3824.6
COBALT		mg/hr		837.86		555.86		1053.20		815.64	619.6
LEAD		mg/hr		364.75		230.23		481.18		358.72	312.0
MANGANESE		mg/hr		27360.90		18494.88		33731.70		26529.16	19011.1
MERCURY		mg/hr		ND 19.35		ND 12.72		ND 24.55		ND 18.873	14.7
SELENIUM		mg/hr		1460.93		826.80		2111.30		1466.342	1595.6
VANADIUM		mg/hr		7265.93		4655.52		9451.75		7124.40	5965.5
CHLORINE		mg/hr		870.75		546.96		1153.85		857.2	754.4

* Ash flow calculated using Run 4 (9/29/93) flue gas/particulate data at the GSA inlet and ESP inlet and Run 1 reinjected fly ash flow.

** Ash samples invalidated due to high lime indicating line out process not complete, average of Run 2 and Run 4 analyses used.

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, field 1 (9A)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-S9A

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			9/28/93	9/29/93	9/29/93
RUN NUMBER	-	-	2	3	4
STREAM FLOW		kg/hr	121.31	56.84	109.21

LABORATORY ANALYSIS RESULTS						AVERAGE	CI
ANTIMONY		mg/kg	ND 10	ND 10	ND 10	ND 10.00	0.00
ARSENIC		mg/kg	27.00	16.00	25.00	22.67	14.56
BARIUM		mg/kg	105.00	71.00	56.00	77.33	62.37
CADMIUM		mg/kg	0.900	0.600	0.800	0.767	0.38
CHROMIUM		mg/kg	51.00	34.00	36.00	40.33	23.08
COBALT		mg/kg	6.00	4.00	4.00	4.67	2.87
LEAD		mg/kg	13.00	8.00	11.00	10.67	6.25
MANGANESE		mg/kg	85.00	32.00	35.00	50.67	73.96
MERCURY		mg/kg	ND 0.030	ND 0.030	ND 0.030	ND 0.030	0.00
SELENIUM		mg/kg	5.00	ND 0.11	4.00	3.018	6.42
VANADIUM		mg/kg	85.00	ND 1.70	52.00	45.950	104.21
CHLORINE		mg/kg	8.10	81.00	220.00	103.03	267.45

MASS FLOW RATE							
ANTIMONY		mg/hr	ND 1213.1	ND 568.4	ND 1092.1	ND 957.87	851.3
ARSENIC		mg/hr	3275.4	909.4	2730.3	2305.02	3078.0
BARIUM		mg/hr	12737.6	4035.6	6115.8	7629.65	11289.3
CADMIUM		mg/hr	109.2	34.1	87.4	76.884	95.9
CHROMIUM		mg/hr	6186.8	1932.6	3931.6	4016.98	5287.7
COBALT		mg/hr	727.9	227.4	436.8	464.02	624.4
LEAD		mg/hr	1577.0	454.7	1201.3	1077.69	1419.2
MANGANESE		mg/hr	10311.4	1818.9	3822.4	5317.53	11028.7
MERCURY		mg/hr	ND 3.6	ND 1.7	ND 3.3	ND 2.874	2.6
SELENIUM		mg/hr	606.6	ND 6.3	436.8	348.839	768.8
VANADIUM		mg/hr	10311.4	ND 96.6	5678.9	5346.195	12706.7
CHLORINE		mg/hr	982.6	4604.0	24026.2	9871.0	30785.5

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, field 1 (9B)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2to4-M-S9B

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA		
TEST DATE			9/28/93	9/29/93	9/29/93		
RUN NUMBER	-	-	2	3	4		
STREAM FLOW		kg/hr	14.53	6.81	13.09		
LABORATORY ANALYSIS RESULTS						AVERAGE	CI
ANTIMONY		mg/kg	ND 10	ND 10	ND 10	ND 10.00	0.00
ARSENIC		mg/kg	9.00	14.00	21.00	14.67	14.97
BARIUM		mg/kg	50.00	84.00	96.00	76.67	59.28
CADMIUM		mg/kg	ND 0.300	1.500	0.600	0.750	1.55
CHROMIUM		mg/kg	13.00	25.00	44.00	27.33	38.83
COBALT		mg/kg	2.00	4.00	4.00	3.33	2.87
LEAD		mg/kg	7.00	10.00	12.00	9.67	6.25
MANGANESE		mg/kg	25.00	53.00	58.00	45.33	44.19
MERCURY		mg/kg	0.320	ND 0.030	ND 0.030	0.117	0.42
SELENIUM		mg/kg	ND 0.11	ND 0.11	5.00	1.703	7.01
VANADIUM		mg/kg	ND 1.70	ND 1.70	62.00	21.233	86.49
CHLORINE		mg/kg	40.00	10.00	7.10	19.03	45.25
MASS FLOW RATE							
ANTIMONY		mg/hr	ND 145.3	ND 68.1	ND 130.9	ND 114.77	102.0
ARSENIC		mg/hr	130.8	95.3	274.9	167.00	236.3
BARIUM		mg/hr	726.5	572.0	1256.6	851.73	892.0
CADMIUM		mg/hr	ND 4.4	10.2	7.9	6.750	7.3
CHROMIUM		mg/hr	188.9	170.3	576.0	311.70	569.0
COBALT		mg/hr	29.1	27.2	52.4	36.22	34.8
LEAD		mg/hr	101.7	68.1	157.1	108.96	111.6
MANGANESE		mg/hr	363.3	360.9	759.2	494.47	569.6
MERCURY		mg/hr	4.6	ND 0.2	ND 0.4	1.649	6.2
SELENIUM		mg/hr	ND 1.6	ND 0.7	65.5	22.208	92.2
VANADIUM		mg/hr	ND 24.7	ND 11.6	811.6	276.573	1138.2
CHLORINE		mg/hr	581.2	68.1	92.9	247.4	718.8

METALS AND CHLORIDE ANALYSIS
LOCATION: Baghouse hopper ash (11)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R2 to 4-M-SS11

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			9/28/93	9/29/93	9/29/93
RUN NUMBER	-	-	2	3	4
STREAM FLOW		kg/hr	0.1851	0.0482	0.1544

LABORATORY ANALYSIS RESULTS						AVERAGE	CI
ANTIMONY		mg/kg	ND 10	ND 10	ND 10	ND 10.00	0.00
ARSENIC		mg/kg	34.00	21.00	8.00	21.00	32.30
BARIUM		mg/kg	67.00	49.50	32.00	49.50	43.48
CADMIUM		mg/kg	16.000	16.500	17.000	16.50	1.24
CHROMIUM		mg/kg	26.00	27.00	28.00	27.00	2.48
COBALT		mg/kg	5.00	4.50	4.00	4.50	1.24
LEAD		mg/kg	16.00	14.50	13.00	14.50	3.73
MANGANESE		mg/kg	104.00	86.00	68.00	86.00	44.72
MERCURY		mg/kg	1.200	0.608	ND 0.030	0.608	1.45
SELENIUM		mg/kg	8.00	6.00	4.00	6.000	4.97
VANADIUM		mg/kg	135.00	96.00	57.00	96.00	96.89
CHLORINE		mg/kg	200.00	141.50	83.00	141.50	145.33

MASS FLOW RATE							
ANTIMONY		mg/hr	ND 1.85	ND 0.48	ND 1.54	ND 1.29	1.8
ARSENIC		mg/hr	6.29	1.01	1.24	2.85	7.4
BARIUM		mg/hr	12.40	2.39	4.94	6.58	12.9
CADMIUM		mg/hr	2.96	0.80	2.62	2.13	2.9
CHROMIUM		mg/hr	4.81	1.30	4.32	3.48	4.7
COBALT		mg/hr	0.93	0.22	0.62	0.59	0.9
LEAD		mg/hr	2.96	0.70	2.01	1.89	2.8
MANGANESE		mg/hr	19.25	4.15	10.50	11.30	18.8
MERCURY		mg/hr	0.22	0.03	ND 0.00	0.085	0.3
SELENIUM		mg/hr	1.48	0.29	0.62	0.796	1.5
VANADIUM		mg/hr	24.99	4.63	8.80	12.81	26.7
CHLORINE		mg/hr	37.02	6.82	12.82	18.9	39.7

* Run 3 ash analysis not performed, values shown for Run 3 (9/29/93) are the average of Run 2 and Run 4 analyses.

METALS AND CHLORIDE ANALYSIS
LOCATION: Reinjected fly ash (13)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BS-R1,R3,R4-M-SS13

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA			
TEST DATE			9/27/93	9/28/93	9/29/93			
RUN NUMBER	-	-	1	*** 3	4			
STREAM FLOW		kg/hr	* 183.16	** 182.35	179.9			
LABORATORY ANALYSIS RESULTS						AVERAGE		CI
ANTIMONY		mg/kg	ND 0.08	*** ND 0.08	ND 0.08	ND	0.08	0.00
ARSENIC		mg/kg	78.00	*** 31.40	35.30		48.23	64.23
BARIUM		mg/kg	183.20	*** 82.40	96.80		120.80	135.44
CADMIUM		mg/kg	0.296	*** 0.327	0.292		0.31	0.05
CHROMIUM		mg/kg	97.00	*** 33.30	25.70		52.00	97.28
COBALT		mg/kg	5.21	*** 4.81	4.96		4.99	0.50
LEAD		mg/kg	30.60	*** 9.30	11.10		17.00	29.35
MANGANESE		mg/kg	67.90	*** 122.00	112.00		100.63	71.51
MERCURY		mg/kg	ND 0.100	*** ND 0.100	ND 0.100	ND	0.100	0.00
SELENIUM		mg/kg	3.47	*** 3.65	3.20		3.440	0.56
VANADIUM		mg/kg	30.00	*** 44.40	36.30		36.90	17.93
CHLORINE		mg/kg	ND 0.02	*** 4.40	4.30		2.90	6.21
MASS FLOW RATE								
ANTIMONY		mg/hr	ND 14.65	ND 14.59	ND 14.39	ND	14.54	0.3
ARSENIC		mg/hr	14286.48	5725.79	6350.47		8787.58	11856.3
BARIUM		mg/hr	33554.91	15025.64	17414.32		21998.29	25040.5
CADMIUM		mg/hr	54.22	59.63	52.53		55.46	9.2
CHROMIUM		mg/hr	17766.52	6072.26	4823.43		9487.40	17903.2
COBALT		mg/hr	954.26	877.10	892.30		907.89	101.5
LEAD		mg/hr	5604.70	1695.86	1996.89		3099.15	5403.6
MANGANESE		mg/hr	12436.56	22246.70	20148.80		18277.35	12833.8
MERCURY		mg/hr	ND 18.32	ND 18.24	ND 17.99	ND	18.180	0.4
SELENIUM		mg/hr	635.57	665.58	575.68		625.608	113.7
VANADIUM		mg/hr	5494.80	8096.34	6530.37		6707.17	3253.9
CHLORINE		mg/hr	3.66	802.34	773.57		526.5	1125.5

* Ash flow data from EPA method 29 (metals) test Run 3 (9/29/93).
** Ash flow data from EPA method 29 (metals) test Run 2 (9/28/93).
*** Sample collected during EPA Method 26 (HCl) test Run 3 (9/28/93)

Appendix B-4—Parallel Configuration, Baseline Tests: Results

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R1to3-M-EI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	-	-	10/21/93	10/22/93	10/22/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches	39.5	39.5	39.5
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.196	0.196	0.196
AVERAGE STACK TEMPERATURE	Fs	°F	272	272	273
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.84	30.03	30.03
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30
AVG. DELTA H	dH	in. H20	1.34	1.31	1.19
AVG. VELOCITY HEAD	dP	in. H20	1.08	1.07	0.97
PITOT COEFFICIENT	Cp	-	0.84	0.84	0.84
GAS SAMPLE VOLUME	Vm	ft^3	65.77	65.47	62.69
METER CALIBRATION FACTOR	Y	-	0.981	0.981	0.981
TOTAL SAMPLING TIME	min	minutes	120	120	120
STACK GAS OXYGEN CONTENT	Co2,m	%	7.22	6.64	6.81
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.78	11.36	11.19
IMPINGER GAIN	Ww	grams	114.8	109.6	109.2

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY	µg		9.785	11.985	15.19	12.32
ARSENIC	µg		358.00	271.06	568.06	399.04
BARIUM	µg		744.65	630.65	263.65	546.32
CADMIUM	µg		11.00	6.10	15.70	10.93
CHROMIUM	µg		433.70	473.70	717.70	541.70
COBALT	µg		93.20	79.10	125.20	99.17
LEAD	µg		274.20	246.05	264.05	261.43
MANGANESE	µg		369.50	349.00	671.00	463.17
MERCURY	µg	ND	0.12	0.44	ND 0.12	0.19
SELENIUM	µg	ND	0.26	ND 0.26	ND 0.26	ND 0.26
VANADIUM	µg		837.00	775.00	ND 36.00	543.33
PARTICULATE	mg		3708	1832	4922	3487

B-101

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R1to3-M-EI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/21/93	10/22/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.03017	0.03017	0.03017	0.03017	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.510	8.510	8.510	8.510	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	732.0	732.0	733.0	732.3	1.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	65.53	65.64	62.83	64.67	3.95
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	5.404	5.159	5.140	5.234	0.365
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0762	0.0729	0.0756	0.0749	0.0044
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	30.01	30.08	30.06	30.05	0.09
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.10	29.20	29.15	29.15	0.13
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.63	27.82	27.82	27.76	0.27
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	71.20	70.50	67.24	69.65	5.26
vm = 0.3048 * vs	vsm	m/s	21.70	21.49	20.49	21.23	1.60
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	36356	35999	34330	35562	2687
Qmass=Q*528/Ts*29.92/Ps*Mw/365*60/2.2046	Qmass	kg/hr	49821	49849	47388	49019	3510
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	22366	22379	21249	21998	1612
Qsdm = Qsd/35.32	Qsdm	dscm/min	633.3	633.6	601.6	622.8	45.6
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	47407	47544	45112	46687	3394
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	99.2	99.3	100.1	99.5	1.3

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP inlet (2)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R1to3-M-EI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag	DATA flag	DATA flag	AVERAGE flag	CI
TEST DATE	–	–	10/21/93	10/22/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
CONCENTRATION @ 3% O2							
ANTIMONY		µg/dscm	6.8993	8.0931	10.8411	8.6112	5.0217
ARSENIC		µg/dscm	252.4208	183.0391	405.5576	280.3392	282.8569
BARIUM		µg/dscm	525.042	425.860	188.229	379.710	430.000
CADMIUM		µg/dscm	7.7559	4.1215	11.2088	7.6954	8.8045
CHROMIUM		µg/dscm	305.796	319.876	512.391	379.354	286.762
COBALT		µg/dscm	65.714	53.414	89.385	69.504	45.420
LEAD		µg/dscm	193.3346	166.1486	188.5122	182.6651	36.0367
MANGANESE		µg/dscm	260.53	235.67	479.05	325.08	332.70
MERCURY		µg/dscm	ND 0.0846	0.2971	ND 0.0857	0.1274	0.3041
SELENIUM		µg/dscm	ND 0.18	ND 0.18	ND 0.19	ND 0.18	0.01
VANADIUM		µg/dscm	590.157	523.336	ND 25.702	375.448	766.204
PARTICULATE		mg/dscm	2614.46	1237.30	3513.84	2455.20	2848.53

MASS FLOW RATE							
ANTIMONY		mg/hr	200.338	245.107	308.034	251.160	134.409
ARSENIC		mg/hr	7329.692	5543.488	11523.331	8132.170	7625.990
BARIUM		mg/hr	15245.96	12897.52	5348.25	11163.91	12847.95
CADMIUM		mg/hr	225.214	124.824	318.481	222.840	240.609
CHROMIUM		mg/hr	8879.57	9687.71	14558.84	11042.04	7632.69
COBALT		mg/hr	1908.18	1617.69	2539.73	2021.87	1171.17
LEAD		mg/hr	5613.970	5031.944	5356.302	5334.072	724.555
MANGANESE		mg/hr	7565.14	7137.45	13611.51	9438.04	8994.94
MERCURY		mg/hr	ND 2.457	8.999	ND 2.434	3.815	9.399
SELENIUM		mg/hr	ND 5.32	ND 5.32	ND 5.27	ND 5.30	0.07
VANADIUM		mg/hr	17136.74	15849.64	ND 730.27	11117.17	22665.73
PARTICULATE		kg/hr	75.9176	37.4726	99.8407	71.0770	78.1686

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-Rlto3-M-EO

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	-	-	10/21/93	10/22/93	10/22/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	29.5	29.5	29.5
WIDTH	W	inches	29.5	29.5	29.5
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234
AVERAGE STACK TEMPERATURE	Fs	°F	253	253	253
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	29.71	30.04	30.04
STACK STATIC PRESSURE	Pg	in. H20	-25	-25	-25
AVG. DELTA H	dH	in. H20	1.27	1.2	1.2
AVG. VELOCITY HEAD	dP	in. H20	0.98	0.94	0.94
PITOT COEFFICIENT	Cp	-	0.8399	0.8399	0.8399
GAS SAMPLE VOLUME	Vm	ft^3	174.77	168.75	168.75
METER CALIBRATION FACTOR	Y	-	1.009	1.009	1.009
TOTAL SAMPLING TIME	min	minutes	240	240	240
STACK GAS OXYGEN CONTENT	Co2,m	%	7.89	7.68	7.5
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.11	10.32	10.5
IMPINGER GAIN	Ww	grams	330.1	289.7	289.7

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY	µg	ND 0.34	ND 0.34	ND 0.34	ND 0.34	
ARSENIC	µg	28.06	28.66	33.86	30.19	
BARIUM	µg	ND 18.60	ND 18.60	ND 18.60	ND 18.60	
CADMIUM	µg	5.20	4.50	5.60	5.10	
CHROMIUM	µg	32.70	36.70	44.70	38.03	
COBALT	µg	6.20	6.80	7.20	6.73	
LEAD	µg	21.05	24.00	23.00	22.68	
MANGANESE	µg	26.40	46.00	88.00	53.47	
MERCURY	µg	2.82	2.64	2.74	2.73	
SELENIUM	µg	74.30	41.60	110.00	75.30	
VANADIUM	µg	ND 36.00	71.00	ND 36.00	NDM 35.67	
PARTICULATE	mg	163	189	179	177	

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R1to3-M-EO

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	DATA
TEST DATE	-	-	10/21/93	10/22/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			6.043	6.043	6.043	6.043	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	713.0	713.0	713.0	713.0	0.0
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	178.29	174.02	174.02	175.44	6.12
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	15.538	13.636	13.636	14.270	2.728
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0802	0.0727	0.0727	0.0752	0.0108
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	29.93	29.96	29.99	29.96	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	28.98	29.09	29.11	29.06	0.18
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.87	28.20	28.20	28.09	0.47
STACK GAS VELOCITY vs = 85.49 Cp [sqrt[(dP*Ts) /(Ps*Mw)]]	vs	ft/s	66.79	64.90	64.88	65.52	2.72
vm = 0.3048 * vs	vsm	m/s	20.36	19.78	19.77	19.97	0.83
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	acf/min	24217	23533	23525	23758	987
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	34220	33778	33790	33929	626
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	15361	15227	15221	15270	196
Qsdm = Qsd/35.32	Qsdm	dscm/min	434.9	431.1	431.0	432.3	5.6
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	32471	32214	32226	32304	360
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	97.9	96.4	96.4	96.9	2.1

EPA METHOD 29: MULTIPLE METALS
LOCATION: ESP outlet (3)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R1to3-M-EO

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	Flag	DATA	flag	DATA	flag	DATA	flag	AVERAGE	DATA
TEST DATE	-	-		10/21/93		10/22/93		10/22/93			
RUN NUMBER	-	-		2		3		4			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	ND	0.0926	ND	0.0934	ND	0.0922	ND	0.0927	0.0016
ARSENIC		µg/dscm		7.6461		7.8739		9.1776		8.2326	2.0529
BARIUM		µg/dscm	ND	5.068	ND	5.110	ND	5.041	ND	5.073	0.086
CADMIUM		µg/dscm		1.4170		1.2363		1.5179		1.3904	0.3544
CHROMIUM		µg/dscm		8.911		10.083		12.116		10.370	4.029
COBALT		µg/dscm		1.689		1.868		1.952		1.836	0.333
LEAD		µg/dscm		5.7352		6.5937		6.2340		6.1876	1.0711
MANGANESE		µg/dscm		7.19		12.64		23.85		14.56	21.10
MERCURY		µg/dscm		0.7684		0.7253		0.7427		0.7455	0.0539
SELENIUM		µg/dscm		20.25		11.43		29.81		20.50	22.84
VANADIUM		µg/dscm	ND	9.810		19.506	ND	9.758	NDM	9.763	13.946
PARTICULATE		mg/dscm		44.28		52.01		48.41		48.23	9.61

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	1.757	ND	1.784	ND	1.784	ND	1.775	0.039
ARSENIC		mg/hr		145.014		150.418		177.649		157.694	43.455
BARIUM		mg/hr	ND	96.12	ND	97.62	ND	97.59	ND	97.11	2.12
CADMIUM		mg/hr		26.873		23.618		29.381		26.624	7.179
CHROMIUM		mg/hr		168.99		192.62		234.52		198.71	82.45
COBALT		mg/hr		32.04		35.69		37.78		35.17	7.21
LEAD		mg/hr		108.770		125.961		120.671		118.468	21.874
MANGANESE		mg/hr		136.43		241.43		461.70		279.85	412.40
MERCURY		mg/hr		14.574		13.856		14.376		14.268	0.921
SELENIUM		mg/hr		383.98		218.33		577.12		393.15	446.11
VANADIUM		mg/hr	ND	186.05		372.63	ND	188.88		186.70	265.62
PARTICULATE		kg/hr		0.8398		0.9935		0.9370		0.9235	0.1932

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R21o4-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	10/21/93	10/22/93	10/22/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches	0	0	0
RECTANGULAR STACK, LENGTH	L	inches	15.5	15.5	15.5
WIDTH	W	inches	15.5	15.5	15.5
NOZZLE DIAMETER	dn	inches	0.227	0.227	0.227
AVERAGE STACK TEMPERATURE	Fs	°F	239	241	247
AVERAGE METER TEMPERATURE	Fm	°F	66	62	76
BAROMETRIC PRESSURE	Pbar	in. Hg	30.04	30.15	30.15
STACK STATIC PRESSURE	Pg	in. H20	-29.75	-29.75	-29.75
AVG. DELTA H	dH	in. H20	0.74	0.84	0.84
AVG. VELOCITY HEAD	dP	in. H20	0.45	0.49	0.48
PITOT COEFFICIENT	Cp	-	0.82	0.82	0.82
GAS SAMPLE VOLUME	Vm	ft^3	44.51	46.19	46.84
METER CALIBRATION FACTOR	Y	-	0.993	0.993	0.993
TOTAL SAMPLING TIME	min	minutes	96	96	96
STACK GAS OXYGEN CONTENT	Co2,m	%	7.89	7.68	7.5
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	10.11	10.32	10.5
IMPINGER GAIN	Ww	grams	73.7	116.4	85.4

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY		µg	13.885	18.785	34.09	22.25
ARSENIC		µg	360.10	524.06	682.06	522.07
BARIUM		µg	1114.65	691.65	2664.65	1490.32
CADMIUM		µg	4.80	10.00	10.00	8.27
CHROMIUM		µg	410.70	877.70	978.70	755.70
COBALT		µg	88.20	144.20	167.20	133.20
LEAD		µg	281.30	404.05	595.05	426.80
MANGANESE		µg	345.50	790.40	861.40	665.77
MERCURY		µg	1.04	1.50	1.72	1.42
SELENIUM		µg	ND 0.26	ND 0.26	17.20	5.82
VANADIUM		µg	882.00	1619.00	1909.00	1470.00
PARTICULATE		mg	3897	4911	5497	4768

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse inlet (12)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-M-BI

DATE: 8/2/94
OPERATOR: JOE RIPEPI
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/21/93	10/22/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04047	0.04047	0.04047	0.04047	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			1.668	1.668	1.668	1.668	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	699.0	701.0	707.0	702.3	10.3
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	526.0	522.0	536.0	528.0	17.9
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	44.61	46.83	46.25	45.89	2.86
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	3.469	5.479	4.020	4.323	2.580
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0722	0.1047	0.0800	0.0856	0.0423
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.93	29.96	29.98	29.96	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.07	28.71	29.02	28.93	0.49
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.85	27.96	27.96	27.93	0.16
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	43.69	45.86	45.33	44.96	2.81
vm = 0.3048 * vs	vsm	m/s	13.32	13.98	13.82	13.70	0.86
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	4374	4591	4538	4501	281
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	6321	6557	6498	6459	306
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	2852	2892	2913	2886	76
Qsdm = Qsd/35.32	Qsdm	dscm/min	80.8	81.9	82.5	81.7	2.2
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	6030	6118	6167	6105	173
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	96.7	100.2	98.2	98.4	4.3

DATA	AVERAGE	CI
	flag	
10/22/93		
4		
34.7643	23.0219	25.7615

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	–	–	10/21/93	10/22/93	10/22/93
RUN NUMBER	-	-	2	3	4
ROUND STACK, DIAMETER	ds	inches			
RECTANGULAR STACK, LENGTH	L	inches	18.5	18.5	18.5
WIDTH	W	inches	18.5	18.5	18.5
NOZZLE DIAMETER	dn	inches	0.296	0.296	0.296
AVERAGE STACK TEMPERATURE	Fs	°F	234	238	236
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60
BAROMETRIC PRESSURE	Pbar	in. Hg	30.04	30.15	30.15
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30
AVG. DELTA H	dH	in. H20	1.22	1.28	1.14
AVG. VELOCITY HEAD	dP	in. H20	0.36	0.38	0.34
PITOT COEFFICIENT	Cp	-	0.78	0.78	0.78
GAS SAMPLE VOLUME	Vm	ft^3	162.44	165.49	156.15
METER CALIBRATION FACTOR	Y	-	0.989	0.989	0.989
TOTAL SAMPLING TIME	min	minutes	240	240	240
STACK GAS OXYGEN CONTENT	Co2,m	%	8.33	8	7.85
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	9.67	10	10.15
IMPINGER GAIN	Ww	grams	242.9	257.8	240.7

LAB ANALYSIS RESULTS									AVERAGE	
ANTIMONY		µg	ND	0.34	ND	0.34	ND	0.34	ND	0.34
ARSENIC		µg		3.46		2.56		3.66		3.23
BARIUM		µg	ND	18.60	ND	18.60	ND	18.60	ND	18.60
CADMIUM		µg		8.90		10.00		11.20		10.03
CHROMIUM		µg	ND	10.80	ND	10.80	ND	10.80	ND	10.80
COBALT		µg	ND	4.80	ND	4.80	ND	4.80	ND	4.80
LEAD		µg		5.20		3.75		3.85		4.26
MANGANESE		µg		18.00		15.00		11.00		14.67
MERCURY		µg	ND	0.12		4.92		10.22		5.07
SELENIUM		µg	ND	0.26	ND	0.26	ND	0.26	ND	0.26
VANADIUM		µg	ND	36.00	ND	36.00	ND	36.00	ND	36.00
PARTICULATE		mg		40		39		36		38

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/21/93	10/22/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.06881	0.06881	0.06881	0.06881	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			2.377	2.377	2.377	2.377	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	694.0	698.0	696.0	696.0	5.0
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	164.20	167.92	158.39	163.50	11.93
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	11.433	12.135	11.330	11.633	1.088
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0651	0.0674	0.0668	0.0664	0.0029
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m))]	Md	g/gmole	29.88	29.92	29.94	29.91	0.07
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.11	29.12	29.14	29.12	0.04
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.83	27.94	27.94	27.91	0.16
STACK GAS VELOCITY vs = 85.49 Cp (sqrt[(dP*Ts) /(Ps*Mw)])	vs	ft/s	37.03	38.07	35.95	37.02	2.64
vm = 0.3048 * vs	vsm	m/s	11.29	11.60	10.96	11.28	0.81
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	5281	5429	5126	5279	377
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7690	7895	7482	7689	513
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dsct/min	3493	3576	3388	3486	234
Qsdm = Qsd/35.32	Qsdm	dscm/min	98.9	101.2	95.9	98.7	6.6
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	7370	7556	7163	7363	487
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	97.5	97.3	96.9	97.2	0.7

EPA METHOD 29: MULTIPLE METALS
LOCATION: Baghouse outlet (10)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R21o4-M-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag		DATA flag		DATA flag		AVERAGE flag		CI -
TEST DATE	-	-		10/21/93		10/22/93		10/22/93			
RUN NUMBER	-	-		2		3		4			
CONCENTRATION @ 3% O2											
ANTIMONY		µg/dscm	ND	0.1041	ND	0.0992	ND	0.1040	ND	0.1024	0.0069
ARSENIC		µg/dscm		1.0595		0.7470		1.1192		0.9752	0.4967
BARIUM		µg/dscm	ND	5.696	ND	5.427	ND	5.688	ND	5.603	0.380
CADMIUM		µg/dscm		2.7254		2.9178		3.4248		3.0227	0.8976
CHROMIUM		µg/dscm	ND	3.307	ND	3.151	ND	3.302	ND	3.254	0.220
COBALT		µg/dscm	ND	1.470	ND	1.401	ND	1.468	ND	1.446	0.098
LEAD		µg/dscm		1.5924		1.0933		1.1763		1.2873	0.6643
MANGANESE		µg/dscm		5.51		4.38		3.36		4.42	2.67
MERCURY		µg/dscm	ND	0.0367		1.4356		3.1251		1.5263	3.8419
SELENIUM		µg/dscm	ND	0.08	ND	0.08	ND	0.08	ND	0.08	0.01
VANADIUM		µg/dscm	ND	11.024	ND	10.504	ND	11.008	ND	10.845	0.735
PARTICULATE		mg/dscm		12.22		11.29		11.07		11.53	1.51

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	0.434	ND	0.434	ND	0.436	ND	0.435	0.003
ARSENIC		mg/hr		4.415		3.270		4.696		4.127	1.877
BARIUM		mg/hr	ND	23.73	ND	23.76	ND	23.87	ND	23.79	0.18
CADMIUM		mg/hr		11.356		12.773		14.371		12.833	3.748
CHROMIUM		mg/hr	ND	13.78	ND	13.80	ND	13.86	ND	13.81	0.10
COBALT		mg/hr	ND	6.12	ND	6.13	ND	6.16	ND	6.14	0.05
LEAD		mg/hr		6.635		4.786		4.936		5.452	2.551
MANGANESE		mg/hr		22.97		19.16		14.11		18.75	11.03
MERCURY		mg/hr	ND	0.153		6.284		13.113		6.491	16.107
SELENIUM		mg/hr	ND	0.33	ND	0.33	ND	0.33	ND	0.33	0.00
VANADIUM		mg/hr	ND	45.93	ND	45.98	ND	46.19	ND	46.04	0.34
PARTICULATE		kg/hr		0.0509		0.0494		0.0464		0.0489	0.0056

EPA METHOD 26A: HCL and HF
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-HCL-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			10/21/93	10/21/93	10/22/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches	40	40	40	
RECTANGULAR STACK, LENGTH	L	inches	0	0	0	
WIDTH	W	inches	0	0	0	
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234	
AVERAGE STACK TEMPERATURE	Fs	°F	297	294	288	
AVERAGE METER TEMPERATURE	Fm	°F	70	73	71	
BAROMETRIC PRESSURE	Pbar	in. Hg	30.04	30.04	30.15	
STACK STATIC PRESSURE	Pg	in. H20	-18	-18	-18	
AVG. DELTA H	dH	in. H20	1.68	1.67	1.65	
AVG. VELOCITY HEAD	dP	in. H20	0.86	0.84	0.82	
PITOT COEFFICIENT	Cp	-	0.8286	0.8286	0.8286	
GAS SAMPLE VOLUME	Vm	ft^3	40.35	40.35	39.78	
METER CALIBRATION FACTOR	Y	-	1.017	1.017	1.017	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	6.77	6.43	6.11	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.23	11.57	11.89	
IMPINGER GAIN	Ww	grams	66.3	69.3	71.1	
LAB ANALYSIS RESULTS			66.3	69.3	71.1	AVERAGE
CHLORIDE		mg	16	21	24	20.333333
FLUORIDE		mg	0.69	3.8	4	2.83

EPA METHOD 26A: HCL and HF
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-HCL-GI

DATE: 8/2/94
OPERATOR: GARY BURROWS
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/21/93	10/21/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.727	8.727	8.727	8.727	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	757.0	754.0	748.0	753.0	11.4
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	530.0	533.0	531.0	531.3	3.8
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	41.20	40.96	40.68	40.95	0.64
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	3.121	3.262	3.347	3.243	0.284
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0704	0.0738	0.0760	0.0734	0.0070
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.07	30.11	30.15	30.11	0.10
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.22	29.22	29.22	29.22	0.01
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.72	28.72	28.83	28.75	0.16
STACK GAS VELOCITY vs = 85.49 Cp [sqrt[(dP*Ts) /(Ps*Mw)]]	vs	ft/s	62.40	61.55	60.44	61.46	2.43
vm = 0.3048 * vs	vsm	m/s	19.02	18.76	18.42	18.73	0.74
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	32671	32226	31649	32182	1274
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	45173	44732	44464	44790	890
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	20323	20054	19880	20086	555
Qsdm = Qsd/35.32	Qsdm	dscm/min	575.4	567.8	562.8	568.7	15.7
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	43153	42639	42323	42705	1041
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	98.8	99.5	99.7	99.3	1.2
HCl concentration, dry		mg/dscm	14.10581	18.61912	21.42582	18.05025	9.17469
HCl concentration, dry @ 3% O2		mg/dscm	17.86935	23.03264	25.93118	22.27772	10.14501
HCl concentration, dry @ 3% O2		ppmv	11.79279	15.20028	17.11315	14.70207	6.69515
HCl mass flow rate		mg/hr	486986	634288	723567	614947	296804.5
HF concentration, dry		mg/dscm	0.62290	3.44998	3.65661	2.57650	4.21099
HF concentration, dry @ 3% O2		mg/dscm	0.78910	4.26777	4.42552	3.16080	5.10647
HF concentration, dry @ 3% O2		ppmv	0.94861	5.13050	5.32013	3.79975	6.13873
HF mass flow rate		mg/hr	21505	117529	123487	87507	142195.7

EPA METHOD 26A: HCL and HF
LOCATION: FF inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-HCL-BI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			10/21/93	10/21/93	10/22/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches	0	0	0	
RECTANGULAR STACK, LENGTH	L	inches	15.5	15.5	15.5	
WIDTH	W	inches	15.5	15.5	15.5	
NOZZLE DIAMETER	dn	inches	0.229	0.229	0.229	
AVERAGE STACK TEMPERATURE	Fs	°F	246	239	249	
AVERAGE METER TEMPERATURE	Fm	°F	65	64	70	
BAROMETRIC PRESSURE	Pbar	in. Hg	30.04	30.04	30.15	
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30	
AVG. DELTA H	dH	in. H20	0.76	0.76	0.83	
AVG. VELOCITY HEAD	dP	in. H20	0.43	0.43	0.47	
PITOT COEFFICIENT	Cp	-	0.82	0.82	0.82	
GAS SAMPLE VOLUME	Vm	ft^3	30.21	30.21	31.52	
METER CALIBRATION FACTOR	Y	-	0.993	0.993	0.993	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	8.01	7.73	7.44	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	9.99	10.27	10.56	
IMPINGER GAIN	Ww	grams	49.1	47.6	51.2	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	15	15	14	14.666667
FLUORIDE		mg	0.45	0.46	0.31	0.4066667

EPA METHOD 26A: HCL and HF
LOCATION: FF Inlet (12)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-HCL-BI

DATE: 8/2/94
OPERATOR: JEFF PYE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/21/93	10/21/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04119	0.04119	0.04119	0.04119	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			1.668	1.668	1.668	1.668	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	706.0	699.0	709.0	704.7	12.7
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	525.0	524.0	530.0	526.3	8.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	30.34	30.39	31.47	30.73	1.59
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	2.311	2.241	2.410	2.321	0.211
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0708	0.0687	0.0711	0.0702	0.0033
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	29.92	29.95	29.99	29.95	0.08
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.08	29.13	29.13	29.11	0.08
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.83	27.83	27.94	27.87	0.16
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	42.94	42.68	44.85	43.49	2.94
vm = 0.3048 * vs	vsm	m/s	13.09	13.01	13.67	13.26	0.90
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	act/min	4298	4272	4490	4353	295
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	6146	6183	6431	6253	385
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dsct/min	2777	2795	2899	2824	164
Qsdm = Qsd/35.32	Qsdm	dscm/min	78.6	79.1	82.1	80.0	4.6
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	5868	5912	6140	5974	362
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	106.2	105.8	105.6	105.8	0.8
HCl concentration, dry		mg/dscm	17.95942	17.92521	16.15666	17.34710	2.56157
HCl concentration, dry @ 3% O2		mg/dscm	24.93977	24.36304	21.48620	23.59634	4.59613
HCl concentration, dry @ 3% O2		ppmv	16.45888	16.07827	14.17971	15.57229	3.03319
HCl mass flow rate		mg/hr	84737	85111	79576	83142	7684.5
HF concentration, dry		mg/dscm	0.55170	0.56289	0.36633	0.49364	0.27426
HF concentration, dry @ 3% O2		mg/dscm	0.76614	0.76505	0.48718	0.67279	0.39935
HF concentration, dry @ 3% O2		ppmv	0.92101	0.91971	0.58566	0.80879	0.48007
HF mass flow rate		mg/hr	2603	2673	1804	2360	1198.7

EPA METHOD 26A: HCL and HF
LOCATION: FF outlet (10)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-HCL-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA	
TEST DATE			10/21/93	10/21/93	10/22/93	
RUN NUMBER	-	-	2	3	4	
ROUND STACK, DIAMETER	ds	inches	0	0	0	
RECTANGULAR STACK, LENGTH	L	inches	18.5	18.5	18.5	
WIDTH	W	inches	18.5	18.5	18.5	
NOZZLE DIAMETER	dn	inches	0.295	0.295	0.295	
AVERAGE STACK TEMPERATURE	Fs	°F	237	236	241	
AVERAGE METER TEMPERATURE	Fm	°F	60	60	60	
BAROMETRIC PRESSURE	Pbar	in. Hg	30.04	30.04	30.15	
STACK STATIC PRESSURE	Pg	in. H20	-30	-30	-30	
AVG. DELTA H	dH	in. H20	1.17	1.24	1.25	
AVG. VELOCITY HEAD	dP	in. H20	0.35	0.37	0.38	
PITOT COEFFICIENT	Cp	-	0.78	0.78	0.78	
GAS SAMPLE VOLUME	Vm	ft^3	39.74	40.86	40.74	
METER CALIBRATION FACTOR	Y	-	0.989	0.989	0.989	
TOTAL SAMPLING TIME	min	minutes	60	60	60	
STACK GAS OXYGEN CONTENT	Co2,m	%	8.42	8.27	7.74	
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	9.58	9.73	10.26	
IMPINGER GAIN	Ww	grams	57.2	60.9	63.1	
LAB ANALYSIS RESULTS						AVERAGE
CHLORIDE		mg	19	19	22	20
FLUORIDE		mg	0.88	1.3	3.7	1.96

EPA METHOD 26A: HCL and HF
LOCATION: FF outlet (10)
PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-HCL-BO

DATE: 8/2/94
OPERATOR: ROB BOULIANNE
ENTERED BY: TERRY HOWE
CHECKED BY: BOB MASTERSON

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	2.5% CC
TEST DATE			10/21/93	10/21/93	10/22/93		
RUN NUMBER	-	-	2	3	4		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.06835	0.06835	0.06835	0.06835	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	0.000	0.000	0.000	0.000	0.000
= L * W/144 (RECTANGULAR)			2.377	2.377	2.377	2.377	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	697.0	696.0	701.0	698.0	6.6
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	520.0	520.0	520.0	520.0	0.0
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	40.17	41.31	41.34	40.94	1.66
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	2.692	2.867	2.970	2.843	0.349
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0628	0.0649	0.0670	0.0649	0.0052
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28[100-(Co2,m)-(Cco2,m)]]	Md	g/gmole	29.87	29.89	29.95	29.90	0.11
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.12	29.12	29.15	29.13	0.04
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	27.83	27.83	27.94	27.87	0.16
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	36.58	37.59	38.13	37.43	1.96
vm = 0.3048 * vs	vsm	m/s	11.15	11.46	11.62	11.41	0.60
ACTUAL GAS FLOW RATE (WET) Q = 60*vs*As	Q	acf/min	5216	5360	5438	5338	279
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	7568	7786	7883	7746	400
DRY GAS FLOW RATE (DRY,STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dscf/min	3444	3536	3567	3516	160
Qsdm = Qsd/35.32	Qsdm	dscm/min	97.5	100.1	101.0	99.5	4.5
Qdmass = Md/24.055*Qsdm*60	Qdmass	Kg/hr(dry)	7264	7463	7546	7425	359
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	97.4	97.5	96.7	97.2	1.0
HCl concentration, dry		mg/dscm	17.18065	16.70686	19.33073	17.73942	3.47393
HCl concentration, dry @ 3% O2		mg/dscm	24.64212	23.67798	26.29332	24.87114	3.28584
HCl concentration, dry @ 3% O2		ppmv	16.26245	15.62617	17.35215	16.41359	2.16848
HCl mass flow rate		mg/hr	100511	100356	117150	106006	23977.4
HF concentration, dry		mg/dscm	0.81482	1.17052	3.32905	1.77146	3.38015
HF concentration, dry @ 3% O2		mg/dscm	1.16869	1.65893	4.52812	2.45191	4.50827
HF concentration, dry @ 3% O2		ppmv	1.40494	1.99428	5.44347	2.94756	5.41961
HF mass flow rate		mg/hr	4767	7031	20175	10658	20668.8

METALS AND CHLORIDE ANALYSIS

PLANT: National Center for Emissions Research
CITY: West Paducah, KY
RUN #: AP-BP-R1to3-M-SS4

DATE: 8/10/94
OPERATOR: DAVE LADD
ENTERED BY: JENNY PONT
CHECKED BY: DESIREE JONES

DATA ENTRY	SYMBOL	UNITS	DATA
RUN NUMBER	-	-	COMPOSITE OF 1-3
STREAM FLOW		kg/hr	
TOTAL SAMPLING TIME	min	minutes	240
TOTAL STREAM MASS	Ww	grams	

METALS CATCH			
ANTIMONY		µg/g	ND 0.54
ARSENIC		µg/g	5
BARIUM		µg/g	57
BERYLLIUM		µg/g	0.8
CADMIUM		µg/g	0.094
CHROMIUM		µg/g	15.7
COBALT		µg/g	3.6
LEAD		µg/g	5
MANGANESE		µg/g	31
MERCURY(1)		µg/g	0.08
MERCURY		µg/g	0.07
SELENIUM		µg/g	1.8
VANADIUM		µg/g	26

CHLORIDE		Wt. %	0.018

MOISTURE		%	10.43

METALS AND CHLORIDE ANALYSIS
LOCATION: GSA Hopper (5)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R1, R2, R4-M-SS5

DATE: 9/14/94
OPERATOR: DAVE LADD'
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS		DATA		DATA		DATA			
TEST DATE				10/19/93		10/21/93		10/22/93			
RUN NUMBER	-	-		1		2		4			
STREAM FLOW		kg/hr	*	189.47	*	212.03	*	245.04			
LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	**	ND 0.08	ND	0.08	ND	0.08	ND	0.08	0.00
ARSENIC		mg/kg	**	23.30		21.20		23.20		22.57	2.94
BARIUM		mg/kg	**	89.40		86.50		101.00		92.30	19.06
CADMIUM		mg/kg	**	ND 0.004	ND	0.004		0.335		0.113	0.47
CHROMIUM		mg/kg	**	20.90		14.50		24.50		19.97	12.58
COBALT		mg/kg	**	7.43		6.80		5.29		6.51	2.73
LEAD		mg/kg	**	3.45		2.60		7.69		4.58	6.77
MANGANESE		mg/kg	**	93.10		77.40		89.90		86.80	20.61
MERCURY		mg/kg	**	ND 0.100	ND	0.100	ND	0.100	ND	0.100	0.00
SELENIUM		mg/kg	**	8.10		18.30		10.30		12.233	13.34
VANADIUM		mg/kg	**	47.50		43.40		46.60		45.833	5.35
CHLORINE		mg/kg	**	4.20		4.10		2.80		3.70	1.94
MASS FLOW RATE											
ANTIMONY		mg/hr		ND 15.2	ND	17.0	ND	19.6	ND	17.24	5.6
ARSENIC		mg/hr		4414.7		4495.0		5684.9		4864.87	1767.2
BARIUM		mg/hr		16938.6		18340.6		24749.0		20009.42	10344.9
CADMIUM		mg/hr		ND 0.8	ND	0.8		82.1		27.630	116.6
CHROMIUM		mg/hr		3959.9		3074.4		6003.5		4345.95	3732.0
COBALT		mg/hr		1407.8		1441.8		1296.3		1381.94	189.1
LEAD		mg/hr		653.7		551.3		1884.4		1029.77	1843.0
MANGANESE		mg/hr		17639.7		16411.1		22029.1		18693.29	7337.4
MERCURY		mg/hr		ND 18.9	ND	21.2	ND	24.5	ND	21.551	6.9
SELENIUM		mg/hr		1534.7		3880.1		2523.9		2646.256	2925.3
VANADIUM		mg/hr		8999.8		9202.1		11418.9		9873.597	3334.1
CHLORINE		mg/hr		795.8		869.3		686.1		783.7	229.0

* Flue gas particulate data not collected at GSA inlet, average of all other GSA inlet particulate data substituted for missing data to generate ash flows.
** Ash samples invalidated due to blockage in baghouse, average of Run 2 and Run 4 analyses used.

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, field 1 (9A)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R21o4-M-S9A

DATE: 9/13/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			10/21/93	10/22/93	10/22/93
RUN NUMBER	-	-	2	3	4
STREAM FLOW		kg/hr	19.37	72.03	48.41

LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	10	ND	10	ND	10	ND	10.00	0.00
ARSENIC		mg/kg		72.00		255.00		145.00		157.33	228.86
BARIUM		mg/kg		38.00	ND	3.10	ND	3.10		13.70	50.06
CADMIUM		mg/kg		1.200		1.400		1.300		1.300	0.25
CHROMIUM		mg/kg		19.00		45.00		38.00		34.00	33.42
COBALT		mg/kg		8.00		8.00		6.00		7.33	2.87
LEAD		mg/kg		19.00		14.00		16.00		16.33	6.25
MANGANESE		mg/kg		27.00		27.00		26.00		26.67	1.43
MERCURY		mg/kg		0.070	ND	0.030	ND	0.030		0.033	0.06
SELENIUM		mg/kg		5.00		4.90		7.80		5.900	4.09
VANADIUM		mg/kg	ND	1.70		86.00		101.00		62.617	132.98
CHLORINE		mg/kg		17.00		14.00		36.00		22.33	29.64

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	193.7	ND	720.3	ND	484.1	ND	466.03	655.3
ARSENIC		mg/hr		1394.6		18367.7		7019.5		8927.25	21479.2
BARIUM		mg/hr		736.1	ND	223.3	ND	150.1		307.58	793.2
CADMIUM		mg/hr		23.2		100.8		62.9		62.340	96.4
CHROMIUM		mg/hr		368.0		3241.4		1839.6		1816.32	3569.5
COBALT		mg/hr		155.0		576.2		290.5		340.55	534.3
LEAD		mg/hr		368.0		1008.4		774.6		717.00	805.1
MANGANESE		mg/hr		523.0		1944.8		1258.7		1242.15	1766.5
MERCURY		mg/hr		1.4	ND	2.2	ND	1.5		1.054	1.1
SELENIUM		mg/hr		96.9		352.9		377.6		275.798	386.2
VANADIUM		mg/hr	ND	32.9		6194.6		4889.4		3700.152	8066.4
CHLORINE		mg/hr		329.3		1008.4		1742.8		1026.8	1756.2

METALS AND CHLORIDE ANALYSIS
LOCATION: ESP hoppers, fields 2-4 (9B)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-M-S9B

DATE: 9/13/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			10/21/93	10/22/93	10/22/93
RUN NUMBER	-	-	2	3	4
STREAM FLOW		kg/hr	2.321	8.63	5.801

LABORATORY ANALYSIS RESULTS									AVERAGE		CI
ANTIMONY		mg/kg	ND	10	ND	10	ND	10	ND	10.00	0.00
ARSENIC		mg/kg		245.00		32.20		116.00		131.07	266.31
BARIUM		mg/kg		56.00	ND	3.10		44.00		33.85	68.90
CADMIUM		mg/kg		1.000		0.600		1.600		1.067	1.25
CHROMIUM		mg/kg		55.00		18.00		58.00		43.67	55.35
COBALT		mg/kg		12.00		3.00		8.00		7.67	11.20
LEAD		mg/kg		25.00	ND	2.30		23.00		16.38	31.22
MANGANESE		mg/kg		46.00		21.00		44.00		37.00	34.51
MERCURY		mg/kg	ND	0.030	ND	0.030	ND	0.030	ND	0.030	0.00
SELENIUM		mg/kg		9.00	ND	0.11		11.40		6.818	14.78
VANADIUM		mg/kg		101.00	ND	1.70		116.00		72.617	154.32
CHLORINE		mg/kg		7.40		5.00	ND	2.00		4.47	6.72

MASS FLOW RATE											
ANTIMONY		mg/hr	ND	23.2	ND	86.3	ND	58.0	ND	55.84	78.5
ARSENIC		mg/hr		568.6		277.9		672.9		506.48	508.6
BARIUM		mg/hr		130.0	ND	26.8		255.2		132.87	284.3
CADMIUM		mg/hr		2.3		5.2		9.3		5.594	8.7
CHROMIUM		mg/hr		127.7		155.3		336.5		206.48	281.7
COBALT		mg/hr		27.9		25.9		46.4		33.38	28.1
LEAD		mg/hr		58.0	ND	19.8		133.4		67.12	143.6
MANGANESE		mg/hr		106.8		181.2		255.2		181.08	184.4
MERCURY		mg/hr	ND	0.1	ND	0.3	ND	0.2	ND	0.168	0.2
SELENIUM		mg/hr		20.9	ND	0.9		66.1		29.165	83.0
VANADIUM		mg/hr		234.4	ND	14.7		672.9		304.891	832.6
CHLORINE		mg/hr		17.2		43.2		11.6		24.0	41.8

METALS AND CHLORIDE ANALYSIS
LOCATION: Baghouse hopper ash (11)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: AP-BP-R2to4-M-SS11

DATE: 8/8/94
OPERATOR: DAVE LADD
ENTERED BY: BOB MASTERSON
CHECKED BY: MATT GARDNER

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE			10/21/93	10/22/93	10/22/93
RUN NUMBER	-	-	2	3	4
STREAM FLOW		kg/hr	14.8958	18.1405	20.7224

LABORATORY ANALYSIS RESULTS						AVERAGE	CI
ANTIMONY		mg/kg	ND 10	ND 10	ND 10	ND 10.00	0.00
ARSENIC		mg/kg	321.00	400.00	141.00	287.33	329.78
BARIUM		mg/kg	ND 3.10	ND 3.10	ND 3.10	ND 3.10	0.00
CADMIUM		mg/kg	3.500	2.700	2.100	2.77	1.74
CHROMIUM		mg/kg	50.00	61.00	51.00	54.00	15.11
COBALT		mg/kg	11.00	8.00	9.00	9.33	3.79
LEAD		mg/kg	18.00	15.00	20.00	17.67	6.25
MANGANESE		mg/kg	39.00	43.00	38.00	40.00	6.57
MERCURY		mg/kg	0.110	0.080	ND 0.030	0.068	0.10
SELENIUM		mg/kg	15.60	14.20	8.40	12.733	9.48
VANADIUM		mg/kg	110.00	130.00	86.00	108.67	54.73
CHLORINE		mg/kg	100.00	340.00	23.00	154.33	410.75

MASS FLOW RATE							
ANTIMONY		mg/hr	ND 148.96	ND 181.41	ND 207.22	ND 179.20	72.5
ARSENIC		mg/hr	4781.55	7256.20	2921.86	4986.54	5402.0
BARIUM		mg/hr	ND 46.18	ND 56.24	ND 64.24	ND 55.55	22.5
CADMIUM		mg/hr	52.14	48.98	43.52	48.21	10.8
CHROMIUM		mg/hr	744.79	1106.57	1056.84	969.40	487.2
COBALT		mg/hr	163.85	145.12	186.50	165.16	51.5
LEAD		mg/hr	268.12	272.11	414.45	318.23	207.1
MANGANESE		mg/hr	580.94	780.04	787.45	716.14	291.0
MERCURY		mg/hr	1.64	1.45	ND 0.62	1.134	1.3
SELENIUM		mg/hr	232.37	257.60	174.07	221.346	106.4
VANADIUM		mg/hr	1638.54	2358.27	1782.13	1926.31	946.3
CHLORINE		mg/hr	1489.58	6167.77	476.62	2711.3	7542.2

ATA
0/22/93
4
182.35

APPENDIX C — MASS BALANCES

This section provides information for the mass balance of all measured constituents for each of the tests conditions. The information provided shows mass balances for trace metals and total particulate and flue gas streams. This appendix contains four sections, one for each test condition. Mass balances were analyzed by calculating the mass flow across the GSA cyclone, the ESP and then the Baghouse. The data analysis shows summaries of total mass inputs, total mass outputs and mass balance of trace metals and chloride across the GSA, ESP, baghouse and across the entire system. Across the GSA, data was analyzed to determine mass flows of the inputs and outputs including calculation of the solids generated from SO_2 removal in the GSA, ESP and baghouse during demonstration tests. An example calculation of the solids generated from SO_2 removal in the GSA is given at the end of this appendix. Wherever possible, data for three runs was included in the spreadsheet calculations, however there were several cases where a complete set of data for a test run was not possible and substitute data was needed to enable a complete analysis. General procedures are described below. Specific assumptions and procedures used for each series of tests are described in the following sub-appendices.

Mass Balances - General Procedures

- Averaging of elemental mass flows - When averaging results of individual runs that were all ND, if the average concentration in the sample was flagged NDM, the mass flow rate was also marked NDM. Average elemental mass flow rates were not marked NDM unless the average concentration was marked NDM. If the average mass flow rate was marked NDM, the normal averaging procedures were used (i.e., one-half of the non-detects was used with detected values in the average).

- If less than three full runs was obtained at a particular location:

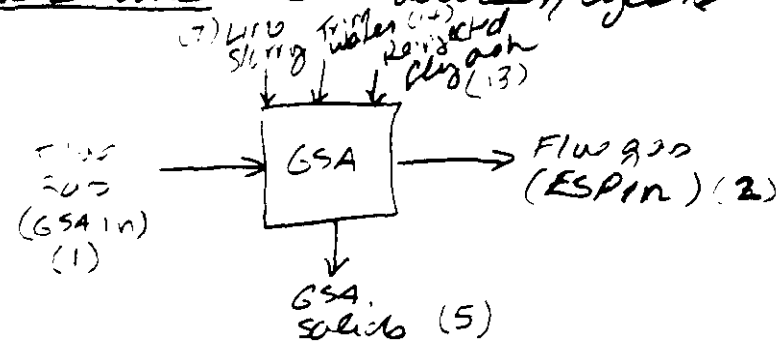
  - If two valid runs were obtained, the average of the two valid runs was substituted for the missing run;

  - If one valid run was obtained, no data were substituted for the missing runs;

- If a make-up run was performed for a run that was invalidated and the make-up run was performed on the same day as planned run of the same type at the same location, the make-up run data were substituted for the invalidated run.

Example calculations for the mass balance around the GSA reactor/cyclone are provided on the following pages.

MASS Balance - GSA absorber/cyclone



Example Calculation

Given: Flue gas flow GSA in: 44824 kg/hr (wet)
Particulate in flue gas, GSA in: 95 kg/hr
Lime slurry flow: 1008 L/hr
Trim water flow: 1199 L/hr
Lime slurry % moisture: 71.2 wt. %
Reinjected fly ash: 198.7 kg/hr
GSA in SO_2 concentration (dry): 1790 ppm
GSA in O_2 concentration (dry): 6.29 %
ESP in SO_2 concentration (dry): 235 ppm
" " O_2 " " (dry): 6.81 %
Flue gas molec. wt, GSA in: 29.00
Flue gas moisture GSA in: 9.3 vol. %
Flue gas molec wt ESP in: 28.30
Flue gas moisture ESP in: 14.8 vol %
SO_2 molec. wt: 64.06
Ca molec wt: 40.08
$Ca(OH)_2$ molec wt: 74.10
$CaSO_4$ molec wt: 136.14
$CaSO_3$ molec wt: 120.14
H_2O molec wt: 18.02
GSA in gas pressure: 28.46 in Hg

Assumptions:
- SO_2 & O_2 concentrations from process data are reported on a dry basis.

Calculate solids produced by lime addition and SO_2 removal

Overall reaction is:

$$Ca(OH)_2(s) + SO_2(g) \rightarrow CaSO_3 \cdot \tfrac{1}{2}H_2O(s) + \tfrac{1}{2}H_2O(g)$$

Therefore, 1 mole of $CaSO_3 \cdot \tfrac{1}{2}H_2O$ solids are generated per mole of SO_2 removed.

molec. wt of solids $= 40.08 + 32.06 + 16 \times 3 + (\tfrac{1}{2} \times 18.02)$
$= 129.15$

per mole of SO_2,

Reactants:

$1 \text{ mole } Ca(OH)_2 \times \frac{74.10 \text{ g}}{\text{mole}} = 74.10 \text{ g}$ solids introduced

Products:

$1 \text{ mole } CaSO_3 \cdot \tfrac{1}{2}H_2O \times 129.15 \frac{\text{g}}{\text{mole}} = 129.15 \text{ g}$ solids produced

net increase in solids $= 129.15 - 74.10 = \boxed{55.05 \text{ g}}$ per mole SO_2

per g of SO_2,

$$\frac{55.05 \text{ g solids}}{\text{mole } SO_2} \times \frac{\text{mole } SO_2}{64.04 \text{ g } SO_2} = \frac{0.85962 \text{ g solids}}{\text{g } SO_2}$$

Assumptions:

- Neglect SO_3 reaction since it was not recovered and is typically < 1% of SO_2.

Gas Flow rate - GSA inlet

Actual gas flow rate = 34,256.4 acfm (wet)
gas temp = 781.3 °R
mole wt = 29.00
1 lb-mole gas = 385 ft³ @ 68°F
inlet gas pressure = 28.46 in. Hg absolute

$$34256 \times \frac{528}{781.3} \times \frac{28.46}{29.92} = \boxed{22{,}020 \text{ scfm @ } 68°F \text{ (wet)}}$$

$$22020 \frac{ft^3}{min} \times \frac{lb\text{-}mole}{385\ ft^3} \times \frac{29.00\ lb}{lb\text{-}mole} \times \frac{60\ min}{hr} \times \frac{kg}{2.2046\ lb}$$

$$= \boxed{45{,}142\ kg/hr}$$

Compare to process venturi data

20,011 scfm @ 32°F

$$20011 \times \frac{528}{492} = 21{,}475 \text{ scfm @ } 68°F$$

$$\frac{22020 - 21475}{22020} \times 100 = \boxed{2.48\%}$$

OK.

SO_2 Removal – based on inlet conditions

inlet gas flow 22020 scfm (wet)

inlet SO_2 conc. 1790 ppm (assume dry)

inlet H_2O conc. 9.3 vol %

inlet O_2 conc 6.29 vol %

outlet SO_2 conc. 235 ppm

outlet O_2 conc. 6.81 vol %

correct outlet SO_2 to inlet O_2 conditions

$$235 \times \frac{20.9-6.29}{20.9-6.81} = 243.7 \text{ ppm}$$

$$SO_2 \text{ removal} = \frac{1790-243.7}{1790} \times 100$$

$$= \boxed{86.39\ \%}$$

SO_2 input flow rate

$$22020 \times \left(1-\frac{9.3}{100}\right) \times 1790 \times 10^{-6} = 35.75 \text{ scfm } SO_2$$

$$35.75 \frac{ft^3}{min} \times \frac{lb\text{-mole}}{385\ ft^3} = 0.09286 \frac{\text{moles } SO_2}{min}$$

$$SO_2 \text{ removed} = 0.09286 \times .8639 = \boxed{0.08022 \frac{\text{moles } SO_2}{min}}$$

$$0.08022 \frac{moles}{min} \times 64.06 \frac{lb}{mole} \times 60 \frac{min}{hr} \times \frac{kg}{2.2046\ lb}$$

$$= \boxed{139.9 \frac{kg}{hr}}$$

GSA
Mass balance is therefore as follows

(a) Gas in : GSA inlet flow = 45142 kg/hr

(b) Solids in : Lime slurry flow = 1008 L/hr

- Assume specific gravity of slurry is 1.1 (typical value)

$1008 \frac{L}{hr} \times 1 \frac{kg}{L} \times 1.1 = 1108.8$ kg/hr

wt % solids = 100 - wt % moisture = 100 - 71.2 = 28.8 %
solids = 1108.8 × .288 = 319.3 kg/hr
reinjected fly ash = 198.7 kg/hr
solids in flue gas = 94.6 kg/hr
Total solids in = 319.3 + 198.7 + 94.6 = $\boxed{612.6 \frac{kg}{hr}}$

(c) water in : Trim water flow = 1199 L/hr

$1199 \frac{L}{hr} \times 1 \frac{kg}{L} = 1199$ kg/hr

water from slurry

$1108 \frac{kg}{hr} \times 0.712 = 788.9 \frac{kg}{hr}$

Total water in = 1199 + 788.9
$\boxed{= 1987.9 \text{ kg/hr}}$

Calculate:
Gas out : = gas in + (H_2O generated by SO_2 removal) − (SO_2 removed) + vaporized water (assume 100 %)

$= 45142 + 0.1406 \times 139.9 - 139.9 + 1988 = \boxed{47010 \frac{kg}{hr}}$

compare to measured gas out = 47407 $\frac{kg}{hr}$

$\frac{47407 - 47010}{47407} \times 100 = \underline{0.84\%}$ very good!

Solids removed in GSA:

= Solids in − Solids in outlet flue gas + Solids generated by SO_2 removal

$= 612.6 - 304 + 0.011599 \times 139.9$

$= 612.6 - 304 + 1.62$

$= \boxed{310.2 \frac{kg}{hr}}$

Compared to TVA rate test = $252.5 \frac{kg}{hr}$

$$\frac{310.2 - 252.5}{310.2} \times 100 = \boxed{18.6\%}$$

pretty clear within ± 50% mass balance goal

Assumptions

- Solids in flue gas measured by multi metals trains
- All water (trim water, slurry, $Ca(OH)_2$ reaction) is converted to vapor and included in gas leaving GSA

- ESP inlet particulate and trace metals data collected on 9/13/93 (Run 1) were invalidated and make-up runs were performed on 9/15/93 (Run 4). The make-up particulate and trace metals data collected on 9/15/93 were substituted for the invalidated data.

- GSA inlet and baghouse inlet HCl data collected on 9/13/93 (Run 1) were invalidated and make-up runs were performed on 9/15/93 (Run 4). The make-up HCl data collected on 9/15/93 at these two locations were substituted for the invalidated data.

- A single HCl run was collected at the ESP outlet on 9/21/93. However, valid HCl runs were collected on all three test days at the baghouse inlet. Since the baghouse inlet is a slipstream of the ESP outlet, and since the Method 26 train measures only gas-phase species, it was assumed that the HCl concentration at the fabric filter inlet was the same as that at the ESP outlet, after correction for different O_2 concentrations at the two locations. Comparison of the calculated data with measured HCl concentration at the ESP outlet on 9/21/93 shows agreement within 7.4% of the measured value (see table). Therefore, the mass flow of HCl at the ESP outlet was calculated using the HCl concentration measured at the baghouse inlet (corrected to ESP outlet O_2 concentration) and the gas flow rate measured during the Method 29 (multiple metals) runs.

- Solids flow rates at the GSA and ESP hoppers, and corresponding elemental mass flow rates, were calculated using the substitutions above.

AirPol Mass Balance - Series configuration, demonstration tests/GSA

NOTE: Values in italics must be input by user. Other values are calculated.

(1) Calculate flow rate of GSA absorber/cyclone solids		A	B	C		
Given:					Mean	2.5% CC
Flue gas flow rate at GSA inlet (wet; stack T, P)	*acfm*	*34115*	*34571*	*33608*	34098	1196.76789
Flue gas temperature at GSA inlet	*°R*	*755*	*759*	*752*	755.333333	8.72470906
Flue gas pressure at GSA inlet	*in. Hg*	*28.52*	*28.53*	*28.46*	28.5033333	0.09405553
Flue gas molecular weight at GSA inlet (wet)	*g/g-mole*	*29.1*	*29.12*	*29*	29.0733333	0.1597206
SO2 conc. at GSA inlet (dry)	*ppmv*	*1745*	*1786*	*1790*	1773.66667	61.8761492
O2 conc. at GSA inlet (dry)	*vol. %*	*6.62*	*6.21*	*6.29*	6.37333333	0.53992696
H2O vapor conc. at GSA inlet	*vol. %*	*8.15*	*8.34*	*9.32*	8.60333333	1.55986635
SO2 conc. at ESP inlet (dry)	*ppmv*	*207*	*178*	*235*	206.666667	70.8072709
O2 conc. at ESP inlet (dry)	*vol. %*	*6.94*	*6.55*	*6.81*	6.76666667	0.49333561
Lime slurry flow rate	*L/hr*	*926.6*	*990.2*	*1008*	974.933333	106.313808
Specific gravity of lime slurry	*-*	*1.14*	*1.14*	*1.14*	1.14	0
Moisture content of lime slurry	*wt. %*	*69.9*	*71.9*	*71.2*	71	2.52132791
Reinjected fly ash flow rate	*kg/hr*	*198.4*	*201.4*	*197.86*	199.22	4.73799186
Particulate flow rate in GSA inlet flue gas	*kg/hr*	*83.2*	*91.14*	*96.44*	90.26	16.5549409
Particulate flow rate in ESP inlet flue gas	*kg/hr*	*377.8*	*269.3*	*303.7*	316.933333	137.749852
Increase in solids generated per mass SO2 removed	kg/kg	*0.85935061*	0.85935061	0.85935061	0.85935061	0
Calculated data:						
Std T = 68°F; std P = 29.92 in. Hg						
Solids in lime slurry	kg/hr	306.79726	306.07082	319.3344	310.73416	18.5254061
Total solids into GSA	kg/hr	588.39726	598.61082	613.6344	600.21416	31.5380188
SO2 at ESP inlet, corrected to GSA inlet O2	ppm	211.744986	182.217422	243.672818	212.545075	76.3574001
SO2 removal	%	87.8656169	89.7974568	86.3869934	88.016689	4.24882281
Flue gas flow rate at GSA inlet at STP (wet)	scfm	22741.5614	22932.1235	22445.6433	22706.4427	608.996001
Flue gas flow rate at GSA inlet (wet)	kg/hr	46781.483	47205.9084	46014.0831	46667.1582	1500.74287
SO2 flow rate at GSA inlet at STP	scfm	36.4497766	37.5409777	36.4331397	36.8079647	1.5772129
SO2 flow rate at GSA inlet	lb-moles/min	0.09467474	0.09750903	0.09463153	0.0956051	0.00409666
SO2 removed	lb-moles/min	0.08318655	0.08756063	0.08174934	0.0841655	0.00751961
SO2 removed	kg/hr	145.031215	152.657191	142.525512	146.737973	13.1100335
Increase in solids generated by SO2 removal	kg/hr	124.632663	131.18605	122.479386	126.099366	11.2661152
Flow rate of solids removed in GSA	kg/hr	335.229923	460.49687	432.413786	409.380193	163.303656
Compare to TVA measured solids after test program	*kg/hr*	*252.5*	*252.5*	*252.5*	252.5	0
Relative percent difference (rel. to calculated value)	%	24.6785615	45.1679227	41.6068571	37.1511138	27.1968341

(2) Calculate gas flow rate at GSA outlet						
Given :					Mean	2.5% CC
Flue gas flow at GSA inlet (wet)	kg/hr	46781.483	47205.9084	46014.0831	46667.1582	1500.74287
SO2 removed	kg/hr	145.031215	152.657191	142.525512	146.737973	13.1100335
Increase in H2O generated per mass SO2 removed	kg/kg	0.14064939	0.14064939	0.14064939	0.14064939	0
Trim water flow rate	*L/hr*	*1333*	*1210*	*1199*	1247.33333	184.817621
Lime slurry flow rate	kg/hr	1056.324	1128.828	1149.12	1111.424	121.197742
Moisture content of lime slurry	wt. %	69.9	71.9	71.2	71	2.52132791
Calculated:						
Water in lime slurry	kg/hr	738.370476	811.627332	818.17344	789.390416	110.070162
Trim water flow rate	kg/hr	1333	1210	1199	1247.33333	184.817621
Total water input to system (besides flue gas)	kg/hr	2071.37046	2021.62733	2017.17344	2036.72375	74.7474591
Water generated from SO2 removal	kg/hr	20.3985521	21.471141	20.0461265	20.6386065	1.84391823
Total gas flow at GSA outlet (wet)	kg/hr	48728.2208	49096.3497	47908.7772	48577.7826	1510.25673
Compare to measured gas flow at ESP inlet (wet)	*kg/hr*	*51603*	*47267*	*43690*	47520	9844.34462
Relative percent difference (rel. to measured value)	%	5.57095356	-3.87024714	-9.65616201	-2.65181853	19.0954464

- = no data available

#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated.

(3) Calculate mass balance around GSA for trace metals and chlorine										
Given:		Flag	Value	Flag	Value	Flag	Value		Mean	2.5% CC
Flue gas analysis results - GSA inlet										
Antimony	*mg/hr*		*50.1843143*		*33.8768195*	*ND*	*3.70941279*		28.6386134	58.5791575
Arsenic	*mg/hr*		*5009.2758*		*5190.78528*		*6220.03065*		5473.36391	1622.19835
Barium	*mg/hr*		*3234.79965*		*2829.29094*		*9149.70305*		5071.26454	8789.20616
Cadmium	*mg/hr*		*193.452807*		*186.679394*		*245.475846*		208.536016	79.9201635
Chromium	*mg/hr*		*10205.0976*		*9660.10961*		*10677.6538*		10180.9537	1265.02895
Cobalt	*mg/hr*		*1409.96751*		*1243.06514*		*1616.86757*		1423.30008	465.211035
Lead	*mg/hr*		*2580.7441*		*2226.97536*		*3749.77993*		2852.4998	1979.88165
Manganese	*mg/hr*		*10128.4192*		*9696.34737*		*14128.4987*		11317.7551	6071.08483
Mercury	*mg/hr*		*14.8779039*		*34.2611595*		*61.0962106*		36.7450913	57.6591514
Selenium	*mg/hr*		*2288.90829*		*2262.82879*		*3099.15984*		2550.29897	1181.31841
Vanadium	*mg/hr*		*23232.4192*		*21731.6777*		*25409.4776*		23457.8582	4594.12512
Chlorine (as HCl)	*mg/hr*		*599580.197*		*773169*		*634214*		668987.732	228237.241
Reinjected ash analysis results										
Antimony	*mg/hr*	*ND*	*15.872*	*ND*	*16.112*	*ND*	*15.8288*	ND	15.9376	0.37903935
Arsenic	*mg/hr*		*10277.12*		*22556.8*		*4986.072*		12606.664	22393.8943
Barium	*mg/hr*		*23470.72*		*35426.26*		*27443.182*		28780.054	15126.7749
Cadmium	*mg/hr*		*55.552*		*73.9138*		*47.28854*		58.9181133	33.8567227
Chromium	*mg/hr*		*3114.88*		*4028*		*3462.55*		3535.14333	1144.95215
Cobalt	*mg/hr*		*837.248*		*994.916*		*959.621*		930.595	205.565755
Lead	*mg/hr*		*3591.04*		*5417.66*		*2473.25*		3827.31667	3692.61384
Manganese	*mg/hr*		*11308.8*		*15447.38*		*22971.546*		16575.9087	14689.1618
Mercury	*mg/hr*	*ND*	*19.84*	*ND*	*20.14*	*ND*	*19.786*	ND	19.922	0.47379919
Selenium	*mg/hr*		*337.28*		*656.564*		*403.6344*		465.826133	418.568059
Vanadium	*mg/hr*		*4225.92*		*6122.56*		*5856.656*		5401.712	2551.18837
Chlorine (as chloride)	*mg/hr*	*ND*	*3.968*	*ND*	*4.028*		*791.44*		265.146	1129.45431
Lime slurry analysis results (archive sample analysis)										
Antimony	*mg/hr*	*ND*	*84.502272*	*ND*	*90.302592*	*ND*	*91.958784*	ND	88.921216	9.72739526
Arsenic	*mg/hr*		*1014.02726*		*1083.6311*		*1103.50541*		1067.05459	116.728743
Barium	*mg/hr*		*1510.47811*		*1614.15883*		*1643.76326*		1589.46674	173.87719
Cadmium	*mg/hr*		*11.6190624*		*12.4166064*		*12.6443328*		12.2266672	1.33751685
Chromium	*mg/hr*		*4763.81558*		*5090.80862*		*5184.17645*		5012.93355	548.381908
Cobalt	*mg/hr*	*ND*	*369.69744*	*ND*	*395.07384*	*ND*	*402.31968*	ND	389.03032	42.5573543
Lead	*mg/hr*	*ND*	*36.969744*	*ND*	*39.507384*	*ND*	*40.231968*	ND	38.903032	4.25573543
Manganese	*mg/hr*		*4932.82013*		*5271.41381*		*5368.09402*		5190.77598	567.836898
Mercury	*mg/hr*	*ND*	*105.62784*	*ND*	*112.87824*	*ND*	*114.94848*	ND	111.15152	12.1592441
Selenium	*mg/hr*		*1531.60368*		*1636.73448*		*1666.75296*		1611.69704	176.309039
Vanadium	*mg/hr*		*2376.6264*		*2539.7604*		*2586.3408*		2500.9092	273.582992
Chlorine (as chloride)	*mg/hr*		*27463.2384*		*29348.3424*		*29886.6048*		28899.3952	3161.40346

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- = no data available
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See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated.

Trim water analysis results									
Antimony	*mg/hr*	*ND*	*2.6662*	*ND*	*2.42088*	*ND*	*2.39818*	ND	2.49508667	0.36922859
Arsenic	*mg/hr*	*ND*	*1.3331*	*ND*	*1.21044*	*ND*	*1.19909*	ND	1.24754333	0.1846143
Barium	*mg/hr*		*51.9909*		*47.20716*		*46.76451*		48.65419	7.19995758
Cadmium	*mg/hr*	*ND*	*0.93317*	*ND*	*0.847308*	*ND*	*0.839363*	ND	0.87328033	0.12923001
Chromium	*mg/hr*	*ND*	*11.9979*	*ND*	*10.89396*	*ND*	*10.79181*	ND	11.22789	1.66152867
Cobalt	*mg/hr*	*ND*	*9.3317*	*ND*	*8.47308*	*ND*	*8.39363*	ND	8.73280333	1.29230008
Lead	*mg/hr*	*ND*	*1.3331*	*ND*	*1.21044*	*ND*	*1.19909*	ND	1.24754333	0.1846143
Manganese	*mg/hr*	*ND*	*1.3331*	*ND*	*1.21044*	*ND*	*1.19909*	ND	1.24754333	0.1846143
Mercury	*mg/hr*	*ND*	*0.26662*	*ND*	*0.242088*	*ND*	*0.239818*	ND	0.24950867	0.03692286
Selenium	*mg/hr*	*ND*	*1.3331*	*ND*	*1.21044*	*ND*	*1.19909*	ND	1.24754333	0.1846143
Vanadium	*mg/hr*	*ND*	*6.6655*	*ND*	*6.0522*	*ND*	*5.99545*	ND	6.23771667	0.92307149
Chlorine (as chloride)	*mg/hr*		*107981.1*		*76257.72*		*80339.03*		88192.6167	42875.6994
Flue gas analysis results - ESP inlet										
Antimony	*mg/hr*	*ND*	*13.8715861*		*58.3567622*	*ND*	*10.3781017*		23.4938687	66.4538196
Arsenic	*mg/hr*		*6323.81132*		*2513.60361*		*3327.09731*		4054.83741	4985.18533
Barium	*mg/hr*		*36025.3251*		*33651.4196*		*46538.1551*		38738.3	17038.4967
Cadmium	*mg/hr*		*244.792696*		*170.513461*		*293.028754*		236.111637	153.326539
Chromium	*mg/hr*		*17082.4503*		*12250.5102*		*16809.4724*		15380.811	6743.37272
Cobalt	*mg/hr*		*2782.47698*		*1740.41326*		*2509.0587*		2343.98298	1342.25944
Lead	*mg/hr*		*4936.65271*		*4292.23541*		*4822.7649*		4683.88434	854.425537
Manganese	*mg/hr*		*30068.7029*		*16257.5766*		*24235.9198*		23520.7331	17224.6213
Mercury	*mg/hr*		*50.5904906*		*9.99561671*		*55.5533679*		38.7131584	62.0925752
Selenium	*mg/hr*		*4283.87219*		*5820.97679*		*4914.33639*		5006.39512	1919.58939
Vanadium	*mg/hr*		*22765.7208*		*18785.8796*		*24174.8722*		21908.8242	6943.27594
Chlorine (as HCl)	*mg/hr*	*ND*	*339.071772*	*ND*	*325.804773*	*ND*	*319.693684*	ND	328.190076	24.6118589
GSA Solids analysis results										
Antimony	*mg/hr*	*ND*	*26.8184*	*ND*	*36.84*	*ND*	*34.5928*	ND	32.7504	13.0643939
Arsenic	*mg/hr*		*7475.629*		*6861.45*		*8345.513*		7560.864	1852.55603
Barium	*mg/hr*		*25242.819*		*26248.5*		*25641.913*		25711.0773	1258.05755
Cadmium	*mg/hr*		*110.6259*	*ND*	*1.842*	*ND*	*1.72964*		37.4705733	156.113017
Chromium	*mg/hr*		*5162.542*		*7321.95*		*6399.668*		6294.72	2691.83667
Cobalt	*mg/hr*		*657.0508*		*828.9*		*1483.1663*		989.7057	1082.92801
Lead	*mg/hr*		*616.8232*		*257.88*		*177.2881*		350.663767	581.326629
Manganese	*mg/hr*		*21052.444*		*41675.25*		*36062.994*		32930.2293	26488.8818
Mercury	*mg/hr*	*ND*	*33.523*	*ND*	*46.05*	*ND*	*43.241*	ND	40.938	16.3304924
Selenium	*mg/hr*	*ND*	*33.523*	*ND*	*46.05*	*ND*	*43.241*	ND	40.938	16.3304924
Vanadium	*mg/hr*		*6168.232*		*9025.8*		*8950.887*		8048.30633	4046.05015
Chlorine (as chloride)	*mg/hr*		*30505.93*		*45129*		*51889.2*		42508.0433	27153.6143

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- no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated.

Calculated:									Mean	2.5% CC
TOTAL MASS INPUT TO GSA										
Antimony	mg/hr		101.70455		88.2945555	ND	113.895177		82.3155647	31.8123225
Arsenic	mg/hr		16301.0896		28831.8216		12310.2076		19147.7063	21417.0058
Barium	mg/hr		28267.9887		39916.9169		38283.4128		35489.4395	15668.8883
Cadmium	mg/hr		261.090454		273.433455		305.828401		280.117437	57.4026046
Chromium	mg/hr		18089.7922		18784.3652		19329.7762		18734.6445	1543.98011
Cobalt	mg/hr		2436.73008		2439.7546		2781.84523		2552.77664	492.855396
Lead	mg/hr		6190.93552		7664.99428		6243.74546		6699.89175	2077.45403
Manganese	mg/hr		26370.7059		30415.7464		42468.7383		33085.0635	20804.8459
Mercury	mg/hr		77.7451339		100.891323		128.58336		102.406606	63.2337701
Selenium	mg/hr		4158.45852		4556.73249		5170.14674		4628.44592	1266.12408
Vanadium	mg/hr		29838.2983		30397.0242		33855.4721		31363.5982	5406.00232
Chlorine (as chloride)	mg/hr		718417.194		857359.065		727662.338		767812.866	193000.616
TOTAL MASS OUTPUT FROM GSA										
Antimony	mg/hr	ND	40.6899861		76.7767622	ND	44.9709017		39.8690687	48.979852
Arsenic	mg/hr		13799.4403		9375.05361		11672.6103		11615.7014	5497.2002
Barium	mg/hr		61268.1441		59899.9196		72180.0681		64449.3773	16719.1892
Cadmium	mg/hr		355.418596		171.434461		293.893574		273.58221	232.679913
Chromium	mg/hr		22244.9923		19572.4602		23209.1404		21675.531	4680.5718
Cobalt	mg/hr		3439.52778		2569.31326		3992.225		3333.68868	1782.10516
Lead	mg/hr		5553.47591		4550.11541		5000.053		5034.54811	1248.55114
Manganese	mg/hr		51121.1469		57932.8266		60298.9138		56450.9624	11837.7588
Mercury	mg/hr		67.3519906		33.0206167		77.1738679		59.1821584	57.5936372
Selenium	mg/hr		4300.63369		5844.00179		4935.95689		5026.86412	1927.07533
Vanadium	mg/hr		28933.9528		27811.6796		33125.7592		29957.1305	6958.37804
Chlorine (as chloride)	mg/hr		30670.7695		45287.3897		52044.6188		42667.5927	27141.6492
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	L	40.0080291		86.9552622	L	39.4844654		55.4825856	67.7165868
Arsenic	%		84.6534842	L	32.5163416		94.8205805		70.6634688	83.0395368
Barium	%	H	216.740373	H	150.061488	H	188.541362	H	185.114408	83.1539745
Cadmium	%		136.12853		62.6969591		96.0975413		98.3076767	91.3382886
Chromium	%		122.969861		104.195484		120.069369		115.744905	25.1084206
Cobalt	%		141.153418		105.310315		143.509961		129.991231	53.1816123
Lead	%		89.7033395		59.3622806		80.0809872		76.3822024	38.5197197
Manganese	%	H	193.855815	H	190.46985		141.984237	H	175.436634	72.0956215
Mercury	%		86.6317764	L	32.7288064		60.0185499		59.7930742	66.9582496
Selenium	%		103.418939		128.249833		95.4703442		109.046372	42.4796201
Vanadium	%		96.9691785		91.4947444		97.8446233		95.4361821	8.54944455
Chlorine (as chloride)	%	L	4.26921428	L	5.28219641	L	7.15230349	L	5.56790473	3.63365593

= no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

(4) Calculate ESP ash flow rate						
Given:					Mean	2.5% CC
Solids in flue gas at ESP inlet	kg/hr	377.8	269.3	303.7	316.933333	137.749852
SO2 conc. at ESP inlet (dry)	ppmv	207	178	235	206.666667	70.8072709
O2 conc. at ESP inlet (dry)	vol. %	6.94	6.55	6.81	6.76666667	0.49333561
Flue gas flow rate at ESP inlet (wet)	kg/hr	51603	47267	43690	47520	9844.34462
Flue gas molecular weight at ESP inlet (wet)	*g/g-mole*	*28.25*	*28.41*	*28.3*	*28.32*	*0.20335185*
H2O in flue gas at ESP inlet	*vol. %*	*15.06*	*13.62*	*14.83*	14.5033333	1.9218461
Solids in flue gas at ESP outlet	*kg/hr*	*0.398*	*0.38*	*0.218*	0.332	0.24628802
Solids in flue gas at baghouse inlet	*kg/hr*	*0.12*	*0.0715*	*0.0475*	0.07966667	0.0917553
SO2 conc. at ESP outlet (dry)	*ppmv*	*173*	*136*	*198*	169	77.4938324
O2 conc. at ESP outlet (dry)	*vol. %*	*7.46*	*7.14*	*7.31*	7.30333333	0.39775281
Percent of ESP ash collected in Row 1	*%*	*89.3*	*89.3*	*89.3*	89.3	3.3506E-06
Increase in solids generated per mass SO2 removed	kg/kg	0.85935061	0.85935061	0.85935061	0.85935061	0
Calculated:						
SO2 at ESP outlet, corrected to ESP inlet O2	ppm	179.693452	141.831395	205.284768	175.603205	79.3095634
SO2 removal across ESP	%	13.1915689	20.3194408	12.6447795	15.3852631	10.637589
Flue gas flow rate at ESP inlet at STP (wet)	acfm	25840.1946	23535.6441	21839.1078	23738.3155	4989.11824
SO2 flow rate at ESP inlet at STP	acfm	5.34892029	4.18934464	5.13219033	4.89015175	1.53163213
SO2 flow rate at ESP inlet	lb-moles/min	0.0138933	0.01088141	0.01333036	0.01270169	0.00397827
SO2 removed across ESP	lb-moles/min	0.00183274	0.00221104	0.0016856	0.00190979	0.00067342
SO2 removed across ESP	kg/hr	3.19528962	3.85483234	2.93874339	3.32962178	1.17406624
Increase in ESP solids generated by SO2 removal	kg/hr	2.74587408	3.31265252	2.52541092	2.86131251	1.00893454
Flow rate of solids removed in ESP - total	kg/hr	380.027874	272.161153	305.959911	319.382979	137.065725
Flow rate of solids removed in ESP - Row 1	kg/hr	339.364892	243.039909	273.2222	285.209	122.399692
Flow rate of solids removed in ESP - Rows 2-4	kg/hr	40.6629825	29.1212433	32.7377105	34.1739788	14.6660326

(5) Calculate gas flow rate at ESP outlet						
Given :						
Flue gas flow at ESP inlet (wet)	kg/hr	51603	47267	43690	47520	9844.34462
SO2 removed	kg/hr	3.19528962	3.85483234	2.93874339	3.32962178	1.17406624
Increase in H2O generated per mass SO2 removed	kg/kg	0.14064939	0.14064939	0.14064939	0.14064939	0
Flue gas flow at baghouse inlet (wet)	kg/hr	7335	7335	7335	7335	0
Calculated:						
Water generated from SO2 removal	kg/hr	0.44941554	0.54217982	0.41333247	0.46830928	0.1651317
Total gas flow at ESP outlet (wet)	kg/hr	44268.4494	39932.5422	36355.4133	40185.4683	9844.38058
Compare to measured gas flow at ESP outlet (wet)	*kg/hr*	*36271*	*33929*	*33398*	34532.6667	3797.74171
Relative percent difference (rel. to measured value)	%	-22.0491561	-17.6944271	-8.85506118	-16.1995481	16.7018924

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- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

(6) Calculate trace metal and chlorine mass balance around ESP									
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - ESP inlet									
Antimony	mg/hr	ND	13.8715861		58.3567622	ND	10.3781017	23.4938687	66.4538196
Arsenic	mg/hr		6323.81132		2513.60361		3327.09731	4054.83741	4985.18533
Barium	mg/hr		36025.3251		33651.4196		46538.1551	38738.3	17038.4967
Cadmium	mg/hr		244.792696		170.513461		293.028754	236.111637	153.326539
Chromium	mg/hr		17082.4503		12250.5102		16809.4724	15380.811	6743.37272
Cobalt	mg/hr		2782.47698		1740.41326		2509.0587	2343.96298	1342.25944
Lead	mg/hr		4936.65271		4292.23541		4822.7649	4683.88434	854.425537
Manganese	mg/hr		30068.7029		16257.5766		24235.9198	23520.7331	17224.6213
Mercury	mg/hr		50.5904906		9.99561671		55.5533679	38.7131584	62.0925752
Selenium	mg/hr		4283.87219		5820.97679		4914.33639	5006.39512	1919.58939
Vanadium	mg/hr		22765.7208		18785.8796		24174.8722	21908.8242	6943.27594
Chlorine (as HCl)	mg/hr	ND	339.071772	ND	325.804773	ND	319.693684	ND 328.190076	24.6118589
Flue gas analysis results - ESP outlet									
Antimony	*mg/hr*		*12.8913606*	*ND*	*1.73981407*	*ND*	*1.71442552*	4.8728268	16.0132738
Arsenic	*mg/hr*		*4.98016346*		*3.37728614*		*4.84073089*	4.39939349	2.20587402
Barium	*mg/hr*	*ND*	*96.4906669*	*ND*	*95.1780639*	*ND*	*93.789161*	ND 95.1526306	3.35617334
Cadmium	*mg/hr*		*4.68706009*	*ND*	*0.0716394*		*3.0431053*	2.5886617	5.81164406
Chromium	*mg/hr*	*ND*	*56.0268389*	*ND*	*55.2646822*	*ND*	*54.4582225*	ND 55.2499145	1.94874581
Cobalt	*mg/hr*	*ND*	*24.9008173*	*ND*	*24.562081*	*ND*	*24.2036544*	ND 24.5555176	0.86610925
Lead	*mg/hr*		*15.2880643*	*ND*	*0.96201484*	*ND*	*0.94797647*	5.41435331	20.5584055
Manganese	*mg/hr*		*166.005449*		*79.3150532*		*5649.53634*	1964.95228	7928.11395
Mercury	*mg/hr*		*3.838876*		*1.73981407*		*5.24412513*	3.60760507	4.38129344
Selenium	*mg/hr*		*6.04363586*		*394.016716*		*1321.11614*	573.725497	1678.67627
Vanadium	*mg/hr*	*ND*	*186.75613*	*ND*	*184.215607*	*ND*	*181.527408*	ND 184.166382	6.49581936
Chlorine (as HCl)	*mg/hr*	*ND*	*219.549354*	*ND*	*276.594792*	*ND*	*269.861133*	ND 255.335093	77.4460265
Flue gas analysis results - Baghouse inlet									
Antimony	*mg/hr*	*ND*	*0.68458768*	*ND*	*0.65365066*	*ND*	*0.61878164*	ND 0.65234299	0.08179131
Arsenic	*mg/hr*		*1.12755618*	*ND*	*0.46140682*	*ND*	*0.43678704*	0.52555104	0.97361714
Barium	*mg/hr*	*ND*	*37.4509733*	*ND*	*35.7590286*	*ND*	*33.8509954*	ND 35.6869991	4.47446575
Cadmium	*mg/hr*		*1.01379382*		*0.96799306*		*1.6443212*	1.20870269	0.93895838
Chromium	*mg/hr*	*ND*	*21.7457264*	*ND*	*20.7633069*	*ND*	*19.6554167*	ND 20.7214833	2.59807688
Cobalt	*mg/hr*	*ND*	*9.6647673*	*ND*	*9.2281364*	*ND*	*8.73574076*	ND 9.20054815	1.15470084
Lead	*mg/hr*		*7.65127411*		*9.03588356*		*7.27978397*	7.98898055	2.29919518
Manganese	*mg/hr*		*8.25532207*		*15.3802273*		*7.27978397*	10.3051111	10.9861475
Mercury	*mg/hr*		*0.885937*		*1.42267103*		*0.80077624*	1.03646142	0.83763649
Selenium	*mg/hr*	*ND*	*0.52350823*		*1.85523992*	*ND*	*0.47318596*	0.78452901	1.94724018
Vanadium	*mg/hr*	*ND*	*72.4857547*	*ND*	*69.211023*	*ND*	*65.5180557*	ND 69.0716111	8.66025628
Chlorine (as HCl)	*mg/hr*	*ND*	*54.1337236*	*ND*	*48.9457886*	*ND*	*55.0939227*	ND 52.7244783	8.21687767

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-- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

Analysis results - ESP Ash Row 1									
Antimony	*mg/hr*	*ND*	*3393.6*	*ND*	*2430.4*	*ND*	*2732.2*	ND	2852.06667	1223.93582
Arsenic	*mg/hr*		*5769.12*		*3402.56*		*4098.3*		4423.32667	3021.69813
Barium	*mg/hr*		*17986.08*		*15311.52*	*ND*	*846.982*		11240.3637	22907.2691
Cadmium	*mg/hr*		*203.616*		*243.04*		*245.898*		230.851333	58.7042641
Chromium	*mg/hr*		*6447.84*		*6319.04*		*9016.26*		7261.04667	3779.72913
Cobalt	*mg/hr*	*ND*	*220.584*	*ND*	*157.976*		*1092.88*		427.386667	1298.39477
Lead	*mg/hr*		*1357.44*		*1944.32*		*1639.32*		1647.02667	729.192742
Manganese	*mg/hr*		*9841.44*		*5832.96*		*6557.28*		7410.56	5306.86453
Mercury	*mg/hr*	*ND*	*10.1808*	*ND*	*7.2912*	*ND*	*8.1966*	ND	8.5562	3.67180746
Selenium	*mg/hr*	*ND*	*37.3296*	*ND*	*26.7344*		*819.66*		283.897333	1129.79775
Vanadium	*mg/hr*	*ND*	*576.912*		*13853.28*		*15027.1*		9722.94533	19937.9488
Chlorine (as chloride)	*mg/hr*		*278275.2*		*267344*		*300542*		282053.733	42031.2132
Analysis results - ESP Ash Rows 2-4									
Antimony	*mg/hr*	*ND*	*406.6*	*ND*	*291.2*	*ND*	*327.4*	ND	341.733333	146.625913
Arsenic	*mg/hr*		*487.92*		*145.6*		*523.84*		385.786667	518.684292
Barium	*mg/hr*		*2805.54*		*1135.68*		*1276.86*		1739.36	2300.58007
Cadmium	*mg/hr*	*ND*	*12.198*		*20.384*		*16.37*		14.2843333	10.1690276
Chromium	*mg/hr*		*528.58*		*349.44*		*1014.94*		630.986667	855.521484
Cobalt	*mg/hr*	*ND*	*26.429*	*ND*	*18.928*		*98.22*		40.2995	108.751575
Lead	*mg/hr*		*325.28*	*ND*	*66.976*		*163.7*		174.156	324.21103
Manganese	*mg/hr*		*731.88*		*465.92*		*851.24*		683.013333	490.04375
Mercury	*mg/hr*	*ND*	*1.2198*	*ND*	*0.8736*	*ND*	*0.9822*	ND	1.0252	0.43987774
Selenium	*mg/hr*	*ND*	*4.4726*	*ND*	*3.2032*	*ND*	*3.6014*	ND	3.75906667	1.61288505
Vanadium	*mg/hr*	*ND*	*69.122*	*ND*	*49.504*	*ND*	*55.658*	ND	58.0946667	24.9264053
Chlorine (as chloride)	*mg/hr*		*31714.8*		*22713.6*		*29138.6*		27855.6667	11516.6799

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- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

Calculated results:											
TOTAL MASS INPUT TO ESP											
Antimony	mg/hr	ND	13.8715861		58.3567622	ND	10.3781017		23.4938687		66.4538196
Arsenic	mg/hr		6323.81132		2513.60361		3327.09731		4054.83741		4985.18533
Barium	mg/hr		36025.3251		33651.4196		46538.1551		38738.3		17038.4967
Cadmium	mg/hr		244.792696		170.513461		293.028754		236.111637		153.326539
Chromium	mg/hr		17082.4503		12250.5102		16809.4724		15380.811		6743.37272
Cobalt	mg/hr		2782.47698		1740.41326		2509.0587		2343.98298		1342.25944
Lead	mg/hr		4936.65271		4292.23541		4822.7649		4683.88434		854.425537
Manganese	mg/hr		30068.7029		16257.5766		24235.9198		23520.7331		17224.6213
Mercury	mg/hr		50.5904906		9.99561671		55.5533679		38.7131584		62.0925752
Selenium	mg/hr		4283.87219		5820.97679		4914.33639		5006.39512		1919.58939
Vanadium	mg/hr		22765.7208		18785.8796		24174.8722		21908.8242		6943.27594
Chlorine (as chloride)	mg/hr	ND	329.678944	ND	316.779463	ND	310.837661	ND	319.098689		23.9300713
TOTAL MASS OUTPUT FROM ESP											
Antimony	mg/hr		1913.33365	ND	2723.99347	ND	3061.93321		1602.099		1466.47994
Arsenic	mg/hr		6263.14772		3551.76799		4627.19912		4814.03828		3391.89659
Barium	mg/hr		20858.5908		16512.6685		1764.17108		13045.1435		24864.1194
Cadmium	mg/hr		215.415854		264.427813		266.955427		248.933031		72.1805252
Chromium	mg/hr		7015.30628		6706.49399		10068.2568		7930.01903		4616.38365
Cobalt	mg/hr	ND	281.578585	ND	210.694217		1207.5697		484.5687		1381.82398
Lead	mg/hr		1705.65934		1987.32489		1810.77377		1834.586		353.607278
Manganese	mg/hr		10747.5808		6393.57528		13065.3361		10068.8307		8415.13395
Mercury	mg/hr		10.425113		7.2448851		10.6343014		9.43476649		4.71868984
Selenium	mg/hr		27.20649		410.840756		2142.81343		860.286893		2800.20245
Vanadium	mg/hr	ND	905.275884		14004.7453		15178.4517		9878.61166		19684.8137
Chlorine (as chloride)	mg/hr		310123.051		290215.861		329838.577		310059.163		49218.3048
MASS BALANCE (OUTPUT/INPUT * 100)											
Antimony	%	H	13793.1858	H	4667.82832	H	29503.7888	H	15988.2677		31209.8562
Arsenic	%		99.0407114		141.301833		139.076159		126.472901		59.0850727
Barium	%		57.8997989	L	49.0697532	L	3.79080579	L	36.9201193		72.1167048
Cadmium	%		87.9992978	H	155.077382		91.1021268		111.392936		94.0660817
Chromium	%	L	41.0673302		54.7446095		59.8963287		51.9027562		24.1747802
Cobalt	%	L	10.1197094	L	12.1059878	L	48.1283956	L	23.4513643		53.1499314
Lead	%	L	34.5509283	L	46.3004636	L	37.5463828	L	39.4659249		15.1679735
Manganese	%	L	35.7434134	L	39.3267425		53.9089757	L	42.9930439		23.9037024
Mercury	%	L	20.6068628		72.4806214	L	19.1424963	L	37.4099935		75.4763781
Selenium	%	L	0.63509108	L	7.05793496	L	43.6033121	L	17.0987794		57.5799136
Vanadium	%	L	3.97648681		74.5493189		62.7860682	L	47.103958		93.9322197
Chlorine (as chloride)	%	H	94068.2007	H	91614.4812	H	106112.81	H	97265.164		19278.179

- no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/baghouse

NOTE: Values in italics must be input by user. Other values are calculated.

(7) Calculate solids removed in fabric filter					Mean	2.5% CC
Given:						
Solids in flue gas at baghouse inlet	kg/hr	0.12	0.0715	0.0475	0.07966667	0.0917553
SO2 conc. at baghouse inlet (dry)	ppmv	*173*	*136*	*198*	169	77.4938324
O2 conc. at baghouse inlet (dry)	vol. %	*7.46*	*7.14*	*7.31*	7.30333333	0.39775281
Flue gas flow rate at baghouse inlet (wet)	kg/hr	*7654*	*7404*	*7335*	7464.33333	416.971826
Flue gas molecular weight at baghouse inlet (wet)	g/g-mole	*28.4*	*28.4*	*28.32*	28.3733333	0.11474667
H2O in flue gas at baghouse outlet	vol. %	12.15	12.82	13.29	12.7533333	1.42331839
Solids in flue gas at baghouse outlet	kg/hr	0.0356	0.0292	0.02795	0.03091667	0.01019512
SO2 conc. at baghouse outlet (dry)	ppmv	*153*	*129*	*179*	153.666667	62.1250153
O2 conc. at baghouse outlet (dry)	vol. %	*7.84*	*7.55*	*7.91*	7.76666667	0.4741985
Increase in solids generated per mass SO2 removed	kg/kg	0.85935061	0.85935061	0.85935061	0.85935061	0
Calculated:						
SO2 at baghouse outlet, corrected to baghouse inlet O2	ppm	157.451761	132.961798	187.267898	159.227152	67.5654201
SO2 removal across baghouse	%	8.98742133	2.23397224	5.42025334	5.54721564	8.39337192
Flue gas flow rate at baghouse inlet at STP (wet)	acfm	3812.49603	3687.96977	3663.92142	3721.46241	198.123768
SO2 flow rate at baghouse inlet at STP	acfm	0.65956181	0.50156389	0.72545644	0.62886071	0.28584885
SO2 flow rate at baghouse inlet	lb-moles/min	0.00171315	0.00130276	0.0018843	0.0016334	0.00074246
SO2 removed across baghouse	lb-moles/min	0.00015397	2.9103E-05	0.00010213	9.5068E-05	0.00015585
SO2 removed across baghouse	kg/hr	0.26843445	0.05074014	0.17806501	0.16574653	0.27170683
Increase in baghouse solids generated by SO2 removal	kg/hr	0.23067931	0.04360357	0.15302027	0.14243439	0.23349315
Flow rate of solids removed in baghouse	kg/hr	0.31507931	0.08590357	0.17257027	0.19118439	0.28747823

(8) Calculate gas flow at baghouse outlet						
Given :						
Flue gas flow at baghouse inlet (wet)	kg/hr	7654	7404	7335	7464.33333	416.971826
SO2 removed in baghouse	kg/hr	0.26843445	0.05074014	0.17806501	0.16574653	0.27170683
Increase in H2O generated per mass SO2 removed	kg/kg	0.14064939	0.14064939	0.14064939	0.14064939	0
Calculated:						
Water generated from SO2 removal	kg/hr	0.03775514	0.00713657	0.02504473	0.02331215	0.03821568
Total gas flow at baghouse outlet (wet)	kg/hr	7654.03776	7404.00714	7335.02504	7464.35665	416.997665
Compare to measured gas flow at baghouse outlet (wet)	kg/hr	*8292*	*8363*	*8276*	8310.33333	115.042118
Relative percent difference (rel. to measured value)	%	7.69370773	11.4670915	11.3699245	10.1769079	5.34396843

See notes for missing data procedures used.

-- = no data available

#VALUE! = insufficient data to calculate number

AirPol Mass Balance - Series configuration, demonstration tests/baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

(9) Calculate trace metals and chlorine mass balance around fabric filter										
Given:		Flag	Value	Flag	Value	Flag	Value			
Flue gas analysis results - Baghouse inlet										
Antimony	mg/hr	ND	0.68456768	ND	0.65365966	ND	0.61878164	ND	0.65234299	0.08179131
Arsenic	mg/hr		1.12755618	ND	0.46140682	ND	0.43678704		0.52555104	0.97361714
Barium	mg/hr	ND	37.4509733	ND	35.7590286	ND	33.8509954	ND	35.6869991	4.47446575
Cadmium	mg/hr		1.01379382		0.96799306		1.6443212		1.20870269	0.93895838
Chromium	mg/hr	ND	21.7457264	ND	20.7633069	ND	19.6554167	ND	20.7214833	2.59807688
Cobalt	mg/hr	ND	9.6647673	ND	9.2281364	ND	8.73574076	ND	9.20954815	1.15470084
Lead	mg/hr		7.65127411		9.03588356		7.27978397		7.98898055	2.29919518
Manganese	mg/hr		8.25532207		15.3802273		7.27978397		10.3051111	10.9861475
Mercury	mg/hr		0.885937		1.42267103		0.80077624		1.03646142	0.83763649
Selenium	mg/hr	ND	0.52350823		1.85523992	ND	0.47318596		0.78452901	1.9472401
Vanadium	mg/hr	ND	72.4857547	ND	69.211023	ND	65.5180557	ND	69.0716111	8.66025628
Chlorine (as HCl)	mg/hr	ND	54.1337236	ND	48.9457886	ND	55.0939227	ND	52.7244783	8.21687767
Flue gas analysis results - Baghouse outlet										
Antimony	*mg/hr*	*ND*	*0.36647983*	*ND*	*0.35438622*	*ND*	*0.3506717*	ND	0.35717925	0.02053528
Arsenic	*mg/hr*	*ND*	*0.25869165*	*ND*	*0.25015498*	*ND*	*0.24753297*	ND	0.25212653	0.01449549
Barium	*mg/hr*	*ND*	*20.0486027*	*ND*	*19.3870109*	*ND*	*19.1838049*	ND	19.5398062	1.12340054
Cadmium	*mg/hr*		*1.94395994*	*ND*	*1.04596051*		*1.54708104*		1.33800708	1.11796951
Chromium	*mg/hr*	*ND*	*11.6411241*	*ND*	*11.2569741*	*ND*	*11.1389835*	ND	11.3456939	0.65229709
Cobalt	*mg/hr*	*ND*	*5.17383295*	*ND*	*5.00309958*	*ND*	*4.95065934*	ND	5.04253062	0.28990982
Lead	*mg/hr*		*1.66748324*		*1.29976358*		*2.06277472*		1.67667385	0.94799512
Manganese	*mg/hr*		*7.97632579*		*7.71311185*		*9.28248626*		8.32397464	2.08799544
Mercury	*mg/hr*		*0.79763258*	*ND*	*0.12507749*		*1.27892033*		0.71303055	1.4398169
Selenium	*mg/hr*	*ND*	*0.28024928*	*ND*	*0.27100123*	*ND*	*0.26816071*	ND	0.27313708	0.01570345
Vanadium	*mg/hr*	*ND*	*38.8037471*	*ND*	*37.5232469*	*ND*	*37.129945*	ND	37.8189797	2.17432363
Chlorine (as HCl)	*mg/hr*	*ND*	*48.1224064*	*ND*	*56.7715765*	*ND*	*56.1934674*	ND	53.6958168	12.0126757
Analysis results - Baghouse ash										
Antimony	*mg/hr*	*ND*	*3.151*	*ND*	*0.859*	*ND*	*1.726*	ND	1.912	2.87503843
Arsenic	*mg/hr*		*4.7265*		*4.6386*		*4.1424*		4.5025	0.78241119
Barium	*mg/hr*		*11.3436*		*5.4117*		*6.3862*		7.71383333	7.90270175
Cadmium	*mg/hr*		*8.44468*		*2.1475*		*3.03776*		4.54331333	8.46632322
Chromium	*mg/hr*		*15.4399*		*2.9206*		*5.178*		7.84616667	16.576802
Cobalt	*mg/hr*		*1.5755*		*0.3436*		*0.863*		0.92736667	1.53648175
Lead	*mg/hr*		*4.4114*		*1.4603*		*2.2438*		2.70516667	3.79778223
Manganese	*mg/hr*		*30.5647*		*7.9887*		*23.4736*		20.6756667	28.6820335
Mercury	*mg/hr*		*0.3151*		*0.05154*		*0.24164*		0.20276	0.33790387
Selenium	*mg/hr*	*ND*	*0.034661*	*ND*	*0.009449*	*ND*	*0.018986*	ND	0.021032	0.03182542
Vanadium	*mg/hr*	*ND*	*0.53567*		*5.0681*		*12.2546*		5.86351167	14.6808072
Chlorine (as chloride)	*mg/hr*		*163.852*		*40.373*		*22.438*		75.5543333	191.274271

C-19

- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

C-20

- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, demonstration tests/baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

Calculated results:										
TOTAL MASS INPUT TO BAGHOUSE										
Antimony	mg/hr	ND	0.68458768	ND	0.65365966	ND	0.61878164	ND	0.65234299	0.08179131
Arsenic	mg/hr		1.12755618	ND	0.46140682	ND	0.43678704		0.52555104	0.97361714
Barium	mg/hr	ND	37.4509733	ND	35.7590286	ND	33.8509954	ND	35.6869991	4.47446575
Cadmium	mg/hr		1.01379382		0.96799306		1.6443212		1.20870269	0.93895838
Chromium	mg/hr	ND	21.7457264	ND	20.7633069	ND	19.6554167	ND	20.7214833	2.59807688
Cobalt	mg/hr	ND	9.6647673	ND	9.2281364	ND	8.73574076	ND	9.20954815	1.15470084
Lead	mg/hr		7.65127411		9.03588356		7.27978397		7.98898055	2.29919518
Manganese	mg/hr		8.25532207		15.3802273		7.27978397		10.3051111	10.9861475
Mercury	mg/hr		0.885937		1.42267103		0.80077624		1.03646142	0.83763649
Selenium	mg/hr	ND	0.52350823		1.85523992	ND	0.47318596		0.78452901	1.94724018
Vanadium	mg/hr	ND	72.4857547	ND	69.211023	ND	65.5180557	ND	69.0716111	8.66025628
Chlorine (as chloride)	mg/hr	ND	52.6341333	ND	47.5899124	ND	53.5677334	ND	51.2639264	7.98925709
TOTAL MASS OUTPUT FROM BAGHOUSE										
Antimony	mg/hr	ND	3.51747983	ND	1.21338622	ND	2.0766717	ND	2.26917925	2.89188729
Arsenic	mg/hr		4.85584582		4.76367749		4.26616648		4.62856327	0.78805746
Barium	mg/hr		21.3679013		15.1052054		15.9781025		17.4837364	8.42682985
Cadmium	mg/hr		10.3886399		2.67048025		4.58484104		5.88132041	9.98479643
Chromium	mg/hr		21.2604621		8.54908703		10.7474918		13.5190136	16.8781052
Cobalt	mg/hr		4.16241647		2.84514979		3.33832967		3.44863198	1.65338788
Lead	mg/hr		6.07888324		2.76006358		4.30657472		4.38184052	4.12571444
Manganese	mg/hr		38.5410258		15.7018119		32.7560863		28.9996413	29.4988966
Mercury	mg/hr		1.11273258		0.11407874		1.52056033		0.91579055	1.79773626
Selenium	mg/hr	ND	0.31491028	ND	0.28045023	ND	0.28714671	ND	0.29416908	0.04539336
Vanadium	mg/hr	ND	39.3394171		23.8297234		30.8195725		24.7730015	19.2968839
Chlorine (as chloride)	mg/hr		187.24667		67.9724567		49.7564095		101.658512	185.527936
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	513.809979	H	185.629662	H	335.60655	H	345.015397	408.157752
Arsenic	%	H	430.652227	H	1032.42459	H	976.71545	H	813.26409	826.092908
Barium	%		57.0556636	L	42.2416549	L	47.201278	L	48.8328655	18.7333387
Cadmium	%	H	1024.72907	H	275.878038	H	278.828798	H	526.478634	1071.99207
Chromium	%		97.768461	L	41.1740147		54.6795416		64.5406724	73.4316024
Cobalt	%	L	43.067943	L	30.8312498	L	38.2146147	L	37.3712692	15.3079568
Lead	%		79.4492937	L	30.5455859		59.1580017		56.3842938	61.0390953
Manganese	%	H	466.862776		102.090896	H	449.959592	H	339.637755	511.513184
Mercury	%		125.599515	L	8.01863133	H	189.885796		107.834647	229.120228
Selenium	%		60.1538366	L	15.1166555		60.6836931	L	45.3180617	64.9816588
Vanadium	%		54.2719287	L	34.430532	L	47.0398155	L	45.2474254	24.9462384
Chlorine (as chloride)	%	H	355.751406		142.829548		92.885038	H	197.155331	346.813524

- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

MASS BALANCE AROUND TOTAL SYSTEM
SERIES CONFIGURATION
DEMONSTRATION TESTS

System balance - DS/A

9/14/94 19:11

TOTAL MASS INPUT											
Antimony	mg/hr		101.7045503		88.29455552	ND	113.8951768		82.31556475		31.8123225
Arsenic	mg/hr		16301.08961		28831.8216		12310.2076		19147.70627		21417.00581
Barium	mg/hr		28267.98866		39916.91693		38283.41282		35489.43947		15668.88825
Cadmium	mg/hr		261.0904541		273.4334549		305.8284006		280.1174365		57.40260461
Chromium	mg/hr		18089.79216		18784.36521		19329.77617		18734.64451		1543.980113
Cobalt	mg/hr		2436.730079		2439.754604		2781.84523		2552.776637		492.8553956
Lead	mg/hr		6190.935522		7664.994277		6243.745457		6699.891752		2077.454033
Manganese	mg/hr		26370.70587		30415.7464		42468.73827		33085.06352		20804.84587
Mercury	mg/hr		77.7451339		100.8913235		128.5833596		102.4066057		63.23377014
Selenium	mg/hr		4158.458523		4556.732489		5170.14674		4628.445918		1266.124082
Vanadium	mg/hr		29838.29832		30397.02424		33855.47213		31363.59823		5406.002317
Chlorine (as chloride)	mg/hr		718417.1941		857359.0652		727662.3381		767812.8658		193000.6156
TOTAL MASS OUTPUT											
Antimony	mg/hr		1928.159301	ND	2761.3932	ND	3097.953897		1619.277616		1496.103601
Arsenic	mg/hr		13742.50501		10417.75096		12976.6879		12378.98129		4325.486996
Barium	mg/hr		46104.05223		42758.39424		27405.02568		38755.82405		24772.33083
Cadmium	mg/hr		335.4166		267.0513		270.7079663		291.0586221		95.54421922
Chromium	mg/hr		12188.23588		14026.61143		16468.7546		14227.8673		5334.7298
Cobalt	mg/hr		797.1701251		932.4781903		2689.691457		1473.113257		2622.858762
Lead	mg/hr		2320.910148		2238.929071		1985.049663		2181.629627		435.0287315
Manganese	mg/hr		31830.31047		48069.14687		49153.39843		43017.61859		24107.14515
Mercury	mg/hr		27.41340858		28.96129282		32.97038546		29.78169562		7.124808937
Selenium	mg/hr		43.863691		432.1507411		2164.340747		880.1183931		2804.785929
Vanadium	mg/hr		6604.296773		23019.76953		24127.18628		17917.08419		24378.30366
Chlorine (as chloride)	mg/hr		340789.9104		335389.0388		381750.7492		352643.2328		62983.14227
MASS BALANCE (OUTPUT/INPUT * 100)											
Antimony	%	H	1895.8	H	3127.5	H	2720.0	H	2581.108871		1558.810947
Arsenic	%		84.3	L	36.1		105.4		75.28369326		88.22022046
Barium	%	H	163.1		107.1		71.6		113.9331345		114.6146983
Cadmium	%		128.5		97.7		88.5		104.8832663		51.99892383
Chromium	%		67.4		74.7		85.2		75.74898079		22.25963656
Cobalt	%	L	32.7	L	38.2		96.7		55.87407563		88.0755804
Lead	%	L	37.5	L	29.2	L	31.8	L	32.83041618		10.52358315
Manganese	%		120.7	H	158.0		115.7		131.4946055		57.44490668
Mercury	%	L	35.3	L	28.7	L	25.6	L	29.86909946		12.20834019
Selenium	%	L	1.1	L	9.5	L	41.9	L	17.46695378		53.52065354
Vanadium	%	L	22.1		75.7		71.3		56.37640381		73.8818222
Chlorine (as chloride)	%	L	47.436213	L	39.11885375		52.462623	L	46.33922992		16.74240722

ESTIMATED HCl AT ESP OUTLET - SERIES CONFIGURATION, DEMONSTRATION TESTS

HCl RUN BI METALS/HCl RUNS EO		RUN 4 RUN 1	RUN 2 RUN 2	RUN 3 RUN 3
GAS FLOW @ EO (METALS)	DSCM/MIN	444.131266	453.082119	446.289266
O2 @ EO (METALS)	VOL. %	7.46	7.14	7.31
HCL @ BI (3% O2)	MG/DSCM	ND 0.01327	ND 0.01179	ND 0.01324
Est. HCL CONC. @ EO (@ EO O2	MG/DSCM	ND 0.00996362	ND 0.00906315	ND 0.01005204
ESTIMATED HCL MASS @ EO	MG/HR	ND 265.509313	ND 246.381095	ND 269.167179
MEASURED HCL MASS @ EO	MG/HR	ND 219.5		
ACCURACY OF ESTIMATE	% RPD	-20.960963		

ESTIMATED HF AT ESP OUTLET - SERIES CONFIGURATION, DEMONSTRATION TESTS

HF RUN BI METALS/HF RUNS EO		RUN 4 RUN 1	RUN 2 RUN 2	RUN 3 RUN 3
GAS FLOW @ EO (METALS)	DSCM/MIN	444.131266	453.082119	446.289266
O2 @ EO (METALS)	VOL. %	7.46	7.14	7.31
HF @ BI (3% O2)	MG/DSCM	ND 0.03398	ND 0.03017	ND 0.03736
Est. HF CONC. @ EO (@ EO O2)	MG/DSCM	ND 0.02551347	ND 0.02319213	ND 0.02836438
ESTIMATED HF MASS @ EO	MG/HR	ND 679.879914	ND 630.476475	ND 759.523097
MEASURED HF MASS @ EO	MG/HR	ND 562		
ACCURACY OF ESTIMATE	% RPD	-20.975074		

- Flue gas particulate and trace metals data were not obtained on 10/13/93 due to a mill outage, however, process samples were collected during HCl sampling prior to the outage. Particulate and trace metals, gas flow, moisture, molecular weight data from the make-up run on 10/15/93 (Run 3) were substituted for the missing data.

- Particulate and metals data at the ESP inlet on 10/14/93 were invalidated because the acetone rinse sample was broken during shipment. The average of Runs 2 and 3 particulate and trace metals data was substituted.

- Particulate and metals data at the ESP outlet were not collected on 10/14/93. The average of the two runs performed on 10/15/93 was substituted for the missing data.

- Solids flow rates at the GSA, ESP, and baghouse hoppers were calculated using the substitutions above.

- HCl data at the ESP inlet were not obtained on 10/13/93. The average of Runs 2 and 3 ESP inlet HCl results (10/14-15/93) was substituted.

- A single (unplanned) HCl run at the ESP outlet was made on 10/15/93 for validation purposes. No data were substituted for the missing runs.

- The HCl sample collected on 10/15/93 at the baghouse inlet (Run 3) was destroyed in shipment. The average of the HCl data collected on 10/13/93 and 10/14/93 was substituted for the missing data.

- No metals data were obtained for the baghouse solids sample collected on 10/15/93. The average of the metals data from the samples collected on 10/13/93 and 10/14/93 was substituted for the missing data.

- No chloride data were obtained for the baghouse ash samples collected on 10/13/93 and 10/15/93. No data were substituted for the missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/GSA

NOTE: Values in italics must be input by user. Other values are calculated.

(1) Calculate flow rate of GSA absorber/cyclone solids						
Given:		A	B	C	Mean	2.5% CC
Flue gas flow rate at GSA inlet (wet; stack T, P)	acfm	*33578*	*33021*	*34492*	33697	1845.08071
Flue gas temperature at GSA inlet	°R	*752*	*744*	*756*	750.666667	15.1795572
Flue gas pressure at GSA inlet	in. Hg	*28.46*	*28.56*	*28.5*	28.5066667	0.12504228
Flue gas molecular weight at GSA inlet (wet)	g/g-mole	*29.05*	*29.22*	*29.17*	29.1466667	0.21705402
SO2 conc. at GSA inlet (dry)	ppmv	*1853*	*1867*	*1808*	1842.66667	76.5858788
O2 conc. at GSA inlet (dry)	vol. %	*5.81*	*6.15*	*6.11*	6.02333333	0.46166821
H2O vapor conc. at GSA inlet	vol. %	*9.32*	*7.62*	*8.03*	8.32333333	2.20397814
SO2 conc. at ESP inlet (dry)	ppmv	*134*	*163*	*155*	150.666667	37.2096247
O2 conc. at ESP inlet (dry)	vol. %	*7.45*	*6.71*	*6.65*	6.93666667	1.10694855
Lime slurry flow rate	L/hr	*1242*	*1249*	*1331*	1274	122.943369
Specific gravity of lime slurry	g/g	*1.14*	*1.14*	*1.14*	1.14	0
Moisture content of lime slurry	wt. %	*70.8*	*70.9*	*64.9*	68.8666667	8.53518728
Reinjected fly ash flow rate	kg/hr	*194.3*	*198.13*	*199.49*	197.306667	6.6857937
Particulate flow rate in GSA inlet flue gas	kg/hr	*99.411*	*100.8173*	*98.2811*	99.5031333	3.15661935
Particulate flow rate in ESP inlet flue gas	kg/hr	*498.3292*	*431.4084*	*364.4876*	431.4084	168.2539
Increase in solids generated per mass SO2 removed	kg/kg	0.85935061	0.85935061	0.85935061	0.85935061	0
Calculated data:						
Std T = 68°F; std P = 29.92 in. Hg						
Solids in lime slurry	kg/hr	398.9304	399.8049	513.8991	437.5448	164.279868
Total solids into GSA	kg/hr	692.8414	698.7522	811.6702	734.3546	166.517612
SO2 at ESP inlet, corrected to GSA inlet O2	ppm	150.339033	169.432699	160.873684	160.215139	23.7598446
SO2 removal	%	91.8867224	90.9248688	91.1021192	91.3045702	1.27170546
Flue gas flow rate at GSA inlet at STP (wet)	acfm	22425.6073	22369.0645	22946.3585	22580.3435	790.60742
Flue gas flow rate at GSA inlet (wet)	kg/hr	46052.2727	46204.9763	47316.3159	46524.5216	1714.07308
SO2 flow rate at GSA inlet at STP	acfm	37.681757	38.5806995	38.1556088	38.1393551	1.11718615
SO2 flow rate at GSA inlet	lb-moles/min	0.09787469	0.10020961	0.09910548	0.09906326	0.00290178
SO2 removed	lb-moles/min	0.08993385	0.09111546	0.09028719	0.0904455	0.00150676
SO2 removed	kg/hr	158.794764	158.854833	157.410798	157.686798	2.62694931
Increase in solids generated by SO2 removal	kg/hr	134.741676	136.511998	135.271065	135.508246	2.25747049
Flow rate of solids removed in GSA	kg/hr	329.053876	403.855798	582.453865	438.454446	323.447698
Compare to TVA measured solids after test program	kg/hr	252.5	252.5	252.5	252.5	0
Relative percent difference (rel. to calculated value)	%	23.2648456	37.4778835	56.6489121	39.1304804	41.6208423

(2) Calculate gas flow rate at GSA outlet		1	2	3		
Given :		32793	32794	32795		
Flue gas flow at GSA inlet (wet)	kg/hr	46052.2727	46204.9763	47316.3159	46524.5216	1714.07308
SO2 removed	kg/hr	158.794764	158.854833	157.410798	157.686798	2.62694931
Increase in H2O generated per mass SO2 removed	kg/kg	0.14064939	0.14064939	0.14064939	0.14064939	0
Trim water flow rate	L/hr	*1034*	*1036*	*966*	1012	99.0001762
Lime slurry flow rate	kg/hr	1415.88	1423.88	1517.34	1452.36	140.155441
Moisture content of lime slurry	wt. %	70.8	70.9	64.9	68.8666667	8.53518728
Calculated:						
Water in lime slurry	kg/hr	1002.44304	1009.51674	984.75366	998.90448	31.6880808
Trim water flow rate	kg/hr	1034	1036	966	1012	99.0001762
Total water input to system (besides flue gas)	kg/hr	2036.44304	2045.51674	1950.75366	2010.90448	129.904377
Water generated from SO2 removal	kg/hr	22.0530882	22.3428356	22.1397329	22.1785522	0.36947882
Total gas flow at GSA outlet (wet)	kg/hr	47953.9741	48113.961	49131.7984	48399.9178	1587.1353
Compare to measured gas flow at ESP inlet (wet)	kg/hr	*52404*	*51074*	*51747*	51741.6667	1652.12476
Relative percent difference (rel. to measured value)	%	8.49176766	5.79554958	5.05382254	6.44704659	4.49466351

- = Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated.

(3) Calculate mass balance around GSA for trace metals and chlorine									
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - GSA inlet									
Antimony	*mg/hr*		*210.210818*		*150.128952*		*182.734566*	181.024779	74.7224423
Arsenic	*mg/hr*		*7504.80417*		*8107.73134*		*9277.86968*	8296.80173	2239.69811
Barium	*mg/hr*		*1522.21627*		*2563.21737*		*1461.54599*	1848.99321	1538.50019
Cadmium	*mg/hr*		*204.92421*		*185.39856*		*188.408868*	192.910546	26.1164781
Chromium	*mg/hr*		*8684.2084*		*11658.1686*		*10353.6733*	10232.0168	3703.42261
Cobalt	*mg/hr*		*1931.51968*		*1889.09065*		*2084.61742*	1968.40925	255.516443
Lead	*mg/hr*		*3619.38665*		*3236.76266*		*4528.94152*	3795.03028	1648.96979
Manganese	*mg/hr*		*5650.67608*		*12736.552*		*5932.12483*	8106.45096	9967.79518
Mercury	*mg/hr*		*15.478318*		*109.922696*		*54.2088673*	59.8699606	117.946456
Selenium	*mg/hr*		*636.19157*		*284.844592*	ND	*2.86469624*	307.489503	788.270432
Vanadium	*mg/hr*		*13178.3707*		*24781.9732*		*17817.8819*	18526.0753	14545.4786
Chlorine (as HCl)	*mg/hr*		*484796*		*691877*		*747943*	641538.667	344347.977
Reinjected ash analysis results									
Antimony	*mg/hr*	ND	*15.544*	ND	*15.8504*	ND	*15.9592*	ND 15.7845333	0.5348635
Arsenic	*mg/hr*		*6567.34*		*6062.778*		*10852.256*	7827.458	6537.96349
Barium	*mg/hr*		*22053.05*		*24607.746*		*29145.489*	25268.7617	8924.05927
Cadmium	*mg/hr*		*57.3185*		*58.84461*		*80.79345*	65.6521667	32.6315383
Chromium	*mg/hr*		*4274.6*		*6399.599*		*5984.7*	5552.96633	2798.27441
Cobalt	*mg/hr*		*1169.686*		*1192.7426*		*1516.124*	1292.85087	481.225165
Lead	*mg/hr*		*2098.44*		*1973.3748*		*3730.463*	2600.75927	2435.51728
Manganese	*mg/hr*		*14708.51*		*17653.383*		*15620.067*	15993.9667	3745.44878
Mercury	*mg/hr*	ND	*19.43*	ND	*19.813*	ND	*19.949*	ND 19.7306667	0.66857937
Selenium	*mg/hr*		*530.439*		*814.3143*		*690.2354*	678.329567	353.550291
Vanadium	*mg/hr*		*6217.6*		*9411.175*		*9515.673*	8381.48267	4657.40276
Chlorine (as chloride)	*mg/hr*		*602.33*		*653.829*		*658.317*	638.158667	77.2867017
Lime slurry analysis results (archive sample analysis)									
Antimony	*mg/hr*	ND	*113.28864*	ND	*113.9088*	ND	*121.36896*	ND 116.1888	11.1717054
Arsenic	*mg/hr*		*764.69832*		*768.8844*		*819.24048*	784.2744	75.4090112
Barium	*mg/hr*		*1954.22904*		*1964.9268*		*2093.61456*	2004.2568	192.711917
Cadmium	*mg/hr*		*25.489944*		*25.62948*		*27.308016*	26.14248	2.51363371
Chromium	*mg/hr*		*5239.5996*		*5268.282*		*5613.3144*	5373.732	516.691373
Cobalt	*mg/hr*	ND	*495.6378*	ND	*498.351*	ND	*530.9892*	ND 508.326	48.876211
Lead	*mg/hr*	ND	*49.56378*	ND	*49.8351*	ND	*53.09892*	ND 50.8326	4.8876211
Manganese	*mg/hr*		*7703.62752*		*7745.7984*		*8253.08928*	7900.8384	759.675965
Mercury	*mg/hr*	ND	*141.6108*	ND	*142.386*	ND	*151.7112*	ND 145.236	13.9646317
Selenium	*mg/hr*		*1430.26908*		*1438.0986*		*1532.28312*	1466.8836	141.04278
Vanadium	*mg/hr*		*3129.59868*		*3146.7306*		*3352.81752*	3209.7156	308.618361
Chlorine (as chloride)	*mg/hr*		*39651.024*		*39868.08*		*42479.136*	40666.08	3910.09688
Trim water analysis results									
Antimony	*mg/hr*	ND	*2.06746*	ND	*2.072*	ND	*1.93144*	ND 2.02363333	0.19843411
Arsenic	*mg/hr*	ND	*1.03373*	ND	*1.036*	ND	*0.96572*	ND 1.01181667	0.09921705
Barium	*mg/hr*		*40.31547*		*40.404*		*37.68308*	39.46085	3.86946512
Cadmium	*mg/hr*	ND	*0.723611*	ND	*0.7252*	ND	*0.676004*	ND 0.70627167	0.06945194
Chromium	*mg/hr*	ND	*9.30357*	ND	*9.324*	ND	*8.69148*	ND 9.10835	0.89295349
Cobalt	*mg/hr*	ND	*7.23611*	ND	*7.252*	ND	*6.76004*	ND 7.08271667	0.69451938
Lead	*mg/hr*	ND	*1.03373*	ND	*1.036*	ND	*0.96572*	ND 1.01181667	0.09921705
Manganese	*mg/hr*	ND	*1.03373*	ND	*1.036*	ND	*0.96572*	ND 1.01181667	0.09921705
Mercury	*mg/hr*	ND	*0.206746*	ND	*0.2072*	ND	*0.193144*	ND 0.20236333	0.01984341
Selenium	*mg/hr*	ND	*1.03373*	ND	*1.036*	ND	*0.96572*	ND 1.01181667	0.09921705
Vanadium	*mg/hr*	ND	*5.16865*	ND	*5.18*	ND	*4.8286*	ND 5.05908333	0.49608527
Chlorine (as chloride)	*mg/hr*		*248095.2*		*90132*		*57943.2*	132056.8	252838.173

- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated.

Flue gas analysis results - ESP inlet											
Antimony	*mg/hr*		*750.563159*		*615.263525*		*479.96389*		615.263525		336.130052
Arsenic	*mg/hr*		*13182.6118*		*11844.2348*		*10505.8578*		11844.2348		3324.9811
Barium	*mg/hr*		*90806.0452*		*61119.8933*		*31433.7414*		61119.8933		73750.4414
Cadmium	*mg/hr*		*346.663764*		*302.559301*		*258.454839*		302.559301		109.570401
Chromium	*mg/hr*		*19355.3935*		*15869.0155*		*12382.6376*		15869.0155		8661.34192
Cobalt	*mg/hr*		*3437.74899*		*3130.43554*		*2823.12209*		3130.43554		783.470552
Lead	*mg/hr*		*9246.06424*		*7871.0639*		*6496.06356*		7871.0639		3415.96588
Manganese	*mg/hr*		*17874.8503*		*15720.2079*		*13565.5655*		15720.2079		5352.86044
Mercury	*mg/hr*		*141.55437*		*102.587011*		*63.6196526*		102.587011		96.8080983
Selenium	*mg/hr*	*ND*	*9.38881027*	*ND*	*9.00198578*	*ND*	*8.6151613*	ND	9.00198578		0.98100285
Vanadium	*mg/hr*		*35063.5953*		*31200.0824*		*27336.5695*		31200.0824		9596.27269
Chlorine (as HCl)	*mg/hr*	*ND*	*305.5*	*ND*	*304*	*ND*	*307*	ND	305.5		3.72850731
GSA Solids analysis results											
Antimony	*mg/hr*	*ND*	*26.324*	*ND*	*32.3088*	*ND*	*46.596*	ND	35.0762667		25.8756257
Arsenic	*mg/hr*		*5462.23*		*5613.654*		*11998.47*		7691.45133		9268.45945
Barium	*mg/hr*		*18196.465*		*20639.176*		*24229.92*		21088.5203		7513.74702
Cadmium	*mg/hr*	*ND*	*1.3162*		*89.65692*		*187.5489*		92.6213067		231.433897
Chromium	*mg/hr*		*5429.325*		*6300.216*		*8853.24*		6860.927		4420.86298
Cobalt	*mg/hr*		*1039.798*		*969.264*		*1362.933*		1123.99833		521.480832
Lead	*mg/hr*	*ND*	*11.51675*		*88.8492*		*308.6985*		134.435358		383.038193
Manganese	*mg/hr*		*22507.02*		*24718.232*		*29821.44*		25681.564		9320.10476
Mercury	*mg/hr*	*ND*	*32.905*	*ND*	*40.386*	*ND*	*58.245*	ND	43.8453333		32.3445322
Selenium	*mg/hr*	*ND*	*32.905*	*ND*	*40.386*	*ND*	*58.245*	ND	43.8453333		32.3445322
Vanadium	*mg/hr*		*7765.58*		*9854.184*		*11649*		9756.25467		4828.46348
Chlorine (as chloride)	*mg/hr*		*30272.6*		*40386*		*122314.5*		64324.3667		125398.633

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- = Data not available
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See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/GSA

NOTE: Values in italics must be input by user. Other values are calculated.

Calculated:			A		B		C		Mean	2.5% CC
TOTAL MASS INPUT TO GSA										
Antimony	mg/hr		275.660868		216.044552		252.364366		248.023262	74.6402113
Arsenic	mg/hr		14837.3594		14939.9117		20949.849		16909.04	8694.73375
Barium	mg/hr		25569.8108		29176.2942		32738.3126		29161.4725	8904.54861
Cadmium	mg/hr		288.094459		270.23525		296.848336		285.059348	33.6987317
Chromium	mg/hr		18203.0598		23330.7116		21956.0334		21163.2683	6593.82897
Cobalt	mg/hr		3352.64264		3334.63475		3869.61604		3518.96448	754.758365
Lead	mg/hr		5743.12541		5235.57301		8286.43664		6421.71175	4061.19175
Manganese	mg/hr		28063.3305		38136.2514		29805.764		32001.7819	13374.6038
Mercury	mg/hr		96.102091		191.125796		140.135539		142.454476	118.140907
Selenium	mg/hr		2597.41651		2537.77549		2224.43373		2453.20858	497.753214
Vanadium	mg/hr		22526.1537		37342.4688		30488.7867		30119.8031	18419.0005
Chlorine (as chloride)	mg/hr		759714.934		803364.815		828304.442		797128.064	86249.9462
TOTAL MASS OUTPUT FROM GSA										
Antimony	mg/hr		763.725159		631.417925		503.26189		632.801658	323.553123
Arsenic	mg/hr		18644.8418		17457.8888		22504.3278		19535.6862	6555.00034
Barium	mg/hr		109002.51		81959.0693		55663.6614		82208.4136	66258.0418
Cadmium	mg/hr		347.321864		392.216221		446.003739		395.180608	122.745386
Chromium	mg/hr		24784.7185		22169.2315		21235.8776		22729.9425	4570.34883
Cobalt	mg/hr		4477.54699		4099.69954		4186.05509		4254.43387	491.867082
Lead	mg/hr		9251.82262		7959.9131		6804.76206		8005.49926	3041.24492
Manganese	mg/hr		40381.8703		40436.4399		43387.0055		41401.7719	4271.76793
Mercury	mg/hr		158.00687		122.780011		92.7421526		124.509678	81.1551827
Selenium	mg/hr	ND	42.2938103	ND	49.3879858	ND	66.8601613	ND	52.8473191	31.4100963
Vanadium	mg/hr		42829.1753		41054.2664		38985.5695		40956.3371	4779.05508
Chlorine (as chloride)	mg/hr		30421.1186		40533.7894		122463.748		64472.8852	125396.103
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	277.052439	H	292.262831	H	199.41876	H	256.244677	123.71225
Arsenic	%		125.661456		116.854029		107.42		116.645162	22.6834288
Barium	%	H	426.293769	H	280.909799	H	170.026055	H	292.409874	319.287956
Cadmium	%		120.556328		145.138808	H	150.246333		138.647823	39.4332697
Chromium	%		136.156881		95.0216689		96.7200094		109.29952	57.8221103
Cobalt	%		133.552767		122.942986		108.177531		121.557761	31.6609174
Lead	%	H	161.093864	H	152.035185		82.1192775		131.749442	107.370552
Manganese	%		143.895502		106.031501		145.565823		131.830942	55.5462604
Mercury	%	H	164.415642		64.2404185		66.1603231		98.2787946	142.31383
Selenium	%	L	1.62830297	L	1.94611328	L	3.00571604	L	2.19337743	1.79177691
Vanadium	%	H	190.114005		109.939883		127.86865		142.640813	104.538321
Chlorine (as chloride)	%	L	4.00428072	L	5.04550219	L	14.7848716	L	7.94488482	14.7729578

-- = Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

(4) Calculate ESP ash flow rate						
Given:		A	B	C	Mean	2.5% CC
Solids in flue gas at ESP inlet	kg/hr	496.3292	431.4084	364.4876	431.4084	166.2539
SO2 conc. at ESP inlet (dry)	ppmv	134	163	155	150.666667	37.2098247
O2 conc. at ESP inlet (dry)	vol. %	7.45	6.71	6.65	6.93666667	1.10694855
Flue gas flow rate at ESP inlet (wet)	kg/hr	52404	51074	51747	51741.6667	1652.12476
Flue gas molecular weight at ESP inlet (wet)	*g/g-mole*	*28.33*	*27.95*	*28.51*	28.2633333	0.7102485
H2O in flue gas at ESP inlet	*vol. %*	*14.74*	*17.56*	*12.97*	15.09	5.75106856
Solids in flue gas at ESP outlet	*kg/hr*	*0.2247*	*6.82585*	*13.427*	*6.82585*	16.3994892
Flue gas flow rate at baghouse inlet (wet)	*kg/hr*	*8026*	*7871*	*7596*	7831	541.021331
Flue gas molecular weight at baghouse inlet	*g/g-mole*	*28.37*	*28.48*	*28.39*	28.4133333	0.14556893
Solids in flue gas at baghouse inlet	*kg/hr*	*46.1928*	*28.5278*	*49.6522*	41.4576	28.1484025
SO2 conc. at ESP outlet (dry)	*ppmv*	*124*	*129*	*126*	126.333333	6.25211406
O2 conc. at ESP outlet (dry)	*vol. %*	*7.91*	*7.21*	*7.16*	7.42666667	1.04174476
Percent of ESP ash collected in Row 1	*%*	*89.3*	*89.3*	*89.3*	89.3	3.3508E-06
Increase in solids generated per mass SO2 removed	kg/kg	0.85935061	0.85935061	0.85935061	0.85935061	0
Calculated:						
SO2 at ESP outlet, corrected to ESP inlet O2	ppm	128.39107	133.711468	130.676856	130.926465	6.63061798
SO2 removal across ESP	%	4.18576862	17.9684244	15.692351	12.6155147	18.3556437
Flue gas flow rate at ESP inlet at STP (wet)	acfm	26167.1935	25849.8092	25675.9926	25897.6651	618.78086
Flue gas flow rate at baghouse inlet at STP (wet)	acfm	4002.01859	3909.57195	3784.93866	3898.84307	270.636188
Flue gas flow rate at ESP entrance at STP (wet)	acfm	22165.1749	21940.2373	21891.0539	21998.822	363.085036
SO2 flow rate at ESP inlet at STP	acfm	2.97013344	3.57625867	3.39311336	3.31316849	0.77230694
SO2 flow rate at ESP inlet	lb-moles/min	0.00771463	0.00928898	0.00881328	0.00860563	0.00200599
SO2 removed across ESP	lb-moles/min	0.00032292	0.00166908	0.00138301	0.001125	0.0017619
SO2 removed across ESP	kg/hr	0.5629876	2.90995701	2.41120445	1.96138302	3.07177227
Increase in ESP solids generated by SO2 removal	kg/hr	0.48380374	2.50067333	2.07207001	1.68551569	2.63972937
Flow rate of solids removed in ESP - total	kg/hr	452.395504	398.555423	303.48047	384.810466	187.326592
Flow rate of solids removed in ESP - Row 1	kg/hr	403.989185	355.909993	271.00808	343.635746	187.282647
Flow rate of solids removed in ESP - Rows 2-4	kg/hr	48.4063189	42.6454303	32.4724103	41.1747198	20.0439453

(5) Calculate gas flow rate at ESP outlet						
Given :						
Flue gas flow at ESP inlet (wet)	kg/hr	52404	51074	51747	51741.6667	1652.12476
SO2 removed	kg/hr	0.5629876	2.90995701	2.41120445	1.96138302	3.07177227
Increase in H2O generated per mass SO2 removed	kg/kg	0.14064939	0.14064939	0.14064939	0.14064939	0
Flue gas flow at baghouse inlet (wet)	kg/hr	8026	7871	7596	7831	541.021331
Calculated:						
Water generated from SO2 removal	kg/hr	0.07918368	0.40928368	0.33913444	0.27586733	0.4320429
Total gas flow at ESP outlet (wet)	kg/hr	44378.0792	43203.4093	44151.3391	43910.9425	1548.09406
Compare to measured gas flow at ESP outlet (wet)	*kg/hr*	*35538*	*35390.5*	*35243*	35390.5	386.439886
Relative percent difference (rel. to measured value)	%	-24.8750047	-22.0762896	-25.2769036	-24.076066	4.3313849

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- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

(6) Calculate trace metal and chlorine mass balance around ESP		A		B		C			
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - ESP inlet									
Antimony	mg/hr		750.563159		615.263525		479.96389	615.263525	336.130052
Arsenic	mg/hr		13182.6118		11844.2348		10505.8578	11844.2348	3324.9811
Barium	mg/hr		90806.0452		61119.8933		31433.7414	61119.8933	73750.4414
Cadmium	mg/hr		346.663764		302.559301		258.454839	302.559301	109.570401
Chromium	mg/hr		19355.3935		15869.0155		12382.6376	15869.0155	8661.34192
Cobalt	mg/hr		3437.74899		3130.43554		2823.12209	3130.43554	783.470552
Lead	mg/hr		9246.06424		7871.0839		6496.06356	7871.0839	3415.98588
Manganese	mg/hr		17874.8503		15720.2079		13565.5655	15720.2079	5352.86044
Mercury	mg/hr		141.55437		102.587011		63.6196526	102.587011	96.8080983
Selenium	mg/hr	ND	9.38881027	ND	9.00198578	ND	8.6151613	ND 9.00198578	0.96100285
Vanadium	mg/hr		35083.5953		31200.0824		27336.5695	31200.0824	9598.27269
Chlorine (as HCl)	mg/hr	ND	305.5	ND	304	ND	307	ND 305.5	3.72650731
Flue gas analysis results - ESP outlet									
Antimony	*mg/hr*	*ND*	*1.70162383*	*ND*	*1.71216948*	*ND*	*1.72271512*	ND 1.71216948	0.02619895
Arsenic	*mg/hr*		*8.8084057*		*382.033491*		*755.258577*	382.033491	927.21734
Barium	*mg/hr*		*158.401159*		*1312.08192*		*2465.76269*	1312.08192	2866.1332
Cadmium	*mg/hr*		*4.02133749*		*11.6464731*		*19.2716087*	11.6464731	18.9434156
Chromium	*mg/hr*	*ND*	*54.0515805*		*542.234433*		*1057.44308*	542.234433	1246.53261
Cobalt	*mg/hr*	*ND*	*24.0229246*		*123.049023*		*234.086584*	123.049023	261.07674
Lead	*mg/hr*		*9.74429881*		*352.067848*		*694.390998*	352.067848	850.446977
Manganese	*mg/hr*		*67.063998*		*709.951025*		*1352.83805*	709.951025	1597.1488
Mercury	*mg/hr*		*34.7331452*		*34.8977324*		*35.0623195*	34.8977324	0.40889018
Selenium	*mg/hr*	*ND*	*1.30124175*	*ND*	*1.30930607*	*ND*	*1.31737039*	ND 1.30930607	0.02003449
Vanadium	*mg/hr*	*ND*	*180.171935*		*1162.27441*		*2234.46285*	1162.27441	2552.59444
Chlorine (as HCl)	*mg/hr*		*-*		*-*		*8982*	8982	NA
Flue gas analysis results - Baghouse inlet									
Antimony	*mg/hr*		*58.101488*		*52.1289418*		*71.0878513*	60.439427	24.0813672
Arsenic	*mg/hr*		*1208.57062*		*479.652771*		*1319.34013*	1002.52117	1133.33482
Barium	*mg/hr*		*4877.20708*		*2598.39629*		*1962.55827*	3079.38721	3527.27362
Cadmium	*mg/hr*		*18.9121959*		*4.73159625*		*15.9461333*	13.1966418	18.5814763
Chromium	*mg/hr*		*1306.22686*		*668.041534*		*969.699801*	981.322733	793.128419
Cobalt	*mg/hr*		*304.305611*		*141.239067*		*186.751509*	210.785396	209.04159
Lead	*mg/hr*		*673.599365*		*106.492856*		*370.712862*	383.601694	704.987774
Manganese	*mg/hr*		*1993.89788*		*874.03705*		*1053.81209*	1307.24901	1494.10746
Mercury	*mg/hr*		*8.6518262*		*9.31092733*		*6.44737353*	8.13670902	3.72567444
Selenium	*mg/hr*	*ND*	*1.29280162*	*ND*	*0.45504532*	*ND*	*0.98340064*	ND 0.90374919	1.04851913
Vanadium	*mg/hr*		*2849.13587*		*1249.62446*		*2415.91238*	2171.55757	2056.24173
Chlorine (as HCl)	*mg/hr*	*ND*	*61*	*ND*	*60*	*ND*	*60.5*	ND 60.5	1.2421691
Analysis results - ESP Ash Row 1									
Antimony	*mg/hr*	*ND*	*4039.9*	*ND*	*3559.1*	*ND*	*2710.1*	ND 3436.36667	1672.80956
Arsenic	*mg/hr*		*20803.49*		*19575.05*		*13821.51*	18000.0167	9080.37023
Barium	*mg/hr*		*36763.09*		*29896.44*		*15447.57*	27369.0333	27030.0891
Cadmium	*mg/hr*		*484.788*		*320.319*		*325.212*	376.773	232.473739
Chromium	*mg/hr*		*9291.77*		*7474.11*		*4878.18*	7214.68667	5510.76365
Cobalt	*mg/hr*		*7675.81*		*5694.56*		*3523.13*	5631.16667	5160.13363
Lead	*mg/hr*	*ND*	*929.177*	*ND*	*818.593*		*1355.05*	742.978333	703.688338
Manganese	*mg/hr*		*929.177*		*6050.47*		*3252.12*	3410.589	6370.64191
Mercury	*mg/hr*	*ND*	*12.1197*	*ND*	*10.6773*	*ND*	*8.1303*	ND 10.3091	5.01842868
Selenium	*mg/hr*	*ND*	*44.4389*	*ND*	*39.1501*	*ND*	*29.8111*	ND 37.8000333	18.4009052
Vanadium	*mg/hr*		*26259.35*	*ND*	*605.047*	*ND*	*460.717*	8930.744	36900.7661
Chlorine (as chloride)	*mg/hr*		*294912.7*		*277609.8*		*230358.5*	267627	83013.8334

- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/ESP

NOTE: Values in italics must be input by user. Other values are calculated.

Analysis results - ESP Ash Rows 2-4									
Antimony	*mg/hr*	*ND*	*484.06*	*ND*	*426.45*	*ND*	*324.72*	ND	411.743333	200.440426
Arsenic	*mg/hr*		*1984.646*		*1620.51*		*1461.24*		1888.79867	666.552926
Barium	*mg/hr*		*4550.164*		*2857.215*		*2337.984*		3248.45433	2873.93614
Cadmium	*mg/hr*		*38.7248*		*68.232*		*29.2248*		45.3938667	50.5334026
Chromium	*mg/hr*		*1548.992*		*1023.48*		*909.216*		1160.56267	847.673073
Cobalt	*mg/hr*		*822.902*		*682.32*		*454.608*		653.276667	461.731176
Lead	*mg/hr*	*ND*	*111.3338*		*255.87*		*194.832*		168.789633	180.259524
Manganese	*mg/hr*		*1355.368*		*938.19*		*552.024*		948.527333	996.136915
Mercury	*mg/hr*	*ND*	*1.45218*	*ND*	*1.27935*	*ND*	*0.97416*	ND	1.23523	0.60132128
Selenium	*mg/hr*	*ND*	*5.32466*	*ND*	*4.69095*	*ND*	*3.57192*	ND	4.52917667	2.20484468
Vanadium	*mg/hr*		*2710.736*	*ND*	*72.4965*	*ND*	*55.2024*		924.861817	3796.57839
Chlorine (as chloride)	*mg/hr*		*37272.62*		*31130.85*		*27601.2*		32001.5567	12158.7199

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- = Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated

Calculated results:			A		B		C		Mean	2.5% CC
TOTAL MASS INPUT TO ESP ENTRANCE										
Antimony	mg/hr		692.461671		563.134583		408.876039		554.824098	352.714795
Arsenic	mg/hr		11974.0412		11364.5821		9186.51772		10841.7137	3640.73414
Barium	mg/hr		86128.8381		58521.497		29471.1831		58040.5061	70385.9964
Cadmium	mg/hr		327.751588		297.827705		242.508706		289.362659	107.440925
Chromium	mg/hr		18049.1666		15200.974		11412.9378		14887.6928	8270.82869
Cobalt	mg/hr		3133.44338		2989.19647		2636.37058		2919.67014	635.309817
Lead	mg/hr		8572.46488		7764.57105		6125.3507		7487.46221	3097.64592
Manganese	mg/hr		15880.9524		14846.1709		12511.7534		14412.9589	4287.64672
Mercury	mg/hr		132.902544		93.2760841		57.1722791		94.4503024	94.1037127
Selenium	mg/hr	ND	8.09600865	ND	6.54694046	ND	7.65176065	ND	8.09623659	1.11197503
Vanadium	mg/hr		32214.4594		29950.4579		24920.6571		29028.5248	9274.72313
Chlorine (as chloride)	mg/hr	ND	237.726961	ND	237.240812	ND	239.671558	ND	238.21311	3.19543007
TOTAL MASS OUTPUT FROM ESP										
Antimony	mg/hr	ND	4525.66162	ND	3987.26217	ND	3036.54272	ND	3849.82217	1873.22412
Arsenic	mg/hr		22598.9444		21577.5935		16038.0086		20070.8488	8768.5594
Barium	mg/hr		41471.6552		34065.7369		20251.3167		31929.5696	26756.9222
Cadmium	mg/hr		527.534137		400.197473		373.708409		433.81334	204.307307
Chromium	mg/hr		10867.7878		9039.82443		6844.83908		8917.48377	5004.10997
Cobalt	mg/hr		8510.72346		6499.92902		4211.82458		6407.49236	5343.66151
Lead	mg/hr		529.999699		1017.23415		2244.273		1263.83562	2194.51938
Manganese	mg/hr		2351.609		7698.61102		5156.98205		5069.06736	6644.57347
Mercury	mg/hr		41.5190852		40.8760574		39.6145495		40.6698974	2.40697693
Selenium	mg/hr	ND	51.0648018	ND	45.1503561	ND	34.7003904	ND	43.6385161	20.5859668
Vanadium	mg/hr		29060.172		1501.04616		2492.42255		11017.8802	38837.5191
Chlorine (as chloride)	mg/hr		#VALUE!		#VALUE!		266692.884		#VALUE!	NA
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	653.561318	H	708.047826	H	742.656069	H	701.421737	111.585163
Arsenic	%	H	188.716107	H	189.867022	H	174.582024	H	184.388384	21.1467643
Barium	%	L	48.1507194		58.2106383		68.7156556		58.3590044	25.5471227
Cadmium	%	H	160.955489		134.372144	H	154.101028		149.809554	34.2875681
Chromium	%		60.2121307		59.4687185		59.9743834		59.8850775	0.94322145
Cobalt	%	H	271.609295	H	217.447367	H	159.758443	H	216.271702	138.960695
Lead	%	L	6.18258233	L	13.1009703	L	36.6390939	L	18.6408822	39.6653007
Manganese	%	L	14.8077328		51.8558697	L	41.217101	L	35.9602345	47.3894984
Mercury	%	L	31.2402487	L	43.8226559		69.2697655	L	48.1175633	48.1587847
Selenium	%	H	630.740454	H	528.263374	H	453.495502	H	537.499777	221.063201
Vanadium	%		90.2084732	L	5.01176363	L	10.0014319	L	35.0738896	118.78387
Chlorine (as chloride)	%	###	#VALUE!	###	#VALUE!	H	111274.315	###	#VALUE!	#VALUE!

- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/Baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

(7) Calculate solids removed in fabric filter						
Given:					Mean	2.5% CC
Solids in flue gas at baghouse inlet	kg/hr	46.1928	28.5278	49.6522	41.4576	28.1484025
SO2 conc. at baghouse inlet (dry)	*ppmv*	*134*	*163*	*155*	150.666667	37.2098247
O2 conc. at baghouse inlet (dry)	*vol. %*	*7.91*	*7.21*	*7.16*	7.42666667	1.04174476
Flue gas flow rate at baghouse inlet (wet)	kg/hr	8026	7871	7596	7831	541.021331
Flue gas molecular weight at baghouse inlet (wet)	g/g-mole	28.37	28.48	28.39	28.4133333	0.14556893
H2O in flue gas at baghouse outlet	*vol. %*	*13.13*	*12.49*	*12.85*	12.8233333	0.79705582
Solids in flue gas at baghouse outlet	*kg/hr*	*0.0416*	*0.0327*	*0.0215*	0.03193333	0.02502203
SO2 conc. at baghouse outlet (dry)	*ppmv*	*52*	*54*	*49.5*	51.8333333	5.60125073
O2 conc. at baghouse outlet (dry)	*vol. %*	*7.74*	*6.95*	*7.12*	7.27	1.03301876
Increase in solids generated per mass SO2 removed	kg/kg	0.85935061	0.85935061	0.85935061	0.85935061	0
Calculated:						
SO2 at baghouse outlet, corrected to baghouse inlet O2	ppm	51.3262675	52.9935484	49.3563135	51.2260431	4.52341079
SO2 removal across baghouse	%	61.6953228	67.4886206	68.1572171	65.7803868	8.82816724
Flue gas flow rate at baghouse inlet at STP (wet)	acfm	4002.01859	3909.57195	3784.93866	3898.84307	270.636188
SO2 flow rate at baghouse inlet at STP	acfm	0.53627049	0.63726023	0.58666549	0.58673207	0.12544641
SO2 flow rate at baghouse inlet	lb-moles/min	0.00139291	0.00165522	0.00152381	0.00152398	0.00032583
SO2 removed across baghouse	lb-moles/min	0.00085936	0.00111709	0.00103858	0.00100501	0.00032819
SO2 removed across baghouse	kg/hr	1.4982483	1.94757871	1.81071478	1.75218059	0.57217573
Increase in baghouse solids generated by SO2 removal	kg/hr	1.28752059	1.67365295	1.55603885	1.50573746	0.49169956
Flow rate of solids removed in baghouse	kg/hr	47.4387206	30.1687529	51.1867388	42.9314041	27.8507343

(8) Calculate gas flow at baghouse outlet						
Given :						
Flue gas flow at baghouse inlet (wet)	kg/hr	8026	7871	7596	7831	541.021331
SO2 removed in baghouse	kg/hr	1.4982483	1.94757871	1.81071478	1.75218059	0.57217573
Increase in H2O generated per mass SO2 removed	kg/kg	0.14064939	0.14064939	0.14064939	0.14064939	0
Calculated:						
Water generated from SO2 removal	kg/hr	0.21072771	0.27392576	0.25467593	0.24644313	0.08047617
Total gas flow at baghouse outlet (wet)	kg/hr	8026.21073	7871.27393	7596.25468	7831.24644	540.976845
Compare to measured gas flow at baghouse outlet (wet)	*kg/hr*	*8600*	*8478*	*8783*	8620.33333	381.378957
Relative percent difference (rel. to measured value)	%	6.67196828	7.15847646	13.5118447	9.11342983	9.48230836

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- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/Baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

(9) Calculate trace metals and chlorine mass balance around fabric filter									
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - Baghouse inlet									
Antimony	mg/hr		58.101488		52.1289418		71.0878513		60.439427	24.0813672
Arsenic	mg/hr		1208.57062		479.652771		1319.34013		1002.52117	1133.33482
Barium	mg/hr		4677.20708		2598.39629		1962.55827		3079.38721	3527.27362
Cadmium	mg/hr		18.9121959		4.73159625		15.9461333		13.1966418	18.5814763
Chromium	mg/hr		1306.22686		668.041534		989.699801		981.322733	793.128419
Cobalt	mg/hr		304.305811		141.239067		186.751509		210.765396	209.04159
Lead	mg/hr		673.599365		106.492856		370.712862		383.601694	704.987774
Manganese	mg/hr		1993.89788		874.03705		1053.81209		1307.24901	1494.10746
Mercury	mg/hr		8.6518262		9.31092733		6.44737353		8.13870902	3.72567444
Selenium	mg/hr	ND	1.29280162	ND	0.45504532	ND	0.98340064	ND	0.90374919	1.04851913
Vanadium	mg/hr		2849.13587		1249.62446		2415.91238		2171.55757	2055.24173
Chlorine (as HCl)	mg/hr	ND	61	ND	60	ND	60.5	ND	60.5	1.2421691
Flue gas analysis results - Baghouse outlet										
Antimony	*mg/hr*	*ND*	*0.41795987*	*ND*	*0.41991887*	*ND*	*0.43027286*	ND	0.4227172	0.01643712
Arsenic	*mg/hr*		*1.42598075*	*ND*	*0.29641332*	*ND*	*0.30372202*		0.57534947	1.61496018
Barium	*mg/hr*	*ND*	*22.8648637*	*ND*	*22.9720325*	*ND*	*23.5384564*	ND	23.1251176	0.89920702
Cadmium	*mg/hr*		*7.37576249*		*10.8684885*		*9.23821138*		9.16082079	4.34175026
Chromium	*mg/hr*	*ND*	*13.2763725*	*ND*	*13.3385995*	*ND*	*13.6674908*	ND	13.4274876	0.52212021
Cobalt	*mg/hr*	*ND*	*5.90060999*	*ND*	*5.92826546*	*ND*	*6.07444036*	ND	5.98777227	0.23205343
Lead	*mg/hr*		*2.0246468*		*5.3107387*		*4.68238111*		4.00592221	4.33358423
Manganese	*mg/hr*		*27.53618*		*22.2309992*		*54.4168616*		34.7280136	42.8700821
Mercury	*mg/hr*		*2.31107225*		*4.54500428*		*8.20049449*		5.01885701	7.38635399
Selenium	*mg/hr*	*ND*	*0.31961637*	*ND*	*0.32111443*	*ND*	*0.32903219*	ND	0.32325433	0.01256956
Vanadium	*mg/hr*	*ND*	*44.254575*	*ND*	*44.4619984*	*ND*	*45.5583027*	ND	44.758292	1.74040069
Chlorine (as HCl)	*mg/hr*	*ND*	*52*	*ND*	*52*	*ND*	*51*	ND	51.6666667	1.43433333
Analysis results - Baghouse ash										
Antimony	*mg/hr*	*ND*	*474.39*	*ND*	*301.69*	*ND*	*511.87*	ND	429.316667	278.507634
Arsenic	*mg/hr*		*2798.901*		*1598.957*		*2866.472*		2421.44333	1771.56882
Barium	*mg/hr*		*3937.437*		*1900.647*		*3736.651*		3191.57833	2788.61462
Cadmium	*mg/hr*		*56.9268*		*24.1352*		*51.187*		44.083	43.5058886
Chromium	*mg/hr*		*1043.658*		*754.225*		*1202.8945*		1000.25917	565.090968
Cobalt	*mg/hr*		*711.585*		*452.535*		*767.805*		643.975	417.76145
Lead	*mg/hr*	*ND*	*109.1097*	*ND*	*69.3887*	*ND*	*117.7301*	ND	98.7428333	64.0567557
Manganese	*mg/hr*		*1233.414*		*573.211*		*1151.7075*		986.110833	894.132933
Mercury	*mg/hr*	*ND*	*1.42317*	*ND*	*0.90507*	*ND*	*1.53561*	ND	1.28795	0.8355229
Selenium	*mg/hr*	*ND*	*5.21829*	*ND*	*3.31859*	*ND*	*5.63057*	ND	4.72248333	3.06358397
Vanadium	*mg/hr*	*ND*	*80.6463*		*1598.957*		*1378.20998*		1005.83004	2037.98228
Chlorine (as chloride)	*mg/hr*		–		*21721.68*		–		21721.68	NA

– = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/Baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

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- - Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/demonstration tests/Baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

Calculated results:											
TOTAL MASS INPUT TO BAGHOUSE											
Antimony	mg/hr		58.101488		52.1289418		71.0878513		60.439427		24.0813672
Arsenic	mg/hr		1208.57062		479.652771		1319.34013		1002.52117		1133.33482
Barium	mg/hr		4677.20708		2598.39629		1962.55827		3079.38721		3527.27362
Cadmium	mg/hr		18.9121959		4.73159625		15.9461333		13.1966418		18.5814763
Chromium	mg/hr		1306.22686		668.041534		969.699801		981.322733		793.128419
Cobalt	mg/hr		304.305611		141.239067		188.751509		210.765398		209.04159
Lead	mg/hr		673.599365		106.492856		370.712862		363.601694		704.987774
Manganese	mg/hr		1993.89788		874.03705		1053.81209		1307.24901		1494.10746
Mercury	mg/hr		8.6518262		9.31092733		6.44737353		8.13670902		3.72567444
Selenium	mg/hr	ND	1.29260162	ND	0.45504532	ND	0.96340064	ND	0.90374919		1.04851913
Vanadium	mg/hr		2849.13587		1249.62446		2415.91238		2171.55757		2055.24173
Chlorine (as chloride)	mg/hr	ND	59.310203	ND	58.3379046	ND	58.8240538	ND	58.8240538		1.20775904
TOTAL MASS OUTPUT FROM BAGHOUSE											
Antimony	mg/hr	ND	474.80796	ND	302.109919	ND	512.300273	ND	429.739384		278.516127
Arsenic	mg/hr		2800.32698		1599.10521		2866.62386		2422.01868		1772.41254
Barium	mg/hr		3948.86943		1912.13302		3748.42023		3203.14089		2788.74126
Cadmium	mg/hr		64.3025625		35.0036885		60.4252114		53.2438208		39.538091
Chromium	mg/hr		1050.29619		760.8943		1209.72825		1008.97291		585.265802
Cobalt	mg/hr		714.535305		455.499133		770.84222		646.968886		417.82141
Lead	mg/hr		56.5794968		40.0050887		63.5474311		53.3773389		30.044148
Manganese	mg/hr		1260.95018		595.441999		1206.12436		1020.83885		917.771584
Mercury	mg/hr		3.02265725		4.99753928		8.96829949		5.66283201		7.52292158
Selenium	mg/hr	ND	5.53790637	ND	3.63970443	ND	5.95960219	ND	5.04573766		3.0700972
Vanadium	mg/hr	ND	124.900875		1621.188		1400.98913		1028.20919		2006.98138
Chlorine (as chloride)	mg/hr		#VALUE!		21746.9596		#VALUE!		#VALUE!		NA
MASS BALANCE (OUTPUT/INPUT * 100)											
Antimony	%	H	817.204475	H	579.543548	H	720.65798	H	705.602001		296.940301
Arsenic	%	H	231.705697	H	333.388089	H	217.277092	H	260.790293		157.219085
Barium	%		84.4279367		73.5889681	H	190.996633		116.337846		161.191661
Cadmium	%	H	340.005797	H	739.78604	H	378.933313	H	486.241717		547.639654
Chromium	%		80.4068738		113.89925		124.752861		108.352995		57.4280516
Cobalt	%	H	234.808455	H	322.502225	H	412.763583	H	323.358086		221.05803
Lead	%	L	8.39957692	L	37.5859834	L	17.1419548	L	21.0358384		37.1858191
Manganese	%		63.2404596		68.1254872		114.453457		81.9398012		70.2158199
Mercury	%	L	34.9386386		53.6739157		139.100045		75.9035331		137.945007
Selenium	%	H	428.364747	H	799.85537	H	618.600803	H	615.606907		461.499123
Vanadium	%	L	4.38381603		129.734016		57.9900638		64.0359654		156.248538
Chlorine (as chloride)	%	###	#VALUE!	H	37277.5812	#####	#VALUE!	###	#VALUE!		#VALUE!

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- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

MASS BALANCE AROUND TOTAL SYSTEM
PARALLEL CONFIGURATION
DEMONSTRATION TESTS

System balance - DP/A

9/14/94 18:12

TOTAL MASS INPUT										
Antimony	mg/hr		275.6608685		216.0445522		252.364366		248.0232622	74.64021133
Arsenic	mg/hr		14837.35936		14939.91174		20949.84902		16909.04004	8694.733754
Barium	mg/hr		25569.81078		29176.29417		32738.31263		29161.47253	8904.548614
Cadmium	mg/hr		288.0944594		270.2352499		296.8483362		285.0593485	33.69673173
Chromium	mg/hr		18203.05979		23330.71162		21956.03344		21163.26828	6593.828972
Cobalt	mg/hr		3352.642635		3334.634752		3869.616039		3518.964475	754.7583853
Lead	mg/hr		5743.12541		5235.573007		8286.436843		6421.711753	4061.191753
Manganese	mg/hr		28063.33047		38136.25135		29805.76397		32001.78193	13374.6038
Mercury	mg/hr		96.10209098		191.1257965		140.1355393		142.4544756	118.140907
Selenium	mg/hr		2597.416515		2537.775492		2224.433728		2453.208578	497.7532143
Vanadium	mg/hr		22528.15373		37342.46878		30488.7867		30119.80307	18419.00047
Chlorine (as chloride)	mg/hr		759714.9336		803364.8155		828304.4421		797128.0637	86249.94616
TOTAL MASS OUTPUT										
Antimony	mg/hr	ND	5026.793584	ND	4321.680888	ND	3595.438988	ND	4314.63782	1778.049027
Arsenic	mg/hr		30859.50139		28790.3527		30903.10244		30184.31884	2999.607142
Barium	mg/hr		63616.98959		56817.04594		48229.65692		56221.23082	19156.60747
Cadmium	mg/hr		592.4948		524.8580816		621.6825201		579.6784672	123.3927738
Chromium	mg/hr		17347.40898		16100.93473		16907.80732		16785.38368	1570.575688
Cobalt	mg/hr		10265.05677		7924.692156		6345.599804		8178.449576	4899.144138
Lead	mg/hr		592.3375706		1146.088437		2616.518929		1451.648312	2598.898808
Manganese	mg/hr		26119.57918		33010.28502		36184.54641		31771.47021	12783.33552
Mercury	mg/hr		60.99424246		66.06659666		77.70534903		68.25539605	21.28548773
Selenium	mg/hr	ND	89.50770813	ND	89.1760605	ND	98.90499257	ND	92.52958707	13.72286992
Vanadium	mg/hr		36888.2024		12976.41816		15542.41168		21802.34408	32613.35474
Chlorine (as chloride)	mg/hr		#VALUE!		#VALUE!		#VALUE!		#VALUE!	FALSE
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	1823.5	H	2000.4	H	1424.7	H	1749.536601	732.5847603
Arsenic	%	H	208.0	H	192.7		147.5	H	182.7342286	78.12503413
Barium	%	H	248.8	H	194.7		147.3	H	196.9509951	126.1435034
Cadmium	%	H	205.7	H	194.2	H	209.4	H	203.1034078	19.67178483
Chromium	%		95.3		69.0		77.0		80.43958001	33.47816906
Cobalt	%	H	306.2	H	237.6	H	164.0	H	235.9371051	176.6658802
Lead	%	L	10.3	L	21.9	L	31.6	L	21.26006264	26.44588233
Manganese	%		93.1		86.6		121.4		100.344559	46.02042009
Mercury	%		63.5	L	34.6		55.5		51.16179537	37.06669208
Selenium	%	L	3.4	L	3.5	L	4.4	L	3.80209137	1.388579693
Vanadium	%	H	163.7	L	34.7		51.0		83.15663569	174.5487148
Chlorine (as chloride)	%	###	#VALUE!	###	#VALUE!	###	#VALUE!	###	#VALUE!	#VALUE!

- All flue gas sampling on 9/27/93 was invalidated because of suspected lime remaining in the system. Make up runs were performed for HCl on 9/28/93 (Run 3) and for particulate and trace metals on 9/29/93 (Run 4). The flue gas sample data (including SO_2 and O_2 data from plant instrumentation) from the make-up runs collected on 9/28-29/93 were substituted for the missing data.

- HCl measurements were not made at the ESP outlet. Therefore, the mass flow of HCl at the ESP outlet was calculated using the HCl concentration measured at the baghouse inlet (corrected to ESP outlet O_2 concentration) and the gas flow rate measured during the Method 29 (multiple metals) runs.

- Solids samples collected at the GSA (location 5), ESP (locations 9A and 9B), and baghouse (location 11) hoppers on 9/27/93 were invalidated because of suspected high concentrations of lime remaining in the system. The average of the results obtained on 9/28 and 9/29 was substituted for the missing data.

- Solids flow rates at the GSA, ESP, and baghouse hoppers were calculated using the substitutions above.

AirPol Mass Balance - Series configuration, baseline tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated

(1) Calculate flow rate of GSA absorber/cyclone solids		A	B	C		
Given:					Mean	2.5% CC
Flue gas flow rate at GSA inlet (wet; stack T, P)	*acfm*	*32798*	*33636*	*32721*	33051.6667	1260.82632
Flue gas temperature at GSA inlet	*°R*	*748*	*751*	*744*	747.666667	8.72470906
Flue gas pressure at GSA inlet	*in. Hg*	*28.71*	*28.52*	*28.71*	28.6466667	0.27252333
Flue gas molecular weight at GSA inlet (wet)	*g/g-mole*	*29.15*	*29.17*	*29.13*	29.15	0.04968676
SO2 conc. at GSA inlet (dry)	*ppmv*	*1815*	*1797*	*1862*	1824.66667	83.3766012
O2 conc. at GSA inlet (dry)	*vol. %*	*6.71*	*6.41*	*6.56*	6.56	0.37265073
H2O vapor conc. at GSA inlet	*vol. %*	*7.64*	*7.78*	*7.94*	7.78666667	0.37292667
SO2 conc. at ESP inlet (dry)	*ppmv*	*1535*	*1528*	*1577*	1546.66667	65.8388686
O2 conc. at ESP inlet (dry)	*vol. %*	*7.23*	*7.22*	*7.08*	7.17666667	0.20834895
Lime slurry flow rate	*L/hr*	*0*	*0*	*0*	0	0
Specific gravity of lime slurry	*-*	*0*	*0*	*0*	0	0
Moisture content of lime slurry	*wt. %*	*0*	*0*	*0*	0	0
Reinjected fly ash flow rate	*kg/hr*	*183.16*	*182.35*	*179.9*	181.803333	4.21681803
Particulate flow rate in GSA inlet flue gas	*kg/hr*	*133.97*	*81.794*	*130.27*	115.344667	72.3304275
Particulate flow rate in ESP inlet flue gas	*kg/hr*	*123.64*	*136.97*	*64.68*	108.43	95.5734014
Increase in solids generated per mass SO2 removed	kg/kg	*0*	0	0	0	0
Calculated data:						
Std T = 68°F; std P = 29.92 in. Hg						
Solids in lime slurry	kg/hr	0	0	0	0	0
Total solids into GSA	kg/hr	317.13	264.144	310.17	297.148	71.5324803
SO2 at ESP inlet, corrected to GSA inlet O2	ppm	1593.39064	1618.47368	1636.33719	1616.06717	53.5975543
SO2 removal	%	12.2098823	9.93468647	12.1193774	11.4213154	3.20045727
Flue gas flow rate at GSA inlet at STP (wet)	acfm	22215.2543	22541.679	22282.2559	22346.3964	428.314403
Flue gas flow rate at GSA inlet (wet)	kg/hr	45777.3414	46481.8504	45883.9038	46047.6985	943.410088
SO2 flow rate at GSA inlet at STP	scfm	37.2401861	37.3559217	38.1952894	37.5971324	1.29493978
SO2 flow rate at GSA inlet	lb-moles/min	0.09672776	0.09702837	0.09920854	0.09765489	0.00336348
SO2 removed	lb-moles/min	0.01181035	0.00963946	0.01202346	0.01115776	0.00327731
SO2 removed	kg/hr	20.5906934	16.8058806	20.9622438	19.4529393	5.713817
Increase in solids generated by SO2 removal	kg/hr	0	0	0	0	0
Flow rate of solids removed in GSA	kg/hr	193.49	127.174	245.49	188.718	147.326659
Compare to TVA measured solids after test program	*kg/hr*	*252.5*	*252.5*	*252.5*	252.5	0
Relative percent difference (rel. to calculated value)	%	-30.4977001	-98.5468728	-2.85551346	-43.9666955	122.346265

(2) Calculate gas flow rate at GSA outlet						
Given :					Mean	2.5% CC
Flue gas flow at GSA inlet (wet)	kg/hr	45777.3414	46481.8504	45883.9038	46047.6985	943.410088
SO2 removed	kg/hr	20.5906934	16.8058806	20.9622438	19.4529393	5.713817
Increase in H2O generated per mass SO2 removed	kg/kg	0	0	0	0	0
Trim water flow rate	*L/hr*	*0*	*0*	*0*	0	0
Lime slurry flow rate	kg/hr	0	0	0	0	0
Moisture content of lime slurry	wt. %	0	0	0	0	0
Calculated:						
Water in lime slurry	kg/hr	0	0	0	0	0
Trim water flow rate	kg/hr	0	0	0	0	0
Total water input to system (besides flue gas)	kg/hr	0	0	0	0	0
Water generated from SO2 removal	kg/hr	0	0	0	0	0
Total gas flow at GSA outlet (wet)	kg/hr	45756.7507	46465.0445	45862.9416	46028.2456	948.984972
Compare to measured gas flow at ESP inlet (wet)	*kg/hr*	*47350*	*49821*	*49807*	48992.6667	3534.24012
Relative percent difference (rel. to measured value)	%	3.36483489	6.73602601	7.918683	6.00651463	5.87036202

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See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated.

(3) Calculate mass balance around GSA for trace metals and chlorine									
Given:		Flag	Value	Flag	Value	Flag	Value	Mean	2.5% CC
Flue gas analysis results - GSA inlet									
Antimony	*mg/hr*		*41.0135235*	*ND*	*3.74797949*	*ND*	*4.09148161*	14.9777514	53.2065747
Arsenic	*mg/hr*		*6022.50576*		*4834.89354*		*5909.30282*	5588.90071	1628.32941
Barium	*mg/hr*		*31316.2788*		*6566.12935*		*24604.8467*	20829.0849	31799.0202
Cadmium	*mg/hr*		*230.251254*		*168.659077*		*221.463476*	206.791269	82.7644257
Chromium	*mg/hr*		*17237.7961*		*8639.09271*		*12788.2868*	12888.3919	10683.215
Cobalt	*mg/hr*		*2134.88415*		*1181.71588*		*1747.30332*	1687.96779	1190.85856
Lead	*mg/hr*		*5205.14319*		*2058.08168*		*4198.58216*	3820.60234	3992.87379
Manganese	*mg/hr*		*23424.356*		*13885.1616*		*25396.067*	20901.8616	15293.8147
Mercury	*mg/hr*		*57.650296*		*30.8657134*		*80.5196674*	56.3452923	61.7427286
Selenium	*mg/hr*		*3699.63122*		*3550.27357*		*4608.5326*	3952.81246	1422.92865
Vanadium	*mg/hr*		*31490.147*		*17516.2924*		*26943.6098*	25316.6831	17707.3062
Chlorine (as HCl)	*mg/hr*		*578077*		*512784*		*506263*	532374.667	98661.6476
Reinjected ash analysis results									
Antimony	*mg/hr*	*ND*	*14.6528*	*ND*	*14.588*	*ND*	*14.392*	ND 14.5442667	0.33734544
Arsenic	*mg/hr*		*14286.48*		*5725.79*		*6350.47*	8787.58	11856.3026
Barium	*mg/hr*		*33554.912*		*15025.64*		*17414.32*	21998.2907	25040.4865
Cadmium	*mg/hr*		*54.21536*		*59.62845*		*52.5308*	55.4582033	9.21306149
Chromium	*mg/hr*		*17766.52*		*6072.255*		*4623.43*	9487.40167	17903.2077
Cobalt	*mg/hr*		*954.2636*		*877.1035*		*892.304*	907.890367	101.542941
Lead	*mg/hr*		*5604.696*		*1695.855*		*1996.89*	3099.147	5403.64255
Manganese	*mg/hr*		*12436.564*		*22246.7*		*20148.8*	18277.3547	12833.8187
Mercury	*mg/hr*	ND	18.316	ND	18.235	ND	17.99	ND 18.1803333	0.4216818
Selenium	*mg/hr*		*635.5652*		*665.5775*		*575.68*	625.607567	113.704444
Vanadium	*mg/hr*		*5494.8*		*8096.34*		*6530.37*	6707.17	3253.86312
Chlorine (as chloride)	*mg/hr*		*3.6632*		*802.34*		*773.57*	526.5244	1125.50336
Lime slurry analysis results (archive sample analysis)									
Antimony	*mg/hr*		*0*		*0*		*0*	0	0
Arsenic	*mg/hr*		*0*		*0*		*0*	0	0
Barium	*mg/hr*		*0*		*0*		*0*	0	0
Cadmium	*mg/hr*		*0*		*0*		*0*	0	0
Chromium	*mg/hr*		*0*		*0*		*0*	0	0
Cobalt	*mg/hr*		*0*		*0*		*0*	0	0
Lead	*mg/hr*		*0*		*0*		*0*	0	0
Manganese	*mg/hr*		*0*		*0*		*0*	0	0
Mercury	*mg/hr*		*0*		*0*		*0*	0	0
Selenium	*mg/hr*		*0*		*0*		*0*	0	0
Vanadium	*mg/hr*		*0*		*0*		*0*	0	0
Chlorine (as chloride)	*mg/hr*		*0*		*0*		*0*	0	0

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- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/GSA

NOTE: Values in italics must be input by user. Other values are calculated.

Trim water analysis results											
Antimony	*mg/hr*		*0*		*0*		*0*		0		0
Arsenic	*mg/hr*		*0*		*0*		*0*		0		0
Barium	*mg/hr*		*0*		*0*		*0*		0		0
Cadmium	*mg/hr*		*0*		*0*		*0*		0		0
Chromium	*mg/hr*		*0*		*0*		*0*		0		0
Cobalt	*mg/hr*		*0*		*0*		*0*		0		0
Lead	*mg/hr*		*0*		*0*		*0*		0		0
Manganese	*mg/hr*		*0*		*0*		*0*		0		0
Mercury	*mg/hr*		*0*		*0*		*0*		0		0
Selenium	*mg/hr*		*0*		*0*		*0*		0		0
Vanadium	*mg/hr*		*0*		*0*		*0*		0		0
Chlorine (as chloride)	*mg/hr*		*0*		*0*		*0*		0		0
Flue gas analysis results - ESP inlet											
Antimony	*mg/hr*		*62.6305628*		*57.0200866*		*126.596522*		82.0823903		96.025385
Arsenic	*mg/hr*		*7675.23843*		*9214.52789*		*7472.16268*		8120.643		2366.97342
Barium	*mg/hr*		*32170.9956*		*50051.7611*		*35710.0439*		39310.9335		23523.3179
Cadmium	*mg/hr*		*249.781241*		*272.304184*		*243.572936*		255.219453		37.5580479
Chromium	*mg/hr*		*18874.4357*		*20406.4346*		*17269.1165*		18849.9956		3897.43437
Cobalt	*mg/hr*		*3272.62454*		*3464.20059*		*3545.11197*		3427.31237		347.65564
Lead	*mg/hr*		*6234.63398*		*7708.46054*		*6199.85229*		6714.3156		2139.33914
Manganese	*mg/hr*		*24138.6513*		*26595.7244*		*20939.0851*		23891.1536		7046.6506
Mercury	*mg/hr*		*45.475676*		*78.2106753*		*51.5801511*		58.4221675		43.244967
Selenium	*mg/hr*		*2904.45428*		*3072.43063*		*2907.83102*		2961.57197		238.549266
Vanadium	*mg/hr*		*27386.9138*		*36218.5038*		*27611.7555*		30405.7244		12509.3132
Chlorine (as HCl)	*mg/hr*		*522199*		*549566*		*683631*		585132		214629.826
GSA Solids analysis results											
Antimony	*mg/hr*	*ND*	*15.48*	*ND*	*10.176*	*ND*	*19.64*	ND	15.0986667		11.7844827
Arsenic	*mg/hr*		*3163.725*		*2098.8*		*3977.1*		3079.875		2340.13034
Barium	*mg/hr*		*16002.45*		*10990.08*		*19394.5*		15462.3433		10504.1848
Cadmium	*mg/hr*	*ND*	*0.774*	*ND*	*0.5088*	*ND*	*0.982*	ND	0.75493333		0.58922413
Chromium	*mg/hr*		*5263.2*		*3510.72*		*6579.4*		5117.77333		3824.63921
Cobalt	*mg/hr*		*837.855*		*555.864*		*1053.195*		815.638		619.6157
Lead	*mg/hr*		*364.7475*		*230.232*		*481.18*		358.719833		311.989501
Manganese	*mg/hr*		*27360.9*		*18494.88*		*33731.7*		26529.16		19011.1154
Mercury	*mg/hr*	*ND*	*19.35*	*ND*	*12.72*	*ND*	*24.55*	ND	18.8733333		14.7306033
Selenium	*mg/hr*		*1460.925*		*826.8*		*2111.3*		1466.34167		1595.60877
Vanadium	*mg/hr*		*7265.925*		*4655.52*		*9451.75*		7124.39833		5965.50488
Chlorine (as chloride)	*mg/hr*		*870.75*		*546.96*		*1153.65*		857.166667		754.424596

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See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/GSA
NOTE: Values in italics must be input by user. Other values are calculated.

Calculated:		A	B	C	Mean	2.5% CC
TOTAL MASS INPUT TO GSA						
Antimony	mg/hr	48.3399235	9.16798974	9.24174081	22.2498847	56.1327933
Arsenic	mg/hr	20308.9858	10560.6835	12259.7728	14376.4807	12937.1034
Barium	mg/hr	64871.1908	21591.7694	42019.1667	42827.3756	53788.4742
Cadmium	mg/hr	284.466614	228.287527	273.994276	262.249472	74.2180298
Chromium	mg/hr	35004.3161	14711.3477	17411.7168	22375.7935	27376.5375
Cobalt	mg/hr	3089.14775	2058.81938	2639.60732	2595.85815	1283.29867
Lead	mg/hr	10809.8392	3753.93668	6195.47216	6919.74934	8902.07165
Manganese	mg/hr	35860.92	36131.8616	45544.867	39179.2162	13699.8323
Mercury	mg/hr	66.808296	39.9832134	89.5148674	65.4354589	61.5975463
Selenium	mg/hr	4335.19642	4215.85107	5184.2126	4578.42003	1311.76659
Vanadium	mg/hr	36984.947	25612.6324	33473.9798	32023.8531	14466.7721
Chlorine (as chloride)	mg/hr	562067.011	499381.407	493012.28	518153.566	94810.4453
TOTAL MASS OUTPUT FROM GSA						
Antimony	mg/hr	70.3705628	62.1080866	136.416522	89.6317236	101.179386
Arsenic	mg/hr	10838.9634	11313.3279	11449.2627	11200.518	796.000129
Barium	mg/hr	48173.4456	61041.8411	55104.5439	54773.2768	16000.6047
Cadmium	mg/hr	250.168241	272.558584	244.063936	255.59692	37.2724557
Chromium	mg/hr	24137.6357	23917.1546	23848.5165	23967.7689	375.281855
Cobalt	mg/hr	4110.47954	4020.06459	4598.30697	4242.95037	772.754794
Lead	mg/hr	6599.38148	7938.69254	6681.03229	7073.03543	1865.22084
Manganese	mg/hr	51499.5513	45090.6044	54670.7851	50420.3136	12124.622
Mercury	mg/hr	55.150676	84.5706753	63.8551511	67.8588341	37.5460852
Selenium	mg/hr	4365.37928	3899.23063	5019.13102	4427.91364	1397.59676
Vanadium	mg/hr	34652.8388	40874.0238	37063.5055	37530.1227	7792.70188
Chlorine (as chloride)	mg/hr	508604.007	534889.108	665847.184	569780.099	209251.342
MASS BALANCE (OUTPUT/INPUT * 100)						
Antimony	%	145.574419 H	677.444983 H	1476.09119 H	766.370196	1663.76389
Arsenic	%	53.3702843	107.126853	93.3888649	84.6286673	69.3836993
Barium	%	74.2601531 H	282.706842	131.141449 H	162.703481	267.684824
Cadmium	%	87.9429181	119.392674	89.0762899	98.8039608	44.3189837
Chromium	%	68.9561699 H	162.576231	136.968208	122.833536	120.202456
Cobalt	%	133.061928 H	195.260673 H	174.204206 H	167.508936	78.592736
Lead	%	61.0497655 H	211.476464	107.837339	126.787856	191.251924
Manganese	%	143.609119	124.794578	120.037204	129.480301	30.9672317
Mercury	%	82.5506402 H	211.515454	71.3346877	121.800261	193.524386
Selenium	%	100.696228	92.4897622	96.8156864	96.6672256	10.1988217
Vanadium	%	93.6944398 H	159.585408	110.723331	121.334393	84.9720264
Chlorine (as chloride)	%	90.4881442	107.110337	135.056917	110.885133	55.9544822

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- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

(4) Calculate ESP ash flow rate		A	B	C		
Given:					Mean	2.5% CC
Solids in flue gas at ESP inlet	kg/hr	123.64	136.97	64.68	108.43	95.5734014
SO2 conc. at ESP inlet (dry)	ppmv	1535	1528	1577	1546.66667	65.8388686
O2 conc. at ESP inlet (dry)	vol. %	7.23	7.22	7.08	7.17666667	0.20834895
Flue gas flow rate at ESP inlet (wet)	kg/hr	47350	49821	49807	48992.6667	3534.24012
Flue gas molecular weight at ESP inlet (wet)	*g/g-mole*	*29.1*	*29.1*	*29.15*	29.1166667	0.07171667
H2O in flue gas at ESP inlet	*vol. %*	*7.56*	*7.62*	*7.29*	7.49	0.4367068
Solids in flue gas at ESP outlet	*kg/hr*	*0.8358*	*0.9109*	*0.919*	0.88856667	0.11397247
Solids in flue gas at baghouse inlet	*kg/hr*	*0.2106*	*0.2134*	*0.1073*	0.1771	0.15021497
SO2 conc. at ESP outlet (dry)	*ppmv*	*1564*	*1554*	*1605*	1574.33333	67.1384453
O2 conc. at ESP outlet (dry)	*vol. %*	*8.21*	*8.12*	*8.05*	8.12666667	0.19926395
Percent of ESP ash collected in Row 1	*%*	*89.3*	*89.3*	*89.3*	89.3	3.3506E-06
Increase in solids generated per mass SO2 removed	kg/kg	0	0	0	0	0
Calculated:						
SO2 at ESP outlet, corrected to ESP inlet O2	ppm	1684.78172	1663.43662	1726.15564	1691.45799	79.2207281
SO2 removal across ESP	%	-9.75776664	-8.86365312	-9.45818909	-9.35986962	1.13060532
Flue gas flow rate at ESP inlet at STP (wet)	acfm	23017.9306	24219.1409	24170.8046	23802.6254	1689.33808
SO2 flow rate at ESP inlet at STP	acfm	35.3325235	37.0068473	38.1173588	36.8189099	3.48278814
SO2 flow rate at ESP inlet	lb-moles/min	0.09177279	0.09612168	0.09900613	0.09563353	0.0090462
SO2 removed across ESP	lb-moles/min	-0.00895497	-0.00851989	-0.00936419	-0.00894635	0.00104892
SO2 removed across ESP	kg/hr	-15.6125102	-14.8539683	-16.3259494	-15.5974759	1.82873552
Increase in ESP solids generated by SO2 removal	kg/hr	0	0	0	0	0
Flow rate of solids removed in ESP - total	kg/hr	122.5936	135.8457	63.6537	107.364333	95.4732543
Flow rate of solids removed in ESP - Row 1	kg/hr	109.476085	121.31021	56.8427541	95.8763497	85.2576161
Flow rate of solids removed in ESP - Rows 2-4	kg/hr	13.1175152	14.5354899	6.8109459	11.4879837	10.2156382

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(5) Calculate gas flow rate at ESP outlet						
Given :						
Flue gas flow at ESP inlet (wet)	kg/hr	47350	49821	49807	48992.6667	3534.24012
SO2 removed	kg/hr	-15.6125102	-14.8539683	-16.3259494	-15.5974759	1.82873552
Increase in H2O generated per mass SO2 removed	kg/kg	0	0	0	0	0
Flue gas flow at baghouse inlet (wet)	kg/hr	7335	7335	7335	7335	0
Calculated:						
Water generated from SO2 removal	kg/hr	0	0	0	0	0
Total gas flow at ESP outlet (wet)	kg/hr	40015	42486	42472	41657.6667	3534.24012
Compare to measured gas flow at ESP outlet (wet)	*kg/hr*	*35391*	*35624*	*35392*	35469	333.484813
Relative percent difference (rel. to measured value)	%	-13.0654686	-19.2622951	-20.0045208	-17.4440948	9.46562212

- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/ESP

NOTE: Values in italics must be input by user. Other values are calculated.

(6) Calculate trace metal and chlorine mass balance around ESP									
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - ESP inlet									
Antimony	mg/hr		62.6305628		57.0200866		126.596522	82.0823903	96.025385
Arsenic	mg/hr		7675.23843		9214.52789		7472.16268	8120.643	2366.97342
Barium	mg/hr		32170.9956		50051.7611		35710.0439	39310.9335	23523.3179
Cadmium	mg/hr		249.781241		272.304184		243.572936	255.219453	37.5580479
Chromium	mg/hr		18874.4357		20406.4346		17269.1165	18849.9956	3897.43437
Cobalt	mg/hr		3272.62454		3464.20059		3545.11197	3427.31237	347.65564
Lead	mg/hr		6234.63398		7708.46054		6199.85229	6714.3156	2139.33914
Manganese	mg/hr		24138.6513		26595.7244		20939.0851	23891.1536	7046.6506
Mercury	mg/hr		45.475676		78.2106753		51.5801511	58.4221675	43.244967
Selenium	mg/hr		2904.45428		3072.43063		2907.83102	2961.57197	238.549266
Vanadium	mg/hr		27386.9138		36218.5038		27611.7555	30405.7244	12509.3132
Chlorine (as HCl)	mg/hr		522199		549566		683631	585132	214629.826
Flue gas analysis results - ESP outlet									
Antimony	*mg/hr*	*ND*	*1.74335257*	*ND*	*1.77988718*	*ND*	*1.73589715*	ND 1.75304563	0.05848743
Arsenic	*mg/hr*		*79.7840175*		*221.753003*		*115.181881*	138.906301	183.587959
Barium	*mg/hr*		*490.446097*		*495.489181*		*559.826831*	515.254036	96.102752
Cadmium	*mg/hr*		*2.58170005*		*6.30027712*		*5.63400736*	4.83866151	4.92587644
Chromium	*mg/hr*		*265.09214*		*181.653192*		*34.717943*	160.487758	289.764261
Cobalt	*mg/hr*		*28.2012915*		*30.8862775*		*32.675711*	30.58776	5.59497123
Lead	*mg/hr*		*107.677659*		*41.0787491*		*43.9079867*	64.2214648	93.5620283
Manganese	*mg/hr*		*239.454603*		*197.358079*		*226.687745*	221.166809	53.6231549
Mercury	*mg/hr*		*9.8448145*		*9.52763138*		*6.33091901*	8.5677883	4.82872493
Selenium	*mg/hr*		*1046.01154*		*544.776351*		*1143.64989*	911.479259	798.229034
Vanadium	*mg/hr*	*ND*	*184.590272*		*413.562021*	*ND*	*183.800875*	199.252532	328.989403
Chlorine (as HCl) (Runs 2&3 results estimated)	*mg/hr*		*511086*		*362199*		*406206*	426497	190025.537
Flue gas analysis results - Baghouse inlet									
Antimony	*mg/hr*	*ND*	*0.59182119*	*ND*	*0.62003033*	*ND*	*0.59139074*	ND 0.60108075	0.04077353
Arsenic	*mg/hr*		*12.2889929*		*15.4278136*		*9.67097795*	12.4625948	7.16071107
Barium	*mg/hr*		*133.420865*		*158.016554*		*119.408747*	136.948722	48.5543561
Cadmium	*mg/hr*		*1.57267777*		*1.64763943*		*1.04971856*	1.42334525	0.80923286
Chromium	*mg/hr*		*74.3257784*		*63.2795664*		*55.1384894*	64.2479447	23.9247487
Cobalt	*mg/hr*		*10.7920334*		*11.8535211*		*15.8283992*	12.8246512	6.59570287
Lead	*mg/hr*		*13.6588849*		*11.7568693*		*8.77867369*	11.3961426	6.11098161
Manganese	*mg/hr*		*55.5267525*		*65.6502707*		*40.7015978*	53.9595403	31.173365
Mercury	*mg/hr*	*ND*	*0.20887807*	*ND*	*0.21883424*		*0.76532919*	0.32639511	0.79109284
Selenium	*mg/hr*		*43.8643938*		*38.6607149*		*32.0046752*	38.1765947	14.7685519
Vanadium	*mg/hr*	*ND*	*62.6634197*	*ND*	*65.6502707*	*ND*	*62.6178428*	ND 63.6438444	4.3171973
Chlorine (as HCl)	*mg/hr*		*94817*		*63938*		*722269*	293674.667	922918.119

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- = no data available

#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/ESP

NOTE: Values in italics must be input by user. Other values are calculated.

Analysis results - ESP Ash Row 1									
Antimony	*mg/hr*	*ND*	*1092.1*	*ND*	*1213.1*	*ND*	*568.4*	ND	957.866667	851.310836
Arsenic	*mg/hr*		*2730.25*		*3275.37*		*909.44*		2305.02	3077.99539
Barium	*mg/hr*		*6115.76*		*12737.55*		*4035.64*		7629.65	11289.3168
Cadmium	*mg/hr*		*87.368*		*109.179*		*34.104*		76.8836667	95.9451558
Chromium	*mg/hr*		*3931.56*		*6186.81*		*1932.56*		4016.97667	5287.69241
Cobalt	*mg/hr*		*436.84*		*727.86*		*227.36*		464.02	624.449796
Lead	*mg/hr*		*1201.31*		*1577.03*		*454.72*		1077.68667	1419.24434
Manganese	*mg/hr*		*3822.35*		*10311.35*		*1818.88*		5317.52667	11028.6644
Mercury	*mg/hr*	*ND*	*3.2763*	*ND*	*3.6393*	*ND*	*1.7052*	ND	2.8736	2.55393251
Selenium	*mg/hr*		*436.84*		*606.55*	*ND*	*6.2524*		348.838733	768.784185
Vanadium	*mg/hr*		*5678.92*		*10311.35*	*ND*	*96.628*		5346.19467	12706.6851
Chlorine (as chloride)	*mg/hr*		*24026.2*		*982.611*		*297550*		107519.604	409851.172
Analysis results - ESP Ash Rows 2-4										
Antimony	*mg/hr*	*ND*	*131.2*	*ND*	*145.4*	*ND*	*68.1*	ND	114.9	102.223499
Arsenic	*mg/hr*		*275.52*		*130.86*		*95.34*		167.24	237.105796
Barium	*mg/hr*		*1259.52*		*727*		*572.04*		852.853333	895.866563
Cadmium	*mg/hr*		*7.872*	*ND*	*4.362*		*10.215*		6.756	7.31842901
Chromium	*mg/hr*		*577.28*		*189.02*		*170.25*		312.183333	570.831836
Cobalt	*mg/hr*		*52.48*		*29.08*		*27.24*		36.2666667	34.9577843
Lead	*mg/hr*		*157.44*		*101.78*		*68.1*		109.106667	112.089335
Manganese	*mg/hr*		*760.96*		*363.5*		*360.93*		495.13	571.942154
Mercury	*mg/hr*	*ND*	*0.3936*		*4.6528*	*ND*	*0.2043*		1.65058333	6.24929761
Selenium	*mg/hr*		*65.6*	*ND*	*1.5994*	*ND*	*0.7491*		22.2580833	92.4140368
Vanadium	*mg/hr*		*813.44*	*ND*	*24.718*	*ND*	*11.577*		277.195833	1140.83133
Chlorine (as chloride)	*mg/hr*		*93.152*		*581.6*		*68.1*		247.617333	719.237223

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- = no data available

#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - *Series configuration, baseline tests/ESP*

NOTE: Values in italics must be input by user. Other values are calculated.

Calculated results:			A		B		C		Mean	2.5% CC
TOTAL MASS INPUT TO ESP										
Antimony	mg/hr		62.6305628		57.0200866		126.596522		82.0823903	96.025385
Arsenic	mg/hr		7675.23843		9214.52789		7472.16268		8120.643	2366.97342
Barium	mg/hr		32170.9956		50051.7611		35710.0439		39310.9335	23523.3179
Cadmium	mg/hr		249.781241		272.304184		243.572936		255.219453	37.5580479
Chromium	mg/hr		18874.4357		20406.4346		17269.1165		18849.9956	3897.43437
Cobalt	mg/hr		3272.62454		3464.20059		3545.11197		3427.31237	347.65564
Lead	mg/hr		6234.63398		7708.46054		6199.85229		6714.3156	2139.33914
Manganese	mg/hr		24138.6513		26595.7244		20939.0851		23891.1536	7046.6506
Mercury	mg/hr		45.475676		78.2106753		51.5801511		58.4221675	43.244967
Selenium	mg/hr		2904.45428		3072.43063		2907.83102		2961.57197	238.549266
Vanadium	mg/hr		27386.9138		36218.5038		27611.7555		30405.7244	12509.3132
Chlorine (as chloride)	mg/hr		507733.257		534342.148		664693.334		568922.913	208684.238
TOTAL MASS OUTPUT FROM ESP										
Antimony	mg/hr	ND	1225.63517	ND	1360.89992	ND	636.827288	ND	1075.12079	953.604588
Arsenic	mg/hr		3097.84301		3643.41082		1129.63286		2623.6289	3284.99521
Barium	mg/hr		7999.14696		14118.0557		5286.91558		9134.70609	11238.5431
Cadmium	mg/hr		99.3943778		119.307917		51.0027259		89.9016734	87.2700787
Chromium	mg/hr		4848.25792		6620.76276		2192.66643		4553.8957	5536.7846
Cobalt	mg/hr		528.313325		799.679799		303.10411		543.699078	617.718567
Lead	mg/hr		1480.08654		1731.64562		575.50666		1262.41294	1510.55255
Manganese	mg/hr		4878.29136		10937.8583		2447.19934		6087.78302	10863.1151
Mercury	mg/hr		11.7842035		16.1094985		8.0509982		11.9815667	10.0190224
Selenium	mg/hr		1592.31593		1190.78677		1179.15531		1320.75267	584.446978
Vanadium	mg/hr		6615.98685		10770.0962	ND	354.623717		5854.46495	13025.7431
Chlorine (as chloride)	mg/hr		613237.875		415896.538		1394832.55		807988.987	1286169.81
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	1956.92825	H	2386.70265	H	504.616778	H	1616.08256	2450.18433
Arsenic	%	L	40.3615215	L	39.5398534	L	15.1178836	L	31.6730862	35.6331387
Barium	%	L	24.8644682	L	28.2069111	L	14.805122	L	22.6255004	17.3302347
Cadmium	%	L	39.792571	L	43.8142062	L	20.939406	L	34.8487278	30.3399961
Chromium	%	L	25.6869026	L	32.4444858	L	12.6970389	L	23.6094757	24.9335479
Cobalt	%	L	16.1434139	L	23.0841078	L	8.54991641	L	15.9258127	18.0599927
Lead	%	L	23.7397504	L	22.4642211	L	9.28258665	L	18.4955194	19.8848486
Manganese	%	L	20.2094612	L	41.1263787	L	11.6872314	L	24.3410238	37.6332719
Mercury	%	L	25.9132014	L	20.5975699	L	15.6087139	L	20.7064951	12.8020612
Selenium	%		54.8232397	L	38.7571572	L	40.551026	L	44.7104743	21.8714214
Vanadium	%	L	24.1574749	L	29.7364469	L	1.28432152	L	18.3927478	37.4554601
Chlorine (as chloride)	%		120.779537		77.833377	H	209.848026		136.15298	167.284569

- = no data available

#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

(7) Calculate solids removed in fabric filter						
Given:		A	B	C	Mean	2.5% CC
Solids in flue gas at baghouse inlet	kg/hr	0.2106	0.2134	0.1073	0.1771	0.15021497
SO2 conc. at baghouse inlet (dry)	*ppmv*	*1564*	*1554*	*1605*	1574.33333	67.1384453
O2 conc. at baghouse inlet (dry)	*vol. %*	*8.21*	*8.12*	*8.05*	8.12666667	0.19926395
Flue gas flow rate at baghouse inlet (wet)	*kg/hr*	*6388*	*6544*	*6211*	6381	413.916393
Flue gas molecular weight at baghouse inlet (wet)	*g/g-mole*	*29.08*	*29.07*	*29.09*	29.08	0.02484338
H2O in flue gas at baghouse outlet	*vol. %*	*6.57*	*6.74*	*6.52*	6.61	0.28650786
Solids in flue gas at baghouse outlet	*kg/hr*	*0.0562*	*0.0283*	*0.0591*	0.04786667	0.04225153
SO2 conc. at baghouse outlet (dry)	*ppmv*	*1441*	*1432*	*1483*	1452	67.6269534
O2 conc. at baghouse outlet (dry)	*vol. %*	*8.36*	*8.34*	*8.35*	8.35	0.02484338
Increase in solids generated per mass SO2 removed	kg/kg	0	0	0	0	0
Calculated:						
SO2 at baghouse outlet, corrected to baghouse inlet O2	ppm	1458.23684	1457.0828	1518.4502	1477.92328	87.205447
SO2 removal across baghouse	%	6.76235025	6.23662789	5.39251095	6.13049636	1.71682483
Flue gas flow rate at baghouse inlet at STP (wet)	acfm	3107.49034	3184.47278	3020.34873	3104.10395	203.999967
SO2 flow rate at baghouse inlet at STP	scfm	4.86011489	4.9486707	4.84765972	4.88548177	0.13682849
SO2 flow rate at baghouse inlet	lb-moles/min	0.01262368	0.01285369	0.01259132	0.01268956	0.0003554
SO2 removed across baghouse	lb-moles/min	0.00085366	0.00080164	0.00067899	0.00077809	0.0002228
SO2 removed across baghouse	kg/hr	1.48830469	1.39761013	1.1837795	1.35656477	0.38844309
Increase in baghouse solids generated by SO2 removal	kg/hr	0	0	0	0	0
Flow rate of solids removed in baghouse	kg/hr	0.1544	0.1851	0.0482	0.12923333	0.17846513

(6) Calculate gas flow at baghouse outlet						
Given :						
Flue gas flow at baghouse inlet (wet)	kg/hr	6388	6544	6211	6381	413.916393
SO2 removed in baghouse	kg/hr	1.48830469	1.39761013	1.1837795	1.35656477	0.38844309
Increase in H2O generated per mass SO2 removed	kg/kg	0	0	0	0	0
Calculated:						
Water generated from SO2 removal	kg/hr	0	0	0	0	0
Total gas flow at baghouse outlet (wet)	kg/hr	6388	6544	6211	6381	413.916393
Compare to measured gas flow at baghouse outlet (wet)	*kg/hr*	*7366*	*7300*	*7350*	7338.66667	85.5324609
Relative percent difference (rel. to measured value)	%	13.2772197	10.3561644	15.4965986	13.0433276	6.40508703

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- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/baghouse

NOTE: Values in italics must be input by user. Other values are calculated.

(9) Calculate trace metals and chlorine mass balance around fabric filter									
Given:		Fla	Value	Fla	Value	Fla	Value		
Flue gas analysis results - Baghouse inlet									
Antimony	mg/hr	ND	0.59182119	ND	0.62003033	ND	0.59139074	ND	0.60108075	0.04077353
Arsenic	mg/hr		12.2889929		15.4278136		9.67097795		12.4625948	7.16071107
Barium	mg/hr		133.420865		158.016554		119.408747		136.948722	48.5543561
Cadmium	mg/hr		1.57267777		1.64763943		1.04971856		1.42334525	0.80923286
Chromium	mg/hr		74.3257784		63.2795664		55.1384894		64.2479447	23.9247487
Cobalt	mg/hr		10.7920334		11.8535211		15.8283992		12.8246512	6.59570287
Lead	mg/hr		13.6588849		11.7568693		8.77867369		11.3981426	6.11098161
Manganese	mg/hr		55.5267525		65.6502707		40.7015978		53.9595403	31.173365
Mercury	mg/hr	ND	0.20887807	ND	0.21883424		0.76532919		0.32639511	0.79109284
Selenium	mg/hr		43.8643938		38.6607149		32.0046752		38.1765947	14.7685519
Vanadium	mg/hr	ND	62.6634197	ND	65.6502707	ND	62.6178428	ND	63.6438444	4.3171973
Chlorine (as HCl)	mg/hr		94817		63938		722269		293674.667	922918.119
Flue gas analysis results - Baghouse outlet										
Antimony	*mg/hr*	*ND*	*0.42629457*	*ND*	*0.35486925*	*ND*	*0.35530589*	ND	0.37882323	0.10213601
Arsenic	*mg/hr*		*0.82751298*	*ND*	*0.25049594*	*ND*	*0.25080416*		0.35938768	0.82741383
Barium	*mg/hr*	*ND*	*23.3208205*	*ND*	*19.4134352*	*ND*	*19.4373222*	ND	20.7238593	5.58744077
Cadmium	*mg/hr*		*3.26428796*		*1.56925268*		*2.72070259*		2.51808108	2.1501768
Chromium	*mg/hr*	*ND*	*13.5411216*	*ND*	*11.2723172*	*ND*	*11.2861871*	ND	12.0332086	3.24432045
Cobalt	*mg/hr*	*ND*	*6.01827625*	*ND*	*5.00991876*	*ND*	*5.01608314*	ND	5.34809271	1.4419202
Lead	*mg/hr*		*3.00913812*		*3.23557253*		*3.55305889*		3.26592318	0.67878977
Manganese	*mg/hr*		*10.0304604*		*17.7434623*		*7.73312817*		11.8356836	13.0269894
Mercury	*mg/hr*		*0.30091381*		*0.25049594*		*1.27492113*		0.60877696	1.43457686
Selenium	*mg/hr*		*7.64822606*		*2.8180793*		*8.4646403*		6.31031522	7.58167632
Vanadium	*mg/hr*	*ND*	*45.1370718*	*ND*	*37.5743907*	*ND*	*37.6206235*	ND	40.1106954	10.8144015
Chlorine (as HCl)	*mg/hr*		*101856*		*107124*		*111644*		106874.667	12170.1796
Analysis results - Baghouse ash										
Antimony	*mg/hr*	*ND*	*1.544*	*ND*	*1.851*	*ND*	*0.482*	ND	1.29233333	1.78465135
Arsenic	*mg/hr*		*1.2352*		*6.2934*		*1.0122*		2.84693333	7.42024522
Barium	*mg/hr*		*4.9408*		*12.4017*		*2.3859*		6.57613333	12.9292557
Cadmium	*mg/hr*		*2.6248*		*2.9616*		*0.7953*		2.12723333	2.89603234
Chromium	*mg/hr*		*4.3232*		*4.8126*		*1.3014*		3.47906667	4.72452429
Cobalt	*mg/hr*		*0.6176*		*0.9255*		*0.2169*		0.58666667	0.88271352
Lead	*mg/hr*		*2.0072*		*2.9616*		*0.6989*		1.88923333	2.82209221
Manganese	*mg/hr*		*10.4992*		*19.2504*		*4.1452*		11.2982667	18.8418092
Mercury	*mg/hr*	*ND*	*0.004632*		*0.22212*		*0.0293056*		0.08458053	0.29584704
Selenium	*mg/hr*		*0.6176*		*1.4808*		*0.2892*		0.79586667	1.52905294
Vanadium	*mg/hr*		*8.8008*		*24.9885*		*4.6272*		12.8055	26.7194993
Chlorine (as chloride)	*mg/hr*		*12.8152*		*37.02*		*6.8203*		18.8851667	39.7213627

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- - no data available

#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

C-47

- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

AirPol Mass Balance - Series configuration, baseline tests/baghouse
NOTE: Values in italics must be input by user Other values are calculated.

Calculated results:		A		B		C		Mean *		2.5% CC
TOTAL MASS INPUT TO BAGHOUSE										
Antimony	mg/hr	ND	0.59182119	ND	0.62003033	ND	0.59139074	ND	0.60108075	0.04077353
Arsenic	mg/hr		12.2889929		15.4278136		9.67097795		12.4625948	7.16071107
Barium	mg/hr		133.420865		158.016554		119.408747		136.948722	48.5543561
Cadmium	mg/hr		1.57267777		1.64763943		1.04971856		1.42334525	0.80923286
Chromium	mg/hr		74.3257784		63.2795664		55.1384894		64.2479447	23.9247487
Cobalt	mg/hr		10.7920334		11.8535211		15.8283992		12.8246512	6.59570287
Lead	mg/hr		13.6588849		11.7568693		8.77867369		11.3981426	6.11098161
Manganese	mg/hr		55.5267525		65.6502707		40.7015978		53.9595403	31.173365
Mercury	mg/hr	ND	0.20887807	ND	0.21883424		0.76532919		0.32639511	0.79109284
Selenium	mg/hr		43.8643938		38.6607149		32.0046752		38.1765947	14.7685519
Vanadium	mg/hr	ND	62.6634197	ND	65.6502707	ND	62.6178428	ND	63.6438444	4.3171973
Chlorine (as chloride)	mg/hr		92190.4183		62166.8157		702261		285539.411	897351.819
TOTAL MASS OUTPUT FROM BAGHOUSE										
Antimony	mg/hr	ND	1.97029457	ND	2.20586925	ND	0.83730589	ND	1.67115657	1.81773795
Arsenic	mg/hr		2.06271298		6.41864797		1.13760208		3.20632101	7.00620415
Barium	mg/hr		16.6012102		22.1084176		12.1045611		16.938063	12.4475977
Cadmium	mg/hr		5.88908796		4.53085268		3.51600259		4.64531441	2.95804221
Chromium	mg/hr		11.0937608		10.4487586		6.94449353		9.49567097	5.54702526
Cobalt	mg/hr		3.62673812		3.43045938		2.72494157		3.26071302	1.17821458
Lead	mg/hr		5.01633812		6.19717253		4.25195889		5.15515651	2.43467291
Manganese	mg/hr		20.5296604		36.9938623		11.8783282		23.1339503	31.6969095
Mercury	mg/hr		0.30322981		0.47261594		1.30422673		0.69335749	1.33102076
Selenium	mg/hr		8.26582606		4.2988793		8.7538403		7.10618189	6.07025575
Vanadium	mg/hr		31.3693359		43.7756953		23.4375118		32.8608477	25.466452
Chlorine (as chloride)	mg/hr		99047.242		104193.515		108558.104		103932.954	11827.392
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	332.920587	H	355.767956		141.582517	H	276.75702	292.209401
Arsenic	%	L	16.785045	L	41.6043915	L	11.7630511	L	23.3841625	39.6940701
Barium	%	L	12.4427392	L	13.9912035	L	10.1370807	L	12.1903411	4.81817152
Cadmium	%	H	374.462466	H	274.990547	H	334.947169	H	328.133394	124.427561
Chromium	%	L	14.9258589	L	16.5120578	L	12.5946387	L	14.6775185	4.89534278
Cobalt	%	L	33.6056977	L	28.940425	L	17.2155222	L	26.587215	20.9794472
Lead	%	L	36.7258248		52.7110778	L	48.4350944	L	45.9573324	20.5595397
Manganese	%	L	36.9725573		56.3499006	L	29.1839358	L	40.8354646	34.7531257
Mercury	%		145.17073	H	215.969835	H	170.413823	H	177.184796	89.1428494
Selenium	%	L	18.8440449	L	11.1195029	L	27.3517548	L	19.1051009	20.1710231
Vanadium	%		50.0600447		66.6801445	L	37.4294462		51.3898785	36.4467895
Chlorine (as chloride)	%		107.437675	H	167.603107	L	15.45837		96.8330508	190.361737

- = no data available
#VALUE! = insufficient data to calculate number

See notes for missing data procedures used.

TOTAL MASS INPUT											
Antimony	mg/hr	ND	18.74428161	ND	18.33597949		48.20952354		22.24988469		42.55882153
Arsenic	mg/hr		20195.78282		10560.68354		12372.97576		14376.48071		12721.00245
Barium	mg/hr		58159.75869		21591.76935		48730.59876		42827.3756		47165.83275
Cadmium	mg/hr		275.6788359		228.2875268		282.7820539		262.2494722		73.59992834
Chromium	mg/hr		30554.80679		14711.34771		21861.22614		22375.79355		19711.3699
Cobalt	mg/hr		2701.566923		2058.819385		3027.18815		2595.858152		1224.189697
Lead	mg/hr		9803.278158		3753.936676		7202.033194		6919.749343		7538.808606
Manganese	mg/hr		37832.63103		36131.86165		43573.156		39179.21622		9686.747895
Mercury	mg/hr		89.67786737		39.98321341		66.64529598		65.43545892		61.78401967
Selenium	mg/hr		5244.097802		4215.851068		4275.311217		4578.420029		1434.108951
Vanadium	mg/hr		32438.40978		25612.63236		38020.51702		32023.85305		15438.47668
Chlorine (as chloride)	mg/hr		578080.6632		513586.34		507036.57		532901.1911		97543.52744
TOTAL MASS OUTPUT											
Antimony	mg/hr	ND	657.566	ND	1371.107	ND	1240.464	ND	1089.712333		943.8188155
Arsenic	mg/hr		5096.3522		5553.7134		6108.6952		5586.2536		1259.448568
Barium	mg/hr		25304.7759		24570.4817		22531.7908		24135.6828		3569.285245
Cadmium	mg/hr		49.3189		117.2815		101.3348		89.31173333		88.29522354
Chromium	mg/hr		8883.6714		9931.3326		9674.3432		9496.449067		1356.487882
Cobalt	mg/hr		1340.9209		1322.0095		1314.9626		1325.964333		33.34837629
Lead	mg/hr		1004.5069		1922.8806		1757.1772		1561.521567		1215.96468
Manganese	mg/hr		37416.0752		29243.4304		30821.4692		32493.65827		10770.45655
Mercury	mg/hr		15.8840556		15.11137		13.521816		14.83908053		2.992209944
Selenium	mg/hr		2114.32995		1542.39495		2351.3076		2002.6775		1033.122195
Vanadium	mg/hr		9437.1697		15101.209		13869.5508		12802.64317		7400.682244
Chlorine (as chloride)	mg/hr		469853.6112		572922.3054		537996.3116		526924.0761		130226.1256
MASS BALANCE (OUTPUT/INPUT * 100)											
Antimony	%	H	3508.1	H	7477.7	H	2573.1	H	4519.614364		6469.403327
Arsenic	%	L	25.2		52.6	L	49.4	L	42.39819434		37.14281141
Barium	%	L	43.5		113.8	L	46.2		67.84737701		98.91566086
Cadmium	%	L	17.9		51.4	L	35.8	L	35.03313279		41.62914936
Chromium	%	L	29.1		67.5	L	44.3	L	46.9453175		48.09082983
Cobalt	%	L	49.6		64.2	L	43.4		52.42845589		26.49503016
Lead	%	L	10.2		51.2	L	24.4	L	28.62267833		51.70468648
Manganese	%		98.9		80.9		70.7		83.52308138		35.42465772
Mercury	%	L	17.7	L	37.8	L	20.3	L	25.26528715		27.14552314
Selenium	%	L	40.3	L	36.6		55.0	L	43.96707827		24.18031568
Vanadium	%	L	29.1		59.0	L	36.5	L	41.51056796		38.6474215
Chlorine (as chloride)	%		81.27820928		111.55326		106.1060175		99.64582893		40.09303184

MASS BALANCE AROUND TOTAL SYSTEM
SERIES CONFIGURATION
BASELINE TESTS

System balance - BS/A

9/14/94 18:44

TOTAL MASS INPUT											
Antimony	mg/hr		48.33992354	ND	18.33597949	ND	18.48348161		22.24988469		42.93026447
Arsenic	mg/hr		20308.98576		10560.68354		12259.77282		14376.48071		12937.10345
Barium	mg/hr		64871.19076		21591.76935		42019.16669		42827.3756		53788.47422
Cadmium	mg/hr		284.4666139		228.2875268		273.9942759		262.2494722		74.21802985
Chromium	mg/hr		35004.31614		14711.34771		17411.71679		22375.79355		27376.53746
Cobalt	mg/hr		3089.14775		2058.819385		2639.607323		2595.858152		1283.298668
Lead	mg/hr		10809.83919		3753.936676		6195.472158		6919.749343		8902.071652
Manganese	mg/hr		35860.92		36131.86165		45544.86703		39179.21622		13699.8323
Mercury	mg/hr		66.80829598		39.98321341		89.51486737		65.43545892		61.59754631
Selenium	mg/hr		4335.196417		4215.851068		5184.212602		4578.420029		1311.76659
Vanadium	mg/hr		36984.94702		25612.63236		33473.97978		32023.85305		14466.77214
Chlorine (as chloride)	mg/hr		562067.0107		499381.4075		493012.2795		518153.5659		94810.44527
TOTAL MASS OUTPUT											
Antimony	mg/hr	ND	1242.493647	ND	1372.661756	ND	658.713203	ND	1091.289536		944.6290441
Arsenic	mg/hr		6251.341731		5733.201651		5098.199483		5694.247622		1434.847427
Barium	mg/hr		23884.77731		24972.2276		24574.11139		24477.03877		1366.84747
Cadmium	mg/hr		104.097788		122.4455298		53.96000996		93.50110926		88.07263846
Chromium	mg/hr		10048.2259		10078.65195		8723.872437		9616.916763		1921.756545
Cobalt	mg/hr		1359.00303		1347.120737		1343.195653		1349.77314		20.44788782
Lead	mg/hr		1836.191497		1956.317922		1052.159946		1614.889788		1219.873928
Manganese	mg/hr		32204.19426		29404.08194		36150.07607		32586.11743		8419.857316
Mercury	mg/hr		21.65799431		22.83269732		20.86489574		21.78519579		2.459615175
Selenium	mg/hr		3017.642367		1983.224931		3267.204477		2756.023925		1691.329033
Vanadium	mg/hr		13881.94947		15436.56672		9621.190449		12979.90221		7479.84572
Chlorine (as chloride)	mg/hr		620965.4487		458470.1973		802283.5015		627239.7159		427287.5523
MASS BALANCE (OUTPUT/INPUT * 100)											
Antimony	%	H	2570.3	H	7486.2	H	3563.8	H	4540.095148		6457.483767
Arsenic	%	L	30.8		54.3	L	41.6	L	42.21803644		29.23144605
Barium	%	L	36.8		115.7		58.5		70.31937		101.1863749
Cadmium	%	L	36.6		53.6	L	19.7	L	36.64147061		42.16268926
Chromium	%	L	28.7		68.5		50.1	L	49.10616946		49.4894562
Cobalt	%	L	44.0		65.4		50.9		53.43690555		27.19030389
Lead	%	L	17.0		52.1	L	17.0	L	28.69426401		50.38706713
Manganese	%		89.8		81.4		79.4		83.51846924		13.74925971
Mercury	%	L	32.4		57.1	L	23.3	L	37.61089679		43.44257458
Selenium	%		69.6	L	47.0		63.0		59.89075592		28.82892994
Vanadium	%	L	37.5		60.3	L	28.7	L	42.18189921		40.4184814
Chlorine (as chloride)	%		110.5		91.8	H	162.7		121.7		91.3

Estimate of HCl mass flow at ESP outlet (series configuration, baseline tests)

HCl run		RUN 3	RUN 2	RUN 4
Metals run		RUN 4	RUN 2	RUN 3
GAS FLOW @ EO (METALS)	DSCM/MIN	453.6	455.8	453.3
O2 @ EO (METALS)	VOL. %	8.21	8.12	8.05
HCL @ BI (3% O2)	MG/DSCM	26.48874	18.55004	20.80457
EST. HCl @ EO (@ EO O2)	MG/DSCM	18.7788889	13.2441068	14.9351243
ESTIMATED HCL MASS @ EO	MG/HR	511086.239	362199.832	406205.51

Estimate of HF mass flow at ESP outlet (series configuration, baseline tests)

HF run		RUN 3	RUN 2	RUN 4
Metals run		RUN 4	RUN 2	RUN 3
GAS FLOW @ EO (METALS)	DSCM/MIN	453.6	455.8	453.3
O2 @ EO (METALS)	VOL. %	8.21	8.12	8.05
HF @ BI (3% O2)	MG/DSCM	6.32894	2.65929	2.58686
EST. HF @ EO (@ EO O2)	MG/DSCM	4.48682953	1.89864392	1.85704754
ESTIMATED HF MASS @ EO	MG/HR	122113.553	51924.114	50507.979

- Flue gas particulate or trace metals runs collected on 10/19/93 were invalidated because of a blockage in the baghouse hopper. Make-up runs were performed for HCl on 10/21/93 (Run 3) and for particulate and trace metals on 10/22/93 (Run 4). The data from the make-up runs were substituted for the missing data.

- Solids samples collected at the GSA (location 5), ESP (locations 9A and 9B), and baghouse (location 11) hoppers on 10/19/93 were invalidated. Make-up samples were collected on 10/22/93. The analysis of the make-up samples was substituted for the missing data at the ESP hoppers (locations 9A and 9B) and baghouse hoppers (location 11). The average analysis of samples collected on 10/21/93 and 10/22/93 at the GSA (location 5) was substituted for the missing data for 10/19/93.

- Flue gas particulate and trace metals data were not collected at the GSA inlet (location 1). Since (1) GSA inlet flue gas results did not vary significantly among the other three test conditions, (2) ESP inlet measurements on 10/19-22/93 indicated flow through the GSA did not vary significantly during this condition, and (3) the difference between GSA inlet and ESP inlet flow rate was small during the series baseline test conditions, the average of the other 9 test runs at the GSA inlet was substituted for the missing data to allow calculation of the GSA solids mass flow and trace metals mass balance. (Attached table compares GSA inlet and ESP inlet data).

- HCl measurements were not made at the ESP outlet (location 3). Therefore, the mass flow of HCl at the ESP outlet was calculated using the HCl concentration measured at the GSA inlet (location 1), corrected to ESP outlet O_2 concentration, and the gas flow rate measured at the ESP outlet during the Method 29 (multiple metals) runs.

- HCl measurements were not made at the ESP inlet (location 2). Examination of the baseline series test results show that HCl removal across the GSA was -11.2 percent, based on concentrations corrected to constant O_2; however, the difference in HCl at the inlet and outlet of the GSA was not statistically significant. Therefore, the mass flow of HCl at the ESP inlet was estimated by assuming the same

concentration as the GSA inlet (location 1) and the measured gas flow rate at the ESP inlet during the Method 29 (trace metals) runs.

AirPol Mass Balance - Parallel configuration/baseline tests/GSA

NOTE: Values in italics must be input by user. Other values are calculated

(1) Calculate flow rate of GSA absorber/cyclone solids						
Given:		A	B	C	Mean	2.5% CC
Flue gas flow rate at GSA inlet (wet; stack T, P)	*acfm*	*34098*	*34098*	*34098*	34098	0
Flue gas temperature at GSA inlet	*°R*	*755*	*755*	*755*	755	0
Flue gas pressure at GSA inlet	*in. Hg*	*28.5*	*28.5*	*28.5*	28.5	0
Flue gas molecular weight at GSA inlet (wet)	*g/g-mole*	*29.07*	*29.07*	*29.07*	29.07	0
SO2 conc. at GSA inlet (dry)	*ppmv*	*1817*	*1817*	*1817*	1817	0
O2 conc. at GSA inlet (dry)	*vol. %*	*6.36333333*	*6.36333333*	*6.36333333*	6.36333333	2.0941E-07
H2O vapor conc. at GSA inlet	*vol. %*	*8.6*	*8.6*	*8.6*	8.6	2.9616E-07
SO2 conc. at ESP inlet (dry)	*ppmv*	*1611*	*1566*	*1653*	1610	108.090127
O2 conc. at ESP inlet (dry)	*vol. %*	*6.81*	*7.22*	*6.66*	6.89666667	0.72017247
Lime slurry flow rate	*L/hr*	*0*	*0*	*0*	0	0
Specific gravity of lime slurry	*–*	*0*	*0*	*0*	0	0
Moisture content of lime slurry	*wt. %*	*0*	*0*	*0*	0	0
Reinjected fly ash flow rate	*kg/hr*	*189.15*	*187.79*	*182.35*	186.43	8.93919986
Particulate flow rate in GSA inlet flue gas	*kg/hr*	*100.16*	*100.16*	*100.16*	100.16	0
Particulate flow rate in ESP inlet flue gas	*kg/hr*	*99.84*	*75.92*	*37.47*	71.0766667	78.1717312
Increase in solids generated per mass SO2 removed	kg/kg	0	0	0	0	0
Calculated data:						
Std T = 68°F; std P = 29.92 in. Hg						
Solids in lime slurry	kg/hr	0	0	0	0	0
Total solids into GSA	kg/hr	289.31	287.95	282.51	286.59	8.93919986
SO2 at ESP inlet, corrected to GSA inlet O2	ppm	1662.07026	1664.06579	1687.4375	1671.19118	35.0417308
SO2 removal	%	8.5266779	8.41685253	7.13057237	8.02470093	1.92854875
Flue gas flow rate at GSA inlet at STP (wet)	acfm	22714.2891	22714.2891	22714.2891	22714.2891	0
Flue gas flow rate at GSA inlet (wet)	kg/hr	46677.2109	46677.2109	46677.2109	46677.2109	0
SO2 flow rate at GSA inlet at STP	scfm	37.722483	37.722483	37.722483	37.722483	1.6753E-06
SO2 flow rate at GSA inlet	lb-moles/min	0.09798048	0.09798048	0.09798048	0.09798048	3.2721E-09
SO2 removed	lb-moles/min	0.00835448	0.00824687	0.00698657	0.00786264	0.0018896
SO2 removed	kg/hr	14.5655799	14.3779723	12.1807019	13.7080847	3.29441681
Increase in solids generated by SO2 removal	kg/hr	0	0	0	0	0
Flow rate of solids removed in GSA	kg/hr	189.47	212.03	245.04	215.513333	69.4329833
Compare to TVA measured solids after test program	kg/hr	252.5	252.5	252.5	252.5	0
Relative percent difference (rel. to calculated value)	%	-33.2664802	-19.0869217	-3.04440091	-18.4659343	37.5647002

(2) Calculate gas flow rate at GSA outlet		1	2	3		
Given :		32793	32794	32795		
Flue gas flow at GSA inlet (wet)	kg/hr	46677.2109	46677.2109	46677.2109	46677.2109	0
SO2 removed	kg/hr	14.5655799	14.3779723	12.1807019	13.7080847	3.29441681
Increase in H2O generated per mass SO2 removed	kg/kg	0	0	0	0	0
Trim water flow rate	*L/hr*	*0*	*0*	*0*	0	0
Lime slurry flow rate	kg/hr	0	0	0	0	0
Moisture content of lime slurry	wt. %	0	0	0	0	0
Calculated:						
Water in lime slurry	kg/hr	0	0	0	0	0
Trim water flow rate	kg/hr	0	0	0	0	0
Total water input to system (besides flue gas)	kg/hr	0	0	0	0	0
Water generated from SO2 removal	kg/hr	0	0	0	0	0
Total gas flow at GSA outlet (wet)	kg/hr	46662.6453	46662.8329	46665.0302	46663.5028	3.29441738
Compare to measured gas flow at ESP inlet (wet)	*kg/hr*	*47388*	*49821*	*49849*	49019.3333	3509.98599
Relative percent difference (rel. to measured value)	%	1.53067166	6.33902788	6.38722905	4.75230953	6.93161247

– Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/GSA

NOTE: Values in italics must be input by user. Other values are calculated.

(3) Calculate mass balance around GSA for trace metals and chlorine									
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - GSA inlet									
Antimony	*mg/hr*		*28.6386134*		*28.6386134*		*28.6386134*	28.6386134	0
Arsenic	*mg/hr*		*5473.36391*		*5473.36391*		*5473.36391*	5473.36391	0.00021444
Barium	*mg/hr*		*5071.26454*		*5071.26454*		*5071.26454*	5071.26454	0.00021444
Cadmium	*mg/hr*		*208.536016*		*208.536016*		*208.536016*	208.536016	0
Chromium	*mg/hr*		*10180.9537*		*10180.9537*		*10180.9537*	10180.9537	0
Cobalt	*mg/hr*		*1423.30008*		*1423.30008*		*1423.30008*	1423.30008	5.361E-05
Lead	*mg/hr*		*2852.4998*		*2852.4998*		*2852.4998*	2852.4998	0
Manganese	*mg/hr*		*11317.7551*		*11317.7551*		*11317.7551*	11317.7551	0
Mercury	*mg/hr*		*36.7450913*		*36.7450913*		*36.7450913*	36.7450913	0
Selenium	*mg/hr*		*2550.29897*		*2550.29897*		*2550.29897*	2550.29897	0
Vanadium	*mg/hr*		*23457.8582*		*23457.8582*		*23457.8582*	23457.8582	0.00085776
Chlorine (as HCl)	*mg/hr*		*634288*		*486986*		*723567*	614947	296805.104
Reinjected ash analysis results									
Antimony	*mg/hr*	*ND*	*15.132*	*ND*	*15.0232*	*ND*	*14.588*	ND 14.9144	0.71513599
Arsenic	*mg/hr*		*10024.95*		*10366.008*		*7640.465*	9343.80767	3689.14798
Barium	*mg/hr*		*21980.315*		*23830.551*		*22301.405*	22697.4237	2474.46666
Cadmium	*mg/hr*		*61.6629*		*85.44445*		*84.79275*	77.3000333	33.6530303
Chromium	*mg/hr*		*4520.685*		*5051.551*		*5069.33*	4880.522	774.504233
Cobalt	*mg/hr*		*1178.4045*		*1434.7156*		*1090.453*	1234.52437	444.351263
Lead	*mg/hr*		*3991.065*		*3361.441*		*2862.895*	3405.13367	1404.52731
Manganese	*mg/hr*		*12956.775*		*13295.532*		*16283.855*	14178.7207	4548.70182
Mercury	*mg/hr*	*ND*	*18.915*	*ND*	*18.779*	*ND*	*18.235*	ND 18.643	0.89391999
Selenium	*mg/hr*		*752.817*		*771.8169*		*800.5165*	775.050133	59.6577974
Vanadium	*mg/hr*		*8076.705*		*8431.771*		*8898.68*	8469.052	1024.17787
Chlorine (as chloride)	*mg/hr*		*567.45*		*1051.624*		*711.165*	776.746333	617.755556
Lime slurry analysis results (archive sample analysis)									
Antimony	*mg/hr*		0		0		0	0	0
Arsenic	*mg/hr*		0		0		0	0	0
Barium	*mg/hr*		0		0		0	0	0
Cadmium	*mg/hr*		0		0		0	0	0
Chromium	*mg/hr*		0		0		0	0	0
Cobalt	*mg/hr*		0		0		0	0	0
Lead	*mg/hr*		0		0		0	0	0
Manganese	*mg/hr*		0		0		0	0	0
Mercury	*mg/hr*		0		0		0	0	0
Selenium	*mg/hr*		0		0		0	0	0
Vanadium	*mg/hr*		0		0		0	0	0
Chlorine (as chloride)	*mg/hr*		0		0		0	0	0
Trim water analysis results									
Antimony	*mg/hr*		0		0		0	0	0
Arsenic	*mg/hr*		0		0		0	0	0
Barium	*mg/hr*		0		0		0	0	0
Cadmium	*mg/hr*		0		0		0	0	0
Chromium	*mg/hr*		0		0		0	0	0
Cobalt	*mg/hr*		0		0		0	0	0
Lead	*mg/hr*		0		0		0	0	0
Manganese	*mg/hr*		0		0		0	0	0
Mercury	*mg/hr*		0		0		0	0	0
Selenium	*mg/hr*		0		0		0	0	0
Vanadium	*mg/hr*		0		0		0	0	0
Chlorine (as chloride)	*mg/hr*		0		0		0	0	0

. = Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/GSA
NOTE. Values in italics must be input by user. Other values are calculated.

Flue gas analysis results - ESP inlet									
Antimony	*mg/hr*		*308.033973*		*200.338078*		*245.107047*		251.159699	134.408837
Arsenic	*mg/hr*		*11523.3308*		*7329.69156*		*5543.48904*		8132.17048	7625.99018
Barium	*mg/hr*		*5348.24874*		*15245.9632*		*12897.5185*		11163.9101	12847.953
Cadmium	*mg/hr*		*318.48096*		*225.213986*		*124.823601*		222.839516	240.609428
Chromium	*mg/hr*		*14558.8398*		*8879.57327*		*9687.71032*		11042.0411	7632.69244
Cobalt	*mg/hr*		*2539.73352*		*1908.17669*		*1617.68606*		2021.86542	1171.16648
Lead	*mg/hr*		*5356.30204*		*5613.97046*		*5031.9444*		5334.0723	724.555038
Manganese	*mg/hr*		*13611.5111*		*7565.14255*		*7137.45177*		9438.03514	8994.93616
Mercury	*mg/hr*	*ND*	*2.43424938*	*ND*	*2.45687985*		*8.99850653*		3.81469038	9.39914505
Selenium	*mg/hr*	*ND*	*5.27420698*	*ND*	*5.32323968*	*ND*	*5.31729931*	*ND*	5.30491533	0.06647978
Vanadium	*mg/hr*	*ND*	*730.274813*		*17136.737*		*15849.6422*		11117.1722	22665.7319
Chlorine (as HCl)	*mg/hr*		*668864*		*541180*		*736783*		648942.333	246723.529
GSA Solids analysis results										
Antimony	*mg/hr*	*ND*	*15.1576*	*ND*	*16.9524*	*ND*	*19.6032*	*ND*	17.2410667	5.55463867
Arsenic	*mg/hr*		*4414.651*		*4495.036*		*5684.928*		4864.87167	1767.17445
Barium	*mg/hr*		*16938.618*		*18340.595*		*24749.04*		20009.4177	10344.9346
Cadmium	*mg/hr*	*ND*	*0.75788*	*ND*	*0.84812*		*82.0884*		27.6304667	116.590413
Chromium	*mg/hr*		*3959.923*		*3074.435*		*6003.48*		4345.946	3731.95767
Cobalt	*mg/hr*		*1407.7621*		*1441.804*		*1296.2616*		1381.94257	189.130333
Lead	*mg/hr*		*653.6715*		*551.278*		*1884.3576*		1029.76903	1843.04129
Manganese	*mg/hr*		*17639.657*		*16411.122*		*22029.096*		18693.2917	7337.43201
Mercury	*mg/hr*	*ND*	*18.947*	*ND*	*21.203*	*ND*	*24.504*	*ND*	21.5513333	6.94329833
Selenium	*mg/hr*		*1534.707*		*3880.149*		*2523.912*		2646.256	2925.30226
Vanadium	*mg/hr*		*8999.825*		*9202.102*		*11418.864*		9873.597	3334.12309
Chlorine (as chloride)	*mg/hr*		*795.774*		*869.323*		*686.112*		783.736333	229.047989

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- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data

AirPol Mass Balance - Parallel configuration/baseline tests/GSA

NOTE: Values in italics must be input by user. Other values are calculated.

Calculated:			A		B		C		Mean	2.5% CC
TOTAL MASS INPUT TO GSA										
Antimony	mg/hr		36.2046134		36.1502134		35.9326134		36.0958134	0.35756799
Arsenic	mg/hr		15498.3139		15839.3719		13113.8289		14817.1716	3689.14798
Barium	mg/hr		27031.5795		28901.8155		27372.6695		27768.6882	2474.46666
Cadmium	mg/hr		270.198916		293.980466		293.328766		285.836049	33.6530303
Chromium	mg/hr		14701.6387		15232.5047		15250.2837		15061.4757	774.504233
Cobalt	mg/hr		2601.70458		2858.01568		2513.75308		2657.82444	444.351263
Lead	mg/hr		6843.5648		6213.9408		5715.3948		6257.63346	1404.52731
Manganese	mg/hr		24274.5301		24613.2871		27601.6101		25496.4758	4548.70182
Mercury	mg/hr		46.2025913		46.1345913		45.8625913		46.0665913	0.44695999
Selenium	mg/hr		3303.11597		3322.11587		3350.81547		3325.34911	59.6577974
Vanadium	mg/hr		31534.5632		31889.6292		32356.5382		31926.9102	1024.17767
Chlorine (as chloride)	mg/hr		617284.663		474547.337		704234.208		598688.736	288101.527
TOTAL MASS OUTPUT FROM GSA										
Antimony	mg/hr		315.612773		208.819278		254.908647		259.780233	133.069001
Arsenic	mg/hr		15937.9818		11824.7276		11228.417		12997.0421	6370.64019
Barium	mg/hr		22286.8667		33586.5582		37646.5585		31173.3278	19773.1775
Cadmium	mg/hr		318.8599		225.638046		206.912001		250.469983	148.968174
Chromium	mg/hr		18518.7628		11954.0083		15691.1903		15387.9871	8180.58649
Cobalt	mg/hr		3947.49562		3349.98069		2913.94766		3403.80799	1289.05408
Lead	mg/hr		6009.97354		6165.24846		6916.302		6363.84134	1204.16661
Manganese	mg/hr		31251.1681		23976.2645		29166.5478		28131.3268	9307.09399
Mercury	mg/hr	ND	21.3812494	ND	23.6598799		21.2505065		14.590357	3.36600024
Selenium	mg/hr		1537.3441		3882.81062		2526.57065		2648.90846	2925.33139
Vanadium	mg/hr		9364.96241		26338.839		27268.5062		20990.7692	25039.5668
Chlorine (as chloride)	mg/hr		651131.177		527057.776		717059.051		631749.335	239669.284
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	871.747392	H	577.643279	H	709.407479	H	719.599383	365.984536
Arsenic	%		102.836876		74.654018		85.6227203		87.7045381	35.2932437
Barium	%		82.4475192		116.209164		137.533383		112.063355	69.0048763
Cadmium	%		118.009319		76.7527345		70.5392806		88.433778	64.0981508
Chromium	%		125.983937		78.4769709		102.891137		102.444015	58.9946853
Cobalt	%	H	151.727281		117.213517		115.920203		128.287	50.4573459
Lead	%		87.8193416		99.2164017		121.011798		102.682514	41.8996169
Manganese	%		128.740569		97.4118754		105.669733		110.607392	40.3394959
Mercury	%	L	46.2771649		51.2844683	L	46.3351632	L	47.9655988	7.14091114
Selenium	%	L	46.5422382		116.87764		75.4018648		79.6071809	67.8357422
Vanadium	%	L	29.697454		82.5937449		84.2751039		65.522101	77.1050189
Chlorine (as chloride)	%		105.483129		111.065374		101.821105		106.123203	11.5652282

- - Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/ESP

NOTE: Values in italics must be input by user. Other values are calculated.

(4) Calculate ESP ash flow rate						
Given:		A	B	C	Mean	2.5% CC
Solids in flue gas at ESP inlet	kg/hr	99.84	75.92	37.47	71.0766667	78.1717312
SO2 conc. at ESP inlet (dry)	ppmv	1611	1566	1653	1610	108.090127
O2 conc. at ESP inlet (dry)	vol. %	6.81	7.22	6.66	6.89666667	0.72017247
Flue gas flow rate at ESP inlet (wet)	kg/hr	47388	49821	49849	49019.3333	3509.98599
Flue gas molecular weight at ESP inlet (wet)	*g/g-mole*	*29.15*	*29.1*	*29.2*	29.15	0.12421691
H2O in flue gas at ESP inlet	*vol. %*	*7.56*	*7.62*	*7.29*	7.49	0.4367068
Solids in flue gas at ESP outlet	*kg/hr*	*0.937*	*0.8298*	*0.9935*	0.9201	0.20656835
Flue gas flow rate at baghouse inlet (wet)	*kg/hr*	*6498*	*6321*	*6557*	6458.66667	305.12218
Flue gas molecular weight at baghouse inlet (wet)	*g/g-mole*	*29.02*	*29.07*	*28.71*	28.9333333	0.48449903
Solids in flue gas at baghouse inlet	*kg/hr*	*20.7688*	*14.9467*	*18.1899*	17.9684667	7.24770775
SO2 conc. at ESP outlet (dry)	*ppmv*	*1549*	*1572*	*1536*	1552.33333	45.2895151
O2 conc. at ESP outlet (dry)	*vol. %*	*7.5*	*7.89*	*7.68*	7.69	0.48492347
Percent of ESP ash collected in Row 1	*%*	*89.3*	89.3	89.3	89.3	3.3508E-06
Increase in solids generated per mass SO2 removed	kg/kg	0	0	0	0	0
Calculated:						
SO2 at ESP outlet, corrected to ESP inlet O2	ppm	1628.76194	1652.95619	1654.51135	1645.40982	35.8699787
SO2 removal across ESP	%	-1.1025413	-5.55275763	-0.09143052	-2.24890988	7.21833634
Flue gas flow rate at ESP inlet at STP (wet)	acfm	22996.8897	24219.1409	24149.7635	23788.598	1705.53902
Flue gas flow rate at baghouse inlet at STP (wet)	acfm	3167.53616	3075.95545	3230.80892	3158.10018	193.422569
Flue gas flow rate at ESP entrance at STP (wet)	acfm	19829.3536	21143.1854	20918.9545	20630.4979	1746.02143
SO2 flow rate at ESP inlet at STP	acfm	31.9450886	33.1102284	34.5790319	33.2114496	3.27904274
SO2 flow rate at ESP inlet	lb-moles/min	0.08297426	0.08600059	0.08981567	0.08626351	0.00851699
SO2 removed across ESP	lb-moles/min	-0.00091483	-0.0047754	-8.2119E-05	-0.00192412	0.00822114
SO2 removed across ESP	kg/hr	-1.59494832	-8.3256579	-0.14316988	-3.35459203	10.8462169
Increase in ESP solids generated by SO2 removal	kg/hr	0	0	0	0	0
Flow rate of solids removed in ESP - total	kg/hr	78.1342	60.1435	18.2866	52.1881	76.2857744
Flow rate of solids removed in ESP - Row 1	kg/hr	69.7738406	53.7081455	16.3299338	46.6039733	68.1231965
Flow rate of solids removed in ESP - Rows 2-4	kg/hr	8.3603594	6.4353545	1.9566662	5.5841267	8.18257786

(5) Calculate gas flow rate at ESP outlet						
Given :						
Flue gas flow at ESP inlet (wet)	kg/hr	47388	49821	49849	49019.3333	3509.98599
SO2 removed	kg/hr	-1.59494832	-8.3256579	-0.14316988	-3.35459203	10.8462169
Increase in H2O generated per mass SO2 removed	kg/kg	0	0	0	0	0
Flue gas flow at baghouse inlet (wet)	kg/hr	6498	6321	6557	6458.66667	305.12218
Calculated:						
Water generated from SO2 removal	kg/hr	0	0	0	0	0
Total gas flow at ESP outlet (wet)	kg/hr	40890	43500	43292	42560.6667	3603.71333
Compare to measured gas flow at ESP outlet (wet)	*kg/hr*	*33790*	*34220*	*33778*	33929.3333	625.546955
Relative percent difference (rel. to measured value)	%	-21.0121338	-27.1186441	-28.1662621	-25.4323466	9.59870644

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-- Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/ESP

NOTE: Values in italics must be input by user. Other values are calculated.

(6) Calculate trace metal and chlorine mass balance around ESP		A		B		C			
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - ESP inlet									
Antimony	mg/hr		308.033973		200.338078		245.107047	251.159699	134.408837
Arsenic	mg/hr		11523.3308		7329.69156		5543.48904	8132.17048	7625.99018
Barium	mg/hr		5348.24874		15245.9632		12897.5185	11163.9101	12847.953
Cadmium	mg/hr		318.48096		225.213986		124.823601	222.839516	240.609428
Chromium	mg/hr		14558.6398		8879.57327		9687.71032	11042.0411	7632.69244
Cobalt	mg/hr		2539.73352		1908.17669		1617.68606	2021.86542	1171.16648
Lead	mg/hr		5356.30204		5613.97046		5031.9444	5334.0723	724.555038
Manganese	mg/hr		13611.5111		7565.14255		7137.45177	9438.03514	6994.93816
Mercury	mg/hr	ND	2.43424938	ND	2.45687985		8.99850653	3.81469038	9.39914505
Selenium	mg/hr	ND	5.27420698	ND	5.32323968	ND	5.31729931	ND 5.30491533	0.06647978
Vanadium	mg/hr	ND	730.274813		17136.737		15849.6422	11117.1722	22685.7319
Chlorine (as HCl)	mg/hr		668864		541180		736783	648942.333	246723.529
Flue gas analysis results - ESP outlet									
Antimony	*mg/hr*	*ND*	*1.78383365*	*ND*	*1.75711338*	*ND*	*1.7844477*	ND 1.77513157	0.03877365
Arsenic	*mg/hr*		*177.648845*		*145.013534*		*150.418444*	157.693608	43.4554832
Barium	*mg/hr*	*ND*	*97.5861936*	*ND*	*96.1244379*	*ND*	*97.6197858*	ND 97.1101391	2.12114664
Cadmium	*mg/hr*		*29.3807895*		*26.8734988*		*23.6176901*	26.6239928	7.17884269
Chromium	*mg/hr*		*234.521659*		*168.992963*		*192.615384*	198.710002	82.4471254
Cobalt	*mg/hr*		*37.7753007*		*32.0414793*		*35.6889539*	35.168578	7.20983475
Lead	*mg/hr*		*120.6711*		*108.770486*		*125.961014*	118.467533	21.8735136
Manganese	*mg/hr*		*461.69812*		*136.434686*		*241.425277*	279.852694	412.404447
Mercury	*mg/hr*		*14.3756006*		*14.5737051*		*13.8557115*	14.2683391	0.92124226
Selenium	*mg/hr*		*577.12265*		*383.980953*		*218.332424*	393.145343	446.114073
Vanadium	*mg/hr*	*ND*	*188.876504*	*ND*	*186.047299*		*372.634668*	*186.698856*	*265.622718*
Chlorine (as HCl)	*mg/hr*		*436826*		*341363*		*501999*	426729.333	NA
Flue gas analysis results - Baghouse inlet									
Antimony	*mg/hr*		*128.775407*		*53.2579176*		*69.583462*	83.8722621	98.7145508
Arsenic	*mg/hr*		*2576.86824*		*1381.21542*		*1941.22487*	1966.43617	1486.19316
Barium	*mg/hr*		*10067.2257*		*4275.40064*		*2562.01232*	5634.87954	9770.80901
Cadmium	*mg/hr*		*37.7938911*		*18.4245162*		*37.0420346*	31.086814	27.2589374
Chromium	*mg/hr*		*3697.59397*		*1575.29901*		*3251.17938*	2841.35745	2779.79515
Cobalt	*mg/hr*		*631.692767*		*338.303805*		*534.146139*	501.380904	371.19406
Lead	*mg/hr*		*2248.12731*		*1078.96667*		*1498.6723*	1607.92209	1471.88713
Manganese	*mg/hr*		*3254.42673*		*1325.21502*		*2927.80242*	2502.48139	2565.17748
Mercury	*mg/hr*		*6.49827488*		*3.98906981*		*5.5637136*	5.35035276	3.15047945
Selenium	*mg/hr*		*84.9827488*	*ND*	*0.99726745*	*ND*	*0.9630929*	21.987643	91.8010274
Vanadium	*mg/hr*		*7212.3295*		*3383.03805*		*5997.10541*	5530.82432	4861.26766
Chlorine (as HCl)	*mg/hr*		*85111*		*84737*		*79576*	83141.3333	7684.86982
Analysis results - ESP Ash Row 1									
Antimony	*mg/hr*	*ND*	*484.1*	*ND*	*193.7*	*ND*	*720.3*	ND 466.033333	655.28014
Arsenic	*mg/hr*		*7019.45*		*1394.64*		*18367.65*	8927.24667	21479.1883
Barium	*mg/hr*	*ND*	*150.071*		*736.06*	*ND*	*223.293*	307.580667	793.223012
Cadmium	*mg/hr*		*62.933*		*23.244*		*100.842*	62.3396667	96.3962909
Chromium	*mg/hr*		*1839.58*		*368.03*		*3241.35*	1816.32	3569.50015
Cobalt	*mg/hr*		*290.46*		*154.96*		*576.24*	340.553333	534.284158
Lead	*mg/hr*		*774.56*		*368.03*		*1008.42*	717.003333	805.053679
Manganese	*mg/hr*		*1258.66*		*522.99*		*1944.81*	1242.15333	1766.4979
Mercury	*mg/hr*	*ND*	*1.4523*		*1.3559*	*ND*	*2.1609*	1.05416667	1.09208821
Selenium	*mg/hr*		*377.598*		*96.85*		*352.947*	275.798333	386.223096
Vanadium	*mg/hr*		*4889.41*	*ND*	*32.929*		*6194.58*	3700.1515	8066.43993
Chlorine (as chloride)	*mg/hr*		*1742.8*		*329.3*		*1008.4*	1026.83333	1756.25387

- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/ESP
NOTE: Values in italics must be input by user. Other values are calculated.

Analysis results - ESP Ash Rows 2-4									
Antimony	*mg/hr*	*ND*	*58.01*	*ND*	*23.21*	*ND*	*86.3*	*ND*	*55.84*	78.5073948
Arsenic	*mg/hr*		*672.916*		*568.645*		*277.886*		506.482333	508.593989
Barium	*mg/hr*		*255.244*		*129.976*	*ND*	*26.753*		132.8655	284.264452
Cadmium	*mg/hr*		*9.2816*		*2.321*		*5.178*		5.59353333	8.69234014
Chromium	*mg/hr*		*336.458*		*127.655*		*155.34*		206.484333	281.744987
Cobalt	*mg/hr*		*46.408*		*27.852*		*25.89*		33.3833333	28.1283501
Lead	*mg/hr*		*133.423*		*58.025*	*ND*	*19.849*		67.1241667	143.581419
Manganese	*mg/hr*		*255.244*		*106.766*		*181.23*		181.08	184.435067
Mercury	*mg/hr*	*ND*	*0.17403*	*ND*	*0.06963*	*ND*	*0.2589*	*ND*	0.16752	0.23552218
Selenium	*mg/hr*		*66.1314*		*20.889*	*ND*	*0.9493*		29.1650167	82.9757343
Vanadium	*mg/hr*		*672.916*		*234.421*	*ND*	*14.671*		304.890833	832.564963
Chlorine (as chloride)	*mg/hr*		*11.602*		*17.1754*		*43.15*		23.9756	41.8301737

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- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data

AirPol Mass Balance - Parallel configuration/baseline tests/ESP

NOTE: Values in italics must be input by user. Other values are calculated.

Calculated results:		A	B	C	Mean	2.5% CC
TOTAL MASS INPUT TO ESP ENTRANCE						
Antimony	mg/hr	179.258567	147.08016	175.523585	167.287437	43.7228036
Arsenic	mg/hr	8946.46261	5948.47614	3602.26418	6165.73431	6654.83449
Barium	mg/hr	-4718.97694	10970.5625	10335.5062	5529.0306	22062.6953
Cadmium	mg/hr	280.687069	206.78947	87.7815667	191.752702	241.795311
Chromium	mg/hr	10861.2458	7304.27426	6436.53094	8200.68368	5824.79966
Cobalt	mg/hr	1908.04075	1569.87288	1083.53992	1520.48452	1029.66697
Lead	mg/hr	3108.17473	4535.00379	3535.2721	3726.15021	1819.31961
Manganese	mg/hr	10357.0844	6239.92753	4209.64935	6935.55375	7761.43793
Mercury	mg/hr	-5.28115019	-2.76062986	3.43479293	-1.53566238	11.1428385
Selenium	mg/hr	-62.3458453 ND	4.32597223 ND	4.35420641	-19.3351853	95.6495785
Vanadium	mg/hr	-6847.1921	13753.6989	9852.53677	5586.34787	27186.1362
Chlorine (as chloride)	mg/hr	586110.71	458790.35	659411.382	568104.147	252198.592
TOTAL MASS OUTPUT FROM ESP						
Antimony	mg/hr	ND 543.893834	ND 218.667113	ND 808.384448	ND 523.648465	733.822539
Arsenic	mg/hr	7870.01484	2108.29853	18795.9544	9591.42261	21057.1514
Barium	mg/hr	379.072597	914.098219	ND 347.665786	489.001236	790.891781
Cadmium	mg/hr	101.595389	52.4384988	129.63769	94.5571928	97.082678
Chromium	mg/hr	2410.55966	664.677963	3589.30538	2221.51434	3655.57936
Cobalt	mg/hr	374.643301	214.853479	637.818954	409.105245	530.600598
Lead	mg/hr	1028.6541	534.825486	1144.30551	902.595033	804.191607
Manganese	mg/hr	1975.60212	766.190686	2367.46528	1703.08603	2073.6693
Mercury	mg/hr	15.1887656	15.9644201	15.0656115	15.4062657	1.21057381
Selenium	mg/hr	1020.85205	501.719953	571.754074	698.108693	699.81056
Vanadium	mg/hr	5656.76425	343.90915	6574.55017	4191.74119	8356.73963
Chlorine (as chloride)	mg/hr	426479.627	332253.177	489144.379	415959.061	196195.473
MASS BALANCE (OUTPUT/INPUT * 100)						
Antimony	%	H 303.413022	148.672066	H 460.556026	H 304.213704	387.416449
Arsenic	%	87.9678951	L 35.4426661	H 521.781677	H 215.064079	663.120495
Barium	%	L -8.03294023	L 8.3322821	L 3.36380028	L 1.22104738	20.8445699
Cadmium	%	L 36.1952511	L 25.3583989	147.682133	69.745261	166.220635
Chromium	%	L 22.1941359	L 9.09084948	55.7645945	L 29.0195266	59.796688
Cobalt	%	L 19.6349736	L 13.6860431	58.8843706	L 30.7284625	60.9837699
Lead	%	L 33.0951181	L 11.7932754	L 32.3682444	L 25.7522126	30.0462228
Manganese	%	L 19.0748868	L 12.2788395	56.2390137	L 29.19758	58.7889081
Mercury	%	L -287.803363	L -578.289042	H 438.617752	L -142.424884	1301.21575
Selenium	%	L -1637.40714	H 11597.8542	H 13131.0742	H 7897.17376	20173.4521
Vanadium	%	L -82.6143647	L 2.50048479	66.7295186	L -4.46145443	186.11408
Chlorine (as chloride)	%	72.7843463	72.419391	74.1789409	73.1208927	2.3163679

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- - Data not available

#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/Baghouse

NOTE: Values in italics must be input by user. Other values are calculated.

(7) Calculate solids removed in fabric filter						
Given:					Mean	2.5% CC
Solids in flue gas at baghouse inlet	kg/hr	20.7688	14.9467	18.1899	17.9684667	7.24770775
SO2 conc. at baghouse inlet (dry)	*ppmv*	*1611*	*1566*	*1653*	1610	108.090127
O2 conc. at baghouse inlet (dry)	*vol. %*	*7.5*	*7.89*	*7.68*	7.69	0.48492347
Flue gas flow rate at baghouse inlet (wet)	kg/hr	6498	6321	6557	6458.66667	305.12218
Flue gas molecular weight at baghouse inlet (wet)	g/g-mole	29.02	29.07	28.71	28.9333333	0.48449903
H2O in flue gas at baghouse outlet	*vol. %*	*6.68*	*6.51*	*6.74*	6.64333333	0.29639033
Solids in flue gas at baghouse outlet	*kg/hr*	*0.0464*	*0.0509*	*0.0494*	0.0489	0.00569233
SO2 conc. at baghouse outlet (dry)	*ppmv*	*1554*	*1531*	*1564*	1549.66667	42.0384479
O2 conc. at baghouse outlet (dry)	*vol. %*	*7.85*	*8.33*	*8*	8.06	0.61005554
Increase in solids generated per mass SO2 removed	kg/kg	0	0	0	0	0
Calculated:						
SO2 at baghouse outlet, corrected to baghouse inlet O2	*ppm*	1595.67816	1584.59109	1602.7969	1594.35538	22.7930657
SO2 removal across baghouse	%	0.95107629	-1.18717049	3.03709019	0.93366533	5.24737981
Flue gas flow rate at baghouse inlet at STP (wet)	acfm	3167.53616	3075.95545	3230.80892	3158.10018	193.422569
SO2 flow rate at baghouse inlet at STP	acfm	5.10290075	4.81694623	5.34052715	5.08679138	0.6512989
SO2 flow rate at baghouse inlet	lb-moles/min	0.01325429	0.01251155	0.0138715	0.01321245	0.00169169
SO2 removed across baghouse	lb-moles/min	0.00012606	-0.00014853	0.00042129	0.00013294	0.00070797
SO2 removed across baghouse	kg/hr	0.21977593	-0.25895991	0.73449605	0.23177069	1.23431012
Increase in baghouse solids generated by SO2 removal	kg/hr	0	0	0	0	0
Flow rate of solids removed in baghouse	kg/hr	20.7224	14.8958	18.1405	17.9195667	7.25321486

(8) Calculate gas flow at baghouse outlet						
Given :						
Flue gas flow at baghouse inlet (wet)	kg/hr	6498	6321	6557	6458.66667	305.12218
SO2 removed in baghouse	kg/hr	0.21977593	-0.25895991	0.73449605	0.23177069	1.23431012
Increase in H2O generated per mass SO2 removed	kg/kg	0.14064939	0.14064939	0.14064939	0.14064939	0
Calculated:						
Water generated from SO2 removal	kg/hr	0.03091135	-0.03642255	0.10330642	0.03259841	0.17360497
Total gas flow at baghouse outlet (wet)	kg/hr	6498.03091	6320.96358	6557.10331	6458.69927	305.287936
Compare to measured gas flow at baghouse outlet (wet)	*kg/hr*	*7482*	*7690*	*7895*	7689	513.020352
Relative percent difference (rel. to measured value)	%	13.1511506	17.8028143	16.9461266	15.9666972	6.15040828

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- = Data not available

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See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/Baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

(9) Calculate trace metals and chlorine mass balance around fabric filter									
Given:		Flag	Value	Flag	Value	Flag	Value		
Flue gas analysis results - Baghouse inlet									
Antimony	mg/hr		128.775407		53.2579176		69.583462	83.8722621	98.7145508
Arsenic	mg/hr		2576.86824		1381.21542		1941.22487	1968.43617	1486.19316
Barium	mg/hr		10067.2257		4275.40064		2562.01232	5634.87954	9770.80901
Cadmium	mg/hr		37.7938911		18.4245182		37.0420346	31.086814	27.2589374
Chromium	mg/hr		3697.59397		1575.29901		3251.17938	2841.35745	2779.79515
Cobalt	mg/hr		631.692767		338.303806		534.146139	501.380904	371.19406
Lead	mg/hr		2248.12731		1078.98667		1496.8723	1607.92209	1471.88713
Manganese	mg/hr		3254.42673		1325.21502		2927.80242	2502.48139	2565.17748
Mercury	mg/hr		6.49627488		3.98906981		5.5637136	5.35035276	3.15047945
Selenium	mg/hr		64.9627488	ND	0.99726745	ND	0.9630929	21.967643	91.8010274
Vanadium	mg/hr		7212.3295		3383.03805		5997.10641	5530.82432	4861.26766
Chlorine (as HCl)	mg/hr		85111		84737		79576	83141.3333	7684.86982
Flue gas analysis results - Baghouse outlet									
Antimony	*mg/hr*	*ND*	*0.43625851*	*ND*	*0.43380697*	*ND*	*0.43429057*	ND 0.43478535	0.00322593
Arsenic	*mg/hr*		*4.69619455*		*4.4146239*		*3.26995251*	4.12692366	1.87665429
Barium	*mg/hr*	*ND*	*23.8659068*	*ND*	*23.7317932*	*ND*	*23.7582487*	ND 23.7853162	0.17647714
Cadmium	*mg/hr*		*14.3708686*		*11.3555355*		*12.773252*	12.8332187	3.74777503
Chromium	*mg/hr*	*ND*	*13.8576233*	*ND*	*13.7797509*	*ND*	*13.7951122*	ND 13.8108288	0.1024706
Cobalt	*mg/hr*	*ND*	*6.15894368*	*ND*	*6.12433374*	*ND*	*6.13116096*	ND 6.13814613	0.04554249
Lead	*mg/hr*		*4.93613873*		*8.63469488*		*4.78613753*	5.45232305	2.55068748
Manganese	*mg/hr*		*14.1142459*		*22.9662515*		*19.159878*	18.7467918	11.0315473
Mercury	*mg/hr*		*13.1134176*	*ND*	*0.15310834*		*6.28443999*	6.49147058	16.1066685
Selenium	*mg/hr*	*ND*	*0.33360945*	*ND*	*0.33173474*	*ND*	*0.33210455*	ND 0.33248292	0.00246688
Vanadium	*mg/hr*	*ND*	*46.1920776*	*ND*	*45.932503*	*ND*	*45.9837072*	ND 46.036096	0.34156866
Chlorine (as HCl)	*mg/hr*		*100356*		*100511*		*117150*	106005.667	23977.8062
Analysis results - Baghouse ash									
Antimony	*mg/hr*	*ND*	*207.224*	*ND*	*148.958*	*ND*	*181.405*	ND 179.195667	72.5321486
Arsenic	*mg/hr*		*2921.8584*		*4781.5518*		*7256.2*	4966.53673	5402.01814
Barium	*mg/hr*	*ND*	*64.23944*	*ND*	*46.17698*	*ND*	*56.23555*	ND 55.5508567	22.4849661
Cadmium	*mg/hr*		*43.51704*		*52.1353*		*48.97935*	48.2105633	10.832363
Chromium	*mg/hr*		*1056.8424*		*744.79*		*1106.5705*	969.400967	487.18237
Cobalt	*mg/hr*		*186.5016*		*163.8538*		*145.124*	165.1598	51.4747247
Lead	*mg/hr*		*414.448*		*268.1244*		*272.1075*	318.226633	207.079386
Manganese	*mg/hr*		*787.4512*		*580.9362*		*780.0415*	716.142967	291.042933
Mercury	*mg/hr*	*ND*	*0.621672*		*1.638538*		*1.45124*	1.133538	1.34448384
Selenium	*mg/hr*		*174.06816*		*232.37448*		*257.5951*	221.345913	106.433218
Vanadium	*mg/hr*		*1782.1264*		*1638.538*		*2358.265*	1926.3098	946.312365
Chlorine (as chloride)	*mg/hr*		*476.6152*		*1489.58*		*6167.77*	2711.32173	NA

= Data not available
#VALUE! = Insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/Baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

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- = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

AirPol Mass Balance - Parallel configuration/baseline tests/Baghouse
NOTE: Values in italics must be input by user. Other values are calculated.

Calculated results:			A		B		C		Mean	2.5% CC
TOTAL MASS INPUT TO BAGHOUSE										
Antimony	mg/hr		128.775407		53.2579176		69.583462		83.8722621	98.7145508
Arsenic	mg/hr		2576.86824		1381.21542		1941.22487		1966.43617	1486.19316
Barium	mg/hr		10067.2257		4275.40064		2562.01232		5634.87954	9770.80901
Cadmium	mg/hr		37.7938911		18.4245162		37.0420346		31.086814	27.2589374
Chromium	mg/hr		3697.59397		1575.29901		3251.17938		2841.35745	2779.79515
Cobalt	mg/hr		631.692767		338.303805		534.146139		501.380904	371.19406
Lead	mg/hr		2248.12731		1078.96667		1496.6723		1607.92209	1471.88713
Manganese	mg/hr		3254.42673		1325.21502		2927.80242		2502.48139	2565.17748
Mercury	mg/hr		6.49827488		3.98906981		5.5637136		5.35035276	3.15047945
Selenium	mg/hr		64.9827488	ND	0.99726745	ND	0.9630929		21.987643	91.8010274
Vanadium	mg/hr		7212.3295		3383.03805		5997.10541		5530.82432	4861.26766
Chlorine (as chloride)	mg/hr		82753.2899		82389.6503		77371.6182		80838.1861	7471.9867
TOTAL MASS OUTPUT FROM BAGHOUSE										
Antimony	mg/hr	ND	207.660259	ND	149.391807	ND	181.839291	ND	179.630452	72.5351175
Arsenic	mg/hr		2926.55459		4785.96642		7259.46995		4990.66366	5400.20191
Barium	mg/hr	ND	88.1053468	ND	69.9087732	ND	79.9937987	ND	79.3359729	22.6474883
Cadmium	mg/hr		57.8879086		63.4908355		61.752602		61.043782	7.12490561
Chromium	mg/hr		1063.77121		751.679875		1113.46808		976.306381	487.210811
Cobalt	mg/hr		189.581072		166.915967		148.18958		168.228873	51.4927873
Lead	mg/hr		419.384137		274.759095		276.893638		323.678956	205.926766
Manganese	mg/hr		801.565446		603.902452		799.201378		734.889758	281.83449
Mercury	mg/hr		13.4242536		1.71509217		7.73567999		7.62500858	14.5467074
Selenium	mg/hr		174.234965		232.540347		257.761152		221.512155	108.432127
Vanadium	mg/hr		1805.22244		1661.50425		2381.25685		1949.32785	946.28742
Chlorine (as chloride)	mg/hr		98080.1193		99243.8329		120104.66		105809.537	NA
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	161.2577	H	280.506267	H	261.325443	H	234.363143	159.080705
Arsenic	%		113.570207	H	346.503981	H	373.963371	H	278.01252	355.438047
Barium	%	L	0.87517008	L	1.6351397	L	3.12230343	L	1.87753774	2.83962105
Cadmium	%	H	153.167389	H	344.599743	H	166.709531	H	221.492214	265.399484
Chromium	%	L	28.7692813	L	47.7166475	L	34.2481274	L	36.9113521	24.2232843
Cobalt	%	L	30.0115945	L	49.3390747	L	27.7432853	L	35.6979782	29.4837838
Lead	%	L	18.6548215	L	25.4850215	L	18.5006189	L	20.8734873	9.88054272
Manganese	%	L	24.6300043	L	45.5701485	L	27.298971	L	32.4990413	28.3169399
Mercury	%	H	206.581806	L	42.9947896		139.03807		129.538222	204.228064
Selenium	%	H	268.124953	H	23317.7516	H	26763.8929	H	16783.2565	36789.2308
Vanadium	%	L	25.0296723	L	49.1127864	L	39.7067701	L	37.9497429	30.1531994
Chlorine (as chloride)	%		118.521112		120.456674	H	155.230901		131.402896	51.3223006

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– = Data not available
#VALUE! = insufficient data to calculate result

See notes for estimating procedures used for missing data.

TOTAL MASS INPUT											
Antimony	mg/hr		82.7036		82.6492		82.4316		82.5948		0.357567994
Arsenic	mg/hr		16562.96		16904.018		14178.475		15881.81767		3689.147984
Barium	mg/hr		31600.475		33470.711		31941.565		32337.58367		2474.466657
Cadmium	mg/hr		267.6129		291.39445		290.74275		283.2500333		33.65303027
Chromium	mg/hr		15829.685		16360.551		16378.33		16189.522		774.504233
Cobalt	mg/hr		2898.8345		3155.1456		2810.883		2954.954367		444.3512628
Lead	mg/hr		7546.245		6916.621		6418.075		6960.313667		1404.527311
Manganese	mg/hr		26749.675		27088.432		30076.755		27971.62067		4548.701821
Mercury	mg/hr		60.4445		60.3765		60.1045		60.3085		0.446959993
Selenium	mg/hr		3023.017		3042.0169		3070.7165		3045.250133		59.65779736
Vanadium	mg/hr		33121.005		33476.071		33942.98		33513.352		1024.177669
Chlorine (as chloride)	mg/hr		634855.45		488037.624		724278.165		615723.7463		296323.4935
TOTAL MASS OUTPUT											
Antimony	mg/hr	ND	386.7839303	ND	774.3447124	ND	1005.520836	ND	722.2164929		776.7157487
Arsenic	mg/hr		17541.25722		16173.22884		18464.8492		17393.11175		2864.368996
Barium	mg/hr		22769.0943		26147.81921		19173.97477		22696.96276		8664.084097
Cadmium	mg/hr		109.9160469		161.781879		253.0610135		174.9196465		180.0429067
Chromium	mg/hr		7371.8371		6261.585639		8947.71272		7527.045153		3353.29234
Cobalt	mg/hr		2202.999616		2566.033766		1687.34757		2152.126984		1096.951023
Lead	mg/hr		1507.905231		2275.910821		3265.288753		2349.701602		2188.733009
Manganese	mg/hr		25112.12359		23660.6239		20005.64364		22926.13038		6536.994399
Mercury	mg/hr		34.53459652		33.82271727		38.18232914		35.51321431		5.810284193
Selenium	mg/hr		2608.584951		5949.287221		3288.254605		3948.708926		4386.262753
Vanadium	mg/hr		16195.53347		14323.04651		18500.74807		16339.77602		5198.682953
Chlorine (as chloride)	mg/hr		580822.2787		569496.4009		536619.8103		562312.83		57040.71481
MASS BALANCE (OUTPUT/INPUT * 100)											
Antimony	%	H	467.7	H	936.9	H	1219.8	H	874.8015313		943.8030794
Arsenic	%		105.9		95.7		130.2		110.604976		44.0970955
Barium	%		72.1		78.1		60.0		70.06759814		22.87715595
Cadmium	%	L	41.1		55.5		87.0		61.21071954		58.39642427
Chromium	%	L	46.6	L	38.3		54.6	L	46.49119143		20.32128283
Cobalt	%		76.0		81.3		60.0		72.45122561		27.53481807
Lead	%	L	20.0	L	32.9		50.9	L	34.58786515		38.5463256
Manganese	%		93.9		87.3		66.5		82.57979918		35.50249738
Mercury	%		57.1		56.0		63.5		58.89354512		10.06367369
Selenium	%		86.3	H	195.6		107.1		129.6485147		144.1638167
Vanadium	%	L	48.9	L	42.8		54.5	L	48.72979069		14.56203918
Chlorine (as chloride)	%		91.48890172		116.6910855		74.09029241		94.0900932		53.21250281

TOTAL MASS INPUT										
Antimony	mg/hr		36.20461341		36.15021341		35.93261341		36.09581341	0.357567994
Arsenic	mg/hr		15498.31391		15839.37191		13113.82891		14817.17157	3689.147984
Barium	mg/hr		27031.57954		28901.81554		27372.66954		27768.68821	2474.466657
Cadmium	mg/hr		270.1989158		293.9804658		293.3287658		285.8360492	33.65303027
Chromium	mg/hr		14701.63868		15232.50468		15250.28368		15061.47568	774.504233
Cobalt	mg/hr		2601.704576		2858.015676		2513.753076		2657.824442	444.3512628
Lead	mg/hr		6843.564798		6213.940798		5715.394798		6257.633464	1404.527311
Manganese	mg/hr		24274.53009		24613.28709		27601.61009		25496.47576	4548.701821
Mercury	mg/hr		46.20259134		46.13459134		45.86259134		46.06659134	0.446959993
Selenium	mg/hr		3303.115973		3322.115873		3350.815473		3325.349106	59.65779736
Vanadium	mg/hr		31534.56317		31889.62917		32356.53817		31926.91017	1024.177669
Chlorine (as chloride)	mg/hr		617284.6634		474547.3371		704234.2081		598688.7362	288101.5271
TOTAL MASS OUTPUT										
Antimony	mg/hr	ND	766.7116922	ND	385.0213204	ND	1009.826938	ND	720.5199836	782.4512637
Arsenic	mg/hr		15211.22044		11389.30096		31740.3524		19446.95793	26871.93099
Barium	mg/hr		17361.74327		19289.64761		24962.86979		20538.08689	9816.510139
Cadmium	mg/hr		159.862238		116.3533942		273.4786921		183.2314415	201.5482751
Chromium	mg/hr		7434.25387		4490.792839		10706.25344		7543.766716	7724.247538
Cobalt	mg/hr		1971.986473		1823.573446		2082.270134		1959.276684	322.5064117
Lead	mg/hr		2101.709736		1360.862581		3305.556751		2256.043023	2438.353496
Manganese	mg/hr		20416.82457		17781.21514		25195.76265		21131.26745	9337.510066
Mercury	mg/hr		38.08651914		28.28101227		35.05329152		33.80694097	12.471782
Selenium	mg/hr		2729.794015		4614.409301		3353.427226		3565.876847	2385.216756
Vanadium	mg/hr		16461.81169		11207.5154		20374.67102		16014.66604	11427.72351
Chlorine (as chloride)	mg/hr		525327.9953		432338.7657		609903.0198		522523.2602	220647.3618
MASS BALANCE (OUTPUT/INPUT * 100)										
Antimony	%	H	2117.7	H	1065.1	H	2810.3	H	1997.704391	2183.250421
Arsenic	%		98.1		71.9	H	242.0		137.3632827	227.5530345
Barium	%		64.2		66.7		91.2		74.0553177	37.01090371
Cadmium	%		59.2	L	39.6		93.2		63.9920288	67.45201331
Chromium	%		50.6	L	29.5		70.2		50.08426582	50.59428265
Cobalt	%		75.8		63.8		82.8		74.1455435	23.90310713
Lead	%	L	30.7	L	21.9		57.8	L	36.81563881	46.53072477
Manganese	%		84.1		72.2		91.3		82.54467462	23.89050702
Mercury	%		82.4		61.3		76.4		73.38864952	27.0541423
Selenium	%		82.6		138.9		100.1		107.2068833	71.54379811
Vanadium	%		52.2	L	35.1		63.0		50.10546621	34.85601784
Chlorine (as chloride)	%		85.1		91.1		86.6		87.6045618	7.759948898

Estimate of HCl mass flow at ESP outlet (parallel configuration, baseline tests)

HCl RUNS		RUN 3	RUN 2	RUN 4
METALS RUNS		RUN 2	RUN 3	RUN 4
GAS FLOW @ EO (METALS)	DSCM/MIN	434.9	431.1	431
O2 @ EO (METALS)	VOL. %	7.89	7.68	7.5
HCL @ GI (3% O2)	MG/DSCM	23.03264	17.86935	25.93118
EST. HCl @ EO (@ EO O2)	MG/DSCM	16.740483	13.1973635	19.4121683
ESTIMATED HCL MASS @ EO	MG/HR	436826.164	341363.005	501998.671

Estimate of HCl mass flow at ESP inlet (parallel configuration, baseline tests)

HCl RUNS		RUN 3	RUN 2	RUN 4
METALS RUNS		RUN 4	RUN 2	RUN 3
GAS FLOW @ EI (METALS)	DSCM/MIN	633.3	633.6	601.6
O2 @ EI (METALS)	VOL. %	7.22	6.64	6.81
HCL @ GI (3% O2)	MG/DSCM	23.03264	17.86935	25.93118
EST. HCL @ EI (@ EI O2)	MG/DSCM	17.6025986	14.2355827	20.4117501
ESTIMATED HCL MASS @ EI	MG/HR	668863.542	541179.913	736782.53

Estimate of HF mass flow at ESP outlet (parallel configuration, baseline tests)

HF RUNS		RUN 3	RUN 2	RUN 4
METALS RUNS		RUN 2	RUN 3	RUN 4
GAS FLOW @ EO (METALS)	DSCM/MIN	434.9	431.1	431
O2 @ EO (METALS)	VOL. %	7.89	7.68	7.5
HF @ GI (3% O2)	MG/DSCM	4.26777	0.7891	4.42552
EST. HF @ EO (@ EO O2)	MG/DSCM	3.10188199	0.58278782	3.31295911
ESTIMATED HF MASS @ EO	MG/HR	80940.5088	15074.3898	85673.1225

Estimate of HF mass flow at ESP inlet (parallel configuration, baseline tests)

HF RUNS		RUN 3	RUN 2	RUN 4
METALS RUNS		RUN 4	RUN 2	RUN 3
GAS FLOW @ EI (METALS)	DSCM/MIN	633.3	633.6	601.6
O2 @ EI (METALS)	VOL. %	7.22	6.64	6.81
HF @ GI (3% O2)	MG/DSCM	4.26777	0.7891	4.42552
EST. HF @ EI (@ EI O2)	MG/DSCM	3.26162534	0.62863497	3.48355178
ESTIMATED HF MASS @ EI	MG/HR	123935.24	23898.1871	125742.285

EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: Average - all runs

DATE: 9/12/94
OPERATOR: --
ENTERED BY: --
CHECKED BY: --

DATA ENTRY	SYMBOL	UNITS	DATA	DATA	DATA
TEST DATE	--	--			
RUN NUMBER	-	-			
ROUND STACK, DIAMETER	ds	inches	40	40	40
RECTANGULAR STACK, LENGTH	L	inches			
WIDTH	W	inches			
NOZZLE DIAMETER	dn	inches	0.234	0.234	0.234
AVERAGE STACK TEMPERATURE	Fs	°F	290	293	290.6667
AVERAGE METER TEMPERATURE	Fm	°F	86.06667	84.66667	87.33333
BAROMETRIC PRESSURE	Pbar	in. Hg	29.85333	29.9	29.86333
STACK STATIC PRESSURE	Pg	in. H20	-18	-18	-18
AVG. DELTA H	dH	in. H20	1.830667	1.72	1.686667
AVG. VELOCITY HEAD	dP	in. H20	0.909	0.924667	0.891333
PITOT COEFFICIENT	Cp	-	0.829	0.829	0.829
GAS SAMPLE VOLUME	Vm	ft^3	113.4567	109.54	108.67
METER CALIBRATION FACTOR	Y	-	1.017	1.017	1.017
TOTAL SAMPLING TIME	min	minutes	160	160	160
STACK GAS OXYGEN CONTENT	Co2,m	%	6.393333	6.293333	6.27
STACK GAS CARBON DIOXIDE CONTENT	Cco2,m	%	11.60667	11.70667	11.73
IMPINGER GAIN	Ww	grams	202.2333	203	219.2667

LAB ANALYSIS RESULTS						AVERAGE
ANTIMONY		µg	6.136667	6.67	7.67	6.83
ARSENIC		µg	538.45	601.94	585.23	575.21
BARIUM		µg	370.65	811.65	1187.65	789.98
CADMIUM		µg	16.37	17.50	20.10	17.99
CHROMIUM		µg	912.70	960.70	1066.03	979.81
COBALT		µg	134.20	149.20	167.20	150.20
LEAD		µg	235.75	320.92	368.45	308.37
MANGANESE		µg	1101.87	1177.27	1248.90	1176.01
MERCURY		µg	4.71	4.75	3.85	4.44
SELENIUM		µg	182.68	187.44	210.83	193.65
VANADIUM		µg	1959.33	1939.00	2045.67	1981.33
PARTICULATE		mg	7960	9373	9753	9029

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EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: Average - all runs

DATE: 9/12/94
OPERATOR: –
ENTERED BY: –
CHECKED BY: –

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA	DATA	DATA	AVERAGE	CI
TEST DATE	–	–	10/1/93	10/2/93	10/2/93		
RUN NUMBER	-	-	1.333333	2.333333	3.333333		
NOZZLE AREA, An = 3.14(dn)**2/4	An	sq. in.	0.04301	0.04301	0.04301	0.04301	0.00000
STACK AREA, As = 3.14*(ds)**2/576 (ROUND)	As	sq. feet	8.727	8.727	8.727	8.727	0.000
= L * W/144 (RECTANGULAR)			0.000	0.000	0.000	0.000	0.000
AVG. STACK TEMPERATURE, Ts = Fs + 460	Ts	°R	755.0	759.0	752.0	755.3	8.7
AVG. METER TEMPERATURE, Tm = Fm + 460	Tm	°R	559.2	560.0	551.0	556.7	12.4
SAMPLE VOLUME AT STP VmStd = 17.64 Y (Vm/Tm) (Pbar + dH/13.6)	VmStd	ft^3	109.43	114.75	111.85	112.01	6.63
VOL. OF WATER VAPOR, VwStd = 0.04707*Ww	VwStd	ft^3	9.706	10.445	11.490	10.547	2.227
WATER FRACTION, Bws = VwStd/(VmStd + VwStd)	Bws	-	0.0815	0.0834	0.0932	0.0860	0.0155
DRY GAS MOL. WEIGHT, Md = [0.32(Co2,m)+ 0.44(Cco2,m)+0.28(100-(Co2,m)-(Cco2,m)]	Md	g/gmole	30.09	30.13	30.13	30.12	0.06
WET STACK GAS MOLECULAR WEIGHT, Mw = Md(1-Bws)+18.0(Bws)	Mw	g/gmole	29.10	29.12	29.00	29.07	0.17
ABS. STACK PRESSURE, Ps = Pbar + Pg/13.6	Ps	in. Hg	28.52	28.53	28.46	28.50	0.09
STACK GAS VELOCITY vs = 85.49 Cp { sqrt[(dP*Ts) /(Ps*Mw)] }	vs	ft/s	65.16	66.03	64.19	65.12	2.29
vm = 0.3048 * vs	vsm	m/s	19.86	20.12	19.56	19.85	0.70
ACTUAL GAS FLOW RATE Q = 60*vs*As	Q	act/min	34115	34571	33608	34098	1197
Qmass=Q*528/Ts*29.92/Ps*Mw/385*60/2.2046	Qmass	kg/hr	46778	47204	46001	46661	1515
DRY GAS FLOW RATE (STP) Qsd = 17.64*Q*(1-Bws)*(Ps/Ts)	Qsd	dsct/min	20878	21008	20344	20743	874
Qsdm = Qsd/35.32	Qsdm	dscm/min	591.1	594.8	576.0	587.3	24.8
Qdmass = Md/24.055*Qsdm*60	Qdmass	kg/hr	44358	44707	43280	44115	1848
ISOKINETIC RATE, I = 13.61*Ts*VmStd/[Ps*vs*An*min*(1-Bws)]	I	%	95.8	99.8	100.4	98.7	6.3

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EPA METHOD 29: MULTIPLE METALS
LOCATION: GSA inlet (1)
PLANT: National Center for Emissions Research/AirPol Demo
CITY: West Paducah, KY
RUN #: Average - all runs

DATE: 9/12/94
OPERATOR: –
ENTERED BY: –
CHECKED BY: –

CALCULATED DATA Std Temperature = 20°C (68°F); Std Pressure = 29.92 in. Hg	SYMBOL	UNITS	DATA Flag	DATA flag	DATA flag	AVERAGE flag	CI
TEST DATE	–	–	1/1/04	1/1/04	1/1/04		
RUN NUMBER	-	-	0	0	0		
CONCENTRATION @ 3% O2							
ANTIMONY		µg/dscm	2.4822	2.500951	2.963673	2.6489	0.6775
ARSENIC		µg/dscm	217.7976	225.8277	225.9244	223.1832	11.5879
BARIUM		µg/dscm	149.923	304.8858	457.1279	303.979	381.605
CADMIUM		µg/dscm	6.6206	6.56699	7.758309	6.9820	1.6716
CHROMIUM		µg/dscm	369.176	360.4995	411.0916	380.256	67.213
COBALT		µg/dscm	54.282	55.98132	64.51739	58.260	13.627
LEAD		µg/dscm	95.3575	120.4208	142.1376	119.3053	58.1584
MANGANESE		µg/dscm	445.69	441.9886	481.38	456.35	54.04
MERCURY		µg/dscm	1.9038	1.78222	1.487809	1.7246	0.5314
SELENIUM		µg/dscm	73.89	70.27958	81.54521	75.24	14.29
VANADIUM		µg/dscm	792.526	727.6293	788.9781	769.711	90.646
PARTICULATE		mg/dscm	3219.72	3513.03	3775.60	3502.78	690.85

MASS FLOW RATE							
ANTIMONY		mg/hr	70.231	73.247	83.598	75.692	17.417
ARSENIC		mg/hr	6162.352	6613.961	6372.748	6383.020	561.411
BARIUM		mg/hr	4241.92	8929.39	12894.41	8688.57	10760.33
CADMIUM		mg/hr	187.322	192.332	218.842	199.499	42.080
CHROMIUM		mg/hr	10445.43	10558.18	11595.84	10866.48	1575.45
COBALT		mg/hr	1535.86	1639.56	1819.87	1665.10	357.04
LEAD		mg/hr	2698.039	3526.843	4009.338	3411.407	1647.680
MANGANESE		mg/hr	12610.36	12944.81	13578.50	13044.55	1221.59
MERCURY		mg/hr	53.866	52.197	41.967	49.343	16.004
SELENIUM		mg/hr	2090.65	2058.32	2300.18	2149.72	326.20
VANADIUM		mg/hr	22423.67	21310.55	22255.05	21996.42	1490.45
PARTICULATE		kg/hr	91.0986	102.8883	106.5001	100.1623	20.0101

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APPENDIX D—QUALITY ASSURANCE/QUALITY CONTROL

This section provides detailed results, including lab reports, for the QA/QC data summarized in Section 7 of the main report. On the next few pages are project memoranda issued after the Sampling and Analysis Plan was approved documenting most of the major deviations from the plan which were made during the project. The following pages present detailed lab reports and correspondence for reference purposes only. All relevant data are summarized and discussed in Section 7 of the report.

ENERGY AND ENVIRONMENTAL RESEARCH CORPORATION
PROJECT CORRESPONDENCE

September 14, 1993

To: Jerry Lewis
Walied Elashi
Desiree Jones
Greg Rooney

c: Bill Fullerton
Tom McGrath
Frank Stevens
Diane Simsovic
Frank Hsu (AirPol)

From: Glenn England

Subject: GSA Air Toxics Characterization (AirPol)
Test Plan Deviation No. 1

IMPORTANT!

Changes to the test plan have been made due to process limitations. One baseline parallel configuration tests (3 runs) will be deleted, plus the schedule will need to accomodate changeover time for the parallel demonstration tests. The new test schedule will be:

Baseline Series tests (3 runs): September 21-22-23
Demonstration Series tests (3 runs): September 24-25-26
Break: September 27 to October 3
Demonstration Parallel tests (3 runs): October 4-5-6

The revised personnel schedule is attached. Please notify all project team members of these changes.

ENERGY AND ENVIRONMENTAL RESEARCH CORPORATION
PROJECT CORRESPONDENCE

September 14, 1993

To: Jerry Lewis
Walied Elashi
Greg Rooney

c: Bill Fullerton
Frank Hsu

From: Glenn England

Subject: GSA Air Toxics Characterization (AirPol)
Test Plan Deviation No. 2

Test Plan Deviations

- Ultra-high purity (HPLC grade) reagents will be used for charging and recovering the metals and HCl trains instead of ACS-grade reagents. This is being done in an attempt to improve accuracy as very low concentrations in the flue gas streams are expected.

- Jerry Lewis will replace Bill Fullerton as Field Manager.

- Greg Rooney will be Bill Oberg's designated alternative as on-site QA Coordinator.

- The amount of HPLC grade water used to rinse the KMnO4 impingers during recovery of the Method 29 trains should be reduced to preserve detection limits.

Test Plan Clarifications

- Note that flue gas temperatures will be approximately 320°F throughout the system during baseline tests (GSA not in operation). Flue gas temperature at locations 2, 10, and 12 will be approximately 150°F during demonstration tests (GSA in operation). Assume that ash samples collected at locations 9 and 11 will be at the same temperature as the flue gas.

ENERGY AND ENVIRONMENTAL RESEARCH CORPORATION
PROJECT CORRESPONDENCE

September 18, 1993

To: Jerry Lewis
Walied Elashi
Greg Rooney
Barry Boulianne

c: Bill Fullerton
Frank Hsu (AirPol)
Ed Puschaver (TVA)

From: Glenn England

Subject: GSA Air Toxics Characterization (AirPol)
Test Plan Deviation No. 3

Test Plan Clarifications

- Charging of the Method 29 trains was modified in the September 9, 1993 revision to the test plan. The concentrations of the reagents will not be changed from the published method. The quantity of HNO_3/H_2O_2 solution will be increased in impingers 2 and 3 to compensate for high SO_2 concentration as follows:

MULTIMETALS TRAINS			Reagent Quantity		
Impinger			Baseline	Demonstration	
No.	Type	Contents	All Locations	Loc 1	Loc. 2,3,10,12
1	1/2 stem	Empty	--	--	--
2	GS Jumbo	$5\%HNO_3/10\%H_2O_2$	***500 ml***	***500 ml***	***200 ml****
3	Mod Jumbo	$5\%HNO_3/10\%H_2O_2$	***500 ml***	***500 ml***	***200 ml****
4	Mod	Empty	--	--	--
5	GS	$4\%KMnO_4/10\%H_2SO_4$	100 ml	100 ml	100 ml
6	Mod	$4\%KMnO_4/10\%H_2SO_4$	100 ml	100 ml	100 ml
7	Mod	Silica gel	200-300 g	200-300 g	200-300 g

*Note normal size (500 ml) impingers may be used.

- Note that all of the flue gas locations are under high negative draft (-30 in. H_2O at locations 2, 3, 10, and 12 and -18 in. H_2O at location 1). Special care to minimize air inleakage and to prevent backflushing of sample trains and ripped filters should be taken, especially when starting and stopping sample trains.

- Metals analysis on all samples should include 13 metals: As, Ba, Be, Cd, Cr, Co, Hg, Mn, Ni, Pb, Sb, Se, and V (Be and Ni were left off Table 5-1 in earlier versions of plan)

Process Sampling

Based on information gathered during pretest activities on-site, the process sampling procedures will be modified as follows:

- Coal (Location 4). A composite coal sample will be collected from the integrated coal sampler for the boiler coal supply. Samples will be pulverized to 100% passing 4 mesh but will not be dried. A 2 liter aliquot of the total coal sample will be placed into a precleaned glass sample jar with Teflon lined caps by TVA personnel and provided to the EER team.

- Lime Slurry Feed (Location 7). The lime slurry in the feed line is expected to be near ambient temperature and the line is under (several psig) positive pressure. This is a quasi-batch process stream. Slurry flows from the feed tank until the level drops below 20 percent, at which point it is refilled from the holding tank. Under some conditions slurry is fed directly from the holding tank, bypassing the feed tank. Therefore, lime slurry will be collected from a sampling valve in the feed line at 1-hour intervals during flue gas sampling. The time of sampling and any observations will be recorded by the process sampler. ***Note the sampling valve should be opened very carefully to avoid overloading the slurry feed system and causing the feed tank to shut down.*** 250 ml of slurry will be collected into a precleaned (for metals) 250 ml amber glass jar at each sampling event. The 250 ml samples will be combined into a larger container (approximately 2 liters) to form a composite sample for that day's test run. A small amount of HPLC-grade water should be used to rinse the small sampling containers between sampling events.

- GSA Solids (Location 5). The solids from the GSA reactor cyclone will be collected from the screw conveyer as stated in the sampling plan. The GSA solids are expected to be approximately 150°F and at ambient pressure at the point of sample collection. A hose will be installed on the gate valve and directed into a 55-gallon drum. Samples will be collected at 1-hour intervals by opening the gate valve and collecting the solids into a 250 ml precleaned amber glass sample jar from the end of the hose. The time of sampling and any observations will be recorded by the process sampler. The 250 ml samples will be combined into a larger container (approximately 2 liters) to form a composite sample for that day's test run. A small amount of HPLC-grade water should be used to rinse the small sampling containers between sampling events.

- ESP Ash (Locations 9A and 9B). There are two ash conveyers from the ESP, one for field #1 (Location 9A) and the other for fields #2, #3, and #4 (Location 9B). The streams are at ambient pressure and approximately 150°F at the point of sample collection. Each location will be sampled at 1-hour intervals during flue gas testing. The time of sampling and any observations will be recorded by the process sampler. There is a valve on the bottom of the horizontal auger from which the sample from location 9B can be collected directly into a 250 ml sample jar. The 250 ml samples will be combined into a larger container (approximately 2 liters) to form a composite sample for that day's test run. A small amount of HPLC-grade water should be used to rinse the small sampling containers between sampling events.

  The other sampling port (location 9A) is located on the 14-inch vertical duct after the conveyer from field #1. A Tedlar lined sample thief will be inserted through the sample port into the flow and opened long enough to fill the sampler. A 250 ml sample jar will be filled for each sampling event. The 250 ml samples will be combined into a larger container (approximately 2 liters) to form a composite sample for that day's test run. A small amount of HPLC-grade water should be used to rinse the sample thief and small sampling containers between sampling events.

  Since the flow rates of the two streams are very different, the samples from location 9A will *not* be mixed with the samples from 9B. If a reasonable approximation of the relative flow rates of the two streams can be made, aliquots from the daily composite samples will be combined in proportion to the mass flow rates of ash and a single analysis will be

performed.

- Fabric Filter Solids (Location 11). The fabric filter solids are expected to be at approximately 150°F and under slightly negative pressure at the point of sample collection. Samples will be collected at 1-hour intervals using a Tedlar-lined sample thief. The time of sampling and any observations will be recorded by the process sampler. The sample thief will be inserted through a double valve into the fabric filter discharge line and opened long enough to fill the sampler. The thief will be withdrawn and the sample placed into a 250 ml sample jar. Sampling will be repeated if necessary until the jar is filled for each sampling event. The 250 ml samples will be combined into a larger container (approximately 2 liters) to form a composite sample for that day's test run. A small amount of HPLC-grade water should used to rinse the sample thief and small sampling containers between sampling events

- Water Trim Feed (Location 14). *This is a new sampling location.* Water is co-injected into the GSA reactor during operation as a means of trimming the process. Samples will be collected from a valve installed in the feed line. One 250 ml sample will be collected directly into a 250 ml amber glass sample jar with Teflon lined cap during flue gas sampling. The time of sampling and any observations will be recorded by the process sampler.

- Fly Ash Reinjection (Location 13). *This is a new sampling location.* Because a significant amount of fly ash is removed in the GSA cyclone during baseline testing, fly ash is reinjected into the flue gas upstream of the ESP to simulate normal inlet dust loading. This stream will be sampled at 1-hour intervals during baseline testing. The time of sampling and any observations will be recorded by the process sampler. 250 ml of solids will be collected into a 250 ml amber glass sample jar during each sampling event. (Does this also operate when the GSA is operating?? - if so, this needs to be sampled during all tests).

ENERGY AND ENVIRONMENTAL RESEARCH CORPORATION
PROJECT CORRESPONDENCE

September 18, 1993

To: Jerry Lewis
Walied Elashi
Greg Rooney
Barry Boulianne

c: Bill Fullerton
Frank Hsu (AirPol)
Ed Puschaver (TVA)

From: Glenn England

Subject: GSA Air Toxics Characterization (AirPol)
Test Plan Deviation No. 4

Sample Train Proof Blanks and Field Blanks

The schedule for proof blanks and field blanks for the HCl and multimetals trains will be as follows:

Proof blanks. The purpose of this sample is to check glassware precleaning procedures and reagent contamination. Perform once at beginning of first series and once at beginning of second series (after the sampling hiatus). If all glassware remains intact and unused during the sampling hiatus, the second proof blank is not necessary. The samples should be archived and not analyzed. If high field blanks are discovered, some or all of these samples may be analyzed to identify the cause of the problem.

Field Blanks. The purpose of field blanks is to test sample recovery procedures for contamination and recovery efficiency. Perform once near beginning of test program, preferrably after first test run and once near end of test program. The first sample should be analyzed and the second sample should be archived. If the first field blank is hign, the second sample should be analyzed to determine if the problem was systematic or random.

The above should be performed once for each sample location and for each type of measurement (i.e., multimetals train and HCl train).

ENERGY AND ENVIRONMENTAL RESEARCH CORPORATION
PROJECT CORRESPONDENCE

October 14, 1993

To: Jerry Lewis
Walied Elashi
Greg Rooney
Barry Boulianne

c: Bill Fullerton
Frank Hsu (AirPol)
Ed Puschaver (TVA)

From: Glenn England

Subject: GSA Air Toxics Characterization (AirPol)
Test Plan Deviation No. 5

The following change to the Test Plan, Revision 3 (September 9, 1993) has been approved:

Test Matrix - Parellel Demonstration Tests

The planned test matrix for the parallel demonstration tests will be modified to add metals train and HCl train sampling at all flue gas sampling locations. This will provide redundant triplicate data sets on metals and HCl removal across the GSA tower and the ESP to that obtained during the series tests. The attached schedule reflects this change.

Target Sample Volumes

Target sample volumes are revised as follows because of high particulate loading at some sampling locations, resulting in large particulate collect and an excessive number of filter changeouts during sampling:

	Sample Volume, dry standard cubic feet	
Series Configuration	Metals Trains	HCl Trains
GSA Inlet*	60-100	40
ESP Inlet*	60-100	40
ESP Outlet	180-200	40
Baghouse Inlet	100	40
Baghouse Outlet	180-200	40
Parallel Configuration		
GSA Inlet*	60-100	40
ESP Inlet*	60-100	40
ESP Outlet	180-200	40
Baghouse Inlet*	60-100	40
Baghouse Outlet	180-200	40

*High dust loading location

Note the minimum sample volume for high dust loading locations should be 30 cubic feet, based on DOE guidelines adopted from the EPRI FCEM program. Sample detection limits for metals will be increased proportionally upward where sample volumes are reduced from the previous target of 120 cubic feet. Sample detection limits for HCl will be increased approximately 50 percent.

The following change to the Test Plan has been proposed:

Test Matrix - Parallel Baseline Tests

Modifications to these tests, planned for next week, are being considered to add metals train and HCl train sampling at all flue gas locations. A final decision will be reached later this week. A revised schedule will be issued if this change is made.

APCL *Applied P & Ch Laboratory*

4066 E. Mission Blvd.
Pomona, CA 91766
Tel. (714) 622-5148
Fax (714) 622-3199

21 July 1994

Energy and Environmental Research Corporation
Attention: Glenn England
8001 Irvine Boulevard
Irvine, CA 92718-1204
Tel: (714) 552-1803 Fax. (714) 859-3194

Subject: Flue Gas Samples – Method 29

Glenn England:

Summary of "Deviations" from Method 29

1. Front-half and back-half volumes reduced from 300 and 150 mL to 100 mL each for better detection limits.

   Method 29, section 2.3.5, states that the final liquid volumes for analysis are 300 mL for the front half (fraction 1) and 150 mL for the back-half (fraction 2A) and then goes on to suggest that reducing these volumes would decrease the detection limits by proportional amounts. Since lower detection limits for these metals were desirable, we followed the method's suggestion.

2. Revised Hg analysis procedure as requested by EER (George Rooney, 10/27/93). EER specified that "Revisions to Method 101A - Determination of Particulate and Gaseous Mercury Emissions from Stationary Sources, EMTIC CTM-013 WPF" be followed. This revision was followed for the first batch of samples (up to, including 93-4314).

3. Revised Hg analysis procedure as requested by EER (George Rooney, 11/22/93). EER specified that the digestate of the permanganate's MnO_2 filter/precipitate be combined with the filtrate of Fraction 5C for the analysis of mercury. This revision was followed for the second batch of samples, starting with 93-4523.

If you have any further questions, please feel free to call

Respectfully submitted,

Glenn Neal

Glenn Neal,
Project Manager
Applied P & Ch Laboratory

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ATMOSPHERIC RESEARCH AND EXPOSURE ASSESSMENT LABORATORY
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27711

September 28, 1993

Mr. Darryl Rasnake
Energy & Environmental Research Corp.
3710 University Dr.
Durham, NC 27707

Dear Mr. Rasnake:

Attached is the evaluation of the EPA Method 29 (multimetals) and EPA Method 26 (chloride) compliance audit samples results submitted by APCL of California. Each element was evaluated separately and the results of this evaluation was based on the criteria of ±10% for both of the above mentioned methods. If you have any questions, please call me at (919) 541-7834.

Sincerely,

Ellen W. Streib

Ellen W. Streib
Physical Scientist
Quality Assurance Support Branch
Quality Assurance and Technical
Support Division (MD-77B)

Attachment

Multi-metal Filters

Element	Low Level (L375) Reported Values		High Level (H375) Reported Values	
Be				
Cd	5.46	P*	49.3	P
Cr	5.76	F	48.0	P
Cu				
P				
Pb	23.30	P	249.0	P
Mn	6.40	P	49.1	P
Ni	10.30	F	215.0	P
Zn				
Ag				
As	7.78	F	18.0	F
Sb	3.12	P	4.93	P
Se	2.75	F	10.1	P
Tl				
Hg	≤0.500	P	≤0.500	P

* P = passed
F = failed

Method 26 (HCl) Samples

Sample No.	First Analysis		Second Analysis
J1531	47.0 mg/L	P*	N/A
J1705	688.0 mg/L	P	N/A

* P = passed
F = failed

APCL *Applied P & Ch Laboratory*

4066 E. Mission Blvd.
Pomona, CA 91766
Tel. (714) 622-5148
Fax (714) 622-3199

Energy and Environmental Research Corporation
58-1271 Denison Street
Markham ON Canada
Attn: Greg Rooney

Re: Analytical Support GSA Air Toxics Characterization

Dear Mr. Rooney:

Cadmium, Lead, Manganese and Nickel in EPA exam filter samples were analyzed by Atomic Absorption Spectrometer [Perkin-Elmer, MOD3100, 1990, 1992]. Antomony, Arsenic, Chromium and Selenium were analyzed by Graphite Furnace [Perkin-Elmer, 1992].

Filters were digested to completion with 3ml of concentrated HNO_3 and 2ml of concentrated HF. The digestate was then analyzed by the standard EPA 7000 method for each individual metal.

Due to the limited amount of sample, we were unable to check possible matrix interference of filter and we were also unable to perform the analysis of a method blank, since we did not have a blank filter.

We would like to have the true spiked values of both filters so that we have some indication as to the possible defects in our sample analysis.

If you have any further questions, please feel free to call me. Thank you.

Sincerely,

George Zhou, Ph.D.
Service Manager
Applied P & Ch Laboratory

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To DARYLL	From Greg
Co.	Co.
Dept.	Phone # 416-946-1732
Fax # 919-493-5670	Fax #

Applied P & Ch Laboratory
4000 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
58-1271 Denison Street
Markham ON Canada
Tel: (416)948-1732 Fax: (416)948-8680

Service ID #: 801-934017
Collected by.
Collected on:
Sample description:
EPA Filter Exam Sample

Received : 09/15/93
Tested : 09/19-24/93
Reported : 09/24/93

Analysis of Metals on Filter

801-934017 Page 1 of 1

Component Analysed	Method	Unit	Concentration HS75 93-4017-1	Concentration LS75 93-4017-2
Antimony, Sb	EPA 29	µg	4.93	3.12
Arsenic, As by HAA	EPA 29	µg	18.	7.78
Cadmium, Cd	EPA 29	µg	49.3	5.46
Chromium, Total	EPA 29	µg	48	5.75
Lead, total	EPA 29	µg	249	23.3
Manganese, by AAS	EPA 29	µg	49.1	6.4
Mercury, Hg	EPA 29	µg	<0.5	<0.5
Nickel, Ni	EPA 29	µg	215	10.3
Selenium, Se	EPA 29	µg	10.1	2.75

N.D. : Not Detected or less than the quantitation limit.

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Pyramid Laboratories
Analytical Services • Consulting
3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: September 20, 1993

Client: IMET-EER
58-1271 Denison St.
Markham, Ontario L3R-4B5

Attn: Greg Rooney

Analysis: Anions/Chloride
Method: EPA 26
Matrix: Aqueous

Date Received: 09-15-93
Date Analyzed: 09-20-93

Lab Project No: 5064

Lab Sample No.	Client Sample No.	Results (mg/L)	Dilution Factor
5064-01	J1531	47.0	5
5064-02	J1708	688	50

Method Detection Limit (MDL) = 0.02 mg/L

Medhat Gorgy
Lab Director

SEP 15 1993

005064

Pyramid Laboratories

(714) 895-1012

6702 Dolan Ave.
Huntington Beach, Ca. 91640

Chain of Custody Record

Lab job no.: _____
Date: _____
Page ____ of ____

Client: EPA / EER
Address: 3710 University Dr. Ste 160 Durham, NC
Project Name / Number: _____
Contract / Purchase Order / Quote: _____

Project Manager: Darryl R.
Telephone No.: 919) 489-1729
Fax. No.: _____
Sampler: (Signature) _____

Laboratory Sample Number	Field Sample Number	Location	Date	Time	Sample Type	Type/Size of Container	Preservation Temp.	Preservation Chemical	No. of Containers	Analysis Required: Chloride							Remarks
5064-01	J-1531				Aq	container			1	✓							
5064-02	J-1708				Aq	" "			1	✓							

Relinquished by:
Signature: _____
Printed: _____
Company: Fed Ex
Reason: _____

Date: 9/15
Time: 1:00pm

Received by:
Signature: Jennifer Maurer
Printed: Jennifer Maurer
Company: Pyramid Labs
Reason: _____

Relinquished by:
Signature: _____
Printed: _____
Company: _____
Reason: _____

Date: _____
Time: _____

Received by:
Signature: _____
Printed: _____
Company: _____
Reason: _____

Method of Shipment: _____
Shipment No.: _____
Special Instructions: _____

Comments: _____

After analysis, samples are to be:
- ☐ Disposed of (additional fee)
- ☐ Stored (90 days max)
- ☐ Stored over 90 days (additional fee)
- ☐ Returned to customer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ATMOSPHERIC RESEARCH AND EXPOSURE ASSESSMENT LABORATORY
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27711

October 5, 1993

Mr. Darryl Rasnake
Energy & Environmental Research Corp.
3710 University Dr.
Durham, NC 27707

Dear Mr. Rasnake:

Attached is the evaluation of the EPA Method 29 (multimetals filters #L378 & H378) results submitted by APCL of California. Each element was evaluated separately and the results of this evaluation was based on the criteria of ±10% for the above mentioned method. If you have any questions, please call me at (919) 541-7834.

Sincerely,

Ellen W. Streib

Ellen W. Streib
Physical Scientist
Quality Assurance Support Branch
Quality Assurance and Technical
Support Division (MD-77B)

Attachment

Multi-metal Filters

Element	Low Level (L378) Reported Values		High Level (H378) Reported Values	
Be				
Cd				
Cr	7.89	F*		
Cu				
P				
Pb				
Mn				
Ni	16.00	P		
Zn				
Ag				
As	10.90	F	16.9	F
Sb				
Se	3.75	P		
Tl				
Hg				

* P = passed
F = failed

Applied P & Ch Laboratory
[illegible] E. Mission Blvd., Pomona, CA 91768
Tel: ([illegible]) [illegible]-5140 Fax: ([illegible]) [illegible]-2190

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
55-1271 Denison Street
Markham ON Canada
Tel: (416)946-1732 Fax: (416)946-8680

Service ID #: 801-934017B
Collected by:
Collected on:
Sample description:
EPA Filter Exam Sample

Received : 09/28/93
Tested : 10/01-03/93
Reported : 10/04/93

Analysis of Metals on Filter

801-934017B Page 1 of 1

Component Analyzed	Method	Unit	Concentration H378 93-4017-1	Concentration L378 93-4017-2
Arsenic, As	EPA 29	µg	16.9	10.9
Chromium, Total	EPA 29	µg	–	7.89
Nickel, Ni	EPA 29	µg	–	16.0
Selenium, Se	EPA 29	µg	–	3.75

N.D. : Not Detected or less than the quantitation limit.

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

Post-it™ orand fax transmittal memo 7671 | # of pages ▸ 1

To DARYLL	From GREG
Co.	Co.
Dept.	Phone #
Fax #	Fax #

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date: November 4, 1993

Client: Energy and Environmental Research Corporation

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-26-93
Date Analyzed: 11-01-93

Client Project No.: 3500
Client Sample No.: 159085

Lab Job No.: 6011
Lab Sample No.: 6011-06

Component	Amount Spiked (ppm)	MS % Recovery	MSD %Recovery	RPD
Chloride	20	91	94	3
Fluoride	20	95	94	1

Component	Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
Chloride	10	95	ND
Fluoride	10	98	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626

Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date: November 4, 1993

Client: Energy and Environmental Research Corporation

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-26-93
Date Analyzed: 11-01-93

Client Project No.: 3500
Client Sample No.: 159184

Lab Job No.: 6011
Lab Sample No.: 6011-19

Component	Amount Spiked (ppm)	MS % Recovery	MSD %Recovery	RPD
Chloride	20	109	103	6
Fluoride	20	105	104	1

Component	Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
Chloride	10	96	ND
Fluoride	10	98	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date: November 5, 1993

Client: Energy and Environmental Research Corporation

Analysis:	Chloride	Date Received:	10-26-93
Method:	IC	Date Extracted:	11-02-93
Matrix:	Solid	Date Analyzed:	11-02-93

Client Project No.: 3500-020
Client Sample No.: 151617

Lab Job No.: 6011
Lab Sample No.: 6011-31

Component	Amount Spiked (ppm)	MS % Recovery	MSD %Recovery	RPD
Chloride	50	84	84	0

Component	Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
Chloride	10	92	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-01-93
Date Analyzed: 10-06-93

Client Project No.: 3500
Client Sample No.: 151813

Lab Job No.: 5083
Lab Sample No.: 5083-24

Component	Amount Spiked (ppm)	MS % Recovery	MSD %Recovery	RPD
Chloride	100	107	105	2
Fluoride	100	95	96	1

Component	Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
Chloride	10	106	ND
Fluoride	10	99	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020
Client Sample No.: 151611

Lab Job No.: 5083B
Lab Sample No.: 5083-37

Component	Amount Spiked (ppm)	MS % Recovery	MSD %Recovery	RPD
Chloride	50	87	88	1

Component	Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
Chloride	10	89	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020
Client Sample No.: 151547

Lab Job No.: 5083B
Lab Sample No.: 5083-56

Component	Amount Spiked (ppm)	MS % Recovery	MSD %Recovery	RPD
Chloride	50	98	99	1

Component	Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
Chloride	10	97	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626

Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020
Client Sample No.: 155927

Lab Job No.: 5083B
Lab Sample No.: 5083-78

Component	Amount Spiked (ppm)	MS % Recovery	MSD %Recovery	RPD
Chloride	50	97	97	0

Component	Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
Chloride	10	101	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

QUALITY CONTROL REPORT

Date:	October 11, 1993
Client:	Energy and Environmental Research Corporation
Analysis:	Chloride
Method:	IC
Matrix:	Aqueous
Date Received:	10-01-93
Date Analyzed:	10-06-93
Client Project No.:	3500-020
Lab Job No.:	5083B 151511
Lab Sample No.:	5083-65

Amount Spiked (ppm)	MS % Recovery	MSD % Recovery	RPD
100	102	103	1

Amount Spiked (ppm)	LCS % Recovery	MB (mg/L)
10	106	ND

MS = Matrix Spike
RPD = Relative Percent Difference
MB = Method Blank
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Sample
ND = Not Detected

Medhat Gorgy
Lab Director

Applied P & Ch Laboratory
4000 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5145 Fax: (909) 622-3190

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934602
Collected by: Jeff P.
Collected on: 10/18/93
Received : 10/28/93
Tested : 11/12-23/04
Reported : 12/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

801-934602 Page 1 of 1

Test No.: AP-DP-FB-M-EI Date: 18-Oct-93 Sample #: 159163-159169														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4602	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D.												
-1F	FH	N.D.	N.D.	N.D.	N.D.	1.2	10	N.D.	N.D.	N.D.	N.D.	N.D.	0.7	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	2.9	N.D.	N.D.	N.D.	9	N.D.	N.D.	6.8	Acetone
Total (μg)		N.D.	N.D.	N.D.	N.D	4.1	10	N.D.	N.D.	9	N.D.	N.D.	7.5	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4006 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5144 Fax: (909) 622-5180

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1903 Fax: (714)857-1943

Service ID #: 801-934618
Collected by: Joe R.
Collected on: 9/27/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Inlet, Project # 3500

Received : 10/28/93
Tested : 11/12-23/04
Reported : 12/01/93

Analysis of Metals

801-934618 Page 1 of 1

Test No.: AP-BP-FB-BI Date: 27-Sep-93 Sample #: 159397-159403

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4618	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D.												
-1F	FH	N.D.	N.D.	N.D.	N.D.	N.D	N.D.	N.D.	N.D.	N.D.	N.D	N.D.	*	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	2.5	N.D.	N.D.	N.D.	0.2	Acetone
Total (μg)		N.D.	N.D.	N.D.	N.D	N.D.	N.D.	N.D.	2.5	N.D.	N.D.	N.D.	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
* : Gross Weight : 0.5343 g (EER 3)

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4006 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-0190

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934624
Collected by: Joe R.
Collected on: 10/18/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Inlet, Project # 3500

Analysis of Metals

801-934624 Page 1 of 1

Test No.: AP-DP-FB-M-BI Date: 18-Oct-93 Sample #: 159146-159152														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4624	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D.												
-1F	FH	N.D	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	1.1	N.D.	N.D.	N.D.	0.3	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D	N.D.	N.D.	4.7	Acetone
Total (μg)		N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	1.1	N.D.	N.D	N.D.	5.0	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4006 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5140 Fax: (909) 622-3190

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934610
Collected by: Barry B.
Collected on: 09/27/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Outlet, Project # 3500

Analysis of Metals

801-934610 Page 1 of 1

Test No.: AP-BP-FB-EO Date: 27-Sep-93 Sample #: 159390-159396														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4610	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D												
-1F	FH	N.D.	N.D.	N.D.	N.D.	1.2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.3	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	1.9	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.5	Acetone
Total (μg)		N.D.	N.D.	N.D.	N.D.	3.1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.8	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4086 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 628-5148 Fax: (909) 628-2100

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)852-1803 Fax: (714)857-1943

Service ID #: 801-934614 Received : 10/28/93
Collected by: Rob B. Tested : 11/12-23/04
Collected on: 10/18/93 Reported : 12/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Outlet, Project # 3500

Analysis of Metals

801-934614 Page 1 of 1

Test No.: AP-DP-FB-M-EO Date: 18-Oct-93 Sample #: 159170-159176

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4614	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D												
-1F	FH	N.D.	N.D.	10.4	N.D.	9.1	11	3.6	6.7	15	N.D	N.D.	0	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	4	N.D.	N.D.	120	Acetone
Total (μg)		N.D.	N.D.	10.4	N.D.	9.1	11	3.6	6.7	19	N.D.	N.D.	120	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4000 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3180

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934536
Collected by: Rob R.
Collected on: 10/18/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse outlet, Project # 3500

Received : 10/25/93
Tested : 11/12-23/04
Reported : 12/01/93

Analysis of Metals

801-934536 Page 1 of 1

Test No.: AP-DP-FB-M-BO Date: 18-Oct-93 Sample #: 159139-159145														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4536	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D.												
-1F	FH	N.D.	N.D.	N.D	N.D.	1.2	N.D.	N.D	0.7	N.D.	N.D.	N.D.	1.9	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	3	N.D.	N.D.	1.4	9	N.D.	N.D.	4.1	Acetone
Total (μg)		N.D.	N.D.	N.D.	N.D.	4.2	N.D.	N.D.	2.1	9	N.D.	N.D.	6.0	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4000 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5146 Fax: (909) 622-2196

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
3001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)852-1803 Fax: (714)857-1943

Service ID #: 801-934547
Collected by: Rob B.
Collected on: 09/27/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse outlet, Project # 3500

Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93

Analysis of Metals

801-934547 Page 1 of 1

Test No.: AP-BP-FB-BO Date: 27-Sep-93 Sample #: 159383-159389														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4547	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D.												
-1F	FH	N.D.	N.D.	N.D.	N.D.	0.7	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.3	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	1.0	N.D.	N.D.	N.D.	65	N.D.	N.D.	1.1	Acetone
Total (μg)		N.D.	N.D.	N.D.	N.D.	1.7	N.D.	N.D.	N.D.	65	N.D.	N.D.	1.4	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona CA 91766
Tel: (714) 622-5148 Fax: (714) 622-3199

APCL QA/QC Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934QC
Collected by:
Collected on:
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Project # 3500

Received : 10/26/93
Tested : 11/12-16/93
Reported : 12/08/93

Analysis of Metals

801-934QC Page 1 of 1

Component	QC Level mg/L	QC Checking %Recov.	Spike Level mg/L	Matrix Spike %Recov.	Spike Dupl. %Recov.	%Diff	Control Limit %Recov.	%Diff
Antimony Sb	0.1	90%	0.1	106%	103%	3%	75-125%	20%
		108%		117%	119%	1.5%	75-125%	20%
Arsenic Tota	0.05	95%	0.05	100%	99%	1%	75-125%	20%
		104%		108%	103%	4.7%	75-125%	20%
Barium Ba	10.0	100%	10.0	93%	95%	2%	75-125%	20%
		98.6%		92%	92%	0%	75-125%	20%
Cadmium Cd	0.5	98.4%	0.5	98%	97%	1%	75-125%	20%
	0.003	105%	0.003	93%	89%	4%	75-125%	20%
Chromium, Total	5.0	95%	5.0	93%	95%	2%	75-125%	20%
		94%		98%	97%	1%	75-125%	20%
Cobalt, Co	1.0	103%	1.0	98%	99%	1%	75-125%	20%
		93 %		100%	98.4%	2%	75-125%	20%
Lead total	3.5	97.7%	3.5	96%	96%	0%	75-125%	20%
	0.03	90 %	0.03	85.7%	82.3%	4%	75-125%	20%
Mercury Hg	0.005	106%	0.005	99%	104%	5%	75-125%	20%
		107%		98%	98%	0%	75-125%	20%
Selenium, Se	0.05	110%	0.05	93.6%	91.4%	2.4%	75-125%	20%
		109%		107 %	97.2%	9.5%	75-125%	20%
Vanadium, V	50.0	102%	25.0	90%	91%	1.1%	75-125%	20%
		100%		86.8%	86.4%	0.2%	75-125%	20%

Note: 1) Method Blank is ND for all components. 2) Digestion method 3050 was used

Respectfully submitted,
Applied P & Ch Laboratory

Shu-Teh Pan
Lab Manager

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4000 E. Mission Blvd., Pomona CA 91766
Tel: (714) 622-5146 Fax: (714) 622-3190

APCL QA/QC Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
58-1271 Denison Street
Markham ON Canada
Tel: (416)948-1732 Fax: (416)946-0680

Service ID #: 801-934017BQC Received : 09/28/93
Collected by: Tested : 10/01-03/93
Collected on: Reported : 10/04/93
Sample description:
EPA Filter Exam Sample

Analysis of Metals on Filter

801-934017BQC Page 1 of 1

Parameter	Sample µg	Duplicate µg	% Diff	Post Digest Spike SA	%Rec	%Rec	%Diff	Filter Spike SA	%Rec	%Rec	STD1	STD2
Chromium	7.89	7.90	0.1	10	94.5	96.0	2	5	108	107	98	103
Arsenic	10.9	11.7	7	15	108	–	–	2.5	89.4	82.9	95.8	96.8

SA : Spiked amount in µg.

Note: 1) Duplicate Analysis conducted at a different dilution. 2) STD1 & 2 are both ERA reference standards. 3) Post Digest Spike: the metal is spiked directly into digestate. 4) Filter Spike: metals are spiked onto a quartz filter which is then digested by using the exact same procedures as the sample. Calculations for the spike filter are blank corrected.

Respectfully submitted,

Shu-Teh Pan,
Lab Manager
Applied P & Ch Laboratory

Glen, this was an 'in house' audit completed by the Lab, which they used to suggest their analysis was satisfactory, and that there was a problem with the initial EPA audit sample.

B.M.

Applied P & Ch Laboratory
4066 E Mission Blvd, Pomona CA 91766
Tel. (714) 622-5148 Fax. (714) 622-3199

APCL QA/QC Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Glenn England
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)859-8851 Fax: (714)857-1943

Service ID #: 801-942824
Collected by: N/A
Collected on: Sep,Oct '93
Sample description:
GSA Toxics, Airpol (Shawnee Plant)
Project# 3500

Received : 06/01/94
Tested : 06/20-22/94
Reported : 07/08/94

QA/QC – Calibration, Matrix Spikes

QC Batch#942824

Analyte	Analysis Method	APCL ID	STD mg/kg	ICV %REC	SPC mg/kg	MS %REC	MSD %REC	%Diff	CL %
Antimony, Sb	GFAA 7041	94-2824-14	0.10	111	5	102	101	1	79-113
Antimony, Sb	GFAA 7041	94-2824-24	0.10	111	5	97	96	1	
Arsenic, As	GFAA 7060	94-2824-14	0.05	105	2.5	96	97	1	79-117
Arsenic, As	GFAA 7060	94-2824-24	0.05	105	2.5	94	97	3	
Barium, Ba	ICP 6010	94-2824-14	20	100.5	200	99	96	3	85-116
Barium, Ba	ICP 6010	94-2824-24	20	100.5	200	99	99	0	
Beryllium, Be	ICP 6010	94-2824-14	0.5	99.6	20	89	88	1	78-111
Beryllium, Be	ICP 6010	94-2824-24	0.5	99.6	20	90	91	1	
Cadmium, Cd	GFAA 7131	94-2824-14	5	96.4	12.5	127*	126*	1	88-112
Cadmium, Cd	GFAA 7131	94-2824-24	5	96.4	12.5	107	102	5	
Chromium, Cr	GFAA 7191	94-2824-14	0.01	98	30	99	99	0	76-124
Chromium, Cr	GFAA 7191	94-2824-24	0.01	98	30	107	106	1	
Cobalt, Co	ICP 6010	94-2824-14	5	99.7	50	89	87	2	79-116
Cobalt, Co	ICP 6010	94-2824-24	5	99.7	50	85	89	4	
Lead, Pb	GFAA 7421	94-2824-14	0.03	95.7	30	94	101	7	81-119
Lead, Pb	GFAA 7421	94-2824-24	0.03	95.7	30	110	121*	11	
Manganese, Mn	ICP 6010	94-2824-14	5	99.8	50	93	90	3	81-111
Manganese, Mn	ICP 6010	94-2824-24	5	99.8	50	87	90	3	
Mercury, Hg	CVAA 7471	94-2824-14	0.005	106	2.5	109	115	6	75-115
Mercury, Hg	CVAA 7471	94-2824-24	0.005	106	2.5	107	105	2	
Nickel, Ni	GFAA 7521	94-2824-14	0.05	98.4	50	87	88	1	78-106
Nickel, Ni	GFAA 7521	94-2824-24	0.05	98.4	50	91	94	3	
Selenium, Se	GFAA 7740	94-2824-14	0.1	101	5	89	89	0	75-115
Selenium, Se	GFAA 7740	94-2824-24	0.1	101	5	82	90	8	
Vanadium, V	ICP 6010	94-2824-14	10	99.8	250	89	87	2	76-113
Vanadium, V	ICP 6010	94-2824-24	10	99.8	250	91	92	1	

NOTES:

* Values outside of CL are due to matrix interferences; CCV & LC samples indicate acceptable performance.

(1) **SPC** MS Standard Concentration.
(2) **%REC** Percent Recovery
(3) **ICV** Initial Calibration Verification
(4) **LCS** Lab Control Sample
(5) **LCSD** Lab Control Sample Duplicate
(6) **CL** Control Limit
(7) **MB** Method Blank
(8) **MS** Matrix Spike
(9) **MSD** Matrix Spike Duplicate
(10) **STD** ICV Standard Concentration

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona CA 91766
Tel. (714) 622-5148 Fax: (714) 622-3199

APCL QA/QC Report

QA/QC – Method Blanks & Continuing Calibration Verification

QC Batch#942824

Analyte	MB_1 mg/kg	SPC mg/kg	ICV %REC	CCV_1 %REC	CCV_2 %REC	CCV_3 %REC	MB_2 mg/kg	LCS %REC	LCSD %REC	%Diff
Antimony, Sb	<0.08	5	111	119	111	111	<0.08	120	111	9
Arsenic, As	<0.06	2.5	102	102	95.4	98.6	<0.06	104	92.2	11.8
Barium, Ba	<0.11	200	101	108	103	103	<0.11	108	105	3
Beryllium, Be	<0.015	20	99.6	96.4	91.2	91.9	<0.015	99.5	96	2.5
Cadmium, Cd	<0.004	12.5	96.4	98.9	97.8	96.4	<0.004	99.8	104	4.2
Chromium, Cr	<0.02	30	98	103	105	110	<0.02	107	106	1
Cobalt, Co	<0.35	50	99.7	97.7	94.6	91.6	<0.35	99.4	95.2	4.2
Lead, Pb	<0.035	30	95.7	94.6	99.3	91.3	<0.035	101	112	11
Manganese, Mn	<0.05	50	99.8	96.8	93.6	92	<0.05	100	96	4
Mercury, Hg	<0.10	2.5	106	103	99	98	<0.10	111	104	7
Nickel, Ni	<0.05	50	98.4	98.4	99.6	93	<0.05	85	87	2
Selenium, Se	<0.1	5	101	92.6	111	103	<0.1	99	103	4
Vanadium, V	<0.4	250	99.9	99.8	94.4	94.3	<0.4	107	103	4

NOTES:

* Values outside of CL are due to matrix interferences; CCV & LC samples indicate acceptable performance.

(1) **SPC** LCS Standard Concentration.
(2) **%REC** Percent Recovery
(3) **ICV** Initial Calibration Verification
(4) **LCS** Lab Control Sample
(5) **LCSD** Lab Control Sample Duplicate
(6) **3050** Digestion method
(7) **MB** Method Blank
(8) **MS** Matrix Spike
(9) **MSD** Matrix Spike Duplicate
(10) **CCV** Continuing Calibration Verification

Respectfully submitted,
Applied P & Ch Laboratory

Jack Y. Zhang, Ph. D.,
Director

CADHS ELAP CERTIFICATION NUMBER 1431

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-953-9300 FAX: 708-953-9306
Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO
4665 PARIS, B-200, DENVER, CO 80239
TEL: (303) 878-4771
FAX: (303) 878-4781

July 6, 1994

CT&E CONNEAUT
2979 E CENTER STREET
CONNEAUT OH 44030

Sample identification by
CTE CONNEAUT

CORRECTED REPORT

Kind of sample COAL
reported to us

Sample taken at XXXXXX

Sample taken by CTE CONNEAUT

Date sampled ------

Date received May 27, 1994

Analysis report no. STANDARD

PARAMETER	Cert. Value corr	Reported Value rep	Standard
Antimony, Sb	6.8	6.7	NBS 1633a
Arsenic, As	3.72	2.32	NBS 1632b
Barium, Ba	0.15	0.14	NBS 1633a
Beryllium, Be	12	8	NBS 1633a
Cadmium, Cd	0.057	0.06	NBS 1633a
Chromium, Cr	196	179	NBS 1633a
Cobalt, Co	46	43	NBS 1633a
Lead, Pb	72	71	NBS 1633a
Manganese, Mn	179	175	NBS 1633a
Mercury, Hg(DGAA)	0.25	0.25	SARM 20
Mercury, Hg(D3684)	0.25	0.21	
Nickel, Ni	127	118	NBS 1633a
Selenium, Se	1.3	1.0	NBS 1632b
Vanadium, V	297	299	NBS 1633c
Chloride, Cl	1260	1160	NBS 1633a

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Byron C. Cat[illegible]

Manager, Denver Laboratory

OVER 40 BRANCH LABORATORIES STRATEGICALLY LOCATED IN PRINCIPAL COAL MINING AREAS, TIDEWATER AND GREAT LAKES PORTS, AND RIVER LOADING FACILITIES
F-465/073/94
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APPENDIX E—ANALYTICAL LAB REPORTS

This section is a compilation of analytical lab reports received for analyses performed by various labs on samples obtained during the test and sampling period. Analyses were performed by Applied P & Ch Laboratory (APCL), Commercial Testing & Engineering Co. (CTE), Tennessee Valley Authority (TVA) and Pyramid Laboratories. APCL performed analysis of metals on filter and acetone rinse flue gas samples from the EPA Method 29 tests and analysis of metals on solid and liquid samples from various points in the process stream. CTE performed analyses for trace metals, moisture and ash on coal samples. TVA performed proximate and ultimate analyses on coal samples. Pyramid Laboratories analyzed solid and aqueous samples for chloride and fluoride.

Several errors were encountered in the reporting of data pertaining to the reported detection limits for some analyses performed by APCL. The analyses for the flue gas samples incorrectly reported the detection limit as the practical quantitation limit (PQL) instead of reporting the method detection limit (MDL). All trace metal results reported as "ND" were corrected by using the MDL instead of the PQL to determine the trace metal total for each flue gas sample. These corrected results were reported in the spreadsheets contained Appendix B. The following data table from APCL shows the PQL's and MDL's for the various methods used to determine trace metal concentrations for both solid and flue gas samples.

In some of the flue gas analyses an asterisk is shown for the particulate results from the filter sample. In these cases APCL did not have needed filter tare weight data and could only report the filter gross weight. Tare weights for these filters are reported on separate sheets in this section.

APCL also incorrectly reported PQL instead of MDL for solid sample analyses. These analyses were corrected by using the MDL instead of the PQL when entering "ND" values in the spreadsheets contained in Appendix B. Mercury results from solid samples taken from all series configuration test solid and liquid samples show an error for the mercury PQL. Analyses from these tests show the PQL as 0.3 mg/kg when in fact the PQL is 0.03 mg/kg. The PQL is correctly reported for all parallel configuration solid sample analyses.

Samples taken for the reinjected fly ash (13), the GSA hopper (5), lime slurry, and trim water were reanalyzed to achieve lower detection limits. In the case of the trim water and lime slurry the original analyses yielded most, if not all, trace metals concentration values below detection limits. The results for the reanalyzed samples are reported in this section and should not be confused with the original sample analyses which are also contained in this section. Results of the most recent analyses were used in the results summary, Appendix B, and data evaluation, Appendix C. Coal samples were also reanalyzed however these samples were reanalyzed as a composite comprised of coal samples from several different runs at the same test condition. The reanalyzed coal analyses are contained in this section.

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Technical Infor.

Detect Limit for Flue gas Sample for EER

Metal	EER Plan μg	DA-AAS PQL μg/L	GFAA PQL μg/L	CV PQL μg/L	Actual PQL μg	DA-AAS MDL μg/L	GFAA MDL μg/L	CV MDL μg/L	Actual MDL μg
Co	7	40	-		4	24	-		2.4
As	6	-	5		0.5	-	1.2		0.12
Be	2	-	-		-	-	-		-
Ba	2	500	-		**50**	93	-		**9.3**
Cd	0.1	-	5*		**0.5**	0.07	-		0.007
V	10	1000	-		**100**	180	-		**18**
Se	8	-	5		0.5	-	1.3		0.13
Pb	5	-	5		0.5	-	0.94		0.094
Mn	2	40	-		**4**	8	-		0.8
Hg	0.4	-	-	1	0.1			0.4	0.04
Ni	10	-	-		-	-	-		-
Sb	8	-	6		0.6	-	1.7		0.17

Final liquid volume: 0.1 L.

PQL for Cd with GFAA should be 0.2. *Here 5 is due to a computer error.

Detect Limit for Solid and Liquid for EER, in mg/kg

Metal	EER Plan	DA-AAS PQL	GFAA PQL	CV PQL	DA-AAS MDL	ICP MDL	GFAA MDL	CV MDL
Co	0.35	2	-		0.65	0.35	0.065	
As	0.3	-	0.2		-	-	0.057	
Be	0.1	-	-		0.15	0.034	0.0011	
Ba	0.1	30	-		3.1	0.31	0.14	
Cd	0.005	0.3	-		0.33	0.31	0.0042	
V	0.5	50	-		1.7	0.37	0.057	
Se	0 4	-	2		-	-	0.11	
Pb	0 25	4	-		2.3	3.7	0.035	
Mn	0.1	2	-		0.2	(0.05)	0.0092	
Hg	0.02			0.03				0.002
Ni	0.5	-	-		1.2	0.76	0.047	
Sb	0.4	10	-		10	2.6	0.084	

Applied P & Ch Laboratory
4086 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Glenn England
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934312
Collected by: Gery
Collected on:
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, GSA Inlet, Project # 3500

Received : 10/06/93
Tested : 10/20-11/04
Reported : 11/04/93

Analysis of Metals

801-934257 Page 1 of 2

Test No.: AP-DS-R1-M-GI Date: 21-Sep-93 Sample #: 151669-151675

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4312	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-29,30,31	BH3	0.2												
-1F	FH	0.6	4.3	432	278	16.9	889	122	223	878	177	1,980	1,040	Filter
-4	BH	0.5	ND	5.7	ND	ND	ND	ND	2.5	7	23	ND	6,230	Aceton
Total (μg)		1.3	4.3	438	278	16.9	889	122	226	885	200	1,980	7,270	Total

Test No.: AP-DS-R2-M-GI Date: 22-Sep-93 Sample #: 151720-151728

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4312	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-32,33,34	BH3	0.1												
-5F	FH	3	3	470	253	16.7	877	112	201	820	206	1,970	969	Filter
-9	BH	ND	ND	2.7	ND	0.3	ND	ND	1.8	63	ND	ND	7,330	Aceton
Total (μg)		3.1	3	473	253	17	877	112	203	883	206	1,970	8,300	Total

Test No.: AP-~~BP~~B-R2-M-GI Sample #: 151837-151844

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4312	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-14,35,36	BH3	0.4												
-10F	FH	2.1	ND	436	591	15.1	781	106	185	1,200	322	1,580	6,650	Filter
-13	BH	0.3	ND	2.6	ND	0.2	ND	ND	1.7	59.6	ND	ND	6,750	Acetone
Total (μg)		2.8	ND	439	591	15.3	781	106	187	1,260	322	1,580	7,420	Total

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metal

Test No.: AP-DS-R3-M-GI Date: 23-Sep-93 Sample #: 151737-151744

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4257	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-38,39,40	BH3	0.5												
-15F	FH	4.9	ND	570	834	21.7	976	145	342	1,130	284	2,320	1,170	Filter
-19	BH	0.2	ND	ND	ND	0.8	ND	ND	1.7	165	ND	ND	7,670	Acetone
Total (μg)		5.6	ND	570	834	23	976	145	344	1,300	284	2,320	8,840	Total

Test No.: AP-~~BP~~ BS-R3-M-GI Date: 29-Sep-93 Sample #: 151889-151895

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4312	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-41,42,43	BH3	0.5												
-20F	FH	5.7	ND	491	2,040	18.4	1,060	144	348	2,110	309	2,230	1,060	Filter
-23	BH	ND.	ND	ND	ND	ND	ND	ND	0.9	ND	47	ND	9,870	Acetone
Total (μg)		6.2	ND	491	2,040	18.4	1,060	144	349	2,110	356	2,230	10,900	Total

Test No.: AP-~~BP~~ BS-R4-M-GI Date: 29-Sep-93 Sample #: 151924-151939

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4312	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-44,45,46	BH3	0.8												
-24F	FH	3.7	3.3	497	2,580	19	1,420	175	428	1,930	290	2,590	1,470	Filter
-28	BH	ND	ND	ND	ND	ND	ND	ND	1.6	3.3	ND	ND	9,810	Acetone
Total (μg)		4.5	3.3	497	2,580	19	1,420	175	430	1,930	290	2,590	11,300	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 · Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Glenn England
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934311 Received : 10/06/93
Collected by: Jeff & John Tested : 10/26-11/05
Collected on: 09/21/93 Reported : 11/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

Test No.: AP-DS-R1-M-EI Date: 21-Sep-93 Sample #: 151654-151660

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4311	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-37,38,39	BH3	ND												
-1F	FH	ND.	2.2	136	310	1.7	103	12	8.1	69	142	211	3,730	Filter
-4	BH	ND	ND	5	60	1.1	ND	ND	2.8	6	53	ND	719	Acetone
Total (μg)		ND	2.2	141	370	2.8	103	12	10.9	75	195	211	4,450	Total

Test No.: AP-DS-R2-M-EI Date: 22-Sep-93 Sample #: 151712-151719

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4311	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-40,41,42	BH3	0.3												
-5F	FH	ND	ND	79	1,140	4.9	414	58	143	535	121	630	3,160	Filter
-9	BH	ND	1.9	6.5	ND.	0.9	ND.	ND.	2.9	18	77	ND.	6,000	Aceton
Total (μg)		0.3	1.9	85.5	1,140	5.8	414	58	146	553	198	630	9,160	Total

Test No.: AP-~~BP~~ BS-R2-M-EI Date: Sample #. 151829-151836,59

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4311	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-49,50,51	BH3	ND												
-10F	FH	3.1	2.7	450	2,440	12.9	994	168	375	1,290	150	1,760	1,750	Filter
-15	BH	0.7	ND	ND	ND.	0.4	ND	ND	1.5	9	ND	ND	4,940	Aceton
Total (μg)		3.8	2.7	450	2,440	13.3	994	168	377	1,300	150	1,760	6,690	Total

Test No.: AP-DS-R3-M-EI Date: 23-Sep-93 Sample #: 151779-151788

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4311	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-46,47,48	BH3	0.2												
-16F	FH	1.6	ND	108	1,520	5.9	548	81	156	788	106	783	3,010	Filter
-22	BH	ND	ND	1.2	ND	3.7	ND	ND.	1.9	6	55	ND	6,940	Aceto
Total (μg)		1.8	ND	109	1,520	9.6	548	81	158	794	161	783	9,950	Total

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Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Test No.: AP-~~BP~~ BS-R3-M-EI Date: 29-Sep-93 Sample #: 151875-151881

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4311	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-52,53,54	BH3	ND												
-23F	FH	2.2	6.1	365	1,740	11.4	841	172	302	1,020	142	1,340	1,520	Filter
-26	BH	0.3	ND	ND	ND	0.5	ND	ND	0.9	3	ND	ND	1,640	Acetone
Total (μg)		2.5	6.1	365	1,740	12	841	172	303	1,020	142	1,340	3,160	Total

Test No.: AP-DS-R4-M-EI Date: 23-Sep-93 Sample #: 151771-151778

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4311	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-43,44,45	BH3	ND												
-27F	FH	1.2	ND	152	852	5.2	416	67	119	584	70	549	3,490	Filter
-31	BH	ND	ND	2.6	31	0.7	ND	ND	1.5	153	35	ND	5,770	Acetone
Total (μg)		1.2	ND	155	883	6	416	67	121	737	105	549	9,260	Total

Test No.: AP-~~BP~~ BS-R4-M-EI Date: 29-Sep-93 Sample #: 151910-151916,40

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4311	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-55,56,57	BH3	ND												
-32F	FH	2.2	3	378	1,580	12.3	927	160	306	1,180	143	1,340	1,590	Filter
-36	BH	ND	ND	ND	ND	ND	ND	ND	1.1	9	ND	ND	4,500	Acetone
Total (μg)		2.2	3	378	1,580	12.3	927	160	307	1,190	143	1,340	6,090	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Labo

4066 E. Mission Blvd., Pomona

Tel: (909) 622-5148 Fax: (9

Submitted to:

Energy and Environmen

Attention: Glenn Engl

8001 Irvine Blvd.

Santa Ana, CA 92706

Tel: (714)552-1803 Fax

Analysis of Met

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Test No.: AP-DS-R3-M-EO Date: 23-Sep-93 Sample #: 151753-151760														
Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4310	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-35,36,37	BH3	1.0												
-13F	FH	ND	ND	0.9	ND	0.6	ND	ND	ND	1,120	235	ND	27.2	Filter
-17	BH	ND	ND	ND	ND	ND	ND	ND	ND	ND	27	ND	16.1	Acetone
Total (μg)		1.0	ND	0.9	ND	0.6	ND	ND	ND	1,120	262	ND	43.3	Total

Test No.: AP-~~BP~~ BS-R3-M-EO Date: 29-Sep-93 Sample #: 151861-151867														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4310	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-38,39,40	BH3	ND												
-18F	FH	ND	ND	22.5	105	1.1	41	5.2	8.1	37.1	181	ND	55.1	Filter
-21	BH	1.2	ND	ND	ND	ND	ND	ND	0.5	7.3	43	ND	125	Acetone
Total (μg)		1.2	ND	22.5	105	1.1	41	5.2	8.6	44.4	224	ND	180	Total

Test No.: AP-~~BP~~ BS-R4-M-EO Date: 29-Sep-93 Sample #: 151896-151902														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4310	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-41,42,43	BH3	0.1												
-22F	FH	ND	ND	15.5	91	0.5	49	4.3	7.3	38	176	ND	50.3	Filter
-25	BH	1.8	ND	ND	ND	ND	ND	ND	13.7	8.7	28	ND	113	Acetone
Total (μg)		1.9	ND	15.5	91	0.5	49	4.3	21.0	46.7	204	ND	163	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934268
Collected by: Walied E.
Collected on:
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Outlet, Project # 3500

Received : 10/06/93
Tested : 10/26-11/16
Reported : 11/17/93

Analysis of Metals

801-934268 Page 1 of 2

Test No.: AP-DS-R1-M-BO Date: 21-Sep-93 Sample #: 151661-151668,151690														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg	
4268	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-28,29,30	BH3	0.7												
-1F	FH	ND	ND.	ND	ND	ND	ND	ND	1.5	7	ND.	ND.	0	Filter
-6	BH	ND	ND	ND	ND	1.8	ND.	ND	ND	N.D.	ND	ND	33	Aceton
Total (μg)		0.7	ND.	ND	ND	1.8	ND	ND	1.5	7	ND	ND	33	Total

Test No.: AP-DS-R2-M-BO Date: 22-Sep-93 Sample #: 151698-151704														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg	
4268	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-31,32,33	BH3	ND												
-7F	FH	ND.	ND.	N.D	ND	ND	ND	ND	ND	N.D.	N.D.	ND	0	Filter
-10	BH	ND	ND	N.D.	ND	1.0	ND	ND	1.2	7	N.D.	ND	28	Aceton
Total (μg)		ND	ND.	N.D.	ND	1.0	ND	ND	1.2	7	ND	ND	28	Total

Test No.: AP-BS-R2-M-BO Sample #: 151852-151858														
Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg	
4268	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-34,35,36	BH3	ND												
-11F	FH	N.D.	ND.	ND	ND	1.5	ND	ND	2.3	5	1.5	ND	2.1	Filter
-14	BH	0.2	ND.	N.D	ND	ND	ND	ND	0.8	12	1.2	ND	25	Aceton
Total (μg)		0.2	ND	ND	ND	1.5	ND	ND	3.1	17	2.7	ND	27.1	Total

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Applied P & Ch Laboratory
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Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metal

Test No.: AP-DS-R3-M-BO Date: 23-Sep-93 Sample #: 151745-151752

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4268	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-37,38,39	BH3	1.2												
-15F	FH	ND	ND	ND	ND	0.5	ND	ND	1.1	3	ND	ND	1.1	Filter
-19	BH	ND	ND	ND	ND	1.0	ND	ND	0.9	6	ND	ND	26	Aceton
Total (μg)		1.2	ND	ND	ND	1.5	ND	ND	2.0	9	ND	ND	27.1	Total

Test No.: AP-B~~6~~-R3-M-BO Date: 29-Sep-93 Sample #: 151882-151888

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4268	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-40,41,42	BH3	1.0												
-20F	FH	ND	ND	ND	ND	2.6	ND	ND	2.7	7	5	ND	1.6	Filter
-23	BH	0.2	ND	ND	ND	ND	ND	ND	0.7	ND	3.1	ND	55	Aceton
Total (μg)		1.2	ND	ND	ND	2.6	ND	ND	3.4	7	8.1	ND	56.6	Total

Test No.: AP-B~~9~~-R4-M-BO Date: 29-Sep-93 Sample #: 151917-151923

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4268	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-43,44,45	BH3	ND												
-24F	FH	ND	ND	0.6	ND	2.6	ND	ND	1.8	6	2.7	ND	4.8	Filter
-27	BH	0.2	ND	ND	ND	ND	ND	ND	0.6	2	3.4	ND	40	Acetone
Total (μg)		0.2	ND	0.6	ND	2.6	ND	ND	2.4	8	6.1	ND	44.8	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
ND: Not detected or below the PQL

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4086 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Glenn England
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934257 Received : 10/06/93
Collected by: Joe Tested : 10/20-11/04
Collected on: Reported : 11/04/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Bag-House Inlet, Project # 3500

Analysis of Metal in Air

Test No.: AP-DS-R1-M-BI Date: 21-Sep-93 Sample #: 151676-151682

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4257	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-26,27,28	BH3	0.4												
-1F	FH	ND	ND	0.5	ND	ND	ND	ND	2.7	3.7	ND	ND	29.7	Filter
-4	BH	ND	ND	ND	ND	0.5	ND	ND	1.1	ND	ND	ND	29.9	Acetone
Total (μg)		0.4	ND	0.5	ND	0.5	ND	ND	3.8	3.7	ND	ND	59.6	Total

Test No.: AP-DS-R2-M-BI Date: 22-Sep-93 Sample #: 151705-151711

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4257	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-29,30,31	BH3	0.7												
-5F	FH	ND	ND	ND	ND	ND	ND	ND	4.1	6	0.9	ND	9.2	Filter
-8	BH	ND	ND	ND	ND	0.5	ND	ND	0.6	2	ND	ND	28.0	Acetone
Total (μg)		0.7	ND	ND	ND	0.5	ND	ND	4.7	8	0.9	ND	37.2	Total

Test No.: AP-~~BP~~ BS-R2-M-BI Date: 28-Sep-93 Sample #: 151845-151860

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4257	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-32,33,34	BH3	ND												
-9F	FH	ND	ND	8.4	82.0	0.9	32	5.3	6.4	32	20.1	ND	47.8	Filter
-13	BH	ND	ND	ND	ND	ND	ND	ND	ND	4	1.1	ND	69.0	Acetone
Total (μg)		ND	ND	8.4	82.0	0.9	32	5.3	6.4	36	21.2	ND	117	Total

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APCL Analytical Report

Analysis of Metal in Air

Test No.: AP-DS-R3-M-BI Date: 23-Sep-93 Sample #: 151766-151770														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4257	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-35,36,37	BH3	0.4												
-14F	FH	ND	ND	ND	ND	ND	ND	ND	2.7	2.7	ND	ND	6.0	Filter
-17	BH	ND	ND	ND	ND	0.9	ND	ND	1.3	1.3	ND	ND	20.1	Acetone
Total (μg)		0.4	ND	ND	ND	0.9	ND	ND	4.0	4.0	ND	ND	26.1	Total

Test No.: AP-~~BP~~ BS-R3-M-BI Date: 29-Sep-93 Sample #: 151868-151874														
Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4257	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-38,39,40	BH3	0.4												
-18F	FH	ND	ND	5.5	64	0.6	29	7.9	5	23	16.4	ND	13.7	Filter
-21	BH	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	48.0	Acetone
Total (μg)		0.4	ND	5.5	64	0.6	29	7.9	5	23	18.4	ND	61.7	Total

Test No.: AP-~~BP~~ BS-R4-M-BI Date: 29-Sep-93 Sample #: 151903-151909														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4257	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-41,42,43	BH3	ND												
-22F	FH	ND	ND	7	72	0.9	40	5	7.8	28.8	23.5	ND	19.7	Filter
-25	BH	ND	ND	ND	ND	ND	ND	ND	ND	3.1	1.7	ND	101	Acetone
Total (μg)		ND	ND	7	72	0.9	40	5	7.8	31.9	25.2	ND	121	Total

PQL:Practical Quantitation Limit
FH: Front Half, BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934523 Received : 10/26/93
Collected by: Gary B. Tested : 11/12-16/93
Collected on: 10/14/93 Reported : 11/24/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, GSA Inlet, Project # 3500

Analysis of Metals

Test No.: AP-DP-R1-M-G1 Date: 14-Oct-93 Sample #: 151974-151980

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4523	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.3												
-1F	FH	8.7	13.6	739	229	15.6	1,060	171	295	1,150	25.9	2,250	1,060	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	1.3	N.D.	N.D.	N.D.	11	N.D.	N.D.	8,130	Acetone
Total (μg)		10	13.6	739	229	16.9	1,060	171	295	1,160	25.9	2,250	9,190	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934528
Collected by: Gary B
Collected on: 10/15/93
Received : 10/26/93
Tested : 11/12-16/93
Reported : 11/24/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, GSA Inlet, Project # 3500

Analysis of Metals

801-934528 Page 1 of 1

Test No.: AP-DP-R2-M-GI Date: 15-Oct-93 Sample #: 159046.51-159056														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4528	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	3.3												
-1F	FH	1.6	16.5	842	128	14.9	937	188	411	538	ND	1,590	813	Filter
-4	BH	ND.	ND	ND	ND	2.2	ND	ND	ND	ND	ND	ND	8,110	Acetone
Total (μg)		4.9	16.5	842	128	17.1	937	188	411	538	ND	1,590	8,920	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 · Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934527
Collected by: Gary B.
Collected on: 10/15/93
Received : 10/26/93
Tested : 11/12-16/93
Reported : 11/24/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, GSA Inlet, Project # 3500

Analysis of Metals

801-934527 Page 1 of 1

Test No.: AP-DP-R3-M-GI Date: 15-Oct-93 Sample #: 159089-159095														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg	
4527	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.3												
-1F	FH	0.1	19.2	675	135	16.5	794	176	332	518	N.D.	1,200	865	Filter
-4	BH	N D	N.D	13.5	N D.	2.3	N D.	N D	N.D.	N.D.	58.3	N D	8,250	Aceto
Total (μg)		1.4	19.2	689	135	18.8	794	176	332	518	58.3	1,200	9,120	Tota

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934604
Collected by: Jeff P
Collected on: 10/14/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

801-934604 Page 1 of 1

Test No.: AP-DP-RI-M-EI Date: 14-Oct-93 Sample #: 151947-151956,159047														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4604	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.2												
-1F	FH	0.6	7.9	112	323	2.5	82	12	0.8	54	ND	118	2,450	Filter
-4	BH	ND	ND	ND	ND	4.9	ND	ND	3.1	13.6	ND	ND	141	Acetone
Total (μg)		0.8	7.9	112	323	7.4	82	12	3.9	67.6	ND	118	2,591	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934603
Collected by: Jeff P
Collected on: 10/15/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plan
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

801-934603 Page 1 of 1

Test No.: AP-DP-R2-M-EI Date: 15-Oct-93 Sample #: 151981-151989														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate	(mg
4603	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.7												
-1F	FH	0.2	14.4	317	944	3.1	371	84	196	409	N.D	816	3,170	Filter
-4	BH	N.D.	N.D	N.D.	N.D	4.7	N.D.	N.D.	N.D	N.D	N.D	N.D.	7,780	Acet
Total (μg)		1.9	14.4	317	944	7.8	371	84	196	409	N.D	816	11,000	Tota

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934612
Collected by: Jeff P.
Collected on: 10/22/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

801-934612 Page 1 of 1

Test No.: AP-P-R3-M-EI Date: 22-Oct-93 Sample # 159262-159268

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4612	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.4												
-1F	FH	ND	11.9	271	626	6.1	471	77.9	246	343	ND	766	*	Filter
-4	BH	ND	ND	ND	ND	ND	ND	ND	ND	6	ND	ND	632	Acetone
Total (μg)		0.4	11.9	271	626	6.1	471	77.9	246	349	ND	766		Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
*: Gross weight 1.7415 (EER 12)

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 , Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934571
Collected by: Jeff P.
Collected on: 10/22/93
Received : 10/28/93
Tested : 11/12-23/04
Reported : 12/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

801-934571 Page 1 of 1

Test No.: AP-P-R[illegible]-M-EI Date: 22-Oct-93 Sample #: 159296-301, 159331

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (m	
4571	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D												
-1F	FH	N.D.	15.1	568	259	11	715	124	264	661	N D	N D	*	Filter
-4	BH	N.D	N.D.	N.D.	N.D.	4.7	N.D.	N.D.	N.D.	10	N.D.	N D	4,150	Acetc
Total (μg)		N.D.	15.1	568	259	15.7	715	124	264	671	N D	N D	*	Tota

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
* : Gross Weight : 1.317 g (EER 10)

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934611 Received : 10/26/93
Collected by: Barry B. Tested : 11/12-23/04
Collected on: 10/15/93 Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Outlet, Project # 3500

Analysis of Metals

801-934611 Page 1 of 1

Test No.: AP-DP-R2-M-EO Date: 15-Oct-93 Sample #: 159057-159062, 159069-159070														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4611	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	5.8												
-1F	FH	1.1	ND	149	482	3.8	206	45	137	251	ND	432	18.7	Filter
-4	BH	ND.	ND	ND	ND	ND	ND	ND.	ND	16	ND.	ND	2,630	Acetone
Total (μg)		6.9	ND	149	482	3.8	206	45	137	267	ND	432	2,650	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4088 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934615
Collected by: Barry B.
Collected on: 10/15/93
Received : 10/28/93
Tested : 11/12-23/04
Reported : 12/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Outlet, Project # 3500

Analysis of Metals

801-934615 Page 1 of 1

Test No.: AP-DP-R3-M-EO Date: 15-Oct-93 Sample #: 159096-159102,159127														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg	
4615	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	6.9												
-1F	FH	N.D.	N.D.	1.7	27	0.8	N.D	N.D.	1.9	N.D.	N.D.	N.D	16.1	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	N.D	N.D	N.D.	N.D	13	N.D.	N.D.	28.8	Acetor
Total (μg)		6.9	N.D	1.7	27	0.8	N.D	N.D	1.9	13	N.D	N.D	44.9	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934616
Collected by: Joe R.
Collected on: 10/14/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Inlet, Project # 3500

Analysis of Metals

801-934616 Page 1 of 1

Test No.: AP-DP-RI-M-BI Date: 14-Oct-93 Sample #: 151965-151973,159063-159067														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4616	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.5												
-1F	FH	4.8	29.7	274	1,480	2.7	379	79.5	60.8	499	N.D	705	11,800	Filter
-4	BH	N D	N D	N D.	N.D.	N D	N.D.	N.D	N D	N D	N.D	N D	4,480	Acetone
Total (μg)		5.3	29.7	274	1,480	2.7	379	79.5	60.8	499	N D	705	16,300	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934617
Collected by: Joe R.
Collected on: 10/15/93

Received : 10/28/93
Tested : 11/12-23/04
Reported : 12/09/93

Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Inlet, Project # 3500

Analysis of Metals

801-934617 Page 1 of 1

Test No.: AP-DP-R2-M-BI Date: 15-Oct-93 Sample #: 151999-152000,159036-159041

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate	(mg)
4617	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.7												
-1F	FH	N.D.	19.1	356	525	4.3	259	49.2	100	284	N.D	642	3,370	Filter
-4	BH	N.D.	N.D	N.D.	N.D	N.D	N.D	N.D	N.D	N.D.	N.D.	N.D.	9,990	Acetone
Total (μg)		1.7	19.1	356	525	4.3	259	49.2	100	284	N.D	642	13,400	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934620
Collected by: Joe R.
Collected on: 10/15/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Inlet, Project # 3500

Analysis of Metals

801-934620 Page 1 of 1

Test No.: AP-DP-R3-M-B1 Date: 15-Oct-93 Sample #: 159119-159126, 159128														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4620	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.7												
-1F	FH	ND	11.6	243	936	3.8	260	60	135	263	ND	564	*	Filter
-4	BH	ND	ND	ND	ND	ND	ND	ND	ND	138	ND	ND	6,580	Acetone
Total (μg)		1.7	11.6	243	936	3.8	260	60	135	401	ND	564	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
*: Net weight for Filter 1A is 0.8923 grams and the gross weight for Filter 1B is 2.2500 grams (Q15).

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934545 Received : 10/26/93
Collected by: Rob B. Tested : 11/12-23/04
Collected on: 10/14/93 Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse outlet, Project # 3500

Analysis of Metals

801-934545 Page 1 of 1

Test No.: AP-DP-RI-M-BO Date: 14-Oct-93 Sample #: 151957-151964														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4545	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	3.6												
-1F	FH	N.D.	N.D.	N.D.	N.D.	5.8	N.D.	N.D.	1.8	10	N.D.	N.D.	7.8	Filter
-4	BH	N.D.	N.D.	N.D.	N.D.	3.0	N.D.	N.D.	2.5	8	N.D.	N.D.	18.7	Aceton
Total (μg)		3.6	N.D.	N.D.	N.D.	8.8	N.D.	N.D.	4.3	18	N.D.	N.D.	26.5	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: *Greg Rooney*
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934546
Collected by: Rob B
Collected on:
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse outlet. Project # 3500

Analysis of Metals

801-934546 Page 1 of 1

Test No.: AP-DP-R2-M-BO Date: 15-Oct-93 Sample #: 151991-151998														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4546	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	6.4												
-1F	FH	ND	ND	ND	ND	5.2	ND	ND	1.5	5	ND	ND	8.6	Filter
-4	BH	ND	ND	ND	ND	2.1	ND	ND	2.2	38	ND	ND	8.4	Acetone
Total (μg)		6.4	ND	ND	ND	7.3	ND	ND	3.7	43	ND	ND	17.0	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934529 Received : 10/26/93
Collected by: Rob B Tested : 11/12-23/04
Collected on: 10/15/93 Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse outlet, Project # 3500

Analysis of Metals

801-934529 Page 1 of 1

Test No.: AP-DP-R3-M-BO Date: 15-Oct-93 Sample #: 159112-159118														
Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4529	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.8												
-1F	FH	ND	ND	1.1	ND	3.8	ND	ND	1.6	ND	ND	ND	5.8	Filter
-4	BH	ND	ND	ND	ND	2.2	ND	ND	ND	22	ND	ND	28	Acetone
Total (μg)		1.8	ND	1.1	ND	6.0	ND	ND	1.6	22	ND	ND	33.8	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934605
Collected by: Jeff P
Collected on: 10-19-93
Received : 10/29/93
Tested : 11/12-23/04
Reported : 12/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

801-934605 Page 1 of 1

Test No.: AP-P-R1-M-EI Date: 19-Oct-93 Sample #: 159190-159197,159220

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4605	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.2												
-1F	FH	0.3	17.4	463	1,140	8.1	563	105	354	436	ND	1,000	*	Filter
-4	BH	ND	ND	35.3	ND	4.1	34.3	ND	9.2	22	ND	ND	3.560	Acetone
Total (μg)		0.5	17.4	498	1,140	12.2	597	105	363	458	ND	1,000	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
* : Particulate Net Weight is 0.2871 g for Filter 1A and 0.2383 g for Filter 1B. The Gross Weight for filter 1C is 0.7039 g (Q16)

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 · Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934572
Collected by: Jeff P
Collected on: 10/21/93
Received : 10/28/93
Tested : 11/12-23/04
Reported : 12/09/93

Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9. ESP Inlet, Project # 3500

Analysis of Metals

801-934572 Page 1 of 1

Test No.: AP-P-R2-M-EI Date: 21-Oct-93 Sample #: 159221-27, 159250

Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4572	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	N.D.												
-1F	FH	N D	9.7	349	740	6.3	431	92	268	363	N.D	828	*	Filter
-4	BH	N D.	N.D	9.3	N D	4.7	N D	N D.	6.2	6.5	N D	N D	3.020	Acetor
Total (μg)		N D	9.7	358	740	11	431	92	274	370	N D	828	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
* : Particulate Net Weight is 0.307 g for Filter IIA-013. The Gross Weight is 0.9184 g for Filter 1B (EER 5).

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934573 Received : 10/28/93
Collected by: Jeff P Tested : 11/12-23/04
Collected on: 10/15/93 Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Inlet, Project # 3500

Analysis of Metals

801-934573 Page 1 of 1

Test No.: AP-DP-R3-M-EI Date: 15-Oct-93 Sample #: 159103-159111														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4573	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	2.1												
-1F	FH	1.8	20.7	365	2,510	4.8	497	94	256	474	ND	962	4,020	Filter
-4	BH	N.D.	ND	ND	ND	4.8	39	N.D	ND	21	ND.	ND	9,730	Acetone
Total (μg)		3.9	20.7	365	2,510	9.6	536	94	256	495	ND	962	13,800	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934846
Collected by: Gary
Collected on: 10/19/93
Received : 11/17/93
Tested : 11/19-29/04
Reported : 12/02/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, ESP Outlet, Project # 3500

Analysis of Metals

801-934846 Page 1 of 1

Test No.: AP-P-R1-M-EO Date: 19-Oct-93 Sample #: 159198-159205

Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4846	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.1												
-1F	FH	ND	ND.	42.5	103	1.2	47	8.3	22.2	30	42.3	84	166	Filter
-4	BH	7.4	ND.	ND	ND	0.4	ND	ND	ND	28	7.6	ND	201	Acetone
Total (μg)		8.5	ND	42.5	103	1.6	47	8.3	22.2	58	49.9	84	367	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934623
Collected by: Joe R
Collected on: 10/21/93
Received : 10/26/93
Tested : 11/12-16/04
Reported : 11/24/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Bag House Inlet, Project # 3500

Analysis of Metals

801-934623 Page 1 of 1

Test No.: AP-P-R2-M-BI Date: 21-Oct-93 Sample #: 159235-159241,159249														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4623	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	1.0												
-1F	FH	ND	13.8	351	1,110	4.8	408	87	274	336	ND	873	*	Filter
-4	BH	ND	ND	9.1	ND	ND	ND	ND	7.3	9.5	ND	ND	3,080	Acetone
Total (μg)		1.0	13.8	360	1,110	4.8	408	87	281	346	ND	873		Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
*: Net weight for Filter 1A is 0.5568 grams and the gross weight for filter EER 11 is 0.8094.

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934621 Received : 10/28/93
Collected by: Joe R Tested : 11/12-23/04
Collected on: 10/22/93 Reported : 12/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Inlet, Project # 3500

Analysis of Metals

801-934621 Page 1 of 1

Test No.: AP-P-R3-M-BI Date: 22-Oct-93 Sample #: 159276-159282														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4621	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.2												
-1F	FH	1.3	18.7	524	687	9.3	875	143	404	790	N.D	1,610	*	Filter
-4	BH	N.D	N.D	N.D	N.D	0.7	N.D	N.D	N.D.	N.D	N.D	N.D	3,490	Acetor
Total (μg)		1.5	18.7	524	687	10.0	875	143	404	790	N.D	1,610	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
* : Gross Weight : 1.9584 g (EER 9)

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4086 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934619 Received : 10/28/93
Collected by: Joe R. Tested : 11/12-23/04
Collected on: 10/22/93 Reported : 12/09/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse Inlet, Project # 3500

Analysis of Metals

801-934619 Page 1 of 1

Test No.: AP-P-RY-M-BI Date: 22-Oct-93 Sample #: 159339-159345														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4619	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.3												
-1F	FH	1.4	34	682	2,660	10	976	166	595	861	5.5	1,900	*	Filter
-4	BH	N.D	N D	N D	N D	N D	N D	N.D.	N D.	N D	11.7	N D	3,690	Acetone
Total (μg)		1.7	34	682	2,660	10	976	166	595	861	17.2	1,900	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
* : Gross Weight : 2.3592 g (EER 7)

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 , Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934613
Collected by: Rob B.
Collected on: 10/19/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse, Project # 3500

Analysis of Metals

801-934613 Page 1 of 1

Test No.: AP-P-R1-M-BO Date: 19-Oct-93 Sample #: 159213-159219														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4613	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.2												
-1F	FH	ND	9.8	85.1	238	62.6	134	26	68.7	99	ND	207	495	Filter
-4	BH	ND	ND	ND	ND	0.9	ND	ND	7.9	7.9	ND	ND	141	Acetone
Total (μg)		0.2	9.8	85.1	238	63.5	134	26	68.7	107	ND	207	636	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934535 Received : 10/26/93
Collected by: Rob B. Tested : 11/12-23/04
Collected on: 10/21/93 Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9,Baghouse outlet, Project # 3500

Analysis of Metals

801-934535 Page 1 of 1

Test No.: AP-P-R2-M-BO Date: 21-Oct-93 Sample #: 159242-159248														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4535	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	ND												
-1F	FH	ND	ND	3.4	ND	7.4	ND	ND	3.5	10	ND	ND	*	Filter
-4	BH	ND	ND	ND	ND	1.5	ND	ND	1.7	8	ND	ND	33.1	Acetone
Total (μg)		ND	ND	3.4	ND	8.9	ND	ND	5.2	18	ND	ND		Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
*: The gross weight of filter is 0.4496 grams (Q17).

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4086 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934548 Received : 10/26/93
Collected by: Rob B. Tested : 11/12-23/04
Collected on: 10/22/93 Reported : 12/01/93
Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse outlet, Project # 3500

Analysis of Metals

801-934549 Page 1 of 1

Test No.: AP-P-R3-M-BO Date: 22-Oct-93 Sample #: 159283-159289														
Lab ID	Desc.	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4548	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	0.1												
-1F	FH	ND	N.D.	2.5	ND	7.1	ND	N.D	3.7	7	N.D	ND	*	Filter
-4	BH	4.8	ND	ND	ND	2.9	ND	ND	ND	8	ND	ND	28.6	Aceton
Total (μg)		4.9	ND	2.5	ND	10.0	ND	ND	3.7	15	ND	ND	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
*: The gross weight is 0.4514 grams (Q20).

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934549
Collected by: Rob B.
Collected on: 10/22/93
Received : 10/26/93
Tested : 11/12-23/04
Reported : 12/01/93

Sample description:
Sample Metal Train from TVA Shawnee Fossil Plant
Unit 9, Baghouse outlet, Project # 3500

Analysis of Metals

801-934549 Page 1 of 1

Test No.: AP-P-RY-M-BO Date: 22-Oct-93 Sample #: 159346-159352														
Lab ID	Desc	Hg	Sb	As	Ba	Cd	Cr	Co	Pb	Mn	Se	V	Particulate (mg)	
4549	PQL	0.1	0.6	0.5	50	0.5	20	4	0.5	4	0.5	100	0.1	
-5,6,7	BH3	ND												
-1F	FH	ND	ND	3.6	N.D.	8	ND	ND.	3.8	6	N.D.	ND	*	Filter
-4	BH	10.2	N.D.	ND	N.D.	3.2	N.D	ND.	ND	5	N.D.	ND	17.0	Acetone
Total (μg)		10.2	ND	3.6	ND	11.2	ND	ND	3.8	11	ND	ND	*	Total

PQL: Practical Quantitation Limit
FH: Front Half
BH: Back Half
*: Gross weight is 0.4456 g (Q22).

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934314 Received : 10/07/93
Collected by: Walied E Tested : 10/26/93
Collected on: 09/21/93 Reported : 11/05/93
Sample description:
Samples from Plant. TVA Shawnee Fossil,Unit:GSA
Project:3500-020

Analysis of Metals

Component Analyzed	Method	Unit	PQL	Concentration 151552 BP-R2M-Coal 93-4314-1	151556 BP-R2M-Cyc 93-4314-2	151559 BP-R2M-ESP 93-4314-3	151562 BP-R2M-ESP 93-4314-4
Arsenic, As by GFAA	206 2/7060	mg/kg	0	N D	4	27	9
Barium, Ba	208 1/7080	mg/kg	30	N D	63	105	50
Cadmium, Cd	213 1/7130	mg/kg	0 3	N D	N D	0 9	N D
Cobalt, Co	219 1/7200	mg/kg	2	N D	3	6	2
Chromium, Total	218 1/7190	mg/kg	10	N D	15	51	13
Manganese, by AAS	243 1/7460	mg/kg	2	17	100	85	25
Lead, total	239 1/7420	mg/kg	4	N D	N D	13	7
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	5	N D
Vanadium, V	286 1/7910	mg/kg	50	N D	N D	85	N D
Mercury, Hg	245 1/7470	mg/kg	0.3	N D	N D	N D	0.32

Component Analyzed	Method	Unit	PQL	151565 BP-R2M-FAB 93-4314-5	151568 BP-R2M-Ash 93-4314-6	151581 BP-R3.4M-Coal 93-4314-7	151585 BP-R3M-Cyc 93-4314-8
Arsenic, As by GFAA	206.2/7060	mg/kg	2	34	7	1	8
Barium, Ba	208 1/7080	mg/kg	30	67	89	N D	81
Cadmium, Cd	213 1/7130	mg/kg	0.3	16	N D	N D	N D
Cobalt, Co	219 1/7200	mg/kg	2	5	N D	3	3
Chromium, Total	218 1/7190	mg/kg	10	26	N D	N D	25
Manganese, by AAS	243 1/7460	mg/kg	2	104	18	23	137
Lead, total	239 1/7420	mg/kg	4	16	12	N D	N D
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	8	N D	N D	5
Vanadium, V	286 1/7910	mg/kg	50	135	N D	N D	N D
Mercury, Hg	245 1/7470	mg/kg	0.3	1.2	N D	N D	N D

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Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Component Analyzed	Method	Unit	PQL	Concentration 151588 BS BP-R3M-ESPA 93-4314-9	151591 BS BP-R3M-ESP B 93-4314-10	151607 BS BP-R4M-ASH 93-4314-17	151610 BS BP-R3M-Ash 93-4314-12
Arsenic, As by GFAA	206.2/7060	mg/kg	2	16	14	18	N D
Barium, Ba	208.1/7080	mg/kg	30	71	84	89	59
Cadmium, Cd	213.1/7130	mg/kg	0.3	0.6	1.5	N D	N D
Cobalt, Co	219.1/7200	mg/kg	2	4	4	4	N D
Chromium, Total	218.1/7190	mg/kg	10	34	25	13	N D
Manganese, by AAS	243.1/7460	mg/kg	2	32	53	103	26
Lead, total	239.1/7420	mg/kg	4	8	10	7	N D
Antimony, Sb	204.1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270.2/7740	mg/kg	2	N D	N D	N D	N D
Vanadium, V	286.1/7910	mg/kg	50	N D	N D	N D	N D
Mercury, Hg	245.1/7470	mg/kg	0.3	N D	N D	N D	N D

Component Analyzed	Method	Unit	PQL	151598 BS BP-R4M-Cyc 93-4314-13	151601 BS BP-R4M-ESP A 93-4314-14	151604 BS BP-R4M-ESP B 93-4314-15	151613 BS BP-R4M-FAB 93-4314-16
Arsenic, As by GFAA	206.2/7060	mg/kg	2	N D	25	21	8
Barium, Ba	208.1/7080	mg/kg	30	N D	56	96	32
Cadmium, Cd	213.1/7130	mg/kg	0.3	N D	0.8	0.6	17
Cobalt, Co	219.1/7200	mg/kg	2	N D	4	4	4
Chromium, Total	218.1/7190	mg/kg	10	N D	36	44	28
Manganese, by AAS	243.1/7460	mg/kg	2	65	35	58	68
Lead, total	239.1/7420	mg/kg	4	N D	11	12	13
Antimony, Sb	204.1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270.2/7740	mg/kg	2	3	4	5	4
Vanadium, V	286.1/7910	mg/kg	50	N D	52	62	57
Mercury, Hg	245.1/7470	mg/kg	0.3	N D.	N D	N D	N D

Component Analyzed	Method	Unit	PQL	151554 BS BP-R2MS-Coal 93-4314-18	151583 BS BP-R3,4MS-Coal 93-4314-19
Moisture, percent		wt%	0.1	9.9	9.6

PQL : Practical Quantitation Limit
– : Analysis not requested.
N.D. : Not Detected or less than the quantitation limit.

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

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Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Glenn England
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934313 Received : 10/07/93
Collected by: Dave Tested : 10/27-11/05/
Collected on: 09/21-23/93 Reported : 11/05/93
Sample description:
Samples from TVA Shawnee Fossil Plant
Unit GSA - Project#: 3500-020

Analysis of Metals

Component	Method	Unit	PQL	Concentration			
				155945 DS-R1M-Coal 93-4313-1	155933 DS-R1M-Cyclone 93-4313-2	155922 DS-R1M-Lime 93-4313-3	155936 DS-R1M-ESP2 93-4313-4
Arsenic, As by GFAA	206 2/7060	mg/kg	2	N D	13	N D	12
Barium, Ba	208 1/7080	mg/kg	30	N D	N D	39	69
Cadmium, Cd	213 1/7130	mg/kg	0.3	N D	N D	N D	N D
Cobalt, Co	219 1/7200	mg/kg	2	2	N D	N D	N D
Chromium, Total	218 1/7190	mg/kg	10	N D	12	N D	13
Manganese, by AAS	243 1/7460	mg/kg	2	26	51	5	18
Lead, total	239 1/7420	mg/kg	4	N D	N D	N D	8
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	N D	N D
Vanadium, V	286 1/7910	mg/kg	50	N D	N D	N D	N D
Mercury, Hg	245 1/7470	mg/kg	0.3	N D	N D	N D	N D

Component	Method	Unit	PQL	155939 DS-R1M-ESP * 93-4313-5	155942 DS-R1M-FAB 93-4313-6	155926 DS-R1M-Ash 93-4313-7	155929 DS-R1M-Trim* 93-4313-8
Arsenic, As by GFAA	206 2/7060	mg/kg	2	17	15	83	<0.03mg/L
Barium, Ba	208 1/7080	mg/kg	30	53	36	149	<0.6mg/L
Cadmium, Cd	213 1/7130	mg/kg	0.3	0.6	26.8	N D	<0.006mg/L
Cobalt, Co	219 1/7200	mg/kg	2	N D	5	4	<0.04mg/L
Chromium, Total	218 1/7190	mg/kg	10	19	49	21	<0.2mg/L
Manganese, by AAS	243 1/7460	mg/kg	2	29	97	70	<0.04mg/L
Lead, total	239 1/7420	mg/kg	4	4	14	21	<0.07mg/L
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	<0.2mg/L
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	N D	<0.04mg/L
Vanadium, V	286 1/7910	mg/kg	50	N D	N D	N D	<1mg/L
Mercury, Hg	245 1/7470	mg/kg	0.3	N D	1.0	N D	<0.006mg/L

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Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Component	Method	Unit	PQL	159461 DS-R2M-Coal 93-4313-9	159465 DS-R2M-Cyclone 93-4313-10	159468 DS-R2M-Lime 93-4313-11	159472 DS-R2M-ESP A 93-4313-12
Arsenic, As by GFAA	206 2/7060	mg/kg	2	N D	3	N D	14
Barium, Ba	208 1/7080	mg/kg	30	N D	32	N D	63
Cadmium, Cd	213 1/7130	mg/kg	0.3	N D	0.6	N D	1
Cobalt, Co	219 1/7200	mg/kg	2	2	2	N D	N D
Chromium, Total	218 1/7190	mg/kg	10	N D	N D	N D	26
Manganese, by AAS	243 1/7460	mg/kg	2	29	64	4	24
Lead, total	239 1/7420	mg/kg	4	N D	N D	N D	8
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	N D	N D
Vanadium, V	286 1/7910	mg/kg	50	N D	N D	N D	57
Mercury, Hg	245 1/7470	mg/kg	0.3	N D	N D	N D	N D

Component	Method	Unit	PQL	159475 DS-R2M-ESP B 93-4313-13	159478 DS-R2M-FAB 93-4313-14	159481 DS-R2M-Ash 93-4313-15	159484 DS-R2M-Trim* 93-4313-16
Arsenic, As by GFAA	206 2/7060	mg/kg	2	5	54	7	<0.03mg/L
Barium, Ba	208 1/7080	mg/kg	30	39	63	39	<0.6mg/L
Cadmium, Cd	213 1/7130	mg/kg	0.3	0.7	25	N D	<0.006mg/L
Cobalt, Co	219 1/7200	mg/kg	2	N D	4	N D	<0.04mg/L
Chromium, Total	218 1/7190	mg/kg	10	12	34	N D	<0.2mg/L
Manganese, by AAS	243 1/7460	mg/kg	2	16	93	19	<0.04mg/L
Lead, total	239 1/7420	mg/kg	4	N D	17	6	<0.07mg/L
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	<0.2mg/L
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	N D	<0.04mg/L
Vanadium, V	286 1/7910	mg/kg	50	N D	59	N D	<1mg/L
Mercury, Hg	245 1/7470	mg/kg	0.3	N D	0.6	N D	<0.006mg/L

Component	Method	Unit	PQL	151503 DS-R3M-Coal 93-4313-17	151507 DS-R3M-Cyclone 93-4313-18	151510 DS-R3M-Lime 93-4313-19	151514 DS-R3M-ESP A 93-4313-20
Arsenic, As by GFAA	206 2/7060	mg/kg	2	N D	6	N D	15
Barium, Ba	208 1/7080	mg/kg	30	N D	N D	N D	N D
Cadmium, Cd	213 1/7130	mg/kg	0.3	N D	N D	N D	0.9
Cobalt, Co	219 1/7200	mg/kg	2	N D	3	N D	4
Chromium, Total	218 1/7190	mg/kg	10	N D	17	N D	33
Manganese, by AAS	243 1/7460	mg/kg	2	7	72	4	24
Lead, total	239 1/7420	mg/kg	4	N D	N D	N D	6
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	N D	3
Vanadium, V	286 1/7910	mg/kg	50	N D	N D	N D	55
Mercury, Hg	245 1/7470	mg/kg	0.3	N D	N D	N D	N D

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Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Component	Method	Unit	PQL	Concentration 151517 DS-R3M-ESP 93-4313-21	151520 DS-R3M-FAB 93-4313-22	151523 DS-R3M-Ash 93-4313-23	151526 DS-R3M-Trim* 93-4313-24
Arsenic, As by GFAA	206.2/7060	mg/kg	2	16	24	18	<0.03mg/L
Barium, Ba	208.1/7080	mg/kg	30	39	37	98	<0.6mg/L
Cadmium, Cd	213.1/7130	mg/kg	0.3	0.5	17.6	N.D.	<0.006mg/L
Cobalt, Co	219.1/7200	mg/kg	2	3	5	3	<0.04mg/L
Chromium, Total	218.1/7190	mg/kg	10	31	30	22	<0.2mg/L
Manganese, by AAS	243.1/7460	mg/kg	2	26	136	75	<0.04mg/L
Lead, total	239.1/7420	mg/kg	4	5	13	8	<0.07mg/L
Antimony, Sb	204.1/7040	mg/kg	10	N.D.	N.D.	N.D.	<0.2mg/L
Selenium, Se	270.2/7740	mg/kg	2	N.D.	N.D.	N.D.	<0.04mg/L
Vanadium, V	286.1/7910	mg/kg	50	N.D.	71	N.D.	<1mg/L
Mercury, Hg	245.1/7470	mg/kg	0.3	N.D.	1.4	N.D.	<0.006mg/L

Component	Method	Unit	PQL	155947 DS-R1MOS-Coal 93-4313-25	155923 DS-R1MOS-Lime 93-4313-26	159463 DS-R2MOS-Coal 93-4313-27	159470 DS-R2MOS-Lime 93-4313-28
Moisture, percent		wt%	0.1	8.2	69.9	8.3	71.9

Component	Method	Unit	PQL	151505 DS-R3MS-Coal 93-4313-29	151512 DS-R3MS-Lime 93-4313-30
Moisture, percent		wt%	0.1	7.8	71.9

PQL : Practical Quantitation Limit
– : Analysis not requested.
N.D. : Not Detected or less than the quantitation limit.
*Liquid sample

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

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Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Greg Rooney
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-934537
Collected by: Walied E
Collected on: 10/14/93
Sample description:
Samples Project: 3500
Unit Shawnee Fossil (GSA)

Received : 10/26/93
Tested : 11/03-15/93
Reported : 11/17/93

Analysis of Metals

801-934537 Page 1 of 5

Component Analyzed	Method	Unit	PQL	Concentration 159440 P-R1M-SS-4 93-4537-2	159444 P-R1M-SS-5 93-4537-3	159447 P-R1M-SS9A 93-4537-4
Arsenic, As by GFAA	206 2/7060	mg/kg	2	4	40	138
Barium, Ba	208 1/7080	mg/kg	30	N D	36	39
Cadmium, Cd	213 1/7130	mg/kg	0.3	N D	N D	1.7
Cobalt, Co	219 1/7200	mg/kg	2	4	11	18
Chromium, Total	218 1/7190	mg/kg	10	N D	26	71
Manganese, by AAS	243 1/7460	mg/kg	2	20	89	58
Lead, total	239 1/7420	mg/kg	4	N D	N D	37
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	N D	9	12
Vanadium, V	286 1/7910	mg/kg	50	N D	N D	163
Mercury, Hg	245 1/7470	mg/kg	0.03	N D	N D	0.09

Component Analyzed	Method	Unit	PQL	Concentration 159450 P-R1M-SS9B 93-4537-5	159453 P-R1M-SS11 93-4537-6	159456 P-R1M-SS13 93-4537-7	152134 DP-R1M-SS-4 93-4537-8
Arsenic, As by GFAA	206 2/7060	mg/kg	2	103	53	61	4
Barium, Ba	208 1/7080	mg/kg	30	106	47	34	N D
Cadmium, Cd	213 1/7130	mg/kg	0.3	1.1	24.4	N D	N D
Cobalt, Co	219 1/7200	mg/kg	2	11	16	8	4
Chromium, Total	218 1/7190	mg/kg	10	45	25	N D	N D
Manganese, by AAS	243 1/7460	mg/kg	2	51	33	63	21
Lead, total	239 1/7420	mg/kg	4	18	4	7	N D
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	12	N D	N D	N D
Vanadium, V	286 1/7910	mg/kg	50	99	55	N D	N D
Mercury, Hg	245 1/7470	mg/kg	0.03	0.06	N D	N D	N D

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Applied P & Ch Laboratory
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APCL Analytical Report

Analysis of Metals

Component Analyzed	Method	Unit	PQL	Concentration 152118 DP-R1M-SS-5 93-4537-9	152123 DP-R1M-SS-7 93-4537-10	152120 DP-R1M-SS9A 93-4537-11	152127 DP-R1M-SS9B 93-4537-12
Arsenic, As by GFAA	206.2/7060	mg/kg	2	15	3	51	41
Barium, Ba	208.1/7080	mg/kg	30	56	41	91	94
Cadmium, Cd	213.1/7130	mg/kg	0.3	N.D	N.D	1.2	0.8
Cobalt, Co	219.1/7200	mg/kg	2	14	9	19	17
Chromium, Total	218.1/7190	mg/kg	10	16	N.D.	23	32
Manganese, by AAS	243.1/7460	mg/kg	2	45	3	23	28
Lead, total	239.1/7420	mg/kg	4	N.D	N.D	N.D	N.D
Antimony, Sb	204.1/7040	mg/kg	10	N.D	N.D	N.D	N.D
Selenium, Se	270.2/7740	mg/kg	2	N.D	N.D	N.D.	N.D
Vanadium, V	286.1/7910	mg/kg	50	N.D	N.D	65	56
Mercury, Hg	245.1/7470	mg/kg	0.03	N.D	N.D.	N.D.	N.D

Component Analyzed	Method	Unit	PQL	152128 DP-R1M-SS11 93-4537-13	152130 DP-R1M-SS13 93-4537-14	152132* DP-R1M-SS14 93-4537-15	149632 DP-R2M-SS-4 93-4537-16
Arsenic, As by GFAA	206.2/7060	mg/kg	2	59	65.3	<0.005	6.0
Barium, Ba	208.1/7080	mg/kg	30	83	36	<0.5	N.D
Cadmium, Cd	213.1/7130	mg/kg	0.3	1.2	N.D	<0.005	N.D
Cobalt, Co	219.1/7200	mg/kg	2	15	5	<0.04	3
Chromium, Total	218.1/7190	mg/kg	10	22	18	<0.2	N.D
Manganese, by AAS	243.1/7460	mg/kg	2	26	71	<0.04	15
Lead, total	239.1/7420	mg/kg	4	N.D	7	<0.07	N.D
Antimony, Sb	204.1/7040	mg/kg	10	N.D	N.D	<0.2	N.D
Selenium, Se	270.2/7740	mg/kg	2	N.D	N.D	<0.005	N.D
Vanadium, V	286.1/7910	mg/kg	50	N.D	N.D	<1	N.D
Mercury, Hg	245.1/7470	mg/kg	0.03	N.D	N.D	<0.0006	N.D

Component Analyzed	Method	Unit	PQL	152138 DP-R2M-SS-5 93-4537-17	152143 DP-R2M-SS-7 93-4537-18	152145 DP-R2M-SS9A 93-4537-19	152148 DP-R2M-SS9B 93-4537-20
Arsenic, As by GFAA	206.2/7060	mg/kg	2	15	N.D	55	38
Barium, Ba	208.1/7080	mg/kg	30	55	35	84	67
Cadmium, Cd	213.1/7130	mg/kg	0.3	0.7	N.D	0.9	1.6
Cobalt, Co	219.1/7200	mg/kg	2	13	9	16	16
Chromium, Total	218.1/7190	mg/kg	10	15	N.D	21	24
Manganese, by AAS	243.1/7460	mg/kg	2	44	4	17	22
Lead, total	239.1/7420	mg/kg	4	N.D	N.D	4	6
Antimony, Sb	204.1/7040	mg/kg	10	N.D	N.D	N.D	N.D
Selenium, Se	270.2/7740	mg/kg	0.03	N.D	N.D.	N.D	N.D
Vanadium, V	286.1/7910	mg/kg	50	N.D	N.D	N.D.	N.D
Mercury, Hg	245.1/7470	mg/kg	0.03	N.D	N.D	N.D	N.D

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Applied P & Ch Laboratory
4666 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Component Analyzed	Method	Unit	PQL	Concentration 152151 DP-R2M-SS11 93-4537-21	152154 DP-R2M-SS13 93-4537-22	152157* DP-R2M-SS14 93-4537-23	149643 DP-R3M-SS-5 93-4537-24
Arsenic, As by GFAA	206 2/7060	mg/kg	2	53	111	<0.005	19
Barium, Ba	208 1/7080	mg/kg	30	63	44	<0.5	60
Cadmium, Cd	213 1/7130	mg/kg	0.3	0.8	N D	<0.03	0.6
Cobalt, Co	219 1/7200	mg/kg	2	15	8	<0.04	12
Chromium, Total	218 1/7190	mg/kg	10	25	22	<0.2	17
Manganese, by AAS	243 1/7460	mg/kg	2	19	68	<0.05	37
Lead, total	239 1/7420	mg/kg	4	N D	12	<0.07	N D
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	<0.2	N D
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	<0.005	N D
Vanadium, V	286 1/7910	mg/kg	50	53	N D	<1	N D
Mercury, Hg	245 1/7470	mg/kg	0.03	N D	N D	<0.0006	N D

Component Analyzed	Method	Unit	PQL	149646 DP-R3M-SS-7 93-4537-25	149650 DP-R3M-SS9A 93-4537-26	149653 DP-R3M-SS9B 93-4537-27	149659 DP-R3M-SS13 93-4537-28
Arsenic, As by GFAA	206 2/7060	mg/kg	2	N D	51	45	39
Barium, Ba	208 1/7080	mg/kg	30	39	57	72	N D
Cadmium, Cd	213 1/7130	mg/kg	0.3	N D.	1.2	0.9	N D
Cobalt, Co	219 1/7200	mg/kg	2	8	13	14	N D
Chromium, Total	218 1/7190	mg/kg	10	N D	18	28	12
Manganese, by AAS	243 1/7460	mg/kg	2	3	12	17	30
Lead, total	239 1/7420	mg/kg	4	N D	5	6	N D
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	N D	N D	N D	N D
Vanadium, V	286 1/7910	mg/kg	50	N D	N D	N D	N D
Mercury, Hg	245 1/7470	mg/kg	0.03	N D	N D	N.D	N D

Component Analyzed	Method	Unit	PQL	149662* DP-R3M-SS14 93-4537-29	159312 P-R4M-SS-4 93-4537-30	159316 P-R4M-SS-5 93-4537-31	159319 P-R4M-SS9A 93-4537-32
Arsenic, As by GFAA	206 2/7060	mg/kg	2	<0.005	3	32	145
Barium, Ba	208 1/7080	mg/kg	30	<0.5	N D	N D	N D
Cadmium, Cd	213 1/7130	mg/kg	0.3	<0.005	0.6	0.9	1.3
Cobalt, Co	219 1/7200	mg/kg	2	<0.04	3	5	6
Chromium, Total	218 1/7190	mg/kg	10	<0.2	N D	25	38
Manganese, by AAS	243 1/7460	mg/kg	2	<0.04	11	82	26
Lead, total	239 1/7420	mg/kg	4	<0.07	N D	N D	16
Antimony, Sb	204 1/7040	mg/kg	10	<0.2	N D	N D	N D
Selenium, Se	270 2/7740	mg/kg	2	<0.005	N D	8.5	7.8
Vanadium, V	286 1/7910	mg/kg	50	<1	N D	N D	101
Mercury, Hg	245 1/7470	mg/kg	0.03	<0.0006	N D	N D	N D

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Tel: (909) 622-6148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Component Analyzed	Method	Unit	PQL	Concentration 159322 P-R4M-SS9B 93-4537-33	159325 P-R4M-SS11 93-4537-34	159328 P-R4M-SS13 93-4537-35	159302 P-R3M-SS-5 93-4537-36
Arsenic, As by GFAA	206.2/7060	mg/kg	2	116	141	55.2	41.5
Barium, Ba	208.1/7080	mg/kg	30	44	N.D.	N.D.	N.D.
Cadmium, Cd	213.1/7130	mg/kg	0.3	1.6	2.1	N.D.	0.9
Cobalt, Co	219.1/7200	mg/kg	2	8	9	3	5
Chromium, Total	218.1/7190	mg/kg	10	58	51	14	20
Manganese, by AAS	243.1/7460	mg/kg	2	44	38	35	58
Lead, total	239.1/7420	mg/kg	4	23	20	N.D.	N.D.
Antimony, Sb	204.1/7040	mg/kg	10	N.D.	N.D.	N.D.	N.D.
Selenium, Se	270.2/7740	mg/kg	2	11.4	8.4	N.D.	7.6
Vanadium, V	286.1/7910	mg/kg	50	116	86	N.D.	N.D.
Mercury, Hg	245.1/7470	mg/kg	0.03	N.D.	N.D.	N.D.	N.D.

Component Analyzed	Method	Unit	PQL	159304 P-R3M-SS9A 93-4537-37	159306 P-R3M-SS9B 93-4537-38	159308 P-R3M-SS11 93-4537-39	159310 P-R3M-SS13 93-4537-40
Arsenic, As by GFAA	206.2/7060	mg/kg	2	255	32.2	400	94.0
Barium, Ba	208.1/7080	mg/kg	30	N.D.	N.D.	N.D.	N.D.
Cadmium, Cd	213.1/7130	mg/kg	0.3	1.4	0.6	2.7	N.D.
Cobalt, Co	219.1/7200	mg/kg	2	8	3	8	4
Chromium, Total	218.1/7190	mg/kg	10	45	18	61	13
Manganese, by AAS	243.1/7460	mg/kg	2	27	21	43	28
Lead, total	239.1/7420	mg/kg	4	14	N.D.	15	5
Antimony, Sb	204.1/7040	mg/kg	10	N.D.	N.D.	N.D.	N.D.
Selenium, Se	270.2/7740	mg/kg	2	4.9	N.D.	14.2	N.D.
Vanadium, V	286.1/7910	mg/kg	50	86	N.D.	130	N.D.
Mercury, Hg	245.1/7470	mg/kg	0.03	N.D.	N.D.	0.08	N.D.

Component Analyzed	Method	Unit	PQL	159421 P-R2M-SS-4 93-4537-41	159425 P-R2M-SS-5 93-4537-42	159428 P-R2M-SS9A 93-4537-43	159431 P-R2M-SS9B 93-4537-44
Arsenic, As by GFAA	206.2/7060	mg/kg	2	3	96	72	245
Barium, Ba	208.1/7080	mg/kg	30	45	N.D.	38	56
Cadmium, Cd	213.1/7130	mg/kg	0.3	1.0	N.D.	1.2	1.0
Cobalt, Co	219.1/7200	mg/kg	2	N.D.	4	8	12
Chromium, Total	218.1/7190	mg/kg	10	N.D.	17	19	55
Manganese, by AAS	243.1/7460	mg/kg	2	9	61	27	46
Lead, total	239.1/7420	mg/kg	4	N.D.	N.D.	19	25
Antimony, Sb	204.1/7040	mg/kg	10	N.D.	N.D.	N.D.	N.D.
Selenium, Se	270.2/7740	mg/kg	2	N.D.	14	5	9
Vanadium, V	286.1/7910	mg/kg	50	N.D.	N.D.	N.D.	101
Mercury, Hg	245.1/7470	mg/kg	0.03	N.D.	N.D.	0.07	N.D.

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Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Component Analyzed	Method	Unit	PQL	Concentration 159434 P-R2M-SS11 93-4537-45	159437 P-R2M-SS13 93-4537-46	159442 SS-4 P-R1 SS-4 93-4537-47	152136 SS-4 DP-R1 SS-4 93-4537-48
Arsenic, As by GFAA	206 2/7060	mg/kg	2	321	9.35	–	–
Barium, Ba	208 1/7080	mg/kg	30	N D	N D	–	–
Cadmium, Cd	213.1/7130	mg/kg	0 3	3.5	0.7	–	–
Cobalt, Co	219 1/7200	mg/kg	2	11	3	–	–
Chromium, Total	218 1/7190	mg/kg	10	50	N D.	–	–
Manganese, by AAS	243 1/7460	mg/kg	2	39	17	–	–
Lead, total	239 1/7420	mg/kg	4	18	N D	–	–
Antimony, Sb	204 1/7040	mg/kg	10	N D	N D	–	–
Selenium, Se	270 2/7740	mg/kg	2	15.6	N D	–	–
Vanadium, V	286 1/7910	mg/kg	50	110	N D	–	–
Mercury, Hg	245 1/7470	mg/kg	0 03	0.11	N D	–	–
Moisture, percent		wt%	0.1	–	–	7.8	8.1

Component Analyzed	Method	Unit	PQL	152124 DP-R2 SS-7 93-4537-49	149634 DP-R2 SS-4 93-4537-50	152141 DP-R2-SS-7 93-4537-51	149648 DP-R3-SS-7 93-4537-52
Moisture, percent		wt%	0.1	70.8	7.2	70.9	64 9

Component Analyzed	Method	Unit	PQL	159314 P-R4-SS-4 93-4537-53	159423 P-R2-SS-4 93-4537-54
Moisture, percent		wt%	0 1	9.8	10.5

PQL : Practical Quantitation Limit
– : Analysis not requested.
N.D. : Not Detected or less than the quantitation limit.
*Water Matrix Samples, Concentration Unit in mg/L

Respectfully submitted,

Shu-Teh Pan
Lab Manager
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

ETS, Inc.

GRAVIMETRIC LABORATORY DATA

Tare Filter Weights

Filter Description: Quartz

Report Prepared on: 10/14/93 Page 1

Filter Number	Date	Time	Weight (g)	Analyst	Constant Weight (g)
Q10/14/92-0014					0.43350
	12/07/92	10:47	0.43370	TLP	
	12/08/92	10:20	0.43350	TLP	
Q10/14/92-0015					0.43630
	12/07/92	10:49	0.43500	TLP	
	12/08/92	10:18	0.43620	TLP	
	12/09/92	10:20	0.43630	TLP	
Q10/14/92-0016					0.41780
	12/07/92	12:40	0.41790	TLP	
	12/08/92	08:45	0.41780	TLP	
Q10/14/92-0017					0.44280
	12/07/92	11:07	0.44280	TLP	
	12/08/92	09:44	0.44280	TLP	
Q10/14/92-0018					0.43810
	12/07/92	11:09	0.43800	TLP	
	12/08/92	09:42	0.43810	TLP	
Q10/14/92-0019					0.43770
	12/07/92	11:10	0.44130	TLP	
	12/08/92	09:32	0.43770	TLP	
Q10/14/92-0020					0.44130
	12/07/92	11:12	0.44120	TLP	
	12/08/92	09:40	0.44130	TLP	
Q10/14/92-0021					0.42840
	12/07/92	11:13	0.42820	TLP	
	12/08/92	09:38	0.42840	TLP	
Q10/14/92-0022					0.42640
	12/07/92	11:15	0.42830	TLP	
	12/08/92	09:36	0.42910	TLP	
	12/09/92	10:20	0.43030	TLP	
	01/22/93	11:15	0.42650	PJB	
	01/27/93	11:59	0.42640	PJB	
Q10/14/92-0023					0.43060
	12/07/92	11:16	0.43040	TLP	
	12/08/92	09:34	0.43060	TLP	

ETS, Inc.
GRAVIMETRIC LABORATORY DATA
Tare Filter Weights
Filter Description: Quartz
Report Prepared on: 10/14/93 Page 2

Filter Number	Date	Time	Weight (g)	Analyst	Constant Weight (g)
Q10/14/92-0024					0.43980
	12/07/92	11:17	0.43950	TLP	
	12/08/92	09:35	0.43980	TLP	
Q10/14/92-0025					0.43460
	12/07/92	11:19	0.43410	TLP	
	12/08/92	09:09	0.43460	TLP	

FILTER WIEGHTS 19 OCT 93

	1st INITIAL	2nd INITIAL
1	.5489	.5489
2	.5438	.5437
3	.5352	.5351
4	.5285	.5284
5	.5374	.5374
6	.5291	.5291
7	.5520	.5519
8	.5423	.5423
9	.5379	.5377
10	.5452	.5451
11	.5494	.5494
12	.5412	.5412

E.E.R. CALIF.

J. Born
19 OCT. 93

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 , Fax: (909) 622-3199

APCL Analytical Report

Submitted to:
Energy and Environmental Research Corporation
Attention: Glenn England
8001 Irvine Blvd.
Santa Ana, CA 92706
Tel: (714)552-1803 Fax: (714)857-1943

Service ID #: 801-942824
Collected by: N/A
Collected on: Sep,Oct '93
Sample description:
GSA Toxics, Airpol (Shawnee Plant)
Metals Re-Analysis

Received : 06/01/94
Tested : 06/20-22/94
Reported : 06/29/94

Analysis of Metals

Analyte	Method	Unit	MDL	Concentration					
				SSS 151622 AP-DP-R1 94-2824-1	SSS 152140 AP-DP-R2 94-2824-2	SSS 149645 AP-DP-R3 94-2824-3	SSS 155935 AP-DS-R1 94-2824-4	SSS 159467 AP-DS-R2 94-2824-5	SSS 151509 AP-DS-R3 94-2824-6
Cyclone Solids, SS-5									
Antimony, Sb	7041	mg/kg	0.08	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Arsenic, As	7060	mg/kg	0.06	16.6	13.9	20.6	22.3	14.9	19.3
Barium, Ba	6010	mg/kg	0.11	55.3	51.8	46.1	75.3	57	59.3
Beryllium, Be	6010	mg/kg	0.015	0.35	0.27	0.21	0.48	0.37	0.42
Cadmium, Cd	7131	mg/kg	0.004	N.D.	0.222	0.322	0.330	N.D.	N.D.
Cobalt, Co	6010	mg/kg	0.35	3.16	2.40	2.34	1.96	1.80	3.43
Chromium, Cr	7191	mg/kg	0.02	16.5	15.6	15.2	15.4	15.9	14.8
Mercury, Hg	7471	mg/kg	0.10	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Manganese, Mn	6010	mg/kg	0.05	68.4	61.2	51.2	62.8	90.5	83.4
Nickel, Ni	7521	mg/kg	0.05	12.0	10.2	12.8	7.53	4.89	5.54
Lead	7421	mg/kg	0.035	N.D.	0.22	0.53	1.84	0.56	0.41
Selenium, Se	7740	mg/kg	0.1	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Vanadium, V	6010	mg/kg	0.4	23.6	24.4	20.0	18.4	19.6	20.7

Analyte	Method	Unit	MDL	159446 AP-P-R1 94-2824-7	159427 AP-P-R2 94-2824-8	159318 AP-P-R4 94-2824-9	151536 AP-DP-R1 94-2824-10	151558 AP-DP-R2 94-2824-11	151600 AP-DP-R4 94-2824-12
Cyclone Solids, SS-5									
Antimony, Sb	7041	mg/kg	0.08	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Arsenic, As	7060	mg/kg	0.06	23.3	21.2	23.2	20.7	16.5	16.2
Barium, Ba	6010	mg/kg	0.11	89.4	86.5	101	58.1	86.4	79.0
Beryllium, Be	6010	mg/kg	0.015	1.03	0.96	0.95	0.55	0.68	0.71
Cadmium, Cd	7131	mg/kg	0.004	N.D.	N.D.	0.335	N.D.	N.D.	N.D.
Cobalt, Co	6010	mg/kg	0.35	7.43	6.80	5.29	2.78	4.37	4.29
Chromium, Cr	7191	mg/kg	0.02	20.9	14.5	24.5	22.3	27.6	26.8
Mercury, Hg	7471	mg/kg	0.10	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Manganese, Mn	6010	mg/kg	0.05	93.1	77.4	89.9	104.4	145.4	137.4
Nickel, Ni	7521	mg/kg	0.05	21.3	20.3	13.4	8.36	12.4	11.7
Lead	7421	mg/kg	0.035	3.45	2.6	7.69	0.89	1.81	1.96
Selenium, Se	7740	mg/kg	0.1	8.1	18.3	10.3	1.62	6.5	8.6
Vanadium, V	6010	mg/kg	0.4	47.5	43.4	46.6	29.7	36.6	38.5

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Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Analyte	Method	Unit	MDL	Concentration 155924 AP-DS-R1 94-2824-25	151626 AP-DP-R1 94-2824-26
Lime Slurry, SS-7					
Antimony, Sb	7041	mg/kg	0.08	N.D	N D
Arsenic, As	7060	mg/kg	0.06	0.96	0.54
Barium, Ba	6010	mg/kg	0.11	1.43	1.38
Beryllium, Be	6010	mg/kg	0.015	N.D.	N D.
Cadmium, Cd	7131	mg/kg	0.004	0.011	0.018
Cobalt, Co	6010	mg/kg	0.35	N.D	N D.
Chromium, Cr	7191	mg/kg	0.02	4.51	3.7
Mercury, Hg	7471	mg/kg	0.10	N D.	N D
Manganese, Mn	6010	mg/kg	0.05	4.76	5.44
Nickel, Ni	7521	mg/kg	0.05	0.75	0.96
Lead	7421	mg/kg	0.035	N.D.	N.D
Selenium, Se	7740	mg/kg	0.1	1.45	1.01
Vanadium, V	6010	mg/kg	0.4	2.25	2.21

Analyte	Method	Unit	MDL	151529 AP-DS-R3 94-2824-27
Trim Water, SS-14				
Antimony, Sb	7041	mg/L	0.002	N D
Arsenic, As	7060	mg/L	0.001	N D.
Barium, Ba	6010	mg/L	0.003	0.039
Beryllium, Be	6010	mg/L	0.0003	N.D
Cadmium, Cd	7131	mg/L	0.0007	N D
Cobalt, Co	6010	mg/L	0.007	N.D.
Chromium, Cr	7191	mg/L	0.009	N D
Mercury, Hg	7471	mg/L	0.0002	N.D.
Manganese, Mn	6010	mg/L	0.001	N D.
Nickel, Ni	7521	mg/L	0.001	N D
Lead	7421	mg/L	0.001	N D.
Selenium, Se	7740	mg/L	0.001	N D
Vanadium, V	6010	mg/L	0.005	N.D

MDL : Method Detection Limit (SW-846)
N.D. : Not Detected or less than the MDL.

Respectfully submitted,

Jack Zhang

Jack Y. Zhang, Ph.D.,
Director
Applied P & Ch Laboratory

CADHS ELAP CERTIFICATION NUMBER 1431

Applied P & Ch Laboratory
4066 E. Mission Blvd., Pomona, CA 91766
Tel: (909) 622-5148 Fax: (909) 622-3199

APCL Analytical Report

Analysis of Metals

Analyte	Method	Unit	MDL	Concentration					
				159458 AP-~~P~~-R1 94-2824-13	159420 AP-~~P~~-R3 94-2824-14	159330 AP-~~P~~-R4 94-2824-15	151548 AP-~~DP~~-R1 94-2824-16	151579 AP-~~DP~~-R3 94-2824-17	151609 AP-~~DP~~-R4 94-2824-18
Re-injected Fly Ash, SS-13									
Antimony, Sb	7041	mg/kg	0.08	N.D.	N.D.	N.D.	N.D.	N.D	N.D
Arsenic, As	7060	mg/kg	0.06	53.0	55.2	41.9	78	31.4	35.3
Barium, Ba	6010	mg/kg	0.11	116.1	126.9	122.3	183.2	82.4	96.8
Beryllium, Be	6010	mg/kg	0.015	1.82	2.06	1.82	2.27	1.27	1.37
Cadmium, Cd	7131	mg/kg	0.004	0.326	0.455	0.465	0.296	0.327	0.292
Cobalt, Co	6010	mg/kg	0.35	6.23	7.64	5.98	5.21	4.81	4.96
Chromium, Cr	7191	mg/kg	0.02	23.9	26.9	27.8	97	33.3	25.7
Mercury, Hg	7471	mg/kg	0.10	N.D	N.D	N.D	N.D	N.D	N.D
Manganese, Mn	6010	mg/kg	0.05	65.8	70.8	89.3	67.9	122.0	112.0
Nickel, Ni	7521	mg/kg	0.05	20.1	22.8	17.4	18.6	12.7	13.9
Lead	7421	mg/kg	0.035	21.1	17.9	15.7	30.6	9.3	11.1
Selenium, Se	7740	mg/kg	0.1	3.98	4.11	4.39	3.47	3.65	3.20
Vanadium, V	6010	mg/kg	0.4	42.7	44.9	48.8	30.0	44.4	36.3

Analyte	Method	Unit	MDL	155928 AP-DS-R1 94-2824-19	159483 AP-DS-R2 94-2824-20	151525 AP-DS-R3 94-2824-21	151638 AP-DP-R1 94-2824-22	152156 AP-DP-R2 94-2824-23	149661 AP-DP-R3 94-2824-24
Re-injected Fly Ash, SS-13									
Antimony, Sb	7041	mg/kg	0.08	N.D.	N.D	N.D.	N.D.	N.D.	N.D
Arsenic, As	7060	mg/kg	0.06	51.8	112	25.2	33.8	30.6	54.4
Barium, Ba	6010	mg/kg	0.11	118.3	175.9	138.7	113.5	124.2	146.1
Beryllium, Be	6010	mg/kg	0.015	1.52	1.92	1.73	1.81	1.50	2.11
Cadmium, Cd	7131	mg/kg	0.004	0.280	0.367	0.239	0.295	0.297	0.405
Cobalt, Co	6010	mg/kg	0.35	4.22	4.94	4.85	6.02	6.02	7.60
Chromium, Cr	7191	mg/kg	0.02	15.7	20.0	17.5	22.0	32.3	30.0
Mercury, Hg	7471	mg/kg	0.10	N.D	N.D	N.D	N.D.	N.D	N.D
Manganese, Mn	6010	mg/kg	0.05	57.0	76.7	116.1	75.7	89.1	78.3
Nickel, Ni	7521	mg/kg	0.05	15.1	18.1	14.3	19.1	17.2	22.5
Lead	7421	mg/kg	0.035	18.1	26.9	12.5	10.8	9.96	18.7
Selenium, Se	7740	mg/kg	0.1	1.7	3.26	2.04	2.73	4.11	3.46
Vanadium, V	6010	mg/kg	0.4	21.3	30.4	29.6	32.0	47.5	47.7

CADHS ELAP CERTIFICATION NUMBER 1431

LABORATORY REPORT

3505 Cadillac Avenue, Bldg. B-2, Costa Mesa, California 92626 Tel (714) 435-9800 Fax (714) 435-9585

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-01-93
Date Analyzed: 10-06-93

Client Project No.: 3500

Lab Job No.: 5083

Lab Sample No.	Client Sample No.	Chloride Results (mg/Sample)	Fluoride Results (mg/Sample)	Dilution Factor	Sample Volume (mL)
5083-01	151652	23	ND	3	488
5083-02	151650	ND	ND	2	450
5083-03	151646	ND	ND	2	495
5083-04	151644	ND	ND	2	515
5083-05	151648	ND	ND	2	438
5083-06	159492	ND	ND	2	436
5083-07	159494	ND	ND	2	515
5083-08	159490	ND	ND	2	485
5083-09	159488	25	2.7	2	512

Method Detection Limit: Chloride 0.02 mg/L
Fluoride 0.05 mg/L

ND = Not Detected

Medhat Gorgy
Lab Director

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3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-01-93
Date Analyzed: 10-06-93

Client Project No.: 3500

Lab Job No.: 5083

Lab Sample No.	Client Sample No.	Chloride Results (mg/Sample)	Fluoride Results (mg/Sample)	Dilution Factor	Sample Volume (mL)
5083-10	151791	20	2.3	2	480
5083-11	151729	ND	ND	2	517
5083-12	151733	21*	2.7	2	410
5083-13	151735	ND	ND	2	512
5083-14	151731**	ND	ND	2	528
5083-15	151789	ND	ND	2	488
5083-16	151795	13	1.9	2	476
5083-17	151793	13	1.9	2	463
5083-18	151809	ND	ND	2	432

* Dilution Factor: 5
** Client Sample No. 151731 was revised on 3-14-94.

Method Detection Limit: Chloride: 0.02 mg/L
Fluoride: 0.05 mg/L

ND = Not Detected

Medhat Gorgy
Lab Director

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Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-01-93
Date Analyzed: 10-06-93

Client Project No.: 3500

Lab Job No.: 5083

Lab Sample No.	Client Sample No.	Chloride Results (mg/Sample)	Fluoride Results (mg/Sample)	Dilution Factor	Sample Volume (mL)
5083-19	151797	17	2.8	2	453
5083-20	151827	17	3.0	2	492
5083-21	151825	19	3.4	2	502
5083-22	151823	21	4.9	2	505
5083-23	151821	19	3.5	2	446
5083-24	151813	15	2.1	2	540
5083-25	151815	18	2.3	2	475
5083-26	151817	20	4.6	2	442
5083-27	151807	17	1.9	2	523

Method Detection Limit: Chloride 0.02 mg/L
Fluoride 0.05 mg/L

Medhat Gorgy
Lab Director

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3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-01-93
Date Analyzed: 10-06-93

Client Project No.: 3500

Lab Job No.: 5083

Lab Sample No.	Client Sample No.	Chloride Results (mg/Sample)	Fluoride Results (mg/Sample)	Dilution Factor	Sample Volume (mL)
5083-28	151931	14	1.7	2	425
5083-29	151933	21	5.4	2	466
5083-30	151937	22	5.3	2	429
5083-31	151935	17	2.9	2	417

Method Detection Limit: Chloride 0.02 mg/L
Fluoride 0.05 mg/L

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Lab Director

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3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: November 5, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-26-93
Date Analyzed: 11-01-93

Client Project No.: 3500

Lab Job No.: 6011

Lab Sample No.	Client Sample No.	Chloride Results (mg/Sample)	Fluoride Results (mg/Sample)	Dilution Factor	Sample Volume (mL)
6011-01	151941	16*	0.83	2	447
6011-02	151943	ND	ND	2	460
6011-03	151945	ND	ND	2	530
6011-04	159081	23	0.40	4	525
6011-05	159083	ND	ND	2	530
6011-06	159085	ND	ND	2	532
6011-07	159087	ND	ND	2	510
6011-08	159071	ND	ND	2	520
6011-10	159075	25	4.5	4	420
6011-11	159077	ND	ND	2	510

* Dilution Factor: 4

Method Detection Limit: Chloride 0.02 mg/L
Fluoride 0.05 mg/L

ND = Not Detected

Medhat Gorgy
Lab Director

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Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: November 4, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-26-93
Date Analyzed: 11-01-93

Client Project No.: 3500

Lab Job No.: 6011

Lab Sample No.	Client Sample No.	Chloride Results (mg/Sample)	Fluoride Results (mg/Sample)	Dilution Factor	Sample Volume (mL)
6011-12	159079	0.52	ND	2	500
6011-13	159129	ND	ND	2	500
6011-14	159131	ND	ND	2	445
6011-15	159133	ND	ND	2	455
6011-16	159135	ND	ND	2	435
6011-17	159137	ND	ND	2	453
6011-18	159153	ND	ND	2	187
6011-19	159184	15	ND	2	534
6011-20	159186	27	4.9	4	505
6011-21	159188	24	ND	2	500

Method Detection Limit: Chloride 0.02 mg/L
Fluoride 0.05 mg/L

ND = Not Detected

Medhat Gorgy
Lab Director

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Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: November 4, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride/Fluoride
Method: 26
Matrix: Aqueous

Date Received: 10-26-93
Date Analyzed: 11-01-93

Client Project No.: 3500

Lab Job No.: 6011

Lab Sample No.	Client Sample No.	Chloride Results (mg/Sample)	Fluoride Results (mg/Sample)	Dilution Factor	Sample Volume (mL)
6011-22	159251	16	0.69	2	468
6011-23	159255	15	0.45	2	405
6011-24	159257	19	0.88	2	483
6011-25	159353	21	4.8	4	470
6011-26	159355	19	1.3	2	500
6011-27	159357	15	0.46	2	457
6011-28	159290	24	4.0	4	485
6011-29	159292	22	3.7	4	435
6011-30	159294	14	0.31	2	418

Method Detection Limit: Chloride 0.02 mg/L
Fluoride 0.05 mg/L

ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

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3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020

Lab Job No.: 5083B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
5083-32	151592	9.1	5
5083-33	151589	32	5
5083-34	151605	7.1	5
5083-35	151599	4.7	5
5083-36	151586	4.7	5
5083-37	151611	3.9	5
5083-38	151602	220	25
5083-39	151614	83	50
5083-40	151608	4.3	5

Method Detection Limit = 0.02 mg/Kg

Medhat Gorgy
Lab Director

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Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020

Lab Job No.: 5083B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
5083-41	151582	ND	5
5083-42	151566	200	20
5083-43	151557	5.2	5
5083-44	151576	10	5
5083-45	151578	4.4	5
5083-46	151574	81	10
5083-47	151569	ND	5
5083-48	151572	4.3	5
5083-49	151560	8.1	5

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

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3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020

Lab Job No.: 5083B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
5083-50	151563	40	10
5083-51	151553	ND	5
5083-52	151541	74	5
5083-53	151538	130	10
5083-54	151544	160	50
5083-55	151531	ND	5
5083-56	151547	ND	5
5083-57	151535	62	5
5083-58	151515	1100	100

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gorgy
Lab Director

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Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020

Lab Job No.: 5083B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
5083-59	151508	120	5
5083-60	151518	890	100
5083-61	151521	130	50
5083-62	151504 DS.SS4.R3	ND	5
5083-63	151524	4.0	5
5083-66	155934	91	5
5083-69	159466	98	5
5083-71	159473	1100	50
5083-72	159476	780	100

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

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3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626

Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 11, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Solid	Date Analyzed:	10-07-93

Client Project No.: 3500-020

Lab Job No.: 5083B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
5083-73	159479	520	40
5083-74	159482	ND	5
5083-76	159462	ND	5
5083-77	155946	ND	5
5083-78	155927	ND	5
5083-79	155943	470	100
5083-80	155940	780	50
5083-81	155937	820	50

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: October 12, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-01-93
Method:	IC	Date Extracted:	10-07-93
Matrix:	Aqueous	Date Analyzed:	10-07-93

Client Project No.: 3500-020

Lab Job No.: 5083B

Lab Sample No.	Client Sample No.	Results (mg/L)	Dilution Factor
5083-64	151527	67	10
5083-65	151511	26	3
5083-67	155925	26	3
5083-68	155930	81	10
5083-70	159469	26	3
5083-75	159485	63	10

Method Detection Limit = 0.02 mg/L

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: November 5, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis: Chloride
Method: IC
Matrix: Aqueous

Date Received: 10-26-93
Date Analyzed: 11-02-93

Client Project No.: 3500-020

Lab Job No.: 6011B

Lab Sample No.	Client Sample No.	Results (mg/L)	Dilution Factor
6011-33	151624	28	2
6011-37	151640	240	10
6011-40	152142	28	2
6011-45	152158	87	10
6011-48	149647	28	2
6011-52	149663	60	4

Method Detection Limit = 0.02 mg/L

Medhat Gorgy
Lab Director

Pyramid Laboratories
Analytical Services • Consulting
3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: November 5, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-26-93
Method:	IC	Date Extracted:	11-03-93
Matrix:	Solid	Date Analyzed:	11-03-93

Client Project No.: 3500-020

Lab Job No.: 6011B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
6011-57	159454	770	50
6011-58	159457	ND	5
6011-59	159411	4.1	5
6011-60	159413	14	5
6011-61	159415	5.0	5
6011-62	159417	340	50
6011-63	159419	5.6	5
6011-64	159422	6.9	5
6011-65	159426	4.2	5
6011-66	159429	17	5

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

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Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: November 5, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-26-93
Method:	IC	Date Extracted:	11-02-93
Matrix:	Solid	Date Analyzed:	11-02-93

Client Project No.: 3500-020

Lab Job No.: 6011B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
6011-31	151617	ND	5
6011-32	151621	92	5
6011-34	151628	730	5
6011-35	151631	770	5
6011-36	151637	3.1	5
6011-38	152135	ND	5
6011-39	152139	100	5
6011-41	152146	780	50
6011-42	152149	730	50
6011-43	152152	720	50

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gorgy
Lab Director

Pyramid Laboratories

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LABORATORY REPORT

Date: November 5, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-26-93
Method:	IC	Date Extracted:	11-02-93
Matrix:	Solid	Date Analyzed:	11-02-93

Client Project No.: 3500-020

Lab Job No.: 6011B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
6011-44	152155	3.3	5
6011-46	149633	ND	5
6011-47	149644	210	10
6011-49	149651	850	50
6011-50	149654	850	50
6011-51	149660	3.3	5
6011-53	159441	ND	5
6011-54	159445	8.5	5
6011-55	159448	66	5
6011-56	159451	39	5

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gergy
Lab Director

Pyramid Laboratories

Analytical Services • Consulting

3505 Cadillac Avenue, Building B-2, Costa Mesa, CA 92626
Tel. (714) 435-9800 • FAX (714) 435-9585

LABORATORY REPORT

Date: November 5, 1993

Client: Energy and Environmental Research Corporation
8001 Irvine Blvd.
Santa Ana, CA 92705

Analysis:	Chloride	Date Received:	10-26-93
Method:	IC	Date Extracted:	11-03-93
Matrix:	Solid	Date Analyzed:	11-03-93

Client Project No.: 3500-020

Lab Job No.: 6011B

Lab Sample No.	Client Sample No.	Results (mg/Kg)	Dilution Factor
6011-67	159432	7.4	5
6011-68	159435	100	5
6011-69	159438	3.0	5
6011-70	159313	2.5	5
6011-71	159317	2.8	5
6011-72	159320	36	5
6011-73	159323	ND	5
6011-74	159326	23	5
6011-75	159329	3.9	5

Method Detection Limit = 0.02 mg/Kg

ND = Not Detected

Medhat Gorgy
Lab Director

Tennessee Valley Authority Post Office Box 150 West Paducah Kentucky 42086

November 18, 1993

Jerry Lewis, Manager
Eastern Field Operations
EER Inc.
3700 University Drive
Durham NC 27707

Dear Jerry:

Enclosed are the proximate and ultimate coal analysis for the test days September 20, 21, 22, 23, 27, 28, 29 and October 13, 14, 15, 19, 21 and 22.

If you have any questions please give me a call at 502-444-4666.

Sincerely,

TENNESSEE VALLEY AUTHORITY

Kenneth M. Schuppert
Manager
National Center for
Emissions Research

KMS:MR
Attachments
cc (w/attachments)
T. A. Burnett, CST 16B - C
L. R. Lepovitz, Radian
T. M. Little, NCER

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00326 - S Date Recd in Lab. 930922
Location SHAWNEE FP Lab No. SH3-1391 Date Analyzed 930924

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	3.65	0.00	13.59	2.96	12259	8.00	6.60	12090	0.9984

Defaults Used - Fuse Wire Factor= 4.1 Concentration Factor= 10.0

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 930920 Thru 000000
Recd in lab. 930922
Location SHAWNEE FP
Lab. No. SH3-1391
Date Analyzed 930924
Analyzed by SHRESJTK

Sample No. SH - 00326 - S
Unit. 09 Status R

Air Dry 6.2 % SO2 4.77 lbs./MBTU
Resid Moist 3.65 % CLM 3.42 %
Total 9.6 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9635	0.864	0.904
% Moisture	3.65			9.6
% Volatile	.00	.00	.00	.00
% Ash	13.09	13.6		12.3
% Fixed Carbon	.00	.00	.00	.00
% Sulfur	2.96	3.07	3.56	2.78
BTU	12090	12548	14523	11343

REMARKS: UNIT 9 DAILY
-(SHRESJTK) 09/30/93

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00361 - S Date Recd in Lab. 930929
Location SHAWNEE FP Lab No. SH3-1426 Date Analyzed 930930

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	2.67	0.00	13.07	3.05	12479	8.00	7.00	12303	1.0026

Defaults Used - Fuse Wire Factor= 4.1 Concentration Factor= 10.0

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 930927 Thru 000000
Recd in lab. 930929
Location SHAWNEE FP
Lab. No. SH3-1426
Date Analyzed 930930
Analyzed by SHRESJTK

Sample No. SH - 00361 - S
Unit. 09 Status R

Air Dry 9.3 % SO2 4.83 lbs./MBTU
Resid Moist 2.67 % CLM 2.42 %
Total 11.7 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9733	0.869	0.883
% Moisture	2.67			11.7
% Volatile	.00	.00	.00	.00
% Ash	12.72	13.1		11.6
% Fixed Carbon	.00	.00	.00	.00
% Sulfur	3.05	3.13	3.61	2.77
BTU	12304	12642	14548	11163

REMARKS: UNIT 9 DAILY
-(SHRESJTK) 10/01/93

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00488 - S Date Recd in Lab. 931021
Location SHAWNEE FP Lab No. CS3-6702 Date Analyzed 931023

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 931018 Thru 000000
Recd in lab. 931021
Location SHAWNEE FP
Lab. No. CS3-6702
Date Analyzed 931023
Analyzed by CSFMSGML

Sample No. SH - 00488 - S
Unit. 09 Status R

Air Dry 4.4 % SO2 4.28 lbs./MBTU
Resid Moist 3.62 % CLM 3.46 %
Total 7.9 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9638	0.860	0.921
% Moisture	3.62			7.9
% Volatile	36.40	37.77	43.92	34.79
% Ash	13.53	14.0		12.9
% Fixed Carbon	46.48	48.23	56.08	44.42
% Sulfur	2.64	2.74	3.19	2.52
BTU	12015	12466	14495	11481

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00491 - S Date Recd in Lab. 931022
Location SHAWNEE FP Lab No. CS3-6727 Date Analysed 931023

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0003	3.33	37.08	12.35	2.78	12334	0.00	0.00	12268	1.0000

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 931019 Thru 000000
Recd in lab. 931022
Location SHAWNEE FP
Lab. No. CS3-6727
Date Analysed 931023
Analysed by CSFMSGML

Sample No. SH - 00491 - S
Unit. 09 Status R

Air Dry 6.3 % SO2 4.40 lbs./MBTU
Resid Moist 3.33 % CLM 3.12 %
Total 9.4 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9667	0.877	0.906
% Moisture	3.33			9.4
% Volatile	35.85	37.08	42.28	33.59
% Ash	11.94	12.3		11.1
% Fixed Carbon	48.93	50.62	57.72	45.86
% Sulfur	2.78	2.88	3.28	2.61
BTU	12334	12759	14548	11560

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00329 - S Date Recd in Lab. 930924
Location SHAWNEE FP Lab No. SH3-1394 Date Analyzed 930928

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	4.38	0.00	12.15	2.96	12278	8.00	6.80	12106	1.0018

Defaults Used - Fuse Wire Factor= 4.1 Concentration Factor= 10.0

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled930921 Thru 000000
Recd in lab.930924
Location SHAWNEE FP
Lab. No. SH3-1394
Date Analyzed 930928
Analyzed by SHRESJTK

Sample No. SH - 00329 - S
Unit. 09 Status R

Air Dry 5.8 % SO2 4.77 lbs./MBTU
Resid Moist 4.38 % CLM 4.13 %
Total 9.9 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9562	0.879	0.901
% Moisture	4.38			9.9
% Volatile	.00	.00	.00	.00
% Ash	11.62	12.1		10.9
% Fixed Carbon	.00	.00	.00	.00
% Sulfur	2.96	3.10	3.52	2.79
BTU	12107	12662	14405	11408

REMARKS: UNIT 9 DAILY
-(SHRESJTK) 09/30/93

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00342 - S Date Recd in Lab. 930924
Location SHAWNEE FP Lab No. SH3-1407 Date Analyzed 930928

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	5.05	0.00	12.14	2.84	12254	8.00	6.70	12086	0.9940

Defaults Used - Fuse Wire Factor= 4.1 Concentration Factor= 10.0

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 930922 Thru 000000
Recd in lab. 930924
Location SHAWNEE FP
Lab. No. SH3-1407
Date Analyzed 930928
Analyzed by SHRESJTK

Sample No. SH - 00342 - S
Unit. 09 Status R

Air Dry 4.3 % SO2 4.58 lbs./MBTU
Resid Moist 5.05 % CLM 4.83 %
Total 9.1 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9495	0.879	0.909
% Moisture	5.05			9.1
% Volatile	.00	.00	.00	.00
% Ash	11.53	12.1		11.0
% Fixed Carbon	.00	.00	.00	.00
% Sulfur	2.84	2.99	3.40	2.72
BTU	12086	12729	14481	11571

REMARKS: UNIT 9 DAILY
-(SHRESJTK) 10/01/93

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00345 - S Date Recd in Lab. 930927
Location SHAWNEE FP Lab No. SH3-1410 Date Analyzed 930929

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	5.80	0.00	10.66	3.10	12435	8.00	7.20	12256	0.9981

Defaults Used - Fuse Wire Factor= 4.1 Concentration Factor= 10.0

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled930923 Thru 000000
Recd in lab.930927
Location SHAWNEE FP
Lab. No. SH3-1410
Date Analyzed 930929
Analyzed by SHRESJTK

Sample No. SH - 00345 - S
Unit. 09 Status R

Air Dry 5.6 % SO2 4.93 lbs./MBTU
Resid Moist 5.80 % CLM 5.48 %
Total 11.1 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9420	0.893	0.889
% Moisture	5.80			11.1
% Volatile	.00	.00	.00	.00
% Ash	10.04	10.7		9.5
% Fixed Carbon	.00	.00	.00	.00
% Sulfur	3.10	3.29	3.69	2.93
BTU	12257	13012	14571	11568

REMARKS: UNIT 9 DAILY
-(SHRESJTK) 10/01/93

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00364 - S Date Recd in Lab. 930930
Location SHAWNEE FP Lab No. CS3-1429 Date Analyzed 931004

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	3.54	0.00	13.01	2.83	12372	8.00	6.60	12206	0.9981

Defaults Used - Fuse Wire Factor= 4.1 Concentration Factor= 10.0

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled930928 Thru 000000
Recd in lab.930930
Location SHAWNEE FP
Lab. No. CS3-1429
Date Analyzed 931004
Analyzed by SHRESJAT

Sample No. SH - 00364 - S
Unit. 09 Status R

Air Dry 7.9 % SO2 4.52 lbs./MBTU
Resid Moist 3.54 % CLM 3.26 %
Total 11.2 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9646	0.870	0.888
% Moisture	3.54			11.2
% Volatile	.00	.00	.00	.00
% Ash	12.55	13.0		11.5
% Fixed Carbon	.00	.00	.00	.00
% Sulfur	2.83	2.93	3.37	2.61
BTU	12206	12654	14545	11237

REMARKS: 9 DAILY
-(SHRESJAT) 10/07/93

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00381 - S Date Recd in Lab. 931001
Location SHAWNEE FP Lab No. SH3-1446 Date Analyzed 931005

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	4.38	0.00	12.61	2.91	12277	8.00	6.70	12108	0.9960

Defaults Used - Fuse Wire Factor= 4.1 Concentration Factor= 10.0

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled930929 Thru 000000
Recd in lab.931001
Location SHAWNEE FP
Lab. No. SH3-1446
Date Analyzed 931005
Analyzed by SHRESJAT

Sample No. SH - 00381 - S
Unit. 09 Status R

Air Dry 7.0 % SO2 4.69 lbs./MBTU
Resid Moist 4.38 % CLM 4.07 %
Total 11.1 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9562	0.874	0.889
% Moisture	4.38			11.1
% Volatile	.00	.00	.00	.00
% Ash	12.06	12.6		11.2
% Fixed Carbon	.00	.00	.00	.00
% Sulfur	2.91	3.04	3.48	2.71
BTU	12108	12663	14489	11257

REMARKS: ***
-(SHRESJAT) 10/14/93

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00457 - S Date Recd in Lab. 931018
Location SHAWNEE FP Lab No. CS3-6417 Date Analyzed 931019

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	3.19	36.37	13.55	2.45	12158	0.00	0.00	12100	1.0000

Inconsistent corrections used Fuse Wire = 4.1 Concentration = 3.7

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 931013 Thru 000000
Recd in lab. 931018
Location SHAWNEE FP
Lab. No. CS3-6417
Date Analyzed 931019
Analyzed by CSFMSGML

Sample No. SH - 00457 - S
Unit. 09 Status R

Air Dry 6.9 % SO2 3.93 lbs./MBTU
Resid Moist 3.19 % CLM 2.97 %
Total 9.9 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9681	0.865	0.901
% Moisture	3.19			9.9
% Volatile	35.21	36.37	42.05	32.77
% Ash	13.12	13.5		12.2
% Fixed Carbon	48.53	50.13	57.95	45.17
% Sulfur	2.45	2.53	2.93	2.28
BTU	12158	12559	14519	11316

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00460 - S Date Recd in Lab. 931019
Location SHAWNEE FP Lab No. CS3-6519 Date Analyzed 931021

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	4.10	37.75	13.11	2.85	12199	0.00	0.00	12131	1.0000

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 931014 Thru 000000
Recd in lab. 931019
Location SHAWNEE FP
Lab. No. CS3-6519
Date Analyzed 931021
Analyzed by CSFMSGML

Sample No. SH - 00460 - S
Unit. 9 Status R

Air Dry 5.8 % SO2 4.56 lbs./MBTU
Resid Moist 4.10 % CLM 3.86 %
Total 9.7 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9590	0.869	0.903
% Moisture	4.10			9.7
% Volatile	36.20	37.75	43.44	34.09
% Ash	12.57	13.1		11.8
% Fixed Carbon	47.13	49.15	56.56	44.38
% Sulfur	2.85	2.97	3.42	2.68
BTU	12199	12721	14639	11487

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00475 - S Date Recd in Lab. 931019
Location SHAWNEE FP Lab No. CS3-6534 Date Analyzed 931021

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	4.12	37.13	13.01	2.85	12167	0.00	0.00	12098	1.0000

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 931015 Thru 000000
Recd in lab. 931019
Location SHAWNEE FP
Lab. No. CS3-6534
Date Analyzed 931021
Analyzed by CSFMSSRS

Sample No. SH - 00475 - S
Unit. 4 Status R

Air Dry 3.4 % SO2 4.57 lbs./MBTU
Resid Moist 4.12 % CLM 3.98 %
Total 7.4 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9588	0.870	0.926
% Moisture	4.12			7.4
% Volatile	35.60	37.13	42.68	34.38
% Ash	12.47	13.0		12.0
% Fixed Carbon	47.82	49.87	57.32	46.18
% Sulfur	2.85	2.97	3.42	2.75
BTU	12167	12690	14586	11751

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00503 - S Date Recd in Lab. 931026
Location SHAWNEE FP Lab No. CS3-6775 Date Analyzed 931028

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	2.77	38.38	10.00	2.62	12804	0.00	0.00	12742	1.0000

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 931021 Thru 000000
Recd in lab. 931026
Location SHAWNEE FP
Lab. No. CS3-6775
Date Analyzed 931028
Analyzed by CSPMSGML

Sample No. SH - 00503 - S
Unit. __ Status R

Air Dry 8.2 % SO2 3.99 lbs./MBTU
Resid Moist 2.77 % CLM 2.54 %
Total 10.7 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9723	0.900	0.893
% Moisture	2.77			10.7
% Volatile	37.32	38.38	42.64	34.27
% Ash	9.72	10.0		8.9
% Fixed Carbon	50.19	51.62	57.36	46.10
% Sulfur	2.62	2.69	2.99	2.41
BTU	12804	13169	14632	11760

TVA6585

TVA 6585 COAL ANALYSIS WORKSHEET

Sample No. SH - 00509 - S Date Recd in Lab. 931026
Location SHAWNEE FP Lab No. CS3-6781 Date Analyzed 931028

SEQ	RESIDUAL MOISTURE	MF % VOLATILE	MF % ASH	AA % SULFUR	AA % BTU	FUSE (cm)	ACID (ml)	CORRCTD BTU(lb)	SAMPLE WEIGHT
0001	2.25	37.75	11.77	2.74	12651	0.00	0.00	12586	1.0000

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COAL ANALYSIS RESULTS
(Proximate Analysis)

Date Sampled 931022 Thru 000000
Recd in lab. 931026
Location SHAWNEE FP
Lab. No. CS3-6781
Date Analyzed 931028
Analyzed by CSFMSGML

Sample No. SH - 00509 - S
Unit. Status R

Air Dry 6.6 % SO2 4.22 lbs./MBTU
Resid Moist 2.25 % CLM 2.10 %
Total 8.7 %

	As Determined	Dry (Moist Free)	Dry Ash Free (MAF)	As Received (As Sampled)
Factor		0.9775	0.882	0.913
% Moisture	2.25			8.7
% Volatile	36.90	37.75	42.80	34.47
% Ash	11.51	11.8		10.8
% Fixed Carbon	49.31	50.45	57.20	46.06
% Sulfur	2.74	2.80	3.18	2.56
BTU	12651	12942	14673	11816

COAL ANALYSIS REPORT

CENTRAL LABORATORIES
CHATTANOOGA POWER SERVICE CENTER

Sample Identity	SH 320S	SH 323S	SH 326S	SH 329S	SH 342S
Date Sampled	9/18/93	9/19/93	9/20/93	9/21/93	9/22/93
Laboratory No.	93-6029	93-6030	93-6031	93-6032	93-6033
Air Dry Moisture					
Residual Moisture	4.7	5.2	3.9	4.6	5.1
Total Moisture					
Proximate Analysis					
% Volatile Matter					
% Ash	13.2	12.0	13.6	12.1	12.1
% Fixed Carbon					
% Total Sulfur	3.05	3.13	3.07	3.10	2.99
Btu/lb					
As Received					
Dry					
A and MF					
Ultimate Analysis					
% Carbon	71.6	72.4	71.2	72.5	71.8
% Hydrogen	5.4	5.5	5.2	5.3	5.3
% Nitrogen	1.4	1.4	1.4	1.4	1.4
% Oxygen	5.35	5.57	5.53	5.60	6.41
Forms of S					
% Sulfate					
% Pyritic					
% Organic					
% Total					
Grindability Index					
% Chlorine					

Note: All results are on dry basis unless stated otherwise.

PRELIMINARY COPY

Date _____

Analyzed by _____

Distribution:

TVA 65858 (PO-8-82)

COAL ANALYSIS REPORT

CENTRAL LABORATORIES
CHATTANOOGA POWER SERVICE CENTER

Sample Identity	SH 351S	SH 354S	SH 361S	SH 364S	SH 381S
Date Sampled	9/25	9/26	9/27	9/28	9/29
Laboratory No.	93-6034	93-6035	93-6036	93-6036	93-6038
Air Dry Moisture					
Residual Moisture	3.1	3.7	2.9	3.7	4.4
Total Moisture					
Proximate Analysis					
% Volatile Matter					
% Ash	13.3	12.9	13.1	13.0	12.6
% Fixed Carbon					
% Total Sulfur	2.67	3.00	3.13	2.93	3.04
Btu/lb As Received					
Dry					
A and MF					
Ultimate Analysis					
% Carbon	71.8	72.2	71.5	72.1	71.7
% Hydrogen	5.2	5.3	5.1	5.2	5.3
% Nitrogen	1.4	1.4	1.4	1.40	1.4
% Oxygen	5.63	5.20	5.77	5.37	5.96
Forms of S					
% Sulfate					
% Pyritic					
% Organic					
% Total					
Grindability Index					
% Chlorine					

Note: All results are on dry basis unless stated otherwise.

PRELIMINARY COPY

Date _____

Analyzed by _____

Distribution:

TVA 65658 (PO-8-82)

COAL ANALYSIS REPORT

CENTRAL LABORATORIES
CHATTANOOGA POWER SERVICE CENTER

5 Hawnee

Sample Identity	518 Bu	565 Bu	613 Bu	449 S	457 S
Date Sampled					10/13/93
Laboratory No.	7554	7555	7556	6373	6417
Air Dry Moisture				4.8	6.9
Residual Moisture	2.11	1.83	3.07	3.97	3.19
Total Moisture					
Proximate Analysis					
% Volatile Matter					
% Ash	12.28	12.39	11.69	12.94	13.55
% Fixed Carbon					
% Total Sulfur	2.87	3.16	3.68	2.73	2.53
Btu/lb					
As Received					
Dry					
A and MF					
Ultimate Analysis					
% Carbon	71.4	71.6	72.3	71.0	71.0
% Hydrogen	4.9	4.8	4.9	4.8	4.7
% Nitrogen	1.4	1.4	1.6	1.4	1.4
% Oxygen	7.2	6.6	5.8	7.1	6.8
Forms of S					
% Sulfate					
% Pyritic					
% Organic					
% Total					
Grindability Index					
% Chlorine					

Note: All results are on dry basis unless stated otherwise.

Date 11/17/93

Analyzed by RCB

Distribution:

TVA 6585B (PO-8-82)

COAL ANALYSIS REPORT

CENTRAL LABORATORIES
CHATTANOOGA POWER SERVICE CENTER

Sample Identity	460 S	475 S	491 S	503 S	509 S
Date Sampled	10/14/93	10/15/93	10/19/93	10/21/93	10/22/93
Laboratory No.	6519	6537	6727	6775	6781
Air Dry Moisture	5.8	3.4	6.3	8.2	6.6
Residual Moisture	4.10	4.12	2.33	2.77	2.25
Total Moisture					
Proximate Analysis					
% Volatile Matter					
% Ash	13.11	13.01	12.35	10.00	11.77
% Fixed Carbon					
% Total Sulfur	2.97	2.97	2.88	2.69	2.80
Btu/lb					
As Received					
Dry					
A and MF					
Ultimate Analysis					
% Carbon	71.5	71.0	71.8	73.3	72.9
% Hydrogen	4.7	5.1	5.2	5.4	5.3
% Nitrogen	1.4	1.4	1.4	1.4	1.4
% Oxygen	6.3	6.5	6.4	7.2	5.8
Forms of S					
% Sulfate					
% Pyritic					
% Organic					
% Total					
Grindability Index					
% Chlorine					

Note: All results are on dry basis unless stated otherwise.

Date 11/17/93

Analyzed by RLB

Distribution:

TVA 6588B (PO-8-82)

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SINCE 1908
Member of the SGS Group (Societe Generale de Surveillance)

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2979 E. CENTER ST., CONNEAUT, OH 44030
TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

June 14, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158117
DATE:	5/20/94
TIME:	11:50
TEST NO:	AP-DS-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the DS condition

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	Submitted
Date sampled	------
Date received	May 25, 1994

P.O. NO:

Analysis report no. 88-37047

	As Received	**Dry Basis**
% Moisture	8.42	xxxxx
% Ash	11.20	12.23

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-98 K. D. Mu

Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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SINCE 1908
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2979 E. CENTER ST., CONNEAUT, OH 44030
TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158117
DATE:	5/20/94
TIME:	11:50
TEST NO:	AP-DS-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the DS condition

CORRECTED REPORT

P.O. NO:

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	Submitted
Date sampled	------
Date received	May 25, 1994

Analysis report no. 88-37047

Procedure: The samples were prepared according to ASTM, Part 05.05, Method D 3683. The samples were analyzed for trace elements by Inductively Coupled Plasma Emission Spectroscopy.

Cadmium, Arsenic, Selenium and Antimony are determined by Graphite Furnace Atomic Absorption.

Mercury was determined by Double Gold Amalgamation, Cold Vapor Atomic Absorption.

* Mercury analysis per ASTM D3684 Part 05.05.

Chloride per ASTM Part 05.05, Method D4208

Results: Results are reported as micrograms per gram (ug/g), on a dry basis.

Chloride results are reported in weight percent (Wt.%), on a dry basis.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-99 J C Halovanic
Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (708) 953-9300
SINCE 908
Member of the SGS Group (Societe Generale de Surveillance)

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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158117
DATE:	5/20/94
TIME:	11:50
TEST NO:	AP-DS-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the DS condition

CORRECTED REPORT

P.O. NO:

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	Submitted
Date sampled	------
Date received	May 25, 1994

Analysis report no. 88-37047

PARAMERER	Results	[illegible]
Antimony, Sb	<0.6	<0.55
Arsenic, As	5	4.6
Barium, Ba	680	623
Beryllium, Be	1.2	1.1
Cadmium, Cd	0.11	0.10
Chromium, Cr	19	17
Cobalt, Co	4	3.7
Lead, Pb	6	5.5
Manganese, Mn	36	33
Mercury, Hg *	0.08	0.07
Mercury, Hg	0.07	0.06
Nickel, Ni	8	7
Selenium, Se	3	2.7
Vanadium, V	32	29
Chloride, Cl	0.02	0.02

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-100 J C Halovanic
Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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June 14, 1994

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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158118
DATE:	5/20/94
TIME:	12:00
TEST NO:	AP-DP-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the DP condition

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	Submitted
Date sampled	------
Date received	May 25, 1994

P.O. NO:

Analysis report no. 88-37048

	As Received	Dry Basis
% Moisture	7.87	xxxxx
% Ash	10.94	11.87

Respectfully submitted.
COMMERCIAL TESTING & ENGINEERING CO

E-101 K. D. Meier

Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158118
DATE:	5/20/94
TIME:	12:00
TEST NO:	AP-DP-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the DP condition

CORRECTED REPORT

P.O. NO:

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	Submitted
Date sampled	------
Date received	May 25, 1994

Analysis report no. 88-37048

Procedure: The samples were prepared according to ASTM, Part 05.05, Method D 3683. The samples were analyzed for trace elements by Inductively Coupled Plasma Emission Spectroscopy.

Cadmium, Arsenic, Selenium and Antimony are determined by Graphite Furnace Atomic Absorption.

Mercury was determined by Double Gold Amalgamation, Cold Vapor Atomic Absorption.

* Mercury analysis per ASTM D3684 Part 05.05.

Chloride per ASTM Part 05.05, Method D4208

Results: Results are reported as micrograms per gram (ug/g), on a dry basis.

Chloride results are reported in weight percent (Wt.%), on a dry basis.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-102 J C Halorence
Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158118
DATE:	5/20/94
TIME:	12:00
TEST NO:	AP-DP-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the DP condition

Kind of sample reported to us Coal

Sample taken at -----

Sample taken by Submitted

Date sampled ------

Date received May 25, 1994

CORRECTED REPORT

P.O. NO:

Analysis report no. 88-37048

PARAMERER	Results	5-7.17 - 5 wet basis
Antimony, Sb	<0.6	<0.55
Arsenic, As	6	5.5
Barium, Ba	70	64
Beryllium, Be	1.2	1.1
Cadmium, Cd	<0.05	0.046
Chromium, Cr	19	17.5
Cobalt, Co	5	4.6
Lead, Pb	6	5.5
Manganese, Mn	26	24
Mercury, Hg *	0.07	0.06
Mercury, Hg	0.08	0.07
Nickel, Ni	13	12
Selenium, Se	2	1.8
Vanadium, V	52	48
Chloride, Cl	0.02	0.018

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

J C Halverson
Manager, Conneaut Laboratory

OVER 40 BRANCH LABORATORIES STRATEGICALLY LOCATED IN PRINCIPAL COAL MINING AREAS, TIDEWATER AND GREAT LAKES PORTS, AND RIVER LOADING FACILITIES

COMMERCIAL TESTING & ENGINEERING CO.
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June 14, 1994

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TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158119
DATE:	5/20/94
TIME:	12:15
TEST NO:	AP-BP-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the BP condition

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	Submitted
Date sampled	------
Date received	May 25, 1994

P.O. NO:

Analysis report no. 88-37049

	As Received	**Dry Basis**
% Moisture	10.43	xxxxx
% Ash	10.86	12.12

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-104 K. D. Marin

Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158119
DATE:	5/20/94
TIME:	12:15
TEST NO:	AP-BP-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the BP condition

CORRECTED REPORT

P.O. NO:

Kind of sample reported to us Coal

Sample taken at -----

Sample taken by Submitted

Date sampled ------

Date received May 25, 1994

Analysis report no. 88-37049

Procedure: The samples were prepared according to ASTM, Part 05.05, Method D 3683. The samples were analyzed for trace elements by Inductively Coupled Plasma Emission Spectroscopy.

Cadmium, Arsenic, Selenium and Antimony are determined by Graphite Furnace Atomic Absorption.

Mercury was determined by Double Gold Amalgamation, Cold Vapor Atomic Absorption.

* Mercury analysis per ASTM D3684 Part 05.05.

Chloride per ASTM Part 05.05, Method D4208

Results: Results are reported as micrograms per gram (ug/g), on a dry basis.

Chloride results are reported in weight percent (Wt.%), on a dry basis.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-105 J C Holowman
Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158119
DATE:	5/20/94
TIME:	12:15
TEST NO:	AP-BP-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the BP condition

CORRECTED REPORT

P.O. NO:

Kind of sample reported to us Coal

Sample taken at -----

Sample taken by Submitted

Date sampled ------

Date received May 25, 1994

Analysis report no. 88-37049

$\frac{100 - 10.43}{1.0} = 0.8957$

PARAMERER	1st run	2nd run	[illegible]
Antimony, Sb	<0.6	<0.6	<0.54
Arsenic, As	5	6	5
Barium, Ba	64	64	57
Beryllium, Be	0.9	0.9	0.8
Cadmium, Cd	0.09	0.12	0.094
Chromium, Cr	18	17	15.7
Cobalt, Co	4	4	3.6
Lead, Pb	5	6	5
Manganese, Mn	35	35	31
Mercury, Hg *	0.09		0.08
Mercury, Hg	0.08	0.08	0.07
Selenium, Se	2	2	1.8
Vanadium, V	33	33	26
Chloride, Cl	0.02		0.018

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-106 J C Halonan
Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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June 14, 1994

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TELEX: 985-506 CT&E COUT
FAX: (216) 224-2808

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO: 158116
DATE: 5/20/94
TIME: 11:40
TEST NO: AP-P-Coal Composite
SITE: Ainpol Shawnee Plant
LOCATION: Run 1,2,&3 Composite
SAMPLE DESC: Coal Composite from the ~~P~~ condition
(BS)

Kind of sample reported to us Coal

Sample taken at -----

Sample taken by Submitted

Date sampled ------

Date received May 25, 1994

P.O. NO:

Analysis report no. 88-37046

	As Received	Dry Basis
% Moisture	9.68	xxxxx
% Ash	10.23	11.33

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-107 K.D. Meier

Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (708) 953-9300
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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2806

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158116
DATE:	5/20/94
TIME:	11:40
TEST NO:	AP-P-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the condition (BS)

CORRECTED REPORT

P.O. NO:

Kind of sample reported to us	Coal
Sample taken at	-----
Sample taken by	Submitted
Date sampled	------
Date received	May 25, 1994

Analysis report no. 88-37046

Procedure: The samples were prepared according to ASTM, Part 05.05, Method D 3683. The samples were analyzed for trace elements by Inductively Coupled Plasma Emission Spectroscopy.

Cadmium, Arsenic, Selenium and Antimony are determined by Graphite Furnace Atomic Absorption.

Mercury was determined by Double Gold Amalgamation, Cold Vapor Atomic Absorption.

* Mercury analysis per ASTM D3684 Part 05.05.

Chloride per ASTM Part 05.05, Method D4208

Results: Results are reported as micrograms per gram (ug/g), on a dry basis.

Chloride results are reported in weight percent (Wt.%), on a dry basis.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-108 J C Halvorsen
Manager, Conneaut Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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TELEPHONE: (216) 224-2261
TELEX: 985-606 CT&E COUT
FAX: (216) 224-2808

July 8, 1994

EER CORPORATION
18 Mason
Irvine, CA 92718
Attn: Glenn England

Sample identification by
ENERGY AND ENVIRONMENTAL

NO:	158116
DATE:	5/20/94
TIME:	11:40
TEST NO:	AP-P-Coal Composite
SITE:	Ainpol Shawnee Plant
LOCATION:	Run 1,2,&3 Composite
SAMPLE DESC:	Coal Composite from the ~~P~~ (BS) condition

CORRECTED REPORT

P.O. NO:

Kind of sample reported to us Coal

Sample taken at -----

Sample taken by Submitted

Date sampled ------

Date received May 25, 1994

Analysis report no. 88-37046

PARAMERER	Results	$\frac{\mu g}{gm\ d}$ * $\frac{100-9.68}{100}$ $\frac{gm\ d}{gm\ w}$ = $\mu g/gm$ wt coal
Antimony, Sb	<0.6	< 0.54
Arsenic, As	4	3.6
Barium, Ba	130	117
Beryllium, Be	0.7	0.63
Cadmium, Cd	0.05	0.045
Chromium, Cr	16	14.5
Cobalt, Co	4	3.6
Lead, Pb	5	4.5
Manganese, Mn	19	17
Mercury, Hg *	0.09	0.08
Mercury, Hg	0.08	0.07
Nickel, Ni	10	9
Selenium, Se	1	0.9
Vanadium, V	29	26
Chloride, Cl (wt%)	0.02	0.02

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO

E-109 J C Halovene

Manager, Conneaut Laboratory