A Study of Toxic Emissions from a Coal-Fired Power Plant Utilizing an ESP While Demonstrating the ICCT CT-121 FGD Project

Contract No. DE-AC22-93PC93253
DCN 93-643-004-03

Final Report, 16 June 1994

Prepared by
Radian Corporation
8501 North Mopac Boulevard
P.O. Box 201088
Austin, Texas 78720-1088

Prepared for
U.S. Department of Energy
Pittsburgh Energy Technology Center
P.O. Box 10940
Pittsburgh, Pennsylvania 15236

[U.S. DOE patent clearance is not required prior to the publication of this document.]

CONTENTS

Section **Page**

LIST OF ILLUSTRATIONS

LIST OF TABLES

GLOSSARY

---

acfm	Actual Cubic Foot (Feet) per Minute
AAS	Atomic Absorption Spectrophotometry
ADA	ADA Technologies, Inc.
AP-42	Publication number of the principal emission factor document published by EPA.
APH	Air Preheater
ASTM	American Society for Testing and Materials
B	Data Flag (value has been blank corrected)
Btu	British Thermal Unit
C	Data Flag (with blank correction, value was below detection limit, detection limit reported)
CE	Combustion-Engineering, Inc.
CEM	Continuous Emission Monitor
CEMS	Continuous Emission Monitoring System
Chicago OPC	Chicago Office of Patent Counsel (U.S. DOE)
CI	Confidence Interval
C_p	Pitot Tube Coefficient
CT-121	Chiyoda Thoroughbred-121 (a second-generation flue gas desulfurization process)
CT&E	Commercial Testing & Engineering
CVAA	Cold Vapor Atomic Absorption
CVAFS	Cold Vapor Atomic Fluorescence Spectrometry
DAS	Data Acquisition System
ΔP	"Delta P"; Pressure Drop; Pressure Difference (measured in inches of water column)
DL	Detection Limit

DNPH	Dinitrophenylhydrazine
DQO	Data Quality Objective
dscfm	Dry Standard Cubic Foot (Feet) per Minute
E	Data Flag (analyte concentration exceeded calibration range)
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ESP	Electrostatic Precipitator
FGD	Flue Gas Desulfurization
f/sec	Foot (Feet) per Second
g	Gram(s)
GC/MS	Gas Chromatography/Mass Spectrometry
GDMS	Glow Discharge Mass Spectrometry
g-mole	Gram-Mole (weight of a mole of a substance expressed in grams)
GPC	Georgia Power Company
HAP	Hazardous Air Pollutant
HHV	Higher Heating Value
HPLC	High Performance Liquid Chromatography
IC	Ion Chromatography
ICCT	Innovative Clean Coal Technology (a U.S. DOE program)
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
INAA	Instrumental Neutron Activation Analysis
J	Data Flag (below the lower detection limit)
JBR	Jet Bubbling Reactor (the absorber design used in the CT-121 process)
kg	Kilogram(s)
L	Liter
m	Meter
mL	Milliliter
MM5	Modified Method 5

μg	Microgram(s)
μL	Microliter
μm	Micrometer; 1 x 10^6 meter
NA	Not Applicable
ND	Not Detected
Nm^3	Normal Cubic Meter(s): $1m^3$ @ 0° C and 1.0 atm (equivalent to 37.44 ft^3 @ 68° F and 1.0 atm)
Orsat	Method of Fixed-Gas (O_2, CO_2, CO) Analysis
PAH	Polycyclic Aromatic Hydrocarbon
PCDD	Polychlorinated Dibenzodioxin
PCDF	Polychlorinated Dibenzofuran
PNR	Probe and Nozzle Rinse
POM	Polycyclic Organic Matter
RPD	Relative Percent Difference
PSD	Particle Size Distribution
RSF	Relative Sensitivity Factor (used in mass spectrometry)
RTI	Research Triangle Institute
scf	Standard Cubic Foot (feet): 1 ft^3 @ 68° F and 1.0 atm (equivalent to 0.02671 m^3 @ 0° C and 1.0 atm)
scfm	Standard Cubic Foot (Feet) per Minute
SCS	Southern Company Services, Inc.
SIE	Specific Ion Electrode
SW-846	Publication number of "Test Methods for Evaluating Solid Waste"
TCLP	Toxicity Characteristic Leaching Procedure
Tenax	An organic resin used for sample collection
UV-Vis	Ultraviolet-Visible
VOC	Volatile Organic Compound; Volatile Organic Chemical
VOST	Volatile Organic Sampling Train

EXECUTIVE SUMMARY

The U.S. Department of Energy is performing comprehensive assessments of toxic emissions from eight selected coal-fired electric utility units. This program responds to the Clean Air Act Amendments of 1990, which require the U.S. Environmental Protection Agency (EPA) to evaluate emissions of hazardous air pollutants (HAPs) from electric utility power plants for potential health risks. The resulting data will be furnished to EPA for emissions factor and health risk determinations.

The assessment of emissions involves the collection and analysis of samples from the major input, process, and output streams of each of the eight power plants for selected hazardous pollutants identified in Title III of the Clean Air Act. Additional goals are to determine the removal efficiencies of pollution control subsystems for these selected pollutants and the concentrations associated with the particulate fraction of the flue gas stream as a function of particle size. Material balances are being performed for selected pollutants around the entire power plant and several subsystems to identify the fate of hazardous substances in each utility system.

Radian Corporation was selected to perform a toxics assessment at a plant demonstrating an Innovative Clean Coal Technology (ICCT) Project. The site selected is Plant Yates Unit No. 1 of Georgia Power Company, which includes a Chiyoda Thoroughbred-121 demonstration project.

Site Description

Plant Yates Unit No. 1 is a bituminous coal-fired steam electricity-generating unit with a net generating capacity of 100 megawatts. Located in Newnan, Georgia, the station is owned and operated by Georgia Power Company. The station uses a tangentially fired CE boiler that burns a 2.5%-sulfur blend of Illinois No. 5 and Illinois No. 6 bituminous coals. It uses an electrostatic precipitator to control particulate matter, and the Chiyoda Thoroughbred-121 process controls sulfur dioxide emissions from the entire flue gas stream.

Process Description

The Chiyoda Thoroughbred-121 is a second-generation FGD process employing a unique absorber design, called a jet bubbling reactor, to combine conventional SO_2 absorption, neutralization, sulfite oxidation, and gypsum crystallization in one reaction vessel. The process is designed to operate in a pH range of 3 to 5, where the driving force for limestone dissolution is high, resulting in nearly complete reagent utilization. Oxidation of sulfite to sulfate is also promoted at the lower pH because of the increased solubility of innate oxidation catalysts such as iron. Because all the absorbed SO_2 is oxidized, there is sufficient surface area for gypsum crystal growth to prevent the slurry from becoming significantly supersaturated with respect to calcium sulfate. This significantly reduces the potential for gypsum scaling.

Sampling Locations

Three flue gas stream locations were identified for testing: the ESP inlet, the ESP outlet (FGD inlet), and the stack. The solid streams sampled were raw coal, pulverized feed coal, pulverizer rejects, individual ESP hopper ash, and raw limestone. Samples collected as slurried or sluiced streams include the bottom ash, the combined ESP hopper ash, limestone, and FGD slurry solids. The following liquid streams were sampled: ash pond water, gypsum pond water, ash sluice water (from the bottom ash and fly ash), FGD slurry blowdown filtrate, limestone slurry filtrate, coal pile run-off, and cooling water at the condenser inlet.

Sample Collection

Radian's approach to meeting the test objectives utilized established sampling methods (where possible) and a sampling strategy consistent with that of the EPRI-sponsored Field Chemical Emissions Monitoring (FCEM) program.[1] Samples were collected with the boiler operating within 10% of full load, at steady-state conditions, and in triplicate over two periods of three days each: June 21-23 and June 25-27, 1993.

Detection Limits

Detection limits for the gaseous phase target metals of interest are presented in Table ES-1. These numbers were derived from instrument method detection limits, the volume of gas sampled, and the amount of solid sample that was analyzed. Data are presented for detection limits derived from gas samples collected from the stack. This location was chosen to illustrate typical detection limits, as it represents the highest level of particulate detection limits, due to the low particulate loading at this location. Loading at the stack averaged 0.0145 g/Nm^3, and the numbers presented in the table represent the analysis of approximately 35 mg of particulate collected from a nominal 3 m^3 sample size.

Quality Assurance and Quality Control

During sample collection, quality assurance audits were conducted by Radian's internal QA auditor and by Research Triangle Institute, under contract with EPA. Radian's auditor also conducted a performance evaluation audit by submitting "double-blind" (identity and composition unknown) samples to the analytical laboratories. Quality control procedures involved the evaluation of results for field and laboratory blank samples, duplicate field samples, matrix-spiked and surrogate-spiked samples, and laboratory control samples.

Overall, QA/QC data associated with this program indicate that measurement data are acceptable and defensible. The QA/QC data indicate that the quality control mechanisms

Table ES-1
Detection Limits for Gaseous Phase Target Metals

Specie	Method	Detection Limits, $\mu g/Nm^3$	
		Vapor	Solids
Antimony	ICP-MS	0.004	0.0008
Arsenic	GF-AAS	0.2	0.04
Barium	ICP-AES	0.16	0.09
Beryllium	ICP-AES	0.17	0.03
Boron	ICP-AES	4.6	NA
Cadmium	GF-AAS	0.07	0.17
Chromium	ICP-AES	0.76	0.44
Cobalt	ICP-AES	1.0	0.59
Copper	ICP-AES	1.2	0.44
Lead	GF-AAS	0.25	0.04
Manganese	ICP-AES	0.12	0.46
Mercury	CV-AAS	0.13	0.01
Molybdenum	ICP-AES	1.4	0.15
Nickel	ICP-AES	3.0	1.0
Selenium	GF-AAS	0.26	0.12
Vanadium	ICP-AES	0.72	0.66

NA = Not analyzed, insufficient sample size.

were effective in ensuring measurement data reliability within the expected limits of sampling and analytical error.

Plant Operating Conditions

During sample collection, operating conditions were continuously monitored using a computerized data acquisition system which logged process information as 15-minute averages. In addition, boiler operating data were logged hourly by control room operators. Overall, all processes were very stable, and the key operating parameters were within the targeted range during the entire test period.

Three continuous emission monitors were operated during the test period, providing data for sulfur dioxide, nitrogen oxides, and carbon monoxide. ESP characteristics were monitored by ADA Technologies, Inc.

Analytical Results

Samples were analyzed for trace elements, minor and major elements, volatile organic compounds, and semivolatile organic compounds. Analytical results have been tabulated in detail with 95% confidence intervals and detection limit ratios.

Procedures were provided by DOE for results below the detection limit, values outside the calibration range, and blanks. In the detailed data tabulations, some data have been flagged; for example, some background contamination was encountered.

Data Analysis: Mass Balances, Removal Efficiencies, and Emission Factors

Emission factors, removal efficiencies, and other results rely on measurement data that are near the limit of detection or below it for many of the substances of interest. For that reason, uncertainty analyses and the calculation of confidence intervals were performed as part of this program.

Following are observations as a result of the data analysis:

- Material balances were calculated for 27 elements. Sixty-percent of these met the target closure objectives of 70-130% for balance around the plant. Eight-five percent met a closure criteria of 50-150 percent.

- Removal efficiencies for non-volatile particulate metals averaged greater than 98% across the ESP. The JBR was also effective in further reducing the emission of several metals, due primarily to its effectiveness as a particulate control device.

- Emission factors have been calculated for the target trace elements and are presented in Table ES-2. Thirteen of these elements have emission rates of less than 10 pounds per billion Btu of coal.

Table ES-2
Emission Factors

	$lb/10^{12}$ Btu	95% CI
Anions		
Chloride	742	647
Fluoride	122	67
Selected Elements[a]		
Antimony	0.06	0.01
Arsenic	1.2	0.2
Barium	2.8	9.9
Beryllium	0.1	0.1
Cadmium	0.6	2.1
Chromium	5.3	49.5
Cobalt	0.7	0.8
Copper	2.0	2.3
Lead	0.6	0.6
Manganese	7.2	48
Mercury	3.0	0.3
Molybdenum	1.5	2.6
Nickel	40.1	435
Selenium	26.5	58
Vanadium	2.1	0.5
Aldehydes		
Acetaldehyde	8.6	9.2
Formaldehyde	24	36
Volatile Organics[b,c]		
Benzene	1.3	0.3
Carbon Disulfide	2.2	1.2
Toluene	2.0	1.0

Table ES-2 (Continued)

	$lb/10^{12}$ Btu	95% CI
Semivolatile Organics[d]		
2-Methylphenol (o-cresol)	2.9	3.8
4-Methylphenol (p-cresol)	0.95	1.9
Acetophenone	3.2	0.7
Benzoic Acid	120	7
Benzyl Alcohol	2.8	12
Naphthalene	1.5	1.0
Phenol	9.2	8.8

[a] Run 1 particulate-phase data were invalidated for all elements included here except arsenic, selenium, and vanadium due to the filter background comprising 20% or greater of the measured concentration.

[b] Only those compounds with an average concentration above the detection limit are included.

[c] Methylene chloride, acetone, and other halogenated hydrocarbons are not included because their presence is strongly suspected to be the result of contamination.

[d] Phthalate esters are not included because their presence is suspected to be the results of contamination.

The method used to determine uncertainties in calculated results is based on "Measurement Uncertainty"[2] and is consistent with the approach to handling data used in the FCEM program.

Comparison of Vapor and Particulate Composition

Most of the substances measured at Plant Yates are distributed between the flue gas (vapor) and the particulate matter associated with bottom ash, collected ESP ash, ash removed in the FGD system, or emitted ash which exits with the flue gas through the stack. (The sampling and analytical techniques used for organic compounds did not quantify distribution between particulate and vapor phases.)

At ESP inlet conditions, more than 99% of most of the substances of interest are in the particulate phase. Exceptions are chloride, fluoride, selenium, and mercury. With these same exceptions, the particulate phase is the predominant phase at the ESP outlet and stack.

Distribution of HAPs as a Function of Particle Size in the Flue Gas and the Particle Size Distribution of the ESP

Most of the metals are removed across the ESP at a rate that is approximately the same as that of the total particulate. Exceptions are arsenic, cadmium, phosphorus, and selenium. Arsenic, cadmium, and phosphorus penetration could be due to low concentrations or to association with particles in the range of 0.5 to 2 μm. The selenium penetration is thought to be due to sampling or analytical error.

Mercury Methods Comparison and Speciation Determinations

Two different methods were used to measure mercury concentrations in the flue gas. The Bloom mercury speciation train[3] was used to measure the concentrations of individual vapor-phase mercury species: ionic mercury, elemental mercury, and methyl mercury. Total mercury, particulate and vapor phases, was measured using a multi-metals train.[4]

Ionic mercury appears to be the predominant species in the ESP inlet and ESP outlet gas streams, but ionic mercury is more efficiently removed by the scrubber. Methyl mercury concentrations also appear to decrease across the scrubber.

Hexavalent Chromium Determinations

Hexavalent chromium as well as total chromium were nondetectable in the samples collected after appropriate blank correction had been applied. Although samples were collected as specified by the published method,[5] it should be noted that the collection procedure for obtaining Cr^{6+} samples from a flue gas matrix containing SO_2 has not been validated.

Determinations of Toxics on Particle Surfaces

Because of the health and environmental importance of toxic substances that are found on the surfaces of particles and because these substances are more available to biological and ecological systems, a comparison between bulk composition and surface leachability was performed. Results have been tabulated, and some conclusions can be drawn for individual elements, but no overall trends are clearly evident.

Recommendations and Considerations

Some technical issues have been identified during this study that may warrant further consideration. Among these are the following sampling, analytical and/or process related issues:

- Selenium sampling and analysis;
- Mercury partitioning and speciation; and
- Fly ash penetration of the FGD process.

Selenium

Selenium could not be accurately quantified throughout the process. Apparent problems were associated with both the collection and the analysis of selenium. Further directed study of selenium is recommended. Problems associated with the quantification of selenium are discussed in Section 8.

Mercury

Mercury was collected and analyzed by both Method 29[6] and by the Bloom method[7] which uses charcoal tubes for the absorption and speciation of mercury. Results obtained from these two methods are presented in Section 9. One of the phenomena observed is an apparent increase in the elemental mercury concentration across the FGD system. Another anomaly is the apparent enrichment in fly ash particles of mercury when collected from the flue gas via filtration. These two items warrant further study and investigation.

Fly Ash Penetration of FGD System

The link between particle size, surface orientation of trace elements, and the penetration of fine particles cannot be demonstrated by comparing the extractable and total metal concentrations of the particulate emissions from the FGD system. Fly ash penetration, the mass contribution from sulfuric acid mist and scrubber mist soluble salts (gypsum) add additional variables to the assessment of air toxic emissions as a function of surface orientation. The following penetration mechanisms can potentially impact the analysis of the particulate emissions from wet scrubbers:

- Direct penetration of the fly ash;
- *Capture of the ash particles in the scrubber liquor and re-entrainment during recycle;*
- Entrainment of scrubber-generated solids;
- Evaporation and penetration of scrubber mist as soluble salts; and
- Condensation and recovery of sulfuric acid mist as particulate.

Controlled condensation test methods should be used in future test efforts for measuring sulfuric acid emissions apart from gypsum, and SO_2 artifacts. The analysis of tracer elements associated only with the coal ash may be warranted to determine ash penetration and dilution from scrubber solids. Analysis of size-fractionated particulate emissions could potentially identify the predominant size ranges associated with individual components.

Test efforts to quantify the relative contribution of each phenomenon to particulate emissions may be of interest to those considering wet scrubbers for the control of air toxics as well as SO_2. This data would provide a basis of comparison between the surface extractability of the dry ash entering an FGD system and the particulate emissions downstream.

References

1. Electric Power Research Institute. *Field Chemical Emissions Monitoring (FCEM) Generic Sampling and Analytical Plan.* Draft Report. Palo Alto, CA (May 1994).

2. American Society of Mechanical Engineers. *Measurement Uncertainty: Instruments and Apparatus.* PTC 19.1-1985 (reaffirmed 1990), pp 1-65. United Engineering Center, New York, NY. Published by the American National Standards Institute.

3. Nicolas S. Bloom, Eric M. Prestbo, and Vesna L. Miklavicic, "Fluegas Mercury Emissions and Speciations from Fossil Fuel Combustion." Published in the proceedings of the Second International Conference on Managing Hazardous Air Pollutants (sponsored by the Electric Power Research Institute) Washington, D.C. (July 1993).

4. 40 CFR 266, Subpart H, "Method 29: Determination of Metals Emissions in Exhaust Gases from Hazardous Waste Incineration and Similar Combustion Processes: Proposed Method."

5. 40 CFR 266, Appendix IX: *Methods Manual for Compliance with the BIF Regulations.* "Determination of Hexavalent Chromium Emissions from Stationary Sources (Method Cr^{+6})."

6. 40 CFR 266, Subpart H, "Method 29: Determination of Metals Emissions in Exhaust Gases from Hazardous Waste Incineration and Similar Combustion Processes: Proposed Method."

7. Nicolas S. Bloom, Eric M. Prestbo, and Vesna L. Miklavicic, "Fluegas Mercury Emissions and Speciations from Fossil Fuel Combustion." Published in the proceedings of the Second International Conference on Managing Hazardous Air Pollutants (sponsored by the Electric Power Research Institute) Washington, D.C. (July 1993).

1

INTRODUCTION

Background

The U.S. Department of Energy is performing comprehensive assessments of toxic emissions from eight selected coal-fired electric utility units. These data are being collected in response to the Clean Air Act Amendments of 1990, which require that EPA conduct a study of the emissions of hazardous air pollutants (HAPs) from electric utility power plants, and these emissions be evaluated for potential health risks. The data will be compiled and combined with similar data that are being collected as part of the Field Chemical Emissions Monitoring program[1] sponsored by the Electric Power Research Institute (EPRI) and will then be furnished to the U.S. Environmental Protection Agency for emissions factor and health risk determinations.

The assessments of emissions involve the collection and analysis of samples from the major input and output streams of each of the eight power plants for selected hazardous pollutants contained in Title III of the Clean Air Act. Additional goals of these assessments are to collect data from the selected plants that may be helpful in characterizing removal efficiencies of pollution control subsystems for these selected pollutants and to determine the concentrations associated with the particulate fraction of the flue gas stream as a function of particle size. Material balances will be performed for selected pollutants around the entire power plant and various subsystems to determine the fate of hazardous substances in each utility system.

Radian Corporation was selected to perform one toxics assessment at a plant demonstrating an Innovative Clean Coal Technology (ICCT) Project. The selected site is the Plant Yates Unit No. 1 of Georgia Power Company, which includes the ICCT CT-121 demonstration project.

Objectives

The specific objectives of this project are:

- To collect and subsequently analyze representative solid, liquid, and gas samples of all specified input and output streams of the Plant Yates, Unit No. 1, including the CT-121 flue gas desulfurization system, for selected hazardous air pollutants that are contained in Title III of the 1990 Clean Air Act Amendments and to assess the potential level of release (concentration) of these pollutants;

- To determine the removal efficiencies of specified pollution control subsystems for selected pollutants at Plant Yates Unit No. 1;
- To determine material balances for selected pollutants in specified subsystems of the power plant and an overall material balance for the power plant;
- To determine the concentration as a function of particle size of the respective pollutants associated with the particulate fraction of the flue gas stream of Plant Yates Unit No. 1;
- To determine the concentration of the respective pollutants associated with the particulate and vapor-phase fractions of the specified flue gas streams of Plant Yates Unit No. 1;
- To determine the concentrations of toxic substances on the surfaces of fly ash particles;
- To provide data for EPA for use in risk assessments and in updating publication AP-42[2];
- To determine hexavalent chromium stack emissions; and
- To compare Method 29[3] vapor-phase mercury results with those obtained via charcoal absorption.

Table 1-1 lists the chemical substances analyzed during this project.

Emission factors, removal efficiencies, and other results rely on measurement data that vary and/or may be near the limit of detection or below it for many of the substances of interest. This report includes uncertainty analysis and confidence intervals in order to assess the quality of the data.

Auditing

During the field sampling program conducted at Plant Yates in June 1993, quality assurance audits were conducted by Radian Corporation's internal QA auditor as well as by Research Triangle Institute, under contract with the U.S. Environmental Protection Agency.

Radian's audit was conducted with the purpose of providing an objective, independent assessment of the sampling effort, ensuring that the sampling procedures, data generating, data gathering, and measurement activities produce reliable and useful results. The audit provided a review of calibration documentation, documentation of QC data, completeness of data forms and notebooks, data review/validation procedures, sample logging procedures, and others.

Table 1-1
Target Analytes

Trace Elements

Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Chromium, total
Cobalt
Copper
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Vanadium

Radionuclides

Hexavalent Chromium

Mercury Speciation/Comparison

Anions

Chloride (HCl)
Fluoride (HF)
Sulfates
Phosphates

Reduced Species

Ammonia
Cyanide

Organics

Formaldehyde
Dioxins
Furans

Volatile Organics

Benzene
Bromoform
Carbon Disulfide
Carbon Tetrachloride
Chlorobenzene
Chloroform
1,4-Dichlorobenzene
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethyl Benzene
Ethyl Chloride (Chloroethane)
Ethylene Dichloride (1,2-Dichloroethane)
Ethylidene Dichloride (1,1-Dichloroethane)
Methyl Bromide (Bromomethane)
Methyl Chloride (Chloromethane)
Methyl Chloroform (1,1,1-Trichloroethane)
Methyl Ethyl Ketone (2-Butanone)
Methylene Chloride (Dichloromethane)
Propylene Dichloride (1,2-Dichloropropane)
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,2-Trichloroethane
Trichloroethene
Vinyl Acetate
Vinyl Chloride
Vinylidene Chloride (1,1-Dichloroethene)
m,p-Xylene
o-Xylene

Table 1-1 (Continued)

Semivolatile Organics

Acenaphthene
Acenaphthylene
Acetophenone
4-Aminobiphenyl
Aniline
Anthracene
Benzidine
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Benzoic Acid
Benzyl Alcohol
4-Bromophenyl Phenyl Ether
Butylbenzylphthalate
4-Chloro-3-Methylphenol
p-Chloraniline
bis(2-Chloroethoxy)methane
bis(2-Chloroethyl)ether
bis(2-Chloroisopropyl)ether
1-Chloronaphthalene
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl Phenyl Ether
Chrysene
bis(2-Ethylhexyl)phthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
Methyl Methanesulfonate
3-Methylchlolanthrene
2-Methylnaphthalene
2-Methylphenol (o-cresol)
4-Methylphenol (p-cresol)
N-Nitroso-di-n-butylamine
N-Nitrosodimethylamine
N-Nitrosodiphenylamine
N-Nitrosopropylamine
N-Nitrosopiperidine
Naphthalene
1-Naphthylamine
2-Naphthylamine
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
Di-n-octylphthalate
Dibenz(a,h)anthracene
Dibenz(a,j)acridine
Dibenzofuran
Dibutylphthalate
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
2,4-Dichlorophenol
2,6-Dichlorophenol
2,6-Dichlorophenol
Diethylphthalate
p-Dimethylaminoazobenzene
7,12-Dimethylbenz(a)anthracene
Dimethylphenethylamine
2,4-Dimethylphenol
Dimethylphthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Diphenylamine
1,2-Diphenylhydrazine
Ethyl Methanesulfonate
2-Nitrophenol
4-Nitrophenol
Pentachlorobenzene
Pentachloronitrobenzene
Pentachlorophenol
Phenacetin
Phenanthrene
Phenol
2-Picoline
Pronamide
Pyrene
Pyridine
1,2,4,5-Tetrachlorobenzene
2,3,4,6-Tetrachlorophenol
1,2,24-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2-Fluorobiphenyl
2-Fluorophenol
Nitrobenzene-d5
Phenol-d5
Terphenyl-d14
2,4,6-Tribromophenol

Additional Elements

Aluminum
Calcium
Iron
Magnesium
Potassium
Sodium
Silicon
Strontium
Titanium
Zinc
Uranium (coal only)
Thorium (coal only)

The completeness of the quality assurance data was reviewed to judge whether the quality of the measurement data could be evaluated with the available information. In general, the results of the QC checks available indicate that the samples are well characterized. An evaluation of the accuracy, precision, and bias of the data, even if only on a qualitative level, is considered to be an important part of the data evaluation. A full discussion of each of these components can be found in Appendix D.

RTI was on site during the field sampling program to conduct a systems audit and a performance audit. These audits addressed the Radian sampling program. Results of the RTI audit are presented in Appendix A.

Project Organization

Figure 1-1 shows the organization of this project.

Report Organization

Table 1-2 lists the contents of the major sections and appendices of this final report.

References

1. Electric Power Research Institute. *Field Chemical Emissions Monitoring (FCEM) Generic Sampling and Analytical Plan.* Draft Report. Palo Alto, CA (May 1994).

2. U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards. *Compilation of Air Pollutant Emission Factors, Vol. 1: Stationary Point and Area Sources.* AP 42, 4th ed., Research Triangle Park, NC (September 1985 with periodic updates).

3. 40 CFR 266, Subpart H, "Method 29: Determination of Metals Emissions in Exhaust Gases from Hazardous Waste Incineration and Similar Combustion Processes: Proposed Method."

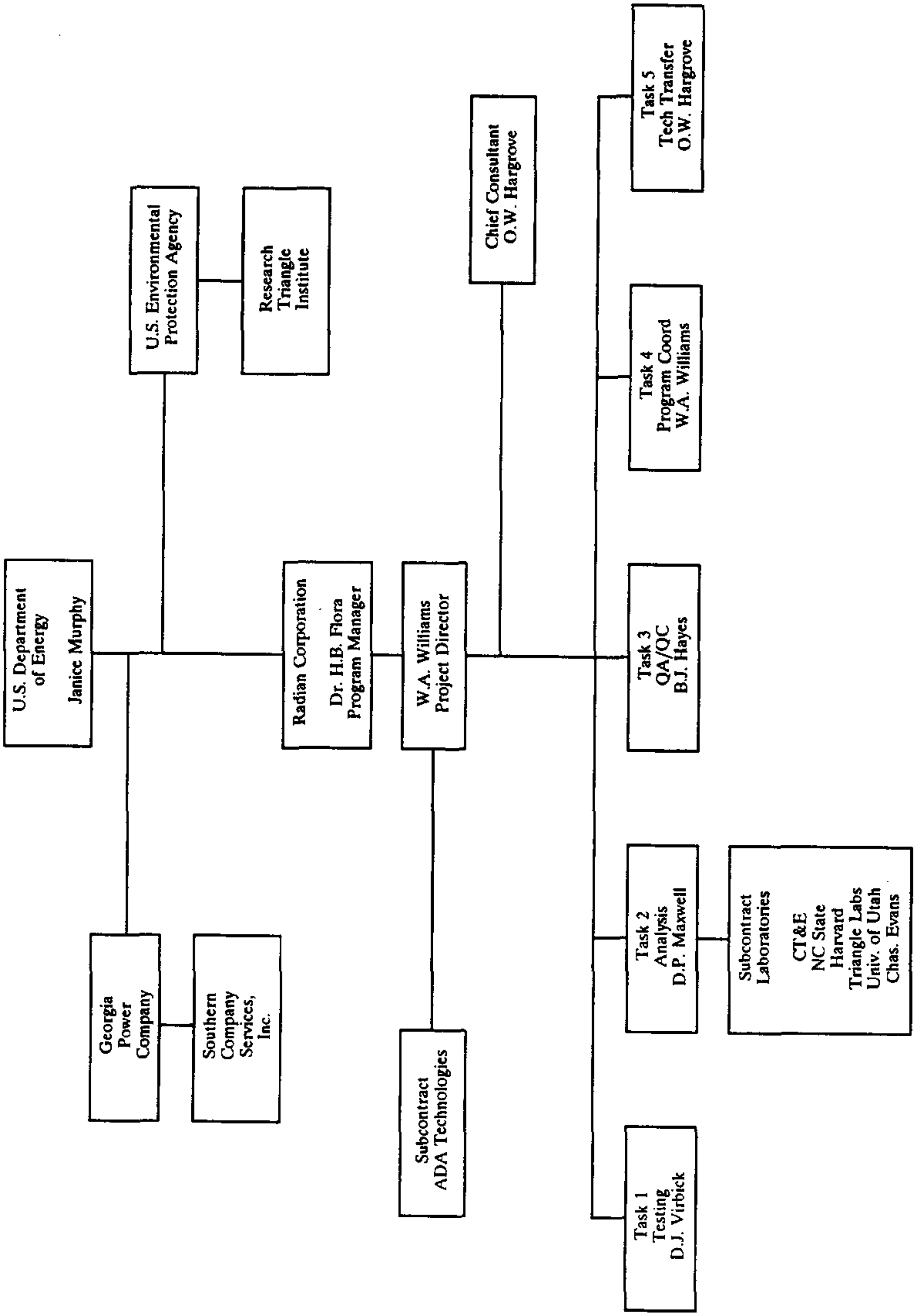


Figure 1-1
Project Organization

Table 1-2
Report Organization

Section	Contents
Glossary	Acronyms, abbreviations, and definitions.
Executive Summary	Stand-alone summary of the document.
Introduction (p. 1-1)	Background, objectives, auditing, contractor organization, and report organization.
Auditing (p. A-1, App. A)	Information on audits conducted by RTI.
Site Description (p. 2-1)	Power plant configuration, process description, sampling locations, and plant operating conditions.
Sample Collection (p. 3-1)	Sampling schedule, test matrix, samples collected, sample handling, sample presentation, sample compositing.
Sampling Protocol (p. B-1, App. B)	Method descriptions, sample train disassembly, sample preparation for transportation, and storage.
Sample Preparation and Analysis Methods (p. 4-1)	Preparation procedures and chemical analysis methods for gases, liquids, and solids.
Analytical Protocol (p. E-1, App. E)	Method descriptions, deviations, and modifications.
Analytical Results (p. 5-1)	Tabulated analytical information for gases, liquids, and solids.
Sampling Data Sheets (p. C-1, App. C)	Data for gas samples, including calculations for samples at the stack outlet.
Data Analysis and Interpretation (p. 6-1)	An evaluation of the overall quality of the data, material balances, trace species removal efficiencies, and emission factor determinations.
Quality Assurance/Quality Control (p. D-1, App. D)	Radian systems and performance audits: precision, accuracy, and completeness in the areas of sample collection, analysis, and DQOs. Detailed QA/QC results in tabular form.

Table 1-2 (Continued)

Section	Contents
Uncertainty Analysis (p. F-1, App. F)	Description of how the error propagation analysis was performed on calculated results.
Treatment of Non-Detects, Values Outside of the Calibration Range, and Blanks (P. G-1, App. G)	Information provided by DOE.

2

SITE DESCRIPTION

Power Plant Configuration

The Plant Yates Unit No. 1 is a bituminous coal-fired steam electricity-generating unit with a net generating capacity of 100 megawatts. Located in Newnan, Georgia, the station is owned and operated by Georgia Power Company. Unit 1 includes a tangentially fired CE boiler that burns a 2.5% sulfur blend of Illinois No. 5 and Illinois No. 6 bituminous coals, an electrostatic precipitator for particulate control, and the CT-121 flue gas desulfurization system for sulfur dioxide (SO_2) emissions control during the ICCT demonstration.[1]

A process flow diagram of the Plant Yates facility that includes sampling locations is presented in Figure 2-1. Flue gas flows through a single duct into the ESP, which is four chambers wide and three rows of chambers deep; however, only the first two rows of chambers are energized. The ESP has a separate row of hoppers to collect the fly ash from each field, i.e., one row of hoppers per field. After the ESP, the flue gas flows through a single ID fan and then to the CT-121 system. The flue gas exiting the CT-121 unit is vented to the atmosphere through a 250-foot exhaust stack. No other units at the station use this stack.

Process Description: Major Process Streams

CT-121 Wet FGD System

The CT-121 is a second-generation FGD process which employs a unique absorber design, called a jet bubbling reactor (JBR), to combine conventional SO_2 absorption, neutralization, sulfite oxidation, and gypsum crystallization in one reaction vessel. The process is designed to operate in a pH range (3 to 5) where the driving force for limestone dissolution is high, resulting in nearly complete reagent utilization. Oxidation of sulfite to sulfate is also promoted at the lower pH because of the increased solubility of innate oxidation catalysts such as iron (Fe). Because all of the absorbed SO_2 is oxidized, there is sufficient surface area for gypsum crystal growth to prevent the slurry from becoming significantly supersaturated with respect to calcium sulfate. This significantly reduces the potential for gypsum scaling, a problem that frequently occurs in natural-oxidation FGD systems. Since much of the crystal attrition and secondary nucleation associated with the large centrifugal pumps in conventional FGD systems is also eliminated in the CT-121 design, large, easily dewatered gypsum crystals can be produced.

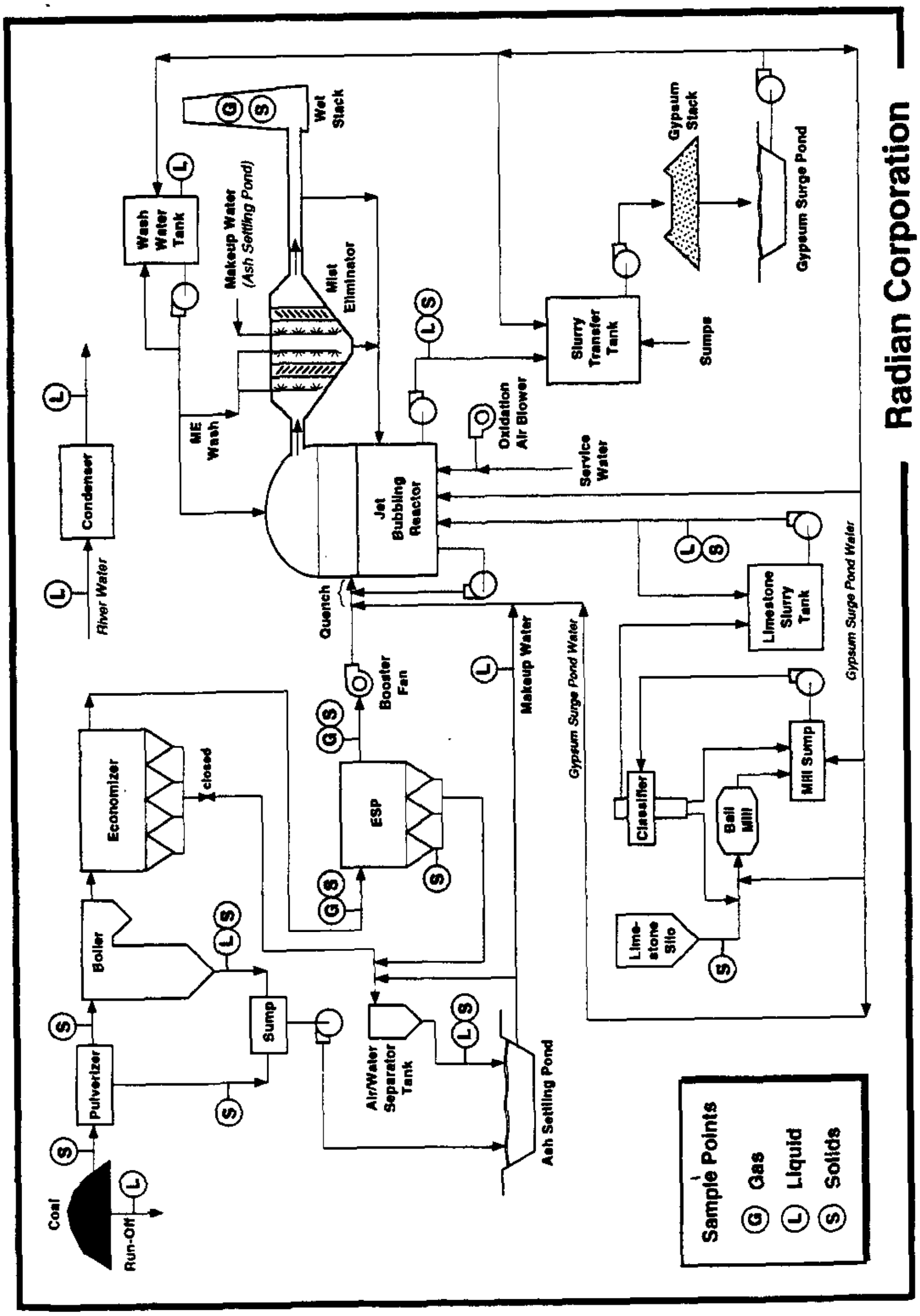


Figure 2-1
Simplified Process Flow Diagram Illustrating Sampling Locations and Flue Gas Flow

Gas Cooling Section. Flue gas from the boiler passes through the ESP and is pressurized by the Unit 1 I.D. fan. From the fan, the flue gas enters the gas cooling section. Here the flue gas is cooled and saturated with a mixture of JBR slurry, makeup water, and pond water. The quench slurry is sprayed into the gas at a liquid-to-gas ratio of about 10 gal/1000 acf at full boiler load using two centrifugal gas cooling pumps. The suction for the gas cooling pumps is located near the bottom of the JBR.

JBR. From the gas cooling section, the flue gas enters the JBR. The JBR is the central feature of the CT-121 process. The gas enters an enclosed plenum chamber formed by an upper deck plate and a lower deck plate. Sparger tube openings in the lower deck plate force the gas into the slurry contained in the jet bubbling (froth) zone of the JBR vessel. After bubbling through the slurry, the gas flows upward through gas risers which pass through both the lower and upper deck plates. Entrained liquor in the gas disengages in a second plenum above the upper deck plate, and the cleaned gas passes to the mist eliminator.

The slurry in the JBR can be divided into two zones: the jet bubbling or froth zone and the reaction zone. SO_2 absorption occurs in the froth zone, while neutralization, sulfite oxidation, and crystal growth occur in both the froth and reaction zones.

The froth zone is formed when the untreated gas is accelerated through the sparger tubes in the lower deck and bubbled beneath the surface of the slurry at a depth of 6 to 16 inches. The froth zone provides the gas-liquid interfacial area for SO_2 mass transfer to the slurry. The bubbles in the froth zone are continually collapsing and reforming to generate new and fresh interfacial areas and to transport reaction products away from the froth zone to the reaction zone. The amount of interfacial area can be varied by changing the level in the JBR, and consequently, the injection depth of flue gas. The deeper the gas is injected into the slurry, the greater the interfacial area for mass transfer and the greater the SO_2 removal. In addition, at deeper sparger depths, there is an increase in the gas-phase residence time. SO_2 removal can also be increased by increasing the pH of the slurry in the froth zone, since a higher pH results in higher slurry alkalinity. The pH is controlled by the amount of limestone fed to the reaction zone of the JBR.

The solids concentration in the JBR is maintained at a constant level by removing a slurry stream from the bottom of the reaction zone and pumping this stream to a holding tank (gypsum slurry transfer tank), where it is diluted with pond water before being pumped to the gypsum stack. This is done to keep the velocity high over a range of operating conditions.

The oxygen which reacts with absorbed SO_2 to produce sulfate is provided to some extent by oxygen diffusion from the flue gas, but the predominant source is air bubbled into the reaction zone of the JBR. The oxidation air lines enter through the very top of the JBR vessel, penetrate the upper and lower deck plates, and introduce the air near the bottom of the JBR. Oxygen diffuses from the air into the slurry as the bubbles rise to the froth zone of the JBR. Excess air mixes with the flue gas and exits the JBR to the mist eliminator. Before the oxidation air enters the JBR, it is saturated with service water to prevent a wet-dry interface at the discharge of the oxidation air lines.

Ash and Cooling System

Plant Yates uses an ash settling and storage area consisting of one ash-settling pond. Bottom ash from the boiler and pyrites from the pulverizers are sluiced together and are disposed of in the ash-settling pond. The ESP ash, economizer ash, and air preheater ash are also sluiced together and disposed of in the same ash-settling pond. Water from the Chattahoochee River is used for cooling water in a once-through type steam condenser.

ESP Design

The ESP is a conventional weighted wire configuration typical of many of the older ESPs found on coal-fired utility boilers in the Midwest and Eastern parts of the United States. Details of the ESP are provided in Table 2-1. The specific collection area (SCA) is 210 ft^2/kacfm at full load. This size is representative of the ESPs built during the 1970s to provide collection efficiencies of 95 to 99 percent. The plate-to-plate spacing is 9 inches, which is typical for this vintage ESP. Current ESP design standards use 12- to 16-inch spacing to reduce the impact of plate or wire misalignment which can cause sparking at lower voltages. The velocity is somewhat lower than many of the older ESPs which often operate at velocities of 6 or 7 ft/sec. The average ESP velocity of 4.4 ft/sec is more characteristic of modern design practices.

Figure 2-2 shows a schematic layout of the ESP. The ESP is configured with three mechanical sections and four electrical sections. As shown in the schematic, the arrangement is somewhat unusual in that the mechanical sections are not aligned with the electrical sections. This provided some minor difficulties in modeling the performance of the ESP, as described in Section 8.

Figure 2-2 also identifies the rapping components. The Plant Yates ESP uses a Forry Rapper Control System programmed to operate vibrators on the high voltage wire frames and electromechanical rappers on the collector plate assemblies. Table 2-2 presents a detailed breakdown of the rapping frequencies. The high-voltage wire frame vibrators are on a 12 minute repeat cycle and have 2 second on-times. The collector plate rappers have a 30 minute repeat cycle and are energized to lift the 20-pound solenoids nominally four inches before releasing them. The rapping cycles are offset so that only one section of the plates is rapped at any single period of time. This rapping procedure results in smaller but more frequent spikes in opacity.

Process Description: Sampling Locations

Samples were collected from streams representing three types of matrices: gases, solids, and liquids. Gaseous samples were collected from the inlet and outlet of the ESP and from the stack. Solids were collected of the coal feed, bottom and fly ashes, limestone,

Table 2-1
Summary of Design Data on the Yates Unit #1 ESP

Manufacturer	Buell
Housing	1 ESP Box
Mechanical Sections	3
Electrical Sections	4
Gas Flow Passages	82
Collector Electrodes	
Plate Spacing	9 inches
Plate Height	30 ft
Total Plate Length	21 ft
Length of Sections	9 ft Section 1, 6 ft for Sections 2 & 3
Total Plate Area	103,320 ft^2
Total Cross Section Area	1845 ft^2
Gas Conditions	
Gas Flow at Full Load	491,000 acfm
Gas Velocity at Full Load	4.4 ft/second
Residence Time at Full Load	4.7 seconds
SCA at Full Load	210 ft^2/kacfm
Emitter Design	
Design	Weighted Wire
Diameter	0.110 inches
Spacing	8 inches
Number	2,296
Total Wire Length	68,880 ft

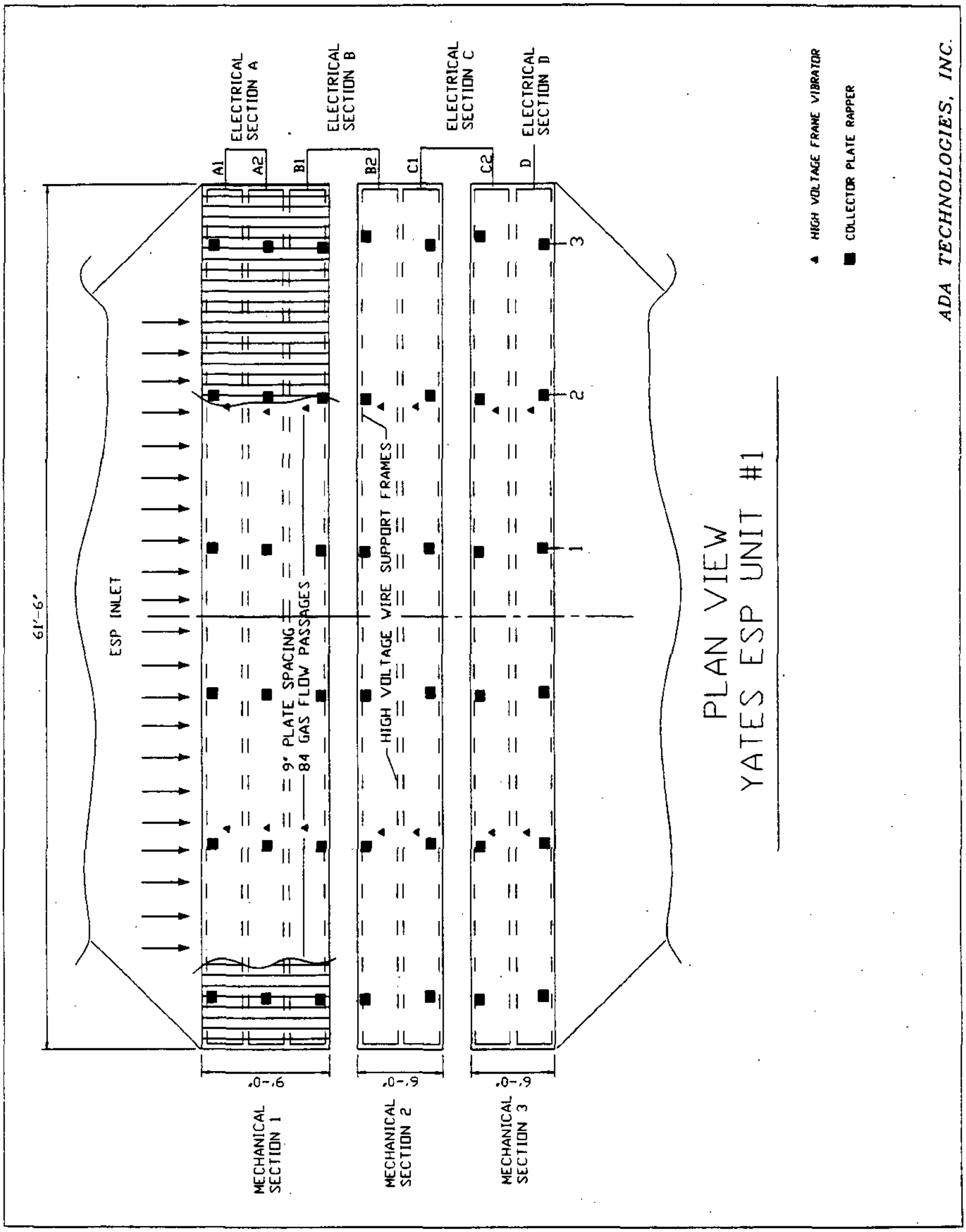


Figure 2-2
Plan View Plant Yates ESP Unit #1

Table 2-2
ESP Rapping Schedule
Plant Yates Unit #1

Mechanical Section	Rapper Type	Cycle Repeat Time	Rapper Identification	Activated (minutes into cycle)
1	HV Vibrator (1 vibrator per frame)	12 minutes	HV: A1 HV: A2 HV: B1	4 8 12
2	HV Vibrator	12 minutes	HV: B2 HV: C1	5 10
3	HV Vibrator	12 minutes	HV: C2 HV: D	6 12
1	Plate Rapper (1 rapper per plate support)	30 minutes	Plate: A1-1 Plate: A1-2 Plate: A1-3	4 8 12
1	Plate Rapper	30 minutes	Plate: A2-1 Plate: A2-2 Plate: A2-3	5 10 15
1	Plate Rapper	30 minutes	Plate: B1-1 Plate: B1-1 Plate: B1-3	6 12 18
2	Plate Rapper	30 minutes	Plate: B2-1 Plate: B2-2 Plate: B2-3	7 14 21
2	Plate Rapper	30 minutes	Plate: C1-1 Plate: C1-2 Plate: C1-3	8 16 24
3	Plate Rapper	30 minutes	Plate: C2-1 Plate: C2-2 Plate: C2-3	9 18 27
3	Plate Rapper	30 minutes	Plate: D-1 Plate: D-2 Plate: D-3	10 20 30

Note: Rapping frequency and cycles are duplicated for each side of the ESP.

and FGD slurry. Liquids included the makeup waters, sluice waters associated with the ash steams, and filtrate from the limestone and FGD slurry streams, cooling water, and coal pile runoff. Figure 2-1 illustrates the sampling locations which are described in detail in the following sections.

Flue Gas Sample Streams

Three flue gas stream locations were identified for testing:

- ESP inlet;
- ESP outlet (FGD inlet); and
- Stack.

The ESP inlet sampling location is located at ground level. Sixteen four-inch ports are located horizontally just downstream of where two ducts which exit the air preheater are combined.

The ESP outlet location is located approximately 60 feet above ground level. Six four-inch ports are located vertically across the duct.

The stack sampling location is approximately 120 feet above ground level and has four four-inch ports, equally spaced at 90 degrees.

Solid Sample Streams

Solid streams sampled were the following:

- Raw coal;
- Pulverized feed coal;
- Pulverizer rejects;
- Bottom ash;
- ESP fly ash;
- Raw limestone;
- Limestone slurry solids; and
- FGD slurry solids.

Solid samples were collected concurrent with the gas stream testing and are considered to be representative of process operation.

Coal Samples. The sample locations for collecting coal samples are located around each of the four coal pulverizers serving Unit 1. Samples of raw coal were collected from each pulverizer feed chute after the weigh belt. Feed coal samples were collected at the exit of each pulverizer, just prior to the boiler feed, and the pulverizer rejects were collected at the inlet to each reject hopper.

Ash Samples. Bottom ash samples were collected wet at the bottom ash sluice water sump upstream of the bottom ash sluice pumps. Bottom ash was separated from the sluice water by allowing the solids to settle and siphoning off the sluice water. ESP fly ash was collected dry from the clean-out ports of the two energized banks of ESP hoppers, and sluiced ESP fly ash was also collected at the sluice water discharge to the ash pond.

Limestone. Limestone samples were collected from two sampling locations. Raw limestone was collected off the weigh belt feed to the grinding mill, and limestone slurry was collected from a sample tap on the recirculating limestone slurry feed line to the JBR. Slurry samples were filtered to obtain the solids.

FGD Solids. FGD solids were sampled from a sample tap at the discharge of the JBR underflow slurry pumps. The solids were filtered through a filter press to separate the solid and liquid phases at the time of collection.

Liquid Sample Streams

The following liquid streams were sampled:

- Ash pond water;
- Gypsum pond water;
- Ash sluice water (bottom ash and fly ash);
- FGD slurry blowdown filtrate;
- Limestone slurry filtrate;
- Coal pile run-off; and
- Cooling water at the condenser inlet.

Liquid samples were collected concurrent with the gas-phase testing and are considered to be representative of process operation during that time period.

Pond Waters. Ash and gypsum pond water were sampled from sample taps. The ash pond water sample tap is located near the limestone slurry tank containment area where ash pond water is used in limestone slurry preparation. Gypsum pond water was collected from a sample tap located on the mist eliminator wash water tank.

Ash Sluice Water. Bottom ash and ESP fly ash sluice water samples were obtained by siphoning the aqueous phase of the ash/water sluice mixture from the solid phase after allowing approximately 2 hours for the solids to settle. The collection points for the ash sluice samples are described in the section on solid sample streams.

Limestone and FGD Filtrates. The aqueous phases of the limestone slurry and JBR underflow slurry were obtained from filtration of the collected solids samples described earlier. Limestone slurry and all FGD filtrates for organic compound analyses were sampled from a filter press at the point of collection to avoid loss of organics and to prevent further reactions in the FGD slurry matrix.

Coal Pile Run-off. Coal pile run-off collection was performed after a rain storm. Samples were collected from shallow trenches leading from the coal pile to the run-off collection pond.

Condenser Water Samples. Cooling water samples at the inlet of the turbine steam condenser were collected from a sample tap located at the discharge of the cooling water pumps.

Plant Operating Conditions

Operating conditions were continuously monitored via a computerized data acquisition system (DAS) which logged process information as 15 minute averages. In addition, boiler operating data were logged hourly by the control room operators. Of the total amount of data collected, key parameters have been summarized and are presented in Table 2-3. These data reflect the general stability of the process. Unit load and furnace gas oxygen concentrations are shown graphically in Figures 2-3 and 2-4. The dashed lines represent the bounds of what is considered normal operation. Also, the grey shaded areas represent the periods during which testing was being performed. Key operating parameters for the CT-121 process are shown in Figures 2-5 and 2-6. Overall, all processes were very stable and the key operating parameters were within the targeted range during the entire test period.

Three continuous emission monitors were operated during the test period. Sulfur dioxide and nitrogen oxides were monitored continuously by existing Plant Yates instrumentation. Carbon monoxide was monitored using an instrument supplied by Radian. The results of the CEM monitoring are presented in Figures 2-7, 2-8, and 2-9.

Table 2-3
Summary of Process Monitoring Data[a]

Parameter	6/21	6/22	6/23	6/25	6/26	6/27
Boiler:						
Load (MW)	101	101	101	100	100	101
Coal Flow (1,000 lb/hr, wet)	89	88	89	90	91	92
Furnace O_2 (%)	3.5	3.6	3.5	3.3	3.3	3.4
Burners in Service	16	16	16	16	16	16
ESP:						
Opacity (%)	15.0	14.4	16.0	17.1	17.7	18.6
JBR:						
SO_2 removal[b] (%)	93.0	91.6	90.7	88.8	--[c]	--[c]
Scrubber pH	4.6	4.5	4.5	4.5	4.5	4.5
JBR ΔP (Inches H_2O)	14.1	14.1	14.1	14.1	14.1	14.1
Stack:						
O_2 (%, dry)	8.2	8.0	7.9	7.7	7.7	7.6
SO_2 (ppmv, dry)	160	181	202	236	182	186
NO_x (ppmv, dry)	430	490	470	430	420	320
CO (ppmv, dry)	3.5	--[d]	2.6	2.6	2.0	5.7

[a] Daily averages.

[b] Based upon SO_2 corrected to 3% O_2.

[c] Inlet O_2 monitor not functioning properly.

[d] CO monitor not functioning properly.

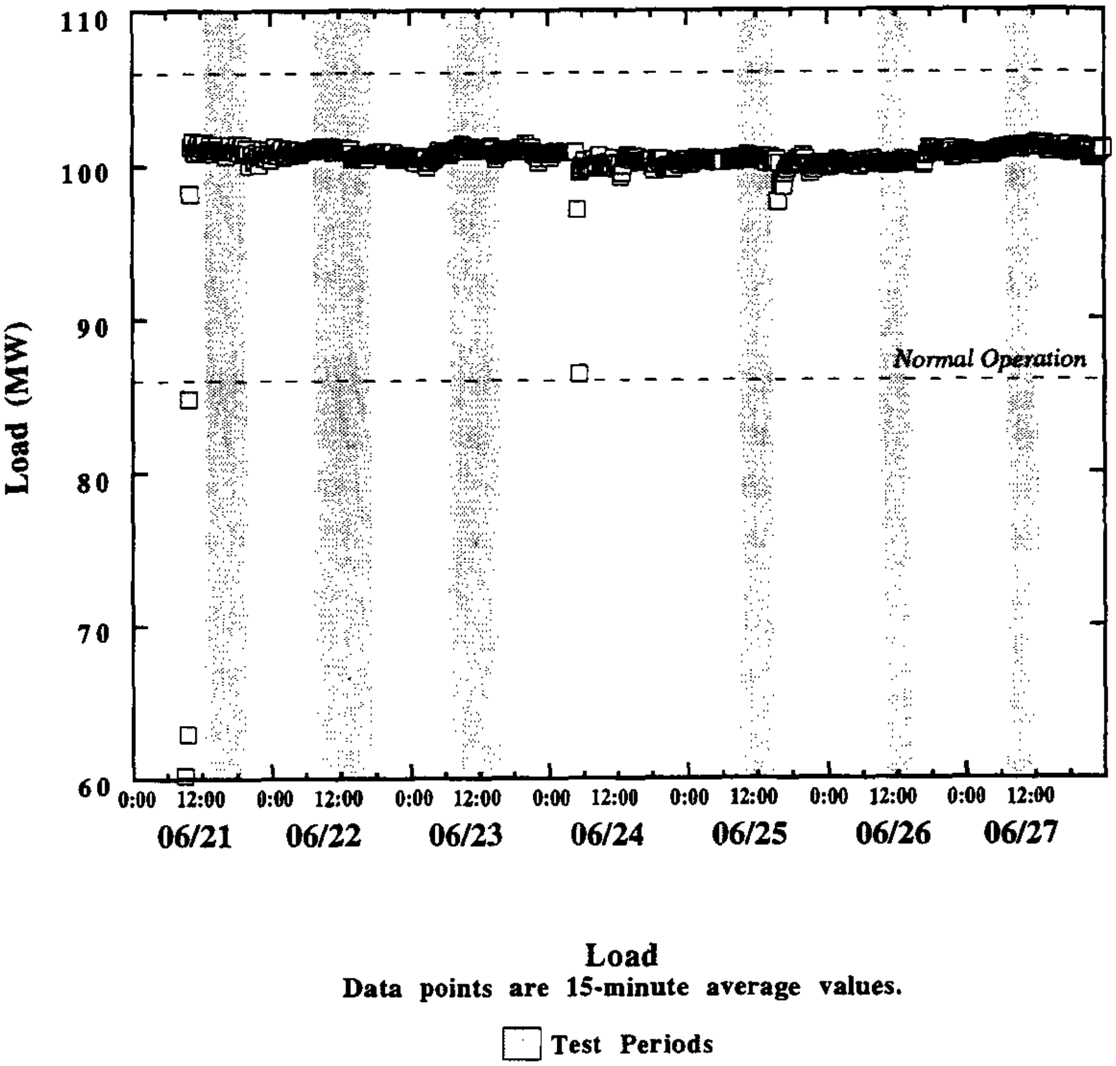


Figure 2-3
Unit 1 Load

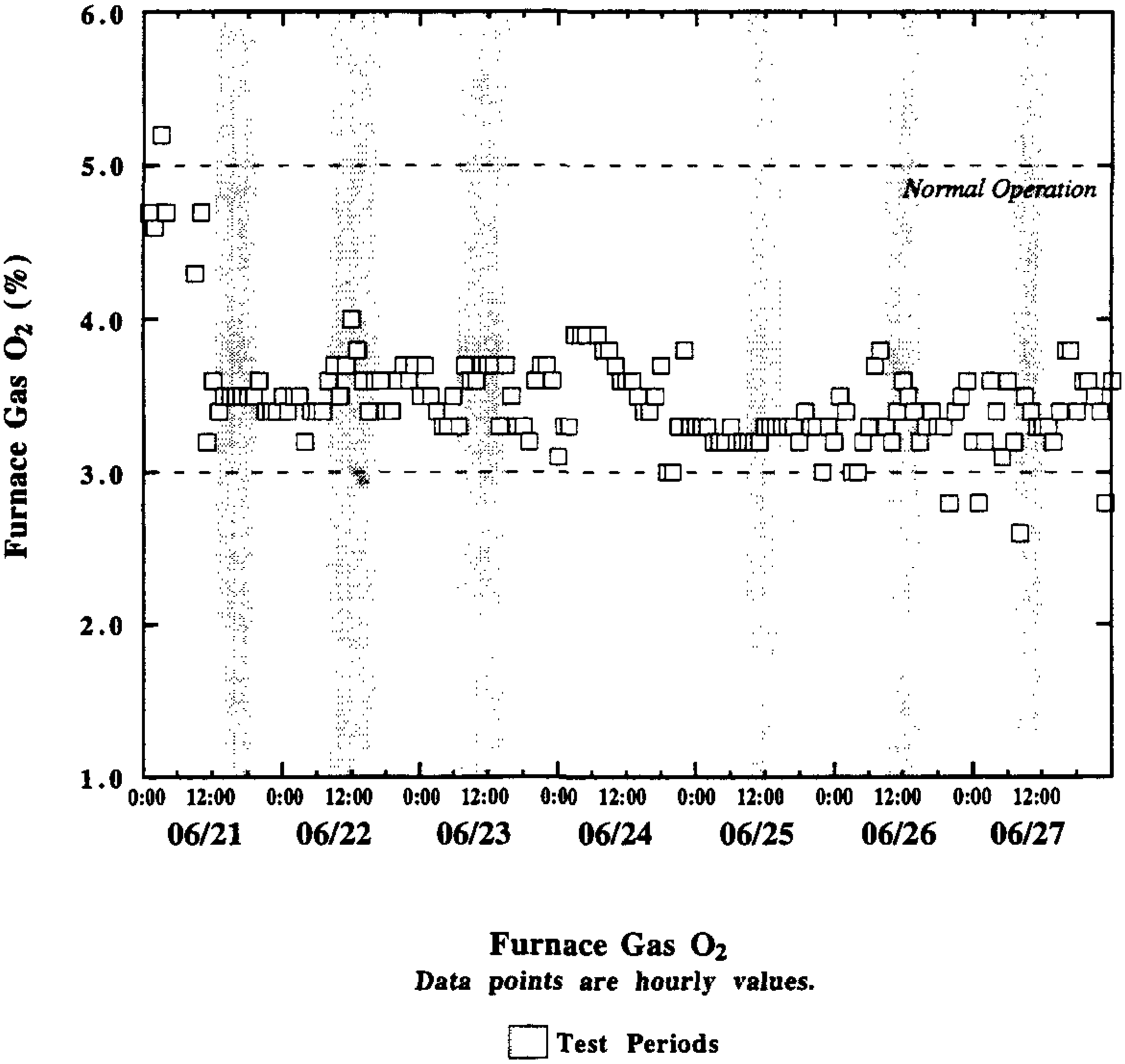


Figure 2-4
Furnace Gas Oxygen

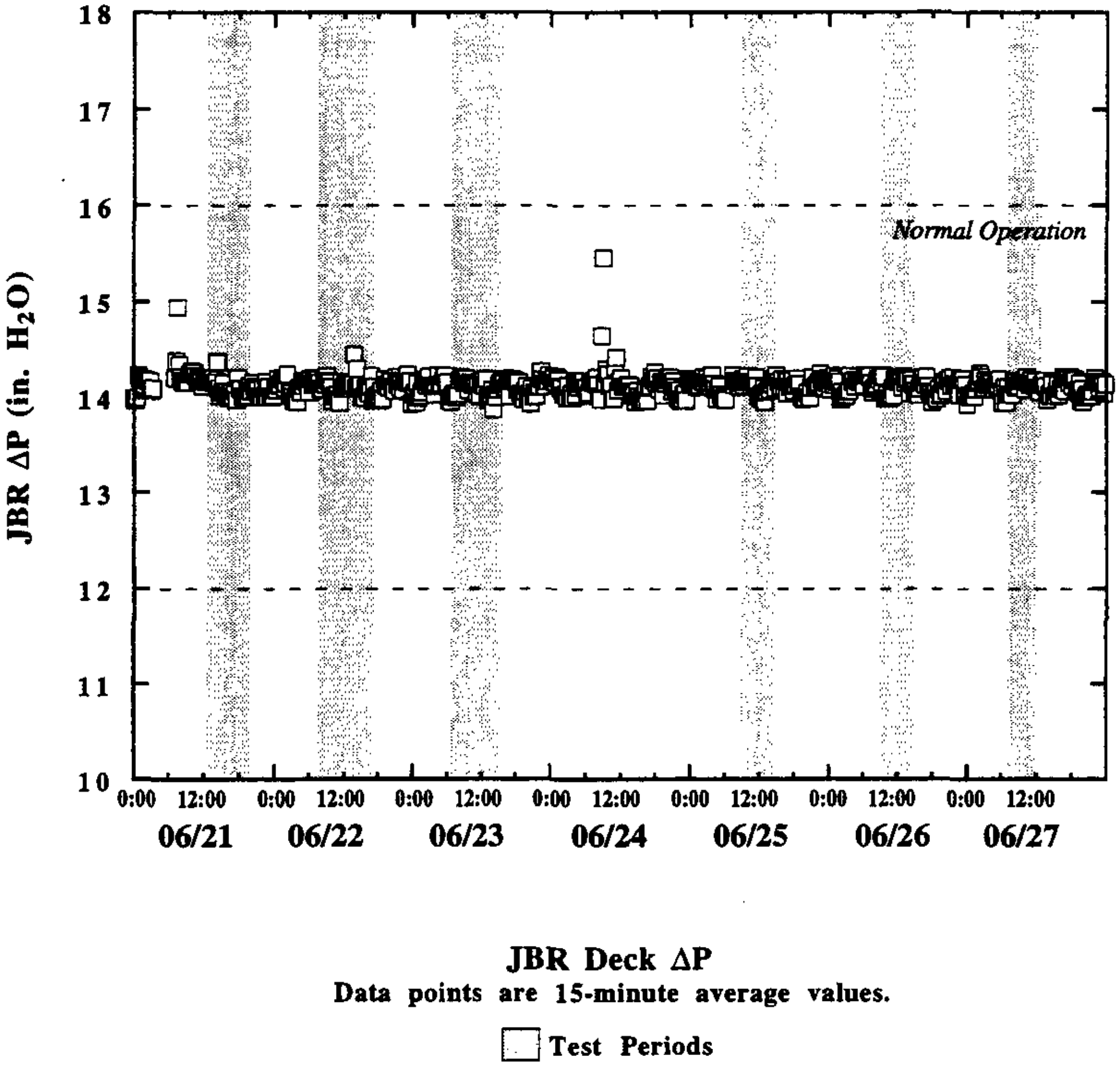


Figure 2-5
JBR Pressure Drop

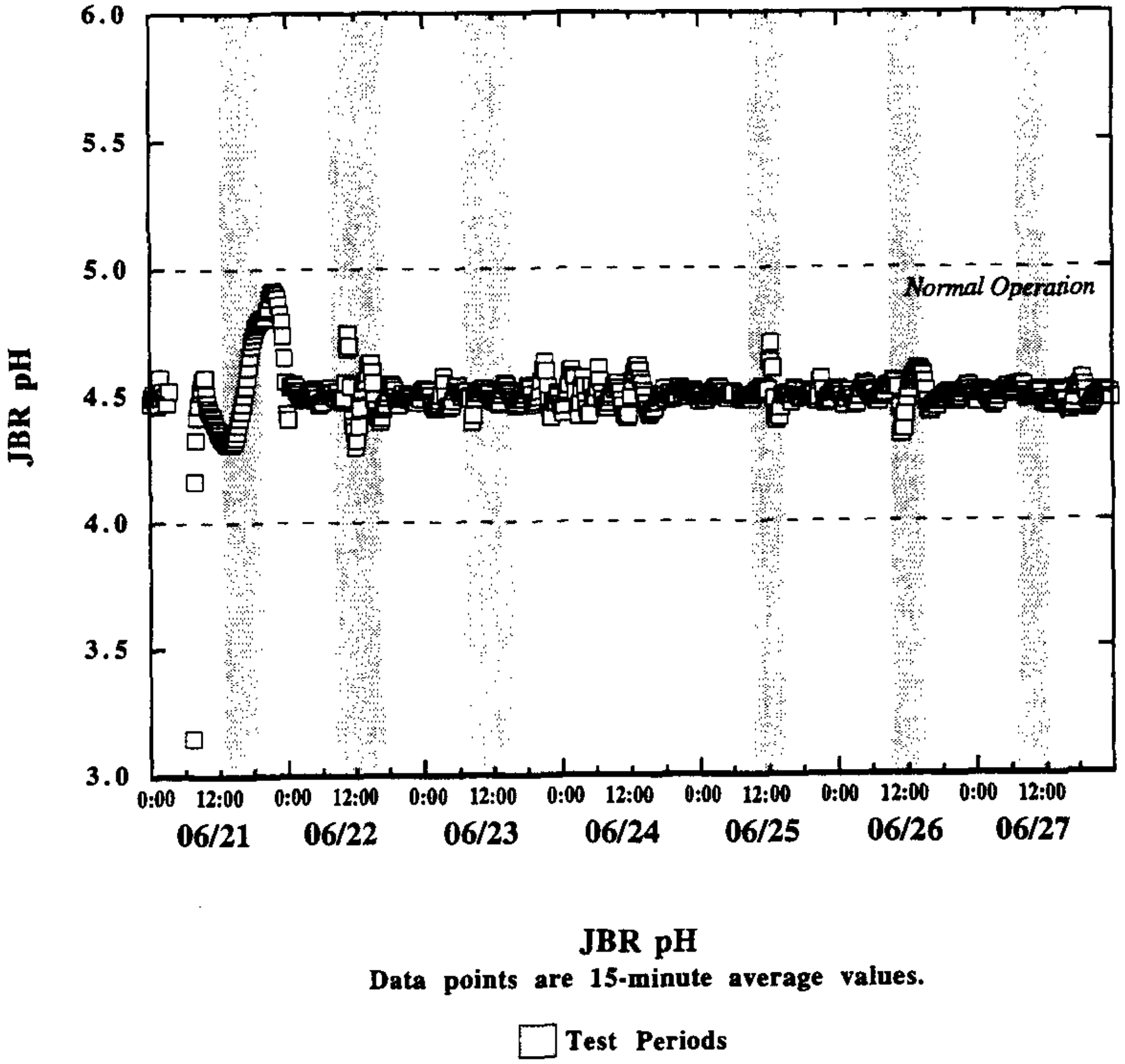
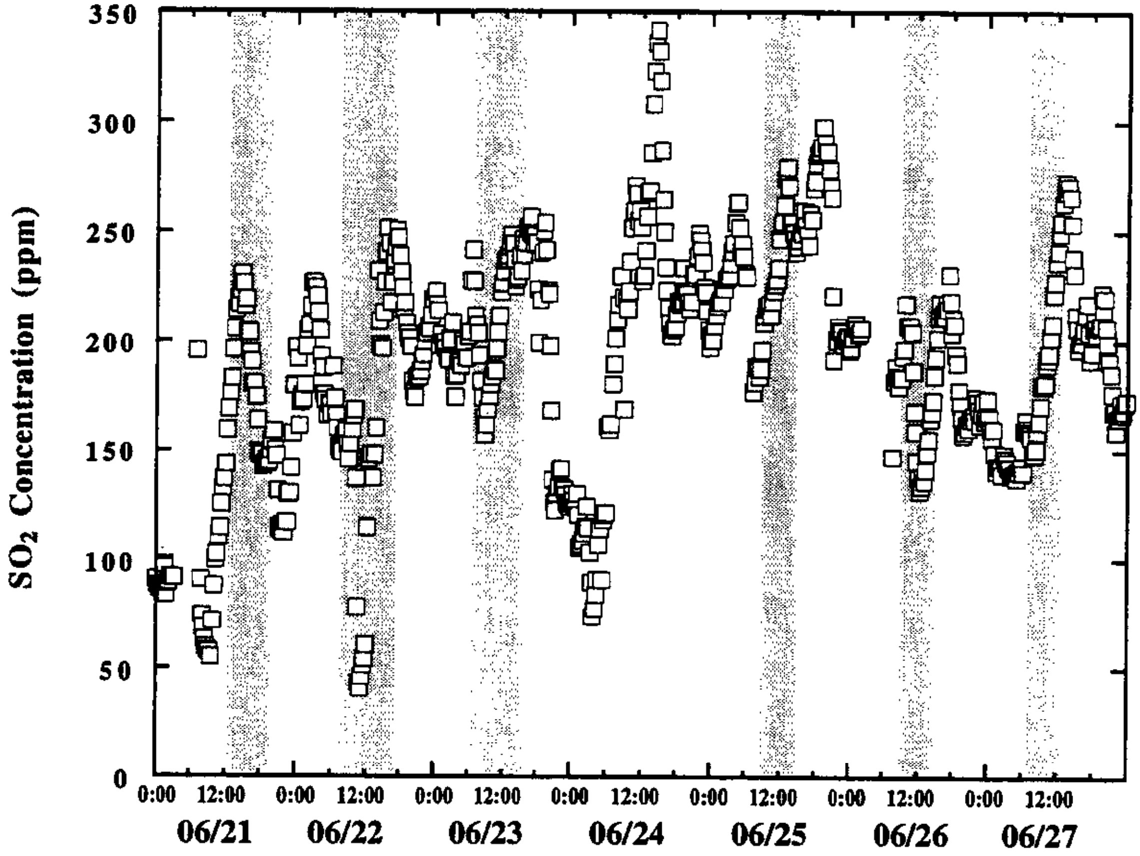


Figure 2-6
JBR pH



Stack SO$_2$ Concentration @ 3% O$_2$

Data points are 15-minute average values.

▨ **Test Periods**

Figure 2-7
Stack SO$_2$

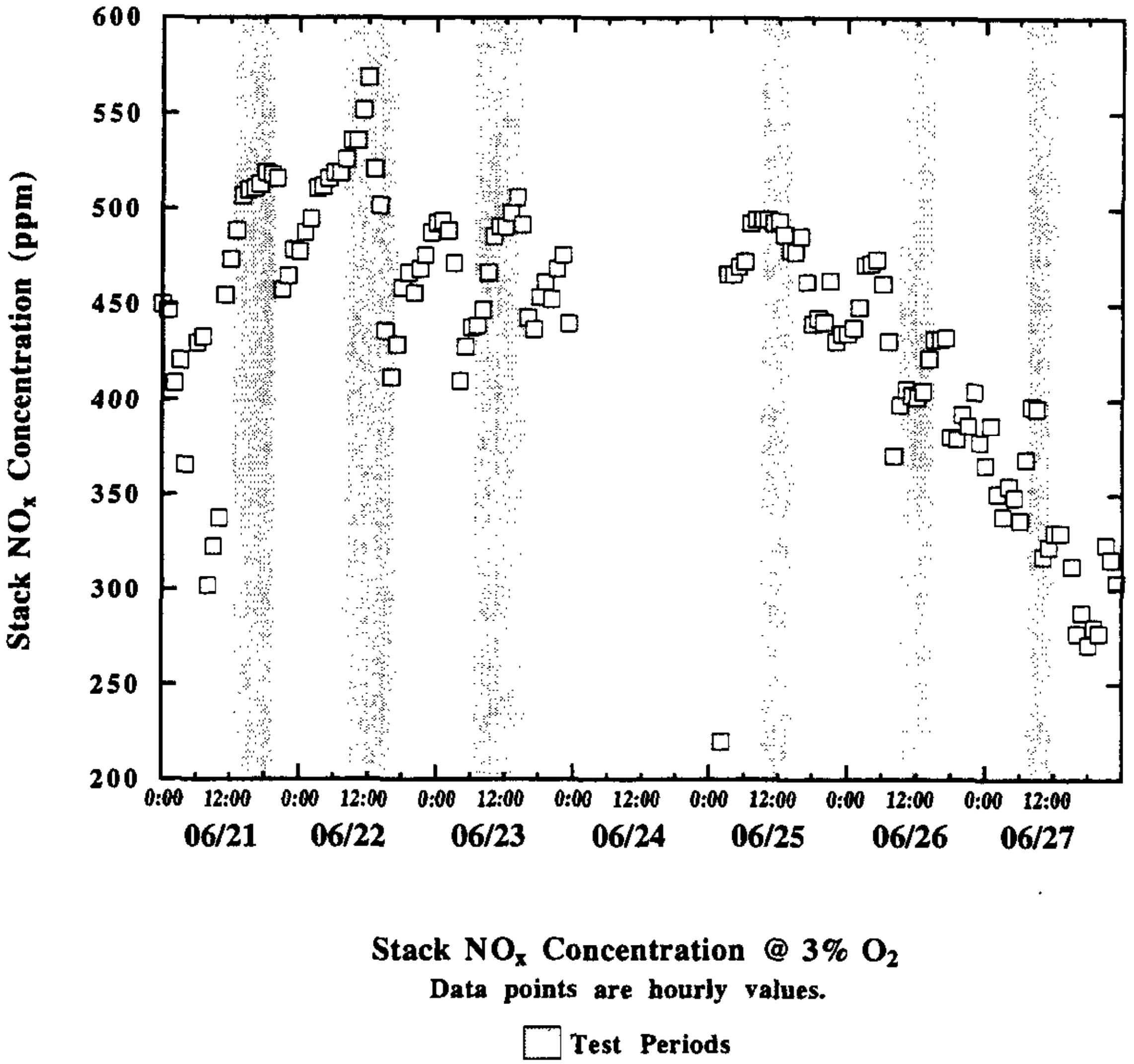


Figure 2-8
Stack NO$_x$

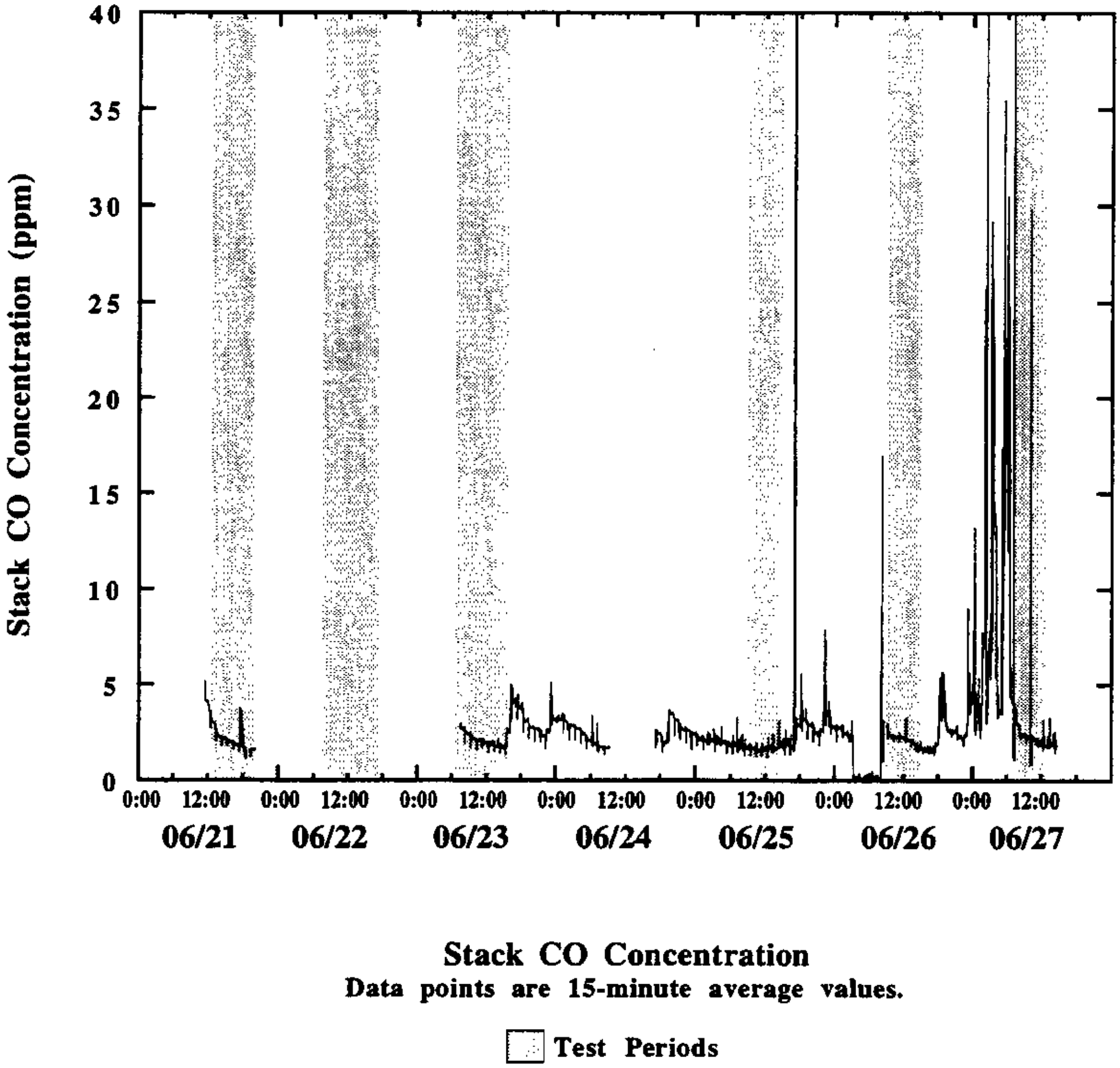


Figure 2-9
Stack CO

Problems

Only slight operational problems were encountered during the test effort. On the first day of testing, a steam leak was detected and, although the leak was minor, plant personnel opted to bring the plant down to fix the leak, rather than run the risk of having a major problem occur while the testing was in progress. Repairing the leak resulted in a six-hour delay in the start of the testing activities on day one.

The average JBR SO_2 removal efficiency dropped below 90% on June 25. A change in the JBR piping is believed to have resulted in a high bias in the pH indicators. For this reason, SO_2 removal was generally lower than expected. However, with respect to the range of SO_2 removal achieved over the previous four days, the 88.8% removal is within normal operating limits and had no effect on the test results.

Deviations from Sampling Plan

The sampling approach was defined with soot blowing confined to the evening shifts and no testing was to be performed during soot blowing events (with the exception of round-the-clock sample collection for PSD at the stack and bulk particulate collection at the stack and ESP Outlet). However, during the second day of the material balance period a high pressure drop was encountered across the air pre-heater (APH). Sampling was delayed for two hours while the APH soot-blowers were activated. A full pressure drop reduction could not be achieved and the decision was made to continue testing with the APH soot blowers activated continuously. Testing on the third day was also done with the APH soot blowers activated. This approach provided consistent process operation for the testing. Soot blowing at all other boiler locations was not performed until after the testing was completed each day. A post-test inspection of boiler operator logs indicated that APH soot-blowing was probably done continuously during the first day of the material balance period also. Although boiler control room instructions were for "no soot blowing," the post-test inspection revealed a steadily decreasing pressure drop across the APH on Day 1 of the material balance period. Typically, this only happens if the APH soot blowers are on. There was, however, no way to confirm this after the fact. The impact of the APH soot blowing is currently judged not to have an impact on the data quality or the overall test results.

References

1. David P. Burford, Oliver W. Hargrove, and Harry J. Ritz, "Demonstration of Innovative Applications of Technology for the CT-121 FGD Process." Published in the proceedings of the First Annual Clean Coal Technology Conference (sponsored by the U.S. Department of Energy), Cleveland, OH (September 1992).

3

SAMPLE COLLECTION

Radian used established sampling methods (where possible) and a sampling strategy consistent with that of the EPRI-sponsored Field Chemical Emissions Monitoring (FCEM) program[1] to accomplish the project goals. Samples were collected with Plant Yates operating within 10% of full load, at steady-state conditions, and in triplicate over two three-day periods.

Sampling Schedule

Radian performed the test program at the Yates facility in two discrete three-day sampling periods. During the first three-day period (Phase I), samples were collected for the characterization of organic species and particle size distribution, and ADA Technologies performed an assessment of the ESP operating characteristics. The second three-day sampling period (Phase II) was a "material balance period," during which samples were collected for analysis of inorganic components.

Figures 3-1 and 3-2 illustrate the sampling periods for each sample stream. Field blank samples were collected June 20, 1993 for the organic-phase test parameters and field blank samples were collected for the "material balance" parameters on June 24, 1993.

Samples Collected

All sampling was performed according to the procedures detailed in the Management Plan for the Plant Yates CT-121 FGD Project.

Only two deviations were noted from the specifications provided in the Management Plan. The first involves the collection of dry ash from the ESP ash hoppers. The management plan specified for the collection of samples from three rows of hoppers; however, after arrival on site, it was discovered that only the first two rows were energized. The sampling approach was modified to limit the sampling to just the first two rows of hoppers. These first two rows (four hoppers per row) of hoppers were to be sampled individually; however, only seven of the eight hoppers could be sampled. A valve stuck open on hopper number 7, and the system could not be isolated from the sluice system.

The second deviation concerned the collection of condenser water. No condenser outlet samples could be collected, as the two valves located at the condenser outlet were not operational.

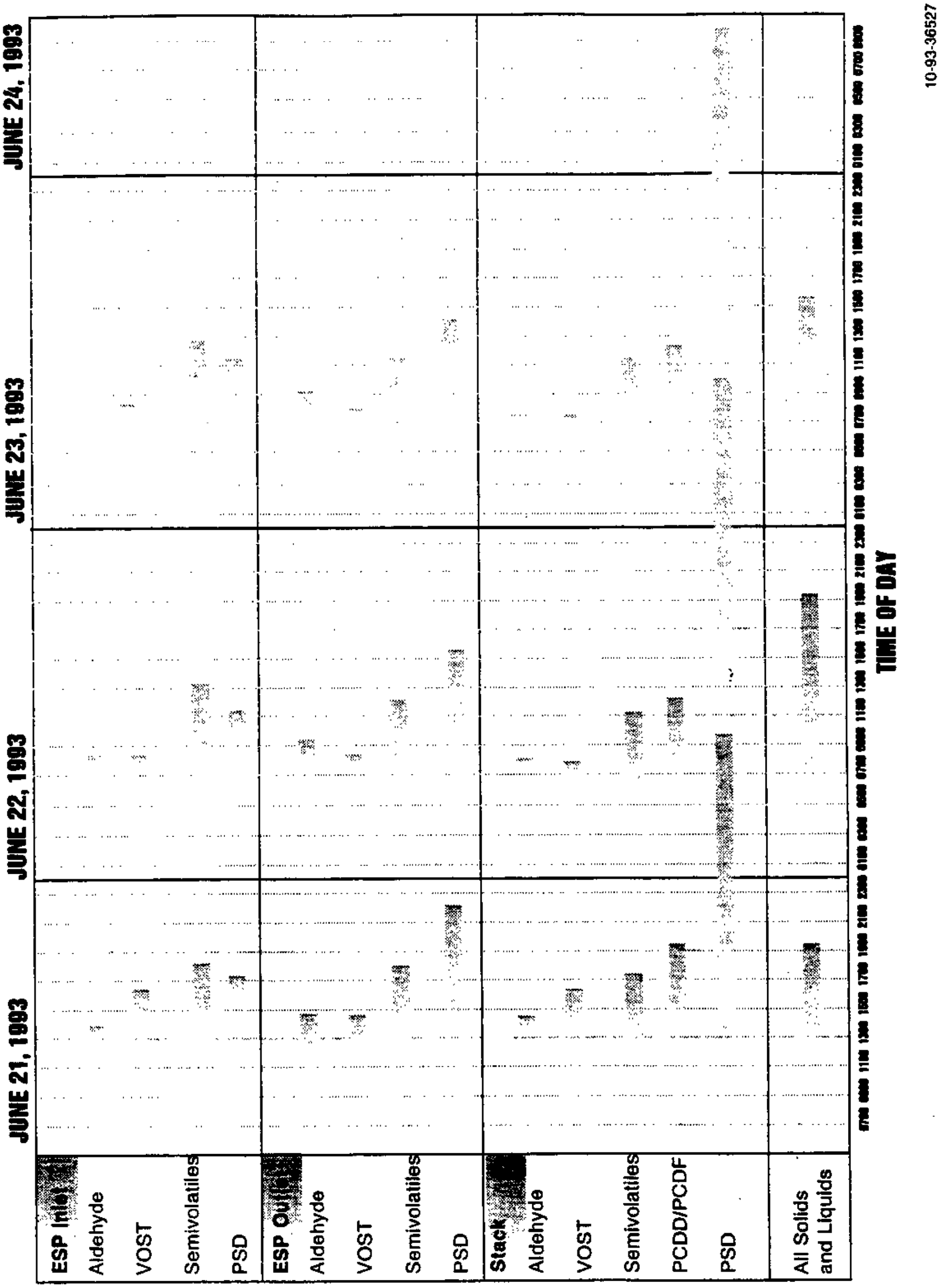


Figure 3-1
Sample Collection Schedule for June 21-24, 1993

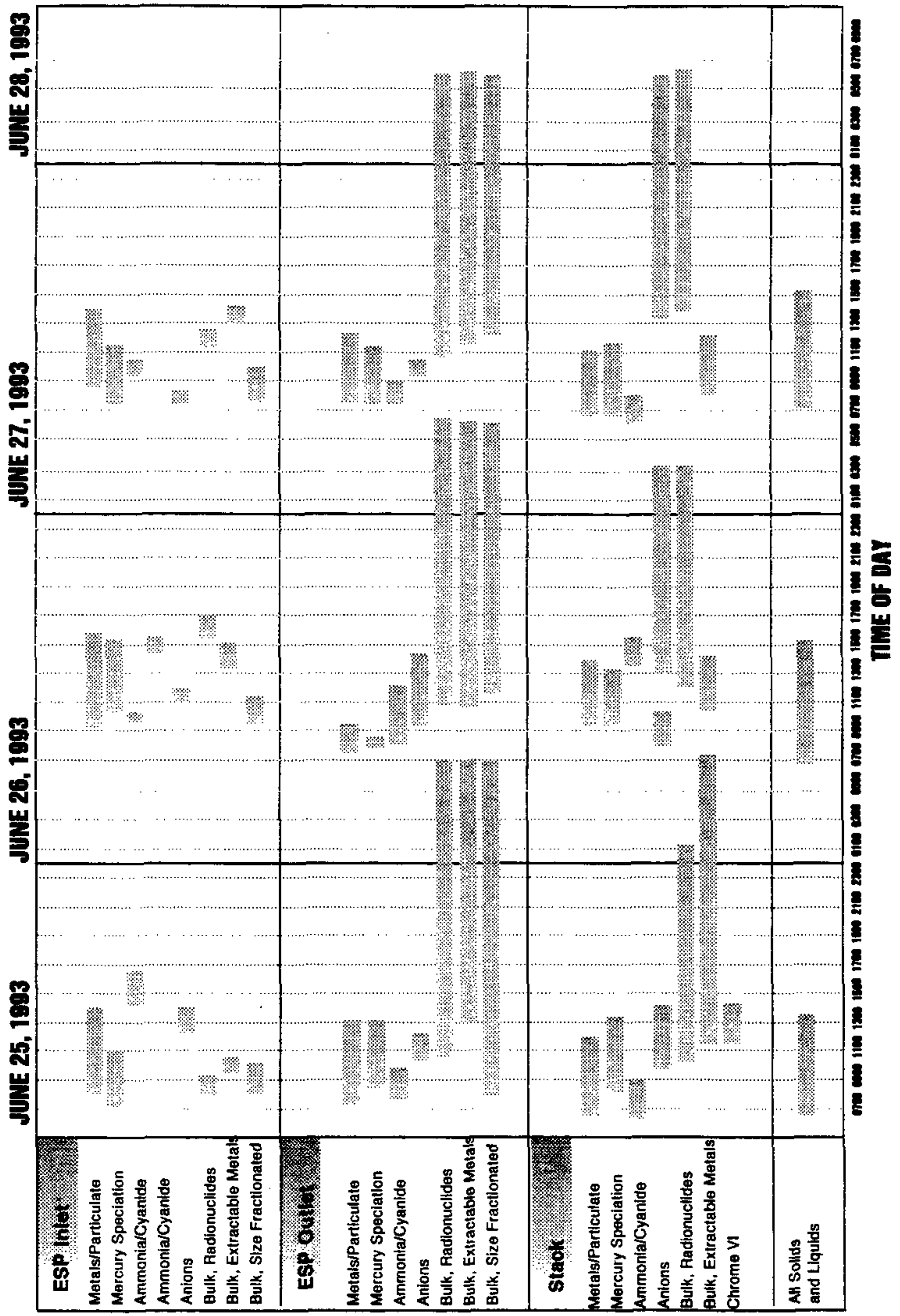


Figure 3-2
Sample Collection Schedule for June 25-28, 1993

Gas Samples

Samples were collected from three separate gas locations during the toxics emission study, namely the ESP inlet, the ESP outlet, and the stack. Sampling was performed concurrently at each location with specific run times varying due to effluent conditions.

A summary of the samples collected from the gaseous locations is presented in Table 3-1. The summary identifies the sample type, collection method, the number of samples collected and analyzed from each location, and the sample preservation techniques. Samples collected as part of the QA/QC program for gaseous samples are identified in Table 3-2.

Gas sampling data sheets are available in Appendix C. Data presented in Appendix C include the sample run times and sample volumes. In addition to the summarized field data, the calculations used for data reduction are also presented.

Liquid Samples

Liquid samples were collected concurrently with the gaseous sampling. The primary liquid collection technique was grab sampling. Table 3-3 identifies each of the streams sampled as well as the collection method, number of samples collected and analyzed, and the sample preservation techniques. Table 3-4 lists the liquid samples which were collected and/or analyzed as part of the QA/QC program.

Liquid samples were composited daily during each test run with the exception of the aldehydes and volatile organic compound (VOC) samples which were collected as single grab samples. The sluices and slurry filtrates were also collected as composite samples during each test run and the solids removed either by settling and decantation, or direct filtration from the process sample point. Detailed descriptions of the sampling techniques are presented in Appendix B.

Solid Samples

Solid samples were collected concurrently with the gaseous and liquid sampling. Sampling was performed by compositing grab samples that were collected at regular intervals during the gas sampling period. In addition to the grab sampling, solids were also collected during sluicing operations of the bottom ash and ESP ash. These samples were collected by grab sampling techniques through the duration of the sluicing and composited into one sample per test run.

Detailed descriptions of the solids sampling techniques are presented in Appendix B. Table 3-5 summarizes the solid sampling effort during this program. The table identifies the sample location or sample type, the collection method, the number of samples collected and analyzed, and the sample preservation techniques. Samples collected or submitted to support the QA/QC program for the solids are listed in Table 3-6.

Table 3-1
Gaseous Sampling Summary

Test Parameter	Collection Method[a]	ESP Inlet		ESP Outlet		Stack		Sample Handling and Preservation
		Samples Collected	Samples Analyzed	Samples Collected	Samples Analyzed	Samples Collected	Samples Analyzed	
Aldehyde	EPA Method 0011	3	3	3	3	3	3	Cooled to <4 °C prior to analysis
Volatile Organics	VOST	9	9	9	9	10	9	Cooled to <4 °C prior to analysis
Semivolatile Organics	Modified Method 5	3	3	3	3	3	3	Cooled to <4 °C prior to analysis
PCDD/PCDF	Method 23	-	-	-	-	3	3	Cooled to <4 °C prior to analysis
Particle Size Distribution	Method 17	3	3	3	3	3	3	No special handling
Particulate Loading and Metals	Method 5/Method 29	3	3	3	3	3	3	No special handling
Mercury Speciation	Nick Bloom Method	3	3	3	3	3	3	No special handling
Anions	Method 5 (Modified)	3	3	3	3	3	3	No special handling
Ammonia/Cyanide	Method 5 (Modified)	4	3	3	3	3	3	Cooled to <4 °C prior to analysis
Radionuclides	Method 5/17	3	3	3	3	3	3	No special handling
Extractable Metals	Method 5/17	3	3	3	3	3	3	No special handling
Size Fractionated Particulate - Metals	Method 17	3	3	3	3	-	-	No special handling
Chromium VI	Method Cr^{+6}	-	-	-	-	3	3	Analyzed on-site

[a] Detailed references are shown in Appendix B.

Table 3-2
Number and Type of Gas Sample Analyses Plant Yates

Parameter	Field Samples	Matrix Spike	Audit Samples	Field Blanks	Trip Blanks	Total Samples
Moisture	9	--	--	--	--	9
Particulate Loading	9	--	--	3	1	13
Particle Size Distribution	9	--	--	--	--	9
Chloride (Particulate)	9	1	--	1	--	11
Fluoride (Particulate)	9	1	--	1	--	11
Sulfate (Particulate)	9	1	--	1	--	11
ICP Screen (Particulate)	9	1	1	3	1	15
GFAAS Metals[a] (Particulate)	9	1	1	3	1	15
Mercury (Particulate)	9	1	1	3	1	15
Semivolatiles (Particulate & Flue Gas)	9	2	--	3	1	15
PCDD/PCFD (Particulate)	3	--	--	1	1	5
Radioactivity (Particulate)	9	--	--	1	--	12
Ammonia (Flue gas)	9	1	1	1	--	12
Cyanide (Flue gas)	9	1	1	1	--	12
Chloride (Flue gas)	9	1	1	1	--	12
Fluoride (Flue gas)	9	1	1	1	--	12
Sulfate (Flue gas)	9	1	1	1	--	12
ICP Screen (Flue gas)	9	1	1	3	1	15
GFAAS Metals[a] (Flue gas)	9	1	1	3	1	15
Mercury (Flue gas)	9	1	1	3	1	15
Aldehydes (Flue gas)	9	2	--	3	2	16
Volatile Organics (Flue gas)	27	--	--	9	1	37
PCDD/PCDF (Flue gas)	3	--	--	1	1	5

[a] GFAAS metals include As, Cd, Pb, and Se.

Table 3-3
Liquids Sampling Summary

Test Parameter	Collection Method	Ash Pond		Gypsum Pond Water		Ash Sluice Filtrates		JBR Slurry		Limestone Slurry Filtrate		Coal Pile Run-Off		Condenser Inlet	
		Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed
Formaldehyde	Grab	3	3	3	3	6	6	3	3	3	3	2	2	3	3
Volatile Organics	Grab	3	3	3	2	6	6	3	3	3	3	2	1	3	3
Semivolatile Organics	Grab	3	3	3	2	8	6	4	3	4	3	2	1	4	3
Metals, Soluble	Grab	3	3	3	3	6	6	3	3	3	3	-	-	3	3
Metals, Total	Grab	3	3	3	3	-	-	-	-	-	-	-	-	3	3
Anions	Grab	3	3	3	3	6	6	3	3	3	3	-	-	3	3
Ammonia	Grab	3	3	3	3	6	6	3	3	3	3	-	-	3	3
Cyanide	Grab	3	3	3	3	6	6	3	3	3	3	-	-	3	3

Table 3-4
Liquid Stream QA/QC Samples

Parameter	Field Samples	Field Dups	Matrix Spike	Audit Samples	Trip Blanks	Total Samples
Chloride	21	7	3	1	--	32
Fluoride	21	7	3	1	--	32
Phosphate	21	7	3	1	--	32
Sulfate	21	7	3	1	--	32
Sulfite	3	1	--	--	--	4
Ammonia	21	7	3	1	--	32
Cyanide	21	7	3	1	--	32
ICP Screen (Soluble)	30	10	4	2	--	46
Arsenic	30	10	4	2	--	46
Cadmium	30	10	4	2	--	46
Lead	30	10	4	2	--	46
Mercury	30	10	4	2	--	46
Selenium	30	10	4	2	--	46
Aldehydes	23	7	6	--	--	36
Semivolatile Organics	22	7	6	--	--	35
Volatile Organics	22	7	--	--	1	30

Table 3-5
Solids Sampling Summary

Test Parameter	Collection Method	Raw Coal		Pulverizer Rejects		Feed Coal		Raw Limestone		Limestone Slurry Solids		Bottom Ash		ESP Fly Ash		FGD Slurry Solids	
		Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed	Collected	Analyzed
Formaldehyde	Grab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Semivolatile Organics	Grab	-	-	-	-	-	-	-	-	-	-	3	3	6	6	3	3
Particle Size Distribution	Grab	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	-
Metals, Total	Grab	3	3	3	3	3	3	3	3	3	3	3	3	6	6	3	3
Anions	Grab	3	3	3	3	3	3	3	3	3	3	3	3	6	6	3	3
Radionuclides	Grab	-	-	-	-	3	3	3	3	-	-	3	3	6	6	3	3
Moisture,	Grab	3	3	3	3	3	3	3	3	-	-	3	3	6	6	-	-
Ultimate/ Proximate	Grab	3	3	3	3	3	3										
Heating Value	Grab	3	3	-	-	3	3										

Table 3-6
Solid Stream QA/QC Samples

Parameter	Field Samples	Field Dups	Matrix Spike	Audit Samples	Total Samples
Moisture	12	4	--	--	16
Particle Size Distribution	6	2	--	--	8
Ultimate/Proximate	9	3	--	1	13
Carbon	12	4	--	--	16
Sulfur	9	3	--	--	12
Heating Value	6	2	--	1	9
Chloride	30	10	4	2	46
Fluoride	30	10	4	2	46
Phosphate (Phosphorus)	30	10	4	2	46
Sulfate/Sulfite	3	1	1	--	5
ICP Screen	30	10	4	2	46
Metals	9	3	--	1	13
Arsenic	30	10	4	2	46
Cadmium	30	10	4	2	46
Lead	30	10	4	2	46
Mercury	30	10	4	2	46
Selenium	30	10	4	2	46
Aldehydes	3	1	2	--	6
Semivolatile Organics	12	4	4	--	20
Radioactivity	15	4	--	--	19

Process Stream Flow Rates

Table 3-7 presents average process stream flow rates for Phase II of the testing. The methods used to measure and equations used to calculate these flow rates are described in Table 3-8. These flow rates were used in the material balance calculations, described in Section 6.2. Those flow rates measured directly are presented on a run-by-run basis. Others are presented as Phase II test period averages, since they are calculated from averaged data; i.e., the dry feed coal flow rate is calculated from the average wet raw coal flow rate and average water content. Gaseous flow rates were measured at three different locations at the site: ESP inlet, outlet, and the stack. The actual measurements from these locations averaged 293,000 dscfm ±<3%, well within the expected limits of the measurement technique. However, given the various physical properties of the three locations, engineering judgment would indicate that the measurements from the stack were the most accurate of the three and, since the stack measurements also reflect ultimate emissions, the measurements from this location should be the reference point for consistency in the treatment of data and determination of internal mass flow rates. An average of 4,000 scfm of oxidation air was added to the flue gas as it passes through the JBR. Therefore, the rate of gas that enters and exits the ESP is that amount measured at the stack minus (-) the oxidation air added at the JBR. The stack flow rate was 288,000 dscfm - 4,000 dscfm (oxidation air) = 284,000 dscfm as the flow rate for the INLET AND OUTLET of the ESP. The ESP operates at negative pressure; therefore, these numbers represent maximum rates, since any inleakage of gas would be measured at the stack.

Coal flow rates were determined from data obtained from the boiler control room. Raw coal is loaded into buckets which hold nominally 500 pounds of coal and a counter records each time a bucket is dumped. These readings, obtained over a 24-hour period, provide the basis for the coal feed rate. The dry feed coal rate was determined from the raw coal rate (corrected for moisture) less the pulverizer rejects. This method yields an average feed coal rate for the material balance period of 80,200 lb/hr. As a consistency check, the full-load unit heat rate was used to calculate a coal feed rate of 86,000 lb/hr, approximately 7% higher than measured. The calculated coal feed rate falls within the 95% confidence interval of the measured coal rate shown in Table 3-7. The bottom ash flow rate was determined by subtracting the ash flow rate measured at the ESP inlet from the ash contained in the feed coal.

Other flow rates used in mass balance calculations were measured by process instrumentation and are discussed in Section 6. Uncertainties for these calculated flow rates, expressed as 95% confidence intervals, were calculated using the method detailed in Appendix F.

References

1. Electric Power Research Institute. *Field Chemical Emissions Monitoring (FCEM) Generic Sampling and Analytical Plan.* Draft Report. Palo Alto, CA (May 1994).

Table 3-7
Process Flow Rates During Phase II of Testing

	Run 1 6/25/93	Run 2 6/26/93	Run 3 6/27/93	Mean	Std. Dev.
Raw Coal Moisture (%)	12.7	11.2	11.2	11.7	0.9
Feed Coal Ash (%, dry)	10.5	11.3	11.6	11.1	0.6
Measured Flow Rates and Grain Loadings:					
Raw Coal (lb/hr, wet)	90,200	90,700	92,000	91,000	3,200[a]
Coal Pulverizer Rejects (lb/hr)	110	130	110	120	15[b]
ESP Inlet Loading (gr/dscf)	3.38	3.67	3.88	3.64	0.25
ESP Outlet Loading, (gr/dscf)	0.0598	0.0489	0.0644	0.0577	0.0080
Stack Gas (dscfm)	290,000	287,000	285,000	288,000	2,500
Stack Loading (gr/dscf)	0.0078	0.0048	0.0051	0.0059	0.0017
Calculated Flow Rates:					95% CI
Feed Coal (lb/hr, dry)	--	--	--	80,200	8,200
ESP Inlet Gas (dscfm)[c]	--	--	--	284,000	6,200
ESP Outlet Gas (dscfm)[c]	--	--	--	284,000	6,200
ESP Inlet Ash, (lb/hr)[d]	--	--	--	8,870	1,500
ESP Outlet Ash, (lb/hr)	--	--	--	140	49
ESP Collected Ash (lb/hr)	--	--	--	8,730	2,500
Bottom Ash (lb/hr)[e]	--	--	--	440	1,100
Particulate Emissions:					
Emissions (lb/hr)	--	--	--	14.6	10.4
Emissions (lb/10^6 Btu)	--	--	--	0.014	0.009

[a] Standard deviation calculated from 71 hourly values measured over the three days of testing.

[b] Standard deviation calculated from 9 values measured over the three days of testing.

[c] The *stack gas flow rate was considered to be the most accurate measurement of the gas flow rate;* the ESP inlet and outlet flow rates were assumed equal to the stack gas less the JBR oxidation air (4,100 scfm).

[d] Includes 4.5% unburned carbon.

[e] Includes 2.3% unburned carbon.

Table 3-8
Flow Rate Calculations

Raw Coal:

Counting of 500 lb (nominal) buckets

Pulverizer Rejects:

Measured by bucket-and-stopwatch method

Stack Gas:

Measured by Pitot tube traverse

Feed Coal, dry basis:

91,000 lb/hr Raw Coal - 91,000 lb/hr * 0.117 lb Water/lb coal - 120 lb/hr Rejects = 80,200 lb/hr

ESP Inlet and ESP Outlet Flue Gas:

288,000 dscfm Stack Gas - 4,100 scfm Oxidation Air = 284,000 dscfm

ESP Inlet Ash:

284,000 dscfm * 3.64 gr/dscf * 0.000143 lb/gr * 60 m/hr = 8,870 lb/hr

ESP Outlet Ash:

284,000 dscfm * 0.0577 gr/dscf * 0.000143 lb/gr * 60 m/hr = 140 lb/hr

ESP Collected Ash:

8,870 lb/hr ESP Inlet Ash - 140 lb/hr ESP Outlet Ash = 8,730 lb/hr

Bottom Ash:

[80,200 lb/hr Dry Feed Coal * 0.111 lb ash/lb coal - (8,870 lb/hr ESP Inlet Ash- 8,870 lb/hr *0.045 lb Carbon/lb Ash]/(1-0.023) lb Carbon-Free Bottom Ash/lb Bottom Ash = 440 lb/hr

Stack Emissions:

288,000 dscfm Stack Gas * 0.0059 gr/dscf * 0.000143 lb/gr * 60 m/hr = 14.6 lb/hr

Stack Emission Factor:

14.6 lb/hr/(80,200 lb/hr Feed coal * 12,700 Btu/lb) * 1,000,000 = 0.014 lb/10^6 Btu

4

SAMPLE PREPARATION AND ANALYSIS METHODS

Preparation procedures and chemical analysis methods for gases are shown in Figures 4-1 through 4-12.

Procedures for liquid sample preparation and analysis are shown in Figure 4-13. Procedures for coal are shown in Figure 4-14 and Table 4-1. Procedures for ash are in Figure 4-15. Procedures for limestone and FGD solids are shown in Figure 4-16.

Appendix E of this technical note contains descriptions of and references for the methods used for this project.

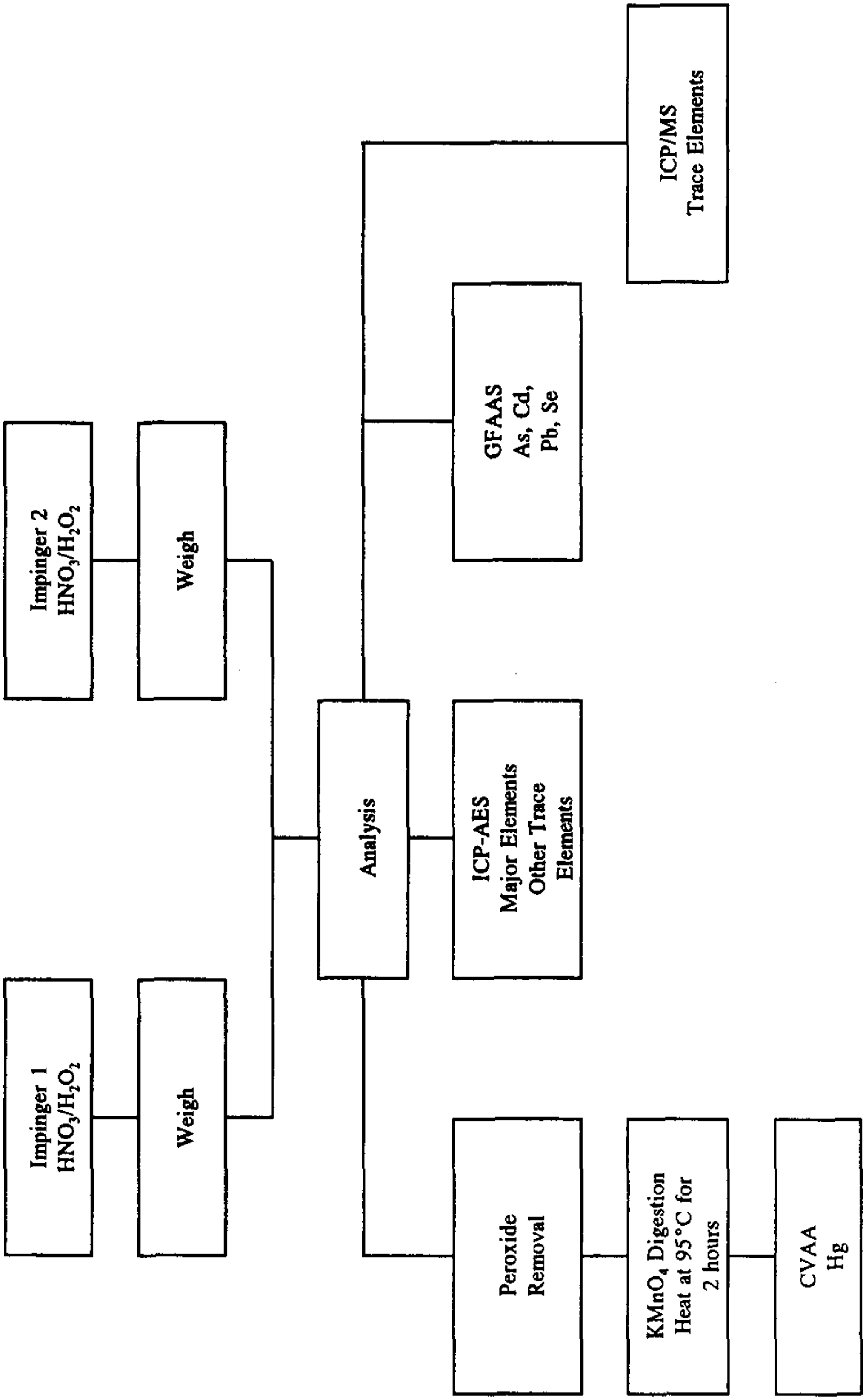


Figure 4-2
Flue Gas Impinger Sample Preparation and Analysis Plan for Metals

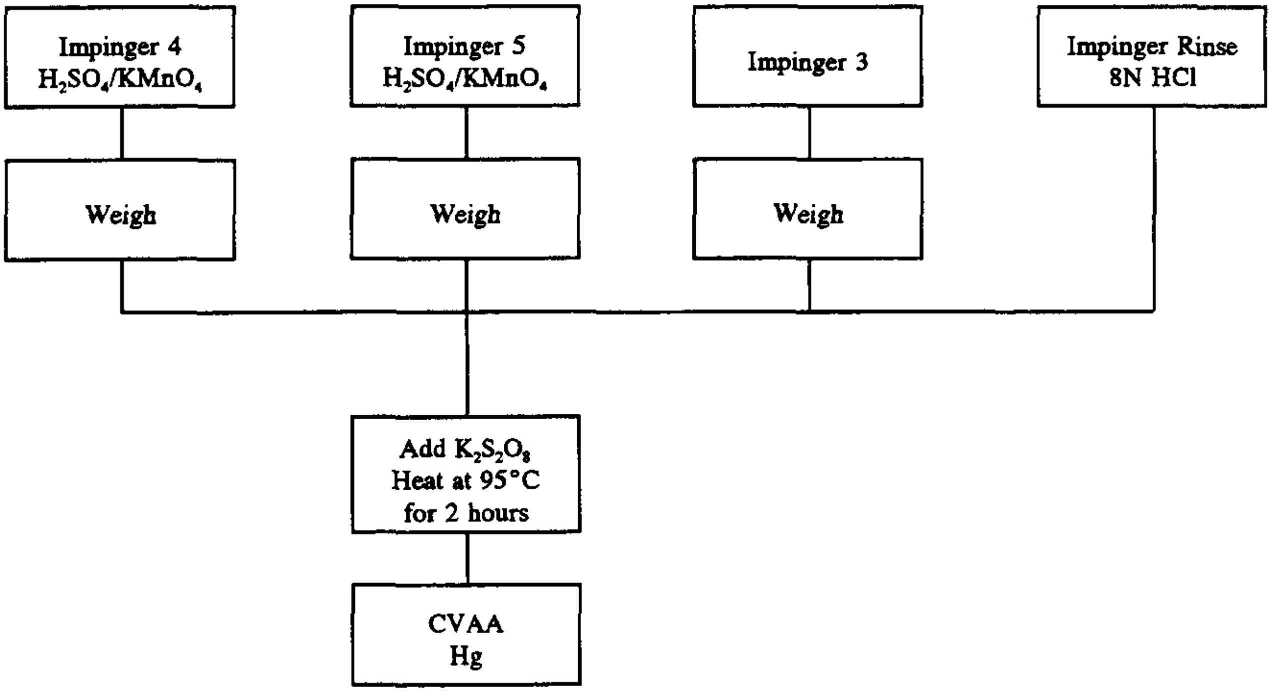


Figure 4-3
Flue Gas Impinger Sample Preparation and Analysis Plan for Mercury

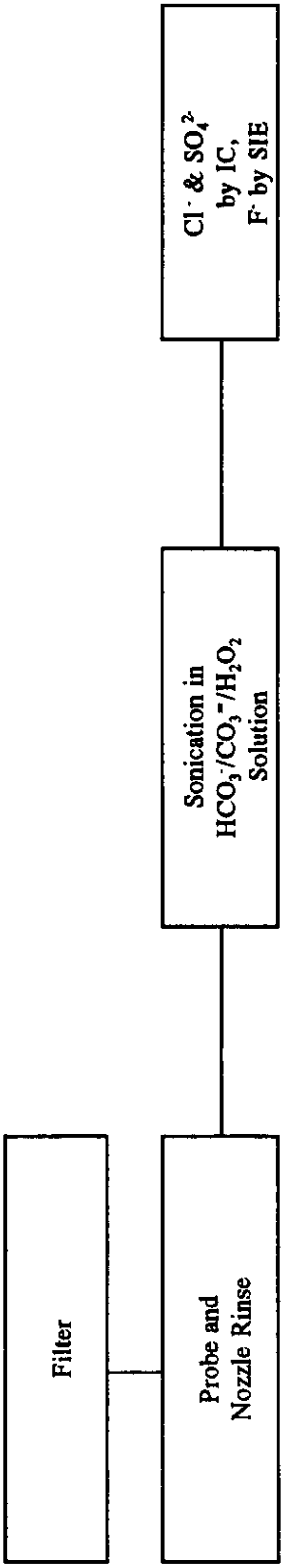


Figure 4-4
Gas Particulate Sample Preparation and Analysis Plan for Anions

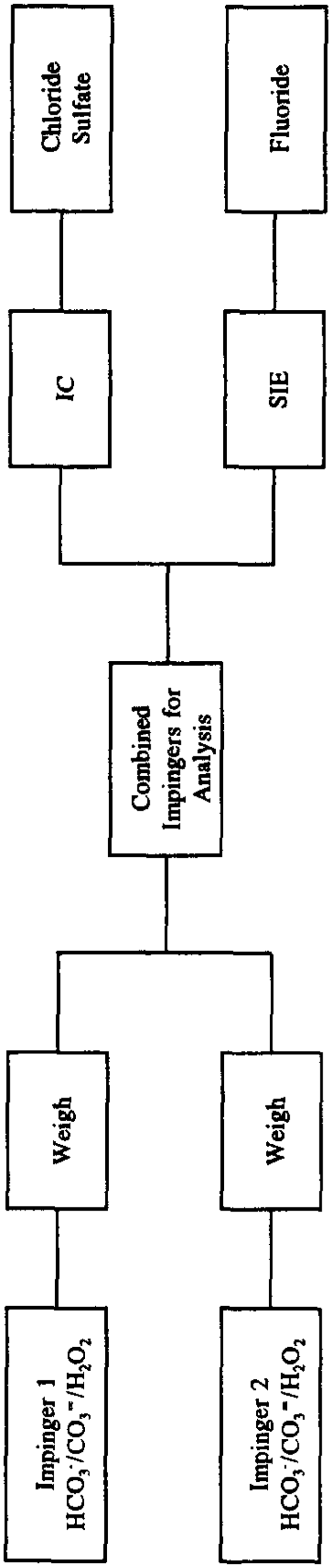


Figure 4-5
Flue Gas Impinger Sample Preparation and Analysis Plan for Anions

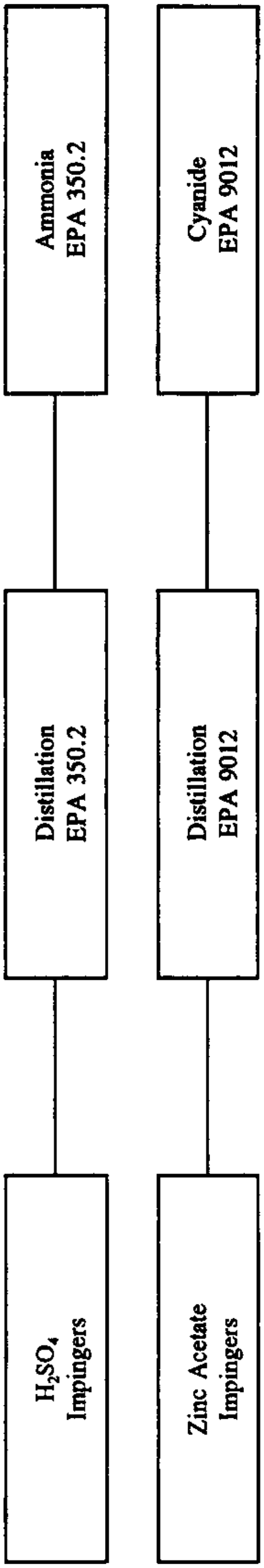


Figure 4-6
Flue Gas Impinger Sample Preparation and Analysis Plan for Ammonia and Cyanide

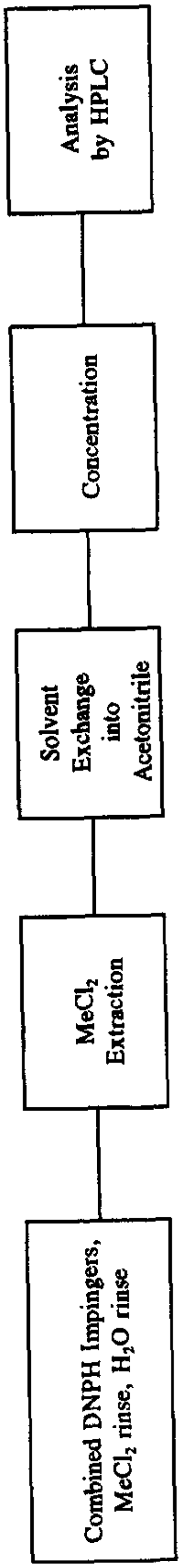


Figure 4-7
Flue Gas Impinger Sample Preparation and Analysis Plan for Formaldehyde

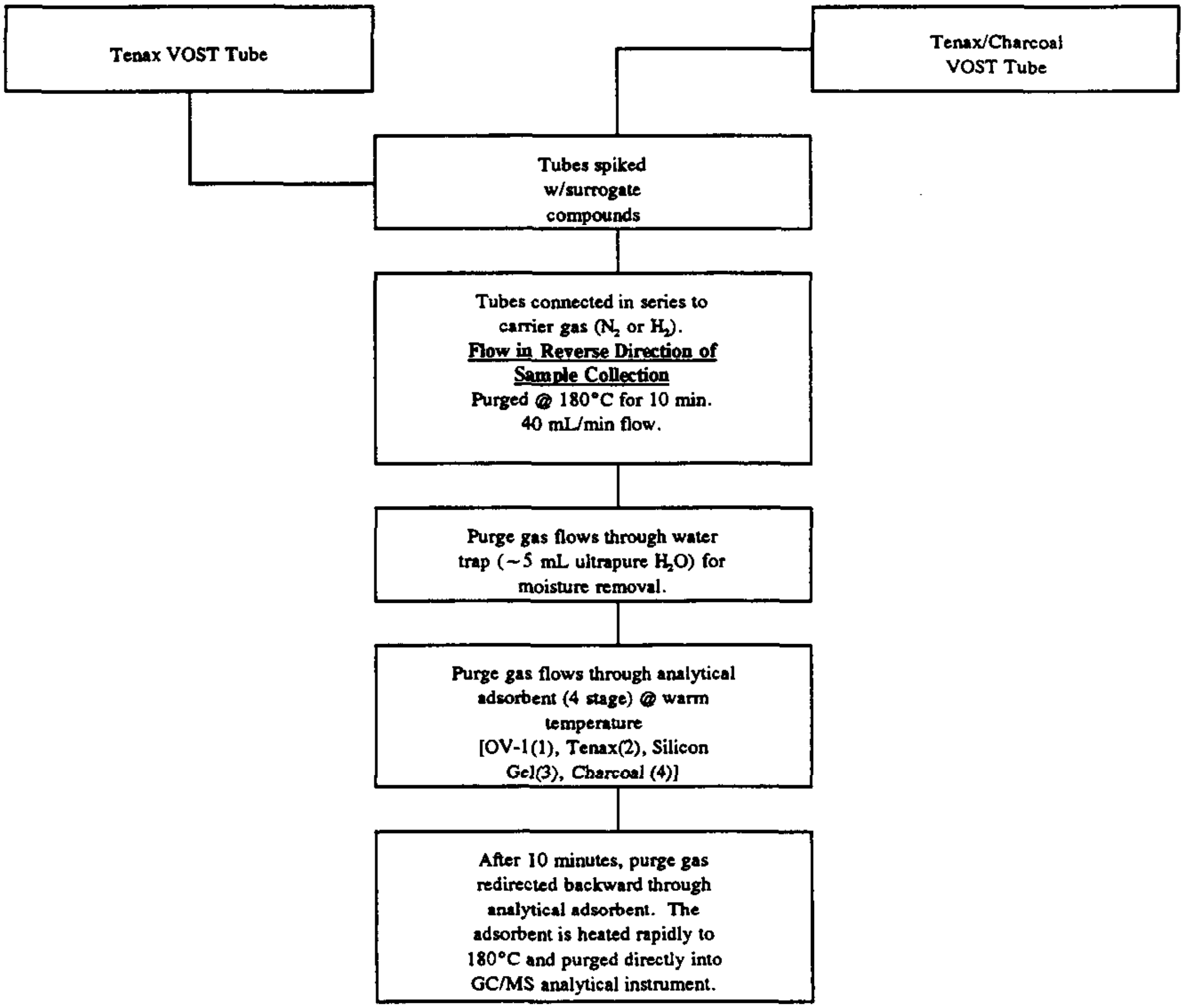


Figure 4-8
VOST Sorbent Sample Preparation and Analysis Plan for Volatile Organic Compounds

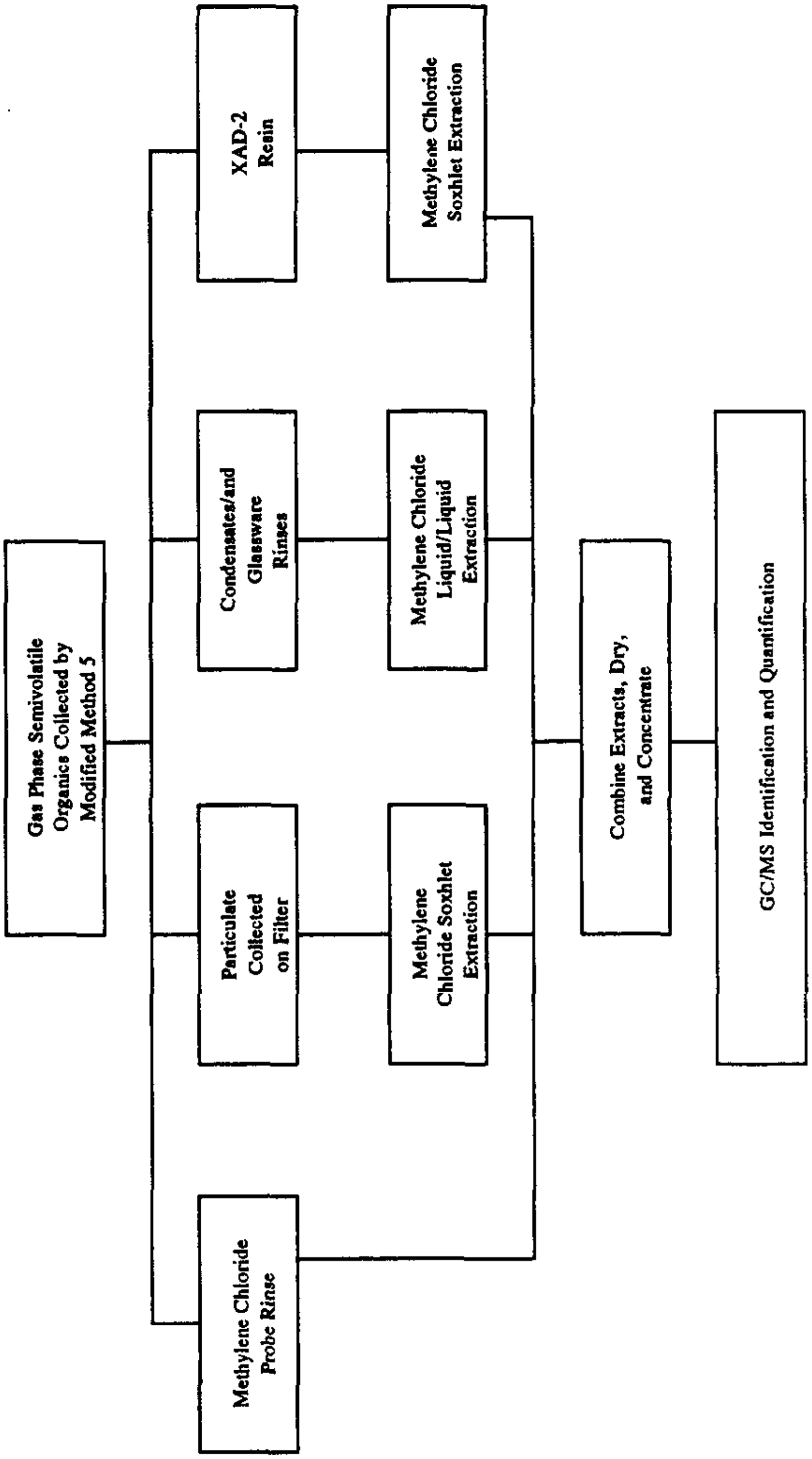


Figure 4-9
Flue Gas Sample Preparation and Analysis Plan for Semivolatile Organic Compounds

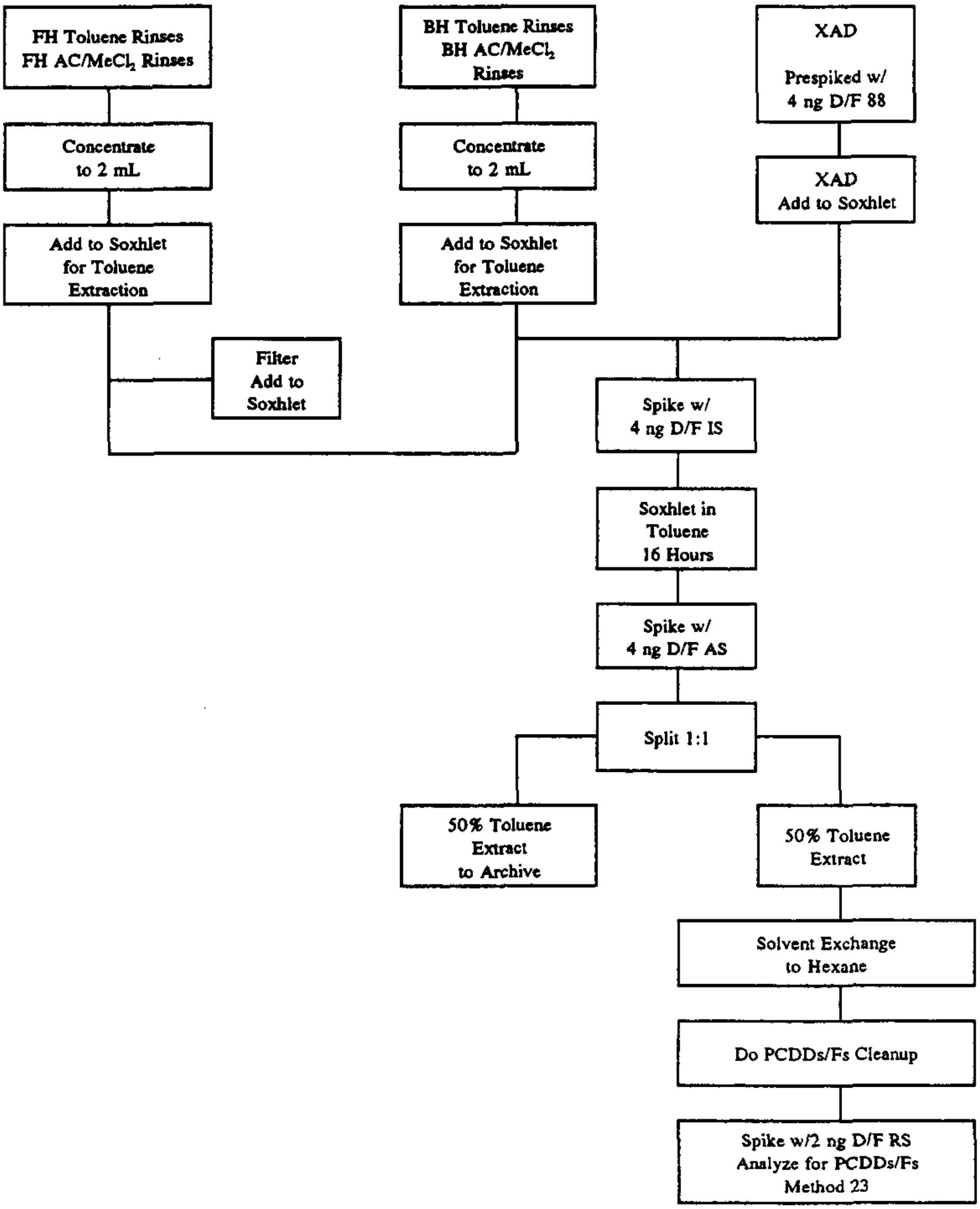


Figure 4-10
Flue Gas Sample Preparation and Analysis Plan for Dioxins and Furans

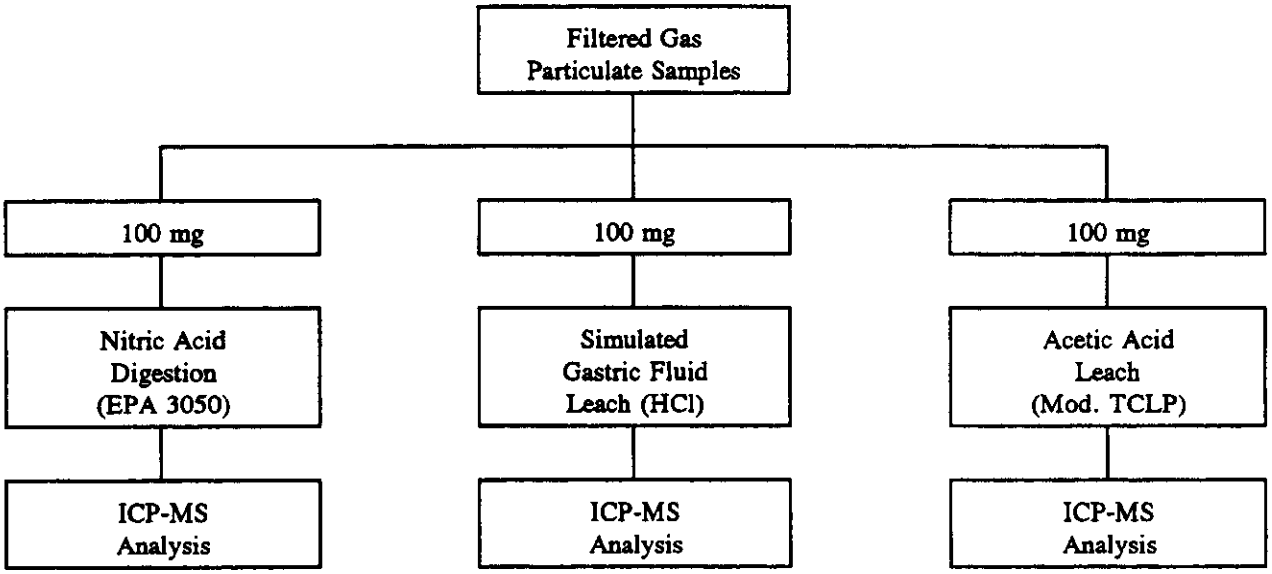


Figure 4-11
Gas Particulate Sample Preparation and Analysis Plan for Extractable Metals

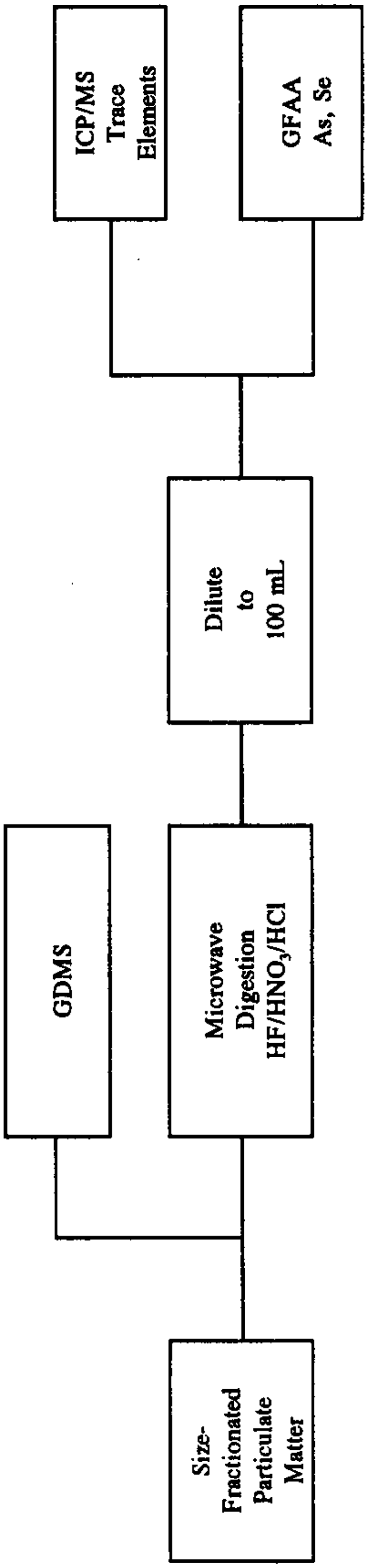


Figure 4-12
Size-Fractionated Particulate Sample Preparation and Analysis Plan for Metals

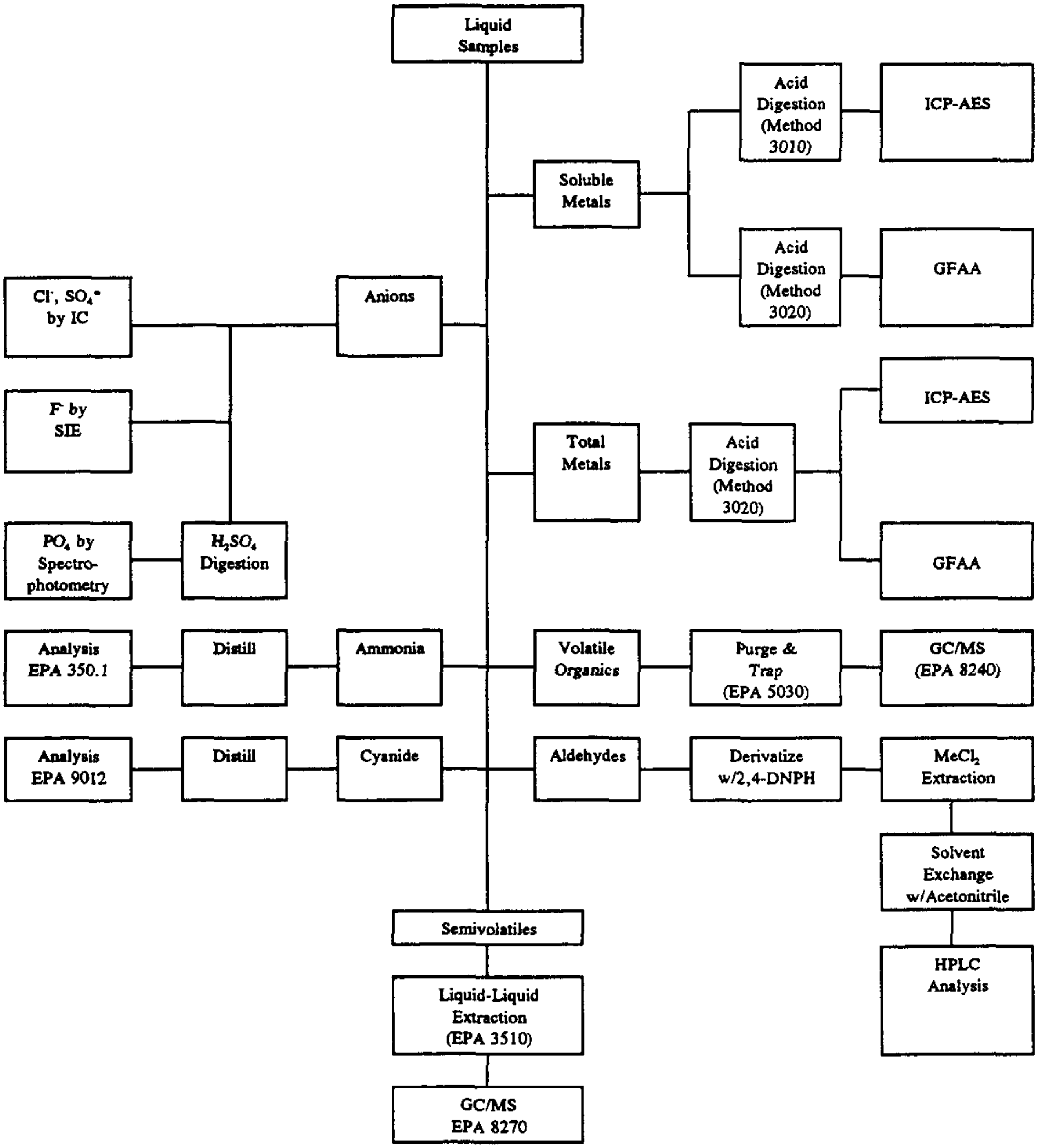


Figure 4-13
Liquid Sample Preparation and Analysis Plan

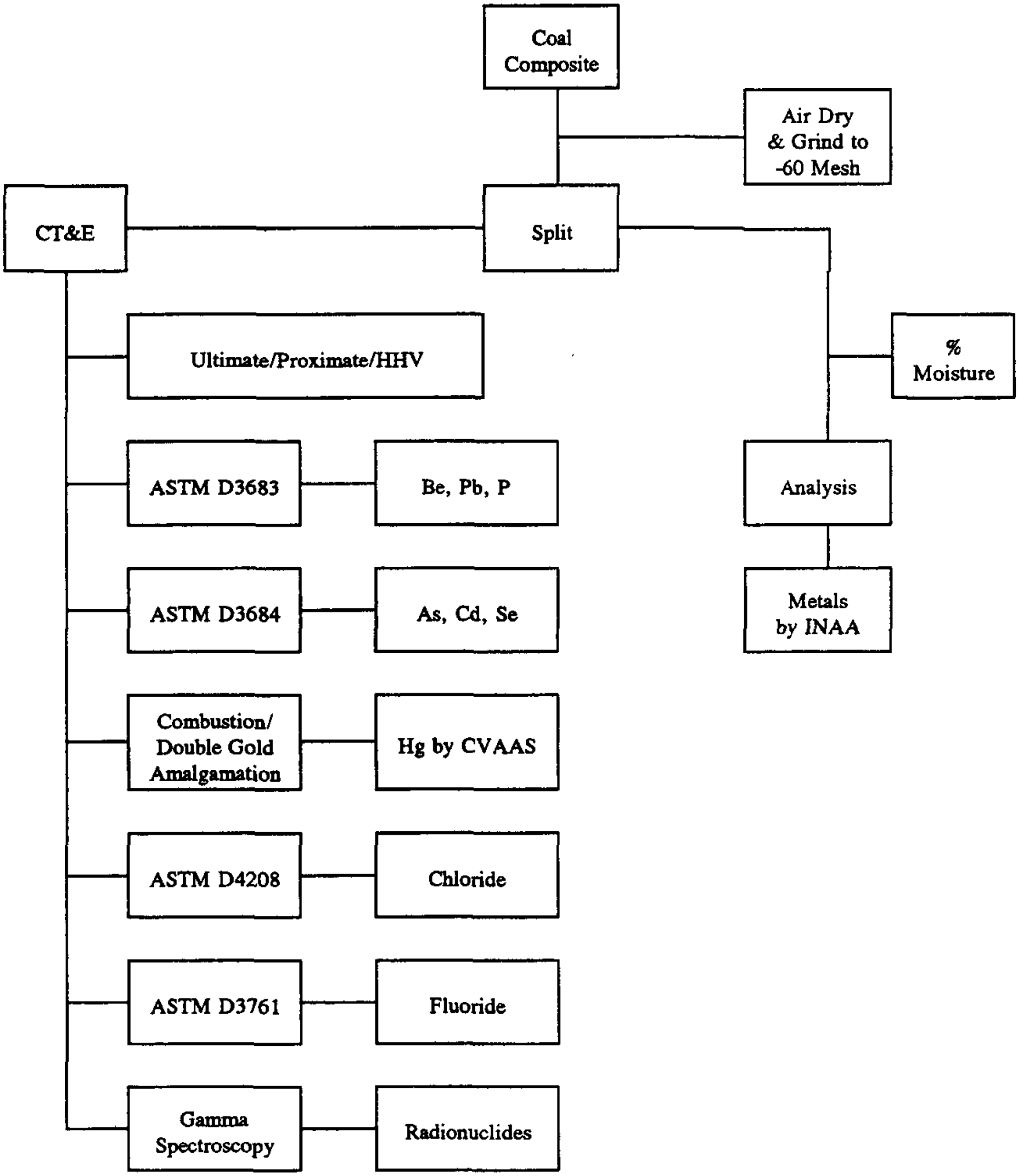


Figure 4-14
Coal Sample Preparation and Analysis Plan

Table 4-1
Summary of Coal Analytical Methods

Chemical Substance	Analytical Method
Ultimate/Proximate/Higher Heating Value	
Moisture	ASTM D3173
Ash	ASTM D3174
Carbon, Hydrogen, Nitrogen	ASTM D5373
Sulfur	ASTM D4239
Volatile Matter	ASTM D3175
Heating Value	ASTM D2015
Chlorine in Coal	ASTM D4208
Fluorine in Coal	ASTM D3761
Radionuclides	Gamma Emission Spectroscopy

ASTM = American Society for Testing and Materials.

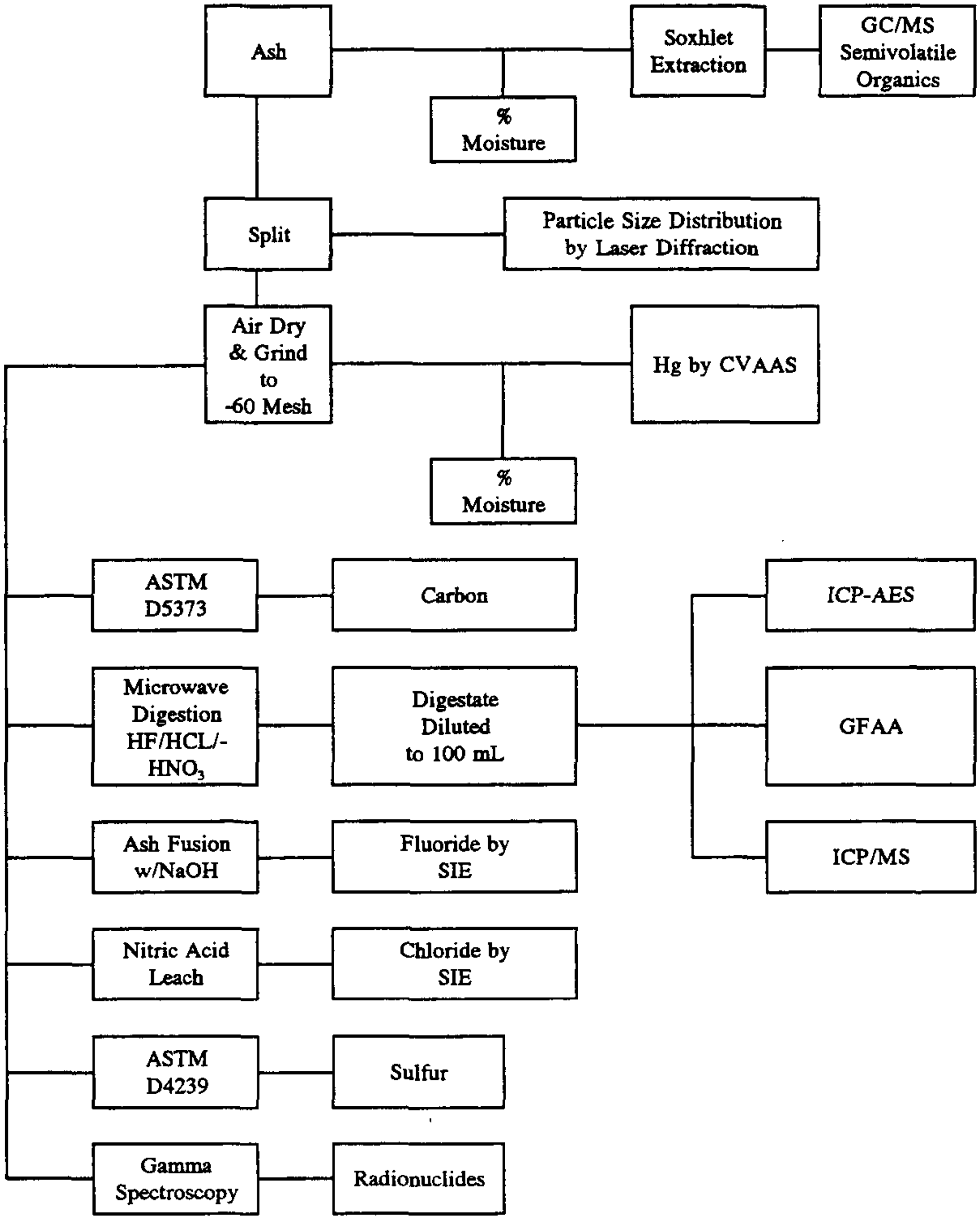


Figure 4-15
Ash Sample Preparation and Analysis Plan

5

Analytical Results

The results of the analyses performed on samples collected during the emissions test program are presented in this section. The results are reported by stream matrix, i.e., gaseous, solid, or liquid, and are presented as averages for individual process streams along with the 95% confidence interval (CI) and the detection limit (DL) ratio. The detection limit ratio represents the percentage of the average value that is contributed by data which were below the detection limit. The analytical results for organic species reported in the following tables have been limited to only those compounds which were detected in any of the three test runs. Complete details of the analytical results may be found in Appendix H. Appendix H contains results on a per run basis, the analytical method used for each analysis, appropriate data flags for each value, additional analytical results for compounds which were not part of the scope of work but which information was obtained by virtue of the particular analytical method used, along with the averages of Runs 1-3, 95% CI, and DL ratios. Treatment of values that were less than the method detection limit are explained in Appendix G. Confidence intervals and error propagation are described in Appendix F.

Some data in Appendix H have been flagged. These data (which have been shaded) are suspect due to extremely high background contamination and have been excluded from the mean and CI calculations. High background contamination was encountered in gaseous particulate samples obtained from three of the multi-metals runs performed at the ESP outlet and the stack. This problem arose from the misidentification (during the field prep phase) of three glass fiber filter substrates. These glass fiber substrates were prepped, labelled and treated as quartz filters. The error was discovered during analysis when very high levels of barium and zinc were identified. The glass fiber substrates were used in Runs 1 and 3 at the ESP outlet and in Run 1 at the stack. Table 5-1 shows results for a blank analysis of a quartz and glass fiber filter. Background results are similar for Sb, As, Se, and V. All other species (except Mo) are substantially higher in the glass fiber matrix. Again, shaded data have been invalidated and are not included in the reported mean values.

Gases

The particulate loading and analytical results for the ESP inlet, ESP outlet and the stack are presented in Table 5-2. Concentration of trace elements as a function of particle size is given for three approximate size ranges; less than 3 μm, 3-10 μm, and greater than 10 μm on an aerodynamic basis. The analysis of boron and silicon in the fly ash samples filtered from the flue gas streams was not performed due to the limited quantity of sample and the limitations of the sampling and sample preparation techniques. For gas particulate samples, the filtered solids are prepared for analysis by digesting the entire filter with a mixed acid solution containing hydrochloric, nitric, and hydrofluoric acids.

Table 5-1
Filter Substrate Data Comparison

Specie	Quartz (μg)	Glass Fiber (μg)
Aluminum	122	36,500
Antimony	<9	<9
Arsenic	0.14	<0.12
Barium	8.6	57,600
Beryllium	0.08	6
Cadmium	<0.13	4
Calcium	101	15,500
Chromium	1.4	21
Cobalt	0.25	22
Copper	0.57	4
Iron	15	312
Lead	<0.13	35
Magnesium	14	2,700
Manganese	0.60	15
Mercury	0.07	0.1
Molybdenum	19	2
Nickel	2.6	8
Phosphorus	<7.5	144
Potassium	<205	30,000
Selenium	0.06	<0.09
Sodium	224	88,800
Strontium	0.80	664
Titanium	8.2	78
Vanadium	0.65	0.15
Zinc	6.3	39,900

Table 5-2
Gas Process Stream Data Summary

		ESP Inlet			ESP Outlet			Stack		
Analyte Group/ Specie	**Units**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**
Particulate Loading	g/Nm^3	8.95	1.5	--	0.142	0.05	--	0.0145	0.010	--
Reduced Species										
Ammonia as N	μg/Nm^3	29.0	7.4	--	27	16	--	11	17	--
Hydrogen Cyanide	μg/Nm^3	0.15	0.24	--	0.90	1.7	--	28	94	--
Anions-Vapor										
Chloride	μg/Nm^3	112,000	34,300	--	136,000	67,000	--	540	820	--
Fluoride	μg/Nm^3	8,300	1,400	--	7,900	3,200	--	124	66	--
Sulfate	μg/Nm^3	7,460,000	432,000	--	6,900,000	1,500,000	--	680,000	160,000	--
Anions-Particulate										
Chloride	μg/Nm^3	6,100	9,100	--	45	94	--	210	310	--
Fluoride	μg/Nm^3	1.3	2.4	--	0.12	0.21	--	0.051	0.041	--
Sulfate	μg/Nm^3	79,000	98,000	--	4,200	760	--	5,900	8,700	--
Anions-Total										
Chloride	μg/Nm^3	118,000	31,000	--	136,000	67,000	--	750	800	--
Fluoride	μg/Nm^3	8,300	1,400	--	7,900	3,200	--	124	66	--
Sulfate	μg/Nm^3	7,500,000	417,000	--	6,900,000	1,500,000	--	690,000	170,000	--
Radionuclides										
Actinium-228 @ 338 KeV	pCi/g	25	36	11%						
Actinium-228 @ 911 KeV	pCi/g	20	15	--						
Actinium-228 @ 968 KeV	pCi/g	29	41	13%						
Bismuth-212 @ 727 KeV	pCi/g	<39	--	100%						
Bismuth-214 @ 1120.4 KeV	pCi/g	<24	--	100%						
Bismuth-214 @ 1764.7 KeV	pCi/g	49	71	12%						
Bismuth-214 @ 609.4 KeV	pCi/g	28	17	--						
K-40 @ 1460 KeV	pCi/g	230	317	--	73	31	--	<56	--	48%
Lead-210 @ 46 KeV	pCi/g	79	33	--						
Lead-212 @ 238 KeV	pCi/g	19	19	--						
Lead-214 @ 295.2 KeV	pCi/g	24	20	--						
Lead-214 @ 352.0 KeV	pCi/g	25	8.0	--						
Radium-226 @ 186.0 KeV	pCi/g	130	50	--						
Thallium-208 @ 583 KeV	pCi/g	17	11	--						
Thallium-208 @ 860 KeV	pCi/g	<67	--	100%						
Thorium-234 @ 1001 KeV	pCi/g	79	35	--						
Thorium-234 @ 63.3 KeV	pCi/g	69	43	--						
Uranium-235 @ 143 KeV	pCi/g	69	43	--						
Part Metals by Wt.										
Aluminum	μg/g	97,000	11,000	--	101,000	--	--	13,800	7,300	--
Antimony	μg/g	3.6	2.4	--	2.7	0.65	--	3.8	5.7	--
Arsenic	μg/g	45	12	--	117	48	--	81	71	--
Barium	μg/g	490	106	--	620	--	--	210	1,100	--
Beryllium	μg/g	10	0.57	--	14	--	--	2.9	2.1	--
Cadmium	μg/g	2.70	1.4	--	8.9	--	--	41	79	--
Calcium	μg/g	18,100	3,900	--	14,800	--	--	18,600	31,000	--
Chromium	μg/g	320	500	--	190	--	--	330	3,000	--
Cobalt	μg/g	31	0.83	--	37	--	--	<150	--	52%

Table 5-2 (Continued)

Analyte Group/ Specie	Units	ESP Inlet			ESP Outlet			Stack		
		Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Copper	µg/g	86	2.6	--	116	35	--	56	49	--
Iron	µg/g	91,000	27,000	--	61,000	14,000	--	11,700	22,000	--
Lead	µg/g	79	19	--	153	--	--	36	20	--
Magnesium	µg/g	4,690	480	--	5,500	--	--	2,800	10,700	--
Manganese	µg/g	237	32	--	243	68	--	490	2,600	--
Mercury	µg/g	0.79	0.59	--	0.90	0.3	--	0.57	5.2	14%
Molybdenum	µg/g	35	39	--	58	31	--	73	120	--
Nickel	µg/g	230	250	--	157	25	--	2,500	27,000	--
Phosphorus	µg/g	230	150	--	830	--	--	<220	--	100%
Potassium	µg/g	17,500	1,900	--	17,900	--	--	2,900	1,600	--
Selenium	µg/g	15	7.0	--	570	860	--	1,700	3,500	--
Sodium	µg/g	5,120	190	--	6,700	--	--	4,200	1,900	--
Strontium	µg/g	324	12	--	360	--	--	106	53	--
Titanium	µg/g	6,140	790	--	5,400	1,600	--	910	1,700	--
Vanadium	µg/g	308	5.7	--	381	93	--	112	46	--
Part Metals by Vol										
Aluminum	µg/Nm^3	870,000	240,000	--	12,100	--	--	190	260	--
Antimony	µg/Nm^3	33	26	--	0.39	0.11	--	0.052	0.019	--
Arsenic	µg/Nm^3	400	170	--	16	6.6	--	1.1	0.24	--
Barium	µg/Nm^3	4,400	1,700	--	74	--	--	2.8	10	--
Beryllium	µg/Nm^3	93	16	--	1.7	--	--	0.041	0.047	--
Cadmium	µg/Nm^3	24	15	--	1.1	--	--	0.59	2.2	--
Calcium	µg/Nm^3	161,300	7,200	--	1,800	--	--	270	920	--
Chromium	µg/Nm^3	2,900	4,600	--	23	--	--	5.1	50	--
Cobalt	µg/Nm^3	275	48	--	4.5	--	--	<0.6	--	59%
Copper	µg/Nm^3	770	130	--	16	1.2	--	0.77	0.76	--
Iron	µg/Nm^3	808,000	99,000	--	8,500	1,100	--	170	600	--
Lead	µg/Nm^3	710	290	--	18	--	--	0.50	0.64	--
Magnesium	µg/Nm^3	42,000	11,000	--	660	--	--	41	220	--
Manganese	µg/Nm^3	2,120	120	--	34	3.7	--	7.2	49	--
Mercury	µg/Nm^3	7.1	5.6	--	0.126	0.037	--	0.0071	0.057	18%
Molybdenum	µg/Nm^3	320	390	--	8.1	1.3	--	1.4	2.6	--
Nickel	µg/Nm^3	2,000	2,300	--	22	5.7	--	39	440	--
Phosphorus	µg/Nm^3	2,100	1,600	--	100	--	--	<2.6	--	100%
Potassium	µg/Nm^3	157,000	43,000	--	2,150	--	--	40	53	--
Selenium	µg/Nm^3	133	73	--	82	130	--	26	58	--
Sodium	µg/Nm^3	45,800	6,200	--	800	--	--	59	140	--
Strontium	µg/Nm^3	2,910	570	--	43	--	--	1.5	3.5	--
Titanium	µg/Nm^3	55,000	16,000	--	760	230	--	12.5	0.59	--
Vanadium	µg/Nm^3	2,760	430	--	54	11	--	1.6	0.47	--
Metals, Vapor										
Aluminum	µg/Nm^3	150	940	--	58	48	--	<8.7	--	50%
Antimony	µg/Nm^3	0.56	6.5	--	0.021	0.0096	--	0.012	0.0019	--
Arsenic	µg/Nm^3	<0.17	--	100%	<0.18	--	100%	<0.18	--	100%
Barium	µg/Nm^3	1.5	7.9	--	1.0	1.1	--	<0.14	--	54%
Beryllium	µg/Nm^3	0.06	0.25	--	<0.16	--	57%	<0.17	--	82%

Table 5-2 (Continued)

		ESP Inlet			ESP Outlet			Stack		
Analyte Group/ Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Boron	μg/Nm^3	6,400	12,000	--	6,900	1,200	--	440	70	--
Cadmium	μg/Nm^3	0.11	0.93	16%	0.10	0.31	21%	<0.064	--	100%
Calcium	μg/Nm^3	300	110	--	184	87	--	<40	--	52%
Chromium	μg/Nm^3	11	140	--	<0.73	--	42%	<0.67	--	100%
Cobalt	μg/Nm^3	<0.74	--	55%	<1.0	--	31%	0.39	0.77	--
Copper	μg/Nm^3	1.1	1.6	--	1.1	1.2	16%	1.2	2.4	14%
Iron	μg/Nm^3	140	120	--	50	78	--	<1.8	--	50%
Lead	μg/Nm^3	<0.21	--	100%	0.40	1.1	20%	<0.22	--	100%
Magnesium	μg/Nm^3	20	18	--	12	6.4	--	<7.0	--	24%
Manganese	μg/Nm^3	<0.10	--	100%	<0.11	--	100%	<0.11	--	100%
Mercury	μg/Nm^3	5.5	5.6	--	5.6	1.1	--	3.0	0.27	--
Molybdenum	μg/Nm^3	<1.4	--	52%	<1.4	--	37%	0.12	0.048	--
Nickel	μg/Nm^3	7	7%	8%	<2.9	--	59%	<2.6	--	46%
Phosphorus	μg/Nm^3	<16	--	100%	<17	--	100%	<16	--	100%
Potassium	μg/Nm^3	10	130	2%	20	100	1%	37	96	0.4%
Selenium	μg/Nm^3	<0.22	--	100%	<0.23	--	100%	0.80	1.6	--
Sodium	μg/Nm^3	240	360	--	290	280	--	<11	--	100%
Strontium	μg/Nm^3	2	4	--	1.4	0.28	--	<0.045	--	100%
Titanium	μg/Nm^3	9	71	--	2.5	3.4	--	<0.27	--	58%
Vanadium	μg/Nm^3	1.2	3	--	1.0	1.3	12%	0.55	0.57	--
Total Metals										
Aluminum	μg/Nm^3	870,000	240,000	--	12,200	--	--	200	250	--
Antimony	μg/Nm^3	33	25	--	0.41	0.12	--	0.065	0.026	--
Arsenic	μg/Nm^3	410	170	--	17	6.6	--	1.2	0.24	--
Barium	μg/Nm^3	4,400	1,700	--	75	--	--	2.9	10	--
Beryllium	μg/Nm^3	93	16	--	1.7	--	--	0.099	0.29	--
Boron (vapor only)	μg/Nm^3	6,600	2,500	--	6,900	1,200	--	440	70	--
Cadmium	μg/Nm^3	24	15	--	1.3	--	--	0.63	2.2	--
Calcium	μg/Nm^3	163,300	6,200	--	1,900	--	--	290	830	--
Chromium	μg/Nm^3	2,900	4,700	--	23	--	--	5.4	50	--
Cobalt	μg/Nm^3	276	48	--	5	--	--	0.74	4	--
Copper	μg/Nm^3	770	130	--	17	1.9	--	2.0	1.8	--
Iron	μg/Nm^3	809,000	98,000	--	8,600	1,100	--	170	600	--
Lead	μg/Nm^3	710	290	--	19	--	--	0.61	0.54	--
Magnesium	μg/Nm^3	42,000	11,200	--	670	--	--	45	230	--
Manganese	μg/Nm^3	2,120	130	--	34	3.7	--	7.3	49	--
Mercury	μg/Nm^3	13	5.6	--	5.7	1.1	--	3.1	0.44	--
Molybdenum	μg/Nm^3	320	390	--	8.7	1.4	--	1.5	2.4	--
Nickel	μg/Nm^3	2,100	2,300	--	24	6.3	--	41	430	--
Phosphorus	μg/Nm^3	2,100	1,600	--	110	--	--	<10	--	100%
Potassium	μg/Nm^3	157,000	43,000	--	2,200	--	--	79	540	--
Selenium	μg/Nm^3	133	73	--	80	130	--	27	57	--
Sodium	μg/Nm^3	46,100	6,200	--	1,000	--	--	65	130	--
Strontium	μg/Nm^3	2,920	580	--	45	--	--	1.5	3.5	--

Table 5-2 (Continued)

		ESP Inlet			ESP Outlet			Stack		
Analyte Group/ Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Titanium	µg/Nm^3	55,000	16,000	--	760	230	--	13	0.26	--
Vanadium	µg/Nm^3	2,770	440	--	55	10	--	2.2	1	--
Hg Vapor, Bloom										
Mercury, Elemental	µg/Nm^3	2.0	1.8	--	2.5	0.28	--	2.8	1.1	--
Mercury II	µg/Nm^3	4.1	1.4	--	4.2	2	--	0.47	0.33	--
Mercury, Methyl	µg/Nm^3	0.31	0.59	--	0.63	0.45	--	0.044	0.041	--
Mercury, Total	µg/Nm^3	6.4	1.1	--	7.3	2.4	--	3.3	0.88	--
Hexavalent Chromium										
Chromium VI	µg/Nm^3							<0.190	--	100%
Total Chromium	µg/Nm^3							<0.560	--	100%
Extract Metals, Nitric										
Antimony	µg/g	2.7	1	--	3.2	3.4	--	5.8	--	--
Arsenic	µg/g	43	45	--	98	40	--	160	--	--
Barium	µg/g	220	145	--	318	8.4	--	350	--	--
Beryllium	µg/g	4.1	2.3	--	5.4	5.8	--	10	--	--
Boron	µg/g	1,520	857	--	1,900	1,200	--	<15	--	100%
Cadmium	µg/g	2.2	5	5%	10	18	--	67	--	--
Chromium	µg/g	29	30	--	64	61	--	44	--	--
Cobalt	µg/g	5.0	10	--	17	3.8	--	<0.90	--	100%
Copper	µg/g	32	36	--	98	32	--	120	--	--
Lead	µg/g	39	52	--	116	31	--	91	--	--
Manganese	µg/g	120	87	--	1000	3,500	--	330	--	--
Mercury	µg/g	80	230	0.4%	4.0	11	8.1%	<7.0	--	100%
Molybdenum	µg/g	43	59	--	72	21	--	51	--	--
Nickel	µg/g	45	30	--	84	46	--	390	--	--
Selenium	µg/g	<23	--	100%	<23	--	100%	<87	--	100%
Vanadium	µg/g	150	160	--	270	260	--	390	--	--
Extract Metals, Gastric										
Antimony	µg/g	0.71	0.095	--	1.0	0.4	--	3.4	--	--
Arsenic	µg/g	<0.68	--	100%	<0.66	--	100%	<2.5	--	100%
Barium	µg/g	103	55	--	125	22	--	210	--	--
Beryllium	µg/g	1.1	0.61	--	2.7	0.66	--	4.2	--	--
Boron	µg/g	698	4.6	--	822	88	--	150	--	--
Cadmium	µg/g	1.8	3.0	--	5.9	3.2	--	12	--	--
Chromium	µg/g	27	13	--	54	18	--	85	--	--
Cobalt	µg/g	1.8	1.4	--	5.5	2	--	11	--	--
Copper	µg/g	10	5.3	--	33	9.3	--	51	--	--
Lead	µg/g	9.4	9.6	--	33	7.1	--	66	--	--
Manganese	µg/g	60	65	--	46	11	--	350	--	--
Mercury	µg/g	1.9	3.0	--	0.38	0.22	--	<0.15	--	100%
Molybdenum	µg/g	29	22	--	61	12	--	49	--	--
Nickel	µg/g	10	21	--	38	22	--	170	--	--
Selenium	µg/g	<0.88	--	100%	18	6.8	--	140	--	--
Vanadium	µg/g	<0.36	--	100%	122	79	--	<1.3	--	100%

Table 5-2 (Continued)

		ESP Inlet			ESP Outlet			Stack		
Analyte Group/ Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Extract Metals, Acetic										
Antimony	μg/g	0.80	1.1	--	0.88	0.38	--	<0.03	--	100%
Arsenic	μg/g	1.0	0.63	--	3.4	3.9	--	<0.5	--	100%
Barium	μg/g	48	30	--	44	13	--	17	--	--
Beryllium	μg/g	0.32	0.54	--	0.98	0.53	--	2.9	--	--
Boron	μg/g	1,010	240	--	910	280	--	<0.82	--	100%
Cadmium	μg/g	1.6	2.9	--	10	27	--	5.9	--	--
Chromium	μg/g	7.4	1	--	19	7.2	--	36	--	--
Cobalt	μg/g	1.5	0.87	--	6.0	7.4	--	7.5	--	--
Copper	μg/g	11	14	--	18	4.9	--	64	--	--
Lead	μg/g	0.21	0.35	--	1.5	0.98	--	20	--	--
Manganese	μg/g	51	52	--	39	8.5	--	470	--	--
Mercury	μg/g	0.70	1.9	--	0.13	0.38	--	<0.38	--	100%
Molybdenum	μg/g	1.5	5.3	--	4.0	12	--	3.5	--	--
Nickel	μg/g	8.6	5.6	--	23	1.0	--	66	--	--
Selenium	μg/g	<0.54	--	41%	4.1	3.3	--	61	--	--
Vanadium	μg/g	1.5	1.0	--	5.0	10	--	<0.19	--	100%
Metals by Size, >10 μm										
Percent of Total Mass	%	57			16					
Aluminum	μg/g	109,000	35,000	--	72,000	16,000	--			
Antimony	μg/g	2.0	1.1	--	3.2	1.0	--			
Arsenic	μg/g	26	8.4	--	49	21	--			
Barium	μg/g	520	130	--	390	100	--			
Beryllium	μg/g	10	5.6	--	10	18	--			
Cadmium	μg/g	1.7	0.88	--	3.6	1.8	--			
Calcium	μg/g	22,100	10,000	--	14,000	3,900	--			
Chromium	μg/g	184	4.3	--	213	35	--			
Cobalt	μg/g	32	4.4	--	32	18	--			
Copper	μg/g	87	23	--	102	33	--			
Iron	μg/g	102,000	2,500	--	160,000	140,000	--			
Lead	μg/g	51	19	--	72	31	--			
Magnesium	μg/g	5,400	2,000	--	3,700	1,600	--			
Manganese	μg/g	238	17	--	700	1,100	--			
Mercury	μg/g	0.50	0.47	--	0.55	0.21	--			
Molybdenum	μg/g	16	20	--	43	13	--			
Nickel	μg/g	121	34	--	129	96	--			
Phosphorus	μg/g	<72	--	100%	<71	--	100%			
Potassium	μg/g	18,500	2,700	--	14,600	2,900	--			
Selenium	μg/g	11	1	--	160	210	--			
Silicon	μg/g	218,000	20,000	--	175,000	77,000	--			
Sodium	μg/g	4,600	1,900	--	5,500	4,000	--			
Strontium	μg/g	357	97	--	294	58	--			
Titanium	μg/g	6,150	560	--	5,300	2,000	--			
Vanadium	μg/g	293	45	--	290	120	--			

Table 5-2 (Continued)

		ESP Inlet			ESP Outlet			Stack		
Analyte Group/ Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Metals by Size, 3-10 μm										
Percent of Total Mass	%	27			44					
Aluminum	μg/g	118,000	23,000	--	105,000	63,000	--			
Antimony	μg/g	4.8	2.7	--	8.6	1.1	--			
Arsenic	μg/g	71	31	--	127	11	--			
Barium	μg/g	630	250	--	629	85	--			
Beryllium	μg/g	13	8.1	--	18	15	--			
Cadmium	μg/g	5.8	3.6	--	11	2.4	--			
Calcium	μg/g	19,000	17,000	--	14,000	1,600	--			
Chromium	μg/g	218	16	--	275	65	--			
Cobalt	μg/g	43	5.6	--	51	10	--			
Copper	μg/g	142	22	--	170	39	--			
Iron	μg/g	64,000	19,000	--	63,000	14,000	--			
Lead	μg/g	119	82	--	191	5.2	--			
Magnesium	μg/g	6,350	520	--	5,000	4,200	--			
Manganese	μg/g	226	34	--	280	110	--			
Mercury	μg/g	0.47	0.54	--	<0.48	--	18%			
Molybdenum	μg/g	46	34	--	80	25	--			
Nickel	μg/g	152	69	--	211	73	--			
Phosphorus	μg/g	<73	--	100%	228	100	--			
Potassium	μg/g	21,800	3,300	--	21,300	7,200	--			
Selenium	μg/g	3.1	7.3	6%	45	33	--			
Silicon	μg/g	231,000	14,000	--	218,000	20,000	--			
Sodium	μg/g	6,700	2,600	--	7,900	1,500	--			
Strontium	μg/g	384	11	--	370	120	--			
Titanium	μg/g	6,830	960	--	6,860	850	--			
Vanadium	μg/g	390	190	--	509	91	--			
Metals by Size, <3 μm										
Percent of Total Mass	%	16			40					
Aluminum	μg/g	135,000	18,000	--	122,000	10,000	--			
Antimony	μg/g	10	5.7	--	13	0.94	--			
Arsenic	μg/g	160	110	--	202	54	--			
Barium	μg/g	780	400	--	758	85	--			
Beryllium	μg/g	17	9.8	--	15	5.0	--			
Cadmium	μg/g	15	12	--	21	8.0	--			
Calcium	μg/g	19,000	13,000	--	16,200	2,100	--			
Chromium	μg/g	246	65	--	290	84	--			
Cobalt	μg/g	63	28	--	64	15	--			
Copper	μg/g	195	52	--	250	180	--			
Iron	μg/g	58,600	4,700	--	67,900	5,100	--			
Lead	μg/g	180	120	--	220	230	--			
Magnesium	μg/g	7,500	1,500	--	6,700	3,500	--			
Manganese	μg/g	267	79	--	319	29	--			
Mercury	μg/g	0.63	0.25	--	0.39	0.15	--			
Molybdenum	μg/g	103	72	--	118	49	--			
Nickel	μg/g	202	49	--	235	52	--			

Table 5-2 (Continued)

		ESP Inlet			ESP Outlet			Stack		
Analyte Group/ Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Phosphorus	μg/g	<499	--	35%	820	790	--			
Potassium	μg/g	24,500	2,600	--	22,700	5,700	--			
Selenium	μg/g	<8.0	--	36%	60	43	--			
Silicon	μg/g	223,000	38,000	--	207,000	18,000	--			
Sodium	μg/g	8,000	2,300	--	8,300	2,800	--			
Strontium	μg/g	430	120	--	429	91	--			
Titanium	μg/g	6,970	480	--	6,890	170	--			
Vanadium	μg/g	2,700	9,100	--	770	230	--			
Organics, Aldehydes										
Acetaldehyde	μg/Nm^3	130	170	--	1.2	2.8	--	8.7	9.2	
Formaldehyde	μg/Nm^3	61	56	--	0.50	1.1	--	24	35	
Organics, Semivolatile										
2-Methylphenol(o-cresol)	ng/Nm^3	1,500	4,500	1%	5,000	11,000	--	3,000	3,700	--
4-Methylphenol(p-cresol)	ng/Nm^3	1,100	2,700	3%	1,730	780	--	960	2,000	3%
Acetophenone	ng/Nm^3	2,400	5,000	1%	3,260	750	--	3,300	710	--
Benzoic acid	ng/Nm^3	140,000	100,000	--	130,000	70,000	--	119,000	5,000	--
Benzyl alcohol	ng/Nm^3	2,300	9,100	4%	4,000	18,000	2%	2,800	1,100	3%
Butylbenzylphthalate	ng/Nm^3	<230	--	39%	340	170	--	300	130	--
Dibutylphthalate	ng/Nm^3	2,600	10,000	--	<160	--	39%	170	260	--
Diethylphthalate	ng/Nm^3	260	360	12%	190	530	24%	240	140	--
Dimethylphthalate	ng/Nm^3	<110	--	100%	<96	--	100%	180	560	18%
Naphthalene	ng/Nm^3	900	460	--	1,100	1,000	--	1,500	980	--
Phenol	ng/Nm^3	8,000	11,000	--	9,000	15,000	--	9,300	8,700	--
bis(2-Ethylhexyl)phthalate	ng/Nm^3	1,400	1,700	--	15,000	41,000	--	1,400	1,400	--
Organics, Volatile										
1,1,1-Trichloroethane	ng/Nm^3	700	270	--	690	190	--	640	810	14%
Acetone	ng/Nm^3	16,000	63,000	6%	<2,600	--	100%	3,600	6,300	13%
Benzene	ng/Nm^3	1,100	680	--	1,470	240	--	1,310	360	--
Carbon Disulfide	ng/Nm^3	7,000	25,000		3,400	7,700		2,300	1,200	
Chloromethane	ng/Nm^3	<460	--	100%	<530	--	100%	6,000	13,000	1%
Methylene Chloride	ng/Nm^3	170,000	540,000	--	33,000	37,000	--	130,000	280,000	--
Tetrachloroethene	ng/Nm^3	1,000	800	--	820	470	--	1,500	2,300	--
Toluene	ng/Nm^3	1,200	2,000	--	1,200	1,100	--	2,000	1,000	--
Trichlorofluoromethane	ng/Nm^3	9,000	27,000	--	<540	--	44%	1,100	1,700	--
m,p-Xylene	ng/Nm^3				<540	--	40%			
Dioxins/Furans										
Total TCDD	ng/Nm^3							0.0067	0.008	16%

Boric acid is added to dissolve the insoluble metal fluorides that are produced during digestion. This addition of boric acid makes the quantification of boron in the sample impossible. Silicon in the gas particulate sample cannot be isolated due to the overwhelming contribution of silicon from the filter media.

The results presented in the data tables in this section of the report have been corrected for significant figures and may vary slightly from the detailed data summary presented in Appendix H. The number of significant figures reported is directly related to the order of magnitude of the 95% CI. Therefore, numbers with a small degree of variability will contain more significant figures than those whose CI is extremely broad.

Detection limit ratios are presented where the mean value is derived in some part from results that are below the method detection limit. If all values used in determining the mean value were above the detection limit, then no DL ratio was calculated and is represented by "--."

Flue Gas Particle Size Distribution Results

Flue gas particle size distributions were measured in three runs at the ESP inlet, ESP outlet, and the stack. All of these measurements were performed with inertial sizing devices. The Andersen High Capacity Source Sampler was used at the ESP inlet. This device has two impaction stages, a cyclone, and a final filter. The University of Washington Mark V cascade impactor was used at the ESP outlet and at the stack. This impactor was equipped with a right angle pre-cutter, eleven impaction stages, and a final filter. Because the cutpoint of the pre-cutter was close to the cutpoints of the first two stages, the weights of the pre-cutter and first two impaction stages were combined for the size distribution calculations.

Since these particle sizing devices are inertial sizing devices, the particle cutpoints are reported from the field in aerodynamic micrometers. Conversion of aerodynamic diameter to physical diameter will be described and used in Section 8. Table 5-3 gives the average cumulative particle size distributions for the ESP inlet, ESP outlet, and stack in terms of aerodynamic particle size for the three runs. As an example of how to read the tables, Table 5-3 shows that at the ESP outlet, 15.5% of the particulate mass was found in particles with aerodynamic diameters less than 2.1 aero μm.

ESP Hopper Particle Size Distribution Results

The particle size distributions of ESP hopper catches were also measured. ESP hopper catches were collected once during Runs 1 and 2 and twice during Run 3. Field 1 and Field 2 hopper catch composites were made and analyzed by Microtracs laser diffraction. This method measures particle volumes as a function of physical particle diameter. Table 5-4 shows the average cumulative percent particle volumes as a function of physical particle diameter for the ESP Field 1 composites and the ESP Field 2 composites, respectively. These results are discussed in Section 8.

Table 5-3
Flue Gas Particle Size Distribution

	Aerodynamic Particle Diameter (Aero μm)	Average Mass Percent Less than Indicated Diameter
ESP Inlet	12.0	32.6
	6.5	20.3
	1.8	3.8
ESP Outlet	10.1	66.3
	4.3	35.0
	2.1	15.5
	1.14	7.4
	0.74	4.1
	0.57	3.1
	0.43	2.1
	0.33	1.4
	0.27	0.7
	0.16	0.7
Stack	10.7	60.8
	4.6	52.6
	2.3	43.2
	1.26	30.0
	0.85	17.7
	0.67	11.7
	0.52	7.3
	0.41	3.7
	0.34	0.6
	0.21	0.6

Table 5-4
ESP Fields 1 and 2 Hopper Composite Catches

Hopper 1		Hopper 2	
Physical Particle Diameter (physical μm)	Average Volume Percent Less than Indicated Diameter	Physical Particle Diameter (physical μm)	Average Volume Percent Less than Indicated Diameter
106	100.0	42	100.0
75	90.6	30	93.4
53	76.6	21	83.9
38	67.7	15	72.5
27	57.3	10.6	60.5
19	46.4	7.5	47.9
13	38.4	5.3	34.6
9.4	30.5	3.7	24.5
6.6	21.2	2.6	17.2
4.7	15.0	1.7	11.1
3.3	8.2	1.01	6.0
2.4	3.5	0.66	2.7
1.7	2.1	0.43	0.8
1.0	0.7	0.34	0.3
0.66	0.1	0.24	0.1

FGD System

Analytical results for influent and effluent streams associated with the JBR have been compiled and are presented in Table 5-5. Mean results are presented for the limestone slurry, the JBR underflow slurry and the inlet and outlet gaseous streams. These data are also presented elsewhere in this section with 95% CI and DL ratios.

Solids

Data for the solid streams have been summarized and are presented in Tables 5-6 to 5-9. Table 5-6 contains data representing the coal feed section of the process. Table 5-7 represents the primary ash streams exiting the boiler, Table 5-8 contains ESP hopper ash data and Table 5-9 contains data from the JBR/FGD removal process.

Liquids

Liquid streams data have been summarized and are presented in Tables 5-10 to 5-12. Table 5-10 contains data from the ash sluice system. Table 5-11 presents the FGD process stream data and ancillary streams such as the cooling water and coal pile run-off are in Table 5-12. As with the gaseous results, the only organic results that are presented are for those species which were detected. Detailed results are contained in Appendix H.

Table 5-5
FGD System Summary

	Limestone Slurry		JBR Underflow Slurry		ESP Outlet	Stack
Specie	Aqueous (μg/mL)	Solids (μg/g)	Aqueous (μg/mL)	Solids (μg/g)	Total (μg/Nm^3)	Total (μg/Nm^3)
Aluminum	0.26	760	12.3	1,100	12,200	200
Antimony	<0.24	0.019	<0.19	0.073	0.53	0.41
Arsenic	0.07	<0.33	0.20	<0.41	17	1.9
Barium	4	5.39	3.39	4.02	75	3.2
Beryllium	<0.0055	0.143	0.0069	0.129	2.4	0.43
Boron	1,400	202	1,400	425	6,900	440
Cadmium	0.0067	0.608	0.456	0.247	1.3	1.2
Calcium	7,070	392,000	17,000	255,000	1,900	300
Chromium	0.063	13.4	0.07	11.3	24	6.4
Cobalt	0.09	1.48	0.304	0.99	6.0	0.74
Copper	0.04	3.71	0.239	2.73	18	2.0
Iron	<0.06	2,510	<0.048	2,190	8,600	170
Lead	0.0017	0.98	0.013	0.84	19	1.3
Magnesium	1,900	1,390	1,800	810	670	47
Manganese	40	429	307	103	35	7.9
Mercury	0.00006	<0.012	0.001	0.178	5.7	3.1
Molybdenum	0.21	0.23	0.064	1.48	9.1	1.5
Nickel	0.8	4.0	1.52	2.8	25	42
Phosphorus	0.16	110	0.720	88	120	<19
Potassium	140	338	123	310	2,200	80
Selenium	0.128	8.4	0.50	25.5	80	27
Silicon	7	370	42.4	447		
Sodium	290	55	244	84.1	1,000	71
Strontium	40	112	32.9	73.8	45	2.1
Titanium	0.5	<0.16	0.82	20.9	760	13
Vanadium	0.19	6.7	0.24	9.9	55	2.2

Table 5-6
Coal Data

			Feed Coal			Raw Coal			Pulverizer Rejects		
Analyte Group	Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Anions	Chloride	µg/g	1,400	90		1,350	220		510	100	
	Fluoride	µg/g	100	0		123	38		323	29	
Metals	Aluminum	µg/g	14,500	1,400		14,300	3,100		27,200	9,600	
	Antimony	µg/g	0.61	0.16		0.62	0.33		1.2	0.45	
	Arsenic	µg/g	2.3	1.4		3.0	0		47	45	
	Barium	µg/g	80	51		112	19		330	520	
	Beryllium	µg/g	1.1	0		1.13	0.14		1.5	1.9	
	Boron	µg/g	100	0		110	25		120	120	
	Bromine	µg/g	7.44	0.53		7.4	1		4.3	1.5	
	Cadmium	µg/g	0.30	0		0.53	0.72		4.1	8.6	
	Calcium	µg/g	2,100	1,300		3,000	1,300		12,700	6,500	
	Chlorine	µg/g	1,240	100		1,210	140		590	130	
	Chromium	µg/g	24.8	2.9		25.8	0.37		64	14	
	Cobalt	µg/g	3.5	1.9		4.08	0.19		7.8	0.8	
	Copper	µg/g	36	62		42	50		68	85	14%
	Iron	µg/g	11,400	1,100		12,800	1,700		127,000	17,000	
	Lead	µg/g	8.0	2.5		9.0	4.3		37	32	
	Magnesium	µg/g	570	170		660	58		1,370	320	
	Manganese	µg/g	23.4	3.3		24.4	5.9		99	53	
	Mercury	µg/g	0.077	0.029		0.043	0.014		0.13	0.29	
	Molybdenum	µg/g	22.3	6.1		18	11		13	20	
	Nickel	µg/g	30.0	6.4		40	14		<120	–	66%
	Phosphorus	µg/g	84	16		100	120		1,500	2,200	
	Potassium	µg/g	3,300	720		3,100	2,300		2,700	6,600	
	Selenium	µg/g	2.3	1.4		2.3	1.4		8.7	3.8	
	Silver	µg/g	<0.52	–	100%	<0.41	–	100%	<1.9	–	59%
	Sodium	µg/g	631	82		679	89		1,110	240	
	Strontium	µg/g	74.9	9.3		88	14		450	460	
	Tin	µg/g	<16	–	100%	<17	–	100%	<31	–	49%
	Titanium	µg/g	890	170		850	170		1,980	110	
	Uranium	µg/g	1.8	0.6		1.60	0.37		4.1	1.9	
	Vanadium	µg/g	39.4	1.2		37.7	6.3		59.8	8.2	
Ultimate/Proximate	% Ash	%	11.1	1.4		12.2	2.5				
	% Carbon	%	72.0	0.52		70.8	1.2		38.5	4.2	
	% Hydrogen	%	4.83	0.014		4.76	0.17				
	% Moisture	%				11.7	2.2				
	% Nitrogen	%	1.52	0.14		1.45	0.052				
	% Oxygen (diff.)	%	7.74	0.62		7.92	0.93				
	% Sulfur	%	2.74	0.29		2.90	0.36		16.0	2.3	
	Fixed Carbon	%	50.8	2.5		50.7	0.74				
	Higher Heating Value	Btu/lb	12,697	64		12,590	270				
	Heating Value (MAF)	MAF Btu	14,290	160		14,330	150				
	Volatile Matter	%	37.0	2.7		37.1	1.9				

Table 5-6 (Continued)

Analyte Group	Specie	Units	Feed Coal			Raw Coal			Pulverizer Rejects		
			Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Radionuclides	Actinium-228 @ 338 KeV	pCi/g	0.33	0.29							
	Actinium-228 @ 911 KeV	pCi/g	0.33	0.14							
	Actinium-228 @ 968 KeV	pCi/g	0.07	0.29							
	Bismuth-212 @ 727 KeV	pCi/g	ND	–							
	Bismuth-214 @ 1120.4 KeV	pCi/g	0.93	0.38							
	Bismuth-214 @ 1764.7 KeV	pCi/g	0.10	0.43							
	Bismuth-214 @ 609.4 KeV	pCi/g	0.67	0.14							
	K-40 @ 1460 KeV	pCi/g	1.4	3.6							
	Lead-210 @ 46 KeV	pCi/g	1.3	0.9							
	Lead-212 @ 238 KeV	pCi/g	0.20	0							
	Lead-214 @ 295.2 KeV	pCi/g	0.63	0.14							
	Lead-214@ 352.0 KeV	pCi/g	0.63	0.14							
	Radium-226 @ 186.0 KeV	pCi/g	1.17	0.72							
	Thallium-208 @ 583 KeV	pCi/g	0.30	0.25							
	Thallium-208 @ 860 KeV	pCi/g	ND	–							
	Thorium-234 @ 63.3 KeV	pCi/g	1.0	1.4							
	Thorium-234 @ 92.6 KeV	pCi/g	0.67	0.38							
	Uranium-235 @ 143 KeV	pCi/g	0.07	0.29							

Table 5-7
Boiler Process Solids Data

			Bottom Ash			Sluiced Fly Ash		
Analyte Group	Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Anions	Chloride	µg/g	130	170	13%	<100	–	100%
	Fluoride	µg/g	32	26		99	67	
Metals	Aluminum	µg/g	76,000	11,000		98,000	8,000	
	Antimony	µg/g	1.14	0.20		339	2.04	
	Arsenic	µg/g	7.2	6.2		61	37	
	Barium	µg/g	457	66		496	87	
	Beryllium	µg/g	7.7	2.9		11.1	3.1	
	Boron	µg/g	280	170		470	230	
	Cadmium	µg/g	0.32	0.39		4.10	3	
	Calcium	µg/g	20,300	3,400		13,800	2,000	
	Chromium	µg/g	192	18		185	21	
	Cobalt	µg/g	31.6	4.3		36.9	5.8	
	Copper	µg/g	77	18		104	23	
	Iron	µg/g	130,000	31,000		89,000	22,000	
	Lead	µg/g	20	3.8		83	40	
	Magnesium	µg/g	3610	820		4,880	350	
	Manganese	µg/g	270	56		245	46	
	Mercury	µg/g	<0.011	–	70%	0.150	0.12	
	Molybdenum	µg/g	<3.0	–	39%	<14	–	29%
	Nickel	µg/g	131	15		143	32	
	Phosphorus	µg/g	400	210		70	140	
	Potassium	µg/g	14,200	1,100		18,210	1,000	
	Selenium	µg/g	<1	–	100%	12	11	
	Silicon	µg/g	213,000	11,000		219,000	7,600	
	Sodium	µg/g	36,10	580		5,100	1,200	
	Strontium	µg/g	280	41		322	30	
	Titanium	µg/g	5,550	560		6,330	750	
	Vanadium	µg/g	277	29		327	58	
Ultimate/Proximate	% Carbon	%	2.3	4.2		4.50	2.7	
	% Sulfur	%	0.15	0.41		0.134	0.041	
Radionuclides	Actinium-228 @ 338 KeV	pCi/g	2.1	0		2.37	0.14	
	Actinium-228 @ 911 KeV	pCi/g	2.20	0.25		2.33	0.14	
	Actinium-228 @ 968 KeV	pCi/g	2.2	1		2.50	0.25	
	Bismuth-212 @ 727 KeV	pCi/g	3.0	1.2		2.60	0.99	
	Bismuth-214 @ 1120.4 KeV	pCi/g	7.4	1.3		6.50	2.4	
	Bismuth-214 @ 1764.7 KeV	pCi/g	6.8	2.2		5.90	1.8	
	Bismuth-214 @ 609.4 KeV	pCi/g	7.1	1.5		6.50	1.4	
	K-40 @ 1460 KeV	pCi/g	16.7	2.9		18.0	2.5	
	Lead-210 @ 46 KeV	pCi/g	1.37	0.52		6.40	2.7	
	Lead-212 @ 238 KeV	pCi/g	2.03	0.72		2.20	0.25	

Table 5-7 (Continued)

Analyte Group	Specie	Units	Bottom Ash Average	95% CI	DL Ratio	Sluiced Fly Ash Average	95% CI	DL Ratio
Radionuclides (Cont'd)	Lead-214 @ 295.2 KeV	pCi/g	7.3	1.9		6.50	1.4	
	Lead-214@ 352.0 KeV	pCi/g	7.6	1.8		6.60	1.3	
	Radium-226 @ 186.0 KeV	pCi/g	10.3	1.5		9.9	2.9	
	Thallium-208 @ 583 KeV	pCi/g	2.20	0.43		2.23	0.29	
	Thallium-208 @ 860 KeV	pCi/g	1.9	4.2		2.97	0.14	
	Thorium-234 @ 63.3 KeV	pCi/g	5.77	0.76		6.60	4.3	
	Thorium-234 @ 92.6 KeV	pCi/g	5.0	1.3		5.00	2.2	
	Uranium-235 @ 143 KeV	pCi/g	0.31	0.16		0.220	0.15	
Organics, Semivolatile	2-Methylnaphthalene	ng/g	34	97	22%	<26	–	100%
	bis(2-Ethylhexyl)phthalate	ng/g	<86	–	26%	230	520	2%

Table 5-8
ESP Hopper Ash

			ESP Hopper Ash-Field 1			ESP Hopper Ash-Field 2		
Analyte Group	Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Anions	Chloride	µg/g	350	650	5%	<100	–	100%
	Fluoride	µg/g	90	49		125	91	
Metals	Aluminum	µg/g	97,000	51,000		89,000	11,000	
	Antimony	µg/g	2.99	1.01		4.19	1.38	
	Arsenic	µg/g	46	11		71.9	9.8	
	Barium	µg/g	490	150		493	98	
	Beryllium	µg/g	10.9	3.3		17.2	3.4	
	Cadmium	µg/g	3.26	0.72		5.42	0.69	
	Calcium	µg/g	17,900	6,400		15,640	960	
	Chromium	µg/g	183	31		220	110	
	Cobalt	µg/g	34.0	4.1		42	6	
	Copper	µg/g	98	26		150	150	
	Iron	µg/g	90,000	17,000		80,000	8,600	
	Lead	µg/g	72	11		96	20	
	Magnesium	µg/g	4,600	2,700		4,100	1,000	
	Manganese	µg/g	219	52		216	25	
	Mercury	µg/g	0.119	0.087		0.18	0.18	
	Molybdenum	µg/g	25	19		49	32	
	Nickel	µg/g	127	28		158	31	
	Phosphorus	µg/g	100	140	12%	<72	–	100%
	Potassium	µg/g	17,400	3,100		18,100	1,100	
	Selenium	µg/g	9.3	4.7		16.6	3.3	
	Silicon	µg/g	223,000	35,000		215,000	15,000	
	Sodium	µg/g	5,200	1,200		6,000	1,400	
	Strontium	µg/g	320	120		327	41	
	Titanium	µg/g	6,120	190		6,450	290	
	Vanadium	µg/g	305	37		357	55	
Radionuclides	Actinium-228 @ 338 KeV	pCi/g	2.13	0.38		2.17	0.38	
	Actinium-228 @ 911 KeV	pCi/g	2.10	0.43		2.2	0.5	
	Actinium-228 @ 968 KeV	pCi/g	2.43	0.87		2.63	0.14	
	Bismuth-212 @ 727 KeV	pCi/g	2.8	1.6		2.8	1.3	
	Bismuth-214 @ 1120.4 KeV	pCi/g	6.1	2.6		6.27	0.76	
	Bismuth-214 @ 1764.7 KeV	pCi/g	5.9	2.3		5.7	0.9	
	Bismuth-214 @ 609.4 KeV	pCi/g	6.2	2.1		6.0	1.9	
	K-40 @ 1460 KeV	pCi/g	17.0	4.3		17.3	1.4	
	Lead-210 @ 46 KeV	pCi/g	5.43	0.72		7.8	1.4	
	Lead-212 @ 238 KeV	pCi/g	2.10	0.75		1.87	0.76	
	Lead-214 @ 295.2 KeV	pCi/g	6.1	1.5		6.0	1.2	
	Lead-214@ 352.0 KeV	pCi/g	6.2	2.1		6.1	1.1	
	Radium-226 @ 186.0 KeV	pCi/g	9.0	2.2		9.7	2.8	

Table 5-8 (Continued)

Analyte Group	Specie	Units	ESP Hopper Ash-Field 1 Average	ESP Hopper Ash-Field 1 95% CI	ESP Hopper Ash-Field 1 DL Ratio	ESP Hopper Ash-Field 2 Average	ESP Hopper Ash-Field 2 95% CI	ESP Hopper Ash-Field 2 DL Ratio
Radionuclides (Cont'd)								
	Thallium-208 @ 583 KeV	pCi/g	2.07	0.29		2.17	0.38	
	Thallium-208 @ 860 KeV	pCi/g	2.1	1.9		2.2	4.8	
	Thorium-234 @ 63.3 KeV	pCi/g	5.6	2.2		5.5	1.6	
	Thorium-234 @ 92.6 KeV	pCi/g	4.3	1.6		4.8	1.6	
	Uranium-235 @ 143 KeV	pCi/g	0.22	0.17		0.9	2.8	
Organics, Semivolatile	bis(2-Ethylhexyl)phthalate	ng/g	190	780	3%	200	590	2%

Table 5-9
FGD Process Solids Data

			JBR Underflow Slurry Solids			Limestone Slurry Solids			Raw Limestone		
Analyte Group	**Specie**	**Units**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**
Anions	Chloride	µg/g	9,550	720		4,100	2,900		179	47	
	Fluoride	µg/g	750	140		85.0	46		59.0	19	
	Sulfate	µg/g	496,300	8,700							
	Sulfite	µg/g	<240	–	100%						
Metals	Aluminum	µg/g	1,100	190		760	320		980	160	
	Antimony	µg/g	0.073	0.028		0.019	0.003		0.007	0.01	
	Arsenic	µg/g	<0.41	–	100%	<0.33	–	100%	<0.33	–	100%
	Barium	µg/g	4.02	0.94		5.39	0.66		4.87	0.59	
	Beryllium	µg/g	0.129	0.066		0.143	0.017		0.137	0.028	
	Boron	µg/g	425	43		202	88		3.5	1.3	
	Cadmium	µg/g	0.247	0.035		0.608	0.042		0.332	0.016	
	Calcium	µg/g	255,000	15,000		392,000	27,000		395,000	9,000	
	Chromium	µg/g	11.3	2.5		13.4	2.3		9.80	0.64	
	Cobalt	µg/g	0.99	0.43		1.48	0.51		1.30	0.62	
	Copper	µg/g	2.73	0.81		3.71	0.48		1.5	1.1	
	Iron	µg/g	2,190	370		2,510	670		1,787	57	
	Lead	µg/g	0.84	0.21		0.98	0.11		1.1	0.2	
	Magnesium	µg/g	810	100		1,390	190		1,233	29	
	Manganese	µg/g	103	11		429	33		207	6.6	
	Mercury	µg/g	0.178	0.055		<0.012	–	29%	0.005	0.012	40%
	Molybdenum	µg/g	1.48	0.56		0.230	0.4		<0.222	–	50%
	Nickel	µg/g	2.8	1.3		4.00	2.5		3.16	0.88	
	Phosphorus	µg/g	88	29		110	10		108	31	
	Potassium	µg/g	310	160		338	86		363	45	
	Selenium	µg/g	25.5	1.2		8.40	2.8		3.9	2	
	Silicon	µg/g	447	73		370	220		440	110	
	Sodium	µg/g	84.1	7.8		55.0	19		20.9	2.5	
	Strontium	µg/g	73.8	7.4		112	5.3		108	2.5	
	Titanium	µg/g	20.9	7.1		<0.16	–	100%	30	110	0.00-2%
	Vanadium	µg/g	9.9	2.1		6.7	4.3		8.13	0.41	
Moisture	Percent Moisture	wt%							8.7	1.4	
Radionuclides	Actinium-228 @ 338 KeV	pCi/g	ND	–					0.30	0.19	
	Actinium-228 @ 911 KeV	pCi/g	0.05	0.23					0.17	0.38	
	Actinium-228 @ 968 KeV	pCi/g	ND	–					ND	–	

Table 5-9 (Continued)

			JBR Underflow Slurry Solids			Limestone Slurry Solids			Raw Limestone		
Analyte Group	Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
	Bismuth-212 @ 727 KeV	pCi/g	ND	–					ND	–	
	Bismuth-214 @ 1120.4 KeV	pCi/g	0.25	0.54					ND	–	
	Bismuth-214 @ 1764.7 KeV	pCi/g	0.11	0.27					0.32	0.32	
	Bismuth-214 @ 609.4 KeV	pCi/g	0.11	0.23					0.15	0.14	
	K-40 @ 1460 KeV	pCi/g	ND	–					0.39	0.86	
	Lead-210 @ 46 KeV	pCi/g	0.30	1.1					0.2	1.1	
	Lead-212 @ 238 KeV	pCi/g	0.09	0.05					0.113	0.038	
	Lead-214 @ 295.2 KeV	pCi/g	0.05	0.23					0.19	0.11	
	Lead-214@ 352.0 KeV	pCi/g	0.140	0.075					0.193	0.072	
	Radium-226 @ 186.0 KeV	pCi/g	0.33	0.72					0.42	0.91	
	Thallium-208 @ 583 KeV	pCi/g	0.20	0.21					0.07	0.3	
	Thallium-208 @ 860 KeV	pCi/g	ND	–					ND	–	
	Thorium-234 @ 63.3 KeV	pCi/g	0.19	0.8					0.12	0.53	
	Thorium-234 @ 92.6 KeV	pCi/g	0.20	0.44					0.08	0.36	
	Uranium-235 @ 143 KeV	pCi/g	ND	–					ND	–	
Aldehydes	Acetaldehyde	µg	<0.10	–	100%						
	Formaldehyde	µg	<0.10	–	100%						
Organics, Semivolatile	bis(2-Ethylhexyl) phthalate	ng/g	100	350	15%						

Table 5-10
Liquid Ash Sluice System Data Summary

			Ash Pond Water			Bottom Ash Sluice Filtrate			ESP Fly Ash Sluice Filtrate		
Analyte Group	**Specie**	**Units**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**
Reduced Species	Cyanide	µg/mL	0.0019	0.0024	–	0.002	0.0011	–	0.0015	0.0016	–
	Ammonia as N	µg/mL	0.20	0.12	–	0.45	0.43	–	0.38	0.08	–
Anions	Chloride	µg/mL	8.9	1.9	–	7.9	1.1	–	10.4	1.6	–
	Fluoride	µg/mL	0.43	0.11	–	0.281	0.046	–	0.74	0.57	–
	Phosphate	µg/mL	<0.014	–	100%	0.025	0.037	13%	0.023	0.047	14%
	Sulfate	µg/mL	113	12	–	81	34	–	340	510	–
Metals, Soluble	Aluminum	µg/mL	0.014	0.012	–	0.31	0.31	–	1.0	3.3	–
	Antimony	µg/mL	<0.024	–	100%	<0.024	–	100%	<0.024	–	67%
	Arsenic	µg/mL	<0.00066	–	100%	0.024	0.088	–	0.017	0.049	–
	Barium	µg/mL	0.155	0.028	–	0.102	0.084	–	0.24	0.16	–
	Beryllium	µg/mL	<0.00055	–	31%	<0.00055	–	100%	<0.00055	–	100%
	Boron	µg/mL	1.08	0.23	–	0.87	0.64	–	10	15	–
	Cadmium	µg/mL	0.0011	0.0010	–	0.0011	0.0021	4%	0.0027	0.004	–
	Calcium	µg/mL	32.8	3.5	–	39	23	–	140	170	–
	Chromium	µg/mL	<0.0025	–	53%	0.0031	0.0026	–	0.0480	0.051	–
	Cobalt	µg/mL	<0.0034	–	60%	<0.0034	–	100%	<0.0034	–	98%
	Copper	µg/mL	0.0044	0.0049	–	0.0180	0.047	–	0.0026	0.0015	–
	Iron	µg/mL	5.40	3.8	–	0.0280	0.034	–	0.0060	0.015	–
	Lead	µg/mL	0.008	0.011	–	0.0100	0.013	–	0.0048	0.0036	–
	Magnesium	µg/mL	3.11	0.17	–	2.3	1.6	–	4.5	2	–
	Manganese	µg/mL	0.560	0.21	–	0.05	0.12	–	0.020	0.045	–
	Mercury	µg/mL	0.00006	0.000043	–	0.00004	0.00007	–	<0.00004	–	38%
	Molybdenum	µg/mL	0.035	0.021	–	0.072	0.083	–	0.62	0.98	–
	Nickel	µg/mL	0.0197	0.0055	–	0.005	0.014	–	0.024	0.026	–
	Phosphorus	µg/mL	0.070	0.18	16%	0.11	0.13	–	0.14	0.26	7%
	Potassium	µg/mL	5.34	0.78	–	4.4	2.7	–	12	17	–
	Selenium	µg/mL	0.0019	0.0037	–	0.0039	0.0009	–	0.035	0.04	–
	Silicon	µg/mL	3.45	0.7	–	4.7	0.5	–	4.1	2.7	–
	Sodium	µg/mL	12.4	0.75	–	9.4	2.2	–	22	25	–
	Strontium	µg/mL	0.342	0.020	–	0.28	0.31	–	0.62	0.66	–
	Tin	µg/mL	<0.014	–	84%	<0.014	–	43%	0.0040	0.015	–
	Titanium	µg/mL	<0.0024	–	62%	0.0013	0.0022	13%	0.016	0.067	–
	Vanadium	µg/mL	0.0050	0.016	–	0.029	0.049	–	0.07	0.12	–
Metals, Total	Aluminum	µg/mL	0.18	0.39	–						
	Antimony	µg/mL	0.018	0.012	–						
	Arsenic	µg/mL	0.0007	0.0014	–						
	Barium	µg/mL	0.153	0.032	–						
	Beryllium	µg/mL	0.00026	0.00064	–						
	Boron	µg/mL	1.03	0.16	–						

Table 5-10 (Continued)

			Ash Pond Water			Bottom Ash Sluice Filtrate			ESP Fly Ash Sluice Filtrate		
Analyte Group	**Specie**	**Units**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**
Metals, Total (Cont'd)	Cadmium	µg/mL	0.0018	0.0039	–						
	Calcium	µg/mL	33.7	2.7	–						
	Chromium	µg/mL	0.0016	0.0011	–						
	Cobalt	µg/mL	0.00638	0.00077	–						
	Copper	µg/mL	0.0073	0.0051	–						
	Iron	µg/mL	10.2	5.4	–						
	Lead	µg/mL	0.017	0.057	1%						
	Magnesium	µg/mL	3.17	0.20	–						
	Manganese	µg/mL	0.56	0.21	–						
	Mercury	µg/mL	0.00005	0.00007	–						
	Molybdenum	µg/mL	0.084	0.034	–						
	Nickel	µg/mL	0.024	0.013	–						
	Phosphorus	µg/mL	0.027	0.052	–						
	Potassium	µg/mL	5.74	0.83	–						
	Selenium	µg/mL	0.0048	0.0026	–						
	Silicon	µg/mL	3.70	0.73	–						
	Sodium	µg/mL	12.8	1.9	–						
	Strontium	µg/mL	0.34	0.026	–						
	Tin	µg/mL	<0.014	–	50%						
	Titanium	µg/mL	0.00068	0.00098	–						
	Vanadium	µg/mL	0.024	0.011	–						
Aldehydes	Acetaldehyde	µg/mL	0.08	0.17	–	0.080	0.16	–	0.04	0.11	–
	Formaldehyde	µg/mL	0.015	0.021	–	0.023	0.036	–	0.03	0.048	–
Organics, Semivolatile	Diethylphthalate	µg/L	<0.39	–	100%	0.5	1.3	24%	<0.38	–	100%
Organics, Volatile	Methylene Chloride	µg/L	<5.0	–	19%	<5.0	–	46%	4.9	2.9	–

Table 5-11
Liquid FGD Process Stream Data Summary

			Gypsum Pond Water			JBR Underflow Slurry Filtrate			Limestone Slurry Filtrate		
Analyte Group	Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Reduced Species	Cyanide	µg/mL	0.0486	0.0046	–	0.082	0.1	–	0.050	0.1	–
	Ammonia as N	µg/mL	15	3	–	<40	–	19%	14.1	2.4	–
Anions	Chloride	µg/mL	16,400	4,100	–	26,100	4,200	–	13,100	2,100	–
	Fluoride	µg/mL	14.9	3.1	–	31.0	16	–	1.84	0.95	–
	Phosphate	µg/mL	0.033	0.021	–	0.050	0.15	7%	<0.020	–	100%
	Sulfate	µg/mL	980	140	–	712	65	–	780	160	–
	Sulfite	µg/mL	–		–	0.033	0.038	–	–	–	–
Metals, Soluble	Aluminum	µg/mL	0.76	0.68	–	12.3	4.7	–	0.260	0.85	–
	Antimony	µg/mL	<0.24	–	100%	<0.19	–	100%	<0.24	–	100%
	Arsenic	µg/mL	0.127	0.027	–	0.200	0.26	–	0.070	0.13	–
	Barium	µg/mL	1.19	0.057	–	3.39	0.29	–	4.00	11	–
	Beryllium	µg/mL	<0.0055	–	68%	0.0069	0.0047	–	<0.0055	–	56%
	Boron	µg/mL	533	89	–	1,400	190	–	1,400	4,100	–
	Cadmium	µg/mL	0.149	0.035	–	0.456	0.065	–	0.0067	0.0026	–
	Calcium	µg/mL	8,100	2,100	–	17,000	10,000	–	7,070	190	–
	Chromium	µg/mL	0.101	0.03	–	0.070	0.091	–	0.063	0.047	–
	Cobalt	µg/mL	0.11	0.13	–	0.304	0.0029	–	0.090	0.3	–
	Copper	µg/mL	0.057	0.048	–	0.239	0.086	–	0.040	0.11	–
	Iron	µg/mL	<0.060	–	100%	<0.048	–	100%	<0.060	–	100%
	Lead	µg/mL	0.0022	0.0072	16%	0.013	0.0089	–	0.0017	0.0013	–
	Magnesium	µg/mL	690	120	–	1,800	100	–	1,900	5,600	–
	Manganese	µg/mL	120	20	–	307	41	–	40	110	–
	Mercury	µg/mL	0.00024	0.00022	–	0.0010	0.0011	–	0.000057	1e-05	–
	Molybdenum	µg/mL	0.087	0.068	–	0.064	0.016	–	0.210	0.63	–
	Nickel	µg/mL	0.62	0.14	–	1.52	0.32	–	0.800	2.3	–
	Phosphorus	µg/mL	0.34	0.13	–	0.72	0.13	–	0.160	0.19	–
	Potassium	µg/mL	52	12	–	123	8.6	–	140	420	–
	Selenium	µg/mL	0.36	0.23	–	0.5	1	0%	0.128	0.049	–
	Silicon	µg/mL	15.8	2.7	–	42	6	–	7	21	–
	Sodium	µg/mL	97	16	–	244	5	–	290	860	–
	Strontium	µg/mL	13.2	2.1	–	32.9	4.3	–	40	110	–
	Tin	µg/mL	0.18	0.6	13%	<0.14	–	100%	<0.14	–	95%
	Titanium	µg/mL	2.19	0.45	–	0.82	0.13	–	0.5	1	0.3%
	Vanadium	µg/mL	0.322	0.065	–	0.24	0.22	–	0.19	0.23	–
Metals, Total	Aluminum	µg/mL	2.04	0.69	–						
	Antimony	µg/mL	<0.14	–	100%						
	Arsenic	µg/mL	0.127	0.031	–						
	Barium	µg/mL	1.19	0.25	–						
	Beryllium	µg/mL	<0.0055	–	35%						
	Boron	µg/mL	540	150	–						

Table 5-11 (Continued)

			Gypsum Pond Water			JBR Underflow Slurry Filtrate			Limestone Slurry Filtrate		
Analyte Group	Specie	Units	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio	Average	95% CI	DL Ratio
Metals, Total (Cont'd)	Calcium	μg/mL	9,500	6,000	–						
	Cadmium	μg/mL	0.177	0.018	–						
	Chromium	μg/mL	0.075	0.094	–						
	Cobalt	μg/mL	0.143	0.065	–						
	Copper	μg/mL	0.053	0.029	–						
	Iron	μg/mL	0.68	0.73	–						
	Lead	μg/mL	0.0036	0.0048	–						
	Magnesium	μg/mL	720	210	–						
	Manganese	μg/mL	123	39	–						
	Mercury	μg/mL	0.00030	0.00004	–						
	Molybdenum	μg/mL	0.076	0.012	–						
	Nickel	μg/mL	0.63	0.18	–						
	Phosphorus	μg/mL	0.236	0.024	–						
	Potassium	μg/mL	52	13	–						
	Selenium	μg/mL	0.27	0.17	–						
	Silicon	μg/mL	18.4	3.2	–						
	Sodium	μg/mL	102	25	–						
	Strontium	μg/mL	13.7	4.6	–						
	Tin	μg/mL	<0.086	–	100%						
	Titanium	μg/mL	1.10	2.8	–						
	Vanadium	μg/mL	0.22	0.28	–						
Aldehydes	Acetaldehyde	μg/mL	0.05	0.11	–	0.06	0.12	–	0.050	0.1	–
	Formaldehyde	μg/mL	0.023	0.027	–	0.08	0.26	–	0.021	0.025	–
Organics, Semivolatile	Dimethylphthalate	μg/L	1.3	2.2	–	2.1	4.2	2%	<0.36	–	100%
	bis(2-Ethylhexyl)phthalate	μg/L	8.0	81	–	4.4	1.5	–	140	560	–
Organics, Volatile	Acetone	μg/L	<10	–	26%	<10	–	60%	22.3	7.2	–

Table 5-12
Liquid Ancillary Stream Data Summary

			Cooling Water			Coal Pile Run-off		
Analyte Group	**Specie**	**Units**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**
Reduced Species	Cyanide	μg/mL	0.00148	0.00091	–			
	Ammonia as N	μg/mL	0.047	0.014	–			
Anions	Chloride	μg/mL	5.7	1.8	–			
	Fluoride	μg/mL	0.134	0.018	–			
	Phosphate	μg/mL	0.094	0.07	–			
	Sulfate	μg/mL	6.3	1.4	–			
Metals, Soluble	Aluminum	μg/mL	0.031	0.047	–			
	Antimony	μg/mL	<0.024	–	65%			
	Arsenic	μg/mL	<0.0007	–	100%			
	Barium	μg/mL	0.0131	0.0081	–			
	Beryllium	μg/mL	<0.0006	–	100%			
	Boron	μg/mL	0.9	3.4	–			
	Cadmium	μg/mL	0.0020	0.007	–			
	Calcium	μg/mL	19	53	–			
	Chromium	μg/mL	0.0020	0.0027	–			
	Cobalt	μg/mL	<0.0034	–	85%			
	Copper	μg/mL	0.03	0.13	–			
	Iron	μg/mL	0.11	0.13	–			
	Lead	μg/mL	0.027	0.097	–			
	Magnesium	μg/mL	3.1	4	–			
	Manganese	μg/mL	0.07	0.25	–			
	Mercury	μg/mL	0.00005	0.00003	–			
	Molybdenum	μg/mL	0.00152	0.00069	–			
	Nickel	μg/mL	0.0021	0.0048	–			
	Phosphorus	μg/mL	<0.061	–	21%			
	Potassium	μg/mL	2.42	0.49	–			
	Selenium	μg/mL	<0.0014	–	100%			
	Silicon	μg/mL	4.6	4.3	–			
	Sodium	μg/mL	8	12	–			
	Strontium	μg/mL	0.049	0.08	–			
	Tin	μg/mL	<0.014	–	68%			
	Titanium	μg/mL	0.0011	0.0012	–			
	Vanadium	μg/mL	0.0027	0.0006	–			
Metals, Total	Aluminum	μg/mL	2.9	4.4	–			
	Antimony	μg/mL	0.022	0.034	–			
	Arsenic	μg/mL	0.007	0.031	3%			
	Barium	μg/mL	0.031	0.028	–			
	Beryllium	μg/mL	<0.0006	–	55%			
	Boron	μg/mL	0.32	0.35	–			

Table 5-12 (Continued)

			Cooling Water			Coal Pile Run-off		
Analyte Group	**Specie**	**Units**	**Average**	**95% CI**	**DL Ratio**	**Average**	**95% CI**	**DL Ratio**
Metals, Total (Cont'd)	Cadmium	µg/mL	0.001	0.0024	–			
	Calcium	µg/mL	5.9	1.6	–			
	Chromium	µg/mL	0.0049	0.0046	–			
	Cobalt	µg/mL	0.005	0.004	–			
	Copper	µg/mL	0.010	0.0081	–			
	Iron	µg/mL	4.1	5.4	–			
	Lead	µg/mL	0.030	0.058	–			
	Magnesium	µg/mL	1.69	0.71	–			
	Manganese	µg/mL	0.18	0.17	–			
	Mercury	µg/mL	0.00004	0.00003	–			
	Molybdenum	µg/mL	0.0024	0.0015	–			
	Nickel	µg/mL	<0.0099	–	34%			
	Phosphorus	µg/mL	0.12	0.2	9%			
	Potassium	µg/mL	2.76	0.97	–			
	Selenium	µg/mL	0.008	0.03	6%			
	Silicon	µg/mL	6.6	4.8	–			
	Sodium	µg/mL	5.4	1.9	–			
	Strontium	µg/mL	0.0276	0.0076	–			
	Tin	µg/mL	<0.014	–	100%			
	Titanium	µg/mL	0.16	0.21	–			
	Vanadium	µg/mL	0.0083	0.0095	–			
Aldehydes	Acetaldehyde	µg/mL	0.06	0.12	–	0.09	0.27	–
	Formaldehyde	µg/mL	0.026	0.049	–	0.06	0.39	–
Organics, Semivolatile	Butylbenzylphthalate	µg/L	<0.45	–	100%	0.54	–	–
	bis(2-Ethylhexyl)phthalate	µg/L	3.5	7.2	3%	3.3	–	–
Organics, Volatile	Acetone	µg/L	<10	–	45%	40	250	–

6

DATA EVALUATION AND ANALYSIS

This section presents an evaluation of data presented in Section 5. In evaluating these data, the following question is fundamental:

- Are the measured concentration data representative?

Since there is insufficient information to address this question directly, statistics, along with engineering and scientific judgment, must be used to answer this question. This is done by addressing related topics which can be evaluated quantitatively:

- Were analytical techniques accurate and precise?
- Were sampling techniques accurate and precise?
- Was process operation steady and representative?

If the answer to each of the above questions is "yes," then the measurements are considered representative and no qualifications made to their use. If analysis turns up potential problems with one or more of the above areas for certain data, caution must be exercised in using these data, since there is a good chance that they are not representative.

Assessment of sampling and analytical techniques is the purview of the QA/QC program. Detailed QA/QC results are presented in Appendix D, and these results are summarized below. An evaluation of process operation and a discussion of mass balance closures, which are used as an additional check on data representativeness, are also presented in this section. Finally, a discussion of the organic results concludes this section.

Evaluation of Sampling Techniques

Several factors are evaluated to determine acceptable sample collection. Key components of the sampling equipment including the Pitot tubes, thermocouples, orifice meters, dry gas meters, and sampling nozzles were calibrated in the Radian Source Sampling Laboratory before use in the field. These calibrations were also checked after the equipment was returned to the laboratory after completion of the field activities. Standard EPA methods or other acceptable sampling methods were used to collect the organic, metal, and anion samples. The sampling runs were well documented, and all gas samples were collected at rates of between 90 and 110% of the isokinetic rates. Sufficient data were collected to ensure acceptable data completeness and comparability of the measurements.

Gas samples were collected from the ESP inlet, ESP outlet, and stack as integrated samples for most analyses over a specified time period. Solid samples of coal, limestone, bottom ash, ESP fly ash, and FGD slurry were collected at hourly intervals over each of the test runs. These individual grabs were combined to provide a single composite sample of each stream for each of the three test runs. Liquid streams were also collected as hourly grabs which were combined to provide a single composite for analysis for each test run. All sampling was conducted while the plant was operating at 85 to 100% of full load and should be representative of typical operation for Plant Yates.

Thus, the applicable QA/QC evaluation indicates that sampling techniques were acceptable and effective in providing measurement data reliability within the expected limits of sampling error.

Evaluation of Analytical Techniques

Generally, the type of quality control information obtained pertains to measurement precision, accuracy (which includes precision and bias), and blank effects that are determined using various types of replicate, spiked and blank samples. The specific characteristics evaluated depend on the type of quality control checks performed. For example, blanks may be prepared at different stages in the sampling and analysis process to isolate the source of the blank effect. Similarly, replicate samples may be generated at different stages to isolate and measure sources of variability. The QA/QC measures used as part of this program data evaluation protocol and the characteristic information obtained are provided in Appendix D.

Different QC checks provide different types of information, particularly pertaining to the sources of inaccuracy, imprecision, and blank effects. As part of this program, measurement precision and accuracy are typically being estimated from QC indicators that cover as much of the total sampling and analytical process as feasible. Precision and accuracy measurements are based primarily on the actual sample matrix. The precision and accuracy estimates obtained experimentally during the test program are compared to the data quality objectives (DQOs) established for the program as listed in the project QAPP.

Appendix D includes a presentation of the types of quality control data reported for the program and a summary of precision and accuracy estimates. Almost all of the quality control results met the project objectives.

The following potential problems were identified by the quality control data.

- Chloromethane, methylene chloride, and tetrachloroethene were found in one or more of the field blanks analyzed for volatile organics. In many cases, the same concentrations were also found in the field samples.

- A standard limestone sample (NIST 1C) was submitted blind as a performance audit sample. Aluminum, silicon, and sodium recoveries in this sample were below 50%, and the recovery of potassium was greater than 200 percent. This may indicate a similar bias for these elements in the limestone process streams.

- Selenium showed no spike recovery in the impinger solutions analyzed by GFAAS.

These and other QA/QC findings are summarized, according to major species categories, in the discussions below.

Semivolatile Organics

Precision. The precision of the semivolatile organic analyses was estimated using matrix spiked duplicate pairs. The precision objective was met for all of the gas-phase solid samples, the gas vapor-phase samples, the solid stream samples, and aqueous-phase sample streams.

Accuracy. The accuracy of the semivolatile analyses was estimated using matrix spiked duplicate samples. All of the spiked compounds analyzed in the gas solid-phase samples and the aqueous process streams were within the accuracy objectives. Matrix spikes into the solid process streams were all within the recovery objects for all analytes in the FGD solid stream and all except pyrene in the ESP ash solids. Recovery for pyrene was 51% and 56% (project objective--52-115%) for the ESP ash sample and 48% and 37% for the ESP ash field duplicate.

Blank Effects. Acetophenone and benzoic acid were found in one or more of the field blanks associated with the gas-phase solids analyses. The concentrations of these compounds in the blanks, however, were not significant in comparison to the concentrations found in the samples. Several phthalates were also found in the field blanks. The concentrations found in the samples were about the same level as found in the blanks and are therefore considered an artifact of the sampling and handling process.

Volatile Organics

Precision. Precision for volatile organic analysis of the aqueous process streams was estimated using matrix spiked duplicate samples. The 50% precision objectives were met for each of the volatile analytes used for the matrix spikes.

Accuracy. Accuracy for the volatile organic analyses in the aqueous process streams was estimated using matrix spiked samples, and accuracy for the gas vapor-phase streams was estimated using surrogates spiked into each sample prior to analysis. The method specified accuracy objectives for matrix spike recoveries (0.1-234% were met for all analytes of interest (actual recoveries ranged from 70-136%) for the aqueous streams. Accuracy objectives for surrogate recoveries of 70 to 130% for the gas-phase streams were met for all samples except for toluene-d8 in one stack sample. Accuracy based on the analysis of two laboratory method spikes met the recovery objectives for all analytes of interest except for one acetone, chloromethane, chloroethane, and methylene chloride spike.

Blank Effects. Chloromethane, methylene chloride, and tetrachloroethene were found in one or more of the field gas vapor-phase blank samples. In most cases these compounds were found in the investigative field samples at about the same level as in the field blank or at lower concentrations. Chloromethane and methylene chloride were also found in one laboratory blank. The presence of these compounds in both blanks and samples merely raises the uncertainty about their presence in the flue gas.

Aldehydes

Precision. Precision for the aldehyde analyses was estimated using duplicate sample analyses. The precision objectives of 50% were met for both formaldehyde and acetaldehyde in the gas vapor-phase samples and the aqueous process stream sample analyses.

Accuracy. Accuracy for the aldehydes was estimated using matrix spiked samples. The project accuracy objectives of recoveries of 50-150% were met for the gas vapor-phase and aqueous stream sample spikes for both formaldehyde and acetaldehyde.

Metals

Precision. The precision of metals analyses by ICP-AES, GFAAS, and CVAAS was estimated for samples using matrix-spiked duplicate samples. The precision objectives (RPD <20%) were met for all target analytes analyzed by ICP-AES except aluminum and barium in the gas solid-phase spiked samples and boron in the process solid-spiked samples. The precision objectives for the GFAAS analyses were met except for lead in the gas vapor-phase matrix-spiked samples, selenium in the process solid matrix-spiked samples, and mercury and selenium in the aqueous process stream matrix spikes.

Accuracy. The accuracy of metals analyses was estimated for the gas solid-phase samples using standard reference material (NIST 1633a fly ash) submitted blind to the laboratory as a performance audit sample. All of the metals analyzed by ICP-AES were within the 75-125% accuracy objectives except for beryllium (147%) which was recovered above the objectives.

The accuracy of the metals analyses was estimated for coal samples using a standard reference coal sample (NIST 1632b) submitted blind to the laboratory. All of the metals analyzed by INAA in the reference sample were within the 75-125% accuracy objective.

The accuracy of the metals analyses was estimated for the limestone samples using a standard reference limestone (NIST Limestone 1C) submitted blind to the laboratory. The results show that the recoveries for most of the metals were outside the 75-125% accuracy objectives. Aluminum, silicon, and sodium recoveries were 50%, and the recovery for potassium was greater than 200 percent. The recoveries of these analytes may show a similar bias in the limestone process streams.

The accuracy of the metals analyses for the gas vapor-phase samples and the aqueous process streams were estimated using performance audit samples prepared from EPA reference standards. The results show that the recoveries of all the metals analyzed by ICP-AES and GFAAS were within the 75-125% accuracy objectives except Ca (368%) and Sb (127%), Ca (169%, 520%), Fe (139%), and Mg (131%, 246%) by ICP-AES and Se (50%) by GFAAS . The concentrations of these elements in the samples were at or near the detection limit.

Matrix-spiked samples were also used to determine the accuracy of the metals analyses in the gas, process solids, and aqueous process matrices. Recoveries for the target analytes were within the 75-125% accuracy objectives except for selenium (0% recovery) in the gas vapor-phase matrix and mercury (35% recovery) in the aqueous process stream matrix.

Blank Effects. Aluminum, iron, manganese, and nickel were found at concentrations above the reporting limits in the field blanks to the gas vapor-phase sampling train. These elements were also found to a lesser extent in the impinger reagent blank solutions.

Anions

Precision. Precision for the anions analyses was estimated for the gas vapor-phase samples, process solid streams, and aqueous process streams by the analysis of matrix spiked samples. The precision objectives of 20% were met for chloride, fluoride, and sulfate except for chloride and sulfate in one matrix spike pair from the stack with RPDs of 22% and 24%, respectively.

Accuracy. Accuracy for the anions analyses was estimated using matrix spiked duplicate samples. The accuracy objectives of 80-120% recovery was met for all analytes and all sample matrices except for the fluoride spikes into the ESP ash solid samples with recoveries of 56% and 60 percent.

Cyanide, Ammonia, and Phosphate

Precision. Precision for the cyanide, ammonia, and phosphate analyses was estimated using matrix spiked duplicate sample analyses. The precision objectives of 20% were met for each of the analytes for both the gas vapor phase and aqueous process streams except for ammonia spikes into the JBR process liquids. The spike concentration was too low in comparison to the level found in the native process sample.

Accuracy. Accuracy for ammonia, cyanide and phosphate was estimated using both matrix spiked duplicate samples and "double blind" performance audit samples. The accuracy objectives (cyanide, 75-125%; ammonia, 80-120%; phosphate, 75-125%) were met for all matrix spiked samples except for the ammonia spikes into the JBR process liquids with recoveries at 60 and 273 percent. Recoveries for the performance audit samples met the accuracy objectives for all analytes with recoveries of 88% for ammonia, 80% for cyanide, and 97% for phosphate. Recoveries for performance audit samples spiked into the gas vapor-phase impinger solutions were not as good as the aqueous spiked audit samples. The recovery for ammonia in the impinger solutions was 63% and the recovery for cyanide was 50 percent. The aqueous spikes and impinger spikes were performed using the same spiking solutions and were spiked at the same concentration levels.

Evaluation of Process Operation

Plant operating data were examined to ensure that process operation was stable and representative of normal operation during the sampling periods. Excessive scatter or significant trends can indicate periods where operational problems were encountered. The availability of data from the CT-121 data acquisition system allowed for a comprehensive review of process operation. Data points were logged as 15-minute averages. Plots of unit load, furnace gas O_2, JBR ΔP, JBR pH, stack SO_2, CO, and NO_x concentrations are located in Section 2. The range of normal operation is indicated on most of these figures. A statistical summary of process data is presented in Table 6-1. Daily average values for process parameters are presented along with the minimum and maximum values. Variability is expressed by the standard deviation. Note that high standard deviations are to be expected for some variables, such as return water flow rates, which are controlled by on/off controllers. Table 6-1 was used to identify areas of concern with process operation. A parameter with values steadily increasing or decreasing over the course of the test period may indicate a period of non-steady operation. The following paragraph summarizes the process analysis and points out areas of concern.

Analysis of the process data revealed that process operation was steady and representative during sampling periods. Problems with data quality are not likely to be the result of process variability. Some comments on process operation are as follows:

- Due to problems with the JBR inlet O_2 monitor, the JBR inlet SO_2 concentration, which is corrected with the O_2 meter reading, is biased low on 6/26 and 6/27. Additionally, the stack O_2 monitor calibration check showed it to be biased on 6/26. However, the average stack CEM O_2 data are not significantly different from the O_2 concentration measured using the Orsat method.

- The average FGD makeup water was approximately twice as high on 6/25 than on other days. This was revealed to be an instrument problem.

- SO_2 removal was slightly lower than expected, even accounting for the bias in the inlet O_2 monitor. The slightly lower SO_2 removal should not raise concerns about the representativeness of the data, however, as SO_2 removal was still within the range of normal operation for this type of scrubber. A possible explanation for the lower removal involves modifications made to the JBR limestone inlet piping. Modifications to the piping are suspected to have created a region of higher limestone concentration in the JBR where the pH indicators are located. As a result, the pH in this region was slightly higher than in the remainder of the reactor. Therefore, the average reactor pH may have been slightly lower than was indicated, resulting in lower SO_2 removal.

- A brief dip in load occurred on 6/24 between 1700 and 1730. The lowest point reached is unknown since the process data are reported on 15 minute average basis, the lowest of which was 86 MW. Since testing was completed by this time on 6/24, there is no effect on data representativeness.

Data Analysis: Mass Balances, Removal Efficiencies, and Emission Factors

Calculations based on measured data have two general purposes: they can be used to assess the representativeness of the measured data or to evaluate process performance. Mass

Table 6-1
Daily Summary

	Date						
	6/21	**6/22**	**6/23**	**6/24**	**6/25**	**6/26**	**6/27**
Gross Load, MW							
Average, daily	100	100	100	100	100	100	100
Sample Std. Dev.	0.5	0.24	0.32	1.5	0.44	0.34	0.22
Maximum Value	100	100	100	100	100	100	100
Minimum Value	98	100	100	86	98	100	100
Raw Coal Flow, lb/hr							
Average, daily	89,000	88,000	89,000	88,000	90,000	91,000	92,000
Sample Std. Dev.	3,000	3,400	3,300	3,000	2,400	2,900	4,000
Maximum Value	94,000	94,000	99,000	95,000	96,000	98,000	100,000
Minimum Value	85,000	82,000	84,000	81,000	84,000	85,000	84,000
Furnace Gas O_2, %							
Average, daily	3.5	3.6	3.5	3.5	3.3	3.3	3.4
Sample Std. Dev.	0.062	0.17	0.19	0.28	0.078	0.23	0.3
Maximum Value	3.6	4.0	3.7	3.9	3.4	3.8	3.8
Minimum Value	3.4	3.2	3.1	3.0	3.0	2.8	2.6
Opacity, %							
Average, daily	15	14	16	17	17	18	19
Sample Std. Dev.	3.6	0.96	1.7	2.5	1.3	1.3	1.5
Maximum Value	31	18	27	33	23	22	23
Minimum Value	12	13	14	14	14	15	16
Stack O_2, % on Dry Basis[a]							
Average, daily	8.2	8	7.9	8	7.7	7.7	7.6
Sample Std. Dev.	0.12	0.23	0.18	0.22	0.072	0.18	0.1
Maximum Value	8.5	8.6	8.1	9	7.9	9	7.7
Minimum Value	7.8	6.6	6.3	6.7	7.6	7.5	7
Stack SO_2, ppm at 3% O_2[a]							
Average, daily	160	180	200	200	240	180	190
Sample Std. Dev.	38	47	37	65	31	25	38
Maximum Value	230	250	260	340	300	230	270
Minimum Value	88	41	120	74	180	130	140

Table 6-1 (Continued)

	Date						
	6/21	6/22	6/23	6/24	6/25	6/26	6/27
JBR pH							
Average, daily	4.6	4.5	4.5	4.5	4.5	4.5	4.5
Sample Std. Dev.	0.22	0.066	0.037	0.049	0.038	0.045	0.027
Maximum Value	4.9	4.7	4.6	4.6	4.7	4.6	4.6
Minimum Value	4.3	4.3	4.4	4.4	4.4	4.3	4.4
JBR ΔP, inches water							
Average, daily	14	14	14	14	14	14	14
Sample Std. Dev.	0.086	0.086	0.08	0.17	0.071	0.076	0.073
Maximum Value	14	14	14	15	14	14	14
Minimum Value	14	14	14	14	14	14	14
SO_2 Removal							
Average, daily	93	92	91	90	89	b	b
Sample Std. Dev.	1.7	1.8	1.7	3.5	1.4		
Maximum Value	96	97	94	96	92		
Minimum Value	90	89	88	83	86		
Transition Duct PW Flow (Gypsum Pond Return, FT 128), gpm							
Average, material balance period					78.6	78.7	79.3
Average, daily	80	79	79	79	79	79	79
Sample Std. Dev.	0.28	0.49	0.4	0.94	0.58	0.5	0.45
Maximum Value	80	81	82	81	83	83	83
Minimum Value	78	78	79	71	77	78	0.12
Transition Duct MU Water Flow, gpm							
Average, daily	0.092	0.09	0.12	0.096	0.14	0.11	0.094
Sample Std. Dev.	0.0055	0.0069	0.23	0.006	0.44	0.15	0.0071
Maximum Value	0.1	0.11	2.4	0.11	4.3	1.6	0.11
Minimum Value	0.08	0.073	0.075	71	0.08	0.084	0.066
Reagent Flow, gpm							
Average, material balance period					35.9	37.3	36.3
Average, daily	48	35	36	35	36	37	38
Sample Std. Dev.	36	7.3	2.8	3.0	1.9	2.9	1.7
Maximum Value	88	61	43	45	39	46	42
Minimum Value	0.1	0.2	26	28	27	30	34

Table 6-1 (Continued)

	Date						
	6/21	**6/22**	**6/23**	**6/24**	**6/25**	**6/26**	**6/27**
JBR Level, ft							
Instantaneous Values (used in accumulation calculations)							
Beginning (t-Δt)					14.1	14.1	14.1
Ending (t)					14.1	14.1	14.1
Average, daily	14	14	14	14	14	14	14
Sample Std. Dev.	0.011	0.017	0.022	0.042	0.026	0.013	0.014
Maximum Value	14	14	14	14	14	14	14
Minimum Value	14	14	14	14	14	14	14
JBR Density, wt% solids							
Average, material balance period					22.8	23.0	23.0
Instantaneous Values (used in accumulation calculations)							
Beginning (t-Δt)					22.2	23.7	22.7
Ending (t)					22.3	23.3	23.5
Average, daily	23	23	23	23	23	23	23
Sample Std. Dev.	0.51	0.55	0.55	0.52	0.51	0.56	0.51
Maximum Value	24	24	24	24	24	24	24
Minimum Value	22	22	22	22	22	22	22
Mist Eliminator/Deck Wash PW Flow (Ash Pond Return FT 150A), gpm[c]							
Average, material balance period					26.1	25.5	28.8
Average, daily	25	25	28	28	25	26	26
Sample Std. Dev.	29	28	32	35	30	32	32
Maximum Value	110	110	120	130	100	120	120
Minimum Value	-0.33	-0.33	-0.34	-0.37	-0.37	-0.37	-0.29
Mist Eliminator Makeup Water Flow (FT 150B), gpm[c]							
Average, material balance period					6.7	6.6	6.0
Average, daily	-2	-4	-4.1	-4.1	-4	-4	-4.2
Sample Std. Dev.	27	25	25	22	24	28	18
Maximum Value	180	240	240	210	230	260	140
Minimum Value	-6.9	-7.2	-7.5	-7.5	-7.3	-7.6	-7.6
JBR Level Control Line PW Flow (Ash Pond Return, FT 142), gpm							
Average, material balance period					36.4	29.4	53.4
Average, daily	44	50	56	54	39	37	48
Sample Std. Dev.	56	84	86	79	68	66	72
Maximum Value	200	270	270	250	220	200	210
Minimum Value	0.27	0.27	0.24	0.24	0.25	0.26	0.3

Table 6-1 (Continued)

	Date						
	6/21	6/22	6/23	6/24	6/25	6/26	6/27
Mist Eliminator Differential Pressure, inches water							
Average, daily	0.67	0.65	0.64	0.64	0.63	0.65	0.66
Sample Std. Dev.	0.014	0.016	0.017	0.022	0.013	0.02	0.013
Maximum Value	0.7	0.68	0.68	0.7	0.66	0.7	0.68
Minimum Value	0.62	0.62	0.61	0.52	0.6	0.62	0.64
Reagent Slurry Density, wt% solids							
Average, material balance period					37.2	37.2	33.9
Average, daily	33	30	33	37	37	37	34
Sample Std. Dev.	0.18	2.9	2.1	0.15	0.025	0.045	2.1
Maximum Value	33	34	38	38	37	37	39
Minimum Value	32	25	30	37	37	37	32
Furnace Pressure, inches water							
Average, daily	-0.21	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22
Sample Std. Dev.	0.017	0.013	0.012	0.016	0.012	0.0095	0.016
Maximum Value	-0.12	-0.19	-0.19	-0.16	-0.19	-0.19	-0.18
Minimum Value	-0.24	-0.27	-0.25	-0.28	-0.26	-0.25	-0.26
JBR Agitator Running[d]							
Average, daily	1	1	1	1	1	1	1
Sample Std. Dev.	0	0	0	0	0	0	0
Maximum Value	1	1	1	1	1	1	1
Minimum Value	1	1	1	1	1	1	1
Oxidation Air "A", scfm							
Average, daily	2,100	2,100	2,100	2,100	2,100	2,100	2,100
Sample Std. Dev.	20	40	50	40	30	50	60
Maximum Value	2,200	2,200	2,200	2,200	2,200	2,200	2,200
Minimum Value	2,100	2,100	2,000	2,000	2,100	2,000	2,000
Oxidation Air "B", scfm							
Average, daily	2,100	2,000	2,000	2,100	2,100	2,000	2,000
Sample Std. Dev.	20	30	50	40	30	40	50
Maximum Value	2,100	2,100	2,100	2,100	2,100	2,100	2,100
Minimum Value	2,000	2,000	2,000	2,000	2,000	2,000	2,000

Table 6-1 (Continued)

	Date						
	6/21	6/22	6/23	6/24	6/25	6/26	6/27
JBR Blowdown (FT 162A), gpm[c]							
Average, material balance period					73.7	68.9	92.0
Average, daily	80	74	83	84	74	78	84
Sample Std. Dev.	73	75	78	80	73	72	79
Maximum Value	200	210	210	210	210	210	210
Minimum Value	-0.36	-0.38	-0.35	-0.49	-0.37	-0.37	-0.41
FGD MU Water Flow, gpm							
Average, daily	94	90	87	90	200[e]	120[e]	77
Sample Std. Dev.	16	14	13	44	120	140	49
Maximum Value	180	210	200	450	430	320	190
Minimum Value	83	83	78	77	78	14	12
SO_2 at JBR Inlet Duct, ppm @ 3% O_2							
Average, daily	2,300	2,100	2,200	2,000	2,100	1,900[f]	1,400[f]
Sample Std. Dev.	11	220	45	86	38	280	200
Maximum Value	2,300	2,300	2,300	2,200	2,200	2,300	1,900
Minimum Value	2,300	1,300	2,100	1700	2,000	1,000	990
O_2 at JBR Inlet Duct, %							
Average, daily	7.8	7.7	7.6	7.6	7.4	14[f]	15[f]
Sample Std. Dev.	0.07	0.31	0.086	0.3	0.27	4.1	0.97
Maximum Value	8	9.6	7.7	8.7	7.7	18	17
Minimum Value	7.5	6	7.2	7.0	6.9	7.4	14
JBR Inlet Duct Pressure, inches water							
Average, daily	-11	-11	-10	-10	-10	-10	-10
Sample Std. Dev.	0.17	0.23	0.13	0.23	0.079	0.19	0.091
Maximum Value	-9.8	-10	-10	-8.5	-9.8	-10	-10
Minimum Value	-11	-11	-11	-10.5	-10	-11	-11
JBR Inlet Duct Temperature, °F							
Average, daily	280	280	280	280	280	280	280
Sample Std. Dev.	4.9	4.3	6	4.2	3.6	5.3	5.8
Maximum Value	280	290	290	290	290	290	290
Minimum Value	260	270	270	280	280	280	270

[a] A bias in the stack O_2 monitor was found during calibration check on 6/27. However, the average CEM stack O_2 concentrations are not significantly different from the stack gas O_2 concentration determined using the Orsat method.

[b] These values not reported since they are known to be biased due to faulty inlet O_2 monitor readings.

[c] *Negative values result of instrumentation bias.*

[d] Value of 1 indicates agitator on, 0 indicates off.

[e] High average due to instrumentation problem.

[f] Problems with inlet O_2 monitor have biased these values.

balance closures were calculated as a check on data representativeness. Since the mass of trace elements must be conserved, an examination of the mass balance can provide clues to sampling and/or analytical deficiencies. Removal efficiencies and emission factors are evaluations of process performance. Removal efficiencies provide an insight into the fate of a substance in power plant processes. Emission factors express plant emissions on a unit-energy basis.

The method used to determine uncertainties in calculated results is based on the ANSI/ASME PTC 19.1-1985, "Measurement Uncertainty" and is consistent with the approach to handling data used in EPRI's Field Chemical Emission Monitoring (FCEM) program. This method, along with an example calculation, is presented in Appendix F. In statistical calculations, a distinction was made between "raw data," such as gas flow rates and concentrations, and calculated data, such as mass balance closures and emission factors. The term "raw" is in quotation marks because some calculations were necessary to obtain these data. The distinction between raw and calculated data was made based on the goal of a particular measurement, i.e., the goal of a Pitot-tube traverse is to determine a gas flow rate, so the flow rate is considered a raw data point and not the individual ΔP measurements. Calculated data are determined using mean raw data. Therefore, calculated data are not presented on a daily or run basis but as mean values for the entire material balance period. Fundamental to obtaining calculated data is the assumption that the power plant processes are reasonably close to steady state. In this project, stream flow rates not directly measured, emission factors, removal efficiencies, and mass balance closures are all treated as calculated data.

Data were reviewed and justifiable eliminations and substitutions made prior to the calculation of material balance closures and removal efficiencies. The following modifications were made to the data set:

- The ESP outlet gas particulate-phase data for Runs 1 and 3 were invalidated for Al, Ba, Be, Cd, Ca, Cr, Co, Pb, Mg, P, K, Na, and Sr due to the filter background concentration comprising greater than 20% of the measured concentration.

- The stack gas particulate-phase data for Run 1 were invalidated for all elements except As, Se, and V due to the filter background concentration comprising greater than 20% of the measured particulate concentration.

- The limestone slurry filtrate Run 3d was substituted for Run 3a. 46% of the detected elements in Run 3a are statistical outliers. An analytical error is suspected to have occurred for Run 3a. No further details are available.

- The ESP inlet gas vapor-phase data for Run 2 were invalidated due to particulate breakthrough into the impinger solutions. This event caused a high bias in the vapor-phase concentrations.

- No flue gas particulate-phase analyses were performed for boron, since boric acid is included in the chemicals used to digest the particulate filters. The sluiced fly ash analyses were substituted so that mass balances could be performed.

- For As, Cr, and Hg, certain analyses are suspected to be biased and cause poor mass balance closures. For these elements, mass balance closures are also calculated with certain data substitutions made (see Table 6-2 for details).

Mass Balances

The results of mass balance closures, emission factors, and removal efficiencies are presented in the following sections. Following the results section are summaries of the equations used. Example calculations are presented in Appendix I.

Table 6-2 presents mass balance closures for selected elements. Mass balances were performed about the boiler, ESP, JBR, and the total plant. Figure 6-1 depicts the mass balance boundaries. Steady-state process operation was assumed for all vessels but the JBR. Due to the short test periods, significant accumulation of a substance could occur in the JBR. Small fluctuations in the JBR level and solids concentration are part of normal operation.

A general mass balance equation which applies to any system is:

$$\begin{bmatrix}\text{Accumulation of}\\ \text{Mass in System}\end{bmatrix} = \begin{bmatrix}\text{Mass into}\\ \text{System}\end{bmatrix} - \begin{bmatrix}\text{Mass out}\\ \text{of System}\end{bmatrix} + \begin{bmatrix}\text{Mass Generated}\\ \text{in System}\end{bmatrix} \tag{6-1}$$

Over a long period of steady operation, the accumulation in the JBR also could be considered negligible. The following general equation was used to calculate mass balance closures.

For all vessels but the JBR, the accumulation term should be negligible and was assumed to be zero. Development of specific mass balance equations is presented in Appendix I.

The mass balance closure for each element met the project objective if it was between 70 and 130 percent. Poor closures and high uncertainties have their root cause in sampling, analytical, or process problems. Since an analysis of the process showed that process operation was steady and representative of normal operation, problems with mass balance closures for some substances may reflect problems with analytical or sampling techniques.

Concerns with mass balance closures fall into three categories:

- Out-of-range mass balance closure is outside target range of 70-130 percent;
- High uncertainty--uncertainty in closure exceeds ±50 percent; and
- Clear bias--closure ± uncertainty does not encompass 100% closure.

Table 6-2
Mass Balance Closures

	Boiler		ESP		JBR		Plant	
	% Closure	95% CI	% Closure	95% CI	% Closure	95% CI	% Closure	95% CI
Anions								
Chloride	104	25	115	45	76	24	77	25
Fluoride	103	16	105	30	97	33	104	39
Elements								
Aluminum[a]	74	17	101	--[b]	65	--[b]	75	6.5
Antimony[c]	67	44	92	52[d]	91	124[e]	65	26
Arsenic	214 (103)[f]	94 (43)[f]	136	67[g]	38[h]	28	270 (135)[f]	142 (71)[f]
Barium	69	30	100	--	76	--	69	27
Beryllium[i]	105	16	107	--	55	--	111	24
Boron [m]	131	110[j]	105	--	109	--	114	32
Cadmium[d]	100	63	155	--	109	--	136	51
Calcium	94	35	76	--	82	--	81	31
Chromium	144 (91)[k]	225 (30)[k]	58 (92)[k]	--	89	--	83	8.9
Cobalt	98	36	120	--	80	--	114	40
Copper[c]	26	24	122	22	74	23	33	30
Iron	89	18	99	21	77	26	87	17
Lead	109	37	106	--	36	--	113	44
Magnesium	92	22	104	--	107	--	103	21
Manganese	113	19	104	18	101	31	103	27
Mercury	205 (110)[l]	84 (35)[l]	55 (102)[l]	18 (26)[l]	88	13	101	30
Molybdenum[c]	18	20	23	27	111	39	4.5	3.6
Nickel	84	86[d]	63	39	121	357[d]	55	9.5
Phosphorus[c]	31	19	34	--	91	--	20	13
Potassium[c]	59	13	104	--	84	--	62	9.6
Selenium[d]	65	31	141	81	188	106	145	54
Sodium	91	12	99	--	100	--	91	15
Strontium[c]	48	7.9	99	--	95	--	59	7.8
Titanium	77	18	103	23	31	10	78	12
Vanadium	87	13	106	17	91	32	92	13

[a] Spike recovery in ESP inlet gas-phase particulate for aluminum was 62%, indicating possible analytical bias.

[b] Since the ESP outlet gas-phase particulate Runs 1 and 3 were invalidated, confidence intervals for the ESP and JBR mass balance closures could not be calculated for many elements.

Table 6-2 (Continued)

[c] These elements are consistently enriched in the coal ash over the process stream solid-phase concentrations, suggesting that the coal analyses are biased high for these elements.

[d] High uncertainties for mass balance closure are caused by high variability in the gas particulate-phase concentrations.

[e] High uncertainty in JBR closure for antimony is the result of high detection limits in liquid-phase samples; antimony was not detected in the JBR blowdown filtrate or limestone slurry filtrate.

[f] Values in parentheses are those obtained when INAA coal analyses are substituted for the GFAA data.

[g] High uncertainty in the ESP closure for arsenic is mostly due to high variability in ESP sluiced ash concentration.

[h] Arsenic concentration was below detection limit in JBR blowdown solid phase.

[i] Spike recovery for beryllium in the performance evaluation ash sample was 147%, indicating possible analytical bias.

[j] High variability in the boiler closure for boron is caused by high variability in the ESP inlet gas vapor-phase analyses.

[k] ESP inlet gas-phase particulate Run 2 Cr concentration, at 550 ng/g, is a statistical outlier. In comparison with sluiced ash, hopper ash, and size fractionated particulate data for chromium, this value is likely to be biased high. The mass balance data in parentheses are calculated with this value replaced with the Run 2 ESP sluiced ash concentration.

[l] ESP inlet particulate data for mercury are suspected to be biased high based on comparison with sluiced ash hopper ash analyses. This is also supported by the high boiler and low ESP mass balance closures. The mass balance data in parentheses are calculated with the ESP sluiced ash analyses substituted for the ESP inlet gas-phase particulate analyses.

[m] Gas particulate-phase data are not available. ESP sluiced ash data were substituted for the boron particulate concentration.

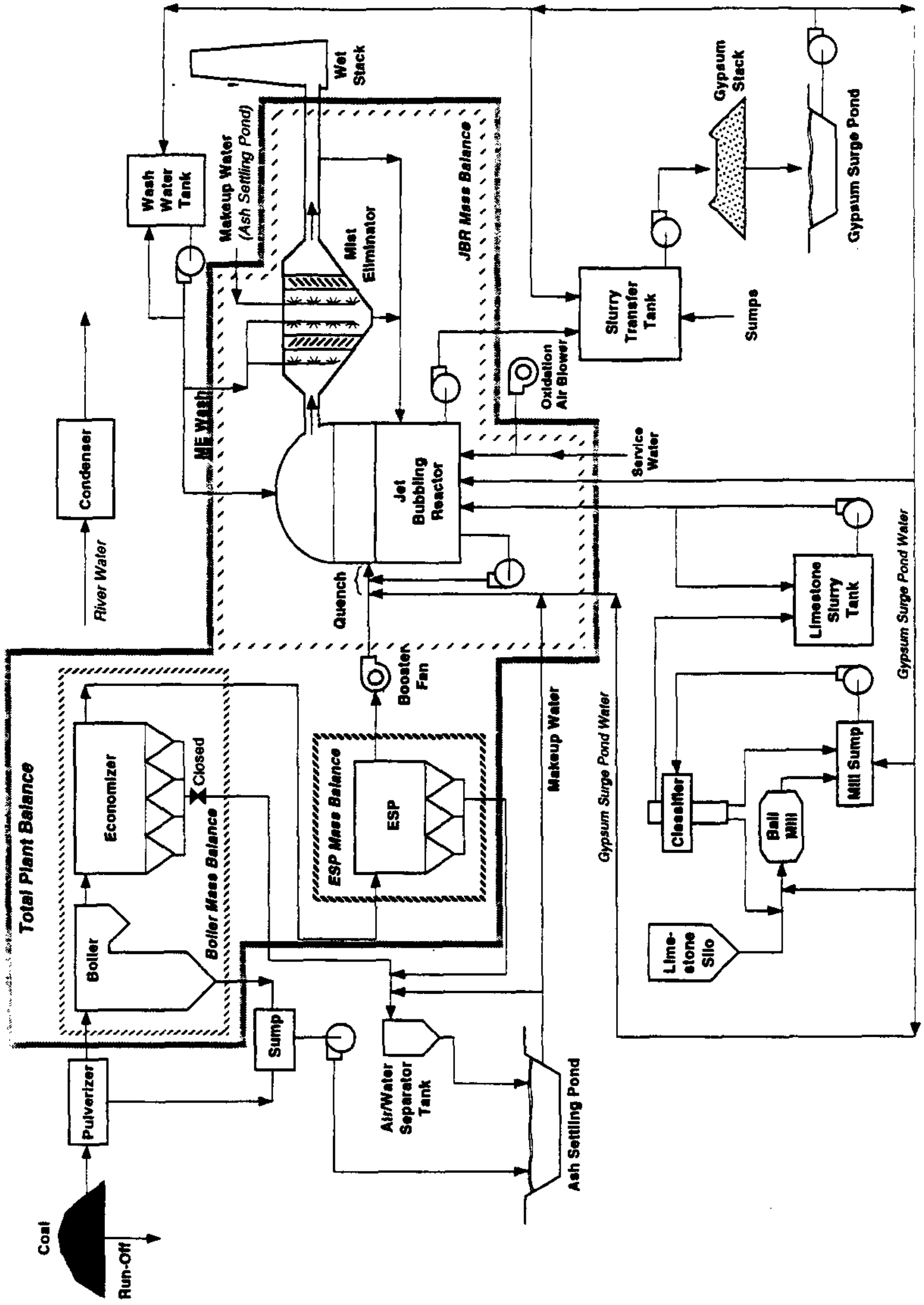


Figure 6-1
Mass Balance Boundaries

$$\text{Mass Balance Closure (\%)} = 100 * \left[1 - \frac{\text{Total Mass Out}}{(\text{Mass In} - \text{Mass Accumulated})}\right] \quad (6\text{-}2)$$

For the boiler closure, 70% of the mass balances performed fell within the target range. The percentage within the target range for the ESP, JBR, and Total Plant were 85%, 78%, and 59%, respectively.

Confidence intervals are not presented for many elements for the ESP and JBR mass balance closures. The precision error for the ESP outlet gas, particulate-phase analyses is unknown for many elements due to the rejection of data from Runs 1 and 3. Discussion of concerns with specific substances is presented in the following paragraphs.

Substitutions. For some elements, both a review of the analytical data and initial mass balance closures suggested that some data were biased. For these elements, data substitutions were made, and the material balances were recalculated. These results are in parentheses on Table 6-2. Specific cases are discussed in the following paragraphs.

> ***As.*** The arsenic coal analyses by GFAA yield mass balance closures about the boiler and plant of 214 and 270%, respectively, suggesting a bias in the coal or ash analyses. When the coal concentration for each run was replaced by the corresponding analysis by INAA, the closures about the boiler and plant were 103 and 134% respectively. This suggests that the GFAA analysis performed for coal may have been biased.
>
> ***Cr.*** The ESP inlet gas, particulate-phase Run 2 analysis for Cr at 550 μg/g is a statistical outlier when compared with all available ash analyses. This value is strongly suspected to be the result of analytical bias or non-representative sampling. This is supported by the boiler mass balance closure, at 144%. When this value is replaced with the Run 2 sluiced ash concentration, the closure is 91%.
>
> ***Hg.*** The ESP inlet, particulate-phase data are suspected to be biased high, based on other ash analyses and prior experience with mercury data. This is also supported by the high mass balance closure about the boiler (205%) and correspondingly lower closure about the ESP (55%). When these data are replaced with the sluiced fly ash analyses, the closures are a much more reasonable 110% about the boiler and 102% about the ESP.

Out-of-Range Mass Balance Closures. Many mass balance closures lie outside the target range. For some of these, poor closure can be attributed to high variability in the concentration in one or more process streams. Other elements have closures which are clearly biased. The following paragraphs provide explanations for poor and clearly biased mass balance closures.

> ***Sb, Cu, Mo, K, P, Sr.*** Antimony, copper, molybdenum, potassium, phosphorus, and strontium have mass balance closures well outside the target range for two or more devices. The confidence intervals for these closures indicate that a clear analytical or

sampling bias exists or that the mass balance closure model is inadequate for these substances. Problems closing material balances for copper, molybdenum, and phosphorus have been encountered in previous work by Radian. For antimony, copper, potassium, and strontium, the boiler and plant closures are out of range, while the ESP and JBR closures are reasonable. Since the boiler and plant closures are driven by the coal analyses, this suggests a high bias in the INAA analyses for coal for these substances. All of these elements show enrichment in the coal ash over bottom ash, collected ash, and the gas particulate phase at all locations (except phosphorus in the ESP outlet). None of these elements are expected to be in the vapor phase. This pattern suggests that the coal analyses for antimony, copper, molybdenum, potassium, phosphorus, and strontium are biased high in varying degrees. See Section 8 for further details on enrichment.

Al and Be. Al and Be analytical QA/QC procedures reveal a possible analytical bias in gas particulate-phase analyses for Al. The Al spike recovery for this matrix was 62%, indicating a possible low bias. This could explain the slight bias apparent in the mass balance closure (74% ±17%). In addition, the spike recovery of Be in the performance evaluation sample for fly ash was 147%. Only the JBR mass balance was outside the target range for Be, however. In addition, QA/QC procedures revealed possible analytical problems with some elements in the gas vapor-phase and limestone samples. For these elements, the limestone and vapor-phase concentrations have a very small effect on mass balance closures, however.

As. Arsenic was not detected in the JBR blowdown solids. This may explain the 36% mass balance closure.

Be, Pb, Se, and Ti. These elements have poor closures about the JBR. No cause for these poor closures was determined, with the exception of the previously mentioned possibility for analytical bias for Be in the solid phase.

High Uncertainties in Mass Balance Closures. Some mass balance closures, both within and outside the target range, have high uncertainties. For those elements outside the target range, high variability in one or more measurements is the usual cause. The causes for high uncertainties in some elements is discussed below.

Cd, Ni, and Se. For these elements, uncertainty in the mass balance closure exceeds 50% for most devices. The cause is high uncertainty in the gas particulate-phase analyses. The Ni closure about the JBR, at 120 ±357%, is especially high because the Run 1 stack gas particulate-phase analyses were invalidated. The cause of the high variability in particulate-phase analyses for these elements in unknown. Insufficient data are available to make a reasonable hypothesis; however, the measurement error associated with the small sample mass collected at the stack is a likely contributor to the data variability.

Sb. The high uncertainty (95% ±120%) in the antimony closure about the JBR is the result of high detection limits in the liquid-phase samples analyzed. Antimony was not detected in the JBR blowdown filtrate or limestone slurry filtrate. The high uncertainty in the boiler closure is the result of variability in the ESP inlet gas particulate-phase analyses.

B. The high uncertainty (131% ±110%) in the boron closure about the boiler is the result of variability in the ESP inlet gas-phase analyses.

As. The high uncertainty in the ESP closure is mostly due to high variability in the ESP inlet gas vapor-phase analyses.

Emission Factors

The emission factor expresses stack emissions on an energy basis. Emission factors for elements are located in Table 6-3. The following general equation was used in calculating emission factors:

$$\text{Emission Factor} = \frac{\text{Mass of Species in Stack Gas}}{\text{Energy of Coal Burned}} \tag{6-3}$$

Detailed emission factor equations and an example calculation are presented in Appendix I.

Removal Efficiencies

Removal efficiencies of elements were calculated for the boiler, ESP, and JBR. Results are presented in Table 6-4. Since all elements but B, Hg, and Se should be present primarily in the solid phase, most of the removal of trace species occurs with the removal of fly ash in the ESP. The following equation defines the removal efficiency for a substance:

$$\text{Removal Efficiency} = 100 * \left(1 - \frac{\text{Mass of Species in Gas Stream Exiting System}}{\text{Mass of Species in Gas Stream (or Coal) Entering System}}\right) \tag{6-4}$$

An example calculation of a removal efficiency is provided in the Example Calculations in Appendix I.

Organic Compound Results

The organic compounds detected in the samples from all three gas streams can be grouped into three categories: plasticizers, outside source contaminants, and process

Table 6-3
Emission Factors

	lb/10^{12} Btu	95% CI
Anions		
Chloride	742	647
Fluoride	122	67
Selected Elements[a]		
Antimony	0.06	0.01
Arsenic	1.2	0.2
Barium	2.8	9.9
Beryllium	0.1	0.1
Cadmium	0.6	2.1
Chromium	5.3	49.5
Cobalt	0.7	0.8
Copper	2.0	2.3
Lead	0.6	0.6
Manganese	7.2	48
Mercury	3.0	0.3
Molybdenum	1.5	2.6
Nickel	40.1	435
Selenium	26.5	58
Vanadium	2.1	0.5
Aldehydes		
Acetaldehyde	8.6	9.2
Formaldehyde	24	36
Volatile Organics[b,c]		
Benzene	1.3	0.3
Carbon Disulfide	2.2	1.2
Toluene	2.0	1.0

Table 6-3 (Continued)

	lb/10^{12} Btu	95% CI
Semivolatile Organics[d]		
2-Methylphenol (o-cresol)	2.9	3.8
4-Methylphenol (p-cresol)	0.95	1.9
Acetophenone	3.2	0.7
Benzoic Acid	120	7
Benzyl Alcohol	2.8	12
Naphthalene	1.5	1.0
Phenol	9.2	8.8

[a] Run 1 particulate-phase data were invalidated for all elements included here except arsenic, selenium, and vanadium due to the filter background comprising 20% or greater of the measured concentration.

[b] Only those compounds with an average concentration above the detection limit are included.

[c] Methylene chloride, acetone, and other halogenated hydrocarbons are not included because their presence is strongly suspected to be the result of contamination.

[d] Phthalate esters are not included because their presence is suspected to be the results of contamination.

Table 6-4
Removal Efficiencies (Includes Particulate and Vapor Phase)

	Boiler		ESP		JBR	
	% Removal	95% CI	%Removal	95% CI	% Removal	95% CI
<u>Anions</u>						
Chloride	-7	126	-12	49	99	1
Fluoride	1.4	15	1.6	37	98	1
<u>Elements</u>						
Aluminum[a]	26.0	16.8	98.6	–[b]	98.4	–
Antimony	32.8	45	98.8	0.6	84.1	3.1
Arsenic	-113.5 (-2.4)[c]	94.7 (43.6)[c]	95.9	1.5	92.7	2.1
Barium	31.5	29.7	98.3	–	96.1	–
Beryllium	-4.3[d]	18.2	98.1	–	92.6	–
Boron[h]	-30.6	114.7	34.3	–	93.5	–
Cadmium	0.5	62.9	95.1	–	46.2	–
Calcium	6.9	44.1	98.8	–	85.3	–
Chromium	-43.2 (10.2)[e]	228.7 (33.3)[e]	98.7	–	76.6	–
Cobalt	3.1	35.2	98.2	–	85.3	–
Copper[f]	73.8	25.4	97.8	0.3	88.1	13.5
Iron	12.5	10.1	98.9	0.1	98.0	7.0
Lead	-9.1	36.9	97.4	–	96.7	–
Magnesium	8.5	24.1	98.4	–	93.3	–
Manganese	-11.4	12.8	98.4	–	78.4	144
Mercury	-105 (-10)[g]	84.1 (35)[g]	55.2 (16.5)[g]	14.4 (20.6)[g]	45.9	7.4
Molybdenum[f]	82.5	19.9	97.2	2.2	82.5	27.2
Nickel	16.4	88.1	98.8	0.7	-75.5	1890
Phosphorus[f]	69.6	21.3	94.8	–	91.1	–
Potassium[f]	41.5	13.9	98.6	–	96.4	–
Selenium	34.8	30.9	38.1	85.1	66.9	56.1
Sodium	10.1	11.9	97.6	–	94.0	–
Strontium[f]	52.1	7.9	98.5	–	96.6	–
Titanium	24.0	18.5	98.6	0.4	98.3	0.4
Vanadium	13.7	12.4	98.0	0.3	96.0	0.9

[a] Spike recovery in ESP inlet gas-phase particulate for Al was 62%, indicating possible analytical bias.

[b] Since the ESP outlet gas-phase particulate Runs 1 and 3 were discarded, confidence intervals for the ESP and JBR removal efficiencies could not be calculated for many elements.

[c] Values in parentheses are those obtained when INAA coal analyses are substituted for the GFAA data.

[d] Spike recovery for Be in the PE ash sample was 147%, indicating possible analytical bias.

[e] ESP inlet gas-phase particulate Run 2, at 550 ng/g, is a statistical outlier. In comparison with sluiced ash, hopper ash, and size fractionated particulate data for chromium, this value is likely to be biased high. The removal efficiency data in parentheses are calculated with this value rejected.

[f] These elements are consistently enriched in the coal ash over the process stream solid-phase concentrations, suggesting that the coal analyses are biased high for these elements.

[g] ESP inlet gas-phase particulate data are suspected to be biased high compared with sluiced ash hopper ash analyses. This is also supported by the high boiler and low ESP mass balance closures. The removal efficiency data in parentheses are calculated with the ESP sluiced ash analyses substituted for the ESP inlet gas-phase particulate analyses.

[h] Gas particulate-phase data were unavailable. ESP sluiced ash data were substituted.

related compounds. The phthalate esters detected in the MM5 gas samples are typical plasticizers commonly attributed to plastic bottles, bags, etc. used in the field laboratory environment. Sample and field blank concentrations are comparable; since phthalates are ubiquitous in the terrestrial environment, their presence is most likely due to contamination.

Methylene chloride and acetone are common reagents used in the field for sample recovery, and the detection of these compounds in the VOST samples is attributed to their presence in the field laboratory environment. Also detected in the VOST samples were chloromethane, trichloroethane, tetrachloroethene, and trichlorofluoromethane. These compounds were also found in the field blanks, but not in the trip blanks. Their presence is attributed to an unknown source of solvents or refrigerants in the field environment and they are not considered to be process-generated compounds.

Six semivolatile organic compounds and two volatile organic compounds detected consistently in the three gas streams are likely associated with the coal combustion process. These are benzene, toluene, phenol, 2-methylphenol (o-cresol), 4-methylphenol (p-cresol), acetophenone, naphthalene, and benzoic acid. The average measurable concentrations of these compounds across all three gas streams are less than 1 ppbv except phenol (2.5 ppbv), formaldehyde (8.2 ppbv), and benzoic acid (37 ppbv). (Note that benzoic acid is not included on the Title III list of compounds in the Clear Air Act Amendments.)

Benzene, toluene, and the phenols are known products of coal devolatilization, and their presence indicates partial oxidation of the coal or the possible presence of lower-temperature combustion zones within the boiler. The presence of naphthalene, in addition to being a process related compound, is sometimes attributed to inadequate cleanup of the XAD resin material used as the sorbent in the MM5 sampling train. At this site, however, naphthalene concentrations in the blank resin samples were less than three times the detection limit indicating a relatively clean resin matrix. The gas sample concentrations were all less than eight times the detection limit with most of the measurable naphthalene concentrations near the levels found in the blank samples. Consequently, the confidence intervals around the naphthalene concentrations are large, and any definitive conclusion about the presence of naphthalene in the flue gas is not possible from these data.

Conversely, benzoic acid is present in the flue gas samples at an average concentration of 37 ppbv, over ten times greater than any other process related compound. The presence of benzoic acid in the flue gas may be explained by at least two well known mechanisms:

- **Oxidation of naphthalene followed by decarboxylation at 300°C.** This route was used commercially to produce benzoic acid until recently, when it was phased out in favor of liquid-phase oxidation of toluene. Naphthalene is oxidized to phthalic acid anhydride then decarboxylated, which takes place spontaneously at 300°C, with about 40% conversion. It is not unreasonable to assume that a similar reaction could occur during the combustion process when naphthalene is present.

- **Oxidation of toluene to benzoic acid.** The catalytic oxidation of toluene to benzoic acid using V_2O_5 was also used to produce benzoic acid commercially in Germany during

> World War II. Although it has also been replaced by the liquid-phase oxidation mechanism, the fact that the process existed indicates that benzoic acid can be obtained by the oxidation of toluene. The oxidation yields benzoic acid and benzaldehyde, which can also be oxidized to benzoic acid.

Benzoic acid is not on the Clean Air Act list of 189 toxic substances, but it is noteworthy that all of the detected organic compounds are aromatic and share a common toluene or substituted-benzene structure. Although benzoic acid may be a degradation product of XAD resin, there is no evidence confirming this compound is generated as a sampling artifact. Another likely hypothesis is that the semivolatile compounds detected in the flue gas are attributed to various oxidation and substitution products of naphthalene, xylene (detected in only one sample), and toluene, with benzoic acid being the predominant product.

Similarly, the presence of acetaldehyde and formaldehyde in the flue gas may be attributed to the oxidation of ethane and methane possibly produced from the partial oxidation of coal. Gas samples were not analyzed for acetic or formic acid, which are the oxidation products of acetaldehyde and formaldehyde, respectively. The analysis of these organic acids, if detected, could provide some insight into the behavior of acetaldehyde and formaldehyde and the level of oxidation possible in the system.

7

COMPARISON OF VAPOR AND PARTICULATE COMPOSITION

Most of the substances measured at Plant Yates are distributed between the flue gas (vapor) and particulate matter (bottom ash, collected ESP ash, ash removed in the FGD system, or emitted ash which exits with the flue gas through the stack). Of the organic compounds tested, the semivolatile compounds should be associated with the particulate matter, and the volatile compounds should remain in the vapor phase. (Some of the organic compounds are at least slightly soluble in water and thus may be removed from the flue gas in the wet FGD system.) The sampling and analytical techniques used in the project did not quantify the distribution of the organic compounds between the particulate and vapor phases.

EPA Proposed Method 29 was the primary method used for collecting the trace metals samples at Plant Yates. The anions train used to measure acid gas concentrations is similar to Method 29 in many respects since both are modifications to the Method 5 sampling procedure. In these methods, the particulate and vapor concentrations are analyzed and may be reported separately. However, because of the low vapor-phase concentrations and the high potential for contamination during sampling, sample handling, or analysis, the partitions between particulate and vapor phases should be used cautiously.

Most of the inorganic elements present in the flue gas downstream of the air heater should be in the particulate phase. As is discussed in Section 8, some of the metals will be enriched in the finer particulate sizes, but the vapor pressure of most elements and their compounds is too low for measurable concentrations to be expected in the vapor phase at temperatures of 300°F and below. Exceptions to this include mercury, hydrochloric acid, hydrofluoric acid, and selenium which may have significant vapor concentrations. Selenium may be present either as vaporous compounds such as SeO_2 or as a component enriched in the finer particulate matter.

Tables 7-1, 7-2, and 7-3 show the particulate and vapor-phase distribution of the inorganic substances of interest measured at Yates in the ESP inlet, ESP outlet, and stack streams, respectively. Rather than summing the components of the sampling train, the concentrations of the particulate and vapor phases have been computed and averaged separately. For values reported from the laboratory as below the detection limit, one-half the detection limit was included in the averaging procedure. The average determined in this manner was used to calculate the particulate percentage, even if the average was less than the average detection limit of the non-detected samples. In this event, the average detection limit has also been included in the tables as a less than value in parentheses (<DL). The percentage of the particulate- and vapor-phase concentrations that result from averaging values below detection limits are included in the tables.

Table 7-1
Vapor and Particulate-Phase Distribution at ESP Inlet

Element	Part. Conc. $\mu g/Nm^3$	% Part. DL[a]	Vapor Conc. $\mu g/Nm^3$ [b]		% Vapor DL[c]	% of Element in Particulate Phase
Antimony	33	0%	0.56		0%	98.3%
Arsenic	400	0%	0.083	(<0.17)	100%	100.0%
Barium	4,400	0%	1.5		0%	100.0%
Beryllium	93	0%	0.06		0%	99.9%
Boron	4,200[d]	0%	6,390		0%	39.7%
Cadmium	24	0%	0.11		16%	99.6%
Chloride	6,100	0%	112,000		0%	5.2%
Chromium	2,900	0%	11		0%	99.6%
Cobalt	275	0%	0.34	(<0.74)	55%	99.9%
Copper	770	0%	1.1		0%	99.9%
Fluoride	1.3	0%	8,300		0%	0.0%
Lead	710	0%	0.103	(<0.21)	100%	100.0%
Manganese	2,120	0%	0.051	(<0.10)	100%	100.0%
Mercury	1.3[e]	0%	5.5		0%	19.2%
Molybdenum	320	0%	0.66	(<1.4)	52%	99.8%
Nickel	2,000	0%	7		7%	99.6%
Phosphorus	2,100	0%	7.8	(<16)	100%	99.6%
Selenium	133	0%	0.11	(<0.22)	100%	99.9%
Strontium	2,910	0%	2		0%	99.9%
Vanadium	2,760	0%	1.20		0%	100.0%

Note: The Hg concentration in the sluiced ash has been substituted for the ESP inlet ash Hg concentration since the latter is believed to be biased high.

[a] Percentage of the particulate concentration that results from using measurements below detection limits.

[b] Note: Run 2 has been excluded from the vapor-phase average because of contamination.

[c] Percentage of the vapor concentration that results from using measurements below detection limits.

[d] Boron concentrations from the sluiced fly ash have been substituted for the gas stream particulate concentrations. Chemicals containing boron are used in the digestion procedure used for the gas stream particulate samples.

[e] The sluiced fly ash mercury concentration was substituted for the mercury concentration measured in the ESP inlet particulate. Material balances around the boiler, ESP, and overall plant support the hypothesis that the ESP inlet particulate mercury concentration is biased high.

Table 7-2
Vapor and Particulate-Phase Distribution at ESP Outlet

Element	Part. Conc. $\mu g/Nm^3$	% Part. DL[a]	Vapor Conc. $\mu g/Nm^3$		% Vapor ND[b]	% of Element in Particulate Phase
Antimony	0.39	0%	0.021		0%	94.8%
Arsenic	16	0%	0.091	(<0.18)	100%	99.4%
Barium	74	0%	1.0		0%	98.7%
Beryllium	1.7	0%	0.093	(<0.16)	57%	94.9%
Cadmium	1.1	0%	0.10		20%	91.1%
Chloride	45	0%	136,000		0%	0.0%
Chromium	23	0%	0.57	(<0.73)	42%	97.6%
Cobalt	4.5	0%	0.54	(<1.0)	31%	89.2%
Copper	16	0%	1.1		16%	93.9%
Fluoride	0.12	0%	7,900		0%	0.0%
Lead	18	0%	0.37		20%	98.0%
Manganese	34	0%	0.055	(<0.11)	100%	99.8%
Mercury	0.126	0%	5.6		0%	2.2%
Molybdenum	8.1	0%	0.61	(<1.4)	37%	93.0%
Nickel	22	0%	1.54	(<2.9)	59%	93.6%
Phosphorus	100	0%	8.49	(<17)	100%	92.2%
Selenium	82	0%	0.12	(<0.23)	100%	99.9%
Strontium	43	0%	1.4		0%	96.9%
Vanadium	54	0%	1		12%	98.2%

[a] Percentage of the particulate concentration that results from using measurements below detection limits.

[b] Percentage of the vapor concentration that results from using measurements below detection limits.

Table 7-3
Vapor and Particulate-Phase Distribution at Stack

Element	Part. Conc. $\mu g/Nm^3$		% Part. DL[a]	Vapor Conc. $\mu g/Nm^3$		% Vapor DL[b]	% of Element in Particulate Phase
Antimony	0.052		0%	0.012		0%	80.6%
Arsenic	1.1		0%	0.089	(<0.18)	100%	92.5%
Barium	2.8		0%	0.082	(<0.14)	54%	97.2%
Beryllium	0.041		0%	0.061	(<0.17)	82%	40.1%
Cadmium	0.59		0%	0.032	(<0.064)	100%	94.9%
Chloride	214		0%	540		0%	28.4%
Chromium	5.1		0%	0.34	(<0.67)	100%	93.8%
Cobalt	0.25	(<0.6)	59%	0.39		0%	39.3%
Copper	0.77		0%	1.2		14%	38.2%
Fluoride	0.051		0%	124		0%	0.0%
Lead	0.50		0%	0.11	(<0.22)	100%	82.1%
Manganese	7.2		0%	0.054	(<0.11)	100%	99.3%
Mercury	0.0071		18%	3.0		0%	0.2%
Molybdenum	1.4		0%	0.12		0%	92.3%
Nickel	39		0%	1.8	(<2.6)	46%	95.7%
Phosphorus	1.3	(<2.6)	100%	8.2	(<16)	100%	13.6%
Selenium	26		0%	0.8		0%	97.1%
Strontium	1.5		0%	0.022	(<0.045)	100%	98.5%
Vanadium	1.6		0%	0.55		0%	74.5%

[a] Percentage of the particulate concentration that results from using measurements below detection limits.

[b] Percentage of the vapor concentration that results from using measurements below detection limits.

At ESP inlet conditions, more than 99% of the mass of the substances of interest were found in the particulate phase. Exceptions to this are chloride, fluoride, and mercury. Most chloride and fluoride exiting the boiler are in the acid gas form (HCl and HF.) In fact, Title III of the Clean Air Act Amendments of 1990, only lists HCl and HF and not chloride and fluoride salts which would be in the particulate form. However, the particulate measurements are included in this section for completeness.

With the exception of mercury, chloride, and fluoride, the particulate phase contains most of the mass of elements at the ESP outlet and stack as well. The percentage found in the particulate phase decreases for some elements in the stack, primarily because the particulate loading (and therefore the particulate concentration of an element on a gas-phase basis) decreases. The gas-phase concentrations of most elements are reasonably consistent at each of the sampling locations. However, these concentrations, while very low, are above those expected. Since the concentrations of the elements in the liquid impinger samples are extremely low (10 ppb level or below for most), contamination of the impinger solutions is the suspected cause.

Field blank concentrations support the hypothesis that contamination may be the cause of the higher-than-expected vapor-phase concentrations of the elements of interest. Table 7-4 compares the stack vapor measurements to the stack field blank concentrations (calculated on an average stack gas volume basis). For most of the elements, the field blank concentration equals or exceeds the measured stack concentration. Since the reagent blanks are generally much lower than the field blanks, sample handling under field conditions is the expected cause of contamination. Possible sources of contamination include incomplete rinsing of the sampling train glassware or inadvertent contact of the rinse solution with external glassware surfaces. Again, because the concentration of these elements is in the ppb range, very little material is required to cause these levels of contamination.

Mercury and fluoride are almost entirely in the vapor phase at the ESP outlet and stack. Chloride shows a substantial particulate percentage at the stack. This high level of particulate chloride is believed to be caused by a minor amount of absorber liquid being re-entrained from the mist eliminator surfaces. Again, this chloride is a calcium salt which is not included on the list of elements and compounds in Title III of the Clean Air Act Amendments of 1990.

Finally, the selenium distribution at Plant Yates is worthy of note. Essentially all of the selenium was found in the particulate phase at Yates, while at most other coal-fired electric utility plants a significant fraction of the selenium has been measured in the vapor phase. (Variability in the selenium data is also high in most cases.) Although the particulate phase contains the selenium, particulate-phase selenium removal efficiency was only 40% (see Table 8-2) compared to greater than 98% removal efficiency for the total particulate matter. All other particulate-phase metals are removed at greater than 90% efficiency. These data indicate that selenium may be reacting or condensing on the particulate filter during gas-phase sampling resulting in a lower-than-expected vaporous selenium concentration. Also note that the spike recovery for the selenium vapor was low, indicating a possible low bias in the vapor-phase selenium concentration.

Table 7-4
Stack Field Blank Versus Vapor Concentration

Element	Vapor Conc. $\mu g/Nm^3$		Field Blank $\mu g/Nm^3$
Antimony	0.012		1.78
Arsenic	0.089	(<0.18)[a]	<0.177
Barium	0.082	(<0.14)	0.734
Beryllium	0.061	(<0.17)	<0.150
Cadmium	0.032	(<0.064)	0.054
Chromium	0.34	(<0.67)	3.19
Cobalt	0.39		1.01
Copper	1.2		1.66
Lead	0.11	(<0.22)	1.08
Manganese	0.054	(<0.11)	10.6
Molybdenum	0.12		0.073
Nickel	1.8	(<2.6)	3.59
Phosphorus	8.2	(<16)	<16.5
Selenium	0.8		<0.228
Strontium	0.022	(<0.045)	0.513
Vanadium	0.55		0.821

[a] The "<" symbol indicates the average D.L. for these substances.

In Table 7-1, the mercury concentration in the sluiced fly ash has been substituted for the mercury concentration measured in the ESP inlet particulate matter because the ESP value is believed to be biased high. (The ESP inlet ash mercury concentration is significantly higher than that measured at most other coal-fired electric utility plants.) As shown in Table 6-2, material balances for mercury around the boiler (205%) and ESP (55%) indicate that the mercury particulate concentration may be high. The overall balance for mercury (101%) is good. (This balance does not use the ESP inlet data.) Since the ESP sluiced ash includes most of the ash at the ESP inlet, concentrations in this stream should be reasonable estimates for the ESP inlet ash concentrations. When this substitution is made, the mercury balances around the boiler (110%) and ESP (102%) become more reasonable.

8

DISTRIBUTION OF HAPs AS A FUNCTION OF PARTICLE SIZE IN THE FLUE GAS AND THE PARTICLE SIZE DISTRIBUTION IN THE ESP

Understanding the distribution of trace metals according to particle size is important in understanding and predicting trace metals emissions rates and removal efficiencies across control devices. For example, if an element was enriched (higher concentration than in the bulk ash) in the fine particulate matter, the removal efficiency for that element across an ESP would be expected to be less than that of the bulk particulate matter. (Theoretically, an ESP does not control the fines as well as the larger particle size fractions.)

Prior to the presentation of results from Plant Yates, expected results based on historical data will be discussed. Trace metals in coal can be grouped into three general categories:

- Elements (and compounds) that are not vaporized during the combustion process and, therefore, are assumed to be uniformly distributed in the bottom ash and fly ash. Included in this category are barium, beryllium, manganese, strontium, vanadium, and, sometimes, chromium and nickel.

- Elements that are partially or completely vaporized in the furnace and then condense as the flue gas temperature drops in cooler regions of the boiler and in downstream equipment. This condensation can occur on the surface of ash particles or by homogenous nucleation, so elements in this category tend to be enriched in the finer fly ash particles. Included here are arsenic, cadmium, copper, lead, molybdenum, and, sometimes, chromium, nickel, and selenium. Antimony and phosphorus may also fall in this category, but not much supporting data on these elements are available as yet.

- Elements that are vaporized and remain primarily in the vapor phase at flue gas temperatures in the stack. Mercury and sometimes selenium fall into this category. Selenium may be present either as vaporous compounds, such as SeO_2, or as a component enriched in the finer particulate matter.

Collection and Analytical Methods

The mass particle size distributions around the ESP can be used to characterize its performance. The size distributions were determined by Anderson High Capacity Source Sampler (4 cuts) for the ESP inlet, by Microtracs laser diffraction for the ESP Field 1 hopper catch and the ESP Field 2 hopper catch, and by University of Washington Mark V cascade impactor (11 cuts) at the ESP outlet.

To convert the size distributions from aerodynamic diameter to physical diameter, it is necessary to know the density of the particles. Particle density measurements were made on samples from the ESP from Plant Yates ESP Hoppers 1-4 on 6/23/93. A helium pycnometer was used to measure the porosity and volume of the ash samples. The samples were then weighed to determine the particle density. The average of three measurements was 2.41 g/cm^3, and it was assumed that this density was representative for all sizes of particles. This value for density was then used in the impactor data reduction to calculate the physical diameters.

Particle Size Distribution and Fractional Efficiency

Figures 8-1, 8-2, 8-3, and 8-4 show the cumulative and differential particle size distribution measured at the inlet and outlet of the ESP. Specific run data for the ESP inlet and outlet PSD tests are included in Appendix C.

The inertial sampling equipment used for these tests is described in Section 5. Sampling was conducted at a fixed, isokinetic flow rate to yield a constant stage cutpoint. The sampling train utilized is essentially a standard EPA reference Method 17 configuration. Stage cutpoints for the cascade impactors and cyclone samplers are derived from empirical calibrations based on operating flow rates, run conditions, and sampler geometry.

ESP particle size data are presented on a physical basis, rather than aerodynamic, using a measured ash density of 2.4 gm/cm^3. The ESP inlet particle size distribution is a direct average of triplicate runs at the same cyclone stage cutpoints. The top and bottom end of the distribution are assumed to be 50 μm and 0.1 μm, respectively. This range was selected to cover the extent of particles which are typical of coal-fired boilers. Mass median diameter and geometric standard deviation of the distribution were estimated graphically, based on the 50 μm upper size limit, assuming a log-normal distribution. The resulting inlet distribution had a mass median diameter of 13 μm with a standard deviation of 4.1 This represents a rather wide spread for an inlet size distribution. Since only four data points are available from the cyclones, it is difficult to discern any more details on the inlet distribution. However, the amount of space charge suppression that was observed in the first field of the ESP does indicate large concentrations of fine particles which would also reflect a large standard deviation.

Data reduction for the outlet PSD follows a standard cascade impactor D_{50} calculation method.[1] Outlet particle size was also extrapolated to a 50 μm upper endpoint. Mass fraction and differential distribution were directly averaged from the raw impactor run data, since stage D_{50} cutpoints were nearly identical between runs. The resulting distribution had a mass median diameter of 4.1 μm and a standard deviation of 3.1. This size is representative of the size distribution commonly measured at the outlet of an ESP.

In Figures 8-3 and 8-4, and Table 8-1, the differential mass has been normalized to the level of the Method 5/29 average measured particulate concentration. This corrects for sample fallout and loss in the particle sizing cyclones and cascade impactor. It also accounts for

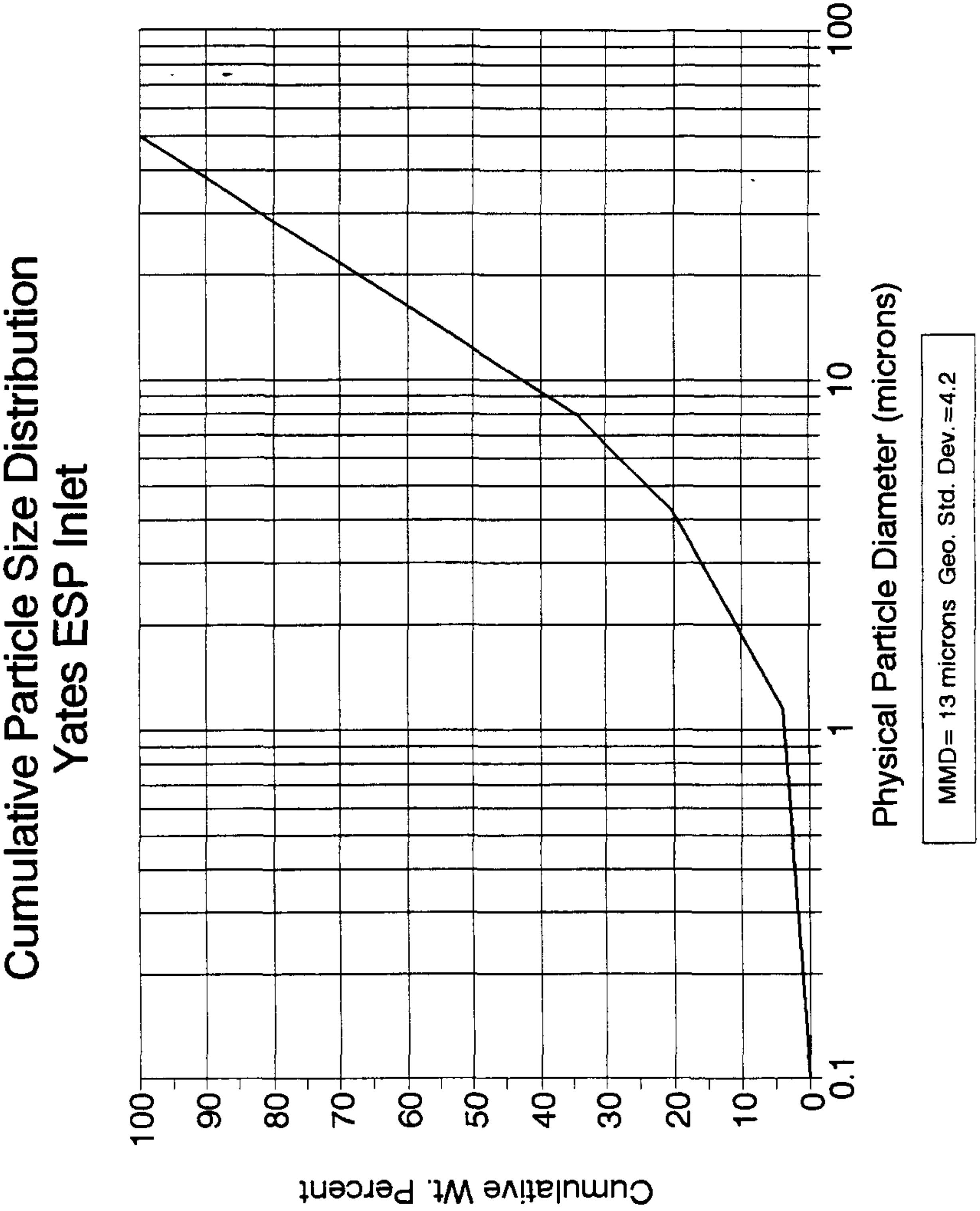


Figure 8-1
Cumulative Particle Size Distribution, Yates ESP Inlet

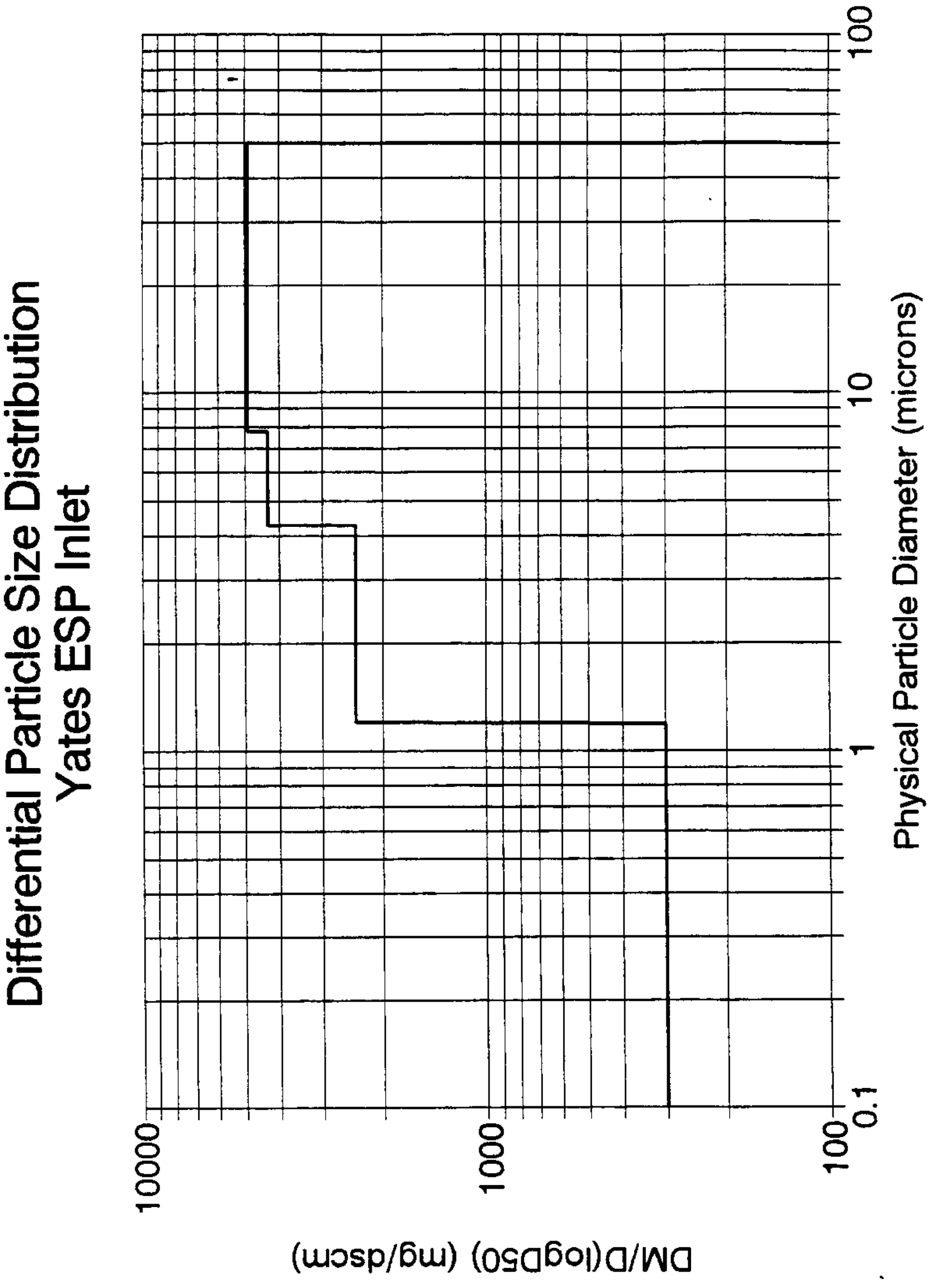


Figure 8-2
Differential Particle Size Distribution, Yates ESP Inlet

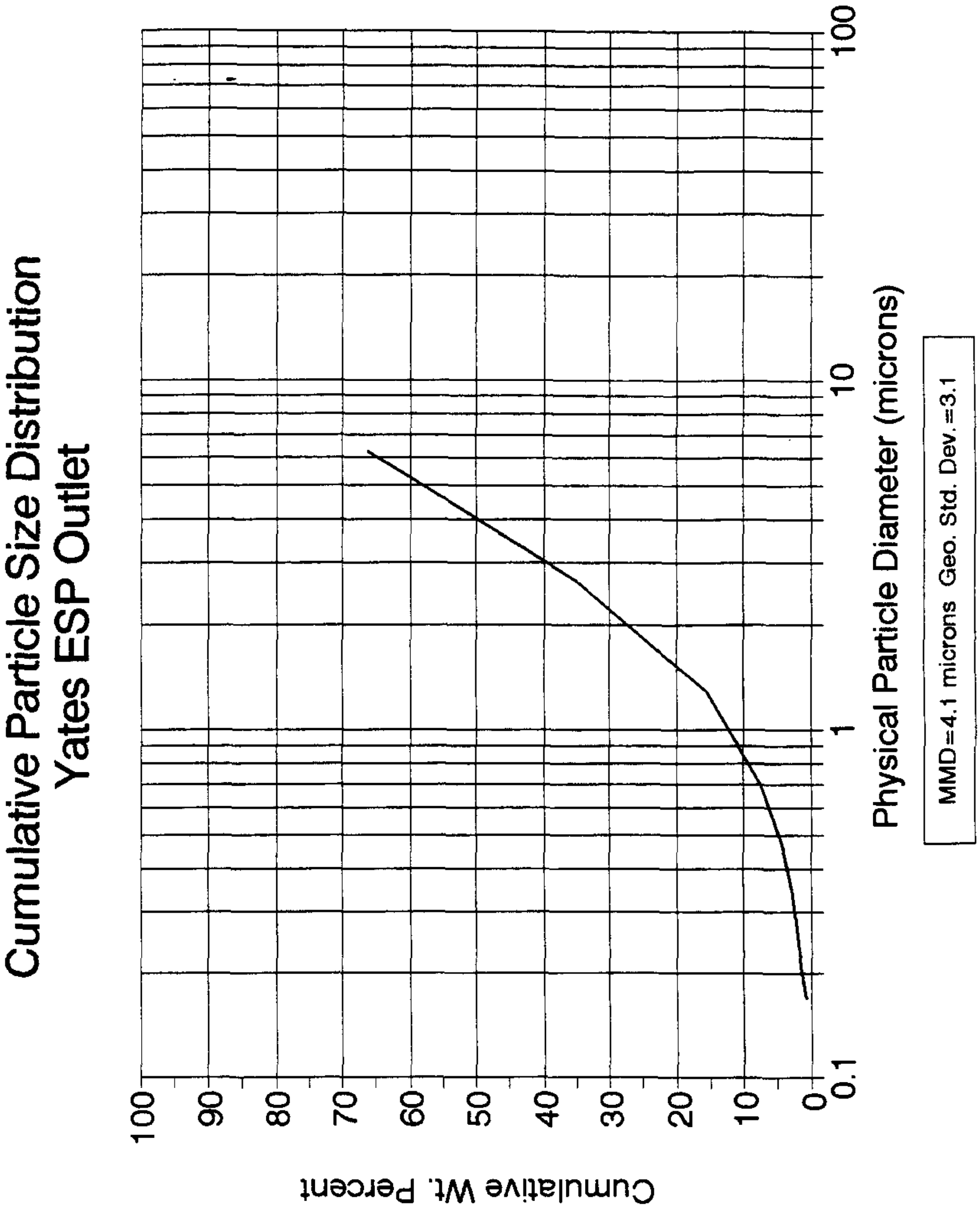


Figure 8-3
Cumulative Particle Size Distribution, Yates ESP Outlet

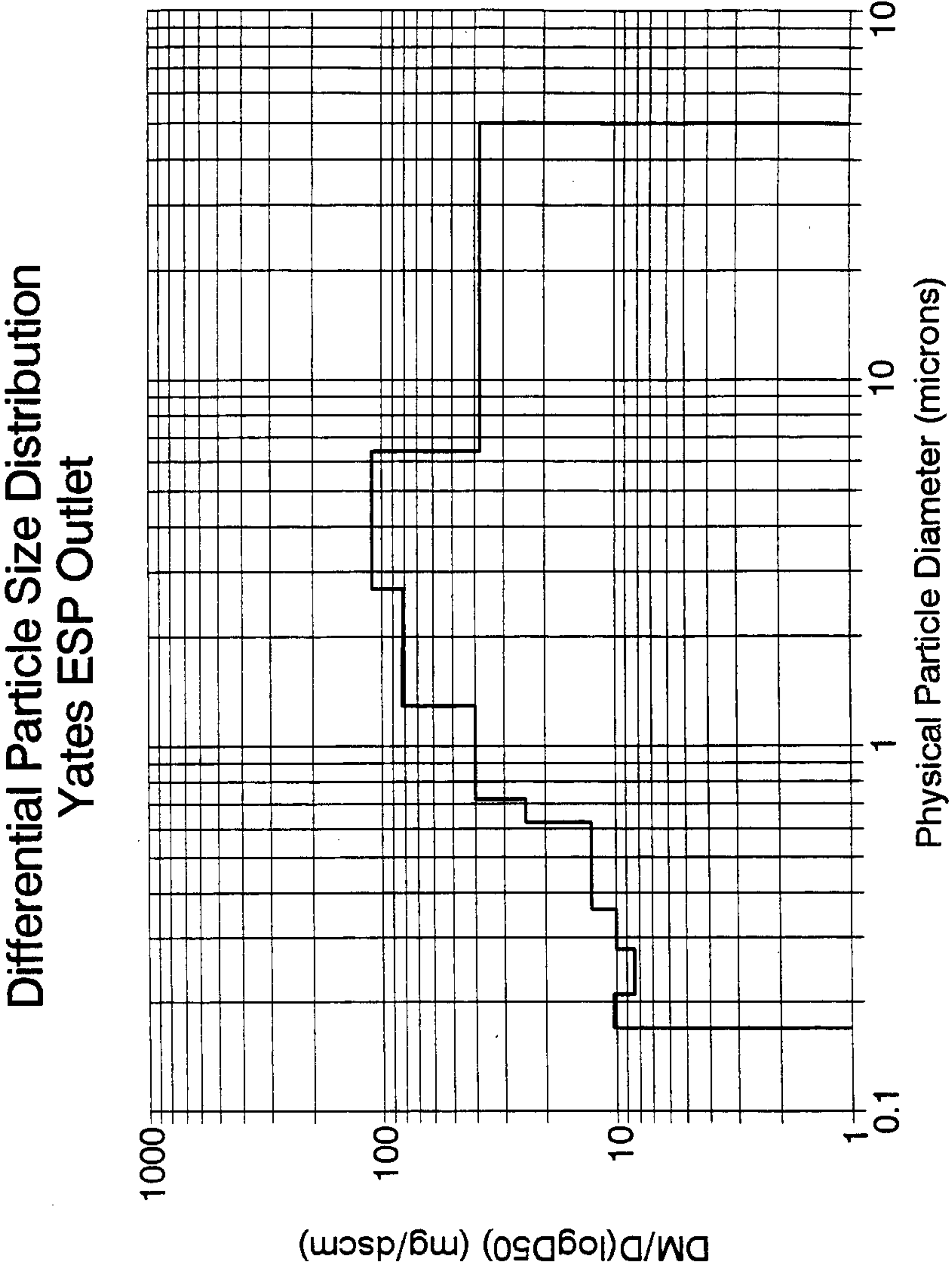


Figure 8-4
Outlet Differential Particle Size Distribution

Table 8-1
Measured Particle Size and Fractional Efficiency

Physical Diameter (microns)	Inlet Cumulative Mass (%)	Inlet DM/d (logD50) (mg/dscm)	Outlet Cumulative Mass (%)	Outlet DM/d(logD50) (mg/dscm)	Fractional Efficiency (%)	Fractional Penetration (%)
0.1 - 1.2	3.8	300	16.0	17.3	94.2	5.8
1.2 - 4.3	20.3	2,413	55.0	81.5	96.6	3.4
4.3 - 7.8	33.8	4,309	78.0	95.5	97.8	2.2
>7.8	100.0	4,927	100.0	51.0	99.0	1.0

Notes:

1. Fly ash density = 2.41 gm/cm^3.
2. Inlet differential distribution normalized to average mass test concentration of 8,338 mg/dscm.
3. Outlet differential distribution normalized to average mass test concentration of 131.8 mg/dscm.

differences between the single-point impactor and cyclone sampler tests and the multipoint Method 5/29 measurements.

Table 8-1 shows the collection efficiency as a function of physical particle size. The overall collection efficiency for all particles was 98.4 percent. The measured collection efficiency for particles below 1.2 μm was 94%, while the collection efficiency for particles between 1.2 - 4.3 microns was 96 percent. The mass fraction above 1 μm represents the majority of particles emitted from the ESP. Although theoretical collection efficiency decreases with the particle diameter, non-ideal effects such as sneakage, gas flow distribution, and reentrainment can have a very significant effect on ESP performance for larger particle sizes. This demonstrates that an ESP can efficiently collect submicron particles and does not emit just fine particles as is commonly believed.

Predicted ESP Performance

ESP performance can be affected by several variables including particle resistivity and the electrical characteristics of the ESP. Both of these conditions can ultimately affect opacity. Each of these are discussed in the following section.

Particle Resistivity. Particle resistivity was measured at the ESP inlet using an extractive resistivity measuring device. In this device, sample collection and resistivity measurement are performed in a chamber external to the duct. The system uses an in-situ probe to isokinetically extract a sample of dust to a temperature-controlled precipitation chamber where a point-plane precipitator deposits the dust onto a disc. Once a suitable layer has been deposited, layer thickness is measured with a precision micrometer. Resistivity is measured in the presence of flue gas by applying increasing voltage across the dust layer. The resulting current is measured with a picoammeter until the dust layer breaks down electrically and sparkover occurs. The resistivity is then calculated using the ratio of the electric field to the current density just prior to sparkover, as described in ASME Power Test Code Number 28. Measurements are typically made over a range of temperatures for the same dust layer. This allows resistivity to be measured over a range of possible ESP operating conditions.

In addition to the in-situ measurements, resistivity was also calculated using a computer model developed by Bickelhaupt.[2,3] This model predicts resistivity as a function of temperature, water vapor content, and SO_3 concentration. An as-received ultimate coal analysis is required to run the Bickelhaupt model.

Figure 8-5 shows a plot of the particle resistivity. The solid triangles are in-situ measurements made during the field test program at the ESP inlet. Although the ESP temperature was steady at approximately 280°F, it was possible to make measurements at a range of temperatures from 240°F to 320°F by varying the temperature in the resistivity chamber.

The lines shown in Figure 8-5 are the predicted values based upon the Bickelhaupt empirical model. This model uses coal and ash characteristics to predict particle resistivity. It has been documented that the weakest part of the model is predicting the gas-phase SO_3 concentration. Therefore, the plot contains the predictions for four values of SO_3 from 0-7 ppm.

At 280°F, the measured resistivity was $8 - 10 \times 10^{10}$ ohm-cm, which represents conditions for very good precipitation. The measured values are higher than the predicted values with greater than 1 ppm of SO_3. The predicted values with no SO_3 match well with the measured values. This means that the amount of SO_3 present in the flue gas was much lower than predicted. This can be caused by conditions in the boiler or by characteristics of the air preheater. Often SO_3 can be scrubbed by the cold surfaces in the heat exchanger.

Another indication that the SO_3 was low was the low dew point that was measured. The resistivity chamber has been modified to allow measurement of acid dew point. A window on the chamber is cooled to a point that condensation occurs on the window face exposed to the flue gas. The window is then heated externally until the mist disappears. A thermocouple attached to the inside of the window is used to determine the temperature of the glass surface. Experience with this system has shown that the dew point can be consistently measured ± 2°F. During the measurements at Plant Yates, there was no detectable dew point above 220°F. This corresponds to an SO_3 concentration of approximately 0.3 ppm.

Electrical Characteristics. The electrical characteristics are shown in Figure 8-6. The voltage current (VI) characteristics are expressed in the normalized terms of electric field strength (kV/cm) and current density (nA/cm^2). All the fields, except Field C, operate at field strengths greater than 3 kV/cm. Cold-side ESPs that are not experiencing problems related to high resistivity will typically operate in the range of 3.0 to 3.5 kV/cm. Therefore, the VI curves shown in Figure 8-6 reflect the moderate particle resistivity levels described previously.

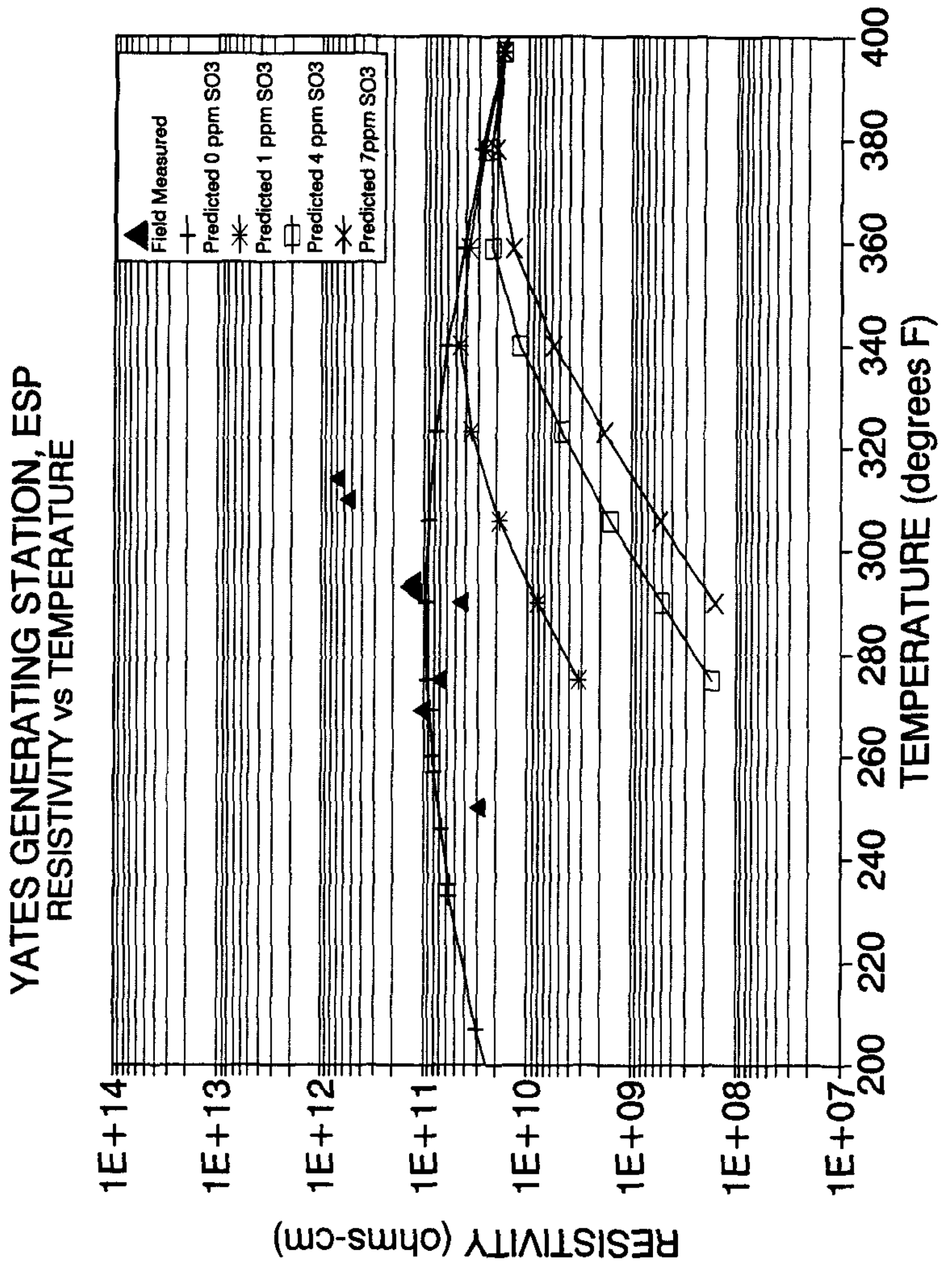


Figure 8-5
Particle Resistivity

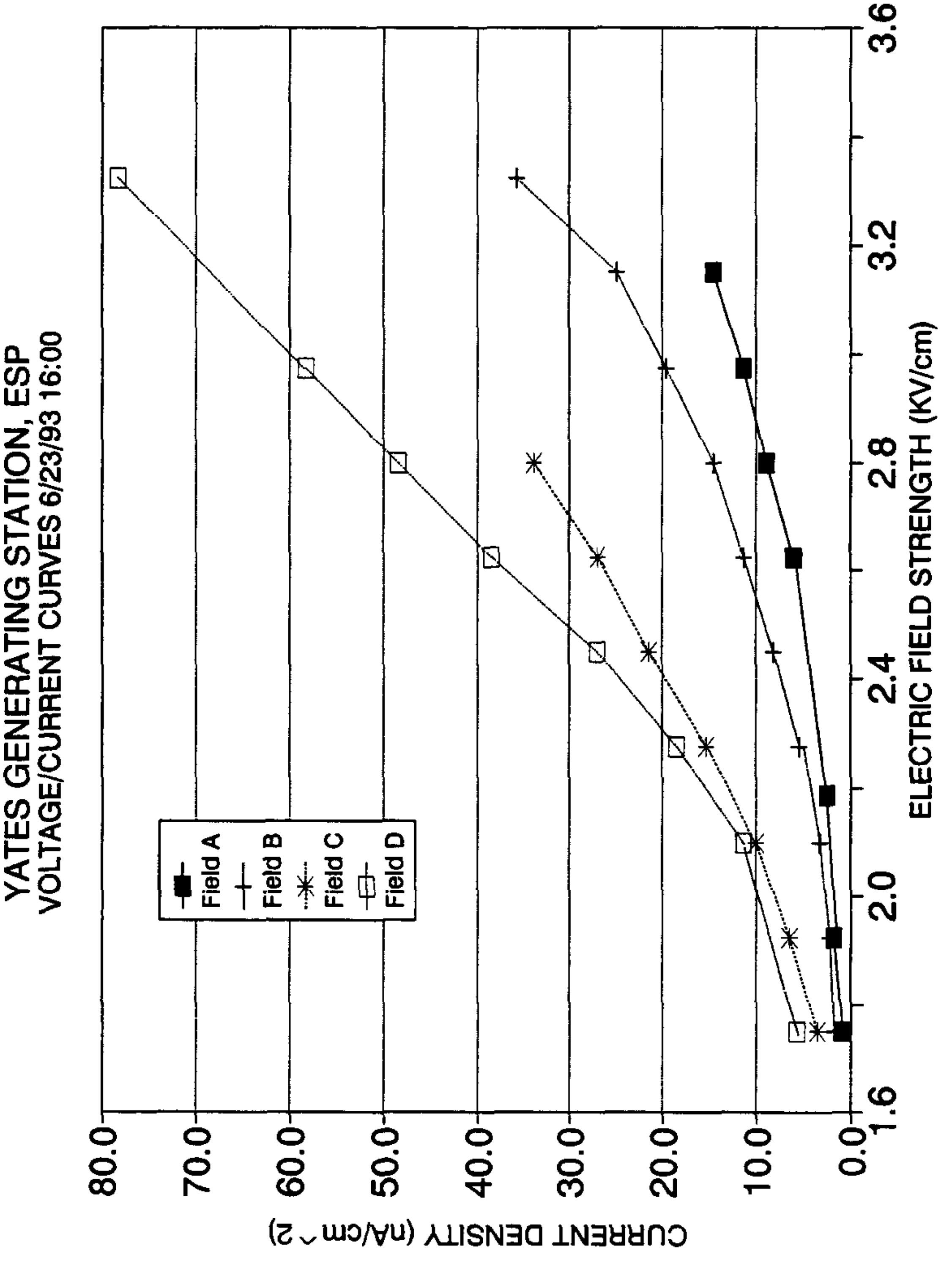


Figure 8-6
Voltage Current Curves

Field C is sparked at 2.8 kV/cm which is lower than the field strengths in Fields B and D which are upstream and downstream of Field C. Since the low voltage sparking is isolated in only one section of the ESP, the problem is probably not related to particle resistivity and is most likely due to some minor misalignment in this field.

Opacity. The opacity over a given period of time is shown in Figure 8-7 which is a plot of 6 minute averages of 15 second readings. During the time period shown in this figure, all sections should have been rapped. The lack of rapping spikes is likely due to the sampling time on the data recorder. However, it could be possible that the rapping spikes are relatively small. The holding force on the collected dust layer is proportional to the square of the particle resistivity. At the resistivity levels measured for this ash, the holding force could be strong enough to inhibit removal of the dust from the plates.

Predicted ESP Performance. The performance of the ESP was predicted using a predictive ESP computer model developed by ADA Technologies for DOE.[4] The non-ideal factor for gas flow distribution (25%) that has been recommended by EPRI for older ESPs was used in the modeling. The EPRI value for sneakage was modified for this application to take into account the fact that there were four electrical sections but only three mechanical sections.

The results of the predictions are shown in Table 8-2. As can be seen, the predicted performance of the ESP matches well with the measured performance. The model predicted 98.4% for the overall collection efficiency which agrees with the measured results from the total particulate tests. The outlet size distributions are also similar as both show a mass median diameter of approximately 4 μm. The opacity values are a little different, but the exact dimensions of the duct where the opacity is measured is not known. This is important for predicting opacity.

Figure 8-8 is a plot of the measured and predicted penetration as a function of particle size. The measured efficiency is much cruder because only 4 data points are available for the calculation from the inlet measurements. However, the measured and predicted efficiencies as a function of particle size are nearly identical. Both show a maximum penetration for submicron particles of 6 to 7 percent.

From the fact that there is a strong correlation between the measured and modeled performance, it is concluded that the ESP is performing as would be expected for the fly ash and flue gas conditions present. No operational or performance problems are observable.

Metals Removal Across ESP

Table 8-3 shows the removal of particulate metals across the ESP as well as the penetration of particulate metals through the ESP. The average penetration is 1.6% for all particles. As can be seen, most of the metals are removed at approximately the same rate as the total particulate. This would be expected because the metals are associated with all sizes of particles and the ESP is showing very high collection efficiency for even submicron particles. Figure 8-9 shows the distribution of metals as a function of particle size measured at the inlet

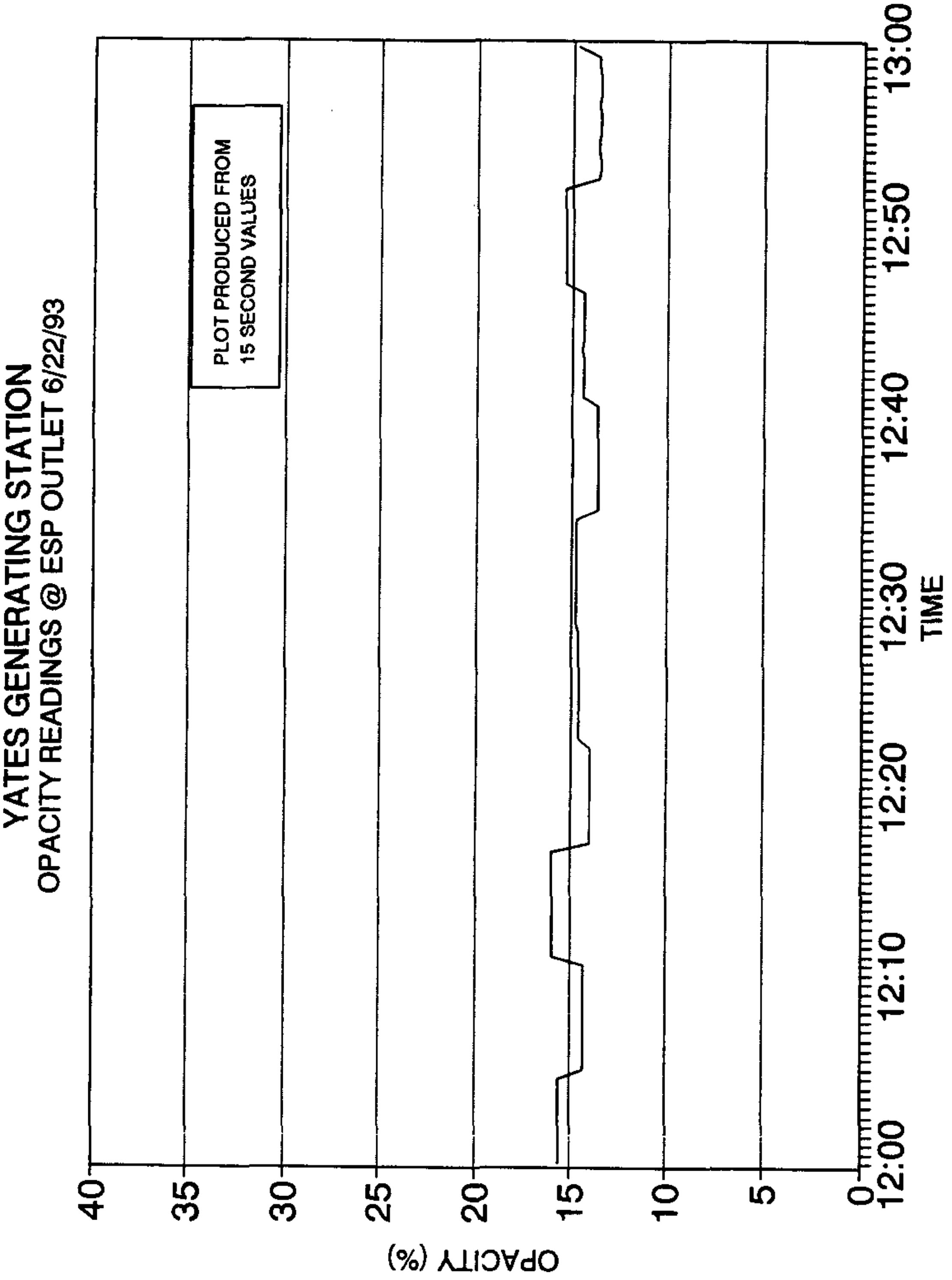


Figure 8-7
Opacity

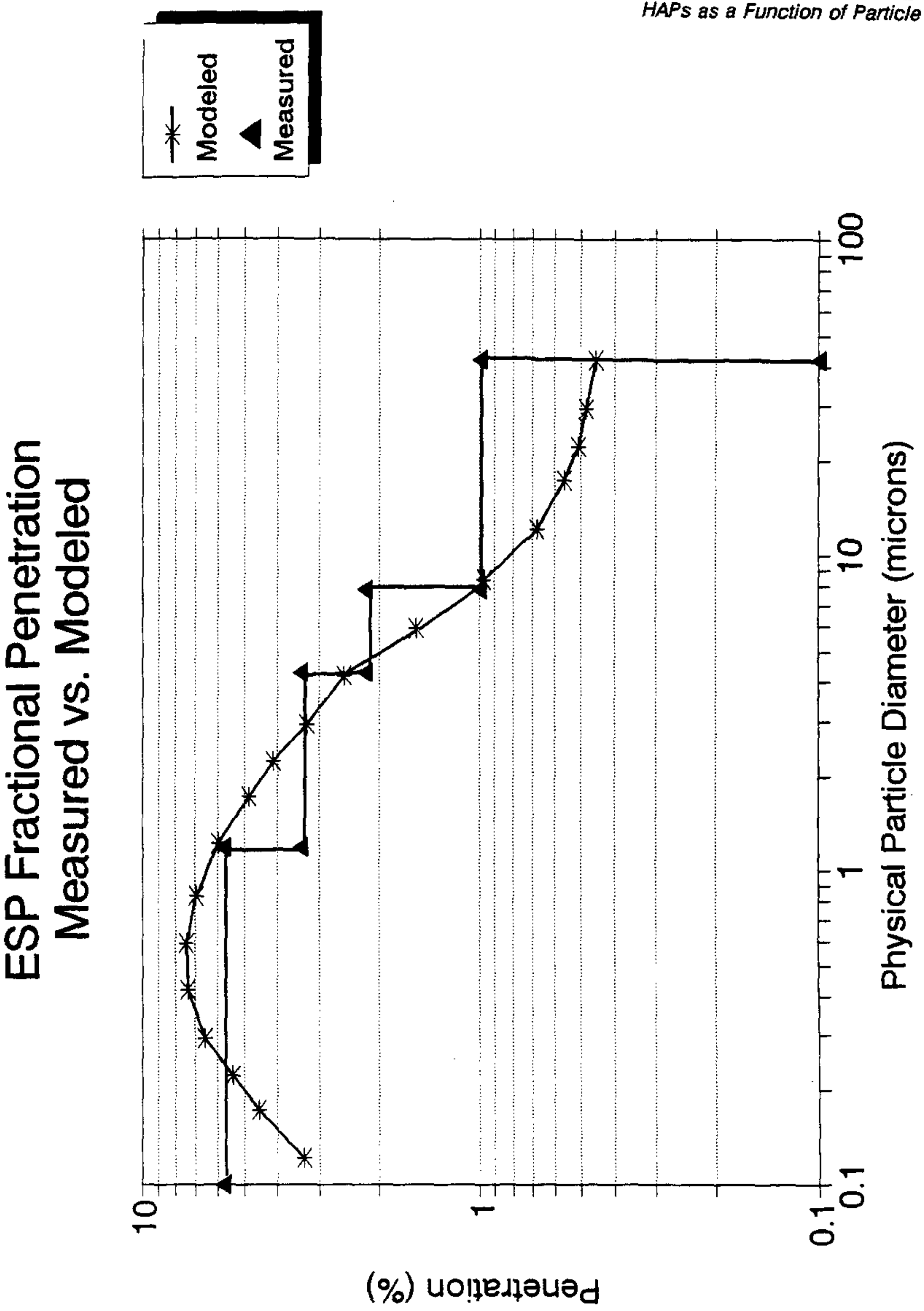


Figure 8-8
ESP Fractional Penetration

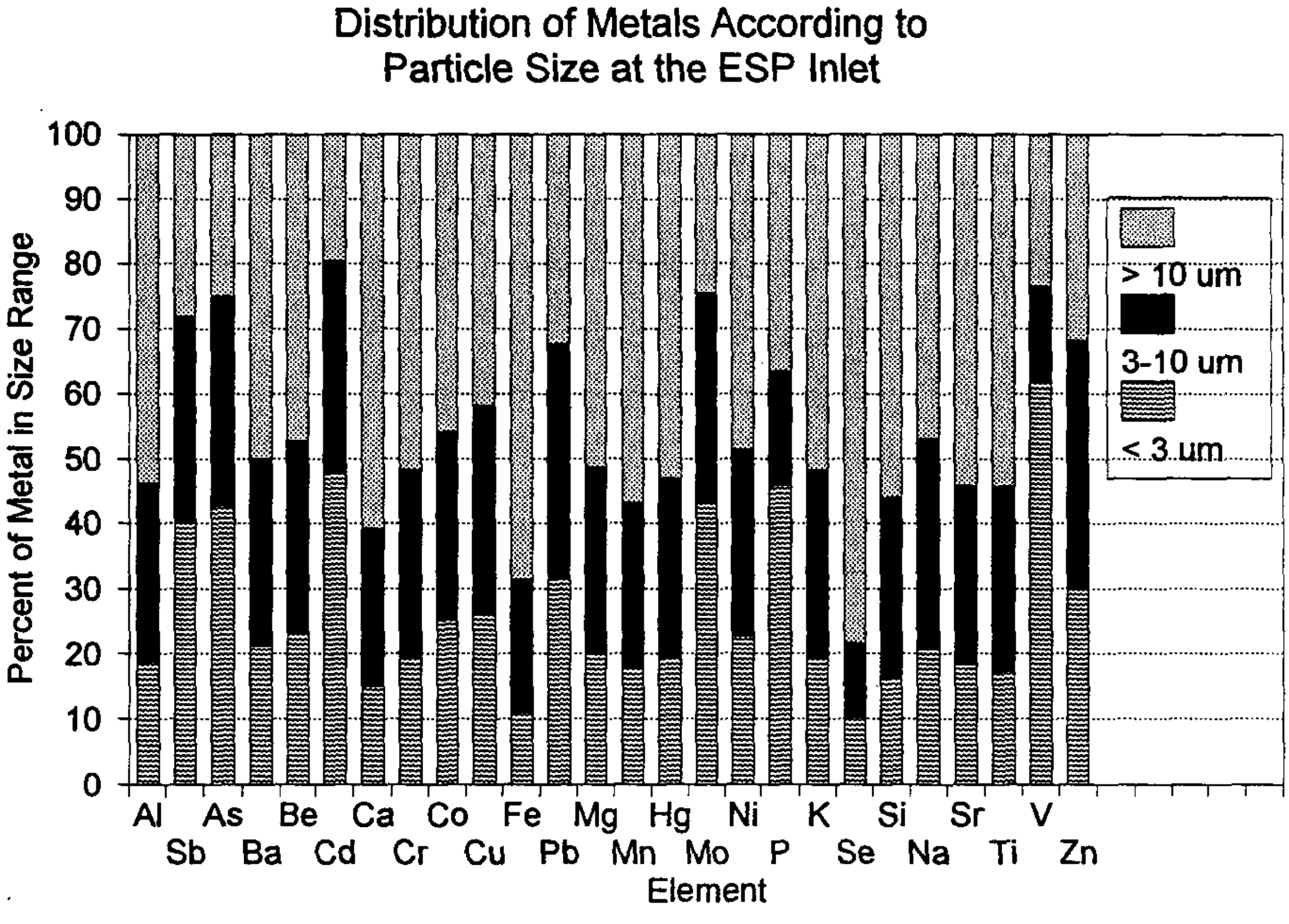


Figure 8-9
Distribution of Metals According to Particle Size at the ESP Inlet

Table 8-2
Comparison of Predicted and Measured ESP Performance

	Predicted	Measured
Collection Efficiency	98.4	98.4
Outlet Size Distribution		
Mass Median Diameter, μm	3.9	4.1
Standard Deviation	3.3	3.1
Opacity	19%	16%

to the ESP. As can be seen, as much as 50 to 70% of all particles are associated with very large particles (i.e., >10 μm).

Figure 8-10 is a similar plot of the distribution of the metals measured at the outlet. At the outlet, the highest concentration of mass is in the finest particles (i.e., <3 μm). This is due to the fact that the efficiency of the ESP drops off slightly as a function of particle size as shown in Figure 8-8.

Four Metals with Higher Penetration than the Average

There are four metals that have penetration values at least twice that of the overall average penetration. The increased penetration in arsenic (3.96%), cadmium (4.46%), and phosphorus (4.83%) [and mercury if substitution of sluiced ash concentration for the ESP inlet is used (10.98%)] are relatively small and could be due to either the low concentrations for arsenic and cadmium, or they could be due to the fact that they might be associated with the submicron particles. Both the measured and the predicted penetration of submicron particles was on the order of 6% so any increased enrichment of the fine particles for these particles could account for the higher penetration. The measured distribution at the outlet also points to an enrichment of the fine particles for these metals. Figure 8-10 shows that for arsenic, cadmium, and phosphorus, there is a greater percentage of the metal in the finest particles.

Selenium is the one metal which cannot be explained by the performance of the ESP. If all the selenium were associated with the most difficult to collect particles, <1 μm, it would have a maximum penetration of less than 7 percent. However, the measured penetration is greater than 50 percent. In addition, Figure 8-10 shows that nearly 50% of the selenium being emitted is associated with particles greater than 10 μm. This points to an error in sampling and analysis because it would not be physically possible for any particulate-phase material to penetrate the ESP at a rate of 50%, especially very large particles. Previous testing observation indicates that vapor-phase selenium may precipitate on the active sites provided by the filter in the Method 29 train under certain conditions. If this was the case at Plant Yates, the "penetration" could actually be caused by vapor-phase selenium which has been characterized as in the particulate phase.

Table 8-3
ESP Particulate-Phase Metals Collection Efficiency

Metal	ESP Inlet μg/Nm³	ESP Inlet lbs/hr	ESP Outlet μg/Nm³	ESP Outlet lbs/hr	Efficiency (%)	Penetration (%)
Aluminum	870,000	926	12,100	12.9	98.60	1.40
Antimony	33	0.035	0.39	0.0004	98.81	1.19
Arsenic	404	0.43	16	0.017	96.04	3.96
Barium	4,440	4.72	74	0.079	99.33	1.67
Beryllium	93	0.10	1.65	0.002	98.23	1.77
Cadmium	24	0.03	1.07	0.001	95.54	4.46
Calcium	161,000	172	1,777	1.9	98.90	1.10
Chromium	2,870	3.05	23	0.024	99.20	0.80
Cobalt	275	0.29	4.45	0.005	98.38	1.62
Copper	768	0.82	16	0.017	97.92	2.08
Iron	808,000	860	8,537	9.1	98.94	1.06
Lead	768	0.82	18	0.019	97.66	2.34
Magnesium	42,100	45	657	0.70	98.44	1.56
Manganese	2,120	2.3	34	0.036	98.39	1.61
Mercury	(1.33)[a]	0.01	0.13	0.0002	90.2	10.98
Molybdenum	315	0.34	8.09	0.009	97.43	2.57
Nickel	2,030	2.16	22	0.023	98.92	1.08
Phosphorus	2,070	2.20	100	0.11	95.17	4.83
Potassium	157,000	167	2,150	2.3	98.63	1.37
Selenium	133	0.14	82	0.087	38.35	61.65
Sodium	45,800	49	803	0.85	98.25	1.75
Strontium	2,906	3.09	43	0.046	98.52	1.48
Titanium	55,100	57	757	0.81	98.63	1.37
Vanadium	2,761	2.9	54	0.057	98.04	1.96

[a] As discussed in Sections 6 and 7, the mercury concentration ESP inlet particulate sample appears to be high. The mercury concentration from the sluiced ash sample has been substituted here.

Notes:

1. Average inlet flow rate = 284,000 dscfm.
2. Average outlet flow rate = 284,000 dscfm.

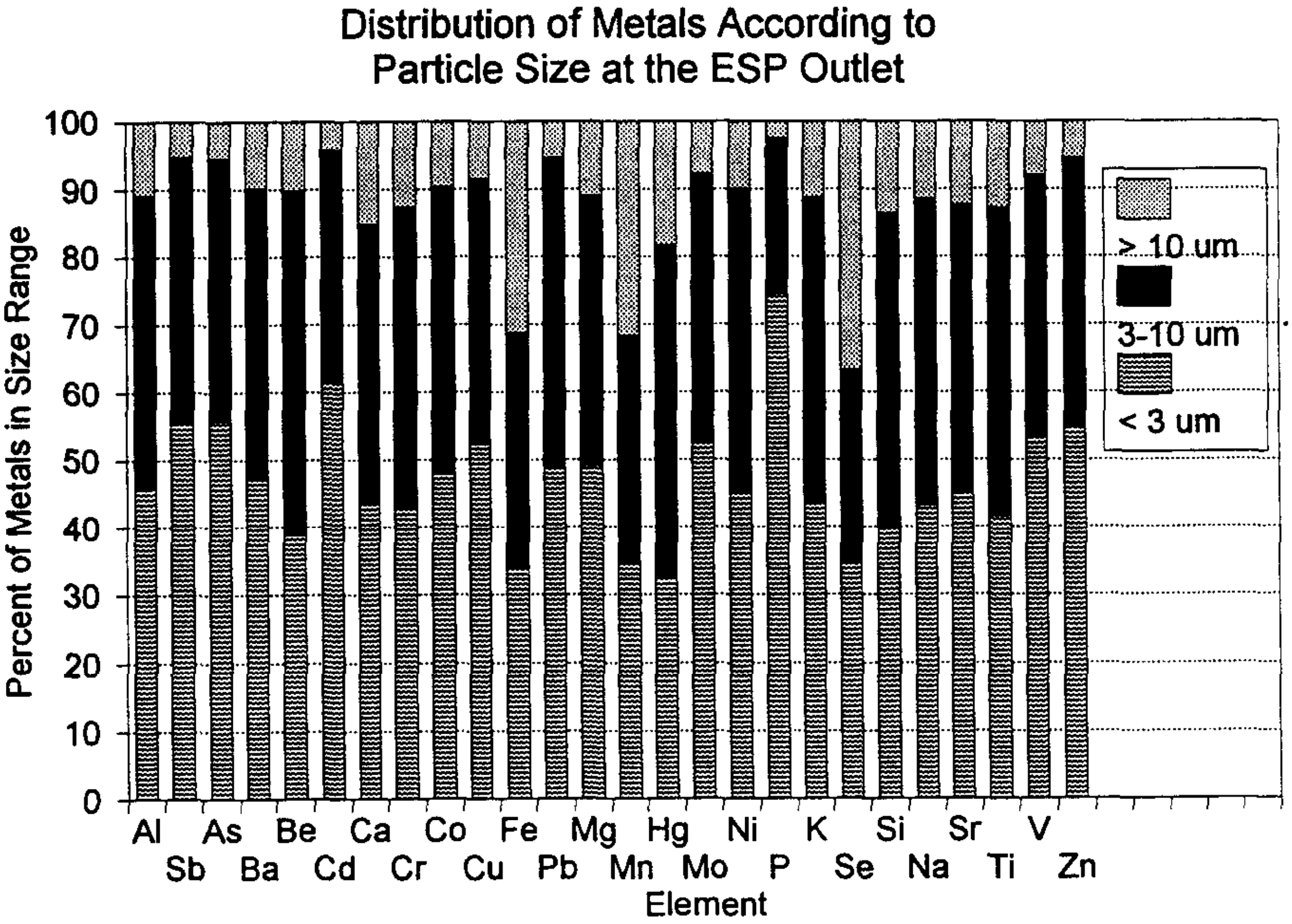


Figure 8-10
Distribution of Metals According to particle Size at the ESP Outlet

Further confusing this issue is the fact that particulate selenium also showed up on particles collected in the cyclones. The flow in the cyclones does not provide the intimate contact between the gas and collected particles that the filter does. However, it does appear that whatever phase shift occurring in Method 29 for selenium is also occurring in the cyclones.

Hopper Distribution

The concentrations of the metals in the hopper ash were also analyzed to determine if any insight could be obtained from this information relative to the performance of the ESP and HAPs. It has been hypothesized that if the metals were concentrated in the finer particles, which are more difficult to collect, then the downstream hopper might have a higher concentration of metals. The concentrations of metals in the particulate collected in the second hopper were divided by the concentrations from the first hopper to verify this hypothesis.

These data are plotted in Figure 8-11. As shown, the metals are distributed about a ratio of 1 with most metals increasing in the downstream hopper (ratio greater than 1). This supports the hypothesis of metals concentrating in the finer particles.

Another way to visualize the interplay between elemental concentration as a function of particle size and elemental enrichment produced by the ESP is to present concentration and enrichment together. Figure 8-12 does this. The vertical scale is enrichment of elements in the particulate material from the ESP inlet to the ESP outlet. The horizontal scale is the ratio of fine particle concentration to coarse particle concentration at the ESP inlet. Note that selenium has been left off the figure. Selenium's coordinates are (0.7, 12.09) which puts it in the far upper left corner of the plot. This implies that selenium is enriched in the ESP outlet particulate but not in the fine fraction of the ESP inlet ash. This result is probably biased by vapor-phase selenium precipitating or reacting on the Method 29 filter as previously discussed. However, the lower selenium concentration in the finer fractions of the ESP inlet ash was also unexpected given the volatile nature of selenium.

The figure shows, with the exception of selenium, a relatively smooth relationship between the two ratios. The plot demonstrates the concept that the elements, which at the ESP inlet have higher concentrations in fine particles than in coarse particles, becomes enriched at the ESP outlet in comparison with the ESP inlet.

Table 8-4 shows enrichment of inorganic elements in the different ash streams at Plant Yates. The factors were determined by dividing the concentration of an element in an ash stream by the coal ash concentration (concentration of an element in the coal divided by the ash fraction). These data generally show the trends expected with the more volatile elements exhibiting greater enrichment ratios in the ESP outlet than in the ESP inlet. (Chloride and fluoride show very little enrichment in the ash streams since the large majority of these elements are in the vapor phase.)

Of particular note is that most elements have significantly lower enrichment ratios in the stack particulate matter than in the ESP outlet ash. Using the major species' (aluminum,

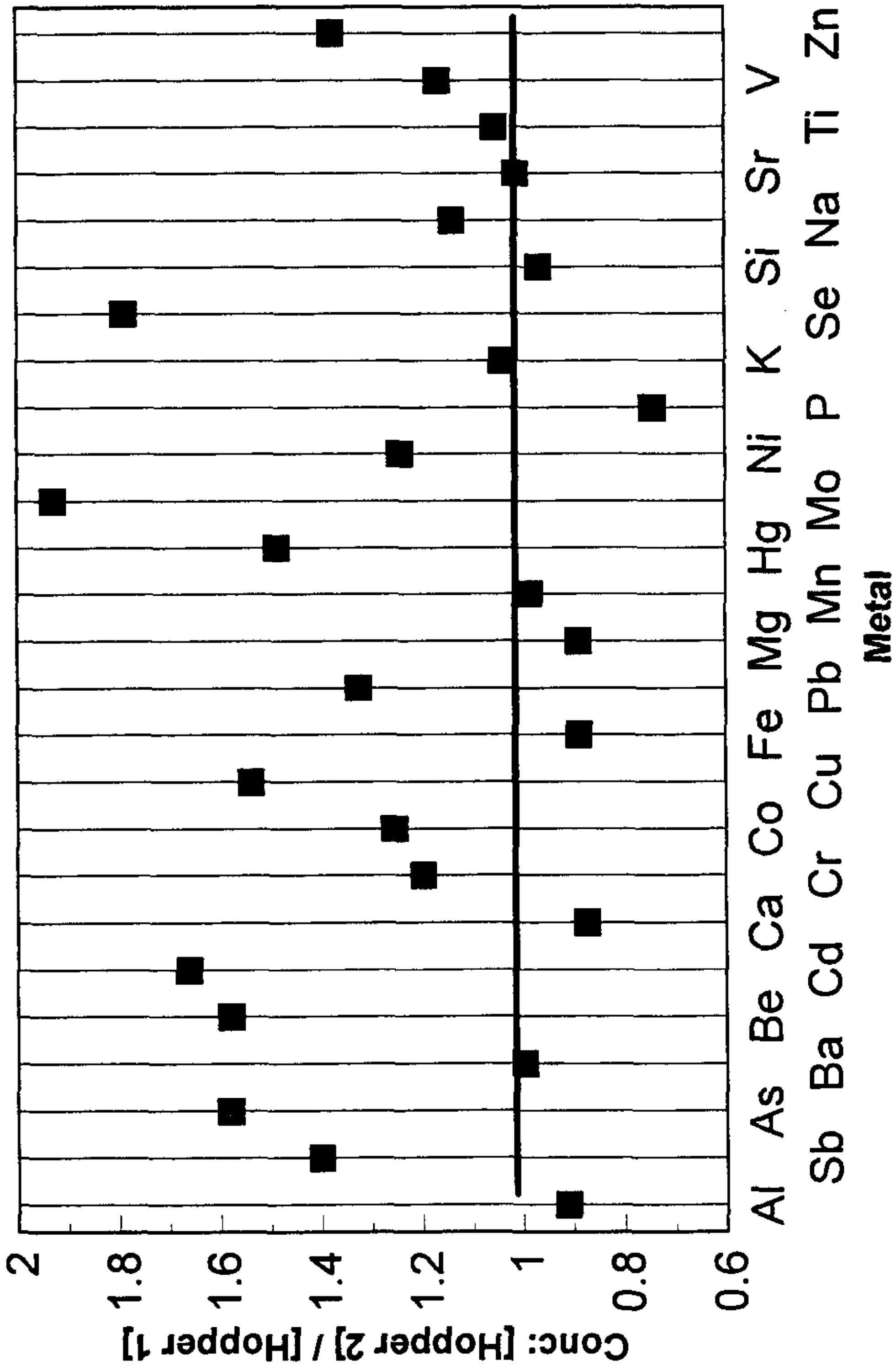


Figure 8-11
Total Metals Collection in Hopper

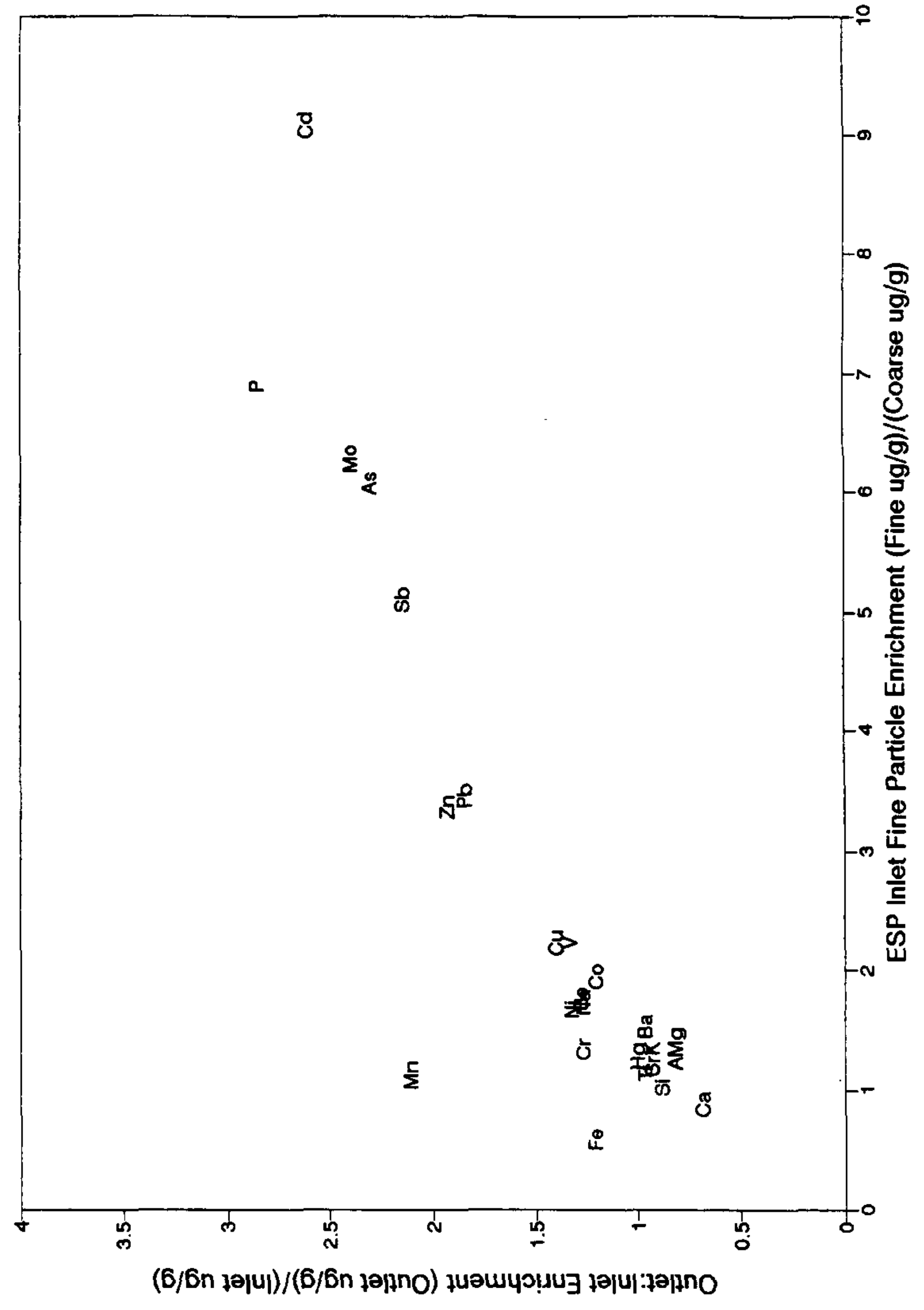


Figure 8-12
Elemental Relationship Between Outlet/Inlet Enrichment and Fine/Coarse Enrichment

Table 8-4
Enrichment of Streams in Inorganic Elements

Element	Coal Ash [a]	Bottom Ash		ESP Inlet Ash		Sluiced Ash		ESP Outlet Ash		Stack Particulate Matter	
	(µg/g)	(µg/g)	Enrichment	(µg/g)	Enrichment	µg/g	Enrichment	(µg/g)	Enrichment	(µg/g)	Enrichment
Aluminum	130,000	76,000	0.58	97,000	0.74	98,000	0.75	100,000	0.77	13,000	0.10
Antimony	5.50	1.1	0.21	3.6	0.66	3.4	0.62	2.7	0.50	3.8	0.69
Arsenic[b]	21.0	7.2	0.34	45	2.14	61	2.89	120	5.57	81	3.86
Barium	720	460	0.63	490	0.69	500	0.69	620	0.86	210	0.30
Beryllium	9.91	7.7	0.77	10	1.05	11	1.12	14	1.41	3	0.30
Boron	900	280	0.31	N/A	N/A	470	0.53	N/A	N/A	N/A	N/A
Cadmium[b]	2.7	0.32	0.12	2.7	0.99	4.1	1.52	8.9	3.30	41	15.17
Calcium	19,000	20,000	1.05	18,000	0.94	14,000	0.71	15,000	0.77	19,000	0.97
Chloride[c]	11,200	130	0.01	680	0.06	50[d]	0.00	317	0.03	15,000	1.34
Chromium[b]	223	190	0.86	320	1.42	190	0.83	190	0.86	330	1.47
Cobalt	31.6	32	1.00	31	0.98	37	1.17	37	1.17	19	0.59
Copper[b]	330	77	0.24	86	0.26	100	0.32	120	0.36	56	0.17
Fluoride[c]	901	32	0.03	0.15	0.00	99	0.11	0.85	0.00	3.5	0.00
Iron	100,000	130,000	1.27	91,000	0.88	84,000	0.82	61,000	0.59	12,000	0.11
Lead[b]	72	20	0.28	79	1.10	83	1.15	150	2.12	36	0.50
Magnesium	5,100	3,600	0.71	4,700	0.92	4,900	0.96	5,500	1.07	2,800	0.55
Manganese	210	270	1.28	240	1.12	250	1.16	240	1.15	490	2.31
Mercury[c]	0.72	0.01[d]	0.01	0.79	1.10	0.15	0.20	0.9	1.25	0.57	0.79
Molybdenum[b]	200	3.0[d]	0.01	35	0.17	7.2[d]	0.04	58	0.29	73	0.36
Nickel[b]	270	130	0.48	230	0.84	140	0.53	160	0.58	2,500	9.28
Phosphorus	760	400	0.52	230	0.30	68	0.09	830	1.09	110	0.14
Potassium	30,000	14,000	0.48	17,000	0.59	18,000	0.61	18,000	0.60	2,900	0.10
Selenium[c]	21	0.57[d]	0.03	15	0.71	12	0.57	570	27.35	3,500	166.50
Sodium	5,700	3,600	0.64	5,100	0.90	5,100	0.89	6,700	1.18	1,900	0.34
Strontium	670	280	0.41	320	0.48	320	0.48	360	0.53	110	0.16
Titanium	8,100	5,600	0.69	6,100	0.76	6,300	0.79	5,400	0.67	910	0.11
Vanadium	350	280	0.78	310	0.87	330	0.92	380	1.07	110	0.32
Sulfate		1,590		8,900			3,450	30,000		410,000	

[a] Coal ash concentrations were calculated by using coal concentrations and dividing by the coal ash fraction.

[b] Denotes an element that is vaporized in the boiler and then condenses and may become enriched on fine particles. Cr & Ni do not always show enrichment.

[c] Denotes an element that is vaporized and can remain in the vapor phase. Selenium can either be enriched in the fine particles or be in the gas phase.

[d] The measured concentrations were below detection limit. Numbers shown are half of the detection limit.

iron, magnesium, potassium, sodium, and titanium) concentrations, it appears that only about 25% of the mass in the stack particulate was fly ash. The bulk of the mass (about 65%) can be attributed to sulfuric acid mist (based on the large increase in sulfate), while gypsum carryover accounts for about 5% and liquid chloride carryover accounts for about 3 percent. Note that these results indicate a flue gas SO_3 concentration of 1-2 ppm, which is in the same low range as that measured in the flue gas in the ESP (0.3 ppm).

Elements that show enrichment in the stack particulate matter (other than calcium [from gypsum] and chloride) are selenium, nickel, manganese, chromium, and cadmium. Problems with selenium have been discussed in this section. The nickel and chromium concentrations in the stack include one high concentration which does not appear to be consistent with other ash numbers. Their enrichment ratios become much more reasonable when these values are excluded. The reason for the apparent high manganese and cadmium enrichments is not known.

References

1. M. Durham, S. Tegtmeyer, K. Yasmundt, and L. Sparks. "A Microcomputer-Based Cascade-Impactor Data-Reduction System," Third Symposium on the Transfer and Utilization of Particulate Control Technology. EPA-600/9-82-005d, 285 (July 1982).

2. R.E. Bickelhaupt and J.E. Sparks. "An Improved Model for Predicting Fly Ash Resistivity." Proceedings: EPA/EPRI Sixth Symposium on the Transfer and Utilization of Particulate Control Technology, EPRI CS-4918, p. 11-1 (November 1986).

3. R.E. Bickelhaupt. "Fly Ash Resistivity Precision Improvement with Emphasis on Sulfur Trioxide." EPA-600/7-86-010, NTIS PB 86-178126 (1986).

4. D.B. Holstein, D.E. Rugg, and M.D. Durham. "Development of an ESP Model for Dry Scrubbing Applications." EPRI Ninth Particulate Control Symposium, Williamsburg, VA (1991).

9

MERCURY METHODS COMPARISON AND SPECIATION DETERMINATIONS

This section compares the results of two different methods used to determine the concentrations of total mercury and its various chemical forms in the flue gas streams. The objectives of the mercury sampling were to determine total mercury concentration and individual mercury species concentrations at each of the three flue gas sampling locations. These results will provide information on the emissions and control of mercury. In addition, the speciation results can be used to more accurately assess the possible health risks associated with mercury emissions.

Two different methods were used to measure mercury concentrations in the flue gas. The Bloom mercury speciation train[1] was used to measure the concentrations of individual vapor-phase mercury species: ionic mercury and elemental mercury. Total mercury, including both particulate and vapor phases, was measured using the proposed EPA Method 29 multi-metals train. Although the Method 29 multi-metals train was designed to measure total concentrations of metals and not to provide speciation information, it may still provide some insight into the vapor-phase mercury species present.

Sample Collection and Analysis

This subsection describes the sampling and analytical methods used to measure mercury concentrations. The methods are described in detail in Appendix B, but the important features are discussed here. In addition, the sample collection schedule is presented.

Methods and Conditions

Bloom Speciation Train. The Bloom mercury speciation train was used to collect samples at the ESP inlet, the ESP outlet, and the stack. A quartz-lined probe was inserted into each duct, and flue gas was extracted non-isokinetically at a single point. The flue gas then passed through a series of four solid adsorbent cartridges which were used to trap the various vapor-phase mercury species. The cartridges were maintained at approximately 110°C in a heated jacket outside the duct. The first two cartridges contained KCl-impregnated soda lime, which is designed to capture ionic mercury species (Hg^{+2} and Hg^{+}). The third and fourth cartridges contained iodated carbon, which is designed to capture elemental mercury. A glass wool plug ahead of the adsorbent cartridges prevented particulate from entering the adsorbents. This plug was not analyzed, because the single-point, nonisokinetic sampling does not provide representative particulate capture. Only vapor-phase species were determined.

The KCl/soda lime traps were dissolved in acetic acid solutions. Ionic mercury was determined by aqueous-phase ethylation, purging onto a carbotrap, cryogenic GC separation, and detection with cold vapor atomic fluorescence spectrometry (CVAFS). This method was used to quantify methyl mercury (MMHg), as methylethyl mercury, however this technique was discovered to produce artifacts (see letter from Frontier Geosciences at the end of this section) due to a reaction during the dissolution of the KCl/soda lime traps. All data for methyl mercury derived using this method is considered in error and has been disregarded. Inorganic ionic mercury (Hg^{+2}) was determined as diethyl mercury. Elemental mercury on iodated carbon traps was determined by digesting with a mixture of HNO_3/H_2SO_4 and BrCl, reducing with $SnCl_2$, purging and preconcentrating on gold, and detecting with CVAFS.

Several QA/QC procedures were used for the Bloom train. Field blanks were collected at each of the three sampling locations to assess the effects of contamination. A trip blank was also analyzed. Laboratory spikes were performed for each type of mercury species to assess analytical efficiency. In addition, the CVAFS instrument was calibrated using certified standards.

Method 29 Multi-Metals Train. The multi-metals trains were used to collect samples at the ESP inlet, the ESP outlet, and the stack. The trains used at the ESP outlet and stack were Method 5 trains, with particulate collected on a quartz filter maintained at constant temperature (approximately 250°F) outside of the duct. Because of the high particulate concentrations at the ESP inlet, a Method 17 train was used, with particulate collected in an in-situ quartz thimble. At all three locations, samples were collected isokinetically while traversing the duct according to Method 1.

The impinger trains, used to collect vapor-phase metals, were identically configured at each location. The first and second impingers contained a 5% HNO_3/10% H_2O_2 solution. The third impinger was empty, to prevent any mist carryover. The fourth and fifth impingers contained a 10% H_2SO_4/4% $KMnO_4$ solution.

Particulate samples were microwave-digested in HF/aqua regia solutions and analyzed for all target metals. Mercury concentrations were determined using cold vapor atomic absorption spectrometry (CVAAS). The HNO_3/H_2O_2 solutions were also analyzed for all target metals, with the mercury determined by CVAAS. The $H_2SO_4/KMnO_4$ solutions were analyzed only for mercury using CVAAS.

The multi-metals train may provide information on mercury speciation. Ionic forms of mercury are water-soluble and should be readily captured in the HNO_3/H_2O_2 solution. Elemental mercury, on the other hand, should pass through the HNO_3/H_2O_2 impingers, because the solubility of elemental mercury in aqueous solutions is very low and the H_2O_2 cannot efficiently oxidize it. The elemental mercury will be oxidized and captured in the $H_2SO_4/KMnO_4$ impingers.

Several QA/QC procedures were followed for the multi-metals trains. Field blanks, reagent blanks, and method blanks were analyzed to assess the effects of contamination. Matrix-spiked and matrix-spiked duplicate samples were analyzed to assess recovery and precision.

The CVAAS instruments were calibrated using certified standards, and calibration checks were routinely performed.

Samples Collected

Figure 3-2 shows the collection schedule for the Bloom train and multi-metals train samples. Three samples were collected for each train type at each of the three sampling locations. Gas sample volumes were approximately 0.1 Nm^3 for the Bloom train and 3 Nm^3 for the multi-metals train. Field data sheet summaries are included in Appendix C.

Data Analysis

Table 9-1 shows the mercury concentrations measured with the Bloom train and the Method 29 multi-metals train. The total vapor-phase mercury concentrations measured using the two techniques are in good agreement. Using the mean multi-metals train results, it appears that approximately 99% of the particulate-phase mercury is removed by the ESP, and the removal of total mercury by the scrubber is approximately 46%.

The speciation results from the two methods show similar trends. Ionic mercury is the predominant species in the ESP inlet and ESP outlet gas streams, but the ionic mercury is more efficiently removed by the scrubber, as shown by its markedly lower concentrations at the stack. The removal of ionic mercury by the scrubber can be attributed to a higher solubility in water as compared to elemental mercury.

While the overall trends in the two methods are similar, the detailed speciation results do not appear equivalent. In particular, the levels of elemental mercury measured by the two techniques do not agree well at any of the three locations, and the agreement is poor between the two techniques for ionic mercury concentrations at the stack.

Table 9-2 shows the mercury concentrations found in the blank samples and their significance relative to the actual sample concentrations. Blank contamination does not appear to be significant. Table 9-3 summarized the spike recoveries for the two techniques. All of the recoveries were within the acceptable range of 75 to 125 percent.

While the QA/QC results for the two techniques indicate acceptable quality, they only address the issues of contamination and analytical accuracy. The issue of species conversion during sampling has not been addressed. Therefore, while each method can be considered to give reliable results for the total concentration of vapor-phase mercury, less confidence can be placed in the speciation results. The possibility of conversion of one species to another within the sampling equipment or in the sampling media make it less certain that the species were actually present in the flue gas at the measured levels.

Table 9-1
Mercury Concentrations in Flue Gas

		Concentrations, $\mu g/Nm^3$					
Location	**Component**	**Run 1**	**Run 2**	**Run 3**	**Mean**	**95% CI**	**% of Vapor**
Bloom Hg Speciation Train[a]							
ESP Inlet	Ionic Hg	4.5	3.8	5.0	4.4	1.5	69
	Elemental Hg	2.4	2.4	1.2	2.0	1.7	31
	Total Vapor	6.9	6.2	6.2	6.4	1.0	--
ESP Outlet	Ionic Hg	5.8	4.6	4.0	4.8	2.3	66
	Elemental Hg	2.5	2.6	2.4	2.5	0.2	34
	Total Vapor	8.3	7.2	6.4	7.3	2.4	--
Stack	Ionic Hg	0.38	0.51	0.63	0.47	0.33	15
	Elemental Hg	3.0	3.1	2.3	2.8	1.1	85
	Total Vapor	3.4	3.6	2.9	3.3	0.9	--
Method 29 Multi-Metals Train							
ESP Inlet	Ionic Hg[b]	4.6	4.9	5.7	5.1	1.5	94
	Elemental Hg[c]	0.51	0.31	0.23	0.35	0.36	6
	Total Vapor	5.1	5.3	6.0	5.4	1.2	--
	Solid	5.2	9.6	6.4	7.1	5.6	--
	Total Vapor + Solid	10.3	14.8	12.4	12.5	5.6	--
ESP Outlet	Ionic Hg	4.8	4.1	4.9	4.6	1.1	82
	Elemental Hg	1.2	1.1	0.65	0.98	0.73	18
	Total Vapor	6.0	5.2	5.5	5.6	1.1	--
	Solid	0.11	0.12	0.14	0.13	0.04	--
	Total Vapor + Solid	6.1	5.3	5.7	5.7	1.1	--
Stack	Ionic Hg	1.1	1.5	1.9	1.5	0.9	50
	Elemental Hg	1.8	1.6	1.2	1.5	0.7	50
	Total Vapor	2.9	3.1	3.1	3.0	0.3	--
	Solid	<0.0050	0.0116	<0.0051	0.0056	0.013	--
	Total Vapor + Solid	2.9	3.1	3.1	3.0	0.3	--

[a] Although MMHg values were originally reported by Frontier Geosciences, a letter from Frontier Geosciences was issued on January 26, 1994 stating, in part, "... we now know that the MMHg we were measuring and reporting is due to an artifact. [this method] ... overestimates the amount of MMHg. The MMHg fraction should tentatively be considered as part of the Hg(II) fraction of the total Hg in flue gas until our ongoing investigations are completed." These investigations are still in progress and, until they are completed, the presence or absence of MMHg in the flue gas cannot be confirmed.

[b] Mercury collected in the HNO_3/H_2O_2 impingers.

[c] Mercury collected in the $H_2SO_4/KMnO_4$ impingers.

Table 9-2
Summary of Blank Results

Blank Sample Type	No. of Blanks	Range of Blank Levels	Max Contribution to Samples[a]
Bloom Train			
Ionic Hg			
Field Blanks	6	0.3-0.6 ng	4%
Trip Blanks	2	0.5-0.8 ng	4%
Elemental Hg			
Field Blanks	6	1.3-4.6 ng	4%
Trip Blanks	2	1.1-3.7 ng	3%
Method 29 Multi-Metals Train			
HNO_3/H_2O_2 Impingers			
Field Blanks	3	<0.24 µg/L	<5%
Reagent Blanks	1	<0.24 µg/L	<5%
$H_2SO_4/KMnO_4$ Impingers			
Field Blanks	3	<0.24 µg/L	<28%
Reagent Blanks	1	<0.24 µg/L	<28%

[a] Maximum blank value as a percentage of the minimum sample result.

Table 9-3
Summary of Spike and Audit Sample Recoveries

Sample Type	No. of Samples	Range of Recoveries
Bloom Train		
Ionic Hg	2	102 - 103%
Elemental Hg	2	100 - 102%
Method 29 Multi-Metals Train		
HNO_3/H_2O_2 Impingers	2	120%
$H_2SO_4/KMnO_4$ Impingers	2	76 - 78%

The Bloom train is a technique that is still being developed.[2] Extensive work has been done to improve the capture efficiency of the traps, to increase the analytical efficiency, and to minimize the chance for species conversion. There are no studies that would conclusively demonstrate the validity of the method, such as the spiking of specific mercury compounds into the flue gas ahead of the sampling train. Therefore, the method can be considered unproven.

There is no published information regarding the ability of the multi-metals train to provide mercury speciation information from utility stack gases. The interpretation of the results thus far relies solely on chemical theory. In addition, the extent of species conversion within the train is unknown.

References

1. Nicolas S. Bloom, Eric M. Prestbo, and Vesna L. Miklavicic, "Fluegas Mercury Emissions and Speciations from Fossil Fuel Combustion." Published in the proceedings of the Second International Conference on Managing Hazardous Air Pollutants (sponsored by the Electric Power Research Institute) Washington, D.C. (July 1993).

2. Ibid.

FRONTIER
GEOSCIENCES
ENVIRONMENTAL RESEARCH CORPORATION
414 Pontius North • Seattle, WA 98109
(206) 622-6960 • fax: (206) 622-6870

January 26, 1994
Eric M. Prestbo and Nicolas S Bloom

Discovery of Methyl Mercury Artifact in the Solid Sorbent Speciation (S ^{3}) method for Coal Combustion Fluegas

We have stated in both reports and presentations (Prestbo and Bloom, 1993, Bloom et al., 1993) that monomethyl mercury (MMHg) can be measured and is found in coal combustion flue gas in the range of 5-15% of the total Hg. Because of very recent experiments we have completed in the laboratory, we now know that the MMHg we were measuring and reporting is due to an artifact. Only through painstaking laboratory work were we able to discover the unusual chemical reactions which produce MMHg in solution. We discovered that Hg(II) and S(IV) collected on the KCl/soda lime sorbent, when digested in 10% acetic acid solution will form MMHg on the high pH surface of the dissolving soda lime. The likely mechanism leading to this can be found (in retrospect) in a paper by Lee and Rochelle (1987). This finding was quite surprising considering that SO_2 is known to be a reducing and not an oxidizing compound. The MMHg forms due to the release of methyl groups during the degradation of acetic acid in conjunction with the oxidation of $SO_3^=$.

What we can state convincingly is that all previous flue gas data generated by our laboratory overestimates the amount of MMHg. The MMHg fraction should tentatively be considered as part of the Hg(II) fraction of the total Hg in fluegas until our ongoing investigations are completed. It should also be clearly stated that although the MMHg values are no longer valid, this is not true for Hg(II), Hg^0 and especially total Hg. Further, please refrain from stating that MMHg is *not* present in fluegas until we have a chance to complete some field site studies using a refined methodology.

We are actively pursuing the problem encountered. Initially we will investigate non-methyl containing solutions (i.e. citric acid) for dissolving KCl/soda lime to avoid the artifact. Secondly, we will use several other means of collecting flue gas, including unique impinger solutions to more conclusively determine the presence or absence of MMHg in combustion flue gas.

As you know, speciation of trace metals, and especially mercury is difficult in any matrix. We regret that previous MMHg fluegas data was in error. We will continue to communicate to you any of our new findings as we have with this one.

Please don 't hesitate to call us if you have any questions or need further clarification on this issue.

References

Bloom N.S., Prestbo E.M. and Miklavcic V.L. (1993) "Fluegas mercury emissions and speciation from fossil fuel combustion", presented at Conference on Managing Air Toxics: State of the Art, Washington D.C. July 13-15 (withdrawn from publication).

Lee Y.J. and Rochelle G.T. (1987) "Oxidative degradation of organic acid conjugated with sulfite oxidation in flue gas desulfurization: products, kinetics, and mechanism", Env. Sci. and Technol., 21:266.

Prestbo E.M. and Bloom N.S. (1993) "Recent advances in the measurement of mercury species in combustion flue gas using solid phase adsorption and cold vapor atomic fluorescence spectroscopy (CVAFS)", Presented at the AWMA 86th Annual Meeting, June 13-18, (93-TA-32.05).

10

HEXAVALENT CHROMIUM DETERMINATIONS

Introduction

The stack gas at Plant Yates was sampled for the presence of hexavalent chromium and total chromium. Hexavalent chromium samples were analyzed on site at Plant Yates in order to provide results as quickly as possible. Radian's experience has shown that hexavalent chromium is unstable and is reduced to trivalent chromium quite rapidly during the first 24 hours after sample collection. Appropriate blanks were analyzed to minimize the possibility that any contamination would go undetected.

Sample Collection and Analysis

Hexavalent chromium samples were collected on June 25, 26, and 27, 1993. Samples were collected and analyzed using EPA's recirculating caustic solution method.[1] This method uses a recirculating probe system that mixes the total gas sample (vapor and particulate) with the caustic impinger solution immediately after the sample nozzle. This provides a high pH environment to minimize the reduction of Cr^{6+}. Analysis was performed on site using an ion chromatograph. However, instrument problems were encountered and no useful data could be obtained.

As a result, the samples were returned to Radian's laboratory in Austin and analyzed for hexavalent chromium as well as total chromium. In addition, QA/QC samples were analyzed as follows:

- One matrix spike;
- One performance audit sample;
- Three field blanks; and
- One trip blank (total chromium only).

Although the hexavalent sample collection method was used as specified in the published method, it should be noted that the collection procedure for obtaining Cr^{6+} samples from a flue gas matrix containing SO_2 has not been validated.

Data Analysis

As shown in Table 10-1, hexavalent chromium and total chromium were nondetectable in the samples collected after appropriate blank correction had been applied.

Table 10-1
Results for Hexavalent Chromium and Total Chromium

Specie	Units	Run 1	Run 2	Run 3	Average
Chromium VI	$\mu g/Nm^3$	<0.18C	<0.19C	<0.20C	<0.190
Total Chromium	$\mu g/Nm^3$	<0.52C	<0.57C	<0.59C	<0.560

C = Data flag; value was blank-corrected below the detection limit.

Experience has shown that measurement of hexavalent chromium can be very difficult in electric utility flue gas. A brief discussion of the technical implications of determination of chromium (VI) in stack gas and, in particular, in combustion sources and utility sources is included here.

The Cr(VI) method depends on the solubility and stability of chromium (VI) in basic aqueous solution. The method calls for the use of a strong base in a solution contained in the impingers and recycled to the probe tip for early gas contact and flushing to the probe walls. The method is theoretically sound but has some limitations when applied to combustion sources in general and utility flue gases specifically.

As mentioned above, Cr(VI) is stable in a strong alkaline solution (pH > ~9). But all combustion gas streams contain large amounts of CO_2 (10-20%), which is an acid gas, and serves to lower the pH of the impinger solution. As a result, the pH may dip lower than desirable during sampling, or the solution must be more alkaline then specified in the method or continually monitored. As a further complication, utility flue gas contains significant levels of SO_2 (100 ppm or more). SO_2 is also an acid gas but is a reductant as well. So the impinger solution designed to absorb Cr(VI) also absorbs CO_2 and SO_2. The result of this is a lowered pH and a solution which contains an oxidant [Cr(VI)] and a reductant (SO_2/HSO_3^-). As the pH falls, the redox couple becomes more favorable, and any Cr(VI) present may be reduced by SO_2/HSO_3^- and not detected as Cr(VI).

References

1. 40 CFR 266, Subpart H, Appendix IX, "Methods Manual for Compliance with the BIF Regulations," Section 3.0, "Sampling and Analytical Methods," Subsection 3.2, "Determination of Hexavalent Chromium Emissions from Stationary Sources (Method Cr^{6+})," 7-1-91 edition.

11

DETERMINATIONS OF TOXICS ON PARTICLE SURFACES

The Clean Air Act Amendments of 1990 (CAAA) require that emissions of hazardous air pollutants (HAPs) from coal-fired power plants be evaluated for potential health risks. The 189 hazardous substances listed in the CAAA include numerous inorganic and organic species that remain volatile under the conditions present in flue gas emission control systems at coal-fired power plants. As the flue gas cools downstream of these control devices and is released into the atmosphere, it is hypothesized that many of these substances condense on the surface of the fine particulate matter not removed by the control device.

Fine-particulate emissions in the respirable size range of less than 10 microns are of particular interest in assessing health risks. The environmental and toxicological impacts resulting from these emissions are typically estimated on a "worst case" basis where the total composition of the emitted particles is considered available to biological and ecological systems. The condensed metal species found predominantly on the surface of fly ash particles are more accessible to the environment than those species trapped in the alumina-silica fly ash matrix. More appropriately, the leachability of these toxic substances and their availability relative to the total composition should be considered when assessing the health risks associated with particulate-borne HAPs.

Radian Corporation, under contract with the United States Department of Energy (DOE Contract No. DE-AC22-92PC90367), is conducting a separate test program to collect and analyze size-fractionated stack gas particulate samples for numerous inorganic HAPs. Specific goals of the program include collecting gram quantities of size-fractionated stack gas particulate matter (after a wet scrubber) and determining the relationship between particle size, bulk composition, and extractable (surface-leachable) composition.

At Plant Yates, extractable metal concentrations were determined on bulk, rather than size-fractionated samples of flue gas particulate matter. But in addition to sampling the gas from the JBR-FGD system, samples were also collected from the ESP inlet and outlet. From the data collected, the relationship between extractable metal emissions from both wet and dry particulate control devices is possible.

This section compares the analytical results for bulk composition and surface leachability of metals in flue gas particulate samples collected from the inlet and outlet of the ESP and from the outlet of the JBR-FGD system. Metal concentrations are reported for arsenic, barium, beryllium, cadmium, chromium, copper, cobalt, lead, manganese, molybdenum, nickel, selenium, and vanadium.

Sample Collection and Analysis

The difficulty in characterizing surface species is that there are currently no standard, certified methods documented for determining the leachability of metals from the surface of micron-sized particles. In a previous study, several leaching agents and analytical techniques were applied to standard reference fly ash samples for evaluation; three were selected for use on the entrained fly ash samples collected during this project. The techniques selected for characterizing surface availability involve acid leaching and digestion of the particulate samples followed by inductively coupled plasma-mass spectrometry (ICP-MS) analysis. For comparison, the total composition was derived from the metals analysis of the size-fractionated particulate matter at the ESP inlet and outlet, and from the analysis of the stack gas multi-metals train filter samples.

Sample Collection

Sample collection at the ESP inlet was performed according to EPA Reference Method 17[1] (in-stack filtration). Quartz-fiber thimble filters were specified to handle the high particulate mass loading encountered upstream of the ESP and to reduce the background levels of trace elements associated with glass-fiber filters. To avoid introducing filter media into the sample and providing blank analyses for background corrections, sample material was recovered directly from the thimble filters and prepared for analysis.

EPA Reference Method 5[2] was used to collect particulate matter from the ESP outlet and stack gas streams. Quartz-fiber filters were also specified; however, due to mis-identification, glass-fiber filters were inadvertently used on all extractable metals test runs at the ESP outlet and on Runs 1 and 3 at the stack location. Enough sample mass was collected on the ESP outlet filters to permit ash sample separation from the filter media; however, the small sample mass collected on the stack gas filters precluded this separation.

Sample Preparation and Analysis

Sample material recovered from the filters was split in 0.1 gram portions and prepared by the techniques described in Figure 11-1. Stack gas filters were split into three roughly equal fractions and weighed to determine each segment's percentage of the total filter mass. The particulate sample mass on each fraction was determined by multiplying this percentage by the filter weight gain representing the total sample mass. Uniform distribution of the sample mass and the mass of the filter media is assumed. Glass-fiber filter blanks were not prepared for analysis; however, a blank quartz-fiber filter was prepared and analyzed to assess the background levels of extractable metals specific to the quartz-fiber media.

An overview of the sample preparation and analysis techniques selected for the size-fractionated particulate samples is presented in Figure 11-1. Analysis of nitric acid digestates was used to represent the highest degree of surface availability for metals not bound in the alumina-silica fly ash matrix. A simulated gastric fluid and an acetic acid buffer solution were selected to extract metals representative of ingestion and ground water leaching mechanisms, respectively. ICP-MS was selected as the analytical technique over atomic

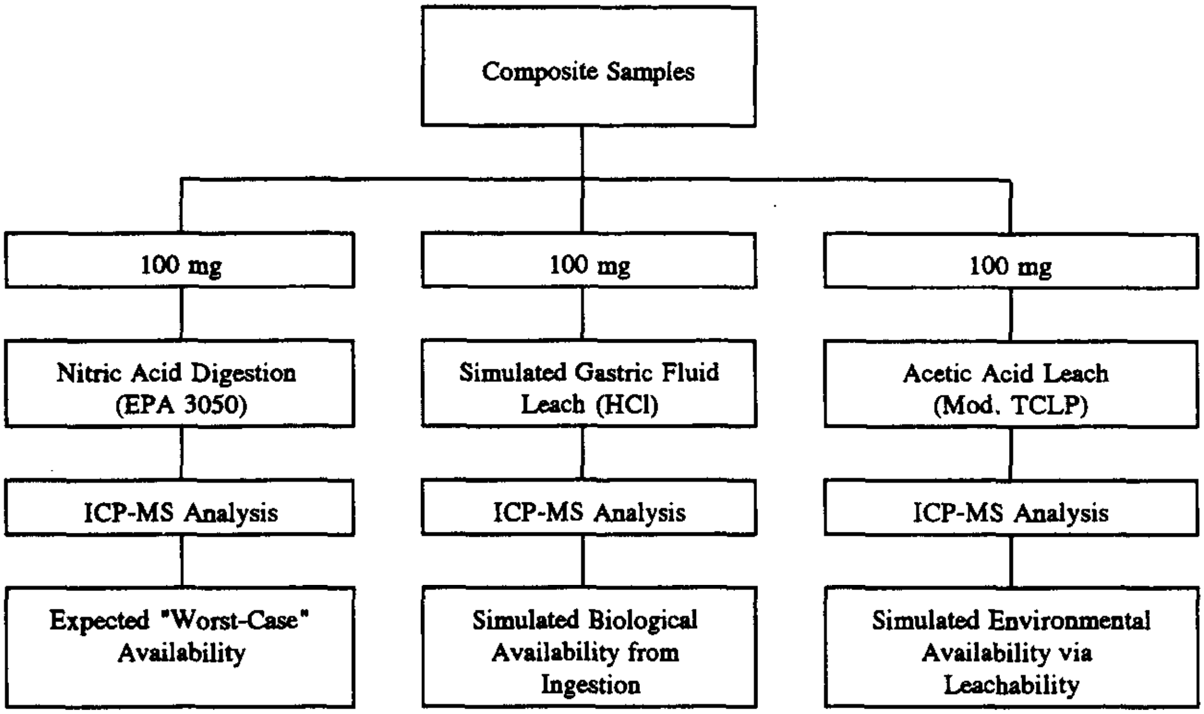


Figure 11-1
Gas Particulate Sample Preparation and Analysis Plan for Extractable Metals

emission and graphite furnace-atomic absorption spectrophotometry since these spectrophotometric techniques failed to provide the sensitivity required to accurately detect the target elements in the low concentration ranges expected.

Total Composition. Total composition analyses were performed on both the size-fractionated particulate samples, and on the filtered particulate matter collected with the multi-metals sampling train. Reported sample results were generated by ICP-AES and GFAA analyses in most cases; ICP-MS results were selected where elemental concentrations were below ICP-AES and GFAA detection limits. High background corrections, attributed to the inadvertent use of glass-fiber filters in some of the multi-metals trains invalidated many trace element results.

Therefore, the total composition of the fly ash collected from the ESP inlet and outlet ducts is represented by a composite of the size-fractionated particulate results. This substitution provided triplicate values for determining the average bulk composition for all trace elements. The resulting averages were biased universally low in these cases, so composition data from the multi-metals trains was not used. The exception is at the stack where two of the three filters used in the multi-metals train were quartz fiber, and no other metals composition data were available. The mass collected in each size fraction was determined relative to the sum, and then factored into the sum of the trace element concentrations. As a confirmation of the validity of this approach, the relative percent difference between the calculated values and the results obtained for fly ash collected from quartz-fiber filters was less than 30% for all elements except antimony, and selenium.

Nitric Acid Digestion. The strongest, most aggressive sample leaching technique performed on each particulate sample was a nitric acid digestion using EPA Method 3050. This procedure refluxes the sample in concentrated nitric acid and hydrogen peroxide. Metals present on the surface of the particle and those that may be loosely bound in the particle's matrix are digested. This technique does not totally digest the alumina-silica ash matrix and therefore may not account for some metals detected by total composition techniques.

All particulate samples were prepared by this method. Samples were digested, filtered through a 0.45 micron nitrocellulose membrane filter, and brought to a 100 mL final volume. Prior to analysis by ICP-MS, 1:20 dilutions were made to bring the sample into the linear range of the mass detector. To assess potential matrix interferences, one of the samples was selected as the source for a matrix spike. The sample selected was split to provide a sample for spiking, and the remaining sample was identified for duplicate analysis. The spike was prepared using a SPEX® multi-element ICP-MS calibration solution. Spike levels in the analyzed digestate were 50 ppb for all elements except molybdenum, which was not present in the calibration solution. This spiking level was based on previous results obtained from this procedure applied to standard reference fly ash samples.

Simulated Gastric Fluid Leach. Simulated gastric fluid is a solution of 85 mM hydrochloric acid, the enzyme pepsin, and sodium chloride. The pH of this solution is approximately 1.2. The leachability of metals in this matrix has a toxicological implication since some fly ash particles trapped in the mucous lining of the upper respiratory tract may be swallowed.

The dissolution of fly ash in gastric fluid represents a likely ingestion mechanism for toxic metals into the body.

Particulate samples were placed in a covered beaker with 10 mL of the gastric fluid solution and stirred mechanically for a minimum of 18 hours at room temperature. Using the same recovery procedure as the nitric acid digestates, the leachate was filtered and brought to a 100 mL final volume with DI water. Undiluted aliquots were analyzed by ICP-MS. In addition, a matrix spike was prepared, and the sample selected for spiking was identified for duplicate analysis. Gastric fluid matrix spikes were also prepared using the SPEX® ICP-MS calibrating solution and were prepared at 69 ppb for each of the target analytes except molybdenum. This spiking level was based on previous results obtained from this procedure applied to standard reference fly ash samples.

Because chloride ions pose adverse matrix effects for a number of the target elements analyzed by ICP-MS, calibration standards were prepared from the gastric fluid matrix to provide calibration curves with the same potential bias present in the samples. Arsenic is one of the key elements that is susceptible to mass detection interferences. Argon and chlorine, with atomic weights of 39.95 and 35.45, respectively, tend to form the polyatomic $ArCl^+$ ion with a mass of 75.4 amu. The high chloride levels in the gastric fluid, coupled with argon plasma source, generate a signal from $ArCl^+$ that can overwhelm the arsenic signal at 74.9 amu.

Acetic Acid Leach. The weakest of the three leaching solutions is an acetic acid solution prepared according to the EPA's Toxicity Characteristic Leaching Procedure[3] (TCLP). The TCLP is the regulatory standard procedure used to determine the hazardous nature of solid wastes. The protocol requires leaching of the solid waste in a buffered acetic acid solution that is maintained at a pH of 4.93 throughout the test. The metal concentrations determined in the acetic acid leachate are compared to regulatory standards to determine whether the material is classified as hazardous or nonhazardous.

The TCLP is designed for leaching sample quantities much larger than 100 mg, and to scale down the volumes specified in the method to accommodate the small quantity of particulate sample available was impracticable. Alternatively, 100 mg particulate samples were placed in a covered beaker with 10 mL of the buffered acetic acid solution (pH 4.93) and stirred for a minimum of 18 hours at room temperature. During this time, no additional pH adjustments were made to the acetic acid solution. Sample recovery and spiking were performed in the same manner as the gastric fluid leaching. The digestate was filtered and diluted to a 100 mL final volume before analysis by ICP-MS, and the same matrix spike and duplicate analysis scheme was used. The 69 ppb spiking level was also based on previous results obtained from this procedure when applied to standard reference fly ash samples.

Data Analysis

ESP Fly Ash

The extractability of metals from the surface of fly ash and flue gas particulate matter relates to a combination of factors. Metal solubility, particle surface area, surface concentration, or other matrix effects can influence the leachability of metals from particles. Increasing extractability was generally observed along the flue gas path, and the relationship between surface area, particle size, and surface concentration is considered influential.

For example, the analytical results for the various fly ash samples collected around the ESP all indicate differences in metal concentration as a function of particle size. Specifically, that enrichment of many trace elements increases as particle size decreases. This is evident from the evaluation of size-fractionated particulate samples collected from the ESP inlet and outlet flue gas (Section 8.0). An analysis of the fly ash collected from the first and second ESP fields also indicates this relationship between increasing trace element concentration and decreasing particle size. Trace element enrichment was more prominent in particles collected from the second (downstream) ESP field where the mean particle diameter was < 10 microns, compared to 30 microns in the first field.

Since the samples collected for extraction were filtered, and not size-fractionated, the mean particle diameter of the samples is an important consideration. It is reasonable to expect higher extractable concentrations at the ESP outlet compared to the inlet, based solely on the reduction in the mean particle diameter across the ESP. The increased surface area associated with an equivalent sample mass exposes more material to the leaching solutions. Barium and vanadium are two elements whose total fly ash concentrations remained relatively constant across the ESP. But due to the smaller mean particle diameter of the ESP outlet sample, the extractable percentage by nitric acid digestion jumped from 39-59% for barium and from 35-61% for vanadium.

All of the remaining trace elements had higher bulk concentrations in the ESP outlet samples when compared to the ESP inlet. In this case, the increase in concentration and surface area exposure should produce an increase in the extractable percentage. Except for antimony, manganese, molybdenum, and mercury, this was true for all of the trace elements. Arsenic and selenium, when detected, showed little change. Tables 11-1 and 11-2 present the extractable metal concentrations of the ESP inlet and outlet fly ash, respectively. The total trace element concentration derived from size-fractionated particulate results is also presented along with the extractable percentage under each leaching condition.

Surface availability may be estimated from the extractable percentages between elements in samples from the same stream. Elements exhibiting the highest degree of extractability are likely to be surface oriented, unbound in the particle matrix, or in a form readily dissolved by the leaching agent. However, an analytical bias in the results for any given element may also manifest itself as high (or low) extractability.

Table 11-1
Extractable Composition of ESP Inlet Gas Particulate Matter

Trace Elements	Total Composition	Nitric Acid Digestion (EPA SW 3050)		Simulated Gastric Fluid Leach		Acetic Acid Leach (TCLP)	
	(μg/g)	(μg/g)	(% Extracted)	(μg/g)	(% Extracted)	(μg/g)	(% Extracted)
Antimony	3.18	2.68	84.3	0.709	22.3	0.798	25.1
Arsenic	44.8	42.6	95.1	<0.678	<1.5	1.02	2.3
Barium	560	220	39.2	103	18.4	48.1	8.6
Beryllium	11.2	4.11	36.7	1.14	10.2	0.322	2.9
Cadmium	3.45	2.22	64.5	1.82	52.9	1.65	47.9
Chromium	197	29.0	14.7	27.5	14.0	7.37	3.7
Cobalt	36.5	5.03	13.8	1.80	4.9	1.48	4.0
Copper	108	32.1	29.8	9.96	9.2	10.9	10.2
Lead	76.4	39.3	51.4	9.37	12.3	0.205	0.3
Manganese	236	120	51.1	60.0	25.5	51.4	21.8
Molybdenum	28.5	42.9	151	29.3	103	1.45	5.1
Nickel	134	45.1	33.8	10.3	7.7	8.64	6.5
Selenium	8.51	<23.3	<274	<0.884	<10.4	0.221	2.6
Vanadium	421	146	34.6	<0.359	<0.1	1.46	0.3

Table 11-2
Extractable Composition of ESP Outlet Gas Particulate Matter

Trace Elements	Total Composition	Nitric Acid Digestion (EPA SW 3050)		Simulated Gastric Fluid Leach		Acetic Acid Leach (TCLP)	
	(μg/g)	(μg/g)	(% Extracted)	(μg/g)	(% Extracted)	(μg/g)	(% Extracted)
Antimony	6.79	3.21	47.4	0.954	14.1	0.875	12.9
Arsenic	103	98.4	95.4	<0.660	<0.6	3.38	3.3
Barium	540	318	58.8	125	23.2	44.1	8.2
Beryllium	13.7	5.43	39.6	2.72	19.8	0.981	7.1
Cadmium	9.23	9.79	106	5.86	63.5	9.57	104
Chromium	248	64.3	25.9	54.3	21.8	19.5	7.8
Cobalt	44.3	16.9	38.3	5.47	12.3	6.02	13.6
Copper	152	98.5	64.9	33.5	22.1	17.9	11.8
Lead	141	116	82.3	32.9	23.4	1.50	1.1
Manganese	497	165	33.1	46.2	9.3	39.3	7.9
Molybdenum	69.1	72.2	105	61.4	88.9	4.43	6.4
Nickel	177	83.8	47.5	38.4	21.7	22.7	12.8
Selenium	101	<23.3	<23.1	18.1	18.0	4.07	4.0
Vanadium	448	272	60.7	122	27.3	4.68	1.0

Table 11-3 ranks the overall extractability of the target elements from fly ash in order from highest to lowest using the percent extractable results from all three leaching techniques. Elements with matrix spike recovery results outside the data quality objective range of 75-125% are identified, and as stated previously, may bias the relative extractability information.

To assess the accuracy of the extractable concentration data, matrix spikes were performed for each leachate matrix as indicators of analytical bias. A complete table of matrix spike recoveries for each of the leachate matrices is presented in Table D-2 of Appendix D. Based on the poor matrix spike and blank spike recoveries, mercury results were invalidated. QC sample results for arsenic in the gastric fluid leachates illustrate the difficulty of arsenic analysis by ICP-MS in a high chloride matrix. Molybdenum and antimony were not included in the spiking solution. Consequently, no spike recovery information is available for qualifying the accuracy of their results.

In addition to matrix spike recovery results, additional factors influencing the extractability data include bias in the bulk composition results. For example, the extractable concentrations of molybdenum reported for nitric acid and gastric fluid is above 100 percent. This element may indeed be 100% extractable from the particle surfaces or there could be an analytical bias in the total composition.

Stack Gas Particulate Matter

Particulate emissions from the FGD system were also characterized using extractability percentages to relate particle size, surface area, and surface concentration of the target elements. However, there are additional mechanisms to consider with the potential for scrubber mist carryover, (i.e., salts) and the leachability of the gas-borne particulate matter through the wet FGD system. With an average FGD slurry pH of 4.5, the JBR provides a mechanism for leaching some elements from the incoming fly ash. A shift in mean particle diameter is also observed as the larger sized particles are trapped in the scrubber.

Table 11-4 presents the extractable metal concentrations, the trace element concentration derived from multi-metals train results for test Runs 2 and 3 (quartz filters used), and the extractable percentage under each leaching condition. Only the results from extractable metals test Run 2 were selected for reporting the stack concentrations since glass-fiber filters were inadvertently used to collect particulate matter from the stack gas during test Runs 1 and 3. Data for the omitted test runs are reported in the Appendix.

Several metals were detected in the leachates at concentrations higher than the equivalent total composition value. Metals extracted by nitric acid digestion at percentages greater than 120% of the bulk composition include: beryllium, vanadium, lead, copper, arsenic, barium, and cadmium. Extractable percentages greater than 120% by gastric fluid leaching are reported for lead and beryllium. Clearly a bias exists in the analysis of either the stack gas particulate matter collected by the multi-metals train, the single Run 2 sample for extractable metals, or both.

Table 11-3
Extractability of Elements in Fly Ash[a]

Extractability (Highest - Lowest)	Average % Extractable	Average Matrix Spike Recovery	Spike Recovery Range
Molybdenum[c]	76%	Not Available[c]	Not Available[c]
Cadmium	73%	96.2%	107% - 88%
Antimony[c]	34%	Not Available[c]	Not Available[c]
Arsenic[b]	33%	80.5%	123% - 0%[b]
Selenium[b]	30%	117%	138%[b] - 84%
Lead	29%	87.7%	97% - 83%
Barium	26%	89.7%	94% - 85%
Manganese[b]	25%	88.8%	108% - 71%[b]
Copper	25%	98.8%	105% - 92%
Nickel	22%	95.3%	103% - 81%
Beryllium	19%	93.1%	108% - 79%
Vanadium[b]	19%	71.0%[b]	109% - 0%[b]
Chromium	15%	97.6%	106% - 88%
Cobalt	15%	97.7%	100% - 92%

[a] Results consider average extractability of elements from fly ash samples collected from the flue gas at the inlet and outlet of the ESP.

[b] Indicates that the spike recovery result obtained is outside the data quality objective range of 75-125 percent. The ranking of these elements may be biased by analytical results indicating higher or lower extractable percentages.

[c] Antimony and molybdenum were not present in the SPEX® ICP-MS calibration solution used to prepare matrix spikes. No spike recovery information is available to determine the relative accuracy of these results. Consequently, the extractable percentages for these elements could be affected by analytical bias.

Table 11-4
Extractable Composition of Stack Gas Particulate Matter

Trace Elements	Total Composition	Nitric Acid Digestion (EPA SW 3050)		Simulated Gastric Fluid Leach		Acetic Acid Leach (TCLP)	
	(μg/g)	(μg/g)	(% Extracted)	(μg/g)	(% Extracted)	(μg/g)	(% Extracted)
Antimony	31.5	5.78	18.4	3.37	10.7	<0.034	<0.1
Arsenic	81.1	164	202	<2.46	<3.0	<0.497	<0.6
Barium	214	354	165	214	100	17.2	8.0
Beryllium	2.94	10.2	349	4.20	143	2.91	98.9
Cadmium	41.4	67.0	162	12.4	29.9	5.92	14.3
Chromium	329	43.8	13.3	84.7	25.7	36.4	11.1
Cobalt	18.1	<0.899	<5.0	10.9	60.4	7.47	41.3
Copper	55.8	124	222	51.3	91.9	63.8	114
Lead	35.7	90.8	254	65.8	184	20.0	56.1
Manganese	488	328	67.2	349	71.5	470	96.3
Molybdenum	100	51.4	51.4	48.6	48.6	3.45	3.5
Nickel	2509	392	15.6	169	6.7	66.2	2.6
Selenium	899	<86.9	<9.7	140	15.6	61.2	6.8
Vanadium	122	385	315	<1.30	<1.1	<0.185	<0.2

Results for matrix spikes performed on the extractable metals sample collected at the ESP inlet and the multi-metals train samples are presented in Table D-2 of Appendix D. Since no QC activities were performed specific to the extractable metals Run 2 sample, data quality can only be estimated from relevant matrix and analytical spike data. In addition, the selection of only one sample result for comparison provides a high degree of uncertainty with these results.

Elements that were found in the stack gas particulate matter at concentrations greater than the ESP outlet (FGD inlet) gas are: antimony, cadmium, chromium, molybdenum, nickel, and selenium. Lower concentrations are noted for arsenic, barium, beryllium, cobalt, copper, lead, and vanadium. The concentration of manganese remained relatively constant across the FGD system.

The reduction in elemental concentrations, in spite of the reduction in mean particle diameter, across the JBR suggests that some elements may be leached from the fly ash by the FGD slurry. Some dilution of the fly ash by FGD solids low in certain trace elements may also be occurring; however, a comparison between calcium concentrations in the gas particulate-phase samples across the JBR system revealed only a slight, and statistically insignificant, increase in calcium concentration.

A comparison of trace metal concentrations between limestone slurry and JBR slurry filtrates suggests that the slurry is leaching trace elements from the fly ash. Enrichment is observed (in order of highest to lowest enrichment) for cadmium, lead, manganese, copper, selenium, cobalt, arsenic, nickel, vanadium, beryllium, and chromium at concentration factors much greater than the 6 cycles of concentration observed for soluble silica. In addition to these elements enriched in the aqueous phase, molybdenum, selenium, vanadium, and arsenic are enriched in the JBR slurry's solid phase.

This concentration mechanism plays an important part in the study of extractable metals in gas particulate matter downstream of wet scrubbing systems. As a result, particle surface characterizations based on extractability data may not be feasible without a more thorough understanding of the enrichment and carryover mechanisms taking place in the scrubber system.

References

1. 40 CFR 60, Appendix A. *Test Methods*. "Method 17: Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)."

2. 40 CFR 60, Appendix A. *Test Methods*. "Method 5: Determination of Particulate Emissions from Stationary Sources."

3. 55 FR 26986 (Friday, June 29, 1990), "Toxicity Characteristic Leaching Procedure (Method 1311)."

APPENDIX A: QUALITY ASSURANCE AUDITS

The purpose of a quality assurance audit is to provide an objective, independent assessment of a sampling or measurement effort. It ensures that the sampling procedures, data generating, data gathering, and measurement activities produce reliable and useful results. Sometimes inadequacies are identified in the sampling/measurement system and/or the quality control program. In such cases, audits provide the mechanism for implementing corrective action.

A technical systems audit (TSA) is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. It is an assessment of overall effectiveness and represents an objective evaluation of a set of interactive systems with respect to strengths, deficiencies, and potential areas of concern. The audit consists of observations and documentation of all aspects of the measurement effort.

A performance audit is an independent check to evaluate the data produced by a measurement system. Audit standards and test equipment which are traceable to acceptable reference standards are used to assess the performance of each analytical method and/or measurement device (performance audit). Performance audits are designed to provide a quantitative, point-in-time evaluation of the data quality of the sampling and analytical systems being tested. This is accomplished by addressing specific parts of the overall system. Each performance audit addresses two general measurement categories of a project:

- Chemical analysis of samples; and
- Physical measurements supporting the sampling effort.

Audit activities consist of challenging the various measurement systems with standards and test equipment traceable to accepted reference standards. Laboratories conducting the analytical work on a program are given performance audit samples prepared by spiking representative sample matrices with target analytes at representative concentration levels. Results for these audit samples are tabulated and considered in evaluating the analytical performance and data reporting protocols for each laboratory.

For this program, technical system audits and performance audits were conducted of each of the DOE contractors by Research Triangle Institute (RTI) under contract to EPA. For the audits of the Radian activities, reports were prepared and subsequently distributed to Radian through DOE detailing the results of the audits. Copies of the RTI audit reports are presented as attachments to this appendix. The following subsections present the Radian response to RTI's findings.

Technical Systems Audit Results

A technical systems audit was conducted of the sampling and on-site analytical activities for this program on June 23-25, 1993. This audit was conducted by J.B. Flanagan and C.O. Whitaker of RTI. Four findings were discussed in the RTI audit report. Each of these findings and RTI recommendations are discussed in the following paragraphs.

Finding 1

Basis due to long sampling lines from the calibration tanks to the probes and nonlinearity of the continuous monitor (CEM) system may go undetected due to infrequent multi-point calibrations. The CEM system at Plant Yates was not a designated part of the Radian effort for the DOE program and was not a negotiated activity between DOE and Georgia Power. Therefore, Radian has no control over and may not initiate any corrective actions related to, the operation of the CEM at Plant Yates.

Finding 2

Aldehyde measurements were performed in accordance with the method; however, acetone (a possible contaminant) was present in the mobile laboratory as a wash bottle under the hood. One or more of the field blanks for the aldehyde sampling trains showed varying concentrations of acetaldehyde and formaldehyde. However, these analytes were not found in the reagent blanks stored in the mobile laboratory. It is not possible with the data available to rule out possible contamination due to the wash bottle of acetone. The concentrations found in the blanks should be considered in the use of the sample data. This precaution was noted in the project QA/QC summary (see Appendix D).

Finding 3

All plant and sampling times are recorded in Central Daylight Savings Time instead of Eastern Daylight Savings Time. Radian has worked on several other Georgia Power projects and is familiar with their timekeeping procedures. In addition, since the field crew was from one of Radian's offices located in the Central Time Zone, the use of CDT was probably less confusing than working on EDT.

Finding 4

Sampling data are hand-entered from field sheets into a portable computer each day, making occasional typographical errors virtually unavoidable. The normal Radian practice is to compare the computer output with the original data sheets to ensure that the information has been input correctly. This is generally done once the field crew has returned to the office and the summary report of field activities is prepared. In addition, the Radian QA coordinator or his/her designee checks a percentage of the data sheets, logbooks, and calculations.

In addition to the technical systems audit, a number of performance evaluation audits were performed during the on-site effort. The greater part of the performance audit was directed toward the off-site analyses and a lesser part to the on-site activities. The results of the off-site performance audit samples are discussed in the next section. The results of the on-site performance audit are discussed in the following paragraphs.

Orsat Determinations

A duplicate analysis of oxygen was performed using a test gas supplied by RTI. The results of the analysis of test gas BLM002689 was 9.0% oxygen which calculates out to a 97.8% recovery as compared to the theoretical concentration of 9.2 percent.

Source Sampling Consoles

An audit of the dry gas meters in four source sampling consoles was performed by RTI using a standard orifice. Audit results calculated as relative percent difference between the dry gas volume measurement and the calculated volume based on the RTI orifice were within the ±10% acceptance criteria for three of the four meters tested. The result for the fourth meter (-11.7%) was just slightly below the criteria. The auditor noted that the audit data set for this meter did not include a meter run stop time. It is not known if a more exact run time would have resulted in this measurement being within the criteria.

Continuous Emissions Monitors

Audit of the continuous emissions monitors was not an negotiated activity between Georgia Power and DOE for this program. Therefore, Plant Yates would not permit RTI to audit the CEM. Any change in the frequency of the calibration approach would have to be decided between DOE and Georgia Power (The yearly calibration is actually a yearly certification or performance audit).

In the RTI audit report five recommendations are discussed. Since the majority of these recommendations were not discussed at the audit wrap-up meeting conducted at Plant Yates, limited corrective action was initiated. A summary of the RTI recommendations and the Radian corrective actions are discussed in the following paragraphs:

Recommendation 1

Due to the unusually large differences seen between the RTI standard orifice and the sampling consoles used for source testing, it is recommended that the average of the pre- and post- test calibrations be used in the emission estimates. Only one of the consoles audited by RTI was outside the acceptance criteria given. The theoretical value for this audit run is not certain because the meter run stop time was not recorded. Therefore, it is not known if the result for this console was actually outside the acceptance criteria. A QA check of the post-test calibration for the consoles used on the project showed that the difference between the pre-test and post-test calibrations was less than 5% as required by the method (RPD-1.38% ±1.08, Range 0.1%-3.47% per Radian QA coordinator).

Recommendation 2

Mass flow rates for solids such as bottom ash and ESP ash are calculated based on coal feed rates and percentage ash in the coal obtained by proximate/ultimate analysis. One or more independent, direct methods of measuring or estimating the amount of ash produced should be attempted. The ESP collected ash flow rate was determined using the measured particulate loadings at the ESP inlet and outlet and the measured gas flow rate, not the coal feed rate and coal ash concentration. The bottom ash was calculated using the ESP inlet particulate loadings and coal feed rate and ash concentration. Radian considered obtaining representative bottom ash and ESP collected ash flow rates using the method described by RTI. However, the level of effort required, particularly for the ESP collected ash flow rate would have required additional sampling personnel and, given the physical design of the ash sluice system, additional information gained in this manner would also have a very large degree of uncertainty as to its accuracy.

Recommendation 3

Because RTI auditors were not allowed to take any completed data sheets off-site, a data audit should be conducted in which raw data sheets, computer-logged data, logbooks, validation procedures, and calculations are examined. Data quality audits of the raw data, logbooks, calculations, and computerized data are checked and counter checked by various project personnel (including the Radian QA coordinator) throughout the progress of the project. The overall project is then peer- reviewed by senior engineers and scientists at least twice prior to the final reporting process.

Recommendation 4

CEMs at Plant Yates are not scheduled for multi-point calibration until the fall of 1993 which will result in a one-year interval since the last multi-point calibration. The interval between multi-point calibrations of the CEM should be changed from yearly to every six months. This recommendation is outside of the scope of the present project and is out of the control of Radian.

Recommendation 5

The major elements for mass balance determinations should be discussed and finalized between DOE and Radian. Elements for the mass balance determinations were finalized between DOE and Radian and are presented in Section 6 of this Document.

Performance Audit Results

At the time of the technical systems audit conducted by RTI in June 1993, a series of performance audit samples were prepared and presented to the Radian sampling team to be submitted to the various analytical laboratories along with the investigative samples. The audit samples were prepared by spiking the impinger solutions or other analytical matrices provided to the auditors by Radian.

VOST

Two sets of Tenax cartridges were spiked with 18 compounds. These were analyzed for 16 of the 18 compounds by Radian's subcontractor, Air Toxics, Limited. In the RTI audit report, the results for these analyses were compared to the wrong set of recovery objectives. Tables A-1 and A-2 show the results and the recovery objectives for volatile organics as presented in Table 9-4 (page C9-9) of the project QAPP.. The QC objectives were met for 10 of the 16 analytes in sample Y194 and 9 of the 16 analytes in sample Y195. Of the analytes with recoveries outside the QC objectives, toluene, methylene chloride, 1,1,1-trichloroethane, trichlorofluoromethane, benzene, chloroform, and carbon tetrachloride were recovered high in one or more of the samples and chlorobenzene was recovered low in one sample. A portion of the methylene chloride recovery may be due to contamination, since this analyte was found in varying concentrations in most of the field and laboratory blanks analyzed with the samples. The high toluene recoveries were also attributed to contamination in the RTI audit report. In this case, the contamination appears to be in the audit cylinder, since this analyte was not found in any of the field or laboratory blanks and the concentration in Y195 is approximately twice the concentration in Y194. This concentration ratio matches the relationship for the RTI theoretical concentrations for other analytes in the two samples.

Semivolatile Organics

Two XAD-2 modules, a train rinse, and a probe rinse were spiked with 16 analytes. Each module was combined with a rinse and reported as a combined sample. The analytical results for the 16 spiked compounds were within the project objectives for sample Y173-177 and 14 of the 16 spiked compounds were within the QC objectives in sample Y178-182. Anthracene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene results were outside the QC objectives. These compounds were spiked at or near the approved detection limits stated in the project QAPP.

Aldehydes

Two DNPH impinger solutions were spiked with formaldehyde. The recovery for this analyte showed recoveries above the stated project QC objectives. RTI attributed these apparent enhanced recoveries to possible contamination. Formaldehyde was found in several of the field blanks and at the detection limit in one laboratory blank but was not found in the reagent blanks. Laboratory control samples and matrix spiked samples showed good recoveries for both formaldehyde and acetaldehyde.

Table A-1
Analysis of Vost Sample ID Y194 by Air Toxics Limited

Analyte	Detection Limit (ng)	Theoretical Concentration (ng)	Analyzed Concentration (ng)	% Recovery	QC Objectives % Rec.	QC Objectives Met?
Benzene	10	63.73	74	116	37-151	yes
Chlorobenzene	10	177.43	53	30	37-160	low
Ethylbenzene	10	153.86	120	78	37-162	yes
Toluene	10	151.68	2300	1520	47-150	high
o-Xylene	10	159.30	71	45	NS	NA
Bromomethane	10	125.33	130	104	D-242	yes
1,3-Butadiene	NA	25.94	NA	-	-	NA
Chloroform	10	87.60	110	126	51-138	yes
Carbon tetrachloride	10	123.28	140	114	70-140	yes
1,2-Dichloroethane	10	74.04	53	72	49-155	yes
1,2-Dibromoethane	NA	300.37	NA	-	-	NA
1,2-Dichloropropane	10	192.00	160	83	D-210	yes
Methylene chloride	10	112.98	5700	5040	D-221	high
Tetrachloroethylene	10	141.40	120	85	46-157	yes
Trichloroethylene	10	103.69	120	116	71-157	yes
1,1,1-Trichloroethane	10	148.77	230	155	52-150	high
Trichlorofluoromethane	10	217.11	470	216	17-181	high
Vinyl chloride	10	40.10	48	120	D-251	yes

Table A-2
Analysis of Vost Sample ID Y195 by Air Toxics Limited

Analyte	Detection Limit (ng)	Theoretical Concentration (ng)	Analyzed Concentration (ng)	% Recovery	QC Objectives % Rec.	QC Objectives Met?
Benzene	10	125.29	190	152	37-151	high
Chlorobenzene	10	348.80	170	49	37-160	yes
Ethylbenzene	10	302.47	420	139	37-162	yes
Toluene	10	298.18	4000	1340	47-150	high
o-Xylene	10	313.17	290	93	NS	-
Bromomethane	10	246.38	180	73	D-242	yes
1,3-Butadiene	NA	51.00	NA	-	-	NA
Chloroform	10	172.22	250	145	51-138	high
Carbon tetrachloride	10	242.36	360	148	70-140	high
1,2-Dichloroethane	10	145.55	150	103	49-155	yes
1,2-Dibromoethane	NA	590.50	NA	-	-	NA
1,2-Dichloropropane	10	377.45	410	109	D-210	yes
Methylene chloride	10	222.11	5800	2610	D-221	high
Tetrachloroethylene	10	277.98	350	126	46-157	yes
Trichloroethylene	10	203.84	320	157	71-157	yes
1,1,1-Trichloroethane	10	292.47	550	188	52-150	high
Trichlorofluoromethane	10	426.22	660	155	17-181	yes
Vinyl chloride	10	78.83	98	124	D-251	yes

NA = Not analyzed.

NS = Not specified.

RTI analyzed the spike solution (about two months later) and found reduced recoveries based on the nominal concentration. It appears that the true concentration of the spike solution is not known. Formaldehyde standards prepared from the commercially available 37% solutions may vary since these reagents may vary in actual concentration from 36-41 percent. Standards prepared as nominal concentrations can be analyzed by a titration procedure to obtain a known concentration for a standard. It is not known if this procedure was used by RTI to assign a theoretical concentration for the spike solution.

Metals

Performance audit samples were prepared by RTI for the filter, the nitric acid-peroxide impingers, and the permanganate impingers of the multi-metals sampling train. Arsenic, cadmium, lead, and selenium were recovered within the QC objectives in the nitric acid/peroxide impinger solutions. However, mercury showed a slightly high recovery in this solution. Metal recoveries for the two spikes onto blank filters showed good recoveries except for one arsenic spike with a high recovery and one cadmium, selenium, and mercury spike with slightly low recoveries on the other filter. Mercury spiked into the two permanganate impinger solutions showed low recoveries (21-40%). The performance audit sample prepared by the Radian QA Coordinator also showed low recovery (33%) for the permanganate solution sample.

Department of Energy
Pittsburgh Energy Technology Center
P.O. Box 10940
Pittsburgh, Pennsylvania 15236-0940

November 10, 1993

Barbara J. Hayes
Radian Corporation
8501 Mo-Pac Blvd.
P.O. Box 201088
Austin, TX 78720-1088

Dear Barbara:

Enclosed are clean copies of the Field Sampling Report and the PE Sample Analysis information prepared by Research Triangle Institute. Please include these documents in the External Audit Section of the Draft Final Report to be submitted to the DOE on December 10, 1993. In addition, provide a response to RTI's finding in the Draft Final Report.

If you have any questions, please call me at (412) 892-4691.

Thomas D. Brown
Project Manager
Environmental Control Division

Enclosures

CC: Hollis Flora, Radian

RESEARCH TRIANGLE INSTITUTE

RTI

Center for Environmental Measurements and Quality Assurance

October 4, 1993

Mr. Tom Brown
PETC, U.S. Department of Energy
P.O. Box 10940, M.S. 922-206
Pittsburgh, PA 15236

Subject: Radian PE sample analysis during the Yates Plant Audit

Dear Tom:

Enclosed are the analysis results for 10 sets of performance evaluation (PE) samples given to Radian Corporation during the audit of the Yates plant. Of particular concern are the mercury and the formaldehyde analyses.

After encountering a serious problem with the aldehyde analysis, we recalculated the PE sample concentrations and analyzed the samples in our laboratory. In the analytical procedure, there are still some undetermined factors such as the percent conversion of aldehyde into the DNPH-derivatives. Even though the molar ratios of DNPH to aldehyde were sufficiently high to drive the conversion reaction to completion, the aldehyde analysis results are lower than expected. The further laboratory work may resolve this issue.

Volatiles

RTI spiked two sets of Tenax cartridges in a VOST train with 18 compounds. The cartridges were analyzed by Radian's subcontractor, Air Toxics, Limited. The laboratory analyzed for 16 of the 18 compounds spiked into the cartridges. Of the compounds quantitated, 10 of 16 were recovered within the data quality objectives (DQOs) set by Radian for sample Y194, and 9 of 16 were recovered within the DQOs for sample Y195. Of the compounds particularly relevant to this project (benzene, toluene, ethylbenzene, and o-xylene), recoveries were mixed. Benzene was recovered well within range on sample Y194, but slightly out of range on sample Y195. Toluene was recovered completely out of range on both samples due to apparent contamination. Ethylbenzene was recovered within range on both samples. O-xylene was recovered out of range on sample Y194, but within range on sample Y195.

Semivolatiles

RTI spiked two XAD-2 modules, a train rinse, and a probe rinse with 16 PAHs in solution. Each module was combined with a rinse and reported by Radian as a combined sample. Radian performed satisfactorily on 28 of the 32 analyses. One undetected analyte was spiked at below the reported detection limit. This occurred because the detection limits reported were much higher than the 1 ng/m^3 required by DOE for the project.

Metals on Filters

Several metals were spiked onto two filters of the M-29 trains to simulate metals in the particulate catch. Radian recovered 6 of the 10 metals concentrations within the limits of their DQOs.

Metals in Impinger Solutions (HNO_3/H_2O_2)

Several metals were spiked into the first impinger of the metals train. Radian recovered eight of the nine metals within the limits of their DQOs.

Metals in Impinger Solutions ($KMnO_4$)

Mercury was spiked into two acidic $KMnO_4$ solutions. Neither was recovered in the range of their DQOs (75 to 125%).

Formaldehyde in Impinger Solutions (DNPH)

RTI spiked two DNPH impinger solutions with a solution containing a nominal concentration of 0.4068 μg/μl. Radian's recoveries calculated based on this concentration are higher indicating possible contamination. RTI has analyzed the spiking solution and our recovery based on the nominal value is 67.6% (average concentration of 0.275 μg/μl). RTI is continuing verification analyses on the spiking solution.

If I can be of further assistance, please call me at 541-5919.

Sincerely,

Shri Kulkarni

Shri Kulkarni, Ph.D.
Manager, Quality Assurance and
Technology Assessment Department

SVK:dmh

cc: S.J. Wasson
J. McSorley

File: 5960-193/4805
91A-04

METALS IN IMPINGER SOLUTIONS (HNO_3/H_2O_2)

SAMPLE ID: Y276

METAL	RTI AMOUNT (μg)	RADIAN AMOUNT (μg)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
As	50	52.10	104.2	75-125	Yes
Cd	30	37.00	123.3	75-125	Yes
Pb	20	19.79	98.9	75-125	Yes
Se	40	41.60	104.0	75-125	Yes
Hg	10	12.68	126.8	75-125	No

METALS IN IMPINGER SOLUTIONS (HNO_3/H_2O_2)

SAMPLE ID: Y279

METAL	RTI AMOUNT (μg)	RADIAN AMOUNT (μg)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
As	15	15.03	100.2	75-125	Yes
Cd	60	68.26	113.8	75-125	Yes
Pb	40	42.34	105.9	75-125	Yes
Se	80	90.72	113.4	72-125	Yes

---

[1] These values are taken from Radian's QA plan (page C9-7).

METALS ON FILTERS

SAMPLE ID: Y278, filter 966

METAL	RTI AMOUNT (µg)	RADIAN AMOUNT (µg)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
As	40	84.4	211.0	75-125	No
Cd	10	9.59	95.9	75-125	Yes
Pb	15	15.3	102.0	75-125	Yes
Se	25	22.3	89.2	75-125	Yes
Hg	10	10	100.0	75-125	Yes

METALS ON FILTERS

SAMPLE ID: Y281, filter 974

METAL	RTI AMOUNT (µg)	RADIAN AMOUNT (µg)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
As	25	27.9	111.6	75-125	Yes
Cd	15	10.6	70.7	75-125	No
Pb	25	25.3	101.2	75-125	Yes
Se	35	23.4	66.9	75-125	No
Hg	20	14.6	73.0	75-125	No

---

[1] These values are taken from Radian's QA plan (page C9-7).

MERCURY IN IMPINGER SOLUTIONS (KMn04)

SAMPLE ID	RTI AMOUNT (µg)	RADIAN AMOUNT (µg)	PERCENT RECOVERY	RECOVERY[3] DQO (%)	DQO MET
Y277[1]	20	4.18	20.9	75-125	No
Y280[2]	50	19.75	39.5	75-125	No

FORMALDEHYDE IN IMPINGER SOLUTIONS (DNPH)

SAMPLE ID	RTI AMOUNT (µg)	RADIAN AMOUNT (µg)	PERCENT RECOVERY	RECOVERY[4] DQO (%)	DQO MET
Y187	24.4	76	311	50-150	No
Y188	34.2	90	263	50-150	No

[1] Also spiked with 30 µg Pb.

[2] Also spiked with 20 µg As.

[3] These values were taken from Radian's QA plan (page C9-7).

[4] These values were taken from Radian's QA plan (page C9-8).

SVOC RECOVERIES FROM XAD-2 MODULES

SAMPLE ID: Y178-182 (Combined)

ANALYTE	RTI VALUE (µg)	Radian VALUE (µg)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
Naphthalene	10	9.98	99.8	21-133	Yes
Acenaphthylene	20	17.3	86.5	33-145	Yes
Acenaphthene	10	8.22	82.2	47-145	Yes
Fluorene	2	1.19	59.5	59-121	Yes
Phenanthrene	1	0.853	85.3	54-120	Yes
Anthracene	1	ND[2]	0.0	27-133	No
Fluoranthene	2	1.44	72.0	26-137	Yes
Pyrene	1	0.634	63.4	52-115	Yes
Chrysene	1	0.844	84.4	17-168	Yes
Benzo(a)anthracene	1	0.694	69.4	33-143	Yes
Benzo(b)fluoranthene	2	1.4	70.0	24-159	Yes
Benzo(k)fluoranthene	1	0.713	71.3	11-162	Yes
Benzo(a)pyrene	1	0.484	48.4	17-163	Yes
Indeno(1,2,3-cd)pyrene[3]	1	ND[2]	0.0	D-171	No
Dibenz(a,h)anthracene	2	ND[2]	0.0	D-227	No
Benzo(g,h,i)perylene	2	ND[2]	0.0	D-219	No
Other Compounds Reported					
Acetophenone	0	0.694	--	--	--
Benzoic Acid	0	14.2	--	--	--
Diethylphthalate	0	0.689	--	--	--

[1] Recovery DQOs (%) were taken from Radian's QA plan (Page C9-10).

[2] ND = not detected.

[3] This compound was spiked at a concentration below the reported detection limit of 1.33 µg.

SVOC RECOVERIES FROM XAD-2 MODULES

SAMPLE ID: Y173-177 (Combined)

ANALYTE	RTI VALUE (μg)	RADIAN VALUE (μg)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
Naphthalene	35.0	30.1	86.0	21-133	Yes
Acenaphthylene	70.0	62.8	89.7	33-145	Yes
Acenaphthene	35.0	28.7	82.0	47-145	Yes
Fluorene	7.0	4.53	64.7	59-121	Yes
Phenanthrene	3.5	2.54	72.6	54-120	Yes
Anthracene	3.5	2.5	71.4	27-133	Yes
Fluoranthene	7.0	4.42	63.1	26-137	Yes
Pyrene	3.5	2.13	60.8	52-115	Yes
Chrysene	3.5	1.52	43.4	17-168	Yes
Benzo(a)anthracene	3.5	1.65	47.1	33-143	Yes
Benzo(b)fluoranthene	7.0	2.82	40.3	24-159	Yes
Benzo(k)fluoranthene	3.5	1.62	46.3	11-162	Yes
Benzo(a)pyrene	3.5	1.33	38.0	17-163	Yes
Indeno(1,2,3-cd)pyrene	3.5	1.33	38.0	D-171	Yes
Dibenz(a,h)anthracene	7.0	2.14	30.6	D-227	Yes
Benzo(g,h,i)perylene	7.0	2.19	31.3	D-219	Yes
Other Materials Recovered					
Benzoic Acid	0	60.3	--	--	--

---

[1] Recovery DQOs (%) were taken from Radian's QA plan (page C9-10).

VOLATILE ORGANICS ON TENAX (VOST)

SAMPLE ID: Y194

COMPOUNDS	RTI AMOUNT (ng)	RADIAN AMOUNT (ng)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
Vinyl Chloride	40.10	48	119.7	50-150	yes
Chloroform	87.60	110	125.6	50-150	yes
Carbon Tetrachloride	123.28	140	113.6	50-150	yes
Methylene Chloride	112.98	5700	5045.1	50-150	no
1,2 Dichloroethane	74.04	53	71.5	50-150	yes
Trichlorethylene	103.69	120	115.7	50-150	yes
Benzene	63.73	74	116.1	50-150	yes
Tetrachloroethylene	141.40	120	84.9	50-150	yes
1,3-Butadiene[1]	25.94	--	--	50-150	--
Bromomethane	125.33	130	103.7	50-150	yes
Trichlorofluoromethane	217.11	470	216.5	50-150	no
1,1,1-Trichloroethane	148.77	230	154.6	50-150	no
1,2-Dichloropropane	192.00	160	83.3	50-150	yes
1,2-Dibromoethane[2]	300.37	--	--	50-150	--
Toluene	151.68	2300	1516.4	50-150	no
Chlorobenzene	177.43	53	29.9	50-150	no
Ethylbenzene	153.86	120	78.0	50-150	yes
Ortho-Xylene	159.30	71	44.6	50-150	no
Other Compounds Reported					
Acetone	0	120	--	--	--

[1] Recovery DQOs (%) were taken from Radian's QA plan (page C9-10).

[2] This compound was not identified or analyzed by Radian's subcontractor, Air Toxics Limited.

VOLATILE ORGANICS ON TENAX (VOST)

SAMPLE ID: Y195

COMPOUNDS	RTI AMOUNT (ng)	RADIAN AMOUNT (ng)	PERCENT RECOVERY	RECOVERY[1] DQO (%)	DQO MET
Vinyl Chloride	78.83	98	124.3	50-150	yes
Chloroform	172.22	250	145.2	50-150	yes
Carbon Tetrachloride	242.36	360	148.5	50-150	yes
Methylene Chloride	222.11	5800	2611.3	50-150	no
1,2 Dichloroethane	145.55	150	103.1	50-150	yes
Trichlorethylene	203.84	320	157.0	50-150	no
Benzene	125.29	190	151.6	50-150	no
Tetrachloroethylene	277.98	350	125.9	50-150	yes
1,3-Butadiene[1]	51.00	--	--	50-150	--
Bromomethane	246.38	180	73.1	50-150	yes
Trichlorofluoromethane	426.82	660	154.6	50-150	no
1,1,1-Trichloroethane	292.47	550	188.1	50-150	no
1,2-Dichloropropane	377.45	410	108.6	50-150	yes
1,2-Dibromoethane[2]	590.50	--	--	50-150	--
Toluene	298.18	4000	1341.5	50-150	no
Chlorobenzene	348.80	170	48.7	50-150	no
Ethylbenzene	302.47	420	138.9	50-150	yes
Ortho-Xylene	313.17	290	92.6	50-150	yes
Other Compounds Reported					
Acetone	0	160	--	--	--

---

[1] Recovery DQOs (%) were taken from Radian's QA plan (page C9-10).

[2] This compound was not identified or analyzed by Radian's subcontractor, Air Toxics Limited.

RESEARCH TRIANGLE INSTITUTE

RTI/5960/193 - 04D August 6, 1993

QA/QC AUDITS ON DOE UTILITY BOILER TEST PROGRAM

FIELD SAMPLING AUDIT REPORT

Site: Yates Station Unit 1, Newnan, GA

DOE Contractor: Radian Corporation

DOE Project Officer: Janice Murphy

Performed for

Joseph A. McSorley
EPA Work Assignment Manager
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Prepared by

Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709

RTI Work Assignment Leader: Shirley J. Wasson

Under EPA Contract No. 68D10009
Work Assignment No. I-193

Field Audit of:

Yates Station Unit 1
Georgia Power Company
Newnan, Georgia

Contractor: Radian Corporation
Dates: June 23-25, 1993
RTI Personnel: J. B. Flanagan and C. O. Whitaker

Introduction

The Yates Station Unit 1 is a bituminous coal-fired steam-electricity-generating unit with a net generating capacity of 105 megawatts. The station is located near Newnan, Georgia, and is owned and operated by Georgia Power Company. Unit 1 has a tangentially fired boiler manufactured by Combustion Engineering in 1949. During this test, the unit was fueled with 2.5% sulfur blend of Illinois No. 5 and Illinois No. 6 bituminous coals. The feed coal is a 50:50 blend mined from the "Arch Captain" and "Old Ben Franklin" mines.

The plant uses electrostatic precipitators for particulate control. Unit 1 currently controls sulfur dioxide (SO_2) using a Jet Bubbling Reactor (JBR) supplied under the CT-121 demonstration project. Sampling for the hazardous air pollutants (HAP) study is being carried out by Radian Corporation, which also operates the CT-121 demonstration project in cooperation with Georgia Power and DOE. The JBR process combines conventional limestone flue gas desulfurization (FGD) chemistry, forced oxidation, and gypsum crystallization in one reaction vessel. It is designed to operate in a medium-acid solution, where limestone is completely soluble and where the sulfite resulting from SO_2 absorption can be oxidized completely to sulfate. Attrition of gypsum crystals and problems of poor sludge quality and chemical scaling are also eliminated due to improvements of the second generation FGD process. The process is not specifically designed to destroy pollutants such as NO_2 or organics.

Findings

1. Finding: **Basis due to long sampling lines from the calibration tanks to the probes and nonlinearity of the continuous emission monitor (CEM) system may go undetected due to infrequent multipoint calibrations.** Line losses and multipoint calibrations are not normally measured and multipoint calibrations are not performed during the demonstration program; the next scheduled full calibration is scheduled for the changeover to Phase II of the demonstration program some time this fall. Daily zero-span checks are conducted for all CEMs.

Effect on Data: If there is loss of calibration gas in the 300 to 600 feet of tubing running from the cylinders to the probes, the span result will be biased. Sulfur dioxide is particularly sensitive to decomposition reactions on surfaces. The potential for nonlinearity is unknown in the absence of regularly scheduled multipoint calibrations.

2. Finding: **Aldehyde measurements were performed in accordance with the method; however, acetone, (a possible contaminant) was present in the mobile laboratory as a wash bottle under the hood.**

   Effect on Data: Any acetone that might be found in the samples would be suspect.

3. Finding: **All plant and sampling times are recorded in Central Daylight Savings Time instead of Eastern Daylight Savings Time.** The central power grid is controlled by Georgia Power's headquarters in Alabama, which is in the Central time zone. Yates plant personnel have adopted Central time to coordinate with the central operations. To avoid confusion, Radian also adopted Central time in conducting the HAP project.

   Effect on Data: Radian and plant personnel were all well-aware of this situation; however, special care should be taken to cross-check data to avoid confusion in sampling times during data validation.

4. Finding: **Sampling data are hand-entered from field sheets into a portable computer each day, making occasional typographical errors virtually unavoidable.**

   Effect on Data: Data validation procedures such as duplicate keying or 100% comparison with original sheets should be used to minimize these errors.

Observations

This section includes general observations for which no adverse effect on the data could necessarily be predicted, but which had the potential to differentiate results at this site from results at other sites.

1. Radian sent an analyst and a high performance liquid chromatography (HPLC) instrument to the site for Cr^{IV} measurements. Having the analyses performed on-site provides faster results: a 1/2- to 2-hour turnaround versus 24 hours or more when samples are sent back to an off-site laboratory. This conscientious effort to obtain more timely analyses of this unstable material should be taken into account when comparing Radian's results for Cr^{IV} with those from other contractors.

2. The "Nick Bloom" method for sampling vapor phase mercury differed from that of another contractor on this project in that differently sized charcoal tubes were used and different methods of analysis will be used. Radian also used a soda-ash tube in conjunction with the charcoal tube which was intended to allow discrimination between oxidation states of mercury. Results of different contractors may not be comparable if different implementations of this method are employed.

Activities

1. Meetings

Audit activities included three meetings between RTI, DOE, Georgia Power, and Radian personnel. An initial meeting was held on 6/22 and an exit meeting on 6/24. Additionally, there was a meeting on the afternoon of 6/22 in which the Georgia Power representatives expressed concerns about data security for the JBR project and misgivings about having "EPA representatives" on-site. Dr. Flanagan called Ms. Wasson, the RTI Project Leader, to inform her of this development immediately after this meeting. Dr. Kulkarni of RTI and Mr. Brown of DOE were contacted later the same day. No further concerns were expressed, however, and the remainder of the audit proceeded normally. Mr. Roy Clarkson, a representative of Georgia Power, reviewed all data to be taken from the site at the exit meeting on 6/24. This information consisted only of the auditor's logbooks and checklists and some blank data forms obtained from Radian. Mr. Al Williams, the Radian Project Manager, made the decision not to release copies of any completed data sheets requested by the auditors based on Georgia Power's concerns.

During one of the meetings with Radian personnel, it was learned that the "major" element(s) for independent mass balance determination had not been selected. This was presumably under negotiation between Radian and DOE as a change in scope.

2. Performance Evaluation Audit

   a) Orsat Determination - Mr. Tom Peters of Radian was observed by Mr. Craig Whitaker of RTI while performing the Orsat procedure using test gas supplied by RTI. The audit gas concentration for tank ID number BLM002689 was 9.21% oxygen in dry nitrogen. Correct procedures appeared to be followed. The following data were taken. Acceptable agreement was found for oxygen. Neither carbon dioxide nor carbon monoxide was present in the tank, and none was found.

Replicate	Orsat Result (mL oxygen)
1	9.0
2	9.0
Average:	9.0

Initial volume was 100 mL

9.0 mL/100 mL x 100 = 9.0% found by Orsat.

$$\text{Percent Difference} = \frac{9.0\% - 9.2\%}{9.2\%} \times 100 = -2.17\%$$

b) Performance Audit of Source Sampling Consoles - Mr. Whitaker provided a standardized orifice (ID number 117) to the sampling console operators. They were instructed to set a constant flow using the orifice and to measure the volume indicated by the console's dry gas meter during a 10- or 20-minute sampling period. Operators reported a pressure drop across the RTI orifice, dry gas meter volume, and temperature. Results are tabulated in the following table. "Calculated Volume," the fifth column in the table, was calculated by RTI based on the orifice constant and pressure drop, multiplied by the run time.

CONSOLE (DRY GAS METER VOLUME) PERFORMANCE AUDIT RESULTS*

Radian console serial number	Console location	Run time (min)	Radian console dry gas meter volume (scf)	Calculated volume based on flow using RTI orifice (scf)	Relative Percent difference
A161362	Stack	20	13.98	15.450	- 9.5
A161394	Stack	21	16.59	16.404	1.1
161364	ESP outlet	10	7.89	7.711	2.3
A161395**	ESP outlet	10**	7.50	8.495	- 11.7

* Acceptance criteria ± 10%.

** This audit data set did not include a meter run stop time; however, runs were requested for 10 minutes and the data appear consistent with a 10-minute run time.

c) VOST Sampling - The operator demonstrated extensive knowledge in the operation and process. Cartridges were inscribed with flow directions and encapsulated before and after use. Two sets of tenax and tenax/charcoal were exposed to measured flows of test gas supplied by RTI. Exposure periods were 10 and 20 minutes. Because analytical results must be received before these audit samples can be evaluated, the tube numbers, compounds, and concentrations will be reported in a separate memorandum.

d) Continuous Emissions Monitors (CEMs) - The facility would not allow RTI to audit the installed monitors, but the system functions were explained by the operator, Mr. Jeff Nelms. The cylinders used for daily zero and span checks were found to be Protocol No. 1 gases. Serial numbers and concentrations for these zero/span gases are provided in the following table.

CEM SPAN GAS SUMMARY

Vendor	Cylinder	Compound	Concentration	Expiration date
Scott	AAL-13190	Nitric oxide Sulfur dioxide Nitrogen	360 ppm 1791 ppm balance	5-18-95
Scott	AAL-17497	Oxygen Nitrogen	20.9% balance	5-18-96
Scott	AAL-4472	Sulfur dioxide	241 ppm	1-4-95

Two locations are being monitored by the CEMs: the ESP outlet (immediately upstream of the JBR) and the stack (downstream of the JBR). The following information is being acquired at each location:

ESP outlet (upstream of JBR):
- Temperature
- Opacity
- Oxygen
- NO_x
- SO_2

Stack (downstream of JBR):
- Temperature
- Oxygen
- SO_2

Because different gases are being monitored at the two locations, different span gas combinations and concentrations were used for the span checks. For the stack gas analyzers, cylinder AAL-4472 (SO_2 in N_2) and cylinder AAL-17497 (O_2 in N_2) were used. On the ESP outlet upstream of the JBR, cylinder AAL-13190 (NO and SO_2 in $N_{2)}$ and cylinder AAL-17497 (O_2 in N_2) were used. Cylinders of zero air were also present for zero determination. According to site personnel, tanks are replaced at intervals of approximately 1 to 2 months. This rather rapid turnover of standard gases is due to the large volume required to fill and purge the hundreds of feet of tubing between the tank, the sampling point, and the analyzers, as described in the next paragraph.

Heated sample lines are used to carry the calibration gas to the probes. The calibration gas then flows back to the CEMs through the same lines that are used acquire gas samples. As part of the audit, the heated sample lines were traced and verified by the operator, who estimated that the fetch (one-way distance from the probe to the CEMs) was 300 to 350 feet. The fetch to the ESP outlet duct probe was estimated to be approximately 600 feet.

3. Technical Systems Audit

The following table summarizes the activities observed by the auditors.

OPERATIONS OBSERVED DURING TSA

Medium	Location	Auditor	Comment
Coal, 1/4" feed	boiler building	Flanagan, Whitaker	Periodic grab samples collected into plastic bucket
Coal, pulverized	boiler building	Flanagan, Whitaker	Cyclone used to capture high-pressure suspension of coal powder prior to burner
Pyrite reject	boiler building	Flanagan, Whitaker	All material caught in plastic buckets
Boiler bottom ash (slurry)	sluice pipe outlet at ash pond	Flanagan, Whitaker	Dipper samples alternately filling two glass carboys

OPERATIONS OBSERVED DURING TSA (continued)

Medium	Location	Auditor	Comment
Condenser water inlet	boiler building	Flanagan	From spigot -- tube allowed to run before sampling
Condenser water outlet	boiler building	not being sampled	Sample point inaccessible
Flue gas	ESP inlet	Whitaker	
Flue gas	ESP outlet	Whitaker	
Stack gas (JBR out)	Stack	Whitaker	
ESP hopper ash (slurry)	sluice pipe outlet at ash pond	Flanagan	Dipper samples alternately filling two glass carboys
JBR makeup water	JBR area	Flanagan	
JBR slurry density	JBR area -- density meter slip stream	Flanagan	Nuclear density meter out of service
Limestone	limestone silo	not observed	
Coal pile runoff	coal pile	not observed	No rain during audit
Cr^{IV} measurement	JBR Project Laboratory	Flanagan	Actual samples not seen; calibration only
XAD-2 cartridge spike for semi-volatiles	laboratory trailer	Flanagan	
Metals train spikes	laboratory trailer	Flanagan	
VOST challenge	stack sampling area	Whitaker	
Orsat procedure (oxygen)	laboratory trailer	Whitaker	Acceptable results.

Recommendations

1. Unusually large differences were seen when RTI's standard orifice was used to test some of the sampling consoles used for source testing. These consoles are scheduled to be re-tested after their return to the laboratory and the results compared with the calibrations prior to the site test. Because of the discrepancies observed with the RTI orifice, the calibration results should be reported to DOE as soon as they are available. The pre- and post-test calibrations must agree within 5% or the data must be corrected. For regulatory purposes, the factor giving the higher emission estimate would be applied; however, for the research work under this project, an average of the two factors would probably be more appropriate.

2. Mass flow rates for solids such as bottom ash and ESP ash are calculated based on coal feed rates and percentage ash in the coal obtained by proximate/ultimate analysis. One or more independent, direct methods of measuring or estimating the amount of ash produced should be attempted. For example, one such method for independently calculating ash production rates would involve multiplying the ash slurry average mass concentration by the length of time the slurry flows and by the flow rate out of the pipe. Ash concentration in the slurry can be obtained by taking representative, time-proportional samples throughout the length of time the slurry flows. Flow rates can be measured at the outfall or obtained from the plant. Intercomparison of different estimates will increase the confidence in the validity of the mass balance calculations. This is a problem common to all contractors at all sites.

3. Because auditors were not allowed to take any completed Radian data sheets off-site, a data audit should be conducted in which raw data sheets, computer-logged data, logbooks, validation procedures, and calculations are examined.

4. A multi-point calibration has not been conducted on the CEMs used for the demonstration project since November 17-20, 1992. The CEMs are not scheduled for another calibration until the next phase of the JBR project, which begins in the fall. This would result in more than a year between calibrations. It is recommended that Georgia Power and Radian make provision to conduct multipoint calibrations at intervals of no more than six months for SO_2, NO_x, and O_2. If possible, line losses between the span gas cylinders and the probes should also be determined at this time.

5. It is recommended that the major elements for mass balance determination be discussed and finalized between DOE and Radian, if this has not already been done.

Personnel Present During Site Visit

Name	*Organization*	*Telephone*
Chuck Schmidt	DOE	(412)892-4690
Tim McIlvried	DOE	
Dave Burford	Georgia Power	(404)253-2111
Roy Clarkson	Georgia Power	
Jeff Nelms	Georgia Power	
Al Williams	Radian	(512)454-4797
Ira Pearl	Radian	(512)454-4797
Barbara Hayes	Radian	(512)454-4797
Renee Cravin	Radian	(512)454-4797
Dave Virbick	Radian	(512)454-4797
Dave Maxwell	Radian	(512)454-4797
Benji Cox	Radian	(512)454-4797
Tom Peters	Radian	(512)454-4797
Ed Zabasaija	Radian	(512)454-4797
Tom Baraga	Radian	(512)454-4797
Jim McGee	Radian	(512)454-4797
Jim Hand	Radian	(512)454-4797
Lori Rodriquez	Radian	(512)454-4797
Jim Flanagan	RTI	(919)541-6417
Craig Whitaker	RTI	(919)541-5988

APPENDIX B: SAMPLING PROTOCOL

Radian used established sampling methods, where possible, to collect representative samples from the various sampling locations within the Yates plant site. The sampling locations at Plant Yates Boiler No. 1 and the various plant processes included:

- Boiler inlet, outlet, and sluice streams;
- ESP inlet, outlet, and ash streams;
- FGD system inlet, outlet, and slurry streams; and
- Stack gas.

For most of the sources, the sampling methods used were standard methods with known performance characteristics, specific for the collection of a representative sample according to the stream matrix. These methods, summarized in Table B-1, provide data for comparisons with industry standards.

Gas Streams

The following section presents the methodology to collect samples from gaseous streams.

Particulate Loading

EPA Reference Method 5[1] or EPA Reference Method 17[2] was performed to determine particulate loading at the selected sampling locations at Plant Yates. Method 5 was used at the stack and ESP outlet locations and Method 17 was used at the ESP inlet sampling location. These methods provided isokinetic extraction of particulate matter on a glass fiber filter. However, since particulate loading determinations were performed in conjunction with the sampling for particulate and vapor-phase metals, quartz fiber filters were used in place of glass. The particulate mass, which included all material that condenses at or above the filtration temperature, was determined gravimetrically, after the removal of uncombined water.

Table B-1
Summary of Sampling Methods

Stream Type	Parameter	Frequency	Sampling Method
Solids	All	Grab sample hourly to composite per test run (time-averaged composite)[a]	EPA Method S007[3] (trowel/ scoop)
Liquids	All	Grab sample hourly to composite per test (time-averaged composite)[a]	EPA Method S007 (trowel/ scoop) EPA Method S004[4] (tap)
Gases	Volatile Organics	4 pairs of VOST traps over 2-hour time period	VOST (SW-846 Method 0030)[5]
	Semivolatile Organics	Integrated sample over 4- to 6-hour time period	Modified Method 5 (SW-846) Method 0010[6]
	Vapor-Phase Inorganic/ Organic Species	Integrated sample over 4- to 6-hour time period	Various impinger solutions sampling trains
	Trace Elements (Metals)	Integrated sample over 1- to 2-hour time period	Multi-metals sampling train[7]
	Particulate	Integrated sample over 1- to 2-hour time period	EPA Methods 5[8] and 17[9] sampling trains
	Particle Size Distribution	Fixed point sample over appropriate time period	In-stack cascade impactor

[a] Solid and liquid samples for volatile organics analyses were sampled only once per day, per test run.

The RM5 sampling system incorporated a calibrated glass nozzle, heated glass lined probe, heated oven (housing the filter holder and substrate), a condenser assembly, and a calibrated extraction system. The Method 17 sampling system was similar except an in-stack filtration system was used as opposed to the hot box and heated filter holder configuration of Method 5. Both systems operated under vacuum for extraction of effluent gas through leak free components. Both systems were leak checked before and after each individual test.

An extraction (sampling) rate was determined based upon preliminary measurements of temperature, flow rate, pressure, and moisture collected prior to the sampling program. The sampling rate was calculated from these variables to assist in providing and maintaining isokinetic sampling throughout the entire test period. At isokinetic conditions, the velocity of the stack gas entering the nozzle of the extraction system is equal to the effluent velocity at the sample point. The extraction system allowed manual adjustment of the sample rate when changes occurred in any of the variables that would affect isokinetic collection.

The individual stream gas velocities and the selection of the proper sample nozzle dictated the required sample time. The sampling was conducted at equal time intervals along the selected traverse points as determined by EPA Reference Method 1.[10]

After each test sequence, the particulate samples were recovered. For Method 5, the collected sample included the particulate deposited inside the extraction nozzle, heated probe, and filter holder (designated as the front half probe and nozzle rinse, PNR), as well as the particulate collected on the filter substrate. The Method 17 collected sample included the particulate deposited inside the nozzle and collected on the in-stack filter.

Particulate Metals and Vapor-Phase Metals

Sampling for the collection of particulate and vapor-phase metals was performed in conjunction with Method 5 and 17 using the procedures detailed in EPA Conditional Method 29. Method 29 is similar to Method 5 with a few sample train modifications. Modifications to Method 5 included replacing the stainless steel nozzle and probe liner with glass components. Method 17 was modified to operate with a glass nozzle and a teflon coated thimble holder to reduce the possibility of metal contamination due to the sampling system. The particulate material was collected on quartz fiber substrates, replacing the standard glass fiber filters normally used with Methods 5 and 17. Vapor-phase metals were collected in a series of impinger solutions. The first two impingers contained a dilute nitric acid and hydrogen peroxide solution. The third impinger was empty. The next two impingers contained acidic potassium permanganate solution for mercury collection. These impingers were followed by one dry impinger, and an impinger filled with silica gel. A minimum of 100 dry standard cubic feet of gas was collected isokinetically.

Sample recovery was performed in the on-site laboratory. An outline of the sample recovery procedure is detailed below:

1 - Petri dish - plastic - filter

1 - 500 mL glass - Acetone PNR. Rinse front half of filter holder with acetone into PNR bottle.

1 - 500 mL glass - HNO_3 PNR. Rinse front half of filter holder into PNR bottle.

1 - 1000 mL plastic - 1st & 2nd Imp.
Rinse back half of filter holder and impingers with 0.1N HNO_3 into sample bottle.

1 - 1000 mL glass - 3rd, 4th, & 5th impingers. Rinse impingers with 0.1N HNO_3 into sample bottle.

1 - 250 mL glass. Rinse 3rd, 4th & 5th impingers with 8N HCl.

Preservation - None

Particle Size Distribution

The particle size distribution of material in the sample gas was measured using cascade impactors. These impactors classify particulate matter with respect to aerodynamic particle size.

The impactor separated the particulate matter into seven size fractions (six impacted fractions and one fraction collected on the back-up filter). The isokinetic flow rate through the sampling nozzle was determined based on velocity data obtained during earlier sampling (EPA Method 5). Operation of the impactor required the flow rate through the impactor be kept constant. This requirement eliminated the possibility of adjusting the flow rate if variations in stack gas velocity occurred. After sampling, the impactor was unloaded and the collected particulate material weighed. The weight gains were used to calculate the particle size distribution. The recovery outline is presented below:

10 - Petri dishes - plastic - filters
1 - 250 mL glass - acetone PNR. Rinse pre-cutter with acetone into PNR bottle.

Preservation - None

Anions

A Method 5 train was used to collect vapor-phase and solid-phase (particulate) acid gas species of hydrochloric, hydrofluoric, sulfuric and phosphoric acids along with sulfur dioxide and sulfur trioxide. The two sorbing impinger solutions for the acid gases were 200 mL of a carbonate/bicarbonate solution containing hydrogen peroxide followed by a dry impinger and an impinger filled with silica gel. The sample train was operated according to the procedures detailed in EPA Reference Method 5.

Recovery procedures for the Anions train are presented below:

1 - Petri dish - Plastic - filter
1 - 500 mL plastic - H_2O PNR. Rinse front half of filter holder with H_2O into PNR bottle.
1 - 1,000 mL plastic - Impinger contents. Pour the contents of the first three impingers into sample bottle. Rinse back half of filter holder, connecting glassware and impingers with H_2O into sample bottle.

Preservation - Keep cold (< 4°C)

Volatile Organics

The volatile component determinations were performed using a volatile organic sampling train (VOST).[11] In VOST, volatile organics were removed from the sample gas by sorbent traps maintained at 20°C. The first resin trap contained Tenax and the second trap contained Tenax followed by petroleum-based charcoal. A dry gas meter was used to measure the volume of gas passed through the pair of traps. Sample volumes of 20 liters were collected on separate pairs of traps with a 0.5 liter per minute sampling rate. The samples were collected at a fixed point in the stack where the velocity matches the average gas velocity.

The VOST consisted of a quartz probe, water-cooled condensers, sorbent traps, and sample gas metering system. During sample collection, the Tenax traps were maintained at 20°C. To further increase the collection efficiency, the sample gas was cooled and dried by passing it through a water-cooled condenser prior to its contact with the sorbent trap.

Before the initial assembly of the sampling train, all sample-contacting components were cleaned with non-ionic detergent, rinsed in HPLC-grade distilled water, and dried at 100°C. The resin traps were stored in clean glass containers with Teflon-lined screw caps, the condensers and other glassware were covered with appropriate end caps prior to use.

Before use, the traps, the Teflon-filled ceramic ferules, and the hardware used in connecting the traps, were conditioned. The virgin Tenax and the charcoal were Soxhlet extracted with methanol. After the resins were dried under infrared lamps, they were placed in a vacuum oven for six hours at 50°C. The tubes were packed individually and thermally conditioned for 12 hours at 200°C with organic free nitrogen at a rate of 40 mL/min. To check for emissions of volatile organic compounds, a tube from each batch was tested as a blank.

Leak checks were performed before and after collection of each pair of resin traps. After the post-collection leak check had been completed, the traps were sealed with end caps and returned to their respective glass containers for storage and transport. During storage and transportation, the traps were kept cool (< 4°C).

Aldehydes

Aldehydes were collected using a 2,4-dinitrophenylhydrazine (DNPH) train according to EPA Method 0011.[12] Sample collection was performed isokinetically following the procedures detailed in EPA Method 5. The impinger solutions were combined into one sample along with the methylene chloride glassware rinse. The solutions were sealed in amber glass containers with Teflon closures and stored at 4°C.

Semivolatile Compounds

Semivolatile organics (SVs) determinations were performed using a Modified Method 5 (MM5)[13] sampling train. The probe washes, filter catches, XAD sorbent traps, and aqueous condensates were extracted and analyzed for SVs according to SW-846 Method 8270 protocol. The MM5 sampling system consisted of a heated probe, heated filter, sorbent module, and pumping and metering unit. A gooseneck nozzle of an appropriate diameter to allow isokinetic sample collection was attached to the probe. S-type Pitot tube differential pressure was monitored to determine the isokinetic sampling rate.

From the heated filter, sample gas entered the sorbent module. The sorbent module consisted of a water-cooled condenser followed by the XAD-2 resin trap. After the resin trap was a dry, modified Greenburg-Smith impinger which collected the aqueous condensate. The stem of this impinger was short to reduce carryover of collected aqueous condensate. Following the condensate trap were two water impingers that collected any mist carryover from the condensate trap, and a final impinger containing silica gel to dry the sample gas before metering. A pump and dry gas meter were used to control and monitor the sample gas flow rate.

Sampling of the stack gases was conducted in accordance with the published MM5 protocol. The sampling rate for each train was between 0.5 and 1.0 dscfm. A minimum of 106 dscf was collected by each train over a minimum sampling period of two hours.

Sampling train preparation and sample retrieval were performed in a controlled environment to reduce the possibility of sample contamination. Prior to assembly, each component of the sampling train was thoroughly rinsed with methylene chloride.

After sample collection, the ends of the sampling train were sealed with solvent-rinsed foil and returned to the clean-up area for sample retrieval. The filter was recovered and placed in a methylene chloride-rinsed glass petri dish. Aqueous condensate collected in the first two impingers and in the sorbent trap was transferred to methylene chloride-rinsed amber glass bottles with Teflon-lined screw cap closures. All components of the sampling train, from the nozzle through the sorbent module, including the probe, filter glassware, and impinger glassware were rinsed thoroughly with a solution of methylene chloride. The probe was cleaned using a nylon brush followed by rinsing with a methylene chloride. The probe rinse and glassware rinses were combined with the recovered condensate sample. The XAD-2 resin cartridges were sealed and transferred to the laboratory intact. The recovery procedures are outlined below:

1 - Petri dish - glass - filter
1 - 500 mL glass - $MeCl_2$ PNR. Rinse front half of filter holder with $MeCl_2$ into PNR bottle.

1 - XAD Resin Cartridge
1 - 500 mL glass - Condensate. Pour the contents of the first two impingers into bottle. Discard third impinger H_2O_2 solution.
1 - 500 mL glass - $MeCl_2$ Train Rinse. Rinse back half of filter holder, condenser, connecting glassware and impingers 1 and 2 with $MeCl_2$ into sample bottle.

Preservation - Keep cold ($< 4°C$)

Dioxins and Furans

Sampling for the collection of dioxins and furans present in the selected gas stream was performed using EPA Reference Method 23.[14] Sample collection procedures specified in Method 23 were followed with the following exception:

- All train component rinses were performed with methylene chloride and acetone. An additional toluene rinse was then performed and added to the respective front half and back half acetone/methylene chloride rinse samples.

Sample rate, volume and procedures were identical to the MM5 procedures described above.

Ammonia

Sample collection for the determination of ammonia present in the gas streams was performed in conjunction with the anions sampling train. Similarly as with the anions sample train, gas was extracted isokinetically through a glass fiber filter then directed to an impinger train which contains the collection solution. For the collection of ammonia, dilute sulfuric acid was placed in the first two impingers of the condenser assembly. Recovery procedures for the ammonia train are presented below:

1 - 1,000 mL plastic - Impinger contents. Pour the contents of the first three impingers into sample bottle. Rinse connecting glassware and impingers with H_2O into sample bottle.

Hydrogen Cyanide

Sample collection for the determination of hydrogen cyanide present in the gas streams was performed in conjunction with the ammonia sampling train. Gas was extracted isokinetically through a glass fiber filter then directed to an impinger train which contains the collection solution. For the collection of cyanide, dilute zinc acetate solution was placed in the third and fourth impingers of the ammonia train. Recovery procedures for the hydrogen cyanide portion of the train are presented below:

1 - 1,000 mL glass - Impinger contents. Pour the contents of the first three impingers into sample bottle. Rinse connecting glassware and impingers with H_2O into sample bottle.

Radionuclides

Flue gas particulate samples for radionuclide analysis were collected using the approach defined by EPA Reference Methods 5 and 17 with one exception. The samples were collected at a single point in the duct representative of the average flue gas velocity. Filter samples were stored and transported in plastic petri dishes and thimbles were contained in plastic bottles.

Extractable Metals

Separate samples for extractable metals content were also collected using the single point isokinetic approach described for radionuclide sample collection. Quartz-fiber filter media was used to reduce the background metals contribution associated with glass fiber filters. Filter samples were stored and transported in glass petri dishes and thimbles were contained in glass bottles.

Vapor-Phase Mercury by Charcoal Sorption

Sampling for mercury speciation was performed using a sample train designed by Nicolas Bloom.[15] The sampling train consists of a quartz probe, tandem pair of soda-lime traps, tandem iodated carbon traps, drierite cartridge and mass flow metering system. The sample train was assembled outside of the stack and leak checked to verify the sample integrity. The probe tip was placed at a single point in the stack that was determined to be representative of normal flow, based upon preliminary velocity measurements. The sample was extracted from the source with the sample rate adjusted to provide a 100 Liter sample collected over a minimum of two hours. At the completion of sampling, the train was leak checked and the sorbent tubes and probe liner recovered. Sorbent tubes were segregated based upon run and location and sealed in plastic bags for transport to the laboratory.

Chrome VI

Samples were collected via the BIF method for chromium (VI).[16] This method used a nozzle, teflon lines, peristaltic pump for recirculating solution and impinger solutions. The impinger contained a known volume of 10 N potassium hydroxide. Samples were collected isokinetically from the outlet stack using the sampling procedures detailed in EPA Reference Method 5. At the completion of the sample collection period, the sample train was purged with ultrapure nitrogen prior to the recovery of the sample. The impinger solutions were recovered from the sample train, filtered, then transported to the on-site laboratory for analysis. All of the train components were rinsed with 0.1N nitric acid and the rinse was retained for total chromium analysis.

Solid Sampling Procedures

Dry solid stream samples (raw coal, boiler feed coal, pulverizer rejects, limestone, and ESP hopper ash) were collected using grab sampling techniques. Individual grab samples of each stream were collected hourly throughout each test run and composited to generate a representative, time-averaged composite sample. Composite samples of raw coal, boiler feed coal, pulverizer rejects, and raw limestone were riffled and split to produce a 1 kilogram (minimum) sample which was placed in a plastic bag and sealed for transportation to the laboratory.

Two composite samples of dry fly ash, one for each ESP field, were prepared from individual grab samples collected from ESP hoppers 1-4, and 5-8. For purposes of compositing, the mass distribution and removal efficiency were assumed to be uniform across the ESP inlet duct and across each bank of ESP ash hoppers. Consequently, the ash collected from each of the four hoppers in the same field were composited equally. Each composite sample was thoroughly mixed and stored in pre-cleaned glass bottles (for analysis of organic compounds), or in plastic bottles. Samples collected for organic compound analyses were refrigerated at 4°C and kept cool during transportation to the laboratory. No preservation was needed on samples for inorganic analyses.

Sluiced ash stream samples (bottom ash and ESP fly ash) were also collected using grab sampling techniques. Bottom ash, which is normally sluiced once per shift at Plant Yates, was sluiced prior to the beginning of each daily test run to remove accumulated ash material that was non-representative of the test period. Bottom ash sluicing operation was then secured immediately before, and throughout each daily test period. At the conclusion of each test period, sluicing operations were resumed while a sampler collected multiple grab samples with a polyethylene dipper. Samples were collected as long as there was visual evidence of bottom ash in the sluice water at concentrations high enough to warrant continued sampling.

These samples were composited directly into a large bucket where the ash was allowed to settle. After the ash had settled, the sluice water component was siphoned off to avoid disturbing the ash fines, and the wet ash mixed and bottled for storage and transportation to the laboratory. Samples for analysis of organic compounds were split from the composite sample and preserved in pre-cleaned, amber-glass containers by cooling to 4°C.

Sluiced fly ash from the ESP hoppers was collected in a manner similar to bottom ash, except sluicing operations were performed continuously to avoid ash buildup in the ESP. Since the ESP ash sluicing system was combined with the sluiced economizer and air preheater ash, the systems were isolated before the start of the test run to avoid bias in the ESP ash composite. Grab samples were collected hourly from the sluice water discharge pipe to the ash pond. Like bottom ash, the fly ash was allowed to settle, and the sluice water component siphoned off to avoid disturbing the ash fines. The wet ash was mixed and bottled for storage and transportation to the laboratory. Samples for analysis of organic compounds were split from the composite sample and preserved in pre-cleaned, amber-glass containers by cooling to 4°C.

Limestone and FGD slurry samples were collected using grab-tap sampling procedures. Sample taps were opened and allowed to purge immediately prior to collecting the process samples to insure representative sample collection. Hourly grab samples of limestone slurry were composited directly to a large container, and FGD slurry was filtered directly from the tap through a filter press. The limestone slurry composites were filtered after mixing. The recovered filter cakes were bottled for storage and transportation to the laboratory. Samples for analysis of organic compounds were split from the composite samples and preserved in pre-cleaned, amber-glass containers by cooling to 4°C. Sub-samples of the FGD solids composite were also taken for the on-site analysis of sulfite and sulfate ions.

Liquid Sampling Procedures

Liquid samples were collected from both filtered and unfiltered sources. Raw, unfiltered water streams consisted of ash pond water, recycled gypsum pond water, coal pile run-off, and cooling water at the inlet of the steam condenser. Filtered streams consisted of bottom ash and fly ash sluice water, and limestone and FGD slurry filtrates.

Raw water samples were sampled by grab-tap sampling techniques. Hourly grab samples were composited into appropriate sample containers and preserved as soon as possible after sample collection. In some cases the sample was added directly to sample bottles containing the preservative in order to reduce the loss of the more volatile species (e.g. NH_3, CN^-). Table B-2 presents the liquid sample preservation techniques for specific analytes.

Filtrate samples were collected as described in the corresponding sluice water or slurry stream. Sluice water that was siphoned from the settled ash material was filtered in its entirety, split into the appropriate sample containers, and preserved according to the techniques presented in Table B-2. Slurry filtrates were also split into appropriate containers and preserved in the same manner as sluice water filtrates.

Sluice water and slurry filtrate samples collected for the analysis of volatile organic compounds and aldehydes present the only exception to the sample collection procedures described above. Due to the volatility of these analytes, bottom ash sluice water, ESP fly ash sluice water, limestone slurry, and FGD slurry samples were collected for volatile organics directly into VOA vials without filtration, and chilled to 4°C.

References

1. 40 CFR 60, Appendix A. *Test Methods.* "Method 5: Determination of Particulate Emissions from Stationary Sources."

2. 40 CFR 60, Appendix A. *Test Methods.* "Method 17: Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)."

3. U.S. Environmental Protection Agency. "Method S007: Solid Grab Sample, Trowel (Scoop)," *Sampling and Analysis Methods for Hazardous Waste Combustion.* EPA-600/8-84-002 (February 1984).

4. U.S. Environmental Protection Agency. "Method S004: Liquid Grab Sample, Tap," *Sampling and Analysis Method for Hazardous Waste Combustion.* EPA-600/8-84-002 (February 1984).

5. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 0030: Volatile Organic Sampling Train," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed., Washington, D.C. (November 1986).

6. U.S. Environmental Protection Agency, Office of Solid Waste. "Method 0010: Modified Method 5 Sampling Train," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd. ed. Washington, D.C. (November 1986).

7. 40 CFR 266, Subpart H, "Method 29: Determination of Metals Emissions in Exhaust Gases from Hazardous Waste Incineration and Similar Combustion Processes: Proposed Method."

8. 40 CFR 60, Appendix A. *Test Methods.* "Method 5: Determination of Particulate Emissions from Stationary Sources."

9. 40 CFR 60, Appendix A. *Test Methods.* "Method 17: Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)."

10. 40 CFR 60, Appendix A. *Test Methods.* "Method 1: Sample and Velocity Traverses from Stationary Sources."

11. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 0030: Volatile Organic Sampling Train," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed., Washington, D.C. (November 1986).

12. 40 CFR 266, Appendix IX, Section 3.5. *Methods Manual for Compliance with the BIF Regulations.* "Sampling for Aldehyde and Ketone Emissions from Stationary Sources (Method 0011)."

13. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 0010: Modified Method 5 Sampling Train," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed., Washington, D.C. (November 1986).

14. 40 CFR 266, Appendix IX: *Methods Manual for Compliance with the BIF Regulations.* "Determination of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans from Stationary Sources (Method 23)."

15. Bloom, Nicolas S., Eric M. Prestbo, and Vesna L. Miklavicic. "Fluegas Mercury Emissions and Speciations from Fossil Fuel Combustion." Published in the proceedings of the Second International Conference on Managing Hazardous Air Pollutants. Sponsored by the Electric Power Research Institute. Washington, D.C. (July 1993).

16. 40 CFR 266, Appendix IX: *Methods Manual for Compliance with the BIF Regulations.* "Determination of Hexavalent Chromium Emissions from Stationary Sources (Method Cr^{6+})."

Table B-2
Preservation, Storage, and Holding Time Requirements for Liquid Samples

Analytical Parameter	Preservation and Storage Requirements	Maximum Holding Time (Days)
Volatile Organics	Cool 4°C; amber glass VOA vial	7 analyze
Semivolatile Organics	Cool 4°C; amber glass	14 extract, 40 analyze
Formaldehyde	Cool 4°C; amber glass	5 derivitize, 3 analyze
Soluble Metals	Filter on-site; HNO_3 pH < 2	6 months analyze[a]
Total Metals	HNO_3 pH <2; plastic	6 months analyze[a]
Anions	Cool 4°C; plastic	28 analyze
Phosphate	Cool 4°C; H_2SO_4 to pH <2	28 analyze
Sulfite	None; plastic	Analyze immediately
Ammonia	Cool 4°C; H_2SO_4 to pH <2	28 analyze
Cyanide	Cool 4°C; NaOH to pH >12	14 analyze

[a] Maximum holding time for Hg is 28 days.

Appendix C: SAMPLE CALCULATIONS

TABLE OF CONTENTS

A brief discussions of the data reduction procedures required to support this program is provided below. All calculations and data reduction procedures are compiled from 40 CFR Part 60, Appendix A for the specific Reference Methods. Included with each calculation is a brief definition of terms and general nomenclature utilized in the data reduction process.

Flow Rate Determination

The average gas velocity is determined from the gas density and from measurements of the average velocity head with a Pitot tube and inclined manometer.

Nomenclature

A = Cross sectional area of the stack or duct, (ft^2)

C_p = Pitot tube coefficient, dimensionless

MW_{dry} = Molecular weight of gas, dry basis, lb/lb-mole

MW_{wet} = Molecular weight of gas, moisture corrected, lb/lb-mole

P_{bar} = Uncorrected barometric pressure at test site, "Hg

P_g = Static pressure of gas, "Hg

P_s = Absolute pressure of gas, "Hg

ACFM = Effluent flow in actual feet per minute

SCFM = Effluent flow in standard cubic feet per minute

DSCFM = Effluent flow in dry standard cubic feet per minute

T_s = Average gas temperature, °F

Vel = Average gas velocity in feet per second

ΔP = Velocity Head of gas, "H_2O

ave ΔP = Average square root of the velocity head, "H_2O

% CO_2 = Percent carbon dioxide by volume, dry basis

% O_2 = Percent oxygen by volume, dry basis

% H_2O = Percent moisture of gas stream

Calculations

Stack Pressure:

$$P_s = P_{bar} + \left(\frac{P_g}{13.6}\right) \tag{C-1}$$

Molecular Weight - Dry Basis:

$$MW_{dry} = 0.44\ (\%\,CO_2) + 0.32\ (\%\,O_2) + 0.28\ (100 - \%\,CO_2 - \%\,O_2) \tag{C-2}$$

Molecular Weight - Wet Basis:

$$MW_{wet} = MW_{dry}\ x \left[\frac{(1 - \%\,H_2O)}{100}\right] + 0.18\ x\ (\%\,H_2O) \tag{C-3}$$

Velocity (fps):

$$VPS = 85.49\ x\ C_p\ x\ (ave\ \sqrt{\Delta P})\ x\ \sqrt{\frac{T_s + 460}{P_s\ x\ MW_{wet}}} \tag{C-4}$$

Flow Rate (ACFM):

$$ACFM = (VPS)\ x\ (A)\ x\ 60 \tag{C-5}$$

Flow Rate (SCFM):

$$SCFM = 17.64\ x \left[\frac{P_s}{(T_s + 460)}\right] x\ ACFM \tag{C-6}$$

Flow Rate (DSCFM):

$$\text{DSCFM} = 17.64 \times \left[\frac{100 - \%H_2O}{100}\right] \times \left[\frac{P_s}{(T_s + 460)}\right] \times \text{ACFM} \qquad \text{(C-7)}$$

Moisture Determination

A gas sample is extracted from the source and moisture is removed from the sample stream and determined gravimetrically.

Nomenclature

B_{wo} = Water vapor in gas stream, proportion by volume

P_{bar} = Uncorrected barometric pressure at test location, "Hg

T_m = Average dry gas meter temperature, °F

V_m = Volume of gas sampled as measured by dry gas meter, acf

V_{mstd} = Volume of gas sampled, corrected to standard conditions, dscf

V_{H2O} = Volume of condensate collected in the condenser system, (mL)

V_w = Volume of water vapor

Y_d = Dry gas meter calibration factor

DH = Average pressure differential, "H_2O

Volume of Water Vapor:

$$V_w = 0.04707 \times (V_{H2O}) \qquad \text{(C-8)}$$

Standard Sample Volume:

$$V_{MSTD} = 17.64\ (Y_d)\ (V_m) \times \left[\frac{P_{bar} + (\Delta H/13.6)}{T_m + 460}\right] \qquad \text{(C-9)}$$

Water Vapor Fraction:

$$B_{wo} = \frac{V_w}{(V_w) + (V_{mstd})} \qquad \text{(C-10)}$$

Percent Moisture:

$$\%\ \text{Moisture} = B_{wo} \times 100 \qquad \text{(C-11)}$$

Particulate Emission Determination

Particulate matter is extracted isokinetically from a source and collected on a heated substrate and condensed in the impinger train. The particulate mass is determined gravimetrically after removal of uncombined water.

A_n = Area of nozzle (ft^2)

B_{wo} = Water vapor in gas stream, proportional by volume

C_{part} = Particulate mass collected, mg

DH = Average orifice pressure drop, "H_2O

DSCFM = Effluent flow, dry standard cubic feet per minute

P_{bar} = Uncorrected barometric pressure at test location, "Hg

P_s = Absolute pressure of gas, "Hg

T = Total sample time, minutes

T_m = Average dry gas meter temperature, °F

T_s = Average gas temperature, °F

V_{H2O} = Volume of condensate collected, mL

V_m = Volume of gas sampled as measured by dry gas meter, acf

V_{mstd} = Volume of gas sampled, corrected to standard conditions, dscf

Vel = Average duct velocity, feet per second

Y_d = Dry gas meter calibration factor

% I = Isokinetic sampling rate

Calculations

Dry Gas Volume:

$$V_{MSTD} = 17.64 \, (Y_d) \, (V_m) \times \left[\frac{P_{bar} + (\Delta H/13.6)}{T_m + 460} \right] \quad \text{(C-12)}$$

Percent Isokinetic:

$$\% \, I = 0.09450 \times \frac{\left[(T_s + 460) \times (V_{mstd})\right]}{(T) \times (V_s) \times (P_s) \times (A_n) \times (1 - B_{wo})} \quad \text{(C-13)}$$

Particulate Concentration:

$$\text{gr/dscf} = \frac{C(\text{part}) \times 0.0154}{V_{mstd}} \quad \text{(C-14)}$$

Particulate Emission:

$$\text{lb/hr} = \frac{(\text{gr/dscf}) \times \text{DSCFM} \times 60}{7000} \quad \text{(C-15)}$$

PLANT YATES
ESP INLET/ALDEHYDES

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1310	0735	0720	-
Time Finish	1345	0805	0750	-
Operator	MKO	MKO	MKO	-
Initial Leak Rate	0.008	0.008	0.009	-
Final Leak Rate	0.009	0.006	0.007	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.009	1.009	1.009	-
Nozzle Diameter (inches)	0.2750	0.2750	0.2750	-
Barometric Pressure ("Hg)	29.51	29.40	29.39	29.43
Static Pressure ("H2O)	-6.4	-6.2	-6.0	-6.2
Meter Volume (acf)	12.281	10.395	10.275	10.984
Average square root of delta p	0.3230	0.3580	0.3132	0.3314
Average delta H (" H2O)	0.39	0.48	0.37	0.41
Average Stack Temperature (F)	315	311	314	313
Average DGM Temp (F)	79.9	76.9	77.7	78.2
Test Duration (minutes)	35.0	30.0	30.0	31.7
% CO2	10.5	10.2	10.8	10.5
% O2	8.5	8.6	8.3	8.5
% N2	81.0	81.2	80.9	81.0
Meter Volume (dscf)	11.964	10.148	10.009	10.707
Flue Gas Moisture (%)	7.9	8.0	8.3	8.1
Gas Molecular Weight (Wet) (g/g-mole)	29.07	29.02	29.06	29.05
Absolute Stack Pressure (" Hg)	29.04	28.94	28.95	28.98
Absolute Stack Temperature (R)	775	771	774	773
Average Gas Velocity (f/sec)	22.22	24.63	21.57	22.81
Avg Flow Rate (acfm)	645,978	716,039	627,156	663,058
Avg Flow Rate (dscfm)	393,345	436,243	379,432	403,007
Isokinetic Sampling Rate (%)	102.10	91.10	103.31	98.83

PLANT YATES
ESP INLET/MODIFIED METHOD 5

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1255	0729	707	-
Time Finish	1815	1341	1250	-
Operator	JWM	JWM	JWM	-
Initial Leak Rate	0.012	0.010	0.008	-
Final Leak Rate	0.015	0.018	0.014	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.999	0.999	0.999	-
Nozzle Diameter (inches)	0.3580	0.3580	0.3580	-
Barometric Pressure ("Hg)	29.51	29.40	29.39	29.43
Static Pressure ("H2O)	-6.4	-6.2	-6.0	-6.2
Meter Volume (acf)	103.779	115.043	111.153	109.992
Average square root of delta p	0.2399	0.2651	0.2470	0.2507
Average delta H (" H2O)	0.74	0.85	0.74	0.78
Average Stack Temperature (F)	295	304	300	300
Average DGM Temp (F)	85.4	84.7	87.1	85.7
Test Duration (minutes)	240.0	240.0	240.0	240.0
Condensed Water (g)	180.8	202.6	203.5	195.6
% CO2	10.5	10.2	10.8	10.5
% O2	8.5	8.6	8.3	8.5
% N2	81.0	81.2	80.9	81.0
Meter Volume (dscf)	99.183	109.693	105.460	104.779
Flue Gas Moisture (%)	7.9	8.0	8.3	8.1
Gas Molecular Weight (Wet) (g/g-mole)	29.07	29.02	29.05	29.05
Absolute Stack Pressure (" Hg)	29.04	28.94	28.95	28.98
Absolute Stack Temperature (R)	755	764	760	760
Average Gas Velocity (f/sec)	16.30	18.15	16.86	17.10
Avg Flow Rate (acfm)	473,726	527,730	490,232	497,230
Avg Flow Rate (dscfm)	295,838	324,601	301,800	307,413
Isokinetic Sampling Rate (%)	96.84	97.61	100.93	98.46

PLANT YATES
ESP INLET/PSD

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1555	0925	0935	-
Time Finish	1740	1145	1130	-
Operator	MKO	MKO	MKO	-
Initial Leak Rate	0.015	0.018	0.016	-
Final Leak Rate	NA	NA	NA	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.988	0.988	0.988	-
Nozzle Diameter (inches)	0.2750	0.2750	0.2750	-
Barometric Pressure ("Hg)	29.51	29.40	29.39	29.43
Static Pressure ("H2O)	-6.4	-6.2	-6.0	-6.2
Meter Volume (acf)	30.730	43.462	40.653	38.282
Average square root of delta p	0.2650	0.2828	0.2915	0.2798
Average delta H (" H2O)	0.27	0.31	0.31	0.30
Average Stack Temperature (F)	318	320	318	319
Average DGM Temp (F)	84.8	85.0	94.0	87.9
Test Duration (minutes)	105.0	140.0	115.0	120.0
% CO2	10.5	10.2	10.8	10.5
% O2	8.5	8.6	8.3	8.5
% N2	81.0	81.2	80.9	81.0
Meter Volume (dscf)	29.041	40.910	37.631	35.861
Flue Gas Moisture (%)	7.9	8.0	8.3	8.1
Gas Molecular Weight (Wet) (g/g-mole)	29.07	29.02	29.06	29.05
Absolute Stack Pressure (" Hg)	29.04	28.94	28.95	28.98
Absolute Stack Temperature (R)	778	780	778	779
Average Gas Velocity (f/sec)	18.27	19.57	20.13	19.32
Avg Flow Rate (acfm)	531,075	568,922	585,210	561,736
Avg Flow Rate (dscfm)	322,049	342,614	352,234	338,966
Isokinetic Sampling Rate (%)	100.90	100.20	109.14	103.42

PLANT YATES
ESP INLET/VOST

Run No.	1A	1B	1C	2A	2B	2C	3A	3B	3C	Average
Date	6/21/93	6/21/93	6/21/93	6/22/93	6/22/93	6/22/93	6/23/93	6/23/93	6/23/93	-
Time Start	1400	1455	1550	0742	0910	1001	0742	0840	0932	-
Time Finish	1440	1535	1630	0822	0950	1041	0822	0920	1012	-
Operator	RVW	RVW	RVW	RVW	RVW	RVW	RVW	RVW	RVW	-
Initial Leak Rate	0.00 @ 17"	0.00 @ 15	0.00 @ 18	0.00 @ 17	0.00 @ 16	0.00 @ 15	0.00 @ 16	0.00 @ 15	0.00 @ 18	-
Final Leak Rate	0.00 @ 16"	0.00 @ 17	0.00 @ 15	0.00 @ 15	0.00 @ 16	0.00 @ 16	0.00 @ 15	0.00 @ 15	0.00 @ 16	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	8.5 x 57	8.5 x 57	8.5 x 57	8.5 x 57	8.5 x 57	8.5 x 57	-
Dry Gas Meter Calibration (Yd)	1.0113	1.0113	1.0113	1.0113	1.0113	1.0113	1.0113	1.0113	1.0113	-
Barometric Pressure ("Hg)	29.51	29.51	29.51	29.40	29.40	29.40	29.39	29.36	29.36	29.45
Static Pressure ("H2O)	-6.4	-6.4	-6.4	-6.2	-6.2	-6.2	-6.0	-6.0	-6.0	-6.3
Meter Volume (aL)	20.235	20.150	20.115	20.045	20.030	20.050	20.040	20.075	20.080	20.095
Average delta H (" H2O)	1.40	1.40	1.50	1.40	1.40	1.40	1.50	1.40	1.40	1.43
Average Stack Temperature (F)	295	295	295	304	304	304	300	300	300	300
Average DGM Temp (C)	26.3	28.5	29.7	24.0	26.7	29.3	25.6	29.4	31.8	27.2
Test Duration (minutes)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
% CO2	10.5	10.5	10.5	10.2	10.2	10.2	10.8	10.8	10.8	10.4
% O2	8.5	8.5	8.5	8.6	8.6	8.6	8.3	8.3	8.3	8.5
% N2	81.0	81.0	81.0	81.2	81.2	81.2	80.9	80.9	80.9	81.1
Meter Volume (dsL)	19.845	19.615	19.503	19.731	19.542	19.391	19.621	19.400	19.254	19.607
Flue Gas Moisture (%)	7.9	7.9	7.9	8.0	8.0	8.0	8.3	8.3	8.3	8.0
Gas Molecular Weight (Wet) (g/g-mole)	29.07	29.07	29.07	29.02	29.02	29.02	29.06	29.06	29.06	29.05
Absolute Stack Pressure (" Hg)	29.04	29.04	29.04	28.94	28.94	28.94	28.95	28.92	28.92	28.99
Absolute Stack Temperature (R)	755	755	755	764	764	764	760	760	760	760

PLANT YATES
ESP INLET/MULTI-METALS - PARTICULATE

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0800	0935	0848	-
Time Finish	1405	1611	1405	-
Operator	JWM	JWM	JWM	-
Initial Leak Rate	0.014	0.006	0.017	-
Final Leak Rate	0.016	0.012	0.015	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.999	0.999	0.999	-
Nozzle Diameter (inches)	0.3580	0.3580	0.3580	-
Barometric Pressure ("Hg)	29.55	29.56	29.40	29.50
Static Pressure ("H2O)	-5.8	-5.8	-5.9	-5.8
Meter Volume (acf)	111.213	110.002	111.690	110.968
Average square root of delta p	0.2403	0.2490	0.2524	0.2472
Average delta H (" H2O)	0.77	0.74	0.76	0.76
Average Stack Temperature (F)	301	299	303	301
Average DGM Temp (F)	84.0	87.0	90.0	87.0
Test Duration (minutes)	240.0	240.0	240.0	240.0
Condensed Water (g)	201.0	244.0	252.2	232.4
Filter Weight Gain (g)	21.4931	24.9809	26.2059	24.2266
PNR Weight Gain (g)	1.8780		0.3098	1.0939
% CO2	10.1	10.5	11.8	10.8
% O2	9.9	8.8	7.0	8.6
% N2	80.0	80.7	81.2	80.6
Meter Volume (dscf)	106.704	104.991	105.454	105.716
Flue Gas Moisture (%)	8.2	9.9	10.1	9.4
Gas Molecular Weight (Wet) (g/g-mole)	29.03	28.84	28.93	28.94
Absolute Stack Pressure (" Hg)	29.12	29.13	28.97	29.07
Absolute Stack Temperature (R)	761	759	763	761
Average Gas Velocity (f/sec)	16.37	16.99	17.29	16.89
Avg Flow Rate (acfm)	475,917	494,021	502,740	490,893
Avg Flow Rate (dscfm)	295,051	301,434	302,524	299,670
Isokinetic Sampling Rate (%)	104.46	100.61	100.69	101.92
Particulate Concentration (gr/dscf)	3.38E+00	3.67E+00	3.88E+00	3.64E+00
Particulate Concentration (lbs/dscf)	4.83E-04	5.25E-04	5.54E-04	5.21E-04
Particulate Emission (grams/sec)	1,077	1,196	1,268	1,180
Particulate Emission (lbs/hour)	8,550	9,489	10,064	9,367

PLANT YATES
ESP INLET/ANIONS

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	1225	1108	0715	-
Time Finish	1405	1213	0837	-
Operator	MKO	MKO	MKO	-
Initial Leak Rate	0.010	0.004	0.009	-
Final Leak Rate	0.004	0.009	0.006	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.003	1.003	1.003	-
Nozzle Diameter (inches)	0.3750	0.3750	0.3750	-
Barometric Pressure ("Hg)	29.55	29.56	29.40	29.50
Static Pressure ("H2O)	-5.8	-5.8	-5.4	-5.7
Meter Volume (acf)	64.816	44.245	45.140	51.400
Average square root of delta p	0.3161	0.3201	0.2783	0.3048
Average delta H (" H2O)	1.36	1.41	0.99	1.25
Average Stack Temperature (F)	290	282	310	294
Average DGM Temp (F)	85.0	88.0	76.0	83.0
Test Duration (minutes)	100.0	65.0	82.0	82.3
% CO2	10.1	10.5	11.8	10.8
% O2	9.9	8.8	7.0	8.6
% N2	80.0	80.7	81.2	80.6
Meter Volume (dscf)	62.414	42.391	43.933	49.579
Flue Gas Moisture (%)	8.2	9.9	10.1	9.4
Gas Molecular Weight (Wet) (g/g-mole)	29.03	28.84	28.94	28.94
Absolute Stack Pressure (" Hg)	29.12	29.13	29.00	29.09
Absolute Stack Temperature (R)	750	742	770	754
Average Gas Velocity (f/sec)	21.38	21.59	19.14	20.71
Avg Flow Rate (acfm)	621,544	627,741	556,462	601,915
Avg Flow Rate (dscfm)	390,837	392,000	332,388	371,741
Isokinetic Sampling Rate (%)	100.90	105.11	101.84	102.62

PLANT YATES
ESP INLET/AMMONIA-CYANIDE

Run No.	1	2	3	4	Average
Date	6/25/93	6/26/93	6/26/93	06/27/93	-
Time Start	1450	0930	1420	0920	-
Time Finish	1650	1035	1520	1040	-
Operator	MKO	MKO	MKO	MKO	-
Initial Leak Rate	0.010	0.009	0.009	0.006	-
Final Leak Rate	0.009	0.006	0.006	0.004	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.003	1.003	1.003	1.003	-
Nozzle Diameter (inches)	0.3750	0.3750	0.3750	0.3750	-
Barometric Pressure ("Hg)	29.55	29.56	29.56	29.40	29.56
Static Pressure ("H2O)	-5.8	-5.8	-5.8	-5.9	-5.8
Meter Volume (acf)	46.663	41.622	41.654	46.885	43.313
Average square root of delta p	0.3122	0.3122	0.3077	0.2871	0.3107
Average delta H (" H2O)	1.33	1.31	1.34	1.09	1.33
Average Stack Temperature (F)	289	283	284	315	285
Average DGM Temp (F)	88.0	80.0	94.0	83.0	87.3
Test Duration (minutes)	70.0	65.0	60.0	80.0	65.0
% CO2	10.1	10.5	10.5	11.8	10.4
% O2	9.9	8.8	8.8	7.0	9.2
% N2	80.0	80.7	80.7	81.2	80.5
Meter Volume (dscf)	44.684	40.459	39.470	45.054	41.538
Flue Gas Moisture (%)	8.2	9.9	9.9	10.1	9.3
Gas Molecular Weight (Wet) (g/g-mole)	29.03	28.84	28.84	28.94	28.90
Absolute Stack Pressure (" Hg)	29.12	29.13	29.13	28.97	29.13
Absolute Stack Temperature (R)	749	743	744	775	745
Average Gas Velocity (f/sec)	21.10	21.08	20.79	19.82	20.99
Avg Flow Rate (acfm)	613,466	612,867	604,440	576,283	610,258
Avg Flow Rate (dscfm)	386,272	381,939	376,181	341,573	381,464
Isokinetic Sampling Rate (%)	104.41	102.97	110.49	104.17	105.95

PLANT YATES
ESP INLET/RADIONUCLIDES

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0745	1540	1120	-
Time Finish	0907	1700	1240	-
Operator	MKO	MKO	MKO	-
Initial Leak Rate	0.009	0.010	0.007	-
Final Leak Rate	0.006	0.009	0.004	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.009	1.009	1.003	-
Nozzle Diameter (inches)	0.3750	0.3750	0.3750	-
Barometric Pressure ("Hg)	29.55	29.56	29.40	29.50
Static Pressure ("H2O)	-5.8	-5.8	-5.9	-5.8
Meter Volume (acf)	53.605	45.950	45.096	48.217
Average square root of delta p	0.3300	0.2905	0.2737	0.2981
Average delta H (" H2O)	1.48	1.10	0.96	1.18
Average Stack Temperature (F)	301	317	316	311
Average DGM Temp (F)	82.0	97.0	93.0	90.7
Test Duration (minutes)	82.0	80.0	80.0	80.7
% CO2	10.1	10.5	11.8	10.8
% O2	9.9	8.8	7.0	8.6
% N2	80.0	80.7	81.2	80.6
Meter Volume (dscf)	52.231	43.540	42.537	46.103
Flue Gas Moisture (%)	8.2	9.9	10.1	9.4
Gas Molecular Weight (Wet) (g/g-mole)	29.03	28.84	28.94	28.94
Absolute Stack Pressure (" Hg)	29.12	29.13	28.97	29.07
Absolute Stack Temperature (R)	761	777	776	771
Average Gas Velocity (f/sec)	22.48	20.06	18.91	20.49
Avg Flow Rate (acfm)	653,616	583,171	549,740	595,509
Avg Flow Rate (dscfm)	405,064	347,529	325,421	359,338
Isokinetic Sampling Rate (%)	99.35	98.94	103.23	100.51

PLANT YATES
ESP INLET/S.F. PARTICULATE

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0800	0915	0740	-
Time Finish	1020	1125	0955	-
Operator	MKO	MKO	RVW	-
Initial Leak Rate	0.009	0.017	0.014	-
Final Leak Rate	NA	NA	NA	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.988	1.009	1.009	-
Nozzle Diameter (inches)	0.2750	0.2750	0.2750	-
Barometric Pressure ("Hg)	29.55	29.56	29.40	29.50
Static Pressure ("H2O)	-5.8	-5.8	-5.9	-5.8
Meter Volume (acf)	41.161	43.983	42.677	42.607
Average *square root of delta p*	0.2826	0.3289	0.2871	0.2995
Average delta H (" H2O)	0.31	0.41	0.32	0.35
Average Stack Temperature (F)	288	311	313	304
Average DGM Temp (F)	81.0	83.8	82.0	82.3
Test Duration (minutes)	130.0	120.0	135.0	128.3
% CO2	10.1	10.5	11.8	10.8
% O2	9.9	8.8	7.0	8.6
% N2	80.0	80.7	81.2	80.6
Meter Volume (dscf)	39.229	42.615	41.253	41.032
Flue Gas Moisture (%)	8.2	9.9	10.1	9.4
Gas Molecular Weight (Wet) (g/g-mole)	29.03	28.84	28.94	28.94
Absolute Stack Pressure (" Hg)	29.12	29.13	28.97	29.07
Absolute Stack Temperature (R)	748	771	773	764
Average Gas Velocity (f/sec)	19.09	22.62	19.80	20.50
Avg Flow Rate (acfm)	554,932	657,618	575,539	596,030
Avg Flow Rate (dscfm)	349,883	395,047	342,015	362,315
Isokinetic Sampling Rate (%)	101.33	105.61	104.97	103.97

PLANT YATES
ESP INLET/EXTRACTABLE METALS

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0945	1345	1300	-
Time Finish	1045	1505	1410	-
Operator	MKO	RVW	MKO	-
Initial Leak Rate	0.001	0.010	0.009	-
Final Leak Rate	0.004	0.007	0.006	-
Duct Dimensions (ft)	8.5 x 57	8.5 x 57	8.5 x 57	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.009	1.009	1.003	-
Nozzle Diameter (inches)	0.3750	0.3750	0.3750	-
Barometric Pressure ("Hg)	29.55	29.56	29.40	29.50
Static Pressure ("H2O)	-5.8	-5.8	-5.9	-5.8
Meter Volume (acf)	43.420	43.280	44.144	43.615
Average square root of delta p	0.3606	0.2676	0.3081	0.3121
Average delta H (" H2O)	1.75	0.96	1.22	1.31
Average Stack Temperature (F)	296	323	316	312
Average DGM Temp (F)	85.0	92.9	94.0	90.6
Test Duration (minutes)	60.0	80.0	70.0	70.0
% CO2	10.1	10.5	11.8	10.8
% O2	9.9	8.8	7.0	8.6
% N2	80.0	80.7	81.2	80.6
Meter Volume (dscf)	42.102	41.299	41.591	41.664
Flue Gas Moisture (%)	8.2	9.9	10.1	9.4
Gas Molecular Weight (Wet) (g/g-mole)	29.03	28.84	28.94	28.94
Absolute Stack Pressure (" Hg)	29.12	29.13	28.97	29.07
Absolute Stack Temperature (R)	756	783	776	772
Average Gas Velocity (f/sec)	24.49	18.55	21.29	21.44
Avg Flow Rate (acfm)	711,874	539,201	618,835	623,303
Avg Flow Rate (dscfm)	444,085	318,945	366,321	376,451
Isokinetic Sampling Rate (%)	99.83	102.26	102.48	101.52

PLANT YATES
ESP OUTLET/MODIFIED METHOD 5

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1249	0753	0712	-
Time Finish	1812	1247	1129	-
Operator	TJB	TJB	TJB	-
Initial Leak Rate	0.005	0.003	0.002	-
Final Leak Rate	0.005	0.005	0.005	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.997	0.997	0.997	-
Nozzle Diameter (inches)	0.1970	0.1970	0.1970	-
Barometric Pressure ("Hg)	29.51	29.40	29.36	29.42
Static Pressure ("H2O)	-11	-11	-11	-11
Meter Volume (acf)	126.423	127.680	118.467	124.190
Average square root of delta p	0.9096	0.9306	0.8958	0.9120
Average delta H (" H2O)	0.93	0.94	0.82	0.90
Average Stack Temperature (F)	280	280	275	278
Average DGM Temp (F)	86.5	84.6	83.5	84.9
Test Duration (minutes)	240.0	240.0	240.0	240.0
Condensed Water (g)	207.6	212.4	211.2	210.4
% CO2	11.1	11.2	10.6	11.0
% O2	8.0	7.9	8.5	8.1
% N2	80.9	80.9	80.9	80.9
Meter Volume (dscf)	120.387	121.556	112.827	118.256
Flue Gas Moisture (%)	7.5	7.6	8.1	7.8
Gas Molecular Weight (Wet) (g/g-mole)	29.19	29.19	29.06	29.14
Absolute Stack Pressure (" Hg)	28.70	28.59	28.55	28.61
Absolute Stack Temperature (R)	740	740	735	738
Average Gas Velocity (f/sec)	61.39	62.93	60.55	61.62
Avg Flow Rate (acfm)	470,365	482,150	463,880	472,132
Avg Flow Rate (dscfm)	297,590	303,573	292,059	297,741
Isokinetic Sampling Rate (%)	101.70	100.67	97.12	99.83

PLANT YATES
ESP OUTLET/ALDEHYDES

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1232	0719	0655	-
Time Finish	1447	0928	0909	-
Operator	APE	APE	APE	-
Initial Leak Rate	0.010	0.002	0.007	-
Final Leak Rate	0.005	0.002	0.005	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.992	0.992	0.992	-
Nozzle Diameter (inches)	0.1900	0.1910	0.1910	-
Barometric Pressure ("Hg)	29.51	29.40	29.36	29.42
Static Pressure ("H2O)	-11	-11	-11	-11
Meter Volume (acf)	66.723	66.100	67.250	66.691
Average square root of delta p	0.8750	0.9583	0.9487	0.9273
Average delta H (" H2O)	0.78	0.89	0.81	0.82
Average Stack Temperature (F)	280	275	270	275
Average DGM Temp (F)	82.0	87.8	87.9	85.9
Test Duration (minutes)	135.0	129.0	135.0	133.0
% CO2	11.1	11.2	10.6	11.0
% O2	8.0	7.9	8.5	8.1
% N2	80.9	80.9	80.9	80.9
Meter Volume (dscf)	63.719	62.240	63.213	63.057
Flue Gas Moisture (%)	7.5	7.6	8.1	7.7
Gas Molecular Weight (Wet) (g/g-mole)	29.19	29.19	29.06	29.15
Absolute Stack Pressure (" Hg)	28.70	28.59	28.55	28.61
Absolute Stack Temperature (R)	740	735	730	735
Average Gas Velocity (f/sec)	59.06	64.58	63.90	62.51
Avg Flow Rate (acfm)	452,448	494,802	489,582	478,944
Avg Flow Rate (dscfm)	286,337	313,723	310,413	303,491
Isokinetic Sampling Rate (%)	106.92	98.71	96.82	100.82

PLANT YATES
ESP OUTLET/VOST

Run No.	1A	1B	1C	2A	2B	2C	3A	3B	3C	Average
Date	6/21/93	6/21/93	6/21/93	6/22/93	6/22/93	6/22/93	6/23/93	6/23/93	6/23/93	-
Time Start	1238	1323	1408	0736	0822	0909	0720	0809	0856	-
Time Finish	1318	1403	1444	0816	0902	0949	0800	0849	0936	-
Operator	DHD	DHD	DHD	DHD	DHD	DHD	DHD	DHD	DHD	-
Initial Leak Rate	0.0 @ 22"	0.0 @ 21"	0.0 @ 18"	0.0 @ 21"	0.0 @ 21"	0.0 @ 20"	0.0 @ 20"	0.0 @ 22"	0.0 @ 22"	-
Final Leak Rate	0.0 @ 14"	0.0 @ 12"	0.0 @ 24"	0.0 @ 11"	0.0 @ 9"	0.0 @ 12"	0.0 @ 11"	0.0 @ 17"	0.0 @ 11"	-
Duct Dimensions (ft)	11.3 x 11.	11.3 x 11.	11.3 x 11.	11.3 x 11.3	11.3 x 11.	11.3 x 11.	11.3 x 11.	11.3 x 11.	11.3 x 11.	-
Dry Gas Meter Calibration (Yd)	1.036	1.036	1.036	1.036	1.036	1.036	1.036	1.036	1.036	1.036
Barometric Pressure ("Hg)	29.51	29.51	29.51	29.40	29.40	29.40	29.39	29.39	29.39	29.44571
Static Pressure ("H2O)	-11	-11	-11	-11	-11	-11	-11	-11		-11
Meter Volume (aL)	20.120	20.000	23.000	20.050	20.000	20.000	20.000	20.000	20.000	20.453
Average delta H (" H2O)	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Average Stack Temperature (F)	280	280	280	280	280	280	275	275	275	279
Average DGM Temp (C)	23.9	25.4	26.1	25.7	26.9	28.1	25.0	27.9	29.4	25.9
Test Duration (minutes)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
% CO2	11.1	11.1	11.1	11.2	11.2	11.2	10.6	10.6	10.6	11.1
% O2	8.0	8.0	8.0	7.9	7.9	7.9	8.5	8.5	8.5	8.0
% N2	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9
Meter Volume (dsL)	19.874	19.647	22.544	19.609	19.480	19.400	19.596	19.409	19.309	20.021
Flue Gas Moisture (%)	7.5	7.5	7.5	7.6	7.6	7.6	8.1	8.1	8.1	7.6
Gas Molecular Weight (Wet) (g/g-mole)	29.19	29.19	29.19	29.19	29.19	29.19	29.06	29.06	29.06	29.17
Absolute Stack Pressure (" Hg)	28.70	28.70	28.70	28.59	28.59	28.59	28.58	28.58	29.39	28.64
Absolute Stack Temperature (R)	740	740	740	740	740	740	735	735	735	739

PLANT YATES
ESP OUTLET/PSD

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1436	1003	0907	-
Time Finish	2236	1550	1407	-
Operator	TJB	DD	DD	-
Initial Leak Rate	0.01	0.009	0.010	-
Final Leak Rate	NA	NA	NA	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.007	1.007	1.007	-
Nozzle Diameter (inches)	0.1910	0.1910	0.1910	-
Barometric Pressure ("Hg)	29.51	29.40	29.36	29.42
Static Pressure ("H2O)	-11	-11	-11	-11
Meter Volume (acf)	254.680	180.019	154.960	196.553
Average square root of delta p	0.9920	0.9460	0.9550	0.9643
Average delta H (" H2O)	0.95	0.90	0.86	0.90
Average Stack Temperature (F)	280	285	282	282
Average DGM Temp (F)	84.4	88.4	93.9	88.9
Test Duration (minutes)	480.0	350.0	300.0	376.7
% CO2	11.1	11.2	10.6	11.0
% O2	8.0	7.9	8.5	8.1
% N2	80.9	80.9	80.9	80.9
Meter Volume (dscf)	245.909	171.888	146.280	188.026
Flue Gas Moisture (%)	7.5	7.6	8.1	7.7
Gas Molecular Weight (Wet) (g/g-mole)	29.19	29.19	29.06	29.15
Absolute Stack Pressure (" Hg)	28.70	28.59	28.55	28.61
Absolute Stack Temperature (R)	740	745	742	742
Average Gas Velocity (f/sec)	66.95	64.17	64.85	65.32
Avg Flow Rate (acfm)	512,947	491,597	496,867	500,470
Avg Flow Rate (dscfm)	324,624	307,714	309,938	314,092
Isokinetic Sampling Rate (%)	101.30	102.44	100.98	101.57

PLANT YATES
ESP OUTLET/MULTI-METALS - PARTICULATE

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0758	0925	0746	-
Time Finish	1316	1410	1210	-
Operator	TJB	TJB	TJB	-
Initial Leak Rate	0.010	0.005	0.008	-
Final Leak Rate	0.015	0.007	0.007	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.997	0.997	0.997	-
Nozzle Diameter (inches)	0.1970	0.1970	0.1970	-
Barometric Pressure ("Hg)	29.55	29.42	29.30	29.42
Static Pressure ("H2O)	-11.0	-11.0	-11.0	-11.0
Meter Volume (acf)	118.957	121.053	125.534	121.848
Average square root of delta p	0.8758	0.9165	0.9210	0.9044
Average delta H (" H2O)	0.79	0.86	0.90	0.85
Average Stack Temperature (F)	279	281	281	281
Average DGM Temp (F)	85.8	88.5	89.8	88.0
Test Duration (minutes)	241.0	240.0	240.0	240.3
Condensed Water (g)	243.4	258.9	277.2	259.8
Filter Weight Gain (g)	0.3241	0.2829	0.3586	0.3219
PNR Weight Gain (g)	0.1157	0.0801	0.1338	0.1099
% CO2	11.2	11.1	11.4	11.2
% O2	7.6	7.5	7.6	7.6
% N2	81.2	81.4	81.0	81.2
Meter Volume (dscf)	113.537	114.483	117.971	115.330
Flue Gas Moisture (%)	9.2	9.6	10.0	9.6
Gas Molecular Weight (Wet) (g/g-mole)	28.98	28.91	28.92	28.94
Absolute Stack Pressure (" Hg)	28.74	28.61	28.49	28.61
Absolute Stack Temperature (R)	739	741	741	741
Average Gas Velocity (f/sec)	59.25	62.30	62.74	61.43
Avg Flow Rate (acfm)	456,368	479,816	483,235	473,140
Avg Flow Rate (dscfm)	284,170	295,247	294,874	291,430
Isokinetic Sampling Rate (%)	100.56	98.00	101.11	99.89
Particulate Concentration (gr/dscf)	5.98E-02	4.89E-02	6.44E-02	5.77E-02
Particulate Concentration (lbs/dscf)	8.54E-06	6.99E-06	9.20E-06	8.25E-06
Particulate Emission (grams/sec)	18.35	15.61	20.52	18.16
Particulate Emission (lbs/hour)	145.63	123.85	162.83	144.11

PLANT YATES
ESP OUTLET/ANIONS

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	1015	1113	0915	-
Time Finish	1152	1243	1038	-
Operator	APE	APE	TJB	-
Initial Leak Rate	< 0.001	0.005	0.010	-
Final Leak Rate	0.007	0.003	0.004	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.992	0.992	0.992	-
Nozzle Diameter (inches)	0.2230	0.2230	0.2290	-
Barometric Pressure ("Hg)	29.55	29.42	29.30	29.42
Static Pressure ("H2O)	-11.0	-11.0	-11.0	-11.0
Meter Volume (acf)	65.200	62.150	60.611	62.654
Average square root of delta p	0.9574	0.9558	0.9327	0.9486
Average delta H (" H2O)	1.50	1.53	1.60	1.54
Average Stack Temperature (F)	282	283	280	282
Average DGM Temp (F)	96.3	96.5	99.7	97.5
Test Duration (minutes)	97.0	90.0	83.0	90.0
% CO2	11.2	11.1	11.4	11.2
% O2	7.6	7.5	7.6	7.6
% N2	81.2	81.4	81.0	81.2
Meter Volume (dscf)	60.855	57.738	55.768	58.121
Flue Gas Moisture (%)	9.2	9.6	10.0	9.6
Gas Molecular Weight (Wet) (g/g-mole)	28.98	28.92	28.92	28.94
Absolute Stack Pressure (" Hg)	28.74	28.61	28.49	28.61
Absolute Stack Temperature (R)	742	743	740	742
Average Gas Velocity (f/sec)	64.89	65.04	63.48	64.47
Avg Flow Rate (acfm)	499,777	500,985	488,928	496,563
Avg Flow Rate (dscfm)	310,071	307,637	298,858	305,522
Isokinetic Sampling Rate (%)	95.78	98.72	100.92	98.47

PLANT YATES
ESP OUTLET/AMMONIA-CYANIDE

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0741	0930	0725	-
Time Finish	0930	1104	0856	-
Operator	TJB	APE	TJB	-
Initial Leak Rate	0.010	0.007	0.010	-
Final Leak Rate	0.015	0.006	0.007	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.992	0.992	0.992	-
Nozzle Diameter (inches)	0.2230	0.2230	0.2290	-
Barometric Pressure ("Hg)	29.55	29.42	29.30	29.42
Static Pressure ("H2O)	-11.0	-11.0	-11.0	-11.0
Meter Volume (acf)	73.525	64.150	63.443	67.039
Average square root of delta p	0.9680	0.9589	0.9434	0.9568
Average delta H (" H2O)	1.55	1.52	1.60	1.56
Average Stack Temperature (F)	280	279	279	280
Average DGM Temp (F)	87.3	88.2	91.5	89.0
Test Duration (minutes)	109.0	95.0	91.0	98.3
% CO2	11.2	11.1	11.4	11.2
% O2	7.6	7.5	7.6	7.6
% N2	81.2	81.4	81.0	81.2
Meter Volume (dscf)	69.762	60.496	59.242	63.167
Flue Gas Moisture (%)	9.2	9.6	10.0	9.6
Gas Molecular Weight (Wet) (g/g-mole)	28.98	28.92	28.92	28.94
Absolute Stack Pressure (" Hg)	28.74	28.61	28.49	28.61
Absolute Stack Temperature (R)	740	739	739	740
Average Gas Velocity (f/sec)	65.52	65.10	64.18	64.93
Avg Flow Rate (acfm)	504,628	501,391	494,303	500,108
Avg Flow Rate (dscfm)	313,927	309,385	302,430	308,581
Isokinetic Sampling Rate (%)	96.51	97.43	96.63	96.86

PLANT YATES
ESP OUTLET/ S.F. PARTICULATE

Run No.	1	2	3	Average
Date	6/24-6/25/93	6/25-6/26/93	6/26-6/27/93	-
Time Start	0740	1130	1218	-
Time Finish	0700	0636	0627	-
Operator	DHD	DHD	DHD	-
Initial Leak Rate	0.012	0.005	0.005	-
Final Leak Rate	NA	NA	NA	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.007	1.007	1.007	-
Nozzle Diameter (inches)	0.2110	0.2110	0.2110	-
Barometric Pressure ("Hg)	29.53	29.55	29.42	29.5
Static Pressure ("H2O)	-11.0	-11.0	-11.0	-11.0
Meter Volume (acf)	852.132	687.620	711.797	750.516
Average square root of delta p	0.9581	0.9954	1.0651	1.0062
Average delta H (" H2O)	1.35	1.42	1.54	1.43
Average Stack Temperature (F)	281	279	281	280
Average DGM Temp (F)	89.8	91.3	92.9	91.3
Test Duration (minutes)	1375.8	1108.7	1055.5	1180.0
% CO2	11.2	11.1	11.4	11.2
% O2	7.6	7.5	7.6	7.6
% N2	81.2	81.4	81.0	81.2
Meter Volume (dscf)	816.056	657.274	675.646	716.325
Flue Gas Moisture (%)	9.2	9.6	10.0	9.6
Gas Molecular Weight (Wet) (g/g-mole	28.98	28.92	28.92	28.94
Absolute Stack Pressure (" Hg)	28.72	28.74	28.61	28.69
Absolute Stack Temperature (R)	741	739	741	740
Average Gas Velocity (f/sec)	64.92	67.39	72.36	68.22
Avg Flow Rate (acfm)	500,013	519,062	557,350	525,475
Avg Flow Rate (dscfm)	310,378	322,050	341,884	324,771
Isokinetic Sampling Rate (%)	101.05	97.33	99.00	99.13

PLANT YATES
ESP OUTLET/RADIONUCLIDES

Run No.	1	2	3	Average
Date	6/24-6/25/93	6/25-6/26/93	6/26-6/27/93	-
Time Start	1040	1050	1055	-
Time Finish	0700	0640	0619	-
Operator	APE	TJB	DHD	-
Initial Leak Rate	< 0.001	0.005	0.005	-
Final Leak Rate	0.007	0.003	0.005	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.005	1.005	1.005	-
Nozzle Diameter (inches)	0.1970	0.1970	0.1970	-
Barometric Pressure ("Hg)	29.53	29.55	29.42	29.50
Static Pressure ("H2O)	-11.0	-11.0	-11.0	-11.0
Meter Volume (acf)	718.510	658.079	667.090	681.226
Average square root of delta p	1.1124	1.0092	1.0217	1.0478
Average delta H (" H2O)	1.27	1.10	1.20	1.19
Average Stack Temperature (F)	283	283	282	283
Average DGM Temp (F)	94.7	93.9	96.9	95.2
Test Duration (minutes)	1166.7	1182.4	1137.7	1162.3
% CO2	11.2	11.1	11.4	11.2
% O2	7.6	7.5	7.6	7.6
% N2	81.2	81.4	81.0	81.2
Meter Volume (dscf)	680.531	624.352	626.886	643.923
Flue Gas Moisture (%)	9.2	9.6	10.0	9.6
Gas Molecular Weight (Wet) (g/g-mole)	28.98	28.92	28.92	28.94
Absolute Stack Pressure (" Hg)	28.72	28.74	28.61	28.69
Absolute Stack Temperature (R)	743	743	742	743
Average Gas Velocity (f/sec)	75.46	68.51	69.48	71.15
Avg Flow Rate (acfm)	581,204	527,706	535,180	548,030
Avg Flow Rate (dscfm)	359,951	325,606	327,622	337,726
Isokinetic Sampling Rate (%)	98.29	98.37	102.02	99.56

PLANT YATES
ESP OUTLET/EXTRACTABLE METALS

Run No.	1	2	3	Average
Date	6/24-6/25/93	6/25-6/26/93	6/26-6/27/93	-
Time Start	1300	1040	1137	-
Time Finish	0700	0636	0621	-
Operator	TJB	TJB	TJB	-
Initial Leak Rate	0.015	0.009	0.010	-
Final Leak Rate	0.014	0.006	0.010	-
Duct Dimensions (ft)	11.3 x 11.3	11.3 x 11.3	11.3 x 11.3	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.998	0.998	0.998	-
Nozzle Diameter (inches)	0.2300	0.2290	0.2290	-
Barometric Pressure ("Hg)	29.53	29.55	29.42	29.50
Static Pressure ("H2O)	-11.0	-11.0	-11.0	-11.0
Meter Volume (acf)	906.500	948.750	812.605	889.285
Average square root of delta p	1.1008	1.0954	0.9840	1.0601
Average delta H (" H2O)	2.49	2.30	1.90	2.23
Average Stack Temperature (F)	282	283	285	283
Average DGM Temp (F)	90.9	92.6	94.5	92.7
Test Duration (minutes)	1101.0	1103.1	1125.0	1109.7
% CO2	11.2	11.1	11.4	11.2
% O2	7.6	7.5	7.6	7.6
% N2	81.2	81.4	81.0	81.2
Meter Volume (dscf)	861.084	898.627	762.923	840.878
Flue Gas Moisture (%)	9.2	9.6	10.0	9.6
Gas Molecular Weight (Wet) (g/g-mole)	28.98	28.92	28.92	28.94
Absolute Stack Pressure (" Hg)	28.72	28.74	28.61	28.69
Absolute Stack Temperature (R)	742	743	745	743
Average Gas Velocity (f/sec)	74.63	74.35	67.06	72.01
Avg Flow Rate (acfm)	574,833	572,664	516,473	554,657
Avg Flow Rate (dscfm)	356,389	353,488	314,897	341,592
Isokinetic Sampling Rate (%)	97.65	103.45	96.67	99.26

PLANT YATES
STACK/MODIFIED METHOD 5

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1240	0655	0645	-
Time Finish	1755	1115	1118	-
Operator	EZ	EZ	EZ	-
Initial Leak Rate	< 0.001	< 0.001	0.002	-
Final Leak Rate	< 0.001	< 0.001	< 0.001	-
Stack Diameter (ft)	13.00	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.994	0.994	0.994	-
Nozzle Diameter (inches)	0.1960	0.1960	0.1950	-
Barometric Pressure ("Hg)	29.31	29.34	29.19	29.28
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	121.788	127.049	125.624	124.820
Average square root of delta p	0.8230	0.8251	0.7944	0.8142
Average delta H (" H2O)	0.85	0.85	0.77	0.82
Average Stack Temperature (F)	127	128	128	128
Average DGM Temp (F)	89.6	94.7	94.5	92.9
Test Duration (minutes)	240.0	240.0	240.0	240.0
Condensed Water (g)	390.2	409.4	398.0	399.2
% CO2	10.2	10.8	10.2	10.4
% O2	8.8	8.6	8.5	8.6
% N2	81.0	80.6	81.3	81.0
Meter Volume (dscf)	114.171	118.129	116.237	116.179
Flue Gas Moisture (%)	13.9	14.1	13.9	14.0
Gas Molecular Weight (Wet) (g/g-mole	28.32	28.37	28.31	28.33
Absolute Stack Pressure (" Hg)	29.27	29.30	29.15	29.24
Absolute Stack Temperature (R)	587	588	588	588
Average Gas Velocity (f/sec)	49.73	49.83	48.15	49.24
Avg Flow Rate (acfm)	396,063	396,819	383,500	392,127
Avg Flow Rate (dscfm)	300,017	299,801	288,743	296,187
Isokinetic Sampling Rate (%)	100.47	104.02	107.37	103.95

PLANT YATES
STACK/METHOD 23

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1400	0812	0810	-
Time Finish	1933	1236	1249	-
Operator	DJV	DJV	DJV	-
Initial Leak Rate	0.008	0.001	0.002	-
Final Leak Rate	0.001	< 0.001	< 0.001	-
Stack Diameter (ft)	13.0	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.029	1.029	1.029	-
Nozzle Diameter (inches)	0.1950	0.1950	0.1950	-
Barometric Pressure ("Hg)	29.31	29.34	29.19	29.28
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	114.442	118.294	115.263	116.000
Average square root of delta p	0.7956	0.8141	0.7932	0.8010
Average delta H (" H2O)	0.79	0.82	0.78	0.80
Average Stack Temperature (F)	123	128	129	127
Average DGM Temp (F)	80.6	86.9	87.3	84.9
Test Duration (minutes)	240.0	240.0	240.0	240.0
Condensed Water (g)	392.0	390.6	387.5	390.0
% CO2	10.2	10.8	10.2	10.4
% O2	8.8	8.6	8.5	8.6
% N2	81.0	80.6	81.3	81.0
Meter Volume (dscf)	112.896	115.477	111.851	113.408
Flue Gas Moisture (%)	14.1	13.8	14.1	14.0
Gas Molecular Weight (Wet) (g/g-mole	28.30	28.41	28.29	28.33
Absolute Stack Pressure (" Hg)	29.27	29.30	29.15	29.24
Absolute Stack Temperature (R)	583	588	589	587
Average Gas Velocity (f/sec)	47.93	49.13	48.14	48.40
Avg Flow Rate (acfm)	381,724	391,287	383,360	385,457
Avg Flow Rate (dscfm)	290,495	296,622	287,675	291,598
Isokinetic Sampling Rate (%)	103.65	103.83	103.70	103.73

PLANT YATES

STACK/VOST

Run No.	1A	1B	1C	1D	2A	2B	2C	3A	3B	3C	Average
Date	6/21/93	6/21/93	6/21/93	6/21/93	6/22/93	6/22/93	6/22/93	6/23/93	6/23/93	6/23/93	-
Time Start	1325	1415	1515	1615	0650	0745	0840	0655	0805	0910	-
Time Finish	1405	1455	1555	1655	0730	0825	0920	0735	0845	0950	-
Operator	JEH	JEH	JEH	JEH	JEH	JEH	JEH	JEH	JEH	JEH	-
Initial Leak Rate	0.004 @ 20"	0.012 @ 22"	0.005 @ 20"	0.012 @ 20"	0.010 @ 20"	0.002 @ 20"	0.005 @ 21"	0.000 @ 21"	0.007 @ 21"	0.004 @ 10"	-
Final Leak Rate	0.010 @ 22"	0.011 @ 20"	0.000 @ 15"	0.010 @ 17"	0.007 @ 22"	0.004 @ 23"	0.009 @ 22"	0.004 @ 25"	0.000 @ 10"	0.000 @ 10"	-
Stack Diameter (ft)	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	-
Dry Gas Meter Calibration (Yd)	1.011	1.011	1.011	1.011	1.011	1.011	1.011	1.011	1.011	1.011	1.011
Barometric Pressure ("Hg)	29.35	29.35	29.35	29.35	29.34	29.34	29.34	29.23	29.23	29.23	29.33
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Meter Volume (dl)	26.485	20.210	20.250	20.200	20.260	20.240	20.640	20.200	20.200	20.200	21.061
Average delta H (" H2O)	2.40	2.10	2.30	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.23
Average Stack Temperature (F)	127	127	127	127	128	128	128	128	128	128	128
Average DGM Temp (F)	20.7	24.5	26.3	26.5	20.8	27.0	29.3	24.8	26.3	26.3	25.0
Test Duration (minutes)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
% CO2	10.2	10.2	10.2	10.2	10.8	10.8	10.8	10.2	10.2	10.2	10.4
% O2	8.8	8.8	8.8	8.8	8.6	8.6	8.6	8.5	8.5	8.5	8.7
% N2	81.0	81.0	81.0	81.0	80.6	80.6	80.6	81.3	81.3	81.3	80.9
Meter Volume (dsL)	26.389	19.864	19.793	19.725	20.164	19.722	19.965	19.759	19.662	19.662	20.673
Flue Gas Moisture (%)	13.9	13.9	13.9	13.9	14.1	14.1	14.1	13.9	13.9	13.9	14.0
Gas Molecular Weight (Wet) (g/g-mole)	28.32	28.32	28.32	28.32	28.37	28.37	28.37	28.31	28.31	28.31	28.34
Absolute Stack Pressure (" Hg)	29.31	29.31	29.31	29.31	29.30	29.30	29.30	29.19	29.19	29.19	29.29
Absolute Stack Temperature (R)	587	587	587	587	588	588	588	588	588	588	588

PLANT YATES
STACK/ALDEHYDES

Run No.	1	2	3	Average
Date	6/21/93	6/22/93	6/23/93	-
Time Start	1340	0715	0700	-
Time Finish	1408	0745	0730	-
Operator	DJV	DJV	DJV	-
Initial Leak Rate	0.001	< 0.001	0.007	-
Final Leak Rate	0.001	0.001	0.002	-
Stack Diameter (ft)	13.0	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.006	1.006	1.006	-
Nozzle Diameter (inches)	0.1747	0.1747	0.1747	-
Barometric Pressure ("Hg)	29.31	29.34	29.19	29.28
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	10.707	11.086	10.929	10.907
Average square root of delta p	0.7680	0.7681	0.7461	0.7607
Average delta H (" H2O)	0.46	0.45	0.43	0.45
Average Stack Temperature (F)	127	133	131	130
Average DGM Temp (F)	81.0	81.5	79.6	80.7
Test Duration (minutes)	28.0	30.0	30.0	29.3
% CO2	10.2	10.8	10.2	10.4
% O2	8.8	8.6	8.5	8.6
% N2	81.0	80.6	81.3	81.0
Meter Volume (dscf)	10.310	10.676	10.507	10.498
Flue Gas Moisture (%)	13.9	14.1	13.9	14.0
Gas Molecular Weight (Wet) (g/g-mole	28.32	28.37	28.31	28.33
Absolute Stack Pressure (" Hg)	29.27	29.30	29.15	29.24
Absolute Stack Temperature (R)	587	593	591	590
Average Gas Velocity (f/sec)	46.41	46.57	45.32	46.10
Avg Flow Rate (acfm)	369,602	370,850	360,938	367,130
Avg Flow Rate (dscfm)	279,942	277,918	270,646	276,169
Isokinetic Sampling Rate (%)	104.90	102.12	103.21	103.41

PLANT YATES
STACK/PSD

Run No.	1	2	3	Average
Date	6/21-6/22/93	6/22-6/23/93	6/23-6/24/93	-
Time Start	1330	1500	1553	-
Time Finish	0945	0953	1000	-
Operator	DJV	DJV	DJV	-
Initial Leak Rate	0.008	0.002	0.004	-
Final Leak Rate	NA	NA	NA	-
Stack Diameter (ft)	13.00	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.994	0.994	0.994	-
Nozzle Diameter (inches)	0.1960	0.1960	0.1960	-
Barometric Pressure ("Hg)	29.31	29.34	29.19	29.28
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	519.949	609.370	557.093	562.137
Average square root of delta p	0.8000	0.8367	0.8367	0.8245
Average delta H (" H2O)	0.80	0.87	0.87	0.85
Average Stack Temperature (F)	125	128	128	127
Average DGM Temp (F)	96.0	95.7	94.9	95.5
Test Duration (minutes)	987.0	1133.0	1080.0	1066.7
% CO2	10.2	10.8	10.2	10.4
% O2	8.8	8.6	8.5	8.6
% N2	81.0	80.6	81.3	81.0
Meter Volume (dscf)	481.761	565.595	515.177	520.844
Flue Gas Moisture (%)	13.9	14.1	13.9	14.0
Gas Molecular Weight (Wet) (g/g-mole)	28.32	28.37	28.31	28.33
Absolute Stack Pressure (" Hg)	29.27	29.30	29.15	29.24
Absolute Stack Temperature (R)	585	588	588	587
Average Gas Velocity (f/sec)	48.26	50.53	50.72	49.84
Avg Flow Rate (acfm)	384,346	402,434	403,909	396,896
Avg Flow Rate (dscfm)	292,105	303,896	304,155	300,052
Isokinetic Sampling Rate (%)	105.88	104.08	99.37	103.11

PLANT YATES
STACK/MULTI-METALS - PARTICULATE

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0641	0921	0653	-
Time Finish	1152	1356	1106	-
Operator	DJV	DJV	DJV	-
Initial Leak Rate	0.002	0.001	0.001	-
Final Leak Rate	0.001	0.002	0.001	-
Stack Diameter (ft)	13.0	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.029	1.029	1.029	-
Nozzle Diameter (inches)	0.1950	0.1950	0.1950	-
Barometric Pressure ("Hg)	29.33	29.36	29.21	29.30
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	114.190	113.406	115.002	114.199
Average square root of delta p	0.8017	0.7958	0.7974	0.7983
Average delta H (" H2O)	0.77	0.75	0.76	0.76
Average Stack Temperature (F)	128	130	130	130
Average DGM Temp (F)	75.1	83.0	90.4	82.8
Test Duration (minutes)	240.0	240.0	240.0	240.0
Condensed Water (g)	403.5	399.5	416.7	406.6
Filter Weight Gain (g)	0.0461	0.0326	0.0352	0.0380
PNR Weight Gain (g)	0.0117	0.0023	0.0016	0.0052
% CO2	10.9	11.4	11.6	11.3
% O2	7.8	7.4	7.4	7.5
% N2	81.3	81.2	81.0	81.2
Meter Volume (dscf)	113.874	111.558	111.039	112.157
Flue Gas Moisture (%)	14.3	14.5	15.0	14.6
Gas Molecular Weight (Wet) (g/g-mole	28.33	28.37	28.32	28.34
Absolute Stack Pressure (" Hg)	29.29	29.32	29.17	29.26
Absolute Stack Temperature (R)	588	590	590	590
Average Gas Velocity (f/sec)	48.47	48.13	48.40	48.33
Avg Flow Rate (acfm)	386,045	383,297	385,419	384,920
Avg Flow Rate (dscfm)	290,497	287,454	285,491	287,814
Isokinetic Sampling Rate (%)	104.55	103.51	103.74	103.93
Particulate Concentration (gr/dscf)	7.83E-03	4.83E-03	5.12E-03	5.93E-03
Particulate Concentration (lbs/dscf)	1.12E-06	6.90E-07	7.31E-07	8.47E-07
Particulate Emission (grams/sec)	2.46	1.50	1.58	1.84
Particulate Emission (lbs/hour)	19.51	11.90	12.52	14.64

PLANT YATES
STACK/ANIONS

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0940	1325	0845	-
Time Finish	1155	1536	1055	-
Operator	EBZ	EBZ	EBZ	-
Initial Leak Rate	< 0.001	< 0.001	< 0.001	-
Final Leak Rate	< 0.001	< 0.001	< 0.001	-
Stack Diameter (ft)	13.0	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.006	1.006	1.006	-
Nozzle Diameter (inches)	0.1950	0.1950	0.1950	-
Barometric Pressure ("Hg)	29.33	29.36	29.21	29.30
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	62.495	60.363	61.975	61.611
Average square root of delta p	0.7874	0.7681	0.8183	0.7913
Average delta H (" H2O)	0.72	0.67	0.74	0.71
Average Stack Temperature (F)	132	133	133	133
Average DGM Temp (F)	91.1	104.5	100.3	98.6
Test Duration (minutes)	134.0	131.0	130.0	131.7
CO2%	10.9	11.4	11.6	11.3
O2%	7.8	7.4	7.4	7.5
% N2	81.3	81.2	81.0	81.2
Meter Volume (dscf)	59.157	55.834	57.465	57.486
Flue Gas Moisture (%)	14.3	14.5	15.0	14.6
Gas Molecular Weight (Wet) (g/g-mole	28.33	28.36	28.33	28.34
Absolute Stack Pressure (" Hg)	29.29	29.32	29.17	29.26
Absolute Stack Temperature (R)	592	593	593	593
Average Gas Velocity (f/sec)	47.76	46.57	49.78	48.04
Avg Flow Rate (acfm)	380,391	370,917	396,432	382,580
Avg Flow Rate (dscfm)	284,451	276,630	292,426	284,503
Isokinetic Sampling Rate (%)	99.35	98.63	96.76	98.25

PLANT YATES
STACK/AMMONIA-CYANIDE

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	0647	1145	0639	-
Time Finish	0904	1315	0809	-
Operator	EBZ	EBZ	EBZ	-
Initial Leak Rate	< 0.001	< 0.001	< 0.001	-
Final Leak Rate	< 0.001	0.001	< 0.001	-
Stack Diameter (ft)	13.0	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	1.006	1.006	1.006	-
Nozzle Diameter (inches)	0.1950	0.1950	0.1950	-
Barometric Pressure ("Hg)	29.33	29.36	29.21	29.30
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	61.781	41.312	43.505	48.866
Average square root of delta p	0.7550	0.7681	0.7874	0.7702
Average delta H (" H2O)	0.68	0.69	0.72	0.70
Average Stack Temperature (F)	132	133	135	133
Average DGM Temp (F)	86.3	97.4	85.4	89.7
Test Duration (minutes)	137.0	90.0	94.0	107.0
% CO2	10.9	11.4	11.6	11.3
% O2	7.8	7.4	7.4	7.5
% N2	81.3	81.2	81.0	81.2
Meter Volume (dscf)	58.984	38.698	41.440	46.374
Flue Gas Moisture (%)	14.3	14.5	15.0	14.6
Gas Molecular Weight (Wet) (g/g-mole	28.33	28.36	28.33	28.34
Absolute Stack Pressure (" Hg)	29.29	29.32	29.17	29.26
Absolute Stack Temperature (R)	592	593	595	593
Average Gas Velocity (f/sec)	45.78	46.59	47.98	46.78
Avg Flow Rate (acfm)	364,612	371,043	382,091	372,582
Avg Flow Rate (dscfm)	272,827	276,537	280,900	276,755
Isokinetic Sampling Rate (%)	101.02	99.53	100.46	100.34

PLANT YATES
STACK/RADIONUCLIDES

Run No.	1	2	3	Average
Date	6/24-6/25/93	6/25-6/26/93	6/26-6/27/93	-
Time Start	1223	0840	1357	-
Time Finish	0153	0331	0614	-
Operator	JEH	JEH	JEH	-
Initial Leak Rate	< 0.001	0.010	< 0.001	-
Final Leak Rate	< 0.001	0.009	< 0.001	-
Stack Diameter (ft)	13.0	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.994	0.988	0.988	-
Nozzle Diameter (inches)	0.2400	0.2400	0.2400	-
Barometric Pressure ("Hg)	29.33	29.33	29.36	29.34
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	599.556	654.007	696.609	650.057
Average square root of delta p	0.8459	0.8370	0.8524	0.8451
Average delta H (" H2O)	1.94	1.87	1.96	1.92
Average Stack Temperature (F)	130	129	131	130
Average DGM Temp (F)	97.3	93.0	97.7	96.0
Test Duration (minutes)	816.0	893.0	908.0	872.3
% CO2	10.9	11.4	11.6	11.3
% O2	7.8	7.4	7.4	7.5
% N2	81.3	81.2	81.0	81.2
Meter Volume (dscf)	556.184	607.560	642.493	602.079
Flue Gas Moisture (%)	14.3	14.5	15.0	14.6
Gas Molecular Weight (Wet) (g/g-mole)	28.33	28.36	28.33	28.34
Absolute Stack Pressure (" Hg)	29.29	29.29	29.32	29.30
Absolute Stack Temperature (R)	590	589	591	590
Average Gas Velocity (f/sec)	51.21	50.61	51.63	51.15
Avg Flow Rate (acfm)	407,813	403,033	411,204	407,350
Avg Flow Rate (dscfm)	306,199	302,339	305,914	304,817
Isokinetic Sampling Rate (%)	94.07	95.09	97.74	95.63

PLANT YATES
STACK/EXTRACTABLE METALS

Run No.	1	2	3	Average
Date	6/24-6/25/93	6/25-6/26/93	6/26-6/27/93	-
Time Start	1150	1246	1442	-
Time Finish	0725	0331	0616	-
Operator	EBZ	EBZ	EBZ	-
Initial Leak Rate	< 0.001	< 0.001	< 0.001	-
Final Leak Rate	< 0.001	0.001	< 0.001	-
Stack Diameter (ft)	*13.0*	*13.0*	*13.0*	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.994	1.029	1.029	-
Nozzle Diameter (inches)	0.2400	0.2400	0.2400	-
Barometric Pressure ("Hg)	29.33	29.33	29.36	29.34
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	818.991	600.910	618.386	679.429
Average square root of delta p	0.7874	0.8000	0.7616	0.7830
Average delta H (" H2O)	1.78	1.75	1.58	1.70
Average Stack Temperature (F)	129	125	126	127
Average DGM Temp (F)	97.6	89.1	90.6	92.4
Test Duration (minutes)	1112.0	857.0	880.0	949.7
CO2 %	10.9	11.4	11.6	11.3
O2%	7.8	7.4	7.4	7.5
% N2	81.3	81.2	81.0	81.2
Meter Volume (dscf)	759.081	585.462	601.172	648.572
Flue Gas Moisture (%)	14.3	14.5	15.0	14.6
Gas Molecular Weight (Wet) (g/g-mole)	28.33	28.36	28.33	28.34
Absolute Stack Pressure (" Hg)	29.29	29.29	29.32	29.30
Absolute Stack Temperature (R)	589	585	586	587
Average Gas Velocity (f/sec)	47.63	48.22	45.93	47.26
Avg Flow Rate (acfm)	379,362	384,045	365,815	376,407
Avg Flow Rate (dscfm)	285,223	289,842	274,469	283,178
Isokinetic Sampling Rate (%)	101.14	99.60	105.18	101.97

PLANT YATES
STACK/CHROME VI

Run No.	1	2	3	Average
Date	6/25/93	6/26/93	6/27/93	-
Time Start	1147	1041	0800	-
Time Finish	1434	1445	1150	-
Operator	JEH	JEH	JEH	-
Initial Leak Rate	< 0.001	< 0.001	0.007	-
Final Leak Rate	< 0.001	0.002	0.008	-
Stack Diameter (ft)	13.0	13.0	13.0	-
Pitot Tube Correction Factor (Cp)	0.84	0.84	0.84	-
Dry Gas Meter Calibration (Yd)	0.994	0.994	0.994	-
Nozzle Diameter (inches)	0.1950	0.1950	0.1950	-
Barometric Pressure ("Hg)	29.33	29.36	29.21	29.30
Static Pressure ("H2O)	-0.5	-0.5	-0.5	-0.5
Meter Volume (acf)	68.563	66.971	69.589	68.374
Average square root of delta p	0.7658	0.7689	0.7868	0.7738
Average delta H (" H2O)	0.69	0.69	0.71	0.70
Average Stack Temperature (F)	127	130	130	129
Average DGM Temp (F)	90.5	90.7	87.5	89.6
Test Duration (minutes)	144.0	144.0	146.0	144.7
CO2 %	10.9	11.4	11.6	11.3
O2%	7.8	7.4	7.4	7.5
% N2	81.3	81.2	81.0	81.2
Meter Volume (dscf)	64.184	62.738	65.242	64.054
Flue Gas Moisture (%)	14.3	14.5	15.0	14.6
Gas Molecular Weight (Wet) (g/g-mole)	28.33	28.36	28.33	28.34
Absolute Stack Pressure (" Hg)	29.29	29.32	29.17	29.26
Absolute Stack Temperature (R)	587	590	590	589
Average Gas Velocity (f/sec)	46.24	46.50	47.74	46.83
Avg Flow Rate (acfm)	368,270	370,354	380,212	372,945
Avg Flow Rate (dscfm)	277,922	277,614	281,887	279,141
Isokinetic Sampling Rate (%)	102.66	100.46	101.47	101.53

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 6/23/93
SAMPLING LOCATION ESP OUTLET
RUN NO. 3 TEST NO.
OPERATOR
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE 29.39
BLANK TUBE NUMBERS T: 14516A T/C: 14516B

ASSUMED MOISTURE % 7
METER BOX NO. V9
METER FACTOR 1.0355
PROBE HEATER SETTING 250 - 300
COMMENTS

Test Number	Leak Check ("Hg) Pre	Leak Check ("Hg) Post	Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack Temp	DGM Temp	Probe Temp	1st Condensor Outlet Temp.	2nd Condensor Outlet Temp.	Pump Vacuum ~~Temp~~
3 A	0@20	0@11	T 14520	0	0720	0.00	1		73	311	58	58	8
			A	10	0730	5.05	1		75	324	55	56	8
			T/C	20	0740	10.0	1		78	272	55	56	8
			14520 B	30	0750	15.05	1		79	273	58	57	8
				40	0800	20.00	1		80	274	58	58	8
3B	0@22	0@17	T 14517	0	0809	0.00	1		81	270	59	59	5
			A	10	0819	5.0	1		82	300	58	58	5
			T/C	20	0829	10.02	1		82	293	58	58	5
			14517 B	30	0839	15.05	1		83	290	59	58	5
				40	0849	20.00	1		83	287	59	58	5
3C	0@22	0@11	T 14526	0	0856	0.00	1		84	260	56	58	5
			A	10	0906	5.06	1		85	273	61	59	5
			T/C 14526	20	0916	9.98	1		85	277	60	59	5
			B	30	0926	15.01	1		85	283	53	58	5
				40	0936	20.00	1		86	289	57	58	5
			T	0									
			T/C										

[redacted]

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 6/22/93
SAMPLING LOCATION ESP out
RUN NO. 2 TEST NO.
OPERATOR
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 29.40
BLANK TUBE NUMBERS T: 14533A T/C: 14533B

ASSUMED MOISTURE % 7
METER BOX NO. V-9
METER FACTOR 1.0355
PROBE HEATER SETTING 300
COMMENTS

Test Number	Leak Check ("Hg) Pre	Leak Check ("Hg) Post	Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack Temp	DGM Temp	Probe Temp	1st Condensor Outlet Temp	2nd Condensor Outlet Temp.	Pump Vacuum ~~Temp~~
2A	0@21	0@11	T 14530 A	0	0736	0.00	1		78	300	61	60	7
				10	0746	5.08	1		78	304	63	61	7
			T/C 14530 B	20	0756	10.13	1		78	305	54	54	7
				30	0806	15.0	1		78	302	57	56	7
				40	0816	20.05	1		79	292	59	56	7
2B	0@21	0@9	T 14527 A	0	0822	0.00	1		79	262	58	54	4
				10	0832	5.00	1		80	273	57	55	4
			T/C 14527 B	20	0842	9.94	1		81	289	56	56	4
				30	0852	15.01	1		81	262	55	55	4
				40	0902	20.00	1		81	280	58	57	4
2C	0@20	0@12	T 14525 A	0	0909	0.00	1		82	267	60	58	4
				10	0919	4.98	1		82	278	58	57	4+1
			T/C 14525 B	20	0929	9.99	1		83	285	57	56	4+1
				30	0939	15.02	1		83	292	58	56	5
				40	0949	20.00	1		83	285	59	56	5
			T	0									
			T/C										

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 6/21/93
SAMPLING LOCATION ESP Out
RUN NO. 1 TEST NO.
OPERATOR
AMBIENT TEMPERATURE 80
BAROMETRIC PRESSURE 29.51
BLANK TUBE NUMBERS T: 14507A T/C: 14507B

ASSUMED MOISTURE % 7
METER BOX NO. V9
METER FACTOR 1.0355
PROBE HEATER SETTING
COMMENTS

Test Number	Leak Check ("Hg)		Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack Temp	DGM Temp	Probe Temp	1st Condensor Outlet Temp	2nd Condensor Outlet Temp.	Pump Vacuum ~~Temp~~
	Pre	Post											
1-A	0@22	0@14	T	0	1238	0.00	1.1	190	74	207	55	52	10
		1450	06A	10	1248	4.9	1.1		75	218	55	51	11
			T/C	20	1258	10 ~~9.62~~	1.1		75	232	55	53	11
		1450	06B	30	1308	15.0	1.1		75	210	55	53	11
				40	1318	20.12	1.1		76	217	55	53	11
1-B	0@21	0@11.5	T	0	1323	0.00	1.0		77	221	56	53	4
		1450	11A	10	1333	5.2	1.0		77	254	57	54	4
			T/C	20	1343	9.9	1.0		78	256	55	53	4
		1450	11B	30	1353	14.96	1.0	190	78	248	54	53	4
				40	1403	20.00	1.0		79	227	53	53	4
1-C	0@18	0@24	T	0	1408	0.00	1.0		79	237	55	53	4 6
		1450	5A	10	1418	5.0	1.0	191	79	236	53	51	4 6
			T/C	20	1428	9.97	1.0		79	279	53	53	6
		1450	5B	30	1438	15	1.0		79	273	53	51	6
				40	14.44	23.00	1.0		79	281	53	53	6
			T	0									
			T/C										

ENTERED

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of 2

SAMPLING LOCATION ~~Stack~~ ~~Off~~ Outlet RUN NO. 1 MM-5

DATE 6/21/93 TIME START 1249 TIME FINISH 1812 TEST DURATION ~~320~~ 240 WAW min.

DUCT DIMENSIONS 11.4 X 11.4 DIAMETER ______ INITIAL LEAK RATE .005@12" cfm

PTCF .84 DGMCF .997 NOZZLE DIA. .197 inches FINAL LEAK RATE .005@10" cfm

BAR PRESS 29.51 " Hg

STATIC PRESS -11.0 " H2O OPERATOR TJB

Traverse Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
1-1	1249	376.71	.89	1.1	187	75	70	254	254	61	4.0	65
2	1254	380.3	.83	[illegible]	173	71	70	245	241	56	5.0	63
3	1259	382.1	.61	[illegible]	192	73	70	249	255	46	5.0	53
4	1304	384.5	.3	.34	190	74	70	245	251	46	4.0	52
5	1309	386.15	.34	.40	191	74	71	257	250	46	4.5	54
6	1314	387.9	.58	.67	181	75	71	252	253	47	5.5	54
7	1319	389.9	.71	.85	161	77	72	246	249	45	6.0	51
8	1324	393.0	.75	.96	137	79	74	254	250	45		51
STOP	1329	395.072	Port	change	Leak ✓		.005	@	10"			
2-1	1343	395.9	.9	1.1	187	79	78	239	252	47	7.0	56
2	1348	398.75	.7	.83	195	81	78	252	255	49	6.0	43
3	1354	401.8	.75	.89	197	83	78	245	245	50	6.0	49
4	1359	404.35	.9	1.1	198	84	78	255	249	50	7.0	42
5	1404	407.05	.7	.81	194	85	79	245	247	50	7.0	41
6	1409	409.65	.65	.76	182	86	80	252	260	50	6.0	41
7	1414	411.95	.73	TB ~~.85~~ .9	160	86	81	245	244	51	6.0	41
8	1419	414.7	.5	.63	153	87	82	249	261	51	5.0	41
STOP	1424	416.85	Port	change	Leak	✓						
3-1	1517	417.9	.54	.56	280	82	82	253	246	53	5.0	51
2	1522	420.5	.95	.98	280	83	82	254	255	56	6.5	51
3	1527	422.6	1.2	1.25	280	84	82	249	249	55	6.5	48
4	1532	425.3	1.3	1.35	281	87	83	253	255	56	6.5	43
5	1537	428.20	1.0	1.05	279	89	84	254	246	56	7.0	42
6	1542	431.35	.92	.96	279	90	84	245	245	58	7.0	45
7	1547	433.91	.73	.76	278	90	84	255	263	60	7.0	43
8	1552	436.45	.52	.54	276	90	85	245	264	63	5.0	42
STOP	1557	438.56										
			√ΔP		ASSUME *							
Avg.	-	~~61.783~~	0.855		280	79.8						
Check'd	-	59.711										

93

CONSOLE # 161364

FILTER # ______

AMBIENT TEMP. ______

PROBE LENGTH 12'

LINER MATERIAL Glass

Velocity 61

% Moisture 7.4

Flowrate (DSCFM) 296,866

Isokinetic (%) 78

REMARKS

Nozzle ID 111

18.10
20.95

* Stack Temp in Error during first 1/3 due to Elec. gr. problem
WAW

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of 2

SAMPLING LOCATION OutLet RUN NO. 1

DATE 6/21/93 TIME START ________ TIME FINISH ________ TEST DURATION ________ min.

DUCT DIMENSIONS ________ X ________ DIAMETER ________ INITIAL LEAK RATE ________ cfm

PTCF ________ DGMCF ________ NOZZLE DIA. ________ inches FINAL LEAK RATE ________ cfm

BAR PRESS ________ " Hg

STATIC PRESS ________ " H2O OPERATOR ________

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
4-1	1604	439.270	.85	.88	281	91	87	251	261	66	6.0	44
2	1609	441.85	1.1	1.15	281	91	87	253	267	63	7.0	46
3	1614	444.76	1.5	1.58	282	92	87	264	245	62	8.0	45
4	1619	448.1	1.5	1.58	281	93	87	253	246	60	8.0	42
5	1624	451.46	1.3	1.4	280	95	89	251	246	55	7.5	39
6	1629	454.75	1.1	1.2	280	95	88	248	245	54	7.0	40
7	1634	457.86	.9	.95	279	96	90	252	258	55	6.0	41
8	1639	460.68	.48	.51	274	96	90	253	251	55	5.0	42
STOP	1644	462.950		Leak	✓	.005	@15"					
5-1	1648	463.40	1.1	1.16	281	96	92	250	251	57	7.0	42
2	1653	466.39	.70	.75	280	96	91	256	253	59	6.0	42
3	1658	468.87	1.2	1.3	282	96	92	249	252	54	7.0	41
4	1703	471.8	1.4	1.5	282	97	92	247	252	54	8.0	41
5	1708	474.93	1.2	1.3	281	99	93	250	248	54	8.0	40
6	1713	478.12	.74	.78	279	99	93	259	257	55	6.0	43
7	1718	480.8	.83	.89	279	98	93	264	247	55	6.0	43
8	1723	483.4	.68	.72	263	97	93	252	263	55	5.0	42
9	1728	485.97		Leak	✓ OK	.005	@ 10"					
6-1	1732	486.49	1.1	1.2	281	96	93	242	250	57	8.0	43
2	1737	489.49	.91	.97	281	97	93	243	257	55	7.0	43
3	1742	492.27	.64	.68	281	96	92	246	248	56	5.0	44
4	1747	494.69	.63	.67	281	96	92	250	258	58	4.7	47
5	1752	497.15	.63	.67	280	96	92	244	262	59	5.0	46
6	1757	499.1	.72	.76	280	95	92	255	262	60	6.0	47
7	1802	502.72	.86	.91	280	96	92	262	245	60	6.0	47
8	1807	504.1	.75	.8	278	96	92	255	260	61	6.0	49
STOP	1812	506.952										
		67.682	0.964			93.27						
Avg.	–	~~129.471~~ TB	0.910	.93	280	86.5						
Check'd	–	126.423										

CONSOLE # ________

FILTER # ________

AMBIENT TEMP. ________

PROBE LENGTH ________

LINER MATERIAL ________

Velocity ________

% Moisture ________

Flowrate (DSCFM) ________

Isokinetic (%) ________

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of 2

SAMPLING LOCATION OUTLET RUN NO. 2
DATE 6/22/93 TIME START 0753 TIME FINISH 1247 TEST DURATION 240 min.
DUCT DIMENSIONS ~~11.4~~ 11.3 X ~~11.4~~ 11.3 DIAMETER INITIAL LEAK RATE .003 @ 10" cfm
PTCF .84 DGMCF .997 NOZZLE DIA. .197 inches FINAL LEAK RATE .005 @ 12" cfm
BAR PRESS 29.4 " Hg
STATIC PRESS -11.0 " H2O OPERATOR TJB

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
1-1	0753	523.3	1.0	1.1	278	79	78	270	241	54	5	54
2	0758	526.5	.83	.88	281	82	78	265	260	60	4.0	46
3	0803	528.92	.58	.61	279	81	77	252	247	56	4.0	41
4	0808	531.07	.34	.4	275	83	79	250	262	55	3.0	42
5	0813	532.87	.36	.42	278	83	79	261	253	54		41
6	0818	534.60	.61	.65	279	83	79	247	248	53	4.0	41
7	0823	536.7	.73	.77	279	84	80	253	246	51	5.0	41
8	0828	539.04	.74	.78	272	85	80	263	252	49		47
STOP	0833	541.45		LEAK	✓	.005	@ 10"					
2-1	0858	542.025	.94	.99	278	79	78	257	253	64	5.0	55
2	0903	544.7	.8	.84	283	75	77	248	250	44	5.0	49
3	0908	547.17	.8	.84	280	81	77	255	252	44	5.0	49
4	0913	550.1	.96	1.0	283	83	78	265	244	43	5.0	48
5	0918	552.79	.82	.86	280	83	78	254	251	48	5.0	43
6	0923	554.92	.72	.76	241	84	79	244	245	45	5.0	50
7	0928	557.7	.69	.72	281	84	79	257	244	47	5.0	50
8	0933	559.77	.57	.59	272	85	80	256	247	48	5.0	50
STOP	0938	561.91	TB	LEAK	✓ .005 @ 10"							
3-1	0946	562.401	~~.95~~ .75	.78	283	83	80	246	250	48	5.0	52
2	0951	565.0	1.1	1.15	285	85	82	253	251	49	6.0	50
3	0956	567.77	1.2	1.25	285	87	82	247	248	49	6.0	48
4	1001	570.77	1.4	1.5	284	87	82	250	251	47	7.0	51
5	1006	574.0	1.2	1.25	283	87	82	250	254	48	6.0	50
6	1011	577.14	1.1	1.15	282	88	82	247	246	48	6.0	50
7	1016	58.13	.8	.84	281	99	83	265	255	50	5.0	50
8	1021	582.6	.59	.62	241	89	83	261	250	51		49
STOP	1026	584.95										
			.0									
Avg.		+61.7	Δp = .90		~~281~~ 280	84	80					
Check'd	–											

CONSOLE # 161364
FILTER #
AMBIENT TEMP.
PROBE LENGTH 12
LINER MATERIAL Glass

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

n=24

18.15
11.88

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

[redacted]

PLANT NAME Plant Yates Station Boiler No. 1 Page 2 of 2

SAMPLING LOCATION Outlet RUN NO. 2
DATE 6/22/93 TIME START ______ TIME FINISH ______ TEST DURATION ______ min.
DUCT DIMENSIONS ______ X ______ DIAMETER ______ INITIAL LEAK RATE ______ cfm
PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches FINAL LEAK RATE ______ cfm
BAR PRESS ______ " Hg
STATIC PRESS ______ " H2O OPERATOR TJB

Traverse Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
4-1	1029	585.751	.85	.89	283	85	83	242	247	54	5.0	49
2	1034	587.9	1.1	1.15	285	89	84	245	252	52	6.0	51
3	1039	590.79	1.4	1.45	284	89	84	251	256	51	6.0	50
4	1044	593.9	1.5	1.57	284	90	84	250	246	51	7.0	51
5 ~~3~~	1049	597.15	1.45	1.52	283	91	85	265	251	53	7.0	51
6 ~~2~~	1054	600.5	1.2	1.25	282	91	85	262	252	53	6.5	50
7	1059	603.59	.85	.90	281	91	86	256	251	55	5.0	51
8	1204	606.35	.50	.53	277	91	86	244	246	58	4.0	51
STOP	1209	608.53		Leak	✓	.005	@10"					
5-1	1113	609.643	.91	.96	285	90	86	257	245	60	5.0	48
2	1118	612.3	.85	.89	284	91	86	256	275	58	5.0	48
3	1123	615.0	1.0	1.1	285	91	85	256	256	57	5.0	47
4	1128	617.74	1.5	1.6	284	91	86	262	250	56	7.0	47
5	1133	621.08	1.3	1.36	283	93	86	264	249	56	7.0	47
6	1138	624.4	.74	.78	283	94	87	259	254	52	5.0	45
7	1143	627.3	.81	.85	281	94	87	263	248	50	5.0	46
8	1148	629.55	.71	.75	279	92	86	256	255	50		46
STOP	1153	632.18	Leak	✓	.01 @	10"						
6-1	1207	632.55	1.1	1.15	285	86	84	254	256	58	6.0	52
2	1212	635.52	.95	1.0	288	87	84	262	249	49	5.0	48
3	1217	638.4	.6	.63	287	88	84	247	257	50	4.0	48
4	1222	640.77	60	.63	287	89	85	254	253	51	4.0	49
5	1227	642.99	.69	73	287	88	85	256	244	52	4.0	49
6	1232	645.38	.75	.78	286	87	84	246	254	52	5.0	48
7	1237	647.9	.82	.86	285	88	85	257	244	53	5.0	52
8	1242	650.3	.83	.87		87	84	262	257	52	5.0	48
STOP	1247	653.96										
	2 pages											
Avg.	–	~~50.66~~	0.9306	.936	280	84.6						
Check'd	–	127.680										

CONSOLE # ______
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS ______

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1　　Page 1 of 2

SAMPLING LOCATION Outlet　　RUN NO. 3
DATE 6/23/93　TIME START 0712　TIME FINISH 1129　TEST DURATION 240 min.
DUCT DIMENSIONS 11.4 X 11.4　DIAMETER ______　INITIAL LEAK RATE .002@12" cfm
PTCF .84　DGMCF .997　NOZZLE DIA. .197 inches　FINAL LEAK RATE .005@15" cfm
BAR PRESS 29.36 " Hg
STATIC PRESS -11.0 " H2O　OPERATOR TJB

Traverse Point	Clock Time	Dry gas meter reading ft3	ΔP in H2O	ΔH in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
1-1	0712	668.7	.95	.94	280	75	72	247	255	68	8	55
2	0717	671.5	.80	.80	275	77	73	242	253	59	6	41
3	0722	673.83	.57	.56	274	81	75	259	245	56	5	43
4	0727	675.97	.35	.35	272	84	77	246	256	55	4	45
5	0732	677.65	.33	.33	274	84	77	246	244	56	4	50
6	0737	679.15	.60	.60	274	83	78	246	255	58	6.	51
7	0742	681.17	.64	.64	273	85	79	253	244	51	6	48
8	0747	683.50	.75	.75	269	85	79	256	251	50	7	47
STOP	0752	685.75	Leak ✓		.003	@15"						
2-1	0756	686.25	.86	.86	277	85	80	241	255	54	7	47
2	0801	688.8	.69	.69	278	86	80	265	244	48	7	47
3	0806	691.0	.71	.71	277	86	80	260	243	47	7	46
4	0811	694.0	.95	.95	277	85	79	259	254	47	7	44
5	0816	695.77	.69	.69	274	85	79	264	247	47	7	45
6	0821	698.15	.60	.60	275	85	80	246	250	47	7	45
7	0826	700.27	.71	.71	274	85	80	252	260	48	7	46
8	0831	702.64	.57	.57	264	85	80	256	249	49	6	48
STOP	0836	704.79		Leak	✓ .005	@	15"					
3-1	0839	705.235	.61	.61	278	83	80	240	251	58	7	51
2	0844	707.62	.96	.96	280	85	80	245	256	53	9	52
3	0849	709.9	1.2	1.2	279	85	80	248	262	52	10.0	53
4	0854	712.88	1.3	1.3	280	85	80	254	265	52	10.0	50
5	0859	716.0	.99	.99	277	85	80	246	254	56	9.0	53
6	0904	718.9	.91	.91	276	85	81	247	259	57	8.0	54
7	0909	721.8	.70	.70	276	84	80	258	246	59	7.0	55
8	0914	723.7	.51	.51		85	81	246	254	59	6.0	55
STOP	0919	725.744										
Avg.	–											
Check'd	–											

CONSOLE # 16364
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH 12'
LINER MATERIAL Glass

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS CO_2 11.2　O_2 7.9　10.0% Bws

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 2 of 2
SAMPLING LOCATION Outlet RUN NO. 3 MM-5
DATE 6/23/93 TIME START ______ TIME FINISH ______ TEST DURATION ______ min.
DUCT DIMENSIONS ______ X ______ DIAMETER ______ INITIAL LEAK RATE ______ cfm
PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches FINAL LEAK RATE ______ cfm
BAR PRESS ______ " Hg
STATIC PRESS ______ " H2O OPERATOR ______

Traverse Point	Clock Time	Dry gas meter reading ft3	^ P in H	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
4-1	0922	725.92	.85	.85	280	84	81	256	251	55	8.0	51
2	0927	728.67	1.0	1.0	280	84	80	252	249	53	9.0	51
3	0932	731.47	1.3	1.3	281	84	80	243	260	51	10.0	49
4	0937	734.37	1.3	1.3	280	85	80	254	255	51	10.0	51
5	0942	737.7	1.3	1.3	280	87	81	245	257	52	10.0	51
6	0947	740.5	1.1	1.1	277	87	81	252	251	53	10.0	51
7	0952	743.7	.79	.79	277	86	81	248	261	55	7.0	51
8	0957	746.05	.48	.48	277	86	81	252	249	56	7.0	52
STOP	1002	748.052		LEAK	✓	.005	@15"					
5-1	1005	748.368	.98	.98	280	85	81	256	259	57	9.0	51
2	1010	750.79	.72	.72	282	86	81	249	244	57	7.0	53
3	1015	753.3	1.0	1.0	282	86	82	261	254	57	9.0	53
4	1020	~~759~~ 756.48	1.2	1.2	282	87	82	257	253	57	9.0	53
5	1025	758.30	1.2	1.2	281	88	82	258	244	56	9.0	52
6	1030	762.3	.71	.71	280	89	83	254	258	57	8.0	51
7	1035	764.55	.75	.75	280	88	83	246	245	58	7.0	52
8	1040	767.3	.68	.68	274	89	84	245	262	58		50
STOP	1045	769.243	~~.88~~	.								
6-1	1049	769.6	.88	.88	283	90	86	255	255	62	8.5	54
2	1054	772.18	.91	.91	284	91	87	262	258	55	9.0	50
3	1059	774.79	.62	.62	284	92	87	245	246	52	7.0	46
4	1104	776.65	.68	.68	283	92	88	266	250	52	7.0	47
5	1109	779.35	.65	.65	282	93	88	250	263	51	7.0	45
6	1114	781.64	.67	.67	281	91	88	245	255	50	7.0	47
7	1119	784.05	.85	.85	282	91	89	246	245	50	8.0	44
8	1124	786.5	82	.82	283	91	89	251	251	49	8.0	48
STOP	1129	788.961										
					?							
Avg.	–	~~720.261~~	0.8958	.82	275	83.54						
Check'd	–	118.467										

CONSOLE # ______
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS ______

MODIFIED METHOD 5 FIELD DATA SHEET

[redacted]

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of ____

SAMPLING LOCATION ESP OUTLET RUN NO. FB.
DATE 6/20/93 TIME START 1000 TIME FINISH 1030 TEST DURATION 30min min.
DUCT DIMENSIONS 11.4 X 11.4 DIAMETER ____ INITIAL LEAK RATE .015 cfm
PTCF .84 DGMCF ____ NOZZLE DIA. .250 inches FINAL LEAK RATE .015 cfm
BAR PRESS 29.56 " Hg
STATIC PRESS -11.0 " H2O OPERATOR TJB

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
	10:15	356.3										
	10:30	357.12										
Avg.	–											
Check'd	–											

CONSOLE # 161364
FILTER # NA
AMBIENT TEMP. ____
PROBE LENGTH 12
LINER MATERIAL GlASS

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS ____

ENTERED

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____ [redacted]

Plant Name Plant Yates Station Boiler No. 1

Sampling Location OUTLet
Train Aldehydes
Run No. 1
Date 6/[illegible]/93
Time Start 1232
Time Finish 1447
Test Duration 135 min.
Duct Dimensions 11'4" X 11'4"
Diameter ____ ft
Initial Leak Rate .01/min @10" cfm
PTCF 0.84
DGMCF 0.992
Nozzle Dia. 0.190 inches
Final Leak Rate .005@10" cfm
Bar Press 29.51 " Hg
Static Press -11" " H2O
Operator APE

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack* Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	1232	417.052	.79	.77	185	75	72	~~185~~ 250	259	58	4.5	
	1301	433.3	0.76	0.78	183	81	73	261	258	55	4.5	
	1316	440.8	0.76	0.77	178	84	75	257	258	59	4.5	
	1332	448.54	0.77	0.78	183	87	78	256	259	63	4.5	
	1345	455.14	0.77	0.79	190	89	80	255	252	64	4.5	
	1355	460.00	0.76	0.79	186	90	81	258	254	65	4.5	
	1410	467.50	0.75	0.78	181	91	82	255	257	67	4.5	
	1428	476.41	0.76	0.77	180	92	84	257	265	68	4.5	
	1447	485.776										
			$\overline{\sqrt{\Delta P}}$									
Avg.	—	66.723	0.875		182	86	78					
Check'd		✓ TB										

Error: Assume 280
WAW

CONSOLE # A161403
FILTER # ____
AMBIENT TEMP. 72 °F
PROBE LENGTH 10'
LINER MATERIAL glass

Velocity 59
% Moisture 8.0
Flowrate (DSCFM) 283,851
Isokinetic (%) 108

REMARKS * These values are biased due to grounding of thermocouple leads. Actual temp approx 280°F

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ___

[redacted]

Plant Name Plant Yates Station Boiler No. 1

Sampling Location OUTLET
Train Aldehydes
Run No. 2

Date 6/24/93
Time Start 0719
Time Finish 0928
Test Duration 129 min.

Duct Dimensions 11'4" X 11'4"
Diameter — ft
Initial Leak Rate pass <0.0025 cfm

PTCF .190 84
DGMCF .992
Nozzle Dia. .194 inches
Final Leak Rate pass <.0025 cfm
@ 8"

Bar Press 2940 " Hg

Static Press -11 " H2O

Operator APS

96.58
95.1
1.48

.51

Travers (min) ~~Point~~ Timer	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
0	0719	495.1	0.88	0.89	273	77	73	256	256	70	4"	
6.8		498.6	0.89	0.89	273	82	74	269	254	71	4	
21.3		506.14	0.88	0.87	274	90	79	256	258	62	4	
31.0		511.25	0.89	0.89	275	92	81	257	258	64	4	
44.0		518.15	0.93	0.90	275	93	83	257	255	57	4	
53.0		522.92	0.95	0.89	275	93	84	256	259	56	4	
63.5		528.46	0.91	0.89	275	95	85	258	253	56	4	
73.0		533.50	0.91	0.88	276	96	87	259	253	58	4	
84.6		539.6	0.94	0.89	276	97	88	256	257	58	4	
95.4		545.41	0.93	0.89	276	96	88	256	254	58	4	
106.2		551.15	0.95	0.89	276	96	88	255	254	58	4	
117.7		557.23	0.95	0.87	277	96	88	258	259	60	4	
125.3		561.2	0.93	0.86	277	95	88	258	259	62	4	
											88	
											275	
											.959	
				WAW							62.34	
			0.9583			✓					58.83	
Avg.	—	66.100	~~0.9595~~	0.885	275.2	87.8						
Check'd		✓ TJB		✓.05✓	✓TB							

CONSOLE # 161403

FILTER #

AMBIENT TEMP.

PROBE LENGTH 10'

LINER MATERIAL GLASS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

[redacted]

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP Out **Train** Aldehydes **Run No.** 3

Date 6/23/93 Time Start 0654 Time Finish 0909 Test Duration 135 min.

Duct Dimensions 11'4" X 11'4" Diameter – ft Initial Leak Rate .007 cfm

PTCF 0.84 DGMCF .992 Nozzle Dia. .191 inches Final Leak Rate .005 cfm @5"

Bar Press ~~29.93~~ " Hg 29.36 DJV

Static Press -.11 " H2O Operator APE

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0655:30	572.6	0.89	0.81	269	79	72	263	255	62	3.5	
	0703	576.79	0.87	0.81	269	84	74	256	260	62	3.5	
	0711	580.78	0.89	0.81	269	88	77	259	261	60	3.5	
	0720:30	585.45	0.91	0.80	269	92	80	260	256	61	3.75	
	0732:45	591.60	0.90	0.80	269	95	83	258	261	60	3.75	
	0746	598.22	0.90	0.80	269	97	87	257	260	63	3.75	
	804:45	607.23	0.92	0.81	271	97	89	257	259	65	3.75	
	821	615.80	0.90	0.80	270	96	89	253	254	56	3.75	
	832:30	621.60	0.90	0.80	271	95	89	258	253	53	3.75	
	841:30	626.16	0.90	0.80	272	96	89	258	256	53	3.75	
	859:45	635.33	0.92	0.81	272	96	89	256	258	53	3.75	
	908:45	639.85										
			WPA		✓		✓					
Avg.	–	67.25	~~0.2194~~	0.805	270	87.9						
Check'd		✓TJB	0.9487		✓TJB							

12.3
12.6

CONSOLE # A161403

FILTER # ____

AMBIENT TEMP. 69

PROBE LENGTH 12

LINER MATERIAL GLASS

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

6:55 - 9:08

120
13
133

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESPOUTlET **Train** Aldehydes **Run No.** FB

Date 6-20-93 Time Start ______ Time Finish ______ Test Duration ______ min.

Duct Dimensions ______ X ______ Diameter ______ ft Initial Leak Rate ______ cfm

PTCF ______ DGMCF ______ Nozzle Dia. ______ inches Final Leak Rate ______ cfm

Bar Press 29.56 " Hg

Static Press ______ " H2O Operator ITB

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
Avg.	—											
Check'd												

CONSOLE # ______

FILTER # ______

AMBIENT TEMP. ______

PROBE LENGTH ______

LINER MATERIAL ______

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS ______

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

[redacted]

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP OUTLET **Train** PSD **Run No.** 1

Date 6/21/93 Time Start 1436 Time Finish 2236 Test Duration 480 min.

Duct Dimensions 11.4 x 11.4 Diameter ____ ft Initial Leak Rate .01 @ 15" cfm

PTCF .84 DGMCF 1.007 Nozzle Dia. .191 inches Final Leak Rate 0.008 @ 15" cfm

through the probe w/out impactor

Bar Press 29.51 " Hg

Static Press -11.0 " H2O Operator TJB

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
0"	1436	62.07	.95	.98								
35"		82.85	.98	.95	278	85	78					
45"		88.12	.98	.95	278	84	78			.52cfm@9"/280		
60"		96.01	.99	.95	277	87	80					
80"		106.42	.97	.95	278	85	80					
120"		127.32	.97	.95	276	85	81					
140"		138.0	.97	.9	281	85	90				9	
180"		158.87	.99	.92	281	88	86				9	
210"		174.70	.98	.91	282	88	84				9	
240"		190.38	.98	.91	282	89	85				9	
249"		195.10	.98	.91	282	88	83				9	
270		206.08	.98	.91	282	87	83				9	
310	1946	225.73	0.98	0.93	283	86	81				9	
351	2027	247.52	1.00	0.97	282	85	81				9	
388	2104	267.27	1.00	0.97	282	86	81				9.5	
419	2135	283.52	1.00	0.97	283	87	81				10	
453	2209	302.04	1.00	0.98	283	88	82				10	
480	2236	316.850	1.00	0.98	278	90	83				10	
Avg.	–	254.68	.992	.95	280	84.4						
Check'd		✓	✓									

of

CONSOLE # 161396
FILTER # SET Y
AMBIENT TEMP. 71
PROBE LENGTH 7'
LINER MATERIAL S.S.

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS 16.6 acc. / LAP .5 @ NOZZLE

.5 acfm @ meter

RADIAN
CORPORATION

FIELD DATA

[redacted]

Run 2
Page 1 of 1

Plant	YATES	Probe Length and Type		Height of Location (ft)	
Date	6/22/93	Nozzle ID (in.)	.191	Duct Dimmensions	
Sampling Location	ESP OUT	Meter Box Number	A1H356	Filter Number	
Sample Type	PSD	Meter ΔH@	1.775	Assumed Moisture (%)	
Run Number	2	Yd	1.007	O2 (%)	7.9
Operator	Doerle	K Factor		CO2 (%)	11.2
Ambient Temperature	75	Probe Heater Setting	250±25	O2/CO2 Method	
Barometric Pressure	29.4	Heater Box Setting		Final Leak Check	
Static Pressure	-11	Intial Leak Check	0.009@10		

★

N_2 = 80.9

98 ΔP = .53 cfm @ 90/275

ΔP	ΔH
.97	.92
.92	.90
.84	.81

Diagram of Duct

16
53
48
80
848
2905
3753
55
22
106
106
1166
3735
4901

Read and Record All Data Every _____ Minutes

Traverse Point Number	Sampling Time (min)	Clock Time (24-hr)	Gas Meter Reading Vm (ft³)	Velocity Head Δ Ps (In. H2O)	Orifice Pressure Differential ΔH (In. H2O)	Flue Gas Temperature (°F)	Filter Temperature (°F)	Dry Gas Meter Temperature Inlet (°F)	Dry Gas Meter Temperature Outlet (°F)	Impinger Exit (°F)	Pump Vacuum (In. H2O)
	0	1003	329.05								
	14		37.35	.97	89	281		84	81		8
	38		48.43	.97	.90	281		86	82		9
	55		83.64	.92	.90	282		88	82		9
	133		98.29	.91	.90	285		89	93		9
	174		430.68	.92	.9	286		93	90		9
	238		453.05	.84	.81	288		92	89		9
	259		464.5	.83	.80	286		93	91		8
	320	1518	494.9	.81	.79	287		92	90		8
Stop	350	1550	509.065								
				√ΔP							
			180.019	0.1517		284.5		88.4			
			TD	0.946							

NRW averaging error

Comments:

SOURCE SAMPLING FIELD DATA SHEET

Page ____ of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP OUTLET **Train** PSD **Run No.** 3

Date 6/23/93 Time Start 0907 Time Finish ______ Test Duration 300 min.

Duct Dimensions 11.4" X 11.4" Diameter ______ ft Initial Leak Rate 0.01 @ 12" cfm

PTCF .84 DGMCF 1.007 Nozzle Dia. .191 inches Final Leak Rate N/A cfm

Bar Press 28.39 " Hg

Static Press -11 " H2O Operator Dave

2409
1959
9450
6

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	1459	.88	.84	276	79	79				8	
	~~12~~ 14	26.6	.88	.84	276	81	79				8	
	35	37.0	.90	.84	278	89	85				8	
	67	53.24	.90	.84	280	92	88				8	
	104	72.15	.92	.84	283	97	92				8	
	121	80.70	.89	.84	283	99	94				8	
	137	88.85	.94	.89	283	99	95				8	
	200	122.0	.93	.89	285	101	97				8	
	233	139.4	.93	.89	286	105	100				8.5	
	258	156.6	.93	.89	286	106	101				8.5	
	288	168.3	.93	.89	287	107	102				8.5	
	300	174.55										
Avg.	—	154.960	0.955	0.863	282	93.9						
Check'd		✓			✓							

CONSOLE # A161396
FILTER # Set 5
AMBIENT TEMP. ______
PROBE LENGTH 8'
LINER MATERIAL S Steel

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS Purge 30 min

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 2

Plant Name DJ✓ **Plant Yates Station Boiler No. 1**
Sampling Location ESP Outlet **Train** **Particulate / Metals** **Run No.** 1
Date 6/24 6-25 Time Start 0758 Time Finish 1316 Test Duration 241 min.
Duct Dimensions 11.4" X 11'4" Diameter ______ ft Initial Leak Rate ~~.241~~ TB .01 @ 15" cfm
PTCF .84 DGMCF .997 NOZZLE DIA. .197 inches Final Leak Rate .015 @ 15" cfm
Bar Press 29.55 " Hg
Static Press -11.0 " H2O Operator TJB/APE

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
1-1	0758	827.24	.83	.8	274	72	71	246	244	66	5.0	
2	0803	830.3	.70	.78	278	72	71	248	254	62	4.0	
3	0808	832.12	.40	.38	278	75	72	249	242	61	3.0	
4	0813	833.9	.26	.25	277	77	73	253	261	62	3.0	
5	0818	835.35	.23	[illegible]	278	77	73	266	255	63	3.0	
6	0823	836.35	.50	.48	278	77	73	244	258	63	4.0	
7	0828	838.7	.62	.60	278	78	74	254	266	62	4.0	
8	0833	841.0	.68	.66	276	79	75	244	264	60	4.0	
STOP	0838	843.02		LEAK	✓	.01 @	10"					
2-1	0843	843.675	.89	.87	282	81	76	256	266	59	5.0	
2	0848	846.14	.68	.67	282	82	76	256	259	59	5.0	
3	0853	843.8	68	.67	282	83	77	245	247	58	4.0	
4	0858	850.61	.92	.92	281	84	78	255	260	59	5.0	
5	0903	853.8	.66	.66	281	85	78	246	260	60	5.0	
6	0908	855.53	.60	.60	280	86	78	253	267	60	5.0	
7	0913	857.73	.76	.76	278	86	79	249	247	61	5.0	
8	0918	859.07	.62	.62	277	86	80	250	246	60	5.0	
STOP	0923	862.38		LEAK'd	.007	@ 10"						
* 3-8	0943	862.99	.48	.48	275	85	83	244	247	65	4.0	
7	0948	865.5	.67	.67	278	86	82	246	257	61	3.5	
* 6	0954	867.65	.93	.93	286	86	82	254	264	56	5.0	
5	0959	870.90	1.0	1.0	280	87	83	250	245	56	5.0	
4	~~09~~1004	873.1	1.3	1.3	282	89	84	254	265	57	5.0	
3	1009	875.7	1.2	1.2	243	90	84	266	246	55	5.0	
2	1014	879.0	.92	.92	283	92	86	246	244	54	5.0	
1	1019	881.53	1.0	1.0	283	93	87	257	243	53	5.5	
STOP	1024	881.372										
Avg.	—	~~[illegible]~~7										
Check'd		~~125.534~~ ~~[illegible]~~		~~.869~~	~~28.54~~		~~89.8~~					

CONSOLE # 161364
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

1st NITRIC RINSE CAUGHT W/ACETON RINSE (F. ½). SECOND RINSE PERFORMED.

REMARKS .197 Nozzle Nozzle ID 11 K= .973

* Sampled PT6 @ 5 min. * Started Sampleing at point 8

SOURCE SAMPLING FIELD DATA SHEET

Page 2 of 2

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP Outlet **Train** Particulate / Metals **Run No.** 1

Date ______ Time Start ______ Time Finish ______ Test Duration ______ min.

Duct Dimensions ______ X ______ Diameter ______ ft Initial Leak Rate ______ cfm

PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches Final Leak Rate ______ cfm

Bar Press ______ " Hg

Static Press ______ " H2O Operator TJB

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
4-8	1028	884.641	.60	60	276	90	87	248	247	59	4.0	
7	1033	887.00	.82	.82	278	92	88	253	261	56	5.0	
6	1038	889.3	1.10	1.10	279	93	89	249	246	52	5.0	
5	1043	892.07	1.3	1.3	280	93	89	253	267	52	5.5	
4	1048	895.14	1.4	1.4	280	95	90	250	250	52	6.0	
3	1053	898.27	1.3	1.3	282	96	90	252	256	52	6.0	
2	1058	901.8	1.1	1.1	283	96	91	248	265	52	5.5	
1	1103	904.3	.81	.81	283	96	91	256	241	53	5.0	
STOP	1108	907.000			Leak	✓	.01 @	15"				
5-8	1151	907.516	.71	.71	275	92	90	244	246	65	4.5	
7	1156	910.0	.82	.82	278	93	90	253	249	54	5.0	
6	1201	912.6	.68	.68	279	94	90	244	251	55	5.0	
5	1206	914.75	.90	.90	280	94	90	253	266	53	5.0	
4	1211	918.0	1.3	1.3	282	94	90	250	253	49	5.0	
3	1216	920.32	1.1	1.1	283	95	90	256	257	49	5.0	
2	1221	923.25	.68	.68	283	96	90	251	263	50	5.5	
1	1226	925.62	.69	.69	283	96	91	248	246	52		
STOP	1231	928.027		Leak	✓	.007	@ 15"					
6-8	1235	928.27	.80	.80	279	96	92	250	255	52	5.0	
7	1241	931.64	.85	.85	279	96	92	257	244	48	5.0	
6	1246	934.22	.75	.75	280	98	92	247	245	48	5.0	
5	1251	936.7	.64	.64	281	98	92	254	246	49	4.0	
4	1256	938.95	.65	.65	282	98	93	249	267	49	4.0	
3	1301	941.19	.57	.57	282	98	93	257	264	49	4.0	
2	1306	943.32	.89	.89	283	97	94	249	252	49	5.0	
1	1311	945.8	.96	.96	284	98	94	265	249	48	5	
STOP	1316	948.490										
Avg.	—											
Check'd		118.957	0.8896	0.81	280	86.7						

↳ Does not include leak cks - WAW

CONSOLE # ______

FILTER # ______

AMBIENT TEMP. ______

PROBE LENGTH ______

LINER MATERIAL ______

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS ______

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 2

Plant Name Plant Yates Station Boiler No. 1

Sampling Location outlet **Train** Particulate / Metals **Run No.** 2

Date 6/26/93 Time Start 0925 Time Finish 1131 Test Duration 240 min.

Duct Dimensions 11.4 x 11.4 Diameter ____ ft Initial Leak Rate .005@12" cfm

PTCF .84 DGMCF .997 NOZZLE DIA. .197 inches Final Leak Rate .007@10" cfm

Bar Press 29.42 " Hg

Static Press -11.0 " H2O Operator TJB K = .915

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
1-8	0925	959.3	.65	.65	270	75	75	254	262	58	4.0	
7	0930	961.4	.81	.81	277	75	75	255	268	49	4.0	
6	0935	963.85	.60	.58	278	75	75	249	266	47	4.0	
5	0940	965.87	.35	.34	279	78	76	251	259	51	4.0	
4	0945	967.48	.34	.33	276	79	76	249	261	51	3.6	
3	0950	969.1	.60	.58	280	80	77	252	266	53	4.0	
2	0955	971.0	.82	.81	281	80	77	247	247	52	4.0	
1	1000	973.8	.86	.84	280	81	78	245	258	51	5.0	
STOP	1005	976.065		LEAK	✓	.007	@12"					
2-8	1008	976.5	.53	.52	274	84	80	253	252	58	4.0	
7	1013	978.53	.80	.79	278	86	81	256	255	57	4.0	
6	1018	980.91	.62	.62	279	86	81	244	248	53	4.0	
5	1023	983.01	.73	.73	281	86	81	254	264	55	4.0	
4	1028	985.5	.99	.99	282	86	82	249	245	53	5.0	
3	1033	988.2	.78	.78	283	89	83	266	253	52	4.0	
2	1038	990.36	.70	.70	283	90	84	250	254	53	4.0	
1	1043	992.70	.98	.98	284	91	84	249	249	54	4.0	
STOP	1048	995.32		Leak	✓	.01@	15"					
3-8	1051	996.0	.63	.63	278	92	86	254	259	57	4.0	
7	1056	998.3	1.0	1.0	279	93	87	253	247	55	5.0	
6	1101	1001.02	1.2	1.2	281	93	87	247	251	54	5.0	
5	1106	1003.75	1.3	1.3	282	95	88	246	248	56	5.0	
4	1111	1006.75	1.3	1.3	283	95	87	248	246	54	5.5	
3	1116	1009.7	1.1	1.1	283	95	88	256	263	56	6.0	
2	1121	1012.7	.72	.72	283	95	88	252	255	57	5.0	
1	1126	1015.05	.70	.70	284	94	88	253	260	59	5.0	
STOP	1131	1017.40										
Avg.	—	121.053	√.9165	.8600	281.1		88.5					
Check'd												

CONSOLE # 161364

FILTER # ____

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 2 of 2

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Outlet **Train** Particulate / Metals **Run No.** 2

Date ____ Time Start ____ Time Finish ____ Test Duration ____ min.

Duct Dimensions ____ X ____ Diameter ____ ft Initial Leak Rate ____ cfm

PTCF ____ DGMCF ____ NOZZLE DIA. ____ inches Final Leak Rate ____ cfm

Bar Press ____ " Hg

Static Press ____ " H2O Operator ____

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
4-8	1133	17.885	.44	.44	277	93	88	253	261	63	4.0	
7	1138	19.66	.80	.80	279	93	88	255	254	62	5.0	
6	1143	22.15	1.20	1.20	281	93	89	251	263	61	6.0	
5	1148	25.13	1.30	1.30	281	93	89	247	251	60	6.0	
4	1153	28.2	1.4	1.4	283	95	89	252	262	61	6.0	
3	1158	31.39	1.4	1.4	284	96	90	247	255	63	6.0	
2	1203	34.75	1.1	1.1	284	97	90	256	258	64	6.0	
1	1208	37.77	.86	.86	285	98	91	252	254	64	5.0	
STOP	1213	40.41	Leak	/	.015	@15"						
5-8	1248	41.30	.75	.75	280	91	89	246	248	60	4.0	
7	1253	43.77	.81	.81	281	91	89	247	263	59	4.0	
6	1258	46.25	.70	.70	281	92	89	256	266	56	4.0	
5	1303	48.56	1.10	1.10	283	93	90	247	258	55	4.0	
4	1308	51.35	1.2	1.2	284	94	90	255	253	56	5.5	
3	1313	54.4	.93	.93	285	95	90	248	247	58	5.0	
2	1318	57.00	.71	.71	285	97	91	256	248	61	4.0	
1	1323	59.35	.98	.98	285	96	91	254	255	60		
STOP	1328	62.05	LEAK	/	.007	④ 9.0"						
6-8	1330	62.367	.87	.87	276	96	93	252	257	63	5.0	
7	1335	65.0	.86	.86	281	97	92	246	255	61	5.0	
6	1340	67.65	.72	.73	281	97	92	256	264	60	5.0	
5	1345	70.15	.66	.67	283	97	92	252	247	60	4.0	
4	1350	72.43	.74	.75	284	97	92	256	258	62	5.0	
3	1355	74.95	.60	.61	284	96	92	246	257	62	5.0	
2	1400	77.15	.94	.95	285	96	92	246	244	62	5.5	
1	1405	79.88	1.1	1.2	285	99	93	248	253	63		
STOP	1410	83.16										
Avg.	—											
Check'd												

CONSOLE # ____

FILTER # ____

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

Flue-Gas Sampling Log

Sponsor: DOE	Sample Run #: 1
Plant Location: YATES	Soda-Lime Trap#: 401
Date: 6/26/93	Iodated Carbon #: 401
Fuel Type: COAL	Pump#: BOX 2
Pollution Control: ESP	Probe#:
Sampling Point: OUTLET	Filter ID:

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
0810	0.00/5"	.283	1323	0.00/1"	.243	313	0	.26
					TOTALS:			

Integrator Volume (l):
Offset Correction (l): -.021 @ BOX, -.016 @ Probe
Total Integrator Volume:
CO_2 Mass Flow Correction:
Actual (dry STP) volume (l):
% O_2: 7.8
% CO_2: 11.2
% H_2O: 10%
ppm SO_2:

COMMENTS:
Initial Leak RATE = 0.00 l/5" @ Probe
= 0.00 @ BOX

Initial Vol = 18.9
Final vol = 118.9
final offset = -.051 @ probe

Flue-Gas Sampling Log

Sponsor: DOE	**Sample Run #:** 2
Plant Location: YATES	**Soda-Lime Trap#:** 403
Date: 6/26/93	**Iodated Carbon #:** 403
Fuel Type: COAL	**Pump#:**
Pollution Control: ESP	**Probe#:**
Sampling Point: OUTLET	**Filter ID:**

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
0925	~~150~~ -.48	~~.368~~	1434	-.54	.326	309		
1434		.352						
					TOTALS:			

Integrator Volume (l): 100.1
Offset Correction (l): -.048
Total Integrator Volume:
CO_2 Mass Flow Correction:
Actual (dry STP) volume (l):
% O_2: 8
% CO_2: 12
% H_2O: 10
ppm SO_2:

COMMENTS:
Initial Volume = 0.0

Flue-Gas Sampling Log

Sponsor: DOE	Sample Run #: 3
Plant Location: YATES	Soda-Lime Trap#: 409
Date: 6/20/93	Iodated Carbon #: 409
Fuel Type: COAL	Pump#:
Pollution Control: ESP	Probe#:
Sampling Point: OUTLET	Filter ID:

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
0706	0/10"	.402	1126	0	.386	~~246~~"	0	.394
						260"		
					TOTALS:			

Integrator Volume (l): 0.0
Offset Correction (l): ~~-.049~~ -.049
Total Integrator Volume: 100
CO_2 Mass Flow Correction:
Actual (dry STP) volume (l):
% O_2:
% CO_2:
% H_2O:
ppm SO_2:

COMMENTS:
Initial Vol=0.00
final Vol=100.0

final offset = -.050

Flue-Gas Sampling Log

Sponsor: DOE-YATES	Sample Run #: FIELD BLANK
Plant Location: ESP OUTLET	Soda-Lime Trap#: 420
Date: 6/27/93	Iodated Carbon #: 420
Fuel Type: COAL	Pump#:
Pollution Control: ESP	Probe#:
Sampling Point: ESP OUTLET	Filter ID:

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
1300	0	0						
					TOTALS:			

Integrator Volume (l):
Offset Correction (l): -.070
Total Integrator Volume:
CO_2 Mass Flow Correction:
Actual (dry STP) volume (l):
% O_2:
% CO_2:
% H_2O:
ppm SO_2:

COMMENTS:
ADJUSTED FLOW TO
.362 LPM, THEN LEAK
✓'ed

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Outlet **Train** Anions **Run No.** 1

Date 6/25/93 Time Start 1015 Time Finish 1152 Test Duration 97 min.

Duct Dimensions 11'4" X 11'4" Diameter ft Initial Leak Rate <0.01 cfm

PTCF 0.84 DGMCF 0.992 Nozzle Dia. .223 inches Final Leak Rate .007@10" cfm

Bar Press 29.55 " Hg

Static Press -11 " H2O Operator MPE ITSB

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	1015	750.37	0.91	1.50	283	93	89	~~[illegible]~~ *	241	56	5"	
	~~[illegible]~~											
	1041	767.51	.91	1.5	278	101	91	274	262	56	5"	
	1052	774.74	0.93	1.5	280	102	92	255	253	56	5	
	1110	786.72	0.91	1.45	283	102	93	256	248	59	5	
	1121	794.31	0.92	1.50	283	103	93	257	250	59	5	
	1139	806.74	0.92	1.55	284	104	93	258	252	60	5	
	1152	815.57										
Avg.	—	65.200	0.9594	1.5	282	96.3						
Check'd												

CONSOLE # 161403

FILTER # 722

AMBIENT TEMP.

PROBE LENGTH

LINER MATERIAL

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

* Thermocouple not correct upon inspection of probe

SOURCE SAMPLING FIELD DATA SHEET

Page ____ of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Outlet **Train** Anions **Run No.** 2

Date 6/26/93 Time Start 1113 Time Finish 1243 Test Duration 90 min.

Duct Dimensions 1'4" x 1'4" Diameter ____ ft Initial Leak Rate 0.005@10 cfm

PTCF 0.84 DGMCF 0.997 Nozzle Dia. 0.223 inches Final Leak Rate 0.003@9 cfm

Bar Press 29.42 " Hg

Static Press -1 " H2O Operator APE/TSB K = 1.63

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack* Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
	1113	896.70	.94	1.5	283	97	90	259	249	59	5.0	
	1125	904.9	.94	1.5	283	101	91	271	259	61	5.0	
	1136	912.1	.94	1.5	283	100	91	251	252	61	5.0	
	1142	916.07	.92	1.55	283	101	91	241	253	62	5.0	
	1156	925.8	.90	1.55	283	101	92	249	245	63	5.0	
	1207	933.3	.89	1.55	283	101	92	246	242	63	5.0	
	1230	949.9	.88	1.55	283	102	93	245	245	63	5.0	
	1240	956.1	0.90	1.55	283	104	93	251	254	63	5.0	
	1243	956.85										
Avg.	–	62.150	√.9558	1.5313	283.0		96.5					
Check'd												

CONSOLE # 161403

FILTER # 934

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

* stack T assumed constant at single point

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Outlet **Train** Anions **Run No.** 3

Date 6/27/93 Time Start 0915 Time Finish 1038 Test Duration 83 min.

Duct Dimensions 11.4 X 11.4 Diameter ____ ft Initial Leak Rate .01@13" cfm

PTCF .84 DGMCF .992 Nozzle Dia. .229 inches Final Leak Rate .004@10" cfm

Bar Press 29.3 " Hg

Static Press -11.0 " H2O Operator TJB

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0915	47.70	.87	1.6	280	101	94	247	250	65	5.0	
	0920	51.28	.87	1.6	280	103	94	247	256	59	5.0	
	0930	58.38	.87	1.6	280	106	95	258	252	59	5.0	
	0945	69.04	.87	1.6	280	106	95	253	260	58	5.0	
	1015	91.28	.87	1.6	2	108	97	253	246	59	5.0	
TB	~~1020~~					~~98~~	98 2	~~251~~	~~252~~	~~51~~	TB	
	1027	100.1	.87	1.6	280	108	97	255	251	65	5.0	
	1038	108.301										
Avg.	—	60.611	√.9327	1.600	280.0		99.7					
Check'd												

CONSOLE # 161403

FILTER # 901

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

[redacted]

Plant Name Plant Yates Station Boiler No. 1
Sampling Location ESP out **Train** Anions **Run No.** F.B.
Date 6/24/93 Time Start 1430 Time Finish ____ Test Duration ____ min.
Duct Dimensions ____ X ____ Diameter ____ ft Initial Leak Rate ____ cfm
PTCF ____ DGMCF ____ Nozzle Dia. ____ inches Final Leak Rate ____ cfm
Bar Press ____ " Hg
Static Press ____ " H2O Operator ____

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
		94.100										
		94.26										
Avg.	—											
Check'd												

CONSOLE # A161-364
FILTER # ____
AMBIENT TEMP. ____
PROBE LENGTH ____
LINER MATERIAL ____

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

[redacted]

Plant Name 6-25-93 ATV **Plant Yates Station Boiler No. 1**

Sampling Location ESP Outlet **Train Ammonia/Hydrogen Cyanide** **Run No.** 1

Date 6/29/93 Time Start 0741 Time Finish 0930 Test Duration 109 min.

Duct Dimensions 11'4" X 11'4" Diameter ______ ft Initial Leak Rate .01@12" cfm

PTCF .84 DGMCF .992 Nozzle Dia. .223 inches Final Leak Rate 0.015@15" cfm

Bar Press 29.55 " Hg

Static Press 11.0 " H2O Operator TJB/APE k=1.03

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0741	674.000	.95	1.55	278	75	74	267	271	63	8.0	
	0810	693.5	.95	1.55	280	94	80	258	265	60	8.0	
	0816	697.43	.95	1.50	280	95	81	254	262	58	8.0	
	0825	703.5	~~.89~~ .95	1.50	280	95	83	266	249	56	8.0	
	0836	710.7	.95	1.58	280	95	83	265	254	56	8.0	
	0855	723.34	0.91	1.55	282	96	85	257	246	56	8.0	
	0914	736.40	0.90	1.60	278	99	87	257	242	59	8.0	
	~~0920~~ 0930	747.525										
			$\sqrt{\Delta P}$									
Avg.	—	73.525	0.9680	1.547	280	87.3						
Check'd	2C	73.525										

CONSOLE # 161403

FILTER # ______

AMBIENT TEMP. ______

PROBE LENGTH ______

LINER MATERIAL ______

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS ______

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name 06-26-93 DJV✓ Plant Yates Station Boiler No. 1
Sampling Location Outlet **Train** Ammonia/Hydrogen Cyanide **Run No.** 2
Date ~~6/25/93~~ Time Start 0930 Time Finish 1104 Test Duration 95 min.
Duct Dimensions 11.4 X ~~11.4~~ Diameter ______ ft Initial Leak Rate .007 @ 12" cfm
PTCF .84 DGMCF ~~1.859~~ Nozzle Dia. .223 inches Final Leak Rate 0.006 @ 12" cfm
Bar Press 29.92 " ~~Hg~~ 0.992 DJV✓
Static Press -1 " H2O Operator AE K=1.63 @ 75° Tm =1.69 @

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
	0	830.3	0.92	1.50	276	78	76	256	239	45	7	
	10	836.99	0.88	1.45	278	86	78	254	250	44	6.5"	
	20	843.60	0.87	1.45	278	89	79	255	245	46	6.5	
	30.7	850.66	0.88	1.45	280	92	81	258	245	46	6.5	
	40.3	856.99	0.85	1.45	280	94	82	257	239	48	6.5	
	51.8	864.57	0.95	1.50	278	96	84	257	240	48	6.75	
	57.8	868.63	1.0	1.65	279	97	85	258	253	49	7.0	
	67.0	875.16	0.95	1.55	283	99	87	258	241	51	7.0	
	75.4	881.05	0.96	1.60	284	100	88	259	244	51	7.0	
	87.9	889.78	0.92	1.60	278	103	90	257	251	50	7.0	
	94	894.0	0.94	1.50								
	94.7	894.45										
Avg.	—	64.50	√.9589	1.5182	279.4		88.2					
Check'd												

CONSOLE # 161403
FILTER # 934
AMBIENT TEMP. /
PROBE LENGTH
LINER MATERIAL

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP Outlet **Train** Ammonia/Hydrogen Cyanide **Run No.** 3

Date 6/27/93 Time Start 0725 Time Finish 0856 Test Duration 91 min.

Duct Dimensions 11.4" X 11.4" Diameter ____ ft Initial Leak Rate .01@10" cfm

PTCF .84 DGMCF .992 Nozzle Dia. ~~.223~~ .229 inches Final Leak Rate .007@12" cfm

Bar Press 29.3 " Hg

Static Press -11.0 " H2O Operator TJB K 1.85

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0725	983.0	.89	1.6	280	81	77	254	263	68	6.0	
	0733	988.45	.89	1.6	280	90	79	253	260	59	6.0	
	0741	993.96	.89	1.6	280	96	81	262	258	54	6.0	
	0753	1002.28	.89	1.6	277	99	84	253	255	53	6.0	
	0803	1009.26	.85	1.6	278	101	87	254	258	53	6.0	
	0818	1019.65	.89	1.6	279	102	89	255	249	54	6.5	
	0830	1028.04	.89	1.6	280	106	92	256	257	57	6.5	
	0845	1036.58	.89	1.6	280	107	93	256	253	57		
	0856	1046.443										
Avg.	—	63.443	√.9434	1.600	279.3		91.5					
Check'd												

CONSOLE # 161403

FILTER # 901

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS Broke Nozzle before run switch to .229

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP Outlet **Train** Ammonia/Hydrogen Cyanide **Run No.** F. B. [redacted]

Date 6-24-93 Time Start ________ Time Finish ________ Test Duration ________ min.

Duct Dimensions ________ X ________ Diameter ________ ft Initial Leak Rate ________ cfm

PTCF ________ DGMCF ________ Nozzle Dia. ________ inches Final Leak Rate ________ cfm

Bar Press ________ " Hg

Static Press ________ " H2O Operator ________

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	____
						Inlet	Outlet					
	1325	90183										
		90.350										
Avg.	—	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Check'd		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

CONSOLE # A16134

FILTER # 654

AMBIENT TEMP. ________

PROBE LENGTH ________

LINER MATERIAL ________

Velocity ________

% Moisture ________

Flowrate (DSCFM) ________

Isokinetic (%) ________

REMARKS ________

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

[redacted]

Page 1 of 2

Plant Name Plant Yates Station Boiler No. 1 ~~1~~ 1 ~~[illegible]~~ gre

Sampling Location OUTLET **Train** Bulk Particulate-Radionuclides **Run No.** 1

Date 6/24/93 Time Start 1040 Time Finish ~~[illegible]~~0700 Test Duration 1198 ** min.

Duct Dimensions 11'4" X 11'4" Diameter — ft Initial Leak Rate < .001 cfm

PTCF .84 DGMCF 1.005 Nozzle Dia. .197 inches Final Leak Rate 0.009 cfm

Bar Press 29.53 " Hg

Static Press -.11 " H2O Operator PRE

.04

Travers Point	Clock Time (min)	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	509.48	1.20	1.26	283	97	89	257	272	91	5.75	
	22.6	517.92	1.20	1.20	284	102	94	259	275	92	5.5	
	46.8	532.23	1.10	1.15	286	107	99	255	281	72	5.25	
	63.0	541.725	1.20	1.25	285	108	101	256	278	74	5.25	
	88.9	557.19	1.25	1.30	288	113	106	258	277	77	5.5	
	118.5	575.05	1.20	1.32	284	106	102	271	253	70	5.5	
	202	625.40	1.2	1.3	287	112	104	252	260	62	6	
	264	662.61	1.2	1.3	288	115	109	253	281	67	6	
	306.4	688.295	1.20	1.23	289	108	103	253	266	63	5.5	
*	329.0	702.5										
*	329.0	702.5	1.2	1.23								
stop	409.0	748.9										
start	409.3	949.45	1.2	1.2	282	88	80	257	254	49	2.5	
	409.4											
	412.4	765.80	1.25	1.35	283	90	82	255	274	69		
→	461.0	775.07	1.25	1.35	277	91	86	251	271	64	2.5	
	522.0	831.80	1.25	1.35	284	88	83	253	266	62	2.5	
	592.4	873.94	1.25	1.35	283	92	85	253	270	66	2.5	
	646.6	906.48	1.25	1.35	283	93	86	252	271	68	2.5	
	729.5	955.17	1.25	1.35	282	91	84	254	272	66	2.5	
	788.3	987.07	1.25	1.35	279	94	87	251	282	66	2.5	
	842.4	1024.10	1.25	1.35	279	93	86	251	272	58	2.5	
	913.5	67.13	1.25	1.35	280	94	86	252	272	58	2.5	
	971.9	103.91	1.25	1.35	279	94	87	252	271	59	2.5	
	1027.9	138.97	1.25	1.35	281	96	88	253	271	62	2.5	
	1077.2	169.17	1.25	1.35	279	94	87	252	274	58	2.5	
19.4W	1137.1	206.40	1.20	1.25	279	93	86	252	276	57	2.5	
	1166.7	273.54										
Avg.	—											
Check'd												

[illegible] **

IMP

CONSOLE # A161400

FILTER # #909

AMBIENT TEMP. 90

PROBE LENGTH 8'

LINER MATERIAL

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS Lost Power 1605 restarted @ 1610 Due train stop - stopped at 1730 to recharge impingers ** timer was off for

C-77

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP OUTLET **Train** Bulk Particulate-Radionuclides **Run No.** 2

Date 6/26/93 Time Start 1050 Time Finish 0640 Test Duration ________ min.

Duct Dimensions 11'4" X 11'4" Diameter ________ ft Initial Leak Rate 0.005 @ 11" cfm

PTCF .84 DGMCF 1.005 Nozzle Dia. .197 inches Final Leak Rate 0.003 @ 5" cfm

Bar Press 29.55 " Hg

Static Press -1 " H2O Operator ASSORTED MISFITS K=1.06

Travers Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
1050	1050	243.171	1.0	1.1	283	83	84	258	280	70	5	
	15"	252.04	1.0	1.1	283	87	84	245	270	72	5	
	59"	275.96	1.0	1.1	284	96	89	254	282	70	5	
	104	300.44	1.1	1.2	284	97	92	254	275	68	5	
	124.4	317.23	1.1	1.35	285	100	94	254	284	71	4.5	
	150	327.64	1.0	1.1	285	102	96	251	270	75	5	
	211	362.32	1.0	1.1	286	102	98	252	276	69	4	
	265.1	392.19	1.05	1.1	286	105	100	253	255	71	4	
4	312	417.51										
	3120	417.6	1.0	1.1	287	103	100	253	261	68	2.0	
1720	390.	458.20	1.0	1.1	288	112	105	252	249	69	4.0	
TM5) →	474.5	508.98	1.0	1.1	284	107	101	253	255	68	4.0	
	536.5	544.95	1.0	1.1	285	101	96	253	260	65	4.0	
	606.0	584.01	1.0	1.1	280	99	93	252	253	61	4.0	
	651.5	609.60	1.0	1.1	280	99	93	253	251	63	4.0	
	693.6	632.72	1.0	1.1	284	97	92	252	260	58	4.0	
	745.2	661.67	1.0	1.1	282	93	88	252	259	55	4.0	
	799.0	691.64	1.0	1.1	282	91	86	252	258	57	4.0	
	887.3	739.44	1.0	1.1	280	94	88	253	264	61	4.0	
	940.50	768.28	1.0	1.1	279	92	87	252	259	57	4.0	
	1021.9	813.06	1.0	1.1	279	89	84	253	250	63	4.0	
	1074.2	841.93	1.0	1.1	279	88	83	253	259	56	4.5	
	1121.3	866.48	1.0	1.1	279	91	85	253	252	55	4.5	
	1170	894.38	1.0	1.1	280	90	85	252	261	55	5	
	1182.4	901.34										
Avg.	—	658.079	1.0092	1.1	282.8		93.9					
Check'd												

CONSOLE # 4161400 N2

FILTER # ~~325~~ 925

AMBIENT TEMP. ________

PROBE LENGTH 10' GLASS

LINER MATERIAL GLASS

Velocity ________

% Moisture ________

Flowrate (DSCFM) ________

Isokinetic (%) ________

REMARKS Stop to Empty water From Imp Si gell OK

Note: some ash seen downstream of filter in hotbox / First half of test 1050 to 17
second half of test 1720-06

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

Page ____ of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP OUT
Train Bulk Particulate-Radionuclides
Run No. 3

Date 6/26/93 Time Start 1055 Time Finish 0619 Test Duration 619 min.

Duct Dimensions 11.4" x 11.4" Diameter ____ ft Initial Leak Rate 0.005@10" cfm

PTCF .84 DGMCF 1.005 Nozzle Dia. .197 inches Final Leak Rate .005@10" cfm

Bar Press 29.42 " Hg

Static Press -11.0 " H2O Operator

K=1.09

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	913.21	1.05	1.2	278	87	85	260	249	65	1	
	24	927.0	1.05	1.2	280	94	89	249	255	64	1	
	47	939.92	1.05	1.2	282	99	92	250	262	68	1	
	62	948.42	1.05	1.2	284	102	95	254	248	57	1	
	107	974.16	1.05	1.2	284	105	101	254	255	63	1	
	146	996.6	1.05	1.2	282	109	105	255	249	59	1	
	189	1021.45	1.05	1.2	286	104	103	252	246	59	1	
	245	1054.43	1.05	1.2	286	104	101	252	251	63	1	
307	~~262~~	1091.2	1.05	1.2	286	104	101	252	252	62	1	
	432	164.5	1.05	1.2	286	106	102	252	252	58	1	
TMS	479.9	191.89	1.05	1.2	284	104	99	253	257	60	1	
	543.3	228.75	1.05	1.2	284	~~97~~ 98	94	256	257	56	1	
	624.5	275.50	1.05	1.2	281	98	93	253	261	58	1	
	665.7	299.15	1.05	1.2	283	97	92	253	256	57	1	
	720.5	330.40	1.05	1.2	281	94	90	253	262	53	1	
	775.8	361.70	1.05	1.2	283	94	89	253	262	54	1	
	837.2	396.50	1.05	1.2	280	91	87	250	262	54	1	
	891.5	427.20	1.05	1.2	280	92	87	252	253	53	1	
	962.1	466.97	1.05	1.2	280	93	87	251	249	55	1	
	1026.2	503.00	1.05	1.2	278	94	88	253	258	55	1	
	1081.4	537.92	1.05	1.2	279	91	86	252	255	51	1	
	1137.7	565.77	1.05	1.2	278	89	84	252	250	51	1	
6/27	0619	580.3										
Avg.	—	667.090	1.0247	1.200	282.0		96.9					
Check'd												

CONSOLE # A161400

FILTER # 928

AMBIENT TEMP. 80

PROBE LENGTH 10'

LINER MATERIAL GLASS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

1 of 1

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

Page 2 of 2

[redacted]

Plant Name Plant Yates Station Boiler No. 1

Sampling Location OUTLET **Train** Bulk Particulate-Ex. Metals **Run No.** 1

Date 6/24/93 Time Start ______ Time Finish c0700 6/25 Test Duration 1101 ** min.

Duct Dimensions 11'4" X 11'4" Diameter ______ ft Initial Leak Rate 0.015 cfm

PTCF .84 DGMCF .998 Nozzle Dia. ~~.223~~ .230 inches Final Leak Rate 0.014 cfm

Bar Press 29.53 " Hg

1.98

Static Press -11 " H2O Operator ______

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	463.0	1.30	2.60	287	99	91	257	252	67	12	
	9.1	470.67	1.30	2.58	286	100	92	256	[illegible]	72	12	
	41.3	497.85	1.30	2.61	285	102	94	259	248	84	11.8	
	121.9	566.92	1.3	2.6	282	109	97	259	253	70	12	
	184	620.24	1.3	2.6	288	114	102	261	250	70	12	
	226.1	656.70	1.15	2.65	289	106	97	261	251	53	11.5	
*	253	680.1										
	253	680.1	1.15	2.65								
	317.6	734.0	1.10	2.2	282	89	81	257	249	49	10.5	
stop	333.7	745.75										
start	344.58	746.3										
	358.6	757.75	1.20	2.45	283	89	80	258	249	50	7.5	
TMD7	408.0	798.16	1.20	2.45	284	93	85	257	257	56	7.5	
	465.9	845.30	1.20	2.45	283	91	82	257	249	54	7.5	
	539.0	905.08	1.20	2.45	281	93	83	258	252	49	7.5	
	589.5	946.30	1.20	2.45	280	94	84	258	250	52	7.5	
	675.7	1016.18	1.20	2.45	279	91	80	259	251	52	8.0	
	742.1	70.38	1.20	2.45	278	93	83	258	250	52	8.0	
	788.5	108.30	1.20	2.45	278	91	81	260	250	46	8.0	
	853.6	164.42	1.20	2.45	279	92	82	258	250	47	8.0	
	917.9	213.46	1.20	2.45	279	91	81	255	250	48	8.0	
	971.9	257.19	1.20	2.45	279	93	83	259	251	50	8.0	
	1023.5	298.82	1.20	2.45	279	92	82	257	251	45	8.0	
11.8hr	1079.3	343.67	1.15	2.35	279	91	82	257	250	45	8.0	
	1111.6	369.5										
Avg.	—		$\sqrt{\Delta P}$									
Check'd		906.5	1.1008	2.49	282	90.9						

CONSOLE # A161395

FILTER # ~~910~~ 929

AMBIENT TEMP. 90

PROBE LENGTH 10'

LINER MATERIAL ______

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS NOZZLE ID 009 .230 .230 .230

Lost Power @ 1610 Due to rain
restart @ 1620

stop - pulled out train to change impingers
** subtract 10.8 min as it was

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP Out
Train Bulk Particulate-Ex. Metals
Run No. 2

Date 6/26/93 Time Start 1040
Time Finish 0636 6/27 Test Duration ____ min.

Duct Dimensions 11.4 x 11.4
Diameter ____ ft
Initial Leak Rate 0.009@14 cfm

PTCF .84 DGMCF 0.998 Nozzle Dia. .229 inches
Final Leak Rate 0.006@7 cfm ~~@4~~

Bar Press 28.55 " Hg

Static Press -1.1 " H2O
Operator Assorted Misfits K=1.9

TMD

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
	1040	390.40	1.2	2.3	282	99	77	278	254	63	8	
	22"	407.91	1.2	2.3	283	92	81	269	253	62	8	
	70"	446.06	1.2	2.3	284	100	88	257	254	64	8	
	116"	483.1	1.2	2.3	284	101	91	260	252	53	8	
	132.5	496.2	1.2	2.3	285	103	92	259	250	54	8	
	162	520.08	1.2	2.3	286	104	94	262	253	56	8	
	223	569.59	1.2	2.3	286	105	95	259	253	50	8	
	276.6	612.07	1.25	2.35	286	108	99	259	250	53	8	
STOP	316.0	644.78										
Start	00.00	644.92	1.2	2.3	286	104	97	261	253	54	5	
1225	00.00	716.50										
	80.9	783.04	1.2	2.3	286	106	97	261	250	57	5	
	143.0	830.90	1.2	2.3	284	101	94	259	252	52	5	
	212.5	885.76	1.2	2.3	281	99	91	260	250	49	5	
	258.0	921.91	1.2	2.3	281	98	90	260	257	51	5	
	300.0	955.15	1.2	2.3	284	98	89	[illegible]	249	47	5	
	351.8	996.15	1.2	2.3	281	95	86	259	251	48	5	
	405.5	1038.30	1.2	2.3	280	92	83	259	250	48	6	
	493.7	1108.81	1.2	2.3	279	95	85	258	251	50	6	
	546.9	1150.79	1.2	2.3	278	93	84	257	250	47	6	
	628.5	1214.88	1.2	2.3	279	90	82	257	250	50	6	
	680.8	1255.44	1.2	2.3	279	89	80	257	250	50	6	
	727.6	1291.96	1.2	2.3	280	92	82	259	249	44	6.5	
	778	1232.13	1.2	2.3	280	92	83	258	255	44	7	
	787.1	1339.29										
Avg.	—	948.750	√1.0854	2.300	282.5	92.6						
Check'd												

CONSOLE # A16135
FILTER # 904
AMBIENT TEMP. ____
PROBE LENGTH ____
LINER MATERIAL ____

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS Stopped 1600 removed spent Si.Gell

SOURCE SAMPLING FIELD DATA SHEET

Page ____ of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP Outlet **Train** ~~Particulate / Metals~~ BulK **Run No.** 3

Date 6/26/93 Time Start 1137 Time Finish 0621 Test Duration 1125 min.

Duct Dimensions 11'4" X 11'4" Diameter ____ ft Initial Leak Rate .01@10" cfm

PTCF 0.84 DGMCF 0.999 NOZZLE DIA. .229 inches Final Leak Rate .01@6" cfm

Bar Press 29.42 " Hg

Static Press -11 " H2O Operator DD/TM/TJB

K=1.97

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	347.00	.97	1.9	282	87	82	274	253	62	4	
	20	361.15	.97	1.9	283	94	85	265	253	47	4	
	66	394.7	.97	1.9	286	104	96	250	253	53	4	
	106	424.01	.97	1.9	286	109	102	255	253	49	4	
	147	454.32	.97	1.9	286	106	101	259	249	54	4	
	203	495.51	.95	1.9	288	106	99	259	249	53	5	
	268	543.4	.97	1.9	290	103	96	254	254	48	5	
	394	635.3	.97	1.9	292	104	98	259	250	50	5	
TMD	441.7	669.83	0.97	1.9	289	102	95	260	249	50	5	
	502.6	713.70	0.97	1.9	285	96	89	259	249	57	5	
	583.2	772.26	0.97	1.9	284	97	89	257	249	48	5	
	624.9	801.86	0.97	1.9	284	97	89	259	250	47	5	
	6796	840.90	0.97	1.9	284	94	87	258	249	44	5	
	735.0	880.77	0.97	1.9	284	94	87	259	249	44	5	
	796.4	924.70	0.97	1.9	282	92	85	259	249	46	5	
	850.4	963.90	0.97	1.9	280	92	84	259	249	45	5	
	921.4	1014.22	0.97	1.9	280	92	85	260	249	46	5	
	985.5	59.70	0.97	1.9	278	92	85	257	250	45	5	
	1040.7	99.50	0.97	1.9	278	91	84	257	249	42	5	
	1097.0	139.63	0.97	1.9	278	89	82	258	247	42	5	
0621	1125	159.605										
Avg.	—	812.605	.9840	1.900	285		94.5					
Check'd												

CONSOLE # A161395

FILTER # 925 QUARTZ

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

Page 1 of ___

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP OUTLET **Train** Size Fract. Particulate **Run No.** 82

Date 2/26/93 Time Start 1130 Time Finish 0636 2/27 Test Duration 1109 min.

Duct Dimensions 11'4" X 11'4" Diameter ___ ft Initial Leak Rate .005@6 cfm

PTCF .84 DGMCF 1.007 Nozzle Dia. .211 inches Final Leak Rate ___ cfm

Bar Press 29.55 " Hg

Static Press -11 " H2O Operator

TB K=~~1.6~~ 1.3

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	568.850	1.1	1.7	277	80	70			70	2	
	24	586.28	1.1	1.7	279	92	81			70	2	
			1.0	1.6	279	94	84			68	2	
	64.6	613.32	1.1	1.6	279	97	89			72	2	9
	97	635.29	1.0	1.6	280	100	93			75	2	
157	~~155.5~~	676.05	1.0	1.6	287	101	95			67	2	
	210.5	712.95	0.96	1.6	286	104	97			70	2	
	235.0	729.7	1.0	1.3	280	114	97			69	2	
	268	749.2	.98	1.3	281	104	99			70	2	
1715	338	790.25	.96	1.3	285	104	99			66	2	
TMD >	426.5	839.85	0.96	1.3	258	100	95			65	2	
	488.4	878.60	0.96	1.3	281	98	93			58	2	
	557.8	921.86	0.96	1.3	276	97	92			58	2	
	603.4	950.60	0.96	1.3	280	95	90			55	2	
	645.5	976.35	0.96	1.3	278	95	90			55	2	
	697.3	1007.95	0.96	1.3	275	92	87			54	2	
	751.1	1041.10	0.96	1.3	274	89	85			53	2	
	838.7	1094.14	0.96	1.3	278	91	86			54	2	
* stop/start	892.5	1126.72	0.96	1.3	272	91	85			53	2	
	951.2	1161.42	0.96	1.3	274	86	80			48	2	
	1003.7	1193.35	0.96	1.3	273	86	81			49	2	
	1050.4	1221.52	0.96	1.3	274	88	82			45	2	
	1094.0	1245.95	0.94	1.3	274	89	84			49	2	
	1103	1253.08	.94	1.3	278	88	83			46	2	
	1108.7	1256.47										
Avg.	—	687.620	~~1.32~~	1.4150	278.7		91.3					
Check'd			.99542									

CONSOLE # A161396

FILTER # 1258 (Thimble)

AMBIENT TEMP. ___

PROBE LENGTH ___

LINER MATERIAL ___

Velocity ___

% Moisture ___

Flowrate (DSCFM) ___

Isokinetic (%) ___

REMARKS ΔH @ 1.775

* empty silica gel

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

Page 1 of 1
BSM

Plant Name Plant Yates Station Boiler No. 1
Sampling Location OUTLET **Train** Size Fract. Particulate **Run No.** 4
Date 6/24/93 Time Start 0140 Time Finish ~~0020~~ 425 Test Duration 1315.8 min.
Duct Dimensions 11'4" X 11'4" Diameter ft Initial Leak Rate 0.012@12 cfm
PTCF .84 DGMCF 1.007 Nozzle Dia. .211 inches Final Leak Rate cfm
Bar Press 29.53 " Hg
Static Press -11 " H2O Operator Doule, et.al.

K ~ 1.30 75/27

Travers Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	715.378	.78	1.288	278	81	78			70	2	
	9	720.37	.95	1.413	278	83	78			66	2	
	40	739.96	1.0	1.04	279	94	85			68	2	
	64	754.77	1.0	1.4	281	95	88			69	2	
	90	770.55	1.0	1.3	282	100	92			65	2	
	131	795.60	1.0	1.3	283	101	95			64	2	
	163	815.04	1.0	1.3	284	104	97			67	2	
	188	831.18	1.0	1.3	284	102	96			59	2	
	211	846.38	.95	1.3	285	104	96			61	2	
	254	872.89	.94	1.2	286	102	96			68	2	
	290	894.6	1.0	1.4	283	96	93			57	2.0	
	377	948.25	1.0	1.4	287	100	93			62	2	
	439	989.68	1.0	1.4	290	105	99			45	2	
	~~[illegible]~~	~~[illegible]~~ ~~[illegible]~~										
	624.8	1107.82	.93	1.7	281	87	80			55	2	
	674.0	1138.68	0.93	1.4	282	89	83			55	2	
	729.4	173.00	0.93	1.4	282	89	82			56	2	
	801.0	217.31	0.93	1.4	282	90	83			57	2.5	
*	857.1	251.94	0.93	1.4	279	89	83			62	2.5	
stop 23:22	941.6	304.910										
start 23:26	941.6	305.125	0.93	1.4	279	84	79			61	2.5	
	1003.0	344.17	0.93	1.4	277	90	82			64	2.5	
	1049.0	372.93	0.86	1.3	279	88	81			54	2.5	
	1118.2	416.54	0.86	1.3	278	89	82			52	2.5	
	1177.5	451.70	0.86	1.3	278	88	81			51	2.5	
	1232.5	484.10	0.86	1.3	278	90	83			57	2.5	
	1283.0	513.84	0.86	1.3	278	89	83			50	2.5	
23.5hr	1353.3	554.81	0.84	1.2	278	88	82			51	2.5	
Avg.	1372.8	567.723										
Check'd		852.132	√.9581	1.3455	281.1		89.8					

CONSOLE # A 161396
FILTER # 1251 (Thimble)
AMBIENT TEMP.
PROBE LENGTH
LINER MATERIAL

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS * Th 9) empty imp., leak check through glass were 0.002@15"

SOURCE SAMPLING FIELD DATA SHEET

ESP OUTLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP OUTLET **Train** Size Fract. Particulate **Run No.** 3

Date 6/26/93 Time Start 1218 Time Finish 0627 Test Duration 1090 min.

Duct Dimensions 11'9 X 11'9 Diameter ______ ft Initial Leak Rate 0.005 @ 6" cfm

PTCF .84 DGMCF 1.007 Nozzle Dia. .21 inches Final Leak Rate ______ cfm

Bar Press 29.42 " Hg

Static Press -11.0 " H2O Operator

13
13
~~39~~
13

R = ~~1.0~~ 1.3

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	0	258.76	1.2	1.6	284	85	82	-	96		3	
	26	274.7	1.2	1.6	282	92	85				3	
	63	300.7	1.2	1.6	282	100	92		128	48	3	
	105	330.67	1.2	1.6	284	101	95			59	3	
	161	370.1	1.3	1.7	283	104	99			55	3	
	225	415.7	1.3	1.7	286	103	79		124	55	3	
	350	503.1	1.2	1.6	288	102	97		127	51	2	
Tmgd	397.7	534.78	1.2	1.6	286	100	94		127	56	2	
	461.0	578.12	1.2	1.6	287	94	89		125	52	2	
	542.0	632.50	1.2	1.6	281	96	90		129	50	2	
	583.4	660.33	1.2	1.6	280	97	91		129	49	2	
	637.7	696.57	1.1	1.5	281	96	90		127	47	2	
	693.5	732.30	1.1	1.5	281	96	90		126	49	2	
	754.5	771.07	1.0	1.4	278	93	88		125	49	2	
	809.1	803.88	1.0	1.4	272	93	88		121	49	2	
	879.8	846.50	1.0	1.4	276	92	87		130	49	2	
	943.9	884.59	1.0	1.4	274	93	87		122	48	2	
	999.1	917.17	1.0	1.4	274	91	86		122	45	2	
	1055.5	950.42	1.0	1.4	274	89	84		125	47	2	
0627	1090	970.557										
Avg.	—											
Check'd												

CONSOLE # A161394
FILTER # 1255 (Thimble)
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS ______

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location OUTLET

Run No. 1

Date 6/21/93

Comments

Operator TJB

Sorbing Reagents: ✓(CO2) ✓(O2) (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0	6.0	6.0	19.4	13.4		
2	0	6.2	6.2	19.0	12.8		
3	0	6.6	6.6	19.6	13.0		

Averaged Results: % CO2 6.3 * % O2 13.1 *

% CO

Y-253

Dry Molecular Weight, MW (dry) =

=0.44 (%CO2) +0.32 (%O2)

= + +

Run # 1 Train orsat

ESP Inlet
[✓ ESP Outlet]
Stack

Component bag

Date 6-21-93 Time Smplr TJB

Lab on site Analysis CO_2 O_2

Tare Wt. Final Wt.

*'s NOT REALISTIC — LEAK IN SAMPLING SYSTEM
WAW

Assume O_2 = 8.0
CO_2 = 11.1

[redacted]

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location ESP Outlet

Run No. 2

Date 6/22/93

Comments ____________

Operator TJB / TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) ________ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.2	11.2	19.0	7.8		
2	0.0	11.1	11.1	19.0	7.9		

Averaged Results: % CO2 11.2 % O2 7.9

% CO ________ % N2 80.9

Dry Molecular Weight, MW (dry) =

=0.44________ +0.32________ +0.28____________
(%CO2) (%O2) (%CO + % N2)

=________ + ________ + __

Y-254

Run # 2 Train orsat [✓ ESP Outlet] ESP Inlet Stack

Component bag

Date 6-22-93 Time ________ Smplr TJB

Lab on site Analysis ________

Tare Wt. ________ Final Wt. ________

[redacted]

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Comments

Location ESP outlet

Run No. 3

Date 6/23/93

Operator TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) ____ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	10.6	10.6	19.0	8.4		
2	0.0	10.6	10.6	19.1	8.5		

Averaged Results: % CO2 10.6 % O2 8.5

% CO ____ % N2 80.9

Dry Molecular Weight, MW (dry) =

=0.44 ____ (%CO2) +0.32 ____ (%O2) +0.28 ____ (%CO + % N2)

= ____ + ____

Y-255

Run # 3 Train orsat ESP Inlet [✓ ESP Outlet] Stack

Component bag

Date 6-23-93 Time ____ Smplr TJB

Lab onsite Analysis CO_2 O_2

Tare Wt. ____ Final Wt. ____

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location ESP Outlet

Run No. Run 2-1 Run 1 phase 2

Date 06-25-93

Comments

Operator DJV

Sorbing Reagents: (CO2) (O2) (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.2	11.2	18.8	7.6		
2	0.0	11.2	11.2	18.8	7.6		

Averaged Results: % CO2 11.2 % O2 7.6

% CO % N2

Dry Molecular Weight, MW (dry) =

$=0.44\_\_\_\_ + 0.32\_\_\_\_ + 0.28\_\_\_\_$

(%CO2) (%O2) (%CO + % N2)

= + +

Y-329

Run # 1 Train Orsat ESP Inlet [✓ ESP Outlet] Stack

Component bag

Date 6-25-93 Time 1540 Smplr TJB

Lab on site Analysis CO2 O2

Tare WT(g) Final Wt(g)

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Comments

Location ESP Outlet

Run No. phase 2 run 2

Date 6/26/93

Operator TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) ____ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.0	11.0	18.6	7.6		
2	0.0	11.2	11.2	18.6	7.4		

Averaged Results: % CO2 11.1 % O2 7.5

% CO ____ % N2 ____

Dry Molecular Weight, MW (dry) =

=0.44 ____ +0.32 ____ +0.28 ____

(%CO2) (%O2) (%CO + % N2)

= ____ + ____ + ____

Y-406

Run # 2 Train orsat

ESP Inlet
[✓ ESP Outlet]
Stack

Component Phase 2 - Bag

Date 6-26-93 Time 1445 Smplr TJB

Lab onsite Analysis CO_2 O_2

Tare WT(g) Na Final Wt(g) Na

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location ESP Outlet

Run No. 2-3

Date 6/27/93

Comments

Operator TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) ____ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.4	11.4	19.0	7.6		
2	0.0	11.4	11.4	19.0	7.6		

Averaged Results: % CO2 11.4 % O2 7.6

% CO ________ % N2 ________

Dry Molecular Weight, MW (dry) =

=0.44 ________ +0.32 ________ +0.28 ________
(%CO2) (%O2) (%

= ________ + ________ + ________

Y-452

Run # 2-3 Train ORSAT

ESP Inl
[✓ ESP Outle]
Stac

Component ORSAT

Date 6/27/93 Time 1300 Smplr TJB

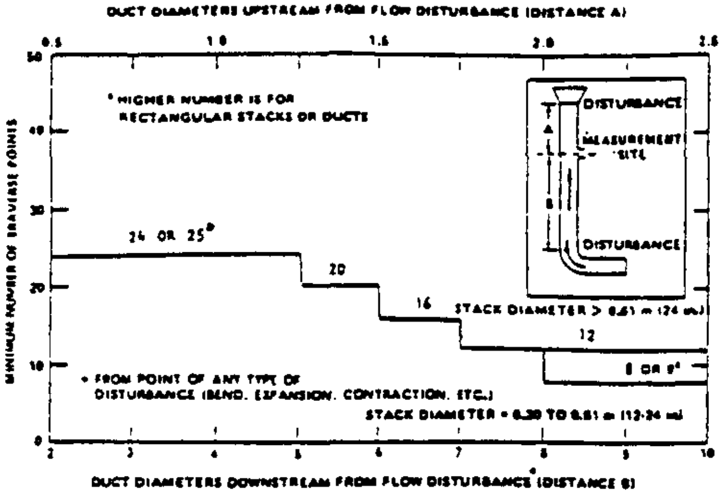
Lab On site Analysis O2/CO2

Tare WT(g) — Final Wt(g) —

TRAVERSE FIELD DATA SHEET

Plant Name Plant Yates Station Boiler No1
Sampling Location ESP OUTLET
Date 06-19-93
Operator RVW / JWM

Stack Diameter 11'4" x 11'4"
Sample Port Diameter 4"
Sample Port Depth 18"
Distance Upstream
Distance downstream



Traverse Point Number	Number Traverse Points On A Diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

Traverse Points	
No.	Distance From Wall
	PORT DEPTH INCLUDED
1	26.5
2	43.5
3	60.5
4	77.5
5	94.5
6	111.5
7	128.5
8	145.5
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	

[redacted]

1 of 3

VELOCITY PROFILE FIELD DATA

Plant Name Yates - Preliminary
Sampling Location Inlet to Scrubber Sample Ident. ESP Outlet
Date 6/14/93 (MMDDYY) Time Start 1600 (HHMM) Time Finish 1630 (HHMM)
Duct Dimensions 11' 4" x 11' 4" ft. or Diameter ______ ft.
PTCF 0.84 % H_2O ≈ 7.0
Bar Press. 29.48 " Hg % CO T % N_2 ______
Static Press. -11 " H_2O % CO_2 ≈ 9.0 % H_2 ______
Operator Initials JWM, RVW % O_2 7.4 % CH_4 ______

Point 1 is all the way in

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
W1-1	207			0.88					
2	205			~~0.75~~	0.90				
3	207			~~0.58~~	0.66				
4	207			0.36					
5	206			0.35					
6	200			0.57					
7	197			0.69					
8	192			0.68					
W2-1	200			0.85					
2	209			0.46					
3	209			0.74					
4	209			0.92					
5	205			0.62					
6	203			0.56					
7	194			0.7					
8	194			0.47					

Weather ______

Remarks ______

12% CO_2 + 7.4 O_2 + 80.6 N_2 = 30.23

29.36 wet

57.11 ft/s

57.11 ft × 129.96 = $\frac{7422\ ft^3}{s}$ × 60 = $\frac{445,320.9\ ft^3}{min}$ = 315,910 $\frac{dscf}{min}$

2 of 3

VELOCITY PROFILE FIELD DATA

Plant Name –
Sampling Location ______ Sample Ident. ______
Date ______(MMDDYY) Time Start ______(HHMM) Time Finish ______(HHMM)
Duct Dimensions ______x______ft. or Diameter ______ft.
PTCF ______ % H_2O ______
Bar. Press. ______" Hg % CO ______ % N_2 ______
Static Press. ______" H_2O % CO_2 ______ % H_2 ______
Operator Initials ______ % O_2 ______ % CH_4 ______

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
W3-1	201			0.85					
2	210	210		0.94					
3	~~218~~ ?	thermocouple		1.1					
4	202			1.15					
5	189			1.1					
6	181			0.93					
7	180			0.73					
8	180			0.43					
W4-1	203			0.88					
2	192			0.99					
3	191			~~1.03~~ 1.3					
4	215			1.25					
5	211			1.3					
6	199			1.1					
7	191			0.80					
8	191			0.47					

Weather ______

Remarks ______

3 of 3

VELOCITY PROFILE FIELD DATA

Plant Name –
Sampling Location ____ Sample Ident. ____
Date ____(MMDDYY) Time Start ____(HHMM) Time Finish ____(HHMM)
Duct Dimensions ____ x ____ ft. or Diameter ____ ft.
PTCF ____ % H_2O ____
Bar Press. ____ " Hg % CO ____ % N_2 ____
Static Press. ____ " H_2O % CO_2 ____ % H_2 ____
Operator Initials ____ % O_2 ____ % CH_4 ____

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
W5-1	219			0.99					
2	221			0.97					
3	202			1.2					
4	221			1.25					
5	216			1.10					
6	207			0.7					
7	191			0.8					
8	191			0.58					
W6-1	216			0.93					
2	225			0.85					
3	227			0.66					
4	226			0.71					
5	219			0.59					
6	204			0.69					
7	194			0.81					
8	191			0.77					
	—			$\sqrt{\Delta P}$					
	203.5			0.896					

Weather 203 ✓TJB $\sqrt{\Delta P}$ .896 ✓ TJB

Remarks ____

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 6-21-93
SAMPLING LOCATION STACK
RUN NO. 1 TEST NO. 1
OPERATOR JEH
AMBIENT TEMPERATURE 77°F
BAROMETRIC PRESSURE 29.35 "Hg
BLANK TUBE NUMBERS T: 44A T/C: 44B

ASSUMED MOISTURE % 12.0
METER BOX NO. V-11 (PPK)
METER FACTOR 1.0113
PROBE HEATER SETTING 130°C
COMMENTS Raw
Run #1 - RATE @0.8 (TOO FAST)
Run #3 - TIP OF B TUBE BROKEN OFF POST Run
ALL TIMES CENTRAL TIME

Test Number	Leak Check ("Hg) Pre	Leak Check ("Hg) Post	Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack Temp	DGM Temp	Probe Temp	1st Condensor Outlet Temp	2nd Condensor Outlet Temp	Pump Vacuum "Hg ~~Temp~~
1	0.004 @20"	0.010 @22"	T	0	1325	0.000	2.2" Hg	128F	19°C	134°C	8°C	9°C	4.0
			38A	20	1345	15.200	2.8" Hg	128F	21°C	134°C	5°C	8°C	6.0
			T/C	30	1355	20.405	2.2" Hg	128°F	22°C	134°C	4°C	7°C	4.5
			38B	40	1405	26.485							
2	0.012 @22"	0.011 @20"	T	0	1415	0.000	2.2" Hg	128F	23°C	133°C	8°C	10°C	5.0
			22A	10	1425	5.007	2.1" Hg	128F	24°C	133°C	7°C	10°C	4.0
			T/C	20	1435	9.502	2.1" Hg	128°F	25°C	133°C	8°C	9°C	5.0
			22B	30	1445	15.021	2.1" Hg	128°F	26°C	133°C	7°C	9°C	6.0
				40	1455	20.210							
3	0.005 @20"	0.008 @15"	T	0	1515	0.000	2.4" Hg	128F	26°C	133°C	5°C	7°C	8.0
			29A	10	1525	5.400	2.2" Hg	128F	26°C	133°C	3°C	6°C	4.5
			T/C	20	1535	10.705	2.2" Hg	129F	26°C	133°C	4°C	7°C	4.0
			29B	30	1545	15.420	2.2" Hg	128F	27°C	133°C	4°C	7°C	5.0
				40	1555	20.250	STEM ON TUBE# 29B BROKEN AFTER RUN.						
~~BLANK~~ 4	0.012 @20"	0.010 @17"	T	0	1615	0.000	2.4" Hg	128F	26°C	133°C	5°C	8°C	4.0
			36A	10	1625	5.530	2.2" Hg	128F	26°C	133°C	6°C	9°C	3.5
			T/C	20	1635	10.650	2.1" Hg	129°F	27°C	133°C	6°C	9°C	3.5
			36B	30	1645	15.545	2.1" Hg	128F	27°C	133°C	7°C	9°C	3.5
				40	1655	20.200							

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1

DATE 6-22-93

SAMPLING LOCATION STACK

RUN NO. 2 TEST NO. 2

OPERATOR JEH

AMBIENT TEMPERATURE 70° F

BAROMETRIC PRESSURE 29.34

BLANK TUBE NUMBERS T: 24A T/C: 24B

ASSUMED MOISTURE % 12.0%

METER BOX NO. V-11 (PPK)

METER FACTOR 1.0113

PROBE HEATER SETTING 130°C

COMMENTS RAIN/HUMID

Test Number	Leak Check ("Hg)		Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack °F Temp	DGM °C Temp	Probe °C Temp	1st Condensor °C Outlet Temp.	2nd Condensor °C Outlet Temp.	Pump Vacuum PRESSURE ~~Temp~~ "Hg
	Pre	Post											
1	0.0[illegible]" @[illegible]"	0.003 @22"	T	0	0650	0.000	2.4"Hg	130	19	132	5	8	2.0
			18A	10	0700	5.400	2.2	129	20	133	5	7	2.0
			T/C	20	0710	10.605	2.1	131	21	132	5	7	2.0
			18B	30	0720	15.155	2.1	131	23	134	5	8	2.0
				40	0730	20.260							
2	0.002 @20"	0.004 @23"	T	0	0745	0.000	2.3	129	26	133	6	7	3.0
			23A	10	0755	5.250	2.1	130	26	133	5	7	3.0
			T/C	20	0805	10.150	2.1	130	27	133	5	7	3.5
			23B	30	0815	15.250	2.1	130	29	133	4	8	4.0
				40	0825	20.240							
3	0.005 @21"	0.009 @22"	T	0	0840	0.000	2.2	128	29	133	5	7	4.0
			21A	10	0850	5.350	2.2	129	29	133	3	7	4.0
			T/C	20	0900	10.200	2.2	128	29	133	4	7	4.0
			21B	30	0910	15.150	2.2	128	30	133	3	8	4.0
				40	0920	20.640							
			T	0									
			T/C										

47
48
49

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 6-23-93
SAMPLING LOCATION STACK
RUN NO. 3 TEST NO. 3
OPERATOR JEH
AMBIENT TEMPERATURE 71°F
BAROMETRIC PRESSURE 29.23
BLANK TUBE NUMBERS T: 08 A T/C: 08 B

ASSUMED MOISTURE % 12.0
METER BOX NO. V-11 (PPK)
METER FACTOR 1.0113
PROBE HEATER SETTING 130°C
COMMENTS

Test Number	Leak Check ("Hg) Pre	Leak Check ("Hg) Post	Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter " H2O Pressure	Stack °F Temp	DGM °C Temp	Probe °C Temp	1st Condensor °C Outlet Temp.	2nd Condensor °C Outlet Temp.	Pump Vacuum PRESSURE ~~Temp~~ "Hg
1	0.000 @21"	0.004 @25"	T	0	0655	0.000	2.3	127	23	133	5	10	5.5
			15A	10	0705	5.105	2.2	128	24	134	5	8	4.0
			T/C	20	0715	10.150	2.1	128	25	134	4	9	4.0
			15B	30	0725	15.200	2.1	128	27	135	4	7	5.0
				40	0735	20.200							
2	0.007 @21"	0.000 @10"	T	0	0805	0.000	2.2	128	26	133	4	9	3.0
			09A	10	0815	5.050	2.2	128	26	135	5	9	2.5
			T/C	20	0825	10.050	2.2	128	26	134	5	9	2.5
			09B	30	0835	15.150	2.2	128	27	132	6	9	2.5
				40	0845	20.200	~~2.2~~	~~128~~	~~26~~	~~133~~	~~6~~	~~10~~	JEH
3	0.004 @10"	0.000 @10"	T	0	0910	0.000	2.2	128	26	133	6	10	2.5
			14A	10	0920	5.250	2.2	128	26	134	7	10	3.0
			T/C	20	0930	10.300	2.2	128	26	133	7	9	4.0
			14B	30	0940	15.350	2.2	128	27	132	7	10	5.0
				40	0950	20.200							
			T	0									
			T/C										

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 6-23-93
SAMPLING LOCATION STACK
RUN NO. AUDIT TEST NO. 1
OPERATOR JEH
AMBIENT TEMPERATURE 87°F
BAROMETRIC PRESSURE 29.26
BLANK TUBE NUMBERS T: 08A T/C: 08B

ASSUMED MOISTURE % 12.0
METER BOX NO. V-11
METER FACTOR 1.0113
PROBE HEATER SETTING NA
COMMENTS AUDIT
CAL DATE 2/8/93 FOR METER BOX

Sample # V-194 & V-195

TIME
1048
1058
V-194
V-195

Test Number	Leak Check ("Hg) Pre	Leak Check ("Hg) Post	Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter "Hg Pressure	Stack °F Temp	DGM °C Temp	Probe Temp	1st Condensor °C Outlet Temp.	2nd Condensor °C Outlet Temp.	Pump Vacuum ~~Temp~~
1	0.004 @11"	0.000 @11"	T	0	0.000	0.000	2.2	128	26	NA	6	10	2.0
			34A	5	05.00	2.480	2.1	128	27	NA	6	9	2.0
			T/C	10	10.00	5.068							
			34B										
2	0.000 @10"	0.006 @14"	T	0	~~10~~ 1124	0.000	2.2	128	28	NA	6	7	2.0
			39A	5	1129	2.500	2.2	128	29	NA	5	8	2.0
			T/C	10	1134	5.250	2.2	128	29	NA	6	8	2.0
			39B	15	1139	7.800	2.2	128	30	NA	5	9	2.0
				20	1144	10.045							
			T	0									
			T/C										
			T	0									
			T/C										

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 — Page 1 of 1

6/21 (EZ)

SAMPLING LOCATION Stack — RUN NO. 1

DATE 6/20 93 — TIME START 1240 — TIME FINISH 1755 — TEST DURATION 240 min.

DUCT DIMENSIONS X — DIAMETER 13 Ft — INITIAL LEAK RATE 0.000 @ cfm 15" Hg

PTCF 0.84 — DGMCF 0.994 — NOZZLE DIA. 0.196 inches — FINAL LEAK RATE 0.000 @ cfm 8" Hg

BAR PRESS 29.31 " Hg

STATIC PRESS -0.5 " H2O — OPERATOR EZ

K = 1.245

Traverse Point	Clock Time	Dry gas meter reading ft3	ΔP in H2O	ΔH in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
						Inlet	Outlet					
E-1	1240	756.882	0.75	0.934	126	73	72	251	249	59	4.0	38
	1250	762.280	0.74	0.92	127	75	72	251	256	55	4.0	38
E-2	1300	767.400	0.76	0.95	128	79	74	253	257	50	4.0	39
	1310	772.465	0.76	0.95	128	83	75	255	251	47	4.0	41
E-3	1320	777.761	0.60	0.75	128	88	78	252	250	42	4.0	39
	1330	782.425	0.62	0.77	128	90	80	253	264	45	4.0	39
STOP	1340	787.198		PORT	CHANGE		LEAK	CHECK	OK	@ 6"	Hg	
N-1	1345	787.270	0.75	0.934	127	89	82	251	252	52	4.0	38
	1355	792.550	0.74	0.92	128	91	84	253	238	46	4.0	40
N-2	1405	797.785	0.75	0.934	129	95	85	254	256	49	4.5	39
	1415	803.140	0.75	0.934	129	97	87	253	263	50	4.5	39
N-3	1425	808.475	0.60	0.75	129	99	89	255	247	50	4.0	41
	1435	813.200	0.66	0.75	129	100	91	254	241	51	4.0	41
STOP	1445	818.148		PORT	CHANGE		LEAK	CHECK	OK	@ 6"	Hg	
W-1	1450	818.201	0.68	0.85	115	98	92	255	242	56	4.0	40
	1500	823.330	0.68	0.85	124	100	93	254	242	53	4.0	43
W-2	1510	828.470	0.67	0.83	128	100	93	253	248	50	4.0	41
	1520	833.575	0.67	0.83	128	101	94	254	245	49	4.0	40
W-3	1530	838.675	0.56	0.69	129	103	95	255	264	49	4.0	41
	1540	843.775	0.56	0.69	128	102	96	254	240	51	4.0	41
STOP	1550	848.095		PORT	CHANGE		LEAK	CHECK	OK @		6" Hg	
S-1	1655	848.225	0.68	0.85	124	88	88	251	254	55	4.0	36
	1705	853.420	0.68	0.85	128	90	88	254	242	45	4.0	38
S-2	1715	858.980	0.74	0.92	122	94	89	251	240	50	4.0	39
	1725	863.842	0.74	0.92	128	97	90	253	240	48	4.0	39
S-3	1735	869.155	0.61	0.76	128	100	91	254	250	46	4.0	39
	1745	874.035	0.62	0.77	128	101	92	255	256	47	4.0	39
END.	1755	878.925										
Avg.	–	TB ~~122.043~~	0.823	.85	127	89.6✓						
Check'd	–	121.788				TB						

CONSOLE # A161361

FILTER #

AMBIENT TEMP. 75

PROBE LENGTH 6'

LINER MATERIAL GLASS LINED

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

PITOT TUBE LEAK CHECK OK.

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1

Page 1 of 1

SAMPLING LOCATION STACK. RUN NO. 2

DATE 6/22/93 TIME START 0655 TIME FINISH 1115 TEST DURATION 240 min

DUCT DIMENSIONS X DIAMETER 13 Ft INITIAL LEAK RATE 0.000 @ 15" Hg cfm

PTCF 0.84 DGMCF 0.994 NOZZLE DIA. 0.196 inches FINAL LEAK RATE 0.000 @ 9" Hg cfm

BAR PRESS 29.34 " Hg

STATIC PRESS -0.50 " H2O OPERATOR EZ

K= 1.245

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
*	6											
(EZ) E-1	0755	888.530	0.74	0.92	127	75	70	253	264	51	6.0	44
	0705	894.425	0.73	0.91	128	80	73	254	243	60	5.5	46
E-2	0715	899.275	0.74	0.92	128	86	76	254	265	50	5.5	44
	0725	904.330	0.74	0.92	129	89	78	254	266	47	5.5	46
E-3	0735	909.060	0.64	0.79	128	95	83	255	254	45	5.0	48
	0745	914.450	0.64	0.79	128	96	85	255	265	42	5.0	43
STOP	0755	919.437	PORT	CHANGE			LEAK	CHECK.	OK @ 8" Hg.			
N-1	0800	919.532	0.73	0.91	127	94	86	251	248	47	6.0	41
	0810	924.565	0.73	0.91	128	96	88	256	255	42	6.0	42
N-2	0820	930.160	0.74	0.92	128	99	89	254	268	44	6.0	43
	0830	935.485	0.74	0.92	128	101	91	255	260	47	6.0	44
N-3	0840	940.840	0.64	0.79	129	102	93	254	264	46	5.5	44
	0850	945.899	0.64	0.79	128	102	93	254	258	47	5.5	44
STOP	0900	950.805	PORT	CHANGE			LEAK	CHECK.	OK @ 8"	Hg		
W-1	0905	950.895	0.68	0.85	128	98	93	254	265	53	5.5	42
	0916	956.145	0.68	0.85	128	100	94	255	261	48	5.5	43
W-2	0925	961.300	0.67	0.83	128	102	95	253	258	50	5.5	43
	0935	966.170	0.67	0.83	128	104	95	254	256	49	5.5	43
W-3	0945	971.282	0.55	0.68	128	106	97	256	264	50	5.0	44
	0955	976.000	0.55	0.68	129	106	98	255	257	51	5.0	45
STOP	1005	980.819	PORT	CHANGE		<0.001	LEAK	CHECK.	9"			
S-1	1015	980.893	0.67	0.83	128	102	98	254	260	46	5.5	43
	1025	987.534	0.67	0.83	128	103	98	255	253	43	5.5	44
S-2	1035	992.670	0.75	0.93	129	106	99	256	252	44	6.0	46
	1045	998.554	0.75	0.93	128	109	100	256	253	44	7.5	45
S-3	1055	005.682	0.64	0.79	129	111	100	254	251	46	5.0	45
(EZ) ~~END~~	1105	010.763	0.64	0.79	129	110	101	253	256	47	5.0	45
END ~~STOP~~	1115	015.838										
				Avg Error - WAW								
Avg.	- TB	~~127.308~~	0.9126	.85	128✓	94.7						
Check'd	-	127.049	0.8251		TB							

CONSOLE # A161361

FILTER #

AMBIENT TEMP. 75°F

PROBE LENGTH 6'

LINER MATERIAL GLASS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

* STARTED @ 0655 CORRECTED ERROR IN INITIAL HOUR LOG TIME FOR START

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of 1

SAMPLING LOCATION STACK RUN NO. 3
DATE 6/23/93 TIME START 0645 TIME FINISH 1118 TEST DURATION 240 min.
DUCT DIMENSIONS ___ X ___ DIAMETER 13 Ft INITIAL LEAK RATE 0.002 @ 15" Hg cfm
PTCF 0.84 DGMCF 0.994 NOZZLE DIA. 0.195 inches FINAL LEAK RATE 0.000 @ 7" Hg cfm
BAR PRESS 29.19 " Hg
STATIC PRESS -0.5 " H2O OPERATOR EZ

K = 1.214

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
E-1	0645	030.212	0.66	0.801	126	73	70	254	255	57	3.5	47
	0655	035.110	0.68	0.826	127	80	73	255	267	56	3.5	45
E-2	0705	039.955	0.70	0.849	128	85	76	254	245	47	4.0	46
	0715	044.935	0.70	0.849	128	88	78	255	250	43	4.0	45
E-3	0725	049.995	0.59	0.716	128	93	81	254	255	43	4.0	41
	0735	054.455	0.59	0.716	127	95	83	255	254	43	4.0	42
STOP	0745	059.353	PORT	CHANGE			LEAK	CHECK		< 0.002	@ 7" Hg	
N-1	0754	059.923	0.68	0.826	126	92	86	256	250	54	4.5	47
	0804	065.010	0.66	0.801	128	96	88	254	260	45	4.5	45
N-2	0814	070.065	0.68	0.826	128	100	90	255	260	46	4.5	46
	0824	075.170	0.68	0.826	128	102	92	254	245	46	4.5	45
N-3	0834	080.282	0.58	0.704	128	104	94	255	260	46	4.5	46
	0844	085.045	0.58	0.704	128	104	95	253	248	48	4.5	48
STOP	0854	089.825	PORT	CHANGE			LEAK	CHECK		< 0.005	@ 7" Hg	
W-1	0900	089.958	0.62	0.753	127	101	96	254	248	51	5.5	50
	0910	097.450	0.62	0.753	128	103	96	253	249	51	4.5	48
W-2	0920	102.190	0.62	0.753	128	103	96	254	260	50	4.5	47
	0930	107.000	0.62	0.753	128	104	97	257	265	47	4.5	45
W-3	0940	114.375	0.52	0.631	128	106	97	254	257	54	4.0	47
	0950	118.925	0.52	0.631	128	105	98	254	266	53	4.0	50
STOP	1000	123.517	PORT	CHANGE			LEAK	CHECK		< 0.005	@ 7" Hg	
S-1	1018	123.605	0.67	0.813	128	98	96	254	258	56	4.0	46
	1028	128.925	0.62	0.753	129	100	96	255	267	50	4.0	44
S-2	1038	133.395	0.67	0.813	129	104	98	255	260	51	4.0	46
	1048	138.736	0.67	0.813	129	106	98	256	263	51	4.0	46
S-3	1058	143.640	0.62	0.753	130	109	101	253	264	51	4.0	44
	1108	149.399	0.62	0.753	130	111	101	254	250	50	4.5	46
END	1118	156.627										
Avg.	- TB	~~126.415~~	0.7944	0.77	128	98.2	90.7					
Check'd	-	125.624	VB									

CONSOLE # A161361
FILTER # ___
AMBIENT TEMP. 77 °F
PROBE LENGTH 6'
LINER MATERIAL GLASS

Velocity ___
% Moisture ___
Flowrate (DSCFM) ___
Isokinetic (%) ___

REMARKS

Nozzle # 3C 0.195" Ø

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1

Page 1 of 1

SAMPLING LOCATION Stack
RUN NO. FB
DATE 06-20-93
TIME START 1015
TIME FINISH 1015
TEST DURATION 0 min.
DUCT DIMENSIONS ____ X ____
DIAMETER 13'
INITIAL LEAK RATE 0.001 cfm @ 12 "Hg
PTCF 0.84
DGMCF 0.994
NOZZLE DIA. 0.195 inches
FINAL LEAK RATE ____ cfm
BAR PRESS ____ " Hg
STATIC PRESS – " H2O
OPERATOR DJV, WAW

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
						Inlet	Outlet					
–	1015	741.332	–	–	–	81	80	250	268	75	–	
Avg.	–											
Check'd	–											

CONSOLE # A161361
FILTER # –
AMBIENT TEMP. 80+
PROBE LENGTH 6'
LINER MATERIAL Glass

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS

Entered ofel-wall

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location STACK **Train** Aldehydes **Run No.** 1-1

Date 06-21-93 Time Start 1340 Time Finish 1408 Test Duration 28 min.

Duct Dimensions ______ X ______ Diameter 13' ft Initial Leak Rate 0.001 @ 12" cfm

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.1747 inches Final Leak Rate <0.001 @ 6" cfm

Bar Press 29.31 " Hg

Static Press -0.5 " H2O Operator OJV k = 0.7864

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
N-1	1340	571.567	0.59	0.46	128	79	78	257	265	74	2.0	
N-1	1356	577.780	0.59	0.46	128	83	80	256	261	59	2.0	
N-1	1404	580.760	0.59	0.46	126	85	81	261	265	57	2.0	
Stop	1408	582.274										
			√ΔP									
Avg.	—	10.707	0.768		127	82	80					
Check'd	VTB	10.707										

CONSOLE # A161362

FILTER # NA

AMBIENT TEMP. 70+

PROBE LENGTH 6'

LINER MATERIAL Glass

Velocity ~~485~~

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS Single Pt. Isokinetic All times CDT

ENTERED

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ___

Plant Name Plant Yates Station Boiler No. 1
Sampling Location STACK **Train** Aldehydes **Run No.** 2
Date 06-22-93 Time Start 0715 Time Finish 0745 Test Duration 30 min.
Duct Dimensions ___ X ___ Diameter 13 ft Initial Leak Rate 0.000 cfm @17"
PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.1747 inches Final Leak Rate < 0.00107 " cfm
Bar Press 29.34 " Hg
Static Press -0.5 " H2O Operator DJV
K = 0.7753

Trave. Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	___
W-1	0715	591.804	0.59	0.45	131	78	77	251	263	75	2.0	
	0724	595.160	0.59	0.45	133	83	79	267	263	56	2.0	
	~~0730~~ 0731	597.715	0.59	0.45	133	85	80	257	265	56	2.0	
	0739	600.660	0.59	0.45	133	88	82	264	259	58	2.0	
	0745	602.890										
Avg.	—	11.086	0.7681	0.45	132.5	81.5						
Check'd												

CONSOLE # A161362
FILTER # NA
AMBIENT TEMP. 70+
PROBE LENGTH 6'
LINER MATERIAL Glass

Velocity 46.45
% Moisture
Flowrate (DSCFM) 283,975
Isokinetic (%)

REMARKS Single Pt. All Times CDT

//

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Aldehydes **Run No.** 3

Date 06-23-93 Time Start 0700 Time Finish 0730 Test Duration 30 min.

Duct Dimensions ____ X ____ Diameter 13' ft Initial Leak Rate 0.007 cfm @ 13"

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.1747 inches Final Leak Rate 0.002 cfm @ 10"

Bar Press 29.19 " Hg

Static Press -0.5 " H2O Operator DJV

k = 0.7766

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
W-1	0700	616.602	0.56	0.43	130	79	76	262	258	65	2.0	
	0705	618.425	0.56	0.43	130	79	76	261	255	55	2.0	
	0710	620.255	0.56	0.43	131	80	77	259	258	56	2.0	
	0715	622.070	0.56	0.43	130	83	78	259	260	57	2.0	
	0720	623.895	0.55	0.43	131	83	78	260	257	57	2.0	
	0725	625.710	0.55	0.43	131	86	80	262	258	57	2.0	
Stop	0730	627.531										
Avg.	—	10.929	0.7461	0.43	130.5	79.6						
Check'd		✓ TB										

CONSOLE # A161362

FILTER # —

AMBIENT TEMP. 70 +

PROBE LENGTH 6'

LINER MATERIAL Glass

Velocity 45.15

% Moisture ____

Flowrate (DSCFM) 275,598

Isokinetic (%) ____

REMARKS Single Pt. All Times CDT

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Aldehydes **Run No.** FIELD BLANK

Date 6-20-93 Time Start 1325 Time Finish 1329 Test Duration 1.00 min.

Duct Dimensions ______ X ~~1.006~~ JEH Diameter 13.0 JEH ft Initial Leak Rate 0.004 cfm @18"

PTCF .84 DGMCF 1.006 Nozzle Dia. — inches Final Leak Rate 0.004 cfm @18"

Bar Press 29. " Hg

Static Press -0.51 " H2O Operator JEH

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
Start	1326	563.880									18	
Stop	1329	564.932										
Avg.	—											
Check'd												

CONSOLE # 4161362
FILTER # —
AMBIENT TEMP. —
PROBE LENGTH 89°F
LINER MATERIAL

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS BLANK -

ENTERED
WAW 6/22

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1
Sampling Location Stack **Train** M23 - Dioxins/Furans **Run No.** 1-1
Date 06-21-93 Time Start 1400 Time Finish 1933 Test Duration 240 min.
Duct Dimensions ____ X ____ Diameter 13 ft Initial Leak Rate 0.008 @ 13" cfm
PTCF 0.84 DGMCF 1.029 Nozzle Dia. 3F= 0.195 inches Final Leak Rate 0.001 @ 10" cfm
Bar Press 29.31 " Hg
Static Press -0.5 " H2O Operator DJV K = 1.2528

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond out
E-1	1400	678.367	0.67	0.84	122	68	67	254	243	56	5.0	58
	1410	683.005	0.67	0.84	122	71	68	257	247	42	5.0	53
E-2	1420	687.810	0.68	0.85	122	73	69	256	245	43	5.0	48
	1430	692.705	0.67	0.84	123	77	72	257	256	42	5.0	53
E-3	1440	697.585	0.56	0.70	123	79	74	257	256	45	4.5	61
	1450	702.055	0.56	0.70	124	84	78	259	243	48	4.5	52
Stop	1500	706.556		leak ck	0.001	@ 10"						
N-1	1505	706.678	0.70	0.88	123	80	78	256	241	58	5.0	55
	1515	711.665	0.67	0.84	122	83	78	253	241	43	5.0	51
N-2	1525	716.625	0.70	0.88	122	84	79	259	242	44	5.0	48
	1535	721.685	0.70	0.88	123	86	81	262	244	46	5.0	49
N-3	1545	726.650	0.59	0.74	124	90	83	260	247	47	4.5	50
	1555	731.290	0.59	0.74	123	89	83	258	248	46	4.5	50
Stop	1605	735.924		leak	ck	@ 0.001	@ 15"					
W-1	1720	736.028	0.62	0.78	127	80	79	260	245	60	5.0	57
	1730	741.950	0.62	0.78	126	80	78	255	250	40	5.0	50
W-2	1740	745.415	0.62	0.78	124	83	80	257	247	42	5.0	52
	1752	751.100	0.62	0.78	124	86	82	257	248	40	5.0	49
W-3	1800	754.870	0.50	0.62	124	86	82	261	256	42	4.5	50
	1810	759.145	0.51	0.63	124	86	81	245	252	43	4.5	50
Stop	1820	763.481		leak	ck @	0.001	@ 10"					
S-1	1833	763.538	0.68	0.85	122	81	80	251	248	58	5.0	57
	1843	768.505	0.70	0.88	122	83	80	250	257	42	5.5	50
S-2	1853	773.555	0.71	0.88	123	87	82	254	246	47	5.5	52
	1903	778.630	0.71	0.88	123	89	83	254	261	47	5.5	52
S-3	1913	783.720	0.59	0.74	124	90	84	254	264	47	5.5	51
	1923	788.405	0.59	0.74	124	90	84	243	251	48	5.5	52
	1933	793.092										
Avg.	—	114.442	0.7756	0.7946	123.3	80.63						
Check'd		~~114~~.725 STD	✓ JB									

(WAW

CONSOLE # A1G1394
FILTER # NA
AMBIENT TEMP. 70+
PROBE LENGTH 5'
LINER MATERIAL Glass

Velocity 47.91
% Moisture ____
Flowrate (DSCFM) 297,272
Isokinetic (%) ____

REMARKS All Times CDT

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location STACK Train M23 - Dioxins/Furans Run No. 2

Date 06-22-93 Time Start 0812 Time Finish 1236 Test Duration 240 min.

Duct Dimensions ____ X ____ Diameter 13' ft Initial Leak Rate 0.001 @ 12" cfm

PTCF 0.84 DGMCF 1.029 Nozzle Dia. 0.195 inches Final Leak Rate ≤ 0.001 @ 10" cfm

Bar Press 29.34 " Hg

Static Press -0.5 " H2O Operator DJV 1.2352

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond out
E-1	0812	809.159	0.73	0.90	127	72	71	248	253	65	5.0	61
	0822	814.180	0.73	0.90	128	76	72	251	245	43	5.0	49
E-2	0832	819.185	0.72	0.89	129	80	74	250	256	45	5.0	48
	0842	824.240	0.72	0.89	129	82	76	252	249	41	5.0	49
E-3	0852	829.255	0.64	0.79	129	84	78	251	253	44	5.0	51
	0902	834.030	0.64	0.79	130	87	81	253	244	46	5.0	51
stop	0912	838.804			leak	ck =	<0.001	@ 10	" Hg			
N-1	0917	838.877	0.75	0.93	128	83	81	254	252	55	5.5	59
	0927	844.050	0.75	0.93	129	87	82	252	242	43	5.5	52
N-2	0937	849.240	0.73	0.90	129	88	82	252	248	45	5.5	51
	0947	854.465	0.73	0.90	128	90	84	253	251	46	5.5	51
N-3	0957	859.590	0.57	0.70	130	93	87	253	243	48	5.0	50
	1007	864.165	0.57	0.70	130	94	88	255	243	46	5.0	49
stop	1017	868.758			leak	ck :	<0.001	@ 10	" Hg			
W-1	1026	868.817	0.68	0.84	130	89	87	255	242	56	5.5	54
	1037	874.265	0.68	0.84	128	90	87	252	251	42	5.5	52
W-2	1047	879.200	0.64	0.79	129	92	88	254	250	44	5.0	50
	1057	884.185	0.64	0.79	128	92	88	252	248	45	5.0	49
W-3	1107	888.940	0.54	0.67	128	93	89	252	243	47	5.0	49
	1117	893.445	0.54	0.67	129	94	90	254	265	47	5.0	50
Stop	1127	897.948			leak	ck =	<0.001	@ 12	" Hg			
S-1	1136	898.035	0.70	0.86	127	93	90	252	255	50	5.5	51
	1146	903.140	0.70	0.86	128	94	90	252	248	46	5.5	49
S-2	1156	908.165	0.70	0.86	127	95	91	257	242	46	5.5	49
	1206	913.280	0.71	0.88	126	95	91	252	266	43	5.5	48
S-3	1216	918.405	0.57	0.70	127	98	93	255	257	45	5.0	48
	1226	923.040	0.57	0.70	127	97	93	253	263	48	5.0	50
End	1236	927.672										
Avg.	—	✓TB	0.8141	0.8200	128.3	86.9						
Check'd		118.294			VTB							

CONSOLE # A161394

FILTER # —

AMBIENT TEMP. 70+

PROBE LENGTH 5'

LINER MATERIAL Glass

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS All Times CDT

SOURCE SAMPLING FIELD DATA SHEET

Page 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location STACK

Train M23 - Dioxins/Furans **Run No.** 3

Date 06-23-93 Time Start 0810 Time Finish 1249 Test Duration 240 min.

Duct Dimensions X Diameter 13' ft Initial Leak Rate 0.002 @ 15" cfm

PTCF 0.84 DGMCF 1.029 Nozzle Dia. 0.195 inches Final Leak Rate <0.001 @ 10" cfm

Bar Press 29.19 " Hg

Static Press -0.5 " H2O Operator DJV 1.2427

Travers Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond Out
E-1	0810	960.872	0.66	0.82	127	75	74	249	262	70	5.0	68
	0820	965.650	0.66	0.82	127	76	74	248	243	45	5.0	55
E-2	0830	970.425	0.68	0.85	127	80	76	252	244	44	5.0	52
	0840	975.335	0.68	0.85	128	83	78	252	261	46	5.0	52
E-3	0850	980.270	0.54	0.67	128	86	79	254	250	49	5.0	53
	0900	984.665	0.54	0.67	129	86	80	251	245	52	4.5	54
Stop	0910	989.083			leak	ck	<0.001	cfm	@ 10	" Hg		
N-1	0916	989.246	0.70	0.87	128	82	81	253	246	59	5.0	58
	0926	994.240	0.69	0.86	128	84	81	251	246	45	5.0	54
N-2	0936	999.205	0.70	0.87	128	87	82	253	247	46	5.0	52
	0946	004.200	0.70	0.87	129	88	83	254	257	48	5.0	53
N-3	0956	009.280	0.58	0.72	129	89	84	253	248	49	5.0	53
	1006	013.905	0.58	0.72	128	89	83	252	253	48	5.0	53
Stop	1016	018.516			leak	ck	< 0.001	cfm	@	10 " Hg		
W-1	1032	018.555	0.62	0.77	127	86	84	250	240	67	5.0	61
	1042	023.260	0.64	0.80	129	87	84	254	248	46	5.0	46
W-2	1052	028.080	0.64	0.80	129	92	87	253	245	49	5.0	52
	1102	032.978	0.62	0.77	130	94	88	254	250	49	5.0	53
W-3	1112	037.780	0.54	0.67	130	97	90	253	244	48	5.0	53
	1122	042.410	0.54	0.67	129	98	91	253	254	50	5.0	53
Stop	1132	046.912			leak	ck	0.001	cfm	@ 8	" Hg		
S-1	1149	046.951	0.68	0.85	129	92	92	253	255	67	5.0	62
	1159	052.020	0.68	0.85	129	95	93	252	242	42	5.0	51
S-2	1209	057.050	0.66	0.82	129	97	93	253	256	48	5.0	54
	1219	062.025	0.66	0.82	130	100	95	255	248	50	5.0	53
S-3	1229	066.995	0.57	0.71	130	101	96	254	251	49	5.0	52
	1239	071.780	0.57	0.71	129	102	96	253	253	51	5.0	51
End	1249	076.376										
Avg.	—	115.263 TB	√ΔP	ΔAW*								
Check'd	TB	~~115.604~~	0.3966	.78	129	87.3						

0.7932 correct

CONSOLE # A161394

FILTER # —

AMBIENT TEMP. 80 +

PROBE LENGTH 5'

LINER MATERIAL Glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS All Times CDT

*Averaging Error

SOURCE SAMPLING FIELD DATA SHEET

Page ____ of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack

Train M23 - Dioxins/Furans

Run No. FB

Date 06-20-93

Time Start 1037

Time Finish 1037

Test Duration — min.

Duct Dimensions ______ X ______

Diameter 13' ft

Initial Leak Rate 0.001 cfm @ 123

PTCF 0.84

DGMCF 1.029

Nozzle Dia. 0.195 inches

Final Leak Rate ______ cfm

Bar Press 29.36 " Hg

Static Press — " H2O

Operator DJV, WAW

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	______
						Inlet	Outlet					
–	1037	661.294	—	—	–	80	79	254	251	84	–	—
Avg.	—											
Check'd												

CONSOLE # A161394

FILTER # –

AMBIENT TEMP. 80 F

PROBE LENGTH 5'

LINER MATERIAL Glass

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS ______

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1
Sampling Location Stack **Train** PSD **Run No.** 1
Date 06-21-93 Time Start 1330 Time Finish 0945 (06-22-93) Test Duration 987 min.
Duct Dimensions ____ X ____ Diameter 13' ft Initial Leak Rate 0.008 @ 15" cfm
PTCF 0.84 DGMCF 0.994 Nozzle Dia. 0.196 inches Final Leak Rate NA cfm
Bar Press 29.31 " Hg
Static Press -0.5 " H2O Operator DJV K = ~~[illegible]~~ 1.2485

Heat 200

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg		impactor exit°
S-1	1330	711.055	0.64	0.80	128	82	78	NA	NA	75	6.0		
	1353	723.540	0.64	0.80	128	95	88	–	–	60	12.0		
	1401	730.900	0.64	0.80	128	94	85	–	–	60	13.0		
	1428	743.321	0.64	0.80	129	104	94	–	–	66	15.0		
	1509	762.330	0.64	0.80	127	103	95	–	–	60	17.0		
	1547	781.770	0.64	0.80	124	101	96	–	–	60	17.0		
	1649	820.825	0.64	0.80	128	108	103	–	–	60	17.0		
STOP	1650	821.572											
Restart	2013	821.911	0.64	0.80	124	79	79	–	–	78	13.0		
	2029	829.170	0.64	0.80	124	81	79	–	–	64	12.0		
	2049	840.700	0.64	0.80	124	88	81	–	–	66	12.0		318
	2127	860.120	0.64	0.80	124	94	85	–	–	66	12.0		315
	2202	877.850	0.64	0.80	124	95	90	–	–	67	12.0		304
	2244	899.440	0.64	0.80	124	103	95	–	–	67	12.0		318
	2310	913.305	0.64	0.80	124	105	97	–	–	67	12.0		318
	2346	931.845	0.64	0.80	124	106	99	–	–	68	12.0		313
	0034	956.945	0.64	0.80	124	106	99	–	–	64	12.0		308
	0120	981.050	0.64	0.80	124	106	99	–	–	64	12.0		304
	0215	1009.895	0.64	0.80	124	102	96	–	–	65	12.0		306
	0253	1029.845	0.64	0.80	124	103	96	–	–	66	12.0		316
	0337	1052.730	0.64	0.80	124	104	97	–	–	67	12.0		311
	0410	1069.620	0.64	0.80	124	102	96	–	–	67	12.0		302
	0442	1086.170	0.64	0.80	124	101	95	–	–	67	12.0		303
	0516	1104.005	0.64	0.80	124	101	95	–	–	65	12.0		314
	0546	1119.400	0.64	0.80	124	101	94	–	–	65	12.0		303
STOP	0700	1157.674	REPLACE SiO2 GEL								12.0		315
START	0725	1157.674	0.64	0.80	126	94	93	—	—	68	12.0		
	0753	1171.250	0.64	0.80	128	101	94	–	–	62	12.5		309
Avg.	—												
Check'd		~~460.195~~	~~0.800~~		~~125~~	~~95.3~~	WJW						

SEE NEXT page for summary

CONSOLE # A161365
FILTER # Set AA
AMBIENT TEMP. ____
PROBE LENGTH ____
LINER MATERIAL ____

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS Added Additional Impinger

SOURCE SAMPLING FIELD DATA SHEET

Page 2 of ____

Plant Name Plant Yates ~~Station~~ Boiler No. 1
Sampling Location Stack Train PSD Run No. 1
Date 06-22-93 Time Start 1330 (06-21-93) Time Finish ____ Test Duration ____ min.
Duct Dimensions ____ X ____ Diameter 13' ft Initial Leak Rate 0.00 cfm
PTCF 0.84 DGMCF 0.994 Nozzle Dia. 0.196 inches Final Leak Rate ____ cfm
Bar Press 29.34 " Hg
Static Press -0.5 " H2O Operator ____

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Imp out
S-1	0838	195.040	0.64	0.80	128	107	99	–	–	58	12.0	310
	0920	217.180	0.64	0.80	128	110	103	–	–	56	12.0	300
Stop	0945	231.343	MM5 TRAIN into port S-1									
Stop	0945	231.343	END RUN									
Avg.	–TB	~~520.288~~	0.800	.80	125	96						
Check'd		519.949 TB										

CONSOLE # A 161365
FILTER # SET AA
AMBIENT TEMP. 70F
PROBE LENGTH ____
LINER MATERIAL Steel

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS All Times CDT

Flue-Gas Sampling Log

Sponsor: YATES	Sample Run #: 1
Plant Location: NEWMAN, COA.	Soda-Lime Trap#: S 400
Date: 6-25-93	Iodated Carbon #: C 400
Fuel Type: COAL	Pump#: 3
Pollution Control: ESP-JPB	Probe#: 1
Sampling Point: STACK	Filter ID: 10

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
0705	-0.026	0.500	1025	-0.024	0.489	200.0	-0.025	0.495
/								
					TOTALS:			

Integrator Volume (l): 0.0
Offset Correction (l): 0.10
Total Integrator Volume: 100.0
CO_2 Mass Flow Correction:
Actual (dry STP) volume (l):
% O_2: 8.0
% CO_2: 10.0
% H_2O: 14.0
ppm SO_2: 200.0

COMMENTS:

LEAK-CHECK METER = -0.026

" " PROBE = -0.025

PROBE TEMP = 100°C < T < 120°C

Flue-Gas Sampling Log

Sponsor: YATES	Sample Run #: 2
Plant Location: NEWNAN, GA.	Soda-Lime Trap#: S-407
Date: 6-26-93	Iodated Carbon #: C-407
Fuel Type: COAL	Pump#: 3
Pollution Control: ESP-JPB	Probe#: 20
Sampling Point: STACK	Filter ID:

start			stop			elapsed	mean	mean
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)	time (min)	zero (l/min)	flow (l/min)
0925	-0.026	0.500	1245	-0.024	0.500	200	-0.025	0.500
					TOTALS:	200	-0.025	0.500

Integrator Volume (l): 0.000
Offset Correction (l): JH ~~10.0~~ 0.10
Total Integrator Volume: 100.00
CO_2 Mass Flow Correction:
Actual (dry STP) volume (l):
% O_2: 8.0
% CO_2: 10.0
% H_2O: 14.0
ppm SO_2: 200.0

COMMENTS:
LEAK CHECK THROUGH METER = -0.026
LEAK CHECK THROUGH PROBE = -0.026
100°C < T < 120°C

Flue-Gas Sampling Log

Sponsor:	YATES	Sample Run #:	3
Plant Location:	NEWNAN, GA.	Soda-Lime Trap#:	S-333
Date:	6-27-93	Iodated Carbon #:	C-333
Fuel Type:	COAL	Pump#:	3
Pollution Control:	ESP-JPD	Probe#:	30
Sampling Point:	STACK	Filter ID:	

start			stop			elapsed	mean	mean
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)	time (min)	zero (l/min)	flow (l/min)
0655	-0.025	0.500	~~0916~~					
			1145	-0.024	.080	290	0.025	0.290
					TOTALS:			

Integrator Volume (l):	0.0
Offset Correction (l):	0.10
Total Integrator Volume:	70.0
CO_2 Mass Flow Correction:	
Actual (dry STP) volume (l):	
% O_2:	8.0
% CO_2:	10.0
% H_2O:	15.0
ppm SO_2:	200

COMMENTS:

LEAK CHECK THROUGH METER -0.025

LEAK CHECK THROUGH PROBE -0.024

100°C < T < 120°C

LOW FLOW DUE TO MOISTURE.

TEMP MAINTAINED AS PER METHOD.

Flue-Gas Sampling Log

Sponsor: YATES	Sample Run #: FIELD BLANK
Plant Location: NEWMAN, GA.	Soda-Lime Trap#: 5405
Date: 6-24-93	Iodated Carbon #: C405
Fuel Type: COAL	Pump#: BOX #3
Pollution Control: ESP-JBR	Probe#:
Sampling Point: STACK	Filter ID: #10

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
1115	-0.027	0.500	1120	-0.026	0.500			
					TOTALS:			

Integrator Volume (l):
Offset Correction (l):
Total Integrator Volume: 0.000
CO_2 Mass Flow Correction:
Actual (dry STP) volume (l):
% O_2:
% CO_2:
% H_2O:
ppm SO_2:

COMMENTS:

LEAK CHECK THROUGH METER = -0.027

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Anions **Run No.** 1

Date 6/25/93 Time Start 0940 Time Finish 1155 Test Duration 134 min.

Duct Dimensions ____ X ____ Diameter 13 ft Initial Leak Rate 0.000 @ 15" Hg cfm

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.195 inches Final Leak Rate 0.000 @ 10" Hg cfm

Bar Press ~~29.41~~ 29.33 Hg

Static Press -0.5 " H2O Operator EZ

K= 1.1606

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	. Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
N-3	0940	739.155	0.62	0.719	131	85	85	254	253	61	1.0	
	0950	743.920	0.62	0.72	132	88	85	255	260	53	1.0	
	1000	748.685	0.62	0.22	133	91	86	254	264	54	1.0	
	1018	756.778	0.62	0.72	133	95	88	251	256	56	1.0	
	1041	767.445	0.62	0.72	133	97	90	252	260	57	1.0	
	1055	774.002	0.62	0.72	132	97	91	253	258	58	1.0	
	1110	780.832	0.62	0.72	132	97	91	253	255	53	1.0	
	1141	795.376	0.62	0.72	132	98	92	251	258	53	1.0	
END	1155	801.650										
Avg.	—	62.495	$\sqrt{.78740}$	.72	132.2		91.066					
Check'd												

CONSOLE # A161362
FILTER # 900
AMBIENT TEMP. 86°F
PROBE LENGTH 6'
LINER MATERIAL GLASS

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Anions **Run No.** 2

Date 6/26/93 Time Start 1325 Time Finish 1536 Test Duration 131 min.

Duct Dimensions ____ X ____ Diameter 13 ft Initial Leak Rate <0.001 @ 15" Hg cfm

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.195 inches Final Leak Rate <0.001 @ 10" Hg cfm

Bar Press 29.32 " Hg

Static Press − 0.5 " H2O Operator EZ

K = 1.1586

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg
E-3	1325	881.665	0.60	0.695	133	105	102	262	257	69	1.5
	1330	884.320	0.58	0.672	133	106	102	260	256	61	1.5
	1340	888.960	0.58	0.672	133	107	103	260	256	59	1.5
	1350	893.515	0.58	0.672	133	106	102	258	252	56	1.5
	1409	902.185	0.58	0.672	134	106	101	258	255	59	1.5
	1434	913.476	0.58	0.672	133	108	102	258	256	57	1.5
	1445	918.660	0.58	0.672	133	108	102	257	253	60	1.5
	1504	927.420	0.58	0.672	133	107	102	257	253	60	1.5
	1521	934.998	0.58	0.672	134	108	102	256	254	63	1.5
	1531	940.110	0.58	0.672	134	108	102	256	255	60	1.5
	1536	942.028									
Avg.	—	60.363	0.58	0.692	133		104.45				
Check'd			√.76808								

CONSOLE # ecc A161362

FILTER # 65t 936

AMBIENT TEMP. 85°F

PROBE LENGTH 6'

LINER MATERIAL GLASS.

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Anions **Run No.** 3

Date 6/27/93 Time Start 0845 Time Finish 1055 Test Duration 130 min.

Duct Dimensions ____ X ____ Diameter 13 ft Initial Leak Rate <0.001 @ cfm 15" Hg

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.195 inches Final Leak Rate <0.001 @ cfm 10" Hg

Bar Press 29.21 " Hg

Static Press -0.5 " H2O Operator EZ

K= 1.1606

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
E-3	0845	995.520	0.640	0.74	132	93	91	264	260	69	1.0	
	0850	997.990	0.640	0.74	132	94	91	259	258	55	1.0	
	0900	003.000	0.640	0.74	132	98	92	259	257	54	1.0	
	0910	007.555	0.640	0.74	133	101	94	259	260	56	1.0	
	0930	016.980	0.640	0.74	133	104	97	260	260	56	1.0	
	1002	032.286	0.640	0.74	133	107	100	260	261	61	1.0	
	1010	035.830	0.645	0.75	133	107	101	260	261	60	1.0	
	1025	043.040	0.645	0.75	133	109	102	260	262	60	1.0	
	1035	047.855	0.645	0.75	133	109	103	260	262	60	1.0	
	1045	052.756	0.640	0.74	133	110	103	260	263	59	1.0	
	1055	057.495										
Avg.	—	61.975	0.64	0.74	133	103.2	97.4	160.2	260.4	58.10	1.0	
Check'd			√.81333				100.3					

CONSOLE # A161362

FILTER # 945

AMBIENT TEMP. 80°F

PROBE LENGTH 6'

LINER MATERIAL GLASS

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location STACK **Train** Anions **Run No.** FB

Date 6/24/93 Time Start 1420 Time Finish 1422 Test Duration 2 min.

Duct Dimensions ___ X ___ Diameter 13 ft Initial Leak Rate 0.000 @ 15" Hg cfm

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.192 inches Final Leak Rate 0.00 @ 15" Hg cfm

Bar Press 29.33 " Hg

Static Press -0.5 " H2O Operator EZ

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	1420	676.022										
	1422	676.395										
Avg.	—											
Check'd												

CONSOLE # A161362

FILTER #

AMBIENT TEMP. 88°F

PROBE LENGTH 6'

LINER MATERIAL GLASS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Ammonia/Hydrogen Cyanide **Run No.** 1

Date 6/25/93 Time Start 0647 Time Finish 0904 Test Duration 137 min.

Duct Dimensions ___ X ___ Diameter 13 ft Initial Leak Rate 0.000 @ 15" cfm

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.195 inches Final Leak Rate 0.000 @ cfm 7" Hg

Bar Press ~~29.41~~ 29.33 Hg

Static Press -0.5 " H2O Operator EZ

K = 1.2056

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
W-3	0647	677.224	0.57	0.69	130	78	74	256	254	60	2.0	
	0700	683.225	0.57	0.69	130	82	76	254	251	59	2.0	
	0713	689.235	0.57	0.69	131	85	78	254	261	58	2.0	
	0733	698.255	0.57	0.69	132	90	82	254	260	56	2.0	
	0747	704.442	0.57	0.69	132	91	83	255	260	56	2.0	
	0800	710.004	0.57	0.69	132	92	85	257	260	56	2.0	
	0813	716.160	0.57	0.69	133	93	86	256	254	56	2.0	
	0825	721.599	0.57	0.69	132	93	87	254	258	55	2.0	
*	0834	726.220	0.57	0.66	132	93	87	254	259	54	2.0	
	0846	731.450	0.57	0.66	133	94	88	257	260	51	2.0	
	0902	738.225	0.57	0.66	133	94	88	256	261	50	2.0	
END.	0904	739.005										
Avg.	—	61.781	0.57	0.682	131.82	84.56	83.091					
Check'd	RCC		√.754983				86.318					

CONSOLE # AIG1362 √.754983

FILTER # ___

AMBIENT TEMP. 70°F

PROBE LENGTH 6'

LINER MATERIAL GLASS

Velocity ___

% Moisture ___

Flowrate (DSCFM) ___

Isokinetic (%) ___

REMARKS * CHANGED K = 1.1606 BASED ON 14% MOISTURE

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Ammonia/Hydrogen Cyanide **Run No.** 2

Date 06/26/93 Time Start 1145 Time Finish 1315 Test Duration 90 min.

Duct Dimensions X Diameter 13 ft Initial Leak Rate 0.000 @ 15" Hg cfm

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.195 inches Final Leak Rate 0.001 @ 10" Hg cfm

Bar Press 29.32 " Hg

Static Press -0.5 " H2O Operator EZ K= 1.1586

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
E-3	1145	840.130	0.60	0.695	134	91	90	239	252	70	4.0	
	1150	842.895	0.60	0.695	133	91	90	249	252	58	4.0	
	1155	844.820	0.60	0.695	133	94	91	260	256	56	4.0	
	1200	847.075	0.60	0.695	133	96	91	256	254	57	4.0	
	1205	849.420	0.60	0.695	133	99	93	257	256	58	4.0	
	1215	854.290	0.60	0.695	133	101	95	258	253	57	4.0	
	1230	860.910	0.58	0.672	134	104	97	264	258	54	4.0	
	1243	866.811	0.58	0.672	133	107	99	263	261	54	4.0	
	1255	872.695	0.58	0.672	134	107	101	262	257	55	4.0	
	1309	878.699	0.58	0.672	134	109	102	263	256	54	4.0	
END	1315	881.442										
Avg.	—	41.312	0.5920	0.6881	133.4		97.4					
Check'd			.76808									

CONSOLE # A161362

FILTER # ~~945~~ 936

AMBIENT TEMP. 80°F

PROBE LENGTH 6'

LINER MATERIAL GLASS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1
Sampling Location Stack **Train** Ammonia/Hydrogen Cyanide **Run No.** 3
Date 6/27/93 Time Start 0635 Time Finish 0809 Test Duration 94 min.
Duct Dimensions ____ X ____ Diameter 13 ft Initial Leak Rate <0.004 @15" Hg cfm
PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.195 inches Final Leak Rate <0.001 @ 10" Hg cfm
Bar Press 29.21 " Hg
Static Press -0.5 " H2O Operator EZ K= 1.1606

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
W-3	0635	951.795	0.62	0.72	133	78	75	265	257	62	4.5	
	0640	954.000	0.62	0.72	133	80	76	263	256	59	4.5	
	0649	958.140	0.62	0.72	133	84	78	264	258	58	4.5	
	0700	963.185	0.62	0.72	133	88	80	264	258	60	4.5	
	0712	968.736	0.62	0.72	133	90	82	259	255	59	4.5	
	0721	973.022	0.62	0.72	133	92	84	257	254	57	4.5	
	0738	980.840	0.62	0.72	133	94	86	257	252	52	4.5	
	0748	985.520	0.62	0.72	133	95	88	260	259	53	4.5	
	0801	992.000	0.62	0.72	133	97	90	260	258	54	4.5	
	0809	995.300										
Avg.	—	43.505	0.62	0.72	133	88.67	82.111	261.0	256.33	57.111	4.5	
Check'd			$\sqrt{.78740}$				85.39					

CONSOLE # A161362
FILTER # 945
AMBIENT TEMP. 75°F
PROBE LENGTH 6'
LINER MATERIAL GLASS

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location STACK
Train Ammonia/Hydrogen Cyanide
Run No. FB

Date 06/24/93 Time Start 1412 Time Finish 1415 Test Duration 3 min

Duct Dimensions ____ X ____ Diameter 13 ft Initial Leak Rate 0.000 @ 15" Hg cfm

PTCF 0.84 DGMCF 1.006 Nozzle Dia. 0.192 inches Final Leak Rate 0.000 15" cfm Hg

Bar Press 29.33 " Hg

Static Press -0.5 " H2O

Operator EZ/JH

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
	1412	675.990										
	1415	676.000										
Avg.	—											
Check'd												

CONSOLE # A161362
FILTER # 940
AMBIENT TEMP. 88
PROBE LENGTH 6'
LINER MATERIAL GLASS

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

STACK

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location STACK **Train** Bulk Particulate-Radionuclides **Run No.** 1

Date 6-24-93 Time Start 1223 Time Finish 0153 Test Duration 816 min.

Duct Dimensions — X — Diameter ~~12~~ 13 ft Initial Leak Rate 0.000 cfm @15"

PTCF 0.84 DGMCF 0.994 Nozzle Dia. 0.240 inches OJ✓ Final Leak Rate 0.000 cfm @ 11"

Bar Press 29.33 " Hg

Static Press -0.51 " H2O Operator JEH

	Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
K-281	S-2	1223	469.418	0.71	1.98	128	94	94	251	251	60	7.0	
		1253	493.740	0.71	1.99	128	102	94	250	250	61	6.0	
		1318	512.945	0.71	1.99	128	105	94	257	250	65	6.0	
[illegible]		13[illegible]	528.560	0.71	1.91	128	108	97	250	251	55	6.0	
		1[illegible]	562.000	0.71	1.92	128	113	102	252	253	60	6.0	
		1488	579.165	0.71	1.92	132	114	103	253	254	60	6.0	
		1515	610.889	0.71	1.92	131	114	104	254	253	63	6.0	
	STOP	1521	612.880	EMTY	H2O	FROM	IMPINGERS.	[illegible]				IMPS	OK.
	START	152[illegible]	612.985	0.71	1.92	131	104	101	252	250	67	5.0	
		1553	632.090	0.71	1.92	130	106	99	254	252	57	5.0	
		1627	658.250	0.71	1.92	129	100	94	250	251	57	5.0	
TMD	→	1904	776.56	0.71	1.92	130	93	85	253	243	68	5.0	
		1934	799.40	0.71	1.92	131	94	85	252	250	57	5.0	
		2026	838.85	0.71	1.92	132	95	85	252	257	55	5.5	
		2126	883.70	0.73	1.97	130	98	88	253	262	58	6.5	
*	Stop	2219	925.610										
	Start	2226	925.740	0.73	1.97	130	90	86	252	253	60	6.5	
		2313	963.90	0.73	1.97	130	98	87	254	251	47	6.5	
		0005	1005.59	0.73	1.97	130	99	88	252	254	51	6.5	
		0101	50.41	0.73	1.97	130	96	87	253	246	51	6.5	
**	Stop	0153	1069.209										
	Avg.	—	599.556	√.84588	1.94	129.8		97.3					
	Check'd												

CONSOLE # A161365

FILTER # #906

AMBIENT TEMP. 82°F

PROBE LENGTH 6'

LINER MATERIAL PYREX

Velocity 50.98

% Moisture 12.0

Flowrate (DSCFM) 0.80

Isokinetic (%)

REMARKS TMD * stopped to empty imp., leak check through glassware 0.001@15"

(TMD) ** silica gel imp. blew the bottom out, ice bath sucked all the way to the meter

SOURCE SAMPLING FIELD DATA SHEET

STACK

Page 1 of 2

Plant Name Plant Yates Station Boiler No. 1
Sampling Location STACK
Train Bulk Particulate-Radionuclides
Run No. 2
Date 6-25-93
Time Start 0840
Time Finish 0331
Test Duration 843820cc min.
Duct Dimensions — X —
Diameter 13 ft
Initial Leak Rate 0.010 cfm @20"
PTCF .84
DGMCF .988
Nozzle Dia. 0.240 inches
Final Leak Rate 0.009 cfm @14"
Bar Press 29.41 " Hg
Static Press -0.51 " H2O
Operator JEH

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
S-1	0840	771.158	.72	1.91	130			260	251			
K-224 STOP	0841	IMPINGER EXIT BLOCKED / REPLACED										
START	0920	771.200	.73	1.93	128	75	73	251	253	52	3.0	—
	0940	785.200	.72	1.92	129	84	76	252	258	46	3.0	—
	0955	797.580	.73		129	91	80	252	250	47	3.0	—
Stop	1042	831.423	.64									
start	1324	831.423	0.58	1.53	127	83	83	255	247	81	3.0	
	1333	837.465	0.58	1.53	127	86	83	252	243	47	3.0	
	1405	857.925	0.76	2.006	128	96	87	254	255	52	3.0	
	1435	880.820	0.67	1.77	128	101	90	251	241	54	3.0	
STOP	1520	913.418	Removed		moisture from TRAIN.							
START	1525	913.488	0.67	1.77	128	100	89	253	248	57	3.0	
	1605	943.425	0.67	1.77	129	106	96	254	250	52	3.0	
	1659	983.300	0.69	1.82	129	107	98	257	255	52	3.0	
Stop	1726	002.885	Removed		Moisture							
Start	1749	002.885	0.69	1.82	130	96	94	254	246	81	3.0	
TM'D →	1859	59.65	0.72	1.93	130	106	96	254	261	53	3.0	
	1935	86.21	0.72	1.93	130	107	97	257	245	46	3.0	
	2014	115.40	0.72	1.93	129	108	98	257	251	48	3.5	
stop	2107	154.179	Removed moisture			leak check		0.001	@ 14"	through glass ware		
start	2112	154.300	0.72	1.93	128	100	95	253	240	52	3.5	
	2211	199.26	0.72	1.93	130	104	95	255	246	57	3.5	
	2304	237.04	0.72	1.93	1.30	102	95	256	243	50	3.5	
	2359	276.93	0.72	1.93	1.30	97	90	252	262	57	3.5	
stop	0018	289.746	Pump main.									
start	0022	289.746	0.72	1.93	129	92	86	253	240	48	3.5	
	0123	333.11	0.72	1.93	129	95	87	254	245	55	3.5	
	0218	373.51	0.72	1.93	128	96	88	255	264	50	3.5	
Avg.	—											
Check'd												

CONSOLE # A161397
FILTER # #988
AMBIENT TEMP. 75°F
PROBE LENGTH 6'
LINER MATERIAL pyrex

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1

Page 2 of 2

SAMPLING LOCATION Stack

RUN NO. 2

DATE 6-26-93

TIME START

TIME FINISH

TEST DURATION min.

DUCT DIMENSIONS X

DIAMETER 13

INITIAL LEAK RATE cfm

PTCF 0.84

DGMCF 0.988

NOZZLE DIA. 0.240 inches

FINAL LEAK RATE cfm

BAR PRESS 29.41 " Hg

STATIC PRESS -0.51 " H2O

OPERATOR JEH/TMcD

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
						Inlet	Outlet					
	0314	412.78	0.72	1.53	128	84	87	252	262	48	3	
Stop	0331	425.356										
Avg.	–	654.007	√.83702	1.8668	128.95		93.047					
Check'd	–											

CONSOLE #

FILTER #

AMBIENT TEMP.

PROBE LENGTH

LINER MATERIAL

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

STACK

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1 RADIONUCLEIDES

Sampling Location STACK **Train** Bulk Particulate-~~Ex. Metals~~ JEH **Run No.** 3

Date 6-25-93 Time Start ~~1743~~ 1357 Time Finish 0614 Test Duration 908 min.

Duct Dimensions — X — Diameter 13 ft Initial Leak Rate 0.000 cfm @ 20"

PTCF .84 DGMCF .988 Nozzle Dia. 0.240 inches Final Leak Rate <0.001 cfm @ 10

Bar Press 29.33 " Hg

Static Press -0.51 " H2O Operator DJV/EBZ/JEH/

	Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
IL							Inlet	Outlet					
2.69	N-1	1357	425.570	.71	1.91	130	89	88	251	249	65	5.0	—
		1412	436.465	.72	1.93	130	93	88	251	259	48	5.0	—
	STOP	1530	495.801		REMOVE MOISTURE			FROM	BACK HALF				
	START	1534	495.801	.72	1.94	130	103	97	251	250	58	5.0	—
		1615	526.800	.73	1.97	130	106	97	250	250	53	5.0	—
		1652	552.780	.73	1.97	131	108	99	256	264	51	5.0	
		1728	580.630	.73	1.97	131	111	101	255	246	48	4.0	
	Stop	1742	590.960		Removed Moisture							3.5	
	Start	1748	590.960	.73	1.97	130	106	101	255	261	66	3.5	
TMcD	=	1821	617.51	0.73	1.97	133	113	102	256	244	50	3.5	
		1915	657.60	0.73	1.97	131	108	101	257	246	54	3.5	
	stop	2006	693.860		pump main.								
	Start	2009	693.860	0.73	1.97	131	101	96	256	266	55	3.5	
	stop	2054	726.450		Removed		moisture		leak check		0.001	@10"	
	start	2100	726.560	0.73	1.97	130	99	95	255	253	54	3.5	
		2147	761.24	0.73	1.97	131	103	95	257	253	52	3.5	
		2236	797.20	0.73	1.97	131	99	91	255	244	52	3.5	
		2330	837.04	0.73	1.97	132	98	90	254	254	53	3.5	
		0034	881.30	0.73	1.97	132	99	91	255	256	53	3.5	
		0132	923.01	0.73	1.97	130	99	91	256	239	49	3.5	
	stop	0232	967.380		Removed moisture								
	start	0243	967.513	0.73	1.97	130	89	88	253	255	51	3.5	
		0342	1012.34	0.73	1.97	129	97	89	254	261	54	3.5	
		0440	55.04	0.73	1.97	130	99	90	255	260	47	3.5	
		0535	95.52	0.73	1.97	130	99	91	254	264	47	3.5	
	Stop	0614	122.422										
	Avg.	—	696.609	.5244	1.959	131		97.74					
	Check'd												

CONSOLE # A161397

FILTER #

AMBIENT TEMP. 70 - 80

PROBE LENGTH 6'

LINER MATERIAL Glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

STACK

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Stack **Train** Bulk Particulate-Ex. Metals **Run No.** 1

Date 6/24/93 Time Start 1150 Time Finish 0725 (6/25/93) Test Duration 1112 min.

Duct Dimensions ___ X ___ Diameter 13 ft Initial Leak Rate 0.0002 cfm 15" Hg

PTCF .84 DGMCF 0.994 Nozzle Dia. 0.24 inches Final Leak Rate 0.0002 cfm 8" Hg

Bar Press 29.33 " Hg

Static Press -0.5 " H2O Operator EZ

K = 2.864

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
N-2	11:50	157.048	0.62	1.776	128	89	88	254	259	60	6.0	
	12.08	171.030	0.62	1.776	129	100	90	254	260	57	6.0	
	12 47	200.722	0.62	1.78	129	106	96	254	260	52	6.0	
	13 10	218.635	0.62	1.78	130	110	96	256	260	56	6.0	
	1351	249.835	0.62	1.78	131	121	108	257	255	59	6.0	
	1436	283.944	0.62	1.78	129	96	116	256	248	63	6.0	
	1515	313.926	0.62	1.78	130	123	117	253	245	61	6.0	
* STOP	1525	321.817										
START	1532	321.820	0.62	1.78	130	111	112	254	246	57	6.0	
	1625	362.285	0.62	1.78	127	100	95	256	250	56	6.0	
TMD →	1908	480.62	0.62	1.78	129	94	86	254	239	62	6.0	
	1836	501.92	0.62	1.78	130	96	85	253	253	49	6.0	
	2029	537.65	0.62	1.78	130	96	85	255	253	53	5.5	
	2128	580.24	0.62	1.78	129	105	93	256	242	57	5.5	
stop	2216	610.853										
** start	2307	610.950	0.62	1.78	127	83	84	251	239	56	7.5	
	0007	658.05	0.62	1.78	128	98	83	256	241	55	7.0	
	0102	697.92	0.62	1.78	128	94	84	254	249	52	7.5	
	0155	736.76	0.62	1.78	129	99	86	256	239	56	7.5	
	0312	783.93	0.62	1.78	129	96	85	255	247	50	7.5	
	0401	830.01	0.62	1.78	129	96	85	256	248	54	7.5	
	0453	868.46	0.62	1.78	130	101	89	256	239	51	7.5	
stop	0524	891.485										
*** start	0529	891.598	0.62	1.78	129	97	91	252	260	56	7.5	
	0629	937.854	0.62	1.78	129	103	92	256	250	49	8.0	
	0717	969.526	0.62	1.78	128	104	94	256	251	48	8.0	
	0725	976.252										
Avg.	—	818.991	√.78740	1.78	129.00		97.565					
Check'd												

CONSOLE # A161361

FILTER # #908

AMBIENT TEMP. 84°F

PROBE LENGTH 6'

LINER MATERIAL GLASS

Velocity ___

% Moisture ___

Flowrate (DSCFM) ___

Isokinetic (%) ___

*** removed imp. catch, leak check through glassware 0.002 @ 14"

REMARKS * REMOVE MOISTURE FROM IMPINGERS

TMD ** " " " " leak check through imp. 0.002 @ 15"

silica gel imp. replaced due to blow out of bottom. liquid level in 3rd imp

SOURCE SAMPLING FIELD DATA SHEET

STACK

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location STACK **Train** Bulk Particulate-Ex. Metals **Run No.** 2

Date 6/25/93 Time Start 1246 Time Finish 0331 Test Duration 857 min.

Duct Dimensions ___ X ___ Diameter 13 ft Initial Leak Rate 0.000 @ 15"Hg cfm

PTCF 0.84 DGMCF ~~0.994~~ 0.5V Nozzle Dia. 0.24 inches Final Leak Rate 0.001 @ 14" cfm 2.7286

Bar Press 29.41 " Hg 1.029 ~~2.7075~~

Static Press -0.5 " H2O Operator EZ K = ~~2.8124~~ EZ

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
E-1	1246	214.097	0.64	1.75	124	81	81	225	259	74	3.0	
	1305	225.225	0.64	1.75	124	89	82	252	248	50	3.0	
	1322	237.899	0.64	1.75	124	94	85	254	250	52	3.0	
	1400	264.902	0.64	1.75	124	99	89	254	250	53	3.0	
	1430	285.726	0.64	1.75	124	101	92	250	262	52	3.0	
STOP	1528	326.305		REMOVE MOISTURE FROM TRAIN.								
START	1531	326.890	0.64	1.75	124	100	91	251	260	53	3.0	
	1612	355.845	0.64	1.75	124	101	92	254	250	53	3.0	
	1658	389.995	0.64	1.75	124	101	92	253	244	49	3.0	
Stop	1729	411.792		Stopped to		Remove Moisture						
Start	1750	411.792	0.64	1.75	126	87	88	~~87~~ 248	252	73	2.0	
TMP →	1902	464.27	0.64	1.75	126	96	87	254	253	46	2.0	
	1936	488.135	0.64	1.75	127	95	87	253	242	42	2.0	
	2016	516.39	0.64	1.75	127	96	87	253	248	41	2.0	
stop	2114	556.829	removed moisture			leak check		0.001 @ 13"		through glassware		
Start	2118	556.935	0.64	1.75	125	86	83	252	255	53	2.0	
	2212	595.23	0.64	1.75	126	91	82	253	259	47	2.0	
	2305	632.71	0.64	1.75	127	92	84	253	255	46	2.0	
TMP	~~0001~~	~~760.90~~										
	0001	670.90	0.64	1.75	127	92	84	257	252	48	2.0	
	0030	691.25	0.64	1.75	127	89	88	252	257	47	2.0	
	0125	729.41	0.64	1.75	126	86	79	253	256	50	2.0	
	0219	767.02	0.64	1.75	126	88	79	253	256	47	2.0	
	0312	803.00	0.64	1.75	124	87	79	253	244	45	2.0	
stop	0331	815.698										
Avg.	—	600.91	√.8000	1.75	125.4		89.05					
Check'd												

CONSOLE # ~~A16136~~ A161394

FILTER # #981

AMBIENT TEMP. 78°F

PROBE LENGTH 6'

LINER MATERIAL GLASS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

STACK

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

EXTRACTABLE METALS

Sampling Location STACK **Train** Bulk Particulate-~~Radionuclides~~ **Run No.** 3

Date 6/26/93 Time Start 1442 Time Finish 0619/(0627) Test Duration 880 min.

Duct Dimensions ____ X ____ Diameter 13 ft Initial Leak Rate <0.001@ 16" Hg cfm

PTCF 0.84 DGMCF 1.029 Nozzle Dia. 0.24 inches Final Leak Rate <0.001@ cfm 10"

Bar Press 29.32 " Hg

Static Press -0.5 " H2O Operator EZ & ME

K=2.6901

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
W-3	1442	943.115	0.58	1.560	125	85	84	254	253	65	4.0	
	1517	967.584	0.58	1.560	126	95	87	252	256	49	4.0	
STOP	1537	979.676	REMOVE EXCESS MOISTURE FROM IMPINGERS.									
START	1540	979.676	0.58	1.560	126	91	86	257	256	55	3.5	
	1617	005.940	0.58	1.560	128	96	89	251	254	50	3.5	
	1650	027.760	0.58	1.56	126	97	89	250	254	46	3.5	
	1729	54.350	0.58	1.6	126	99	90	253	253	44	3.5	
Stop	1743	63.953		Removed Moisture								
Start	1750	63.953	0.58	1.6	126	90	89	253	249	67	3.5	
TMD →	1823	89.31	0.58	1.6	128	100	91	255	239	47	3.5	
	1916	126.52	0.58	1.6	125	94	87	252	241	49	3.5	
	2005	159.89	0.58	1.6	125	91	83	253	256	45	3.5	
Stop	2055	194.406		Removed moisture Leak check						0.003	@12"	
Start	2103	194.615	0.58	1.6	125	83	80	253	252	55	3.5	
	2146	224.01	0.58	1.6	126	91	83	252	239	47	3.5	
	2235	257.75	0.58	1.6	126	92	84	254	244	49	3.5	
	2329	293.40	0.58	1.6	127	93	85	254	255	46	3.5	
	0032	334.90	0.58	1.6	128	92	84	253	248	48	3.5	
	0131	374.90	0.58	1.6	125	90	83	253	256	44	3.5	
Stop	0232	416.035	Removed moisture Leak check 0.002@12"									
Start	0241	416.215	0.58	1.6	126	82	80	250	240	55	3.5	
	0341	458.11	0.58	1.6	126	88	80	253	255	48	3.5	
	0439	497.84	0.58	1.6	126	90	81	254	250	42	3.5	
	0533	535.24	0.58	1.6	126	89	82	252	241	43	3.5	
	0616	561.891										
Avg.	—	618.386	.76157	1.583	126.0		90583					
Check'd												

CONSOLE # 161394

FILTER # #924

AMBIENT TEMP. 89°F

PROBE LENGTH 6'

LINER MATERIAL Glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

~~MODIFIED METHOD~~ 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of 1

SAMPLING LOCATION STACK RUN NO. 1
DATE 6-25-93 TIME START 1147 TIME FINISH 1434 TEST DURATION 144 ~~48.0~~ 0V min.
DUCT DIMENSIONS — X — DIAMETER 13 INITIAL LEAK RATE 0.000 cfm @12"
PTCF — DGMCF 0.994 NOZZLE DIA. 0.195 inches FINAL LEAK RATE 0.000 cfm @11"
BAR PRESS 29.44 " Hg
STATIC PRESS -0.51 " H2O OPERATOR JEH

	Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
K													
	E-1	1147	981.490	.60	.70	128	80	79	—	—	68	1.0	—
	-2	1159	987.420	.61	.72	128	84	80	—	—	52	1.5	—
1.16	-3	1211	993.200	.55	.64	128	89	83	—	—	55	1.5	—
	STOP	1223	998.725										
	S-1	1235	998.725	.60	.70	128	86	84	—	—	67	1.0	—
	-2	1247	1004.380	.61	-72	128	93	87	—	—	54	1.5	—
	-3	1259	1010.125	.58	.68	128	97	90	—	—	54	1.0	—
	STOP	1311	1015.654	LEAK ✓ OK									
	N-1	1318	1015.710	.60	.71	126	92	90	—	—	62	1.0	—
	-2	1330	1021.400	.61	.72	125	97	92	—	—	56	1.5	—
	-3	1342	1027.265	.55	.66	126	98	92	—	—	59	1.0	—
	STOP	1354	1032.900	LEAK CHECK OK									
1.20	S-1	1358	1032.920	.56	.67	126	96	93	—	—	61	1.0	—
	-2	1410	1038.510	.58	.70	125	100	94	—	—	56	1.0	—
	-3	1422	1044.300	.59	.71	126	102	95	—	—	58	1.0	—
	STOP	1434	1050.129										
	Avg.	–	68.563	√.76581	0.694	126.8	90.54						
	Check'd	–											

CONSOLE # A161361
FILTER # —
AMBIENT TEMP. 81°F
PROBE LENGTH 6'
LINER MATERIAL PYREX

Velocity
% Moisture 14.0
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

ALL TIMES CDT

~~MODIFIED METHOD 5~~ FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page (of 1

SAMPLING LOCATION STACK RUN NO. 2

DATE 6-26-93 TIME START 1041 TIME FINISH 1445 TEST DURATION 144 min.

DUCT DIMENSIONS X DIAMETER 13.0 INITIAL LEAK RATE 0.000 cfm @ 11 "

PTCF .84 DGMCF .994 NOZZLE DIA. ~~[illegible]~~ .195 inches FINAL LEAK RATE 0.002 cfm @ 15 "

BAR PRESS 29.32 " Hg

STATIC PRESS -0.51 " H2O OPERATOR JEH

K	Traverse Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F	
							Inlet	Outlet						
1.16	E-1	1041	087.000	.61	.71	130	78	79	—	—	62	1.0	—	
	-2	1053	092.825	.64	.74	130	83	81	—	—	59	1.0	—	
	-3	1105	098.525	.56	.65	130	88	82	—	—	60	1.0	—	
	STOP	1117	103.792	LEAK ✓ OK										
1.15	H-1	1140	103.826	.62	.72	130	87	85	—	—	65	1.0	—	
	-2	1152	109.805	.64	74	130	91	86	—	—	58	1.0	—	
	-3	1206	116.550	.57	66	130	95	88	—	—	59	1.0	—	
	STOP	1218	121.770	LEAK ✓ OK										
1.16	W-1	1300	121.800	.56	.65	130	94	91	—	—	63	1.0	—	
	-2	1312	127.050	.59	.70	130	96	92	—	—	60	1.0	—	
	-3	1324	132.525	.52	.61	130	102	95	—	—	61	1.0	—	
	STOP	1336	137.922	LEAK ✓ OK										
1.17	S-1	140[illegible]	137.950	.61	.71	130	96	95	—	—	65	1.0	—	
	-2	1421	143.000	.61	.71	130	98	96	—	—	62	5.0	—	*
	-3	1433	149.250	.57	.67	130	102	97	—	—	65	5.0	—	
	STOP	1445	154.063											
	Avg.	–												
	Check'd	–	66.971	√.76886	.6892	130.0		90.708						

CONSOLE # A116361

FILTER # —

AMBIENT TEMP. 78°F

PROBE LENGTH 6'

LINER MATERIAL PYREX

Velocity 50.64

% Moisture 14.0

Flowrate (DSCFM) [illegible].50

Isokinetic (%) 92.91

REMARKS

ALL TIMES CDT * KOH CRYSTALIZING IN PROBE -

~~MODIFIED METHOD 5~~ FIELD DATA SHEET
CHROME VI

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of ____

SAMPLING LOCATION STACK RUN NO. 3
DATE 6-27-93 TIME START 0800 TIME FINISH 1150 TEST DURATION 146 min.
DUCT DIMENSIONS — X — DIAMETER 13.0 INITIAL LEAK RATE 0.007 cfm @12"
PTCF .84 DGMCF .994 NOZZLE DIA. ~~0.245~~ 0.195 inches FINAL LEAK RATE 0.008 cfm @10
BAR PRESS 29.21 " Hg
STATIC PRESS -0.51 " H2O OPERATOR JEH

K	Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
1.14	E-1	0800	154.230	.66	.75	130	73	72	—	—	68	1.0	—
	-2	0812	160.180	.68	.77	130	77	73	—	—	65	1.0	—
	-3	0824	166.145	.60	.68	130	82	76	—	—	65	1.0	—
	Stop	0838	172.622	LEAK ✓		OK							
1.15	N-1	0901	172.655	.65	.74	130	84	82	—	—	68	1.0	—
	-2	0913	178.530	.69	.79	130	91	85	—	—	51	1.0	—
	-3	0925	184.450	.58	.67	130	96	88	—	—	54	1.0	—
	Stop	0937	190.040	LEAK ✓		OK							
	W-1	1011	190.066	.62	.71	130	92	89	—	—	68	1.0	—
	-2	1023	195.660	.60	.69	130	94	90	—	—	53	1.0	—
	-3	1035	201.380	.52	.60	130	98	92	—	—	55	1.0	—
	Stop	1047	206.678										
	W-1	1114	206.700	.62	.72	130	94	92	—	—	68	1.0	—
	-2	1126	212.680	.64	.75	130	96	93	—	—	58	1.0	—
	-3	1138	218.500	.58	.67	130	100	94	—	—	59	1.0	—
	Stop	1150	223.900										
	Avg.	–	69.589	√78684	.7117	130.0		875					
	Check'd	–											

CONSOLE # A161361
FILTER # —
AMBIENT TEMP. 78°F
PROBE LENGTH 6'
LINER MATERIAL PYREX

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS
ALL TIMES CDT

ORSAT DATA SHEET

Plant ______ Plant Yates Station Boiler No. 1 ________

Location ~~ESP~~ tmp IN STACK

Run No. 1

Date 6/21/93

Comments ________

Operator ~~Jount~~ tmp DJV

Sorbing Reagents: ________ [✓ (CO2)] ________ [✓ (O2)] ________ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	10.1	18.8	8.7			
2	0.0	10.2	19.0	8.8			

Averaged Results: % CO2 10.2 % O2 8.8

% CO ________ % N2 81

Dry Molecular Weight, MW (dry) =

=0.44 ________ +0.32 ________ +0.28 ________
(%CO2) (%O2) (%CO + % N2)

= ________ + ________ + __

Y-096

Run # 1 Train orsat

ESP Inlet
ESP Outlet
[✓ Stack]

Component bag

Date 6-21-93 Time 1900 Smplr DJV

Lab on site Analysis O2 CO2

Tare Wt. Na Final Wt. Na

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location STACK

Run No. 2

Date 6-22-93

Comments

Operator JEH

Sorbing Reagents: ✓ (CO2) ✓ (O2) ______ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	10.8	10.8	19.4	8.6		
2	0.0	10.7	10.7	19.3	8.6		

Averaged Results: % CO2 10.8 % O2 8.6

% CO ______ % N2 80.6

Dry Molecular Weight, MW (dry) =

=0.44 ______ +0.32 ______ +0.28 ______
(%CO2) (%O2) (%CO + % N2)

= ______ + ______ + __

Y-252

Run # 2 Train Or Sat~~ag~~ ecc

ESP Inlet
ESP Outlet
[✓ Stack]

Component bag

Date 6-22-93 Time ______ Smplr DJV

Lab on Site Analysis CO_2 O_2

Tare Wt. ______ Final Wt. ______

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location stack

Run No. 3

Date 6/22/93

Comments

Operator TMP

Sorbing Reagents: [✓ (CO2)] [✓ (O2)] (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	10.2	10.2	18.6	8.4		
2	0.0	10.2	10.2	18.7	8.5		

Averaged Results: % CO2 10.2 % O2 8.5

% CO % N2 81.3

Dry Molecular Weight, MW (dry) =

=0.44 ______ +0.32 ______ +0.28 ______
(%CO2) (%O2) (%CO + % N2)

= ______ + ______ + __

Y-257

Run # 3 Train Orsat

ESP Inlet
ESP Outlet
[✓ Stack]

Component Bag

Date 6-22-93 Time ______ Smplr DJV

Lab on site Analysis CO_2 O_2

Tare Wt. ______ Final Wt. ______

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location LAB - AUDIT SAMPLE

Run No. AUDIT

Date 6/23/93

Comments

Operator TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	0.0	0.0	9.0	9.0		
2	0.0	0.0	0.0	9.0	9.0		

Averaged Results: % CO2 0.0 % O2 9.0

% CO ______ % N2 ______

Dry Molecular Weight, MW (dry) =

=0.44 ______ +0.32 ______ +0.28 ______

(%CO2) (%O2) (%CO + % N2)

= ______ + ______ + .

Y-197

[✓ LAB]
~~ESP~~ Inlet
ESP Outlet
Stack

Run # B Train orsat

Component Cyld.

Date 6-23-93 Time 1450 Smplr TMP

Lab on site Analysis CO_2 O_2 RCC

Tare Wt. ______ Final Wt. ______

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location STACK

Run No. 2-1

Date 06-25-93

Comments

Operator TMP

Sorbing Reagents: ________(CO2) ________(O2) ________(CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.0	11.0	18.8	7.8		
2	0.0	10.8	10.8	18.6	7.8		

Averaged Results: % CO2 10.9 % O2 7.8

% CO ________ % N2 ________

Dry Molecular Weight, MW (dry) =

=0.44________ +0.32________ +0.28________
(%CO2) (%O2) (%CO + % N2)

= ________ + ________ +

Y-319

Run #2-1 Train orsat

ESP Inlet
ESP Outlet
[✓ Stack]

Component bag

Date 6-25-93 Time 1400 Smplr DJV

Lab on site Analysis CO_2 O_2

Tare WT(g)________ Final Wt(g)________

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location STACK

Run No. phase 2 run 2

Date 6/26/93

Comments

Operator TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) ______ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.4	11.4	18.8	7.4		
2	0.0	11.4	11.4	18.8	7.4		

Averaged Results: % CO2 11.4 % O2 7.4

% CO ______ % N2 ______

Dry Molecular Weight, MW (dry) =

=0.44 ______ +0.32 ______ +0.28 ______
(%CO2) (%O2) (%CO + % N2)

= ______ + ______ + ____

Y-385

Run # 2-2 Train ORSAT

ESP Inle
ESP Outlet
[✓ Stac]

Component ORSAT

Date 6/26/93 Time 1400 Smplr DJV

Lab Mobile Lab Analysis ORSAT

Tare WT(g) — Final Wt(g) —

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location STACK

Run No. 2-3

Date 6/27/93

Comments

Operator TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) ____ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.6	11.6	19.0	7.4		
2	0.0	11.6	11.6	19.0	7.4		

Averaged Results: % CO2 11.6 % O2 7.4

% CO ____ % N2 ____

Dry Molecular Weight, MW (dry) =

=0.44 ____ +0.32 ____ +0.28 ____
(%CO2) (%O2) (%CO + % N2)

= ____ + ____ + ____

Y-453

Run # 2-3 Train ORSAT

ESP Inlet
ESP Outlet
[✓ Stack]

Component ORSAT

Date 6/27/93 Time 1300 Smplr DJV

Lab On Site Analysis O_2/CO_2

Tare WT(g) — Final Wt(g) —

TRAVERSE FIELD DATA SHEET

Plant Name Plant Yates Station Boiler No1

Sampling Location Stack

Date 06-18-93

Operator DJV, JEH

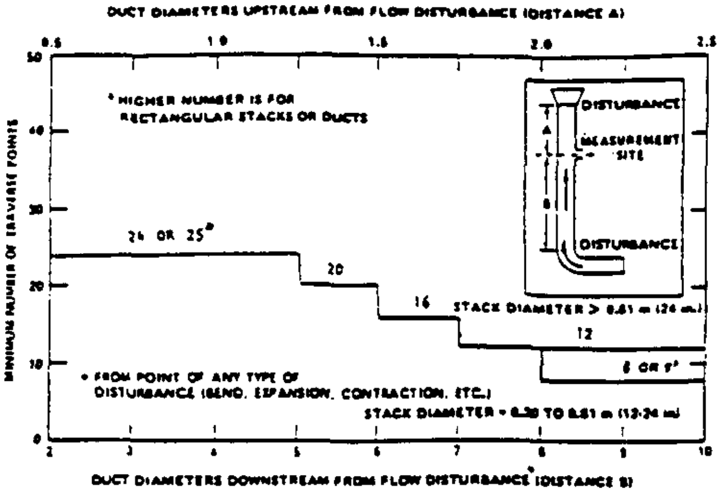
Stack Diameter 13'

Sample Port Diameter 4"

Sample Port Depth 6"

Distance Upstream

Distance downstream



Traverse Point Number	Number Traverse Points On A Diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

Traverse Points	
No.	Distance From Wall
1	6.86 + 6"
2	22.8 + 6"
3	46.2 + 6"
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	

VELOCITY PROFILE FIELD DATA

Plant Name - Yates

Sampling Location Stack Sample Ident. Preliminary Flow

Date 06-18-93 (MMDDYY) Time Start 1500 (HHMM) Time Finish 1506 (HHMM)

Duct Dimensions ___ x ___ ft. or Diameter 13 ft.

PTCF 0.84 % H_2O ___

Bar Press. 29.3 " Hg % CO ___ % N_2 ___

Static Press. -0.5 " H_2O % CO_2 ≈ 9.0 % H_2 ___

Operator Initials DSV, JEH % O_2 ≈ 7.0 % CH_4 ___

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
E-1	122			0.70					
E-2	122			0.69					
E-3	121			0.61					
N-1	121			0.66					
N-2	122			0.71					
N-3	121			0.59					
W-1	122			0.68					
W-2	122			0.64					
W-3	122			0.49					
S-1	121			0.64					
S-2	122			0.67					
S-3	121			0.58					

Weather

Remarks Point 1 all the way in.

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 06-21-93
SAMPLING LOCATION ESP INLET
RUN NO. 1 TEST NO. 1
OPERATOR RJW
AMBIENT TEMPERATURE 80 °F
BAROMETRIC PRESSURE 29.51
BLANK TUBE NUMBERS T: 14528A T/C: 14528 B

ASSUMED MOISTURE % 7.0
METER BOX NO. A167043
METER FACTOR 0.9910
PROBE HEATER SETTING 250 °F
COMMENTS SAMPLED @ 0.5 L PER min
20 L SAMPLES

Test Number	Leak Check ("Hg) Pre	Leak Check ("Hg) Post	Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack Temp	DGM Temp	Probe Temp	1st Condensor Outlet Temp.	2nd Condensor Outlet Temp.	Pump Vacuum ~~Temp~~ PRESSURE
1ST PAIR	0@17"		T	0	1400	07.000	1.4	306	76	250	55	59	5.0
			14540A	10	1410	11.85	1.5	309	78	242	53	59	5.0
			T/C	20	1420	16.90	1.4	307	81	256	53	58	5.0
			14540B	30	1430	22.17	1.4	310	82	256	53	58	5.0
		0@16"		STOP	1440	27.235							
2ND PAIR	0@15		T	0	1455	28.000	1.4	310	82	259	55	59	3.0
			14543A	10	1505	33.12	1.4	318	83	261	54	58	3.0
			T/C	20	1515	37.89	1.4	320	83	264	55	59	3.0
			14543B	30	1525	43.14	1.4	319	85	265	56	59	3.0
		0.@17"	BW ~~[illegible]~~	STOP	1535	48.150							
3RD PAIR	0.@18"		T	0	1550	50.000	1.5	300	85	265	55	52	4.0
			14541A	10	1600	54.84	1.5	301	85	266	55	51	4.0
			T/C	20	1610	59.92	1.4	305	85	261	55	52	4.0
			14541B	30	1620	65.21	1.4	308	87	257	56	53	4.0
		0@15"		STOP	1630	70.115							
			T	0									
			T/C										

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1

DATE 06-22-93

SAMPLING LOCATION ESP INLET

RUN NO. 2 TEST NO. 1

OPERATOR RVW

AMBIENT TEMPERATURE 80 °F

BAROMETRIC PRESSURE 29.4

BLANK TUBE NUMBERS T: 14519 A T/C: 14519 B

ASSUMED MOISTURE % 7.0

METER BOX NO. A 167043

METER FACTOR 0.9910

PROBE HEATER SETTING 250 °F

COMMENTS SAmpleD @ 0.5L PER MIN

20 L Samples

Test Number	Leak Check ("Hg)		Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack Temp	DGM Temp	Probe Temp	1st Condensor Outlet Temp.	2nd Condensor Outlet Temp.	Pump Vacuum PRESSURE ~~Temp~~
	Pre	Post											
1ST PAIR	0@17"		T	0	0742	71.000	1.4	274	73	257	61	59	4.0
			14510A	10	0752	75.93	1.4	269	74	258	60	60	4.0
			T/C	20	0802	80.87	1.4	270	76	259	60	57	4.0
			14510B	30	0812	86.07	1.4	272	78	258	60	56	4.0
		0@15"		STOP	0822	91.045							
2ND PAIR	0@16"		T	0	0910	92.000	1.4	275	78	261	63	58	5.0
			14513A	10	0920	96.94	1.4	280	79	260	60	56	5.0
			T/C	20	0930	101.80	1.4	276	80	260	45	58	5.0
			14513B	30	0940	106.89	1.4	293	83	263	57	61	5.0
		0@16"		STOP	0950	112.030							
3RD PAIR	0@15"		T	0	1001	113.000	1.4	295	84	262	58	63	4.0
			14512A	10	1011	118.16	1.4	302	84	262	57	61	5.0
			T/C	20	1021	123.14	1.4	300	85	264	57	62	5.0
			14512B	30	1031	128.21	1.4	301	86	263	57	61	5.0
		0@16"		STOP	1041	133.050							
			T	0									
			T/C										

VOST FIELD DATA SHEET

PLANT Plant Yates Station Boiler No. 1
DATE 06-23-92
SAMPLING LOCATION ESP INLET
RUN NO. 3 TEST NO. 1
OPERATOR RVW
AMBIENT TEMPERATURE 75 °F
BAROMETRIC PRESSURE 29.39
BLANK TUBE NUMBERS T: 14502A T/C: 14502B

ASSUMED MOISTURE % 7.0
METER BOX NO. A167043
METER FACTOR 0.9910
PROBE HEATER SETTING 250 °F
COMMENTS Sampled @ 0.5 L per min
20L Samples

Test Number	Leak Check ("Hg) Pre	Leak Check ("Hg) Post	Tube N (Lab)	Sampling (min)	Clock Time	Gas Meter Reading	Meter Pressure	Stack Temp	DGM Temp	Probe Temp	1st Condensor Outlet Temp.	2nd Condensor Outlet Temp.	Pump Vacuum Pressure ~~Temp~~
1ST PAIR	0@16"		T	0	0742	156.000	1.5	297	RVW ~~262~~ 76	262	60	61	5.0
			14501A	10	0752	161.07	1.5	300	RVW ~~261~~ 78	261	60	60	5.0
			T/C	20	0802	166.12	1.4	294	78	263	61	62	5.0
			14501B	30	0812	170.88	1.4	309	80	266	57	60	5.0
		0@15"		STOP	0822	176.040							
2ND PAIR	0@15"		T	0	0840	177.000	1.4	305	83	258	60	61	5.0
			14504A	10	0850	182.08	1.4	311	84	262	57	64	5.0
			T/C	20	0900	186.98	1.4	307	86	257	62	64	5.0
			14504B	30	0910	190.96	1.4	314	87	250	62	64	5.0
		0@15"		STOP	0920	197.075							
3RD PAIR	0@18"		T	0	0932	197.500	1.4	315	88	251	63	63	4.0
			14532A	10	0942	202.47	1.4	317	88	247	61	62	4.0
			T/C	20	0952	207.38	1.4	320	90	256	60	62	4.0
			14532B	30	1002	212.34	1.4	318	91	259	60	62	4.0
		0@16"		STOP	1012	217.58							
			T	0									
			T/C										

(ENTERED)

MODIFIED METHOD 5 FIELD DATA SHEET

1 of 3

PLANT NAME Plant Yates Station Boiler No. 1
Page 1 of

SAMPLING LOCATION ESP inlet
RUN NO. Semivolatile Organics Aldehyde Run 1
DATE 6/21/97 TIME START 1155
TIME FINISH 1815
TEST DURATION 240 min.
DUCT DIMENSIONS 8.5 X 57
DIAMETER —
INITIAL LEAK RATE 0.012@15" cfm
PTCF 0.84 DGMCF 0.999
NOZZLE DIA. 0.358 inches
FINAL LEAK RATE 0.015@11" Hg
BAR PRESS 29.51 " Hg
STATIC PRESS -6.4 " H2O
OPERATOR JWM

ΔH@ 1.822

	Traverse Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F	
		1255				283						4		KFm
	E1-1	~~1259~~	075.475	0.09	1.03	~~183~~	73	72	—	235	54	~~39~~	39	11.47
	2	~~12~~ 1300	78.3	0.09	1.03	298	74	73	—	237	48	~~39~~ 4	39	11.2
12.54	3	1305	80.9	0.06	0.68	297	76	74	—	240	47	4	39	
	4	1310	83.1	0.03	0.34	254	79	76	—	245	49	4	39	
	5	1315	84.6	0.05	0.56	293	79	76	—	250	52	4	40	
	6	1320	86.2	0.03	0.34	299	80	77	—	247	51	4	40	
	Stop	1325	88.020	Good leak check at 6"Hg										
							x̄=76					~~2~~		
	E3-1	1336	~~X~~ 88.065	0.02	0.22	295	80	78	—	230	60	2	40	11.3
	2	1341	89.7	0.02	0.22	308	80	78	—	236	59	2	40	
	3	1346	91.0	0.04	0.45	307	80	78	—	232	56	4	40	
12.98	4	1351	92.8	0.08	0.91	308	81	79	—	240	52	4	41	
	5	1356	95.3	0.10	1.15	307	83	80	—	248	49	4	41	
	6	~~13~~ 1401	98.0	0.10	1.15	306	85	81	—	251	50	4	42	
	Stop	1406	101.046	Good leak check at 6"Hg										
							x̄=80							
	E4-1	1415	101.119	0.02	0.23	290	85	82	—	245	60	2	42	
	2	1420	102.7	0.04	0.45	308	85	82	—	243	57	2	43	
	3	1425	104.3	0.06	0.68	308	85	83	—	251	55	2	43	
5.924	4	1430	106.3	0.10	1.11	310	85	82	—	250	52	5	42	11.12
	5	1435	109.4	0.18	2.0	308	88	83	—	243	53	7	43	
	6	1440	113.8	~~0.22~~ 0.23	2.4	309	90	88	—	244	55	8	44	
	Stop	1445	117.043	Good leak check @ 10"Hg										
	E6-1			0.02			x̄=85							10.8
	2	~~1458~~	~~117.278~~	~~0.08~~	0.23	318	85	84	—	230	62	3	44	
	3	1503 ~~1453~~	118.8	0.03 ~~0.02~~	0.33	323	86	84	—	235	60	4	44	
	4	~~145~~ 1508	120.4	~~0.06~~	0.65		85	84			58	5	45	
	5	1513			Next Data Sheet JWM									
	6	1518												
	~~Stop~~ Avg.	1523				299								
	Check'd	—												

CONSOLE #
FILTER # Instack
AMBIENT TEMP. 90°F
PROBE LENGTH 8ft
LINER MATERIAL quartz glass

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

✓

2 of 3

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page ____ of ____

SAMPLING LOCATION Inlet RUN NO. Semivolatile Organic Phase I Run 1

DATE 6/20/93 TIME START ________ TIME FINISH ________ TEST DURATION ________ min.

DUCT DIMENSIONS ________ X ________ DIAMETER ________ INITIAL LEAK RATE ________ cfm

PTCF ________ DGMCF ________ NOZZLE DIA. ________ inches FINAL LEAK RATE ________ cfm

BAR PRESS ________ " Hg

STATIC PRESS ________ " H2O OPERATOR ________

	Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
	E6-1	1458	117.278	0.02	0.23	318	85	84	–	230	62	3	44
	2	1503	118.8	0.03	0.33	323	86	84	–	235	60	4	44
	3	1508	120.4	0.06	0.65	320	85	84	–	241	58	5	45
15.348	4	1513		0.1	1.1	320	87	84	–	250	56	6	47
	5	1518	125.4	0.16	1.7	321	88	84	–	244	57	7	48
	6	1523	129.5	0.2	2.2	330	90	86	–	240	59	7	50
	Stop	1528	132.626										
							x̄=86						
	W2-1	1541	132.755	0.02	0.2	278	87	86	–	230	59	3	44
	2	1546	134.1	0.04	0.44	300	87	85	–	255	56	4	43
12.576	3	1551	135.6	0.05	0.56	293	87	85	–	240	53	4	43
	4	1556	137.7	0.03	0.33	302	88	86	–	245	54	4	42
	5	1601	139.5	0.06	0.67	300	89	86	–	247	54	5	42
	6	1606	142.0	0.17	1.9	305	91	87	–	246	57	8	44
	Stop	1611	145.331				x̄=87						
	W4-1	1618	145.552	0.02	0.2	298	90	89	–	230	59	3	44
	2	1623	~~148.5~~	0.04	0.44	299	90	88	–	254	57	5	44
15.313	3	1628	148.5	0.07	0.78	291	90	88	–	255	54	5	43
	4	1633	150.9	0.12	1.3	298	91	88	–	255	52	7	43
	5	1638	154.2	0.15	1.7	286	93	89	–	254	52	8	45
	6	1643	157.7	0.16	1.8	282	95	90	–	252	52	9	46
	Stop	1648	160.865										
							x̄=90						
	Avg.	–				303	88	88					
	Check'd	–											

CONSOLE # ________

FILTER # ________

AMBIENT TEMP. ________

PROBE LENGTH ________

LINER MATERIAL ________

Velocity ________

% Moisture ________

Flowrate (DSCFM) ________

Isokinetic (%) ________

REMARKS ________

✓ 3 of 3

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page ____ of ____

SAMPLING LOCATION INLET RUN NO. Semivolatile Organic Phase I Run 1
DATE 6/21/93 TIME START ______ TIME FINISH ______ TEST DURATION ______ min.
DUCT DIMENSIONS ______ X ______ DIAMETER ______ INITIAL LEAK RATE ______ cfm
PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches FINAL LEAK RATE ______ cfm
BAR PRESS ______ " Hg
STATIC PRESS ______ " H2O OPERATOR ______

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
						Inlet	Outlet					
W6 1	1658	161.014	0.01	0.11	265	90	89	—	225	61	2	46
2	1703	162.0	0.02	0.22	281	90	90	—	253	61	4	47
3	1708	—	0.02	0.22	280	90	89	—	242	60	4	48
4	1713	165.0	0.03	0.35	291	90	89	—	225	60	4	51
5	1718	—	0.05	0.57	271	91	89	—	238	60	5	51
6	1723	168.3	0.05	0.57	273	91	90	—	249	60	5	52
Stop	1728	170.421										
W8 1	1745	171.000	0.06	0.69	273	89	89	—	227	64	5	56
2	1750	173.0	0.03	0.34	~~222~~275	89	89	—	237	60	4	52
3	1755	174.7	0.02	0.23	279	90	89	—	249	58	4	47
4	1800	176.1	0.02	0.23	279	90	89	—	253	58	4	46
5	1805	177.4	0.02	0.23	273	90	89	—	244	59	4	45
6	1810	—	0.04	0.46	282	91	90	—	244	56	5	45
Stop	1815	180.685										
Avg.	–	103.779	$\overline{\sqrt{\Delta P}} = 0.23985$	0.29375	275.29	89.354						
Check'd	–	✓			✓							

9,407
9685

CONSOLE # ______
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

W1 - VOST collection
E8 - Aldehyde collec
E7 - PSD collection

Single pt sampling for Aldehy
< 150

REMARKS ______

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of 3

SAMPLING LOCATION ESP INLET RUN NO. 2 Semivolatile Phase I Run 2

DATE 6/22/93 TIME START 0729 , TIME FINISH 1341 TEST DURATION 240 min.

DUCT DIMENSIONS 8'6" X 45'57' DIAMETER Na INITIAL LEAK RATE 0.010 @ cfm 15" Hg

PTCF 0.84 DGMCF 0.999 NOZZLE DIA. 0.358 inches FINAL LEAK RATE 0.018 @ cfm 12" Hg

BAR PRESS 29.40 " Hg

STATIC PRESS -6.2 " H2O OPERATOR SWM

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
W8-1	729	187.155	0.07	0.77	270	72	71	–	233	56	3	56
2	734	189.3	0.06	0.66	272	73	72	–	253	54	6	53
3	739	191.3	0.03	0.33	274	75	72	–	251	57	4	56
4	744	193.0	0.02	0.22	271	75	73	–	247	56	3	55
10,295 5	749	194.30	0.03	0.33	269	76	73	–	250	58	5	56
6	754	195.9	0.04	0.44	269	77	74	–	250	57	6	54
Stop	754	197.450	Good Final leak check									
					279 SWM				224			
W6-1	825	198.107	0.03	0.34	~~224~~	77	75	–	~~279~~	58	2	48
2	830	199.9	0.04	0.45	~~224~~ 232	77	75	–	~~254~~	53	3	46
3	835	201.6	0.06	0.68	279	78	76	–	248	51	4	46
4	840	203.8	0.09	0.79	280	81	77	–	243	49	4	46
13.275 5	845	206.3	0.06	0.68	279	82	78	–	243	49	4	47
6	850	208.6	0.10	1.1		85	80			49	5	47
Stop	855	211.382	Good final leak check									
			Good Initial leak check									
W4-1	930	211.568	0.03	0.34	276	80	80	–	222	58	3	46
2	935	213.3	0.05	0.55	~~292~~ 300	81	80	–	252	55	3	47
16.310 3	940	215.3	0.07	0.77	294	82	80	–	245	53	5	45
4	945	217.7	0.12	1.3	291	83	80	–	250	54	5	48
5	950	220.7	0.15	1.7	293	85	81	–	249	51	6	48
6	955	224.3	0.17	1.9	293	88	82	–	250	53	7	50
Stop	1000	227.878	Good leak check									
Avg.	–											
Check'd	–											

CONSOLE # A161363

FILTER #

AMBIENT TEMP. 80 @ start

PROBE LENGTH 5 ft

LINER MATERIAL quartz

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1

Page 2 of 3

SAMPLING LOCATION Inlet

RUN NO. Semivolatile Organics Phase 1 Run 2

DATE ________ TIME START ________ TIME FINISH ________ TEST DURATION ________ min.

DUCT DIMENSIONS ________ X ________ DIAMETER ________ INITIAL LEAK RATE ________ cfm

PTCF ________ DGMCF ________ NOZZLE DIA. ________ inches FINAL LEAK RATE ________ cfm

BAR PRESS ________ " Hg

STATIC PRESS ________ " H2O

OPERATOR JWM

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
W2-1	1003	227.968	0.03	0.33	292	87	84	–	247	60	3	50
2	1008	229.7	0.04	0.44	298	88	84	–	247	60	3	57
3	1013	231.6	0.05	0.55	302	87	84	–	250	54	4	47
4	1018	233.6	0.09	0.99	303	88	84	–	252	52	5	47
5	1023	236.4	0.12	1.3	319	90	85	–	253	50	6	46
6	1028	239.6	0.16	1.8	319	91	86	–	245	50	7	46
Stop	1033	243.148	Good Final leak check									
			Good Initial leak check									
~~E7-1~~	SWM											
E7-1 2	1049	243.311	0.04	0.44	325	87	86	–	229	58	4	45
2 3	1054	245.6	0.05	0.55	328	87	86	–	249	58	5	44
3 4	1059	247.5	0.08	0.87	330	87	86	–	248	55	5	45
4 5	1104	250.2	0.12	1.3	337	89	86	–	254	52	7	44
5 6	1109	253.2	0.18	2.0	341	91	87	–	251	52	8	43
6 ~~Stop~~	1114	257.3	0.21	2.2	336	93	88	–		53	10	45
Stop	1119	261.159	Good Final leak check									
E5-1	1126	261.347	0.02	0.21	313	91	89	–	228	61	3	50
2	1131	262.8	0.03	0.32	324	91	89	–	256	60	4	49
3	1136	264.3	0.07	0.75	323	92	89	–	250	58	5	49
4	1141	266.7	0.13	1.4	327	93	90	–	250	55	8	49
5	1146	269.8	0.19	2.0	330	94	90	–	250	55	10	49
6	1151	273.8	0.20	2.1	324	96	91	–	242	58	11	50
STOP	1156	277.405										
Avg.	–											
Check'd	–											

5.180

17.848

16.058

CONSOLE # ________

FILTER # ________

AMBIENT TEMP. ________

PROBE LENGTH ________

LINER MATERIAL ________

Velocity ________

% Moisture ________

Flowrate (DSCFM) ________

Isokinetic (%) ________

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1

Page 3 of 3

SAMPLING LOCATION Inlet

RUN NO. Semivolatile Phase 1 Run 2

DATE ________ TIME START ________ TIME FINISH ________ TEST DURATION ________ min.

DUCT DIMENSIONS ________ X ________ DIAMETER ________ INITIAL LEAK RATE ________ cfm

PTCF ________ DGMCF ________ NOZZLE DIA. ________ inches FINAL LEAK RATE ________ cfm

BAR PRESS ________ " Hg

STATIC PRESS ________ " H2O

OPERATOR JWM

13,366
~~13,724~~

12,711

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
W3-1	1227	278.979	0.03	0.32	306	88	88	~~223~~	223	64	3	~~33~~ 53
2	1232	280.4	0.02	0.21	313	87	87	–	239	64	2	56
3	1237	281.7	0.05	0.54	314	87	87	–	250	60	5	53
4	1242	283.8	0.07	0.75	316	90	88	–	250	58	6	49
5	1247	286.3	0.10	1.1	316	91	88	–	239	56	7	46
6	1252	289.0	0.14	1.5	315	93	89	–	243	56	9	47
Stop	1257	292.345	Good Final leak check					Good initial				
W1-1	1311	292.700	~~0.10~~ 0.09	0.96	311	91	89	–	225	57	7	49
2	1316	–	0.08	0.46	312	91	89	–	242	57	7	49
3	1321	298.0	0.04	0.43	311	91	89	–	248	59	5	50
4	1326	299.8	0.04	0.43	309	91	89	–	249	61	5	51
5	1331	301.7	0.04	0.43	309	91	89	–	252	62	5	49
6	1336	303.5	0.04	0.43	305	91	89	–	247	64	5	52
Stop	1341	305.411	Final leak check 0.014 @ 12" Hg									
		– zero pitot leak check – JWM										
			JDP									
Avg.	–	115.043	0.26513	0.85125	303.52	84.74						
Check'd	–	✓ TB		✓ TB								

CONSOLE # ________

FILTER # ________

AMBIENT TEMP. ________

PROBE LENGTH ________

LINER MATERIAL ________

Velocity ________

% Moisture ________

Flowrate (DSCFM) ________

Isokinetic (%) ________

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of 3

SAMPLING LOCATION INLET RUN NO. 3 Phase 1 Run 3

DATE 6/23/93 TIME START 0707 TIME FINISH 1250 TEST DURATION 240 min.

DUCT DIMENSIONS ____ X ____ DIAMETER ____ INITIAL LEAK RATE 0.0058 cfm 13"Hg

PTCF 0.84 DGMCF 0.999 NOZZLE DIA. ~~0.359~~ 0.358 inches FINAL LEAK RATE 0.014 cfm 11"Hg

BAR PRESS 29.39 " Hg

STATIC PRESS -6.0 " H2O OPERATOR JWM

Traverse Point	Clock Time	Dry gas meter reading ft3	ΔP in H2O	ΔH in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
E1-1	0707	314.121	0.1	1.1	290	69	68	—	230	51	3.5	40
2	0712	317.0	0.08	0.87	290	71	69	—	256	51	4	42
3	0717	319.5	0.07	0.76	293	74	70	—	250	52	4	43
4	0722	321.8	0.05	0.54	293	75	71	—	250	53	3	44
5	0727	323.8	0.06	0.65	292	76	72	—	242	~~4~~53		44
6	0732	326.0	0.06	0.65	287	78	73	—	244	52	4.0	42
STOP	0737	328.105	Good leak check									
E3-1	0740	328.358	0.02	0.22	293	78	74	—	240	62	2.0	56
-2	0745	329.9	0.03	0.33	298	79	75	—	241	65	3.0	58
-3	0750	331.4	0.05	0.55	297	80	76	—	247	70	4.0	55
-4	0755	333.4	0.08	0.87	297	82	77	—	252	68	4.5	51
5	0800	336.0	0.11	1.2	296	83	70	—	255	68	5	49
6	0805	339.2	0.16	1.75	292	86	79	—	254	69	7	50
Stop	0810	342.495										
E5-1	817	342.769	0.03	0.33	300	84	80	—	226	69	3	58
2	822	44.3	0.05	0.55	309	84	80	—	258	69	3.5	54
3	827	346.1	0.06	0.66	309	85	81	—	249	69	4	51
4	832	348.5	0.12	1.32	313	88	83	—	248	70	6	50
5	837	351.7	0.17	1.9	311	89	84	—	250	71	7	49
6	842	355.4	0.22	2.4	311	93	86	—	246	72	9	57
Stop	847	360.062										
Avg.	-	45.667										
Check'd	-											

CONSOLE # ____

FILTER # ____

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 2 of 3

SAMPLING LOCATION Inlet RUN NO. Semi Vol Phase II - Run 3

DATE ____ TIME START ____ TIME FINISH ____ TEST DURATION ____ min.

DUCT DIMENSIONS ____ X ____ DIAMETER ____ INITIAL LEAK RATE ____ cfm

PTCF ____ DGMCF ____ NOZZLE DIA. ____ inches FINAL LEAK RATE ____ cfm

BAR PRESS ____ " Hg

STATIC PRESS ____ " H2O OPERATOR Jw

Traverse Point	Clock Time	Dry gas meter reading ft3	ΔP in H2O	ΔH in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
E-1 1	851	360.172	0.03	0.33	316	91	87	—	227	~~6~~58	~~5~~ 3	54
2	856	361.8	0.03	0.33	320	92	88	—	257	57	3	57
3	~~4~~901	363.7	0.05	0.55	326	92	88	—	243	56	4	53
4	906	365.8	0.09	1.0	327	92	89	—	252	53	5	57
5	911	368.5	0.15	1.7	332	94	89	—	~~24~~254	52	7	48
6	916	372.1	0.21	2.3	330	96	91	—	246	52	9.5	50
Stop	921	376.091	Good leak Check Final									
			Good leak Check Initial									
W-2-1	946	376.420	0.03	0.33	278	90	89	—	219	65	3	56
2	951	378.2	0.03	0.33	300	91	89	—	258	60	3.5	56
3	956	379.9	0.04	0.44	304	91	89	—	250	59	4	53
4	1001	381.8	0.07	0.78	307	91	89	—	248	58	5	53
5	1006	384.2	0.12	1.3	297	93	90	—	248	56	7	54
6	1011	387.4	0.15	1.7	307	96	91	—	250	57	8	55
Stop	1016	390.767	Good Final leak check									
W4-1	1022	390.980	0.02	0.22	290	94	92	—	216	67	3	59
2	1027	392.5	0.02	0.22	298	95	93	—	242	64	3	55
3	1032	393.8	0.05	0.55	297	95	93	—	245	58	5	53
4	1037	396.0	0.1	1.1	307	96	93	—	242	54	7	49
5	1042	398.8	0.13	1.45	307	97	93	—	244	52	8	49
6	1047	402.0	0.14	1.6	299	99	94	—	245	52	8.5	49
Stop	1052	405.540	Good Final leak Check									
Avg.	–	44.426										
Check'd	–											

CONSOLE # ____

FILTER # ____

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 3 of 3
SAMPLING LOCATION Inlet – Semivolatile RUN NO. Phase 1 Run 3
DATE ______ TIME START ______ TIME FINISH ______ TEST DURATION ______ min.
DUCT DIMENSIONS ______ X ______ DIAMETER ______ INITIAL LEAK RATE ______ cfm
PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches FINAL LEAK RATE ______ cfm
BAR PRESS ______ " Hg
STATIC PRESS ______ " H2O OPERATOR JWM

Traverse Point	Clock Time	Dry gas meter reading ft3	ΔP in H2O	ΔH in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
U6 1	1111	405.659	0.01	0.11	299	94	93	–	215	69	3	56
2	1116	406.8	0.02	0.22	302	93	93	–	234	65	3	55
3	1121	408.2	0.03	0.34	299	94	93	–	247	62	4	53
4	1126	409.4	0.03	0.34	289	94	93	–	248	60	4	53
5	1131	411.6	0.04	0.45	291	95	94	–	248	60	5	54
6	1136	–	0.07	0.79	281	97	95	–	248	60	6	55
Stop	1141	416.100	Good Final									
W5 1	1220	416.178	0.04	0.45	289	91	90	–	226	63	4	55
2	1225	418.7	0.03	0.34	290	91	91	–	249	61	4	53
3	1230	420.4	0.02	0.23	281	92	91	–	242	62	4	54
4	1235	421.8	0.01	0.11	294	93	91	–	245	65	2.5	57
5	1240	423.0	0.04	0.44	293	94	91	–	247	65	4	52
6	1245	424.7	0.03	0.33	291	95	93	–	245	62	4	54
Stop	1250	426.397										
		Final leak check			0.014@ 11" Hg							
		TB	√ΔP		TB	✓						
Avg.	–	~~112.276~~	0.2470	.735	~~305~~	87.1						
Check'd	–	111.153	TB✓		300.5		✓TB					

CONSOLE # ______
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS

MODIFIED METHOD 5 FIELD DATA SHEET

PLANT NAME Plant Yates Station Boiler No. 1 Page 1 of ____

SAMPLING LOCATION ESP INLET RUN NO. Field Blank (Semi Vol)
DATE 6/20/93 TIME START ____ TIME FINISH ____ TEST DURATION ____ min.
DUCT DIMENSIONS 8.5 X 43? DIAMETER ____ INITIAL LEAK RATE ____ cfm
PTCF 0.84 DGMCF ____ NOZZLE DIA. ____ inches FINAL LEAK RATE ____ cfm
BAR PRESS 29.56 " Hg
STATIC PRESS ____ " H2O OPERATOR Jwm

Traverse Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Cond. Exit Temp. F
		061.325										
		064.965										
Avg.	–											
Check'd	–											

CONSOLE # A161393
FILTER # ____
AMBIENT TEMP. 90
PROBE LENGTH ____
LINER MATERIAL ____

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS

ENTRVEC

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1
Sampling Location INLET - **Train** Aldehydes **Run No.** 1.
Date 6-21-93 Time Start 1310 Time Finish 1345 Test Duration 35 min.
Duct Dimensions 8'6" x 45' Diameter ____ ft Initial Leak Rate 0.008@15" cfm
PTCF .84 DGMCF 1.009 Nozzle Dia. .275 inches Final Leak Rate 0.007 at 10" cfm
Bar Press 29.51 " Hg
Static Press -6.4 " H2O Operator MKO

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	3.86
N/A	1310	582.234										
	1315	584.13	.11	.42	314	77	77	N/A	251	63	4.0	3.86
	1320	585.94	.11	.47	313	78	77		248	63	4.0	3.86
	1325	587.60	.10	.38	315	79	78		258	64	4.0	3.76
	1330	589.32	.10	.38	320	81	79		251	63	4.0	3.76
	1335	591.04	.10	.38	314	82	80		250	63	3.5	3.76
	1340	592.81	.10	.38	314	84	81		251	61	4.0	3.76
	1345	594.515	.10	.38	314	85	81		252	61	4.0	3.76
		12.281										
			√ΔP									
Avg.	–	12.281	0.323	0.39	315	81	79		252			
Check'd		✓	✓	✓			✓					

CONSOLE # A161402
FILTER # NA
AMBIENT TEMP. 80 °F
PROBE LENGTH
LINER MATERIAL glass

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

Single port collection from Port E-8

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP INLET **Train** Aldehydes **Run No.** 2

Date 6-22-93 Time Start 0735 Time Finish 0805 Test Duration 30 min.

Duct Dimensions 8' 6" X 45 57' Diameter .215 ft Initial Leak Rate 0.008 at 5" cfm

PTCF .84 DGMCF 1.009 Nozzle Dia. .215 inches Final Leak Rate 0.006 cfm at 10"

Bar Press 29.40 " Hg

Static Press -6.4 " H2O Operator MKO

Port E-8

Travers Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K: 3.50
N/A	0735	603.980						N/A				
	0740	604.95	.14	.53	310	78	76		260	67	4.0	
	0745	606.90	.13	.49	311	77	77		250	55	4.0	
	0750	608.72	.13	.49	311	78	76		250	56	4.0	
	0755	610.66	.13	.49	311	78	76		252	57	4.0	
	0800	612.30	.13	.49	311	78	76		253	58	4.0	
	0805	614.375	.11	.41	311	79	76		247	58	4.0	
Avg.	—	10.395	0.358	0.483	311	76.9						
Check'd		✓	✓	✓	✓							

CONSOLE # A16/402

FILTER #

AMBIENT TEMP. 74

PROBE LENGTH 10'

LINER MATERIAL Glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

C-172 Single point sample collection from port E-8

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP INLET **Train** Aldehydes **Run No.** 3

Date 5-23-93 Time Start 0720 Time Finish 0756 Test Duration 30 min.

Duct Dimensions 8'6" X ~~45~~ 57' Diameter ____ ft Initial Leak Rate 0.009 at 12" cfm

PTCF .84 DGMCF 1.009 ΔT Nozzle Dia. .275 inches Final Leak Rate 0.007 at 10" cfm

Bar Press 29.39 " Hg

Static Press -6.4 " H2O Operator MEO

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=38
						Inlet	Outlet					
N/A	0720	622.675	0					N/A				
	0725	624.42	.11	.41	311	76	75		262	62	3.5	
	0730	626.16	.10	.38	310	76	75		256	55	3.5	
	0735	627.90	.10	.38	316	76	75		258	56	3.5	
	0740	629.51	.08	.30	317	77	76		260	57	3.5	
	0745	631.16	.10	.38	318	83	79		261	63	3.5	
	0750	632.90	0.10	.38	313	84	80		263	60	3.5	
Avg.	—	10.275	0.3132	0.37	314	77.7						
Check'd		✓ OJV		✓								

CONSOLE # A 161402

FILTER # –

AMBIENT TEMP. 72°F

PROBE LENGTH 10'

LINER MATERIAL Glass

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP INLET **Train** Aldehydes **Run No.** FB

Date 6/21/93 Time Start 1306 Time Finish ____ Test Duration ____ min.

Duct Dimensions ____ X ____ Diameter ____ ft Initial Leak Rate ____ cfm

PTCF ____ DGMCF ____ Nozzle Dia. ____ inches Final Leak Rate ____ cfm

Bar Press 29.58 " Hg

Static Press -6.4 " H2O Operator JWM

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	1306	319.212										
		319.440										
Avg.	—											
Check'd												

CONSOLE # ____

FILTER # ____

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

ENTERED

SOURCE SAMPLING FIELD DATA SHEET

Page ____ of ____

15 15.8

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet Train PSD Run No. 1

Date 6-21 Time Start 1555 Time Finish 1740 Test Duration 105 min.

Duct Dimensions 8'6 x ~~45~~ 57 avr Diameter ____ ft Initial Leak Rate 0.015@11"Hg cfm

PTCF .84 DGMCF .9880 Nozzle Dia. ~~.250~~ .275 inches Final Leak Rate ____ cfm

Bar Press 29.51 " Hg

Static Press -6.4 " H2O Operator MKO

Port E-7

3.95

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=
N/A	1555	608.920										
	1600	610.83	.07	.27	315	80	79	N/A	262	61	3.0	
	1605	611.84	.07	.27	314	80	77		253	66	3.0	
	1610	613.29	.07	.27	315	80	78		251	57	3.0	
	1615	614.72	.07	.27	319	81	79		249	58	3.0	
	1620	616.16	.07	.27	317	81	80		252	58	2.5	
	1625	617.57	.07	.27	316	82	80		248	60	2.5	
	1630	619.04	.07	.27	318	82	80		245	57	3.0	
	1635	620.62	.07	.27	318	83	80		255	57	3.0	
	1640	621.81	.07	.27	320	87	83		251	57	3.0	
	1645	623.33	.07	.27	322	88	84		255	58	3.0	
	1650	624.75	.07	.27	321	88	84		254	58	3.0	
	1655	626.25	.07	.27	319	89	85		248	59	3.0	
	1700	627.75	.07	.27	320	89	86		250	59	3.0	
	1705	629.14	.07	.27	318	89	86		247	61	3.0	
	1710	630.57	.07	.27	318	90	86		245	59	3.0	
	1715	632.04	.07	.27	319	90	86		249	60	3.0	
	1720	633.75	.07	.27	319	90	86		251	61	3.5	
	1725	634.93	.07	.27	319	90	86		251	62	3.0	
	1730	636.37	.07	.27	318	91	87		251	61	3.0	
	1735	638.00	.07	.27	319	91	87		250	61	3.0	
	1740	639.650	.07	.27	320	91	87		251	62	3.0	
Avg.	—	30.730	.265		318	84.8						
Check'd		✓			✓							

CONSOLE # A161397

FILTER # Thimble # 1314

AMBIENT TEMP. 77

PROBE LENGTH 10'

LINER MATERIAL Glass

Velocity ____

% Moisture 10.8

Flowrate (DSCFM) 246,521

Isokinetic (%) 104

REMARKS ____

Single point sample collection from port ~~E8~~ E7 JWM

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location INLET **Train** **PSD** **Run No.** 2

Date 6-22-93 Time Start 0925 Time Finish 1145 Test Duration 140 min.

Duct Dimensions 8.6" X 57' Diameter – ft Initial Leak Rate 0.018 at cfm 18"

PTCF .84 DGMCF .9880 Nozzle Dia. .275 inches Final Leak Rate NA cfm

Bar Press 29.40 " Hg

Static Press -6.4 " H2O Operator MEO

E-~~@~~8 Po

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=393
N/A	0925	652.063										
	0945	658.40	.08	.31	319	82	80	N/A	253	63	3.5	
	1005	664.40	.08	.31	319	82	80		243	63	3.5	
	1025	670.53	.08	.31	321	82	80		253	63	3.5	
	1045	676.60	.08	.31	320	86	83		242	60	3.5	
	1105	682.84	.08	.31	321	90	85		246	60	3.5	
	1125	688.23	.08	.31	319	96	86		245	61	3.5	
	1145	695.525	.08	.31	321	91	88		250	62	3.5	
Avg.	–	43.462	0.2828		320	85						
Check'd		✓			✓	✓						

CONSOLE # A161397

FILTER # ____

AMBIENT TEMP. 76°F

PROBE LENGTH 10

LINER MATERIAL Glass

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS

Single point sample collection from port E-8

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet **Train** PSD **Run No.** 3

Date 6-23-93 Time Start 0935 Time Finish 1130 Test Duration 115 min.

Duct Dimensions 8.6' X 45'57' DW Diameter ____ ft Initial Leak Rate 0.016 cfm at 15"

PTCF .84 DGMCF .9880 Nozzle Dia. .275 inches Final Leak Rate ____ cfm

Bar Press 29.36 " Hg

Static Press -.6 " H2O Operator MKO

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
N/A	0935	702.172	—									K= 3.93
	0955	708.40	.08	.31	316	90	87	N/A	205	68	3.0	
	1015	714.51	.08	.31	317	93	89		256	57	3.0	
	1035	720.71	.09	.31	317	94	90		250	57	3.0	
	1055	726.93	.09	.31	319	99	94		243	60	3.0	
	1100	733.22	.08	.31	318	99	95		241	61	3.0	
	1120	739.50	.09	.31	320	99	95		242	61	3.0	
1130	[illegible]	742.825	.08	.31	319	100	95		245	61	3.0	
Avg.	—	40.653	0.295	.31	318	94						
Check'd		✓	✓			✓						

CONSOLE # 4161397

FILTER # ____

AMBIENT TEMP. 78'

PROBE LENGTH 10'

LINER MATERIAL ~~Glass~~ SS

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 2

Plant Name Plant Yates Station Boiler No. 1
Sampling Location ESP Inlet **Train** Particulate / Metals **Run No.** 1/Phase 2
Date 6/25/93 Time Start 0800 Time Finish 1405 Test Duration 240 min.
Duct Dimensions 8'6" X 45 57 Diameter ft Initial Leak Rate 0.017 cfm @18"Hg
PTCF 0.84 DGMCF ~~1.00~~ NOZZLE DIA. 0.358 inches Final Leak Rate 0.016 cfm @24"Hg
Bar Press 29.55 " Hg 0.999
Static Press -5.8 " H2O Operator SWm

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
WB-1	0800	446.205	0.06	0.66	277	74	73	~~226~~	226	49	7	
2	805	448.6	0.04	0.44	283	72	72	—	248	43	5	
10.37 3	810	450.2	0.03	0.33	284	74	73	—	247	43	4.5	
4	815	~~45~~452.0	0.02	0.22	276	74	73	—	246	45	3	
5	820	453.0	0.02	0.22	284	75	73	—	227	48	3	
6	825	454.6	0.06	0.66	275	76	73	—	252	46	7	
Stop	830	456.576	Good leak	check								
WE-1	836	456.677	0.03	0.33	286	77	75	—	~~225~~	49	4	
2	841	458.6	0.03	0.33	288	79	76	—	253	50	4	
12.508 3	846	461.2	0.04	0.44	288	79	77	—	246	57	5	
4	851 ~~856~~	462.1	0.07	0.77	284	82	79	—	232	47	7.5	
5	856	464.5	0.06	0.66	286	84	79	—	244	48	7	
6	901	466.6	0.09	0.98	293	86	81	—	249	48	9	
Stop	906	469.185	Good leak	check								
34-1	922	469.800	0.03	0.33	290	83	82	—	221	54	5	
16.07 2	927	471.6	0.04	0.44	289	83	81	—	255	53	5	
3	932	473.4	0.07	0.77	306	83	82	—	244	49	7.5	
4	937	476.0	0.01	1.1	292	85	82	—	248	49	11	
5	942	478.7	0.15	1.7	292	88	83	—	243	49	18	
6	947	482.2	0.15	1.7	285	90	84	—	242	53	19	
Stop	952	485.872										
W2-1	1020	486.100	0.03	0.33	291	83	82	—	232	54	5	
14.930 2	1025	488.3	0.04	0.44	290	83	82	—	256	52	5	
3	1030	489.8	0.05	0.55	293	84	83	—	243	50	6	
4	1035	492.0	0.08	0.88	296	86	84	—	247	49	9	
5	1040	494.2	0.14	1.55	299	88	84	—	246	48	17	
6	1045	497.6	0.14	1.55	300	90	85	—	243	51	17	
Stop	1050	501.030										
Avg.	—	111.213	.2403	.7685	301		84					
Check'd		111.										

CONSOLE # 161363
FILTER # 1252
AMBIENT TEMP.
PROBE LENGTH
LINER MATERIAL

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS Good pitot leak check

SOURCE SAMPLING FIELD DATA SHEET

Page 2 of 2

Plant Name Plant Yates Station Boiler No. 1
Sampling Location Inlet   **Train** Particulate / Metals   **Run No.** 1 / Phase 2
Date 6/25/93 Time Start ______ Time Finish ______ Test Duration ______ min.
Duct Dimensions ______ X ______ Diameter ______ ft Initial Leak Rate ______ cfm
PTCF ______ DGMCF ______ NOZZLE DIA. 0.358 inches Final Leak Rate ______ cfm
Bar Press ______ " Hg
Static Press ______ " H2O   Operator JWM

Travers Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
E2-1	1058	501.500	0.03	0.33	316	88	86	—	223	57	5	
2	1103	503.2	0.04	0.44	324	87	86	—	253	55	6	
3	1108	505.0	0.06	0.66	327	88	85	—	250	53	8	
4	1113	507.3	~~0.06~~ 0.1	1.1	332	88	86	—	249	52	13	
15.425 5	1118	510.2	0.15	1.6	336	91	87	—	247	53	22	
6	1123	—	0.18	1.6	336	93	88	—	247	56	22	
Stop	1128	516.925	Leak Check 0.011 @ 23"Hg - Changed Silica Gel impinger									
			Leak Check on Silica Gel recharge - 0.013 @ 24"Hg									
E5-1	1211	518.040	0.02	0.22	309	82	82	—	233	65	5	
2	1216	—	0.04	0.44	313	82	82	—	249	54	6.5	
3	1221	521.6	0.07	0.77	315	83	82	—	248	52	9.0	
16.049 4	1226	524.0	0.11	1.2	315	85	83	—	245	51	14.0	
5	1231	527.0	0.16	1.75	316	88	84	—	253	53	22	
6	1236	530.4	0.22	1.75	315	90	85	—	246	62	22	
Stop	1241	534.089	Good leak check @ 23"Hg									
E3-1	1255	534.268	0.02	0.22	298	87	85	—	236	62	5	
2	~~12~~ 1300	—	0.02	0.22	305	86	85	—	224	58	5	
3	1305	537.3	0.04	0.44	311	86	85	—	241	56	7	
13.504 4	1310	539.2	0.07	0.77	312	87	85	—	253	49	10	
5	1315	541.6	0.1	1.1	311	89	86	—	243	48	15	
6	1320	544.4	~~0.16~~ 0.2	~~1.7~~ 1.5	308	92	87	—	249	49	22	
Stop	1325	547.772										
E1-1	1335	548.300	0.09	1.0	308	90	87	—	209	49	17	
2	1340	—	0.07	0.76	307	90	87	—	243	49	12	
12.354 3	1345	553.2	0.05	0.54	307	90	87	—	242	52	9	
4	1350	555.3	0.03	0.33	305	90	88	—	252	53	7	
5	1355	557.0	0.03	0.33	304	91	88	—	253	54	7	
6	~~1400~~ 1400	558.7	0.04	0.44	284	91	88	—	246	53	9	
Avg. Stop	1405	560.159										
Check'd		111.215										

CONSOLE # ______
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS Could not pull the proper rate through the silica gel impinger. The impinger mass ~~was~~ wasn't determined and then the silica gel impinger was re-charged with fresh silica gel.

C-179

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 3

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Inlet　**Train** Particulate / Metals　**Run No.** 2/Phase 2

Date 6/26/93 Time Start 0935　Time Finish 1611　Test Duration 240 min.

Duct Dimensions ____ X ____　Diameter ____ ft　Initial Leak Rate 0.006 cfm @ 23"Hg

PTCF 0.84　DGMCF 0.999　NOZZLE DIA. 0.358 inches　Final Leak Rate 0.012 cfm @ 24"Hg

Bar Press 29.56 " Hg

Static Press -0.58 " H2O　Operator JWN　DHC = 1.822

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K Factor
E1-1	935	579.944	0.1	1.1	289	72	72	–	222	52	10	10.8
2	940	582.9	0.08	0.87	294	73	72	–	262	45	8	
3	945	585.5	0.05	0.55	293	75	72	–	244	49	6	
4	950	587.5	0.03	0.33	295	76	73	–	246	53	5	
5	955	589.2	0.03	0.33	296	77	74	–	257	54	5	10.9
6	1000	590.9	0.03	0.33	287	78	75	–	244	55	5	
Stop	1005	592.536	Good leak check @ 23"Hg									
E3-1	1011	592.798	0.03	0.33	290	78	76	–	219	54	5	
2	1016	594.7	0.02	0.22	305	79	76	–	244	52	4	
3	1021	596.0	0.05	0.55	306	80	77	–	251	48	6	
4	1026	598.1	0.08	0.88	304	82	78	–	249	46	9	
5	1031	600.4	0.11	1.2	302	84	79	–	257	47	12.5	
6	1036	603.9	0.15	1.6	300	87	80	–	243	47	18	
Stop	1041	607.235	Good leak check @ 24"Hg									
E5-1	1113	607.821	0.03	0.33	298	82	80	–	212	56	5	
2	1118	609.6	0.02	0.22	307	82	81	–	227	54	4	
3	1123	611.0	0.07	0.77	312	83	81	–	254	52	8	
4	1128	613.57	0.14	1.5	313	87	83	–	249	49	18	
5	1133	616.7	0.14	1.6	313	89	83	–	247	53	19	
6	1138	619.9	0.19	1.7	311	90	83	–	243	55	22	
Stop	1143	623.582		Good leak ✓ @ 28"Hg								
Avg.	—	110.002	√.2490	.7392	299		87					
Check'd												

12.59

14.43

15.76

CONSOLE # 161363

FILTER # 1250

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

C-180

SOURCE SAMPLING FIELD DATA SHEET

Page 2 of 3

Plant Name Plant Yates Station Boiler No. 1
Sampling Location Inlet **Train** Particulate / Metals **Run No.** ____
Date 6/26/97 Time Start ____ Time Finish ____ Test Duration ____ min.
Duct Dimensions ____ X ____ Diameter ____ ft Initial Leak Rate ____ cfm
PTCF ____ DGMCF ____ NOZZLE DIA. ____ inches Final Leak Rate ____ cfm
Bar Press ____ " Hg
Static Press ____ " H2O Operator ____

Travers Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
E2-1	~~E7~~1148	623.800	0.03	0.33	322	86	84	–	248	55	6.0	
2	1153	625.9	0.04	0.44	321	88	85	–	250	56	6.0	
3	1158	627.6	0.07	0.77	323	90	86	–	251	55	9.0	
4	1203	629.9	0.1	1.1	328	91	86	–	249	54	12.0	
5	1208	632.6	0.14	1.5	332	93	87	–	247	53	20.0	
6	1213	635.9	0.15	1.5	335	94	87	–	245	53	22.0	
Stop	1218	639.164	Good leak check @ 23" Hg									
W2-1	1336	639.840	0.03	0.33	274	84	83	–	232	60	6	
2	1341	–	0.04	0.44	299	84	83	–	246	49	7	
3	1346	643.3	0.04	0.44	293	85	84	–	241	47	7	
4	1351	–	0.08	0.88	295	87	84	–	253	47	12	
5	1356	647.7	0.12	1.3	296	88	84	–	249	47	18	
6	1401	651.0	0.15	1.5	295	91	85	–	244	57	22	
Stop	1406	654.580	GOOD LEAK @ 26" Hg									
W4 1	1422	654.791	0.03	0.33	288	87	85	–	217	63	6	
2	1427	656.6	0.05	0.55	298	87	85	–	253	49	8	
3	1432	658.6	0.06	0.66	296	88	85	–	244	45	10	
4	1437	661.0	0.11	1.2	300	91	86	–	245	48	18	
5	1442	664.1	0.15	1.65	293	93	87	–	244	51	22	
6	1447	667.3	0.11	1.2	280	95	91	–	243	52	18	
Stop	1452	670.100	GOOD LEAK @ 25" Hg									
Avg.	–											
Check'd												

15.364

14.740

15.309

CONSOLE # ____
FILTER # ____
AMBIENT TEMP. ____
PROBE LENGTH ____
LINER MATERIAL ____

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 3 of 3

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Inlet **Train** Particulate / Metals **Run No.** 2/Phase2

Date 6/26/97 Time Start ______ Time Finish ______ Test Duration ______ min.

Duct Dimensions ______ X ______ Diameter ______ ft Initial Leak Rate ______ cfm

PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches Final Leak Rate ______ cfm

Bar Press ______ " Hg

Static Press ______ " H2O Operator JW

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K Factor
W-1	1457	670.485	0.03	0.33	285	93	89	–	217	56	6	11
2	~~14~~1502	672.1	0.03	0.33	298	92	89	–	238	56	7	
3	1507	673.8	0.03	0.33	298	92	89	–	243	56	7	
4	1512	675.3	0.04	0.44	299	93	90	–	244	56	8	
5	1517	677.3	0.06	0.66	295	95	91	–	253	54	10	
6	1522	679.6	0.08	0.88	283	96	93	–	251	57	14	
Stop	1527	682.283	Good leak check @ 22" Hg									
E-1	1541	682.477	0.03	0.33	279	92	91	–	217	62	7	
2	1546	684.2	0.05	0.55	292	92	91	–	239	56	9	
3	1551	686.2	0.02	0.22	291	93	91	–	251	57	6	
4	1556	687.65	0.03 ~~0.04~~	0.33	286	93	92	–	235	58	7	
5	1601	689.4	0.02	0.22	281	94	92	–	245	59	6	
6	1606	691.0	0.03	0.33	282	94	92	–	242	60	7	
Stop	1611	692.478										
			√ΔP									
Avg.	–	109.994	0.2480									
Check'd												

11.79

10.001

CONSOLE # ______

FILTER # ______

AMBIENT TEMP. ______

PROBE LENGTH ______

LINER MATERIAL ______

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS ______

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 3

Plant Name Plant Yates Station Boiler No. 1
Sampling Location INLET **Train** Particulate / Metals **Run No.** 3 / Phase 2
Date 6/27/93 Time Start 848 Time Finish 1405 Test Duration 240 min.
Duct Dimensions 8' 6" x 45 Diameter ft Initial Leak Rate 0.017 cfm @ 24"Hg
PTCF 0.84 DGMCF 0.999 NOZZLE DIA. 0.358 inches Final Leak Rate 0.010 cfm @ 23"Hg
Bar Press 29.4 " Hg
Static Press ~~-0.5~~ 5.9 SWM H2O Operator SWM

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	E Fract
W8-1	848	712.843	0.04	0.44	281	75	74	–	226	54	6	11.0
2	853	714.8	0.05	0.55	281	75	74	–	235	50	6	
3	858	716.7	0.04	0.44	278	77	75	–	230	49	5	
4	903	718.6	0.02	0.22	276	78	76	–	242	50	4	
5	908	720.0	0.02	0.22	279	79	76	–	245	~~79~~ 59	4	
6	913	721.3	0.05	0.55	276	80	77	–	242	52	6	
Stop	918	723.565	Good leak check @ 22"Hg									
W6-1	939	723.840	0.02	0.22	284	80	77	–	225	55	4	
2	944	725.5	0.03	0.33	286	80	78	–	232	53	5	
3	949	727.0	0.05	0.55	288	81	78	–	236	52	6	
4	954	728.3	0.04	0.44	287	82	79	–	232	52	5	
5	959	730.9	0.07	0.77	278	83	80	–	245	48	7	
6	1004	733.6	0.08	0.90	284	85	80	–	250	48	9	
Stop	1009	735.654	Good leak check @ 12"Hg / Good leak check @ 22"Hg									
W4-1	1015	735.999	0.02	0.22	275	83	81	–	205	59	4	
2	1020	737.5	0.04	0.46	289	84	82	–	240	54	6	
3	1025	739.4	0.08	0.90	293	85	82	–	249	50	9	
4	1030	742.5	0.11	1.25	295	87	83	–	248	45	14	
5	1035	–	0.14	1.6	291	88	83	–	240	44	19	
6	1040	748.9	0.16	1.8	292	90	84	–	244	47	21.5	
Stop	1045	752.419	Good leak check @ 25"Hg									
vg.	–	111.690	√.2524	.7602	303		90					
heck'd												

ONSOLE # A161363
ILTER # 916 / thimble
MBIENT TEMP. 80
ROBE LENGTH 8ft
NER MATERIAL glass

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

EMARKS Good Leak check of pitot tube & line (all Phase 2 pitots & lines were leak checked where applicable.)

AT END OF RUN – Thimble became dislodged from

SOURCE SAMPLING FIELD DATA SHEET

Page 2 of 3

Plant Name Plant Yates Station Boiler No. 1
Sampling Location Inlet **Train** Particulate / Metals **Run No.** 3/Phase 2
Date 6/27/93 Time Start ______ Time Finish ______ Test Duration ______ min.
Duct Dimensions ______ X ______ Diameter ______ ft Initial Leak Rate ______ cfm
PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches Final Leak Rate ______ cfm
Bar Press ______ " Hg
Static Press ______ " H2O Operator SWM

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K Factor
W2-1	1049	752.642	0.02	0.22	285	87	84	–	204	60	4	
2	1054	754.1	0.03	0.33	298	87	84	–	221	55	5	
3	1059	755.7	0.04	0.44	307	88	85	–	243	55	6	
4	1104	757.7	0.09	0.99	299	89	86	–	257	49	11	11.06
5	1109	760.2	0.14	1.55	302	91	87	–	241	47	19	
6	1114	763.9	0.15	1.7	301	94	88	–		58	22	
Stop	1119	767.291	Good at 22"Hg leak check / Good initial leak check @25"Hg									
E2-1	1148	768.450	0.03	0.33	317	89	87	–	216	65	6	~~11.12~~ 10.88
2	1153	770.2	0.04	0.44	322	89	87	–	240	55	7	
3	1158	772.0	0.06	0.66	328	90	87	–	242	52	8	
4	1203	774.3	0.09	1.0	330	91	88	–	244	57	12	
5	1208	777.0	0.18	1.6	333	93	89	–	242	54	22	
6	1213	780.6	0.19	1.6	336	95	90	–	249	57	22	
Stop	1218	783.812	Good leak check @ 23"Hg (0.018 ft3/min)									
S-1	1225	784.027	0.02	0.22	316	92	90	–	222	67	5	
2	1230	785.6	0.04	0.45	322	92	89	–	247	60	7	
3	1235	787.4	0.07	0.77	321	92	90	–	248	57	11	
4	1240	790.0	0.11	1.25	321	92	91	–	250	58	18	
5	1245	792.5	0.14	1.55	322	96	92	–	251	59	21	
6	1250	796.6	0.16	1.4	322	97	92	–	245	63	22	
Stop	1255	799.342										
			Sqr									
	–	111.690	0.2525									
k'd												

'SOLE # ______
ER # ______
IENT TEMP. ______
BE LENGTH ______
R MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

ARKS ______

SOURCE SAMPLING FIELD DATA SHEET

Page 3 of 3

Plant Name Plant Yates Station Boiler No. 1
Sampling Location Inlet **Train** Particulate / Metals **Run No.** 3/Phase 2
Date 6/27/93 Time Start ______ Time Finish ______ Test Duration ______ min.
Duct Dimensions ______ X ______ Diameter ______ ft Initial Leak Rate ______ cfm
PTCF ______ DGMCF ______ NOZZLE DIA. ______ inches Final Leak Rate ______ cfm
Bar Press ______ " Hg
Static Press ______ " H2O Operator Swm

14.190

.278

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
E3-1	1259	799.545	0.02	0.22	307	94	92	–	206	66	6	
2	1304	801.1	0.03	0.33	315	94	92	–	226	65	7	
3	1309	802.7	0.05	0.55	318	95	92	–	244	65	10	
4	1314	804.8	0.09	[illegible]	316	96	93	–	247	55	15	
5	1319	807.7	0.11	1.3	316	99	94	–	245	54	20	
6	1324	810.5	0.14	1.3	314	99	94	–	242	56	22	
Stop	1329	813.735	Good leak check @ 22" Hg									
E1-1	1335	814.000	0.07	0.77	309	97	94	–	205	58	13	
2	~~1337~~ 1340	816.5	0.09	1.0	314	97	94	–	239	54	12	
3	1345	819.4	0.04	0.44	312	97	93	–	241	54	11	
4	1350	821.5	0.03	0.33	310	98	94	–	260	56	9	
5	1355	823.3	0.04	0.44	309	97	94	–	252	52	10	
6	~~1400~~ 1400	825.2	0.05	0.55	303	97	94	–	257	57	11	
Stop	~~1405~~ 1405	827.278										
Avg.	–											
Check'd												

CONSOLE # ______
FILTER # ______
AMBIENT TEMP. ______
PROBE LENGTH ______
LINER MATERIAL ______

Velocity ______
% Moisture ______
Flowrate (DSCFM) ______
Isokinetic (%) ______

REMARKS ______

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Inlet **Train** Particulate / Metals **Run No.** Phase 2/FB

Date 24 Jun 93 Time Start 1206 Time Finish ________ Test Duration ________ min.

Duct Dimensions ________ X ________ Diameter ________ ft Initial Leak Rate 0.017 cfm @15"Hg

PTCF ________ DGMCF ________ NOZZLE DIA. 0.358 inches Final Leak Rate ________ cfm

Bar Press ________ " Hg

Static Press ________ " H2O Operator JWM

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
	1206	426.815										
	1211	426.845										
Avg.	—	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Check'd		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

CONSOLE # ~~Quartz~~ A161363

FILTER # 1254

AMBIENT TEMP. 85

PROBE LENGTH 8'

LINER MATERIAL Quartz

Velocity ________

% Moisture ________

Flowrate (DSCFM) ________

Isokinetic (%) ________

REMARKS ________

Flue-Gas Sampling Log

Sponsor: PLANT YATES STATION BOILER #1	Sample Run #: 1
Plant Location: ESP INLET	Soda-Lime Trap#: SL 404
Date: 06-25-93	Iodated Carbon #: IC 404
Fuel Type: COAL	Pump#: BOX #1
Pollution Control: ESP	Probe#: 2
Sampling Point: ~~E~~ RVW W-1	Filter ID:

start			stop			elapsed	mean	mean
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)	time (min)	zero (l/min)	flow (l/min)
0705	-0.012	0.500	1100	-0.005	0.273	~~246~~ RVW 235	-0.0085	0.3865
					TOTALS:	235	-0.0085	0.3865

Integrator Volume (l):	100.0
Offset Correction (l):	
Total Integrator Volume:	
CO_2 Mass Flow Correction:	
Actual (dry STP) volume (l):	
% O_2:	8.0
% CO_2:	10.0
% H_2O:	7.0
ppm SO_2:	1500 TO 2000

COMMENTS:

START: LEAK ✓ @ METER → -0.012

STOP: LEAK ✓ @ METER → -0.005

HEAT SHEATHED PROBE TEMP
105 °C TO 115 °C

Flue-Gas Sampling Log

Sponsor: YATES STATION BOILER # 1	Sample Run #: 2
Plant Location: ESP INLET	Soda-Lime Trap#: SL - 421
Date: 06-26-93	Iodated Carbon #: IC - 421
Fuel Type: COAL	Pump#: Box #1
Pollution Control: ESP	Probe#: #2
Sampling Point: W-1	Filter ID:

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
1045	- 0.003	0.500	~~312~~ 1512	- 0.006	0.242	267		
					TOTALS:			

Integrator Volume (l):	100.0
Offset Correction (l):	
Total Integrator Volume:	
CO_2 Mass Flow Correction:	
Actual (dry STP) volume (l):	
% O_2:	8.0
% CO_2:	10.0
% H_2O:	7.0
ppm SO_2:	1500 TO 2000

COMMENTS:

START: LEAK ✓ @ METER -0.006

STOP: LEAK ✓ @ METER -0.008

HEAT SHEATHED PROBE TEMP

105 °C TO 115 °C

Flue-Gas Sampling Log

Sponsor: YATES STATION BOILER # 1	Sample Run #: 3
Plant Location: ESP INLET	Soda-Lime Trap#: SL-410
Date: 06-27-95	Iodated Carbon #: IC-410
Fuel Type: COAL	Pump#: BOX # 1
Pollution Control: ESP	Probe#: # 2
Sampling Point: W-1	Filter ID:

start			stop			elapsed	mean	mean
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)	time (min)	zero (l/min)	flow (l/min)
0715	-0.006	0.500	1145	~~0.265~~ RVW	0.265	270	~~0.38~~ -0.006 RVW	0.3825
					TOTALS:			

Integrator Volume (l):	100.0
Offset Correction (l):	
Total Integrator Volume:	
CO_2 Mass Flow Correction:	
Actual (dry STP) volume (l):	
% O_2:	8.0
% CO_2:	10.0
% H_2O:	7.0
ppm SO_2:	1500 TO 2000

COMMENTS:

START LEAK ✓ @ METER -0.006

STOP LEAK ✓@ METER -- 0.008

HEAT SHEATH PROBE TEMP

105 °C TO 115 °C

Flue-Gas Sampling Log

Sponsor:	YATES	Sample Run #:	FIELD BLANK
Plant Location:	ESP INLET	Soda-Lime Trap#:	406
Date:	06-24-93	Iodated Carbon #:	406
Fuel Type:	COAL	Pump#:	BOX #1
Pollution Control:	ESP	Probe#:	2
Sampling Point:		Filter ID:	

start			stop			elapsed time (min)	mean zero (l/min)	mean flow (l/min)
time (hh:mm)	zero (l/min)	flow (l/min)	time (hh:mm)	zero (l/min)	flow (l/min)			
1200	-0.011	0.50	1210	-0.011	0.500			
					TOTALS:			

Integrator Volume (l): 0

Offset Correction (l):

Total Integrator Volume:

CO_2 Mass Flow Correction:

Actual (dry STP) volume (l):

% O_2: 8.0

% CO_2: 10.0

% H_2O: 7.0

ppm SO_2: 1500 - 2000

COMMENTS:

LEAK ✓ @ METER → -0.011

HEAT SHEATHED PROBE TEMP
105 °C

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inleT **Train** Anions **Run No.** 1

Date 6-25-95 Time Start 1225 Time Finish 1405 Test Duration ~~[illegible]~~ 100 min.

Duct Dimensions 8'4" X 45' Diameter ft Initial Leak Rate ~~0.0[illegible]~~ cfm 0.01 @ 10"

PTCF .84 DGMCF 1.003 Nozzle Dia. .375 inches Final Leak Rate 0.004 ~~cfm~~ @ 8"

Bar Press 29.55 " Hg

Static Press -5.8 " H2O Operator MKO Port W-3

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=13.6
W	1225	385.897										
	1245	397.46	.11	1.49	290	79	78		258	62	3.0	
	1305	410.73	.10	1.36	290	87	81		263	57	3.0	
	1325	423.28	.10	1.36	291	87	84		260	55	3.5	
	1345	435.99	.09	1.22	290	93	87		258	53	3.5	
	1405	448.713	.10	1.36	290	93	87		260	52	5.0	
Avg.	—	64.816	√.3161	1.3580	290		85					
Check'd												

CONSOLE # A 161404
FILTER # 1229
AMBIENT TEMP. 78
PROBE LENGTH 10'
LINER MATERIAL Glass

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1 Anions

Sampling Location Inlet **Train** ~~Bulk Particulate Radionuclides~~ **Run No.** V

Date 6-26-93 Time Start 1108 Time Finish 1213 Test Duration 65 min.

Duct Dimensions 8'6" X 95 57 Diameter ft Initial Leak Rate 0.004 cfm @ 10"

PTCF .84 DGMCF 1.003 Nozzle Dia. .375 inches Final Leak Rate 0.009 cfm at 8"

Bar Press 29.50 " Hg

Static Press 58 " H2O Operator MKO

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=17.8
N/A	1108	550.082	—	—								
	1128	562.72	.10	1.38	275	84	83		245	62	3.0	
	1148	575.72	.10	1.38	284	90	84		254	54	3.0	
	1208	589.54	.11	1.51	283	94	87		257	54	3.5	
	[illegible]	594.327	.10	1.35	284	95	87		258	55	3.5	13.5 K
	1213											
Avg.	—	44.245	0.3201	1.405	281.5	88.0						
Check'd												

CONSOLE # A161401

THIMBLE # — #1232

AMBIENT TEMP. 74

PROBE LENGTH 10

LINER MATERIAL glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ___

Plant Name Plant Yates Station Boiler No. 1

Sampling Location INLET **Train** Anions **Run No.** 3

Date 6-27-93 Time Start 0715 Time Finish 0837 Test Duration 82 ✓ min.

Duct Dimensions 8 6" X 45 Diameter ___ ft Initial Leak Rate 0.009 cfm at 12"

PTCF .84 DGMCF 1.003 Nozzle Dia. .375 inches Final Leak Rate 0.006 cfm at 9"

Bar Press 29.50 " Hg

Static Press -5.4 " H2O Operator MKO Pott E-5

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=12.8
N/A	0715	655.883										
	0735	666.72	.08	1.02	310	72	71		256	58	2.0	
	0755	678.17	.08	1.02	308	73	71		268	53	2.5	
	0815	689.30	.08	[illegible]	310	83	76		261	56	2.5	
	0835	701.023	.07	.89	311	84	76		258	56	2.5	
Avg.	—	45.140	.2783	.9875	310		76					
Check'd												

CONSOLE # A161401

FILTER # —

AMBIENT TEMP. 74

PROBE LENGTH 10'

LINER MATERIAL GLASS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location INLET **Train** Anions **Run No.** Run FB/Phase 2

Date 6/24/93 ~~6/23/93 pm~~ Time Start ____ Time Finish ____ Test Duration ____ min.

Duct Dimensions ____ X ____ Diameter ____ ft Initial Leak Rate 0.002 cfm @15" Hg

PTCF ____ DGMCF ____ Nozzle Dia. ____ inches Final Leak Rate ____ cfm

Bar Press ____ " Hg

Static Press ____ " H2O Operator ____

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
	1410	636690										
	1412	637.163										
Avg.	—											
Check'd												

CONSOLE # ____

FILTER # ____

AMBIENT TEMP. ____

PROBE LENGTH ____

LINER MATERIAL ____

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1
Sampling Location SFT ESP Inlet **Train** Ammonia/Hydrogen Cyanide **Run No.** 1
Date 6-25-93 Time Start 1456 Time Finish 1650 Test Duration 70 min
Duct Dimensions 8 6" X 45 Diameter ___ ft Initial Leak Rate 0.010 at 10" cfm
PTCF .84 DGMCF 1.003 Nozzle Dia. .375 inches Final Leak Rate 0.009 at 12" cfm
Bar Press 29.55 " Hg
Static Press -5.8 " H2O Operator MKO Port 4-3

Travers Point	Clock Time	Dry gas meter reading ft3	^P in H2O	^H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
~~[illegible]~~	~~1450~~	~~451.~~ [illegible]										
WA	1450	450.134										
	1500	464463	.10	1.36	285	88	86		250	61	3	~~[illegible]~~ 13.6
	1530	477493	.10	1.36	291	88	86		257	63	3	
	STOP	leak check 0.006 at 17"										
		put Bulk particulate filter on										
		because Thimble on HCl was ~~[illegible]~~ losing particulate										
CAME OFF		TO TRANSFER LINE. Tip of probe broke										
		fire polished the end										
		leak check 0.009 at 12"										
	1620	477.890										
	1640	490.34	.09	1.22	289	89	86		253	62	3.5	
	1650	497.194	.10	1.36	291	92	90		252	58	4.5	
		46.663 ft3										
Avg.	—	46.663	√.3122	1.3250	289		88					
Check'd												

CONSOLE # A161401
FILTER # —
AMBIENT TEMP. 80
PROBE LENGTH 10' 5/455
LINER MATERIAL Glass

Velocity
% Moisture
Flowrate (DSCFM)
Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location INLET **Train** Ammonia/Hydrogen Cyanide **Run No.** 2

Date 6-26-93 Time Start 0930 Time Finish 1035 Test Duration ~~6~~ 65 min.

Duct Dimensions 86" X 45' Diameter ______ ft Initial Leak Rate 0.009 cfm at 10"

PTCF .84 DGMCF 1.003 Nozzle Dia. .375 inches Final Leak Rate 0.006 cfm at 8"

Bar Press 29.56 " Hg

Static Press -5.8 " H2O Operator MKO Port W-4

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	13.8 -k
	0930	507.563										
	0950	520.62	.10	1.38	280	75	74		260	61	4.5	
	1010	533.67	.10	1.38	280	83	77		255	52	4.5	
	1030	546.65	.10	1.38	283	80	77		258	54	4.5	
	1035	548.185	.09	1.24	285	88	81		254	54	4.5	
Avg.	—	41.622	$\sqrt{.3122}$	1.31	283		80					
Check'd												

CONSOLE # A161401

FILTER # —

AMBIENT TEMP. 70

PROBE LENGTH 10'

LINER MATERIAL glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of

Same Day as Run 2 JWM

Plant Name Plant Yates Station Boiler No. 1

Sampling Location INLET **Train** Ammonia/Hydrogen Cyanide **Run No.** 3

Date 6-26-97 Time Start 1420 Time Finish 1520 Test Duration 60 min.

Duct Dimensions 8'6" X 45 Diameter ft Initial Leak Rate 0.009 cfm at 10"

PTCF .84 DGMCF 1.003 Nozzle Dia. .375 inches Final Leak Rate 0.006 cfm

Bar Press 29.85 " Hg

Static Press -5.8 " H2O Operator MKO Port 4 - Pt 12"

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	13.5
N/A	1420	595.310	—	—	—	—	—	—	—	—	—	
	1440	610.13	.11	1.48	281	96	93		266	68	5.0	
	1500	622.85	.09	1.21	289	95	92		266	63	5.5	
	1520	636.974	.10	1.35	286	95	92		265	62	5.5	
Avg.	—	41.654	.3077	1.34	284		94					
Check'd												

CONSOLE # A161401

FILTER # —

AMBIENT TEMP. 78

PROBE LENGTH 10'

LINER MATERIAL S/S

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location INLET **Train** Ammonia/Hydrogen Cyanide **Run No.** 4

Date 6-21-93 Time Start 0920 Time Finish 1040 Test Duration 80 min.

Duct Dimensions 8'6" X 45" Diameter ____ ft Initial Leak Rate 0.006 cfm @ 12"

PTCF .84 DGMCF 1.003 Nozzle Dia. .315 inches Final Leak Rate 0.004 cfm @ 8"

Bar Press 29.40 " Hg

Static Press -5.8 " H2O Operator Mike E-5 part

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=12.8
4-A	0920	701.417										
	0940	713.022	.08	1.02	313	82	81		260	66	5.0	
	1000	725.17	.09	1.15	315	83	81		259	59	5.0	
	1020	736.622	.08	1.02	315	85	82		257	60	5.0	
	1040	748.302	.08	1.02	316	86	82		259	61	5.0	
Avg.	—	46.885	$\sqrt{.2871}$	1.0850	315		83					
Check'd												

CONSOLE # 416140/

FILTER # —

AMBIENT TEMP. 76

PROBE LENGTH 10'

LINER MATERIAL Glass

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location Inlet **Train** Ammonia/Hydrogen Cyanide **Run No.** Run FB/Phase 2

Date 6/24/93 Time Start 1352 Time Finish 1403 Test Duration ______ min.

Duct Dimensions ______ X ______ Diameter ______ ft Initial Leak Rate ______ cfm

PTCF ______ DGMCF ______ Nozzle Dia. ______ inches Final Leak Rate ______ cfm

Bar Press ______ " Hg

Static Press ______ " H2O Operator JWn

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
	1352	633.055										
	1403	636.689										
Avg.	—											
Check'd												

CONSOLE # ______

FILTER # ______

AMBIENT TEMP. ______

PROBE LENGTH ______

LINER MATERIAL ______

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS ______

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet **Train** Bulk Particulate-Radionuclides **Run No.** 1

Date 6-25-93 Time Start 0745 Time Finish 0907 Test Duration 82 min.

Duct Dimensions 8'6" x 45 Diameter ____ ft Initial Leak Rate 0.009 cfm @ 21"

PTCF .84 DGMCF 1.009 Nozzle Dia. .375 inches Final Leak Rate 0.006 cfm at 8"

Bar Press 29.55 " Hg

Static Press -6.4 " H2O Operator MKL

Part E-4

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=13.5
NA	0745	656.235	~~.08~~	~~1.08~~				NA				
	0805	667.72	.08	1.08	300	78	77		250	61	3.0	
	0825	679.80	.16	1.35	300	84	79		247	54	3.0	
	0845	694.05	.13	1.75	300	85	80		243	56	4.0	
	0907	709.84	.13	1.75	301	90	83		244	69	4.0	
Avg.	— 82	53.605	√.3300	1.4825	301		82					
Check'd												

Same impinger Train was used for Radionuclides and Bulk Part/ Extractable metals

JWM

CONSOLE # A16/401
THIMBLE # —
AMBIENT TEMP. 74
PROBE LENGTH 10'
LINER MATERIAL ~~SS~~ Glass

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

53.6

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location ESP Inlet

Train Bulk Particulate-Radionuclides **Run No.** 2

Date 6-26-93 Time Start 1540 Time Finish 1710 Test Duration 90 min.

Duct Dimensions 8'6" x ~~100~~ 45 Diameter ft Initial Leak Rate 0.010 @ 10" cfm

PTCF .84 DGMCF 1.009 Nozzle Dia. .375 inches Final Leak Rate 0.009 cfm

Bar Press 29.56 " Hg

Static Press -5.8 " H2O Operator MKO ~~Port~~ E-7 E-7 Port

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	
						Inlet	Outlet					
N/A	1540	866.050										K=13.
	1600	879.56	.11	1.45	290	100	97		241	57	4.5	K=13.2
	1620	890.74	.08	1.05	326	100	94		231	62	4.5	K=13.2
	1645	900.74	.07	.89	325	100	94		251	66	4.5	K=12.7
	1700	912.00	.08	[illegible]	326	100	95		249	64	4.5	K=12.7
	[illegible]											
Avg.	—	45.950	$\sqrt{.2905}$	1.1	317		97					
Check'd												

CONSOLE # A161402

THIMBLE # —

AMBIENT TEMP. 78

PROBE LENGTH 10'

LINER MATERIAL SS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page ____ of ____

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet

Train Bulk Particulate-Radionuclides

Run No. 3

Date 6-27-93 Time Start 1120 Time Finish 1240 Test Duration 80 MIN min.

Duct Dimensions 8'6" X 45 Diameter ____ ft Initial Leak Rate 0.017 cfm @ 10"

PTCF .84 DGMCF 1.003 Nozzle Dia. ~~[illegible]~~ 0.375 SWM inches Final Leak Rate 0.009 cfm @ 10"

Bar Press 29.40 " Hg

Static Press -5.3 " H2O Operator MKC

Port E-5

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	k - 12.
						Inlet	Outlet					
init	1120	748.695										
	1140	760.35	.08	1.02	317	91	89	~~[illegible]~~	256	65	3.5	
	1200	771.90	.67	.99	316	91	90		261	57	3.5	
	1220	783.40	.68	1.32	315	93	90		255	56	3.5	
	1240	793.791	.07	.89	316	98	93		272	59	4.0	
Avg.	—	45.096	$\sqrt{.2737}$	.955	316		93					
Check'd												

CONSOLE # A16491

THIMBLE # —

AMBIENT TEMP. 78

PROBE LENGTH 10'

LINER MATERIAL Glass

Velocity ____

% Moisture ____

Flowrate (DSCFM) ____

Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet

Train Bulk Particulate-Ex. Metals

Run No. 1

Date 6-8-93

Time Start 0945

Time Finish 1045

Test Duration 60 min.

Duct Dimensions 8'6' X 45'

Diameter ft

Initial Leak Rate 0.001 cfm @ 12''

PTCF .84

DGMCF 1.009

Nozzle Dia. .375 inches

Final Leak Rate 0.004 @ 10''

Bar Press 29.55 " Hg

Static Press -5.8 " H2O

Operator MKO

E-4

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	13.5
N/A	0945	711.425										
	1005	725.55	.13	1.75	294	86	84		252	59	3.0	
	1025	741.00	.13	1.75	295	86	84		251	49	3.5	
	1045	754.849	.13	1.75	298	86	85		252	50	4.0	
Avg.	–	43.420	$\sqrt{.3606}$	1.75	296		85					
Check'd												

CONSOLE # A16/402

FILTER # (Thimble)

AMBIENT TEMP. 78

PROBE LENGTH 10' glass

LINER MATERIAL glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of ____

Plant Name / Plant Yates Station Boiler No. 1

Sampling Location Inlet
Train Bulk Particulate-Ex. Metals
Run No. 2

Date 6-26 93
Time Start 1345
Time Finish 1505
Test Duration 80 min.

Duct Dimensions 8'6" X 42
Diameter Na ft
Initial Leak Rate 0.01 cfm

PTCF .84
DGMCF 1.007
Nozzle Dia. .375 inches
Final Leak Rate 0.007 cfm

Bar Press 29.56 " Hg

Static Press -5.8 " H2O

Operator RW

13.2

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=18
E-7	1345	822.565	0.08	1.1	322	87	86	—	225	56	4.0	
	1400	832.25	0.07	0.97	323	92	88	—	238	57	4.0	
	1415	839.15	0.07	0.92	323	96	90	—	241	58	4.0	
	1430	847.04	0.07	0.92	323	96	90	—	245	60	4.0	
	1445	855.00	0.07	0.92	323	100	94	—	247	60	4.0	
	1500	863.00	0.07	0.92	323	101	95	—	238	62	4.0	
STOP	1505	865.845										
Avg.	—	43.280	0.2676	0.9583	322.8	92.9						
Check'd												

CONSOLE # A161401
FILTER # 1065 (Thimble)
AMBIENT TEMP. 78
PROBE LENGTH 10'
LINER MATERIAL ~~[illegible]~~ SS

Velocity ____
% Moisture ____
Flowrate (DSCFM) ____
Isokinetic (%) ____

REMARKS ____

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet   **Train** Bulk Particulate-Ex. Metals   **Run No.** 3

Date 6-27-97 Time Start 1300   Time Finish 1410   Test Duration 70 min.

Duct Dimensions 9' 6" X 45'   Diameter ______ ft   Initial Leak Rate 0.009 cfm at 10"

PTCF .84 DGMCF 1.003   Nozzle Dia. ~~.275~~ inches 0.375 swm   Final Leak Rate 0.006 cfm at 10"

Bar Press 29.40 " Hg

Static Press -5.8 " H2O   Operator MKO   E-5

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	12.8
N/A	1300	793.42										
	1320	806.03	.09	1.15	311	90	92		268	66	3.5	
	1340	818.55	.09	1.15	318	98	93		251	53	4.0	
	1400	831.57	.10	1.28	317	96	92		263	57	4.5	
	1410	837.63	.10	1.28	318	97	93		260	58	4.5	
Avg.	—	44.144	$\sqrt{.3071}$	1.215	316		94					
Check'd												

CONSOLE # A16144

FILTER # 1001 (Thimble)

AMBIENT TEMP. 76

PROBE LENGTH 10'

LINER MATERIAL glass

Velocity ______

% Moisture ______

Flowrate (DSCFM) ______

Isokinetic (%) ______

REMARKS Spilled some bulk particulate at end of run ≈ 1 gram was lost.

SOURCF SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet **Train** Size Fract. Particulate **Run No.** 1

Date 6-25-93 Time Start 0800 Time Finish 1020 Test Duration 140 min.

Duct Dimensions 8'6" X 45 Diameter ft Initial Leak Rate 0.009 cfm at 15"

PTCF .84 DGMCF .9880 Nozzle Dia. .375 inches Final Leak Rate cfm

Bar Press 29.55 " Hg

Static Press -6.4 " H2O Operator MKC

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. ° F	Dry gas meter temp.		Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=3.93
						Inlet	Outlet					
N/A	0800	341.86						N/A				
	0820	348.23	.08	.31	290	76	75		248	61	2.0	
	0840	354.58	.08	.31	286	87	77		245	61	2.0	
	0900	360.87	.07	.31	288	88	78		250	62	2.0	
	0920	367.08	.08	.31	288	82	78		261	66	2.0	
	0940	373.42	.08	.31	289	83	78		262	64	2.0	
	1000	379.80	.09	.31	290	86	82		251	65	3.0	
	1020	383.02	.08	.31	288	87	81		254	64	3.5	
Avg.	—	41.161	$\sqrt{2826}$	.31	288		81					
Check'd												

CONSOLE # AC61401

FILTER # F1308 (~~47mm~~) Thimble

AMBIENT TEMP. 70°

PROBE LENGTH 10'

LINER MATERIAL SS.

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet **Train** Size Fract. Particulate **Run No.** 2

Date 6-26-93 Time Start [illegible]694 Time Finish 1125 Test Duration 120 min.

Duct Dimensions 8'6" X 45' Diameter ~~[illegible]~~ ft Initial Leak Rate 0.017 cfm at 10"

PTCF .84 DGMCF 1.009 Nozzle Dia. .275 inches Final Leak Rate NA cfm

Bar Press 28.56 " Hg

Static Press -5.8 " H2O Operator MKO Port E-8

Travers Point	Clock Time	Dry gas meter reading ft3 775	^ P in H2O	^ H in H2O	Stack Temp. °F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	K=386
4A	0915	769.[illegible]						NA				
	0935	777.03	.11	.42	311	81	79		248	62	3.0	
	0955	783.87	.10	.38	311	82	80		246	61	3.0	
	1015	790.78	.10	.38	311	86	84		244	60	3.0	
	1045	798.24	.12	.46	310	85	82		242	61	3.0	
	1105	805.76	.12	.46	311	88	84		241	60	3.0	
	1125	813.78	.10	.38	311	89	86		252	59	3.5	
Avg.	—	43.9830	0.3287	0.913	310.8	83.8						
Check'd												

CONSOLE # A161402

FILTER # 1311 ~~(47mm)~~

AMBIENT TEMP. 76

PROBE LENGTH 10'

LINER MATERIAL glass

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

SOURCE SAMPLING FIELD DATA SHEET

ESP INLET

Page 1 of 1

Plant Name Plant Yates Station Boiler No. 1

Sampling Location inlet **Train** Size Fract. Particulate **Run No.** 3

Date 6-27-93 Time Start 0740 Time Finish 0955 Test Duration 135 min.

Duct Dimensions 8'6" X 45 Diameter Na ft Initial Leak Rate 0.014 cfm at 10"

PTCF 0.84 DGMCF 1.009 Nozzle Dia. .215 inches Final Leak Rate Na cfm

Bar Press 29.50 " Hg

Static Press -5.8 " H2O Operator RW

Travers Point	Clock Time	Dry gas meter reading ft3	^ P in H2O	^ H in H2O	Stack Temp. ' F	Dry gas meter temp. Inlet	Dry gas meter temp. Outlet	Hot box Temp.	Probe Temp	Last Impinger	Vacuum in. Hg	Δ=3.8
E-8	0740	938.170	0.08	0.31	310	74	73	—	240	63	2.0	
	0755	942.70	0.09	0.34	312	78	75	—	238	62	2.0	
	0810	948.27	0.08	0.31	314	81	78	—	237	60	2.0	
	0825	952.28	0.09	0.34	314	82	79	—	238	61	2.0	
	0840	958.47	0.08	0.31	314	84	80	—	247	62	2.0	
	0855	962.12	0.08	0.31	314	86	82	—	249	63	2.0	
	0910	966.85	0.08	0.31	314	87	84	—	246	64	2.0	
	0925	971.45	0.08	0.31	315	87	84	—	241	65	2.0	
	0940	975.93	0.08	0.31	314	89	87	—	243	65	2.0	
STOP	0955	980.847										
			√.2871									
Avg.	—	42.677	~~.28[illegible]~~	.3200	313		82					
Check'd												

CONSOLE # A161402

FILTER # (47mm)

AMBIENT TEMP. 72

PROBE LENGTH 10'

LINER MATERIAL SS

Velocity

% Moisture

Flowrate (DSCFM)

Isokinetic (%)

REMARKS

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1
Location ESP IN
Run No. 1
Date

Comments

Operator JWM

Sorbing Reagents: ____(CO2) ____(O2) ____(CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	0.8	18.0	17.2			
		BAD Bag Sample					

WAW ASSUME CO_2 = 10.5 N_2 = 81
O_2 = 8.5

Averaged Results: % CO2 ________ % O2 ________

% CO ________ % N2 ________

Dry Molecular Weight, MW (dry) =

=0.44 ________ +0.32 ________ +0.28 ________
(%CO2) (%O2) (%CO + % N2)

= ________ + ________ + __

Y-097

Run # 1 Train orsat

[✓ ESP Inlet]
ESP Outlet
Stack

Component bag
Date 6-21-93 Time 1930 Smplr JWM
Lab on site Analysis CO_2 O_2
Tare Wt. Na Final Wt. Na

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location ESP Inlet

Run No. 2

Date 6/22/93

Comments

Operator JWM /TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	10.2	10.2	18.0	7.8		
2	0.0	10.0	10.0	18.6	8.6		
3	0.0	10.0	10.0	18.6	8.6		

Averaged Results: % CO2 10.2 % O2 8.6

% CO % N2 81.2

Dry Molecular Weight, MW (dry) =

=0.44 ______ +0.32 ______ +0.28 ______
(%CO2) (%O2) (%CO + % N2)

= ______ + ______ + _

Y-251

Run # 2 Train orsat [✓ ESP Inlet] ESP Outlet Stack

Component bag

Date 6-22-93 Time ______ Smplr JWM

Lab on site Analysis CO2 O2

Tare Wt. ______ Final Wt. ______

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location ESP Inlet

Run No. 3

Date 6/23/93

Comments

Operator TMP

Sorbing Reagents: ✓ (CO2) ✓ (O2) ____ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	10.8	10.8	19.0	8.2		
2	0.0	10.9	10.9	19.4	8.5		
3	0.0	10.8	10.8	19.0	8.2		

Averaged Results: % CO2 10.8 % O2 8.3

% CO ____ % N2 80.9

Dry Molecular Weight, MW (dry) =

=0.44 ____ (%CO2) +0.32 ____ (%O2) +0.28 ____ (%CO + % N2)

= ____ + ____ + ____

Y-256

Run # 3 Train orsat

[✓ ESP Inlet]
ESP Outlet
Stack

Component bag

Date 6-23-93 Time ____ Smplr JWM

Lab on site Analysis CO2 O2

Tare Wt. ____ Final Wt. ____ C-211

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location ESP Inlet

Run No. Metals ~~Run~~ 2-1

Date 6/25/93

Comments

Operator TMP

Sorbing Reagents: ____ (CO2) ____ (O2) ____ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	10.2	10.2	19.0	8.8		
2	0.0	10.0	10.0	19.0	9.0		

Averaged Results: % CO2 10.1 % O2 9.9

% CO ____ % N2 ____

Dry Molecular Weight, MW (dry) =

=0.44 ____ +0.32 ____ +0.28 ____

(%CO2) (%O2) (%CO + % N2)

= ____ + ____ +

Y-337

Run # 1 Train Orsat

Component bag - Phase Two

Date 6-25-93 Time 1430 Smplr JWM

Lab on site Analysis CO_2 O_2

Tare WT(g) ____ Final Wt(g) ____

[✓ ESP Inlet]
ESP Outlet
Stack

ORSAT DATA SHEET

Plant Plant Yates Station Boiler No. 1

Location ESP Inlet

Run No. 2-3

Date 6/27/93

Comments

Operator TMP

Sorbing Reagents: ______ [✓ (CO2)] ______ [✓ (O2)] ______ (CO)

Replicate Number	Original Volume Reading	(CO2) Reading 2 (ml)	(CO2) Volume (2-1) (ml)	(O2) Reading 3 (ml)	(O2) Volume (3-2) (ml)	(CO) Reading 4 (ml)	(CO) Volume (4-3) (ml)
1	0.0	11.8	18.8	7.0			
2	0.0	11.8	18.8	70			

Averaged Results: % CO2 11.8 % O2 7.0

% CO ______ % N2 ______

Dry Molecular Weight, MW (dry) =

=0.44 ______ +0.32 ______ +0.28 ______
(%CO2) (%O2) (%CO + % N2)

= ______ + ______ + ____

Y-454

Run # 2-3 Train ORSAT

[✓ ESP Inlet]
ESP Outlet
Stack

Component ORSAT

Date 6/27/93 Time 1400 Smplr JWM

Lab On Site Analysis O2/CO2

Tare WT(g) — Final Wt(g) —

TRAVERSE FIELD DATA SHEET

Plant Name Plant Yates Station Boiler No1

Sampling Location ESP INLET

Date 06-18-93

Operator RVW/DJV/JWM

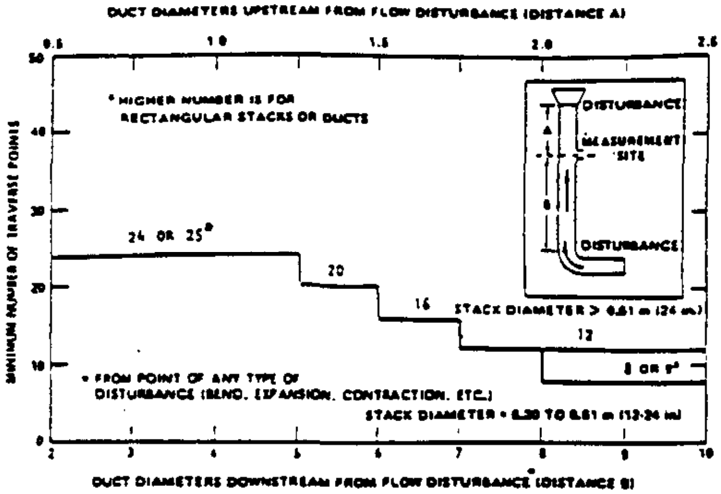
Stack Diameter 8'6" x 45'

Sample Port Diameter 4"

Sample Port Depth 14"

Distance Upstream

Distance downstream



Traverse Point Number	Number Traverse Points On A Diameter											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	86.8	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

Traverse Points	
No.	Distance From Wall
	PORT DEPTH INCLUDED
1	22.5
2	39.5
3	56.5
4	73.5
5	90.5
6	107.5
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	

1 of 6

VELOCITY PROFILE FIELD DATA

Plant Name Inlet Preliminary velocity traverse (75 MW Production,

Sampling Location Inlet Sample Ident. ______

Date 6/19/93 (MMDDYY) Time Start 1100 (HHMM) Time Finish 1230 (HHMM)

Duct Dimensions 8.5' x 45' ft. or Diameter ______ ft.

PTCF 0.84 % H_2O ~7.0

Bar Press. 29.58 " Hg % CO ______ % N_2 ______

Static Press. -6.5 " H_2O % CO_2 9.0 % H_2 ______

Operator Initials DJV, JWM % O_2 7.4 % CH_4 ______

1 all the way in

97 MW

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
E1-1	283	284		0.055	0.06				
2	285	285		0.06	0.06				
3	285	285		0.04	0.035				
4	284	285		0.025	0.02				
5	283	283		0.025	0.03				
6	269	269		0.03	0.03				
E2-1	281	282		0.02	0.02				
2	282	283		0.02	0.015				
3	284	284		0.01	0.02				
4	282	282		0.03	0.02				
5	274	275		0.04	0.03				
6	261	263		0.04	0.05				
E3-1	294			0.02					
2	295			0.02					
3	295			0.04					
4	296			0.08					
5	294			0.09					
6	270			0.13					

Weather Ave $\sqrt{dP}$ = 0.2537

Stack Temp = 283 °F

Remarks Vel = 17.12 fps

ACFM = 392,904

DSCFM

2 of 6

VELOCITY PROFILE FIELD DATA

Plant Name ______
Sampling Location ______ Sample Ident. ______
Date ______(MMDDYY) Time Start ______(HHMM) Time Finish ______(HHMM)
Duct Dimensions ______x______ft. or Diameter ______ft.
PTCF ______ % H_2O ______
Bar Press. ______" Hg % CO ______ % N_2 ______
Static Press. ______" H_2O % CO_2 ______ % H_2 ______
Operator Initials ______ % O_2 ______ % CH_4 ______

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
E4-1	290		~~0.02~~ ~~0.06~~	0.02					
2	293	~~0.05~~	~~0.05~~	0.05					
3	298			0.06					
4	299			0.14					
5	299			0.16					
6	290			0.19					
E5-1	290			0.03					
2	292			0.03					
3	295			0.06					
4	299			0.12					
5	300			0.15					
6	296			0.20					
E6-1	295			0.03					
2	298			0.04					
3	302			0.07					
4	305			0.14					
5	307			0.17					
6	308			0.18					

Weather ______
______
Remarks ______
______

3 of 6

VELOCITY PROFILE FIELD DATA

Plant Name ____
Sampling Location ____ Sample Ident. ____
Date ____(MMDDYY) Time Start ____(HHMM) Time Finish ____(HHMM)
Duct Dimensions ____ x ____ ft. or Diameter ____ ft.
PTCF ____ % H_2O ____
Bar Press. ____ " Hg % CO ____ % N_2 ____
Static Press. ~~-0.6~~ -6.4 " H_2O % CO_2 ____ % H_2 ____
Operator Initials ____ % O_2 ____ % CH_4 ____

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
E7-1	309			0.03					
2	309			0.04					
3	311			0.09					
4	311			0.12					
5	314			0.19					
6	314			0.20					
access? E8-1	304			0.07					
2	305			0.1					
3	307			0.08					
4	308			0.11					
5	314			0.14					
6	315			0.22					
W1-1 ~~[illegible]~~	274			0.06					
2	275			0.07					
3	281			0.09					
4	282			0.06					
5	277			0.1					
6	262			0.13					

Weather ____

Remarks ____

4 of

VELOCITY PROFILE FIELD DATA

Plant Name -
Sampling Location ____ Sample Ident. ____
Date ____(MMDDYY) Time Start ____(HHMM) Time Finish ____(HHMM)
Duct Dimensions ____x____ft. or Diameter ____ft.
PTCF ____ % H_2O ____
Bar Press. ____" Hg % CO ____ % N_2 ____
Static Press. ____" H_2O % CO_2 ____ % H_2 ____
Operator Initials ____ % O_2 ____ % CH_4 ____

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
W2-1	273			0.04					
2	277			0.03					
3	277			0.05					
4	279			0.07					
5	286			0.16					
6	276			0.15					
W3-1	278			0.02					
2	282			0.04					
3	284			0.06					
4	282			0.13					
5	281			0.17					
6	279			0.19					
W4-1	284			0.03					
2	280			0.05					
3	282			0.08					
4	284			0.13					
5	280			0.17					
6	272			0.13					

Weather ____

Remarks ____

5 of 6

VELOCITY PROFILE FIELD DATA

Plant Name -
Sampling Location ______ Sample Ident. ______
Date ______(MMDDYY) Time Start ______(HHMM) Time Finish ______(HHMM)
Duct Dimensions ______ x ______ ft. or Diameter ______ ft.
PTCF ______ % H_2O ______
Bar. Press. ______ " Hg % CO ______ % N_2 ______
Static Press. ______ " H_2O % CO_2 ______ % H_2 ______
Operator Initials ______ % O_2 ______ % CH_4 ______

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
W5-1	275			0.04					
2	275			0.06					
3	274			0.10					
4	277			0.11					
5	273			0.13					
6	262			0.15					
W6-1	266			0.03					
2	266			0.03					
3	272			0.05					
4	271			0.06					
5	265			0.06					
6	261			0.16					
W7-1	260			0.02					
2	263			0.02					
3	263			0.02					
4	258			0.02					
5	260			0.04					
6	273			0.04					

Weather ______

Remarks ______

VELOCITY PROFILE FIELD DATA

Plant Name –
Sampling Location ______ Sample Ident. ______
Date ______(MMDDYY) Time Start ______(HHMM) Time Finish ______(HHMM)
Duct Dimensions ______ x ______ ft. or Diameter ______ ft.
PTCF 0.84 % H_2O ≈7.0
Bar Press. 29.58 " Hg % CO ______ % N_2 ______
Static Press. -6.4 " H_2O % CO_2 ______ % H_2 ______
Operator Initials JWM % O_2 7.4 % CH_4 ______

Mult.
107.7
Finish

Pt.	Stack Temp. °F			Velocity Pressure " H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
W8-1	254			0.04					
2	262			0.04					
3	267			0.02					
4	264			0.01					
5	250			0.02					
6	255			0.08					
	282.9			√ 0.2556					

Weather ______ Vel = 17.113
ACFM = 191,966
Remarks ______ DSCFM = 123,417

Facing ports
(East) E1 – E8 W1 – W8 (West

APPENDIX D:
QUALITY ASSURANCE/QUALITY CONTROL

Appendix D presents a summary of analytical results for QC samples, estimates of measurement precision and accuracy based on analysis of QC samples, and potential limitations in the use of the data.

Overall, QA/QC data associated with this program indicate that measurement data are acceptable and defensible. The QA/QC data indicate that the quality control mechanisms were effective in ensuring measurement data reliability within the expected limits of sampling and analytical error.

Quality control data provide information for identifying and defining qualitative limitations associated with measurement data. The following key types of QC procedures provide the primary basis for quantitatively evaluating data quality:

- Field and laboratory blank samples;
- Duplicate field samples;
- Matrix and surrogate spiked samples;
- Laboratory control samples; and
- Performance evaluation (audit) samples.

Additional details of the project QA/QC program are documented in the DOE Quality Assurance Project Plan.

Sample Collection

Several factors are evaluated to determine acceptable sample collection. Key components of the sampling equipment including the Pitot tubes, thermocouples, orifice meters, dry gas meters, and sampling nozzles were calibrated in the Radian Source Sampling Laboratory before use in the field. These calibrations were also checked after the equipment was returned to the laboratory after the field activities. The presampling calibrations were reviewed by the Radian QA Coordinator as part of the on-site Technical Systems audit.

These calibrations as well as the post sampling calibrations are on file at Radian Corporation. Standard EPA methods or other acceptable sampling methods were used to collect the organic, metal, and anion samples. The sampling runs were well documented, and all gas samples were collected at rates of between 90 and 110% of the isokinetic rates. Sufficient data were collected to ensure acceptable data completeness and comparability of the measurements.

Gas samples were collected from the ESP inlet, ESP outlet, and stack as integrated samples for most analyses over a specified time period. Solid samples of coal, limestone, bottom ash, ESP fly ash, and FGD slurry were collected at hourly intervals over each of the test runs. These individual grabs were combined to provide a single composite sample of each stream for each of the three test runs. Liquid streams were also collected as hourly grabs which were combined to provide a single composite for analysis for each test run. Liquid streams include the ash pond, gypsum recycle water, ash sluice filtrates, FGD slurry filtrate, limestone slurry filtrate, and the inlet and outlet to the condenser. All sampling was conducted while the plant was operating at 85 to 100% of full load and should be representative of typical operation for Plant Yates.

Analytical Quality Control Results

Generally, the type of quality control information obtained pertains to measurement precision, accuracy (which includes precision and bias), and blank effects that are determined using various types of replicate, spiked and blank samples. The specific characteristics evaluated depend on the type of quality control checks performed. For example, blanks may be prepared at different stages in the sampling and analysis process to isolate the source of the blank effect. Similarly, replicate samples may be generated at different stages to isolate and measure sources of variability. The QA/QC measures used as part of this program data evaluation protocol and the characteristic information obtained are summarized in Table D-1. The absence of any of these types of quality control checks from the data for a particular analytical technique does not necessarily reflect poorly on the quality of the data but does limit the ability to estimate the magnitude of the measurement error and hence, prevents placing an estimate of confidence in the results.

As shown in Table D-1, different QC checks provide different types of information, particularly pertaining to the sources of inaccuracy, imprecision, and blank effects. As part of this program, measurement precision and accuracy are typically being estimated from QC indicators that cover as much of the total sampling and analytical process as feasible. Precision and accuracy measurements are based primarily on the actual sample matrix. The precision and accuracy estimates obtained experimentally during the test program are compared to the data quality objectives (DQOs) established for the program as listed in the project QAPP.

These DQOs were not intended to be used as validation criteria but as empirical estimates of the precision and accuracy that would be expected from existing reference measurement methods and that would be considered acceptable. The precision and accuracy objectives are not necessarily derived from analyses of the same types of samples being investigated.

Table D-1
Types of Quality Control Samples

QC Activity	Characteristic Measured
Precision	
Replicate samples collected over time under the same conditions	Total variability, including process or temporal, sampling, and analytical, but not bias.
Duplicate field samples collected simultaneously	Sampling plus analytical variability at the actual sample concentrations.
Duplicate Analyses of a Single Sample	Analytical variability at the actual sample concentrations.
Matrix- or Media-Spiked Duplicates	Sampling plus analytical variability at an established concentration.
Laboratory Control Sample Duplicates	Analytical variability in the absence of sample matrix effects.
Surrogate-Spiked Sample Sets	Analytical variability in the sample matrix but at an established concentration.
Accuracy (Including Bias and Precision)	
Matrix-Spiked Samples	Analyte recovery in the sample matrix, indicating possible matrix interferences and other effects. In a single sample indicates both random error (imprecision) and systematic error (bias).
Media-Spiked Samples	Same as matrix-spiked samples. Used where a matrix-spiked sample is not feasible, such as the stack sampling methods.
Surrogate-Spiked Samples	Analyte recovery in the sample matrix, to the extent that the surrogate compounds are chemically similar to the compounds of interest. Primarily used as indicator of analytical efficacy.
Laboratory Control Samples (LCS)	Analyte recovery in the absence of actual sample matrix effects. Used as an indicator of analytical control.

Table D-1 (Continued)

QC Activity	Characteristic Measured
Standard Reference Material	Analyte recovery in a matrix similar to the actual samples.
Blank Effects	
Field Blank	Total sampling plus analytical blank effect, including sampling equipment and reagents, sample transport and storage, and analytical reagents and equipment.
Trip Blank	Blank effects arising from sample transport and storage. Typically only used for volatile organic compound analyses.
Method Blank	Blank effects inherent in analytical method, including reagents and equipment.
Reagent Blank	Blank effects from reagents used.

Although analytical precision and accuracy are relatively easy to quantify and control, sampling precision and accuracy are unique to each sample matrix. Data that do not meet these objectives are not necessarily unacceptable. Rather, the intent is to document the precision and accuracy obtained, and the objectives serve as benchmarks for comparison. The effects of not meeting the objectives should be considered in light of the intended use of the data.

Table D-2 presents the types of quality control data reported for the program and a summary of precision and accuracy estimates. Almost all of the quality control results met the project objectives.

The following potential problems were identified by the quality control data.

- Chloromethane, methylene chloride, and tetrachloroethene were found in one or more of the field blanks analyzed for VOST. In many cases, the same concentrations were also found in the field samples.
- A standard limestone sample (NIST 1C) was submitted blind as a performance audit sample. Aluminum, silicon, and sodium recoveries in this sample were below 50%, and the recovery of potassium was greater than 200 percent. This may indicate a similar low bias for these elements in the limestone process streams.
- Selenium showed no spike recovery in the impinger solutions analyzed by GFAAS. However, selenium recoveries in the audit samples submitted by RTI showed recoveries of 104 and 113 percent.

A discussion of the overall measurement precision, accuracy and blank effects is presented below for each measurement type.

Precision is a measure of the reproducibility of measurements under a given set of conditions. It is expressed in terms of the distribution, or scatter, of the data, calculated as the standard deviation or coefficient of variation (CV, standard deviation divided by the mean). For duplicates, precision is expressed as the relative percent difference (RPD).

Accuracy is a measure of the degree of conformity of a value generated by a specific procedure to be assumed or accepted true value, and includes both precision and bias. Bias is the persistent positive or negative deviation of the method average value from the assumed or accepted true value.

The efficiency of the analytical procedure for a given sample matrix is quantified by the analysis of spiked samples containing target or indicator analytes or other quality assurance measures, as necessary. However, all spikes, unless made to the flowing stream ahead of the sampling, produce only estimates of the recovery of the analyte through all of the measurement steps occurring after the addition of the spike. A good spike recovery tells little about the true value of the sample before spiking.

Table D-2
Summary of Precision and Accuracy Estimates

		Objectives		Measured	
Measurement Parameter	**How Measured**	**Precision (% RPD)**	**Accuracy (% Recovery)**	**Precision (% RPD)**	**Accuracy (% Recovery)**
Semivolatile Organics in Gas Solid Phase - SW8270	Precision- Matrix-Spiked Duplicates Accuracy - Matrix Spikes				
Acenaphthene		54	47-145	4.1	86
4-Chloro-3-methylphenol		69	22-147	5.0	84
2-Chlorophenol		62	23-134	3.0	82
1,4-Dichlorobenzene		58	20-124	3.2	80
2,4-Dinitrotoluene		55	39-139	3.2	78
n-Nitrosodipropylamine		130	0.1-230	6.3	60
4-Nitrophenol		78	0.1-132	7.0	89
Pentachlorophenol		84	14-176	9.0	45
Phenol		43	5-112	3.4	58
Pyrene		36	52-115	4.1	86
1,2,4-Trichlorobenzene		55	44-142	4.0	90
Semivolatile Organics in Fly Ash - SW8270	Precision- Matrix-Spiked Duplicates Accuracy - Matrix Spikes				
Acenaphthene		54	47-145	1.3	82
4-Chloro-3-methylphenol		69	22-147	5.6	84
2-Chlorophenol		62	23-134	1.8	84
1,4-Dichlorobenzene		58	20-124	2.5	81
2,4-Dinitrotoluene		55	39-139	2.7	76
n-Nitrosodipropylamine		130	0.1-230	7.8	60
4-Nitrophenol		78	0.1-132	37	49
Pentachlorophenol		84	14-176	5.3	64
Phenol		43	5-112	2.7	76
Pyrene		36	52-115	17.7	48Q
1,2,4-Trichlorobenzene		55	44-142	1.2	89
Semivolatile Organics in FGD Solids - SW8270	Precision- Matrix-Spiked Duplicates Accuracy - Matrix Spikes				
Acenaphthene		54	47-145	7.3	82
4-Chloro-3-methylphenol		69	22-147	9.3	76
2-Chlorophenol		62	23-134	7.1	84
1,4-Dichlorobenzene		58	20-124	8.7	80
2,4-Dinitrotoluene		55	39-139	4.0	74
n-Nitrosodipropylamine		130	0.1-230	14	52
4-Nitrophenol		78	0.1-132	14	92
Pentachlorophenol		84	14-176	4.1	74
Phenol		43	5-112	5.5	73
Pyrene		36	52-115	4.4	90
1,2,4-Trichlorobenzene		55	44-142	9.8	92
Semivolatile Organics in Aqueous Streams - SW8270	Precision- Matrix-Spiked Duplicates Accuracy - Matrix Spikes				
Acenaphthene		54	47-145	11	79
4-Chloro-3-methylphenol		69	22-147	10	83
2-Chlorophenol		62	23-134	10	80
1,4-Dichlorobenzene		58	20-124	6.8	72
2,4-Dinitrotoluene		55	39-139	7.4	82
n-Nitrosodipropylamine		130	0.1-230	12	75
4-Nitrophenol		78	0.1-132	8.6	47
Pentachlorophenol		84	14-176	11	72
Phenol		43	5-112	12	40
Pyrene		36	52-115	7.6	78
1,2,4-Trichlorobenzene		55	44-142	9.7	82

Table D-2 (Continued)

		Objectives		Measured	
Measurement Parameter	**How Measured**	**Precision (% RPD)**	**Accuracy (% Recovery)**	**Precision (% RPD)**	**Accuracy (% Recovery)**
Dioxins and Furans in Stack Gas Solid Phase	Precision: NA Accuracy: Internal Standard Recovery				
$^{13}C_{12}$-2,3,7,8-TCDF		50	40-120		60
$^{13}C_{12}$-2,3,7,8-TCDD		50	40-120		61
$^{13}C_{12}$-1,2,3,7,8-PeCDF		50	40-120		56
$^{13}C_{12}$-1,2,3,7,8-PeCDD		50	40-120		63
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF		50	40-120		69
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD		50	40-120		69
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF		50	40-120		57
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD		50	40-120		64
$^{13}C_{12}$-1,2,3,4,6,7,8,9-OCDD		50	40-120		50
PCDD/PCDF	Precision - NA Accuracy - Internal Standard Recovery, average for all samples analyzed.				
$^{13}C_{12}$2,3,7,8-TCDF			40-120		57.2
$^{13}C_{12}$-2,3,7,8-TCDD			40-120		54.7
$^{13}C_{12}$-1,2,3,7,8-PeCDF			40-120		55.7
$^{13}C_{12}$-1,2,3,7,8-PeCDD			40-120		63.3
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF			40-120		69.2
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD			40-120		69.0
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF			40-120		57.1
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD			40-120		63.6
$^{13}C_{12}$-1,2,3,4,6,7,8,9-OCDD			40-120		50.0
PCDD/PCDF in Stack Gas	Precision - NA Accuracy - Surrogate Spike Recovery, average for alll samples analyzed.				
$^{37}Cl_{4}$-2,3,7,8-TCDD			70-130		118.4
$^{13}C_{12}$-2,3,4,7,8-PeCDF			70-130		113.2
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF			70-130		120.8
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD			70-130		141.6
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF			70-130		104.7
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF			70-130		75.4
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF			70-130		84.3
Volatile Organics in Vapor Phase - SW8240	Precision - NA Accuracy - Surrogate Spike Recovery				
1,2-Dichloroethane-d4		50	70-130		114
Toluene-d8		50	70-130		101
4-Bromofluorobenzene		50	70-130		108
Aldehydes in Vapor Phase	Precision - Duplicate Analyses Accuracy - Matrix Spiked Samples				
Acetaldehyde		50	50-150	10	94
Formaldehyde		50	50-150	36	90
Aldehydes in Aqueous Streams	Precision - Duplicate Analyses Accuracy - Matrix Spiked Samples				
Acetaldehyde		50	50-150	14	101
Formaldehyde		50	50-150	18	94

Table D-2 (Continued)

		Objectives		Measured	
Measurement Parameter	How Measured	Precision (% RPD)	Accuracy (% Recovery)	Precision (% RPD)	Accuracy (% Recovery)
Metals in Gas Solid Phase - ICP-AES	Precision - Matrix-spiked pairs Accuracy - Matrix-spiked Sample				
Aluminum		20	75-125	62Q	62Q
Antimony		20	75-125	20	84
Barium		20	75-125	30Q	75
Beryllium		20	75-125	<1	89
Chromium		20	75-125	2.9	88
Cobalt		20	75-125	1	91
Copper		20	75-125	<1	93
Manganese		20	75-125	2.2	91
Molybdenum		20	75-125	3.7	94
Nickel		20	75-125	5	89
Vanadium		20	75-125	2.2	94
Metals in Gas Solid Phase - ICP-AES	Precision - NA Accuracy - Standard reference material (NIST 1633a Fly Ash)				
Aluminum		20	75-125		94
Antimony		20	75-125		NC
Barium		20	75-125		82
Beryllium		20	75-125		147Q
Calcium		20	75-125		99
Chromium		20	75-125		96
Cobalt		20	75-125		88
Copper		20	75-125		95
Iron		20	75-125		93
Magnesium		20	75-125		95
Manganese		20	75-125		94
Potassium		20	75-125		109
Nickel		20	75-125		94
Silicon		20	75-125		98
Sodium		20	75-125		96
Strontium		20	75-125		92
Titanium		20	75-125		97
Vanadium		20	75-125		95
Zinc		20	75-125		97
Metals in Gas Vapor Phase - ICP-AES	*Precision - Matrix-spiked Duplicates* Accuracy - Matrix-spiked Sample				
Aluminum		20	75-125	<1	104
Antimony		20	75-125	4	101
Barium		20	75-125	0	106
Beryllium		20	75-125	0	108
Boron		20	75-125	2.9	104
Chromium		20	75-125	0	105
Cobalt		20	75-125	0	102
Copper		20	75-125	0	105
Manganese		20	75-125	<1	104
Molybdenum		20	75-125	2.0	100
Nickel		20	75-125	0	102
Vanadium		20	75-125	0	107

Table D-2 (Continued)

		Objectives		Measured	
Measurement Parameter	**How Measured**	**Precision (% RPD)**	**Accuracy (% Recovery)**	**Precision (% RPD)**	**Accuracy (% Recovery)**
Metals in Gas Vapor Phase - ICP-AES (HNO_3/H_2O_2 Impinger Solution)	**Precision - NA** **Accuracy - Standard reference material (EPA ICP-19)**				
Antimony		20	75-125		93
Beryllium		20	75-125		101
Calcium		20	75-125		109
Chromium		20	75-125		99
Cobalt		20	75-125		100
Copper		20	75-125		119
Iron		20	75-125		93
Manganese		20	75-125		97
Molybdenum		20	75-125		108
Nickel		20	75-125		102
Vanadium		20	75-125		103
Metals in Coal - INAAS	**Precision - NA** ***Accuracy - Standard Reference Material*** **(NIST 1632b coal)**				
Antimony		20	80-120		94
Barium		20	80-120		99
Beryllium		20	80-120		109
Boron		20	80-120		99
Chromium		20	80-120		99
Cobalt		20	80-120		NC
Copper		20	80-120		99
Manganese		20	80-120		103
Molybdenum		20	80-120		102
Nickel		20	80-120		99
Vanadium		20	80-120		97
Metals in Limestone - ICP-AES	**Precision - NA** **Accuracy- Standard reference material (NIST Limestone 1c)**				
Aluminum		20	75-125		14Q
Calcium		20	75-125		101
Iron		20	75-125		70Q
Magnesium		20	75-125		69Q
Manganese		20	75-125		74Q
Potassium		20	75-125		224Q
Silicon		20	75-125		1.5Q
Sodium		20	75-125		47Q
Strontium		20	75-125		97
Metals in FGD Solids - ICP-AES	**Precision - Matrix-spiked Duplicates** **Accuracy - Matrix-spiked Samples**				
Aluminum		20	75-125	8.7	94
Antimony		20	75-125	4.7	83
Barium		20	75-125	6.0	84
Beryllium		20	75-125	4.6	81
Boron		20	75-125	28Q	91
Chromium		20	75-125	5.7	82
Cobalt		20	75-125	5.6	78
Copper		20	75-125	5.1	87
Manganese		20	75-125	15	79
Molybdenum		20	75-125	5.1	79
Nickel		20	75-125	5.0	79
Vanadium		20	75-125	5.6	84

Table D-2 (Continued)

Measurement Parameter	How Measured	Objectives		Measured	
		Precision (% RPD)	Accuracy (% Recovery)	Precision (% RPD)	Accuracy (% Recovery)
Metals in ESP Fly Ash - ICP-AES	Precision - Matrix-spiked Duplicates Accuracy - Matrix-spiked Samples				
Aluminum		20	75-125	16	78
Antimony		20	75-125	8.4	91
Barium		20	75-125	10.2	85
Beryllium		20	75-125	1.8	92
Chromium		20	75-125	1.7	94
Cobalt		20	75-125	1.8	93
Copper		20	75-125	2.4	95
Manganese		20	75-125	2.5	92
Molybdenum		20	75-125	4.5	84
Nickel		20	75-125	5.2	96
Vanadium		20	75-125	2.8	94
Metals in Aqueous Process Streams - ICP-AES	Precision - Matrix-spiked Duplicates Accuracy - Matrix-spiked Samples				
Aluminum		20	75-125	4.4	96
Antimony		20	75-125	16	87
Barium		20	75-125	7.6	99
Beryllium		20	75-125	4.4	92
Boron		20	75-125	1.0	96
Chromium		20	75-125	4.9	92
Cobalt		20	75-125	4.6	89
Copper		20	75-125	4.0	96
Manganese		20	75-125	4.5	92
Molybdenum		20	75-125	4.8	89
Nickel		20	75-125	7.3	90
Vanadium		20	75-125	3.6	95
Metals in Aqueous Process Streams - ICP-AES	Precision - NA Accuracy - Performance Audit Samples (2 concentrations)				
Antimony		20	75-125		127Q/82
Beryllium		20	75-125		99/93
Calcium		20	75-125		169Q
Chromium		20	75-125		94/97
Cobalt		20	75-125		100/87
Copper		20	75-125		96/110
Iron		20	75-125		103/139Q
Magnesium		20	75-125		131Q
Manganese		20	75-125		96/95
Molybdenum		20	75-125		98/114
Nickel		20	75-125		104/111
Titanium		20	75-125		98
Vanadium		20	75-125		96/104
Zinc		20	75-125		99
Metals in Gas Vapor Phase - GFAAS and CVAAS	Precision - Matrix spiked Duplicates Accuracy - Matrix Spiked Samples				
Arsenic		20	75-125	4.0	100
Cadmium		20	75-125	<1	114
Lead		20	75-125	45Q	84
Mercury		20	75-125	1.3	98
Selenium		20	75-125	94Q	0
Metals in Gas Solid Phase - CVAAS	Precision - Matrix spiked Duplicates Accuracy - Matrix Spiked Samples				
Mercury		20	75-125	1.0	128Q
Metals in Gas Vapor Phase - CVAAS	Precision - NA Accuracy - Performance Audit Samples				
Mercury ($KMnO_4$ Impinger Solution)		20	75-125		33Q

Table D-2 (Continued)

		Objectives		Measured	
Measurement Parameter	**How Measured**	**Precision (% RPD)**	**Accuracy (% Recovery)**	**Precision (% RPD)**	**Accuracy (% Recovery)**
Metals in Process Solid Streams - GFAAS and CVAAS	**Precision - Matrix spiked Duplicates** **Accuracy - Matrix Spiked Samples**				
Arsenic		20	75-125	<1	104
Cadmium		20	75-125	8.8	110
Lead		20	75-125	1.2	86
Mercury		20	75-125	2.6	107
Selenium		20	75-125	25.3Q	103
Metals in Solid Phase - GFAAS and CVAAS	**Precision - NA** **Accuracy - Standard reference material (NIST 1633a Fly Ash)**				
Arsenic		20	75-125		NA
Cadmium		20	75-125		NA
Lead		20	75-125		NA
Mercury		20	75-125		119
Selenium		20	75-125		NA
Metals in Aqueous Process Streams - GFAAS and CVAAS	**Precision - Matrix Spiked Duplicates** **Accuracy - Matrix Spiked Samples**				
Arsenic		20	75-125	4.2	99
Cadmium		20	75-125	2.2	108
Lead		20	75-125	12	76
Mercury		20	75-125	24.6Q	35Q
Selenium		20	75-125	41.2Q	76.4
Metals in Aqueous Process Streams - GFAAS and CVAAS	**Precision - NA** **Accuracy - Performance Audit Samples (2 concentrations)**				
Arsenic		20	75-125		94/100
Cadmium		20	75-125		93/100
Lead		20	75-125		99/96
Selenium		20	75-125		96/50
Metals in Gas Vapor - ICP/MS (HNO_3/H_2O_2 Impinger Solution)	**Precision - NA** **Accuracy - Performance Audit Samples**				
Antimony		NA	NA		89
Arsenic		NA	NA		109
Beryllium		NA	NA		98
Cadmium		NA	NA		97
Chromium		NA	NA		97
Cobalt		NA	NA		88
Copper		NA	NA		83
Lead		NA	NA		87
Manganese		NA	NA		97
Molybdenum		NA	NA		94
Nickel		NA	NA		90
Selenium		NA	NA		106
Vanadium		NA	NA		93

Table D-2 (Continued)

		Objectives		Measured	
Measurement Parameter	**How Measured**	**Precision (% RPD)**	**Accuracy (% Recovery)**	**Precision (% RPD)**	**Accuracy (% Recovery)**
Extractable Metals - ICP/MS	Precision - Duplicate Analysis				
Nitric acid digestate)	Accuracy - Matrix-Spiked Samples				
Antimony		20	NA	40Q	NA
Arsenic		20	75-125	434Q	118
Barium		20	75-125	5.8	94
Beryllium		20	75-125	11	108
Cadmium		20	75-125	0	94
Chromium		20	75-125	9.4	98
Cobalt		20	75-125	7.7	100
Copper		20	75-125	19	100
Lead		20	75-125	1.6	83
Manganese		20	75-125	9.6	108
Mercury		20	75-125	NC	852Q
Molybdenum		20	NA	12	NA
Nickel		20	75-125	13	103
Selenium		20	75-125	43Q	138Q
Vanadium		20	75-125	3.6	109
Extractable Metals - ICP/MS	Precision - Duplicate analysis				
(Gastric fluid leachate)	Accuracy - Matrix-spiked samples				
Antimony		20	NA	6.5	NA
Arsenic		20	75-125	NC	0Q
Barium		20	75-125	1.5	85
Beryllium		20	75-125	12	79
Cadmium		20	75-125	27Q	107
Chromium		20	75-125	4.2	88
Cobalt		20	75-125	3.4	92
Copper		20	75-125	14	92
Lead		20	75-125	3.2	97
Manganese		20	75-125	3.2	71Q
Mercury		20	75-125	61Q	124
Molybdenum		20	NA	10	NA
Nickel		20	75-125	3.7	81
Selenium		20	75-125	NC	84
Vanadium		20	75-125	NC	0Q
Metals in Gas Solid Phase - GDMS	Precision - NA				
	Accuracy - Standard Reference Material				
Aluminum	(NIST 1633a Fly Ash)				
Antimony		NA	NA		180Q
Barium		NA	NA		NC
Beryllium		NA	NA		357Q
Calcium		NA	NA		NC
Chromium		NA	NA		70Q
Cobalt		NA	NA		140Q
Copper		NA	NA		NC
Iron		NA	NA		203Q
Magnesium		NA	NA		79
Manganese		NA	NA		120
Potassium		NA	NA		58Q
Nickel		NA	NA		119
Silicon		NA	NA		115
Sodium		NA	NA		111
Strontium		NA	NA		39Q
Titanium		NA	NA		320Q
Vanadium		NA	NA		131Q
Zinc		NA	NA		141Q
		NA	NA		129Q

Table D-2 (Continued)

		Objectives		Measured	
Measurement Parameter	**How Measured**	**Precision (% RPD)**	**Accuracy (% Recovery)**	**Precision (% RPD)**	**Accuracy (% Recovery)**
Anions in Aqueous Process Streams -	Precision - NA Accuracy - Performance Audit Samples				
Chloride		20	80-120		0Q
Fluoride		20	80-120		39Q
Sulfate		20	75-125		350Q
Anions in Gas Vapor Phase -	Precision - Matrix spiked Duplicates Accuracy - Matrix Spiked Samples				
Chloride		20	80-120	9.7	100
Fluoride		20	80-120	1.9	107
Anions in Process Solid Streams	Precision - Matrix spiked Duplicates Accuracy - Matrix Spiked Samples				
Chloride		20	80-120	<1	95
Fluoride		20	80-120	3.5	70
Anions in Aqueous Process Streams	Precision - Matrix spiked Duplicates Accuracy - Matrix Spiked Samples				
Chloride		20	80-120	3.6	111
Fluoride		20	80-120	1.6	101
Sulfate		20	75-125	1.5	97
Ammonia in Gas Vapor Phase by 350.2	Precision - Matrix spiked Duplicates Accuracy - Performance Audit Standard				
Ammonia		20	80-120	39Q	63Q
Ammonia in Aqueous Streams by 350.1	Precision - Matrix spiked Duplicates Accuracy - Performance Audit Standard				
Ammonia		20	80-120	60Q	88
Cyanide in Gas Vapor Phase by 335.2	Precision - Matrix spiked Duplicates Accuracy - Performance Audit Standard				
Cyanide		20	75-125	16	50
Cyanide in Aqueous Streams by 335.2	Precision - Matrix spiked Duplicates Accuracy - Performance Audit Standard				
Cyanide		20	75-125	13	80
Phosphate in Aqueous Streams by 365.2	Precision - Matrix spiked Duplicates Accuracy - Performance Audit Standard				
Phosphate		20	75-125	6.1	97

NA = Not applicable.

NC = Not calculated.

Q = Outside project QC objectives.

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. The representativeness criterion is based on making certain that the sampling locations are properly selected and that a sufficient number of samples are collected.

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Sampling data should be comparable with other measurement data for similar samples under similar conditions. This goal is achieved using standard techniques to collect and analyze representative samples and by reporting results in appropriate units. Data sets can be compared with confidence when the precision and accuracy is known.

Completeness is an expression of the number of valid measurements obtained compared with the number planned for a given study. The goal is to generate a sufficient amount of valid data.

Semivolatile Organics

Precision. The precision of the semivolatile organic analyses was estimated using matrix spiked duplicate pairs. The precision was met for all of the gas-phase solid samples, the gas vapor-phase samples, the solid stream samples, and aqueous-phase sample streams. The precision estimates are summarized for each stream in Table D-2.

Accuracy. The accuracy of the semivolatile analyses was estimated using matrix spiked duplicate samples. All of the spiked compounds analyzed in the gas solid-phase samples and the aqueous process streams were within the accuracy objectives. Matrix spikes into the solid process streams were all within the recovery objects for all analytes in the FGD solid stream and all the except pyrene in the ESP ash solids. Recovery for pyrene was 51% and 56% (project objective--52-115%) for the ESP ash sample and 48% and 37% for the ESP ash field duplicate.

Blank Effects. Acetophenone and benzoic acid were found in one or more of the field blanks associated with the gas-phase solids analyses. The concentrations of these compounds in the blanks, however, were not significant in comparison to the concentrations found in the samples. Several phthalates were also found in the field blanks. The concentrations found in the samples were about the same level as found in the blanks and are therefore considered an artifact of the sampling and handling process.

Volatile Organics

Precision. Precision for volatile organic analysis of the aqueous process streams was estimated using matrix spiked duplicate samples. The 50% precision objectives were met for each of the volatile analytes used for the matrix spikes.

Accuracy. Accuracy for the volatile organic analyses in the aqueous process streams was estimated using matrix spiked samples and accuracy for the gas vapor-phase streams was estimated using surrogates spiked into each sample prior to analysis. The accuracy objectives for recoveries ranging from 0.1% to 234% were met for all analytes of interest (actual recoveries ranged from 70-136%) for the aqueous streams. Accuracy objectives for surrogate recoveries of 70 to 130% for the gas-phase streams were met for all samples except for toluene-d8 in one stack sample. Accuracy based on the analysis of two laboratory method spikes met the recovery objectives for all analytes of interest except for one acetone, chloromethane, chloroethane, and methylene chloride spike.

Blank Effects. Chloromethane, methylene chloride, and tetrachloroethene were found in one or more of the field gas vapor-phase blank samples. In most cases these compounds were found in the investigative field samples at about the same level as in the field blank or at lower concentrations. The sampling, handling, and transport from the field may have contributed this observed contamination. Chloromethane and methylene chloride were also found in one laboratory blank.

Aldehydes

Precision. Precision for the aldehyde analyses was estimated using duplicate sample analyses. The precision objectives of 50% were met for both formaldehyde and acetaldehyde in the gas vapor-phase samples and the aqueous process stream sample analyses.

Accuracy. Accuracy for the aldehydes was estimated using matrix spiked samples. The project accuracy objectives of recoveries of 50-150% were met for the gas vapor-phase and aqueous stream sample spikes for both formaldehyde and acetaldehyde.

Blank Effects. Formaldehyde and acetaldehyde were found in concentrations (3.8-8.2 μg, formaldehyde; 2.7-8.6 μg, acetaldehyde) above the reporting limits in the field blanks to the gas vapor-phase sampling train. Low levels (within 3 times the detection limit) of these analytes were also found in two of the four laboratory (method) blanks but were not found in the trip blanks.

Metals

Precision. The precision of metals analyses by ICP-AES, GFAAS, and CVAAS was estimated for samples using matrix-spiked duplicate samples. The precision objectives (RPD <20%) were met for all target analytes analyzed by ICP-AES except aluminum and barium in the gas solid-phase spiked samples and boron in the process solid-spiked samples. The precision objectives for the GFAAS analyses were met except for lead in the gas vapor-phase matrix-spiked samples, selenium in the process solid matrix-spiked samples, and mercury and selenium in the aqueous process stream matrix spikes. In most of these cases, the concentrations of the analytes of interest were within 10 times the detection limit where the precision would not be expected as good or the spiked amount was low (<4 times) the amount found in the original sample.

Accuracy. The accuracy of metals analyses was estimated for the gas solid-phase samples using standard reference material (NIST 1633a fly ash) submitted blind to the laboratory as a performance audit sample. All of the metals analyzed by ICP-AES were within the 75-125% accuracy objectives except for beryllium (147%) which was recovered above the objectives. The fly ash (NIST 1633a) reference standard was also submitted for GDMS analysis. The results for this analysis are shown in Table D-2. Accuracy objectives were not assigned to the GDMS analyses since this technique has not been validated or widely used for these types of samples at the present time. However, the recoveries have been compared to the accuracy objectives for ICP-AES and flagged with a Q when outside the QC objectives.

The accuracy of the metals analyses was estimated for coal samples using a standard reference coal sample (NIST 1632b) submitted blind to the laboratory. All of the metals analyzed by INAA in the reference sample were within the 75-125% accuracy objective.

The accuracy of the metals analyses was estimated for the limestone samples using a standard reference limestone (NIST Limestone 1C) submitted blind to the laboratory. The results show that the recoveries for most of the metals were outside the 75-125% accuracy objectives. Aluminum, silicon, and sodium recoveries were 50%, and the recovery for potassium was greater than 200 percent. The recoveries of these analytes may show a similar bias in the limestone process streams.

The accuracy of the metals analyses for the gas vapor-phase samples and the aqueous process streams were estimated using performance audit samples prepared from EPA reference standards. The gas-phase audit sample was prepared in the solutions used for the impingers (multi-metals train) and the two aqueous-phase samples were prepared in HPLC grade water. The results show that the recoveries of all the metals analyzed by ICP-AES and GFAAS were within the 75-125% accuracy objectives except Sb (127%), Ca (169%), Fe (139%), and Mg (131%) by ICP-AES and Se (50%) and Hg (33%) by GFAAS. The concentrations of these elements in the samples were at or near the detection limit and are not expected to be as accurate as concentrations at higher levels (at least 10 times the detection limit). The gas-phase audit sample prepared in the HNO_3/H_2O_2 impinger solution was also analyzed by ICP/MS. The results for this analysis showed recoveries ranging from 83 to 109%, all within the accuracy objectives for ICP-AES (accuracy objectives were not assigned for ICP/MS).

Matrix-spiked samples were also used to determine the accuracy of the metals analyses in the gas, process solids, and aqueous process matrices. Recoveries for the target analytes were within the 75-125% accuracy objectives except for selenium (0% recovery) in the gas vapor-phase matrix mercury (35% recovery) in the aqueous process stream matrix.

Blank Effects. Aluminum, iron, manganese, and nickel were found at concentrations above the reporting limits in the field blanks to the gas vapor-phase sampling train. These elements were also found to a lesser extent in the impinger reagent blank solutions. Field blank filters combined with probe/nozzle rinses were also analyzed to determine the contribution of the filter media to the gas solid-phase components. Background or blank correction was performed for the gas-phase samples using the results of the analysis of the impinger reagent blanks and the blank filter media.

Anions

Precision. Precision for the anions analyses was estimated for the gas vapor-phase samples, process solid streams, and aqueous process streams by the analysis of matrix spiked samples. The precision objectives of 20% were met for chloride, fluoride, and sulfate except for chloride and sulfate in one matrix spike pair from the stack with RPDs of 22% and 24%, respectively.

Accuracy. Accuracy for the anions analyses was estimated using matrix spiked duplicate samples. The accuracy objectives of 80-120% recovery were met for all analytes and all sample matrices except for the fluoride spikes into the ESP ash solid samples with recoveries of 56% and 60 percent. A performance audit sample was submitted for analysis of the target anions in an aqueous matrix. The recoveries for this sample were outside the accuracy objectives for all three analytes. This sample was prepared with each analyte concentration at the MDL; therefore, no corrective action was initiated.

Cyanide, Ammonia, and Phosphate

Precision. Precision for the cyanide, ammonia, and phosphate analyses was estimated using matrix spiked duplicate sample analyses. The precision objectives of 20% were met for each of the analytes for both the gas vapor-phase and aqueous process streams except for ammonia spikes into the JBR process liquids. The spike concentration was too low in comparison to the level found in the native process sample.

Accuracy. Accuracy for ammonia, cyanide and phosphate was estimated using both matrix spiked duplicate samples and "double blind" performance audit samples. The accuracy objectives (cyanide, 75-125%; ammonia, 80-120%; phosphate, 75-125%) were met for all matrix spiked samples except for the ammonia spikes into the JBR process liquids with recoveries at 60 and 273 percent. Recoveries for the performance audit samples met the accuracy objectives for all analytes with recoveries of 88% for ammonia, 80% for cyanide, and 97% for phosphate. Recoveries for performance audit samples spiked into the gas vapor-phase impinger solutions were not as good as the aqueous spiked audit samples. The recovery for ammonia in the impinger solutions was 63% and the recovery for cyanide was 50 percent. The aqueous spikes and impinger spikes were performed using the same spiking solutions and were spiked at the same concentration levels.

Performance Evaluation Audit Samples

Performance audit samples are samples of known composition which provide a point-in-time assessment of analytical performance. Audit samples were prepared for this study by spiking known concentrations of target analytes from EPA Quality Control Check material, vendor-certified standard material, or standards obtained from NIST (formerly NBS). Audit samples are similar to QCCS except that they are submitted "double blind" to the analytical laboratory. That is, the laboratory does not know the identity or composition of the audit samples.

Audit samples were prepared at concentration levels simulating the expected range of the analytes in the field samples when possible. Organic audit samples were not prepared because the laboratories performing organic analyses have consistently shown acceptable performance on surrogate recoveries and internal quality control samples. Results for these samples are shown in Table D-2.

Quality Assurance Audits

The purpose of a quality assurance audit is to provide an objective, independent assessment of a sampling or measurement effort. It ensures that the sampling procedures, data generating, data gathering, and measurement activities produce reliable and useful results. Sometimes inadequacies are identified in the sampling/measurement system and/or the quality control program. In such cases, audits provide the mechanism for implementing corrective action.

A technical systems audit (TSA) is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. It is an assessment of overall effectiveness and represents a subjective evaluation of a set of interactive systems with respect to strengths, deficiencies, and potential areas of concern. The audit consists of observations and documentation of all aspects of the measurement effort. Checklists that delineate the critical aspects of each methodology are used by the Radian auditor during the audit to document all observations. In addition to evaluating sampling and analytical procedures and techniques, the systems audit emphasizes review of all recordkeeping and data handling systems including:

- Calibration documentation for analytical instrumentation and sampling apparatus;
- Documentation of quality control data (control charts, etc.);
- Completeness of data forms and notebooks;
- Data review and validation procedures;
- Sample logging procedures;
- Chain-of-custody procedures;

- Documentation of maintenance; and
- Review of malfunction reporting procedures.

A technical systems audit of the Radian sampling and on-site analytical efforts was conducted on June 23 - 25, 1993 at Plant Yates by Barbara Hayes, a member of Radian's Quality Assurance Section. No critical or major concerns were observed during the audit; therefore, no Recommendations for Corrective Action (RCAs) were made. The sampling team was led by Dave Virbick and the analytical team was led by David Maxwell. The sampling team appeared well versed in the sampling methodology and requirements of the program. The equipment and instrumentation were generally in good working condition. All sampling and measurement procedures conformed to those described in the site Management Plan. Sampling information and any problems encountered were recorded onto preformatted data sheets or into bound laboratory notebooks. Duplicate samples were collected for the solid and aqueous streams at a rate of ten percent or one duplicate set per sample type (bottom ash, fly ash, etc.).

Sample collection procedures used by the sampling team followed those outlined in the site test plan. A detailed sampling schedule was used by the team to guide the collection of the samples for each analytical species at each sampling point.

No problems were identified with the sample custody procedures or documentation. A detailed master logbook was prepared prior to the field effort for all samples to be collected during each sampling period. This log was updated as the various samples were collected with the actual dates and times of sample collection. Samples were labelled with preformatted sample labels and stored at ambient temperature or cooled as required by the analytical species. Chain-of-custody forms were filled out and the samples were prepared for shipment to the laboratories for analysis.

Calibration of all on-site equipment was checked and found to be up-to-date. The analytical balance and top loading balance in the on-site laboratory trailer had been calibrated and certified within the past year. In addition, certified weights were available for daily balance checkout. All dry gas meters, consoles, Pitot tubes, and nozzles had been calibrated in the Radian Source Sampling Laboratory prior to being transported to the field location. Documentation for each of the observed instruments and equipment in use could be found in the records maintained by the sampling crew chief in the on-site laboratory. Sufficient replacement units were on hand to allow for breakage or equipment malfunction.

Recordkeeping practices by the project team were observed to be sound. Entries were made onto preformatted data sheets in ink, without erasures, signed and the time noted as each sample was collected.

Coal Round Robin

An interlaboratory study consisting of a coal round robin analysis was conducted by CONSOL, Inc. The objective of this round robin study was to estimate the analytical variability one can expect on trace element analyses when comparing results from the same laboratory or results from two or more laboratories. The results of CONSOL's study is contained in the document entitled "Interlaboratory Variability and Accuracy of Coal Analyses in the U.S. Department of Energy Utility Air Toxics Assessment Program," which follows this section. The results from Radian's laboratory are designated as "Lab III" in the above referenced document. Radian's objectives in assessing this data are (1) to compare Radian's round robin results with the overall results of the study, and (2) based on this assessment, determine if a change in any of the analytical methods for Phase II should be made.

The analytical accuracy for each laboratory involved in the round robin study was measured by a comparative analysis of a standard reference material (SRM) coal sample (NIST 1632b). Each laboratory's analytical results for the standard reference material were compared to the certified or informational (non-certified) values. The round robin criteria for accurate results was 90-110% recovery of the SRM's certified value. (This is more stringent than the 80-120% recovery objective established for the program at Plant Yates). The following discussion addresses the performance of Radian's subcontracted coal laboratories with respect to the accuracy and precision assessments conducted by CONSOL on the NIST SRM.

Discussion of Results

The results of Radian's analysis of the SRM and the SRM-certified values are shown in Table D-3. Accuracy and precision objectives for the SRM coal in the round robin study were met by Radian for all ultimate and proximate parameters (% ash, C, H, N, S, and HHV) with the exception of one sulfur analysis which was reported outside the objective range for accuracy and precision. The methods used for ultimate, proximate, and HHV analyses are current ASTM protocols and are consistent with the methods used by most of the other laboratories. No change in the analytical approach for Phase II of this project is warranted.

Major ash minerals were primarily determined by instrumental neutron activation analysis (INAA). Silicon dioxide (SiO_2) and sulfur trioxide (SO_3) were not reported for the Plant Yates or the round robin study. The accuracy and precision objectives were met for all major ash minerals reported except calcium, magnesium and potassium. For future work, other ASTM methods (ASTM D-4326 or alternate) should be used to improve analytical bias and precision for these elements. This is especially important where these major elements are considered key factors in assessing mass flow rates in material balance closures.

Radian analyzed most of the trace elements in coal by INAA. Other methods of analysis using different preparation techniques were performed for As, B, Be, Cd, F, Hg, Pb, and Se. Of the target trace elements, 82% were detected. Cadmium, copper, and nickel were not detected. The results for copper and nickel are surprising, since this same SRM (1632b) was used as an internal audit sample during the Plant Yates study, and recovery by the same method (INAA) was 99% for both elements. Cadmium was determined by ICP-AES and this technique does not have the sensitivity to detect cadmium at the levels present in the SRM. Analysis of cadmium by graphite furnace-AA will be specified in Phase II of this project.

The accuracy objectives of the round robin study were met for 50% of the detected trace elements. Elements meeting accuracy objectives were barium, chromium, cobalt, and vanadium. Certified values for boron, beryllium, fluorine, and mercury are not available for this SRM, so no accuracy measurements were performed for these elements in the round robin report. However, the results for these noncertified elements appear consistent with those from the other laboratories. Elements that did not meet the 90-110% recovery range were arsenic, cobalt (1 result), manganese, molybdenum, lead, antimony, and selenium. (Antimony, manganese and molybdenum SRM recovery values obtained during the Plant Yates study were well within the 90-110% objective of the round robin study. See Table D-2.)

One of the requirements of the round robin study was to report analytical results for the target analytes that were determined by the same methods used to report plant coal sample results. For the Yates project (and the coal round robin study), Radian performed multiple techniques for some elements (i.e., INAA vs. GFAA or ICP-AES) to provide comparative results, especially where questionable results by any one technique had been previously encountered. Performance evaluation (PE) audit samples (SRMs) were submitted for analysis by each method and the accuracy and precision were assessed before selecting the best qualified data for reporting and for use in material balance calculations.

Comments

One of the conclusions evident from the round robin study is that there is a high degree of variability and repeatability between methods, laboratories, and duplicate results for trace elements. Evidence of the variability in trace element analyses can be shown, for example, with neutron activation analysis where unacceptable results were reported for the analysis of the NIST SRM in the round robin study, but the same technique produced 90-110% recovery for the same elements in the NIST 1632b standard reference coal submitted as an audit sample during this project. This suggests that the performance of some techniques, like INAA, may vary substantially between repeated analysis and analytical batches. Neutron activation appears to be a cost effective analytical technique; however, as with all analytical techniques, the results must be evaluated on a case-by-case basis.

Although the round robin analysis is useful for indicating problematic methods and poor quality control, the project-specific quality control activities should be used for assessing the accuracy and precision of the coal analyses performed at each site.

Table D-3
Radian Lab analysis of Standard Reference Coal, 1632b

Parameter	Certified Value	Analytical Method	Average % Recovery	Run 1	Run 2
Ulitmate/Proximate (% Dry Basis)					
Ash	6.80	D 3174	99.6	6.78	6.77
Carbon	78.11	D 5373	99.4	77.74	77.52
Hydrogen	5.07	D 5373	101.2	5.14	5.12
Nitrogen	1.56	D 5373	97.1	1.54	1.49
Sulfur	1.89	D 4239	140.7	1.93	3.39[a]
Chlorine	0.126	D 4208	84.5	0.107	0.106
BTU/lb	13,890	D 2015	99.2	13,767	13,797
Major Ash Minerals					
SiO_2	44.03	--		--	--
Al_2O_3	23.75	INAA	98.5	24.37	22.43
TiO_2	1.11	INAA	92.8	0.97	1.09
Fe_2O_3	15.96	INAA	91.7	14.24	15.04
CaO	4.2	INAA	53.5	2.3[a]	2.19[a]
MgO	0.93	INAA	80.1	0.77	0.72[a]
Na_2O	1.02	INAA	85.3	0.87	0.87
K_2O	1.33	INAA	74.1	1.07[a]	0.9[a]
P_2O_5	--	ICP-AES	--	0.36	0.39
SO_3	--	--	--	--	--

Table D-3 (Continued)

Parameter	Certified Value	Analytical Method	Average % Recovery	Run 1	Run 2
Trace Elements					
As	3.72	GF/AA	53.8	2[b]	2[b]
B	--	ICP-AES	--	61	60
Ba	67.5	INAA	106.6	71.2	72.7
Be	--	ICP-AES	--	0.6	0.6
Cd	0.0573	ICP-AES	--	<0.2	<0.2
Cr	11[d]	INAA	96.4	11	10.2
Co	2.29	INAA	89.5	2.09	2.01[c]
Cu	6.28	INAA	--	<35.3	<35.7
F	--	D 3761	--	40	40
Hg	--	DGA/CVAA	--	0.05	0.05
Mn	12.4	INAA	86.3	10.8[c]	10.6[c]
Mo	0.9[d]	INAA	191.7	1.55[b]	1.9[b]
Ni	6.1	INAA	145.1	<8.8	<8.9
Pb	3.67	ICP-AES	81.7	3[c]	3[c]
Sb	0.24[d]	INAA	81.3	0.196[c]	0.194[c]
Se	1.29	GF/AA	77.5	1[c]	1[c]
V	14[d]	INAA	101.1	14.2	14.1

[a] Results exceed ASTM reproducibility limits.

[b] Results exceed certified values by more than 25 percent.

[c] Results exceed certified values by more than 10 percent.

[d] Informational value (not certified).

Interlaboratory Variability and Accuracy of Coal Analyses in the U.S. Department of Energy Utility Air Toxics Assessment Program

Lawrence W. Rosendale
Matthew S. DeVito
CONSOL Inc.
Research and Development
4000 Brownsville Road
Library, PA 15129

INTRODUCTION

The 1990 Clean Air Act Amendments (CAAA) empower the Environmental Protection Agency to set emission standards for a variety of potentially hazardous air pollutants from combustion sources. In order to define emissions from coal combustion sources, the U.S. Department of Energy (DOE) is coordinating an air toxics assessment program to characterize stack emissions from coal-fired utility boilers of volatile and semi-volatile organics, metals and anions specified in Title III of the Clean Air Act Amendments of 1990. The information from the DOE study will enable the Environmental Protection Agency to properly classify coal-fired utility boilers with regard to the CAAA and evaluate the potential risk to human health posed by these types of emission sources.

The first phase of DOE study consisted of sampling eight power plants. These plants represented a diverse range of boiler configurations, emission controls, and coal feeds. Part of the sampling protocol at each of the sites was to collect representative samples of the feed coal to the boiler. By analyzing the feed coal as well as all gas, solid, and water effluent streams, a material balance around each site could be established. A material balance closure near 100% would indicate that sampling and analyses of all streams was handled properly, and reliable emission estimates could be calculated.

Five laboratories participated in analyzing samples that were collected at the eight test sites. As part of the DOE program, CONSOL R&D conducted a coal analysis round robin among these laboratories. The primary purpose of this study was to estimate the analytical variability one can expect on trace element analyses when comparing results from the same laboratory or results from two or more laboratories.

Trace elements in coal generally are defined as those elements that occur at concentrations of 100 parts per million (ppm) or less. Seventeen trace elements were included in this study. Thirteen of these elements are listed in the 1990 CAAA as hazardous air pollutants. Earlier studies[1] have shown the interlaboratory variability of trace element analyses can be quite large. This analytical variability should be considered when determining the potential emissions from coal combustion sources.

The variability of other commonly measured coal quality parameters also was evaluated.

COAL SAMPLES

The coal samples used in the round robin study were supplied to CONSOL R&D by the prime contractor at each of the eight test sites. These were the same coals that were being fed to the boilers during the testing period at each site. The coals were geologically diverse and ranged from lignite to bituminous in rank. Once received, all sample reduction and preparation was according to ASTM D 2013 "Standard Method of Preparing Coal Samples for Analyses".[2] A spinning riffle was used to divide the gross sample prepared from each coal into homogenous splits. This is the preferred method in the coal industry to divide a sample of coal into several samples having the same composition and is widely used in commercially sponsored coal analyses round robin programs.

ROUND ROBIN DESIGN

Each participating laboratory was provided duplicate samples of each of the eight coals, along with a sample of a National Institute for Standard and Technology (NIST) certified reference coal. The samples were randomized and were identified only by code letters. Each laboratory was requested to analyze the samples in duplicate using the same procedures used to analyze the samples from the DOE Air Toxics Assessment programs. By using this round robin design, intralaboratory repeatability and interlaboratory reproducibility, as well as individual laboratory precision, could be established. The suite of analyses included in this study is shown below:

Proximate-Ultimate	Major Ash Elements	Trace Elements	
Moisture	SiO_2	As	Hg
Ash	Al_2O_3	B	Mn
Carbon	TiO_2	Ba	Mo
Hydrogen	Fe_2O_3	Be	Ni
Nitrogen	CaO	Cd	Pb
Sulfur	MgO	Cr	Sb
Chlorine	Na_2O	Co	Se
Heating Value (Btu/lb)	K_2O	Cu	V
	P_2O_5	F	
	SO_3		

The average interlaboratory results for this suite of analyses for all eight samples are shown in Table 1. Individual laboratory results for all samples are presented in Appendix A. Samples identified as A&J and B&K are Illinois basin bituminous coals. Samples C&L, F&O, and H&Q are mid-sulfur bituminous coals. Sample D&M is a subbituminous coal from the Powder River basin. Sample G&P is also a subbituminous coal. Sample E&N is ranked as a lignite.

ANALYTICAL TECHNIQUES

The analytical techniques used by the participating laboratories to complete the suite of analysis in this study are shown in Table 2. No one parameter was measured by all laboratories by the same analytical technique. All of the labs used ASTM standard methods for the Proximate and Ultimate analyses. However, numerous techniques were used for the major ash and trace element analyses. The techniques included graphite furnace atomic absorption (GF/AA), inductively coupled plasma emission spectroscopy (ICP/ES), inductively coupled plasma mass spectroscopy (ICP/MS), instrumental neutron activation analyses (INAA), ion chromatography (IC), cold vapor atomic fluorescence (CV/AF), and X-ray fluorescence (XRF). Mercury was measured by gold amalgam cold vapor atomic absorption (GA/CVAA), double gold amalgam cold vapor atomic absorption (DGA/CVAA), and cold vapor atomic fluorescence (CV/AF). The techniques of AA, GF/AA, ICP/ES, ICP/MS, IC, and CVAA require that the analysis sample first be put into solution before being introduced into the instrument. INAA, XRF, GA/CVAA, and DGA/CVAA analyses can be performed on the whole coal or an ash sample of the coal.

ACCURACY

The accuracy of analyses performed by each laboratory was evaluated using the NIST Standard Reference Coal 1632b. This Pittsburgh seam coal is the most characterized standard reference material available from NIST. Certified or informational values are listed for all of the parameters included in this study except for boron, barium, fluorine, phosphorus, and mercury. For trace elements, all definitive results ("<" values ignored) that fell within 10% of the certified or informational value arbitrarily were considered accurate values. Values outside this range were considered to be inaccurate. ASTM interlaboratory reproducibility limits were the criteria for accuracy on all other analyses. Table 3 shows the results reported by the each laboratory for NIST SRM 1632b. Using the previously described criteria for accuracy, the percentage of accurate results (accurate results/total definitive results) was calculated. Parameters without a certified or informational value were not included.

The table below shows the percentage of accurate results reported by each lab for the suite of trace elements, the percentage of accurate results for all analyses, and the percentage of trace element results that were reported as definitive. Although lab IV showed the highest percentage of accurate results (75%), that figure is based on only the 80% of definitive results reported by that laboratory.

As shown in the table below, the percentage of accurate trace element analyses ranged from 38% to 75%. Non-definitive results reported for antimony, cadmium, copper, fluorine, molybdenum, nickel, and selenium. Only one laboratory reported definitive results for the entire suite of trace elements. The most troublesome elements, with respect to accuracy, were arsenic, cadmium, molybdenum, antimony, and selenium. Only one lab reported accurate results for cadmium, molybdenum or antimony.

The Proximate and Ultimate analyses reported by labs II, III, IV, and V were all within ASTM reproducibility limits except for a single sulfur analysis. Lab I reported results that exceeded ASTM reproducibility limits for hydrogen, nitrogen, sulfur chlorine and heating value. Two labs reported all major ash elements within ASTM limits. Lab I exceeded limits for silicon, iron, calcium, magnesium, and potassium. Lab III exceeded limits for calcium, magnesium, and potassium. Lab IV performed only a limited number of major ash element analyses, but reported results for aluminum and potassium that were outside established ASTM reproducibility limits.

% ACCURATE RESULTS ON NIST 1632b

Lab	Definitive Trace Element Results	Trace Elements	All Analyses
I	88	38	43
II	100	73	88
III	82	50	63
IV	80	75	80
V	100	48	78

REPRODUCIBILITY

The percent relative standard deviation (PRSD) of the analytical results was chosen to represent interlaboratory reproducibility in this study. Table 4 shows the average PRSD for all labs, on all samples, for the entire suite of analyses. Reproducibility for trace elements ranged from 11.0 PRSD for vanadium to 60.7 PRSD for molybdenum. The average PRSD for all of the trace elements (all coals, all labs) was 27.9%. In most cases the PRSDs for cadmium, copper and antimony are based on results from only three laboratories. These elements were either below detection limits at laboratories II and III or were not determined.

Excluding Lab I's results, Proximate and Ultimate analyses were generally within ASTM limits. Aside from the determination of percent ash this particular laboratory reported only a single sulfur analyses on the standard reference material that was within established ASTM limits. Chlorine, although not generally considered a trace element in coal, is listed in the 1990 CAAA as a hazardous air pollutant. It showed an average PRSD for all labs of 37.2 %. Three of the coals sampled in the study are ranked subbituminous or lignites. Chlorine on these samples (D&M, E&N, G&P) was reported as below detection limits (0.01 and 0.02%) by two laboratories and not determined by another laboratory. Therefore, the PRSD for these three samples was calculated with data from only two labs. The reproducibility estimates for chlorine may have been larger if more labs had reported data.

Major ash elements were determined with an average PRSD of 21.7%. This is only slightly better than the average PRSD of 27.9% for trace elements. Phosphorous, calcium, and magnesium had PRSDs greater than 35%. Including only labs II and V, the overall average PRSD for the major ash elements drops to 7%. These were the only labs that did not exceed ASTM limits on the certified reference material. Labs I and III showed a consistent low bias for calcium and magnesium on most samples as well as on the certified reference material. Lab I showed poor intralaboratory repeatability for most major ash elements.

Figure 1 shows the interlaboratory reproducibility as PRSD for the suite of trace elements on all samples. The overall average PRSDs for V, F, Be, Mn, B, Hg, Cu, Sb, and Cr, and Ba are between 9.6 and 22.9%. PRSDs for Ba, Co, Ni, and Se were somewhat poorer, averaging nearly 30%. Ni, As, Cd, Pb and Mo showed the most variability with PRSDs from 36.2 to 60.7%.

Figure 2 shows the average interlaboratory reproducibility for the suite of trace elements, as well as the range of PRSDs, for each element on each sample. Although the average PRSD for many elements is reasonably good (~20%), on any given sample the range of reported values can be quite large. The average minimum PRSD for interlaboratory trace element analyses was 13.6%. The average maximum was 48.1%. Ba, Cd, Cu, Hg, Mo, Ni, Pb and Sb all had a PRSD range over 30%. The range of reported values for Mo, Ni, and Cd on some samples was 52%, 76%, and 110% respectively. This shows that outliers are to be expected when comparing trace element analyses between laboratories.

REPEATABILITY

Figure 3 shows the average intralaboratory repeatability for each trace element for all coals. Intralaboratory repeatability was calculated as the average percent difference in a given laboratory's results on the eight paired samples. The data show that the overall laboratory repeatability on trace elements ranged from a low of 7.8% for chromium to a high of 32.5% for cadmium. The average repeatability for all trace elements was 14.6%. Overall intralaboratory repeatability for all elements by all labs was less than 10% on half of the analyses, less than 20% on 68%, and less than 30% on 75% of all trace element results. In general, elements with lower between-lab reproducibility also had lower same-lab repeatability. Similarly, elements like cadmium, that showed reproducibilities with a high PRSD, had higher average repeatabilities, with the exception of molybdenum. This element had a relatively low repeatability (16.8%), but showed the highest reproducibility (60.7%). This may suggest bias in the various methods used for its determination. Data showing the complete list of individual laboratory repeatability for all samples is presented in Appendix B.

VARIABILITY vs COAL RANK

Figure 4 shows the variability in interlaboratory trace element analyses as PRSD plotted as a function of the as-determined heating value for the eight coals. The as-determined heating value of a coal is one way to roughly establish coal rank. The data clearly show that trace element analytical variability is a function of coal rank, increasing as the coal rank decreases. This is not unusual; many ASTM coal standards have precision statements that are rank-dependant. In the case of the eight coals studied here, as the heating value of the coal (Btu/lb) decreases, the analytical variability of trace elements increases. Sample pairs A&J, C&L, H&Q, F&O, and B&K are bituminous coals. Samples G&P and D&M are subbituminous and samples E&N are classified as lignites. A regression analyses of the data is shown in Figure 5 and has an r^2 value of 0.95. Average trace element intralaboratory repeatability showed a similar trend. The overall trace element repeatability for the bituminous coals was slightly better (14.8%) than that for the subbituminous and lignite samples (20.2%).

MERCURY

Of the potential hazardous air pollutants mentioned in the CAAA, mercury is receiving the most attention regarding possible emissions from coal combustion sources. As mentioned earlier, four of the five laboratories in this study used some form of gold amalgamation followed by cold vapor atomic absorption for mercury analyses, the other used cold vapor atomic fluorescence. The table below summarizes intralaboratory repeatability and interlaboratory reproducibility for mercury analyses. Repeatability is shown as the percent difference in a laboratory's results on the eight paired samples, and reproducibility is shown as PRSDs.

REPEATABILITY AND REPRODUCIBILITY OF MERCURY RESULTS

	A&J	B&K	C&L	D&M	E&N	F&O	G&P	H&Q	Avg.
Repeatability, as % difference	11.3	46.3	19.1	19.1	25.8	11.7	8.6	21.2	17.6
Reproducibility, as PRSD	10.4	40.6	24.8	16.7	16.9	20.4	9.1	26.1	20.6

A recent, more extensive round robin on mercury analyses[3] estimated interlaboratory reproducibility and intralaboratory repeatability at 25 and 50%, respectively. That particular round robin involved three coal samples and 12 laboratories. Although the majority of laboratories in that study also used cold vapor atomic absorption for mercury analyses, some data were provided by labs using neutron activation and cold vapor atomic fluorescence.

SUMMARY AND CONCLUSIONS

Based on the analyses of the certified reference coal, even the best laboratory in this study reported trace element levels to within 10% of their certified value only about 80% of the time. On average, only 57% of the reported data from all labs met this 10% level of accuracy.

The techniques used in many laboratories for trace element analyses produced a significant number of non-definitive ("<") results. If certain detection limits are required, analytical techniques must be specified.

Although the overall interlaboratory trace element reproducibility is 28%, it may be very poor, approaching 60% for some elements.

Interlaboratory reproducibility for trace element analyses is dependent on coal rank. As coal rank decreases, analytical variability increases.

The variability of coal trace element analyses makes accurate estimates of emissions from combustion sources difficult, especially if the estimates are based solely on feed coal analyses.

RECOMMENDATIONS FOR CONDUCTING FUTURE COAL ANALYSES ROUND ROBIN PROGRAM

1. Follow ASTM standard method E 691. This standard lists specific guidelines for conducting an interlaboratory coal analysis round robin program. The standard also specifies software for the statistical interpretation of results. Both the method and the software are available from ASTM for a nominal fee. One of the guidelines violated in this round robin was the number of participating laboratories. E 691 states that a minimum of six laboratories is necessary to generate ASTM precision statements. For that reason we were unable to use the software from this standard that would have generated ASTM limits for repeatability and reproducibility.

2. Laboratories that are candidates for the round robin should be evaluated. Based on the data reported on the standard reference coal in this study, it is obvious that Lab I was not proficient with coal analyses. Laboratories that are candidates for round robins should be audited by someone familiar with the guidelines set forth in ASTM D 4182, "Evaluation of Laboratories Using ASTM Procedures in the Sampling and Analysis of Coal and Coke". These labs also should be able to demonstrate their ability to conform with ASTM D 4621, "Accountability and Quality Control in the Coal Analysis Laboratory". A lab not in compliance with either of the standards should not be included in the study. As a minimum, candidate labs should be able to demonstrate proficiency by analyzing a certified reference material within specified precision limits prior to conducting the actual round robin.

3. Specify the minimum detection limits that are required for each element. Based on the large number of non-definitive results reported for several of the trace elements it is apparent that

most laboratories are not using techniques that can accurately assess the levels of some of the trace elements found in coal. Using half the detection limit, which is the common practice for treating this type of result, would lead to a considerable overestimation of some trace element levels. Examples of this overestimation based on half the detection limit are found in Table 3. For instance, Lab III reported an average detection limit for Cu as 35.5 ppm. Using one half of this value, or 17.8 ppm, would overstate the certified value for Cu on this sample by nearly three fold.

REFERENCES

1. Lengyel, John Jr. and Obermiller, Edward L. "Interlaboratory Variability and Accuracy In Trace Element Analyses of Coal". Proceedings, Fourth Annual Pittsburgh Coal Conference, Pittsburgh, PA, 1987, pp. 148-159.

2. "ASTM Volume 05.05 Gaseous Fuels; Coal and Coke", American Society for Testing and Materials, Philadelphia, PA, 1993.

3. Lengyel, John Jr., Devito, M. S., and Bilonick, R. A. "Interlaboratory and Intralaboratory Variability in The Analyses of Mercury In Coal". Paper to be presented at the Air Waste Management Association Annual Meeting, Cincinnati, OH, 6/19-24/94.

Table 1. Average of Interlaboratory Results for All Samples.

	A&J IL BASIN	B&K IL BASIN	C&L BIT.	D&M PRB	E&N ND LIG.	F&O BIT.	G&P SUB. BIT.	H&Q BIT.
Trace Elements				ppm Dry Coal				
As	2.39	2.74	9.43	1.24	7.64	26.0	1.70	3.45
B	227	212	72.3	83.4	126	70.7	76.5	169
Ba	47.3	48.9	31.1	370	568	76.1	312	48.6
Be	1.33	1.61	1.33	0.42	0.72	2.37	1.29	1.41
Cd	0.580	1.013	0.112	0.058	0.079	0.085	0.560	0.508
Cr	28.3	34.7	16.3	4.40	8.05	20.0	9.61	21.4
Co	3.87	3.57	5.50	0.86	2.10	6.95	4.14	4.42
Cu	10.7	11.3	8.47	9.52	9.28	21.2	14.5	13.1
F	97.1	112	58.0	44.3	56.9	81.3	80.3	79.5
Hg	0.101	0.109	0.126	0.084	0.145	0.260	0.080	0.085
Mn	41.3	34.3	18.4	145	123	26.5	76.6	29.0
Mo	8.34	7.91	1.87	7.93	3.98	4.54	2.11	5.80
Ni	17.6	18.5	14.1	5.09	7.26	28.2	6.84	18.3
Pb	9.12	13.1	6.00	5.22	3.31	13.6	8.86	8.47
Sb	0.49	0.79	0.64	0.47	0.75	2.10	1.74	0.62
Se	2.94	3.16	1.92	0.84	0.80	2.56	1.18	2.21
V	36.6	46.3	31.0	9.36	16.8	34.0	26.1	38.5
Proximate & Ultimate				% Dry Basis				
Ash	11.99	12.54	11.56	11.7	16.71	13.35	20.57	10.59
Carbon	69.58	69.80	72.08	67.6	58.80	70.26	61.27	71.03
Hydrogen	4.87	4.78	4.96	4.80	4.53	4.86	4.78	5.14
Nitrogen	1.33	1.33	1.39	1.01	0.89	1.37	1.05	1.42
Sulfur	3.42	3.53	3.26	1.15	1.12	3.01	0.65	2.89
Chlorine	0.064	0.074	0.085	0.03	0.040	0.140	0.039	0.115
Heating Valu	12214	12189	12888	11350	9601	12452	10636	12587
Major Ash Elements				% Dry Ash				
SiO_2	44.58	49.7	44.98	42.12	39.48	45.67	59.26	51.55
Al_2O_3	16.78	18.6	21.41	16.48	10.58	22.54	20.62	21.74
TiO_2	0.89	0.99	0.99	0.88	0.47	1.22	1.00	1.03
Fe_2O_3	15.95	15.1	24.75	6.07	6.14	21.33	4.45	16.39
CaO	4.11	2.69	1.04	7.79	10.54	1.50	3.29	2.46
MgO	0.77	0.82	0.60	2.55	2.97	0.73	0.93	0.79
Na_2O_3	0.91	0.75	0.43	0.29	0.84	0.30	0.23	0.84
K_2O	1.95	2.20	1.84	0.51	1.35	2.17	1.26	2.50
P_2O_5	0.29	0.36	0.16	0.37	0.17	0.58	0.04	0.26
SO_3	4.57	2.61	1.39	11.41	15.08	1.71	3.68	2.56

Table 2. Analytical Methods Used on DOE Air Toxics Assessment Coal Samples.

Parameter	**Lab I**	**Lab II**	**Lab III**	**Lab IV**	**Lab V**
Moisture	D3173	D 5142	D 3173	D 3173	D 3173
Ash	D3174	D 5142	D 3174	D 3174	D 3174
Carbon	D3178	D 5373	D 5373	D 3178	D 5373
Hydrogen	D3178	D 5373	D 5373	D 3178	D 5373
Nitrogen	D3179	D 5373	D 5373	D 3179	D 5373
Sulfur	D3177	D 4239	D 4239	D 4239	D 4239
Chlorine	D4208	LECO	D 4208	***IC	D 4208
Btu/lb	D2015	D 1989	D 2015	D 2015	D 2015
Major Ash Elements					
SiO_2	ICP/ES	ICP/ES	ND	D 4326 XRF	ICP/ES
Al_2O_3	"	"	INAA	"	"
TiO_2	"	"	"	"	"
Fe_2O_3	"	"	"	ND	"
CaO	"	"	"	ND	"
MgO	"	"	"	ND	"
NaO	"	"	"	D 4326 XRF	"
K_2O_3	"	"	"	"	"
P_2O_5	"	"	ICP/ES	ND	"
SO_3	"	"	ND	ND	"
Trace Elements					
As	GF/AA	ICP/MS	GF/AA	GF/AA	CV/AF
B	ICP/ES	"	ICP/ES	ICP/ES	ICP/ES
Ba	"	ICP/ES	INAA	"	"
Be	"	ICP/MS	ICP/ES	"	"
Cd	AA	"	"	"	GF/AA
Cr	ICP/ES	"	INAA	"	ICP/ES
Co	"	"	"	"	"
Cu	"	"	"	"	"
Cu	"	"	"	"	"
F	D3761	*IC	D 3761	***IC	"
Hg	CVAA	DGA/CVAA	DGA/CVAA	GA/CVAA	CV/AF
Mn	ICP/ES	ICP/MS	INAA	ICP/ES	ICP/ES
Mo	"	"	"	"	"
Ni	"	"	"	"	"
Pb	AA	"	ICP/ES	GF/AA	GF/AA
Sb	GF/AA	"	INAA	"	CV/AF
Se	GF/AA	**#ICP/MS	GF/AA	"	"
V	ICP/ES	ICP/MS	INAA	ICP/ES	ICP/ES

*IC Hydropyrolysis with IC Finish
**#ICP/MS Hydropyrolysis with ICP/MS Finish
***IC-Soluble Species Only

AA	Atomic Absorption	ICP/ES	Inductively Coupled Plasma Emission Spectroscopy
CVAA	Cold Vapor Atomic Absorption	ICP/MS	Inductively Coupled Plasma Mass Spectroscopy
CV/AF	Cold Vapor Atomic Fluorescence	INAA	Instrumental Neutron Activation Analyses
DGA/CVAA	Double Gold Amalgam Cold Vapor Atomic Absorption	ND	Not Determined
GF/AA	Graphite Furnace Atomic Absorption	XRF	X-ray Fluorescence
IC	Ion Chromatography		

Table 3. Individual Laboratory Analyses of National Institute of Standard and Technology, Standard Reference Coal 1632b.

PARAMETER	CERTIFIED VALUE	LAB I Run 1	LAB I Run 2	LAB II Run 1	LAB II Run 2	LAB III Run 1	LAB III Run 2	LAB IV Run 1	LAB IV Run 2	LAB V Run 1	LAB V Run 2
						Parts Per Million, Dry Coal					
As	3.72	3.04	3.54	3.71	3.67	2	2	2	ND	4.1	3.1
B		87.1	81.0	52.0	51.0	61	60	60	55	31.1	18.6
Ba	67.5	50.6	48.5	66.0	66.4	71.2	72.7	63	70	67.2	67.6
Be		0.93	0.82	0.58	0.59	0.6	0.6	0.5	0.6	0.693	0.668
Cd	0.0573	0.27	0.41	0.040	0.060	<0.2	<0.2	<0.2	<0.2	0.028	ND
Cr	*11	12.2	11.1	8.7	9.64	11	10.2	9	11	7.6	8.1
Co	2.29	4.15	2.83	1.89	2.06	2.09	2.01	2	2	2.18	1.42
Cu	6.28	6.07	5.87	5.4	5.66	<35.3	<35.7	6	6	8.4	8.8
F		<100	<100	43.0	35.9	40	40	ND	ND	41	41
Hg		0.17	0.15	0.099	0.095	0.05	0.05	0.05	0.07	0.057	0.062
Mn	12.4	11.1	11.1	11.5	12	10.8	10.6	12	13	10.9	11.1
Mo	*0.9	6.38	2.63	0.85	0.9	1.55	1.9	<3	<3	ND	ND
Ni	6.1	8.91	7.39	5.65	6.23	<8.8	<8.9	6	7	5.2	6
Pb	3.67	3.44	3.44	3.81	4.03	3	3	4	4	3.2	1.8
Sb	*0.24	<0.8	<0.8	0.22	0.23	0.196	0.194	<1	<1	ND	ND
Se	1.29	1.42	0.75	1.46	1.52	1	1	1	ND	1.23	0.751
V	*14	19.2	18.2	11.0	12.7	14.2	14.1	14	15	15.3	14.8

Single – underlined results exceed certified values by more than 10%
Double – underlined results exceed certified values by more than 25%
* Informational Value
ND=Not Determined

PARAMETER	CERTIFIED VALUE	LAB I Run 1	LAB I Run 2	LAB II Run 1	LAB II Run 2	LAB III Run 1	LAB III Run 2	LAB IV Run 1	LAB IV Run 2	LAB V Run 1	LAB V Run 2
						wt %, Dry Coal					
Ash	6.80	6.92	6.91	6.91	6.91	6.78	6.77	6.78	6.79	6.78	6.83
Carbon	78.11	76.43	76.97	77.93	78.39	77.74	77.52	76.89	76.72	77.62	77.2
Hydrogen	5.07	6.78	6.14	5.03	4.99	5.14	5.12	4.94	4.94	5.06	5.01
Nitrogen	1.56	0.47	0.48	1.54	1.6	1.54	1.49	1.5	1.56	1.46	1.41
Sulfur	1.89	2.27	1.96	1.89	1.92	1.93	3.39	1.96	1.95	1.92	1.91
Chlorine	0.126	0.030	0.040	0.112	0.109	0.107	0.106	ND	ND	0.12	0.12
Btu/lb	13890	12798	13022	13809	13809	13767	13797	13760	13763	13774	13778

Underlined results exceed ASTM reproducibility limits

PARAMETER	CERTIFIED VALUE	LAB I Run 1	LAB I Run 2	LAB II Run 1	LAB II Run 2	LAB III Run 1	LAB III Run 2	LAB IV Run 1	LAB IV Run 2	LAB V Run 1	LAB V Run 2
						wt %, Dry Ash					
SiO_2	44.03	50.15	47.08	45.27	45.41	ND	ND	44.62	ND	44.4	43.8
Al_2O_3	23.75	25.7	23.79	24.99	25.06	24.37	22.43	18.57	ND	24.3	24.2
TiO_2	1.11	1.37	1.25	1.1	1.11	0.97	1.09	0.94	ND	1	0.8
Fe_2O_3	15.96	17.99	16.75	16.88	17.03	14.24	15.04	ND	ND	16.4	16
CaO	4.2	1.72	1.72	4.64	4.63	2.3	2.19	ND	ND	4.2	4.2
MgO	0.93	0.24	0.23	1.03	1.02	0.77	0.72	ND	ND	0.95	0.97
Na_2O	1.02	1.12	1.05	1.04	1.05	0.87	0.87	1.01	ND	1	1
K_2O	1.33	1.6	1.24	1.39	1.37	1.07	0.9	2.05	ND	1.3	1.3
P_2O_5		0.29	0.24	0.17	0.18	0.36	0.39	ND	ND	0.23	0.23
SO_3		ND	ND	4.14	4.15	ND	ND	ND	ND	4.66	4.54

Underlined results exceed ASTM reproducibility limits

Table 4. Percent Relative Standard Deviation for All Samples.

Trace Elements	A&J	B&K	C&L	D&M	E&N	F&O	G&P	H&Q		Average PRSD	Maximum PRSD	Minimum PRSD
As	24.3	37.7	36.2	40.4	43.7	38.5	39.3	29.3		36.2	43.7	24.3
B	14.6	14.7	16.0	33.8	35.0	18.3	16.7	21.6		21.3	35.0	14.6
Ba	37.7	21.5	20.6	53.4	34.7	26.6	45.0	14.4		31.7	53.4	14.4
Be	11.4	15.9	15.7	17.9	17.0	11.8	8.40	21.7		15.0	17.9	8.4
Cd	35.1	58.4	32.0	62.9	38.6	39.0	142	57.9		58.3	142	32.0
Cr	9.91	4.34	19.0	19.2	13.0	20.9	14.1	14.3		14.3	20.9	4.34
Co	29.0	21.4	30.6	43.1	45.5	27.8	25.4	40.3		32.9	45.5	21.4
Cu	17.7	17.7	19.8	22.1	29.7	12.5	49.2	14.8		22.9	49.2	12.5
F	16.0	14.9	7.75	14.4	7.7	15.4	16.8	9.83		12.9	16.8	7.7
Hg	10.4	40.6	24.8	16.7	16.9	20.4	9.05	26.1		20.6	40.6	9.05
Mn	24.4	14.0	10.1	19.1	17.1	11.3	20.1	13.0		16.1	24.4	10.1
Mo	51.6	53.6	46.9	55.1	88.0	46.3	97	47.5		60.7	97	46.3
Ni	15.5	13.9	15.4	89.8	49.9	38.2	17.5	25.0		33.1	89.8	13.9
Pb	34.8	29.9	43.8	27.2	63.6	33.7	22.6	38.5		36.8	63.6	22.6
Sb	5.86	35.2	7.59	4.08	36.9	11.6	44.0	25.0		21.4	44.0	5.86
Se	20.5	37.6	25.6	28.2	33.9	24.0	33.8	26.1		26.7	37.6	20.5
V	11.5	9.4	13.7	9.31	8.73	13.9	6.07	15.3		11.0	13.9	6.07
AVG.	21.8	25.9	22.7	32.8	34.1	24.1	35.7	25.9		27.9	49.1	16.1
Proximate & Ultimate												
Ash	1.48	0.66	0.56	1.68	2.66	0.68	0.66	0.72		1.14		
Carbon	0.85	2.71	0.82	1.97	2.15	2.07	1.87	2.78		1.90		
Hydrogen	5.79	4.01	4.66	14.0	23.9	4.50	7.65	11.4		9.49		
Nitrogen	5.42	3.70	3.21	8.60	19.5	3.24	4.93	4.11		6.58		
Sulfur	6.78	4.45	4.01	53.3	3.50	2.42	16.0	4.75		11.9		
Chlorine	23.1	31.0	25.4	46.0	25.0	60.5	58.1	28.5		37.2		
Heating Value, Btu/lb	4.89	3.44	1.58	6.79	6.35	3.55	4.39	3.53		4.32		
									AVG.	10.4		
Major Ash Elements												
SiO_2	17.71	3.38	1.93	3.27	3.18	3.09	3.25	10.7		5.81		
Al_2O_3	17.08	4.60	4.2	26.0	34.9	4.72	11.4	7.23		13.8		
TiO_2	8.77	25.7	5.58	15.6	5.67	32.0	16.3	30.0		17.5		
Fe_2O_3	7.74	36.8	5.71	15.2	16.1	3.43	7.40	10.8		12.9		
CaO	50.7	38.5	27.2	62.2	63.9	21.5	37.9	30.6		41.6		
MgO	43.7	42.4	30.7	60.2	66.2	28.6	47.5	38.1		44.7		
Na_2O_3	9.35	14.1	13.7	12.2	7.84	26.0	26.3	9.64		14.9		
K_2O	13.1	7.38	7.80	18.3	23.2	8.94	8.38	12.2		12.4		
P_2O_5	34.9	30.2	37.2	38.7	39.3	33.5	37.8	31.0		35.3		
SO_3	36.6	32.4	17.8	29.1	3.37	8.01	4.18	12.8		18.0		
									AVG.	21.7		

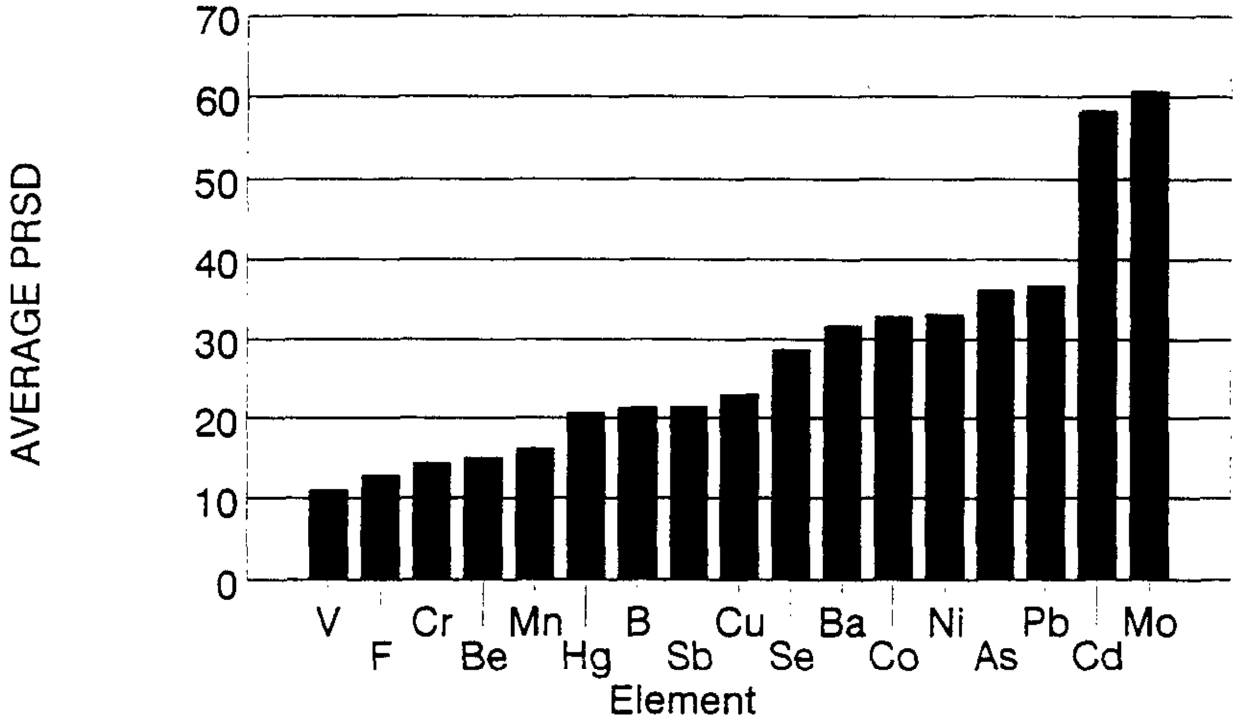


Figure 1. Average Variability for All Coals.

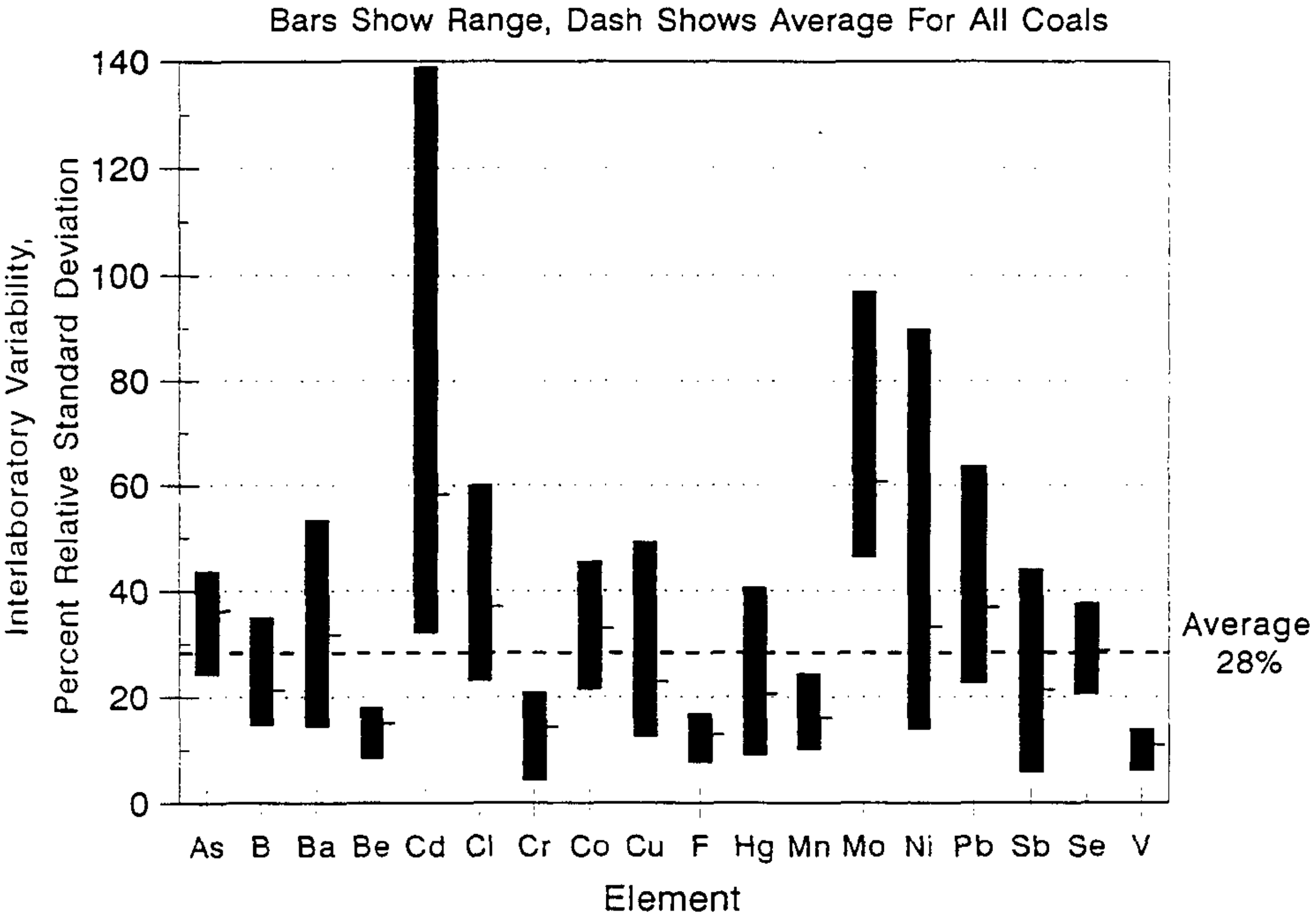


Figure 2. Interlaboratory Variability by Element

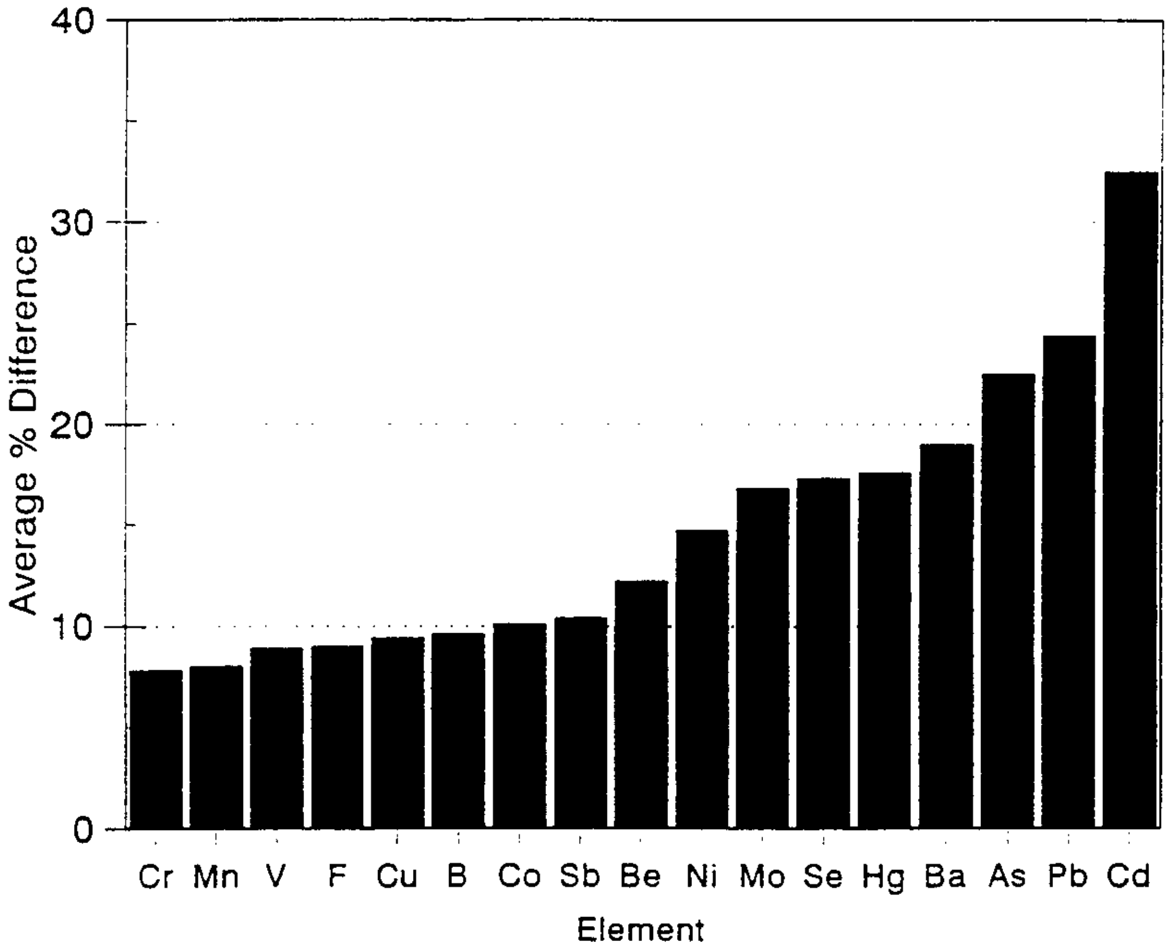


Figure 3. Average Interlaboratory Repeatability.

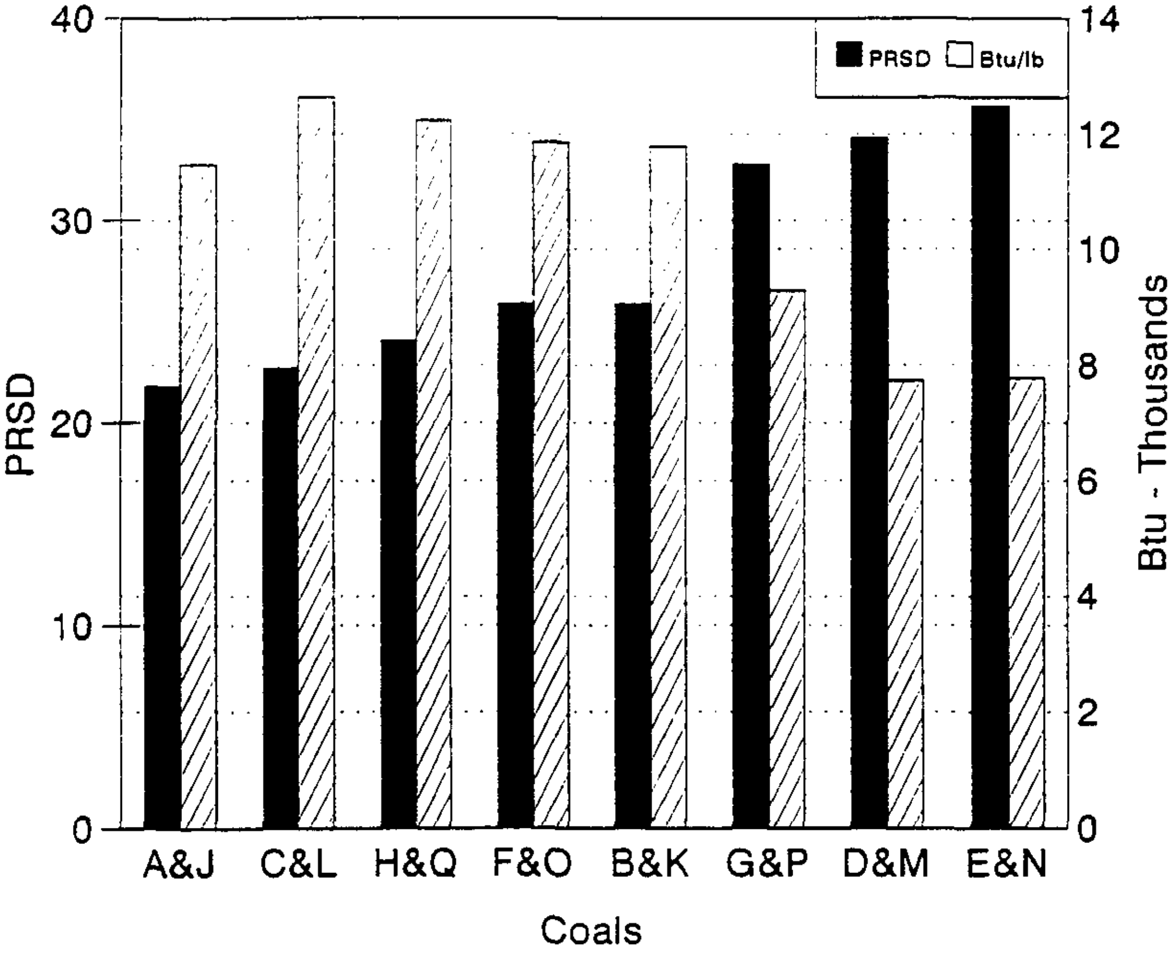


Figure 4. Comparison of Interlaboratory Variability vs. Heating Value.

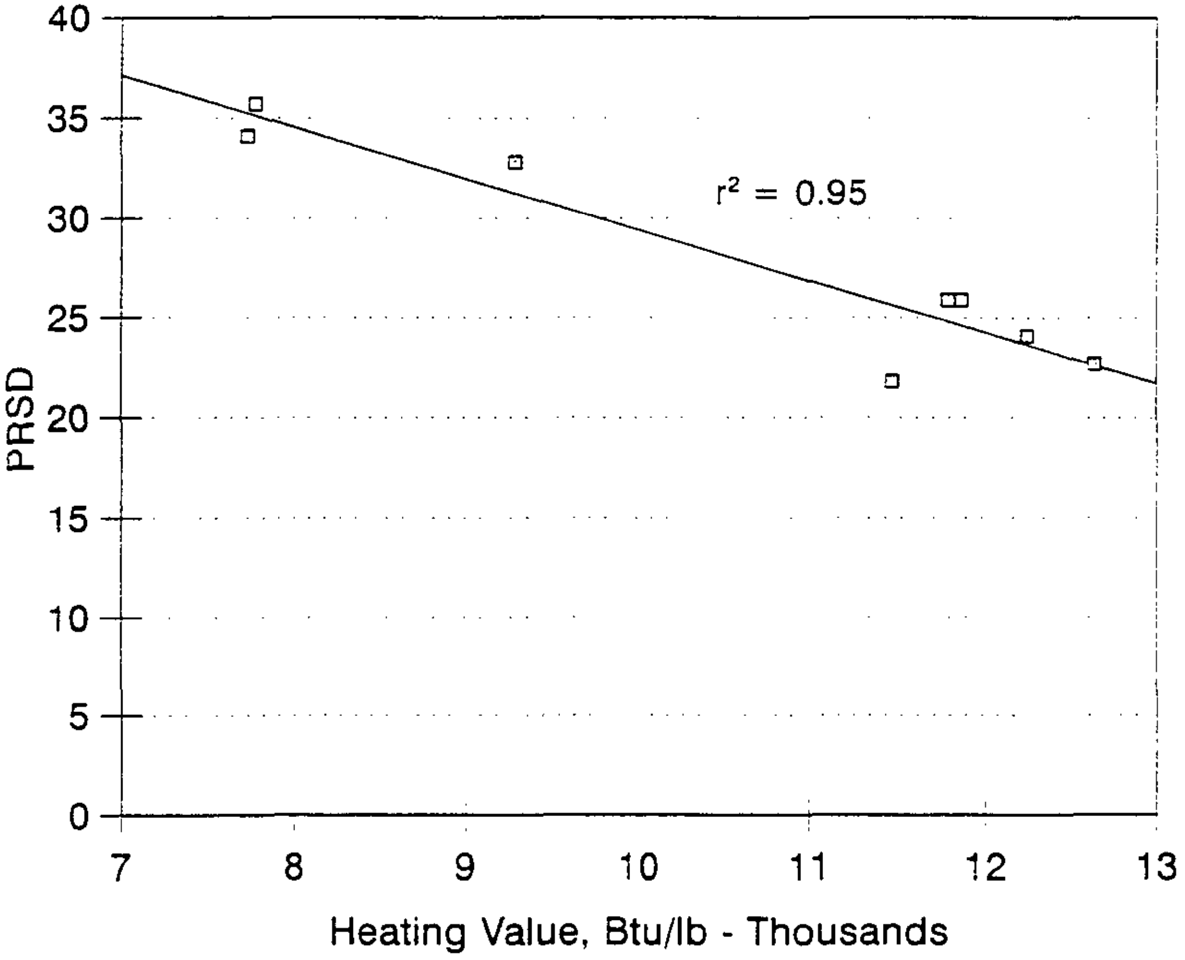


Figure 5. Correlation of Variability vs. Heating Value.

APPENDIX A

INDIVIDUAL LABORATORY ANALYSIS OF ROUND ROBIN SAMPLES

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE A

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	2.36	3.01	3.43	3.46	2	2	2	NA	2.6	2
B	236.33	290.64	179.81	182.77	250	230	230	230	276	217
Ba	29	32.29	55.8	63.3	76.7	72	58	55	49.4	49.8
Be	1.29	1.61	1.1	1.09	1.3	1.3	1.4	1.3	1.49	1.35
Cd	0.5	0.55	0.57	0.59	<0.3	<0.3	<0.4	<0.4	0.373	0.545
Cr	25.78	30.14	26.56	24.44	25.2	28	35	34	24.6	25.5
Co	4.73	5.81	3.41	3.35	3.28	3.44	5	5	2.71	3.79
Cu	8.7	10.76	8.76	8.54	<37.3	<38.3	12	12	13.2	13.1
F	<100	<100	108.92	107.67	100	100	ND	ND	72	67
Hg	<0.1	<0.1	0.094	0.095	0.09	0.09	0.1	0.1	0.123	0.109
Mn	36.52	39.83	51.8	51.8	29.3	31.2	53	55	42.8	41.7
Mo	11.82	8.61	7.01	6.78	15.1	14.6	6	<6	6.5	5.1
Ni	17.19	19.38	16.32	15.28	12.8	14	23	21	18	17.6
Pb	4.08	6.89	10.89	10.71	8	8	13	12	6.7	6.8
Sb	<0.8	<0.8	0.52	0.53	0.466	0.512	<1	<1	ND	ND
Se	3.01	3.55	3.58	3.61	3	2	3	ND	1.3	2.9
V	35.45	40.9	29.03	28.9	34.3	35.8	45	41	40.1	38.1

% DRY BASIS

PROXIMATE & ULTIMATE	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
ASH	12.16	12.18	12.08	12.13	12.18	12.26	11.83	11.75	11.86	11.95
CARBON	68.39	68.88	70.09	70.22	70.32	70.15	69.2	69.25	69.2	69.14
HYDROGEN	4.97	5.88	4.83	4.79	4.89	4.92	4.67	4.6	4.76	4.71
NITROGEN	1.25	1.26	1.37	1.41	1.48	1.4	1.35	1.31	1.25	1.28
SULFUR	3.44	3.6	3.44	3.48	3.46	3.42	3.41	3.4	3.43	3.4
CHLORINE	0.06	0.05	0.077	0.064	0.075	0.072	ND	ND	0.1	0.09
Btu/lb	12460	11297	12478	12462	12425	12477	12453	12455	12427	12402

% DRY ASH

MAJOR ASH ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
SiO_2	39.75	49.24	48.71	48.87	ND	ND	47.03	ND	45.9	46.8
Al_2O_3	13.18	15.36	18.5	18.84	16.37	17.74	18.21	ND	17.9	17.8
TiO_2	0.8	0.97	0.95	0.95	0.72	0.7	0.89	ND	0.9	0.8
Fe_2O_3	13.89	16.43	17.27	17.35	15.21	15.17	ND	ND	17	17.3
CaO	2.47	2.23	6.48	6.43	2.36	2.21	ND	ND	5.5	5.9
MgO	0.4	0.35	1.06	1.06	0.59	0.72	ND	ND	1.1	1
Na_2O_3	0.77	0.96	0.95	0.95	0.78	0.78	0.97	ND	0.99	0.97
K_2O	1.92	2.24	2.18	2.18	1.68	1.85	2.01	ND	2.1	2
P_2O_5	0.26	0.3	0.25	0.22	0.2	0.24	ND	ND	0.24	0.26
SO_3	ND	ND	3.33	3.29	ND	ND	ND	ND	6.18	5.97

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE B

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
As	2.7	2.79	3.26	3.18	1	2	5	ND	5.3	1.2
B	260.01	258.48	193.41	189.71	260	270	190	200	227	192
Ba	37.44	34.12	47.8	49.3	64.3	73.7	47	46	46.5	46.5
Be	1.87	1.86	1.37	1.44	1.5	1.5	1.4	1.3	1.8	1.89
Cd	0.92	0.77	0.97	1	<0.3	<0.3	<0.4	<0.4	0.573	0.941
Cr	36.4	35.15	32.57	35.14	35.2	34.5	38	37	31.1	32.8
Co	5.62	4.55	3.43	3.58	3.57	3.53	3	3	2.77	3.07
Cu	11.44	11.37	9.61	9.79	<41.8	<42.4	10	10	13.2	13.8
F	<100	<100	124.37	125.42	110	120	ND	ND	88	95
Hg	<0.1	<0.1	0.131	0.115	0.11	0.11	0.12	0.11	0.105	0.106
Mn	32.24	31.02	40.6	39.9	29.9	28.1	38	37	35	34.8
Mo	7.28	7.03	7.2	7.36	<13.6	<13.8	5	3	4.9	6.6
Ni	19.76	18.61	16.94	17.49	22.9	21.8	21	21	17.3	19.4
Pb	7.49	2.38	14.95	14.77	15	16	15	15	10.2	9.1
Sb	<0.8	<0.8	0.69	0.69	0.707	0.566	<1	<1	2.56	ND
Se	3.33	1.45	4.71	4.78	3	4	1	ND	3.2	2.5
V	49.92	50.66	38.79	39.29	44.7	49.1	47	47	49.5	49.8
					% DRY BASIS					
PROXIMATE & ULTIMATE										
ASH	12.68	12.54	12.69	12.72	12.56	12.53	12.45	12.55	12.43	12.48
CARBON	68.33	67.79	70.23	70.07	70.12	69.95	68.86	68.82	68.84	68.78
HYDROGEN	5.1	5.29	4.82	4.84	4.83	4.81	4.51	4.56	4.68	4.68
NITROGEN	1.26	1.23	1.33	1.44	1.42	1.4	1.35	1.3	1.33	1.27
SULFUR	3.63	3.63	3.43	3.49	3.46	3.47	3.48	3.47	3.51	3.48
CHLORINE	0.05	0.05	0.084	0.077	0.079	0.078	ND	ND	0.1	0.12
Btu/lb	11900	11480	12398	12402	12376	12367	12390	12378	12350	12321
					% DRY ASH					
MAJOR ASH ELEMENTS										
SiO_2	49.21	49.47	51.04	51.01	ND	ND	50.45	ND	49.2	49.3
Al_2O_3	18.59	18.69	19.41	19.46	18.28	19.4	19.05	ND	19	18.9
TiO_2	1.01	1	1	0.99	0.86	0.78	0.96	ND	0.8	0.8
Fe_2O_3	16.42	16.5	17.97	17.83	16.7	16.42	ND	ND	17.1	16.7
CaO	1.84	1.62	3.94	3.85	1.84	1.97	ND	ND	3.6	3.3
MgO	0.3	0.36	1.09	1.1	0.77	0.77	ND	ND	1.1	1.1
Na_2O_3	0.7	0.71	0.79	0.79	0.78	0.7	0.73	ND	0.86	0.84
K_2O	2.37	2.19	2.39	2.38	2.25	2.22	2.26	ND	2.2	2.2
P_2O_5	0.3	0.3	0.26	0.27	0.51	0.51	ND	ND	0.43	0.3
SO_3	ND	ND	1.94	1.96	ND	ND	ND	ND	3	3.2

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE C

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
As	3.06	5.82	13.61	13.04	5	7	6	ND	12.1	13.4
B	91.69	86.72	66.46	63.46	80	80	73	76	79.1	54
Ba	28.52	27.55	32.2	34.9	34.6	45.2	35	35	35.2	34.3
Be	1.63	1.63	1.13	1.17	1.3	1.2	1.2	1.2	1.53	1.51
Cd	0.08	0.08	0.1	0.11	<0.3	<0.3	<0.4	<0.4	0.079	0.237
Cr	21.39	20.4	16.77	15.9	17.2	18.2	19	20	9.9	12.4
Co	9.37	8.67	4.51	4.46	4.92	5.13	5	7	4.03	4.6
Cu	9.88	8.06	6.98	6.95	<38	<39.3	8	8	10.9	11.2
F	<100	<100	63.96	63.22	60	60	ND	ND	58	53
Hg	<0.1	0.16	0.147	0.143	0.1	0.11	0.14	0.14	0.135	0.145
Mn	18.34	18.36	15.7	16.4	19	18.5	22	23	19	19.6
Mo	3.77	3.06	1.62	1.65	1.71	2.87	<6	<6	ND	0.977
Ni	16.3	16.32	12.44	12.06	10.4	10.7	15	15	14.2	13.8
Pb	3.77	0.65	6.44	6.52	5	7	7	8	4.5	5.7
Sb	<0.8	<0.8	0.66	0.7	0.603	0.654	<1	<1	ND	ND
Se	1.94	1.53	2.47	2.57	1	2	2	1	0.837	1.1
V	37.69	37.75	24.63	25.27	30.6	29.9	33	33	33	33.2

% DRY BASIS

PROXIMATE & ULTIMATE	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
ASH	11.59	11.62	11.52	11.53	11.64	11.6	11.57	11.51	11.61	11.59
CARBON	71.69	71.12	72.79	72.63	72.98	72.72	71.64	71.72	71.99	71.86
HYDROGEN	5.76	5.01	4.85	4.86	4.99	4.98	4.6	4.6	4.85	4.86
NITROGEN	1.4	1.38	1.44	1.39	1.42	1.42	1.45	1.45	1.43	1.36
SULFUR	3.44	3.55	3.15	3.16	3.28	3.27	3.13	3.18	3.37	3.16
CHLORINE	0.05	0.05	0.092	0.089	0.098	0.104	ND	ND	0.11	0.11
Btu/lb	11987	12644	12957	12971	12972	12932	12989	12953	12906	12906

% DRY ASH

MAJOR ASH ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
SiO_2	47.09	45.15	45.02	45.57	ND	ND	44.73	ND	44.5	44.3
Al_2O_3	23.24	21.56	21.31	21.63	19.36	18.78	21.74	ND	21.4	21.5
TiO_2	1.08	1.04	0.96	0.98	1.1	1.09	0.99	ND	0.9	0.9
Fe_2O_3	25.13	25.11	25.63	26.06	23.41	24.61	ND	ND	25.2	25.4
CaO	0.64	0.64	1.22	1.29	1.17	1.04	ND	ND	1.1	1.1
MgO	0.35	0.33	0.71	0.69	0.72	0.63	ND	ND	0.73	0.71
Na_2O_3	0.54	0.37	0.4	0.42	0.38	0.41	0.42	ND	0.44	0.46
K_2O	2.12	2.01	1.93	1.89	1.77	1.9	1.85	ND	1.7	1.8
P_2O_5	0.13	0.12	0.07	0.08	0.21	0.23	ND	ND	0.15	0.23
SO_3	ND	ND	1.44	1.51	ND	ND	ND	ND	1.04	1.05

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE D

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	1.25	1.87	1.93	1.69	<1	<1	1	ND	0.45	0.63
B	117.71	104.86	40.44	39.86	100	110	90	90	102	76
Ba	187.83	137.31	432.1	424.4	697	640	170	150	450	536
Be	0.53	0.47	0.45	0.41	0.4	0.4	0.3	0.3	0.421	0.408
Cd	<0.06	<0.06	0.07	0.07	<0.3	<0.3	<0.4	<0.4	0.049	ND
Cr	6.01	4.62	6.17	4.64	4.79	3.97	4	4	3.03	3.54
Co	<2.0	<2.0	1.19	1.17	0.757	0.663	<1	<1	ND	0.77
Cu	11.65	8.74	7.5	7.07	<45	<43.9	8	8	14	12.1
F	<100	<100	48.59	48.12	50	50	ND	ND	39	35
Hg	<0.1	<0.1	0.086	0.096	0.08	0.08	0.1	0.1	0.102	0.091
Mn	137.74	121.08	188.4	186.3	98	99.8	160	150	148	151
Mo	8.01	6.99	6.55	6.39	11.1	10.8	7	4	4.84	5.37
Ni	5.01	3.74	4.15	3.34	16	15.2	2	1	2.08	2.08
Pb	5.13	5.12	5.44	5.45	8	7	5	5	3.8	2.9
Sb	<0.8	<0.8	0.48	0.48	0.451	0.429	<1	<1	ND	ND
Se	<0.6	0.97	0.9	0.92	<1	<1	1	ND	ND	ND
V	11.65	10.86	8.54	7.99	9.73	8.3	9	9	9.5	10
					% DRY BASIS					
PROXIMATE & ULTIMATE										
ASH	12	11.67	11.86	11.93	11.51	11.51	11.7	11.79	11.48	11.55
CARBON	62.27	65.9	68.55	68.65	68.41	68.21	67.27	67.36	67.38	67.43
HYDROGEN	7.42	1.95	4.68	4.71	4.63	4.61	4.51	4.52	4.33	4.38
NITROGEN	0.98	0.94	0.93	0.85	1.08	1.1	1.02	1.01	1.08	1.12
SULFUR	0.93	0.91	0.96	0.96	0.95	4.82	0.91	0.92	0.97	1
CHLORINE	0.04	0.04	<0.02	<0.02	<0.01	<0.1	ND	ND	0.03	0.04
Btu/lb	11342	9083	11735	11717	11693	11601	11751	11759	11634	11663
					% DRY ASH					
MAJOR ASH ELEMENTS										
SiO_2	42.49	38.97	44.35	44.06	ND	ND	41.94	ND	41.7	41.8
Al_2O_3	9.07	8.89	19.24	19.09	18.48	18.26	18.88	ND	18.2	18.1
TiO_2	0.92	0.86	0.86	0.85	0.8	0.87	0.85	ND	0.8	0.8
Fe_2O_3	5.22	4.74	6.8	7.12	6.97	6.1	ND	ND	6.3	6.8
CaO	2.92	2.55	13.24	13.12	4.2	4.01	ND	ND	11.7	11.5
MgO	1	1.01	4.13	4.09	1.22	1.21	ND	ND	4	3.8
Na_2O_3	0.31	0.25	0.32	0.32	0.27	0.26	0.3	ND	0.25	0.24
K_2O	0.72	0.67	0.52	0.51	0.4	0.4	0.5	ND	0.47	0.48
P_2O_5	0.33	0.29	0.3	0.3	0.56	0.56	ND	ND	0.26	0.24
SO_3	ND	ND	11.31	11.21	ND	ND	ND	ND	13.02	13.54

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE E

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	<0.6	8.63	11.53	11.69	4	5	7	8	8.4	9.2
B	153.79	139.65	45.15	45.15	150	150	130	140	151	138
Ba	192.23	266.6	658.9	669.8	795	667	400	380	714	701
Be	0.82	0.71	0.72	0.73	0.7	0.7	0.6	0.7	0.639	0.732
Cd	0.12	<0.06	0.1	0.1	<0.3	<0.3	<0.4	<0.4	0.052	0.092
Cr	8.59	7.87	7.88	9.85	9.8	8.14	8	8	6.4	6
Co	3.33	2.79	2.66	2.54	1.91	1.91	1	2	2.02	ND
Cu	9.36	8.89	6.97	7.1	<48.2	<46.3	7	7	11.9	11
F	<100	<100	55.8	60.87	60	60	ND	ND	54	57
Hg	<0.1	<0.1	0.159	0.144	0.17	0.17	0.18	0.18	0.113	0.136
Mn	108.93	99.02	149.2	151.2	93.9	88.8	140	140	124	122
Mo	3.59	3.3	2.77	2.75	7.51	7.13	<6	<6	ND	0.977
Ni	8.07	5.71	6.97	7.62	18.1	<17.4	6	3	3.7	4.92
Pb	1.92	<0.6	3.04	2.63	4	4	4	4	4	1.8
Sb	<0.8	<0.8	0.77	0.72	0.679	0.073	<1	<1	ND	2.3
Se	<0.6	<0.6	0.88	0.98	<1	<1	1	1	ND	0.746
V	17.94	16.5	14.34	14.32	16.4	15.5	17	18	16.2	16.2
% DRY BASIS										
PROXIMATE & ULTIMATE										
ASH	17.69	16.32	16.15	16.19	16.23	16.29	17.45	17.5	16.83	16.67
CARBON	55.85	54.93	59.58	59.55	59.05	59.17	58.91	58.61	59.38	59.33
HYDROGEN	7.41	7.38	4.21	4.15	4.24	4.31	3.92	3.9	3.91	3.87
NITROGEN	0.09	0.88	0.99	0.91	1.02	1.02	0.79	0.82	1.05	1.02
SULFUR	1.15	1.09	1.13	1.13	1.15	1.14	1.13	1.12	1.11	1.12
CHLORINE	0.03	0.03	<0.02	<0.02	<0.01	<0.01	ND	ND	0.05	0.05
Btu/lb	9252	8208	9842	9841	9920	9914	9777	9823	9939	9917
% DRY ASH										
MAJOR ASH ELEMENTS										
SiO_2	37.26	36.67	39.92	40.18	ND	ND	39.61	ND	38.5	38.7
Al_2O_3	3.01	3.53	12.68	12.69	12.35	11.98	12.38	ND	11.6	11.7
TiO_2	0.45	0.44	0.45	0.46	0.55	0.43	0.49	ND	0.5	0.4
Fe_2O_3	4.35	4.67	6.93	7	6.43	6.17	ND	ND	6.7	6.6
CaO	2.23	3.16	17.34	17.53	5.32	5.04	ND	ND	16.2	16.3
MgO	0.94	1.15	4.96	4.97	1.19	1.05	ND	ND	4.8	4.8
Na_2O_3	0.67	0.72	0.89	0.89	0.8	0.78	0.87	ND	0.84	0.84
K_2O	1.4	0.12	1.39	1.39	1.99	2.1	1.25	ND	1.3	1.3
P_2O_5	0.13	0.13	0.13	0.14	0.22	0.21	ND	ND	0.13	0.11
SO_3	ND	ND	14.99	15.21	ND	ND	ND	ND	15.42	16.02

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE F

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	4.82	50.43	35.51	35.07	17	17	24	ND	28.7	28.1
B	89.23	96.74	64.7	63.46	73	76	68	65	64.9	53.4
Ba	55.38	53.51	86.4	98.1	93	85.6	83	83	59	87.3
Be	2.67	2.78	2.14	2.18	1.9	2	2.3	2.4	2.75	2.41
Cd	0.07	0.09	0.1	0.12	<0.3	<0.3	<0.4	<0.4	0.093	ND
Cr	22.56	22.64	25.35	28.97	19.7	21.7	20	21	11	14.4
Co	9.74	11.32	5.9	5.88	6.23	6	8	7	4.56	3.59
Cu	21.54	21.61	17.35	17.07	<37.8	<37.4	20	21	22.2	29
F	<100	<100	90.46	92.55	90	100	ND	ND	63	65
Hg	0.21	0.27	0.238	0.251	0.24	0.26	0.25	0.25	0.338	0.323
Mn	25.64	15.73	26.6	26.6	27	23.2	30	31	25.5	26.6
Mo	7.38	6.48	4.25	4.46	3.65	3.8	<6	<6	1.92	1.51
Ni	26.67	29.84	21.98	22.39	26.8	28.2	25	28	23.5	23.8
Pb	7.28	<0.6	15.67	15.66	15	15	16	17	12.3	11.5
Sb	1.95	2.88	2.2	2.25	1.97	2.1	2	2	ND	ND
Se	1.13	2.26	3.27	3.29	2	2	3	ND	1.5	2.2
V	40	42.19	28.06	27.98	33.6	36.3	35	36	35.5	38.2
					% DRY BASIS					
PROXIMATE & ULTIMATE										
ASH	13.42	13.42	13.42	13.45	13.44	13.4	13.21	13.27	13.39	13.37
CARBON	66.75	66.24	71.23	71.11	71.34	71.38	70.41	70.23	69.98	69.94
HYDROGEN	5.3	5.28	4.76	4.77	4.94	4.88	4.63	4.58	4.77	4.75
NITROGEN	1.39	1.35	1.43	1.43	1.45	1.39	1.39	1.35	1.28	1.32
SULFUR	3.1	2.96	2.9	2.95	3.1	3	2.96	2.99	3.16	3.13
CHLORINE	0.6	0.05	0.155	0.14	0.119	0.122	ND	ND	0.12	0.13
Btu/lb	12207	10953	12674	12648	12645	12609	12665	12688	12623	12583
					% DRY ASH					
MAJOR ASH ELEMENTS										
SiO_2	45.86	49.3	47.18	46.04	ND	ND	44.91	ND	46.1	45.3
Al_2O_3	23.1	24.62	23.19	23.37	22.98	23.97	22.55	ND	22.1	22.2
TiO_2	1.12	1.23	1.06	1.07	1.3	1.12	1.12	ND	1	1
Fe_2O_3	20.76	23.02	21.68	22.01	20.9	19.67	ND	ND	21.4	21
CaO	1.18	1.07	1.85	1.91	1.44	1.36	ND	ND	1.7	1.8
MgO	0.43	0.33	0.87	0.87	0.73	0.86	ND	ND	0.86	0.86
Na_2O_3	0.22	0.21	0.3	0.3	0.25	0.25	0.38	ND	0.24	0.26
K_2O	2.39	2.22	2.3	2.32	1.92	2.11	2.05	ND	2.2	2.2
P_2O_5	0.47	0.53	0.48	0.46	0.89	0.89	ND	ND	0.45	0.46
SO_3	ND	ND	1.78	1.83	ND	ND	ND	ND	1.53	1.49

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE G

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	1.53	1.65	2.53	2.57	1	1	2	ND	0.75	1.21
B	95.36	74.61	87.94	90.9	86	84	82	65	60.7	47.4
Ba	95.36	88.87	404.6	417.4	402	461	250	250	365	389
Be	1.53	1.21	1.33	1.4	1.2	1.2	1	1.3	1.47	1.39
Cd	<0.06	<0.06	,0.01	<0.01	<0.4	<0.4	<0.6	<0.6	0.036	0.34
Cr	10.96	8.56	12.89	10.44	10.2	10	9	10	7	7.5
Co	5.59	4.83	3.96	4.07	4.24	4.38	4	4	2.34	2.38
Cu	52.61	10.53	10.44	10.47	<40.5	<42.9	10	10	14.1	14.7
F	<100	<100	92.65	91.53	90	90	ND	ND	73	78
Hg	<0.1	<0.1	0.097	0.093	0.08	0.08	0.07	0.07	0.078	0.071
Mn	54.81	50.47	99.5	100.7	73.9	82.7	77	82	76.3	75.5
Mo	2.52	<2	1.75	1.73	6.65	5.92	<6	<6	0.429	0.795
Ni	7.45	6.69	8.4	7.74	<15.2	<16.1	6	4	6.4	6.4
Pb	6.25	5.05	10.02	10.06	12	12	10	11	6.1	7.5
Sb	1.97	0.99	1.72	1.72	1.38	1.63	1	1	4.43	3.22
Se	<0.6	<0.6	1.62	1.84	1	1	2	ND	1.07	1.77
V	29.6	24.14	24.82	25.52	25	26.8	27	29	27	27.9

% DRY BASIS

PROXIMATE & ULTIMATE	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
ASH	20.52	20.6	20.54	20.66	20.6	20.63	20.64	20.61	20.71	20.86
CARBON	58.09	58.61	62.29	62.02	61.81	61.95	61.25	61.29	61.35	61.13
HYDROGEN	5.82	5.38	4.6	4.62	4.71	4.76	4.51	4.5	4.35	4.56
NITROGEN	1.01	1.02	0.89	1.03	1.1	1.06	1.04	1.04	1.09	1.09
SULFUR	0.6	0.53	0.71	0.73	0.71	0.69	0.69	0.67	0.72	0.69
CHLORINE	0.08	0.05	<0.02	<0.02	<0.01	<0.01	ND	nd	0.04	0.04
Btu/lb	9769	9471	10855	10858	10848	10848	10848	10857	10804	10797

% DRY ASH

MAJOR ASH ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
SiO_2	62.96	50.22	61.22	61.62	ND	ND	59.37	60.34	59.8	59.6
Al_2O_3	18.16	16.1	22.76	22.61	20.51	22.92	21.59	21.81	21.1	20.7
TiO_2	0.98	0.81	0.96	0.93	1.35	1.48	1.19	0.94	0.8	0.8
Fe_2O_3	4.35	3.5	4.63	4.68	4.48	4.87	ND	ND	4.6	4.6
CaO	2.24	2.01	4.68	4.68	1.52	2.13	ND	ND	4.2	4.2
MgO	0.23	0.33	1.33	1.32	0.73	0.84	ND	ND	1.3	1.3
Na_2O_3	0.12	0.11	0.25	0.27	0.2	0.23	0.31	0.19	0.25	0.29
K_2O	1.16	1.09	1.4	1.39	1.15	1.27	1.23	1.28	1.3	1.3
P_2O_5	0.04	0.03	0.03	0.03	0.05	0.03	ND	ND	0.05	0.1
SO_3	ND	ND	3.53	3.54	ND	ND	ND	ND	3.79	3.7

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE H

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	<0.6	3.63	4.63	4.51	3	3	3	ND	3.1	4.3
B	203.01	181.49	142.76	134.99	160	170	160	150	167	142
Ba	37.4	33.09	51.1	50	54.5	49.9	50	48	48.8	46
Be	1.71	1.49	1.23	1.26	1.1	1.1	1.3	1.2	1.5	1.46
Cd	0.46	0.4	0.56	0.63	<0.2	<0.2	<0.4	<0.4	0.332	0.107
Cr	22.44	21.35	19.58	19.89	23.1	20.1	22	22	18.2	17.8
Co	6.41	7.79	3.59	3.62	4.08	3.71	5	4	2.48	2.47
Cu	13.89	11.74	10.99	11.19	<34.0	<32.2	12	12	15.1	14.8
F	<100	<100	92.92	93.09	80	80	2.84	ND	71	71
Hg	<0.1	0.15	0.098	0.098	0.05	0.05	0.05	0.06	0.118	0.098
Mn	26.71	23.49	31.7	31.7	21.2	22.3	31	31	27.3	26.7
Mo	5.98	6.73	5.05	5.1	11.5	11.4	4	2	3.4	3.54
Ni	20.3	18.15	15.19	15.32	13.6	13.4	18	18	16.2	16.3
Pb	5.45	<0.6	10.6	10.73	9	9	11	11	7.6	6.8
Sb	<0.8	<0.8	0.62	0.61	0.585	0.417	<1	<1	ND	ND
Se	1.39	1.71	3.09	3.01	2	2	2	ND	1.5	1.9
V	40.6	37.37	31.43	31.58	36.1	36.5	39	38	40.4	39.6
% DRY BASIS										
PROXIMATE & ULTIMATE										
ASH	10.47	10.68	10.67	10.71	10.57	10.5	10.51	10.48	10.59	10.69
CARBON	67.37	67.64	72.52	72.14	72.59	72.71	71.27	71.23	71.23	71.19
HYDROGEN	6	6.63	4.91	4.8	5.1	5.01	4.7	4.73	4.81	4.79
NITROGEN	1.29	1.43	1.4	1.54	1.46	1.5	1.43	1.43	1.43	1.35
SULFUR	3.08	2.87	2.8	2.84	2.87	2.86	2.86	2.89	2.86	2.82
CHLORINE	0.06	0.06	0.122	0.124	0.135	0.148	ND	ND	0.14	0.14
Btu/lb	11827	11670	12858	12828	12815	12809	12776	12767	12734	12706
% DRY ASH										
MAJOR ASH ELEMENTS										
SiO_2	50.3	44.98	50.71	50.64	ND	ND	48.97	ND	49.7	49.6
Al_2O_3	23.13	18.88	22.1	22.14	21.61	20.21	21.32	ND	21.4	21
TiO_2	1.16	0.98	1.09	1.09	1.1	1.02	1.08	ND	0.9	0.9
Fe_2O_3	16.05	14.01	16.52	16.59	15.37	13.41	ND	ND	16.1	16.1
CaO	1.71	1.54	3.3	3.39	1.89	1.68	ND	ND	2.9	2.9
MgO	0.39	0.38	1.06	1.07	0.85	0.85	ND	ND	1	1
Na_2O_3	0.85	0.69	0.91	0.93	0.79	0.72	0.76	ND	0.96	0.88
K_2O	2.83	2.41	2.6	2.61	2.78	2.29	2.28	ND	2.4	2.4
P_2O_5	0.21	0.18	0.18	0.2	0.35	0.34	ND	ND	0.27	0.22
SO_3	ND	ND	2.24	2.3	ND	ND	ND	ND	2.93	2.7

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE J

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	1.03	2.9	3.42	3.34	2	2	2	nd	2.1	2.2
B	311.53	257.9	186.96	179.35	230	220	200	210	222	205
Ba	3.22	27.94	54.1	57.7	54.7	55.6	51	49	ND	51.6
Be	1.61	1.5	1.15	1.19	1.4	1.4	1.1	1.2	1.47	1.43
Cd	0.88	1.01	0.6	0.65	<0.3	<0.3	<0.4	<0.4	0.417	0.276
Cr	34.38	26.86	26.3	26.97	28.6	26.5	30	28	26	33.3
Co	6.45	5.48	3.65	3.59	3.49	3.13	3	3	2.52	2.63
Cu	8.81	10.75	9.35	9.18	<39.2	<35.2	10	9	13.1	13.9
F	0.01	0.01	111.15	110.27	100	110	4.35	ND	91	87
Hg	0.18	<0.1	0.117	0.111	0.1	0.1	0.09	0.09	0.113	0.107
Mn	17.19	35.46	53.4	51.8	30.6	28.2	45	45	42.6	43.8
Mo	10.74	7.52	7.07	7.04	16.7	15.6	5	5	5.2	5.4
Ni	21.48	19.34	16.12	16.55	15.3	13.2	19	17	18.3	21.5
Pb	<0.6	8.81	11.16	10.85	16	12	11	11	7.6	7
Sb	<0.8	<0.8	0.51	0.49	0.49	0.421	<1	<1	ND	ND
Se	1.93	2.79	4.16	3.99	3	3	3	ND	2.5	2.5
V	45.12	36.54	32.32	33.8	33.5	32.1	36	36	38.5	38.6
					% DRY BASIS					
PROXIMATE & ULTIMATE										
ASH	12.2	12.17	12.13	12.16	11.75	11.77	11.89	11.87	11.84	11.85
CARBON	69.43	69.07	70.45	70.4	70.01	69.92	69.56	69.4	68.98	69.34
HYDROGEN	4.78	5.7	4.86	4.84	4.88	4.95	4.43	4.47	4.77	4.73
NITROGEN	1.29	1.3	1.26	1.26	1.37	1.42	1.27	1.31	1.32	1.25
SULFUR	3.52	4.05	3.46	3.42	3.53	2.15	3.42	3.44	3.44	3.39
CHLORINE	0.04	0.04	0.08	0.075	0.079	0.076	ND	ND	0.11	0.01
Btu/lb	10161	11035	12502	12493	12493	12515	12446	12451	12410	12422
					% DRY ASH					
MAJOR ASH ELEMENTS										
SiO_2	7.17	43.52	48.35	48.95	ND	ND	48.17	ND	47.5	48.2
Al_2O_3	5.65	13.51	18.95	18.67	18.56	17.23	18.57	ND	17.6	17.8
TiO_2	1.09	0.9	0.94	0.93	0.9	0.74	0.94	ND	0.9	0.9
Fe_2O_3	15.11	13.89	17.2	17.23	14.94	14.01	ND	ND	16.4	16.8
CaO	1.85	1.98	6.55	6.45	2.21	2.1	ND	ND	5.3	5.5
MgO	0.15	0.28	1.06	1.04	0.92	0.74	ND	ND	1	1
Na_2O_3	0.69	0.9	0.93	0.91	0.85	0.82	1.01	ND	0.99	1
K_2O	1.7	2.02	2.17	2.15	1.47	1.25	2.05	ND	2.1	2.1
P_2O_5	0.28	0.24	0.27	0.29	0.51	0.55	ND	ND	0.24	0.28
SO_3	ND	ND	2.98	2.88	ND	ND	ND	ND	5.86	6.05

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE K

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	2.49	2.8	3.18	3.22	1	2	2	ND	1.9	2.8
B	228.69	238.84	173	167.32	200	180	200	200	201	205
Ba	32.22	32.19	48.5	46.7	61.1	57.4	52	49	50.1	56.5
Be	1.66	1.77	1.34	1.42	1.7	1.7	1.2	1.4	1.69	2.37
Cd	2.18	2.08	1.01	0.96	<0.3	<0.3	<0.4	<.04	0.564	0.184
Cr	33.26	33.23	35.54	33.49	36.9	34.2	32	38	30.5	38.1
Co	4.57	4.88	3.44	3.68	3.67	3.42	3	3	1.82	3.84
Cu	11.43	11.42	9.61	9.7	<35.4	<33.9	9	10	13.8	15.9
F	0.01	0.01	128.14	134.87	110	120	ND	ND	96	88
Hg	0.18	0.19	0.107	0.105	0.011	0.011	0.012	0.12	0.121	0.095
Mn	28.07	28.04	39.9	39.9	27.3	28.5	34	39	33.9	40.8
Mo	7.07	7.58	7.39	7.38	17.6	18.4	<6	<6	5.8	6.9
Ni	17.67	17.65	17.46	17.52	13.5	12.2	18	19	17.4	23
Pb	9.77	14.54	15.25	15.61	18	18	15	16	10.2	9.5
Sb	<0.8	<0.8	0.68	0.73	0.657	0.597	<1	<1	ND	ND
Se	2.81	3.53	5.56	4.94	3	3	3	ND	3.1	2.2
V	46.78	45.69	38.76	41	44.8	46.8	42	48	48.6	57.9
					% DRY BASIS					
PROXIMATE & ULTIMATE										
ASH	12.59	12.38	12.63	12.6	12.44	12.49	12.47	12.46	12.44	12.62
CARBON	68.06	81.55	70.23	70.02	69.61	69.21	68.99	68.92	68.7	68.93
HYDROGEN	4.98	4.6	4.82	4.87	4.91	4.9	4.55	4.53	4.69	4.7
NITROGEN	1.33	1.35	1.34	1.32	1.41	1.36	1.29	1.35	1.33	1.26
SULFUR	4	3.88	3.4	3.43	3.51	3.54	3.48	3.45	3.44	3.39
CHLORINE	0.04	0.03	0.073	0.09	0.086	0.088	ND	ND	0.07	0.07
Btu/lb	11326	11013	12359	12363	12391	12411	12392	12389	12384	12388
					% DRY ASH					
MAJOR ASH ELEMENTS										
SiO_2	46	46.73	51.78	51.75	ND	ND	48.95	ND	50.6	51
Al_2O_3	15.6	17.43	19.36	19.39	18.74	17	18.5	ND	18.6	18.4
TiO_2	0.94	0.98	0.99	0.98	0.85	0.71	1.68	ND	0.9	1
Fe_2O_3	14.17	15.59	19.07	18.9	1.74	1.59	ND	ND	17.5	17.4
CaO	1.5	1.41	3.81	3.68	1.92	1.81	ND	ND	3.5	3.5
MgO	0.3	0.26	1.09	1.09	0.74	0.81	ND	ND	1.1	1.1
Na_2O_3	0.7	0.27	0.77	0.76	0.8	0.7	0.77	ND	0.92	0.82
K_2O	2.19	2.32	2.36	2.35	1.71	2.05	1.95	ND	2.2	2.2
P_2O_5	0.26	0.27	0.31	0.28	0.59	0.51	ND	ND	0.39	0.32
SO_3	ND	ND	1.87	1.82	ND	ND	ND	ND	3.56	3.54

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE L

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	14.26	10.18	13.18	13.29	7	8	8	ND	10.9	10.7
B	81.46	98.77	62.87	64.7	79	72	59	63	63.9	50.1
Ba	25.46	27.49	32.7	32.9	34.4	34.1	30	30	ND	33
Be	1.32	1.63	0.99	1.05	1.5	1.5	1.1	1.1	1.43	1.44
Cd	0.09	0.12	0.15	0.15	<0.3	<0.3	<0.2	<0.2	0.088	0.054
Cr	16.29	20.36	15.08	14.92	17	16.5	15	16	11.7	11.9
Co	6.11	9.67	4.54	4.43	5.18	5.56	4	4	4.49	4.33
Cu	7.33	8.96	6.91	6.76	<34.9	<32.6	7	7	11	10.6
F	<100	<100	61.87	61.71	60	50	ND	ND	52	52
Hg	<0.1	0.19	0.155	0.154	0.12	0.12	0.1	0.1	0.185	0.176
Mn	15.27	18.33	16.3	16.3	19.3	17.5	18	18	18.9	19.2
Mo	<2	3.56	1.58	1.54	1.87	2.02	<3	<3	ND	ND
Ni	13.24	16.29	12.39	12.18	19.3	16.7	14	12	14.3	14.7
Pb	3.46	3.67	6.67	6.55	15	9	6	6	4.7	4.3
Sb	<0.8	<0.8	0.67	0.66	0.546	0.597	<1	<1	ND	ND
Se	1.93	2.14	2.65	2.74	2	2	2	ND	1.1	2.3
V	30.55	37.67	24.64	24.07	32.7	32.5	28	27	32.8	32.3

% DRY BASIS

PROXIMATE & ULTIMATE	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
ASH	11.58	11.56	11.45	11.53	11.61	11.61	11.45	11.38	11.49	11.67
CARBON	71.12	71.51	72.74	72.82	72.69	72.38	71.92	71.97	71.59	71.67
HYDROGEN	5.17	5.41	4.9	4.88	5.03	5.05	4.88	4.87	4.82	4.81
NITROGEN	1.36	1.37	1.39	1.42	1.43	1.42	1.41	1.38	1.34	1.23
SULFUR	3.41	3.52	3.12	3.17	3.26	3.29	3.08	3.15	3.29	3.25
CHLORINE	0.05	0.06	0.091	0.078	0.099	0.096	ND	ND	0.1	0.09
Btu/lb	12539	13308	13004	13009	12925	12950	12977	12973	12925	12936

% DRY ASH

MAJOR ASH ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
SiO_2	39.57	47.19	45.66	45.89	ND	ND	45.42	ND	45.1	44.3
Al_2O_3	19.93	23.29	21.77	21.86	21.55	21.56	22.07	ND	21.2	20.7
TiO_2	0.94	1.07	0.97	0.98	0.96	1.08	0.97	ND	0.9	1
Fe_2O_3	22.63	26.45	26.21	26.12	21.83	21.53	ND	ND	25.4	25.2
CaO	0.5	0.6	1.28	1.29	1.21	1.17	ND	ND	1.2	1.2
MgO	0.26	0.28	0.7	0.71	0.68	0.69	ND	ND	0.73	0.71
Na_2O_3	0.37	0.38	0.41	0.41	0.36	0.33	0.5	ND	0.57	0.52
K_2O	1.7	2.02	1.9	1.92	1.58	1.42	1.83	ND	1.9	1.8
P_2O_5	0.11	0.13	0.1	0.1	0.24	0.21	ND	ND	0.19	0.21
SO_3	ND	ND	1.64	1.62	ND	ND	ND	ND	1.42	1.4

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE M

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	1.36	1.36	1.74	1.75	2	1	1	ND	0.54	0.52
B	101.72	105.45	26.13	31.55	99	100	97	96	79.6	61.2
Ba	161.27	173.68	438.5	451.3	559	589	120	140	445	503
Be	0.52	0.5	0.52	0.53	0.4	0.4	0.3	0.4	0.383	0.319
Cd	<0.06	<0.06	0.1	0.11	<0.3	<0.3	<0.4	<0.4	0.068	ND
Cr	5.21	5.09	4.8	4.76	4.94	5.01	3	4	3.3	3.2
Co	<2.0	2.73	1.19	1.16	0.619	0.641	1	1	ND	0.86
Cu	10.42	10.3	8.21	8.21	<36.7	<41.6	7	8	11.5	11.6
F	<100	<100	50.01	53.25	40	40	ND	ND	39	39
Hg	<0.1	<0.1	0.082	0.08	0.07	0.07	0.06	0.06	0.102	0.088
Mn	119.09	119.09	184.4	186.5	126.3	132.7	140	160	141	141
Mo	7.57	7.2	6.93	7.33	18.7	19.8	5	4	5.7	5.3
Ni	4.09	4.47	3.6	3.56	7.91	10.4	1	2	ND	ND
Pb	4.09	4.84	5.49	5.44	7	8	5	5	3.8	2.9
Sb	<0.8	<0.8	0.49	0.5	0.479	0.481	<1	<1	ND	ND
Se	<0.6	<0.6	0.98	0.95	1	1	1	ND	1.01	ND
V	9.68	10.67	9.3	9.35	8.68	9.07	8	9	9.3	9.6

% DRY BASIS

PROXIMATE & ULTIMATE	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
ASH	11.94	12.07	11.74	11.88	11.54	11.49	11.43	11.46	11.53	11.62
CARBON	67.62	67.2	68.81	68.56	68.36	68.49	67.86	67.72	67.51	67.67
HYDROGEN	7.29	6.03	4.72	4.75	4.72	4.79	4.59	4.58	4.38	4.33
NITROGEN	0.98	1	0.84	0.97	1.15	1.11	0.96	0.96	1.11	1.1
SULFUR	0.89	0.83	0.98	0.99	1.05	1.03	0.94	0.96	0.98	0.98
CHLORINE	0.01	0.01	<0.02	<0.02	<0.1	<0.01	ND	ND	0.04	0.04
Btu/lb	10898	8333	11747	11743	11738	11707	11775	11745	11670	11662

% DRY ASH

MAJOR ASH ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
SiO_2	40.07	41.85	43.44	43.5	ND	ND	43.29	ND	40.3	40.9
Al_2O_3	8.64	7.77	18.96	18.97	15.34	16.2	18.98	ND	19.5	19.1
TiO_2	0.81	0.86	0.81	0.81	1.29	1.23	0.84	ND	0.8	0.8
Fe_2O_3	4.75	4.85	7.05	7.64	5.21	6.02	ND	ND	5.9	5.6
CaO	2.76	2.16	12.82	12.83	3.75	4.21	ND	ND	11.4	11.4
MgO	1.45	1.11	4.04	4.02	0.96	0.99	ND	ND	3.9	3.9
Na_2O_3	0.24	0.24	0.29	0.32	0.26	0.29	0.32	ND	0.32	0.38
K_2O	0.84	0.46	0.5	0.51	0.37	0.44	0.48	ND	0.49	0.51
P_2O_5	0.31	0.31	0.29	0.29	0.64	0.6	ND	ND	0.29	0.27
SO_3	ND	ND	1.77	11.84	ND	ND	ND	ND	14.48	14.08

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE N

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	11.83	10.07	11.69	11.71	4	5	3	ND	8.9	10.1
B	199.3	149.18	41.06	49.2	145	145	150	140	136	124
Ba	361.24	335.65	695.5	655	73	77.9	390	460	754	729
Be	0.97	0.77	0.51	0.51	0.8	0.8	0.6	0.6	0.711	1.13
Cd	0.11	<0.06	0.13	0.13	<0.4	<0.4	<0.4	<0.4	0.11	ND
Cr	10.09	7.71	8.01	8.45	9.06	8.67	8	20	6.4	6
Co	4.73	3.11	2.78	2.67	1.85	1.95	1	1	1.27	1.51
Cu	11.58	8.95	7.72	7.57	<39.7	<40.7	7	7	16.2	13.2
F	<100	<100	62.27	62.91	50	50	2.05	ND	54	56
Hg	<0.1	<0.1	0.129	0.167	0.11	0.1	0.13	0.13	0.153	0.155
Mn	137.02	105.67	150.8	147.9	93.1	96.5	130	130	120	124
Mo	3.99	3.85	2.82	2.88	10.5	11	<6	<6	0.142	0.44
Ni	7.22	5.59	7.3	7.49	15.5	16.4	4	4	5.32	11.8
Pb	3.61	2.98	2.6	2.5	9	8	3	3	1.97	0.05
Sb	<0.8	<0.8	0.77	0.79	0.672	0.704	<1	<1	ND	ND
Se	0.95	<0.6	1.03	1.03	<1	<1	1	ND	1.56	ND
V	21.18	16.16	15.72	15.78	19.4	19.2	16	17	16	16.2
					% DRY BASIS					
PROXIMATE & ULTIMATE										
ASH	16.73	16.96	16.11	16.15	16.64	16.46	16.74	16.69	17.06	17.32
CARBON	58.35	58.36	59.77	59.64	59.26	59.22	58.96	59.22	59.26	59.64
HYDROGEN	6.03	4.36	4.23	4.25	4.28	4.31	4.06	4.02	3.8	3.87
NITROGEN	0.82	0.82	0.91	0.91	1.06	1.05	0.81	0.77	1.02	0.99
SULFUR	1.02	1.02	1.15	1.13	1.18	1.16	1.13	1.14	1.13	1.12
CHLORINE	ND	ND	<0.02	<0.02	<0.01	<0.01	ND	ND	0.04	0.04
Btu/lb	9107	7314	9887	9881	9924	9906	9906	9894	9892	9885
					% DRY ASH					
MAJOR ASH ELEMENTS										
SiO_2	46.27	34.56	41.36	40.88	ND	ND	39.59	ND	39.6	39.4
Al_2O_3	4.36	3.6	12.34	12.09	12.98	13.13	12.28	ND	12.1	12.2
TiO_2	0.57	0.44	0.43	0.42	0.44	0.53	0.48	ND	0.5	0.5
Fe_2O_3	5.22	4.19	7.09	7.06	6.25	6.38	ND	ND	6.6	6.6
CaO	4.9	3.9	17.58	17.35	4.77	5.06	ND	ND	15.9	16
MgO	1.23	1.34	4.8	4.73	1.11	1.05	ND	ND	4.7	4.7
Na_2O_3	0.94	0.82	0.87	0.84	0.8	0.81	0.85	ND	0.95	0.92
K_2O	1.79	1.24	1.37	1.33	1.19	1.36	1.26	ND	1.4	1.4
P_2O_5	0.19	0.14	0.13	0.12	0.33	0.31	ND	ND	0.18	0.15
SO_3	ND	ND	14.56	14.4	ND	ND	ND	ND	15.11	14.94

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE O

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
As	46.12	35.85	34.96	36.04	21	18	27	ND	29.4	31
B	99.41	74.78	58.5	62.38	73	77	72	80	54.5	47.8
Ba	53.29	48.15	84.8	86.2	107	100	85	89	ND	85
Be	2.97	2.25	1.9	2.03	2.7	2.4	2.1	2.4	2.58	2.61
Cd	0.11	0.06	0.14	0.13	<0.3	<0.3	<0.4	<0.4	0.11	ND
Cr	22.55	18.44	20.68	19.39	21	22.6	20	20	13.3	13.9
Co	9.74	9.12	5.9	6.16	6.67	7.72	8	7	4.6	5.8
Cu	23.57	18.44	17.81	18.62	<31	<32.6	22	22	22.7	23.5
F	0.01	0.1	80.03	68.12	90	90	ND	ND	73	73
Hg	0.14	0.3	0.248	0.273	0.23	0.23	0.2	0.2	0.399	0.353
Mn	26.64	21.51	27.2	24.8	27.4	30.4	30	31	26	26.4
Mo	10.25	5.33	4.05	4.09	5.09	5.68	<6	<6	1.85	2.79
Ni	27.67	21.51	21.12	22.1	54.5	61.9	26	25	23.7	24.1
Pb	9.94	11.27	15.29	15.14	17	20	19	18	10.5	9.7
Sb	2.15	1.43	2.09	2.17	1.85	1.78	2	2	2.6	2.4
Se	2.05	2.15	3.39	3.37	2	3	3	ND	3.3	2.2
V	44.07	33.8	28.47	30.13	32.3	32.1	28	26	35.6	36.6

% DRY BASIS

PROXIMATE & ULTIMATE	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
ASH	13.29	13.46	13.32	13.3	13.28	13.4	13.12	13.18	13.31	13.46
CARBON	69.61	69.56	71.35	71.16	71.19	71.46	70.38	70.79	70.5	70.66
HYDROGEN	5.06	5.24	4.82	4.78	4.91	5	4.6	4.65	4.76	4.79
NITROGEN	1.3	1.31	1.34	1.47	1.41	1.37	1.36	1.38	1.33	1.35
SULFUR	3.08	3.1	2.92	2.97	3.02	2.99	3.01	3.04	2.93	2.91
CHLORINE	0.02	0.02	0.13	0.13	0.127	0.13	ND	ND	0.12	0.12
Btu/lb	11774	11530	12737	12720	12654	12655	12690	12708	12644	12637

% DRY ASH

MAJOR ASH ELEMENTS	LAB I RUN 1	LAB I RUN 2	LAB II RUN 1	LAB II RUN 2	LAB III RUN 1	LAB III RUN 2	LAB IV RUN 1	LAB IV RUN 2	LAB V RUN 1	LAB V RUN 2
SiO_2	52.88	39.14	46.16	46.9	ND	ND	42.89	ND	45.3	45
Al_2O_3	24.76	20.13	23.46	23.32	20.52	20.27	21.3	ND	22.5	22.6
TiO_2	1.29	0.96	1.09	1.08	1.03	1.02	2.32	ND	1.1	1.1
Fe_2O_3	23.15	17.41	22.28	22.17	20.6	22.79	ND	ND	21	21.4
CaO	1.19	0.97	1.84	1.8	1.31	1.22	ND	ND	1.7	1.7
MgO	0.37	0.44	0.88	0.87	0.83	0.77	ND	ND	0.85	0.85
Na_2O_3	0.24	0.21	0.31	0.29	0.25	0.25	0.36	ND	0.47	0.44
K_2O	2.51	2.11	2.32	2.32	2.27	2.33	1.72	ND	2.2	2.2
P_2O_5	0.53	0.4	0.48	0.47	0.97	0.85	ND	ND	0.49	0.53
SO_3	ND	ND	1.83	1.75	ND	ND	ND	ND	1.74	1.74

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE P

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	1.75	2.19	2.48	2.6	1	1	1	ND	2.3	2.4
B	89.74	90.81	75.17	75.9	80	77	82	74	45.2	65.9
Ba	82.08	79.87	397.2	377.8	495	462	230	240	385	374
Be	1.42	1.42	1.14	1.16	1.2	1.4	1.3	1.1	1.32	1.35
Cd	<0.06	2.95	<.01	<0.1	<0.4	<0.4	<0.6	<0.6	0.018	ND
Cr	10.84	10.72	9.42	9.9	10.8	9.9	10	9	7.6	7.4
Co	6.24	6.24	4.15	4	4.34	3.79	5	3	2.74	3.41
Cu	13.13	14.22	11.56	11.49	<39.2	<35.7	11	10	13.7	13.4
F	0.01	<100	87.98	88.66	80	80	ND	ND	56	56
Hg	<0.1	0.16	0.082	0.089	0.07	0.08	0.08	0.08	0.078	0.077
Mn	51.44	47.05	90.6	90.6	82.5	79.1	87	79	77.1	75.4
Mo	2.96	2.95	1.68	1.66	<19.6	<17.8	<8	<8	0.488	ND
Ni	8.54	8.1	7.28	8.23	<14.7	<13.4	5	6	5.9	7.3
Pb	7.33	6.1	9.45	9.63	11	9	10	9	6.72	7
Sb	1.42	1.97	1.7	1.73	1.77	1.55	2	1	2.6	ND
Se	1.2	1.03	1.59	1.72	1	1	<1	ND	0.79	0.26
V	26.27	27.35	22.37	23.81	26.1	21.6	28	26	27	26.1
PROXIMATE & ULTIMATE					% DRY BASIS					
ASH	20.56	20.54	20.58	20.6	20.44	20.43	20.24	20.29	20.51	20.75
CARBON	60.52	61.06	62.04	62.16	62.33	62.4	61.56	61.24	61.09	61.27
HYDROGEN	5.12	5.39	4.65	4.66	4.8	4.84	4.61	4.65	4.51	4.58
NITROGEN	1.02	1.02	0.98	1	1.11	1.15	1.08	1	1.09	1.08
SULFUR	0.61	0.64	0.7	0.072	0.71	0.7	0.69	0.7	0.7	0.71
CHLORINE	0.01	0.01	<0.02	<0.02	<0.01	<0.01	ND	ND	0.04	0.04
Btu/lb	10329	9469	10913	10898	10872	10870	10852	10865	10857	10830
MAJOR ASH ELEMENTS					% DRY ASH					
SiO_2	57.03	55.93	61.79	61.01	ND	ND	60.75	59.54	58.2	58.8
Al_2O_3	16.09	15.09	22.5	22.16	22.53	19.93	22.08	21.79	21.1	20.9
TiO_2	0.98	0.98	0.95	0.93	1	1.04	0.94	0.93	1	1
Fe_2O_3	4.11	3.88	4.84	4.86	4.5	4.35	ND	ND	4.4	4.5
CaO	2.31	2.01	4.57	4.51	2.38	2.52	ND	ND	4.3	4.3
MgO	0.32	0.28	1.34	1.31	0.93	0.91	ND	ND	1.2	1.2
Na_2O_3	0.13	0.11	0.27	0.26	0.26	0.24	0.26	0.22	0.27	0.27
K_2O	1.09	1.03	1.39	1.39	1.32	1.26	1.3	1.27	1.3	1.3
P_2O_5	0.03	0.04	0.04	0.04	0.02	0.03	ND	ND	0.04	0.04
SO_3	ND	ND	3.61	3.52	ND	ND	ND	ND	3.92	3.8

INDIVIDUAL LABORATORY ANALYSES OF ROUND ROBIN SAMPLE Q

PPM DRY WHOLE COAL BASIS

TRACE ELEMENTS	LAB I		LAB II		LAB III		LAB IV		LAB V	
	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2	RUN 1	RUN 2
As	4.72	5.67	4.39	4.43	3	3	3	ND	2.3	3.3
B	235.98	288.74	138.35	135.55	160	180	160	170	140	160
Ba	39.69	41.71	50.9	50.8	56.8	67.1	50	47	48.6	50.2
Be	1.93	2.35	1.11	1.18	1.5	1.5	1.2	1.2	1.44	1.48
Cd	0.55	1.39	0.66	0.63	<0.2	<0.2	<0.3	<0.3	0.286	0.089
Cr	25.74	32.08	19.39	20.28	21.9	21.5	22	22	19.2	17.4
Co	7.08	8.77	3.61	3.59	3.88	4.23	4	5	2.79	2.29
Cu	12.87	18.18	10.72	10.79	<34.3	<34.8	12	12	15.3	15.3
F	<100	<100	80.61	80.89	80	80	ND	ND	70	75
Hg	<0.1	0.18	0.098	0.109	0.07	0.07	0.09	0.08	0.117	0.113
Mn	33.25	34.22	32.4	33.2	29.7	29.3	31	30	26.6	26.9
Mo	6.54	9.09	5.06	5.1	<8.6	<8.7	<6	<6	4.34	4
Ni	21.45	24.6	15.19	15.24	28.4	29.7	18	16	17.3	16.5
Pb	6.22	1.39	10.87	10.68	11	12	11	12	6.8	6.2
Sb	<0.8	<0.8	0.61	0.58	0.445	0.596	<1	<1	1.78	ND
Se	1.39	2.03	3.04	2.91	3	3	2	ND	2.4	1.87
V	48.27	57.75	31.51	32.81	36.6	35.7	39	39	40	39.4
					% DRY BASIS					
PROXIMATE & ULTIMATE										
ASH	10.61	10.58	10.65	10.76	10.56	10.55	10.46	10.51	10.62	10.64
CARBON	66.15	68.69	72.54	72.7	72.68	72.58	71.32	71.6	71.25	71.23
HYDROGEN	6.38	5.87	4.89	4.89	5.11	5.09	4.71	4.73	4.77	4.79
NITROGEN	1.41	1.42	1.48	1.48	1.52	1.45	1.37	1.36	1.34	1.31
SULFUR	3.25	3.25	2.77	2.76	2.78	2.86	2.9	2.92	2.87	2.78
CHLORINE	0.07	0.08	0.139	0.137	0.148	0.136	ND	ND	0.1	0.1
Btu/lb	12206	11290	12901	12875	12765	12769	12815	12809	12768	12733
					% DRY ASH					
MAJOR ASH ELEMENTS										
SiO_2	60.66	69.31	50.76	50.64	ND	ND	49.64	ND	50.1	50.2
Al_2O_3	24.82	26.73	22.2	22.07	19.79	19.71	21.62	ND	21.7	21.5
TiO_2	1.37	1.64	1.11	1.01	0.27	0.27	1.07	ND	1.2	1.2
Fe_2O_3	18.79	21.68	16.92	16.92	16.53	16.39	ND	ND	15.4	15.5
CaO	1.7	1.56	3.31	3.4	2.22	2.01	ND	ND	2.9	3
MgO	0.34	0.28	1.03	1.04	0.69	0.66	ND	ND	1	1
Na_2O_3	0.91	1.01	0.87	0.89	0.7	0.81	0.81	ND	0.9	0.91
K_2O	2.92	3.41	2.58	2.56	1.9	2.04	2.38	ND	2.5	2.4
P_2O_5	0.22	0.3	0.2	0.21	0.39	0.43	ND	ND	0.21	0.21
SO_3	ND	ND	2.23	2.32	ND	ND	ND	ND	2.82	2.9

APPENDIX B

INTRALABORATORY TRACE ELEMENT REPEATABILITY AS PERCENT DIFFERENCE

Laboratory Repeatability
Samples A & J

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	31.0%	1.9%	0.0%	0.0%	6.7%	7.9%	13.2%	166.3%
B	7.7%	1.0%	6.5%	11.5%	14.3%	8.2%	5.1%	62.0%
Ba	65.2%	6.3%	29.7%	12.2%	63.1%	35.3%	27.7%	78.5%
Be	57.1%	6.6%	7.4%	16.0%	2.1%	17.8%	22.5%	126.2%
Cd	9.1%	7.5%			27.9%	14.8%	11.4%	76.7%
Cr	12.4%	4.4%	3.5%	17.3%	16.8%	10.9%	6.6%	61.0%
Co	0.5%	6.9%	1.5%	50.0%	23.2%	16.4%	20.9%	127.2%
Cu		6.9%		23.3%	2.6%	10.9%	10.9%	99.8%
F		2.2%	4.9%		24.6%	10.6%	12.2%	115.8%
Hg		18.7%	10.5%	10.5%	5.3%	11.3%	5.5%	49.1%
Mn	36.7%	1.5%	2.8%	18.2%	2.2%	12.3%	15.3%	124.4%
Mo	11.2%	2.3%	8.4%	50.0%	9.0%	16.2%	19.2%	118.6%
Ni	11.0%	3.3%	6.1%	20.0%	11.1%	10.3%	6.3%	61.5%
Pb	21.8%	1.9%	54.5%	12.8%	7.8%	19.8%	20.8%	105.1%
Sb		4.9%	7.1%			6.0%	1.6%	26.2%
Se	32.6%	12.5%	18.2%	0.0%	17.4%	16.1%	11.7%	72.7%
V	6.7%	13.2%	6.6%	17.7%	1.4%	9.1%	6.4%	69.7%
Average	23.3%	6.0%	11.2%	18.5%	14.7%	13.8%	7.9%	57.8%

Laboratory Repeatability
Samples B & K

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	3.7%	0.6%	0.0%	85.7%	32.1%	24.4%	36.8%	150.5%
B	10.3%	11.8%	33.0%	2.5%	3.2%	12.2%	12.4%	101.6%
Ba	10.5%	2.0%	15.2%	8.2%	13.6%	9.9%	5.2%	52.4%
Be	8.4%	1.8%	12.5%	3.8%	9.5%	7.2%	4.4%	60.5%
Cd	86.4%	0.0%			67.7%	51.4%	45.5%	88.5%
Cr	7.3%	1.9%	2.0%	6.9%	7.1%	5.0%	2.8%	55.9%
Co	7.3%	1.6%	0.1%	0.0%	3.1%	2.4%	3.0%	123.9%
Cu	0.2%	0.5%		5.1%	9.5%	3.8%	4.4%	115.4%
F		5.2%	0.0%		0.5%	1.9%	2.8%	149.1%
Hg		14.8%	163.6%	4.3%	2.3%	46.3%	78.4%	169.5%
Mn	12.0%	0.9%	3.9%	2.7%	6.8%	5.2%	4.3%	82.8%
Mo	2.3%	1.4%			9.9%	4.5%	4.7%	102.6%
Ni	8.3%	1.6%	54.0%	12.7%	9.6%	17.2%	20.9%	121.6%
Pb	84.5%	3.8%	14.9%	3.3%	2.1%	21.7%	35.5%	163.5%
Sb		2.2%	1.5%			1.8%	0.5%	25.0%
Se	28.1%	10.1%	15.4%	100.0%	7.3%	32.2%	38.7%	120.4%
V		2.1%	2.4%	4.3%	7.0%	4.0%	2.3%	56.9%
Average	20.7%	3.7%	22.7%	17.2%	12.0%	14.8%	23.8%	160.7%

Laboratory Repeatability
Samples C & L

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	93.4%	0.7%	22.2%	28.6%	16.6%	32.3%	35.7%	110.6%
B	1.0%	1.8%	5.8%	19.9%	15.5%	8.8%	8.5%	96.2%
Ba	5.7%	2.3%	15.2%	15.4%	71.2%	22.0%	28.1%	128.1%
Be	10.0%	12.0%	18.2%	8.7%	5.8%	10.9%	4.6%	42.5%
Cd	27.0%	35.3%			76.0%	46.1%	26.2%	56.9%
Cr	13.1%	8.5%	5.5%	22.9%	5.7%	11.1%	7.2%	65.0%
Co	13.4%	0.0%	6.6%	40.0%	2.2%	12.4%	16.2%	130.5%
Cu	9.6%	1.9%		13.3%	2.3%	6.8%	5.6%	83.1%
F		2.9%	8.7%		6.5%	6.0%	2.9%	48.8%
Hg	17.1%	6.3%	13.3%	33.3%	25.3%	19.1%	10.5%	55.0%
Mn	8.8%	1.5%	1.9%	22.2%	1.3%	7.2%	9.0%	125.7%
Mo	62.9%	4.7%	16.3%			28.0%	30.8%	110.2%
Ni	9.9%	0.3%	52.2%	14.3%	3.5%	16.0%	20.9%	130.6%
Pb	46.9%	2.0%	66.7%	22.2%	12.5%	30.1%	26.4%	87.7%
Sb		2.2%	9.5%			5.9%	5.1%	87.6%
Se	15.9%	6.7%	28.6%	0.0%	54.8%	21.2%	21.6%	102.0%
V	10.1%	2.4%	7.5%	18.2%	1.7%	8.0%	6.7%	84.1%
Average	23.0%	5.4%	18.5%	19.9%	20.0%	17.2%	11.6%	67.9%

Laboratory Repeatability
Samples D & M

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	13.7%	9.0%		0.0%	1.9%	6.1%	6.4%	103.5%
B	7.2%	32.8%	5.4%	7.0%	23.3%	15.1%	12.3%	81.2%
Ba	0.3%	3.8%	15.2%	20.7%	3.9%	8.8%	8.7%	99.1%
Be	0.2%	19.9%	0.0%	15.4%	16.6%	10.4%	9.6%	91.8%
Cd		40.0%			32.5%	36.2%	5.3%	14.7%
Cr	3.2%	12.3%	12.7%	13.3%	1.1%	8.5%	5.9%	69.1%
Co		0.4%	11.9%		11.0%	7.8%	6.4%	82.1%
Cu	1.6%	11.9%		6.5%	12.2%	8.0%	5.0%	62.7%
F		6.6%	22.2%		5.3%	11.3%	9.4%	83.2%
Hg		11.6%	13.3%	50.0%	1.6%	19.1%	21.2%	110.9%
Mn	8.3%	1.0%	26.8%	3.3%	5.9%	9.0%	10.3%	113.7%
Mo	1.5%	9.7%	55.0%	20.0%	7.4%	18.7%	21.3%	113.9%
Ni	2.2%	4.5%	52.1%	0.0%		14.7%	25.0%	170.0%
Pb	13.8%	0.4%	0.0%	0.0%	0.0%	2.8%	6.1%	216.4%
Sb		3.1%	8.7%			5.9%	4.0%	67.5%
Se		5.9%		0.0%		2.9%	4.1%	141.4%
V	10.1%	12.1%	1.6%	5.7%	3.1%	6.5%	4.5%	68.7%
	5.6%	10.9%	17.3%	10.9%	9.0%	11.3%	7.1%	63.0%

Laboratory Repeatability
Samples E & N

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	86.9%	0.8%	0.0%	85.7%	7.7%	36.2%	45.8%	126.6%
B	17.1%	0.0%	3.4%	7.1%	10.6%	7.6%	6.6%	86.2%
Ba	41.2%	1.6%	163.0%	8.6%	4.7%	43.8%	68.5%	156.3%
Be	12.8%	34.8%	13.3%	8.0%	29.3%	19.6%	11.7%	59.4%
Cd	8.7%	26.1%			26.8%	20.5%	10.2%	49.9%
Cr	7.8%	7.4%	1.2%	0.0%	0.0%	3.3%	4.0%	121.5%
Co	24.6%	4.7%	0.5%	40.0%	31.7%	20.3%	17.1%	84.3%
Cu	11.8%	8.3%		0.0%	24.9%	11.2%	10.3%	92.0%
F		7.0%	18.2%		0.9%	8.7%	8.8%	100.6%
Hg		2.3%	47.3%	32.3%	21.2%	25.8%	18.9%	73.5%
Mn	15.4%	0.6%	3.7%	7.4%	0.8%	5.6%	6.1%	110.2%
Mo	12.9%	3.2%	38.0%		50.7%	26.2%	21.9%	83.7%
Ni	7.3%	1.4%		11.8%	66.0%	21.6%	29.9%	138.4%
Pb	109.8%	10.6%	72.0%	28.6%	96.7%	63.5%	42.8%	67.4%
Sb		4.6%	58.6%			31.6%	38.2%	120.9%
Se		10.2%		0.0%	70.6%	26.9%	38.2%	141.7%
V	81.0%	9.4%	19.0%	5.9%	0.6%	23.2%	33.0%	142.3%
Average	33.6%	7.8%	33.7%	18.1%	27.7%	23.3%	19.5%	83.9%

Laboratory Repeatability
Samples F & O

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	38.9%	0.6%	13.7%	11.8%	6.1%	14.2%	14.7%	103.5%
B	6.5%	5.8%	0.7%	13.3%	14.5%	8.2%	5.7%	70.1%
Ba	7.1%	7.6%	14.7%	4.7%	53.0%	17.4%	20.2%	116.1%
Be	4.3%	9.5%	26.7%	4.3%	0.6%	9.1%	10.3%	113.9%
Cd	6.1%	20.4%			16.7%	14.4%	7.4%	51.6%
Cr	9.8%	30.2%	5.2%	2.5%	6.8%	10.9%	11.1%	102.0%
Co	11.0%	2.3%	16.2%	0.0%	24.3%	10.8%	10.0%	92.7%
Cu	2.7%	5.7%		7.1%	10.3%	6.4%	3.1%	48.9%
F		21.1%	5.4%		13.1%	13.2%	7.8%	59.3%
Hg	8.7%	6.3%	8.3%	22.2%	12.9%	11.7%	6.3%	54.3%
Mn	15.1%	2.3%	14.1%	0.0%	0.6%	6.4%	7.5%	117.5%
Mo	11.7%	6.8%	36.4%		30.0%	21.2%	14.2%	67.1%
Ni	13.9%	2.6%	71.6%	3.8%	1.1%	18.6%	30.1%	161.5%
Pb	97.8%	2.9%	20.9%	11.4%	16.4%	29.9%	38.5%	129.0%
Sb	29.7%	4.4%	11.4%	0.0%		11.4%	13.1%	115.1%
Se	21.3%	3.0%	22.2%	0.0%	39.1%	17.1%	16.0%	93.2%
V	5.4%	4.5%	8.2%	27.2%	2.1%	9.5%	10.2%	107.3%
Average	18.1%	8.0%	18.4%	7.7%	15.5%	13.6%	9.8%	72.6%

Laboratory Repeatability
Samples G & P

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	21.3%	0.4%	0.0%	66.7%	82.3%	34.1%	38.2%	112.0%
B	6.0%	16.8%	8.0%	5.9%	2.7%	7.9%	5.3%	67.6%
Ba	12.9%	5.9%	10.3%	6.2%	0.7%	7.2%	4.7%	65.1%
Be	3.6%	17.1%	8.0%	4.3%	6.9%	8.0%	5.4%	68.0%
Cd					165.0%	165.0%		
Cr	9.9%	18.8%	2.4%	0.0%	3.4%	6.9%	7.6%	109.9%
Co	18.0%	1.5%	5.9%	0.0%	26.3%	10.3%	11.4%	110.3%
Cu	79.1%	9.7%		4.9%	6.1%	24.9%	36.2%	144.9%
F		4.2%	11.8%		29.7%	15.2%	13.1%	86.1%
Hg		10.5%	6.5%	13.3%	3.9%	8.6%	4.2%	48.8%
Mn	6.7%	10.0%	3.1%	4.3%	0.5%	4.9%	3.6%	73.4%
Mo	80.4%	4.1%			86.0%	56.8%	45.7%	80.5%
Ni	16.2%	4.0%		9.5%	3.1%	8.2%	6.0%	73.8%
Pb	30.9%	5.1%	18.2%	10.0%	0.9%	13.0%	11.9%	91.4%
Sb	13.5%	0.3%	9.8%	40.0%	98.5%	32.4%	39.8%	122.7%
Se		4.4%	0.0%		92.0%	32.2%	51.9%	161.4%
V	0.2%	8.6%	8.2%	3.6%	3.3%	4.8%	3.6%	74.4%
Average	23.0%	7.6%	7.1%	13.0%	36.0%	25.9%	18.9%	73.1%

Laboratory Repeatability
Samples H & Q

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	96.4%	3.6%	0.0%	0.0%	27.7%	25.5%	41.3%	161.7%
B	30.8%	1.4%	3.0%	6.3%	3.0%	8.9%	12.4%	139.5%
Ba	14.4%	0.6%	17.1%	1.0%	4.1%	7.4%	7.8%	104.1%
Be	28.9%	8.4%	30.8%	4.1%	1.4%	14.7%	14.1%	95.7%
Cd	77.1%	8.1%			15.7%	33.6%	37.8%	112.5%
Cr	27.6%	0.5%	0.5%	0.0%	1.7%	6.0%	12.1%	199.6%
Co	11.0%	0.1%	4.0%	0.0%	2.6%	3.6%	4.5%	126.6%
Cu	19.1%	3.1%		0.0%	2.3%	6.1%	8.8%	143.0%
F		14.1%	0.0%		2.1%	5.4%	7.6%	141.0%
Hg	18.2%	5.5%	33.3%	42.9%	6.3%	21.2%	16.6%	78.0%
Mn	29.4%	3.4%	30.2%	1.6%	0.9%	13.1%	15.3%	116.4%
Mo	20.6%	0.1%			18.3%	13.0%	11.2%	86.4%
Ni	18.0%	0.3%	73.1%	5.7%	3.9%	20.2%	30.3%	150.1%
Pb	33.1%	1.0%	24.4%	4.4%	10.2%	14.6%	13.6%	93.2%
Sb		3.3%	3.8%		100.0%	35.7%	55.7%	155.9%
Se	9.8%	2.5%	40.0%	0.0%	22.7%	15.0%	16.5%	110.2%
V	30.5%	2.1%	0.4%	1.3%	0.8%	7.0%	13.1%	187.8%
Average	31.0%	3.4%	18.6%	5.2%	13.2%	14.8%	15.2%	103.2%

Laboratory Repeatability
All Coals

TRACE ELEMENTS	LAB I	LAB II	LAB III	LAB IV	LAB V	MEAN	SDEV	PRSD
As	48.2%	2.2%	4.5%	34.8%	22.6%	22.5%	19.7%	87.6%
B	10.8%	8.9%	8.2%	9.2%	10.9%	9.6%	1.2%	12.4%
Ba	19.7%	3.8%	35.1%	9.6%	26.8%	19.0%	12.6%	66.6%
Be	15.7%	13.8%	14.6%	8.1%	9.0%	12.2%	3.4%	28.2%
Cd	26.8%	17.2%			53.6%	32.5%	18.9%	58.0%
Cr	11.4%	10.5%	4.1%	7.9%	5.3%	7.8%	3.2%	40.3%
Co	10.7%	2.2%	5.9%	16.3%	15.5%	10.1%	6.1%	60.2%
Cu	15.5%	6.0%		7.5%	8.8%	9.4%	4.2%	44.5%
F		7.9%	8.9%		10.3%	9.0%	1.2%	13.6%
Hg	5.5%	9.5%	37.0%	26.1%	9.8%	17.6%	13.4%	76.3%
Mn	16.6%	2.6%	10.8%	7.5%	2.4%	8.0%	6.0%	74.7%
Mo	25.4%	4.0%	19.3%	8.8%	26.4%	16.8%	10.0%	59.7%
Ni	10.9%	2.2%	38.6%	9.7%	12.3%	14.7%	13.9%	94.3%
Pb	54.8%	3.5%	34.0%	11.6%	18.3%	24.4%	20.4%	83.3%
Sb	5.4%	3.1%	13.8%	5.0%	24.8%	10.4%	9.0%	86.7%
Se	13.5%	6.9%	15.5%	12.5%	38.0%	17.3%	12.0%	69.5%
V	18.0%	6.8%	6.7%	10.5%	2.5%	8.9%	5.8%	65.3%
Average	19.3%	6.5%	17.1%	12.3%	17.5%	14.7%	6.9%	46.6%

Average Repeatability by Coals

Coal	Avg
A & J	13.8%
B & K	14.8%
C & L	17.2%
D & M	11.3%
E & N	23.3%
F & O	13.6%
G & P	25.9%
H & Q	14.7%

DOE COAL ROUND ROBIN TRACE ELEMENT REPEATABILITY RESULTS
% of Individual Lab Analysis Within Repeatability Ranges

Repeatability Range	Lab I	Lab II	Lab III	Lab IV	Lab V	All Labs
Less than 10%	31.0	79.0	42.0	46.0	52.0	50.0
10 to 20%	24.0	14.0	19.0	17.0	15.0	18.0
20 to 30%	8.0	2.0	7.0	7.0	11.0	7.0
30 to 50%	7.0	4.0	6.0	6.0	3.0	5.0
Greater than 50%	10.0	0.0	9.0	4.0	12.0	7.0
Non Determined	20.0	1.0	18.0	21.0	7.0	13.0

APPENDIX E:
ANALYTICAL PROTOCOL

Introduction

This appendix contains brief descriptions of the analytical methods used. The analogous water, solid, and gas methods are described together.

Methods used for sample analysis are presented in Table E-1. Most of the laboratory methods identified in this document were published by the United States Environmental Protection Agency in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846," Third Edition, or "Methods for Chemical Analysis of Water and Wastes." Additional methods identified were published in "Criteria for Identification of Hazardous and Extremely Hazardous Wastes," "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," 40 CFR 136, 49 FR 209 (26 October 1984), Annual Book of ASTM Standards, Volume 4.08, and "Standard Methods for the Examination of Water and Wastewater."

Extraction Methods

Extraction/digestion methods for liquid and solid matrices are briefly described in this section.

Method SW3005[1]
Acid Digestion of Aqueous Samples for Analyses by ICP

This method is an acid digestion procedure used to prepare water samples for metals analysis. The digested samples can be analyzed for total recoverable and dissolved metals determination by either flame (FLAA) or inductively coupled plasma atomic emission spectroscopy (ICP-AES). Samples may be analyzed for the following metals:

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

Table E-1
Analytical Methods Used During Sampling Activities at Plant Yates

	Analytical Method[a]		
Parameter	**Water**	**Gas**	**Solids**
Moisture Content	NA	NA	A-D3173[2]
Particulate Loading	NA	EPA M5/M17	NA
Particle Size Distribution	NA	EPA	
Ultimate	NA	NA	ASTM D-3176[3]
Proximate	NA	NA	ASTM D-3172[4]
Carbon	NA	NA	ASTM D-5373[5]
Sulfur	NA	NA	ASTM D-4239[6]
Heating Value	NA	NA	ASTM D-2015[7]
Chloride	E300.0	E300.0	SM4500-Cl-D[8]
Fluoride	E340.2	E340.2	E340.2[9]
Phosphate	E365.2	E365.2	NA
Sulfate	E300.0	E300.0	E300.0[10]
Sulfite	E377.1	NA	E377.1[11]
Ammonia	E350.1	E350.2	NA
Cyanide, Total	SW9012	SW9012	NA
ICP-AES Metals	SW6010	SW6010	SW6010[12]
ICP-MS Metals	SW6020	SW6020	SW6020[13]
Metals	NA	NA	INAA
Metals	NA	NA	GDMS
Arsenic	SW7060	SW7060	SW7060[14]
Cadmium	SW7131	SW7131	SW7131[15]
Lead	SW7421	SW7421	SW7421[16]
Mercury	SW7470	SW7471	SW7471[17]
Selenium	SW7740	SW7740	SW7740[18]
Aldehydes	SW8315	E0011a	NA
Volatile Organic Compounds	SW8240	SW8240	NA
Semivolatile Organic Compounds	SW8270	SW8270	SW8270[19]
Polychlorinated Dioxins and Furans	NA	Method 23	Method 23[20]
Radionuclides	NA	NA	E901.1/900.0[21]

[a] Method abbreviations include ASTM = American Society of Testing and Materials, EPA = EPA "Methods for Chemical Analysis of Water and Wastes," SM = "Standard Methods for the Examination of Water and Wastewater," and SW = SW-846 "Test Methods for Evaluating Solid Waste."

NA = Not Applicable.

For analysis of total recoverable metals, the entire sample is acidified at collection time with nitric (HNO_3) acid to a pH <2. At the time of analysis, a 50-mL aliquot of the sample is heated with 1 mL of 1:1 nitric acid and 5 mL of hydrochloric acid and reduced to a specific volume. The sample must not be boiled because antimony is volatile and easily lost. The digestate is then adjusted to a final volume of 50 mL with reagent water.

For analysis of dissolved metals, the samples are filtered through a 0.45 μm filter immediately upon collection in the field, and acidified with nitric (HNO_3) acid to a pH <2. For analysis, the sample is digested as described above.

Modified Method SW3020[22]
Acid Digestion of Aqueous Samples for Analyses by Graphite Furnace Atomic Absorption Spectroscopy

Water samples are digested according to a modification of method SW3020. In Method SW3020, the sample is treated in a manner similar to that described in Method SW3005 except that 1 mL of 1:1 HNO_3 and 5 mL of H_2O_2 are used.

Microwave Assisted Acid Digestion of Solids

Microwave assisted digestion is applicable to the preparation of solid samples and water samples containing solids for metals analysis by FLAA or GFAA or ICP. A representative sample of up to 0.5 g (wet weight) is digested with concentrated nitric acid for 60 minutes using microwave heating in a suitable laboratory microwave unit. The sample is placed in a Teflon PFA vessel with 10 mL of concentrated acid. The vessel is capped and heated in the microwave unit for three 20-minute intervals with 5-minute cooling period between each heating period. After the samples are cooled and vented, 5 mL of hydrofluoric acid and 1 mL of hydrochloric acid are added and the sample is digested for 15 minutes. After cooling, the vessel contents are diluted to volume and analyzed by the appropriate SW-846 method. A separate sample is dried for a total solids and/or percent moisture determination.

Some samples can contain diverse matrix types, which may present specific analytical problems. Spiked samples and any relevant standard reference material are processed to aid in determining whether the method is applicable to a given matrix.

SW3500 Series Methods
Organic Extraction and Sample Preparation

The SW3500 series methods are used to quantitatively extract nonvolatile and semivolatile organic compounds from various sample matrices. Prior to analysis, a sample of a known volume or weight is solvent extracted, then dried and concentrated in a Kuderna-Danish apparatus.

Method SW3510[23]
Separatory Extraction

Method SW3510 is designed to quantitatively extract nonvolatile and semivolatile organic compounds from liquid samples using standard separatory funnel techniques. The sample and extracting solvent must be immiscible in order to yield recovery of target compounds. Subsequent cleanup and detection methods are described in the organic analytical method that will be used to analyze the extract.

Samples are adjusted to a specified extraction pH and extracted with the appropriate solvent for the analytical method. Methylene chloride should be employed when a solvent is not specified.

Method SW3520[24]
Liquid-Liquid Extraction

Method SW3520 is designed to quantitatively extract nonvolatile and semivolatile organic compounds from liquid samples using standard liquid/liquid techniques. The sample and extracting solvent must be immiscible in order to yield recovery of target compounds. Subsequent cleanup and detection methods are described in the organic analytical method that will be used to analyze the extract.

Samples are adjusted to a specified extraction pH and extracted with the appropriate solvent for the analytical method. Methylene chloride should be employed when a solvent is not specified.

Method SW3540[25]
Soxhlet Extraction

Method SW3540 is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils and sludges. The Soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent. Extraction is accomplished by mixing the solid sample with anhydrous sodium sulfate, placing it in an extraction thimble or between two plugs of glass wool, and extracting it with an appropriate solvent in the Soxhlet extractor. Methylene chloride should be employed when a solvent is not specified. The extract is dried and concentrated, and then treated using a clean-up method, or analyzed directly by the appropriate measurement technique.

Method SW3550[26]
Sonication Extraction

Method SW3550 is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent. Extraction is accomplished by mixing the solid sample with anhydrous sodium sulfate, mixing with the extraction medium, and dispersing into the solvent by sonication. The extract is dried and then concentrated.

The resulting solution may then be cleaned up or analyzed directly using the appropriate technique.

Method SW5030[27]
Purge-and-Trap Method

Method SW5030 is used to determine the concentration of volatile organic compounds (VOCs) in a variety of liquid and solid matrices. It is based upon a purge-and-trap gas chromatographic procedure. The method is applicable to the types of samples collected for this project. The success of this method depends on the level of interferences in the sample; results may vary due to the large variability and complexity of some matrices.

A direct purge-and-trap can be performed for low-concentration samples. If higher concentrations are expected, a portion of the solid sample is dispersed in methanol to dissolve the volatile organic constituents. A portion of the methanol solution is combined with water in a purging chamber. An inert gas is then bubbled through the solution at ambient temperature to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column. The gas chromatographic column is heated to elute the components that are detected by the appropriate detector.

Organic and Inorganic Analytical Methods for Water and Solid Samples

Method ASTM D-3173
Percent Moisture

Percent moisture was determined for solid samples undergoing analysis for organic and inorganic analytes. The percent moisture must be known so that the analytical results can be reported on a dry weight basis (i.e., μg/kg or mg/kg). The sample is weighed, dried, and then re-weighed. Percent moisture is calculated as:

$$\frac{\text{Wet Weight} - \text{Dried Weight}}{\text{Wet Weight}} \times 100$$

Method E300.0
Anions (Cl, F and SO_4) by Ion Chromatography

Water samples were analyzed for fluoride, chloride, and sulfate anions by ion chromatography using U.S. EPA Method 300.0. Ion chromatography is a rapid method for separating and analyzing complex solutions of ionic species. The technique employs a carbonate/ bicarbonate eluent and ion exchange resins to separate individual ions, and a suppressor column to remove the eluent ions. The detection and quantitation of the anions is performed conductimetrically.

Method E350.1
Nitrogen, Ammonia

Ammonia nitrogen in water samples were measured by U.S. EPA Method 350.1. This method is an automated colorimetric procedure in which alkaline phenol and hypochlorite react with ammonia to form an indophenol blue complex that is proportional to the ammonia concentration. The blue color is intensified with sodium nitroprusside and is measured at 630-660 nm.

Method SW9012[28]
Cyanide, Total

Water and impinger samples were analyzed for total cyanide using SW9012. Cyanide as hydrocyanic acid (HCN) is released from cyanide complexes by means of an reflux-distillation under highly acidic conditions. The released cyanide is absorbed into a scrubber containing sodium hydroxide solution. The cyanide ion in the absorbing solution is then determined using an automated UV colorimetry. The colorimetric procedure is sensitive to about 0.02 mg/L.

Method 365.2[29]
Total Phosphate

Total phosphate was determined on acid-preserved water samples using EPA Method 365.2. Complexed phosphates are digested to the ortho-phosphate form by heating with sulfuric acid and potassium persulfate. The ortho-phosphate is reacted with ammonium molybdate and antimony potassium tartrate to form an antimony-phospho-molybdate complex which is reduced to an intensely blue-colored complex by ascorbic acid. The sample intensity is measured at 650 or 880 nm and compared with the intensity of a standard phosphate solution.

Method SW6010[30]
ICP Metals

Samples are analyzed for trace elements or metals using SW6010. Analysis for most metals requires digestion of the sample with acid. This digestion is performed as SW846 Method 3005 for water or SW846 Method 3050 for solids. Following digestion, the trace elements are simultaneously or sequentially determined using ICP-AES.

Methods
SW7060[31]/SW7041[32]/SW7131[33]/SW7421[34]/SW7740[35]/SW7841[36]
Graphite Furnace Atomic Absorption Metals Analyses for Arsenic, Cadmium, Lead, and Selenium

Graphite furnace AA spectrometry was used to measure concentrations of arsenic (As), cadmium (Cd), lead (Pb), and selenium (Se) in the water and solid samples. The samples are extracted using SW3020 or SW3050 as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is resistively heated by an electrical current. The sample solution is dried and charred to remove sample matrix components, and then atomized at temperatures sufficient to vaporize the element of interest. Matrix modification is used to eliminate interference effects, and may also enhance the vaporization efficiency and allow lower detection limits. This method usually has a linear analysis range at the ppb or sub-ppb level.

Method SW7470[37]/SW7471[38]
Mercury - Manual Cold-Vapor Technique

Liquid (water and impinger) and solid samples were analyzed for mercury using SW7470 and SW7471, respectively. This method is a cold-vapor flameless AA technique based on the absorption of radiation by mercury vapor. Mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an AA spectrophotometer. Mercury concentration is measured as a function of absorbance.

Instrumental Neutron Activation Analysis (INAA)

Neutron activation is a non-destructive technique that measures the number and energy of gamma and X-rays emitted by the radioactive isotopes produced in the sample matrix by irradiation with thermal neutrons. The samples require no special preparation except for encapsulation in high purity polyethylene vials prior to irradiation. Both samples and standards of the elements of interest are irradiated in a nuclear reactor. Each sample is then counted on a gamma ray detector to produce its characteristic gamma ray spectrum. Quantitation of sample concentration is done by comparison with the energy spectra from those standards run simultaneously with the unknown samples.

This technique is applicable to determining bulk composition and is feasible for very small sample quantities. The method does not introduce any contaminating or interfering substances, and it provides a multi-element analysis. It is not applicable to those elements that have either extremely short half-lives, or those elements, such as lead, that do not produce radioactive isotopes.

Glow Discharge Mass Spectrometry (GDMS)

Glow discharge mass spectrometry was used as an alternative to INAA for determining the bulk composition of the size fractionated fly ash samples. In this technique, the sample is mixed with silver powder and is pressed into the shape of a pin to serve as a conducting electrode in a low-pressure argon plasma ionization chamber. Sample atoms are sputtered into the plasma and then ionized. The plasma is a constant matrix in which the ionization efficiencies of the elements also remain constant. The ionization efficiencies expressed as relative sensitivity factors (RSFs) are used to convert ion intensities to elemental concentrations. The application of this technique to fly ash particles has been demonstrated successfully, and it can provide a complete analysis on the target list, including fluorine, beryllium, and lead, that cannot be determined by INAA.

EPA Method 0011A[39]
Aldehydes

Aldehydes in the gas, liquid, and solid samples were determined using EPA Method 0011A. Samples collected in dinitrophenylhydrazine (DNPH) are extracted with methylene chloride and then solvent exchanged to acetonitrile. The acetonitrile is concentrated and analyzed by high performance liquid chromatography as the DNPH adduct.

Method SW8240[40]
Volatile Organic Compounds

Volatile, or purgeable, organics in water and by VOST in the gas streams were analyzed using Method SW8240. This method uses a purge-and-trap GC/MS technique. An inert gas is bubbled through the water samples to transfer the purgeable organic compounds from the liquid to vapor phase. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a gas chromatographic column where they are separated and then detected with a mass spectrometer. VOST samples are thermally desorbed from the resin/charcoal traps and analyzed directly.

Method SW8270[41]
Semivolatile Organic Compounds

Semivolatile organics, also known as base/neutral and acid extractables (BNA), were analyzed using Method SW8270. These techniques quantitatively determine the concentration of a number of semivolatile organic compounds. Organic compounds are extracted from the sample with methylene chloride at a pH greater than 12 to obtain base/neutral extractables. Acid extractable compounds are obtained from the sample by extraction with methylene chloride at a pH of 2 or less. Both base/neutral and acid extracts are then concentrated by removal of the methylene chloride through evaporation. Compounds of interest are separated and quantified using a GC/MS.

Method 23[42]
Chlorinated Dioxins and Furans

Flue gas and gas particulate samples were analyzed for chlorinated dioxins and furans using Method 23. The dioxins and furans are extracted from the samples with toluene using the soxhlet extraction described in Method 23. The extracts are cleaned by passing the solvent through alumina, silica gel, and carbon columns. The cleaned extracts are concentrated and injected onto the a fused silica capillary column of a gas chromatograph/mass spectrometer.

References

1. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 3005: Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by Flame Atomic Absorption Spectroscopy or Inductively Coupled Plasma Spectroscopy," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

2. American Society for Testing and Materials. "Test Method for Moisture in the Analysis Sample of Coal and Coke," *1991 Annual Book of ASTM Standards.* Section 5, Vol. 5.05, Method D-3173. Philadelphia, PA (1991).

3. American Society for Testing and Materials. "Standard Practice of Ultimate Analysis of coal and Coke," *1991 Annual Book of ASTM Standards.* Section 5, Vol. 5.05, Method D-3176-89. Philadelphia, PA (1991).

4. American Society for Testing and Materials. "Standard Practice of Proximate Analysis of Coal and Coke," *1991 Annual Book of ASTM Standards.* Section 5, Vol. 5.05, Method D-3172-89. Philadelphia, PA (1991).

5. American Society for Testing and Materials. "Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal and Coke," *1991 Annual Book of ASTM Standards.* Section 5, Vol. 5.05, Method D-5373. Philadelphia, PA (1991).

6. American Society for Testing and Materials. "Test Method for Sulfur in the Analysis Sample of Coal and Coke Using High Temperature Tube Furnace Combustion Methods," *1991 Annual Book of ASTM Standards.* Section 5, Vol. 5.05, Method D-4239. Philadelphia, PA (1991).

7. American Society for Testing and Materials. "Standard Test Method for Gross Calorific Value of Coal and Coke by the Adiabatic Bomb Calorimeter," *1991 Annual Book of ASTM Standards.* Section 5, vol. 5.05, Method D-2015-85. Philadelphia, PA (1991).

8. American Public Health Association, et al. "4500-Cl^-D. Potentiometric Method," *Standard Methods for the Examination of Water and Wastewater.* 17th ed. Washington, D.C. (1989).

9. U.S. Environmental protection Agency. Environmental Monitoring and Support Laboratory. "Fluoride, Method 340.2 (Potentiometric, Ion Selective Electrode)," *Methods for Chemical Analysis of Water and Wastes.* EPA-600/4-79-020. Cincinnati, OH (March 1983).

10. J.W. O'Dell, J.D. Pfaff, M.E. Gales, and G.D. McKee. U.S. Environmental Protection Agency. Environmental Monitoring and Support Laboratory. "Test Method: The Determination of Inorganic Anions in Water by Ion Chromatography--Method 300.0." EPA-600/4-84-017. Cincinnati, OH (March 1984).

11. U.S. Environmental Protection Agency. Environmental Monitoring and Support Laboratory. "Sulfite, Method 377.1 (Titrimetric)," *Methods for Chemical Analysis of Water and Wastes.* EPA-600/4-79-020. Cincinnati, OH (March 1983).

12. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 6010: Inductively Coupled Plasma Atomic Emission Spectroscopy," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

13. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 6020: Inductively Coupled Plasma - Mass Spectrometry," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

14. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7060: Arsenic (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

15. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7131: Cadmium (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

16. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7421: Lead (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

17. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7471: Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

18. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7740: Selenium (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

19. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 8270: Gas Chromatography/Mass Spectrometry for Semivolatile Organics: Capillary Column Technique," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

20. 40 CFR 266, Appendix IX: *Methods Manual for Compliance with the BIF Regulations.* "Determination of Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) from Stationary Sources (Method 23)."

21. U.S. Environmental Protection Agency. Methods 901.1 and 900.0. *Prescribed Procedures for the Measurement of Radioactivity in Drinking Water.* EPA-600/4/80-032 (1980).

22. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 3020: Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by GFAA Spectroscopy," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

23. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 3510: Separatory Funnel Liquid-Liquid Extraction," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

24. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 3520: Continuous Liquid-Liquid Extraction," *Test Methods for Evaluating Solid Waste.* SW-484, 3rd ed. Washington, D.C. (November 1986).

25. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 3540: Soxhlet Extraction," *Test Methods for Evaluating Solid Waste.* SW-484, 3rd ed. Washington, D.C. (November 1986).

26. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 3550: Sonication Extraction," *Test Methods for Evaluating Solid Waste.* SW-484, 3rd ed. Washington, D.C. (November 1986).

27. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 5030: Purge-and-Trap," *Test Methods for Evaluating Solid Waste.* SW-484, 3rd ed. Washington, D.C. (November 1986).

28. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 9012: Total and Amenable Cyanide (Colorimetric, Automated UV)," *Test Methods for Evaluating Solid Waste.* SW-484, 3rd ed. Washington, D.C. (November 1986).

29. U.S. Environmental Protection Agency. Environmental Monitoring and Support Laboratory. "Phosphorus, All Forms, Method 365.2 (Colorimetric, Ascorbic Acid, Single Reagent)," *Methods for Chemical Analysis of Water and Wastes.* EPA-600/4-79-020. Cincinnati, OH (March 1983).

30. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 6010: Inductively Coupled Plasma Atomic Emission Spectroscopy," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

31. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7060: Arsenic (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste.* SW-846, 3rd ed. Washington, D.C. (November 1986).

32. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7041: Antimony (Atomic Absorption, Furnace Technique)," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

33. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7131: Cadmium (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

34. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7421: Lead (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

35. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7740: Selenium (AA, Furnace Technique)," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

36. U.S. Environmental Protection Agency, Office of Solid Waste. "Method 7841: Thallium (AA, Furnace Technique)." *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. November 1986.

37. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7470: Mercury in Liquid Waste (Manual Cold-Vapor Technique)," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

38. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 7471: Mercury in Solid or Semisolid Waste Manual Cold-Vapor Technique," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

39. 40 CFR 266, Appendix IX: *Methods Manual for Compliance with the BIF Regulations*. "Analysis for Aldehydes and Ketones by High Performance Liquid Chromatography (HPLC) (Method 0011A)."

40. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 8240: Gas Chromatography/Mass Spectrometry for Volatile Organics," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

41. U.S. Environmental Protection Agency. Office of Solid Waste. "Method 8270: Gas Chromatography/Mass Spectrometry for Semivolatile Organics: Capillary Column Technique," *Test Methods for Evaluating Solid Waste*. SW-846, 3rd ed. Washington, D.C. (November 1986).

42. 40 CFR 266, Appendix IX: *Methods Manual for Compliance with the BIF Regulations*. "Determination of Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) from Stationary Sources (Method 23)."

APPENDIX F:
ERROR PROPAGATION AND UNCERTAINTY CALCULATIONS

An error propagation analysis was performed on calculated results to determine the contribution of process, sampling, and analytical variability and measurement bias to the overall uncertainty in the result. This uncertainty was determined by propagating the bias and precision error of individual parameters through the calculation of the results. This uncertainty does not represent the total uncertainty in the result since some important bias errors are unknown and have been assigned a value of zero for this analysis. Also, the uncertainties calculated apply only over the period of time during which the measurements were made.

The procedure described below is based on ANSI/ASME PTC 19.1-1985, "Measurement *Uncertainty.*"

Nomenclature

r = Calculated result, a function of several parameters;

S_{pi} = Sample standard deviation of parameter i;

θ_i = Sensitivity of the result to parameter i;

β_{pi} = Bias error estimate for parameter i;

v_i = Degrees of freedom in parameter i;

v_r = Degrees of freedom in result;

S_r = Precision component of result uncertainty;

β_r = Bias component of result uncertainty;

t = Student "t" factor (two-tailed distribution at 95%);

U_r = Uncertainty in r; and

N_i = Number of measurements of parameter i.

For a result, r, the uncertainty in r is calculated as:

$$U_r = \sqrt{\beta_r^2 + (S_r * t)^2} \qquad \textbf{(F-1)}$$

The components are calculated by combining the errors in the parameters used in the result calculation.

$$\beta_r = \sqrt{\sum_{i=1}^{j} (\theta_i * \beta_{\overline{pi}})^2} \qquad \textbf{(F-2)}$$

$$S_r = \sqrt{\sum_{i=1}^{j} (\theta_i * S_{\overline{pi}})^2} \qquad \textbf{(F-3)}$$

The sensitivity of the result to each parameter is found from a Taylor series estimation method:

$$\theta_i = \frac{\partial r}{\partial p_i} \qquad \textbf{(F-4)}$$

Or using a perturbation method (useful in computer applications):

$$\theta_i = \frac{r_{P_i + \Delta P_i} - r_{P_i}}{\Delta P_i} \qquad \textbf{(F-5)}$$

The standard deviation of the average for each parameter is calculated as:

$$S_{\overline{pi}} = \frac{S_{pi}}{\sqrt{N}} \qquad \textbf{(F-6)}$$

The degrees of freedom for each parameter is found from

$$v_i = N_i - 1 \tag{F-7}$$

and the degrees of freedom for the result if found by weighing the sensitivity and precision error in each parameter.

$$v_r = \frac{S_r^4}{\sum_{i=1}^{j} \left[\frac{(S_{\overline{pi}} \times \theta_i)^4}{v_i} \right]} \tag{F-8}$$

The student "t" in Equation 1 is associated with the degrees of freedom in the result.

The precision error terms are easily generated using collected data. The bias error terms are more difficult to quantify. The percentage bias assumed in certain flow rates is based on how accurately particular flows were felt to be measured. For example, the coal flow rate was measured by counting (nominally) 500 lb buckets. While this method has good precision, there is likely to be a bias. A 5% bias is therefore assumed for the coal flow rate to account for the uncertainty. Similarly, measurements of slurry flow rates in FGD systems are quite precise, but are frequently biased. For this reason a 20% bias was assumed for limestone and JBR blowdown slurry flow rates. The following conventions were used for this report:

- 5% bias in coal flow rates.
- 20% bias in limestone slurry and JBR blowdown slurry flow rates.
- No bias in gas flow rates.
- No bias in analytical results unless the result is less than detection limit. Then one-half the detection limit is used for both the parameter value and its bias in calculations.

In addition to the assumptions about bias errors referred to above, the calculations also assume that the population distribution of each measurement is normally distributed and that *the samples collected reflect the true population.*

Also, the uncertainty calculated is only for the average value over the sampling period. The uncertainty does not represent long-term process variations. In other words, the calculated uncertainty does not include a bias term to reflect the fact that the sampled system was probably not operating (and emitting) at conditions equivalent to the average conditions for that system over a longer period (in other words, autocorrelation may be important). An example of the confidence interval calculation is provided below.

Confidence Interval Calculations

The following example shows an example calculation for the 95% confidence interval for emission factor. This procedure utilizes the same method outlined earlier in this appendix. The example uses concentration data for mercury in the stack gas.

$$E = \frac{\left(Q_{gas} * C_{i,s}\right) + \left(Q_{gas} * C_{i,v}\right)}{H_{coal} * F_{coal} * (1-C_{w,coal})} * 2204.6 \qquad \textbf{(F-9)}$$

where:

E = Emission factor in lb/10^{12} Btu;

$Q_{stackgas}$ = Gas flow rate, Nm^3/hr;

$C_{i,s}$ = Solid-phase conc., μg/Nm^3;

$C_{i,v}$ = Vapor-phase conc., μg/Nm^3;

H_{coal} = Coal higher heating value, Btu/lb on a dry basis;

F_{coal} = Coal feed rate, lb/hr;

$C_{w,coal}$ = Coal water content, weight fraction; and

2204.6 = Conversion from μg/Btu to lb/10^{12} Btu.

The values used to calculate the emission factor and the confidence interval are as follows:

	Parameter					
	$Q_{stackgas}$ Nm^3/hr	$C_{i,s}$ $\mu g/Nm^3$	$C_{i,v}$ $\mu g/Nm^3$	H_{coal} Btu/lb	$C_{w,coal}$ g/g	F_{coal} lb/hr
Mean	456,000	0.00707	3.04	12,700	0.117	91,000
S_p	3,990	0.00638	0.11	260	0.0087	3,200
$S_{\bar{p}}$	2,310	0.00451	0.064	150	0.0050	380
N	3	2	3	3	3	71
β_p	0	0	0	0	0	4,540
θ	6.6×10^{-6}	0.99	0.99	-2.3×10^{-4}	2.73	-3.2×10^{-5}
v_p	2	1	2	2	2	70

The calculation of the sensitivity, θ, for the vapor-phase concentration is shown below:

Vapor-phase analytical: 2.92 $\mu g/Nm^3$

3.13 $\mu g/Nm^3$

3.07 $\mu g/Nm^3$

$$N = 3$$

$$\text{Mean} = \Sigma C_{i,v} / N = 3.04$$

$$S_p = \sqrt{[\Sigma(C_{i,v} - \text{Mean})^2/(N-1)]} = 0.11$$

$$S_{\bar{p}} = \frac{0.11}{\sqrt{3}} = 0.064$$

As explained above, the β for analytical results is set equal to zero.

$$\beta_p = 0$$

Next, calculate the sensitivity using perturbation method. The perturbation is equal to the standard deviation:

$$\theta = [r_{Ci,v = 3.15} - r_{Ci,v = 3.04}] / 0.11 = [3.109 - 3.00] / 0.11$$

$$= 0.99$$

Similar calculations are performed for each parameter.

The precision component is then found by root-sum-squaring the product of the normalized standard deviations and their respective sensitivities.

$$S_r = \sqrt{\left(\theta_{Q_{stackgas}} S_{\overline{Q_{stackgas}}}\right)^2 + \left(\theta_{C_{i,s}} S_{\overline{C_{i,s}}}\right)^2 + \left(\theta_{C_{i,v}} S_{\overline{C_{i,v}}}\right)^2 + \left(\theta_{H_{coal}} S_{\overline{H_{coal}}}\right)^2 + \left(\theta_{F_{coal}} S_{\overline{F_{coal}}}\right)^2 + \left(\theta_{C_{w,coal}} S_{\overline{C_{w,coal}}}\right)^2}$$

$S_r = 0.066$

The bias component is found using the same equation substituting βp for the Sp term.

$$\beta_r = \sqrt{\left(\theta_{Q_{stackgas}} \beta_{Q_{stackgas}}\right)^2 + \left(\theta_{C_{i,s}} \beta_{C_{i,s}}\right)^2 + \left(\theta_{C_{i,v}} \beta_{C_{i,v}}\right)^2 + \left(\theta_{H_{coal}} \beta_{H_{coal}}\right)^2 + \left(\theta_{F_{coal}} \beta_{F_{coal}}\right)^2 + \left(\theta_{C_{w,coal}} \beta_{C_{w,coal}}\right)^2}$$

$\beta_r = 0.14$

The uncertainty in the result is then

$$U_r = \sqrt{\beta_r^2 + \left(t \times S_r\right)^2} \qquad \textbf{(F-12)}$$

To calculate the Student t factor, the degrees of freedom must be calculated using the following equation:

$$v_r = \frac{S_r^4}{\sum_{i=1}^{j} \frac{\left(S_{\overline{pi}}\, \theta_i\right)^4}{v_{pi}}}$$

$$= 2.7$$

The Student t factor for a two-tailed 95% confidence interval with 2.7 degrees of freedom is 3.2. The uncertainty in the emission factor can now be calculated.

$$U_r = \sqrt{(0.14)^2 + (3.2 \times .066)^2}$$

$$= 0.25$$

The emission rate is calculated as 3.0 lb/10^{12} Btu.

The value is reported as 3.0 ± 0.3 lb/10^{12} Btu.

APPENDIX G: TREATMENT OF NONDETECTS, VALUES OUTSIDE OF THE CALIBRATION RANGE, AND BLANKS

Treatment of nondetects (analytical results for which the concentration of the species of interest is below the detection limit of the method) and blank values is of critical importance in this program because detection levels and blank concentrations are often on the same order of magnitude as sample values. When the results are then used for risk assessments or policy decisions, treatment of the data becomes important. This discussion describes how blank and nondetect values are to be treated in presenting/developing reported results.

Nondetects

The discussion presented below explains how averages, sums, and reported emission values are to be calculated for all species given various combinations of detected and nondetected values.

All values detected. The arithmetic average or sum is taken, as appropriate. No special techniques required.

All values below the detection limit. For individual test runs or species, the data are to be reported as "ND < (detection limit)." For cases where all three runs are below the detection limit, the average is reported as nondetected less than the average detection limit of the three runs.

Some values are detected and some are nondetects. As an approximation, half of the detection limit for nondetect values and the actual value for detects will be used to determine reported values. As an example of averaging, an average for three test runs with results of 10, 8, and ND <6 would be 7. As an example for summing (such as for mercury fractions), *individual species values of* 50, ND <1, *and* ND <2 *would be summed to provide* a value of 50+ 0.5 + 1, or 51.5. In reporting these types of sums or average no "<" sign is used. The only exception to this rule occurs when the average is less than the highest detection limit of the nondetected values. In this case, the average is reported as "ND < (the highest detection limit)." For example, 5, ND <4, and ND <3 would be reported as "ND <4."

This approach is also used to obtain test train totals which required analyses of separate fractions for each individual run. Specifically, the volatile, metals, and anion test train totals for each run are obtained by addition of test train fractions which were analyzed separately.

Fractions from the volatile test train included separate analyses of the tenax and tenax/charcoal tubes for each sample period. Separate analyses were conducted on the filterable and gaseous test train components for both the metals and anion test trains.

Detection limit ratio. These methods of treating the data may result in some loss of information in going from raw data to final values. Specifically, what is often lost is the amount of a final emission value that is attributable to detection limits and the amount that is attributable to measured values. In order to quantify and present this information, all results in this report are presented along with the "Detection Limit Component Ratio," which is calculated as the ratio of the contribution of detection limit values to a final emission result.

For example, a set of three values of 16, ND <6, and ND <5 should be reported as 7, with a detection limit ratio of 26% [(3+2.5)/(16+3+2.5)], while a set of values of 12, ND <6, and 9 should be reported as 8, with a detection limit ratio of 13 percent. The different ratios provide insight as to the extent something is "really there" and, it is hoped, can help provide better information to those making decisions on risk and policy issues.

Values Outside the Calibration Range

It is possible that the reported lab data will be outside the calibration range of the instrument. Data reported below the lower detection limit will be flagged with a qualifier (e.g., "J"). Data with the "J" flag will have been tentatively identified and tentatively quantified. Data reported above the upper detection limit will be flagged with a qualifier (e.g., "E"). Data with the "E" flag will have been positively identified and tentatively quantified. Data with both qualifiers will be estimates. Consider J and E values to be quantitatively representative when calculating averages. Neither flag should cause a value to be weighted more or less important. The J and E data qualifiers should appear in the respective laboratory analytical report. The data qualifiers need not appear on the calculated data summaries.

Blank Values

The level and treatment of blank values is important in interpreting data, since in some cases species are detected but not at levels significantly higher than blanks. In these cases, measured values may not represent emissions, but rather just limitations of the method. However, most of the test methods used in this program either do not allow subtraction of blanks or are silent on how to treat blank values.

When a method does not specify how the sample will be blank-corrected, the appropriate blank train values should be subtracted. Laboratory and site/reagent blanks will be analyzed and the results evaluated for identification of contamination. If a sample compound is blank-corrected, the data will be flagged by a "B." If the value is blank-corrected below the detection limit, it should be reported as "ND < (detection limit) BC." A "C" flag indicates that the blank value was greater than the sampled value. In no case should the blank-corrected values be reported below the method detection limit.

APPENDIX H: DETAILED ANALYTICAL RESULTS

TABLE OF CONTENTS

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Particulate Loading		Grav	g/Nm3	8.305	9.017	9.533	8.952	1.53	
Reduced Species	Ammonia as N	EPA 350.1	ug/Nm3	27.98 B	32.33 B	26.65 B	29	7.38	
Reduced Species	Hydrogen Cyanide	SW 9012	ug/Nm3	0.043 J	0.221 J	0.199 J	0.154	0.24	
Anions - Vapor Phase	Chloride	EPA 300.0	ug/Nm3	127,702	105,013	102,681	111,799	34,338	
Anions - Vapor Phase	Fluoride	EPA 340.2	ug/Nm3	7,866	8,946	8,123	8,311	1,401	
Anions - Vapor Phase	Sulfate	EPA 300.0	ug/Nm3	7,339,547	7,389,801	7,662,782	7,464,043	432,118	
Anions - Particulate	Chloride	EPA 300.0	ug/Nm3	3,703	10,334	4,333	6,123	9,094	
Anions - Particulate	Fluoride	EPA 340.2	ug/Nm3	0.248 B	2.01 B	1.72 B	1.33	2.35	
Anions - Particulate	Sulfate	EPA 300.0	ug/Nm3	52,251	124,668	61,094	79,338	98,145	
Anions - Total	Chloride	EPA 300.0	ug/Nm3	131,404	115,347	107,014	117,922	30,799	
Anions - Total	Fluoride	EPA 340.2	ug/Nm3	7,866	8,948	8,124	8,313	1,403	
Anions - Total	Sulfate	EPA 300.0	ug/Nm3	7,391,798	7,514,469	7,723,876	7,543,381	417,161	
Radionuclides	Actinium-228 @ 338 KeV	EPA 901.1	pCi/g	< 16	32	34	24.7	35.9	11%
Radionuclides	Actinium-228 @ 911 KeV	EPA 901.1	pCi/g	16	18	27	20.3	14.6	
Radionuclides	Actinium-228 @ 968 KeV	EPA 901.1	pCi/g	< 22	34	43	29.3	41.0	13%
Radionuclides	Bismuth-212 @ 727 KeV	EPA 901.1	pCi/g	< 37	< 43	< 38	< 39.3	- -	100%
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA 901.1	pCi/g	< 25	< 24	< 24	< 24.3	- -	100%
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA 901.1	pCi/g	71	< 34	60	49.3	70.9	11%
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA 901.1	pCi/g	21	28	35	28.0	17.4	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g	170	150	380	233	317	
Radionuclides	Lead-210 @ 46 KeV	EPA 901.1	pCi/g	73	94	70	79.0	32.5	
Radionuclides	Lead-212 @ 238 KeV	EPA 901.1	pCi/g	11	20	26	19.0	18.8	
Radionuclides	Lead-214 @ 295.2 KeV	EPA 901.1	pCi/g	24	16	32	24.0	19.9	
Radionuclides	Lead-214 @ 352.0 KeV	EPA 901.1	pCi/g	24	23	29	25.3	7.99	
Radionuclides	Radium-226 @ 186.0 KeV	EPA 901.1	pCi/g	110	130	150	130	50	
Radionuclides	Thallium-208 @ 583 KeV	EPA 901.1	pCi/g	12	19	20	17.0	10.8	

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Radionuclides	Thallium-208 @ 860 KeV	EPA 901.1	pCi/g	< 61	< 72	< 67	< 66.7	--	100%
Radionuclides	Thorium-234 @ 1001 KeV	EPA 901.1	pCi/g	68	75	95	79.3	34.8	
Radionuclides	Thorium-234 @ 63.3 KeV	EPA 901.1	pCi/g	66	54	88	69.3	42.8	
Radionuclides	Uranium-235 @ 143 KeV	EPA 901.1	pCi/g	66	54	88	69.3	42.8	
Part Metals by Wt	Aluminum	SW 6010	ug/g	94,401	94,503	102,093	96,999	10,961	
Part Metals by Wt	Antimony	ICP-MS	ug/g	3.24	2.89	4.68	3.61	2.36	
Part Metals by Wt	Arsenic	SW 7060	ug/g	41	44	50	44.9	11.6	
Part Metals by Wt	Barium	SW 6010	ug/g	447	504	530	494	106	
Part Metals by Wt	Beryllium	SW 6010	ug/g	11	10	11	10.4	0.57	
Part Metals by Wt	Boron			--	--	--			
Part Metals by Wt	Cadmium	SW 7131	ug/g	2.76	2.07	3.21	2.68	1.43	
Part Metals by Wt	Calcium	SW 6010	ug/g	19,815	17,647	16,792	18,085	3,871	
Part Metals by Wt	Chromium	SW 6010	ug/g	183	550	223	318	500	
Part Metals by Wt	Cobalt	SW 6010	ug/g	31	31	31	31	0.83	
Part Metals by Wt	Copper	SW 6010	ug/g	86	85	86	86	2.64	
Part Metals by Wt	Iron	SW 6010	ug/g	102,776	87,367	82,002	90,715	26,792	
Part Metals by Wt	Lead	SW 7421	ug/g	71	79	86	79	19	
Part Metals by Wt	Magnesium	SW 6010	ug/g	4,549	4,619	4,910	4,692	476	
Part Metals by Wt	Manganese	SW 6010	ug/g	248	239	223	237	32	
Part Metals by Wt	Mercury	SW 7471	ug/g	0.63	1.06	0.68	0.79	0.59	
Part Metals by Wt	Molybdenum	SW 6010	ug/g	17	41	46	35	39	
Part Metals by Wt	Nickel	SW 6010	ug/g	160	339	179	226	245	
Part Metals by Wt	Phosphorus	SW 6010	ug/g	161	256	269	228	146	
Part Metals by Wt	Potassium	SW 6010	ug/g	16,630	17,647	18,125	17,467	1,897	
Part Metals by Wt	Selenium	SW 7740	ug/g	12	18	14	15	7.01	
Part Metals by Wt	Sodium	SW 6010	ug/g	5,196	5,121	5,042	5,120	192	
Part Metals by Wt	Strontium	SW 6010	ug/g	319	329	325	324	12	
Part Metals by Wt	Titanium	SW 6010	ug/g	5,811	6,172	6,446	6,143	792	
Part Metals by Wt	Vanadium	SW 6010	ug/g	310	310	306	308	5.74	
Part Metals by Wt	Zinc	SW 6010	ug/g	391	419	458	423	84	

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units	Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Part Metals by Vol	Aluminum	SW 6010	ug/Nm3	784,242		852,556		973,562		870,120	238,184	
Part Metals by Vol	Antimony	ICP-MS	ug/Nm3	26.92		26.10		44.68		32.56	26.08	
Part Metals by Vol	Arsenic	SW 7060	ug/Nm3	339		397		477		404	172	
Part Metals by Vol	Barium	SW 6010	ug/Nm3	3,713		4,550		5,053		4,438	1,682	
Part Metals by Vol	Beryllium	SW 6010	ug/Nm3	87		91		100		93	16	
Part Metals by Vol	Boron			--		--		--				
Part Metals by Vol	Cadmium	SW 7131	ug/Nm3	23		19		31		24	15	
Part Metals by Vol	Calcium	SW 6010	ug/Nm3	164,612		159,202		160,128		161,314	7,188	
Part Metals by Vol	Chromium	SW 6010	ug/Nm3	1,518		4,959		2,127		2,868	4,562	
Part Metals by Vol	Cobalt	SW 6010	ug/Nm3	254		281		291		275	48	
Part Metals by Vol	Copper	SW 6010	ug/Nm3	718		763		823		768	131	
Part Metals by Vol	Iron	SW 6010	ug/Nm3	853,821		788,179		781,972		807,991	98,905	
Part Metals by Vol	Lead	SW 7421	ug/Nm3	589		717		819		708	286	
Part Metals by Vol	Magnesium	SW 6010	ug/Nm3	37,788		41,671		46,820		42,093	11,256	
Part Metals by Vol	Manganese	SW 6010	ug/Nm3	2,062		2,157		2,126		2,115	121	
Part Metals by Vol	Mercury	SW 7471	ug/Nm3	5.23		10		6.44		7.08	5.56	
Part Metals by Vol	Molybdenum	SW 6010	ug/Nm3	139		371		435		315	387	
Part Metals by Vol	Nickel	SW 6010	ug/Nm3	1,327		3,062		1,704		2,031	2,267	
Part Metals by Vol	Phosphorus	SW 6010	ug/Nm3	1,338		2,305		2,564		2,069	1,606	
Part Metals by Vol	Potassium	SW 6010	ug/Nm3	138,151		159,202		172,840		156,731	43,416	
Part Metals by Vol	Selenium	SW 7740	ug/Nm3	103		162		134		133	73	
Part Metals by Vol	Sodium	SW 6010	ug/Nm3	43,168		46,195		48,080		45,814	6,156	
Part Metals by Vol	Strontium	SW 6010	ug/Nm3	2,651		2,967		3,100		2,906	572	
Part Metals by Vol	Titanium	SW 6010	ug/Nm3	48,274		55,677		61,471		55,141	16,434	
Part Metals by Vol	Vanadium	SW 6010	ug/Nm3	2,575		2,793		2,916		2,761	429	
Part Metals by Vol	Zinc	SW 6010	ug/Nm3	3,247		3,784		4,371		3,801	1,397	
Metals, Vapor	Aluminum	SW 6010	ug/Nm3	72	B	1,821	B	220	B	146	937	
Metals, Vapor	Antimony	ICP-MS	ug/Nm3	1.07	B	< 0.004	C	0.044	B	0.56	6.50	
Metals, Vapor	Arsenic	SW 7060	ug/Nm3	< 0.19	C	10.42	B	< 0.14	C	< 0.08	- -	100%

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3			Average	95% CI	DL Ratio
Metals, Vapor	Barium	SW 6010	ug/Nm3		0.87	B		11.97	B		2.11	B		1.49	7.85	
Metals, Vapor	Beryllium	SW 6010	ug/Nm3		0.076	J		0.37	B		0.037	J		0.06	0.25	
Metals, Vapor	Boron	SW 6010	ug/Nm3		7,330	B		7,080	B		5,451	B		6,390	11,939	
Metals, Vapor	Cadmium	SW 7131	ug/Nm3	<	0.07	C		0.67	B		0.18	B		0.11	0.93	16%
Metals, Vapor	Calcium	SW 6010	ug/Nm3		288	B		5,333	B		305	B		297	106	
Metals, Vapor	Chromium	SW 6010	ug/Nm3		22	B		102	B		0.65	B		11.33	136	
Metals, Vapor	Cobalt	SW 6010	ug/Nm3		0.30	J	<	1.22	C	<	0.74	C	<	1.22	- -	55%
Metals, Vapor	Copper	SW 6010	ug/Nm3		1.01	J		10	B		1.26	B		1.13	1.59	
Metals, Vapor	Iron	SW 6010	ug/Nm3		146	B		1,321	B		128	B		137	118	
Metals, Vapor	Lead	SW 7421	ug/Nm3	<	0.24	C		2.51	B	<	0.17	C	<	0.10	- -	100%
Metals, Vapor	Magnesium	SW 6010	ug/Nm3		19	B		188	B		22	B		20.50	18	
Metals, Vapor	Manganese	SW 6010	ug/Nm3	<	0.12	C		13	B	<	0.09	C	<	0.05	- -	100%
Metals, Vapor	Mercury	CVAA	ug/Nm3		5.09	B		5.26	B		5.97	B		5.53	5.59	
Metals, Vapor	Molybdenum	SW 6010	ug/Nm3	<	1.36	C		14	B		0.63	J	<	0.66	- -	52%
Metals, Vapor	Nickel	SW 6010	ug/Nm3		13	B		53	B	<	2.15	C		7.18	78	7%
Metals, Vapor	Phosphorus	SW 6010	ug/Nm3	<	18	C		45	B	<	13	C	<	7.80	- -	100%
Metals, Vapor	Potassium	SW 6010	ug/Nm3	<	0.84	C		209	B		21	B		10.74	131	2%
Metals, Vapor	Selenium	SW 7740	ug/Nm3	<	0.25	C		0.21	J	<	0.18	C	<	0.25	- -	100%
Metals, Vapor	Sodium	SW 6010	ug/Nm3		214	B		227	B		270	B		242	356	
Metals, Vapor	Strontium	SW 6010	ug/Nm3		1.68	B		32	B		2.32	B		2.00	4	
Metals, Vapor	Titanium	SW 6010	ug/Nm3		3.31	B		94	B		14	B		8.89	71	
Metals, Vapor	Vanadium	SW 6010	ug/Nm3		0.96	B		28	B		1.45	B		1.20	3	
Metals, Vapor	Zinc	SW 6010	ug/Nm3		46	B		57	B		16	B		31	185	
Total Metals	Aluminum	SW 6010	ug/Nm3		784,314			854,177			973,781			870,757	238,039	
Total Metals	Antimony	ICP-MS	ug/Nm3		27.98			26.68			44.72			33.13	25	
Total Metals	Arsenic	SW 7060	ug/Nm3		340			407			477			408	171	
Total Metals	Barium	SW 6010	ug/Nm3		3,713			4,562			5,055			4,443	1,686	
Total Metals	Beryllium	SW 6010	ug/Nm3		88			92			100			93	16	
Total Metals	Boron(vapor only)	SW 6010	ug/Nm3		7,330			7,080			5,451			6,620	2,536	
Total Metals	Cadmium	SW 7131	ug/Nm3		24			19			31			25	14	

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Total Metals	Calcium	SW 6010	ug/Nm3	164,900	164,535	160,433	163,289	6,162	
Total Metals	Chromium	SW 6010	ug/Nm3	1,540	5,061	2,127	2,909	4,686	
Total Metals	Cobalt	SW 6010	ug/Nm3	254	283	293	277	49	
Total Metals	Copper	SW 6010	ug/Nm3	719	773	825	772	131	
Total Metals	Iron	SW 6010	ug/Nm3	853,967	789,500	782,099	808,522	98,206	
Total Metals	Lead	SW 7421	ug/Nm3	590	719	819	710	286	
Total Metals	Magnesium	SW 6010	ug/Nm3	37,807	41,859	46,842	42,169	11,243	
Total Metals	Manganese	SW 6010	ug/Nm3	2,063	2,170	2,127	2,120	134	
Total Metals	Mercury	SW 7471	ug/Nm3	10	15	12	13	5.60	
Total Metals	Molybdenum	SW 6010	ug/Nm3	141	385	436	321	391	
Total Metals	Nickel	SW 6010	ug/Nm3	1,341	3,115	1,707	2,054	2,328	
Total Metals	Phosphorus	SW 6010	ug/Nm3	1,356	2,350	2,578	2,095	1,614	
Total Metals	Potassium	SW 6010	ug/Nm3	138,153	159,411	172,861	156,808	43,476	
Total Metals	Selenium	SW 7740	ug/Nm3	104	162	135	134	72	
Total Metals	Sodium	SW 6010	ug/Nm3	43,382	46,422	48,349	46,051	6,222	
Total Metals	Strontium	SW 6010	ug/Nm3	2,653	2,999	3,102	2,918	585	
Total Metals	Titanium	SW 6010	ug/Nm3	48,277	55,771	61,485	55,178	16,457	
Total Metals	Vanadium	SW 6010	ug/Nm3	2,576	2,820	2,917	2,771	437	
Total Metals	Zinc	SW 6010	ug/Nm3	3,293	3,842	4,388	3,841	1,360	
Hg Vapor, Bloom	Mercury, Elemental	CVAFS	ug/Nm3	2.43	2.36	1.15	1.98	1.78	
Hg Vapor, Bloom	Mercury II	CVAFS	ug/Nm3	4.38	3.46	4.45	4.10	1.37	
Hg Vapor, Bloom	Mercury, Methyl	CVAFS	ug/Nm3	0.10	0.28	0.57	0.31	0.59	
Hg Vapor, Bloom	Mercury, Total	CVAFS	ug/Nm3	6.91	6.09	6.17	6.39	1.12	
Extract Metals, Nitric	Antimony	ICP-MS	ug/g	2.37	3.04	2.62	2.68	0.85	
Extract Metals, Nitric	Arsenic	ICP-MS	ug/g	36.33	63.18	28.23	43	45	
Extract Metals, Nitric	Barium	ICP-MS	ug/g	181	287	192	220	145	
Extract Metals, Nitric	Beryllium	ICP-MS	ug/g	3.36	5.14	3.83	4.11	2.29	
Extract Metals, Nitric	Boron	ICP-MS	ug/g	1,495	1,871	1,181	1,516	857	
Extract Metals, Nitric	Cadmium	ICP-MS	ug/g	< 0.72	2.28	4.03	2.22	4.57	5%

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Extract Metals, Nitric	Chromium	ICP-MS	ug/g	35.93	36.16	14.92	29	30	
Extract Metals, Nitric	Cobalt	ICP-MS	ug/g	3.75	9.51	1.81	5.03	9.95	
Extract Metals, Nitric	Copper	ICP-MS	ug/g	28.83	47.95	19.56	32	36	
Extract Metals, Nitric	Lead	ICP-MS	ug/g	22.90	62.80	32.06	39	52	
Extract Metals, Nitric	Manganese	ICP-MS	ug/g	138	143	80.04	120	87	
Extract Metals, Nitric	Mercury	ICP-MS	ug/g	< 1.92	180	64.11	82	226	0.4%
Extract Metals, Nitric	Molybdenum	ICP-MS	ug/g	34.16	69.84	24.60	43	59	
Extract Metals, Nitric	Nickel	ICP-MS	ug/g	53.31	50.81	31.25	45	30	
Extract Metals, Nitric	Selenium	ICP-MS	ug/g	< 23.43	< 22.58	< 23.92	< 23	- -	100%
Extract Metals, Nitric	Vanadium	ICP-MS	ug/g	107.21	220.17	109.68	146	160	
Extract Metals, Gastric	Antimony	ICP-MS	ug/g	0.66	0.73	0.73	0.71	0.09	
Extract Metals, Gastric	Arsenic	ICP-MS	ug/g	< 0.65	< 0.68	< 0.71	< 0.68	- -	100%
Extract Metals, Gastric	Barium	ICP-MS	ug/g	81.68	103	126	103	55	
Extract Metals, Gastric	Beryllium	ICP-MS	ug/g	0.90	1.39	1.13	1.14	0.61	
Extract Metals, Gastric	Boron	ICP-MS	ug/g	699	696	699	698	4.55	
Extract Metals, Gastric	Cadmium	ICP-MS	ug/g	0.55	2.91	2.01	1.82	2.97	
Extract Metals, Gastric	Chromium	ICP-MS	ug/g	28.99	31.89	21.52	27	13	
Extract Metals, Gastric	Cobalt	ICP-MS	ug/g	1.21	2.37	1.80	1.80	1.44	
Extract Metals, Gastric	Copper	ICP-MS	ug/g	8.57	12.41	8.89	9.96	5.29	
Extract Metals, Gastric	Lead	ICP-MS	ug/g	5.63	13.36	9.12	9.37	9.62	
Extract Metals, Gastric	Manganese	ICP-MS	ug/g	87.97	36.41	55.76	60	65	
Extract Metals, Gastric	Mercury	ICP-MS	ug/g	1.63	3.23	0.84	1.90	3.03	
Extract Metals, Gastric	Molybdenum	ICP-MS	ug/g	20.75	38.48	28.60	29	22	
Extract Metals, Gastric	Nickel	ICP-MS	ug/g	6.17	20.16	4.58	10	21	
Extract Metals, Gastric	Selenium	ICP-MS	ug/g	< 0.84	< 0.88	< 0.92	< 0.88	- -	100%
Extract Metals, Gastric	Vanadium	ICP-MS	ug/g	< 0.34	< 0.36	< 0.37	< 0.36	- -	100%
Extract Metals, Acetic	Antimony	ICP-MS	ug/g	0.44	1.30	0.65	0.80	1.11	
Extract Metals, Acetic	Arsenic	ICP-MS	ug/g	1.16	0.73	1.17	1.02	0.63	
Extract Metals, Acetic	Barium	ICP-MS	ug/g	34.39	53.34	56.47	48	30	

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Extract Metals, Acetic	Beryllium	ICP-MS	ug/g	0.12	0.56	0.28	0.32	0.54	
Extract Metals, Acetic	Boron	ICP-MS	ug/g	904	1,041	1,086	1,010	236	
Extract Metals, Acetic	Cadmium	ICP-MS	ug/g	0.82	2.97	1.17	1.65	2.86	
Extract Metals, Acetic	Chromium	ICP-MS	ug/g	5.32	11.11	5.67	7.37	8.07	
Extract Metals, Acetic	Cobalt	ICP-MS	ug/g	1.19	1.86	1.37	1.48	0.87	
Extract Metals, Acetic	Copper	ICP-MS	ug/g	5.56	17.04	10.24	10.95	14.35	
Extract Metals, Acetic	Lead	ICP-MS	ug/g	0.14	0.37	0.11	0.21	0.35	
Extract Metals, Acetic	Manganese	ICP-MS	ug/g	72.92	31.05	50.15	51.37	52.09	
Extract Metals, Acetic	Mercury	ICP-MS	ug/g	0.17	1.56	0.39	0.71	1.86	
Extract Metals, Acetic	Molybdenum	ICP-MS	ug/g	0.39	3.91	0.06	1.45	5.30	
Extract Metals, Acetic	Nickel	ICP-MS	ug/g	6.62	11.09	8.19	8.64	5.63	
Extract Metals, Acetic	Selenium	ICP-MS	ug/g	< 0.54	0.23 J	0.17 J	< 0.54	- -	41%
Extract Metals, Acetic	Vanadium	ICP-MS	ug/g	1.45	1.05	1.88	1.46	1.03	
Metals by Size, >10 um	Aluminum	SW 6010	ug/g	98,300	103,000	125,000	108,767	35,411	
Metals by Size, >10 um	Antimony	ICP-MS	ug/g	2.53	1.71	1.82	2.02	1.10	
Metals by Size, >10 um	Arsenic	SW 7060	ug/g	29.80	23.30	25.00	26	8.37	
Metals by Size, >10 um	Barium	SW 6010	ug/g	459	521	565	515	132	
Metals by Size, >10 um	Beryllium	SW 6010	ug/g	11.20	10.70	7.09	10	5.57	
Metals by Size, >10 um	Cadmium	SW 7131	ug/g	2.03	1.64	1.32	1.66	0.88	
Metals by Size, >10 um	Calcium	SW 6010	ug/g	19,500	20,000	26,700	22,067	9,988	
Metals by Size, >10 um	Chromium	SW 6010	ug/g	185	182	185	184	4.30	
Metals by Size, >10 um	Cobalt	SW 6010	ug/g	30.30	33.40	33.30	32	4.38	
Metals by Size, >10 um	Copper	SW 6010	ug/g	97.80	84.90	79.60	87	23	
Metals by Size, >10 um	Iron	SW 6010	ug/g	102,000	101,000	103,000	102,000	2,484	
Metals by Size, >10 um	Lead	SW 7421	ug/g	59.40	47.80	45.30	51	19	
Metals by Size, >10 um	Magnesium	SW 6010	ug/g	4,860	4,900	6,300	5,353	2,037	
Metals by Size, >10 um	Manganese	SW 6010	ug/g	241	230	243	238	17	
Metals by Size, >10 um	Mercury	SW 7471	ug/g	0.32	0.69	0.48	0.50	0.47	
Metals by Size, >10 um	Molybdenum	SW 6010	ug/g	7.27	20.80	21.40	16	20	
Metals by Size, >10 um	Nickel	SW 6010	ug/g	133	124	106	121	34	

Gas Stream Data

SAMPLE STREAM: ESP INLET

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Metals by Size, >10 um	Phosphorus	SW 6010	ug/g	<	72.60	<	72.20	<	72.20	<	72	- -	100%
Metals by Size, >10 um	Potassium	SW 6010	ug/g		17,800		17,900		19,700		18,467	2,656	
Metals by Size, >10 um	Selenium	SW 7740	ug/g		6.47		10.70		15.00		11	11	
Metals by Size, >10 um	Silicon	SW 6010	ug/g		223,000		223,000		209,000		218,333	20,081	
Metals by Size, >10 um	Sodium	SW 6010	ug/g		5,470		4,330		4,060		4,620	1,859	
Metals by Size, >10 um	Strontium	SW 6010	ug/g		340		330		402		357	97	
Metals by Size, >10 um	Titanium	SW 6010	ug/g		6,340		6,210		5,900		6,150	562	
Metals by Size, >10 um	Vanadium	SW 6010	ug/g		310		296		274		293	45	
Metals by Size, >10 um	Zinc	SW 6010	ug/g		346		276		243		288	131	
Metals by Size, 10-3 um	Aluminum	SW 6010	ug/g		123,000		107,000		123,000		117,667	22,949	
Metals by Size, 10-3 um	Antimony	ICP-MS	ug/g		6.04		4.19		4.19		4.81	2.66	
Metals by Size, 10-3 um	Arsenic	SW 7060	ug/g		82.90		72.10		57.90		71	31	
Metals by Size, 10-3 um	Barium	SW 6010	ug/g		575.00		572.00		745.00		631	246	
Metals by Size, 10-3 um	Beryllium	SW 6010	ug/g		16.50		11.30		10.50		13	8.09	
Metals by Size, 10-3 um	Cadmium	SW 7131	ug/g		7.30		5.81		4.40		5.84	3.60	
Metals by Size, 10-3 um	Calcium	SW 6010	ug/g		14,500		15,000		26,300		18,600	16,578	
Metals by Size, 10-3 um	Chromium	SW 6010	ug/g		225		215		213		218	16	
Metals by Size, 10-3 um	Cobalt	SW 6010	ug/g		45.70		42.40		41.40		43	5.59	
Metals by Size, 10-3 um	Copper	SW 6010	ug/g		152		140		135		142	22	
Metals by Size, 10-3 um	Iron	SW 6010	ug/g		60,700		59,300		72,900		64,300	18,584	
Metals by Size, 10-3 um	Lead	SW 7421	ug/g		157		104		97		119	82	
Metals by Size, 10-3 um	Magnesium	SW 6010	ug/g		6,460		6,480		6,110		6,350	517	
Metals by Size, 10-3 um	Manganese	SW 6010	ug/g		228		211		238		226	34	
Metals by Size, 10-3 um	Mercury	SW 7471	ug/g		0.22		0.60		0.60		0.47	0.54	
Metals by Size, 10-3 um	Molybdenum	SW 6010	ug/g		55.90		51.90		30.50		46	34	
Metals by Size, 10-3 um	Nickel	SW 6010	ug/g		182		128		145		152	69	
Metals by Size, 10-3 um	Phosphorus	SW 6010	ug/g	<	72.80	<	72.60	<	72.50	<	73	- -	100%
Metals by Size, 10-3 um	Potassium	SW 6010	ug/g		23,300		21,500		20,700		21,833	3,308	
Metals by Size, 10-3 um	Selenium	SW 7740	ug/g		6.29		2.39	<	1.15		3.09	7.25	6%
Metals by Size, 10-3 um	Silicon	SW 6010	ug/g		236,000		231,000		225,000		230,667	13,683	

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3			Average	95% CI	DL Ratio
Part Metals by Vol	Molybdenum	SW 6010	ug/Nm3		7.88	B		8.67	B		7.72	B		8.09	1.27	
Part Metals by Vol	Nickel	SW 6010	ug/Nm3		22	B		20	B		25	B		22	5.68	
Part Metals by Vol	Phosphorus	SW 6010	ug/Nm3		122	B		100	B		141	B		100	--	
Part Metals by Vol	Potassium	SW 6010	ug/Nm3		1,969	B		2,150	B		2,377	B		2,150	--	
Part Metals by Vol	Selenium	SW 7740	ug/Nm3		142	B		44	B		61	B		82	131	
Part Metals by Vol	Sodium	SW 6010	ug/Nm3	<	16	C		803	B	<	16	C		803	--	
Part Metals by Vol	Strontium	SW 6010	ug/Nm3		32	B		43	B	<	0.35	C		43	--	
Part Metals by Vol	Titanium	SW 6010	ug/Nm3		691	B		719	B		861	B		757	227	
Part Metals by Vol	Vanadium	SW 6010	ug/Nm3		51.35	B		51	B		58.42	B		54	11	
Part Metals by Vol	Zinc	SW 6010	ug/Nm3	<	0.73	C		108	B	<	0.70	C		108	--	
Metals, Vapor	Aluminum	SW 6010	ug/Nm3		58	B		38	B		77	B		58	48	
Metals, Vapor	Antimony	ICP-MS	ug/Nm3		0.021	B		0.018	B		0.025	B		0.02	0.010	
Metals, Vapor	Arsenic	SW 7060	ug/Nm3	<	0.17	C	<	0.19	C	<	0.18	C	<	0.18	- -	100%
Metals, Vapor	Barium	SW 6010	ug/Nm3		0.81	B		0.69	B		1.50	B		1.00	1.08	
Metals, Vapor	Beryllium	SW 6010	ug/Nm3		0.12	J	<	0.16	C	<	0.16	C	<	0.16	- -	57%
Metals, Vapor	Boron	SW 6010	ug/Nm3		7,482	B		6,621	B		6,617	B		6,906	1,237	
Metals, Vapor	Cadmium	SW 7131	ug/Nm3	<	0.06	C		0.25	B	<	0.07	C		0.10	0.31	21%
Metals, Vapor	Calcium	SW 6010	ug/Nm3		224	B		171	B		158	B		184	87	
Metals, Vapor	Chromium	SW 6010	ug/Nm3		0.99	B	<	0.73	C	<	0.70	C	<	0.73	- -	42%
Metals, Vapor	Cobalt	SW 6010	ug/Nm3		0.66	J	<	1.00	C		0.45	J	<	1.00	- -	31%
Metals, Vapor	Copper	SW 6010	ug/Nm3	<	0.99	C		1.39	B		1.28	B		1.06	1.21	16%
Metals, Vapor	Iron	SW 6010	ug/Nm3		34	B		31	B		87	B		50	78	
Metals, Vapor	Lead	SW 7421	ug/Nm3	<	0.21	C		0.88	B	<	0.22	C		0.37	1.11	20%
Metals, Vapor	Magnesium	SW 6010	ug/Nm3		15	B		10	B		11	B		12	6.40	
Metals, Vapor	Manganese	SW 6010	ug/Nm3	<	0.10	C	<	0.12	C	<	0.11	C	<	0.11	- -	100%
Metals, Vapor	Mercury	CVAA	ug/Nm3		6.04	B		5.18	B		5.54	B		5.59	1.07	
Metals, Vapor	Molybdenum	SW 6010	ug/Nm3		0.55	J	<	1.36	C		0.60	J	<	1.36	- -	37%
Metals, Vapor	Nickel	SW 6010	ug/Nm3	<	2.57	C	<	2.90	C		1.87	J	<	2.90	- -	59%
Metals, Vapor	Phosphorus	SW 6010	ug/Nm3	<	16	C	<	18	C	<	17	C	<	17	- -	100%
Metals, Vapor	Potassium	SW 6010	ug/Nm3		71	B	<	0.84	C	<	0.81	C		24	101	1%

ESP Outlet - Page 3

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3			Average	95% CI	DL Ratio
Metals, Vapor	Selenium	SW 7740	ug/Nm3	<	0.22	C	<	0.25	C	<	0.24	C	<	0.23	- -	100%
Metals, Vapor	Sodium	SW 6010	ug/Nm3		416	B		241	B		204	B		287	282	
Metals, Vapor	Strontium	SW 6010	ug/Nm3		1.49	B		1.31	B		1.28	B		1.36	0.28	
Metals, Vapor	Titanium	SW 6010	ug/Nm3		2.16	B		1.38	B		4.01	B		2.52	3.36	
Metals, Vapor	Vanadium	SW 6010	ug/Nm3		1.35	B	<	0.69	C		1.18	B		0.96	1.33	12%
Metals, Vapor	Zinc	SW 6010	ug/Nm3		14	B		113	B		59	B		62	123	
Total Metals	Aluminum	SW 6010	ug/Nm3		6,636			12,179			7,890			12,179	--	
Total Metals	Antimony	ICP-MS	ug/Nm3		0.384			0.377			0.463			0.408	0.119	
Total Metals	Arsenic	SW 7060	ug/Nm3		14.13			16.14			19.43			16.57	6.64	
Total Metals	Barium	SW 6010	ug/Nm3		1.09			75			1.77			74.98	--	
Total Metals	Beryllium	SW 6010	ug/Nm3		1.84			1.73			2.02			1.73	--	
Total Metals	Boron(Vapor Only)	SW 6010	ug/Nm3		7,482			6,621			6,617			6,906	1,237	
Total Metals	Cadmium	SW 7131	ug/Nm3		0.42			1.32			0.96			1.32	--	
Total Metals	Calcium	SW 6010	ug/Nm3		1,693			1,948			1,732			1,948	--	
Total Metals	Chromium	SW 6010	ug/Nm3		25.40			23			26.76			23.43	--	
Total Metals	Cobalt	SW 6010	ug/Nm3		1.73			4.95			5.20			4.95	--	
Total Metals	Copper	SW 6010	ug/Nm3		16.53			17.22			18.03			17.26	1.87	
Total Metals	Iron	SW 6010	ug/Nm3		8,808			8,069			8,885			8,587	1,119	
Total Metals	Lead	SW 7421	ug/Nm3		15.22			19			18.36			19.21	--	
Total Metals	Magnesium	SW 6010	ug/Nm3		449			668			426			668	--	
Total Metals	Manganese	SW 6010	ug/Nm3		35.60			32.60			34.27			34.15	3.74	
Total Metals	Mercury	SW 7471	ug/Nm3		6.153			5.302			5.683			5.713	1.06	
Total Metals	Molybdenum	SW 6010	ug/Nm3		8.436			9.352			8.317			8.702	1.41	
Total Metals	Nickel	SW 6010	ug/Nm3		22.86			21.55			26.46			23.62	6.32	
Total Metals	Phosphorus	SW 6010	ug/Nm3		130			109			150			108.72	--	
Total Metals	Potassium	SW 6010	ug/Nm3		2,040			2,150			2,378			2,150	--	
Total Metals	Selenium	SW 7740	ug/Nm3		143			44.13			60.80			82.51	131	
Total Metals	Sodium	SW 6010	ug/Nm3		424			1,044			212			1,044	--	
Total Metals	Strontium	SW 6010	ug/Nm3		33.20			44.74			1.46			44.74	--	
Total Metals	Titanium	SW 6010	ug/Nm3		694			720			865			760	230	

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Total Metals	Vanadium	SW 6010	ug/Nm3	52.70	51.11	59.60	54.47	11	
Total Metals	Zinc	SW 6010	ug/Nm3	14.13	221	59.62	221.22	–	
Hg Vapor, Bloom	Mercury, Elemental	CVAFS	ug/Nm3	2.52	2.60	2.38	2.50	0.28	
Hg Vapor, Bloom	Mercury II	CVAFS	ug/Nm3	5.07	3.78	3.64	4.16	1.96	
Hg Vapor, Bloom	Mercury, Methyl	CVAFS	ug/Nm3	0.72	0.75	0.42	0.63	0.45	
Hg Vapor, Bloom	Mercury, Total	CVAFS	ug/Nm3	8.32	7.14	6.43	7.30	2.36	
Extract Metals, Nitric	Antimony	ICP-MS	ug/g	4.790	2.379	2.471	3.21	3.39	
Extract Metals, Nitric	Arsenic	ICP-MS	ug/g	94	116	85	98.39	39.98	
Extract Metals, Nitric	Barium	ICP-MS	ug/g	316	322	315	318	8.38	
Extract Metals, Nitric	Beryllium	ICP-MS	ug/g	3.992	8.127	4.183	5.43	5.80	
Extract Metals, Nitric	Boron	ICP-MS	ug/g	2413	1987	1430	1,943	1,225	
Extract Metals, Nitric	Cadmium	ICP-MS	ug/g	14	13	1.521	9.79	17.83	
Extract Metals, Nitric	Chromium	ICP-MS	ug/g	92	54	47	64	61	
Extract Metals, Nitric	Cobalt	ICP-MS	ug/g	18	18	15	17	3.76	
Extract Metals, Nitric	Copper	ICP-MS	ug/g	113	91	91	98	32	
Extract Metals, Nitric	Lead	ICP-MS	ug/g	126	120	102	116	31	
Extract Metals, Nitric	Manganese	ICP-MS	ug/g	2,584	197	132	971	3,471	
Extract Metals, Nitric	Mercury	ICP-MS	ug/g	8.782	1.784	< 1.853	3.83	10.71	8%
Extract Metals, Nitric	Molybdenum	ICP-MS	ug/g	72	80	64	72	21	
Extract Metals, Nitric	Nickel	ICP-MS	ug/g	95	93	63	84	46	
Extract Metals, Nitric	Selenium	ICP-MS	ug/g	< 24	< 24	< 23	< 23.26	- -	100%
Extract Metals, Nitric	Vanadium	ICP-MS	ug/g	325	339	152	272	259	
Extract Metals, Gastric	Antimony	ICP-MS	ug/g	1.024	0.769	1.068	0.95	0.40	
Extract Metals, Gastric	Arsenic	ICP-MS	ug/g	< 0.668	< 0.629	< 0.684	< 0.66	- -	100%
Extract Metals, Gastric	Barium	ICP-MS	ug/g	115	129	132	125	22	
Extract Metals, Gastric	Beryllium	ICP-MS	ug/g	2.829	2.909	2.416	2.72	0.66	
Extract Metals, Gastric	Boron	ICP-MS	ug/g	861	792	814	822	88	
Extract Metals, Gastric	Cadmium	ICP-MS	ug/g	4.803	7.294	5.486	5.86	3.20	

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Extract Metals, Gastric	Chromium	ICP-MS	ug/g	52	63	49	54	18	
Extract Metals, Gastric	Cobalt	ICP-MS	ug/g	5.432	6.286	4.678	5.47	2.00	
Extract Metals, Gastric	Copper	ICP-MS	ug/g	36	36	29	33	9.29	
Extract Metals, Gastric	Lead	ICP-MS	ug/g	34	35	30	33	7.07	
Extract Metals, Gastric	Manganese	ICP-MS	ug/g	49	48	41	46	10.69	
Extract Metals, Gastric	Mercury	ICP-MS	ug/g	0.479	0.345	0.318	0.38	0.22	
Extract Metals, Gastric	Molybdenum	ICP-MS	ug/g	62	66	56	61	11.70	
Extract Metals, Gastric	Nickel	ICP-MS	ug/g	38	47	30	38	22	
Extract Metals, Gastric	Selenium	ICP-MS	ug/g	17	21	16	18	6.83	
Extract Metals, Gastric	Vanadium	ICP-MS	ug/g	127	152	89	122.27	78.53	
Extract Metals, Acetic	Antimony	ICP-MS	ug/g	1.023	0.882	0.721	0.88	0.38	
Extract Metals, Acetic	Arsenic	ICP-MS	ug/g	5.183	2.711	2.250	3.38	3.92	
Extract Metals, Acetic	Barium	ICP-MS	ug/g	45	38	49	44.11	13.44	
Extract Metals, Acetic	Beryllium	ICP-MS	ug/g	1.197	0.976	0.769	0.98	0.53	
Extract Metals, Acetic	Boron	ICP-MS	ug/g	779	1000	942	907	284	
Extract Metals, Acetic	Cadmium	ICP-MS	ug/g	3.243	22	3.394	9.57	26.91	
Extract Metals, Acetic	Chromium	ICP-MS	ug/g	21	21	16	19.47	7.19	
Extract Metals, Acetic	Cobalt	ICP-MS	ug/g	4.566	9.437	4.058	6.02	7.38	
Extract Metals, Acetic	Copper	ICP-MS	ug/g	19	19	16	17.90	4.94	
Extract Metals, Acetic	Lead	ICP-MS	ug/g	1.950	1.220	1.317	1.50	0.98	
Extract Metals, Acetic	Manganese	ICP-MS	ug/g	39	43	36	39	8.45	
Extract Metals, Acetic	Mercury	ICP-MS	ug/g	0.309	0.019 J	0.077 J	0.13	0.38	
Extract Metals, Acetic	Molybdenum	ICP-MS	ug/g	9.913	1.379	2.010	4.43	11.81	
Extract Metals, Acetic	Nickel	ICP-MS	ug/g	22	23	23	23	1.03	
Extract Metals, Acetic	Selenium	ICP-MS	ug/g	3.938	2.786	5.471	4.07	3.35	
Extract Metals, Acetic	Vanadium	ICP-MS	ug/g	9.440	2.758	1.856	4.68	10.29	
Metals by Size, > 10 um	Aluminum	SW 6010	ug/g	70,100	66,700	79,300	72,033	16,195	
Metals by Size, > 10 um	Antimony	ICP-MS	ug/g	3.58	2.74	3.17	3.17	1.04	
Metals by Size, > 10 um	Arsenic	SW 7060	ug/g	58	41	49	49	21	

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Metals by Size, > 10 um	Barium	SW 6010	ug/g	409	347	424	393	101	
Metals by Size, > 10 um	Beryllium	SW 6010	ug/g	18	4.04	8.05	10	18	
Metals by Size, > 10 um	Cadmium	SW 7131	ug/g	4.03	2.76	4.03	3.61	1.82	
Metals by Size, > 10 um	Calcium	SW 6010	ug/g	15,800	12,800	13,500	14,033	3,899	
Metals by Size, > 10 um	Chromium	SW 6010	ug/g	197	219	223	213	35	
Metals by Size, > 10 um	Cobalt	SW 6010	ug/g	40	26	30	32	18	
Metals by Size, > 10 um	Copper	SW 6010	ug/g	117	94	94	102	33	
Metals by Size, > 10 um	Iron	SW 6010	ug/g	95,000	203,000	169,000	155,667	137,187	
Metals by Size, > 10 um	Lead	SW 7421	ug/g	86	62	68	72	31	
Metals by Size, > 10 um	Magnesium	SW 6010	ug/g	3,000	3,920	4,270	3,730	1,630	
Metals by Size, > 10 um	Manganese	SW 6010	ug/g	299	1,160	723	727	1,070	
Metals by Size, > 10 um	Mercury	SW 7471	ug/g	0.59	0.60	0.45	0.55	0.21	
Metals by Size, > 10 um	Molybdenum	SW 6010	ug/g	46	37	47	43	13	
Metals by Size, > 10 um	Nickel	SW 6010	ug/g	174	105	109	129	96	
Metals by Size, > 10 um	Phosphorus	SW 6010	ug/g	< 71	< 71	< 71	< 71	- -	100%
Metals by Size, > 10 um	Potassium	SW 6010	ug/g	15,500	13,300	15,000	14,600	2,865	
Metals by Size, > 10 um	Selenium	SW 7740	ug/g	76	245	153	158	210	
Metals by Size, > 10 um	Silicon	SW 6010	ug/g	207,000	145,000	174,000	175,333	77,068	
Metals by Size, > 10 um	Sodium	SW 6010	ug/g	7,310	4,640	4,450	5,467	3,973	
Metals by Size, > 10 um	Strontium	SW 6010	ug/g	309	267	305	294	58	
Metals by Size, > 10 um	Titanium	SW 6010	ug/g	6,170	4,640	4,940	5,250	2,014	
Metals by Size, > 10 um	Vanadium	SW 6010	ug/g	340	247	272	286	120	
Metals by Size, > 10 um	Zinc	SW 6010	ug/g	517	346	378	414	226	
Metals by Size, 10 - 3 um	Aluminum	SW 6010	ug/g	75,800	119,000	120,000	104,933	62,693	
Metals by Size, 10 - 3 um	Antimony	ICP-MS	ug/g	8.95	8.65	8.12	8.57	1.05	
Metals by Size, 10 - 3 um	Arsenic	SW 7060	ug/g	132	124	125	127	11	
Metals by Size, 10 - 3 um	Barium	SW 6010	ug/g	603	668	616	629	85	
Metals by Size, 10 - 3 um	Beryllium	SW 6010	ug/g	25	15	15	18	15	
Metals by Size, 10 - 3 um	Cadmium	SW 7131	ug/g	12	10	10	11	2.39	
Metals by Size, 10 - 3 um	Calcium	SW 6010	ug/g	13,500	14,700	13,700	13,967	1,597	

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Metals by Size, 10 - 3 um	Chromium	SW 6010	ug/g	282	297	246	275	65	
Metals by Size, 10 - 3 um	Cobalt	SW 6010	ug/g	50	55	48	51	10	
Metals by Size, 10 - 3 um	Copper	SW 6010	ug/g	165	187	157	170	39	
Metals by Size, 10 - 3 um	Iron	SW 6010	ug/g	60,900	69,600	58,700	63,067	14,320	
Metals by Size, 10 - 3 um	Lead	SW 7421	ug/g	193	190	189	191	5.17	
Metals by Size, 10 - 3 um	Magnesium	SW 6010	ug/g	3,190	6,600	5,100	4,963	4,246	
Metals by Size, 10 - 3 um	Manganese	SW 6010	ug/g	253	334	255	281	115	
Metals by Size, 10 - 3 um	Mercury	SW 7471	ug/g	0.76	< 0.48	0.36	< 0.48	- -	18%
Metals by Size, 10 - 3 um	Molybdenum	SW 6010	ug/g	90	80	70	80	25	
Metals by Size, 10 - 3 um	Nickel	SW 6010	ug/g	245	192	197	211	73	
Metals by Size, 10 - 3 um	Phosphorus	SW 6010	ug/g	193	220	272	228	100	
Metals by Size, 10 - 3 um	Potassium	SW 6010	ug/g	18,500	24,300	21,100	21,300	7,217	
Metals by Size, 10 - 3 um	Selenium	SW 7740	ug/g	58	46	31	45	33	
Metals by Size, 10 - 3 um	Silicon	SW 6010	ug/g	211,000	227,000	216,000	218,000	20,335	
Metals by Size, 10 - 3 um	Sodium	SW 6010	ug/g	8,080	8,420	7,280	7,927	1,454	
Metals by Size, 10 - 3 um	Strontium	SW 6010	ug/g	319	413	363	365	117	
Metals by Size, 10 - 3 um	Titanium	SW 6010	ug/g	6,540	7,220	6,810	6,857	851	
Metals by Size, 10 - 3 um	Vanadium	SW 6010	ug/g	505	548	475	509	91	
Metals by Size, 10 - 3 um	Zinc	SW 6010	ug/g	1,090	1,120	1,030	1,080	114	
Metals by Size, < 3 um	Aluminum	SW 6010	ug/g	123,000	125,000	117,000	121,667	10,343	
Metals by Size, < 3 um	Antimony	ICP-MS	ug/g	13.10	13.78	13.17	13	0.94	
Metals by Size, < 3 um	Arsenic	SW 7060	ug/g	183	198	226	202	54	
Metals by Size, < 3 um	Barium	SW 6010	ug/g	773	782	719	758	85	
Metals by Size, < 3 um	Beryllium	SW 6010	ug/g	14	14	18	15	5.02	
Metals by Size, < 3 um	Cadmium	SW 7131	ug/g	23	23	17	21	8.04	
Metals by Size, < 3 um	Calcium	SW 6010	ug/g	17,100	16,000	15,400	16,167	2,142	
Metals by Size, < 3 um	Chromium	SW 6010	ug/g	326	284	259	290	84	
Metals by Size, < 3 um	Cobalt	SW 6010	ug/g	69	65	57	64	15	
Metals by Size, < 3 um	Copper	SW 6010	ug/g	332	222	195	250	180	
Metals by Size, < 3 um	Iron	SW 6010	ug/g	70,300	67,000	66,500	67,933	5,130	

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Metals by Size, < 3 um	Lead	SW 7421	ug/g	311	236	124	224	234	
Metals by Size, < 3 um	Magnesium	SW 6010	ug/g	7,870	7,080	5,160	6,703	3,462	
Metals by Size, < 3 um	Manganese	SW 6010	ug/g	327	325	306	319	29	
Metals by Size, < 3 um	Mercury	SW 7471	ug/g	0.44	0.32	0.40	0.39	0.15	
Metals by Size, < 3 um	Molybdenum	SW 6010	ug/g	138	117	98	118	49	
Metals by Size, < 3 um	Nickel	SW 6010	ug/g	259	227	220	235	52	
Metals by Size, < 3 um	Phosphorus	SW 6010	ug/g	528	773	1,160	820	792	
Metals by Size, < 3 um	Potassium	SW 6010	ug/g	25,100	22,500	20,500	22,700	5,730	
Metals by Size, < 3 um	Selenium	SW 7740	ug/g	79	55	45	60	43	
Metals by Size, < 3 um	Silicon	SW 6010	ug/g	213,000	209,000	199,000	207,000	17,915	
Metals by Size, < 3 um	Sodium	SW 6010	ug/g	9,490	8,240	7,210	8,313	2,837	
Metals by Size, < 3 um	Strontium	SW 6010	ug/g	460	439	389	429	91	
Metals by Size, < 3 um	Titanium	SW 6010	ug/g	6,880	6,820	6,960	6,887	174	
Metals by Size, < 3 um	Vanadium	SW 6010	ug/g	852	781	668	767	231	
Metals by Size, < 3 um	Zinc	SW 6010	ug/g	1,790	1,580	1,570	1,647	309	
Organics, Aldehydes	Acetaldehyde	BIF-0011	ug/Nm3	2.38	1.22	0.14	1.24	2.78	
Organics, Aldehydes	Fomaldehyde	BIF-0011	ug/Nm3	1.01	0.40	0.11	0.50	1.15	
Organics, Semi-Volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ng/Nm3	< 182	< 180	< 131	< 164	--	100%
Organics, Semi-Volatile	1,2,4-Trichlorobenzene	SW 8270	ng/Nm3	< 186	< 184	< 197	< 189	--	100%
Organics, Semi-Volatile	1,2-Dichlorobenzene	SW 8270	ng/Nm3	< 245	< 243	< 213	< 234	--	100%
Organics, Semi-Volatile	1,2-Diphenylhydrazine	SW 8270	ng/Nm3	< 31,477	< 31,174	< 33,586	< 32,079	--	100%
Organics, Semi-Volatile	1,3-Dichlorobenzene	SW 8270	ng/Nm3	< 125	< 123	< 241	< 163	--	100%
Organics, Semi-Volatile	1,4-Dichlorobenzene	SW 8270	ng/Nm3	< 254	< 252	< 197	< 235	--	100%
Organics, Semi-Volatile	1-Chloronaphthalene	SW 8270	ng/Nm3	< 203	< 201	< 180	< 195	--	100%
Organics, Semi-Volatile	1-Naphthylamine	SW 8270	ng/Nm3	< 491	< 486	< 682	< 553	--	100%
Organics, Semi-Volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ng/Nm3	< 158	< 157	< 156	< 157	--	100%
Organics, Semi-Volatile	2,4,5-Trichlorophenol	SW 8270	ng/Nm3	< 104	< 103	< 171	< 126	--	100%
Organics, Semi-Volatile	2,4,6-Trichlorophenol	SW 8270	ng/Nm3	< 110	< 109	< 170	< 130	--	100%
Organics, Semi-Volatile	2,4-Dichlorophenol	SW 8270	ng/Nm3	< 139	< 138	< 191	< 156	--	100%

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Organics, Semi-Volatile	2,4-Dimethylphenol	SW 8270	ng/Nm3	<	346	<	343	<	437	<	375	--	100%
Organics, Semi-Volatile	2,4-Dinitrophenol	SW 8270	ng/Nm3	<	2,203	<	2,182	<	1,404	<	1,930	--	100%
Organics, Semi-Volatile	2,4-Dinitrotoluene	SW 8270	ng/Nm3	<	173	<	171	<	198	<	181	--	100%
Organics, Semi-Volatile	2,6-Dichlorophenol	SW 8270	ng/Nm3	<	228	<	225	<	172	<	208	--	100%
Organics, Semi-Volatile	2,6-Dinitrotoluene	SW 8270	ng/Nm3	<	109	<	108	<	289	<	169	--	100%
Organics, Semi-Volatile	2-Chloronaphthalene	SW 8270	ng/Nm3	<	102	<	101	<	132	<	112	--	100%
Organics, Semi-Volatile	2-Chlorophenol	SW 8270	ng/Nm3	<	240	<	238	<	213	<	231	--	100%
Organics, Semi-Volatile	2-Methylnaphthalene	SW 8270	ng/Nm3	<	208	<	206	<	122	<	179	--	100%
Organics, Semi-Volatile	2-Methylphenol(o-cresol)	SW 8270	ng/Nm3		2,487		2,837		10,378		5,234	11,076	
Organics, Semi-Volatile	2-Naphthylamine	SW 8270	ng/Nm3	<	614	<	608	<	537	<	586	--	100%
Organics, Semi-Volatile	2-Nitroaniline	SW 8270	ng/Nm3	<	127	<	125	<	223	<	158	--	100%
Organics, Semi-Volatile	2-Nitrophenol	SW 8270	ng/Nm3	<	138	<	137	<	175	<	150	--	100%
Organics, Semi-Volatile	2-Picoline	SW 8270	ng/Nm3	<	343	<	340	<	278	<	320	--	100%
Organics, Semi-Volatile	3,3'-Dichlorobenzidine	SW 8270	ng/Nm3	<	154	<	153	<	112	<	140	--	100%
Organics, Semi-Volatile	3-Methylcholanthrene	SW 8270	ng/Nm3	<	246	<	244	<	168	<	219	--	100%
Organics, Semi-Volatile	3-Nitroaniline	SW 8270	ng/Nm3	<	160	<	159	<	132	<	150	--	100%
Organics, Semi-Volatile	4,6-Dinitro-2-methylphenol	SW 8270	ng/Nm3	<	249	<	247	<	144	<	214	--	100%
Organics, Semi-Volatile	4-Aminobiphenyl	SW 8270	ng/Nm3	<	235	<	233	<	400	<	289	--	100%
Organics, Semi-Volatile	4-Bromophenyl phenyl	SW 8270	ng/Nm3	<	144	<	142	<	163	<	149	--	100%
Organics, Semi-Volatile	4-Chloro-3-methylphenol	SW 8270	ng/Nm3	<	228	<	225	<	173	<	209	--	100%
Organics, Semi-Volatile	4-Chlorophenyl phenyl ether	SW 8270	ng/Nm3	<	166	<	165	<	141	<	157	--	100%
Organics, Semi-Volatile	4-Methylphenol(p-cresol)	SW 8270	ng/Nm3		2,068		1,443		1,679		1,730	784	
Organics, Semi-Volatile	4-Nitroaniline	SW 8270	ng/Nm3	<	152	<	151	<	204	<	169	--	100%
Organics, Semi-Volatile	4-Nitrophenol	SW 8270	ng/Nm3	<	218	<	215	<	315	<	249	--	100%
Organics, Semi-Volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ng/Nm3	<	604	<	599	<	447	<	550	--	100%
Organics, Semi-Volatile	Acenaphthene	SW 8270	ng/Nm3	<	150	<	149	<	91	<	130	--	100%
Organics, Semi-Volatile	Acenaphthylene	SW 8270	ng/Nm3	<	71	<	70	<	140	<	94	--	100%
Organics, Semi-Volatile	Acetophenone	SW 8270	ng/Nm3		3,525		2,930		3,322		3,259	751	
Organics, Semi-Volatile	Aniline	SW 8270	ng/Nm3	<	294	<	291	<	207	<	264	--	100%
Organics, Semi-Volatile	Anthracene	SW 8270	ng/Nm3	<	183	<	181	<	124	<	163	--	100%
Organics, Semi-Volatile	Benzidine	SW 8270	ng/Nm3	<	6,295	<	6,235	<	6,717	<	6,416	--	100%

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Organics, Semi-Volatile	Benzo(a)anthracene	SW 8270	ng/Nm3	<	162	<	161	<	151	<	158	- -	100%
Organics, Semi-Volatile	Benzo(a)pyrene	SW 8270	ng/Nm3	<	121	<	119	<	174	<	138	- -	100%
Organics, Semi-Volatile	Benzo(b)fluoranthene	SW 8270	ng/Nm3	<	179	<	177	<	305	<	220	- -	100%
Organics, Semi-Volatile	Benzo(g,h,i)perylene	SW 8270	ng/Nm3	<	153	<	152	<	343	<	216	- -	100%
Organics, Semi-Volatile	Benzo(k)fluoranthene	SW 8270	ng/Nm3	<	305	<	302	<	336	<	314	- -	100%
Organics, Semi-Volatile	Benzoic acid	SW 8270	ng/Nm3		123,074		105,679		160,875		129,876	70,107	
Organics, Semi-Volatile	Benzyl alcohol	SW 8270	ng/Nm3		12,685	<	337	<	205		4,319	18,001	2%
Organics, Semi-Volatile	Butylbenzylphthalate	SW 8270	ng/Nm3		409		324		274		336	170	
Organics, Semi-Volatile	Chrysene	SW 8270	ng/Nm3	<	211	<	209	<	180	<	200	- -	100%
Organics, Semi-Volatile	Di-n-octylphthalate	SW 8270	ng/Nm3	<	287	<	284	<	118	<	230	- -	100%
Organics, Semi-Volatile	Dibenz(a,h)anthracene	SW 8270	ng/Nm3	<	149	<	148	<	272	<	190	- -	100%
Organics, Semi-Volatile	Dibenz(a,j)acridine	SW 8270	ng/Nm3	<	183	<	181	<	283	<	216	- -	100%
Organics, Semi-Volatile	Dibenzofuran	SW 8270	ng/Nm3	<	128	<	127	<	180	<	145	- -	100%
Organics, Semi-Volatile	Dibutylphthalate	SW 8270	ng/Nm3	<	155		209	<	109	<	155	- -	39%
Organics, Semi-Volatile	Diethylphthalate	SW 8270	ng/Nm3		434	<	105	<	173		191	525	24%
Organics, Semi-Volatile	Dimethylphenethylamine	SW 8270	ng/Nm3	<	37,772	<	37,409	<	40,303	<	38,494	- -	100%
Organics, Semi-Volatile	Dimethylphthalate	SW 8270	ng/Nm3	<	88	<	87	<	113	<	96	- -	100%
Organics, Semi-Volatile	Diphenylamine	SW 8270	ng/Nm3	<	166	<	165	<	93	<	141	- -	100%
Organics, Semi-Volatile	Ethyl methanesulfonate	SW 8270	ng/Nm3	<	158	<	157	<	228	<	181	- -	100%
Organics, Semi-Volatile	Fluoranthene	SW 8270	ng/Nm3	<	201	<	199	<	158	<	186	- -	100%
Organics, Semi-Volatile	Fluorene	SW 8270	ng/Nm3	<	106	<	105	<	128	<	113	- -	100%
Organics, Semi-Volatile	Hexachlorobenzene	SW 8270	ng/Nm3	<	74	<	73	<	105	<	84	- -	100%
Organics, Semi-Volatile	Hexachlorobutadiene	SW 8270	ng/Nm3	<	220	<	218	<	172	<	203	- -	100%
Organics, Semi-Volatile	Hexachlorocyclopentadiene	SW 8270	ng/Nm3	<	2,808	<	2,781	<	1,978	<	2,522	- -	100%
Organics, Semi-Volatile	Hexachloroethane	SW 8270	ng/Nm3	<	187	<	185	<	213	<	195	- -	100%
Organics, Semi-Volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ng/Nm3	<	165	<	164	<	447	<	259	- -	100%
Organics, Semi-Volatile	Isophorone	SW 8270	ng/Nm3	<	90	<	89	<	207	<	129	- -	100%
Organics, Semi-Volatile	Methyl methanesulfonate	SW 8270	ng/Nm3	<	15,738	<	15,587	<	16,793	<	16,039	- -	100%
Organics, Semi-Volatile	N-Nitroso-di-n-butylamine	SW 8270	ng/Nm3	<	412	<	408	<	211	<	344	- -	100%
Organics, Semi-Volatile	N-Nitrosodimethylamine	SW 8270	ng/Nm3	<	419	<	415	<	264	<	366	- -	100%
Organics, Semi-Volatile	N-Nitrosodiphenylamine	SW 8270	ng/Nm3	<	178	<	176	<	90	<	148	- -	100%

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Organics, Semi-Volatile	N-Nitrosodipropylamine	SW 8270	ng/Nm3	<	236	<	234	<	220	<	230	- -	100%
Organics, Semi-Volatile	N-Nitrosopiperidine	SW 8270	ng/Nm3	<	297	<	294	<	201	<	264	- -	100%
Organics, Semi-Volatile	Naphthalene	SW 8270	ng/Nm3		957		773		1,562		1,097	1,025	
Organics, Semi-Volatile	Nitrobenzene	SW 8270	ng/Nm3	<	166	<	165	<	283	<	205	- -	100%
Organics, Semi-Volatile	Pentachlorobenzene	SW 8270	ng/Nm3	<	139	<	138	<	126	<	134	- -	100%
Organics, Semi-Volatile	Pentachloronitrobenzene	SW 8270	ng/Nm3	<	652	<	645	<	463	<	587	- -	100%
Organics, Semi-Volatile	Pentachlorophenol	SW 8270	ng/Nm3	<	272	<	269	<	299	<	280	- -	100%
Organics, Semi-Volatile	Phenacetin	SW 8270	ng/Nm3	<	170	<	168	<	130	<	156	- -	100%
Organics, Semi-Volatile	Phenanthrene	SW 8270	ng/Nm3	<	196	<	194	<	157	<	182	- -	100%
Organics, Semi-Volatile	Phenol	SW 8270	ng/Nm3		4,407		5,767		15,449		8,541	14,959	
Organics, Semi-Volatile	Pronamide	SW 8270	ng/Nm3	<	233	<	230	<	81	<	181	- -	100%
Organics, Semi-Volatile	Pyrene	SW 8270	ng/Nm3	<	147	<	146	<	137	<	143	- -	100%
Organics, Semi-Volatile	Pyridine	SW 8270	ng/Nm3	<	365	<	362	<	197	<	308	- -	100%
Organics, Semi-Volatile	bis(2-Chloroethoxy)methane	SW 8270	ng/Nm3	<	177	<	175	<	204	<	185	- -	100%
Organics, Semi-Volatile	bis(2-Chloroethyl)ether	SW 8270	ng/Nm3	<	230	<	228	<	129	<	196	- -	100%
Organics, Semi-Volatile	bis(2-Chloroisopropyl)ether	SW 8270	ng/Nm3	<	229	<	226	<	268	<	241	- -	100%
Organics, Semi-Volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ng/Nm3		7,271		3,367		33,922		14,853	41,311	
Organics, Semi-Volatile	p-Chloroaniline	SW 8270	ng/Nm3	<	176	<	174	<	250	<	200	- -	100%
Organics, Semi-Volatile	p-Dimethylaminoazobenzene	SW 8270	ng/Nm3	<	162	<	161	<	244	<	189	- -	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ng/Nm3		757		697		608		687	186	
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,2-Dichlorobenzene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,3-Dichlorobenzene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	1,4-Dichlorobenzene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	2-Butanone	SW 8240	ng/Nm3	<	2,561	<	2,681	<	2,683	<	2,642	- -	100%

Gas Stream Data

SAMPLE STREAM: ESP OUTLET

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Organics, Volatile	2-Hexanone	SW 8240	ng/Nm3	<	2,561	<	2,681	<	2,683	<	2,642	- -	100%
Organics, Volatile	4-Methyl-2-Pentanone	SW 8240	ng/Nm3	<	2,561	<	2,681	<	2,683	<	2,642	- -	100%
Organics, Volatile	Acetone	SW 8240	ng/Nm3	<	2,561	<	2,681	<	2,683	<	2,642	- -	100%
Organics, Volatile	Benzene	SW 8240	ng/Nm3		1,366		1,555		1,502		1,474	243	
Organics, Volatile	Bromodichloromethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Bromoform	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Bromomethane	SW 8240	ng/Nm3	<	654	<	536	<	537	<	576	- -	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ng/Nm3		2,356		6,901		948		3,402	7,730	
Organics, Volatile	Carbon Tetrachloride	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Chlorobenzene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Chloroethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Chloroform	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Chloromethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Ethyl Benzene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Methylene Chloride	SW 8240	ng/Nm3		18,300		47,739		31,659		32,566	36,621	
Organics, Volatile	Styrene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ng/Nm3		1,021		786		644		817	473	
Organics, Volatile	Toluene	SW 8240	ng/Nm3		688		1,341		1,502		1,177	1,071	
Organics, Volatile	Trichloroethene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	Trichlorofluoromethane	SW 8240	ng/Nm3	<	512		679	<	537	<	537	- -	44%
Organics, Volatile	Vinyl Acetate	SW 8240	ng/Nm3	<	2,561	<	2,681	<	2,683	<	2,642	- -	100%
Organics, Volatile	Vinyl Chloride	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	m,p-Xylene	SW 8240	ng/Nm3		789	<	536	<	537	<	537	- -	40%
Organics, Volatile	o-Xylene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	trans-1,2-Dichloroethene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ng/Nm3	<	512	<	536	<	537	<	528	- -	100%

Note: Shaded data has been invalidated due to high background in filter substrate. Shaded data is not included in "average" data calculation.

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3			Average	95% CI	DL Ratio
Particulate Loading		Grav	g/Nm3		0.0192			0.0118			0.0125			0.0145	0.0101	
Reduced Species	Ammonia as N	EPA 350.1	ug/Nm3		18.72	B		5.91	B		8.98	B		11.20	16.62	
Reduced Species	Cyanide	SW 9012	ug/Nm3		4.87			8.55			71.99			28	93.74	
Anions - Vapor Phase	Chloride	EPA 300.0	ug/Nm3		294			914			411			540	819	
Anions - Vapor Phase	Fluoride	EPA 340.2	ug/Nm3		126			96			150			124	66	
Anions - Vapor Phase	Sulfate	EPA 300.0	ug/Nm3		754,933			633,232			650,180			679,449	163,764	
Anions - Particulate	Chloride	EPA 300.0	ug/Nm3		345.2			203.6			93.4			214	314	
Anions - Particulate	Fluoride	EPA 340.2	ug/Nm3		0.057			0.063			0.032			0.051	0.041	
Anions - Particulate	Sulfate	EPA 300.0	ug/Nm3		9,961	B		4,121	B		3,633	B		5,905	8,748	
Anions - Total	Chloride	EPA 300.0	ug/Nm3		640			1,118			504			754	801	
Anions - Total	Fluoride	EPA 340.2	ug/Nm3		125.9			96.5			149.8			124	66	
Anions - Total	Sulfate	EPA 300.0	ug/Nm3		764,894			637,353			653,814			685,353	172,349	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g	<	56		<	56			62		<	56	–	47%
Part Metals by Wt	Aluminum	SW 6010	ug/g		2,096	B		14,330	B		13,177	B		13,754	7,328	
Part Metals by Wt	Antimony	ICP-MS	ug/g		7.46	****		4.22	B		3.33	B		3.77	5.66	
Part Metals by Wt	Arsenic	SW 7060	ug/g		66	B		87	B		76	B		81	71	
Part Metals by Wt	Barium	SW 6010	ug/g	<	180	C		303	B		126	B		214	1,120	
Part Metals by Wt	Beryllium	SW 6010	ug/g	<	1.60	C		3.11	B		2.77	B		2.94	2.12	
Part Metals by Wt	Boron	SW 6010	ug/g		–			--			--			--	--	
Part Metals by Wt	Cadmium	SW 7131	ug/g	<	10	C		35	B		48	B		41	79	
Part Metals by Wt	Calcium	SW 6010	ug/g		8,386	B		16,154	B		21,087	B		18,621	31,343	
Part Metals by Wt	Chromium	SW 6010	ug/g	<	110	C		93	B		565	B		329	2,995	
Part Metals by Wt	Cobalt	SW 6010	ug/g	<	147	C		18	J	<	37	C	<	37	- -	52%
Part Metals by Wt	Copper	SW 6010	ug/g	<	27	C		60	B		52	B		56	49	
Part Metals by Wt	Iron	SW 6010	ug/g		6,478	B		9,994	B		13,386	B		11,690	21,547	

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3			Average	95% CI	DL Ratio
Part Metals by Wt	Lead	SW 7421	ug/g	<	14	C		37	B		34	B		36	20	
Part Metals by Wt	Magnesium	SW 6010	ug/g		1,468	B		1,940	B		3,627	B		2,784	10,716	
Part Metals by Wt	Manganese	SW 6010	ug/g		182	B		285	B		691	B		488	2,579	
Part Metals by Wt	Mercury	SW 7471	ug/g	<	0.31	C		0.972	B	<	0.320	C		0.57	5.16	14%
Part Metals by Wt	Molybdenum	SW 6010	ug/g		18	B		100	B		100	B		73	118	
Part Metals by Wt	Nickel	SW 6010	ug/g		527	B		382	B		4,636	B		2,509	27,022	
Part Metals by Wt	Phosphorus	SW 6010	ug/g		419	B	<	217	C	<	162	C	<	217	- -	100%
Part Metals by Wt	Potassium	SW 6010	ug/g	<	17,191	C		3,020	J		2,772	J		2,896	1,576	
Part Metals by Wt	Selenium	SW 7740	ug/g		3,331	B		819	B		979	B		1,710	3,495	
Part Metals by Wt	Sodium	SW 6010	ug/g		16,771	B		4,046	B		4,350	B		4,198	1,932	
Part Metals by Wt	Strontium	SW 6010	ug/g		42	B		102	B		111	B		106	53	
Part Metals by Wt	Titanium	SW 6010	ug/g		726	B		1,044	B		784	B		914	1,656	
Part Metals by Wt	Vanadium	SW 6010	ug/g		92.56	B		130	B		114	B		112	46	
Part Metals by Wt	Zinc	SW 6010	ug/g	<	229	C		650	B		423	B		536	1,446	
Part Metals by Vol	Aluminum	SW 6010	ug/Nm3		33.28	B		171	B		211	B		191	255	
Part Metals by Vol	Antimony	ICP-MS	ug/Nm3		0.118			0.050			0.053			0.052	0.019	
Part Metals by Vol	Arsenic	SW 7060	ug/Nm3		1.053	B		1.03	B		1.21	B		1.10	0.239	
Part Metals by Vol	Barium	SW 6010	ug/Nm3	<	2.86	C		3.61	B		2.02	B		2.814	10.081	
Part Metals by Vol	Beryllium	SW 6010	ug/Nm3	<	0.025	C		0.037	B		0.044	B		0.041	0.047	
Part Metals by Vol	Boron				--			--			--					
Part Metals by Vol	Cadmium	SW 7131	ug/Nm3	<	0.166	C		0.419	B		0.763	B		0.591	2.18	
Part Metals by Vol	Calcium	SW 6010	ug/Nm3		133	B		193	B		338	B		265	921	
Part Metals by Vol	Chromium	SW 6010	ug/Nm3	<	1.75	C		1.11	B		9.04	B		5.07	50	
Part Metals by Vol	Cobalt	SW 6010	ug/Nm3	<	2.33	C		0.21	J	<	0.597	C	<	0.597	- -	59%
Part Metals by Vol	Copper	SW 6010	ug/Nm3	<	0.436	C		0.711	B		0.831	B		0.771	0.759	
Part Metals by Vol	Iron	SW 6010	ug/Nm3		103	B		119	B		214	B		167	604	
Part Metals by Vol	Lead	SW 7421	ug/Nm3	<	0.218	C		0.445	B		0.546	B		0.495	0.642	
Part Metals by Vol	Magnesium	SW 6010	ug/Nm3		23.29	B		23.13	B		58.05	B		41	222	
Part Metals by Vol	Manganese	SW 6010	ug/Nm3		2.90	B		3.40	B		11.06	B		7.23	49	
Part Metals by Vol	Mercury	SW 7471	ug/Nm3	<	0.005	C		0.0116	B	<	0.0051	C		0.0071	0.0573	18%

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3			Average	95% CI	DL Ratio
Part Metals by Vol	Molybdenum	SW 6010	ug/Nm3		0.286	B		1.19	B		1.60	B		1.40	2.64	
Part Metals by Vol	Nickel	SW 6010	ug/Nm3		6.36	B		4.56	B		74.20	B		39.38	442	
Part Metals by Vol	Phosphorus	SW 6010	ug/Nm3		6.66	B	<	2.59	C	<	2.60	C	<	2.59	- -	100%
Part Metals by Vol	Potassium	SW 6010	ug/Nm3	<	273	C		36.01	J		44.37	J		40.19	53.13	
Part Metals by Vol	Selenium	SW 7740	ug/Nm3		52.88	B		9.76	B		15.68	B		26.11	58.07	
Part Metals by Vol	Sodium	SW 6010	ug/Nm3		295	B		48.23	B		69.62	B		58.93	136	
Part Metals by Vol	Strontium	SW 6010	ug/Nm3		0.636	B		1.22	B		1.77	B		1.49	3.51	
Part Metals by Vol	Titanium	SW 6010	ug/Nm3		11.51	B		12.45	B		12.55	B		12.50	0.59	
Part Metals by Vol	Vanadium	SW 6010	ug/Nm3		1.469	B		1.55	B		1.83	B		1.61	0.468	
Part Metals by Vol	Zinc	SW 6010	ug/Nm3	<	3.63	C		7.75	B		6.76	B		7.26	6.27	
Metals, Vapor	Aluminum	SW 6010	ug/Nm3		8.25	B	<	8.70	C	<	7.59	C	<	8.70	- -	50%
Metals, Vapor	Antimony	ICP-MS	ug/Nm3		0.012	B		0.012	B		0.013	B		0.012	0.0019	
Metals, Vapor	Arsenic	SW 7060	ug/Nm3	<	0.156	C	<	0.201	C	<	0.176	C	<	0.178	- -	100%
Metals, Vapor	Barium	SW 6010	ug/Nm3	<	0.126	C		0.113	J	<	0.142	C	<	0.142	- -	54%
Metals, Vapor	Beryllium	SW 6010	ug/Nm3	<	0.131	C	<	0.170	C		0.032	J	<	0.170	- -	82%
Metals, Vapor	Boron	SW 6010	ug/Nm3		468	B		412	B		440	B		440	70	
Metals, Vapor	Cadmium	SW 7131	ug/Nm3	<	0.056	C	<	0.073	C	<	0.063	C	<	0.064	- -	100%
Metals, Vapor	Calcium	SW 6010	ug/Nm3	<	35.09	C		34.91	J	<	39.57	C	<	39.57	- -	52%
Metals, Vapor	Chromium	SW 6010	ug/Nm3	<	0.590	C	<	0.763	C	<	0.666	C	<	0.673	- -	100%
Metals, Vapor	Cobalt	SW 6010	ug/Nm3		0.218	J		0.211	J		0.751	J		0.394	0.770	
Metals, Vapor	Copper	SW 6010	ug/Nm3		2.32	B		0.910	J	<	1.02	C		1.25	2.36	14%
Metals, Vapor	Iron	SW 6010	ug/Nm3		1.71	B	<	1.83	C	<	1.59	C	<	1.83	- -	50%
Metals, Vapor	Lead	SW 7421	ug/Nm3	<	0.190	C	<	0.245	C	<	0.214	C	<	0.216	- -	100%
Metals, Vapor	Magnesium	SW 6010	ug/Nm3		5.55	B	<	6.98	C		5.27	J	<	6.98	- -	24%
Metals, Vapor	Manganese	SW 6010	ug/Nm3	<	0.094	C	<	0.121	C	<	0.106	C	<	0.107	- -	100%
Metals, Vapor	Mercury	CVAA	ug/Nm3		2.92	B		3.13	B		3.07	B		3.04	0.269	
Metals, Vapor	Molybdenum	SW 6010	ug/Nm3		0.12	J		0.13	J		0.10	J		0.116	0.048	
Metals, Vapor	Nickel	SW 6010	ug/Nm3	<	2.34	C		2.88	J	<	2.64	C	<	2.64	- -	46%
Metals, Vapor	Phosphorus	SW 6010	ug/Nm3	<	14.46	C	<	18.68	C	<	16.31	C	<	16.48	- -	100%
Metals, Vapor	Potassium	SW 6010	ug/Nm3		32.28	B	<	0.88	C		77.56	B		36.76	96.28	0.4%

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3			Average	95% CI	DL Ratio
Metals, Vapor	Selenium	SW 7740	ug/Nm3		0.11	J		0.84	B		1.40	B		0.781	1.61	
Metals, Vapor	Sodium	SW 6010	ug/Nm3	<	9.41	C	<	12.16	C	<	10.61	C	<	10.73	- -	100%
Metals, Vapor	Strontium	SW 6010	ug/Nm3	<	0.04	C	<	0.05	C	<	0.04	C	<	0.045	- -	100%
Metals, Vapor	Titanium	SW 6010	ug/Nm3	<	0.242	C		0.190	J	<	0.273	C	<	0.273	- -	58%
Metals, Vapor	Vanadium	SW 6010	ug/Nm3		0.422	J		0.420	J		0.821	B		0.554	0.574	
Metals, Vapor	Zinc	SW 6010	ug/Nm3		1.11	B		373	B		114	B		163	474	
Total Metals	Aluminum	SW 6010	ug/Nm3		41.53			175			215			195	251	
Total Metals	Antimony	ICP-MS	ug/Nm3		0.13			0.06			0.07			0.065	0.026	
Total Metals	Arsenic	SW 7060	ug/Nm3		1.13			1.13			1.30			1.19	0.236	
Total Metals	Barium	SW 6010	ug/Nm3	<	1.49			3.72			2.09			2.906	10.351	
Total Metals	Beryllium	SW 6010	ug/Nm3	<	0.08			0.12			0.08			0.099	0.288	
Total Metals	Boron(vapor only)	SW 6010	ug/Nm3		468			412			440			440	70	
Total Metals	Cadmium	SW 7131	ug/Nm3	<	0.11			0.46			0.79			0.625	2.152	
Total Metals	Calcium	SW 6010	ug/Nm3		151			228			357			292	825	
Total Metals	Chromium	SW 6010	ug/Nm3	<	1.17			1.49			9.37			5.431	50.05	
Total Metals	Cobalt	SW 6010	ug/Nm3		1.36			0.42			1.05			0.735	4.000	
Total Metals	Copper	SW 6010	ug/Nm3		2.54			1.62			1.34			1.480	1.784	
Total Metals	Iron	SW 6010	ug/Nm3		105			120			215			168	603	
Total Metals	Lead	SW 7421	ug/Nm3	<	0.20			0.57			0.65			0.610	0.543	
Total Metals	Magnesium	SW 6010	ug/Nm3		28.85			26.62			63.32			44.97	233	
Total Metals	Manganese	SW 6010	ug/Nm3		2.94			3.46			11.11			7.284	48.623	
Total Metals	Mercury	SW 7471	ug/Nm3		2.92			3.14			3.07			3.107	0.439	
Total Metals	Molybdenum	SW 6010	ug/Nm3		0.40			1.32			1.70			1.512	2.393	
Total Metals	Nickel	SW 6010	ug/Nm3		9.53			7.44			75.52			41.48	433	
Total Metals	Phosphorus	SW 6010	ug/Nm3		13.89		<	10.63		<	9.45		<	10.04	- -	100%
Total Metals	Potassium	SW 6010	ug/Nm3		169			36.44			122			79.19	543	
Total Metals	Selenium	SW 7740	ug/Nm3		52.99			10.60			17.08			27	57	
Total Metals	Sodium	SW 6010	ug/Nm3		271			54.31			74.93			64.62	131	
Total Metals	Strontium	SW 6010	ug/Nm3		0.89			1.24			1.79			1.517	3.486	
Total Metals	Titanium	SW 6010	ug/Nm3		11.84			12.64			12.68			12.66	0.255	

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units	Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Total Metals	Vanadium	SW 6010	ug/Nm3	1.89		1.97		2.65		2.17	1.04	
Total Metals	Zinc	SW 6010	ug/Nm3	2.93		380.73		120.36		251	1,654	
Hg Vapor, Bloom	Mercury, Elemental	CVAFS	ug/Nm3	2.98		3.08		2.29		2.78	1.07	
Hg Vapor, Bloom	Mercury II	CVAFS	ug/Nm3	0.33		0.47		0.60		0.468	0.335	
Hg Vapor, Bloom	Mercury, Methyl	CVAFS	ug/Nm3	0.045		0.061		0.028		0.044	0.041	
Hg Vapor, Bloom	Mercury, Total	CVAFS	ug/Nm3	3.36		3.62		2.92		3.30	0.88	
Hexavalent Chromium	Chromium VI	Cr(VI) BIF	ug/Nm3	< 0.18	C	< 0.19	C	< 0.20	C	< 0.190	- -	100%
Hexavalent Chromium	Total Chromium	SW 7191	ug/Nm3	< 0.52	C	< 0.57	C	< 0.59	C	< 0.560	- -	100%
Extract Metals, Nitric	Antimony	ICP-MS	ug/g	3.919		5.782		2.034		5.78	- -	
Extract Metals, Nitric	Arsenic	ICP-MS	ug/g	< 3.603		164		16		164	- -	
Extract Metals, Nitric	Barium	ICP-MS	ug/g	4097		354		1361		354	- -	
Extract Metals, Nitric	Beryllium	ICP-MS	ug/g	< 0.531		10.250		1.350		10.25	- -	
Extract Metals, Nitric	Boron	ICP-MS	ug/g	3762		< 15		< 1.259		< 15.34	- -	100%
Extract Metals, Nitric	Cadmium	ICP-MS	ug/g	< 0.636		67		< 0.968		67.00	- -	
Extract Metals, Nitric	Chromium	ICP-MS	ug/g	43		44		< 2.173		43.77	- -	
Extract Metals, Nitric	Cobalt	ICP-MS	ug/g	< 0.283		< 0.899		< 0.334		< 0.90	- -	100%
Extract Metals, Nitric	Copper	ICP-MS	ug/g	14.024		124		26		124	- -	
Extract Metals, Nitric	Lead	ICP-MS	ug/g	26		91		40		90.84	- -	
Extract Metals, Nitric	Manganese	ICP-MS	ug/g	239		328		71		328	- -	
Extract Metals, Nitric	Mercury	ICP-MS	ug/g	< 2.247		< 7.136		< 2.840		< 7.14	- -	100%
Extract Metals, Nitric	Molybdenum	ICP-MS	ug/g	3.503		51		7.061		51.40	- -	
Extract Metals, Nitric	Nickel	ICP-MS	ug/g	96		392		123		392	- -	
Extract Metals, Nitric	Selenium	ICP-MS	ug/g	< 27		< 87		< 32		< 86.88	- -	100%
Extract Metals, Nitric	Vanadium	ICP-MS	ug/g	46		385		< 1.304		385	- -	
Extract Metals, Gastric	Antimony	ICP-MS	ug/g	0.957		3.367		0.528		3.37	- -	
Extract Metals, Gastric	Arsenic	ICP-MS	ug/g	< 0.696		< 2.465		< 0.962		< 2.46	- -	100%
Extract Metals, Gastric	Barium	ICP-MS	ug/g	20		214		54		214	- -	

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Extract Metals, Gastric	Beryllium	ICP-MS	ug/g	1.674	4.196	1.056	4.20	- -	
Extract Metals, Gastric	Boron	ICP-MS	ug/g	126	147	265	147	- -	
Extract Metals, Gastric	Cadmium	ICP-MS	ug/g	4.026	12	4.119	12.40	- -	
Extract Metals, Gastric	Chromium	ICP-MS	ug/g	84	85	33	84.69	- -	
Extract Metals, Gastric	Cobalt	ICP-MS	ug/g	3.412	11	2.298	10.92	- -	
Extract Metals, Gastric	Copper	ICP-MS	ug/g	45	51	29	51.26	- -	
Extract Metals, Gastric	Lead	ICP-MS	ug/g	5.759	66	4.340	65.75	- -	
Extract Metals, Gastric	Manganese	ICP-MS	ug/g	126	349	86	349	- -	
Extract Metals, Gastric	Mercury	ICP-MS	ug/g	< 0.042	< 0.149	< 0.058	< 0.15	- -	100%
Extract Metals, Gastric	Molybdenum	ICP-MS	ug/g	16	49	11	48.58	- -	
Extract Metals, Gastric	Nickel	ICP-MS	ug/g	17	169	9.036	169	- -	
Extract Metals, Gastric	Selenium	ICP-MS	ug/g	135	140	276	140	- -	
Extract Metals, Gastric	Vanadium	ICP-MS	ug/g	< 0.368	< 1.304	< 0.509	< 1.30	- -	100%
Extract Metals, Acetic	Antimony	ICP-MS	ug/g	< 0.011	< 0.034	< 0.012	< 0.03	- -	100%
Extract Metals, Acetic	Arsenic	ICP-MS	ug/g	45	< 0.497	8.352	< 0.50	- -	100%
Extract Metals, Acetic	Barium	ICP-MS	ug/g	58	17	80	17.20	- -	
Extract Metals, Acetic	Beryllium	ICP-MS	ug/g	2.148	2.907	2.774	2.91	- -	
Extract Metals, Acetic	Boron	ICP-MS	ug/g	450	< 0.82	321	< 0.82	- -	100%
Extract Metals, Acetic	Cadmium	ICP-MS	ug/g	2.326	5.916	0.578	5.92	- -	
Extract Metals, Acetic	Chromium	ICP-MS	ug/g	80	36	19	36.41	- -	
Extract Metals, Acetic	Cobalt	ICP-MS	ug/g	2.221	7.465	4.081	7.47	- -	
Extract Metals, Acetic	Copper	ICP-MS	ug/g	33	64	44	63.85	- -	
Extract Metals, Acetic	Lead	ICP-MS	ug/g	< 0.013	20.033	< 0.014	20.03	- -	
Extract Metals, Acetic	Manganese	ICP-MS	ug/g	158	470	203	470	- -	
Extract Metals, Acetic	Mercury	ICP-MS	ug/g	0.164	< 0.384	< 0.136	< 0.38	- -	100%
Extract Metals, Acetic	Molybdenum	ICP-MS	ug/g	7.892	3.454	6.287	3.45	- -	
Extract Metals, Acetic	Nickel	ICP-MS	ug/g	54	66	33	66.17	- -	
Extract Metals, Acetic	Selenium	ICP-MS	ug/g	71	61	82	61.21	- -	
Extract Metals, Acetic	Vanadium	ICP-MS	ug/g	15	< 0.185	11	< 0.19	- -	100%

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Aldehydes	Acetaldehyde	BIF-0011	ug/Nm3		4.78		12.07		9.38		8.74	9.16	
Aldehydes	Fomaldehyde	BIF-0011	ug/Nm3		40.43		17.04		14.79		24	35	
Organics, Semi-Volatiles	1,2,4,5-Tetrachlorobenzene	SW 8270	ng/Nm3	<	192	<	192	<	129	<	171	--	100%
Organics, Semi-Volatiles	1,2,4-Trichlorobenzene	SW 8270	ng/Nm3	<	196	<	196	<	195	<	196	--	100%
Organics, Semi-Volatiles	1,2-Dichlorobenzene	SW 8270	ng/Nm3	<	259	<	259	<	211	<	243	--	100%
Organics, Semi-Volatiles	1,2-Diphenylhydrazine	SW 8270	ng/Nm3	<	33,190	<	33,190	<	33,190	<	33,190	--	100%
Organics, Semi-Volatiles	1,3-Dichlorobenzene	SW 8270	ng/Nm3	<	131	<	131	<	238	<	167	--	100%
Organics, Semi-Volatiles	1,4-Dichlorobenzene	SW 8270	ng/Nm3	<	268	<	268	<	195	<	244	--	100%
Organics, Semi-Volatiles	1-Chloronaphthalene	SW 8270	ng/Nm3	<	214	<	214	<	178	<	202	--	100%
Organics, Semi-Volatiles	1-Naphthylamine	SW 8270	ng/Nm3	<	518	<	518	<	674	<	570	--	100%
Organics, Semi-Volatiles	2,3,4,6-Tetrachlorophenol	SW 8270	ng/Nm3	<	167	<	167	<	154	<	163	--	100%
Organics, Semi-Volatiles	2,4,5-Trichlorophenol	SW 8270	ng/Nm3	<	110	<	110	<	169	<	129	--	100%
Organics, Semi-Volatiles	2,4,6-Trichlorophenol	SW 8270	ng/Nm3	<	116	<	116	<	168	<	133	--	100%
Organics, Semi-Volatiles	2,4-Dichlorophenol	SW 8270	ng/Nm3	<	147	<	147	<	189	<	161	--	100%
Organics, Semi-Volatiles	2,4-Dimethylphenol	SW 8270	ng/Nm3	<	365	<	365	<	431	<	387	--	100%
Organics, Semi-Volatiles	2,4-Dinitrophenol	SW 8270	ng/Nm3	<	2,323	<	2,323	<	1,387	<	2,011	--	100%
Organics, Semi-Volatiles	2,4-Dinitrotoluene	SW 8270	ng/Nm3	<	183	<	183	<	196	<	187	--	100%
Organics, Semi-Volatiles	2,6-Dichlorophenol	SW 8270	ng/Nm3	<	240	<	240	<	170	<	217	--	100%
Organics, Semi-Volatiles	2,6-Dinitrotoluene	SW 8270	ng/Nm3	<	115	<	115	<	286	<	172	--	100%
Organics, Semi-Volatiles	2-Chloronaphthalene	SW 8270	ng/Nm3	<	106	<	108	<	130	<	115	--	100%
Organics, Semi-Volatiles	2-Chlorophenol	SW 8270	ng/Nm3	<	254	<	254	<	211	<	239	--	100%
Organics, Semi-Volatiles	2-Methylnaphthalene	SW 8270	ng/Nm3	<	219	<	219	<	121	<	186	--	100%
Organics, Semi-Volatiles	2-Methylphenol(o-cresol)	SW 8270	ng/Nm3		1,404		4,414		3,034		2,951	3,744	
Organics, Semi-Volatiles	2-Naphthylamine	SW 8270	ng/Nm3	<	647	<	647	<	531	<	608	--	100%
Organics, Semi-Volatiles	2-Nitroaniline	SW 8270	ng/Nm3	<	133	<	133	<	220	<	162	--	100%
Organics, Semi-Volatiles	2-Nitrophenol	SW 8270	ng/Nm3	<	146	<	146	<	173	<	155	--	100%
Organics, Semi-Volatiles	2-Picoline	SW 8270	ng/Nm3	<	362	<	362	<	274	<	333	--	100%
Organics, Semi-Volatiles	3,3'-Dichlorobenzidine	SW 8270	ng/Nm3	<	163	<	163	<	111	<	145	--	100%
Organics, Semi-Volatiles	3-Methylcholanthrene	SW 8270	ng/Nm3	<	260	<	260	<	166	<	229	--	100%
Organics, Semi-Volatiles	3-Nitroaniline	SW 8270	ng/Nm3	<	169	<	169	<	130	<	156	--	100%

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Organics, Semi-Volatiles	4,6-Dinitro-2-methylphenol	SW 8270	ng/Nm3	<	263	<	263	<	143	<	223	- -	100%
Organics, Semi-Volatiles	4-Aminobiphenyl	SW 8270	ng/Nm3	<	248	<	248	<	395	<	297	- -	100%
Organics, Semi-Volatiles	4-Bromophenyl phenyl	SW 8270	ng/Nm3	<	151	<	151	<	161	<	154	- -	100%
Organics, Semi-Volatiles	4-Chloro-3-methylphenol	SW 8270	ng/Nm3	<	240	<	240	<	171	<	217	- -	100%
Organics, Semi-Volatiles	4-Chlorophenyl phenyl ether	SW 8270	ng/Nm3	<	175	<	175	<	140	<	163	- -	100%
Organics, Semi-Volatiles	4-Methylphenol(p-cresol)	SW 8270	ng/Nm3		1,314		1,494	<	152		961	1,917	3%
Organics, Semi-Volatiles	4-Nitroaniline	SW 8270	ng/Nm3	<	161	<	161	<	201	<	174	- -	100%
Organics, Semi-Volatiles	4-Nitrophenol	SW 8270	ng/Nm3	<	229	<	229	<	311	<	257	- -	100%
Organics, Semi-Volatiles	7,12-Dimethylbenz(a)anthracene	SW 8270	ng/Nm3	<	637	<	637	<	441	<	572	- -	100%
Organics, Semi-Volatiles	Acenaphthene	SW 8270	ng/Nm3	<	159	<	159	<	90	<	136	- -	100%
Organics, Semi-Volatiles	Acenaphthylene	SW 8270	ng/Nm3	<	75	<	75	<	139	<	96	- -	100%
Organics, Semi-Volatiles	Acetophenone	SW 8270	ng/Nm3		2,967		3,518		3,385		3,290	714	
Organics, Semi-Volatiles	Aniline	SW 8270	ng/Nm3	<	310	<	310	<	204	<	275	- -	100%
Organics, Semi-Volatiles	Anthracene	SW 8270	ng/Nm3	<	193	<	193	<	122	<	169	- -	100%
Organics, Semi-Volatiles	Benzidine	SW 8270	ng/Nm3	<	6,638	<	6,638	<	6,638	<	6,638	- -	100%
Organics, Semi-Volatiles	Benzo(a)anthracene	SW 8270	ng/Nm3	<	171	<	171	<	149	<	164	- -	100%
Organics, Semi-Volatiles	Benzo(a)pyrene	SW 8270	ng/Nm3	<	127	<	127	<	172	<	142	- -	100%
Organics, Semi-Volatiles	Benzo(b)fluoranthene	SW 8270	ng/Nm3	<	189	<	189	<	301	<	226	- -	100%
Organics, Semi-Volatiles	Benzo(g,h,i)perylene	SW 8270	ng/Nm3	<	162	<	162	<	339	<	221	- -	100%
Organics, Semi-Volatiles	Benzo(k)fluoranthene	SW 8270	ng/Nm3	<	321	<	321	<	332	<	325	- -	100%
Organics, Semi-Volatiles	Benzoic acid	SW 8270	ng/Nm3		120,481		116,498		118,821		118,600	4,970	
Organics, Semi-Volatiles	Benzyl alcohol	SW 8270	ng/Nm3		8,098	<	358	<	202		2,793	11,415	3%
Organics, Semi-Volatiles	Butylbenzylphthalate	SW 8270	ng/Nm3		325		335		243		301	125	
Organics, Semi-Volatiles	Chrysene	SW 8270	ng/Nm3	<	222	<	222	<	178	<	207	- -	100%
Organics, Semi-Volatiles	Di-n-octylphthalate	SW 8270	ng/Nm3	<	302	<	302	<	117	<	241	- -	100%
Organics, Semi-Volatiles	Dibenz(a,h)anthracene	SW 8270	ng/Nm3	<	157	<	157	<	269	<	195	- -	100%
Organics, Semi-Volatiles	Dibenz(a,j)acridine	SW 8270	ng/Nm3	<	193	<	193	<	279	<	222	- -	100%
Organics, Semi-Volatiles	Dibenzofuran	SW 8270	ng/Nm3	<	135	<	135	<	178	<	150	- -	100%
Organics, Semi-Volatiles	Dibutylphthalate	SW 8270	ng/Nm3		253		208	<	108		172	260	10%
Organics, Semi-Volatiles	Diethylphthalate	SW 8270	ng/Nm3		298		194		213		235	137	
Organics, Semi-Volatiles	Dimethylphenethylamine	SW 8270	ng/Nm3	<	39,828	<	39,828	<	39,828	<	39,828	- -	100%

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Organics, Semi-Volatiles	Dimethylphthalate	SW 8270	ng/Nm3	< 93	< 93	435	176	557	18%
Organics, Semi-Volatiles	Diphenylamine	SW 8270	ng/Nm3	< 175	< 175	< 92	< 147	- -	100%
Organics, Semi-Volatiles	Ethyl methanesulfonate	SW 8270	ng/Nm3	< 167	< 167	< 225	< 186	- -	100%
Organics, Semi-Volatiles	Fluoranthene	SW 8270	ng/Nm3	< 212	< 212	< 156	< 193	- -	100%
Organics, Semi-Volatiles	Fluorene	SW 8270	ng/Nm3	< 112	< 112	< 126	< 116	- -	100%
Organics, Semi-Volatiles	Hexachlorobenzene	SW 8270	ng/Nm3	< 78	< 78	< 104	< 87	- -	100%
Organics, Semi-Volatiles	Hexachlorobutadiene	SW 8270	ng/Nm3	< 232	< 232	< 170	< 211	- -	100%
Organics, Semi-Volatiles	Hexachlorocyclopentadiene	SW 8270	ng/Nm3	< 2,961	< 2,961	< 1,955	< 2,625	- -	100%
Organics, Semi-Volatiles	Hexachloroethane	SW 8270	ng/Nm3	< 197	< 197	< 211	< 202	- -	100%
Organics, Semi-Volatiles	Indeno(1,2,3-cd)pyrene	SW 8270	ng/Nm3	< 174	< 174	< 441	< 263	- -	100%
Organics, Semi-Volatiles	Isophorone	SW 8270	ng/Nm3	< 95	< 95	< 204	< 132	- -	100%
Organics, Semi-Volatiles	Methyl methanesulfonate	SW 8270	ng/Nm3	< 16,595	< 16,595	< 16,595	< 16,595	- -	100%
Organics, Semi-Volatiles	N-Nitroso-di-n-butylamine	SW 8270	ng/Nm3	< 435	< 435	< 209	< 359	- -	100%
Organics, Semi-Volatiles	N-Nitrosodimethylamine	SW 8270	ng/Nm3	< 441	< 441	< 261	< 381	- -	100%
Organics, Semi-Volatiles	N-Nitrosodiphenylamine	SW 8270	ng/Nm3	< 188	< 188	< 89	< 155	- -	100%
Organics, Semi-Volatiles	N-Nitrosodipropylamine	SW 8270	ng/Nm3	< 249	< 249	< 217	< 239	- -	100%
Organics, Semi-Volatiles	N-Nitrosopiperidine	SW 8270	ng/Nm3	< 313	< 313	< 198	< 275	- -	100%
Organics, Semi-Volatiles	Naphthalene	SW 8270	ng/Nm3	1,955	1,470	1,175	1,533	978	
Organics, Semi-Volatiles	Nitrobenzene	SW 8270	ng/Nm3	< 175	< 175	< 279	< 210	- -	100%
Organics, Semi-Volatiles	Pentachlorobenzene	SW 8270	ng/Nm3	< 147	< 147	< 124	< 139	- -	100%
Organics, Semi-Volatiles	Pentachloronitrobenzene	SW 8270	ng/Nm3	< 687	< 687	< 458	< 611	- -	100%
Organics, Semi-Volatiles	Pentachlorophenol	SW 8270	ng/Nm3	< 287	< 287	< 295	< 290	- -	100%
Organics, Semi-Volatiles	Phenacetin	SW 8270	ng/Nm3	< 179	< 179	< 128	< 162	- -	100%
Organics, Semi-Volatiles	Phenanthrene	SW 8270	ng/Nm3	< 206	< 206	< 155	< 189	- -	100%
Organics, Semi-Volatiles	Phenol	SW 8270	ng/Nm3	5,277	11,417	11,285	9,326	8,713	
Organics, Semi-Volatiles	Pronamide	SW 8270	ng/Nm3	< 245	< 245	< 80	< 190	- -	100%
Organics, Semi-Volatiles	Pyrene	SW 8270	ng/Nm3	< 155	< 155	< 135	< 149	- -	100%
Organics, Semi-Volatiles	Pyridine	SW 8270	ng/Nm3	< 385	< 385	< 195	< 322	- -	100%
rganics, Semi-Volatiles	bis(2-Chloroethoxy)methane	SW 8270	ng/Nm3	< 187	< 187	< 201	< 191	- -	100%
rganics, Semi-Volatiles	bis(2-Chloroethyl)ether	SW 8270	ng/Nm3	< 243	< 243	< 127	< 204	- -	100%
rganics, Semi-Volatiles	bis(2-Chloroisopropyl)ether	SW 8270	ng/Nm3	< 241	< 241	< 265	< 249	- -	100%

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Average	95% CI	DL Ratio
Organics, Semi-Volatiles	bis(2-Ethylhexyl)phthalate	SW 8270	ng/Nm3		2,005		1,099		1,019		1,374	1,360	
Organics, Semi-Volatiles	p-Chloroaniline	SW 8270	ng/Nm3	<	186	<	186	<	247	<	206	- -	100%
Organics, Semi-Volatiles	p-Dimethylaminoazobenzene	SW 8270	ng/Nm3	<	171	<	171	<	241	<	194	- -	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ng/Nm3		881		774	<	545		643	807	14%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,2-Dichlorobenzene	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,3-Dichlorobenzene	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	1,4-Dichlorobenzene	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	2-Butanone	SW 8240	ng/Nm3	<	2,485	<	2,690	<	2,725	<	2,633	- -	100%
Organics, Volatile	2-Hexanone	SW 8240	ng/Nm3	<	2,485	<	2,690	<	2,725	<	2,633	- -	100%
Organics, Volatile	4-Methyl-2-Pentanone	SW 8240	ng/Nm3	<	2,485	<	2,690	<	2,725	<	2,633	- -	100%
Organics, Volatile	Acetone	SW 8240	ng/Nm3		2,965	<	2,690		6,341		3,550	6,332	13%
Organics, Volatile	Benzene	SW 8240	ng/Nm3		1,153		1,329		1,435		1,306	355	
Organics, Volatile	Bromodichloromethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Bromoform	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Bromomethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ng/Nm3		1,978		2,797		1,998		2,258	1,160	
Organics, Volatile	Carbon Tetrachloride	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Chlorobenzene	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Chloroethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Chloroform	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Chloromethane	SW 8240	ng/Nm3		7,880		10,034	<	545		6,062	12,741	1%
Organics, Volatile	Dibromochloromethane	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Ethyl Benzene	SW 8240	ng/Nm3	<	497	<	538	<	545	<	527	- -	100%
Organics, Volatile	Methylene Chloride	SW 8240	ng/Nm3		242,946		110,653		22,912		125,503	275,181	

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Average	95% CI	DL Ratio
Organics, Volatile	Styrene	SW 8240	ng/Nm3	< 544	< 538	< 545	< 542	- -	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ng/Nm3	2,494	664	1,272	1,477	2,315	
Organics, Volatile	Toluene	SW 8240	ng/Nm3	1,989	2,474	1,670	2,044	1,006	
Organics, Volatile	Trichloroethene	SW 8240	ng/Nm3	< 497	< 538	< 545	< 527	- -	100%
Organics, Volatile	Trichlorofluoromethane	SW 8240	ng/Nm3	741	1,919	690	1,117	1,727	
Organics, Volatile	Vinyl Acetate	SW 8240	ng/Nm3	< 2,485	< 2,690	< 2,725	< 2,633	- -	100%
Organics, Volatile	Vinyl Chloride	SW 8240	ng/Nm3	< 497	< 538	< 545	< 527	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ng/Nm3	< 497	< 538	< 545	< 527	- -	100%
Organics, Volatile	m,p-Xylene	SW 8240	ng/Nm3	< 544	< 538	< 545	< 542	- -	100%
Organics, Volatile	o-Xylene	SW 8240	ng/Nm3	< 497	< 538	< 545	< 527	- -	100%
Organics, Volatile	trans-1,2-Dichloroethene	SW 8240	ng/Nm3	< 497	< 538	< 545	< 527	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ng/Nm3	< 497	< 538	< 545	< 527	- -	100%
Dioxins/Furans	1234678-HpCDD	HR-GCMS	ng/Nm3	< 0.0067	< 0.0656	< 0.0068	< 0.0264	- -	100%
Dioxins/Furans	1234678-HpCDF	HR-GCMS	ng/Nm3	0.0067	< 0.0230	0.0034	< 0.0230	- -	53%
Dioxins/Furans	123478-HxCDD	HR-GCMS	ng/Nm3	< 0.0067	< 0.0328	< 0.0068	< 0.0154	- -	100%
Dioxins/Furans	123478-HxCDF	HR-GCMS	ng/Nm3	0.0020	< 0.0164	< 0.0034	< 0.0164	- -	83%
Dioxins/Furans	1234789-HpCDF	HR-GCMS	ng/Nm3	< 0.0067	< 0.0328	< 0.0068	< 0.0154	- -	100%
Dioxins/Furans	123678-HxCDD	HR-GCMS	ng/Nm3	< 0.0034	< 0.0230	< 0.0034	< 0.0099	- -	100%
Dioxins/Furans	123678-HxCDF	HR-GCMS	ng/Nm3	< 0.0020	< 0.0131	< 0.0024	< 0.0058	- -	100%
Dioxins/Furans	12378-PeCDD	HR-GCMS	ng/Nm3	< 0.0020	< 0.0098	< 0.0024	< 0.0047	- -	100%
Dioxins/Furans	12378-PeCDF	HR-GCMS	ng/Nm3	< 0.0013	< 0.0066	< 0.0017	< 0.0032	- -	100%
Dioxins/Furans	123789-HxCDD	HR-GCMS	ng/Nm3	< 0.0034	< 0.0295	< 0.0034	< 0.0121	- -	100%
Dioxins/Furans	123789-HxCDF	HR-GCMS	ng/Nm3	< 0.0034	< 0.0197	< 0.0034	< 0.0088	- -	100%
Dioxins/Furans	234678-HxCDF	HR-GCMS	ng/Nm3	0.0034	< 0.0164	0.0030	< 0.0164	- -	56%
Dioxins/Furans	23478-PeCDF	HR-GCMS	ng/Nm3	< 0.0013	< 0.0066	< 0.0017	< 0.0032	- -	100%
Dioxins/Furans	2378-TCDD	HR-GCMS	ng/Nm3	< 0.0017	< 0.0066	< 0.0017	< 0.0033	- -	100%
Dioxins/Furans	2378-TCDF	HR-GCMS	ng/Nm3	0.0020 M	< 0.0033	0.0017	< 0.0033	- -	31%
Dioxins/Furans	OCDD	HR-GCMS	ng/Nm3	0.0168	< 0.1313	< 0.0102	< 0.1313	- -	81%
Dioxins/Furans	OCDF	HR-GCMS	ng/Nm3	0.0168	< 0.1313	0.0136 M	< 0.1313	- -	68%
Dioxins/Furans	Total HpCDD	HR-GCMS	ng/Nm3	< 0.0067	< 0.0656	< 0.0068	< 0.0264	- -	100%

Gas Stream Data

SAMPLE STREAM: STACK

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2		Run 3		Average	95% CI	DL Ratio
Dioxins/Furans	Total HpCDF	HR-GCMS	ng/Nm3		0.0067		<	0.0295		0.0034	<	0.0295	- -	59%
Dioxins/Furans	Total HxCDD	HR-GCMS	ng/Nm3		0.0101		<	0.0263	<	0.0034	<	0.0263	- -	60%
Dioxins/Furans	Total HxCDF	HR-GCMS	ng/Nm3		0.0034		<	0.0164		0.0030	<	0.0164	- -	56%
Dioxins/Furans	Total PeCDD	HR-GCMS	ng/Nm3	<	0.0020		<	0.0098	<	0.0024	<	0.0047	- -	100%
Dioxins/Furans	Total PeCDF	HR-GCMS	ng/Nm3		0.0023	M	<	0.0066	<	0.0017	<	0.0066	- -	64%
Dioxins/Furans	Total TCDD	HR-GCMS	ng/Nm3		0.0101	M	<	0.0066		0.0068		0.0067	0.0084	16%
Dioxins/Furans	Total TCDF	HR-GCMS	ng/Nm3		0.0020	M	<	0.0033		0.0017	<	0.0033	- -	31%

Note: Shaded data invalid due to high background in filter substrate. Shaded data not used in calculation of average.

M= Maximum Estimated Concentration

Solid Stream Data

Sample Stream: Raw Coal

Analyte Group	Specie	Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	D4208	ug/g	1250	1410	1390	1500	1,350	217	
Anions	Fluoride	D3761	ug/g	120	140	110	120	123	38	
Metals	Aluminum	INAA	ug/g	12,847	15,153	14,863	13,776	14,287	3,121	
Metals	Antimony	INAA	ug/g	0.77	0.56	0.52	0.49	0.62	0.33	
Metals	Arsenic	GFAA	ug/g	3.00	3.00	3.00	3.00	3.00		
Metals	Barium	INAA	ug/g	120	108	106	110	112	19	
Metals	Beryllium	ICPES	ug/g	1.20	1.10	1.10	1.10	1.13	0.14	
Metals	Boron	ICPES	ug/g	110	120	100	100	110	25	
Metals	Bromine	INAA	ug/g	7.16	7.89	7.20	6.89	7.42	1.02	
Metals	Cadmium	ICPES	ug/g	0.700	0.200	0.700	0.200	0.533	0.717	
Metals	Calcium	INAA	ug/g	2,793	3,611	2,624	2,677	3,010	1,311	
Metals	Cerium	INAA	ug/g	15.18	16.56	16.60	15.81	16.11	2.01	
Metals	Cesium	INAA	ug/g	1.10	1.21	1.20	1.15	1.17	0.16	
Metals	Chlorine	INAA	ug/g	1,169	1,180	1,269	1,427	1,206	136	
Metals	Chromium	INAA	ug/g	25.66	25.92	25.67	23.57	25.75	0.37	
Metals	Cobalt	INAA	ug/g	3.99	4.12	4.13	3.80	4.08	0.19	
Metals	Copper	INAA	ug/g	23.58	63.57	38.73	38.93	41.96	50.15	
Metals	Europium	INAA	ug/g	0.300	0.294	0.305	0.306	0.299	0.014	
Metals	Hafnium	INAA	ug/g	0.667	0.652	0.696	0.728	0.672	0.056	
Metals	Iodine	INAA	ug/g	< 2.09	1.99	1.94	1.05	< 2.09	- -	21%
Metals	Iron	INAA	ug/g	12,989	13,405	12,074	11,827	12,823	1,691	
Metals	Lanthanum	INAA	ug/g	6.53	7.37	6.39	6.41	6.76	1.31	
Metals	Lead	ICPES	ug/g	8.00	8.00	11.00	8.00	9.00	4.30	
Metals	Lutetium	INAA	ug/g	0.119	0.121	0.121	0.101	0.120	0.003	
Metals	Magnesium	INAA	ug/g	653	641	686	630	660	57.87	
Metals	Manganese	INAA	ug/g	22.05	24.41	26.78	24.63	24.41	5.88	
Metals	Mercury	DGA/CVAA	ug/g	0.040	0.040	0.050	0.040	0.043	0.014	
Metals	Molybdenum	INAA	ug/g	20.29	21.36	13.53	21.63	18.39	10.54	
Metals	Neodymium	INAA	ug/g	7.09	9.32	7.50	11.38	7.97	2.95	
Metals	Nickel	INAA	ug/g	39.21	46.03	34.57	25.89	39.94	14.32	
Metals	Phosphorus	ICPES	ug/g	70	150	66	97	95	118	
Metals	Potassium	INAA	ug/g	2,940	2,182	4,034	3,125	3,052	2,313	
Metals	Rubidium	INAA	ug/g	19.71	22.53	20.40	19.57	20.88	3.66	
Metals	Samarium	INAA	ug/g	1.45	1.54	1.30	1.27	1.43	0.31	

Solid Stream Data

Sample Stream: Raw Coal

Analyte Group	Specie	Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Metals	Scandium	INAA	ug/g	3.19	3.29	3.23	3.10	3.24	0.12	
Metals	Selenium	GFAA	ug/g	2.00	2.00	3.00	2.00	2.33	1.43	
Metals	Silver	INAA	ug/g	< 0.39	< 0.69	< 0.15	< 0.62	< 0.41	- -	100%
Metals	Sodium	INAA	ug/g	674	717	646	625	679	88.78	
Metals	Strontium	INAA	ug/g	83.77	94.25	84.97	82.07	87.66	14.25	
Metals	Tantalum	INAA	ug/g	0.20	0.196	0.201	0.205	0.201	0.010	
Metals	Terbium	INAA	ug/g	0.17	0.194	0.177	0.174	0.179	0.036	
Metals	Thorium	INAA	ug/g	2.60	2.74	2.65	2.56	2.67	0.18	
Metals	Tin	INAA	ug/g	< 16.48	< 17.55	< 16.31	< 15.46	< 16.78	- -	100%
Metals	Titanium	INAA	ug/g	814	929	806	890	850	170.97	
Metals	Tungsten	INAA	ug/g	0.26	0.30	0.24	< 1.03	0.27	0.08	
Metals	Uranium	INAA	ug/g	1.57	1.76	1.47	1.55	1.60	0.37	
Metals	Vanadium	INAA	ug/g	35.25	37.56	40.34	37.67	37.71	6.33	
Metals	Ytterbium	INAA	ug/g	0.77	0.79	0.66	0.70	0.74	0.18	
Metals	Zinc	INAA	ug/g	18.18	20.89	21.40	16.89	20.15	4.30	
Metals	Zirconium	INAA	ug/g	108.46	70.19	77.67	92.33	85.44	50.40	
Ultimate/Proximate	% Ash	D3174	%	11	12.59	12.87	12.21	12.15	2.51	
Ultimate/Proximate	% Carbon	D3176	%	71.37	70.41	70.65	70.73	70.81	1.24	
Ultimate/Proximate	% Hydrogen	D3176	%	4.84	4.74	4.71	4.75	4.76	0.17	
Ultimate/Proximate	% Moisture	D3173	%	12.7	11.2	11.2	11.3	11.70	2.15	
Ultimate/Proximate	% Nitrogen	D3176	%	1.43	1.47	1.44	1.51	1.45	0.05	
Ultimate/Proximate	% Oxygen (diff)	D3176	%	8.3	7.92	7.55	8.06	7.92	0.93	
Ultimate/Proximate	% Sulfur	D4239	%	3.06	2.87	2.78	2.74	2.90	0.36	
Ultimate/Proximate	Fixed Carbon	D3172	%	51.03	50.44	50.68	51.5	50.72	0.74	
Ultimate/Proximate	Higher Heating Value	D2015	Btu/lb	12,715	12,511	12,547	12,544	12,591	271	
Ultimate/Proximate	Heating Value (MAF)	D2015	MAF Btu	14,287	14,313	14,400	14,289	14,333	147	
Ultimate/Proximate	Volatile	D3175	%	37.97	36.97	36.45	36.29	37.13	1.92	

Solid Stream Data

Sample Stream: Feed Coal

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	D4208	ug/g	1,410	1,430	1,360	1,400	1,400	90	
Anions	Fluoride	D3761	ug/g	100	100	100	110	100		
Metals	Aluminum	INAA	ug/g	13,856	14,674	14,977	15,511	14,502	1,441	
Metals	Antimony	INAA	ug/g	0.68	0.57	0.57	0.65	0.61	0.16	
Metals	Arsenic	GFAA	ug/g	2.00	3.00	2.00	3.00	2.33	1.43	
Metals	Barium	INAA	ug/g	66.1	70.3	103	89.1	79.9	50.7	
Metals	Beryllium	ICPES	ug/g	1.10	1.10	1.10	1.20	1.10		
Metals	Boron	ICPES	ug/g	100	100	100	120	100		
Metals	Bromine	INAA	ug/g	7.25	7.67	7.38	8.24	7.44	0.53	
Metals	Cadmium	ICPES	ug/g	0.30	0.30	0.30	0.40	0.30		
Metals	Calcium	INAA	ug/g	1,764	1,941	2,717	2,365	2,141	1,260	
Metals	Cerium	INAA	ug/g	15.3	14.7	17.4	16.7	15.8	3.5	
Metals	Cesium	INAA	ug/g	1.16	1.04	1.31	1.13	1.17	0.34	
Metals	Chlorine	INAA	ug/g	1,220	1,293	1,222	1,266	1,245	103	
Metals	Chromium	INAA	ug/g	26.0	24.7	23.7	27.8	24.8	2.9	
Metals	Cobalt	INAA	ug/g	3.81	2.63	4.08	4.01	3.51	1.92	
Metals	Copper	INAA	ug/g	59.5	9.83	39.0	< 23.0	36.1	62.1	
Metals	Europium	INAA	ug/g	0.32	0.27	0.32	0.29	0.30	0.08	
Metals	Hafnium	INAA	ug/g	0.68	0.66	0.78	0.83	0.70	0.16	
Metals	Iodine	INAA	ug/g	< 1.66	1.32	0.87	1.03	< 1.66	- -	27%
Metals	Iron	INAA	ug/g	11,814	10,938	11,390	11,939	11,381	1,089	
Metals	Lanthanum	INAA	ug/g	6.76	7.02	7.15	7.44	6.98	0.49	
Metals	Lead	ICPES	ug/g	9.00	8.00	7.00	8.00	8.00	2.48	
Metals	Lutetium	INAA	ug/g	0.13	0.11	0.11	0.12	0.12	0.03	
Metals	Magnesium	INAA	ug/g	586	489	626	705	567	175	
Metals	Manganese	INAA	ug/g	24.9	22.8	22.5	24.4	23.4	3.3	
Metals	Mercury	DGA/CVAA	ug/g	0.09	0.07	0.07	0.09	0.08	0.03	
Metals	Molybdenum	INAA	ug/g	23.6	19.5	23.8	21.8	22.3	6.1	
Metals	Neodymium	INAA	ug/g	8.55	8.70	6.17	8.11	7.81	3.53	
Metals	Nickel	INAA	ug/g	29.9	32.7	27.5	46.4	30.0	6.39	
Metals	Phosphorus	ICPES	ug/g	77.0	87.0	89.0	89.0	84.3	16.0	
Metals	Potassium	INAA	ug/g	3,395	3,538	2,982	2,594	3,305	717	
Metals	Rubidium	INAA	ug/g	20.7	18.0	20.8	21.8	19.8	3.92	
Metals	Samarium	INAA	ug/g	1.45	1.37	1.37	1.53	1.40	0.12	
Metals	Scandium	INAA	ug/g	3.14	3.03	3.36	3.35	3.18	0.42	
Metals	Selenium	GFAA	ug/g	2.00	2.00	3.00	3.00	2.33	1.43	

Solid Stream Data

Sample Stream: Feed Coal

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Metals	Silver	INAA	ug/g	< 0.61	< 0.45	< 0.49	< 0.48	< 0.52	- -	100%
Metals	Sodium	INAA	ug/g	663	632	597	653	631	82	
Metals	Strontium	INAA	ug/g	76.1	77.8	70.6	46.8	74.9	9.3	
Metals	Tantalum	INAA	ug/g	0.18	0.19	0.21	0.20	0.19	0.04	
Metals	Terbium	INAA	ug/g	0.18	0.16	0.19	0.18	0.18	0.03	
Metals	Thorium	INAA	ug/g	2.57	2.42	2.80	2.77	2.60	0.47	
Metals	Tin	INAA	ug/g	< 15.6	< 16.1	< 16.2	< 17.2	< 15.9	- -	100%
Metals	Titanium	INAA	ug/g	912	818	953	732	894	172	
Metals	Tungsten	INAA	ug/g	0.44	0.20	< 1.08	0.29	< 1.08	- -	46%
Metals	Uranium	INAA	ug/g	2.03	1.69	1.56	2.04	1.76	0.60	
Metals	Vanadium	INAA	ug/g	39.3	40.0	39.1	40.4	39.4	1.2	
Metals	Ytterbium	INAA	ug/g	0.71	0.62	6,584	0.73	2,195	9,442	
Metals	Zinc	INAA	ug/g	18.1	38.0	19.0	37.9	25.0	28	
Metals	Zirconium	INAA	ug/g	< 61.8	147.6	77.3	111.6	85.3	146	12%
Ultimate/Proximate	% Ash	D3174	%	10.5	11.3	11.6	12.2	11.1	1.4	
Ultimate/Proximate	% Carbon	D3176	%	72.2	72.1	71.8	71.3	72.0	0.5	
Ultimate/Proximate	% Hydrogen	D3176	%	4.82	4.83	4.83	4.83	4.83	0.01	
Ultimate/Proximate	% Nitrogen	D3176	%	1.55	1.55	1.45	1.49	1.52	0.14	
Ultimate/Proximate	% Oxygen (diff)	D3176	%	8.03	7.61	7.59	7.52	7.74	0.62	
Ultimate/Proximate	% Sulfur	D4239	%	2.87	2.65	2.69	2.66	2.74	0.29	
Ultimate/Proximate	Fixed Carbon	D3172	%	51.4	49.7	51.4	50.8	50.8	2.5	
Ultimate/Proximate	Higher Heating Value	D2015	Btu/lb	12,721	12,699	12,670	12,673	12,697	64	
Ultimate/Proximate	Heating Value (MAF)	D2015	MAF Btu	14,217	14,314	14,339	14,436	14,290	160	
Ultimate/Proximate	Volatile	D3175	%	38.1	36.0	36.9	37.0	37.0	2.7	
Radionuclides	Actinium-228 @ 338 KeV	EPA901.1	pCi/g	0.40	0.40	0.20	0.20	0.33	0.29	
Radionuclides	Actinium-228 @ 911 KeV	EPA901.1	pCi/g	0.30	0.30	0.40	0.30	0.33	0.14	
Radionuclides	Actinium-228 @ 968 KeV	EPA901.1	pCi/g	ND	ND	0.20	ND	0.07	0.29	
Radionuclides	Bismuth-212 @ 727 KeV	EPA901.1	pCi/g	ND	ND	ND	ND	ND		
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA901.1	pCi/g	0.80	1.10	0.90	0.90	0.93	0.38	
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA901.1	pCi/g	ND	0.30	ND	0.40	0.10	0.43	
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA901.1	pCi/g	0.70	0.60	0.70	0.60	0.67	0.14	
Radionuclides	K-40 @ 1460 KeV	EPA901.1	pCi/g	1.20	2.90	ND	3.20	1.37	3.62	
Radionuclides	Lead-210 @ 46 KeV	EPA901.1	pCi/g	1.20	1.00	1.70	1.00	1.30	0.90	
Radionuclides	Lead-212 @ 238 KeV	EPA901.1	pCi/g	0.20	0.20	0.20	0.20	0.20	0.00	
Radionuclides	Lead-214 @ 295.2 KeV	EPA901.1	pCi/g	0.70	0.60	0.60	0.40	0.63	0.14	
Radionuclides	Lead-214@ 352.0 KeV	EPA901.1	pCi/g	0.70	0.60	0.60	0.50	0.63	0.14	

Solid Stream Data

Sample Stream: Feed Coal

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Radionuclides	Radium-226 @ 186.0 KeV	EPA901.1	pCi/g	1.00	1.50	1.00	1.60	1.17	0.72	
Radionuclides	Thallium-208 @ 583 KeV	EPA901.1	pCi/g	0.20	0.30	0.40	0.40	0.30	0.25	
Radionuclides	Thallium-208 @ 860 KeV	EPA901.1	pCi/g	ND	ND	ND	ND	ND		
Radionuclides	Thorium-234 @ 63.3 KeV	EPA901.1	pCi/g	0.60	1.60	0.70	1.30	0.97	1.37	
Radionuclides	Thorium-234 @ 92.6 KeV	EPA901.1	pCi/g	0.70	0.50	0.80	0.50	0.67	0.38	
Radionuclides	Uranium-235 @ 143 KeV	EPA901.1	pCi/g	0.20	ND	ND	ND	0.07	0.29	

Solid Stream Data

Sample Stream: Pulverizer Rejects

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	D4208	ug/g	520	540	460	460	507	103	
Anions	Fluoride	D3761	ug/g	330	310	330	340	323	29	
Metals	Aluminum	INAA	ug/g	22,782	28,605	30,095	32,254	27,161	9,601	
Metals	Antimony	INAA	ug/g	1.03	1.35	1.34	1.14	1.24	0.45	
Metals	Arsenic	GFAA	ug/g	32.0	67.0	42.0	40.0	47.0	44.8	
Metals	Barium	INAA	ug/g	540	123	327	339	330	519	
Metals	Beryllium	ICPES	ug/g	1.90	1.90	0.60	1.10	1.47	1.86	
Metals	Boron	ICPES	ug/g	100	170	75	73	115	122	
Metals	Bromine	INAA	ug/g	4.85	4.42	3.65	4.98	4.31	1.51	
Metals	Cadmium	ICPES	ug/g	1.00	7.80	3.40	1.80	4.07	8.57	
Metals	Calcium	INAA	ug/g	11,715	15,640	10,690	11,298	12,682	6,490	
Metals	Cerium	INAA	ug/g	25.9	33.1	30.7	33.6	29.9	9.06	
Metals	Cesium	INAA	ug/g	1.88	2.30	2.23	2.72	2.14	0.55	
Metals	Chlorine	INAA	ug/g	554	643	559	648	585	125	
Metals	Chromium	INAA	ug/g	58.0	64.2	69.5	76.1	63.9	14.3	
Metals	Cobalt	INAA	ug/g	7.41	8.02	7.87	8.38	7.77	0.80	
Metals	Copper	INAA	ug/g	81.5	94.2	< 59.0	< 56.1	68.4	85.2	14%
Metals	Europium	INAA	ug/g	0.59	0.65	0.67	0.67	0.64	0.11	
Metals	Hafnium	INAA	ug/g	2.30	1.82	2.34	2.47	2.15	0.73	
Metals	Iodine	INAA	ug/g	1.44	1.92	2.65	2.63	2.00	1.52	
Metals	Iron	INAA	ug/g	133,094	126,965	119,458	112,069	126,506	16,967	
Metals	Lanthanum	INAA	ug/g	14.5	17.4	16.5	16.6	16.2	3.7	
Metals	Lead	ICPES	ug/g	41.0	48.0	23.0	33.0	37.3	32.0	
Metals	Lutetium	INAA	ug/g	0.23	0.18	0.20	0.26	0.20	0.06	
Metals	Magnesium	INAA	ug/g	1,226	1,467	1,420	1,696	1,371	318	
Metals	Manganese	INAA	ug/g	93.9	80.1	122	122	98.6	52.7	
Metals	Mercury	DGA/CVAA	ug/g	0.26	0.090	0.040	0.21	0.130	0.287	
Metals	Molybdenum	INAA	ug/g	18.36	17.3	4.07	4.17	13.2	19.8	
Metals	Neodymium	INAA	ug/g	19.56	20.6	16.3	30.3	18.8	5.6	
Metals	Nickel	INAA	ug/g	56	< 115	< 103	117	< 115	- -	66%
Metals	Phosphorus	ICPES	ug/g	1,200	2,500	780	990	1,493	2,228	
Metals	Potassium	INAA	ug/g	2,707	5,303	8.54	4,558	2,673	6,577	
Metals	Rubidium	INAA	ug/g	41.0	36.4	36.3	40.9	37.9	6.6	
Metals	Samarium	INAA	ug/g	2.18	2.50	2.54	2.67	2.41	0.49	

Solid Stream Data

Sample Stream: Pulverizer Rejects

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Metals	Scandium	INAA	ug/g	4.60	5.83	5.22	6.32	5.22	1.53	
Metals	Selenium	GFAA	ug/g	7.00	9.00	10.00	7.00	8.67	3.79	
Metals	Silver	INAA	ug/g	1.30	< 1.87	< 1.94	< 1.44	< 1.94	- -	59%
Metals	Sodium	INAA	ug/g	1,169	998	1,160	1,162	1,109	239	
Metals	Strontium	INAA	ug/g	308	377	658	297	448	461	
Metals	Tantalum	INAA	ug/g	0.43	0.57	0.55	0.48	0.52	0.18	
Metals	Terbium	INAA	ug/g	0.32	0.29	0.35	0.40	0.32	0.08	
Metals	Thorium	INAA	ug/g	3.79	4.41	4.22	5.43	4.14	0.79	
Metals	Tin	INAA	ug/g	31.9	< 30.7	< 29.5	< 28.0	< 30.7	- -	49%
Metals	Titanium	INAA	ug/g	1,993	1,936	2,020	2,028	1,983	106	
Metals	Tungsten	INAA	ug/g	0.30	0.49	< 0.74	< 1.05	< 0.74	- -	32%
Metals	Uranium	INAA	ug/g	3.84	4.95	3.51	4.09	4.10	1.87	
Metals	Vanadium	INAA	ug/g	61.5	56.0	61.8	66.2	59.8	8.2	
Metals	Ytterbium	INAA	ug/g	1.09	1.86	1.32	1.44	1.42	0.99	
Metals	Zinc	INAA	ug/g	486	1,594	1,503	559	1,194	1,528	
Metals	Zirconium	INAA	ug/g	291	251	448	240	330	259	
Ultimate/Proximate	% Carbon	D3176	%	39.5	39.6	36.6	38.4	38.5	4.2	
Ultimate/Proximate	% Sulfur	D3176	%	17.1	15.3	15.7	15.1	16.0	2.3	

Solid Stream Data

Sample Stream: Bottom Ash

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	SM407C	ug/g	172	< 99.8	163	< 99.8	128	169	13%
Anions	Fluoride	EPA 340.2	ug/g	30.9	21.4	42.3	16.7	31.5	26.0	
Metals	Aluminum	SW 6010	ug/g	75,600	80,800	72,000	70,200	76,133	10,991	
Metals	Antimony	ICP-MS	ug/g	1.21	1.15	1.05	0.95	1.14	0.20	
Metals	Arsenic	SW 7060	ug/g	4.28	8.67	8.49	4.92	7.15	6.17	
Metals	Barium	SW 6010	ug/g	428	481	461	460	457	66	
Metals	Beryllium	SW 6010	ug/g	8.47	8.17	6.30	6.51	7.65	2.92	
Metals	Boron	ICPES	ug/g	360	240	250	240	283	165	
Metals	Cadmium	SW 7131	ug/g	0.29 J	0.18 J	0.49	0.29 J	0.32	0.39	
Metals	Calcium	SW 6010	ug/g	21,800	19,900	19,100	18,600	20,267	3,445	
Metals	Chromium	SW 6010	ug/g	196	197	184	182	192	18	
Metals	Cobalt	SW 6010	ug/g	33.1	32.1	29.7	27.5	31.6	4.34	
Metals	Copper	SW 6010	ug/g	84.0	76.9	69.6	68.3	76.8	17.9	
Metals	Iron	SW 6010	ug/g	144,000	127,000	120,000	118,000	130,333	30,663	
Metals	Lead	SW 7421	ug/g	20.2	21.2	18.2	18.3	19.9	3.8	
Metals	Magnesium	SW 6010	ug/g	3740	3850	3230	3070	3,607	822	
Metals	Manganese	SW 6010	ug/g	296	262	253	240	270	56	
Metals	Mercury	SW 7471	ug/g	0.0048 J	< 0.0109	< 0.0114	0.0048 J	< 0.0114	- -	70%
Metals	Molybdenum	SW 6010	ug/g	4.57	< 2.89	< 2.97	4.52	< 2.97	- -	39%
Metals	Nickel	SW 6010	ug/g	138	130	126	124	131	15	
Metals	Phosphorus	SW 6010	ug/g	306	413	470	420	396	207	
Metals	Potassium	SW 6010	ug/g	14,200	14,600	13,700	13,200	14,167	1,120	
Metals	Selenium	SW 7740	ug/g	< 1.13	< 1.13	< 1.16	< 1.14	< 1.14	- -	100%
Metals	Silicon	SW 6010	ug/g	213,000	209,000	218,000	216,000	213,333	11,203	
Metals	Sodium	SW 6010	ug/g	3,850	3,610	3,380	3,300	3,613	584	
Metals	Strontium	SW 6010	ug/g	280	297	264	260	280	41	
Metals	Titanium	SW 6010	ug/g	5,450	5,810	5,400	5,430	5,553	556	
Metals	Vanadium	SW 6010	ug/g	281	286	264	260	277	29	
Metals	Zinc	SW 6010	ug/g	216	229	194	186	213	44	
Ultimate/Proximate	% Carbon	D3176	%	1.18	1.53	4.29	3.46	2.33	4.23	
Ultimate/Proximate	% Sulfur	D4239	%	0.053	0.052	0.340	0.133	0.148	0.412	
Radionuclides	Actinium-228 @ 338 KeV	EPA 901.1	pCi/g	2.1	2.1	2.1	2.2	2.1	0	

Solid Stream Data

Sample Stream: Bottom Ash

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Radionuclides	Actinium-228 @ 911 KeV	EPA 901.1	pCi/g	2.3	2.2	2.1	2.0	2.2	0.2	
Radionuclides	Actinium-228 @ 968 KeV	EPA 901.1	pCi/g	2.6	2.3	1.8	2.4	2.2	1.0	
Radionuclides	Bismuth-212 @ 727 KeV	EPA 901.1	pCi/g	3.5	2.8	2.6	3.0	3.0	1.2	
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA 901.1	pCi/g	7.8	7.6	6.8	6.8	7.4	1.3	
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA 901.1	pCi/g	7.4	7.3	5.8	6.5	6.8	2.2	
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA 901.1	pCi/g	7.7	7.1	6.5	6.7	7.1	1.5	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g	16	18	16	16	17	3	
Radionuclides	Lead-210 @ 46 KeV	EPA 901.1	pCi/g	1.2	1.3	1.6	1.6	1.4	0.5	
Radionuclides	Lead-212 @ 238 KeV	EPA 901.1	pCi/g	1.7	2.2	2.2	2.1	2.0	0.7	
Radionuclides	Lead-214 @ 295.2 KeV	EPA 901.1	pCi/g	8.1	7.3	6.6	7.0	7.3	1.9	
Radionuclides	Lead-214@ 352.0 KeV	EPA 901.1	pCi/g	8.2	7.8	6.8	7.1	7.6	1.8	
Radionuclides	Radium-226 @ 186.0 KeV	EPA 901.1	pCi/g	11	10	9.9	10	10	1.5	
Radionuclides	Thallium-208 @ 583 KeV	EPA 901.1	pCi/g	2.3	2.3	2.0	2.2	2.2	0.4	
Radionuclides	Thallium-208 @ 860 KeV	EPA 901.1	pCi/g	3.3	2.4	ND	2.6	1.9	4.2	
Radionuclides	Thorium-234 @ 63.3 KeV	EPA 901.1	pCi/g	6.1	5.5	5.7	5.0	5.8	0.8	
Radionuclides	Thorium-234 @ 92.6 KeV	EPA 901.1	pCi/g	5.1	4.5	5.5	4.5	5.0	1.3	
Radionuclides	Uranium-235 @ 143 KeV	EPA 901.1	pCi/g	0.26	0.28	0.38	0.25	0.31	0.16	
Organics, Semi-Volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ng/g	< 27.2	< 25.4	< 16.9		< 23.2	--	100%
Organics, Semi-Volatile	1,2,4-Trichlorobenzene	SW 8270	ng/g	< 27.8	< 25.9	< 25.6		< 26.4	--	100%
Organics, Semi-Volatile	1,2-Dichlorobenzene	SW 8270	ng/g	< 36.6	< 34.2	< 27.6		< 32.8	--	100%
Organics, Semi-Volatile	1,2-Diphenylhydrazine	SW 8270	ng/g	< 100	< 100	< 100		< 100	--	100%
Organics, Semi-Volatile	1,3-Dichlorobenzene	SW 8270	ng/g	< 18.6	< 17.4	< 31.2		< 22.4	--	100%
Organics, Semi-Volatile	1,4-Dichlorobenzene	SW 8270	ng/g	< 38.0	< 35.5	< 25.6		< 33.0	--	100%
Organics, Semi-Volatile	1-Chloronaphthalene	SW 8270	ng/g	< 30.3	< 28.3	< 23.3		< 27.3	--	100%
Organics, Semi-Volatile	1-Naphthylamine	SW 8270	ng/g	< 73.3	< 68.5	< 88.2		< 76.7	--	100%
Organics, Semi-Volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ng/g	< 23.6	< 22.1	< 20.2		< 22.0	--	100%
Organics, Semi-Volatile	2,4,5-Trichlorophenol	SW 8270	ng/g	< 15.5	< 14.5	< 22.1		< 17.4	--	100%
Organics, Semi-Volatile	2,4,6-Trichlorophenol	SW 8270	ng/g	< 16.4	< 15.3	< 22.0		< 17.9	--	100%
Organics, Semi-Volatile	2,4-Dichlorophenol	SW 8270	ng/g	< 20.8	< 19.4	< 24.7		< 21.6	--	100%
Organics, Semi-Volatile	2,4-Dimethylphenol	SW 8270	ng/g	< 51.7	< 48.3	< 56.5		< 52.2	--	100%
Organics, Semi-Volatile	2,4-Dinitrophenol	SW 8270	ng/g	< 329	< 307	< 182		< 273	--	100%
Organics, Semi-Volatile	2,4-Dinitrotoluene	SW 8270	ng/g	< 25.8	< 24.1	< 25.7		< 25.2	--	100%
Organics, Semi-Volatile	2,6-Dichlorophenol	SW 8270	ng/g	< 34.0	< 31.7	< 22.2		< 29.3	--	100%
Organics, Semi-Volatile	2,6-Dinitrotoluene	SW 8270	ng/g	< 16.3	< 15.2	< 37.4		< 23.0	--	100%

Solid Stream Data

Sample Stream: Bottom Ash

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2		Run 3	Run 3d		Average	95% CI	DL Ratio
Organics, Semi-Volatile	2-Chloronaphthalene	SW 8270	ng/g	<	15.2		<	14.2	<	17.0		<	15.5	- -	100%
Organics, Semi-Volatile	2-Chlorophenol	SW 8270	ng/g	<	35.9		<	33.5	<	27.6		<	32.3	- -	100%
Organics, Semi-Volatile	2-Methylnaphthalene	SW 8270	ng/g		78.9		<	29.0	<	15.8			33.8	97	22%
Organics, Semi-Volatile	2-Methylphenol(o-cresol)	SW 8270	ng/g	<	25.1		<	23.4	<	13.5		<	20.7	- -	100%
Organics, Semi-Volatile	2-Naphthylamine	SW 8270	ng/g	<	91.6		<	85.6	<	69.5		<	82.2	- -	100%
Organics, Semi-Volatile	2-Nitroaniline	SW 8270	ng/g	<	18.9		<	17.6	<	28.8		<	21.8	- -	100%
Organics, Semi-Volatile	2-Nitrophenol	SW 8270	ng/g	<	20.7		<	19.3	<	22.7		<	20.9	- -	100%
Organics, Semi-Volatile	2-Picoline	SW 8270	ng/g	<	51.2		<	47.8	<	35.9		<	45.0	- -	100%
Organics, Semi-Volatile	3,3'-Dichlorobenzidine	SW 8270	ng/g	<	23.0		<	21.5	<	14.5		<	19.7	- -	100%
Organics, Semi-Volatile	3-Methylcholanthrene	SW 8270	ng/g	<	36.8		<	34.4	<	21.7		<	31.0	- -	100%
Organics, Semi-Volatile	3-Nitroaniline	SW 8270	ng/g	<	23.9		<	22.3	<	17.1		<	21.1	- -	100%
Organics, Semi-Volatile	4,6-Dinitro-2-methylphenol	SW 8270	ng/g	<	37.2		<	34.8	<	18.7		<	30.2	- -	100%
Organics, Semi-Volatile	4-Aminobiphenyl	SW 8270	ng/g	<	35.1		<	32.8	<	51.7		<	39.9	- -	100%
Organics, Semi-Volatile	4-Bromophenyl phenyl	SW 8270	ng/g	<	21.4		<	20.0	<	21.0		<	20.8	- -	100%
Organics, Semi-Volatile	4-Chloro-3-methylphenol	SW 8270	ng/g	<	34.0		<	31.7	<	22.4		<	29.4	- -	100%
Organics, Semi-Volatile	4-Chlorophenyl phenyl ether	SW 8270	ng/g	<	24.8		<	23.2	<	18.3		<	22.1	- -	100%
Organics, Semi-Volatile	4-Methylphenol(p-cresol)	SW 8270	ng/g	<	27.0		<	25.2	<	19.9		<	24.0	- -	100%
Organics, Semi-Volatile	4-Nitroaniline	SW 8270	ng/g	<	22.7		<	21.2	<	26.3		<	23.4	- -	100%
Organics, Semi-Volatile	4-Nitrophenol	SW 8270	ng/g	<	32.5		<	30.3	<	40.7		<	34.5	- -	100%
Organics, Semi-Volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ng/g	<	90.2		<	84.3	<	57.8		<	77.4	- -	100%
Organics, Semi-Volatile	Acenaphthene	SW 8270	ng/g	<	22.5		<	21.0	<	11.8		<	18.4	- -	100%
Organics, Semi-Volatile	Acenaphthylene	SW 8270	ng/g	<	10.6		<	9.9	<	18.2		<	12.9	- -	100%
Organics, Semi-Volatile	Acetophenone	SW 8270	ng/g	<	21.6		<	20.1	<	24.3		<	22.0	- -	100%
Organics, Semi-Volatile	Aniline	SW 8270	ng/g	<	43.8		<	40.9	<	26.8		<	37.2	- -	100%
Organics, Semi-Volatile	Anthracene	SW 8270	ng/g		14.6	J	<	25.5	<	16.0		<	25.5	- -	59%
Organics, Semi-Volatile	Benzidine	SW 8270	ng/g	<	20.0		<	20.0	<	20.0		<	20.0	- -	100%
Organics, Semi-Volatile	Benzo(a)anthracene	SW 8270	ng/g		21.0	J	<	22.6	<	19.5		<	22.6	- -	50%
Organics, Semi-Volatile	Benzo(a)pyrene	SW 8270	ng/g	<	18.0		<	16.8	<	22.5		<	19.1	- -	100%
Organics, Semi-Volatile	Benzo(b)fluoranthene	SW 8270	ng/g		24.2		<	25.0	<	39.5		<	39.5	- -	57%
Organics, Semi-Volatile	Benzo(g,h,i)perylene	SW 8270	ng/g		11.8	J	<	21.4	<	44.3		<	44.3	- -	74%
Organics, Semi-Volatile	Benzo(k)fluoranthene	SW 8270	ng/g		24.2		<	42.5	<	43.4		<	43.4	- -	64%
Organics, Semi-Volatile	Benzoic acid	SW 8270	ng/g	<	186		<	174	<	1,680		<	680	- -	100%
Organics, Semi-Volatile	Benzyl alcohol	SW 8270	ng/g	<	50.7		<	47.4	<	26.5		<	41.5	- -	100%
Organics, Semi-Volatile	Butylbenzylphthalate	SW 8270	ng/g	<	18.5		<	17.2	<	27.2		<	21.0	- -	100%
Organics, Semi-Volatile	Chrysene	SW 8270	ng/g		12.0	J	<	29.4	<	23.3		<	29.4	- -	69%

Solid Stream Data

Sample Stream: Bottom Ash

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2		Run 3	Run 3d		Average	95% CI	DL Ratio
Organics, Semi-Volatile	Di-n-octylphthalate	SW 8270	ng/g	<	42.8		<	40.0	<	15.3		<	32.7	- -	100%
Organics, Semi-Volatile	Dibenz(a,h)anthracene	SW 8270	ng/g	<	22.3		<	20.8	<	35.2		<	26.1	- -	100%
Organics, Semi-Volatile	Dibenz(a,j)acridine	SW 8270	ng/g	<	27.3		<	25.5	<	36.6		<	29.8	- -	100%
Organics, Semi-Volatile	Dibenzofuran	SW 8270	ng/g	<	19.2		<	17.9	<	23.3		<	20.1	- -	100%
Organics, Semi-Volatile	Dibutylphthalate	SW 8270	ng/g	<	23.2		<	21.6	<	14.1		<	19.6	- -	100%
Organics, Semi-Volatile	Diethylphthalate	SW 8270	ng/g	<	15.8		<	14.7	<	22.4		<	17.6	- -	100%
Organics, Semi-Volatile	Dimethylphenethylamine	SW 8270	ng/g	<	120		<	120	<	120		<	120	- -	100%
Organics, Semi-Volatile	Dimethylphthalate	SW 8270	ng/g	<	13.2		<	12.3	<	14.6		<	13.4	- -	100%
Organics, Semi-Volatile	Diphenylamine	SW 8270	ng/g	<	24.8		<	23.2	<	12.0		<	20.0	- -	100%
Organics, Semi-Volatile	Ethyl methanesulfonate	SW 8270	ng/g	<	23.6		<	22.1	<	29.5		<	25.1	- -	100%
Organics, Semi-Volatile	Fluoranthene	SW 8270	ng/g	<	30.0		<	28.0	<	20.5		<	26.2	- -	100%
Organics, Semi-Volatile	Fluorene	SW 8270	ng/g		11.3	J	<	14.7	<	16.5		<	16.5	- -	58%
Organics, Semi-Volatile	Hexachlorobenzene	SW 8270	ng/g	<	11.0		<	10.3	<	13.6		<	11.6	- -	100%
Organics, Semi-Volatile	Hexachlorobutadiene	SW 8270	ng/g	<	32.8		<	30.6	<	22.2		<	28.5	- -	100%
Organics, Semi-Volatile	Hexachlorocyclopentadiene	SW 8270	ng/g	<	419		<	391	<	256		<	355	- -	100%
Organics, Semi-Volatile	Hexachloroethane	SW 8270	ng/g	<	27.9		<	26.1	<	27.6		<	27.2	- -	100%
Organics, Semi-Volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ng/g	<	24.7		<	23.0	<	57.8		<	35.2	- -	100%
Organics, Semi-Volatile	Isophorone	SW 8270	ng/g	<	13.5		<	12.6	<	26.8		<	17.6	- -	100%
Organics, Semi-Volatile	Methyl methanesulfonate	SW 8270	ng/g	<	50.0		<	50.0	<	50.0		<	50.0	- -	100%
Organics, Semi-Volatile	N-Nitroso-di-n-butylamine	SW 8270	ng/g	<	61.6		<	57.5	<	27.3		<	48.8	- -	100%
Organics, Semi-Volatile	N-Nitrosodimethylamine	SW 8270	ng/g	<	62.5		<	58.4	<	34.2		<	51.7	- -	100%
Organics, Semi-Volatile	N-Nitrosodiphenylamine	SW 8270	ng/g	<	26.6		<	24.8	<	11.7		<	21.0	- -	100%
Organics, Semi-Volatile	N-Nitrosodipropylamine	SW 8270	ng/g	<	35.3		<	33.0	<	28.4		<	32.2	- -	100%
Organics, Semi-Volatile	N-Nitrosopiperidine	SW 8270	ng/g	<	44.3		<	41.4	<	25.9		<	37.2	- -	100%
Organics, Semi-Volatile	Naphthalene	SW 8270	ng/g		52.2		<	32.0	<	20.8		<	32.0	- -	34%
Organics, Semi-Volatile	Nitrobenzene	SW 8270	ng/g	<	24.8		<	23.2	<	36.6		<	28.2	- -	100%
Organics, Semi-Volatile	Pentachlorobenzene	SW 8270	ng/g	<	20.8		<	19.4	<	16.3		<	18.8	- -	100%
Organics, Semi-Volatile	Pentachloronitrobenzene	SW 8270	ng/g	<	97.3		<	90.8	<	60.0		<	82.7	- -	100%
Organics, Semi-Volatile	Pentachlorophenol	SW 8270	ng/g	<	40.6		<	37.9	<	38.6		<	39.0	- -	100%
Organics, Semi-Volatile	Phenacetin	SW 8270	ng/g	<	25.4		<	23.7	<	16.8		<	22.0	- -	100%
Organics, Semi-Volatile	Phenanthrene	SW 8270	ng/g		31.1		<	27.3	<	20.3		<	27.3	- -	43%
Organics, Semi-Volatile	Phenol	SW 8270	ng/g	<	18.7		<	17.5	<	38.4		<	24.9	- -	100%
Organics, Semi-Volatile	Pronamide	SW 8270	ng/g	<	34.7		<	32.4	<	10.5		<	25.9	- -	100%
Organics, Semi-Volatile	Pyrene	SW 8270	ng/g	<	22.0		<	20.5	<	17.7		<	20.1	- -	100%
Organics, Semi-Volatile	Pyridine	SW 8270	ng/g	<	54.5		<	50.9	<	25.6		<	43.7	- -	100%

Solid Stream Data

Sample Stream: Bottom Ash

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3	Run 3d		Average	95% CI	DL Ratio
Organics, Semi-Volatile	bis(2-Chloroethoxy)methane	SW 8270	ng/g	<	26.4	<	24.7	<	26.3		<	25.8	- -	100%
Organics, Semi-Volatile	bis(2-Chloroethyl)ether	SW 8270	ng/g	<	34.4	<	32.1	<	16.6		<	27.7	- -	100%
Organics, Semi-Volatile	bis(2-Chloroisopropyl)ether	SW 8270	ng/g	<	34.1	<	31.9	<	34.7		<	33.6	- -	100%
Organics, Semi-Volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ng/g	<	86.0		157.0	<	25.2		<	86.0	- -	26%
Organics, Semi-Volatile	p-Chloroaniline	SW 8270	ng/g	<	26.3	<	24.5	<	32.4		<	27.7	- -	100%
Organics, Semi-Volatile	p-Dimethylaminoazobenzene	SW 8270	ng/g	<	24.2	<	22.6	<	31.5		<	26.1	- -	100%

Solid Stream Data

Sample Stream: Sluiced Fly Ash

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chlorine	SM407C	ug/g	< 99	< 100	< 100	433	< 100	- -	100%
Anions	Fluorine	EPA 350.2	ug/g	77.2	129	91.0	NA	99.1	66.6	
Metals	Aluminum	SW 6010	ug/g	95,466	96,879	101,609	101,809	97,985	7,992	
Metals	Antimony	ICP-MS	ug/g	3.28	4.26	2.63	2.74	3.39	2.04	
Metals	Arsenic	SW 7060	ug/g	53.1	77.9	50.9	50.8	60.6	37.2	
Metals	Barium	SW 6010	ug/g	456	522	509	510	496	87.4	
Metals	Beryllium	SW 6010	ug/g	11.1	12.4	9.9	10.1	11.1	3.09	
Metals	Boron	ICPES	ug/g	580	410	430	450	473	231	
Metals	Cadmium	SW 7131	ug/g	3.89	5.41	3.07	3.26	4.12	2.95	
Metals	Calcium	SW 6010	ug/g	14,285	12,877	14,185	13,709	13,782	1,952	
Metals	Chromium	SW 6010	ug/g	186	193	176	174	185	21.4	
Metals	Cobalt	SW 6010	ug/g	38.8	37.6	34.3	35.7	36.9	5.82	
Metals	Copper	SW 6010	ug/g	110	110	93.4	88.7	104	23.4	
Metals	Iron	SW 6010	ug/g	96,371	79,073	92,353	83,968	89,266	22,491	
Metals	Lead	SW 7421	ug/g	81.4	100	68.2	69.8	83.2	39.8	
Metals	Magnesium	SW 6010	ug/g	4,778	4,829	5,040	5,010	4,882	345	
Metals	Manganese	SW 6010	ug/g	262	225	248	231	245	45.5	
Metals	Mercury	SW 7471	ug/g	0.091	0.188	0.156	0.181	0.145	0.122	
Metals	Molybdenum	SW 6010	ug/g	< 14.3	13.2 J	3.9	2.59 J	< 14.3	- -	29%
Metals	Nickel	SW 6010	ug/g	151	149	128	154	143	32	
Metals	Phosphorus	SW 6010	ug/g	8.53 J	72.5	124	98.0	68.3	143	
Metals	Potassium	SW 6010	ug/g	18,208	18,611	17,807	17,539	18,209	999	
Metals	Selenium	SW 7740	ug/g	8.14	16.7	11.2	11.0	12.0	10.8	
Metals	Silicon	SW 6010	ug/g	218,294	222,330	216,296	213,699	218,973	7,636	
Metals	Sodium	SW 6010	ug/g	5,422	5,231	4,507	4,334	5,053	1,199	
Metals	Strontium	SW 6010	ug/g	315	336	315	313	322	30.3	
Metals	Titanium	SW 6010	ug/g	6,277	6,650	6,056	6,209	6,328	745	
Metals	Vanadium	SW 6010	ug/g	335	345	301	293	327	57.6	
Metals	Zinc	SW 6010	ug/g	509	601	427	431	512	216	
Ultimate/Proximate	% Carbon	D3176	%	3.38	4.50	5.54	5.71	4.47	2.68	

Solid Stream Data

Sample Stream: Sluiced Fly Ash

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Ultimate/Proximate	% Sulfur	D3176	%	0.115	0.146	0.140	0.141	0.134	0.041	
Radionuclides	Actinium-228 @ 338 KeV	EPA 901.1	pCi/g	2.3	2.4	2.4	2.2	2.4	0.14	
Radionuclides	Actinium-228 @ 911 KeV	EPA 901.1	pCi/g	2.3	2.3	2.4	2.4	2.3	0.14	
Radionuclides	Actinium-228 @ 968 KeV	EPA 901.1	pCi/g	2.5	2.4	2.6	2.3	2.5	0.25	
Radionuclides	Bismuth-212 @ 727 KeV	EPA 901.1	pCi/g	2.2	3.0	2.6	3.0	2.6	0.99	
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA 901.1	pCi/g	7.2	6.9	5.4	6.4	6.5	2.40	
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA 901.1	pCi/g	6.7	5.4	5.5	5.8	5.9	1.80	
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA 901.1	pCi/g	7.1	6.4	6.0	6.0	6.5	1.38	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g	19	18	17	16	18.0	2.48	
Radionuclides	Lead-210 @ 46 KeV	EPA 901.1	pCi/g	6.2	7.6	5.5	4.6	6.4	2.66	
Radionuclides	Lead-212 @ 238 KeV	EPA 901.1	pCi/g	2.3	2.2	2.1	2.1	2.2	0.25	
Radionuclides	Lead-214 @ 295.2 KeV	EPA 901.1	pCi/g	7.0	6.7	5.9	5.9	6.5	1.41	
Radionuclides	Lead-214@ 352.0 KeV	EPA 901.1	pCi/g	7.1	6.7	6.1	6.2	6.6	1.25	
Radionuclides	Radium-226 @ 186.0 KeV	EPA 901.1	pCi/g	9.9	11	8.7	9.3	9.9	2.86	
Radionuclides	Thallium-208 @ 583 KeV	EPA 901.1	pCi/g	2.3	2.3	2.1	2.2	2.2	0.29	
Radionuclides	Thallium-208 @ 860 KeV	EPA 901.1	pCi/g	3.0	2.9	3.0	2.6	3.0	0.14	
Radionuclides	Thorium-234 @ 63.3 KeV	EPA 901.1	pCi/g	6.0	8.5	5.2	5.3	6.6	4.28	
Radionuclides	Thorium-234 @ 92.6 KeV	EPA 901.1	pCi/g	5.7	4.0	5.3	4.2	5.0	2.21	
Radionuclides	Uranium-235 @ 143 KeV	EPA 901.1	pCi/g	0.16	0.23	0.28	< 0.013	0.22	0.15	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ng/g	< 27.5	< 25.7	< 17.4	< 17.5	< 23.5	- -	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ng/g	< 28.1	< 26.3	< 26.2	< 26.3	< 26.9	- -	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ng/g	< 37.0	< 34.6	< 28.3	< 28.5	< 33.3	- -	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ng/g	< 100	< 100	< 100	< 100	< 100	- -	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ng/g	< 18.8	< 17.6	< 31.9	< 32.1	< 22.8	- -	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ng/g	< 38.4	< 35.9	< 26.2	< 26.3	< 33.5	- -	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ng/g	< 30.6	< 28.6	< 23.9	< 24.1	< 27.7	- -	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ng/g	< 74.2	< 69.3	< 90.4	< 91.0	< 78.0	- -	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ng/g	< 23.9	< 22.4	< 20.7	< 20.8	< 22.3	- -	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ng/g	< 15.7	< 14.7	< 22.7	< 22.8	< 17.7	- -	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ng/g	< 16.6	< 15.5	< 22.5	< 22.7	< 18.2	- -	100%

Solid Stream Data

Sample Stream: Sluiced Fly Ash

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ng/g	<	21.1	<	19.7	<	25.3	<	25.5	<	22.0	- -	100%
Organics, Semi-volatile	*2,4-Dimethylphenol*	SW 8270	ng/g	<	52.3	<	48.9	<	57.9	<	58.2	<	53.0	- -	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ng/g	<	333	<	311	<	186	<	187	<	277	- -	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ng/g	<	26.1	<	24.4	<	26.3	<	26.5	<	25.6	- -	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ng/g	<	34.4	<	32.1	<	22.8	<	22.9	<	29.8	- -	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ng/g	<	16.4	<	15.4	<	38.3	<	38.6	<	23.4	- -	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ng/g	<	15.4	<	14.4	<	17.5	<	17.6	<	15.8	- -	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ng/g	<	36.3	<	34.0	<	28.3	<	28.5	<	32.9	- -	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ng/g	<	31.4	<	29.3	<	16.2	<	16.3	<	25.6	- -	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ng/g	<	25.4	<	23.7	<	13.8	<	13.9	<	21.0	- -	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ng/g	<	92.7	<	86.7	<	71.2	<	71.7	<	83.5	- -	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ng/g	<	19.1	<	17.9	<	29.5	<	29.7	<	22.2	- -	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ng/g	<	20.9	<	19.6	<	23.2	<	23.4	<	21.2	- -	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ng/g	<	51.8	<	48.4	<	36.8	<	37.1	<	45.7	- -	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ng/g	<	23.3	<	21.8	<	14.8	<	14.9	<	20.0	- -	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ng/g	<	37.2	<	34.8	<	22.3	<	22.4	<	31.4	- -	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ng/g	<	24.2	<	22.6	<	17.5	<	17.6	<	21.4	- -	100%
Organics, Semi-volatile	*4,6-Dinitro-2-methylphenol*	SW 8270	ng/g	<	37.6	<	35.2	<	19.1	<	19.3	<	30.6	- -	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ng/g	<	35.6	<	33.2	<	53.0	<	53.3	<	40.6	- -	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ng/g	<	21.7	<	20.3	<	21.5	<	21.7	<	21.2	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ng/g	<	34.4	<	32.1	<	22.9	<	23.1	<	29.8	- -	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ng/g	<	25.1	<	23.5	<	18.7	<	18.9	<	22.4	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ng/g	<	27.3	<	25.6	<	20.4	<	20.6	<	24.4	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ng/g	<	23.0	<	21.5	<	27.0	<	27.2	<	23.8	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ng/g	<	32.8	<	30.7	<	41.7	<	42.0	<	35.1	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ng/g	<	91.3	<	85.3	<	59.2	<	59.6	<	78.6	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ng/g	<	22.7	<	21.2	<	12.1	<	12.2	<	18.7	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ng/g	<	10.7	<	10.0	<	18.6	<	18.7	<	13.1	- -	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ng/g	<	21.8	<	20.4	<	24.9	<	25.0	<	22.4	- -	100%
Organics, Semi-volatile	Aniline	SW 8270	ng/g	<	44.4	<	41.5	<	27.4	<	27.6	<	37.8	- -	100%
Organics, Semi-volatile	Anthracene	SW 8270	ng/g	<	27.6	<	25.8	<	16.4	<	16.5	<	23.3	- -	100%
Organics, Semi-volatile	Benzidine	SW 8270	ng/g	<	20	<	20	<	20	<	20	<	20	- -	100%

Solid Stream Data

Sample Stream: Sluiced Fly Ash

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ng/g	<	24.5	<	22.9	<	20.0	<	20.1	<	22.5	- -	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ng/g	<	18.2	<	17.0	<	23.1	<	23.2	<	19.4	- -	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ng/g	<	27.0	<	25.3	<	40.4	<	40.7	<	30.9	- -	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ng/g	<	23.1	<	21.6	<	45.4	<	45.7	<	30.0	- -	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ng/g	<	46.0	<	43.0	<	44.5	<	44.8	<	44.5	- -	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ng/g	<	188	<	176	<	1,720	<	1,730	<	695	- -	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ng/g	<	51.3	<	48.0	<	27.2	<	27.3	<	42.2	- -	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ng/g	<	18.7	<	17.5	<	27.8	<	28.0	<	21.3	- -	100%
Organics, Semi-volatile	Chrysene	SW 8270	ng/g	<	31.8	<	29.7	<	23.9	<	24.1	<	28.5	- -	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ng/g	<	43.3	<	40.5	<	15.7	<	15.8	<	33.2	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ng/g	<	22.5	<	21.1	<	36.1	<	36.3	<	26.6	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ng/g	<	27.6	<	25.8	<	37.5	<	37.7	<	30.3	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ng/g	<	19.4	<	18.1	<	23.9	<	24.1	<	20.5	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ng/g	<	23.4	<	21.9	<	14.4	<	14.5	<	19.9	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ng/g	<	16.0	<	14.9	<	22.9	<	23.1	<	17.9	- -	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ng/g	<	120	<	120	<	120	<	120	<	120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ng/g	<	13.3	<	12.4	<	15.0	<	15.1	<	13.6	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ng/g	<	25.1	<	23.5	<	12.3	<	12.4	<	20.3	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ng/g	<	23.9	<	22.4	<	30.2	<	30.4	<	25.5	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ng/g	<	30.3	<	28.4	<	21.0	<	21.1	<	26.6	- -	100%
Organics, Semi-volatile	Fluorene	SW 8270	ng/g	<	16.0	<	14.9	<	16.9	<	17.0	<	15.9	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ng/g	<	11.1	<	10.4	<	14.0	<	14.1	<	11.8	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ng/g	<	33.2	<	31.0	<	22.8	<	22.9	<	29.0	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ng/g	<	424	<	396	<	262	<	264	<	361	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ng/g	<	28.2	<	26.4	<	28.3	<	28.5	<	27.6	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ng/g	<	25.0	<	23.3	<	59.2	<	59.6	<	35.8	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ng/g	<	13.6	<	12.8	<	27.4	<	27.6	<	17.9	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ng/g	<	50	<	50	<	50	<	50	<	50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ng/g	<	62.3	<	58.2	<	28.0	<	28.2	<	49.5	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ng/g	<	63.2	<	59.1	<	35.0	<	35.2	<	52.4	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ng/g	<	26.9	<	25.2	<	12.0	<	12.1	<	21.4	- -	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ng/g	<	35.7	<	33.4	<	29.1	<	29.3	<	32.7	- -	100%

Solid Stream Data

Sample Stream: Sluiced Fly Ash

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ng/g	< 44.8	< 41.9	< 26.6	< 26.7	< 37.8	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ng/g	< 34.7	< 32.4	< 21.3	< 21.4	< 29.5	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ng/g	< 25.1	< 23.5	< 37.5	< 37.7	< 28.7	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ng/g	< 21.1	< 19.7	< 16.6	< 16.8	< 19.1	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ng/g	< 98.4	< 92.0	< 61.4	< 61.8	< 83.9	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ng/g	< 41.1	< 38.4	< 39.6	< 39.8	< 39.7	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ng/g	< 25.7	< 24.0	< 17.2	< 17.3	< 22.3	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ng/g	< 29.6	< 27.6	< 20.8	< 21.0	< 26.0	- -	100%
Organics, Semi-volatile	Phenol	SW 8270	ng/g	< 19.0	< 17.7	< 39.3	< 39.6	< 25.3	- -	100%
Organics, Semi-volatile	Pronamide	SW 8270	ng/g	< 35.1	< 32.8	< 10.7	< 10.8	< 26.2	- -	100%
Organics, Semi-volatile	Pyrene	SW 8270	ng/g	< 22.2	< 20.8	< 18.2	< 18.3	< 20.4	- -	100%
Organics, Semi-volatile	Pyridine	SW 8270	ng/g	< 55.1	< 51.6	< 26.2	< 26.3	< 44.3	- -	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ng/g	< 26.7	< 25.0	< 27.0	< 27.2	< 26.2	- -	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ng/g	< 34.8	< 32.5	< 17.0	< 17.2	< 28.1	- -	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ng/g	< 34.5	< 32.3	< 35.5	< 35.8	< 34.1	- -	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ng/g	431	259	< 25.9	< 26.0	234	522	2%
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ng/g	< 26.6	< 24.8	< 33.2	< 33.4	< 28.2	- -	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ng/g	< 24.5	< 22.9	< 32.3	< 32.5	< 26.6	- -	100%

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 1

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	SM407C	ug/g	474	523	< 99.80	665	349	646	5%
Anions	Fluoride	EPA 340.2	ug/g	70.8	87.7	110	111	89.5	49	
Metals	Aluminum	SW 6010	ug/g	104,000	113,224	74,047	102,201	97,091	50,884	
Metals	Antimony	ICP-MS	ug/g	3.42	2.94	2.61	2.50	2.99	1.01	
Metals	Arsenic	SW 7060	ug/g	50.0	41.0	45.6	48.3	45.5	11.2	
Metals	Barium	SW 6010	ug/g	461	564	456	505	494	152	
Metals	Beryllium	SW 6010	ug/g	10.8	12.2	9.60	15.9	10.9	3.26	
Metals	Cadmium	SW 7131	ug/g	3.59	3.06	3.14	3.29	3.26	0.72	
Metals	Calcium	SW 6010	ug/g	19,900	18,837	15,030	18,737	17,922	6,362	
Metals	Chromium	SW 6010	ug/g	182	196	171	181	183	31.2	
Metals	Cobalt	SW 6010	ug/g	33.8	35.8	32.5	33.9	34.0	4.13	
Metals	Copper	SW 6010	ug/g	104.0	104.2	86.3	88.8	98.2	25.6	
Metals	Iron	SW 6010	ug/g	97,800	88,275	84,268	88,975	90,114	17,269	
Metals	Lead	SW 7421	ug/g	75.2	67.3	74.5	67.8	72.4	10.8	
Metals	Magnesium	SW 6010	ug/g	5,400	5,010	3,337	5,080	4,582	2,723	
Metals	Manganese	SW 6010	ug/g	243	211	203	215	219	52.0	
Metals	Mercury	SW 7471	ug/g	0.09	0.12	0.16	0.15	0.12	0.09	
Metals	Molybdenum	SW 6010	ug/g	25.3	32.8	17.6	22.8	25	18.8	
Metals	Nickel	SW 6010	ug/g	140	118	124	124	127	27.9	
Metals	Phosphorus	SW 6010	ug/g	104	< 71.7	150	< 69.7	96.7	143	12%
Metals	Potassium	SW 6010	ug/g	18,600	17,535	16,132	18,136	17,422	3,075	
Metals	Selenium	SW 7740	ug/g	8.60	7.88	11.4	10.4	9.30	4.66	
Metals	Silicon	SW 6010	ug/g	217,000	238,472	212,423	200,395	222,632	34,552	
Metals	Sodium	SW 6010	ug/g	5,630	5,361	4,679	4,870	5,223	1,217	
Metals	Strontium	SW 6010	ug/g	330	368	272	325	323	120	
Metals	Titanium	SW 6010	ug/g	6,120	6,042	6,192	5,932	6,118	187	
Metals	Vanadium	SW 6010	ug/g	322	302	293	298	305	37.4	
Metals	Zinc	SW 6010	ug/g	472	406	422	394	433	85.8	
Radionuclides	Actinium-228 @ 338 KeV	EPA 901.1	pCi/g	2.3	2.1	2.0	1.9	2.1	0.4	
Radionuclides	Actinium-228 @ 911 KeV	EPA 901.1	pCi/g	2.3	2.0	2.0	2.3	2.1	0.4	
Radionuclides	Actinium-228 @ 968 KeV	EPA 901.1	pCi/g	2.8	2.4	2.1	1.8	2.4	0.9	

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 1

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Run 3d		Average	95% CI	DL Ratio
Radionuclides	Bismuth-212 @ 727 KeV	EPA 901.1	pCi/g		3.4		2.8		2.1		2.7		2.8	1.6	
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA 901.1	pCi/g		7.3		5.8		5.3		5.5		6.1	2.6	
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA 901.1	pCi/g		6.9		5.1		5.6		5.2		5.9	2.3	
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA 901.1	pCi/g		7.2		5.6		5.9		5.5		6.2	2.1	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g		19		16		16		19		17	4.3	
Radionuclides	Lead-210 @ 46 KeV	EPA 901.1	pCi/g		5.6		5.1		5.6		3.7		5.4	0.7	
Radionuclides	Lead-212 @ 238 KeV	EPA 901.1	pCi/g		2.4		1.8		2.1		2.0		2.1	0.7	
Radionuclides	Lead-214 @ 295.2 KeV	EPA 901.1	pCi/g		6.8		5.7		5.9		5.8		6.1	1.5	
Radionuclides	Lead-214@ 352.0 KeV	EPA 901.1	pCi/g		7.2		5.6		5.9		6.0		6.2	2.1	
Radionuclides	Radium-226 @ 186.0 KeV	EPA 901.1	pCi/g		10		8.8		8.3		9.3		9.0	2.2	
Radionuclides	Thallium-208 @ 583 KeV	EPA 901.1	pCi/g		2.2		2.0		2.0		2.1		2.1	0.3	
Radionuclides	Thallium-208 @ 860 KeV	EPA 901.1	pCi/g		2.7		2.3		1.2		2.7		2.1	1.9	
Radionuclides	Thorium-234 @ 63.3 KeV	EPA 901.1	pCi/g		6.3		5.8		4.6		5.4		5.6	2.2	
Radionuclides	Thorium-234 @ 92.6 KeV	EPA 901.1	pCi/g		4.6		3.6		4.8		3.8		4.3	1.6	
Radionuclides	Uranium-235 @ 143 KeV	EPA 901.1	pCi/g		0.24		0.3		0.1		0.3		0.2	0.2	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ng/g	<	19.2	<	13.0	<	12.9	<	13.0	<	15.0	- -	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ng/g	<	19.6	<	19.6	<	19.5	<	19.6	<	19.6	- -	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ng/g	<	25.9	<	21.2	<	21.1	<	21.2	<	22.7	- -	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ng/g	<	100	<	100	<	100	<	100	<	100	- -	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ng/g	<	13.2	<	23.9	<	23.8	<	23.9	<	20.3	- -	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ng/g	<	26.8	<	19.6	<	19.5	<	19.6	<	22.0	- -	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ng/g	<	21.4	<	17.9	<	17.8	<	17.9	<	19.0	- -	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ng/g	<	51.8	<	67.7	<	67.4	<	67.7	<	62.3	- -	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ng/g	<	16.7	<	15.5	<	15.4	<	15.5	<	15.9	- -	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ng/g	<	11.0	<	17.0	<	16.9	<	17.0	<	15.0	- -	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ng/g	<	11.6	<	16.9	<	16.8	<	16.9	<	15.1	- -	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ng/g	<	14.7	<	19.0	<	18.9	<	19.0	<	17.5	- -	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ng/g	<	36.5	<	43.3	<	43.1	<	43.3	<	41.0	- -	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ng/g	<	233	<	139	<	139	<	139	<	170	- -	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ng/g	<	18.3	<	19.7	<	19.6	<	19.7	<	19.2	- -	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ng/g	<	24.0	<	17.1	<	17.0	<	17.1	<	19.4	- -	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ng/g	<	11.5	<	28.7	<	28.6	<	28.7	<	22.9	- -	100%

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 1

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ng/g	< 10.8	< 13.1	< 13.0	< 13.1	< 12.3	- -	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ng/g	< 25.4	< 21.2	< 21.1	< 21.2	< 22.6	- -	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ng/g	< 21.9	< 12.1	< 12.1	< 12.1	< 15.4	- -	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ng/g	< 17.7	< 10.3	< 10.3	< 10.3	< 12.8	- -	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ng/g	< 64.8	< 53.3	< 53.1	< 53.3	< 57.1	- -	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ng/g	< 13.4	< 22.1	< 22.0	< 22.1	< 19.2	- -	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ng/g	< 14.6	< 17.4	< 17.3	< 17.4	< 16.4	- -	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ng/g	< 36.2	< 27.6	< 27.4	< 27.6	< 30.4	- -	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ng/g	< 16.3	< 11.1	< 11.1	< 11.1	< 12.8	- -	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ng/g	< 26.0	< 16.7	< 16.6	< 16.7	< 19.8	- -	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ng/g	< 16.9	< 13.1	< 13.0	< 13.1	< 14.3	- -	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ng/g	< 26.3	< 14.3	< 14.3	< 14.3	< 18.3	- -	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ng/g	< 24.8	< 39.7	< 39.5	< 39.7	< 34.7	- -	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ng/g	< 15.1	< 16.1	< 16.1	< 16.1	< 15.8	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ng/g	< 24.0	< 17.2	< 17.1	< 17.2	< 19.4	- -	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ng/g	< 17.5	< 14.0	< 14.0	< 14.0	< 15.2	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ng/g	< 19.1	< 15.3	< 15.2	< 15.3	< 16.5	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ng/g	< 16.1	< 20.2	< 20.1	< 20.2	< 18.8	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ng/g	< 23.0	< 31.2	< 31.1	< 31.2	< 28.4	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ng/g	< 63.8	< 44.3	< 44.1	< 44.3	< 50.7	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ng/g	< 15.9	< 9.07	< 9.03	< 9.07	< 11.3	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ng/g	< 7.5	< 13.9	< 13.9	< 13.9	< 11.8	- -	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ng/g	< 15.2	< 18.6	< 18.6	< 18.6	< 17.5	- -	100%
Organics, Semi-volatile	Aniline	SW 8270	ng/g	< 31.0	< 20.5	< 20.4	< 20.5	< 24.0	- -	100%
Organics, Semi-volatile	Anthracene	SW 8270	ng/g	< 19.3	< 12.3	< 12.2	< 12.3	< 14.6	- -	100%
Organics, Semi-volatile	Benzidine	SW 8270	ng/g	< 20	< 20	< 20	< 20	< 20	- -	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ng/g	< 17.1	< 15.0	< 14.9	< 15.0	< 15.7	- -	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ng/g	< 12.7	< 17.3	< 17.2	< 17.3	< 15.7	- -	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ng/g	< 18.9	< 30.3	< 30.1	< 30.3	< 26.4	- -	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ng/g	< 16.2	< 34.0	< 33.9	< 34.0	< 28.0	- -	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ng/g	< 32.2	< 33.3	< 33.2	< 33.3	< 32.9	- -	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ng/g	< 132	< 1,290	< 1,280	< 1,290	< 901	- -	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ng/g	< 35.9	< 20.3	< 20.2	< 20.3	< 25.5	- -	100%

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 1

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ng/g	< 13.1	< 20.8	< 20.7	< 20.8	< 18.2	- -	100%
Organics, Semi-volatile	Chrysene	SW 8270	ng/g	< 22.2	< 17.9	< 17.8	< 17.9	< 19.3	- -	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ng/g	< 30.3	< 11.7	< 11.7	< 11.7	< 17.9	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ng/g	< 15.7	< 27.0	< 26.9	< 27.0	< 23.2	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ng/g	< 19.3	< 28.1	< 27.9	< 28.1	< 25.1	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ng/g	< 13.6	< 17.9	< 17.8	< 17.9	< 16.4	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ng/g	< 16.4	< 10.8	< 10.8	< 10.8	< 12.7	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ng/g	< 11.2	< 17.2	< 17.1	< 17.2	< 15.2	- -	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ng/g	< 120	< 120	< 120	< 120	< 120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ng/g	< 9.3	< 11.2	< 11.2	< 11.2	< 10.6	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ng/g	< 17.5	< 9.2	< 9.2	< 9.2	< 12.0	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ng/g	< 16.7	< 22.6	< 22.5	< 22.6	< 20.6	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ng/g	< 21.2	< 15.7	< 15.6	< 15.7	< 17.5	- -	100%
Organics, Semi-volatile	Fluorene	SW 8270	ng/g	< 11.2	< 12.7	< 12.6	< 12.7	< 12.2	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ng/g	< 7.8	< 10.5	< 10.4	< 10.5	< 9.6	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ng/g	< 23.2	< 17.1	< 17.0	< 17.1	< 19.1	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ng/g	< 296	< 196	< 195	< 196	< 229	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ng/g	< 19.7	< 21.2	< 21.1	< 21.2	< 20.7	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ng/g	< 17.4	< 44.3	< 44.1	< 44.3	< 35.3	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ng/g	< 9.5	< 20.5	< 20.4	< 20.5	< 16.8	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ng/g	< 50	< 50	< 50	< 50	< 50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ng/g	< 43.5	< 21.0	< 20.9	< 21.0	< 28.5	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ng/g	< 44.2	< 26.2	< 26.1	< 26.2	< 32.2	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ng/g	< 18.8	< 9.0	< 8.9	< 9.0	< 12.2	- -	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ng/g	< 24.9	< 21.8	< 21.7	< 21.8	< 22.8	- -	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ng/g	< 31.3	< 19.9	< 19.8	< 19.9	< 23.7	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ng/g	< 24.2	< 15.9	< 15.9	< 15.9	< 18.7	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ng/g	< 17.5	< 28.1	< 27.9	< 28.1	< 24.5	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ng/g	< 14.7	< 12.5	< 12.4	< 12.5	< 13.2	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ng/g	< 68.8	< 46.0	< 45.8	< 46.0	< 53.5	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ng/g	< 28.7	< 29.6	< 29.5	< 29.6	< 29.3	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ng/g	< 17.9	< 12.9	< 12.8	< 12.9	< 14.5	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ng/g	< 20.7	< 15.6	< 15.5	< 15.6	< 17.3	- -	100%

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 1

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Phenol	SW 8270	ng/g	<	13.3	<	29.4	<	29.3	<	29.4	<	24.0	- -	100%
Organics, Semi-volatile	Pronamide	SW 8270	ng/g	<	24.6	<	8.03	<	8.00	<	8.03	<	13.5	- -	100%
Organics, Semi-volatile	Pyrene	SW 8270	ng/g	<	15.5	<	13.6	<	13.5	<	13.6	<	14.2	- -	100%
Organics, Semi-volatile	Pyridine	SW 8270	ng/g	<	38.5	<	19.6	<	19.5	<	19.6	<	25.9	- -	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ng/g	<	18.7	<	20.2	<	20.1	<	20.2	<	19.7	- -	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ng/g	<	24.3	<	12.8	<	12.7	<	12.8	<	16.6	- -	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ng/g	<	24.1	<	26.6	<	26.5	<	26.6	<	25.7	- -	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ng/g		550	<	19.4	<	19.3	<	19.4		190	775	3%
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ng/g	<	18.6	<	24.8	<	24.7	<	24.8	<	22.7	- -	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ng/g	<	17.1	<	24.2	<	24.1	<	24.2	<	21.8	- -	100%

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 2

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	SM407C	ug/g	< 99.90	< 99.70	< 99.80	< 99.80	< 99.8	- -	100%
Anions	Fluoride	EPA 340.2	ug/g	139.00	152.00	83.40	45.40	124.8	90.5	
Metals	Aluminum	SW 6010	ug/g	83,768	89,800	92,100	68,200	88,556	10,691	
Metals	Antimony	ICP-MS	ug/g	4.83	3.87	3.86	3.76	4.19	1.38	
Metals	Arsenic	SW 7060	ug/g	74.2	67.4	74.2	61.1	71.9	9.8	
Metals	Barium	SW 6010	ug/g	449	503	526	467	493	98.3	
Metals	Beryllium	SW 6010	ug/g	18.7	16.5	16.3	19.2	17.2	3.36	
Metals	Cadmium	SW 7131	ug/g	5.73	5.20	5.33	5.03	5.42	0.69	
Metals	Calcium	SW 6010	ug/g	15,230	16,000	15,700	14,800	15,643	964	
Metals	Chromium	SW 6010	ug/g	194	193	271	190	219	111	
Metals	Cobalt	SW 6010	ug/g	41.3	45.5	41.3	38.8	42.7	6.04	
Metals	Copper	SW 6010	ug/g	126	109	218	107	151	146	
Metals	Iron	SW 6010	ug/g	83,968	78,500	77,600	74,600	80,023	8,562	
Metals	Lead	SW 7421	ug/g	103	87.0	97.7	97.3	96.0	20.5	
Metals	Magnesium	SW 6010	ug/g	3,627	4,170	4,420	2,620	4,072	1,007	
Metals	Manganese	SW 6010	ug/g	227	212	209	206	216	24.6	
Metals	Mercury	SW 7471	ug/g	0.096	0.202	0.235	0.258	0.178	0.181	
Metals	Molybdenum	SW 6010	ug/g	49.1	35.5	61.4	38.1	48.7	32.2	
Metals	Nickel	SW 6010	ug/g	165	166	144	154	158	31.1	
Metals	Phosphorus	SW 6010	ug/g	< 72.9	< 71.4	< 71.3	< 72.7	< 71.9	- -	100%
Metals	Potassium	SW 6010	ug/g	17,936	17,800	18,600	16,000	18,112	1,064	
Metals	Selenium	SW 7740	ug/g	15.1	17.3	17.5	16.2	16.6	3.27	
Metals	Silicon	SW 6010	ug/g	221,443	215,000	209,000	218,000	215,148	15,459	
Metals	Sodium	SW 6010	ug/g	6,603	5,660	5,590	5,750	5,951	1,406	
Metals	Strontium	SW 6010	ug/g	309	333	340	300	327	41	
Metals	Titanium	SW 6010	ug/g	6,583	6,410	6,360	6,650	6,451	291	
Metals	Vanadium	SW 6010	ug/g	382	347	341	348	357	55	
Metals	Zinc	SW 6010	ug/g	653	570	566	606	596	122	
Radionuclides	Actinium-228 @ 338 KeV	EPA 901.1	pCi/g	2.3	2.0	2.2	2.4	2.2	0.4	
Radionuclides	Actinium-228 @ 911 KeV	EPA 901.1	pCi/g	2.4	2.2	2.0	2.3	2.2	0.5	
Radionuclides	Actinium-228 @ 968 KeV	EPA 901.1	pCi/g	2.6	2.6	2.7	2.7	2.6	0.1	

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 2

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Radionuclides	Bismuth-212 @ 727 KeV	EPA 901.1	pCi/g	3.4	2.4	2.7	2.7	2.8	1.3	
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA 901.1	pCi/g	6.6	6.2	6.0	6.0	6.3	0.8	
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA 901.1	pCi/g	6.1	5.6	5.4	5.6	5.7	0.9	
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA 901.1	pCi/g	6.9	5.5	5.7	6.2	6.0	1.9	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g	18	17	17	19	17	1.4	
Radionuclides	Lead-210 @ 46 KeV	EPA 901.1	pCi/g	7.8	7.3	8.4	7.6	7.8	1.4	
Radionuclides	Lead-212 @ 238 KeV	EPA 901.1	pCi/g	1.8	1.6	2.2	1.9	1.9	0.8	
Radionuclides	Lead-214 @ 295.2 KeV	EPA 901.1	pCi/g	6.6	5.8	5.7	6.0	6.0	1.2	
Radionuclides	Lead-214@ 352.0 KeV	EPA 901.1	pCi/g	6.6	5.7	6.0	6.4	6.1	1.1	
Radionuclides	Radium-226 @ 186.0 KeV	EPA 901.1	pCi/g	11	9.2	8.9	9.5	9.7	2.8	
Radionuclides	Thallium-208 @ 583 KeV	EPA 901.1	pCi/g	2.3	2.2	2.0	2.2	2.2	0.4	
Radionuclides	Thallium-208 @ 860 KeV	EPA 901.1	pCi/g	3.6	ND	3.1	2.6	2.2	4.8	
Radionuclides	Thorium-234 @ 63.3 KeV	EPA 901.1	pCi/g	6.2	5.1	5.1	5.8	5.5	1.6	
Radionuclides	Thorium-234 @ 92.6 KeV	EPA 901.1	pCi/g	4.3	4.6	5.5	4.3	4.8	1.6	
Radionuclides	Uranium-235 @ 143 KeV	EPA 901.1	pCi/g	0.28	0.3	2.2	0.2	0.9	2.8	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ng/g	< 19.3	< 13.0	< 13.0		< 15.1	--	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ng/g	< 19.7	< 19.6	< 19.6		< 19.6	--	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ng/g	< 26.0	< 21.1	< 21.1		< 22.7	--	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ng/g	< 100	< 100	< 100		< 100	--	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ng/g	< 13.2	< 23.9	< 23.9		< 20.3	--	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ng/g	< 27.0	< 19.6	< 19.6		< 22.1	--	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ng/g	< 21.5	< 17.9	< 17.9		< 19.1	--	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ng/g	< 52.1	< 67.6	< 67.6		< 62.4	--	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ng/g	< 16.8	< 15.5	< 15.5		< 15.9	--	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ng/g	< 11.0	< 16.9	< 16.9		< 14.9	--	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ng/g	< 11.7	< 16.8	< 16.8		< 15.1	--	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ng/g	< 14.8	< 18.9	< 18.9		< 17.5	--	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ng/g	< 36.7	< 43.3	< 43.3		< 41.1	--	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ng/g	< 234	< 139	< 139		< 171	--	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ng/g	< 18.4	< 19.7	< 19.7		< 19.3	--	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ng/g	< 24.1	< 17.0	< 17.0		< 19.4	--	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ng/g	< 11.6	< 28.7	< 28.7		< 23.0	--	100%

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 2

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3	Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ng/g	<	10.8	<	13.1	<	13.1		<	12.3	--	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ng/g	<	25.5	<	21.1	<	21.1		<	22.6	--	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ng/g	<	22.0	<	12.1	<	12.1		<	15.4	--	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ng/g	<	17.8	<	10.3	<	10.3		<	12.8	--	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ng/g	<	65.1	<	53.3	<	53.3		<	57.2	--	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ng/g	<	13.4	<	22.1	<	22.1		<	19.2	--	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ng/g	<	14.7	<	17.4	<	17.4		<	16.5	--	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ng/g	<	36.4	<	27.5	<	27.5		<	30.5	--	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ng/g	<	16.4	<	11.1	<	11.1		<	12.9	--	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ng/g	<	26.2	<	16.6	<	16.6		<	19.8	--	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ng/g	<	17.0	<	13.1	<	13.1		<	14.4	--	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ng/g	<	26.5	<	14.3	<	14.3		<	18.4	--	100%
Organics, Semi-volatile	*4-Aminobiphenyl*	SW 8270	ng/g	<	25.0	<	39.6	<	39.6		<	34.7	--	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ng/g	<	15.2	<	16.1	<	16.1		<	15.8	--	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ng/g	<	24.1	<	17.1	<	17.1		<	19.4	--	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ng/g	<	17.6	<	14.0	<	14.0		<	15.2	--	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ng/g	<	19.2	<	15.3	<	15.3		<	16.6	--	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ng/g	<	16.2	<	20.2	<	20.2		<	18.9	--	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ng/g	<	23.1	<	31.2	<	31.2		<	28.5	--	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ng/g	<	64.1	<	44.3	<	44.3		<	50.9	--	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ng/g	<	16.0	<	9.06	<	9.06		<	11.4	--	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ng/g	<	7.55	<	13.9	<	13.9		<	11.8	--	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ng/g	<	15.3	<	18.6	<	18.6		<	17.5	--	100%
Organics, Semi-volatile	Aniline	SW 8270	ng/g	<	31.2	<	20.5	<	20.5		<	24.1	--	100%
Organics, Semi-volatile	Anthracene	SW 8270	ng/g	<	19.4	<	12.3	<	12.3		<	14.7	--	100%
Organics, Semi-volatile	*Benzidine*	SW 8270	ng/g	<	20.0	<	20.0	<	20.0		<	20.0	--	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ng/g	<	17.2	<	15.0	<	15.0		<	15.7	--	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ng/g	<	12.8	<	17.2	<	17.2		<	15.7	--	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ng/g	<	19.0	<	30.2	<	30.2		<	26.5	--	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ng/g	<	16.3	<	34.0	<	34.0		<	28.1	--	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ng/g	<	32.3	<	33.3	<	33.3		<	33.0	--	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ng/g	<	132	<	1,290	<	1,290		<	904	--	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ng/g	<	36.1	<	20.3	<	20.3		<	25.6	--	100%

Solid Stream Data

Sample Stream: ESP Hopper Ash-Field 2

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ng/g	< 13.1	< 20.8	< 20.8		< 18.2	- -	100%
Organics, Semi-volatile	Chrysene	SW 8270	ng/g	< 22.3	< 17.9	< 17.9		< 19.4	- -	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ng/g	< 30.4	< 11.7	< 11.7		< 17.9	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ng/g	< 15.8	< 27.0	< 27.0		< 23.3	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ng/g	< 19.4	< 28.0	< 28.0		< 25.1	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ng/g	< 13.6	< 17.9	< 17.9		< 16.5	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ng/g	< 16.5	< 10.8	< 10.8		< 12.7	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ng/g	< 11.2	< 17.1	< 17.1		< 15.1	- -	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ng/g	< 120.0	< 120.0	< 120.0		< 120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ng/g	< 9.4	< 11.2	< 11.2		< 10.6	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ng/g	< 17.6	< 9.22	< 9.22		< 12.0	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ng/g	< 16.8	< 22.6	< 22.6		< 20.7	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ng/g	< 21.3	< 15.7	< 15.7		< 17.6	- -	100%
Organics, Semi-volatile	Fluorene	SW 8270	ng/g	< 11.2	< 12.7	< 12.7		< 12.2	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ng/g	< 7.82	< 10.5	< 10.5		< 9.6	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ng/g	< 23.3	< 17.0	< 17.0		< 19.1	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ng/g	< 298	< 196	< 196		< 230	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ng/g	< 19.8	< 21.1	< 21.1		< 20.7	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ng/g	< 17.5	< 44.3	< 44.3		< 35.4	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ng/g	< 9.58	< 20.5	< 20.5		< 16.9	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ng/g	< 50.0	< 50.0	< 50.0		< 50.0	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ng/g	< 43.8	< 20.9	< 20.9		< 28.5	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ng/g	< 44.4	< 26.2	< 26.2		< 32.3	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ng/g	< 18.9	< 8.96	< 8.96		< 12.3	- -	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ng/g	< 25.1	< 21.8	< 21.8		< 22.9	- -	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ng/g	< 31.5	< 19.9	< 19.9		< 23.8	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ng/g	< 24.3	< 15.9	< 15.9		< 18.7	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ng/g	< 17.6	< 28.0	< 28.0		< 24.5	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ng/g	< 14.8	< 12.5	< 12.5		< 13.3	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ng/g	< 69.1	< 46.0	< 46.0		< 53.7	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ng/g	< 28.9	< 29.6	< 29.6		< 29.4	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ng/g	< 18.0	< 12.9	< 12.9		< 14.6	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ng/g	< 20.8	< 15.6	< 15.6		< 17.3	- -	100%

Run 3d		Average	95% CI	DL Ratio
	<	24.0	- -	100%
	<	13.6	- -	100%
	<	14.3	- -	100%

Solid Stream Data

Sample Stream: Raw Limestone

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3		Run 3d			Average	95% CI	DL Ratio
Anions	Chloride	SM407C	ug/g		157			189			191		196			179	47	
Anions	Fluoride	EPA 340.2	ug/g		52.5			56.5			67.4		40.20	B		58.8	19.2	
Metals	Aluminum	SW 6010	ug/g		913			976			1040		1,015			976	158	
Metals	Antimony	ICP-MS	ug/g		0.00885			0.01048			0.00254		0.00641			0.00729	0.01042	
Metals	Arsenic	SW 7060	ug/g	<	0.342		<	0.327		<	0.333	<	0.327		<	0.334	- -	100%
Metals	Barium	SW 6010	ug/g		4.77			5.14			4.7		4.66			4.87	0.59	
Metals	Beryllium	SW 6010	ug/g		0.145			0.141			0.124		0.140			0.137	0.028	
Metals	Boron	SW 6010	ug/g		3.71			3.97			2.93		3.95			3.54	1.34	
Metals	Cadmium	SW 7131	ug/g		0.339			0.332			0.326		0.325			0.332	0.016	
Metals	Calcium	SW 6010	ug/g		392,000			394,000			399,000		408,333			395,000	8,957	
Metals	Chromium	SW 6010	ug/g		9.64			9.67			10.1		10.0			9.80	0.64	
Metals	Cobalt	SW 6010	ug/g		1.38			1.5			1.02		1.32			1.30	0.62	
Metals	Copper	SW 6010	ug/g		1.01			1.57			1.86		1.81			1.48	1.07	
Metals	Iron	SW 6010	ug/g		1760			1800			1800		1,885			1,787	57	
Metals	Lead	SW 7421	ug/g		1.18			1.04			1.04		1.07			1.09	0.20	
Metals	Magnesium	SW 6010	ug/g		1220			1240			1240		1,281			1,233	29	
Metals	Manganese	SW 6010	ug/g		208			209			204		215			207	7	
Metals	Mercury	SW 7471	ug/g		0.005	J		0.01	J	<	0.012		0.01	J		0.01	0.01	40%
Metals	Molybdenum	SW 6010	ug/g		0.219	J	<	0.211		<	0.222		0.126	J	<	0.222	- -	50%
Metals	Nickel	SW 6010	ug/g		3.34			2.75			3.39		3.59			3.16	0.88	
Metals	Phosphorus	SW 6010	ug/g		112			94			118		84.17			108	31	
Metals	Potassium	SW 6010	ug/g		342			372			374		386			363	45	
Metals	Selenium	SW 7740	ug/g		3.12			4.74			3.93		4.73			3.93	2.01	
Metals	Silicon	SW 6010	ug/g		479			392			436		466			436	108	
Metals	Sodium	SW 6010	ug/g		20			20.8			22		20.31			20.9	2.5	
Metals	Strontium	SW 6010	ug/g		108			109			107		111			108	2	
Metals	Titanium	SW 6010	ug/g		75		<	0.148		<	0.156	<	0.15			25	107	0.2%
Metals	Vanadium	SW 6010	ug/g		8.11			7.98			8.31		8.14			8.13	0.41	
Metals	Zinc	SW 6010	ug/g		8.65			8.75			8.83		9.06			8.74	0.22	

Raw Limestone - Page 1

Solid Stream Data

Sample Stream: Raw Limestone

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Ultimate/Proximate	Percent Moisture	D3173	wt %	9.00	9.00	8.00	9.00	8.67	1.43	
Radionuclides	Actinium-228 @ 338 KeV	EPA 901.1	pCi/g	0.26	0.39	0.26	0.33	0.30	0.19	
Radionuclides	Actinium-228 @ 911 KeV	EPA 901.1	pCi/g	0.2	ND	0.3	ND	0.2	0.4	
Radionuclides	Actinium-228 @ 968 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND	ND	- -	
Radionuclides	Bismuth-212 @ 727 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND	ND	- -	
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND	ND	- -	
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA 901.1	pCi/g	0.17	0.41	0.37	ND	0.32	0.32	
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA 901.1	pCi/g	0.21	0.1	0.14	0.10	0.15	0.14	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g	0.66	ND	0.51	ND	0.39	0.86	
Radionuclides	Lead-210 @ 46 KeV	EPA 901.1	pCi/g	ND	ND	0.74	ND	0.25	1.06	
Radionuclides	Lead-212 @ 238 KeV	EPA 901.1	pCi/g	0.11	0.1	0.13	0.16	0.11	0.04	
Radionuclides	Lead-214 @ 295.2 KeV	EPA 901.1	pCi/g	0.14	0.2	0.23	0.12	0.19	0.11	
Radionuclides	Lead-214@ 352.0 KeV	EPA 901.1	pCi/g	0.21	0.16	0.21	0.18	0.19	0.07	
Radionuclides	Radium-226 @ 186.0 KeV	EPA 901.1	pCi/g	0.6	0.66	ND	0.48	0.42	0.91	
Radionuclides	Thallium-208 @ 583 KeV	EPA 901.1	pCi/g	0.21	ND	ND	0.12	0.07	0.30	
Radionuclides	Thallium-208 @ 860 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND	ND	- -	
Radionuclides	Thorium-234 @ 63.3 KeV	EPA 901.1	pCi/g	ND	ND	0.37	0.46	0.12	0.53	
Radionuclides	Thorium-234 @ 92.6 KeV	EPA 901.1	pCi/g	ND	0.25	ND	ND	0.08	0.36	
Radionuclides	Uranium-235 @ 143 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND	ND	- -	

ND= Not Detected, (no detection limit specified)

Solid Stream Data

Sample Stream: Limestone Slurry Solids

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	SM407C	ug/g	5,270	3,950	2,950	5,590	4,057	2891	
Anions	Fluoride	EPA 340.2	ug/g	99.50	64.10	92.00	98.00	85.20	46.34	
Metals	Aluminum	SW 6010	ug/g	814	609	845	865	756	318	
Metals	Antimony	SW 6010	ug/g	0.020	0.020	0.018	0.014	0.019	0.003	
Metals	Arsenic	SW 7060	ug/g	< 0.34	< 0.32	< 0.34	< 0.36	< 0.33	- -	100%
Metals	Barium	SW 6010	ug/g	5.67	5.15	5.33	5.22	5.39	0.66	
Metals	Beryllium	SW 6010	ug/g	0.15	0.13	0.15	0.14	0.14	0.02	
Metals	Boron	SW 6010	ug/g	241	194	172	258	202	88	
Metals	Cadmium	SW 7131	ug/g	0.61	0.59	0.62	0.63	0.61	0.04	
Metals	Calcium	SW 6010	ug/g	382,490	404,082	390,244	377,174	392,272	27,173	
Metals	Chromium	SW 6010	ug/g	13.39	12.45	14.30	13.70	13.38	2.30	
Metals	Cobalt	SW 6010	ug/g	1.72	1.38	1.35	1.52	1.48	0.51	
Metals	Copper	SW 6010	ug/g	3.75	3.50	3.88	3.62	3.71	0.48	
Metals	Iron	SW 6010	ug/g	2,571	2,214	2,738	2,620	2,508	665	
Metals	Lead	SW 7421	ug/g	0.96	0.94	1.03	1.09	0.98	0.11	
Metals	Magnesium	SW 6010	ug/g	1,456	1,306	1,397	1,457	1,386	187	
Metals	Manganese	SW 6010	ug/g	424	419	445	417	429	33	
Metals	Mercury	SW 7471	ug/g	0.01 J	< 0.01	0.01 J	0.01	< 0.01	- -	29%
Metals	Molybdenum	SW 6010	ug/g	0.24	0.38	0.06 J	< 0.22	0.23	0.40	
Metals	Nickel	SW 6010	ug/g	3.88	3.09	5.12	3.63	4.03	2.54	
Metals	Phosphorus	SW 6010	ug/g	106	110	114	111	110	10	
Metals	Potassium	SW 6010	ug/g	355	298	360	350	338	86	
Metals	Selenium	SW 7740	ug/g	8.11	7.46	9.63	10.67	8.40	2.77	
Metals	Silicon	SW 6010	ug/g	398	263	435	491	365	224	
Metals	Sodium	SW 6010	ug/g	62.37	55.20	47.12	61.52	54.90	18.95	
Metals	Strontium	SW 6010	ug/g	113	109	113	110	112	5.29	
Metals	Titanium	SW 6010	ug/g	< 0.17	< 0.16	< 0.16	< 0.16	< 0.16	- -	100%
Metals	Vanadium	SW 6010	ug/g	7.83	4.72	7.63	7.65	6.73	4.32	
Metals	Zinc	SW 6010	ug/g	10.04	8.82	10.51	9.95	9.79	2.17	

Solid Stream Data

Sample Stream: JBR Underflow Slurry Solids

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Anions	Chloride	SM407C	ug/g	9,310	9,470	9,870	9,840	9,550	717	
Anions	Fluoride	EPA 340.2	ug/g	684	777	789	594	750	143	
Anions	Sulfate	EPA 300.0	ug/g	500,000	493,000	496,000	495,000	496,333	8,725	
Anions	Sulfite	EPRI-FGD-M2	ug/g	< 240	< 240	< 240	< 240	< 240	- -	100%
Metals	Aluminum	SW 6010	ug/g	1,031	1,184	1,081	1,064	1,099	194	
Metals	Antimony	ICP-MS	ug/g	0.067	0.086	0.066	0.073	0.073	0.028	
Metals	Arsenic	SW 7060	ug/g	< 0.40	< 0.47	< 0.36	< 0.39	< 0.41	- -	100%
Metals	Barium	SW 6010	ug/g	3.61	4.35	4.09	4.08	4.02	0.94	
Metals	Beryllium	SW 6010	ug/g	0.10	0.16	0.13	0.19	0.13	0.07	
Metals	Boron	SW 6010	ug/g	417	445	413	422	425	43	
Metals	Cadmium	SW 7131	ug/g	0.26	0.24	0.24	0.23	0.25	0.04	
Metals	*Calcium*	SW 6010	ug/g	260,714	256,627	248,786	231,317	255,376	15,059	
Metals	Chromium	SW 6010	ug/g	10.39	12.41	11.10	11.07	11.30	2.54	
Metals	Cobalt	SW 6010	ug/g	0.90	1.19	0.87	1.23	0.99	0.43	
Metals	Copper	SW 6010	ug/g	2.48	3.10	2.61	2.70	2.73	0.81	
Metals	Iron	SW 6010	ug/g	2,060	2,349	2,148	2,112	2,186	369	
Metals	Lead	SW 7421	ug/g	0.86	0.91	0.75	0.87	0.84	0.21	
Metals	Magnesium	SW 6010	ug/g	785	860	795	796	813	102	
Metals	Manganese	SW 6010	ug/g	100	108	100	101	103	11.08	
Metals	Mercury	SW 7471	ug/g	0.19	0.15	0.19	0.16	0.18	0.06	
Metals	Molybdenum	SW 6010	ug/g	1.23	1.65	1.58	1.21	1.48	0.56	
Metals	Nickel	SW 6010	ug/g	2.32	3.36	2.79	2.70	2.82	1.29	
Metals	Phosphorus	SW 6010	ug/g	74.76	92.17	96.48	74.26	87.80	28.57	
Metals	Potassium	SW 6010	ug/g	238	370	312	319	307	164	
Metals	Selenium	SW 7740	ug/g	25.71	25.90	25.00	20.40	25.54	1.18	
Metals	Silicon	SW 6010	ug/g	469	458	414	447	447	72.50	
Metals	Sodium	SW 6010	ug/g	82.62	87.71	82.04	89.21	84.12	7.75	
Metals	Strontium	SW 6010	ug/g	73.21	76.99	71.12	72.60	73.77	7.39	
Metals	Titanium	SW 6010	ug/g	20.12	24.10	18.57	23.37	20.93	7.08	
Metals	Vanadium	SW 6010	ug/g	9.01	10.73	9.82	8.90	9.85	2.14	
Metals	Zinc	SW 6010	ug/g	7.86	8.90	8.33	9.99	8.36	1.30	

Solid Stream Data

Sample Stream: JBR Underflow Slurry Solids

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3	Run 3d	Average	95% CI	DL Ratio
Radionuclides	Actinium-228 @ 338 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND			
Radionuclides	Actinium-228 @ 911 KeV	EPA 901.1	pCi/g	ND	ND	0.16	ND	0.05	0.23	
Radionuclides	Actinium-228 @ 968 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND			
Radionuclides	Bismuth-212 @ 727 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND			
Radionuclides	Bismuth-214 @ 1120.4 KeV	EPA 901.1	pCi/g	0.40	ND	0.35	ND	0.25	0.54	
Radionuclides	Bismuth-214 @ 1764.7 KeV	EPA 901.1	pCi/g	0.11	ND	0.22	0.35	0.11	0.27	
Radionuclides	Bismuth-214 @ 609.4 KeV	EPA 901.1	pCi/g	0.14	ND	0.18	0.25	0.11	0.23	
Radionuclides	K-40 @ 1460 KeV	EPA 901.1	pCi/g	ND	ND	ND	0.79			
Radionuclides	Lead-210 @ 46 KeV	EPA 901.1	pCi/g	0.79	ND	ND	ND	0.26	1.13	
Radionuclides	Lead-212 @ 238 KeV	EPA 901.1	pCi/g	0.07	0.09	0.11	0.13	0.09	0.05	
Radionuclides	Lead-214 @ 295.2 KeV	EPA 901.1	pCi/g	ND	0.16	ND	0.16	0.05	0.23	
Radionuclides	Lead-214@ 352.0 KeV	EPA 901.1	pCi/g	0.17	0.11	0.14	0.16	0.14	0.07	
Radionuclides	Radium-226 @ 186.0 KeV	EPA 901.1	pCi/g	0.54	ND	0.45	ND	0.33	0.72	
Radionuclides	Thallium-208 @ 583 KeV	EPA 901.1	pCi/g	0.15	0.30	0.16	0.14	0.20	0.21	
Radionuclides	Thallium-208 @ 860 KeV	EPA 901.1	pCi/g	ND	ND	ND	0.92			
Radionuclides	Thorium-234 @ 63.3 KeV	EPA 901.1	pCi/g	ND	0.56	ND	ND	0.19	0.80	
Radionuclides	Thorium-234 @ 92.6 KeV	EPA 901.1	pCi/g	ND	0.28	0.33	0.21	0.20	0.44	
Radionuclides	Uranium-235 @ 143 KeV	EPA 901.1	pCi/g	ND	ND	ND	ND	ND		
Aldehydes	Acetaldehyde	SW 8315	ug/g	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	- -	100%
Aldehydes	Formaldehyde	SW 8315	ug/g	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	- -	100%
Semi-Volatiles	1,2,4,5-Tetrachlorobenzene	SW 8270	ng/g	< 29	< 30	< 20		< 26	- -	100%
Semi-Volatiles	1,2,4-Trichlorobenzene	SW 8270	ng/g	< 29	< 31	< 30		< 30	- -	100%
Semi-Volatiles	1,2-Dichlorobenzene	SW 8270	ng/g	< 39	< 40	< 32		< 37	- -	100%
Semi-Volatiles	1,2-Diphenylhydrazine	SW 8270	ng/g	< 100	< 100	< 100		< 100	- -	100%
Semi-Volatiles	1,3-Dichlorobenzene	SW 8270	ng/g	< 20	< 21	< 36		< 25	- -	100%
Semi-Volatiles	1,4-Dichlorobenzene	SW 8270	ng/g	< 40	< 42	< 30		< 37	- -	100%
Semi-Volatiles	1-Chloronaphthalene	SW 8270	ng/g	< 32	< 33	< 27		< 31	- -	100%
Semi-Volatiles	1-Naphthylamine	SW 8270	ng/g	< 77	< 81	< 102		< 87	- -	100%
Semi-Volatiles	2,3,4,6-Tetrachlorophenol	SW 8270	ng/g	< 25	< 26	< 23		< 25	- -	100%

Solid Stream Data

Sample Stream: JBR Underflow Slurry Solids

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3	Run 3d		Average	95% CI	DL Ratio
Semi-Volatiles	2,4,5-Trichlorophenol	SW 8270	ng/g	<	16	<	17	<	26		<	20	- -	100%
Semi-Volatiles	2,4,6-Trichlorophenol	SW 8270	ng/g	<	17	<	18	<	25		<	20	- -	100%
Semi-Volatiles	2,4-Dichlorophenol	SW 8270	ng/g	<	22	<	23	<	29		<	25	- -	100%
Semi-Volatiles	2,4-Dimethylphenol	SW 8270	ng/g	<	54	<	57	<	65		<	59	- -	100%
Semi-Volatiles	2,4-Dinitrophenol	SW 8270	ng/g	<	346	<	363	<	210		<	306	- -	100%
Semi-Volatiles	2,4-Dinitrotoluene	SW 8270	ng/g	<	27	<	29	<	30		<	28	- -	100%
Semi-Volatiles	2,6-Dichlorophenol	SW 8270	ng/g	<	36	<	38	<	26		<	33	- -	100%
Semi-Volatiles	2,6-Dinitrotoluene	SW 8270	ng/g	<	17	<	18	<	43		<	26	- -	100%
Semi-Volatiles	2-Chloronaphthalene	SW 8270	ng/g	<	16	<	17	<	20		<	18	- -	100%
Semi-Volatiles	2-Chlorophenol	SW 8270	ng/g	<	38	<	40	<	32		<	36	- -	100%
Semi-Volatiles	2-Methylnaphthalene	SW 8270	ng/g	<	33	<	34	<	18		<	28	- -	100%
Semi-Volatiles	2-Methylphenol(o-cresol)	SW 8270	ng/g	<	26	<	28	<	16		<	23	- -	100%
Semi-Volatiles	2-Naphthylamine	SW 8270	ng/g	<	96	<	101	<	80		<	93	- -	100%
Semi-Volatiles	2-Nitroaniline	SW 8270	ng/g	<	20	<	21	<	33		<	25	- -	100%
Semi-Volatiles	2-Nitrophenol	SW 8270	ng/g	<	22	<	23	<	26		<	24	- -	100%
Semi-Volatiles	2-Picoline	SW 8270	ng/g	<	54	<	57	<	42		<	51	- -	100%
Semi-Volatiles	3,3'-Dichlorobenzidine	SW 8270	ng/g	<	24	<	25	<	17		<	22	- -	100%
Semi-Volatiles	3-Methylcholanthrene	SW 8270	ng/g	<	39	<	41	<	25		<	35	- -	100%
Semi-Volatiles	3-Nitroaniline	SW 8270	ng/g	<	25	<	26	<	20		<	24	- -	100%
Semi-Volatiles	4,6-Dinitro-2-methylphenol	SW 8270	ng/g	<	39	<	41	<	22		<	34	- -	100%
Semi-Volatiles	4-Aminobiphenyl	SW 8270	ng/g	<	37	<	39	<	60		<	45	- -	100%
Semi-Volatiles	4-Bromophenyl phenyl	SW 8270	ng/g	<	23	<	24	<	24		<	23	- -	100%
Semi-Volatiles	4-Chloro-3-methylphenol	SW 8270	ng/g	<	36	<	38	<	26		<	33	- -	100%
Semi-Volatiles	4-Chlorophenyl phenyl ether	SW 8270	ng/g	<	26	<	27	<	21		<	25	- -	100%
Semi-Volatiles	4-Methylphenol(p-cresol)	SW 8270	ng/g	<	28	<	30	<	23		<	27	- -	100%
Semi-Volatiles	4-Nitroaniline	SW 8270	ng/g	<	24	<	25	<	30		<	26	- -	100%
Semi-Volatiles	4-Nitrophenol	SW 8270	ng/g	<	34	<	36	<	47		<	39	- -	100%
Semi-Volatiles	7,12-Dimethylbenz(a)anthracen	SW 8270	ng/g	<	95	<	100	<	67		<	87	- -	100%
Semi-Volatiles	Acenaphthene	SW 8270	ng/g	<	24	<	25	<	14		<	21	- -	100%
Semi-Volatiles	Acenaphthylene	SW 8270	ng/g	<	11	<	12	<	21		<	15	- -	100%
Semi-Volatiles	Acetophenone	SW 8270	ng/g	<	23	<	24	<	28		<	25	- -	100%
Semi-Volatiles	Aniline	SW 8270	ng/g	<	46	<	48	<	31		<	42	- -	100%

Solid Stream Data

Sample Stream: JBR Underflow Slurry Solids

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3	Run 3d		Average	95% CI	DL Ratio
Semi-Volatiles	Anthracene	SW 8270	ng/g	<	29	<	30	<	19		<	26	--	100%
Semi-Volatiles	Benzidine	SW 8270	ng/g	<	20	<	20	<	20		<	20	--	100%
Semi-Volatiles	Benzo(a)anthracene	SW 8270	ng/g	<	26	<	27	<	23		<	25	--	100%
Semi-Volatiles	Benzo(a)pyrene	SW 8270	ng/g	<	19	<	20	<	26		<	22	--	100%
Semi-Volatiles	Benzo(b)fluoranthene	SW 8270	ng/g	<	28	<	30	<	46		<	34	--	100%
Semi-Volatiles	Benzo(g,h,i)perylene	SW 8270	ng/g	<	24	<	25	<	51		<	34	--	100%
Semi-Volatiles	Benzo(k)fluoranthene	SW 8270	ng/g	<	48	<	50	<	50		<	49	--	100%
Semi-Volatiles	Benzoic acid	SW 8270	ng/g	<	196	<	205	<	1,940		<	780	--	100%
Semi-Volatiles	Benzyl alcohol	SW 8270	ng/g	<	53	<	56	<	31		<	47	--	100%
Semi-Volatiles	Butylbenzylphthalate	SW 8270	ng/g	<	19	<	20	<	31		<	24	--	100%
Semi-Volatiles	Chrysene	SW 8270	ng/g	<	33	<	35	<	27		<	32	--	100%
Semi-Volatiles	Di-n-octylphthalate	SW 8270	ng/g	<	45	<	47	<	18		<	37	--	100%
Semi-Volatiles	Dibenz(a,h)anthracene	SW 8270	ng/g	<	23	<	25	<	41		<	30	--	100%
Semi-Volatiles	Dibenz(a,j)acridine	SW 8270	ng/g	<	29	<	30	<	42		<	34	--	100%
Semi-Volatiles	Dibenzofuran	SW 8270	ng/g	<	20	<	21	<	27		<	23	--	100%
Semi-Volatiles	Dibutylphthalate	SW 8270	ng/g	<	24	<	26	<	16		<	22	--	100%
Semi-Volatiles	Diethylphthalate	SW 8270	ng/g	<	17	<	17	<	26		<	20	--	100%
Semi-Volatiles	Dimethylphenethylamine	SW 8270	ng/g	<	120	<	120	<	120		<	120	--	100%
Semi-Volatiles	Dimethylphthalate	SW 8270	ng/g	<	14	<	15	<	17		<	15	--	100%
Semi-Volatiles	Diphenylamine	SW 8270	ng/g	<	26	<	27	<	14		<	22	--	100%
Semi-Volatiles	Ethyl methanesulfonate	SW 8270	ng/g	<	25	<	26	<	34		<	28	--	100%
Semi-Volatiles	Fluoranthene	SW 8270	ng/g	<	32	<	33	<	24		<	29	--	100%
Semi-Volatiles	Fluorene	SW 8270	ng/g	<	17	<	17	<	19		<	18	--	100%
Semi-Volatiles	Hexachlorobenzene	SW 8270	ng/g	<	12	<	12	<	16		<	13	--	100%
Semi-Volatiles	Hexachlorobutadiene	SW 8270	ng/g	<	35	<	36	<	26		<	32	--	100%
Semi-Volatiles	Hexachlorocyclopentadiene	SW 8270	ng/g	<	441	<	462	<	296		<	400	--	100%
Semi-Volatiles	Hexachloroethane	SW 8270	ng/g	<	29	<	31	<	32		<	31	--	100%
Semi-Volatiles	Indeno(1,2,3-cd)pyrene	SW 8270	ng/g	<	26	<	27	<	67		<	40	--	100%
Semi-Volatiles	Isophorone	SW 8270	ng/g	<	14	<	15	<	31		<	20	--	100%
Semi-Volatiles	Methyl methanesulfonate	SW 8270	ng/g	<	50	<	50	<	50		<	50	--	100%
Semi-Volatiles	N-Nitroso-di-n-butylamine	SW 8270	ng/g	<	65	<	68	<	32		<	55	--	100%
Semi-Volatiles	N-Nitrosodimethylamine	SW 8270	ng/g	<	66	<	69	<	40		<	58	--	100%

Solid Stream Data

Sample Stream: JBR Underflow Slurry Solids

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3	Run 3d		Average	95% CI	DL Ratio
Semi-Volatiles	N-Nitrosodiphenylamine	SW 8270	ng/g	<	28	<	29	<	14		<	24	- -	100%
Semi-Volatiles	N-Nitrosodipropylamine	SW 8270	ng/g	<	37	<	39	<	33		<	36	- -	100%
Semi-Volatiles	N-Nitrosopiperidine	SW 8270	ng/g	<	47	<	49	<	30		<	42	- -	100%
Semi-Volatiles	Naphthalene	SW 8270	ng/g	<	36	<	38	<	24		<	33	- -	100%
Semi-Volatiles	Nitrobenzene	SW 8270	ng/g	<	26	<	27	<	42		<	32	- -	100%
Semi-Volatiles	Pentachlorobenzene	SW 8270	ng/g	<	22	<	23	<	19		<	21	- -	100%
Semi-Volatiles	Pentachloronitrobenzene	SW 8270	ng/g	<	102	<	107	<	69		<	93	- -	100%
Semi-Volatiles	Pentachlorophenol	SW 8270	ng/g	<	43	<	45	<	45		<	44	- -	100%
Semi-Volatiles	Phenacetin	SW 8270	ng/g	<	27	<	28	<	19		<	25	- -	100%
Semi-Volatiles	Phenanthrene	SW 8270	ng/g	<	31	<	32	<	24		<	29	- -	100%
Semi-Volatiles	Phenol	SW 8270	ng/g	<	20	<	21	<	44		<	28	- -	100%
Semi-Volatiles	Pronamide	SW 8270	ng/g	<	37	<	38	<	12		<	29	- -	100%
Semi-Volatiles	Pyrene	SW 8270	ng/g	<	23	<	24	<	21		<	23	- -	100%
Semi-Volatiles	Pyridine	SW 8270	ng/g	<	57	<	60	<	30		<	49	- -	100%
Semi-Volatiles	bis(2-Chloroethoxy)methane	SW 8270	ng/g	<	0	<	29	<	29		<	19	- -	100%
Semi-Volatiles	bis(2-Chloroethyl)ether	SW 8270	ng/g	<	28	<	29	<	30		<	29	- -	100%
Semi-Volatiles	bis(2-Chloroisopropyl)ether	SW 8270	ng/g	<	36	<	38	<	19		<	31	- -	100%
Semi-Volatiles	bis(2-Ethylhexyl)phthalate	SW 8270	ng/g		262	<	95	<	29			108	334	19%
Semi-Volatiles	p-Chloroaniline	SW 8270	ng/g	<	0.03	<	29	<	29		<	19	- -	100%
Semi-Volatiles	p-Dimethylaminoazobenzene	SW 8270	ng/g	<	28	<	29	<	37		<	31	- -	100%
Semi-Volatiles	p-Dimethylaminoazobe	SW 8270	ng/g	<	26	<	27	<	36		<	30	- -	100%

ND= Not Detected, (no detection limit specified).

Liquid Stream Data Summary

Sample Stream: Ash Pond Water

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3a			Run 3d			Average	95% CI	DL Ratio
Reduced Species	Cyanide	SW 9012	ug/ml		0.0024	J		0.0026	J		0.00084	J		0.0015	J		0.0019	0.0024	
Reduced Species	Ammonia as N	EPA 350.1	ug/ml		0.194			0.255			0.164			0.151			0.204	0.115	
Anions	Chloride	EPA 300	ug/ml		9.28			9.37			7.99			9			8.88	1.92	
Anions	Fluoride	EPA 340.2	ug/ml		0.377			0.461			0.443			0.441			0.427	0.110	
Anions	Phosphate	EPA 365.2	ug/ml	<	0.02		<	0.002		<	0.02			0.00176	J	<	0.014	- -	100%
Anions	Sulfate	EPA 300.0	ug/ml		108			115			117			120			113	12	
Metals, Soluble	Aluminum	SW 6010	ug/ml		0.0167	J		0.0172	J		0.00881	J		0.00481	J		0.014	0.012	
Metals, Soluble	Antimony	SW 6010	ug/ml	<	0.0241		<	0.0241		<	0.0241		<	0.0241		<	0.024	- -	100%
Metals, Soluble	Arsenic	SW 7060	ug/ml	<	0.000657		<	0.000657		<	0.000657		<	0.000657		<	0.00066	- -	100%
Metals, Soluble	Barium	SW 6010	ug/ml		0.147			0.168			0.151			0.15			0.155	0.028	
Metals, Soluble	Beryllium	SW 6010	ug/ml	<	0.000554			0.00058			0.00005	J		0.00018	J	<	0.00055	- -	31%
Metals, Soluble	Boron	SW 6010	ug/ml		1.14			0.97			1.12			1.06			1.08	0.23	
Metals, Soluble	Cadmium	SW 7131	ug/ml		0.0012			0.00058			0.00137			0.00196			0.0011	0.0010	
Metals, Soluble	Calcium	SW 6010	ug/ml		31.4			32.8			34.2			33.6			32.8	3.478	
Metals, Soluble	Chromium	SW 6010	ug/ml	<	0.00249		<	0.00249			0.00218	J	<	0.00249		<	0.0025	- -	53%
Metals, Soluble	Cobalt	SW 6010	ug/ml	<	0.0034		<	0.0034			0.00228	J		0.00164	J	<	0.0034	- -	60%
Metals, Soluble	Copper	SW 6010	ug/ml		0.00364	J		0.00297	J		0.00667			0.00397			0.0044	0.0049	
Metals, Soluble	Iron	SW 6010	ug/ml		3.76			5.63			6.75			6.67			5.38	3.75	
Metals, Soluble	Lead	SW 7421	ug/ml		0.0115			0.0035			0.0098			0.0132			0.0083	0.010	
Metals, Soluble	Magnesium	SW 6010	ug/ml		3.06			3.09			3.19			3.15			3.11	0.17	
Metals, Soluble	Manganese	SW 6010	ug/ml		0.458			0.606			0.603			0.593			0.556	0.210	
Metals, Soluble	Mercury	SW 7470	ug/ml		0.00005			0.00008			0.00005			0.00002	J		0.00006	0.00004	
Metals, Soluble	Molybdenum	SW 6010	ug/ml		0.0447			0.0319			0.0284			0.0248			0.035	0.021	
Metals, Soluble	Nickel	SW 6010	ug/ml		0.0213			0.0172			0.0207			0.0191			0.020	0.0055	
Metals, Soluble	Phosphorus	SW 6010	ug/ml		0.147		<	0.061			0.0179	J	<	0.061			0.065	0.177	16%
Metals, Soluble	Potassium	SW 6010	ug/ml		5.29			5.06			5.68			5.38			5.34	0.78	
Metals, Soluble	Selenium	SW 7740	ug/ml		0.0003	J		0.002			0.0033			0.0016			0.0019	0.0037	
Metals, Soluble	Silicon	SW 6010	ug/ml		3.77			3.34			3.24			3.2			3.45	0.70	
Metals, Soluble	Sodium	SW 6010	ug/ml		12.7			12.4			12.1			12			12.4	0.7	
Metals, Soluble	Strontium	SW 6010	ug/ml		0.334			0.343			0.35			0.346			0.342	0.020	
Metals, Soluble	Tin	SW 6010	ug/ml	<	0.0144			0.0028	J	<	0.0144		<	0.0144		<	0.014	- -	84%

Liquid Stream Data Summary

Sample Stream: Ash Pond Water

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2		Run 3a			Run 3d			Average	95% CI	DL Ratio
Metals, Soluble	Titanium	SW 6010	ug/ml		0.00042	J	<	0.00236		0.00031	J		0.00024	J	<	0.0024	- -	62%
Metals, Soluble	Vanadium	SW 6010	ug/ml		0.00019	J		0.0118		0.00167	J		0.00116	J		0.0046	0.016	
Metals, Soluble	Zinc	SW 6010	ug/ml		0.0109			0.00881	J	0.00995			0.0102			0.010	0.0026	
Metals, Total	Aluminum	SW 6010	ug/ml		0.0708			0.355		0.102			0.123			0.176	0.387	
Metals, Total	Antimony	SW 6010	ug/ml		0.0146	J		0.0166	J	0.0241			0.0131	J		0.018	0.012	
Metals, Total	Arsenic	SW 7060	ug/ml		0.0004	J		0.0004	J	0.0014			0.0014			0.00073	0.0014	
Metals, Total	Barium	SW 6010	ug/ml		0.144			0.168		0.148			0.144			0.153	0.032	
Metals, Total	Beryllium	SW 6010	ug/ml		0.00013	J		9E-05	J	0.000554		<	0.000554			0.00026	0.000639	
Metals, Total	Boron	SW 6010	ug/ml		0.976			1.02		1.1			0.996			1.03	0.16	
Metals, Total	Cadmium	SW 7131	ug/ml		0.00079			0.0036		0.00105			0.00083			0.0018	0.0039	
Metals, Total	Calcium	SW 6010	ug/ml		32.6			34.8		33.8			32.7			33.7	2.7	
Metals, Total	Chromium	SW 6010	ug/ml		0.00111	J		0.0018	J	0.00194	J		0.00175	J		0.0016	0.0011	
Metals, Total	Cobalt	SW 6010	ug/ml		0.00674			0.00622		0.00619			0.00411			0.0064	0.00077	
Metals, Total	Copper	SW 6010	ug/ml		0.00832			0.00866		0.00493			0.00869			0.0073	0.0051	
Metals, Total	Iron	SW 6010	ug/ml		8.28			12.6		9.8			9.71			10.2	5.4	
Metals, Total	Lead	SW 7421	ug/ml	<	0.0008			0.0435		0.0079			0.0039			0.017	0.057	1%
Metals, Total	Magnesium	SW 6010	ug/ml		3.11			3.26		3.13			3.02			3.17	0.20	
Metals, Total	Manganese	SW 6010	ug/ml		0.487			0.647		0.531			0.497			0.555	0.205	
Metals, Total	Mercury	SW 7470	ug/ml		7E-05			6E-05		2E-05	J		1E-05	J		5E-05	7E-05	
Metals, Total	Molybdenum	SW 6010	ug/ml		0.0761			0.1		0.0761			0.0736			0.084	0.034	
Metals, Total	Nickel	SW 6010	ug/ml		0.0296			0.0195		0.022			0.0269			0.024	0.013	
Metals, Total	Phosphorus	SW 6010	ug/ml		0.0038	J		0.0326	J	0.0446	J	<	0.061			0.027	0.052	
Metals, Total	Potassium	SW 6010	ug/ml		5.87			5.99		5.36			5.4			5.74	0.83	
Metals, Total	Selenium	SW 7740	ug/ml		0.006			0.0043		0.0041			0.0042			0.0048	0.0026	
Metals, Total	Silicon	SW 6010	ug/ml		4.03			3.58		3.48			3.34			3.697	0.728	
Metals, Total	Sodium	SW 6010	ug/ml		13			13.5		12			11.7			12.8	1.9	
Metals, Total	Strontium	SW 6010	ug/ml		0.329			0.35		0.337			0.326			0.339	0.026	
Metals, Total	Tin	SW 6010	ug/ml	<	0.0144		<	0.0144		0.0144		<	0.0144		<	0.014	- -	50%
Metals, Total	Titanium	SW 6010	ug/ml		0.00024	J		0.0008	J	0.001	J		0.00041	J		0.00068	0.0010	
Metals, Total	Vanadium	SW 6010	ug/ml		0.0286			0.0227		0.0202			0.0239			0.024	0.011	
Metals, Total	Zinc	SW 6010	ug/ml		0.0128			0.0124		0.0107			0.011			0.012	0.0028	

Liquid Stream Data Summary

Sample Stream: Ash Pond Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Aldehydes	Acetaldehyde	SW 8315	ug/ml	0.006	0.102	0.134	61	0.081	0.165	
Aldehydes	Formaldehyde	SW 8315	ug/ml	0.006	0.018	0.022	11	0.015	0.021	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	< 0.561	< 0.556	< 0.386	< 0.371	< 0.501	--	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	< 0.574	< 0.568	< 0.582	< 0.56	< 0.575	--	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	< 0.756	< 0.749	< 0.629	< 0.605	< 0.711	--	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	< 100	< 100	< 100	< 100	< 100	--	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	< 0.384	< 0.381	< 0.71	< 0.683	< 0.492	--	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	< 0.784	< 0.777	< 0.582	< 0.56	< 0.714	--	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	< 0.625	< 0.619	< 0.532	< 0.511	< 0.592	--	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	< 1.51	< 1.5	< 2.01	< 1.93	< 1.67	--	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	< 0.488	< 0.484	< 0.46	< 0.443	< 0.477	--	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	< 0.32	< 0.317	< 0.504	< 0.485	< 0.380	--	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	< 0.339	< 0.336	< 0.501	< 0.482	< 0.392	--	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	< 0.43	< 0.426	< 0.563	< 0.542	< 0.473	--	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	< 1.07	< 1.06	< 1.29	< 1.24	< 1.14	--	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	< 6.8	< 6.73	< 4.14	< 3.98	< 5.89	--	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	< 0.534	< 0.529	< 0.585	< 0.563	< 0.549	--	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	< 0.702	< 0.695	< 0.507	< 0.488	< 0.635	--	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	< 0.336	< 0.333	< 0.852	< 0.82	< 0.507	--	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	< 0.315	< 0.312	< 0.388	< 0.373	< 0.338	--	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	< 0.742	< 0.735	< 0.629	< 0.605	< 0.702	--	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	< 0.641	< 0.635	< 0.36	< 0.347	< 0.545	--	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	< 0.518	< 0.513	< 0.307	< 0.295	< 0.446	--	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	< 1.89	< 1.87	< 1.58	< 1.52	< 1.78	--	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	< 0.39	< 0.387	< 0.656	< 0.631	< 0.478	--	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	< 0.427	< 0.423	< 0.517	< 0.497	< 0.456	--	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	< 1.06	< 1.05	< 0.819	< 0.788	< 0.98	--	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	< 0.476	< 0.471	< 0.33	< 0.317	< 0.426	--	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	< 0.76	< 0.753	< 0.495	< 0.476	< 0.669	--	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	< 0.494	< 0.489	< 0.389	< 0.374	< 0.457	--	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	< 0.769	< 0.762	< 0.426	< 0.41	< 0.652	--	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	< 0.726	< 0.719	< 1.18	< 1.13	< 0.875	--	100%

Liquid Stream Data Summary

Sample Stream: Ash Pond Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ug/L	< 0.443	< 0.438	< 0.479	< 0.461	< 0.453	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	< 0.702	< 0.695	< 0.51	< 0.49	< 0.636	- -	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ug/L	< 0.513	< 0.508	< 0.417	< 0.401	< 0.479	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ug/L	< 0.558	< 0.553	< 0.454	< 0.437	< 0.522	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	< 0.47	< 0.465	< 0.6	< 0.577	< 0.512	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	< 0.671	< 0.664	< 0.928	< 0.892	< 0.754	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ug/L	< 1.86	< 1.85	< 1.32	< 1.27	< 1.68	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	< 0.464	< 0.46	< 0.269	< 0.259	< 0.398	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	< 0.219	< 0.217	< 0.414	< 0.398	< 0.283	- -	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	< 0.446	< 0.441	< 0.553	< 0.532	< 0.480	- -	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	< 0.906	< 0.897	< 0.61	< 0.587	< 0.804	- -	100%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	< 0.564	< 0.559	< 0.364	< 0.35	< 0.496	- -	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	< 20	< 20	< 20	< 20	< 20	- -	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	< 0.5	< 0.495	< 0.445	< 0.428	< 0.480	- -	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	< 0.372	< 0.368	< 0.513	< 0.493	< 0.418	- -	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	< 0.552	< 0.547	< 0.899	< 0.865	< 0.666	- -	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	< 0.473	< 0.468	< 1.01	< 0.971	< 0.650	- -	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	< 0.94	< 0.931	< 0.989	< 0.951	< 0.953	- -	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	< 3.84	< 3.81	< 38.2	< 36.8	< 15.3	- -	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	< 1.05	< 1.04	< 0.604	< 0.581	< 0.898	- -	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L	0.305 J	0.292 J	< 0.619	< 0.595	< 0.619	- -	34%
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	< 0.65	< 0.643	< 0.532	< 0.511	< 0.608	- -	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	< 0.884	< 0.876	< 0.349	< 0.335	< 0.703	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	< 0.46	< 0.456	< 0.803	< 0.772	< 0.573	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	< 0.564	< 0.559	< 0.834	< 0.802	< 0.652	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	< 0.396	< 0.392	< 0.532	< 0.511	< 0.440	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	< 0.479	< 0.474	< 0.321	< 0.309	< 0.425	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	< 0.326	< 0.323	< 0.51	< 0.49	< 0.39	- -	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	< 120	< 120	< 120	< 120	< 120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L	< 0.272	< 0.269	< 0.333	< 0.32	< 0.291	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	< 0.513	< 0.508	< 0.274	< 0.264	< 0.432	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	< 0.488	< 0.484	< 0.672	< 0.647	< 0.548	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	< 0.619	< 0.613	< 0.466	< 0.449	< 0.566	- -	100%

Liquid Stream Data Summary

Sample Stream: Ash Pond Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	<	0.326	<	0.323	<	0.376	<	0.362	<	0.342	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	<	0.227	<	0.225	<	0.311	<	0.299	<	0.254	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	<	0.678	<	0.671	<	0.507	<	0.488	<	0.619	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ug/L	<	8.66	<	8.58	<	5.83	<	5.61	<	7.69	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	<	0.577	<	0.571	<	0.629	<	0.605	<	0.592	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	<	0.51	<	0.505	<	1.32	<	1.27	<	0.78	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	<	0.279	<	0.276	<	0.61	<	0.587	<	0.388	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ug/L	<	50	<	50	<	50	<	50	<	50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	<	1.27	<	1.26	<	0.623	<	0.599	<	1.051	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	<	1.29	<	1.28	<	0.778	<	0.749	<	1.116	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	<	0.55	<	0.544	<	0.266	<	0.256	<	0.453	- -	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ug/L	<	0.729	<	0.722	<	0.648	<	0.623	<	0.700	- -	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ug/L	<	0.916	<	0.907	<	0.591	<	0.569	<	0.805	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	<	0.708	<	0.701	<	0.473	<	0.455	<	0.627	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	<	0.513	<	0.508	<	0.834	<	0.802	<	0.618	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	<	0.43	<	0.426	<	0.37	<	0.356	<	0.409	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	<	2.01	<	1.99	<	1.37	<	1.31	<	1.79	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	<	0.839	<	0.831	<	0.88	<	0.847	<	0.850	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	<	0.524	<	0.519	<	0.382	<	0.368	<	0.475	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	<	0.604	<	0.598	<	0.463	<	0.446	<	0.555	- -	100%
Organics, Semi-volatile	Phenol	SW 8270	ug/L	<	0.387	<	0.384	<	0.874	<	0.841	<	0.548	- -	100%
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	<	0.717	<	0.711	<	0.239	<	0.23	<	0.556	- -	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	<	0.454	<	0.45	<	0.404	<	0.389	<	0.436	- -	100%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	<	1.13	<	1.12	<	0.582	<	0.56	<	0.944	- -	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	<	0.546	<	0.54	<	0.6	<	0.577	<	0.56	- -	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	<	0.711	<	0.704	<	0.379	<	0.365	<	0.598	- -	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	<	0.705	<	0.698	<	0.79	<	0.76	<	0.731	- -	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L	<	1.78	<	1.76	<	0.575		447	<	1.37	- -	100%
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ug/L	<	0.543	<	0.537	<	0.738	<	0.71	<	0.606	- -	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	<	0.5	<	0.495	<	0.719	<	0.691	<	0.571	- -	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	- -	100%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	- -	100%

Liquid Stream Data Summary

Sample Stream: Ash Pond Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2			Run 3a		Run 3d			Average	95% CI	DL Ratio
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	4-Methyl-2-pentanone (MIBK)	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	Acetone	SW 8240	ug/L	<	10		3.3	J		9.7		6	J	<	10	- -	28%
Organics, Volatile	Benzene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	Chloroform	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Chloromethane	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L	<	5		4.2	J		6.2		7.7		<	5	- -	19%
Organics, Volatile	Styrene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Toluene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	<	10	<	10		<	10	<	10		<	10	- -	100%
Organics, Volatile	Xylenes	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5	<	5		<	5	- -	100%

Liquid Stream Data Summary

Sample Stream: Bottom Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Reduced Species	Cyanide	SW 9012	ug/ml	0.0025 J	0.0017 J	0.0017 J	0.0025 J	0.0020	0.0011	
Reduced Species	Ammonia as N	EPA 350.1	ug/ml	0.293	0.421	0.638	0.402	0.451	0.433	
Anions	Chloride	EPA 300	ug/ml	8.39	7.74	7.55	7.62	7.89	1.09	
Anions	Fluoride	EPA 340.2	ug/ml	0.272	0.268	0.302	0.302	0.281	0.046	
Anions	Phosphate	EPA 365.2	ug/ml	0.0396	< 0.02	0.0264	0.0235	0.0253	0.0368	13%
Anions	Sulfate	EPA 300.0	ug/ml	67.5	95.1	79	79.1	80.5	34.4	
Metals, Soluble	Aluminum	SW 6010	ug/ml	0.182	0.302	0.431	0.399	0.305	0.309	
Metals, Soluble	Antimony	SW 6010	ug/ml	< 0.0241	< 0.0241	< 0.0241	< 0.0241	< 0.0241	- -	100%
Metals, Soluble	Arsenic	SW 7060	ug/ml	0.0028	0.0646	0.0031	0.004	0.024	0.088	
Metals, Soluble	Barium	SW 6010	ug/ml	0.0744	0.14	0.0927	0.0919	0.102	0.084	
Metals, Soluble	Beryllium	SW 6010	ug/ml	< 0.000554	< 0.000554	< 0.000554	< 0.000554	< 0.000554	- -	100%
Metals, Soluble	Boron	SW 6010	ug/ml	0.624	1.14	0.849	0.936	0.871	0.643	
Metals, Soluble	Cadmium	SW 7131	ug/ml	< 0.000237	0.00173	0.00131	0.00179	0.00105	0.00208	4%
Metals, Soluble	Calcium	SW 6010	ug/ml	29.1	39	47.4	44.5	38.5	22.8	
Metals, Soluble	Chromium	SW 6010	ug/ml	0.00211 J	0.00419	0.00301	0.00318	0.00310	0.00259	
Metals, Soluble	Cobalt	SW 6010	ug/ml	< 0.0034	< 0.0034	< 0.0034	< 0.0034	< 0.0034	- -	100%
Metals, Soluble	Copper	SW 6010	ug/ml	0.00355 J	0.0116	0.0393	0.00533	0.0182	0.0466	
Metals, Soluble	Iron	SW 6010	ug/ml	0.0199	0.0439	0.0212	0.0059 J	0.0283	0.0335	
Metals, Soluble	Lead	SW 7421	ug/ml	0.009	0.006	0.016	0.017	0.010	0.013	
Metals, Soluble	Magnesium	SW 6010	ug/ml	2.07	2.98	1.71	1.8	2.25	1.63	
Metals, Soluble	Manganese	SW 6010	ug/ml	0.07	0.0918	0.00172	0.00257	0.0545	0.1168	
Metals, Soluble	Mercury	SW 7470	ug/ml	0.00007	0.00002 J	0.00003 J	0.00007	0.00004	0.00007	
Metals, Soluble	Molybdenum	SW 6010	ug/ml	0.0472	0.11	0.0587	0.0593	0.0720	0.0831	
Metals, Soluble	Nickel	SW 6010	ug/ml	0.00016 J	0.011	0.00466 J	0.0026 J	0.0053	0.0135	
Metals, Soluble	Phosphorus	SW 6010	ug/ml	0.0872	0.172	0.0791	0.197	0.113	0.128	
Metals, Soluble	Potassium	SW 6010	ug/ml	3.67	5.64	3.85	3.83	4.39	2.71	
Metals, Soluble	Selenium	SW 7740	ug/ml	0.0038	0.0036	0.0043	0.0035	0.0039	0.0009	
Metals, Soluble	Silicon	SW 6010	ug/ml	4.63	4.61	4.97	4.8	4.74	0.50	
Metals, Soluble	Sodium	SW 6010	ug/ml	9.05	10.4	8.69	8.69	9.38	2.24	
Metals, Soluble	Strontium	SW 6010	ug/ml	0.194	0.423	0.225	0.22	0.281	0.309	
Metals, Soluble	Tin	SW 6010	ug/ml	0.00499 J	< 0.0144	0.00446 J	0.00236 J	< 0.0144	- -	43%

Liquid Stream Data Summary

Sample Stream: Bottom Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Metals, Soluble	Titanium	SW 6010	ug/ml	0.00101 J	0.00226	< 0.00102	0.00076 J	0.0013	0.0022	13%
Metals, Soluble	Vanadium	SW 6010	ug/ml	0.0349	0.00712	0.0453	0.0444	0.0291	0.0490	
Metals, Soluble	Zinc	SW 6010	ug/ml	0.00339	0.0162	0.00565	0.00342	0.0084	0.0170	
Aldehydes	Acetaldehyde	SW 8315	ug/ml	0.006	0.09	0.134	0.09	0.077	0.162	
Aldehydes	Formaldehyde	SW 8315	ug/ml	0.006	0.032	0.03	0.026	0.023	0.036	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	< 0.556	< 0.578	< 0.402	< 0.373	< 0.512	--	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	< 0.568	< 0.591	< 0.606	< 0.563	< 0.588	--	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	< 0.749	< 0.779	< 0.655	< 0.608	< 0.728	--	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	< 100	< 100	< 100	< 100	< 100	--	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	< 0.381	< 0.396	< 0.739	< 0.686	< 0.505	--	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	< 0.777	< 0.808	< 0.606	< 0.563	< 0.730	--	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	< 0.619	< 0.644	< 0.554	< 0.514	< 0.606	--	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	< 1.5	< 1.56	< 2.09	< 1.94	< 1.72	--	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	< 0.484	< 0.503	< 0.479	< 0.445	< 0.489	--	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	< 0.317	< 0.33	< 0.525	< 0.487	< 0.391	--	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	< 0.336	< 0.349	< 0.522	< 0.484	< 0.402	--	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	< 0.426	< 0.443	< 0.587	< 0.544	< 0.485	--	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	< 1.06	< 1.1	< 1.34	< 1.24	< 1.17	--	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	< 6.73	< 7	< 4.31	< 4	< 6.01	--	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	< 0.529	< 0.55	< 0.609	< 0.566	< 0.563	--	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	< 0.695	< 0.723	< 0.528	< 0.49	< 0.649	--	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	< 0.333	< 0.346	< 0.888	< 0.824	< 0.522	--	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	< 0.312	< 0.324	< 0.404	< 0.375	< 0.347	--	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	< 0.735	< 0.764	< 0.655	< 0.608	< 0.718	--	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	< 0.635	< 0.66	< 0.375	< 0.348	< 0.557	--	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	< 0.513	< 0.534	< 0.32	< 0.297	< 0.456	--	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	< 1.87	< 1.95	< 1.65	< 1.53	< 1.82	--	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	< 0.387	< 0.402	< 0.684	< 0.634	< 0.491	--	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	< 0.423	< 0.44	< 0.538	< 0.5	< 0.467	--	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	< 1.05	< 1.09	< 0.853	< 0.791	< 0.998	--	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	< 0.471	< 0.49	< 0.343	< 0.319	< 0.435	--	100%

Liquid Stream Data Summary

Sample Stream: Bottom Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	<	0.753	<	0.783	<	0.515	<	0.478	<	0.684	- -	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	<	0.489	<	0.509	<	0.405	<	0.376	<	0.468	- -	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	<	0.762	<	0.792	<	0.443	<	0.411	<	0.666	- -	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	<	0.719	<	0.748	<	1.23	<	1.14	<	0.899	- -	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ug/L	<	0.438	<	0.456	<	0.499	<	0.463	<	0.464	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	<	0.695	<	0.723	<	0.531	<	0.493	<	0.650	- -	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ug/L	<	0.508	<	0.528	<	0.434	<	0.403	<	0.490	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ug/L	<	0.553	<	0.575	<	0.473	<	0.439	<	0.534	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	<	0.465	<	0.484	<	0.625	<	0.58	<	0.525	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	<	0.664	<	0.691	<	0.966	<	0.897	<	0.774	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ug/L	<	1.85	<	1.92	<	1.37	<	1.27	<	1.71	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	<	0.46	<	0.478	<	0.28	<	0.26	<	0.406	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	<	0.217	<	0.226	<	0.431	<	0.4	<	0.291	- -	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	<	0.441	<	0.459	<	0.576	<	0.535	<	0.492	- -	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	<	0.897	<	0.933	<	0.635	<	0.589	<	0.822	- -	100%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	<	0.559	<	0.581	<	0.379	<	0.352	<	0.506	- -	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	<	20	<	20	<	20	<	20	<	20	- -	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	<	0.495	<	0.515	<	0.463	<	0.43	<	0.491	- -	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	<	0.368	<	0.383	<	0.534	<	0.496	<	0.428	- -	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	<	0.547	<	0.569	<	0.936	<	0.869	<	0.684	- -	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	<	0.468	<	0.487	<	1.05	<	0.976	<	0.668	- -	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	<	0.931	<	0.968	<	1.03	<	0.956	<	0.976	- -	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	<	3.81	<	3.96	<	39.8	<	36.9	<	15.86	- -	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	<	1.04	<	1.08	<	0.629	<	0.584	<	0.916	- -	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L	<	0.378	<	0.393	<	0.644	<	0.598	<	0.472	- -	100%
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	<	0.643	<	0.669	<	0.554	<	0.514	<	0.622	- -	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	<	0.876	<	0.911	<	0.363	<	0.337	<	0.717	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	<	0.456	<	0.474	<	0.836	<	0.776	<	0.589	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	<	0.559	<	0.581	<	0.868	<	0.806	<	0.669	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	<	0.392	<	0.408	<	0.554	<	0.514	<	0.451	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	<	0.474	<	0.493	<	0.334	<	0.31	<	0.434	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	<	0.323	<	0.336		1.06	<	0.493		0.463	1.2841	24%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	<	120	<	120	<	120	<	120	<	120	- -	100%

Bottom Ash Sluice Filtrate - Page 3

Liquid Stream Data Summary

Sample Stream: Bottom Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a			Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L	<	0.269	<	0.28	<	0.346		<	0.322	<	0.298	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	<	0.508	<	0.528		0.608		<	0.265	<	0.528	- -	46%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	<	0.484	<	0.503	<	0.7		<	0.65	<	0.562	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	<	0.613	<	0.638		0.19	J	<	0.451	<	0.638	- -	77%
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	<	0.323	<	0.336	<	0.392		<	0.364	<	0.350	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	<	0.225	<	0.234	<	0.324		<	0.3	<	0.261	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	<	0.671	<	0.698	<	0.528		<	0.49	<	0.632	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ug/L	<	8.58	<	8.92	<	6.07		<	5.64	<	7.86	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	<	0.571	<	0.594	<	0.655		<	0.608	<	0.607	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	<	0.505	<	0.525	<	1.37		<	1.27	<	0.800	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	<	0.276	<	0.287	<	0.635		<	0.589	<	0.399	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ug/L	<	50	<	50	<	50		<	50	<	50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	<	1.26	<	1.31	<	0.648		<	0.602	<	1.07	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	<	1.28	<	1.33	<	0.81		<	0.752	<	1.14	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	<	0.544	<	0.566		0.621		<	0.257	<	0.566	- -	47%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ug/L	<	0.722	<	0.751	<	0.674		<	0.626	<	0.716	- -	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ug/L	<	0.907	<	0.943	<	0.615		<	0.571	<	0.822	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	<	0.701	<	0.729	<	0.493		<	0.457	<	0.641	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	<	0.508	<	0.528	<	0.868		<	0.806	<	0.635	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	<	0.426	<	0.443	<	0.386		<	0.358	<	0.418	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	<	1.99	<	2.07	<	1.42		<	1.32	<	1.83	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	<	0.831	<	0.864	<	0.916		<	0.851	<	0.870	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	<	0.519	<	0.54	<	0.398		<	0.369	<	0.486	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	<	0.598	<	0.622	<	0.482		<	0.448	<	0.567	- -	100%
Organics, Semi-volatile	Phenol	SW 8270	ug/L	<	0.384	<	0.399	<	0.91		<	0.845	<	0.564	- -	100%
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	<	0.711	<	0.739	<	0.248		<	0.231	<	0.566	- -	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	<	0.45	<	0.468		0.501		<	0.39	<	0.468	- -	48%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	<	1.12	<	1.16	<	0.606		<	0.563	<	0.962	- -	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	<	0.54	<	0.562	<	0.625		<	0.58	<	0.576	- -	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	<	0.704	<	0.732	<	0.395		<	0.367	<	0.610	- -	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	<	0.698	<	0.726	<	0.823		<	0.764	<	0.749	- -	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L	<	1.76		1.37	<	0.599			1.03	<	1.76	- -	46%
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ug/L	<	0.537	<	0.559	<	0.768		<	0.713	<	0.621	- -	100%

Liquid Stream Data Summary

Sample Stream: Bottom Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	<	0.495	<	0.515	<	0.748	<	0.695	<	0.586	- -	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	<	5			<	2.88	<	2.88	<	5	- -	100%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ug/L	<	5			<	1.67	<	1.67	<	5	- -	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	<	5			<	0.932	<	0.932	<	5	- -	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	<	5			<	1.64	<	1.64	<	5	- -	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	<	5			<	2.09	<	2.09	<	5	- -	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	<	5			<	1.07	<	1.07	<	5	- -	100%
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	<	5			<	NA	<	NA	<	5	- -	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	<	5			<	0.602	<	0.602	<	5	- -	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	<	10			<	6.32	<	6.32	<	10	- -	100%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	<	10			<	NA	<	NA	<	10	- -	100%
Organics, Volatile	*4-Methyl-2-pentanone (MIBK)*	*SW 8240*	*ug/L*	<	*10*			<	NA	<	NA	<	10	- -	100%
Organics, Volatile	Acetone	SW 8240	ug/L	<	10			<	NA	<	NA	<	10	- -	100%
Organics, Volatile	Benzene	SW 8240	ug/L	<	5			<	0.848		16.3	<	5	- -	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	<	5			<	NA	<	NA	<	5	- -	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	<	5			<	NA	<	NA	<	5	- -	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	<	10			<	5.07	<	5.07	<	10	- -	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	<	5			<	1.73	<	1.73	<	5	- -	100%
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	<	5			<	1.22	<	1.22	<	5	- -	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	<	5			<	1.2	<	1.2	<	5	- -	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	<	10			<	1.41	<	1.41	<	10	- -	100%
Organics, Volatile	Chloroform	SW 8240	ug/L	<	5			<	0.995	<	0.995	<	5	- -	100%
Organics, Volatile	Chloromethane	SW 8240	ug/L	<	10			<	1.95	<	1.95	<	10	- -	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	<	5			<	NA	<	NA	<	5	- -	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	<	5			<	0.893		2.43	<	5	- -	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L	<	5				2.94		1.47	<	5	- -	46%
Organics, Volatile	Styrene	SW 8240	ug/L	<	5			<	1.36	<	1.36	<	5	- -	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	<	5			<	0.843	<	0.843	<	5	- -	100%
Organics, Volatile	Toluene	SW 8240	ug/L	<	5				0.352 J		3.53	<	5	- -	88%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	<	5			<	1.3	<	1.3	<	5	- -	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	<	10			<	4.01	<	4.01	<	10	- -	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	<	10			<	1.67	<	1.67	<	10	- -	100%

Liquid Stream Data Summary

Sample Stream: Bottom Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1	Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Volatile	Xylenes	SW 8240	ug/L	<	5		<	2.06		5.78	<	5	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	<	5		<	0.459	<	0.459	<	5	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	<	5		<	1.35	<	1.35	<	5	- -	100%

Liquid Stream Data Summary

Sample Stream: ESP Fly Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Reduced Species	Cyanide	SW 9012	ug/ml	0.0014 J	0.0009 J	0.0022 J	< 0.01	0.0015	0.0016	
Reduced Species	Ammonia as N	EPA 350.1	ug/ml	0.379	0.419	0.355	0.438	0.3843	0.0803	
Anions	Chloride	EPA 300	ug/ml	10.9	10.7	9.71	10.1	10.4	1.6	
Anions	Fluoride	EPA 340.2	ug/ml	0.633	1	0.576	0.698	0.736	0.572	
Anions	Phosphate	EPA 365.2	ug/ml	0.015 J	0.0453	< 0.02	< 0.02	0.023	0.047	14%
Anions	Sulfate	EPA 300.0	ug/ml	238	582	210	236	343	515	
Metals, Soluble	Aluminum	SW 6010	ug/ml	0.381	2.48	0.0307	0.204	0.964	3.291	
Metals, Soluble	Antimony	SW 6010	ug/ml	0.0118 J	< 0.0241	< 0.0241	< 0.0241	< 0.024	- -	67%
Metals, Soluble	Arsenic	SW 7060	ug/ml	0.0108	0.0387	0.0004 J	0.0127	0.017	0.049	
Metals, Soluble	Barium	SW 6010	ug/ml	0.198	0.314	0.213	0.226	0.242	0.157	
Metals, Soluble	Beryllium	SW 6010	ug/ml	< 0.000554	< 0.000554	< 0.000554	< 0.000554	< 0.000554	- -	100%
Metals, Soluble	Boron	SW 6010	ug/ml	7.03	17	5.73	6.16	9.92	15.32	
Metals, Soluble	Cadmium	SW 7131	ug/ml	0.00275	0.00108	0.00426	0.00269	0.0027	0.0040	
Metals, Soluble	Calcium	SW 6010	ug/ml	104	219	93.6	99.2	138.9	172.9	
Metals, Soluble	Chromium	SW 6010	ug/ml	0.0582	0.0619	0.0244	0.0329	0.0482	0.0513	
Metals, Soluble	Cobalt	SW 6010	ug/ml	< 0.0034	< 0.0034	0.00008 J	0.00042 J	< 0.0034	- -	98%
Metals, Soluble	Copper	SW 6010	ug/ml	0.00332 J	0.00236 J	0.00226 J	0.00209 J	0.0026	0.0015	
Metals, Soluble	Iron	SW 6010	ug/ml	0.0131	0.00277 J	0.00289 J	0.00444 J	0.0063	0.0147	
Metals, Soluble	Lead	SW 7421	ug/ml	0.0065	0.004	0.004	0.004	0.0048	0.0036	
Metals, Soluble	Magnesium	SW 6010	ug/ml	3.9	5.39	4.08	3.85	4.46	2.02	
Metals, Soluble	Manganese	SW 6010	ug/ml	0.00372	0.0394	0.0173	0.00213	0.0201	0.0447	
Metals, Soluble	Mercury	SW 7470	ug/ml	< 0.00005	0.00008	< 0.00005	< 0.00005	< 0.00005	- -	38%
Metals, Soluble	Molybdenum	SW 6010	ug/ml	0.513	1.06	0.29	0.425	0.62	0.98	
Metals, Soluble	Nickel	SW 6010	ug/ml	0.0272	0.0122	0.032	0.0273	0.0238	0.0257	
Metals, Soluble	Phosphorus	SW 6010	ug/ml	< 0.061	0.243	0.149	0.13	0.14	0.26	7%
Metals, Soluble	Potassium	SW 6010	ug/ml	8.73	19.4	6.98	8.27	11.70	16.70	
Metals, Soluble	Selenium	SW 7740	ug/ml	0.0331	0.0518	0.0198	0.0259	0.0349	0.0399	
Metals, Soluble	Silicon	SW 6010	ug/ml	4.64	2.78	4.74	4.67	4.05	2.74	
Metals, Soluble	Sodium	SW 6010	ug/ml	17.7	32.8	14.1	16.2	21.5	24.6	
Metals, Soluble	Strontium	SW 6010	ug/ml	0.488	0.926	0.45	0.514	0.621	0.657	
Metals, Soluble	Tin	SW 6010	ug/ml	0.0111 J	0.00125 J	0.00021 J	< 0.0144	0.0042	0.0149	
Metals, Soluble	Titanium	SW 6010	ug/ml	0.00095 J	0.00058 J	0.0475	0.00055 J	0.0163	0.0670	
Metals, Soluble	Vanadium	SW 6010	ug/ml	0.0634	0.12	0.0224	0.0681	0.0686	0.1218	

Liquid Stream Data Summary

Sample Stream: ESP Fly Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2			Run 3a		Run 3d		Average	95% CI	DL Ratio
Metals, Soluble	Zinc	SW 6010	ug/ml		0.00659		9E-05	J		0.204		0.00605		0.0702	0.2879	
Aldehydes	Acetaldehyde	SW 8315	ug/ml		0.014		0.088			0.012		0.086		0.038	0.108	
Aldehydes	Formaldehyde	SW 8315	ug/ml		0.016		0.052			0.022		0.034		0.030	0.048	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	<	0.55	<	0.578		<	0.375	<	0.375	<	0.501	--	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	<	0.563	<	0.591		<	0.565	<	0.565	<	0.573	--	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	<	0.742	<	0.779		<	0.611	<	0.611	<	0.711	--	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	<	100	<	100		<	100	<	100	<	100	--	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	<	0.377	<	0.396		<	0.689	<	0.689	<	0.487	--	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	<	0.77	<	0.808		<	0.565	<	0.565	<	0.714	--	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	<	0.613	<	0.644		<	0.516	<	0.516	<	0.591	--	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	<	1.49	<	1.56		<	1.95	<	1.95	<	1.67	--	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	<	0.479	<	0.503		<	0.447	<	0.447	<	0.476	--	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	<	0.314	<	0.33		<	0.489	<	0.489	<	0.378	--	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	<	0.332	<	0.349		<	0.487	<	0.487	<	0.389	--	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	<	0.422	<	0.443		<	0.547	<	0.547	<	0.471	--	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	<	1.05	<	1.1		<	1.25	<	1.25	<	1.13	--	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	<	6.67	<	7		<	4.02	<	4.02	<	5.90	--	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	<	0.524	<	0.55		<	0.568	<	0.568	<	0.547	--	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	<	0.689	<	0.723		<	0.492	<	0.492	<	0.635	--	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	<	0.33	<	0.346		<	0.828	<	0.828	<	0.501	--	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	<	0.309	<	0.324		<	0.377	<	0.377	<	0.337	--	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	<	0.728	<	0.764		<	0.611	<	0.611	<	0.701	--	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	<	0.629	<	0.66		<	0.35	<	0.35	<	0.55	--	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	<	0.509	<	0.534		<	0.298	<	0.298	<	0.447	--	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	<	1.86	<	1.95		<	1.54	<	1.54	<	1.78	--	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	<	0.383	<	0.402		<	0.637	<	0.637	<	0.474	--	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	<	0.419	<	0.44		<	0.502	<	0.502	<	0.454	--	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	<	1.04	<	1.09		<	0.795	<	0.795	<	0.975	--	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	<	0.467	<	0.49		<	0.32	<	0.32	<	0.43	--	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	<	0.746	<	0.783		<	0.481	<	0.481	<	0.670	--	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	<	0.485	<	0.509		<	0.378	<	0.378	<	0.457	--	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	<	0.754	<	0.792		<	0.413	<	0.413	<	0.653	--	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	<	0.712	<	0.748		<	1.14	<	1.14	<	0.867	--	100%

Liquid Stream Data Summary

Sample Stream: ESP Fly Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	4-Bromophenyl phenyl ether	SW 8270	ug/L	<	0.434	<	0.456	<	0.465	<	0.465	<	0.452	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	<	0.689	<	0.723	<	0.495	<	0.495	<	0.636	- -	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ug/L	<	0.503	<	0.528	<	0.405	<	0.405	<	0.479	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ug/L	<	0.548	<	0.575	<	0.441	<	0.441	<	0.521	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	<	0.461	<	0.484	<	0.583	<	0.583	<	0.509	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	<	0.658	<	0.691	<	0.901	<	0.901	<	0.750	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ug/L	<	1.83	<	1.92	<	1.28	<	1.28	<	1.68	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	<	0.455	<	0.478	<	0.262	<	0.262	<	0.398	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	<	0.215	<	0.226	<	0.402	<	0.402	<	0.281	- -	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	<	0.437	<	0.459	<	0.537	<	0.537	<	0.478	- -	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	<	0.889	<	0.933	<	0.592	<	0.592	<	0.805	- -	100%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	<	0.553	<	0.581	<	0.354	<	0.354	<	0.496	- -	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	<	20	<	20	<	20	<	20	<	20	- -	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	<	0.49	<	0.515	<	0.432	<	0.432	<	0.479	- -	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	<	0.365	<	0.383	<	0.498	<	0.498	<	0.415	- -	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	<	0.542	<	0.569	<	0.873	<	0.873	<	0.661	- -	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	<	0.464	<	0.487	<	0.981	<	0.981	<	0.644	- -	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	<	0.922	<	0.968	<	0.961	<	0.961	<	0.950	- -	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	<	3.77	<	3.96	<	37.1	<	37.1	<	14.9	- -	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	<	1.03	<	1.08	<	0.587	<	0.587	<	0.899	- -	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L	<	0.374	<	0.393	<	0.601	<	0.601	<	0.456	- -	100%
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	<	0.637	<	0.669	<	0.516	<	0.516	<	0.607	- -	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	<	0.868	<	0.911	<	0.338	<	0.338	<	0.706	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	<	0.451	<	0.474	<	0.78	<	0.78	<	0.568	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	<	0.553	<	0.581	<	0.81	<	0.81	<	0.648	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	<	0.389	<	0.408	<	0.516	<	0.516	<	0.438	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	<	0.47	<	0.493	<	0.312	<	0.312	<	0.425	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	<	0.32	<	0.336	<	0.495	<	0.495	<	0.384	- -	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	<	120	<	120	<	120	<	120	<	120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L	<	0.267	<	0.28	<	0.323	<	0.323	<	0.290	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	<	0.503	<	0.528	<	0.266	<	0.266	<	0.432	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	<	0.479	<	0.503	<	0.653	<	0.653	<	0.545	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	<	0.608	<	0.638	<	0.453	<	0.453	<	0.566	- -	100%
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	<	0.32	<	0.336	<	0.365	<	0.365	<	0.340	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	<	0.223	<	0.234	<	0.302	<	0.302	<	0.253	- -	100%

Liquid Stream Data Summary

Sample Stream: ESP Fly Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	<	0.665	<	0.698	<	0.492	<	0.492	<	0.618	--	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ug/L	<	8.5	<	8.92	<	5.66	<	5.66	<	7.69	--	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	<	0.566	<	0.594	<	0.611	<	0.611	<	0.590	--	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	<	0.5	<	0.525	<	1.28	<	1.28	<	0.768	--	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	<	0.273	<	0.287	<	0.592	<	0.592	<	0.384	--	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ug/L	<	50	<	50	<	50	<	50	<	50	--	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	<	1.25	<	1.31	<	0.605	<	0.605	<	1.055	--	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	<	1.27	<	1.33	<	0.756	<	0.756	<	1.119	--	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	<	0.539	<	0.566	<	0.259	<	0.259	<	0.455	--	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ug/L	<	0.715	<	0.751	<	0.629	<	0.629	<	0.698	--	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ug/L	<	0.898	<	0.943	<	0.574	<	0.574	<	0.805	--	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	<	0.694	<	0.729	<	0.46	<	0.46	<	0.628	--	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	<	0.503	<	0.528	<	0.81	<	0.81	<	0.614	--	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	<	0.422	<	0.443	<	0.36	<	0.36	<	0.408	--	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	<	1.97	<	2.07	<	1.33	<	1.33	<	1.79	--	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	<	0.823	<	0.864	<	0.855	<	0.855	<	0.847	--	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	<	0.514	<	0.54	<	0.371	<	0.371	<	0.475	--	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	<	0.592	<	0.622	<	0.45	<	0.45	<	0.555	--	100%
Organics, Semi-volatile	Phenol	SW 8270	ug/L	<	0.38	<	0.399	<	0.849	<	0.849	<	0.543	--	100%
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	<	0.704	<	0.739	<	0.232	<	0.232	<	0.558	--	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	<	0.446	<	0.468	<	0.392	<	0.392	<	0.435	--	100%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	<	1.1	<	1.16	<	0.565	<	0.565	<	0.942	--	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	<	0.535	<	0.562	<	0.583	<	0.583	<	0.560	--	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	<	0.697	<	0.732	<	0.368	<	0.368	<	0.599	--	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	<	0.691	<	0.726	<	0.767	<	0.767	<	0.728	--	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L	<	1.74		2.35	<	0.559	<	0.559	<	1.740	--	33%
Organics, Semi-volatile	*p-Chloroaniline*	SW 8270	ug/L	<	0.532	<	0.559	<	0.716	<	0.716	<	0.602	--	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	<	0.49	<	0.515	<	0.698	<	0.698	<	0.568	--	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%

Liquid Stream Data Summary

Sample Stream: ESP Fly Ash Sluice Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	4-Methyl-2-pentanone (MIBK)	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Acetone	SW 8240	ug/L	<	10	<	10		13	<	10	<	10	--	43%
Organics, Volatile	Benzene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Chloroform	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Chloromethane	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L		5.5		3.6		5.7		6.5		4.9	2.9	
Organics, Volatile	Styrene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Toluene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Xylenes	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%

Liquid Stream Data Summary

Sample Stream: Gypsum Pond Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Reduced Species	Cyanide	SW 9012	ug/ml	0.0477	0.0507	0.0473	0.043	0.0486	0.0046	
Reduced Species	Ammonia as N	EPA 350.1	ug/ml	16.7	14.4	14.9	15.3	15.3	3.0	
Anions	Chloride	EPA 300	ug/ml	18300	15200	15700	17300	16,400	4,135	
Anions	Fluoride	EPA 340.2	ug/ml	15.2	13.5	15.9	16.2	14.9	3.1	
Anions	Phosphate	EPA 365.2	ug/ml	0.0264	0.0424	0.0292	0.0292	0.0327	0.0212	
Anions	Sulfate	EPA 300.0	ug/ml	914	1010	1010	709	978	138	
Metals, Soluble	Aluminum	SW 6010	ug/ml	0.497	0.73	1.04	1.15	0.76	0.68	
Metals, Soluble	Antimony	SW 6010	ug/ml	< 0.241	< 0.241	< 0.241	< 0.241	< 0.24	- -	100%
Metals, Soluble	Arsenic	SW 7060	ug/ml	0.132	0.114	0.134	0.132	0.13	0.03	
Metals, Soluble	Barium	SW 6010	ug/ml	1.2	1.16	1.2	1.26	1.19	0.06	
Metals, Soluble	Beryllium	SW 6010	ug/ml	< 0.00554	0.0004 J	0.0009 J	< 0.00554	< 0.0055	- -	68%
Metals, Soluble	Boron	SW 6010	ug/ml	533	497	569	568	533	89	
Metals, Soluble	Cadmium	SW 7131	ug/ml	0.16	0.133	0.153	0.15	0.15	0.03	
Metals, Soluble	Calcium	SW 6010	ug/ml	8800	7160	8390	20100	8,117	2,120	
Metals, Soluble	Chromium	SW 6010	ug/ml	0.0877	0.106	0.11	0.112	0.101	0.030	
Metals, Soluble	Cobalt	SW 6010	ug/ml	0.152	0.0472	0.116	0.106	0.105	0.132	
Metals, Soluble	Copper	SW 6010	ug/ml	0.0431	0.0489	0.0789	0.0738	0.0570	0.0477	
Metals, Soluble	Iron	SW 6010	ug/ml	< 0.0596	< 0.0596	< 0.0596	< 0.0596	< 0.0596	- -	100%
Metals, Soluble	Lead	SW 7421	ug/ml	< 0.0011	< 0.0011	0.0056	0.0052	0.0022	0.0072	16%
Metals, Soluble	Magnesium	SW 6010	ug/ml	708	632	723	722	688	121	
Metals, Soluble	Manganese	SW 6010	ug/ml	121	111	127	127	120	20	
Metals, Soluble	Mercury	SW 7470	ug/ml	0.00019	0.00019	0.00034	0.00023	0.00024	0.00022	
Metals, Soluble	Molybdenum	SW 6010	ug/ml	0.103	0.0552	0.102	0.0886	0.0867	0.0679	
Metals, Soluble	Nickel	SW 6010	ug/ml	0.679	0.57	0.62	0.687	0.623	0.136	
Metals, Soluble	Phosphorus	SW 6010	ug/ml	0.39	0.288	0.355	0.265	0.344	0.129	
Metals, Soluble	Potassium	SW 6010	ug/ml	54.4	45.9	54.4	55.2	51.6	12.2	
Metals, Soluble	Selenium	SW 7740	ug/ml	0.405	0.253	0.424	0.33	0.361	0.233	
Metals, Soluble	Silicon	SW 6010	ug/ml	15.7	14.8	17	16.9	15.8	2.7	
Metals, Soluble	Sodium	SW 6010	ug/ml	99.7	90.2	102	102	97.3	15.5	
Metals, Soluble	Strontium	SW 6010	ug/ml	13.3	12.3	14	13.9	13.2	2.1	
Metals, Soluble	Tin	SW 6010	ug/ml	< 0.144	0.457 J	0.0083 J	< 0.144	0.1791	0.6031	13%

Gypsum Pond Water - Page 1

Liquid Stream Data Summary

Sample Stream: Gypsum Pond Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Metals, Soluble	Titanium	SW 6010	ug/ml	2.39	2.14	2.04	2.04	2.190	0.448	
Metals, Soluble	Vanadium	SW 6010	ug/ml	0.348	0.296	0.323	0.342	0.322	0.065	
Metals, Soluble	Zinc	SW 6010	ug/ml	0.81	0.739	0.868	0.865	0.806	0.161	
Metals, Total	Aluminum	SW 6010	ug/ml	1.91	1.85	2.36	2.83	2.04	0.69	
Metals, Total	Antimony	SW 6010	ug/ml	< 0.0964	< 0.0964	< 0.241	< 0.241	< 0.1446	- -	100%
Metals, Total	Arsenic	SW 7060	ug/ml	0.121	0.118	0.141	0.127	0.127	0.031	
Metals, Total	Barium	SW 6010	ug/ml	1.28	1.08	1.21	1.06	1.19	0.25	
Metals, Total	Beryllium	SW 6010	ug/ml	0.00396	0.00116 J	< 0.00554	0.0012 J	< 0.0055	- -	35%
Metals, Total	Boron	SW 6010	ug/ml	589	472	566	512	542	154	
Metals, Total	Calcium	SW 6010	ug/ml	12200	7720	8470	8340	9,463	5,961	
Metals, Total	Cadmium	SW 7131	ug/ml	0.174	0.185	0.171	0.168	0.177	0.018	
Metals, Total	Chromium	SW 6010	ug/ml	0.0586	0.0476	0.118	0.0646	0.075	0.094	
Metals, Total	Cobalt	SW 6010	ug/ml	0.163	0.113	0.152	0.143	0.143	0.065	
Metals, Total	Copper	SW 6010	ug/ml	0.0633	0.0403	0.0563	0.0824	0.0533	0.0293	
Metals, Total	Iron	SW 6010	ug/ml	0.557	1.01	0.462	0.451	0.676	0.728	
Metals, Total	Lead	SW 7421	ug/ml	0.0022	0.0027	0.0058	0.0043	0.0036	0.0048	
Metals, Total	Magnesium	SW 6010	ug/ml	784	620	744	668	716	212	
Metals, Total	Manganese	SW 6010	ug/ml	135	105	129	116	123	39	
Metals, Total	Mercury	SW 7470	ug/ml	0.00028	0.00031	0.0003	0.00036	0.00030	0.00004	
Metals, Total	Molybdenum	SW 6010	ug/ml	0.0816	0.0749	0.0718	0.0565	0.0761	0.0124	
Metals, Total	Nickel	SW 6010	ug/ml	0.668	0.545	0.678	0.638	0.630	0.184	
Metals, Total	Phosphorus	SW 6010	ug/ml	0.227	0.235	0.246	0.322	0.236	0.024	
Metals, Total	Potassium	SW 6010	ug/ml	53.2	45.9	56	52.2	51.7	13.0	
Metals, Total	Selenium	SW 7740	ug/ml	0.242	0.343	0.212	0.0462	0.2657	0.1705	
Metals, Total	Silicon	SW 6010	ug/ml	19.2	16.9	19	17.1	18.4	3.2	
Metals, Total	Sodium	SW 6010	ug/ml	109	91	107	95.5	102.3	24.5	
Metals, Total	Strontium	SW 6010	ug/ml	15.3	11.7	14.1	12.6	13.7	4.6	
Metals, Total	Tin	SW 6010	ug/ml	< 0.0576	< 0.0576	< 0.144	< 0.144	< 0.086	- -	100%
Metals, Total	Titanium	SW 6010	ug/ml	0.351	0.566	2.38	0.855	1.099	2.769	
Metals, Total	Vanadium	SW 6010	ug/ml	0.158	0.145	0.346	0.163	0.216	0.279	
Metals, Total	Zinc	SW 6010	ug/ml	0.841	0.715	0.884	0.81	0.813	0.218	

Liquid Stream Data Summary

Sample Stream: Gypsum Pond Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Aldehydes	Acetaldehyde	SW 8315	ug/ml	0.002	0.082	0.072	0.074	0.052	0.108	
Aldehydes	Formaldehyde	SW 8315	ug/ml	0.012	0.024	0.034	0.032	0.023	0.027	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	< 0.55		< 0.382	< 0.373	< 0.466	--	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	< 0.563		< 0.576	< 0.563	< 0.570	--	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	< 0.742		< 0.623	< 0.608	< 0.683	--	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	< 100		< 100	< 100	< 100	--	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	< 0.377		< 0.703	< 0.686	< 0.540	--	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	< 0.77		< 0.576	< 0.563	< 0.673	--	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	< 0.613		< 0.526	< 0.514	< 0.570	--	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	< 1.49		< 1.99	< 1.94	< 1.74	--	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	< 0.479		< 0.456	< 0.445	< 0.468	--	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	< 0.314		< 0.499	< 0.487	< 0.407	--	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	< 0.332		< 0.496	< 0.484	< 0.414	--	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	< 0.422		< 0.558	< 0.544	< 0.490	--	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	< 1.05		< 1.27	< 1.24	< 1.16	--	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	< 6.67		< 4.1	< 4	< 5.39	--	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	< 0.524		< 0.579	< 0.566	< 0.552	--	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	< 0.689		< 0.502	< 0.49	< 0.596	--	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	< 0.33		< 0.844	< 0.824	< 0.587	--	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	< 0.309		< 0.384	< 0.375	< 0.347	--	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	< 0.728		< 0.623	< 0.608	< 0.676	--	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	< 0.629		< 0.357	< 0.348	< 0.493	--	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	< 0.509		< 0.304	< 0.297	< 0.407	--	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	< 1.86		< 1.57	< 1.53	< 1.72	--	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	< 0.383		< 0.65	< 0.634	< 0.517	--	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	< 0.419		< 0.512	< 0.5	< 0.466	--	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	< 1.04		< 0.811	< 0.791	< 0.926	--	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	< 0.467		< 0.326	< 0.319	< 0.397	--	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	< 0.746		< 0.49	< 0.478	< 0.618	--	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	< 0.485		< 0.385	< 0.376	< 0.435	--	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	< 0.754		< 0.422	< 0.411	< 0.588	--	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	< 0.712		< 1.17	< 1.14	< 0.941	--	100%

Liquid Stream Data Summary

Sample Stream: Gypsum Pond Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ug/L	<	0.434			<	0.475	<	0.463	<	0.455	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	<	0.689			<	0.505	<	0.493	<	0.597	- -	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ug/L	<	0.503			<	0.413	<	0.403	<	0.458	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ug/L	<	0.548			<	0.45	<	0.439	<	0.499	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	<	0.461			<	0.594	<	0.58	<	0.528	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	<	0.658			<	0.919	<	0.897	<	0.789	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracen	SW 8270	ug/L	<	1.83			<	1.3	<	1.27	<	1.57	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	<	0.455			<	0.267	<	0.26	<	0.361	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	<	0.215			<	0.41	<	0.4	<	0.313	- -	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	<	0.437			<	0.548	<	0.535	<	0.493	- -	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	<	0.889			<	0.604	<	0.589	<	0.747	- -	100%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	<	0.553			<	0.361	<	0.352	<	0.457	- -	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	<	20			<	20	<	20	<	20	- -	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	<	0.49			<	0.44	<	0.43	<	0.47	- -	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	<	0.365			<	0.508	<	0.496	<	0.437	- -	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	<	0.542			<	0.89	<	0.869	<	0.716	- -	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	<	0.464			<	1	<	0.976	<	0.732	- -	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	<	0.922			<	0.979	<	0.956	<	0.951	- -	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	<	3.77			<	37.8	<	36.9	<	20.79	- -	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	<	1.03			<	0.598	<	0.584	<	0.814	- -	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L		0.296	J		<	0.613	<	0.598	<	0.613	- -	51%
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	<	0.637			<	0.526	<	0.514	<	0.582	- -	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	<	0.868			<	0.345	<	0.337	<	0.607	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	<	0.451			<	0.795	<	0.776	<	0.623	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	<	0.553			<	0.825	<	0.806	<	0.689	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	<	0.389			<	0.526	<	0.514	<	0.458	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	<	0.47			<	0.318	<	0.31	<	0.394	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	<	0.32			<	0.505	<	0.493	<	0.413	- -	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	<	120			<	120	<	120	<	120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L		1.44				1.09		1.02		1.27	2.22	
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	<	0.503			<	0.272	<	0.265	<	0.388	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	<	0.479			<	0.666	<	0.65	<	0.573	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	<	0.608			<	0.462	<	0.451	<	0.535	- -	100%

Liquid Stream Data Summary

Sample Stream: Gypsum Pond Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	< 0.32		< 0.373	< 0.364	< 0.347	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	< 0.223		< 0.308	< 0.3	< 0.266	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	< 0.665		< 0.502	< 0.49	< 0.584	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ug/L	< 8.5		< 5.77	< 5.64	< 7.14	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	< 0.566		< 0.623	< 0.608	< 0.595	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	< 0.5		< 1.3	< 1.27	< 0.90	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	< 0.273		< 0.604	< 0.589	< 0.439	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ug/L	< 50		< 50	< 50	< 50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	< 1.25		< 0.617	< 0.602	< 0.934	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	< 1.27		< 0.771	< 0.752	< 1.021	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	< 0.539		< 0.264	< 0.257	< 0.402	- -	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ug/L	< 0.715		< 0.641	< 0.626	< 0.678	- -	100%
Organics, Semi-volatile	*N-Nitrosopiperidine*	SW 8270	ug/L	< 0.898		< 0.585	< 0.571	< 0.742	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	< 0.694		< 0.469	< 0.457	< 0.582	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	< 0.503		< 0.825	< 0.806	< 0.664	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	< 0.422		< 0.367	< 0.358	< 0.395	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	< 1.97		< 1.35	< 1.32	< 1.66	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	< 0.823		< 0.872	< 0.851	< 0.848	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	< 0.514		< 0.378	< 0.369	< 0.446	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	< 0.592		< 0.459	< 0.448	< 0.526	- -	100%
Organics, Semi-volatile	Phenol	SW 8270	ug/L	< 0.38		< 0.866	< 0.845	< 0.623	- -	100%
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	< 0.704		< 0.236	< 0.231	< 0.470	- -	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	< 0.446		< 0.4	< 0.39	< 0.423	- -	100%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	< 1.1		< 0.576	< 0.563	< 0.838	- -	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	< 0.535		< 0.594	< 0.58	< 0.565	- -	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	< 0.697		< 0.375	< 0.367	< 0.536	- -	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	< 0.691		< 0.782	< 0.764	< 0.737	- -	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L	14.7		2.03	< 0.556	8.365	80.52	
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ug/L	< 0.532		< 0.73	< 0.713	< 0.631	- -	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	< 0.49		< 0.712	< 0.695	< 0.601	- -	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	< 5	< 5	< 5	< 5	< 5	- -	100%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ug/L	< 5	< 5	< 5	< 5	< 5	- -	100%

Liquid Stream Data Summary

Sample Stream: Gypsum Pond Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2			Run 3a			Run 3d		Average	95% CI	DL Ratio
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	4-Methyl-2-pentanone (MIBK)	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	Acetone	SW 8240	ug/L	<	10		6.8	J		7.1	J		11	<	10	--	26%
Organics, Volatile	Benzene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	Chloroform	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Chloromethane	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L	<	5		3.8	J		4.9	J		7	<	5	--	22%
Organics, Volatile	Styrene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Toluene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	<	10	<	10		<	10		<	10	<	10	--	100%
Organics, Volatile	Xylenes	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5		<	5	<	5	--	100%

Liquid Stream Data Summary

Sample Stream: JBR Underflow Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Reduced Species	Cyanide	SW 9012	ug/ml	0.114	0.0372	0.0959	0.0205	0.0824	0.0997	
Reduced Species	Ammonia as N	EPA 350.1	ug/ml	43.9	43	< 40.2	41.6	< 40.2	- -	19%
Anions	Chloride	EPA 300	ug/ml	27,200	24,100	26,900	25,600	26,067	4,248	
Anions	Fluoride	EPA 340.2	ug/ml	23.8	35.1	34.1	34.1	31.0	15.5	
Anions	Phosphate	EPA 365.2	ug/ml	< 0.02	0.118	0.0122 J	< 0.02	0.047	0.153	7%
Anions	Sulfate	EPA 300.0	ug/ml	740	688	709	709	712	65	
Anions	Sulfite	EPRI-FGD-M2	ug/ml	4	1.6	2.4	1.6	2.67	3.04	
Metals, Soluble	Aluminum	SW 6010	ug/ml	10.7	14.4	11.9	12.4	12.3	4.7	
Metals, Soluble	Antimony	SW 6010	ug/ml	< 0.241	< 0.241	< 0.0964	< 0.241	< 0.1928	- -	100%
Metals, Soluble	Arsenic	SW 7060	ug/ml	0.315	0.157	0.121	0.352	0.198	0.256	
Metals, Soluble	Barium	SW 6010	ug/ml	3.33	3.52	3.31	3.99	3.39	0.29	
Metals, Soluble	Beryllium	SW 6010	ug/ml	0.0085	0.0048 J	0.00728	0.0042 J	0.0069	0.0047	
Metals, Soluble	Boron	SW 6010	ug/ml	1450	1430	1310	1480	1,397	188	
Metals, Soluble	Cadmium	SW 7131	ug/ml	0.473	0.47	0.426	0.467	0.456	0.065	
Metals, Soluble	Calcium	SW 6010	ug/ml	20,100	19,300	12,600	19,000	17,333	10,232	
Metals, Soluble	Chromium	SW 6010	ug/ml	0.096	0.0851	0.0277	0.0791	0.0696	0.0912	
Metals, Soluble	Cobalt	SW 6010	ug/ml	0.303	0.303	0.305	0.316	0.304	0.003	
Metals, Soluble	Copper	SW 6010	ug/ml	0.242	0.272	0.203	0.234	0.239	0.086	
Metals, Soluble	Iron	SW 6010	ug/ml	< 0.0596	< 0.0596	< 0.0238	< 0.0596	< 0.0477	- -	100%
Metals, Soluble	Lead	SW 7421	ug/ml	0.0139	0.016	0.009	0.012	0.013	0.009	
Metals, Soluble	Magnesium	SW 6010	ug/ml	1830	1810	1750	1870	1,797	103	
Metals, Soluble	Manganese	SW 6010	ug/ml	318	315	288	326	307	41	
Metals, Soluble	Mercury	SW 7470	ug/ml	0.00056	0.0014	0.00111	0.00125	0.00102	0.00106	
Metals, Soluble	Molybdenum	SW 6010	ug/ml	0.0571	0.0659	0.0695	0.0619	0.0642	0.0158	
Metals, Soluble	Nickel	SW 6010	ug/ml	1.57	1.61	1.37	1.61	1.52	0.32	
Metals, Soluble	Phosphorus	SW 6010	ug/ml	0.675	0.777	0.703	0.916	0.718	0.131	
Metals, Soluble	Potassium	SW 6010	ug/ml	125	125	119	126	123	9	
Metals, Soluble	Selenium	SW 7740	ug/ml	< 0.00288	0.734	0.728	0.814	0.488	1.046	0.1%
Metals, Soluble	Silicon	SW 6010	ug/ml	39.7	44.3	43.3	45.4	42.4	6.0	

Liquid Stream Data Summary

Sample Stream: JBR Underflow Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Metals, Soluble	Sodium	SW 6010	ug/ml		244		242		246		256		244	5	
Metals, Soluble	Strontium	SW 6010	ug/ml		34.1		33.6		30.9		35		32.9	4.3	
Metals, Soluble	Tin	SW 6010	ug/ml	<	0.144		0.0007 J	<	0.144	<	0.144	<	0.144	- -	100%
Metals, Soluble	Titanium	SW 6010	ug/ml		0.762		0.817		0.868		0.739		0.816	0.132	
Metals, Soluble	Vanadium	SW 6010	ug/ml		0.296		0.29		0.138		0.288		0.241	0.222	
Metals, Soluble	Zinc	SW 6010	ug/ml		2.34		2.43		2.18		2.52		2.32	0.31	
Aldehydes	Acetaldehyde	SW 8315	ug/ml		0.008		0.078		0.096		0.072		0.061	0.115	
Aldehydes	Formaldehyde	SW 8315	ug/ml		0.004		0.048		0.2		0.152		0.084	0.255	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	<	0.625	<	0.567	<	0.561	<	0.456	<	0.584	- -	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	<	0.639	<	0.579	<	0.846	<	0.688	<	0.688	- -	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	<	0.842	<	0.764	<	0.914	<	0.743	<	0.840	- -	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	<	100	<	100	<	100	<	100	<	100	- -	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	<	0.428	<	0.388	<	1.03	<	0.839	<	0.615	- -	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	<	0.874	<	0.792	<	0.846	<	0.688	<	0.837	- -	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	<	0.696	<	0.631	<	0.773	<	0.628	<	0.700	- -	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	<	1.69	<	1.53	<	2.92	<	2.37	<	2.05	- -	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	<	0.544	<	0.493	<	0.669	<	0.544	<	0.569	- -	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	<	0.357	<	0.324	<	0.732	<	0.595	<	0.471	- -	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	<	0.377	<	0.342	<	0.728	<	0.592	<	0.482	- -	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	<	0.479	<	0.434	<	0.819	<	0.665	<	0.577	- -	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	<	1.19	<	1.08	<	1.87	<	1.52	<	1.38	- -	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	<	7.57	<	6.86	<	6.01	<	4.89	<	6.81	- -	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	<	0.595	<	0.539	<	0.85	<	0.691	<	0.661	- -	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	<	0.782	<	0.709	<	0.737	<	0.599	<	0.743	- -	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	<	0.374	<	0.339	<	1.24	<	1.01	<	0.651	- -	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	<	0.35	<	0.318	<	0.564	<	0.458	<	0.411	- -	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	<	0.826	<	0.749	<	0.914	<	0.743	<	0.830	- -	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	<	0.714	<	0.647	<	0.524	<	0.426	<	0.628	- -	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	<	0.577	<	0.524	<	0.446	<	0.363	<	0.516	- -	100%

Liquid Stream Data Summary

Sample Stream: ***JBR Underflow Slurry Filtrate***

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	< 2.11	< 1.91	< 2.3	< 1.87	< 2.11	- -	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	< 0.435	< 0.394	< 0.954	< 0.775	< 0.594	- -	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	< 0.476	< 0.431	< 0.751	< 0.611	< 0.553	- -	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	< 1.18	< 1.07	< 1.19	< 0.967	< 1.15	- -	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	< 0.53	< 0.48	< 0.479	< 0.389	< 0.496	- -	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	< 0.846	< 0.768	< 0.719	< 0.585	< 0.778	- -	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	< 0.55	< 0.499	< 0.565	< 0.46	< 0.538	- -	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	< 0.856	< 0.776	< 0.619	< 0.503	< 0.750	- -	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	< 0.809	< 0.733	< 1.71	< 1.39	< 1.084	- -	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ug/L	< 0.493	< 0.447	< 0.696	< 0.566	< 0.545	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	< 0.782	< 0.709	< 0.741	< 0.602	< 0.744	- -	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ug/L	< 0.571	< 0.518	< 0.606	< 0.492	< 0.565	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ug/L	< 0.622	< 0.564	< 0.66	< 0.537	< 0.615	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	< 0.523	< 0.475	< 0.872	< 0.709	< 0.623	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	< 0.747	< 0.677	< 1.35	< 1.1	< 0.925	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ug/L	< 2.08	< 1.88	< 1.91	< 1.56	< 1.96	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	< 0.517	< 0.469	< 0.391	< 0.318	< 0.459	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	< 0.244	< 0.222	< 0.601	< 0.489	< 0.356	- -	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	< 0.496	< 0.45	< 0.804	< 0.654	< 0.583	- -	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	< 1.01	< 0.915	1.57	< 0.72	< 1.010	- -	38%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	< 0.628	< 0.57	< 0.529	< 0.43	< 0.576	- -	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	< 20	< 20	< 20	< 20	< 20	- -	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	< 0.557	< 0.505	< 0.646	< 0.525	< 0.569	- -	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	< 0.414	< 0.375	< 0.745	< 0.606	< 0.511	- -	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	< 0.615	< 0.558	< 1.31	< 1.06	< 0.828	- -	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	< 0.526	< 0.477	< 1.47	< 1.19	< 0.824	- -	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	< 1.05	< 0.949	< 1.44	< 1.17	< 1.146	- -	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	< 4.28	4.73	< 55.5	< 45.1	< 55.50	- -	86%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	< 1.17	< 1.06	< 0.878	< 0.713	< 1.036	- -	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L	< 0.425	< 0.385	< 0.899	< 0.731	< 0.570	- -	100%
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	< 0.723	< 0.656	< 0.773	< 0.628	< 0.717	- -	100%

Liquid Stream Data Summary

Sample Stream: JBR Underflow Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	<	0.985	<	0.893	<	0.506	<	0.412	<	0.795	- -	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	<	0.512	<	0.465	<	1.17	<	0.949	<	0.716	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	<	0.628	<	0.57	<	1.21	<	0.985	<	0.803	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	<	0.441	<	0.4	<	0.773	<	0.628	<	0.538	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	<	0.533	<	0.483	<	0.466	<	0.379	<	0.494	- -	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	<	0.363	<	0.329	<	0.741	<	0.602	<	0.478	- -	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	<	120	<	120	<	120	<	120	<	120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L	<	0.303		3.09		3.04		2.65		2.094	4.18	2%
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	<	0.571	<	0.518	<	0.399	<	0.324	<	0.496	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	<	0.544	<	0.493	<	0.977	<	0.794	<	0.671	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	<	0.69	<	0.625	<	0.678	<	0.551	<	0.664	- -	100%
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	<	0.363	<	0.329	<	0.547	<	0.444	<	0.413	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	<	0.253	<	0.229	<	0.452	<	0.367	<	0.311	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	<	0.755	<	0.684	<	0.737	<	0.599	<	0.725	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ug/L	<	9.64	<	8.75	<	8.47	<	6.89	<	8.95	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	<	0.642	<	0.582	<	0.914	<	0.743	<	0.713	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	<	0.568	<	0.515	<	1.91	<	1.56	<	0.998	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	<	0.31	<	0.281	<	0.886	<	0.72	<	0.492	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ug/L	<	50	<	50	<	50	<	50	<	50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	<	1.42	<	1.28	<	0.905	<	0.736	<	1.20	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	<	1.44	<	1.3	<	1.13	<	0.919	<	1.29	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	<	0.612	<	0.555	<	0.387	<	0.315	<	0.518	- -	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ug/L	<	0.812	<	0.736	<	0.941	<	0.765	<	0.830	- -	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ug/L	<	1.02	<	0.925	<	0.859	<	0.698	<	0.935	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	<	0.788	<	0.715	<	0.688	<	0.559	<	0.730	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	<	0.571	<	0.518	<	1.21	<	0.985	<	0.766	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	<	0.479	<	0.434	<	0.538	<	0.437	<	0.484	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	<	2.24	<	2.03	<	1.99	<	1.61	<	2.09	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	<	0.934	<	0.847	<	1.28	<	1.04	<	1.020	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	<	0.584	<	0.529	<	0.555	<	0.451	<	0.556	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	<	0.672	<	0.61	<	0.673	<	0.547	<	0.652	- -	100%

Liquid Stream Data Summary

Sample Stream: JBR Underflow Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Phenol	SW 8270	ug/L	<	0.431	<	0.391	<	1.27	<	1.03	<	0.697	--	100%
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	<	0.799	<	0.725	<	0.347	<	0.282	<	0.624	--	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	<	0.506	<	0.459	<	0.587	<	0.477	<	0.517	--	100%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	<	1.25	<	1.14	<	0.846	<	0.688	<	1.079	--	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	<	0.608	<	0.551	<	0.872	<	0.709	<	0.677	--	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	<	0.791	<	0.718	<	0.551	<	0.448	<	0.687	--	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	<	0.785	<	0.712	<	1.15	<	0.933	<	0.882	--	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L		4		5.11		4.16		2.98		4.42	1.49	
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ug/L	<	0.604	<	0.548	<	1.07	<	0.871	<	0.741	--	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	<	0.557	<	0.505	<	1.04	<	0.849	<	0.701	--	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	4-Methyl-2-pentanone (MIBK)	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Acetone	SW 8240	ug/L	<	10		6.8 J	<	10	<	10	<	10	--	60%
Organics, Volatile	Benzene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%

Liquid Stream Data Summary

Sample Stream: JBR Underflow Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2			Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Volatile	Chloroform	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	Chloromethane	SW 8240	ug/L	<	10	<	10		<	10	<	10	<	10	- -	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L	<	5		4.6	J		5.7		5	<	5	- -	20%
Organics, Volatile	Styrene	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	Toluene	SW 8240	ug/L	<	5		2	J	<	5	<	5	<	5	- -	71%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	<	10	<	10		<	10	<	10	<	10	- -	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	<	10	<	10		<	10	<	10	<	10	- -	100%
Organics, Volatile	Xylenes	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5	<	5	<	5	- -	100%

Liquid Stream Data Summary

Sample Stream: Limestone Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Reduced Species	Cyanide	SW 9012	ug/ml	0.0593	0.0834	0.003 J	0.0786	0.0486	0.1025	
Reduced Species	*Ammonia as N*	*EPA 350.1*	*ug/ml*	13.9	15.2	13.3	13.8	14.1	2.4	
Anions	Chloride	EPA 300	ug/ml	14,000	12,900	12,300	13,700	13,067	2,142	
Anions	Fluoride	EPA 340.2	ug/ml	2.1	2.02	1.4	1.46	1.84	0.95	
Anions	Phosphate	EPA 365.2	ug/ml	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	- -	100%
Anions	*Sulfate*	*EPA 300.0*	*ug/ml*	827	818	709	709	785	163	
Metals, Soluble	Aluminum	SW 6010	ug/ml	0.089 J	0.0418 J	0.654	0.0725 J	0.2616	0.8463	
Metals, Soluble	Antimony	SW 6010	ug/ml	< 0.241	< 0.241	< 0.241	< 0.241	< 0.241	- -	100%
Metals, Soluble	Arsenic	SW 7060	ug/ml	0.105	0.089	0.0068	0.09	0.067	0.131	
Metals, Soluble	*Barium*	*SW 6010*	*ug/ml*	1.08	1.13	8.48	1.09	3.56	10.58	
Metals, Soluble	Beryllium	SW 6010	ug/ml	0.0005 J	< 0.00554	0.0017 J	< 0.00554	< 0.0055	- -	56%
Metals, Soluble	Boron	SW 6010	ug/ml	443	449	3330	432	1,407	4,137	
Metals, Soluble	Cadmium	SW 7131	ug/ml	0.00736	0.00713	0.00546	0.0053	0.0067	0.0026	
Metals, Soluble	Calcium	SW 6010	ug/ml	7,160	7,030	7,030	6,470	7,073	186	
Metals, Soluble	*Chromium*	*SW 6010*	*ug/ml*	0.0515	0.0523	0.0848	0.0361	0.0629	0.0472	
Metals, Soluble	Cobalt	SW 6010	ug/ml	0.0347	0.0108 J	0.23	0.0207 J	0.0918	0.2987	
Metals, Soluble	Copper	SW 6010	ug/ml	0.0255 J	0.0132 J	0.0923	0.0273 J	0.0437	0.1057	
Metals, Soluble	Iron	SW 6010	ug/ml	< 0.0596	< 0.0596	< 0.0596	< 0.0596	< 0.0596	- -	100%
Metals, Soluble	Lead	SW 7421	ug/ml	0.0011	0.002	0.002	0.005	0.0017	0.0013	
Metals, Soluble	*Magnesium*	*SW 6010*	*ug/ml*	583	592	4470	568	1,882	5,569	
Metals, Soluble	Manganese	SW 6010	ug/ml	17.2	15.5	90.6	12.5	41.1	106.5	
Metals, Soluble	Mercury	SW 7470	ug/ml	0.00006	0.00006	0.00005	0.00006	0.00006	0.00001	
Metals, Soluble	Molybdenum	SW 6010	ug/ml	0.0671	0.0698	0.506	0.102	0.214	0.628	
Metals, Soluble	Nickel	SW 6010	ug/ml	0.303	0.32	1.91	0.302	0.844	2.293	
Metals, Soluble	Phosphorus	SW 6010	ug/ml	*0.104*	*0.246*	0.118	0.711	0.156	0.194	
Metals, Soluble	Potassium	SW 6010	ug/ml	41.3	40.9	333	43.7	138.4	418.7	
Metals, Soluble	Selenium	SW 7740	ug/ml	0.105	0.141	0.137	0.157	0.128	0.049	
Metals, Soluble	Silicon	SW 6010	ug/ml	2.38	2.3	16.9	2.38	7.2	20.9	
Metals, Soluble	Sodium	SW 6010	ug/ml	83.3	84.7	687	82.9	285.0	864.9	

Liquid Stream Data Summary

Sample Stream: Limestone Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Metals, Soluble	Strontium	SW 6010	ug/ml	11.3	11.4	85.1	10.9	35.9	105.8	
Metals, Soluble	Tin	SW 6010	ug/ml	0.007 J	< 0.144	< 0.144	0.109 J	< 0.144	- -	95%
Metals, Soluble	Titanium	SW 6010	ug/ml	0.725	0.731	< 0.0102	0.0059 J	0.4870	1.0369	0.3%
Metals, Soluble	Vanadium	SW 6010	ug/ml	0.137	0.128	0.29	0.063	0.185	0.226	
Metals, Soluble	Zinc	SW 6010	ug/ml	0.0133 J	0.0307	0.0765	0.0195	0.0402	0.0811	
Aldehydes	Acetaldehyde	SW 8315	ug/ml	0.0042	0.068	0.08	0.076	0.051	0.101	
Aldehydes	Formaldehyde	SW 8315	ug/ml	0.01	0.022	0.03	0.026	0.021	0.025	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	< 0.578	< 0.593	< 0.6	< 0.531	< 0.590	- -	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	< 0.591	< 0.606	< 0.905	< 0.8	< 0.701	- -	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	< 0.779	< 0.799	< 0.977	< 0.864	< 0.852	- -	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	< 100	< 100	< 100	< 100	< 100	- -	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	< 0.396	< 0.406	< 1.1	< 0.976	< 0.634	- -	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	< 0.808	< 0.829	< 0.905	< 0.8	< 0.847	- -	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	< 0.644	< 0.661	< 0.826	< 0.731	< 0.710	- -	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	< 1.56	< 1.6	< 3.12	< 2.76	< 2.09	- -	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	< 0.503	< 0.516	< 0.715	< 0.633	< 0.578	- -	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	< 0.33	< 0.338	< 0.783	< 0.693	< 0.484	- -	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	< 0.349	< 0.358	< 0.778	< 0.688	< 0.495	- -	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	< 0.443	< 0.454	< 0.875	< 0.774	< 0.591	- -	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	< 1.1	< 1.13	< 2	< 1.77	< 1.41	- -	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	< 7	< 7.18	< 6.43	< 5.69	< 6.87	- -	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	< 0.55	< 0.564	< 0.909	< 0.804	< 0.674	- -	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	< 0.723	< 0.742	< 0.788	< 0.697	< 0.751	- -	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	< 0.346	< 0.355	< 1.32	< 1.17	< 0.674	- -	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	< 0.324	< 0.332	< 0.603	< 0.533	< 0.420	- -	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	< 0.764	< 0.784	< 0.977	< 0.864	< 0.842	- -	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	< 0.66	< 0.677	< 0.56	< 0.495	< 0.632	- -	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	< 0.534	< 0.548	< 0.477	< 0.422	< 0.520	- -	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	< 1.95	< 2	< 2.46	< 2.18	< 2.14	- -	100%

Liquid Stream Data Summary

Sample Stream: Limestone Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1			Run 2			Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	<	0.402		<	0.412		<	1.02	<	0.902	<	0.611	--	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	<	0.44		<	0.451		<	0.803	<	0.71	<	0.565	--	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	<	1.09		<	1.12		<	1.27	<	1.13	<	1.16	--	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	<	0.49		<	0.503		<	0.512	<	0.453	<	0.502	--	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	<	0.783		<	0.803		<	0.769	<	0.68	<	0.785	--	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	<	0.509		<	0.522		<	0.605	<	0.535	<	0.545	--	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	<	0.792		<	0.812		<	0.662	<	0.585	<	0.755	--	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	<	0.748		<	0.767		<	1.83	<	1.62	<	1.115	--	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ug/L	<	0.456		<	0.468		<	0.745	<	0.659	<	0.556	--	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	<	0.723		<	0.742		<	0.792	<	0.701	<	0.752	--	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ug/L	<	0.528		<	0.542		<	0.648	<	0.573	<	0.573	--	100%
Organics, Semi-volatile	*4-Methylphenol(p-cresol)*	SW 8270	ug/L	<	0.575		<	0.59		<	0.706	<	0.624	<	0.624	--	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	<	0.484		<	0.496		<	0.932	<	0.824	<	0.637	--	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	<	0.691		<	0.709		<	1.44	<	1.27	<	0.947	--	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ug/L	<	1.92		<	1.97		<	2.05	<	1.81	<	1.98	--	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	<	0.478		<	0.49		<	0.418	<	0.37	<	0.462	--	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	<	0.226		<	0.232		<	0.643	<	0.569	<	0.367	--	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	<	0.459		<	0.471		<	0.86	<	0.761	<	0.597	--	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	<	0.933		<	0.957		<	0.948		0.996	<	0.946	--	100%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	<	0.581		<	0.596		<	0.566	<	0.501	<	0.581	--	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	<	20		<	20		<	20	<	20	<	20	--	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	<	0.515		<	0.528		<	0.691	<	0.611	<	0.578	--	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	<	0.383		<	0.393		<	0.797	<	0.705	<	0.524	--	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	<	0.569		<	0.584		<	1.4	<	1.24	<	0.851	--	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	<	0.487		<	0.499		<	1.57	<	1.39	<	0.852	--	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	<	0.968		<	0.993		<	1.54	<	1.36	<	1.167	--	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	<	3.96		<	4.06		<	59.4	<	52.5	<	22.473	--	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	<	1.08		<	1.11		<	0.938	<	0.83	<	1.043	--	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L		0.319	J		0.355	J	<	0.962	<	0.85	<	0.962	--	42%
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	<	0.669		<	0.686		<	0.826	<	0.731	<	0.727	--	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	<	0.911		<	0.934		<	0.542	<	0.479	<	0.796	--	100%

Liquid Stream Data Summary

Sample Stream: Limestone Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2			Run 3a			Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	<	0.474	<	0.486		<	1.25		<	1.1	<	0.737	- -	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	<	0.581	<	0.596		<	1.3		<	1.15	<	0.826	- -	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	<	0.408	<	0.418		<	0.826		<	0.731	<	0.551	- -	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	<	0.493	<	0.506			0.769		<	0.441	<	0.506	- -	39%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	<	0.336	<	0.345			0.482	J	<	0.701	<	0.345	- -	41%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	<	120	<	120		<	120		<	120	<	120	- -	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L	<	0.28	<	0.287		<	0.517		<	0.457	<	0.361	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	<	0.528	<	0.542		<	0.426		<	0.377	<	0.499	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	<	0.503	<	0.516		<	1.04		<	0.924	<	0.686	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	<	0.638	<	0.654		<	0.725		<	0.641	<	0.672	- -	100%
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	<	0.336	<	0.345		<	0.585		<	0.517	<	0.422	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	<	0.234	<	0.24		<	0.483		<	0.427	<	0.319	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	<	0.698	<	0.716		<	0.788		<	0.697	<	0.734	- -	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ug/L	<	8.92	<	9.15		<	9.06		<	8.01	<	9.04	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	<	0.594	<	0.609		<	0.977		<	0.864	<	0.727	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	<	0.525	<	0.538		<	2.05		<	1.81	<	1.038	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	<	0.287	<	0.294		<	0.948		<	0.838	<	0.510	- -	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ug/L	<	50	<	50		<	50		<	50	<	50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	<	1.31	<	1.34		<	0.968		<	0.856	<	1.21	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	<	1.33	<	1.36		<	1.21		<	1.07	<	1.30	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	<	0.566	<	0.581		<	0.414		<	0.366	<	0.520	- -	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ug/L	<	0.751	<	0.77		<	1.01		<	0.89	<	0.84	- -	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ug/L	<	0.943	<	0.967		<	0.918		<	0.812	<	0.943	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	<	0.729		0.206	J	<	0.735		<	0.65	<	0.735	- -	78%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	<	0.528	<	0.542		<	1.3		<	1.15	<	0.790	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	<	0.443	<	0.454		<	0.575		<	0.509	<	0.491	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	<	2.07	<	2.12		<	2.12		<	1.88	<	2.10	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	<	0.864	<	0.886		<	1.37		<	1.21	<	1.040	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	<	0.54	<	0.554		<	0.594		<	0.525	<	0.563	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	<	0.622	<	0.638		<	0.72		<	0.637	<	0.660	- -	100%
Organics, Semi-volatile	Phenol	SW 8270	ug/L	<	0.399	<	0.409		<	1.36		<	1.2	<	0.723	- -	100%

Liquid Stream Data Summary

Sample Stream: Limestone Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	<	0.739	<	0.758	<	0.371	<	0.328	<	0.623	--	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	<	0.468	<	0.48	<	0.628	<	0.555	<	0.525	--	100%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	<	1.16	<	1.19	<	0.905	<	0.8	<	1.085	--	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	<	0.562	<	0.576	<	0.932	<	0.824	<	0.690	--	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	<	0.732	<	0.751	<	0.589	<	0.521	<	0.691	--	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	<	0.726	<	0.745	<	1.23	<	1.09	<	0.900	--	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L		5.17		6.43		399		0.918		137	564	
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ug/L	<	0.559	<	0.573	<	1.15	<	1.01	<	0.761	--	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	<	0.515	<	0.528	<	1.12	<	0.988	<	0.721	--	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	*1,1,2,2-Tetrachloroethane*	*SW 8240*	*ug/L*	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	<	10	<	10		5.1	<	10	<	10	--	66%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	4-Methyl-2-pentanone (MIBK)	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Acetone	SW 8240	ug/L		19		24		24		18		22	7	
Organics, Volatile	Benzene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	<	10	<	10	<	10	<	10	<	10	--	100%
Organics, Volatile	Chloroform	SW 8240	ug/L	<	5	<	5	<	5	<	5	<	5	--	100%

Liquid Stream Data Summary

Sample Stream: Limestone Slurry Filtrate

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d			Average	95% CI	DL Ratio
Organics, Volatile	Chloromethane	SW 8240	ug/L	<	10	<	10	<	10	<	10		<	10	- -	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L	<	5		5		5		4.8	J	<	5	- -	20%
Organics, Volatile	Styrene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	Toluene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	<	10	<	10	<	10	<	10		<	10	- -	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	<	10	<	10	<	10	<	10		<	10	- -	100%
Organics, Volatile	Xylenes	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	- -	100%

Liquid Stream Data Summary

Sample Stream: Cooling Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Reduced Species	Cyanide	SW 9012	ug/ml	0.0019 J	0.0013 J	0.00124 J	0.00269 J	0.00148	0.00091	
Reduced Species	Ammonia as N	EPA 350.1	ug/ml	0.0532	0.0455	0.0421	0.0333	0.047	0.014	
Anions	Chloride	EPA 300	ug/ml	6.55	5.34	5.25	5.26	5.71	1.80	
Anions	Fluoride	EPA 340.2	ug/ml	0.142	0.132	0.128	0.146	0.134	0.018	
Anions	Phosphate	EPA 365.2	ug/ml	0.106	0.114	0.0614	0.0623	0.094	0.070	
Anions	Sulfate	EPA 300.0	ug/ml	6.79	6.51	5.73	6.02	6.34	1.36	
Metals, Soluble	Aluminum	SW 6010	ug/ml	0.0265 J	0.052	0.0151 J	0.0423	0.031	0.047	
Metals, Soluble	Antimony	SW 6010	ug/ml	< 0.0241	< 0.0241	0.0127 J	< 0.0241	< 0.024	- -	65%
Metals, Soluble	Arsenic	SW 7060	ug/ml	< 0.000657	< 0.000657	< 0.000657	< 0.000657	< 0.001	- -	100%
Metals, Soluble	Barium	SW 6010	ug/ml	0.0112	0.0169	0.0113	0.0109	0.013	0.0081	
Metals, Soluble	Beryllium	SW 6010	ug/ml	< 0.000554	< 0.000554	< 0.000554	< 0.000554	< 0.001	- -	100%
Metals, Soluble	Boron	SW 6010	ug/ml	0.0601	2.52	0.196	0.0807	0.93	3.44	
Metals, Soluble	Cadmium	SW 7131	ug/ml	0.00031	0.00522	0.00042	0.00136	0.00198	0.00697	
Metals, Soluble	Calcium	SW 6010	ug/ml	5.13	43.5	8.72	4.97	19.12	52.65	
Metals, Soluble	Chromium	SW 6010	ug/ml	0.00239 J	0.00081 J	0.00291	0.00061 J	0.0020	0.0027	
Metals, Soluble	Cobalt	SW 6010	ug/ml	< 0.0034	< 0.0034	0.00062 J	< 0.0034	< 0.0034	- -	85%
Metals, Soluble	Copper	SW 6010	ug/ml	0.00429	0.00447	0.0959	0.0103	0.035	0.131	
Metals, Soluble	Iron	SW 6010	ug/ml	0.079	0.0844	0.173	0.0923	0.112	0.131	
Metals, Soluble	Lead	SW 7421	ug/ml	0.0023	0.0722	0.0072	0.0121	0.027	0.097	
Metals, Soluble	Magnesium	SW 6010	ug/ml	1.23	4.1	3.95	1.23	3.09	4.01	
Metals, Soluble	Manganese	SW 6010	ug/ml	0.00932	0.188	0.0186	0.0107	0.072	0.250	
Metals, Soluble	Mercury	SW 7470	ug/ml	0.00005	0.00006	0.00004 J	< 0.00005	0.00005	0.00002	
Metals, Soluble	Molybdenum	SW 6010	ug/ml	0.00135 J	0.00184 J	0.00137 J	0.00057 J	0.00152	0.00069	
Metals, Soluble	Nickel	SW 6010	ug/ml	0.00401 J	0.00231 J	0.00012 J	0.0017 J	0.00215	0.00484	
Metals, Soluble	Phosphorus	SW 6010	ug/ml	0.021 J	< 0.061	0.0929	0.0941	< 0.061	- -	21%
Metals, Soluble	Potassium	SW 6010	ug/ml	2.25	2.64	2.38	2.04	2.42	0.49	
Metals, Soluble	Selenium	SW 7740	ug/ml	< 0.00144	< 0.00144	< 0.00144	< 0.00144	< 0.0014	- -	100%
Metals, Soluble	Silicon	SW 6010	ug/ml	3.58	3.55	6.53	3.75	4.55	4.25	
Metals, Soluble	Sodium	SW 6010	ug/ml	5.85	5.62	13.8	5.29	8.42	11.57	
Metals, Soluble	Strontium	SW 6010	ug/ml	0.0265	0.0856	0.0335	0.0251	0.049	0.080	
Metals, Soluble	Tin	SW 6010	ug/ml	< 0.0144	< 0.0144	0.00666 J	< 0.0144	< 0.014	- -	68%
Metals, Soluble	Titanium	SW 6010	ug/ml	0.00141	0.00136	0.00055 J	0.00125	0.00111	0.00120	
Metals, Soluble	Vanadium	SW 6010	ug/ml	0.003	0.0026	0.00256	0.00089 J	0.00272	0.00060	
Metals, Soluble	Zinc	SW 6010	ug/ml	0.00684	0.00616	0.0413	0.00857	0.018	0.050	

Liquid Stream Data Summary

Sample Stream: Cooling Water

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Run 3a	Run 3d	Average	95% CI	DL Ratio
Metals, Total	Aluminum	SW 6010	ug/ml	2.98	4.6	1.03	1.15	2.87	4.44	
Metals, Total	Antimony	SW 6010	ug/ml	0.036	0.0219 J	0.00859 J	0.0346	0.022	0.034	
Metals, Total	Arsenic	SW 7060	ug/ml	0.0216	< 0.000657	< 0.000657	< 0.000657	0.0074	0.0305	3%
Metals, Total	Barium	SW 6010	ug/ml	0.0322	0.0409	0.0188	0.0181	0.031	0.028	
Metals, Total	Beryllium	SW 6010	ug/ml	9E-05 J	0.00014 J	< 0.000554	< 0.000554	< 0.00055	- -	55%
Metals, Total	Boron	SW 6010	ug/ml	0.247	0.488	0.236	0.0846	0.324	0.354	
Metals, Total	Cadmium	SW 7131	ug/ml	0.00023 J	0.00209	0.00064	0.00031	0.00099	0.00243	
Metals, Total	Calcium	SW 6010	ug/ml	5.91	6.54	5.28	4.62	5.91	1.57	
Metals, Total	Chromium	SW 6010	ug/ml	0.00566	0.00634	0.00283	0.00449	0.00494	0.00462	
Metals, Total	Cobalt	SW 6010	ug/ml	0.00453	0.00682	0.00368	0.00622	0.00501	0.00403	
Metals, Total	Copper	SW 6010	ug/ml	0.0112	0.0132	0.00682	0.00552	0.010	0.00811	
Metals, Total	Iron	SW 6010	ug/ml	4.12	6.21	1.87	1.94	4.07	5.39	
Metals, Total	Lead	SW 7421	ug/ml	0.0163	0.0572	0.0173	0.0092	0.030	0.058	
Metals, Total	Magnesium	SW 6010	ug/ml	1.81	1.89	1.36	1.28	1.69	0.71	
Metals, Total	Manganese	SW 6010	ug/ml	0.193	0.237	0.104	0.0934	0.178	0.168	
Metals, Total	Mercury	SW 7470	ug/ml	0.00003 J	0.00004 J	0.00005	0.00006	0.00004	0.00002	
Metals, Total	Molybdenum	SW 6010	ug/ml	0.00175 J	0.00246 J	0.00295 J	< 0.00463	0.00239	0.00150	
Metals, Total	Nickel	SW 6010	ug/ml	0.00524 J	0.00445 J	< 0.00986	0.00078 J	< 0.010	- -	34%
Metals, Total	Phosphorus	SW 6010	ug/ml	0.138	0.184	< 0.061	< 0.061	0.118	0.196	9%
Metals, Total	Potassium	SW 6010	ug/ml	3.1	2.84	2.33	2.43	2.76	0.97	
Metals, Total	Selenium	SW 7740	ug/ml	0.0214	< 0.00144	< 0.00144	< 0.00144	0.008	0.030	6%
Metals, Total	Silicon	SW 6010	ug/ml	7.01	8.22	4.47	4.56	6.57	4.75	
Metals, Total	Sodium	SW 6010	ug/ml	6.27	5.1	4.81	4.7	5.39	1.92	
Metals, Total	Strontium	SW 6010	ug/ml	0.0295	0.0293	0.0241	0.0224	0.028	0.0076	
Metals, Total	Tin	SW 6010	ug/ml	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.014	- -	100%
Metals, Total	Titanium	SW 6010	ug/ml	0.167	0.235	0.0677	0.069	0.157	0.209	
Metals, Total	Vanadium	SW 6010	ug/ml	0.00881	0.0119	0.00427	0.00629	0.00833	0.010	
Metals, Total	Zinc	SW 6010	ug/ml	0.0275	0.0382	0.0136	0.0136	0.026	0.031	
Aldehydes	Acetaldehyde	SW 8315	ug/ml	0.004	0.066	0.096	0.09	0.055	0.117	
Aldehydes	Formaldehyde	SW 8315	ug/ml	0.0054	0.044	0.03	0.026	0.026	0.049	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	< 0.55	< 0.556	< 0.371	< 0.375	< 0.492	- -	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	< 0.563	< 0.568	< 0.56	< 0.565	< 0.564	- -	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	< 0.742	< 0.749	< 0.605	< 0.611	< 0.699	- -	100%

Liquid Stream Data Summary

Sample Stream: Cooling Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	<	100	<	100	<	100	<	100	<	100	- -	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	<	0.377	<	0.381	<	0.683	<	0.689	<	0.480	- -	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	<	0.77	<	0.777	<	0.56	<	0.565	<	0.702	- -	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	<	0.613	<	0.619	<	0.511	<	0.516	<	0.581	- -	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	<	1.49	<	1.5	<	1.93	<	1.95	<	1.64	- -	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	<	0.479	<	0.484	<	0.443	<	0.447	<	0.469	- -	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	<	0.314	<	0.317	<	0.485	<	0.489	<	0.372	- -	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	<	0.332	<	0.336	<	0.482	<	0.487	<	0.383	- -	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	<	0.422	<	0.426	<	0.542	<	0.547	<	0.463	- -	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	<	1.05	<	1.06	<	1.24	<	1.25	<	1.12	- -	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	<	6.67	<	6.73	<	3.98	<	4.02	<	5.79	- -	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	<	0.524	<	0.529	<	0.563	<	0.568	<	0.539	- -	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	<	0.689	<	0.695	<	0.488	<	0.492	<	0.624	- -	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	<	0.33	<	0.333	<	0.82	<	0.828	<	0.494	- -	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	<	0.309	<	0.312	<	0.373	<	0.377	<	0.331	- -	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	<	0.728	<	0.735	<	0.605	<	0.611	<	0.689	- -	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	<	0.629	<	0.635	<	0.347	<	0.35	<	0.54	- -	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	<	0.509	<	0.513	<	0.295	<	0.298	<	0.439	- -	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	<	1.86	<	1.87	<	1.52	<	1.54	<	1.75	- -	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	<	0.383	<	0.387	<	0.631	<	0.637	<	0.467	- -	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	<	0.419	<	0.423	<	0.497	<	0.502	<	0.446	- -	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	<	1.04	<	1.05	<	0.788	<	0.795	<	0.959	- -	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	<	0.467	<	0.471	<	0.317	<	0.32	<	0.418	- -	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	<	0.746	<	0.753	<	0.476	<	0.481	<	0.658	- -	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	<	0.485	<	0.489	<	0.374	<	0.378	<	0.449	- -	100%
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	<	0.754	<	0.762	<	0.41	<	0.413	<	0.642	- -	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	<	0.712	<	0.719	<	1.13	<	1.14	<	0.854	- -	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ug/L	<	0.434	<	0.438	<	0.461	<	0.465	<	0.444	- -	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	<	0.689	<	0.695	<	0.49	<	0.495	<	0.625	- -	100%
Organics, Semi-volatile	*4-Chlorophenyl phenyl ether*	SW 8270	ug/L	<	0.503	<	0.508	<	0.401	<	0.405	<	0.471	- -	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ug/L	<	0.548	<	0.553	<	0.437	<	0.441	<	0.513	- -	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	<	0.461	<	0.465	<	0.577	<	0.583	<	0.501	- -	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	<	0.658	<	0.664	<	0.892	<	0.901	<	0.738	- -	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ug/L	<	1.83	<	1.85	<	1.27	<	1.28	<	1.65	- -	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	<	0.455	<	0.46	<	0.259	<	0.262	<	0.391	- -	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	<	0.215	<	0.217	<	0.398	<	0.402	<	0.277	- -	100%

Liquid Stream Data Summary

Sample Stream: Cooling Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d		Average	95% CI	DL Ratio
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	<	0.437	<	0.441	<	0.532	<	0.537	<	0.470	--	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	<	0.889	<	0.897	<	0.587	<	0.592	<	0.791	--	100%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	<	0.553	<	0.559	<	0.35	<	0.354	<	0.487	--	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	<	20	<	20	<	20	<	20	<	20	--	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	<	0.49	<	0.495	<	0.428	<	0.432	<	0.471	--	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	<	0.365	<	0.368	<	0.493	<	0.498	<	0.409	--	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	<	0.542	<	0.547	<	0.865	<	0.873	<	0.651	--	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	<	0.464	<	0.468	<	0.971	<	0.981	<	0.634	--	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	<	0.922	<	0.931	<	0.951	<	0.961	<	0.935	--	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	<	3.77	<	3.81	<	36.8	<	37.1	<	14.79	--	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	<	1.03	<	1.04	<	0.581	<	0.587	<	0.884	--	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L	<	0.374	<	0.378	<	0.595	<	0.601	<	0.449	--	100%
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	<	0.637	<	0.643	<	0.511	<	0.516	<	0.597	--	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	<	0.868	<	0.876	<	0.335	<	0.338	<	0.693	--	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	<	0.451	<	0.456	<	0.772	<	0.78	<	0.56	--	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	<	0.553	<	0.559	<	0.802	<	0.81	<	0.64	--	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	<	0.389	<	0.392	<	0.511	<	0.516	<	0.431	--	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	<	0.47	<	0.474	<	0.309	<	0.312	<	0.418	--	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	<	0.32	<	0.323	<	0.49	<	0.495	<	0.378	--	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	<	120	<	120	<	120	<	120	<	120	--	100%
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L	<	0.267	<	0.269	<	0.32	<	0.323	<	0.285	--	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	<	0.503	<	0.508	<	0.264	<	0.266	<	0.425	--	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	<	0.479	<	0.484	<	0.647	<	0.653	<	0.537	--	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	<	0.608	<	0.613	<	0.449	<	0.453	<	0.557	--	100%
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	<	0.32	<	0.323	<	0.362	<	0.365	<	0.335	--	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	<	0.223	<	0.225	<	0.299	<	0.302	<	0.249	--	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	<	0.665	<	0.671	<	0.488	<	0.492	<	0.608	--	100%
Organics, Semi-volatile	Hexachlorocyclopentadiene	SW 8270	ug/L	<	8.5	<	8.58	<	5.61	<	5.66	<	7.56	--	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	<	0.566	<	0.571	<	0.605	<	0.611	<	0.581	--	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	<	0.5	<	0.505	<	1.27	<	1.28	<	0.76	--	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	<	0.273	<	0.276	<	0.587	<	0.592	<	0.379	--	100%
Organics, Semi-volatile	Methyl methanesulfonate	SW 8270	ug/L	<	50	<	50	<	50	<	50	<	50	--	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	<	1.25	<	1.26	<	0.599	<	0.605	<	1.036	--	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	<	1.27	<	1.28	<	0.749	<	0.756	<	1.100	--	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	<	0.539	<	0.544	<	0.256	<	0.259	<	0.446	--	100%
Organics, Semi-volatile	N-Nitrosodipropylamine	SW 8270	ug/L	<	0.715	<	0.722	<	0.623	<	0.629	<	0.687	--	100%

Liquid Stream Data Summary

Sample Stream: Cooling Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2		Run 3a		Run 3d			Average	95% CI	DL Ratio
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ug/L	<	0.898	<	0.907	<	0.569	<	0.574		<	0.791	--	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	<	0.694	<	0.701	<	0.455	<	0.46		<	0.62	--	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	<	0.503	<	0.508	<	0.802	<	0.81		<	0.604	--	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	<	0.422	<	0.426	<	0.356	<	0.36		<	0.401	--	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	<	1.97	<	1.99	<	1.31	<	1.33		<	1.76	--	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	<	0.823	<	0.831	<	0.847	<	0.855		<	0.834	--	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	<	0.514	<	0.519	<	0.368	<	0.371		<	0.467	--	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	<	0.592	<	0.598	<	0.446	<	0.45		<	0.545	--	100%
Organics, Semi-volatile	Phenol	SW 8270	ug/L	<	0.38	<	0.384	<	0.841	<	0.849		<	0.535	--	100%
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	<	0.704	<	0.711	<	0.23	<	0.232		<	0.548	--	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	<	0.446	<	0.45	<	0.389	<	0.392		<	0.428	--	100%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	<	1.1	<	1.12	<	0.56	<	0.565		<	0.93	--	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	<	0.535	<	0.54	<	0.577	<	0.583		<	0.551	--	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	<	0.697	<	0.704	<	0.365	<	0.368		<	0.589	--	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	<	0.691	<	0.698	<	0.76	<	0.767		<	0.716	--	100%
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L		4.56		5.8	<	0.553	<	0.559			3.55	7.2	3%
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ug/L	<	0.532	<	0.537	<	0.71	<	0.716		<	0.593	--	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	<	0.49	<	0.495	<	0.691	<	0.698		<	0.559	--	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	<	10	<	10	<	10	<	10		<	10	--	100%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	<	10	<	10	<	10	<	10		<	10	--	100%
Organics, Volatile	4-Methyl-2-pentanone (MIBK)	SW 8240	ug/L	<	10	<	10	<	10	<	10		<	10	--	100%
Organics, Volatile	Acetone	SW 8240	ug/L	<	10	<	10		12		8	J	<	10	--	45%
Organics, Volatile	Benzene	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	<	10	<	10	<	10	<	10		<	10	--	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	<	5	<	5	<	5	<	5		<	5	--	100%

Liquid Stream Data Summary

Sample Stream: Cooling Water

Analyte Group	Specie	Analytical Method	Units		Run 1		Run 2			Run 3a			Run 3d			Average	95% CI	DL Ratio
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	<	10	<	10		<	10		<	10		<	10	- -	100%
Organics, Volatile	Chloroform	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Chloromethane	SW 8240	ug/L	<	10	<	10		<	10		<	10		<	10	- -	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L	<	5		3.3	J		4.9	J		4.9	J	<	5	- -	23%
Organics, Volatile	Styrene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Toluene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	<	10	<	10		<	10		<	10		<	10	- -	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	<	10	<	10		<	10		<	10		<	10	- -	100%
Organics, Volatile	Xylenes	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	<	5	<	5		<	5		<	5		<	5	- -	100%

Liquid Stream Data Summary

Sample Stream: Coal Pile Run-off

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Average	95% CI	DL Ratio
Aldehydes	Acetaldehyde	SW 8315	ug/ml	0.07	0.112	0.091	0.267	
Aldehydes	Formaldehyde	SW 8315	ug/ml	0.026	0.088	0.057	0.394	
Organics, Semi-volatile	1,2,4,5-Tetrachlorobenzene	SW 8270	ug/L	< 0.709		< 0.709	--	100%
Organics, Semi-volatile	1,2,4-Trichlorobenzene	SW 8270	ug/L	< 0.725		< 0.725	--	100%
Organics, Semi-volatile	1,2-Dichlorobenzene	SW 8270	ug/L	< 0.956		< 0.956	--	100%
Organics, Semi-volatile	1,2-Diphenylhydrazine	SW 8270	ug/L	< 100		< 100	--	100%
Organics, Semi-volatile	1,3-Dichlorobenzene	SW 8270	ug/L	< 0.486		< 0.486	--	100%
Organics, Semi-volatile	1,4-Dichlorobenzene	SW 8270	ug/L	< 0.991		< 0.991	--	100%
Organics, Semi-volatile	1-Chloronaphthalene	SW 8270	ug/L	< 0.79		< 0.79	--	100%
Organics, Semi-volatile	1-Naphthylamine	SW 8270	ug/L	< 1.91		< 1.91	--	100%
Organics, Semi-volatile	2,3,4,6-Tetrachlorophenol	SW 8270	ug/L	< 0.617		< 0.617	--	100%
Organics, Semi-volatile	2,4,5-Trichlorophenol	SW 8270	ug/L	< 0.405		< 0.405	--	100%
Organics, Semi-volatile	2,4,6-Trichlorophenol	SW 8270	ug/L	< 0.428		< 0.428	--	100%
Organics, Semi-volatile	2,4-Dichlorophenol	SW 8270	ug/L	< 0.544		< 0.544	--	100%
Organics, Semi-volatile	2,4-Dimethylphenol	SW 8270	ug/L	< 1.35		< 1.35	--	100%
Organics, Semi-volatile	2,4-Dinitrophenol	SW 8270	ug/L	< 8.59		< 8.59	--	100%
Organics, Semi-volatile	2,4-Dinitrotoluene	SW 8270	ug/L	< 0.675		< 0.675	--	100%
Organics, Semi-volatile	2,6-Dichlorophenol	SW 8270	ug/L	< 0.887		< 0.887	--	100%
Organics, Semi-volatile	2,6-Dinitrotoluene	SW 8270	ug/L	< 0.425		< 0.425	--	100%
Organics, Semi-volatile	2-Chloronaphthalene	SW 8270	ug/L	< 0.398		< 0.398	--	100%
Organics, Semi-volatile	2-Chlorophenol	SW 8270	ug/L	< 0.937		< 0.937	--	100%
Organics, Semi-volatile	2-Methylnaphthalene	SW 8270	ug/L	< 0.81		< 0.81	--	100%
Organics, Semi-volatile	2-Methylphenol(o-cresol)	SW 8270	ug/L	< 0.655		< 0.655	--	100%
Organics, Semi-volatile	2-Naphthylamine	SW 8270	ug/L	< 2.39		< 2.39	--	100%
Organics, Semi-volatile	2-Nitroaniline	SW 8270	ug/L	< 0.493		< 0.493	--	100%
Organics, Semi-volatile	2-Nitrophenol	SW 8270	ug/L	< 0.54		< 0.54	--	100%
Organics, Semi-volatile	2-Picoline	SW 8270	ug/L	< 1.34		< 1.34	--	100%
Organics, Semi-volatile	3,3'-Dichlorobenzidine	SW 8270	ug/L	< 0.601		< 0.601	--	100%
Organics, Semi-volatile	3-Methylcholanthrene	SW 8270	ug/L	< 0.961		< 0.961	--	100%
Organics, Semi-volatile	3-Nitroaniline	SW 8270	ug/L	< 0.625		< 0.625	--	100%

Liquid Stream Data Summary

Sample Stream: Coal Pile Run-off

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Average	95% CI	DL Ratio
Organics, Semi-volatile	4,6-Dinitro-2-methylphenol	SW 8270	ug/L	< 0.972		< 0.972	--	100%
Organics, Semi-volatile	4-Aminobiphenyl	SW 8270	ug/L	< 0.918		< 0.918	--	100%
Organics, Semi-volatile	4-Bromophenyl phenyl	SW 8270	ug/L	< 0.56		< 0.56	--	100%
Organics, Semi-volatile	4-Chloro-3-methylphenol	SW 8270	ug/L	< 0.887		< 0.887	--	100%
Organics, Semi-volatile	4-Chlorophenyl phenyl ether	SW 8270	ug/L	< 0.648		< 0.648	--	100%
Organics, Semi-volatile	4-Methylphenol(p-cresol)	SW 8270	ug/L	< 0.706		< 0.706	--	100%
Organics, Semi-volatile	4-Nitroaniline	SW 8270	ug/L	< 0.594		< 0.594	--	100%
Organics, Semi-volatile	4-Nitrophenol	SW 8270	ug/L	< 0.848		< 0.848	--	100%
Organics, Semi-volatile	7,12-Dimethylbenz(a)anthracene	SW 8270	ug/L	< 2.36		< 2.36	--	100%
Organics, Semi-volatile	Acenaphthene	SW 8270	ug/L	< 0.587		< 0.587	--	100%
Organics, Semi-volatile	Acenaphthylene	SW 8270	ug/L	< 0.277		< 0.277	--	100%
Organics, Semi-volatile	Acetophenone	SW 8270	ug/L	< 0.563		< 0.563	--	100%
Organics, Semi-volatile	Aniline	SW 8270	ug/L	< 1.14		< 1.14	--	100%
Organics, Semi-volatile	Anthracene	SW 8270	ug/L	< 0.713		< 0.713	--	100%
Organics, Semi-volatile	Benzidine	SW 8270	ug/L	< 20		< 20	--	100%
Organics, Semi-volatile	Benzo(a)anthracene	SW 8270	ug/L	< 0.632		< 0.632	--	100%
Organics, Semi-volatile	Benzo(a)pyrene	SW 8270	ug/L	< 0.47		< 0.47	--	100%
Organics, Semi-volatile	Benzo(b)fluoranthene	SW 8270	ug/L	< 0.698		< 0.698	--	100%
Organics, Semi-volatile	Benzo(g,h,i)perylene	SW 8270	ug/L	< 0.598		< 0.598	--	100%
Organics, Semi-volatile	Benzo(k)fluoranthene	SW 8270	ug/L	< 1.19		< 1.19	--	100%
Organics, Semi-volatile	Benzoic acid	SW 8270	ug/L	< 4.86		< 4.86	--	100%
Organics, Semi-volatile	Benzyl alcohol	SW 8270	ug/L	< 1.33		< 1.33	--	100%
Organics, Semi-volatile	Butylbenzylphthalate	SW 8270	ug/L	0.539		0.539	--	
Organics, Semi-volatile	Chrysene	SW 8270	ug/L	< 0.821		< 0.821	--	100%
Organics, Semi-volatile	Di-n-octylphthalate	SW 8270	ug/L	< 1.12		< 1.12	--	100%
Organics, Semi-volatile	Dibenz(a,h)anthracene	SW 8270	ug/L	< 0.582		< 0.582	--	100%
Organics, Semi-volatile	Dibenz(a,j)acridine	SW 8270	ug/L	< 0.713		< 0.713	--	100%
Organics, Semi-volatile	Dibenzofuran	SW 8270	ug/L	< 0.501		< 0.501	--	100%
Organics, Semi-volatile	Dibutylphthalate	SW 8270	ug/L	< 0.605		< 0.605	--	100%
Organics, Semi-volatile	Diethylphthalate	SW 8270	ug/L	< 0.412		< 0.412	--	100%
Organics, Semi-volatile	Dimethylphenethylamine	SW 8270	ug/L	< 120		< 120	--	100%

Liquid Stream Data Summary

Sample Stream: Coal Pile Run-off

Analyte Group	Specie	Analytical Method	Units		Run 1	Run 2		Average	95% CI	DL Ratio
Organics, Semi-volatile	Dimethylphthalate	SW 8270	ug/L	<	0.344		<	0.344	- -	100%
Organics, Semi-volatile	Diphenylamine	SW 8270	ug/L	<	0.648		<	0.648	- -	100%
Organics, Semi-volatile	Ethyl methanesulfonate	SW 8270	ug/L	<	0.617		<	0.617	- -	100%
Organics, Semi-volatile	Fluoranthene	SW 8270	ug/L	<	0.783		<	0.783	- -	100%
Organics, Semi-volatile	Fluorene	SW 8270	ug/L	<	0.412		<	0.412	- -	100%
Organics, Semi-volatile	Hexachlorobenzene	SW 8270	ug/L	<	0.287		<	0.287	- -	100%
Organics, Semi-volatile	Hexachlorobutadiene	SW 8270	ug/L	<	0.856		<	0.856	- -	100%
Organics, Semi-volatile	*Hexachlorocyclopentadiene*	SW 8270	*ug/L*	<	10.9		<	10.9	- -	100%
Organics, Semi-volatile	Hexachloroethane	SW 8270	ug/L	<	0.729		<	0.729	- -	100%
Organics, Semi-volatile	Indeno(1,2,3-cd)pyrene	SW 8270	ug/L	<	0.644		<	0.644	- -	100%
Organics, Semi-volatile	Isophorone	SW 8270	ug/L	<	0.352		<	0.352	- -	100%
Organics, Semi-volatile	*Methyl methanesulfonate*	SW 8270	*ug/L*	<	50		<	50	- -	100%
Organics, Semi-volatile	N-Nitroso-di-n-butylamine	SW 8270	ug/L	<	1.61		<	1.61	- -	100%
Organics, Semi-volatile	N-Nitrosodimethylamine	SW 8270	ug/L	<	1.63		<	1.63	- -	100%
Organics, Semi-volatile	N-Nitrosodiphenylamine	SW 8270	ug/L	<	0.694		<	0.694	- -	100%
Organics, Semi-volatile	*N-Nitrosodipropylamine*	SW 8270	ug/L	<	0.921		<	0.921	- -	100%
Organics, Semi-volatile	N-Nitrosopiperidine	SW 8270	ug/L	<	1.16		<	1.16	- -	100%
Organics, Semi-volatile	Naphthalene	SW 8270	ug/L	<	0.894		<	0.894	- -	100%
Organics, Semi-volatile	Nitrobenzene	SW 8270	ug/L	<	0.648		<	0.648	- -	100%
Organics, Semi-volatile	Pentachlorobenzene	SW 8270	ug/L	<	0.544		<	0.544	- -	100%
Organics, Semi-volatile	Pentachloronitrobenzene	SW 8270	ug/L	<	2.54		<	2.54	- -	100%
Organics, Semi-volatile	Pentachlorophenol	SW 8270	ug/L	<	1.06		<	1.06	- -	100%
Organics, Semi-volatile	Phenacetin	SW 8270	ug/L	<	0.663		<	0.663	- -	100%
Organics, Semi-volatile	Phenanthrene	SW 8270	ug/L	<	0.763		<	0.763	- -	100%
Organics, Semi-volatile	Phenol	SW 8270	ug/L	<	0.49		<	0.49	- -	100%
Organics, Semi-volatile	Pronamide	SW 8270	ug/L	<	0.907		<	0.907	- -	100%
Organics, Semi-volatile	Pyrene	SW 8270	ug/L	<	0.574		<	0.574	- -	100%
Organics, Semi-volatile	Pyridine	SW 8270	ug/L	<	1.42		<	1.42	- -	100%
Organics, Semi-volatile	bis(2-Chloroethoxy)methane	SW 8270	ug/L	<	0.69		<	0.69	- -	100%
Organics, Semi-volatile	bis(2-Chloroethyl)ether	SW 8270	ug/L	<	0.898		<	0.898	- -	100%
Organics, Semi-volatile	bis(2-Chloroisopropyl)ether	SW 8270	ug/L	<	0.891		<	0.891	- -	100%

Liquid Stream Data Summary

Sample Stream: Coal Pile Run-off

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Average	95% CI	DL Ratio
Organics, Semi-volatile	bis(2-Ethylhexyl)phthalate	SW 8270	ug/L	3.3		3.3	--	
Organics, Semi-volatile	p-Chloroaniline	SW 8270	ug/L	< 0.686		< 0.686	--	100%
Organics, Semi-volatile	p-Dimethylaminoazobenzene	SW 8270	ug/L	< 0.632		< 0.632	--	100%
Organics, Volatile	1,1,1-Trichloroethane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	1,1,2,2-Tetrachloroethane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	1,1,2-Trichloroethane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	1,1-Dichloroethane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	1,1-Dichloroethene	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	1,2-Dichloroethane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	1,2-Dichloroethene (total)	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	1,2-Dichloropropane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	2-Butanone (MEK)	SW 8240	ug/L	< 10	< 10	< 10	--	100%
Organics, Volatile	2-Hexanone	SW 8240	ug/L	< 10	< 10	< 10	--	100%
Organics, Volatile	4-Methyl-2-pentanone (MIBK)	SW 8240	ug/L	< 10	< 10	< 10	--	100%
Organics, Volatile	Acetone	SW 8240	ug/L	60	20	40	254	
Organics, Volatile	Benzene	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Bromodichloromethane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Bromoform	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Bromomethane	SW 8240	ug/L	< 10	< 10	< 10	--	100%
Organics, Volatile	Carbon Disulfide	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Carbon Tetrachloride	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Chlorobenzene	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Chloroethane	SW 8240	ug/L	< 10	< 10	< 10	--	100%
Organics, Volatile	Chloroform	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Chloromethane	SW 8240	ug/L	< 10	< 10	< 10	--	100%
Organics, Volatile	Dibromochloromethane	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Ethylbenzene	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Methylene Chloride	SW 8240	ug/L	< 5	3.5 J	< 5	--	71%
Organics, Volatile	Styrene	SW 8240	ug/L	< 5	< 5	< 5	--	100%
Organics, Volatile	Tetrachloroethene	SW 8240	ug/L	< 5	< 5	< 5	--	100%

Liquid Stream Data Summary

Sample Stream: Coal Pile Run-off

Analyte Group	Specie	Analytical Method	Units	Run 1	Run 2	Average	95% CI	DL Ratio
Organics, Volatile	Toluene	SW 8240	ug/L	< 5	< 5	< 5	- -	100%
Organics, Volatile	Trichloroethene	SW 8240	ug/L	< 5	< 5	< 5	- -	100%
Organics, Volatile	Vinyl acetate	SW 8240	ug/L	< 10	< 10	< 10	- -	100%
Organics, Volatile	Vinyl chloride	SW 8240	ug/L	< 10	< 10	< 10	- -	100%
Organics, Volatile	Xylenes	SW 8240	ug/L	< 5	< 5	< 5	- -	100%
Organics, Volatile	cis-1,3-Dichloropropene	SW 8240	ug/L	< 5	< 5	< 5	- -	100%
Organics, Volatile	trans-1,3-Dichloropropene	SW 8240	ug/L	< 5	< 5	< 5	- -	100%

APPENDIX I: DEVELOPMENT OF MASS BALANCE EQUATIONS AND EXAMPLE CALCULATIONS

Mass Balances

Mass balances for ash and trace metals around Plant Yates power generation and emission control systems were calculated as a check on data consistency. Mass balances were calculated for the following processes: boiler, ESP, JBR, and total plant. The mathematical expressions used are developed in the paragraphs below.

A general mass balance equation which applies to any system is:

$$\begin{bmatrix}\text{Accumulation of}\\ \text{Mass in System}\end{bmatrix} = \begin{bmatrix}\text{Mass into}\\ \text{System}\end{bmatrix} - \begin{bmatrix}\text{Mass out}\\ \text{of System}\end{bmatrix} + \begin{bmatrix}\text{Mass Generated}\\ \text{in System}\end{bmatrix} \tag{I-1}$$

For all species, the generation term in Equation I-1 is equal to zero. Ash is considered to be a component of coal and not to be generated. Mass balance closure is defined by the following expression:

$$\%\ \text{Closure} = 100 * \frac{\text{Out}}{\text{In} - \text{Accumulation}} \tag{I-2}$$

Uncertainties for mass balance closures (95% confidence intervals) were calculated using an error propagation analysis method based on ANSI/SME PTC 19.1-1985, "Measurement Uncertainty." The development of this method is treated in Appendix F.

The following sections detail the development of mass balances for the boiler, ESP, JBR and total plant (power generation and emission control systems). The equations are developed from Equation I-1 above. The purpose of this development is to present the variables considered in each mass balance. The equations presented below are simplified for clarity. The exact equations, which are more complex, are presented in Table I-1.

Table I-1
Detailed Mass Balance Equations

Mass Balance About Boiler:

$$\text{Closure} = 100 * \frac{\left(F_{coal}\ (1 - C_{w,coal})\ C_{ash,coal} - Q_{espin}\ C_{ash,espin}\right) C_{i,bottomash} + Q_{espin}\left(C_{i,espin,v} + C_{i,espin,s}\right)}{F_{coal}\left(1 - C_{w,coal}\right) C_{i,coal}}$$

Mass Balance About ESP:

$$\text{Closure} = 100 * \frac{\left(Q_{espin}\ C_{ash,espin} - Q_{espout}\ C_{ash,espout}\right) C_{i,collected\ ash} + Q_{espout}\left(C_{i,espout,v} + C_{i,espout,s}\right)}{Q_{espin}\left(C_{i,espin,v} + C_{i,espin,s}\right)}$$

Mass Balance About JBR:

$$\text{Closure} = 100 * \frac{O_{JBR}}{I_{JBR}}$$

where,

$$I_{JBR} = -\frac{\Delta M_i}{\Delta t} + Q_{espout}\left(C_{i,espout,v} + C_{i,espout,s}\right) + \left(F_{return,FT128} + F_{return,FT142} + F_{return,FT150B}\right)$$

$$* \ C_{i,return} + F_{makeup,FT150A}\ C_{i,makeup} + F_{ls}\left[\frac{C_{solids,ls}\ C_{i,solids,ls} + \hat{V}_{l,ls}\left(1 - C_{solids,ls}\right) C_{i,liq,ls}}{C_{solids,ls}\hat{V}_{s,ls} + \left(1 - C_{solids,ls}\right)\hat{V}_{l,ls}}\right]$$

$$O_{JBR} = F_{bdwn\ FT162A}\left[\frac{C_{solids,bdwn}\ C_{i,solids,bdwn} + \hat{V}_{l,bdwn}\left(1 - C_{solids,bdwn}\right) C_{i,liq,bdwn}}{C_{solids,bdwn}\ \hat{V}_{s,bdwn} + \left(1 - C_{solids}\right)\hat{V}_{l,bdwn}}\right]$$

$$+ \ Q_{stackgas}\left(C_{i,stackgas,v} + C_{i,stackgas,s}\right)$$

Table I-1 (Continued)

$$\frac{\Delta M_i}{\Delta t}=\frac{A_{\text{JBR}}}{\Delta t}\left[C_{\text{i,solids,JBR}}\left(\left[\frac{L_{\text{JBR}}C_{\text{solids,JBR}}}{C_{\text{solids,JBR}}\hat{V}_{\text{s,JBR}}+(1-C_{\text{solids,JBR}})\hat{V}_{\text{l,JBR}}}\right]_t-\left[\frac{L_{\text{JBR}}C_{\text{solids,JBR}}}{C_{\text{solids,JBR}}\hat{V}_{\text{s,JBR}}+(1-C_{\text{solids,JBR}})\hat{V}_{\text{l,JBR}}}\right]_{t-\Delta t}\right)\right.$$
$$\left.+C_{\text{i,liq,JBR}}\left(\left[\frac{L_{\text{JBR}}(1-C_{\text{solids,JBR}})\hat{V}_{\text{l,JBR}}}{C_{\text{solids,JBR}}\hat{V}_{\text{s,JBR}}+(1-C_{\text{solids,JBR}})\hat{V}_{\text{l,JBR}}}\right]_t-\left[\frac{L_{\text{JBR}}+(1-C_{\text{solids,JBR}})\hat{V}_{\text{l,JBR}}}{C_{\text{solids,JBR}}\hat{V}_{\text{s,JBR}}+(1-C_{\text{solids,JBR}})\hat{V}_{\text{l,JBR}}}\right]_{t-\Delta t}\right)\right]$$

Mass Balance About Entire Plant

$$\text{Closure} = 100 * \frac{O_{\text{plant}}}{I_{\text{plant}}}$$

where,

$$I_{\text{plant}} = -\frac{\Delta M_i}{\Delta t} + F_{\text{coal}}\,(1 - C_{\text{w,coal}})\;C_{\text{i,coal}} + (F_{\text{return,FT128}} + F_{\text{return,FT142}} + F_{\text{return,FT150B}})\;C_{\text{i,return}}$$
$$+\;F_{\text{makeup,FT150A}}\;C_{\text{i,makeup}} + F_{\text{ls}}\left[\frac{C_{\text{solids,ls}}\;C_{\text{i,solids,ls}} + \hat{V}_{\text{l,ls}}\,(1 - C_{\text{solids,ls}})\;C_{\text{i,liq,ls}}}{C_{\text{solids,ls}}\;\hat{V}_{\text{s,ls}} + (1 - C_{\text{solids,ls}})\;\hat{V}_{\text{l,ls}}}\right]$$

$$O_{\text{plant}} = Q_{\text{stackgas}}\,(C_{\text{i,stackgas,v}} + C_{\text{i,stackgas,s}})$$
$$+\;F_{\text{bdwn,FT162A}}\left[\frac{C_{\text{solids,bdwn}}\;C_{\text{i,solids,bdwn}} + \hat{V}_{\text{l,bdwn}}\,(1 - C_{\text{solids,bdwn}})\;C_{\text{i,liq,bdwn}}}{C_{\text{solids,bdwn}}\;\hat{V}_{\text{s,bdwn}} + (1 - C_{\text{solids,bdwn}})\;\hat{V}_{\text{l,bdwn}}}\right]$$
$$+\;\left[F_{\text{coal}}\,(1 - C_{\text{w,coal}})\;C_{\text{ash,coal}} - Q_{\text{espin}}\;C_{\text{ash,espin}}\right]\;C_{\text{i,bottomash}}$$
$$+\;\left[Q_{\text{espin}}\;C_{\text{ash,espin}} - Q_{\text{espout}}\;C_{\text{ash,espout}}\right]\;C_{\text{i,collectedash}}$$

Boiler

The following form of Equation I-1 applies to the boiler:

$$\text{Feed Coal} + \text{Air} = \text{Bottom Ash} + \begin{array}{c}\text{ESP Inlet Gas}\\ \text{(including entrained particulates)}\end{array} \qquad \text{(I-3)}$$

The accumulation term for ash and trace metal species in the boiler is small and was neglected. For ash, Equation I-3 is expressed mathematically as:

$$F_{coal}\, C_{ash,coal} = F_{bottomash} + Q_{espin}\, C_{ash,espin} \qquad \text{(I-4)}$$

Since the bottom ash flow rate could not be measured accurately, Equation I-4 was used to calculate it. The concentrations of trace metal species in combustion air are very low and were neglected. Applied to a trace metal species, Equation I-3 becomes:

$$F_{coal}\, C_{i,coal} = F_{bottomash}\, C_{i,bottomash} + Q_{espin}\, C_{i,espin} \qquad \text{(I-5)}$$

The exact equation used in calculating the data presented in Table 6-2 in Section 6 was obtained by substituting Equation I-4 into Equation I-5 and rewriting in closure format. This equation is located in Table I-1.

ESP

The following form of Equation I-1 applies to the ESP:

$$\text{ESP Inlet Gas} = \text{ESP Outlet Gas} + \text{ESP Collected Fly Ash} \qquad \text{(I-6)}$$

The accumulation term for solids and trace metals is small and was neglected. For ash, Equation I-6, expressed mathematically, becomes:

$$Q_{espin}\, C_{ash,espin} = Q_{espout}\, C_{ash,espout} + F_{collectedash} \qquad \text{(I-7)}$$

Since the collected fly ash flow rate could not be measured, Equation I-7 was used to solve for it. Applied for a trace species, Equation I-6 becomes:

$$Q_{espin}\, C_{i,espin} = Q_{espout}\, C_{i,espout} + F_{collectedash}\, C_{i,collectedash} \tag{I-8}$$

The exact equation used in calculating the data presented in Table 6-2 of Section 6 was obtained by substituting Equation I-7 into Equation I-8 and rewriting in closure format. This equation is located in Table I-1.

JBR

The following form of Equation 1 applies to the JBR:

$$\begin{matrix}\text{JBR}\\ \text{Accumulation}\end{matrix} = \begin{matrix}\text{ESP}\\ \text{Outlet Gas}\end{matrix} + \begin{matrix}\text{Makeup}\\ \text{Water}\end{matrix} + \begin{matrix}\text{Return}\\ \text{Water}\end{matrix} + \begin{matrix}\text{Limestone}\\ \text{Slurry}\end{matrix} + \begin{matrix}\text{Oxidation}\\ \text{Air}\end{matrix} - \left(\begin{matrix}\text{JBR Slurry}\\ \text{Blowdown}\end{matrix} + \begin{matrix}\text{Stack}\\ \text{Gas}\end{matrix}\right) \tag{I-9}$$

In the JBR, because of potential changes in volume or slurry solids concentration, the accumulation of solids and trace metals was not considered to be negligible over the test period. Mass flows of trace metal species in oxidation air are very low and were neglected. For a trace metal species, Equation I-1 becomes:

$$\begin{aligned}\frac{dM_i}{dt} &= Q_{espout}\, C_{i,espout} + F_{makeup}\, C_{i,makeup} + F_{return}\, C_{i,return}\\ &+ \left[F_{ls}\, C_{solids,ls} + F_{ls}\, C_{liq,ls}\, C_{i,liq,ls}\right]\\ &- \left[\left(F_{bdwn}\, C_{solids}\, C_{i,solids} + F_{bdwn}\, C_{liq,bdwn}\, C_{i,liq,bdwn}\right) + Q_{stackgas}\, C_{i,stackgas}\right]\end{aligned} \tag{I-10}$$

The accumulation term in Equation I-10 was approximated:

$$\frac{dM_i}{dt} \approx \frac{\Delta M_i}{\Delta t} \tag{I-11}$$

ΔM_i, the change in the mass of a species in the JBR over a test period, was calculated with the following equation:

$$\Delta M_i = A_{JBR}\ \Delta \left[\frac{L_{JBR}\ C_{solids,JBR}\ C_{i,solids} + L_{JBR}\left(1 - C_{solids,JBR}\right)\hat{V}_l\ C_{i,liq}}{C_{solids,JBR}\ \hat{V}_s + \left(1 - C_{solids,JBR}\right)\hat{V}_l} \right] \qquad \text{(I-12)}$$

The exact equation used in calculating the data presented in Table 6-2 of Section 6 was obtained by substituting Equation I-12 into Equation I-10 and rewriting in closure format. This equation is located in Table I-1. Densities used in making the above calculations are as follows: JBR solids (gypsum), 2.32 g/cc; limestone solids ($CaCO_3$), 2.72 g/cc; JBR and limestone liquid phase, 1.00 g/cc.

Total Plant

Equation I-1, applied to the combined power generation/emission control system is:

$$\begin{array}{c}\Sigma\ \text{Accumulation}\\ \text{in Each Vessel}\end{array} = \begin{array}{c}\text{Comb.}\\ \text{Air}\end{array} + \begin{array}{c}\text{Feed}\\ \text{Coal}\end{array} + \begin{array}{c}\text{Return}\\ \text{Water}\end{array} + \begin{array}{c}\text{Makeup}\\ \text{Water}\end{array} + \begin{array}{c}\text{Oxidated}\\ \text{Air}\end{array} + \begin{array}{c}\text{Limestone}\\ \text{Slurry}\end{array}$$

$$- \left(\begin{array}{c}\text{Stack}\\ \text{Gas}\end{array} + \begin{array}{c}\text{Blowdown}\\ \text{Slurry}\end{array} + \begin{array}{c}\text{ESP Collected}\\ \text{Fly Ash}\end{array} + \begin{array}{c}\text{Bottom}\\ \text{Ash}\end{array} \right) \qquad \text{(I-13)}$$

Since most trace metal species will be removed with the bottom and fly ash, the accumulation term in the JBR will be relatively small in the total plant balance. Accumulations in other vessels have been neglected in previous equations and are also neglected in Equation I-13. Trace metals concentrations in the combustion and oxidation air streams are very low and assumed negligible. Expressed mathematically for a trace species, Equation I-13 becomes:

$$\begin{aligned}\frac{\Delta M_{i,JBR}}{\Delta t} = {} & F_{coal}\ C_{i,coal} + F_{return}\ C_{i,return} + F_{makeup}\ C_{i,makeup} \\ & + \left[F_{LS}\ C_{solids,LS}\ C_{i,solids,LS} + F_{LS}\ C_{liq,LS}\ C_{i,liq,LS}\right] \\ & - \left[Q_{stackgas}\ C_{stackgas} + F_{bdwn}\ C_{solids,bdwn}\ C_{i,solids,bdwn}\right] \\ & - \left[F_{bdwn}\ C_{liq,bdwn}\ C_{i,liq,bdwn}\right] \\ & - \left[F_{collectedash}\ C_{i,collectedash} + F_{bottomash}\ C_{i,bottomash}\right]\end{aligned} \qquad \text{(I-14)}$$

The exact equation used in calculating the data presented in Table 6-2 of Section 6 was obtained by substituting Equations I-4 and I-7 into Equation I-14 and rewriting in closure format. This equation is located in Table I-1.

Example Calculations

Emission Factor

The unit-energy-based emission factors were determined by dividing the mass flow rate of a substance being emitted by the heat input to the boiler during testing. Mathematically, Equation 6-3 of Section 6 can be expressed as:

$$\text{Emission Factor for Species i} = \frac{Q_{stackgas}\left(C_{i,stackgas,s} + C_{i,stackgas,v}\right)}{H_{coal}\,F_{coal}\,\left(1 - C_{w,coal}\right)} \qquad \text{(I-15)}$$

Lead will be used for the following example calculation. The following data were taken from tables in Sections 3 and 5.

$Q_{stack\ gas}$ = 456,000 Nm^3/hr

$C_{i,stackgas,s}$ = 0.50 $\mu g/Nm^3$

$C_{i,stackgas,v}$ = $<$0.22 $\mu g/Nm^3$; for calculations, use 0.11 $\mu g/Nm^3$

H_{coal} = 12,700 Btu/lb

F_{coal} = 91,000 lb/hr (coal rejects subtracted)

$C_{w,coal}$ = 0.117 lb water/lb coal

The emission factor for lead is calculated directly from Equation I-15.

$$\text{Emission Factor, Pb} = 2202.6 * \frac{456{,}000\ (0.50 + 0.11)}{12{,}700 * 91{,}000\ (1 - 0.117)} = 0.6\frac{\text{lb}}{10^{12}\text{Btu}} \qquad \text{(I-16)}$$

Mass Balance

An example calculation for each of the mass balance equations presented in Table I-1 follows:

In this appendix, aluminum mass balance sample calculations are shown using equations and data from the report. The four sample calculations include boiler closure, ESP closure, JBR closure, and total plant closure.

Boiler Closure. The data required and the location of the data found in the report are shown below:

$C_{i,coal} = 1.45 \times 10^7\ \mu g/kg$ (Table 5-6)

$F_{coal} = 4.13 \times 10^4\ kg/hr\ (9.1 \times 10^4\ lb/hr)$ (Table 3-7)

$C_{w,coal} = 0.117\ kg/kg$ (Table 3-7)

$C_{ash,coal} = 0.111\ kg/kg$ (Table 3-7)

$Q_{espin} = 2.84 \times 10^5\ dscfm\ (4.5 \times 10^5\ Nm^3/hr)$ (Table 3-7)

$C_{ash,espin} = 3.64\ gr/dscf\ (0.00896\ kg/Nm^3)$ (Table 3-7)

$C_{i,bottomash} = 7.61 \times 10^7\ \mu g/kg$ (Table 5-7)

$C_{i,espin,s} = 8.7 \times 10^5\ \mu g/Nm^3$ (Table 5-2)

$C_{i,espin,v} = 146\ \mu g/Nm^3$ (Table 5-2)

The material balance around the boiler is represented by the following equation:

$$Closure_{boiler} = 100 * \frac{\left(F_{coal}\,(1 - C_{w,coal})\,C_{ash,coal} - Q_{espin}\,C_{ash,espin}\right)C_{i,bottomash} + Q_{espin}\left(C_{i,espin,v} + C_{i,espin,s}\right)}{F_{coal}\left(1 - C_{w,coal}\right)C_{i,coal}}$$

Substitution of the values listed above results in the following boiler closure for aluminum:

$Closure_{boiler} = 74\%$

ESP Closure. The data used in calculating the material balance closure around the ESP are shown as follows:

$Q_{espin} = 2.84 \times 10^5\ dscfm\ (4.5 \times 10^5\ Nm^3/hr)$ (Table 3-7)

$C_{i,espin,s} = 8.7 \times 10^5\ \mu g/Nm^3$ (Table 5-2)

$C_{i,espin,v} = 146\ \mu g/Nm^3$ (Table 5-2)

$Q_{espout} = Q_{espin}\ (4.5 \times 10^5\ Nm^3/hr)$ (Table 3-7)

$C_{i,espout,s} = 1.21 \times 10^4\ \mu g/Nm^3$ (Table 5-2)

$C_{i,espout,v} = 57.5\ \mu g/Nm^3$ (Table 5-2)

$C_{ash,espin}$ = 3.64 gr/dscf (8.96 x 10^{-3} kg/Nm^3) (Table 3-7)

$C_{ash,espout}$ = 0.0577 gr/dscf (1.42 x 10^{-4} kg/Nm^3) (Table 3-7)

$C_{i,collectedash}$ = 9.8 x 10^7 μg/kg (Table 5-7)

The material balance closure equation for the ESP is represented by the following equation:

$$\mathrm{Closure}_{ESP} = 100 * \frac{\left(Q_{espin}\ C_{ash,espin} - Q_{espout}\ C_{ash,espout}\right)\ C_{i,collected\ ash} + Q_{espout}\left(C_{i,espout,v} + C_{i,espout,s}\right)}{Q_{espin}\left(C_{i,espin,v} + C_{i,espin,s}\right)}$$

After substitution of the data presented above into this equation, the material balance closure for aluminum around the ESP is calculated to be:

$\mathrm{Closure}_{esp}$ = *101%*

JBR Closure. Unlike the other unit operations considered at Plant Yates, the accumulation term for the JBR could be important in the material balance calculations. This is because the residence time of the slurry in the JBR is much greater than any of the sampling times. The first step shown is the calculation for one of the runs in Test Period 1. An average accumulation rate was calculated for each test period; the average of these was then used in the mass balance calculations.

Data required to calculate accumulation are as follows:

$C_{i,liq,JBR}$ = 10.7 mg/L (1.07 x 10^7 μg/m^3) (App. H, Run-1)

A_{JBR} = 127 m^2 (Design Drawings)

Δt = 8 hr (Run 1)

$C_{i,solids,JBR}$ = 1.03 x 10^6 μg/kg (App. H, Run 1)

$L_{JBR,t-\Delta t}$ = 4.29 m (Average in Table 6-1)

$V_{s,JBR}$ = 0.000431 m^3/kg (Sp. Gr. = 2.32) (App. I, p. 6)

$V_{l,JBR}$ = 0.001 m^3/kg (Sp. Gr. = 1.0) (App. I, p. 6)

$C_{solids,JBR,t-\Delta t}$ = 0.222 kg/kg (Average % solids in Table 6-1)

$C_{solids,JBR,t}$ = 0.223 kg/kg (Average % solids in Table 6-1)

$L_{JBR,t}$ = 4.3 m (Average level in Table 6-1)

The accumulation term ($\Delta m_i/\Delta t$) is represented by the following equations. The change in mass of aluminum contained in the JBR during the run is calculated:

$$\Delta m_i = A_{JBR}\left[\begin{array}{l} C_{i,solids,JBR}\left[\left[\dfrac{L_{JBR,t}C_{solids,JBR,t}}{C_{solids,JBR,t}\hat{V}_{s,JBR} + (1-C_{solids,JBR,t})\hat{V}_{l,JBR}}\right] - \left[\dfrac{L_{JBR,t-\Delta t}C_{solids,JBR,t-\Delta t}}{C_{solids,JBR,t-\Delta t}\hat{V}_{s,JBR} + (1-C_{solids,JBR,t-\Delta t})\hat{V}_{l,JBR}}\right]\right] \\ + C_{i,liq,JBR}\left[\left[\dfrac{L_{JBR,t}(1-C_{solids,JBR,t})\hat{V}_{l,JBR}}{C_{solids,JBR,t}\hat{V}_{s,JBR} + (1-C_{solids,JBR,t})\hat{V}_{l,JBR}}\right] - \left[\dfrac{L_{JBR,t-\Delta t}(1-C_{solids,JBR,t-\Delta t})\hat{V}_{l,JBR}}{C_{solids,JBR,t-\Delta t}\hat{V}_{s,JBR} + (1-C_{solids,JBR,t-\Delta t})\hat{V}_{l,JBR}}\right]\right] \end{array}\right]$$

The accumulation of aluminum in the JBR during Run 1 is the change in mass divided by the length of the run and is calculated to be:

$acc = \Delta m_i/\Delta t$ $\qquad$ $acc = 1.37 \times 10^8$ µg/hr

In a similar manner, the accumulations in Runs 2 and 3 were calculated and when combined with the accumulation from Run 1, an average accumulation of 1.42×10^8 µg/hr was calculated. This average accumulation is used with the following data to calculate mass balance closure around the JBR:

$acc_{avg} = 1.42 \times 10^8$ µg/hr

$Q_{espout} = 2.84 \times 10^5$ dscfm (4.5×10^5 Nm^3/hr) (Table 3-7)

$C_{i,espout,s} = 1.21 \times 10^4$ µg/Nm^3 (Table 5-2)

$C_{i,espout,v} = 57.5$ µg/Nm^3 (Table 5-2)

$F_{makeup,FT150A} = 26.8$ gal/min (6.09 m^3/hr) (Mat'l bal. average in Table 6-1 Mist Elim/Deck Wash [Ash Pond Return])

$C_{i,makeup} = 0.176$ mg/L (1.76×10^5 µg/m^3) (Table 5-10)

$F_{return,FT128} = 78.9$ gal/min (17.9 m^3/hr) (Mat'l bal. average in Table 6-1 Transition Duct PW Flow [Gypsum Pond Return])

$F_{return,FT142} = 39.9$ gal/min (9.06 m^3/hr) (Mat'l bal. average in Table 6-1)

$F_{return,FT150B} = 6.39$ gal/min (1.45 m^3/hr) (Mat'l bal. average in Table 6-1)

$C_{i,return} = 2.04$ mg/L (2.04×10^6 µg/m^3) (Table 5-10)

$F_{ls} = 36.5$ gal/min (8.29 m^3/hr) (Mat'l bal. average in Table 6-1 Reagent Flow)

$C_{solids,ls}$ = 0.361 kg/kg (Mat'l bal. average in Table 6-1)

$C_{i,liq,ls}$ = 6.78 x 10^{-2} mg/L (6.78 x 10^{4} μg/m^3) (App. H, Run 3d substituted for Run 3)

$F_{bdwn,FT162A}$ = 78.4 gal/min (17.8 m^3/hr) (JBR blowdown in Table 6-1)

$C_{solids,bdwn}$ = 0.229 kg/kg (JBR density, mat'l bal. average in Table 6-1)

$C_{i,solids,bdwn}$ = 1.1 x 10^{3} μg/gm (1.1 x 10^{6} μg/kg) (Table 5-9)

$V_{s,ls}$ = 0.000367 m^3/kg (App. I, p. 6)

$V_{l,ls}$ = 0.001 m^3/kg (App. I, p. 6)

$V_{s,bdwn}$ = 0.00431 m^3/kg (Sp. Gr. = 2.32) (App. I, p. 6)

$V_{l,bdwn}$ = 0.001 m^3/kg (Sp. Gr. = 1.0) (App. I, p. 6)

$C_{i,solids,ls}$ = 756 μg/gm (7.56 x 10^{5} μg/kg) (Table 5-9)

$C_{i,liq,bdwn}$ = 12.3 mg/L (1.23 x 10^{7} μg/m^3) (Table 5-10)

$Q_{stackgas}$ = 2.88 x 10^{5} dscfm (4.56 x 10^{5} Nm^3/hr) (Table 3-7)

$C_{i,stackgas,s}$ = 191 μg/Nm^3 (Table 5-2)

$C_{i,stackgas,v}$ = 4.35 μg/Nm^3 (Table 5-2)

With these input values, the terms I_{SBR} and O_{JBR} can be calculated as shown below:

$$I_{JBR} = -\frac{\Delta M_i}{\Delta t} + Q_{espout}\left(C_{i,espout,v} + C_{i,espout,s}\right) + \left(F_{return,FT128} + F_{return,FT142} + F_{return,FT150B}\right)$$

$$* \; C_{i,return} + F_{makeup,FT150A}\, C_{i,makeup} + F_{ls}\left[\frac{C_{solids,ls}\; C_{i,solids,ls} + \hat{V}_{l,ls}\left(1 - C_{solids,ls}\right)\; C_{i,liq,ls}}{C_{solids,ls}\hat{V}_{s,ls} + \left(1 - C_{solids,ls}\right)\hat{V}_{l,ls}}\right]$$

I_{JBR} = 8.32 x 10^{9} μg/hr

$$O_{JBR} = F_{bdwn\ FT162A} \left[\frac{C_{solids,bdwn}\ C_{i,solids,bdwn} + \hat{V}_{l,bdwn}\ \left(1 - C_{solids,bdwn}\right)\ C_{i,liq,bdwn}}{C_{solids,bdwn}\ \hat{V}_{s,bdwn} + \left(1 - C_{solids}\right)\ \hat{V}_{l,bdwn}} \right]$$
$$+ Q_{stackgas}\ \left(C_{i,stackgas,v} + C_{i,stackgas,s}\right)$$

$O_{JBR} = 5.44 \times 10^{9}\ \mu g/hr$

Mass balance closure for aluminum around the JBR is calculated to be:

$Closure_{JBR} = 100 * O_{JBR}/I_{JBR} = 65\%$

Note that the accumulation of aluminum in the JBR (1.42 x 10^{8} μg/hr) is small relative to the throughput (outlet equals 5.5 x 10^{9} μg/hr). However, the accumulation calculations are based on a single concentration and only reflect changes in the JBR density and level.

Total Plant Closure. All of the data required for the total plant calculations have been specified in previous calculations. The total flow of aluminum into the plant (minus JBR accumulation) is calculated according to the following equation:

$$I_{plant} = -\frac{\Delta M_i}{\Delta t} + F_{coal}\ \left(1 - C_{w,coal}\right)\ C_{i,coal} + \left(F_{return,FT128} + F_{return,FT142} + F_{return,FT150B}\right)\ C_{i,return}$$
$$+ F_{makeup,FT150A}\ C_{i,makeup} + F_{ls} \left[\frac{C_{solids,ls}\ C_{i,solids,ls} + \hat{V}_{l,ls}\ \left(1 - C_{solids,ls}\right)\ C_{i,liq,ls}}{C_{solids,ls}\ \hat{V}_{s,ls} + \left(1 - C_{solids,ls}\right)\ \hat{V}_{l,ls}} \right]$$

Substituting values defined above, the mass flow of aluminum into the plant becomes:

$L_{plant} = 5.32 \times 10^{11}\ \mu g/hr$

The total flow of aluminum exiting the plant is calculated with the following equation:

$$O_{plant} = Q_{stackgas}\ \left(C_{i,stackgas,v} + C_{i,stackgas,s}\right)$$
$$+ F_{bdwn,FT162A} \left[\frac{C_{solids,bdwn}\ C_{i,solids,bdwn} + \hat{V}_{l,bdwn}\ \left(1 - C_{solids,bdwn}\right)\ C_{i,liq,bdwn}}{C_{solids,bdwn}\ \hat{V}_{s,bdwn} + \left(1 - C_{solids,bdwn}\right)\ \hat{V}_{l,bdwn}} \right]$$
$$+ \left[F_{coal}\ \left(1 - C_{w,coal}\right)\ C_{ash,coal} - Q_{espin}\ C_{ash,espin}\right]\ C_{i,bottomash}$$
$$+ \left[Q_{espin}\ C_{ash,espin} - Q_{espout}\ C_{ash,espout}\right]\ C_{i,collectedash}$$

Again, values previously given are substituted, which results in the outlet mass flow for aluminum being:

$O_{plant} = 3.95 \times 10^{11}$ µg/hr

Using the mass flows inlet and outlet,the overall plant closure for aluminum is calculated:

$\text{Closure}_{plant} = 100 * O_{plant}/I_{plant} = 75\%$

Removal Efficiencies

An example will be developed for lead removal in the JBR. Equation 6-4 applied to the JBR becomes:

$$\%\ \text{Removal} = \left[\frac{1 - Q_{stackgas}\left(C_{i,stackgas,s} + C_{i,stackgas,v}\right)}{Q_{espout}\left(C_{i,espout,s} + C_{i,espout,v}\right)}\right] * 100 \qquad \text{(I-17)}$$

The following data were obtained from tables in Sections 3 and 5.

$Q_{stackgas} = 456{,}000\ \text{Nm}^3/\text{hr}$

$C_{i,stackgas,s} = 0.50\ \mu\text{g/Nm}^3$

$C_{i,stackgas,v} = <0.22\ \mu\text{g/Nm}^3$; for calculations use $0.11\ \mu\text{g/Nm}^3$

$Q_{ESPout} = 450{,}000\ \text{Nm}^3/\text{hr}$

$C_{i,ESPout,s} = 18\ \mu\text{g/Nm}^3$

$C_{i,ESPout,v} = 0.4\ \mu\text{g/Nm}^3$

The removal efficiency for lead is calculated directly from Equation I-17.

$$\text{Removal Efficiency of JBR for Pb} = \left[1 - \frac{456{,}000\ (0.50 + 0.11)}{450{,}000\ (18 + 0.4)}\right] * 100 = 96.7\% \qquad \text{(I-18)}$$

Nomenclature

A	Cross-sectional area, m^2
C	Concentration $\mu g/Nm^3$ (gas), µg/L (liquid), µg/kg (solid), or weight fraction (ash or water fraction)
F	Coal flow rate, kg/hr or water/slurry flow rate, m^3/hr
L	Level, m

Q	Gas flow rate, Nm^3/hr
$\hat{V}$,V	Specific volume, m^3/kg

Subscripts

bdwn	JBR blowdown slurry
bottomash	Bottom ash
coal	Feed coal
collectedash	ESP sluiced ash
espin	ESP inlet
espout	ESP outlet
FTx	As indicated by flow transmitter x (flow from data acquisition system)
i	Species, i
JBR	JBR
l, liq	Liquid
ls	Limestone slurry
makeup	FGD makeup water (ash pond return)
return	Gypsum pond return
s	Solid phase
solids	Solids
stackgas	Stack gas
v	Vapor phase
w	Water