AP42 Section:	1.1
Reference:	49
Title:	Field Chemical Emissions Monitoring Project: Site 12 Emissions Monitoring. Radian Corporation, Austin, Texas. November, 1992. (EPRI Report)

Ref 12

EPRI

Preliminary Draft

FIELD CHEMICAL EMISSIONS MONITORING PROJECT:

SITE 12 EMISSIONS MONITORING

EPRI Project RP3177-1

November 1992

Prepared by:
Radian Corporation
P.O. Box 201088
8501 Mo-Pac Boulevard
Austin, Texas 78759

Prepared For:

Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, California 94304

DCN 92-213-152-27

FIELD CHEMICAL EMISSIONS MONITORING PROJECT: SITE 12 EMISSIONS REPORT

PRELIMINARY DRAFT REPORT

Prepared for:

Winston Chow, P.E.
Program Manager
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, California 94303

Prepared by:

Radian Corporation
P.O. Box 201088
8501 North Mopac Boulevard
Austin, Texas 78759

23 November 1992

EPRI
Electric Power
Research Institute *Leadership in Science and Technology*

November 20, 1992

Mr. William H. Maxwell, P.E. (MD13)
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Maxwell:

In response to the Clean Air Act Amendments of 1990, the Electric Power Research Institute (EPRI) initiated the PISCES (Power Plant Integrated Systems: Chemical Emissions Studies) program to better characterize the source, distribution, and fate of trace elements from utility fossil-fuel-fired power plants. As part of the PISCES program, the Field Chemical Emissions Monitoring (FCEM) program has sampled extensively at a number of utility sites, encompassing a range of fuels, boiler configurations, and particulate, SO_2, and NO_x control technologies. EPRI is actively pursuing additional FCEM sampling programs, with at least 22 sites either completed or planned.

This site report presents a preliminary summary of data gathered during a sampling program conducted at one of the FCEM sampling programs - Site 12. Site 12 consists of a pulverized coal-fired boiler burning bituminous coal, an electrostatic precipitator, and a wet limestone flue gas desulfurization (FGD) system. **It should be noted that the results presented in this report are considered PRELIMINARY.** The results are believed to be essentially correct except as noted. As additional data from other sites are collected and evaluated, however, EPRI may conduct verification tests at this site. If this is done, the new data will be made available to the Environmental Protection Agency (EPA).

The primary objective of this report is to transmit the preliminary results from Site 12 to the EPA for use in evaluating select trace chemical emissions from fossil-fuel-fired steam generating plants. In addition to the raw data in the Appendix, the report provides an assessment of the trace metals material balances, discusses the data quality, identifies suspect data, and offers possible explanations for the questionable data. Because the discussion only focuses upon the suspect or invalidated data, please keep in mind that most of the data meet the standards of quality established for this study. This report does not compare the results from Site 12 with the results from previous utility sites. Generic conclusions and recommendations were not drawn concerning the effectiveness of the ESP or the wet FGD system as potential control

Headquarters: 3412 Hillview Avenue, Post Office Box 10412, Palo Alto, CA 94303, USA • (415) 855-2000 • Telex: 82977 EPRI UF • Fax: (415) 855-2954
Washington Office: 1019 Nineteenth Street, NW, Suite 1000, Washington, DC 20036, USA • (202) 872-9222 • Fax: (202) 296-5436

technologies for trace elements; however, removal efficiencies were calculated where possible. Nor does this site report attempt to address the environmental and health risk impacts associated with the trace chemical emissions.

A thorough evaluation of the results from Site 12 revealed that some sampling and analytical errors may have occurred. The data have been qualified to note potential sampling or analytical errors, and where significant biases or inconsistencies were substantiated, the data were discarded. The two most notable examples were the flue gas measurements of the volatile organic compounds (VOCs) and mercury.

At Site 12, a teflon-lined probe, instead of the glass-lined probe specified in the EPA sampling protocol, was used to sample for the VOCs. EPRI later retested using a glass-lined probe. This retest confirmed that the results from the teflon-lined probe were contaminated and were invalid, and thus excluded. Only the results using the glass-lined probe are included in this site report.

The Site 12 mercury measurements in flue gas are believed to be biased low due to incomplete recovery of mercury from the impinger solution prior to analysis. The material balance calculations indicated that approximately 35% of the mercury in the inlet streams could be accounted for in the outlet streams. The mercury data are included in the report, even though the data are suspect, because they do provide an approximation for mercury emissions. The reader is strongly advised to exercise good scientific judgment in using the flue gas mercury concentrations in any further evaluations.

EPRI hopes that this site report is of assistance to the EPA in evaluating utility trace chemical emissions as well as the associated health risk impacts.

Sincerely,

Paul Chu
Manager, Toxic Substances Control
Environment Division

LIST OF ILLUSTRATIONS

LIST OF TABLES

CONTENTS

Section 1

INTRODUCTION

This report presents a summary of data gathered during a sampling program sponsored by the Electric Power Research Institute (EPRI). The data have been prepared in a manner suitable for use by the Environmental Protection Agency to study emissions from fossil-fuel-fired power plants as mandated by the Clean Air Act Amendments of 1990.

The plants studied during this project were chosen to reflect a cross section of the existing technologies for controlling air emissions. They were not chosen to represent "typical" fossil-fuel-fired power plant operation per se, nor should the solid or aqueous waste treatment systems used or discharge levels achieved be deemed representative of the industry as a whole.

The project examined the fate of selected substances found in the process streams at the host site. Pertinent analytical data generated during the project are presented in the appendices. The body of the report presents information relative to the coal and gas stream compositions. Information for the gas streams is presented on both a concentration and unit energy basis.

This report is one of a series being produced under the Field Chemical Emissions Monitoring (FCEM) project (RP 3177-1) sponsored by EPRI. The objective of this project has been to measure certain inorganic and organic substances in the process and discharge streams of power plants. Table 1-1 presents the list of substances which are of interest to the program. Data for additional substances detected by the analytical methods employed are presented in Appendix C. By characterizing all streams of interest, information regarding the control and fate of these substances can be developed.

This report presents summarized information about stack emissions from the operation of a balanced draft, natural circulation boiler burning medium sulfur bituminous coal. Sampling was conducted during the late summer of 1990. The stack emissions were resampled in August 1992 for volatile organic substances. **It should be noted that the results presented herein are considered preliminary.** At the present time, they are believed to be correct; however, as information is obtained from other sites, existing samples are occasionally reanalyzed to obtain additional information, often by alternate analytical procedures. Plants also have been resampled when the initial results do not appear to be reasonable indicators of process performance.

The results reported in this document are of generally good quality and meet the objectives of the FCEM study. They provide a more accurate and comprehensive

Table 1-1

FCEM Substances

Elements	Organic Compounds
Arsenic	Benzene
Barium	Toluene
Beryllium	Formaldehyde
Cadmium	Polycyclic Organic Matter (POM) [a]
Chlorine (as chloride)	
Chromium	
Cobalt	
Copper	
Fluorine (as fluoride)	
Lead	
Manganese	
Mercury	
Molybdenum	
Nickel	
Phosphorus	
Selenium	
Vanadium	

[a]Also referred to as semivolatile organic compounds. Includes polynuclear aromatic hydrocarbons (PAHs).

characterization of a power plant system than is often found in the published literature. The samples upon which the reported results are based have been collected in a careful manner using accepted and appropriate sampling and analytical methods. The sampling and analytical results have been subjected to an extensive QA/QC evaluation (a separate QA/QC report is provided in Appendix F). In this report, the data which are of satisfactory quality are simply reported and not extensively discussed. The focus of the discussions is, instead, on those results which are questionable, uncertain, or known to be of poor quality. This focus is provided to express our concerns with respect to the representativeness of the levels of the reported parameters.

The technical approach used at each plant has been to employ "standard" sampling and analytical procedures to the extent possible, i.e., the FCEM program is not a methods development or research program designed to measure extremely low levels of emissions. The target detection level for the selected substances in gas streams was initially chosen as 20 $\mu g/Nm^3$ (as the FCEM project has progressed, lower detection levels for some species have been sought to provide more detailed information). The sampling protocol is to obtain three sets of samples for chemical analysis of each process stream. The results are presented both by individual run and as an average, with a 95% confidence interval about the mean presented to incorporate process, sampling, and analytical variability.

Section 2 of this report presents a brief description of the plant and sample locations. Section 3 presents the chemical analysis of the coal and the two gas streams sampled at the plant. Section 4 discusses the results in terms of both analytical and engineering considerations. Section 5 presents example calculations, and a glossary of terms is provided in Section 6. The appendices present sampling and analytical methods, stream concentrations, measured and calculated stream flows, particulate measurement results, QA/QC information, and blank correction data.

Section 2

SITE DESCRIPTION

Descriptions of the test site (Site 12) and the sampling locations are given in this section of the report.

Facility Information

Site 12 includes an approximately 700-MW coal-fired steam electric generating unit which commenced commercial operation in the mid-1980s. A process flow diagram of the plant is given in Figure 2-1.

Steam is generated in a Babcock and Wilcox balanced draft, opposed-wall, natural circulation, pulverized coal-fired radiant boiler. The boiler contains 48 burners; the burners are placed at three elevations on the front and rear walls of the boiler. Bottom ash is removed from the boiler ash hoppers via an ash sluicing system. An electrostatic precipitator (ESP) system removes fly ash from the boiler flue gases. A wet flue gas desulfurization (FGD) system is used to control sulfur dioxide emissions.

Plant wastewaters and liquids are collected, treated in a liquid treatment system (LTS) and recycled within the plant. The flue gas treatment, ash removal, FGD waste handling, and liquid waste treatment facilities are described in greater detail below.

Flue Gas Treatment Facilities

An illustration of the flue gas treatment facilities is provided in Figure 2-2. Four ducts distribute the flue gas evenly to the "A" and "B" sides of two electrostatic precipitators. These electrostatic precipitators are equipped with an Energy Management System (EMS), in use during the test program, to optimize energy consumption of these units. (In Figure 2-2, a top view of the flue gas treatment facilities, the dots represent sampling locations. Also, "A" sides are to the left of each ESP, and the "B" sides are to the right.)

The low-dust gas leaving the electrostatic precipitators enters a wet limestone scrubber system to remove sulfur dioxide. This FGD system utilizes six scrubber modules. Usually, four modules are on-line and the remaining modules are on standby or undergoing maintenance. Freshwater and recycled wastewater treatment effluents are used to prepare the limestone slurry. Emulsified sulfur is also added to improve scrubber performance. Limestone slurry is added to the scrubber system to maintain the pH of the recirculating slurry at the desired set point. A portion of the recirculating slurry is directed to a waste slurry sump and subsequently to thickeners for dewatering. After the

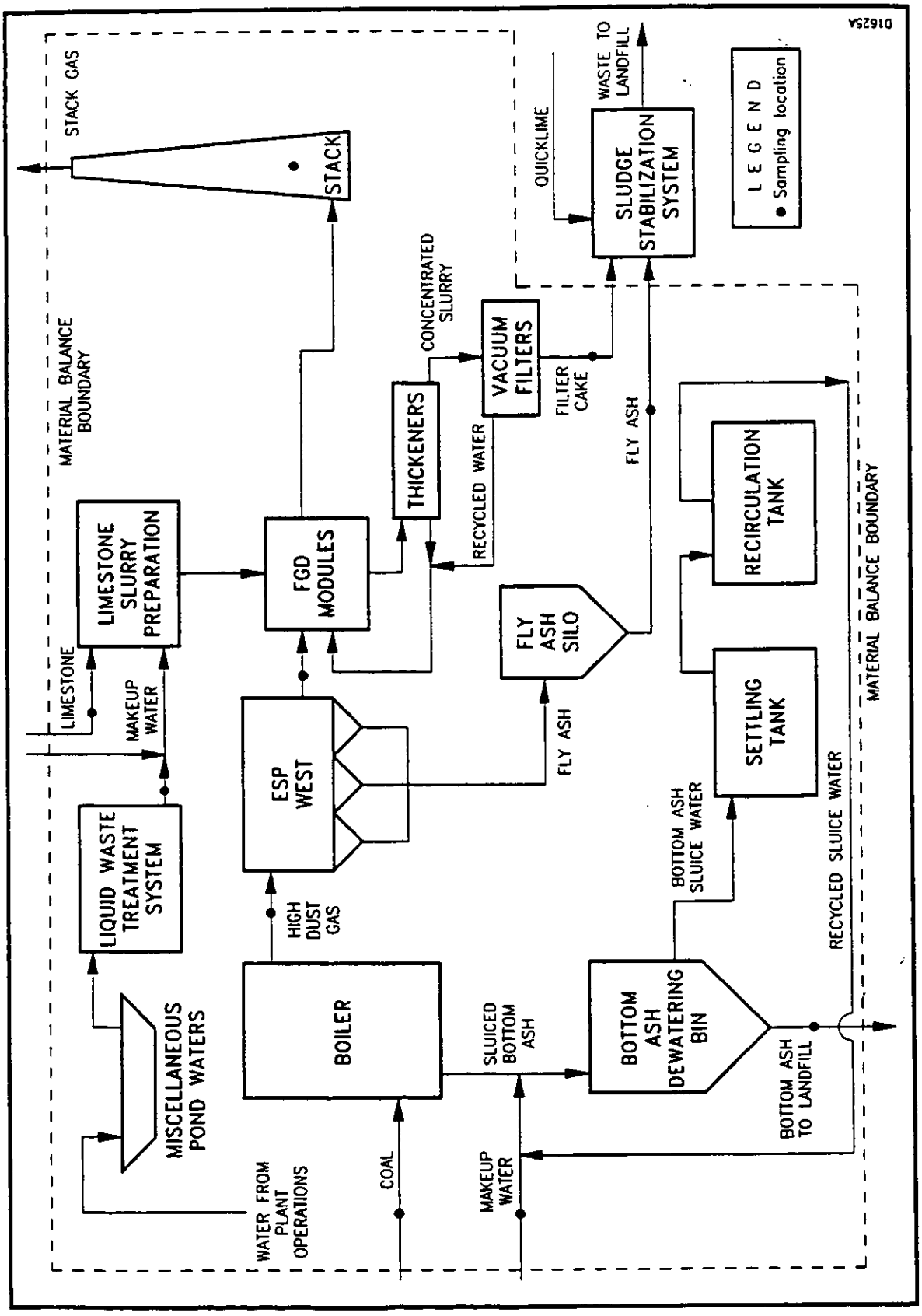

Figure 2-1. Process Flow Diagram for Site 12

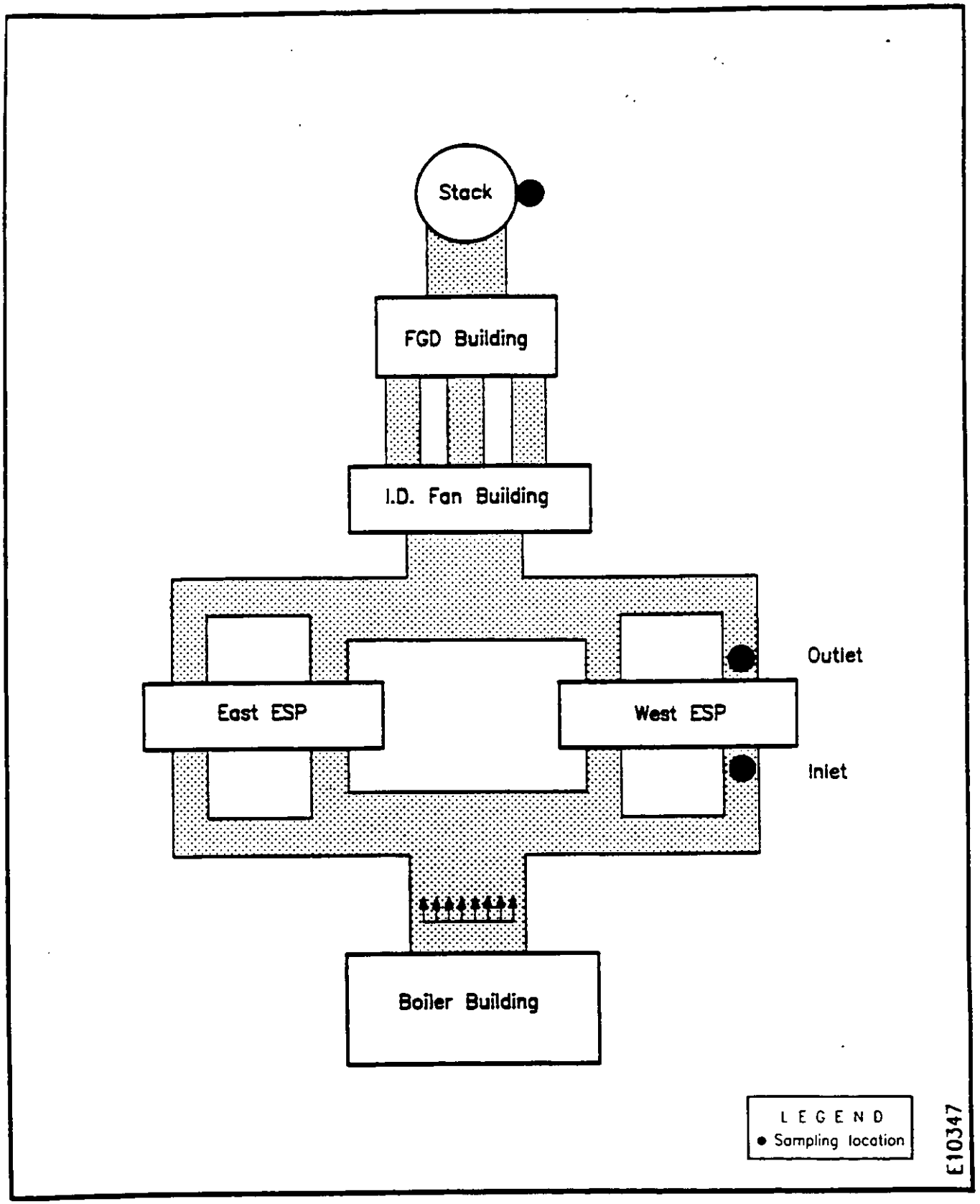

Figure 2-2. Diagram of the Flue Gas Treatment System for Site 12

scrubbed flue gases travel through mist eliminators, the gas streams are subsequently combined and discharged through a stack.

Ash Removal Facilities

A wet system is used to convey bottom ash to the storage and disposal system, whereas, a dry system is used to convey the fly ash.

Bottom ash collects in the boiler ash hopper and is discharged through a clinker grinder to an ash sluice system. The sluice system transports the bottom ash to one of two dewatering bins where the sluice water is decanted into a second settling tank. The clarified water then overflows to a storage tank for recirculation in the sluicing loop. Solids collected in the settling and storage tanks are returned to the dewatering bins. Bottom ash from the dewatering bins is transported by truck to an on-site landfill for disposal. Water is added to the system to make up evaporative loss and replace water entrained with the ash.

Fly ash collects in ESP hoppers and is pneumatically conveyed to a fly ash silo in the FGD waste handling facility for blending and stabilization with dewatered FGD waste and a small amount of quicklime. The resulting stabilized sludge is landfilled on site.

FGD Waste Handling Facilities

As discussed previously, a portion of the FGD scrubber slurry is diverted to the waste slurry sump and then to thickeners where the slurry is concentrated to approximately 35 weight percent solids. The thickener overflow (supernate) is recirculated within the FGD system. The thickener underflow is pumped to the sludge stabilization system for further dewatering with a rotary drum vacuum filter. The resulting filter cake is blended and stabilized with quicklime and fly ash, and the stabilized sludge is land disposed on site. The filtrate is returned to the thickeners.

Liquid Treatment Facilities

The LTS processes three types of liquid wastes:

- Demineralizer regenerant wastes and boiler blowdown;
- Material storage pile runoff and maintenance cleaning wastes; and
- Drainage from contaminated yard areas and building, floor, and equipment drainage.

The LTS treats the wastes either for recycling to the FGD system or for permitted discharge to a nearby lake. In the water reuse mode, the wastewater is processed through an oil-water separator, a reaction tank for pH adjustment, and a Lamella separator for suspended solids removal. The Lamella separator sludge is dewatered by means of thickeners and belt presses and disposed at an approved disposal site.

The LTS was operating in the reuse mode during the test.

Sampling Locations

Samples were collected at 11 locations in the plant. Three feed streams were sampled: coal, limestone, and makeup water. Three intermediate process streams were sampled: the recycled plant water to the FGD system, the inlet gas to the electrostatic precipitators, and the outlet gas from the electrostatic precipitators. In addition, four discharge streams were sampled: the emitted gases from the stack, the bottom ash, the fly ash, and the dewatered FGD scrubber solids. The locations of the sampling points are represented in Figure 2-1. A brief description of each sampling location is provided below:

- Coal samples were collected by plant personnel from the "as fired" coal sampling system located at the discharge end of two conveyors within the transfer house prior to milling.

- Limestone samples were collected from an active limestone weigh belt located in the FGD building.

- Makeup water samples were collected from a service water tap.

- Samples of the recycled plant water from the wastewater treatment facility were collected from a bleed valve located on an active water recycle pump in the wastewater treatment building.

- A portion of the flue gases entering the electrostatic precipitator system was sampled at ports located at the west side (B) entrance duct to the west side ESP (Figure 2-2). This entrance duct is one of four ducts entering the fly ash removal system. This location was selected after a review of historical records indicated a relatively even flow distribution of gases through each of the four ducts.

- Flue gases leaving the electrostatic precipitator system were sampled at ports located at the west side exit duct from the west side (B) ESP (Figure 2-2). This sampling location was selected to ensure that the same parcel of gas which entered the ESP system was sampled at the exit of the ESP system.

- Gases emitted from the plant were sampled at ports located in the stack.

- Bottom ash samples (liquid and solid) were collected at the bottom ash land disposal site during a bottom ash disposal event.

- Fly ash samples were collected by plant personnel from the fly ash silo located adjacent to the sludge stabilization building.

- Samples of dewatered FGD sludge were collected from the conveyor belt which transfers the FGD filter cake from the vacuum filters to the mixers where fly ash and quicklime are added to stabilize the sludge.

Sample collection, sample pretreatment, and chemical analysis procedures are summarized in Appendix A. Table 2-1 presents an overview of the types of analyses performed on these samples.

Table 2-1

Process Stream Analyses

Stream	Metals	Anions	Volatile Organic Compounds	Semivolatile Organic Compounds	Aldehydes
Coal	✓	✓			
Limestone	✓	✓			
Bottom Ash	✓	✓			
Collected Fly Ash	✓	✓			
FGD Solids	✓	✓			
ESP Inlet Gas	✓	✓	✓	✓	✓
FGD Inlet Gas	✓	✓	✓	✓	✓
Stack Gas	✓	✓	✓	✓	✓
Service Water	✓	✓			
Wastewater Treatment Effluent	✓	✓			

Section 3

RESULTS

This section presents a summary of the results from coal characterization and gas stream analyses. Additional relevant data are presented in the appendices.

Sampling Schedule

Site 12 was initially sampled in late July and early August 1990. The plant was operated at approximately full-load conditions during all testing. To obtain samples for the analytes in Table 1-1, five sampling trains were used for sampling the ESP inlet, outlet, and stack gases. The multi-metals and semivolatile trains require full traversing of the ducts. The other three trains (VOST, anions, and aldehydes) are sampled at single points. Because of equipment failures, it was not possible to complete the sampling with all five trains on three successive days. Figure 3-1 presents the actual schedule showing when the various gas train measurements were conducted. To our knowledge, there is no reason to suspect that the operation of the plant during any test day was irregular and would, therefore, have resulted in a nonrepresentative data set. However, there is a high probability that two of the metal sample gas trains were misidentified. This issue is also addressed later.

As shown on Figure 3-1, three VOST (volatile organic sampling train) runs were conducted. Upon reviewing the data, it became evident that all of these samples were contaminated. (This problem is discussed further in Section 4.) For this reason, none of the original VOST data are considered valid and are not reported here. A resampling effort was conducted on August 17, 1992, for VOST substances in the stack gas. Coal was also sampled at that time.

Data Treatment

Several conventions were developed for treating the test data and developing average concentrations of substances in the various streams.

To determine the total gas concentration for each run, both the solid and vapor phase contributions were considered. However, the absence of some reportable concentrations in either (or both) phases required that conventions be developed for dealing with these data and formulating emission factors. These conventions are summarized below.

For each substance, there are three possible combinations of vapor and solid phase concentrations in the emitted gas stream. These are:

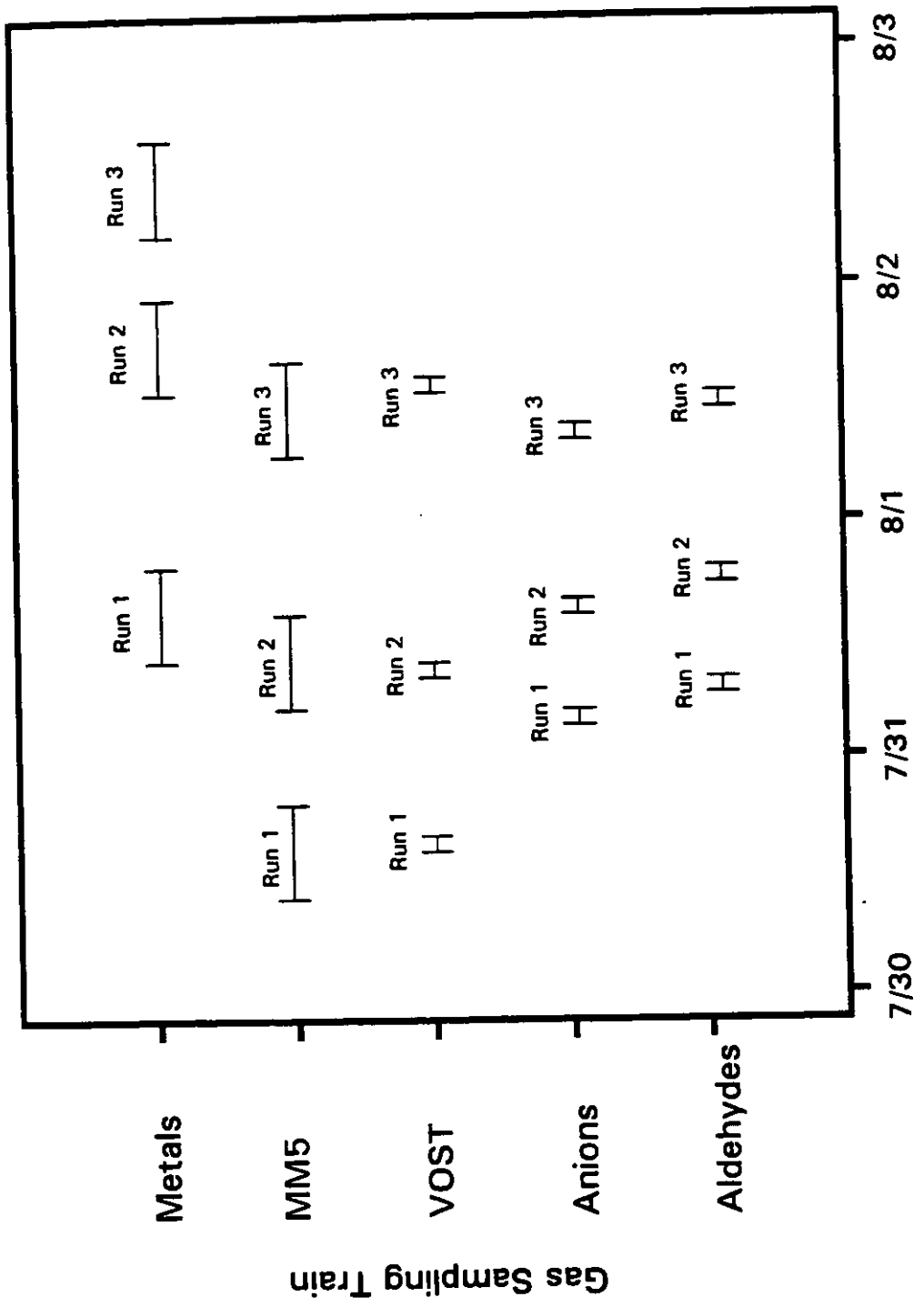

Figure 3-1. Summary of Gas Train Runs Completed

Case 1: The concentrations in both the solid and vapor phases are above the reporting limits.

Case 2: The concentrations in both the solid and vapor phases are below the reporting limits.

Case 3: The concentration in one phase is above the reporting limit, while the concentration in the other phase is below the reporting limit.

For those constituents of interest other than mercury, HCl, and HF, the stack gas stream data from coal-fired power plants have indicated that most of the material is present in the solid phase, and only a minor fraction is generally found in the vapor phase. Thus, the following conventions were selected for defining total gas stream concentrations:

Case 1: The total concentration is the sum of the concentrations in the vapor and solid phases.

For example, the total selenium concentration in the ESP inlet gas is calculated as follows for Run 1:

Se in solid phase = 171 $\mu g/Nm^3$

Se in vapor phase = 4.5 $\mu g/Nm^3$

Total Se in ESP inlet gas = 175.5 $\mu g/Nm^3$

Case 2: The total concentration is considered to be the reporting limit in the solid phase.

For example, the beryllium concentration in the FGD inlet gas is calculated as follows for Run 1:

Be in solid phase = NR(0.15 $\mu g/Nm^3$)

Be in vapor phase = NR(0.7 $\mu g/Nm^3$)

where NR(0.15) indicates that the analytical result was below the reporting limit of 0.15 $\mu g/Nm^3$ (see footnote in Table 3-1 for additional details)

Total Be in ESP inlet gas = NR(0.15 $\mu g/Nm^3$)

Case 3: The total concentration is considered to be the level measured above the reporting limit, regardless of which phase this represents.

For example, the chromium concentration in the stack gas is calculated as follows for Run 1:

Cr in solid phase = 2.5 $\mu g/Nm^3$

Cr in vapor phase = NR(3.7 $\mu g/Nm^3$)

Total Cr in stack gas = 2.5 $\mu g/Nm^3$

The above conventions are also in agreement with guidance provided by EPA (Technical Implementation Document for EPA's Boiler and Furnace Regulations, U.S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C., March 1992).

Testing at several sites has indicated that mercury, HCl, and HF are present primarily in the vapor phase. For Case 2, then, the total concentration in the gas stream is considered to be the reporting limit in the vapor phase. For Cases 1 and 3, the methodologies are unchanged from those described above.

The following criteria were used in the averaging of results from different runs:

- When all values for a given variable were above the method reporting limit, the mean concentration was calculated as the true arithmetic mean.

- For results that include values both above and below the reporting limit, one-half of the reporting limit was used to calculate the mean. For example:

Analytical Values	Calculation	Mean Value
10, 12, NR(8)	(10+12+[8/2])/3	8.7

  where NR(8) means the measurement was below the analytical reporting limit of 8.

  By our convention, the calculated mean was not allowed to be smaller than the largest reporting limit value. In the following example, using one-half the reporting limit value would yield a calculated value of 2.8. This is less than the highest reporting level obtained, so the reported mean is NR(4).

Analytical Values	Mean Value
5, NR(4), NR(3)	NR(4)

- When all analytical results for a given variable are less than the reporting limit, the reported mean is NR (the largest reporting limit). The bias estimate (used in calculating bias intervals) is one-half of the reporting level, and no confidence interval is reported.

- Questionable analytical data have been excluded from all summary calculations. These include results that indicate a sampling bias, analytical interference, or the presence of organic compounds known to be common laboratory contaminants.

- Concentrations were blank corrected where appropriate. Details of blank corrections are provided in Appendix G.

Coal

The results of the coal sample analyses are presented in Table 3-1. The plant burned a western Pennsylvania bituminous coal. The four sample runs correspond to the sample dates shown on Figure 3-1. Three of the runs were analyzed for all metals; a fourth set was used for additional volatile metals data. Some of the substances were analyzed in all four samples. Appendix A presents the analytical method reported for each combination of substance and stream. The concentrations reported here were measured using our choice of the best method for each matrix. For each substance, a mean concentration has been calculated along with the 95% confidence interval about the mean. The confidence interval is the range about the calculated mean in which there is a 95% probability that the true mean lies. For example, it can be said, with a 95% certainty, that the true mean arsenic concentration in coal is between 4.8 and 7.6 mg/kg, based on the four results presented in Table 3-1. The calculation of this confidence interval is discussed in Section 5 and in Appendix E. Most of the substances in the table were analyzed using Inductively Coupled Argon Plasma Emission Spectrometry (ICP-AES). Other analyses were made using Neutron Activation Analysis (NAA) and Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS). Mercury was measured using Double Gold Amalgamation (DGA) followed by Cold Vapor Atomic Absorption Spectrophotometry (CVAAS).

For those substances that could not be quantified, the notation "NR(x)" is provided. The term means "not reported at a concentration of x." It should be noted that reporting limits for a substance in a given sampled stream may vary among determinations due to variations in the amount of sampled gas, laboratory dilutions, etc. (see footnote in Table 3-1 for additional details concerning the reporting limit).

On August 17, 1992, (VOST resampling) the coal consumption was 452,000 lb/hr (wet) with a heating value (as received) of 13,166 Btu/lb.

ESP Inlet Gas

Table 3-2 summarizes the concentration measurements made on the gas exiting the air preheaters and entering one of four electrostatic precipitators at Site 12. In addition to the substances shown in this table, the other substances listed in Table 1-1 were also analyzed; however, none were reported (except for the original VOST data which are considered invalid). These values are presented in Appendix B. The trace elements and anions concentrations for both solid and vapor phase fractions are presented in Table 3-2. For the multi-metals train, the particulate filter, probe rinse, and nozzle rinse

Table 3-1

Site 12 Coal Analyses (mg/kg unless noted)

Substance	Run 1A	Run 1B	Run 2	Run 3	Average	95% CI
Load (MW)	675	675	680	680		
Dry Flow (lb/hr)	419,200		419,200	441,300	426,000	13,000
Ash % (dry)	9.66		10.3	8.1	9.35	2.8
HHV Btu/lb (dry)	13,700		13,600	13,900	13,733	380
Sulfur % (dry)	2.91		2.78	2.66	2.78	0.31
Moisture % (as received)	3.96		4.34	4.07	4.12	0.49
Arsenic	6.3	6	5.1	7.2	6.2	1.4
Barium	111		116	105	111	14
Beryllium	0.56	0.62	0.63	0.86	0.67	0.2
Cadmium	NR(2.57) [a]		NR(2.89)	NR(3.4)	NR(3.4)	
Chloride	740		870	880	830	194
Chromium	18.5		16.8	15.3	17	4
Cobalt	2.09		3.87	2.99	3.0	2.2
Copper	NR(32.3)		NR(30.7)	NR(38)	NR(38)	
Fluoride	63.9		80	64.2	69	23
Lead	2.4	2.4	2.3	2.3	2.4	0.09
Manganese	18.7		15.7	18.8	18	4
Mercury	0.18	0.134	0.163	0.117	0.15	0.05
Molybdenum	NR(1.2)		NR(1.29)	NR(1.54)	NR(1.54)	
Nickel	15.8		NR(25.7)	NR(32)	NR(32)	
Phosphorus	27		37	11	25	33
Selenium	1.29	1.23	1.28	1.18	1.2	0.08
Vanadium	16.8		17.9	16.8	17	2

[a]NR = Below reporting limit; the reporting limit is shown in parentheses. The "reporting limit" is the concentration below which results are not routinely reported. The reporting limit is set at a concentration representing an upper tolerance for the method detection limit (MDL). As described in Appendix B to 40 CFR 136, the MDL is a value that is calculated from a series of measurements made at a particular point in time under a particular set of conditions; it is not an intrinsic characteristic of a method. Thus, for a given method, the numerical value of the MDL will vary somewhat with each determination. Likewise, MDLs would be expected to vary somewhat between instruments, between analysts, and between laboratories all using the same method. Thus, the reporting limit, as the upper tolerance for the MDL, represents a laboratory-specific value below which the MDL would be expected to fall for any determination in that particular laboratory, regardless of instrument, analyst, etc.

Table 3-2

ESP Inlet Gas Composition ($\mu g/Nm^3$ unless noted)

	Solid Phase			Vapor Phase							
Substance	Run 1	Run 2	Run 3	Run 1		Run 2		Run 3		Combined Average	95% CI About Mean
Gas Flow (scfm)	337,000	345,000	356,000							548,000	24,000
Gas Flow (Nm^3/hr)	534,000	546,000	564,000							556,000	37,000
Particulate (lb/hr)	9,090	5,880	9,110							8,026	4,600
Particulate (gram/Nm^3)	7.73	4.89	7.34							6.65	3.8
Arsenic	424	361	898	NR(2.28)[a]		NR(2.13)		NR(2.22)		561	729
Barium	5,410	6,360	9,790	49.6[b]		56.8[b]		74.6[b]		7,250	5,750
Beryllium	40.6	51.6	106	NR(0.912)		NR(0.852)		NR(0.89)		66	87
Cadmium	22.4[b]	39.5	51.4[b]	NR(0.253)	B[c]	NR(0.308)[b]		0.512[b]		38	37
Chloride	--[d]	--[d]	--[d]	74,700		71,100		65,000		70,400	12,200
Chromium	899	1,200	2,120	NR(4.56)	B	8.44[b]	B	NR(4.45)		1,410	1,580
Cobalt	225	170	571	NR(4.56)		NR(4.26)		NR(4.45)		322	1,620
Copper	466	350	1,060	NR(9.12)	B	NR(8.52)	B	NR(8.9)	B	625	2,840
Fluoride	--[d]	--[d]	--[d]	211		388		933		511	376
Formaldehyde				NR(4.47)		26.3[b]		34.7[b]		21	45
Lead	278	317	676	8.25	B	4.43[b]	B	2.65[b]	B	429	539
Manganese	1,350	1,460	2,940	53.3[c]		NR(4.26)		10.8		1,940	3,660
Mercury	NR(0.12)	NR(0.01)	NR(0.13)	1.0[e]		1.1[e]		0.3[e]		0.8[e]	1.1
Molybdenum	965	1,010	1,530	NR(22.8)		NR(21.3)		NR(22.2)		1,170	780
Nickel	539	594	1,140	NR(9.12)	B	NR(8.52)	B	NR(8.9)	B	758	825
Phosphorus	--[d]	--[d]	--[d]	24.9		23.9		24.5		--[d]	--[d]
Selenium	171	155	343	4.46[b]		9.98[b]		13.3		232	267
Vanadium	1,080	1,290	2,450	NR(9.12)		NR(8.52)		NR(8.9)		1,610	1,830

[a] NR = Below reporting limit. Reporting limit is shown in parentheses.
[b] Indicates concentration that is less than five times the reporting limit.
[c] "B" indicates that the blank correction was equal to or greater than 50% of the measured concentration. Refer to Appendix G for additional details of blank corrections.
[d] Particulate filters were not analyzed for these elements. Since the majority of the phosphorus is in the particulate fraction, this precludes calculating a combined average phosphorus concentration.
[e] The reported vapor-phase mercury concentrations are considered to be low. Problems were encountered in analyzing these samples (see discussion in Section 4).

fractions were combined and analyzed. The laboratory reported the elemental result on a total weight basis, e.g., total milligrams of arsenic. If appropriate (i.e., if the substance was reported in the blank sample), this value was blank corrected. Blank corrections are discussed and summarized in Appendix G. This total weight was divided by the total mass of particulate collected to obtain an elemental composition of the suspended ash. The gas concentration of the solid phase was obtained by dividing the total mass of a substance by the gas volume sampled. The multi-metals train impingers were analyzed directly for total elemental mass and divided by the sampled gas volume to obtain the vapor phase concentration.

Measurements of chloride, fluoride, and phosphorus were not made on the suspended ash fraction. The solid phase gas concentrations presented in Table 3-2 were estimated from the analysis of the collected fly ash for these three substances, using the measured particulate concentration to express the concentration on a gas basis. Since 98% of the entrained particulate matter is collected in the ESP, the collected ash composition is a reasonable estimate of the composition of the entrained ash in the ESP inlet gas.

The Run 2 ESP inlet particulate filter analyses for cobalt and copper were questionable. Examination of the high dust particulate values in Appendix B show cobalt concentrations of 29, 2120, and 75 mg/kg for Runs 1, 2, and 3, respectively. Concentrations of cobalt in the collected fly ash were 34, 36, and 34 mg/kg which indicates that the cobalt concentration in the ash did not dramatically increase in Run 2. Since 98% of the entrained ash in the ESP inlet gas is collected in the ESP, it is highly unlikely that a significant increase in the copper concentration in the entrained ash occurred in Run 2. Appendix B also shows that copper concentrations in the high dust particulate were 60, 7940, and 139 mg/kg while the collected ash concentrations were 69, 72, and 69 mg/kg for Runs 1, 2, and 3. Again, the collected ash concentration indicates the high dust gas measurement is questionable. Since the collected ash concentration should be a reasonable estimate of the ESP inlet suspended ash concentration, the collected ash concentrations for cobalt and copper for Run 2 were used to calculate the particulate concentrations for these elements in Table 3-2.

FGD Inlet Gas

Table 3-3 presents the concentration of the substances measured downstream from one of the four ESPs, prior to entering the FGD system at Site 12. As expected, the solid phase concentrations have been significantly reduced across the ESP, as seen in the particulate mass reduction (8,026 to 155 pounds per hour on the one module sampled).

As with the ESP inlet gas particulate filter, the chloride, fluoride, and phosphate concentrations were not analyzed. Substitution of collected ash concentrations has not been made since there are changes in particulate particle size and concentrations across ESPs. Since the contributions from particulate fraction are negligible for chloride (0.005% if the collected ash compositions were used) and for fluoride (0.5% if the collected ash compositions were used), the vapor phase is used in the combined average. Since the particulate phase contribution is 10 times the vapor phase phosphorus (if the

Table 3-3

FGD Inlet Gas Composition ($\mu g/Nm^3$ unless noted)

Substance	Solid Phase Run 1		Solid Phase Run 2		Solid Phase Run 3 [a]	Vapor Phase Run 1		Vapor Phase Run 2		Vapor Phase Run 3 [a]	Combined Average	95% CI About Mean
Gas Flow (scfm)	382,000		389,000		357,000						376,000	42,000
Gas Flow (Nm^3/hr)	605,000		616,000		565,000						595,000	68,000
Particulate (lb/hr)	130		180								155	320
Particulate (mg/Nm^3)	98		133								115	220
Arsenic	2.59		1.73 [b]			NR(1.8) [c]		NR(2.01)			2.2	5.5
Barium	7.54	B [d]	1.26 [b]	B		69 [b]		103			90	180
Benzo(a)anthracene	3.63 [b]		NR(2.4)		NR(2.65)						NR(2.7)	
Benzo(a)pyrene	3.11 [b]		NR(2.4)		NR(2.65)						NR(2.7)	
Benzo(b)fluoranthene	6.22 [b]		NR(2.4)		NR(2.65)						2.9	7.1
Benzo(k)fluoranthene	6.22 [b]		NR(2.4)		NR(2.65)						2.9	7.1
Beryllium	NR(0.148)		NR(0.157)		NR(0.142)	NR(0.7)		NR(0.805)			NR(0.16)	
Cadmium	1.8 [b]		2.46 [b]			NR(0.2)	B	NR(0.223)	B		2.1	4.2
Chloride	-- [e]		-- [e]			55,900		61,100		55,100	57,369	8,095
Chromium	5.1		2.88 [b]	B		12.2	B	NR(4.03)	B		10.1	90
Chrysene	4.4 [b]		NR(2.4)		NR(2.65)						NR(2.7)	
Cobalt	NR(0.0739)	B	5.38			NR(3.7)		NR(4.03)			NR(4.0)	
Copper	1.55 [b]	B	NR(0.126)	B		NR(7.3)	B	NR(8.05)	B		0.8	2.6
Fluoranthene	9.58 [b]		NR(2.4)		NR(2.65)						4.0	12
Fluoride	-- [e]		-- [e]			167		268		1,120	520	1,296
Formaldehyde						NR(6)		25.9 [b]		266	98	362
Lead	4.66		10.4			4.3 [b]	B	2.96 [b]	B		11	8
Manganese	21.7		1.84 [b]	B		32 [b]		80.8			68	51
Mercury	NR(0.007)		NR(0.007)			0.14 [f]		0.20 [f]			0.17 [f]	0.37
Molybdenum	NR(3.4)	B	10.8 [b]	B		NR(18.3)		NR(20.1)			6.3	16
Nickel	3.12 [b]		2.1 [b]			NR(7.3)	B	NR(8.05)	B		2.6	1.8
Phenanthrene	7.25 [b]		NR(2.4)		NR(2.65)						3.3	8.6
Phosphorus	-- [e]		-- [e]			18		23.8		22.5	-- [e]	--
Pyrene	5.7 [b]		NR(2.4)		NR(2.65)						2.7	6.4
Selenium	34		65.1			8 [b]		3.43 [b]			55	46
Vanadium	3.39 [b]		NR(1.57)			NR(7.3)		NR(8.05)			2.1	4.6

[a] Metals concentrations measured during Run 3 are believed to be invalid because of a sample processing error. For this reason, metals concentrations are not reported for Run 3.
[b] The concentration shown is less than five times the reporting limit.
[c] NR = Below reporting limit. Reporting limit is shown in parentheses.
[d] "B" indicates that the blank correction was equal to or greater than 50% of the measured concentration. Refer to Appendix G for additional details of blank corrections.
[e] Analyses of solid phase samples for these substances were not performed. Since most of the phosphorus is expected to be present in the particulate, a combined average concentration of phosphorus could not be calculated.
[f] The reported vapor-phase mercury concentrations are suspected to be low. Problems were encountered in analyzing these samples (see discussion in Section 4).

collected ash compositions were used), no combined average is shown for phosphorus in Table 3-2.

Of note in this stream was the detection of eight polynuclear aromatic hydrocarbons (PAHs). (Benzo (b) and (k) fluoranthene co-elute and cannot be distinguished; therefore, the concentration reported for each compound is identical.) All eight values are less than five times the reporting limit. Of nine sets of measurements (three each at the ESP inlet, FGD inlet, and stack), only one run had reported levels of these PAHs. The PAHs identified are all higher molecular weight substances; naphthalene and several other three-ring PAH compounds were not detected. Reporting limits in all three streams are comparable, about 3 $\mu g/Nm^3$.

The metal values for Run 3 results have not been presented because we believe a sample processing error occurred during the dismantling of this train and Run 2 of the stack. The mass loading for Run 3 at the FGD inlet was 13 mg/Nm^3 versus 98 and 133 mg/Nm^3 in the first two runs. The Run 2 stack value was 94 versus 16 and 12 mg/Nm^3. Therefore, all data associated with the multi-metals train for these two runs are considered invalid.

Stack Gas

Table 3-4a and 3-4b present the concentration and unit-energy basis results of stack gas emission measurements from Site 12. Again, the data are presented as solid and vapor phase components with the mean and confidence interval corresponding to the combined phases. The concentrations of many substances of interest are very low.

In addition to concentration values that are less than five times the reporting limit, there are a number of substances for which particulate matter concentrations were corrected for a reportable concentration of the substance in the blank sample. In such cases, the blank value was subtracted from the sample value. The blank results are summarized in Appendix G.

The emitted particulate matter was not analyzed for chloride, fluoride, and phosphate. The contribution from the particulate matter is expected to be negligible for chloride (0.007% if collected ash concentrations were used) and fluoride (0.2% if collected ash concentrations were used). It is possible that small amounts of chloride and fluoride could have been extracted from the FGD system, but even in this case, the particulate contribution would be expected to be small and these elements would not be in the acid forms, HCl and HF, which are the species identified in Title III of the Clean Air Act Amendments. Therefore, emission factors have been calculated for chloride and fluoride based on vapor phase measurements only. An emission rate has not been calculated for phosphorus since the majority would be in the particulate phase which was not measured.

Stack gas samples analyzed for two of the analytes of interest to the FCEM project, benzene and toluene, were collected using the "standard" Volatile Organic Sampling

Table 3-4a

Stack Gas Composition ($\mu g/Nm^3$ unless noted)

Substance	Solid Phase Run 1		Solid Phase Run 2 [a]	Solid Phase Run 3		Vapor Phase Run 1		Vapor Phase Run 2 [a]	Vapor Phase Run 3		Combined Average	95% CI About Mean
Gas Flow (scfm)	1,473,000		1,491,000	1,491,000							1,490,000	26,000
Gas Flow (Nm^3/hr)	2,330,000		2,360,000	2,360,000							2,350,000	41,000
Particulate (lb/hr)	82			63							73	120
Particulate (mg/Nm^3)	16			12							14	25
Arsenic	0.49 [b]			0.54 [b]		NR(1.9) [c]			NR(2.7)		0.51	0.32
Barium	NR(7.1)	B [d]		1.38 [b]	B	NR(3.7)			NR(5.5)		NR(7.1)	
Beryllium	NR(0.15)			NR(0.18)		NR(0.75)			NR(1.10)		NR(0.18)	
Cadmium	0.13 [b]			1.6 [b]		0.26 [b]	B		0.64 [b]		1.3	12
Chloride	-- [e]			-- [e]		2,450		3,070	2,890		2,800	793
Chromium	2.5 [b]	B		6.2		NR(3.7)	B		NR(5.5)	B	4	24
Cobalt	NR(0.75)	B		NR(0.92)	B	NR(3.7)			NR(5.5)		NR(0.9)	
Copper	NR(2.48)	B		9.2		NR(7.5)	B		NR(11.0)	B	5.2	51
Fluoride	-- [e]			-- [e]		30.1 [b]		17.5 [b]	38.5 [b]		29	26
Formaldehyde						NR(7.0)			NR(9.4)		NR(9.4)	
Lead	NR(1.1)	B		0.92 [b]	B	3.0 [b]	B		8.5	B	6.5	37
Manganese	NR(1.8)	B		2.9 [b]		NR(3.7)			NR(5.5)		NR(1.8)	
Mercury	NR(0.007)			NR(0.008)		0.28 [f]			0.079 [f]		0.18 [f]	1.26
Molybdenum	NR(2.9)	B		8.48 [b]	B	NR(18.7)			NR(27.4)		NR(4.5)	
Nickel	NR(0.46)	B		10.6		NR(7.5)	B		NR(11.0)	B	5	66
Phosphorus	-- [e]			-- [e]		35.4		NR(3.7)	NR(3.4)	B	-- [e]	-- [e]
Selenium	12			8.8		2.7 [b]			6.3 [b]		15	3
Vanadium	NR(1.5)			NR(1.8)		NR(7.5)			NR(11.0)		NR(1.8)	

[a]Metals concentrations measured during Run 2 are believed to be invalid because of a sample processing error. For this reason, metals concentrations are not reported for Run 2.

[b]Concentration shown is less than five times reporting limit.

[c]NR = Not reported. Reporting limit is shown in parentheses.

[d]"B" indicates that the blank correction was equal to or greater than 50% of the measured concentration. Refer to Appendix G for additional details of blank corrections.

[e]These elements were not analyzed in the particulate fraction. Since the particulate fraction contains the majority of the phosphorus, no combined average concentration of phosphorus was calculated.

[f]The reported vapor-phase mercury concentrations are suspected to be low. Problems were encountered in analyzing these samples (see discussion in Section 4).

Table 3-4b

Stack Gas Composition (lb/10^{12} Btu unless noted)

Substance	Combined Average	95% CI of Mean
Gas Flow (scfm)	1,490,000	26,000
Gas Flow (Nm^3/hr)	2,395,000	41,000
Heat Input (10^{12} Btu/hr)	0.0058	0.0002
Particulate (lb/hr)	73	120
Particulate (lb/MM Btu)	0.013	0.02
Arsenic	0.45	0.3
Barium	NR(6.3) [a]	
Beryllium	NR(0.16)	
Cadmium	1.2	1.1
Chloride	2,500	730
Chromium	3.5	22
Cobalt	NR(1.0)	
Copper	4.4	46
Fluoride	27	20
Formaldehyde	NR(8.4)	
Lead	5.7	32
Manganese	NR(1.6)	
Mercury	0.16 [b]	1.2 [b]
Molybdenum	NR(4)	
Nickel	4.4	59
Phosphorus	-- [c]	-- [c]
Selenium	13	1.2
Vanadium	NR(1.6)	

[a]NR = Concentration was below reporting limit. Emission factor calculated from reporting limit is shown in parentheses.

[b]The reported vapor-phase mercury concentrations are suspected to be low. Problems were encountered in analyzing these samples (see discussion in Section 4).

[c]Phosphorus was not measured in the particulate phase, and an emissions factor has not been calculated.

Train (VOST) as described in SW-846 Method 0030. However, in 1990 at Site 12, a Teflon® sample probe was used with heat tape and insulation wrapping to maintain temperature. It is believed that the original VOST samples were contaminated by substances (specifically benzene and toluene) diffusing through the probe from the heat tape or insulation. During the recent resampling effort, VOST samples were collected using glass probes at the stack of Site 12 to replace those discarded because of contamination.

The resampling effort was done on August 17, 1992. Twenty-liter stack gas samples were collected according to SW-846 Method 0030. Four tube pairs were collected for each run; three for analysis and one spare. A summary of sampling times, sampled gas volumes, and sampling conditions is shown in Appendix D. The results are presented here.

Table 3-5 presents the concentrations of volatile organic substances reported in the stack gas on August 17, 1992. The values in this table were derived by dividing the cumulative mass found on three tube pairs by the total gas volume sampled (about 60 liters). For each run, the cumulative mass was derived by adding either the reported value or one-half the reporting limit (as appropriate). The previously stated conventions regarding reporting limits were used here also. Shown on Table 3-5 is the mean concentration value and the 95% confidence interval about the mean. An emission factor is also provided, derived by multiplying the concentration by the gas flow and dividing by the heat input rate.

Control Device Performance

Table 3-6 presents the average removal efficiency of the ESP and combined ESP/FGD systems calculated for various substances. Because only one of four ESP modules was sampled and oxygen concentration varies, indicating in-leakage, the concentrations in Tables 3-2, 3-3, and 3-4a cannot be used directly to calculate removal efficiency. Instead, mass rates were calculated using the gas flows and concentration measurements made at each location. These mass rates were then used to compute the removal efficiencies shown in Table 3-6.

The average particulate removal efficiency is 99.8% for the combined devices. Most of the trace elements are removed quite effectively. Only a few of the trace elements are not controlled in excess of 98% by the ESP. As expected, the acid gases are not controlled by a particulate removal device such as an ESP.

Other Species of Interest

Some individual polynuclear aromatic hydrocarbons (PAHs), which fall under the broader category of polycyclic organic matter (POMs), were reported in the FGD inlet gas. Eight POM compounds were reported during one test run, and the reported concentrations are provided in Table 3-7. All concentrations reported for Run 1 were within five times the reporting limit, so the accuracy of these concentrations is uncertain.

Table 3-5

VOST Results from August 17, 1992

Substance	Run 1 ($\mu g/Nm^3$)	Run 2 ($\mu g/Nm^3$)	Run 3 ($\mu g/Nm^3$)	Mean ($\mu g/Nm^3$)	95% CI	Emission Factor ($lb/10^{12}$ Btu)
Bromomethane	1.1	NR(0.5)	NR(0.5)	0.53	1.3	0.43
1,1,1-Trichloroethane	1.8	NR(0.5)	0.76	0.93	2.0	0.75
Benzene	1.1	0.69	0.84	0.86	0.5	0.69
Toluene	1.3	1.1	1.5	1.3	0.5	1.04
m,p-Xylene	0.87	0.80	1.0	0.90	0.3	0.72
Styrene	NR(0.5)	NR(0.5)	0.51	NR(0.5)		

Gas flow calculated to be 2,180,000 Nm^3/hr; coal feed rate was 452,000 lb/hr, 13,166 Btu/lb.

Table 3-6

Control Device Performance

Substance	ESP Reduction (%)	ESP/FGD Reduction (%)
Particulate	98.1	99.8
Arsenic	99.6	99.9
Barium	98.6	>99.9
Beryllium	>99.7	>99.7
Cadmium	94.0	96.3
Chloride	11	95.7
Chromium	99.2	99.7
Cobalt	>98.8	>99.7
Copper	99.9	99.1
Fluoride	5	94.6
Formaldehyde	NC [a]	>49.5
Lead	97.2	98.4
Manganese	96.2	>99.9
Mercury	78.8 [b]	77.5 [b]
Molybdenum	99.4	>99.6
Nickel	99.6	99.3
Phosphorus	-- [c]	-- [c]
Selenium	74.2	93.1
Vanadium	99.9	>99.9

[a] NC = Not calculated. Formaldehyde concentrations in the inlet and outlet gas streams were generally below reporting levels or within five times the reporting levels. Thus, there was a great deal of uncertainty in evaluating the performance of the control devices.

[b] Vapor-phase mercury concentrations at the inlet and outlet of the control systems are suspected to be low, due to problems encountered in sampling and analysis for this substance. Calculated control device performance for mercury is suspect.

[c] Analyses of solid phase samples for phosphorus were not performed for the ESP and FGD outlet streams. Since most of the phosphorus is expected to be in the solid phases of these streams, control device performances were not calculated.

Table 3-7

Other Species of Interest

	Stream Concentration, mg/Nm^3								
	ESP Inlet Gas			FGD Inlet Gas			Stack Gas		
Substance	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
Benzo(a)anthracene				0.0036 [a]	NR(0.0024) [b]	NR(0.0027)			
Benzo(a)pyrene				0.0031 [a]	NR(0.0024)	NR(0.0027)			
Benzo(b)fluoranthene				0.0062 [a]	NR(0.0024)	NR(0.0027)			
Benzo(k)fluoranthene				0.0062 [a]	NR(0.0024)	NR(0.0027)			
Chrysene				0.0044 [a]	NR(0.0024)	NR(0.0027)			
Fluoranthene				0.0096 [a]	NR(0.0024)	NR(0.0027)			
Phenanthrene				0.0073 [a]	NR(0.0024)	NR(0.0027)			
Pyrene				0.0057 [a]	NR(0.0024)	NR(0.0027)			
bis(2-ethylhexyl)phthalate	0.0032 [a]	NR(0.0030)	NR(0.0034)	0.0044 [a]	0.0043 [a]	0.0029 [a]	0.022	0.0033 [a]	0.0038 [a]
Phenol	--	--	--	--	--	--	NR(0.0025)	NR(0.0024)	0.016

[a]Reported concentration is within five times the reporting limit.

[b]NR = Below reporting limit. Reporting limit is given in parentheses.

None of these compounds were reported in any other stream or during any of the other test runs. No reason for the unexpected appearance of these POMs in the ESP inlet stream has been identified.

Two other compounds which were reported are not on the FCEM list (Table 1-1) but are listed in Title III of the CAAA of 1990. bis(2-Ethylhexyl) phthalate was found in the ESP inlet, ESP outlet, and stack gas streams. The measured concentrations are shown in Table 3-7. This compound is known to be a common laboratory contaminant. It is present in plastic and rubber materials used in the sampling and analytical equipment (M.A. Mazurek, et al., Environmental Science and Technology, Volume 25, Number 4, 1991).

Phenol was also reported at a low level in one stack gas sample.

Section 4

DATA ASSESSMENT

There are several procedures that can be used to assess the information developed during a field sampling program. Within the overall FCEM program, three methods are used to assess data quality. The first is the use of material balances. If closure of a substance material balance can be made within an acceptable percentage, the measurements that have been made should be representative of the process operation. Since material balances involve the summation and comparison of component mass flows in several streams, often sampled by different procedures and analyzed by different methods, good agreement indicates either accurate results or a statistically improbable degree of luck. The second data assessment method involves the traditional QA/QC protocols of laboratory analysis, i.e., duplicates, blanks, spike recovery, etc. For some elements, it is not possible to obtain a material balance, perhaps due to low concentration levels, so that QA/QC results are the only means of verifying that the measurements were performed correctly. Finally, current results can be compared with literature information, where available.

Material Balance Results

At Site 12, six key streams define the overall plant material balance: coal, limestone, bottom ash, collected fly ash, FGD solids (which contain some liquid), and stack gas. For substances of interest, stream flow and concentration distributions (average and standard deviation) were used as input to an error propagation model to estimate the uncertainty in the overall material balance closure. Closure is defined as the ratio of outlet to inlet mass. A 100% closure indicates perfect agreement. When trace substances are analyzed, a mean closure between 70 and 130% has been set as a goal for the FCEM project. This range reflects the typical level of uncertainty in the measurement and, therefore, permits one to interpret the inlet and outlet stream component mass flow rates as being statistically equivalent.

Poor closures usually indicate sampling problems and/or an analytical problem in one or more types of sample matrices. However, poor closures do not necessarily mean that emissions measurements are in error. The emission rates of many substances are equivalent to less than 1% of the mass entering with the coal. Some of the major components in a material balance closure are coal, bottom ash, collected fly ash, and FGD slurry.

Table 4-1 presents the results of the material balance error propagation analysis. The detailed calculations are presented in Appendix E. These calculations include the impact of selected variables on the overall uncertainty of the closure for each substance. All of

Table 4-1

Material Balance Closure and Uncertainty

Substance	Closure (%)	Uncertainty (%)
Aluminum	115	±22
Arsenic	42	±60
Barium	78	±16
Beryllium	84	±28
Calcium	72	±17
Chloride	52	±14
Chromium	76	±19
Cobalt	110	±55
Fluoride	92	±28
Iron	77	±30
Lead	151	±52
Magnesium	136	±24
Manganese	103	±23
Mercury	38 [a]	±14 [a]
Phosphorus	550 [b]	±270 [b]
Selenium	96	±52
Sodium	104	±27
Sulfur	87	±18
Titanium	102	±20
Vanadium	100	±26

[a]Mercury analyses of gas samples were unreliable, due to problems encountered during analyses. For this reason, material balance closures are suspected to be inaccurate.

[b]Material balance does not include particulate phase phosphorus in the stack gas, which was not analyzed at this site.

the substances present at relatively high concentrations in the coal show closure in the desired range (aluminum, calcium, iron, sodium, sulfur, and titanium). This indicates that the flow rates for the streams and the chemical analyses for these substances are both probably within acceptable levels of accuracy.

The closures for some substances could not be calculated because their average concentration was below reporting limits in a key stream, i.e., either the substance was not reported or it was below the reporting limit. Specifically, the mean levels of cadmium, copper, molybdenum, and nickel were below reporting limits in the coal; therefore, material balances could not be developed for these substances. For those substances showing closures between 70 and 130%, the data are considered valid and no further discussion is presented (barium, beryllium, chromium, cobalt, fluoride, manganese, selenium, and vanadium). Substances which did not or could not show desirable closure, and the organic substances measured, are discussed below. Material balances were not attempted for organic species since these substances may not be conserved in the plant (they can be created, altered, and/or destroyed as they pass through the plant).

Substance Discussion

Although closure is outside the desired range for some substances, the uncertainty associated with the closure is typically large and often encompasses 100 percent. For most substances the data are adequate in terms of describing the operation of Site 12. A brief discussion of individual substances which do not have material balance closure within the desired range is presented below.

Arsenic

As shown in Table 4-1, the closure for arsenic is 42 $\pm$ 60 percent. The two major contributors to this uncertainty term in the material balance calculations are the collected fly ash rate and concentration and the coal concentration. A closure below 100% indicates that the coal arsenic concentration is high and/or that the ash flow rate and/or arsenic levels are low, since arsenic was not detected in the vapor phase of the stack gas. For arsenic, the ash concentration is suspected to be low. No sampling point was available to collect a representative fly ash sample corresponding to the samples being collected. For this reason, the fly ash at Site 12 was collected from a large silo two weeks after the sampling events (this was estimated to be the approximate residence time in the silo). Therefore, the results of minor variations in the coal (and ash) composition may have been dampened and not seen in the silo two weeks later. An analysis of the particulate matter collected upstream of the ESP reported an average arsenic level of 82 mg/kg compared to 22 mg/kg for the ash in the silo. If the 82 mg/kg value is used in the material balance calculation, closure of 106% is achieved.

In all three gas streams (ESP inlet/outlet and stack gas), the concentration of arsenic present in a vapor state was less than the reporting limit of about 2-3 $\mu g/Nm^3$. Thus, the vapor phase arsenic in the stack gas is less than 1% of the total arsenic entering the plant.

Cadmium

An overall material balance could not be performed for cadmium because concentrations were below analytical reporting limits in the coal (using INAA) and in fly ash and bottom ash (using microwave digestion and GFAA). The cadmium mass rates in the emitted particulate matter could be measured (value was less than five times the reporting limit). The calculated mass rate in the stack gas (solids) is on the order of 1 lb/trillion Btu. With this low emission rate, additional efforts to quantify the incoming cadmium concentrations may not be warranted. The estimated coal concentration equivalent to this emission rate is 0.01 mg/kg, well below the reporting limit of 3 mg/kg in the coal.

Chlorine

The overall chlorine material balance closure is 52 $\pm$ 14 percent. The low closure is primarily due to the low mass measured in the FGD solids. An estimated 160 kg/hr of chloride enters the plant with the coal. Over 140 kg/hr (or about 88% of the chlorine in the coal) was measured in the ESP inlet and outlet gas streams. The stack contains about 7 kg/hr, (about 5% of the chlorine in the coal) equivalent to a chloride removal efficiency of 95% across the FGD unit. The measured FGD solids mass rate of chloride is only about 80 kg/hr. Poor closure is presumably due to fluctuations in the coal chloride level over a relatively short time period. At Site 12, the residence time of the FGD liquid phase is on the order of several months. Therefore, it takes a significant time period for the chloride level in the FGD system to respond to fluctuations in the coal chlorine levels. A change in the inlet concentration upsets the approach to steady state, and a new equilibrium must be established. Short-term variations in the coal chlorine level are quickly reflected in the vapor-phase chloride concentrations, but will probably not be detected in the FGD liquid. Any other soluble substance will also be subject to this phenomena.

Copper

The copper material balance could not be calculated because the copper concentration in the coal was below the INAA reporting limit (38 mg/kg). Copper concentrations in ashes indicated that the coal copper concentration should be 15% or less of the INAA reporting limit. No vapor phase copper was detected at levels of 7 to 11 $\mu g/Nm^3$ in the ESP inlet/outlet or stack gas streams.

Lead

The overall material balance for lead was 151 $\pm$ 52 percent. Again, nonrepresentative composition of the collected fly ash from the silo may be responsible for the poor closure. The lead concentration in the silo ash was 42 mg/kg. The lead concentration in fly ash obtained from a small test facility (a pilot plant associated with the Site 12 plant) during the sampling period had an average concentration of 31 mg/kg which would satisfactorily close the material balance.

Mercury

The analyses of mercury in the gas stream samples were considered to be unreliable. Later sampling efforts at other sites revealed that a large portion of the mercury present in sampled gas streams was trapped in the nitric acid impingers of the sampling train. However, these impingers were not analyzed properly at Site 12 because insufficient permanganate (which reacts with the H_2O_2 in the solution) was added prior to analysis by CVAAS. Thus, the measured vapor phase mercury level is believed to be lower than the true concentration. (At some subsequent test sites, the mercury balance closure was still low, even when the correct analytical procedures were used for impinger solutions. There remains a possibility that mercury concentrations measured in the coal are high.)

Molybdenum

The molybdenum concentration in coal is below the INAA reporting limit (1.5 mg/kg). This reporting limit is near the low end of coal molybdenum concentrations reported for this coal type in the PISCES database. In addition, internally consistent analytical data could not be obtained for molybdenum in any of the ash streams prepared by microwave digestion and analyzed by ICP-AES. Molybdenum recovery from the NBS (NTIS) 1633a Standard Reference Material (coal fly ash) analyzed with the Site 12 samples was over 300 percent. This bias can be attributed to spectral interferences from aluminum and iron in the ash matrix. The concentrations reported were less than five times the analytical reporting limit and less than three times the concentration in the digestion blank. The multi-element ICP-AES method developed for hazardous waste incinerators is not suited to measuring low molybdenum concentrations in coal ash matrices. It is probable that similar interferences would be observed if coal were digested and analyzed by ICP-AES. Alternate methods should be identified for measuring molybdenum in coals and in their associated ashes.

Analysis by another analytical technique such as INAA can also be used to identify a systematic bias resulting from such a procedure. For the purposes of this study, one fly ash sample and one bottom ash sample were submitted for analysis by a standard INAA method for ashes. The molybdenum concentrations measured were below the INAA reporting limits; however, this reporting limit is lower than the concentrations measured by ICP-AES [NR(11) mg/kg for INAA versus about 60 mg/kg for ICP-AES]. Therefore, it is possible that the measured solid phase concentrations presented in Tables 3-2, 3-3, and 3-4a are high since they are based on ICP-AES results.

Nickel

Two of the three nickel concentrations measured in the coal were below INAA reporting limits [15.8, NR(25.7), NR(32)]. Based on the fly ash nickel concentration of 70 mg/kg, the coal concentration would be expected to be about 7 mg/kg.

Phosphorus

The calculated phosphorus closure of 550 ± 270 percent is probably caused by a low coal analysis. The average measured coal concentration of 25 mg/kg is about an order of magnitude too low to correspond with consistent ash concentrations in the 2,000 to 2,500 mg/kg range. The phosphorus concentration at a plant burning a similar coal (Site 15) was 247 mg/kg. Phosphorus was identified in the vapor phase of the flue gases in the range of 20 to 30 $\mu g/Nm^3$. No explanation of the low phosphorus levels measured in the coal is apparent at this time.

Formaldehyde

Formaldehyde was measured at varying levels of NR(6) to 266 $\mu g/Nm^3$ in the ESP inlet and outlet; however, it was not seen in the stack gas at reporting limits of 7 to 10 $\mu g/Nm^3$.

POMs

As discussed in Section 3, eight PAHs were identified at low levels in one of three samples of the FGD inlet gas stream. A review of the QA/QC information on surrogate spike recovery and duplicate analysis does not indicate any basis to invalidate these values.

No other polycyclic organic substances were identified in any gas stream.

Volatile Organics

The VOST samples originally collected at this site indicated contamination with aromatic compounds in the gas streams. It is believed that the VOST train was contaminated during sampling because of the use of a Teflon® probe. The sampling method specifies the use of a glass-lined probe, but a Teflon® probe was used at some sites in an effort to overcome some sampling problems (i.e., breaking probes and sampling with vertical probe orientation). However, it was later discovered that aromatics (benzene and toluene) were apparently being released from the insulation surrounding the probe. These aromatics were diffusing through the Teflon® probe and contaminating the samples. (In subsequent testing at another site, VOST results with Teflon® were confirmed to be higher while results of VOST with a glass probe were in agreement with canister results.) For this reason, none of the original VOST results are reported.

During the resampling effort, glass probes were used and consistent results were obtained. QA/QC analysis indicates that the reported results are valid.

Section 5

EXAMPLE CALCULATIONS

This section presents the methodology and sample calculations used to develop the results presented in Sections 3 and 4. Specifically, the calculation of stream flow rates, unit-energy basis results, and confidence intervals are presented.

Stream Flows

Appendix D contains information regarding the stream flows that were measured or calculated at Site 12 during the sampling period. After receiving data from the laboratory on stream compositions, it became evident that not all of the measurements were consistent. Therefore, to present the distribution of substances more accurately, some realistic simplifications have been made where appropriate. Several flows have been used as measured, since there is no alternative method of determining them short of performing design basis calculations. These flows include the coal feed rate (taken from plant totalizers), the stack gas flow rate (measured during testing), the average limestone consumption (weigh scales), FGD solids generation (filtercake scales), and the bottom ash generation rate (estimated by truck volumes during testing). Using these five flow rates and appropriate concentration measurements, a set of consistent stream flows were determined.

There were two stream flow rates that were very difficult to measure at Site 12; the ESP inlet ash flow rate and the collected fly ash flow rate. The collected fly ash was evacuated from hoppers to a large storage silo on an irregular schedule. Since hopper volume varied, it was impossible to determine this flow directly. Similarly, the gas entering the ESP has a high dust load and, as in most power plants, the duct arrangement is not ideal for sampling. The duct used for sampling was horizontal, which required vertical probe traverses. It is likely that stratification occurs both vertically and horizontally in the transition duct between the air preheater and the ESP. As shown in Figure 2-2, only one of the four modules was used for sampling. Therefore, the corresponding gas flow and grain loading measured at this location could be unrepresentative, although prior measurements indicated good distribution. Since ash is a major source of most trace substances, an ash balance was developed, and the ash distribution was used to set several flow rates. Table 5-1 presents the measured and calculated distribution of ash at Site 12 using data from July 31, 1990. The coal ash concentration multiplied by the consumption rate gives the total ash input. As described earlier, the bottom ash rate was measured by weighing trucks moving bottom ash to storage over the test period. By difference, the suspended ash rate can be calculated as 35,865 lb/hr, versus 36,371 measured at the duct. (Other runs were not so close in agreement. See Appendix D.) Because of the uncertainty in the measurement of the suspended ash rate, the calculated

Table 5-1

Ash Distribution for July 31, 1990

Stream	Source	Rate (lbs/hr)
Coal @ 9.66% Ash	Measured	40,495
Bottom Ash	Measured	4,630
Suspended Ash	Calculated	35,865
ESP Inlet x 4	Measured	36,371
ESP Outlet x 4	Measured	505
Collected Fly Ash	Calculated	35,360
Emitted Particulate	Measured	82
Ash to FGD Solids	Calculated	423

rate was used in the determination of additional ash flow rates. The ash rate measured at the exit of the ESP was then subtracted from the calculated suspended ash rate (at the ESP inlet) to provide the calculated collected fly ash rate. This calculation was duplicated for each test period. Average flows and standard deviations were used to perform the material balance calculations detailed in Appendix E.

The calculation of the ESP inlet gas compositions shown on Table 3-2 requires the addition of the solid phase and gas phase concentrations according to the conventions described in Section 3. The gas phase concentrations were obtained by direct measurement, with the laboratory analyses of the collection impingers providing the total collected mass of a vapor phase substance, which is divided by the gas volume measured during the sampling. The solid phase component of the gas stream was calculated by multiplying the ash elemental concentrations (either suspended, FGD outlet, or emitted particulate matter) by the ash mass rate (calculated for suspended ash, measured for FGD inlet gas, measured for emitted gas) and dividing by the respective volumetric gas flow rate (ESP inlet, ESP outlet, stack).

As an example, the arsenic concentration for the high dust gas, solid phase for Run 1 (presented in Appendix B) is 0.424 mg/Nm^3, which is shown in Table 3-2. The vapor phase concentration is also in Appendix B as NR(0.00228 mg/Nm^3).

Unit Energy Calculation

In addition to the gas phase concentrations, unit-energy basis emission factors have also been developed for each substance. These values were determined by using the mass flow of a substance (concentration times flow rate) from the stack gas and dividing by the heat input to the boiler during testing. The heat input was obtained from the coal flow rate and the higher heating value (HHV) of the fuel for each sampling period.

For example, the average coal mass rate was 426,000 lb/hr with an HHV of 13,700 Btu/lb, for a heat input of 5.84 x 10^9 Btu/hr. The arsenic mass flow in the stack (0.51 μg/Nm^3 x 2,390,000 Nm^3/hr = 0.0026 lb/hr) is 0.45 lb/10^{12} Btu exiting the stack, as shown on Table 3-4b.

Confidence Interval Calculations

An example showing the calculation of confidence intervals is provided in Appendix E.

Section 6

GLOSSARY

Btu	British Thermal Unit
CFBC	Circulating Fluidized Bed Combustion
CVAAS	Cold Vapor Atomic Absorption Spectrophotometry
dNm^3	Dry Normal Cubic Meter
DQO	Data Quality Objectives
dscfh	Dry Standard Cubic Feet per Hour
FCEM	Field Chemical Emissions Monitoring
GFAAS	Graphite Furnace Atomic Absorption Spectrophotometry
HHV	Higher Heating Value
IC	Ion Chromatography
ICP (ICAP, ICAPES, ICP-AES)	Inductively Coupled Argon Plasma Emissions Spectrometry
ID	Induced Draft
MSD	Matrix Spike Duplicate
NAA	Neutron Activation Analysis
NBS	National Bureau of Standards
PAH	Polynuclear Aromatic Hydrocarbons
POM	Polycyclic Organic Matter
PSD	Particle Size Distribution
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
SIE	Selective Ion Electrode
TNMHC	Total Non-Methane Hydrocarbons
VOC	Volatile Organic Compound
VOST	Volatile Organic Sampling Train

Appendix A

Detailed Sample Collection/Preparation/Analysis Tables

Table A-1

Sample Collection, Preservation, and Handling Techniques for Site 12

Stream	Collection Method	Fraction Description	Sample Handling	Comments
GASES				
ESP Inlet	SW 0030	VOST	Cooled to 4°C.	Used Teflon® probe liner.
	SW 0010	MM5-Thimble MM5-XAD Resin MM5-PNR/Condensate	Cooled to 4°C. Cooled to 4°C. Cooled to 4°C.	
	EPA Draft Method[a]	"Metals" Probe and Nozzle Rinse	Acetone portion dried and weighed; nitric acid portion cooled.	Subsamples of the acetone probe and nozzle rinse, and filter catch were digested and combined with the digested nitric acid probe and nozzle rinse.
		"Metals" Filter	Desiccated to constant weight.	See above.
		"Metals" - Impinger 1 & 2		
		"Metals" - Impinger 3 & 4		For mercury analysis only.
	SW 0011	Formaldehyde Impinger	Rinsed with water and $MeCl_2$.	
	Radian Method	Anion Train		
ESP Outlet	SW 0030	VOST	Cooled to 4°C.	Used Teflon® probe liner.
	SW 0010	MM5-Filter MM5-XAD Resin MM5-PNR/Condensate	Cooled to 4°C. Cooled to 4°C. Cooled to 4°C.	
	EPA Draft Method[a]	"Metals" probe and Nozzle Rinse	Acetone portion dried and weighed; nitric acid portion cooled.	Entire filter digested with sample and combined with digested probe and nozzle rinse.
		Metals-Filter Metals-Impinger 1&2 Metals-Impinger 3&4	Desiccated to constant weight.	 For metals in vapor phase. For mercury analysis only.
	SW 0011	Formaldehyde Impinger	Rinsed with water and $MeCl_2$.	
	Radian Method	Anion Train		

Table A-1

(Continued)

Stream	Collection Method	Fraction Description	Sample Handling	Comments
Stack	SW 0030	VOST	Cooled to 4°C.	Used Teflon® probe liner. [b]
	SW 0010	MM5-Filter	Cooled to 4°C.	
		MM5-XAD Resin	Cooled to 4°C.	
		MM5-PNR/Condensate	Cooled to 4°C.	
	EPA Draft Method[a]	"Metals" Probe and Nozzle Rinse	Acetone portion dried and weighted; nitric acid portion cooled.	Entire filter digested with sample and combined with digested probe and nozzle rinse.
		"Metals" Filter	Desiccated to constant weight.	
		"Metals" - Impinger 1 & 2		For metals in vapor phase. For mercury analysis only.
		"Metals" - Impinger 3 & 4		
	SW 0011	Formaldehyde Impinger	Rinsed with water and $MeCl_2$.	
	Radian Method	Anion Train		
LIQUIDS				
Makeup Water	Grab		Samples not filtered, HNO3 preserved.	
Wastewater Treatment	Grab			
SOLIDS				
Coal	24 Hr. Composite		None	
Limestone	Grab		Samples riffled, and a subsample dried at 105°C and ground to -60 mesh.	
Baghouse Ash	Grab			
Fly Ash	Grab			
Bottom Ash	Grab			In some cases the bottom ash was collected from a wet system. If so, 5 gal. of sluice water was collected, the water decanted, and the solids were washed with acetone, then dried and ground.
Scrubber Solids	Grab		Dried at 50°C.	

[a]U.S. Environmental Protection Agency, Environmental Monitoring Branch. "Methodology for the Determination of Metals Emissions in Exhaust Gases from Incineration Processes." Draft, October 1989.

[b]Used glass probe liner during resampling effort.

Table A-2

Preparation Procedures and Chemical Analysis Methods Applied to Coal at Site 12

Component	Method Reference	Coal
ULTIMATE ANALYSIS OF COAL		
Ash	ASTM D 3174	X
Carbon	ASTM D 3178	X
Hydrogen	ASTM D 3178	X
Nitrogen	ASTM D 3179	X
Sulfur	ASTM D 4239	X
Heating Value	ASTM D 2015	X
PROXIMATE ANALYSIS OF COAL		
Moisture	ASTM D 3173	X
Ash	ASTM D 3174	X
Volatiles	ASTM D 3175	X
Fixed Carbon	Calculated	X
FCEM TARGET ELEMENTS BY INAA		
Preparation		None
Analysis by INAA		
Arsenic	Karr, Chapters 12 and 46	X
Barium	Karr, Chapters 12 and 46	X
Cadmium	Karr, Chapters 12 and 46	X
Chromium	Karr, Chapters 12 and 46	X
Chlorine	Karr, Chapters 12 and 46	X
Cobalt	Karr, Chapters 12 and 46	X
Copper	Karr, Chapters 12 and 46	X
Manganese	Karr, Chapters 12 and 46	X
Mercury	Karr, Chapters 12 and 46	X
Molybdenum	Karr, Chapters 12 and 46	X
Nickel	Karr, Chapters 12 and 46	X
Selenium	Karr, Chapters 12 and 46	X
Vanadium	Karr, Chapters 12 and 46	X

Table A-2

(Continued)

Component	Method Reference	Coal
BERYLLIUM, AND LEAD ANALYSIS IN COAL		
Preparation		
Oxygen Bomb Combustion	ASTM D 3684	X
Mixed Acid Residue Digestion	Lindahl and Bishop	X
Analysis by ICAPES		
Beryllium	SW 6010	X
Analysis by GFAA		
Lead	SW 7421	X
ARSENIC AND SELENIUM ANALYSIS IN COAL		
Preparation		
Eschka Mixture Fusion	ASTM D 4606	X
Analysis by HGAA		
Arsenic	ASTM D 4606	X
Selenium	ASTM D 4606	X
CHLORINE AND FLUORINE ANALYSIS IN COAL		
Preparation		
Oxygen Bomb Digestion	ASTM D 2361/ASTM D 3761	X
Analysis by Ion Chromatography		
Chloride	SM 407C	X
Analysis by Ion Selective Electrode		
Fluoride	ASTM D 3761	X
TOTAL PHOSPHORUS ANALYSIS IN COAL		
Preparation		
Ash and Acid Digestion	ASTM D 2795	X
Spectrophotometric Analysis		
Total P, Spectrophotometric	ASTM D 2795	X
MERCURY ANALYSIS IN COAL		
Preparation		
Double Amalgamation	Karr, Chapter 14	X
Analysis by CVAA		
Mercury	Karr, Chapter 14	X

Table A-2

(Continued)

Component	Method Reference	Coal
ADDITIONAL INORGANIC ANALYTES IN COAL		
Preparation		None
Analysis by INAA		
Aluminum	Karr, Chapters 12 and 46	X
Calcium	Karr, Chapters 12 and 46	X
Iron	Karr, Chapters 12 and 46	X
Magnesium	Karr, Chapters 12 and 46	X
Potassium	Karr, Chapters 12 and 46	X
Sodium	Karr, Chapters 12 and 46	X
Titanium	Karr, Chapters 12 and 46	X
Zinc	Karr, Chapters 12 and 46	X

Karr, C. Jr., (ed)., "Analytical Methods for Coal and Coal Products".

SW is EPA SW-846, "Test Methods for Evaluating Solid Waste".

Lindahl, P.C. and A.M. Bishop. "Determination of Trace Elements in Coal by an Oxygen Bomb Combustion/Atomic Absorption Spectrophotometric Method." Fuel 61, (7), pp. 658-662 (1982).

Table A–3

Preparation Procedures and Chemical Analysis Methods for Inorganic Chemical Components in Non–Coal Solids, Aqueous Streams, and Flue Gas at Site 12

Component	Method Reference	Non-Coal Solids	Aqueous Streams	ESP Inlet Solids	ESP Outlet & Stack Solids	Metals [a] Impingers 1 & 2	Metals Impingers 3 & 4	Anions Impingers (Combined)
FCEM TARGET ELEMENTS BY ICAPES								
Preparation								
Water Digestion for ICAPES	SW 3005		X			X		
MW Digestion for Solids	CEM-FA	X		X				
MW Digestion for Filters	CEM-F				X			
Analysis by ICAPES								
Barium	SW 6010	X	X	X	X	X		
Beryllium	SW 6010	X	X	X	X	X		
Chromium	SW 6010	X	X	X	X	X		
Cobalt	SW 6010	X	X	X	X	X		
Copper	SW 6010	X	X	X	X	X		
Manganese	SW 6010	X	X	X	X	X		
Molybdenum	SW 6010	X	X	X	X	X		
Nickel	SW 6010	X	X	X	X	X		
Vanadium	SW 6010	X	X	X	X	X		
FCEM TARGET ELEMENTS BY HGAA								
Preparation								
MW Digestion for Solids	CEM-FA	X		X				
MW Digestion for Filters	CEM-F				X			
Analysis by HGAA								
Arsenic by HGAA	SW 7061	X	X	X	X	X		
Selenium by HGAA	SW 7741	X	X	X	X	X		
FCEM TARGET ELEMENTS BY GFAA								
Preparation								
Water Digestion for GFAA	CLP 3/90 D-5		X			X		
MW Digestion for Solids	CEM-FA	X		X				
MW Digestion for Filters	CEM-F				X			
Analysis by GFAA								
Arsenic	SW 7060	X						

Table A-3

(Continued)

Component	Method Reference	Non-Coal Solids	Aqueous Streams	ESP Inlet Solids	ESP Outlet & Stack Solids	Metals [a] Impingers 1 & 2	Metals Impingers 3 & 4	Anions Impingers (Combined)
Cadmium	SW 7131	X	X	X	X	X		
Lead	SW 7421	X	X	X	X	X		
MERCURY BY CVAA								
Preparation								
MW Digestion for Solids	CEM-FA	X		X				
MW Digestion for Filters	CEM-F				X			
Analysis by CVAA								
Mercury	SW 7470	X	X	X	X		X	
FCEM ACID-FORMING ANIONS								
Aqueous Extraction of Solids	Radian	X						
Chloride by IC	EPA 300.0	X	X					X
Sodium Hydroxide Fusion	McQuaker and Gurney	X						
Fluoride by SIE	McQuaker and Gurney	X						
Fluoride by SIE	EPA 340.2		X					X
Total P Spectrophotometric	EPA 365.3		X					X
X-Ray Fluorescence for P	ASTM D 4326	X						
ADDITIONAL INORGANIC ANALYTES BY ICAPES								
Preparation								
Water Digestion for ICAPES	SW 3005		X			X		
MW Digestion for Solids	CEM-FA	X		X				
MW Digestion for Filters	CEM-F				X			
Analysis by ICAPES								
Aluminum	SW 6010	X	X	X	X	X		
Calcium	SW 6010	X	X	X	X	X		
Iron	SW 6010	X	X	X	X	X		
Magnesium	SW 6010	X	X	X	X	X		
Potassium	SW 6010	X	X	X	X	X		
Titanium	SW 6010	X	X	X	X	X		
Zinc	SW 6010	X	X	X	X	X		

Table A-3

(Continued)

Component	Method Reference	Non-Coal Solids	Aqueous Streams	ESP Inlet Solids	ESP Outlet & Stack Solids	Metals [a] Impingers 1 & 2	Metals Impingers 3 & 4	Anions Impingers (Combined)
MAJOR AND MINOR ELEMENTS BY X-RAY FLUORESCENCE								
Aluminum	ASTM D 4326	X						
Calcium	ASTM D 4326	X						
Iron	ASTM D 4326	X						
Magnesium	ASTM D 4326	X						
Potassium	ASTM D 4326	X						
Silicon	ASTM D 4326	X						
Sodium	ASTM D 4326	X						
Titanium	ASTM D 4326	X						
TOTAL SULFUR ANALYSIS								
Sulfate by IC (a)	EPA 300.0		X					X
Total Sulfur by Leco	ASTM D 4239	X		X	X			

ASTM is American Society for Testing and Materials.

EPA is EPA Methods for Chemical Analysis of Water and Wastes, 1983.

SW EPA is SW-846, "Test Methods for Evaluating Solid Waste", 3rd ed.

CEM-FA CEM Corporation, Matthews, NC Procedure for microwave digestion of coal fly ash.

CEM-F CEM Corporation, Matthews, NC Procedure for microwave digestion of glass or quartz filters.

CLP is EPA Contract Laboratory Program SOW 3/90.

McQuaker, N. R., and M. Gurney. "Determination of Total Fluoride in Soil and Vegetation Using An Alkali Fusion-Selective Ion Electrode Technique", Analytical Chemistry, Vol. 49, No. 1, January 1977, pp. 53-56.

[a]Nitric acid peroxide impingers were not concentrated because of concerns about the loss of volatile metals and because the 20 $\mu g/Nm^3$ reporting limit goal could be reached without the concentration step.

Table A-4

Preparation Procedures and Chemical Analysis Methods Used to Measure Organic Chemical Components at Site 12

Component	Method Reference	Flue Gases
VOLATILE ORGANIC COMPOUNDS		
Sample Collection		
VOST	SW 0030	X
Analysis by GC/MS		
Benzene	SW 8240	X
Toluene	SW 8240	X
FORMALDEHYDE		
Sample Collection		
DNPH Impinger [a]	SW 0011	X
Analysis by HPLC		
Formaldehyde	TO5 [b]	X
POLYNUCLEAR AROMATIC ORGANIC COMPOUNDS		
Sample Collection		
MM5	SW 0010	X
Preparation		
Soxhlet Extraction	SW 3540	X
Analysis by GC/MS		
Acenaphthene	SW 8270	X
Acenaphthylene	SW 8270	X
Anthracene	SW 8270	X
Benzo(a)anthracene	SW 8270	X
Benzo(a)pyrene	SW 8270	X
Benzo(b)fluoranthene	SW 8270	X
Benzo(g,h,i)perylene	SW 8270	X
Benzo(k)fluoranthene	SW 8270	X
Chrysene	SW 8270	X
Dibenzo(a,h)anthracene	SW 8270	X
Fluoranthene	SW 8270	X
Fluorene	SW 8270	X
Indeno(1,2,3-cd)pyrene	SW 8270	X

Table A-4

(Continued)

Component	Method Reference	Flue Gases
Naphthalene	SW 8270	X
Phenanthrene	SW 8270	X
Pyrene	SW 8270	X
2-Methylnaphthalene	SW 8270	X
3-Methylcholanthrene	SW 8270	X
7,12-Dimethylbenz(a)anthracene	SW 8270	X

[a] DNPH is 2,4-dinitrophenylhydrazine.

[b] TO5 is EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA 600/4/84/041.

SW is EPA SW-846, "Test Methods for Evaluating Solid Waste".

Appendix B

Data Used in Calculations

Site 12 Data Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
high dust gas	1-Chloronaphthalene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1-Chloronaphthalene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1-Chloronaphthalene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	1-Naphthylamine	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1-Naphthylamine	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1-Naphthylamine	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
stack gas	1,1,1-Trichloroethane	8240	mg/Nm3	0.0018	< 0.0005		0.00076		
high dust gas	1,2-Diphenylhydrazine	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1,2-Diphenylhydrazine	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1,2-Diphenylhydrazine	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2-Chloronaphthalene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2-Chloronaphthalene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2-Chloronaphthalene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2-Methylnaphthalene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2-Methylnaphthalene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2-Methylnaphthalene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2-Naphthylamine	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2-Naphthylamine	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2-Naphthylamine	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	3-Methylcholanthrene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	3-Methylcholanthrene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	3-Methylcholanthrene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	3,3'-Dichlorobenzidine	8270SNT1	mg/Nm3	< 0.00634	< 0.00608		< 0.00684		
FGD inlet gas	3,3'-Dichlorobenzidine	8270SNT1	mg/Nm3	< 0.00518	< 0.0048		< 0.00529		
stack gas	3,3'-Dichlorobenzidine	8270SNT1	mg/Nm3	< 0.00505	< 0.00507		< 0.00543		
high dust gas	4-Aminobiphenyl	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	4-Aminobiphenyl	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	4-Aminobiphenyl	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	4-Bromophenyl phenyl ether	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	4-Bromophenyl phenyl ether	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	4-Bromophenyl phenyl ether	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	4-Chlorophenyl phenyl ether	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	4-Chlorophenyl phenyl ether	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	4-Chlorophenyl phenyl ether	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	7,12-Dimethylbenz(a)anthracene	8270SNT1	mg/Nm3	< 0.00792	< 0.0076		< 0.00855		
FGD inlet gas	7,12-Dimethylbenz(a)anthracene	8270SNT1	mg/Nm3	< 0.00647	< 0.00599		< 0.00662		
stack gas	7,12-Dimethylbenz(a)anthracene	8270SNT1	mg/Nm3	< 0.00631	< 0.00634		< 0.00678		
high dust gas	Acenaphthene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Acenaphthene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Acenaphthene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Acenaphthylene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Acenaphthylene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Acenaphthylene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Aluminum	NAA	mg/kg	9210	9430		9790		
limestone	Aluminum	ICP8SN00	mg/kg	437 @	< 540		380 @		
bottom ash	Aluminum	D4326	mg/kg	112000	111000		109000		
collected fly ash	Aluminum	D4326	mg/kg	119000	117000		116000		
collected fly ash (baghouse)	Aluminum	D4326	mg/kg	111000	107000		109000		
high dust gas particulate	Aluminum	ICP8WN00	mg/kg	81700 R	139000 R		107000 R		
FGD inlet particulate	Aluminum	ICP8WN00	mg/kg	5170 R	1020 R				
stack gas particulate	Aluminum	ICP8WN00	mg/kg	2520 @R			15800 R		
FGD solids	Aluminum	D4326	mg/kg	1010	2670	5150	918		
high dust gas, solid phase	Aluminum	ICP8WN00	mg/Nm3	632 R	680 R		816 R		
high dust gas, vapor phase	Aluminum	ICP8WN00	mg/Nm3	0.514 @	0.237 J		0.269 J		
FGD inlet gas, solid phase	Aluminum	ICP8WN00	mg/Nm3	0.505 R	0.138 R				
FGD inlet gas, vapor phase	Aluminum	ICP8WN00	mg/Nm3	0.228 J	0.337 @				

Site 12 Data Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
stack gas, solid phase	Aluminum	ICPSWN00	mg/Nm3	0.0403 @R			0.194 R		
stack gas, vapor phase	Aluminum	ICPSWN00	mg/Nm3	< 0.0746			< 0.11		
makeup water	Aluminum	I39RWN00	mg/L	< 0.2	< 0.2		< 0.2		
wastewater treatment effluent	Aluminum	I39RWN00	mg/L	< 0.2	< 0.2	< 0.2			
high dust gas	Anthracene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Anthracene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Anthracene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Arsenic	HGAA	mg/kg	6.3	5.1		7.2	6.4	6
limestone	Arsenic	ASHRSN00	mg/kg	< 2.6	< 2.7		< 2.5	< 2.4	
bottom ash	Arsenic	ASHRSN00	mg/kg	4.6 @	4.7 @		5.5 @		4.4 @
collected fly ash	Arsenic	ASHRSN00	mg/kg	15	< 12		44		
collected fly ash (baghouse)	Arsenic	ASHRSN00	mg/kg	19 @	15 @		55 @		34
high dust gas particulate	Arsenic	ASHRSN00	mg/kg	54.9	74.1		116		
FGD inlet particulate	Arsenic	ASHRSN00	mg/kg	26.5	13 @				
stack gas particulate	Arsenic	ASHRSN00	mg/kg	30.4 @			43.6 @		
FGD solids	Arsenic	ASHRSN00	mg/kg		< 2.5	< 2.3	< 13		
high dust gas, solid phase	Arsenic	ASHRSN00	mg/Nm3	0.424	0.361		0.898		
high dust gas, vapor phase	Arsenic	ASHRWA00	mg/Nm3	< 0.00226	< 0.00213		< 0.00222		
FGD inlet gas, solid phase	Arsenic	ASHRSN00	mg/Nm3	0.00259	0.00173 @				
FGD inlet gas, vapor phase	Arsenic	ASHRWA00	mg/Nm3	< 0.00163	< 0.00201				
stack gas, solid phase	Arsenic	ASHRSN00	mg/Nm3	0.000485 @			0.000535 @		
stack gas, vapor phase	Arsenic	ASHRWA00	mg/Nm3	< 0.00187			< 0.00274		
coal	Ash	proximat	%	9.66	10.3	9.83	8.1		
coal	Barium	NAA	mg/kg	111	116		105		
limestone	Barium	ICPSSN00	mg/kg	5.45 @	< 27		< 4.9		
bottom ash	Barium	I39RSN00	mg/kg	690	750		730		720
collected fly ash	Barium	ICPSSN00	mg/kg	923	1040		938		
collected fly ash (baghouse)	Barium	ICPSSN00	mg/kg	661	762		562		694
high dust gas particulate	Barium	ICPSWN00	mg/kg	699 R	1300 R		1260 R		
FGD inlet particulate	Barium	ICPSWN00	mg/kg	77.3 R	9.45 @R				
stack gas particulate	Barium	ICPSWN00	mg/kg	< 445			113 @R		
FGD solids	Barium	ICPSSN00	mg/kg	2.19 @	< 25	9.63 @	< 10		
high dust gas, solid phase	Barium	ICPSWN00	mg/Nm3	5.41 R	6.38 R		9.79 R		
high dust gas, vapor phase	Barium	ICPSWN00	mg/Nm3	0.0496 @	0.0566 @		0.0746 @		
FGD inlet gas, solid phase	Barium	ICPSWN00	mg/Nm3	0.00754 R	0.00126 @R				
FGD inlet gas, vapor phase	Barium	ICPSWN00	mg/Nm3	0.0688 @	0.103				
stack gas, solid phase	Barium	ICPSWN00	mg/Nm3	< 0.0071			0.00136 @R		
stack gas, vapor phase	Barium	ICPSWN00	mg/Nm3	< 0.00373			< 0.00548		
makeup water	Barium	I39RWN00	mg/L	0.022 @	0.022 @		0.023 @		
wastewater treatment effluent	Barium	I39RWN00	mg/L	0.044 @	0.046 @	0.047 @			
stack gas	Benzene	8240	mg/Nm3	0.0011	0.00069		0.00084		
high dust gas	Benzo(a)anthracene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Benzo(a)anthracene	827SSNT1	mg/Nm3	0.00363 @	< 0.0024		< 0.00265		
stack gas	Benzo(a)anthracene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Benzo(a)pyrene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Benzo(a)pyrene	827SSNT1	mg/Nm3	0.00311 @	< 0.0024		< 0.00265		
stack gas	Benzo(a)pyrene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Benzo(b)fluoranthene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Benzo(b)fluoranthene	827SSNT1	mg/Nm3	0.00622 @	< 0.0024		< 0.00265		
stack gas	Benzo(b)fluoranthene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Benzo(g,h,i)perylene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Benzo(g,h,i)perylene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Benzo(g,h,i)perylene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Benzo(k)fluoranthene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Benzo(k)fluoranthene	827SSNT1	mg/Nm3	0.00622 @	< 0.0024		< 0.00265		
stack gas	Benzo(k)fluoranthene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		

Site 12 Data Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
coal	Beryllium	ICP	mg/kg	0.56	0.63		0.66	0.56	0.62
limestone	Beryllium	ICPSSN00	mg/kg	< 1	< 5.4		< 0.98		
bottom ash	Beryllium	I39RSN00	mg/kg	4.6 @	5.4 @		5.4 @		5.3
collected fly ash	Beryllium	ICPSSN00	mg/kg	8.92	7.91 @		6.95		
collected fly ash (baghouse)	Beryllium	ICPSSN00	mg/kg	< 9.9	5.96		< 5.1		5.38
high dust gas particulate	Beryllium	ICPSWN00	mg/kg	5.25	10.6		13.9		
FGD inlet particulate	Beryllium	ICPSWN00	mg/kg	< 1.52	< 1.18				
stack gas particulate	Beryllium	ICPSWN00	mg/kg	< 9.35			< 15		
FGD solids	Beryllium	ICPSSN00	mg/kg	0.0567 @	< 5.1	< 0.94	< 2		
high dust gas, solid phase	Beryllium	ICPSWN00	mg/Nm3	0.0406	0.0516		0.106		
high dust gas, vapor phase	Beryllium	ICPSWN00	mg/Nm3	< 0.000912	< 0.000852		< 0.00089		
FGD inlet gas, solid phase	Beryllium	ICPSWN00	mg/Nm3	< 0.000148	< 0.000157				
FGD inlet gas, vapor phase	Beryllium	ICPSWN00	mg/Nm3	< 0.000731	< 0.000805				
stack gas, solid phase	Beryllium	ICPSWN00	mg/Nm3	< 0.000149			< 0.000184		
stack gas, vapor phase	Beryllium	ICPSWN00	mg/Nm3	< 0.000748			< 0.0011		
makeup water	Beryllium	I39RWN00	mg/L	< 0.002	< 0.002		< 0.002		
wastewater treatment effluent	Beryllium	I39RWN00	mg/L	< 0.002	< 0.002	< 0.002			
stack gas	Bromomethane	0240	mg/Nm3	0.0011	< 0.0005		< 0.0005		
coal	Cadmium	NAA	mg/kg	< 2.57	< 2.69		< 3.4		
limestone	Cadmium	CDGSSA00	mg/kg	< 0.52	< 0.54		< 0.49	< 5	
bottom ash	Cadmium	CDGSSA00	mg/kg	< 0.49	< 0.6		< 5		< 5
collected fly ash	Cadmium	CDGSSA00	mg/kg	< 0.5	< 0.47		< 5.1		
collected fly ash (baghouse)	Cadmium	CDGSSA00	mg/kg	< 0.5	0.502 @		< 0.51		< 5
high dust gas particulate	Cadmium	CDGSWA00	mg/kg	2.9 @R	8.09 R				
FGD inlet particulate	Cadmium	CDGSWA00	mg/kg	16.5 @R	16.5 @R				
stack gas particulate	Cadmium	CDGSWA00	mg/kg	8.41 @R			131 @R		
FGD solids	Cadmium	CDGSSA00	mg/kg	< 0.5	< 0.51	< 0.47	< 0.5		
high dust gas, solid phase	Cadmium	CDGSWA00	mg/Nm3	0.0224 @R	0.0395 R		0.0514 @		
high dust gas, vapor phase	Cadmium	CDGSWA00	mg/Nm3	< 0.000253	0.000308 @		0.000512 @		
FGD inlet gas, solid phase	Cadmium	CDGSWA00	mg/Nm3	0.0018 @R	0.00246 @R				
FGD inlet gas, vapor phase	Cadmium	CDGSWA00	mg/Nm3	< 0.000198	< 0.000223				
stack gas, solid phase	Cadmium	CDGSWA00	mg/Nm3	0.000134 @R			0.0016 @R		
stack gas, vapor phase	Cadmium	CDGSWA00	mg/Nm3	0.000264 @			0.00084 @		
makeup water	Cadmium	CDGSWA00	mg/L	< 0.001	< 0.002		< 0.001		
wastewater treatment effluent	Cadmium	CDGSWA00	mg/L	< 0.001	< 0.001	< 0.002			
coal	Calcium	NAA	mg/kg	1840	2600		1450		
limestone	Calcium	D4326	mg/kg	389000	391000		391000	390000	
bottom ash	Calcium	D4326	mg/kg	37300	38100		35700		
collected fly ash	Calcium	D4326	mg/kg	37300	39000		39100		
collected fly ash (baghouse)	Calcium	D4326	mg/kg	40500	38700		39300		
high dust gas particulate	Calcium	ICPSWN00	mg/kg	37200 R	43900 R		40500 R		
FGD inlet particulate	Calcium	ICPSWN00	mg/kg	5000 R	< 1590				
stack gas particulate	Calcium	ICPSWN00	mg/kg	< 13000			< 29500		
FGD solids	Calcium	D4326	mg/kg	226000	224000	220000	222000		
high dust gas, solid phase	Calcium	ICPSWN00	mg/Nm3	287 R	214 R		309 R		
high dust gas, vapor phase	Calcium	ICPSWN00	mg/Nm3	49.6	1.81 J		2.07 @		
FGD inlet gas, solid phase	Calcium	ICPSWN00	mg/Nm3	0.488 R	< 0.212				
FGD inlet gas, vapor phase	Calcium	ICPSWN00	mg/Nm3	17.9	2.78 @				
stack gas, solid phase	Calcium	ICPSWN00	mg/Nm3	< 0.208			< 0.381		
stack gas, vapor phase	Calcium	ICPSWN00	mg/Nm3	< 0.373			< 0.548		
makeup water	Calcium	I39RWN00	mg/L	36.5	34.8		36.9		
wastewater treatment effluent	Calcium	I39RWN00	mg/L	199	195	197			
coal	Chloride	CLIESN00	mg/kg	740	670		680		
limestone	Chloride	IC	mg/kg	159	155		170	157	
bottom ash	Chloride	IC	mg/kg	11.6 E	16 E		43 E		32.4 E
collected fly ash	Chloride	IC	mg/kg	6.58 E	39.1 E		27.1 E		

Site 12 Data Used In Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
collected fly ash (baghouse)	Chloride	IC	mg/kg	5.91 E	8.56 E		4.95 E		3.52 E
FGD solids	Chloride	IC	mg/kg	4390	4060	3520	4520		
high dust gas, solid phase (CFA)	Chloride	IC	mg/Nm3	0.05	0.19		0.036		
high dust gas, vapor phase	Chloride	CLFWN00	mg/Nm3	74.7	71.1		65		
FGD inlet gas, solid phase (CFA)	Chloride	IC	mg/Nm3	0.0006	0.0051				
FGD inlet gas, vapor phase	Chloride	CLFWN00	mg/Nm3	55.9	61.1				
stack gas, solid phase (CFA)	Chloride	IC	mg/Nm3	0.0001			0.0003		
stack gas, vapor phase	Chloride	CLFWN00	mg/Nm3	2.45			2.69		
makeup water	Chloride	CLFWN00	mg/L	20	20		22		
wastewater treatment effluent	Chloride	CLFWN00	mg/L	240	240				
coal	Chromium	NAA	mg/kg	16.5	16.8		15.3		
limestone	Chromium	ICPSSN00	mg/kg	8.53 @	< 27		7.43 @		
bottom ash	Chromium	I39RSN00	mg/kg	92	100		96		98
collected fly ash	Chromium	ICPSSN00	mg/kg	134	156		130		
collected fly ash (baghouse)	Chromium	ICPSSN00	mg/kg	142 @	118		84 @		106
high dust gas particulate	Chromium	ICPSWN00	mg/kg	116 R	246 R		278 R		
FGD inlet particulate	Chromium	ICPSWN00	mg/kg	52.3 R	21.7 @R				
stack gas particulate	Chromium	ICPSWN00	mg/kg	154 @R			504 R		
FGD solids	Chromium	ICPSSN00	mg/kg	5.62 @	< 25	9.33 @	< 10		
high dust gas, solid phase	Chromium	ICPSWN00	mg/Nm3	0.899 R	1.2 R		2.12 R		
high dust gas, vapor phase	Chromium	ICPSWN00	mg/Nm3	< 0.00456	0.00844 @		< 0.00445		
FGD inlet gas, solid phase	Chromium	ICPSWN00	mg/Nm3	0.0051 R	0.00288 @R				
FGD inlet gas, vapor phase	Chromium	ICPSWN00	mg/Nm3	0.0122 J	< 0.00403				
stack gas, solid phase	Chromium	ICPSWN00	mg/Nm3	0.00245 @R			0.00618 R		
stack gas, vapor phase	Chromium	ICPSWN00	mg/Nm3	< 0.00373			< 0.00548		
makeup water	Chromium	I39RWN00	mg/L	< 0.01	< 0.01		< 0.01		
wastewater treatment effluent	Chromium	I39RWN00	mg/L	< 0.01	< 0.01	< 0.01			
high dust gas	Chrysene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Chrysene	8270SNT1	mg/Nm3	0.0044 @	< 0.0024		< 0.00265		
stack gas	Chrysene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Cobalt	NAA	mg/kg	2.09	3.87		2.99		
limestone	Cobalt	ICPSSN00	mg/kg	< 5.2	< 27		< 4.9		
bottom ash	Cobalt	I39RSN00	mg/kg	42	46		44		45
collected fly ash	Cobalt	ICPSSN00	mg/kg	34.1	38.1 @		34.4		
collected fly ash (baghouse)	Cobalt	ICPSSN00	mg/kg	< 50	27		< 26		31.5
high dust gas particulate	Cobalt	ICPSWN00	mg/kg	29 R	2120 R		74.9 R		
FGD inlet particulate	Cobalt	ICPSWN00	mg/kg	< 0.756	40.4 R				
stack gas particulate	Cobalt	ICPSWN00	mg/kg	< 46.7			< 75.2		
FGD solids	Cobalt	ICPSSN00	mg/kg	1.26 @	< 25	< 4.7	< 10		
high dust gas, solid phase	Cobalt	ICPSWN00	mg/Nm3	0.225 R	10.3 R		0.571 R		
high dust gas, vapor phase	Cobalt	ICPSWN00	mg/Nm3	< 0.00456	< 0.00426		< 0.00445		
FGD inlet gas, solid phase	Cobalt	ICPSWN00	mg/Nm3	< 0.000074	0.00538 R				
FGD inlet gas, vapor phase	Cobalt	ICPSWN00	mg/Nm3	< 0.00365	< 0.00403				
stack gas, solid phase	Cobalt	ICPSWN00	mg/Nm3	< 0.000746			< 0.000922		
stack gas, vapor phase	Cobalt	ICPSWN00	mg/Nm3	< 0.00373			< 0.00548		
makeup water	Cobalt	I39RWN00	mg/L	< 0.01	< 0.01		< 0.01		
wastewater treatment effluent	Cobalt	I39RWN00	mg/L	< 0.01	< 0.01	< 0.01			
coal	Copper	NAA	mg/kg	< 32.3	< 30.7		< 38		
limestone	Copper	ICPSSN00	mg/kg	< 10	< 54		< 9.6		
bottom ash	Copper	I39RSN00	mg/kg	39 @	46 @		42 @		40 @
collected fly ash	Copper	ICPSSN00	mg/kg	68.7	71.5 @		68.6		
collected fly ash (baghouse)	Copper	ICPSSN00	mg/kg	< 99	58.6		< 51		55.6
high dust gas particulate	Copper	ICPSWN00	mg/kg	60.3 R	7940 R		139 R		
FGD inlet particulate	Copper	ICPSWN00	mg/kg	16.9 @R	< 0.945				
stack gas particulate	Copper	ICPSWN00	mg/kg	< 155			752 R		
FGD solids	Copper	ICPSSN00	mg/kg	< 20	< 51	< 9.4	< 20		

Site 12 Data Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
high dust gas, solid phase	Copper	ICPSWN00	mg/Nm3	0.466 R	38.7 R		1.06 R		
high dust gas, vapor phase	Copper	ICPSWN00	mg/Nm3	< 0.00912	< 0.00852		< 0.0089		
FGD inlet gas, solid phase	Copper	ICPSWN00	mg/Nm3	0.00155 @R	< 0.000126				
FGD inlet gas, vapor phase	Copper	ICPSWN00	mg/Nm3	< 0.00731	< 0.00805				
stack gas, solid phase	Copper	ICPSWN00	mg/Nm3	< 0.00246			0.00922 R		
stack gas, vapor phase	Copper	ICPSWN00	mg/Nm3	< 0.00748			< 0.011		
makeup water	Copper	I39RWN00	mg/L	< 0.02	< 0.02		< 0.02		
wastewater treatment effluent	Copper	I39RWN00	mg/L	< 0.02	< 0.02	< 0.02			
high dust gas	Dibenzofuran	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Dibenzofuran	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Dibenzofuran	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Dibenz(a,h)anthracene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Dibenz(a,h)anthracene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Dibenz(a,h)anthracene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Dibenz(a,j)acridine	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Dibenz(a,j)acridine	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Dibenz(a,j)acridine	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Diphenylamine	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Diphenylamine	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Diphenylamine	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Fluoranthene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Fluoranthene	8270SNT1	mg/Nm3	0.00958 @	< 0.0024		< 0.00265		
stack gas	Fluoranthene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Fluorene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Fluorene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Fluorene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Fluoride	F_SESA00	mg/kg	83.9 I	80 I		64.2 I		
limestone	Fluoride	acid dis	mg/kg	76.1 @	83.1 @		72.1 @	76.7 @	
bottom ash	Fluoride	NaOH fus	mg/kg	5.46 J	3.87 J		7.37 J		5.24 J
collected fly ash	Fluoride	NaOH fus	mg/kg	9.3 J	34.9 @		1.98 J		
collected fly ash (baghouse)	Fluoride	NaOH fus	mg/kg	14.8 J	8.37 J		26.2 @		10.7 J
FGD solids	Fluoride	acid dis	mg/kg	711	756	130	708		
high dust gas, solid phase (CFA)	Fluoride	NaOH fus	mg/Nm3	0.071	0.17		0.014		
high dust gas, vapor phase	Fluoride	SIE	mg/Nm3	0.211	0.388		0.933		
FGD inlet gas, solid phase (CFA)	Fluoride	NaOH fus	mg/Nm3	0.0009	0.0046				
FGD inlet gas, vapor phase	Fluoride	SIE	mg/Nm3	0.167	0.268				
stack gas, solid phase (CFA)	Fluoride	NaOH fus	mg/Nm3	0.00015			0.00002		
stack gas, vapor phase	Fluoride	SIE	mg/Nm3	0.0301 @			0.0385 @		
makeup water	Fluoride	aq	mg/L	0.137 @	0.133 @		0.133 @		
wastewater treatment effluent	Fluoride	aq	mg/L	0.602	0.706	0.711			
high dust gas, vapor phase	Formaldehyde	ALDELKA8	mg/Nm3	< 0.00447	0.0263 @		0.0347 @		
FGD inlet gas, vapor phase	Formaldehyde	ALDELKA8	mg/Nm3	< 0.00626	0.0259 @				
stack gas, vapor phase	Formaldehyde	ALDELKA8	mg/Nm3	< 0.00699			< 0.00935		
coal	HHV	HHV	Btu/lb	13700	13600	13600	13900		
high dust gas	Indeno(1,2,3-cd)pyrene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Indeno(1,2,3-cd)pyrene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Indeno(1,2,3-cd)pyrene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Iron	NAA	mg/kg	12600	14200		19600		
limestone	Iron	D4326	mg/kg	627	668		550	668	
bottom ash	Iron	D4326	mg/kg	170000	169000		158000		
collected fly ash	Iron	D4326	mg/kg	115000	122000		128000		
collected fly ash (baghouse)	Iron	D4326	mg/kg	138000	149000		154000		
high dust gas particulate	Iron	ICPSWN00	mg/kg	89900 R	153000 R		182000 R		
FGD inlet particulate	Iron	ICPSWN00	mg/kg	51300 R	2050 R				
stack gas particulate	Iron	ICPSWN00	mg/kg	< 6830			19500 R		
FGD solids	Iron	D4326	mg/kg	1330	3930	6800	1470		

Site 12 Data Used In Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
high dust gas, solid phase	Iron	ICPSWN00	mg/Nm3	695 R	749 R		1390 R		
high dust gas, vapor phase	Iron	ICPSWN00	mg/Nm3	0.0789 @	0.0369 @		0.0418		
FGD inlet gas, solid phase	Iron	ICPSWN00	mg/Nm3	5.01 R	0.272 R				
FGD inlet gas, vapor phase	Iron	ICPSWN00	mg/Nm3	0.0515 @	0.0414				
stack gas, solid phase	Iron	ICPSWN00	mg/Nm3	< 0.141			0.239 R		
stack gas, vapor phase	Iron	ICPSWN00	mg/Nm3	0.0175 @			0.0239 @		
makeup water	Iron	I39RWN00	mg/L	< 0.04	0.895		0.135 @		
wastewater treatment effluent	Iron	I39RWN00	mg/L	0.337	0.04 @	0.063 @			
coal	Lead	GFAA	mg/kg	2.4	2.3		2.3	1.8	2.4
limestone	Lead	PBGSSA00	mg/kg	1.8 @	1.8 @		1.6 @	2.6 @	
bottom ash	Lead	PBGSSA00	mg/kg	12	16		15		12
collected fly ash	Lead	PBGSSA00	mg/kg	32.6	49		43.7		
collected fly ash (baghouse)	Lead	PBGSSA00	mg/kg	42	32.4		26		23.6
high dust gas particulate	Lead	PBGSWA00	mg/kg	36 R	65 R		66.7 R		
FGD inlet particulate	Lead	PBGSWA00	mg/kg	47.7 R	77.9 R				
stack gas particulate	Lead	PBGSWA00	mg/kg	< 70.1			75.2 @R		
FGD solids	Lead	PBGSSA00	mg/kg	3.5 @	1.7 @	< 1.4	< 1.5		
high dust gas, solid phase	Lead	PBGSWA00	mg/Nm3	0.276 R	0.317 R		0.676 R		
high dust gas, vapor phase	Lead	PBGSWA00	mg/Nm3	0.00825	0.00443 @		0.00265 @		
FGD inlet gas, solid phase	Lead	PBGSWA00	mg/Nm3	0.00466 R	0.0104 R				
FGD inlet gas, vapor phase	Lead	PBGSWA00	mg/Nm3	0.00427 @	0.00296 @				
stack gas, solid phase	Lead	PBGSWA00	mg/Nm3	< 0.00112			0.000922 @R		
stack gas, vapor phase	Lead	PBGSWA00	mg/Nm3	0.003 @			0.00845		
makeup water	Lead	PBGSWA00	mg/L	0.0039 @	0.0039 @		0.0033 @		
wastewater treatment effluent	Lead	PBGSWA00	mg/L	< 0.003	0.0031 @	< 0.003			
coal	Magnesium	NAA	mg/kg	353	391		427		
limestone	Magnesium	D4326	mg/kg	3170	3420		3490	4030	
bottom ash	Magnesium	D4326	mg/kg	5900	5660		5660		
collected fly ash	Magnesium	D4326	mg/kg	5790	6200		6390		
collected fly ash (baghouse)	Magnesium	D4326	mg/kg	6330	6630		6090		
high dust gas particulate	Magnesium	ICPSWN00	mg/kg	4550	7410		6660		
FGD inlet particulate	Magnesium	ICPSWN00	mg/kg	1080 @	< 590				
stack gas particulate	Magnesium	ICPSWN00	mg/kg	< 4870			< 7520		
FGD solids	Magnesium	D4326	mg/kg	3450	3790	3420	3820		
high dust gas, solid phase	Magnesium	ICPSWN00	mg/Nm3	35.2	38.1		52.3		
high dust gas, vapor phase	Magnesium	ICPSWN00	mg/Nm3	< 0.456	< 0.426		< 0.445		
FGD inlet gas, solid phase	Magnesium	ICPSWN00	mg/Nm3	0.105 @	< 0.0785				
FGD inlet gas, vapor phase	Magnesium	ICPSWN00	mg/Nm3	< 0.365	< 0.403				
stack gas, solid phase	Magnesium	ICPSWN00	mg/Nm3	< 0.0746			< 0.0922		
stack gas, vapor phase	Magnesium	ICPSWN00	mg/Nm3	< 0.373			< 0.548		
makeup water	Magnesium	I39RWN00	mg/L	5.12	6.16		6.3		
wastewater treatment effluent	Magnesium	I39RWN00	mg/L	43.1	33.8	34.3			
coal	Manganese	NAA	mg/kg	16.7	15.7		16.6		
limestone	Manganese	ICPSSN00	mg/kg	76.4	72.4 @		62.6		
bottom ash	Manganese	I39RSN00	mg/kg	160	160		160		160
collected fly ash	Manganese	ICPSSN00	mg/kg	204	247		210		
collected fly ash (baghouse)	Manganese	ICPSSN00	mg/kg	248 @	209		169		240
high dust gas particulate	Manganese	ICPSWN00	mg/kg	176 R	299 R		385 R		
FGD inlet particulate	Manganese	ICPSWN00	mg/kg	222 R	13.8 @R				
stack gas particulate	Manganese	ICPSWN00	mg/kg	< 114			240 @R		
FGD solids	Manganese	ICPSSN00	mg/kg	45.3 @	64.6 @	59.4	37.7 @		
high dust gas, solid phase	Manganese	ICPSWN00	mg/Nm3	1.35 R	1.48 R		2.94 R		
high dust gas, vapor phase	Manganese	ICPSWN00	mg/Nm3	0.0533 @	< 0.00426		0.0108 J		
FGD inlet gas, solid phase	Manganese	ICPSWN00	mg/Nm3	0.0217 R	0.00184 @R				
FGD inlet gas, vapor phase	Manganese	ICPSWN00	mg/Nm3	0.0316 @	0.0808				
stack gas, solid phase	Manganese	ICPSWN00	mg/Nm3	< 0.00162			0.00294 @R		

Site 12 Data Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
stack gas, vapor phase	Manganese	ICPSWN00	mg/Nm3	< 0.00373			< 0.00548		
makeup water	Manganese	I39RWN00	mg/L	< 0.01	< 0.01		< 0.01		
wastewater treatment effluent	Manganese	I39RWN00	mg/L	0.057	0.015 @	0.016 @			
coal	Mercury	DGA/CBA	mg/kg	0.18	0.163		0.117	0.137	0.134
limestone	Mercury	HGC_SN00	mg/kg	< 0.045	< 0.045		< 0.045	< 0.045	
bottom ash	Mercury	HGC_SN00	mg/kg	< 0.045	< 0.045		< 0.045		< 0.045
collected fly ash	Mercury	HGC_SN00	mg/kg	< 0.045	0.045 @		< 0.045		
collected fly ash (baghouse)	Mercury	HGC_SN00	mg/kg	< 0.045	0.076 @		< 0.045		< 0.045
high dust gas particulate	Mercury	HGC_WN00	mg/kg		< 0.00159		< 0.0162		
FGD inlet particulate	Mercury	HGC_WN00	mg/kg	< 0.0682	< 0.0531				
stack gas particulate	Mercury	HGC_WN00	mg/kg	< 0.421			< 0.677		
FGD solids	Mercury	HGC_SN00	mg/kg	0.474	0.8	0.76	0.84		
high dust gas, solid phase	Mercury	HGC_WN00	mg/Nm3	< 0.000117	< 7.7E-06		< 0.000139		
high dust gas, vapor phase	Mercury	HGC_WN00	mg/Nm3	0.00101	0.00112		0.000348		
FGD inlet gas, solid phase	Mercury	HGC_WN00	mg/Nm3	< 0.000007	< 0.000007		< 0.000008		
FGD inlet gas, vapor phase	Mercury	HGC_WN00	mg/Nm3	0.000139	0.000203		0.000204		
stack gas, solid phase	Mercury	HGC_WN00	mg/Nm3	< 0.000007	< 0.000008		< 0.000008		
stack gas, vapor phase	Mercury	HGC_WN00	mg/Nm3	0.000276	0.000132		0.000079		
makeup water	Mercury	HGC_WN00	mg/L	< 0.0002	< 0.0002		< 0.0002		
wastewater treatment effluent	Mercury	HGC_WN00	mg/L	< 0.0002	< 0.0002	< 0.0002			
coal	Moisture	proximat	% as receive	3.98	4.34	4.68	4.07		
bottom ash	Moisture	oven dry	%	10.2	8.81		23.5		17
FGD solids	Moisture	MSTCSA00	%	25.1					
coal	Molybdenum	NAA	mg/kg	< 1.2	< 1.29		< 1.54		
limestone	Molybdenum	ICPSSN00	mg/kg	< 26	< 140		< 25		
bottom ash	Molybdenum	I39RSN00	mg/kg	41 @	42 @		38 @		40 @
collected fly ash	Molybdenum	ICPSSN00	mg/kg	60.6 @	150 @		52.3 @		
collected fly ash (baghouse)	Molybdenum	ICPSSN00	mg/kg	< 250	48 @		< 130		53 @
high dust gas particulate	Molybdenum	ICPSWN00	mg/kg	125 R	208 R		200 R		
FGD inlet particulate	Molybdenum	ICPSWN00	mg/kg	< 34.8	80.9 @R				
stack gas particulate	Molybdenum	ICPSWN00	mg/kg	< 182			692 @R		
FGD solids	Molybdenum	ICPSSN00	mg/kg	37.1 @	< 130	30.2 @	< 50		
high dust gas, solid phase	Molybdenum	ICPSWN00	mg/Nm3	0.965 R	1.01 R		1.53 R		
high dust gas, vapor phase	Molybdenum	ICPSWN00	mg/Nm3	< 0.0226	< 0.0213		< 0.0222		
FGD inlet gas, solid phase	Molybdenum	ICPSWN00	mg/Nm3	< 0.0034	0.0106 @R				
FGD inlet gas, vapor phase	Molybdenum	ICPSWN00	mg/Nm3	< 0.0163	< 0.0201				
stack gas, solid phase	Molybdenum	ICPSWN00	mg/Nm3	< 0.00291			0.00848 @R		
stack gas, vapor phase	Molybdenum	ICPSWN00	mg/Nm3	< 0.0187			< 0.0274		
makeup water	Molybdenum	I39RWN00	mg/L	< 0.05	< 0.05		< 0.05		
wastewater treatment effluent	Molybdenum	I39RWN00	mg/L	0.058 @	0.059 @	< 0.05			
stack gas	m,p-Xylene	8240	mg/Nm3	0.00087	0.00080		0.0010		
high dust gas	Naphthalene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Naphthalene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Naphthalene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Nickel	NAA	mg/kg	15.8	< 25.7		< 32		
limestone	Nickel	ICPSSN00	mg/kg	< 10	< 54		11.8 @		
bottom ash	Nickel	I39RSN00	mg/kg	58	66		60		64
collected fly ash	Nickel	ICPSSN00	mg/kg	71	70.9 @		70.3		
collected fly ash (baghouse)	Nickel	ICPSSN00	mg/kg	< 99	65.2		< 51		67.6
high dust gas particulate	Nickel	ICPSWN00	mg/kg	69.6 R	121 R		150 R		
FGD inlet particulate	Nickel	ICPSWN00	mg/kg	32 @R	15.6 @R				
stack gas particulate	Nickel	ICPSWN00	mg/kg	< 26.5			865 R		
FGD solids	Nickel	ICPSSN00	mg/kg	9.22 @	< 51	< 9.4	< 20		
high dust gas, solid phase	Nickel	ICPSWN00	mg/Nm3	0.539 R	0.594		1.14 R		
high dust gas, vapor phase	Nickel	ICPSWN00	mg/Nm3	< 0.00912	< 0.00852		< 0.0089		
FGD inlet gas, solid phase	Nickel	ICPSWN00	mg/Nm3	0.00312 @R	0.0021 @R				

Site 12 Data Used In Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
FGD inlet gas, vapor phase	Nickel	ICPSWN00	mg/Nm3	< 0.00731	< 0.00805				
stack gas, solid phase	Nickel	ICPSWN00	mg/Nm3	< 0.000455			0.0106 R		
stack gas, vapor phase	Nickel	ICPSWN00	mg/Nm3	< 0.00746			< 0.011		
makeup water	Nickel	I39RWN00	mg/L	< 0.02	< 0.02		< 0.02		
wastewater treatment effluent	Nickel	I39RWN00	mg/L	< 0.02	< 0.02	< 0.02			
high dust gas	N-Nitrosodiphenylamine	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	N-Nitrosodiphenylamine	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	N-Nitrosodiphenylamine	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	N-Nitrosodipropylamine	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	N-Nitrosodipropylamine	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	N-Nitrosodipropylamine	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Particulate matter	Multimetal	mg/Nm3	7730	4890		7340		
FGD inlet gas	Particulate matter	Multimetal	mg/Nm3	98	133				
stack gas	Particulate matter	Multimetal	mg/Nm3	16			12		
high dust gas	Phenanthrene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Phenanthrene	827SSNT1	mg/Nm3	0.00725 @	< 0.0024		< 0.00265		
stack gas	Phenanthrene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Phosphorus	TPORSN00	mg/kg	27	37		11		
limestone	Phosphorus	D4326	mg/kg	220	196		220	196	
bottom ash	Phosphorus	D4326	mg/kg	1660	1740		1780		
collected fly ash	Phosphorus	D4326	mg/kg	2410	2630		2500		
collected fly ash (baghouse)	Phosphorus	D4326	mg/kg	2200	2010		2080		
FGD solids	Phosphorus	D4326	mg/kg	64	95.7	96.5	94.6		
high dust gas, solid phase (CFA)	Phosphorus	D4326	mg/Nm3	18.3	12.7		16.1		
high dust gas, vapor phase	Phosphorus	Imp	mg/Nm3	0.0249	0.0239		0.0245		
FGD inlet gas, solid phase (CFA)	Phosphorus	D4326	mg/Nm3	0.23	0.34				
FGD inlet gas, vapor phase	Phosphorus	Imp	mg/Nm3	0.0161	0.0238				
stack gas, solid phase (CFA)	Phosphorus	D4326	mg/Nm3	0.039			0.03		
stack gas, vapor phase	Phosphorus	Imp	mg/Nm3	0.0354			< 0.00337		
makeup water	Phosphorus	aq	mg/L	0.009 @	0.0176 @		0.0204 @		
wastewater treatment effluent	Phosphorus	aq	mg/L	0.0204 @	0.0147 @	0.0147 @			
coal	Potassium	NAA	mg/kg	< 1760	< 1850		< 1970		
limestone	Potassium	D4326	mg/kg	93	93.3		93.2	93.2	
bottom ash	Potassium	D4326	mg/kg	11600	11700		11500		
collected fly ash	Potassium	D4326	mg/kg	13700	13500		13200		
collected fly ash (baghouse)	Potassium	D4326	mg/kg	13400	12200		12300		
high dust gas particulate	Potassium	ICPSWN00	mg/kg	12600	24700		30000		
FGD inlet particulate	Potassium	ICPSWN00	mg/kg	< 2270	< 1770				
stack gas particulate	Potassium	ICPSWN00	mg/kg	< 14000			< 22600		
FGD solids	Potassium	D4326	mg/kg		243	428			
high dust gas, solid phase	Potassium	ICPSWN00	mg/Nm3	99.3	120		229		
high dust gas, vapor phase	Potassium	ICPSWN00	mg/Nm3	< 1.37	< 1.28		< 1.33		
FGD inlet gas, solid phase	Potassium	ICPSWN00	mg/Nm3	< 0.222	< 0.235				
FGD inlet gas, vapor phase	Potassium	ICPSWN00	mg/Nm3	< 1.1	< 1.21				
stack gas, solid phase	Potassium	ICPSWN00	mg/Nm3	< 0.224			< 0.277		
stack gas, vapor phase	Potassium	ICPSWN00	mg/Nm3	< 1.12			< 1.64		
makeup water	Potassium	I39RWN00	mg/L	< 3	< 3		< 3		
wastewater treatment effluent	Potassium	I39RWN00	mg/L	4.64 @	4.87 @	4.67 @			
high dust gas	Pyrene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Pyrene	827SSNT1	mg/Nm3	0.0057 @	< 0.0024		< 0.00265		
stack gas	Pyrene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Selenium	HGAA	mg/kg	1.29	1.28		1.16	1.25	1.23
limestone	Selenium	SEHRSN00	mg/kg	< 2.6	< 2.7		< 2.5	< 2.4	
bottom ash	Selenium	SEHRSN00	mg/kg	< 2.6	< 2.9		< 2.6		< 2.4
collected fly ash	Selenium	SEHRSN00	mg/kg	4.7 @	3.9 @		5 @		
collected fly ash (baghouse)	Selenium	SEHRSN00	mg/kg	5.4 @	< 13		17		5.6 @

Site 12 Data Used In Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
high dust gas particulate	Selenium	SEHRSN00	mg/kg	22.2	31.8		45		
FGD inlet particulate	Selenium	SEHRSN00	mg/kg	346	490				
stack gas particulate	Selenium	SEHRSN00	mg/kg	748			714		
FGD solids	Selenium	SEHRSN00	mg/kg	< 13	< 2.5	< 2.3	< 2.7		
high dust gas, solid phase	Selenium	SEHRSN00	mg/Nm3	0.171	0.155		0.343		
high dust gas, vapor phase	Selenium	SEHRWN00	mg/Nm3	0.00446 @	0.00998 @		0.0133		
FGD inlet gas, solid phase	Selenium	SEHRSN00	mg/Nm3	0.034	0.0651				
FGD inlet gas, vapor phase	Selenium	SEHRWN00	mg/Nm3	0.00827 @	0.00343 @				
stack gas, solid phase	Selenium	SEHRSN00	mg/Nm3	0.0119			0.00876		
stack gas, vapor phase	Selenium	SEHRWN00	mg/Nm3	0.0027 @			0.00634 @		
coal	Sodium	NAA	mg/kg	586	644		769		
limestone	Sodium	D4326	mg/kg	125	125		125	125	
bottom ash	Sodium	D4326	mg/kg	6150	6520		6250		
collected fly ash	Sodium	D4326	mg/kg	7840	7200		6860		
collected fly ash (baghouse)	Sodium	D4326	mg/kg	6830	6470		6830		
high dust gas particulate	Sodium	ICPSWN00	mg/kg	549000 R	529000 R		575000 R		
FGD inlet particulate	Sodium	ICPSWN00	mg/kg	1170 @R	< 2490				
stack gas particulate	Sodium	ICPSWN00	mg/kg	< 17600			< 977		
FGD solids	Sodium	D4326	mg/kg	489	271	492	429		
high dust gas, solid phase	Sodium	ICPSWN00	mg/Nm3	4240 R	2580 R		5140 R		
high dust gas, vapor phase	Sodium	ICPSWN00	mg/Nm3	2.71 @	2.08 @		2.34 @		
FGD inlet gas, solid phase	Sodium	ICPSWN00	mg/Nm3	0.114 @R	< 0.33				
FGD inlet gas, vapor phase	Sodium	ICPSWN00	mg/Nm3	2.26 @	3.45 @				
stack gas, solid phase	Sodium	ICPSWN00	mg/Nm3	< 0.281			< 0.012		
stack gas, vapor phase	Sodium	ICPSWN00	mg/Nm3	< 0.373			< 0.548		
makeup water	Sodium	I39RWN00	mg/L	11.2	11.6		12.2		
wastewater treatment effluent	Sodium	I39RWN00	mg/L	389	441	446			
stack gas	Styrene	6240	mg/Nm3	< 0.0005	< 0.0005		0.00051		
high dust gas, vapor phase	Sulfate	SFIFWN00	mg/Nm3	5600 I	5630 I		5260		
FGD inlet gas, vapor phase	Sulfate	SFIFWN00	mg/Nm3	4690	5620				
stack gas, vapor phase	Sulfate	SFIFWN00	mg/Nm3	1170			1010		
coal	Sulfur	ultimate	%	2.91	2.76	2.73	2.66		
limestone	Sulfur	TTSRSN00	%	0.0269	0.0331		0.0435	0.0366	
bottom ash	Sulfur	TTSRSN00	%	0.0382	0.0533		0.191		0.108
collected fly ash	Sulfur	TTSRSN00	%	0.507	0.513		0.494		
collected fly ash (baghouse)	Sulfur	TTSRSN00	%	0.662	0.576		0.57		0.43
FGD solids	Sulfur	TTSRSN00	%	22.5	21.8	22.1	19.6		
makeup water	Sulfur	I39RWN00	mg/L	6.66 @	6.65 @		6.94 @		
wastewater treatment effluent	Sulfur	I39RWN00	mg/L	373	394	399			
coal	Titanium	NAA	mg/kg	503	509		543		
limestone	Titanium	D4326	mg/kg	705	674		404	606	
bottom ash	Titanium	D4326	mg/kg	5930	5390		5520		
collected fly ash	Titanium	D4326	mg/kg	6220	6170		6060		
collected fly ash (baghouse)	Titanium	D4326	mg/kg	5650	5510		5530		
high dust gas particulate	Titanium	TIESWN00	mg/kg	4900	10200		12900		
FGD inlet particulate	Titanium	TIESWN00	mg/kg	371	68.5 @				
stack gas particulate	Titanium	TIESWN00	mg/kg	355 @			1200 @		
FGD solids	Titanium	D4326	mg/kg	220	176	309	88.6		
high dust gas, solid phase	Titanium	TIESWN00	mg/Nm3	37.9	49.9		98		
high dust gas, vapor phase	Titanium	TIESWN00	mg/Nm3	< 0.0228	< 0.0213		< 0.0222		
FGD inlet gas, solid phase	Titanium	TIESWN00	mg/Nm3	0.0382	0.0118 @				
FGD inlet gas, vapor phase	Titanium	TIESWN00	mg/Nm3	< 0.0183	< 0.0201				
stack gas, solid phase	Titanium	TIESWN00	mg/Nm3	0.00567 @			0.0148 @		
stack gas, vapor phase	Titanium	TIESWN00	mg/Nm3	< 0.0187			< 0.0274		
makeup water	Titanium	I39RWN00	mg/L	< 0.05	< 0.05		< 0.05		
wastewater treatment effluent	Titanium	I39RWN00	mg/L	< 0.05	< 0.05	< 0.05			

Site 12 Data Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
stack gas	Toluene	8240	mg/Nm3	0.0013	0.0011		0.0015		
coal	Vanadium	NAA	mg/kg	16.8	17.9		16.8		
limestone	Vanadium	ICPSSN00	mg/kg	< 10	54		< 9.8		97
bottom ash	Vanadium	139RSN00	mg/kg	88	100		90		
collected fly ash	Vanadium	ICPBSN00	mg/kg	186	213 @		180		142
collected fly ash (baghouse)	Vanadium	ICPSSN00	mg/kg	194 @	156		124 @		
high dust gas particulate	Vanadium	ICPSWN00	mg/kg	140	285		321		
FGD inlet particulate	Vanadium	ICPSWN00	mg/kg	34.7 @	< 11.8				
stack gas particulate	Vanadium	ICPBWN00	mg/kg	< 93.5			< 150		
FGD solids	Vanadium	ICPSSN00	mg/kg	9.5 @	< 51	< 9.4	< 20		
high dust gas, solid phase	Vanadium	ICPSWN00	mg/Nm3	1.06	1.29		2.45		
high dust gas, vapor phase	Vanadium	ICPSWN00	mg/Nm3	< 0.00812	< 0.00852		< 0.0089		
FGD inlet gas, solid phase	Vanadium	ICPSWN00	mg/Nm3	0.00339 @	< 0.00157				
FGD inlet gas, vapor phase	Vanadium	ICPSWN00	mg/Nm3	< 0.00731	< 0.00805				
stack gas, solid phase	Vanadium	ICPBWN00	mg/Nm3	< 0.00149			< 0.00184		
stack gas, vapor phase	Vanadium	ICPBWN00	mg/Nm3	< 0.00748			< 0.011		
makeup water	Vanadium	139RWN00	mg/L	< 0.02	< 0.02		< 0.02		
wastewater treatment effluent	Vanadium	139RWN00	mg/L	< 0.02	< 0.02	< 0.02			

Key to Data Flags

Flag	Description
@	Less than five times the detection limit.
B	Detected in blank, not corrected in sample result.
E	Estimated analyte result greater than calibration range.
F	Sample result corrected for nonisokinetic sampling conditions.
I	Updated result.
Int	Interference due to laboratory contamination.
J	Estimated analyte result less than the detection limit.
NA	Not analyzed.
R	Detected in blank, corrected in sample result.
S	Result obtained by using Method of Standard Additions.
#	The measured mercury concentrations are suspected to be low due to analytical problems. Thus, they are not presented in this table.

Methods Key

Method Code	Method Description
8240	Gas Chromatography/Mass Spectroscopy
827SSNT1	Gas Chromatography/Mass Spectroscopy
827SWNT1	Gas Chromatography/Mass Spectroscopy
AGESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
ALDELKAS	High Performance Liquid Chromatography
ALESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
ASGSSAOO	Graphite Furnace Atomic Absorption Spectrophotometry
ASHRWAOO	Hydride Generation Atomic Absorption Spectrophotometry
BAESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
BEESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
B_ESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
CAESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
CDGSSAOO	Graphite Furnace Atomic Absorption Spectrophotometry
CDGSWAOO	Graphite Furnace Atomic Absorption Spectrophotometry
CDGSWOOO	Graphite Furnace Atomic Absorption Spectrophotometry
CLIESNOO	Ion Chromatography
CLIFWNOO	Ion Chromatography
COESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
CRESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
CUESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
D2361	Parr Bomb Digestion/Potentiometric Titration
D2795	Parr Bomb Digestion/Visible Spectrophotometry
D3302	Oven Drying
D3761	Parr Bomb Digestion/Ion Selective Electrode
D4326	X-ray Fluorescence
FEESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
F_SESAOO	Ion Specific Electrode
GFAA	Graphite Furnace Atomic Absorption Spectrophotometry
HGAA	Hydride Generation Atomic Absorption Spectrophotometry
HGC_SNOO	Cold Vapor Atomic Absorption Spectrophotometry
HGC_WNOO	Cold Vapor Atomic Absorption Spectrophotometry

Method Code	Method Description
HHV	Adiabatic Bomb Calorimetry
HPLC	High Performance Liquid Chromatography
I39RWNOO	Inductively Coupled Plasma Emission Spectrometry
IC	Ion Chromatography
ICP	Inductively Coupled Plasma Emission Spectrometry
ICPSSNOO	Inductively Coupled Plasma Emission Spectrometry
ICPSWNOO	Inductively Coupled Plasma Emission Spectrometry
K_ESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
MGESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
MNESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
MOESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
NAA	Neutron Activation Analysis
NAESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
NIESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
NaOH FUS	Sodium Hydroxide Fusion/Ion Chromatography
PBGSSAOO	Graphite Furnace Atomic Absorption Spectrophotometry
PBGSWAOO	Graphite Furnace Atomic Absorption Spectrophotometry
PBGSWOOO	Graphite Furnace Atomic Absorption Spectrophotometry
P_ESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
PROXIMAT	Oven Drying, Oven Heating, Ignition
SEHRSNOO	Hydride Generation Atomic Absorption Spectrometry
SEHRWNOO	Hydride Generation Atomic Absorption Spectrophotometry
SFIFWNOO	Ion Chromatography
SIESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
SNESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
SRESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
S_ESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
TIESSNOO	Inductively Coupled Argon Plasma Emission Spectrometry
TIESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
TPOESJ	Visible Spectrophotometry
TPOEWJ	Visible Spectrophotometry
TPORSNOO	Visible Spectrophotometry
TTSRSNOO	Leco Total Sulfur Analysis
ULTIMATE	Combustion/Gas Absorption, Digestion/Titration, Ignition

Method Code	Method Description
VSTSAOT2	Gas Chromatography/Mass Spectroscopy
V_ESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
ZNESWNOO	Inductively Coupled Argon Plasma Emission Spectrometry
AC DISS	Acid Dissolution/Ion Chromatography
AQ	Ion Specific Electrode
IMP	Ion Specific Electrode
OVEN DRY	Oven Drying

Appendix C

Data Not Used in Calculations

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
stack gas	1,1-Dichloroethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	1,1-Dichloroethene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	1,1,2-Trichloroethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	1,1,2,2-Tetrachloroethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
high dust gas	1,2-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1,2-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1,2-Dichlorobenzene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	1,2-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
stack gas	1,2-Dichloroethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	1,2-Dichloropropane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
high dust gas	1,2,4-Trichlorobenzene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1,2,4-Trichlorobenzene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1,2,4-Trichlorobenzene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	1,2,4,5-Tetrachlorobenzene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1,2,4,5-Tetrachlorobenzene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1,2,4,5-Tetrachlorobenzene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	1,3-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1,3-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1,3-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
stack gas	1,3-Dichlorobenzene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
high dust gas	1,4-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	1,4-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	1,4-Dichlorobenzene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
stack gas	1,4-Dichlorobenzene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	2-Butanone	8240	mg/Nm3	< 0.005	< 0.005		< 0.005		
high dust gas	2-Chlorophenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2-Chlorophenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2-Chlorophenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
stack gas	2-Hexanone	8240	mg/Nm3	< 0.005	< 0.005		< 0.005		
high dust gas	2-Methylphenol(o-cresol)	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2-Methylphenol(o-cresol)	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2-Methylphenol(o-cresol)	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2-Nitroaniline	8270SNT1	mg/Nm3	< 0.0158	< 0.0152		< 0.0171		
FGD inlet gas	2-Nitroaniline	8270SNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	2-Nitroaniline	8270SNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0138		
high dust gas	2-Nitrophenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2-Nitrophenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2-Nitrophenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2-Picoline	8270SNT1	mg/Nm3	< 0.00158	< 0.00152		< 0.00171		
FGD inlet gas	2-Picoline	8270SNT1	mg/Nm3	< 0.00129	< 0.0012		< 0.00132		
stack gas	2-Picoline	8270SNT1	mg/Nm3	< 0.00126	< 0.00127		< 0.00138		
high dust gas	2,3,4,6-Tetrachlorophenol	8270SNT1	mg/Nm3	< 0.00634	< 0.00608		< 0.00684		
FGD inlet gas	2,3,4,6-Tetrachlorophenol	8270SNT1	mg/Nm3	< 0.00518	< 0.0048		< 0.00529		
stack gas	2,3,4,6-Tetrachlorophenol	8270SNT1	mg/Nm3	< 0.00505	< 0.00507		< 0.00543		
high dust gas	2,4-Dichlorophenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2,4-Dichlorophenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2,4-Dichlorophenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2,4-Dimethylphenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2,4-Dimethylphenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2,4-Dimethylphenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2,4-Dinitrophenol	8270SNT1	mg/Nm3	< 0.0158	< 0.0152		< 0.0171		
FGD inlet gas	2,4-Dinitrophenol	8270SNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	2,4-Dinitrophenol	8270SNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0138		
high dust gas	2,4-Dinitrotoluene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2,4-Dinitrotoluene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2,4-Dinitrotoluene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
high dust gas	2,4,5-Trichlorophenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2,4,5-Trichlorophenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2,4,5-Trichlorophenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2,4,6-Trichlorophenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2,4,6-Trichlorophenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2,4,6-Trichlorophenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2,6-Dichlorophenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2,6-Dichlorophenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2,6-Dichlorophenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	2,6-Dinitrotoluene	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	2,6-Dinitrotoluene	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	2,6-Dinitrotoluene	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	3-Nitroaniline	8270SNT1	mg/Nm3	< 0.0158	< 0.0152		< 0.0171		
FGD inlet gas	3-Nitroaniline	8270SNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	3-Nitroaniline	8270SNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0136		
high dust gas	4-Chloro-3-methylphenol	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	4-Chloro-3-methylphenol	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	4-Chloro-3-methylphenol	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
stack gas	4-Methyl-2-pentanone	8240	mg/Nm3	< 0.005	< 0.005		< 0.005		
high dust gas	4-Methylphenol(p-cresol)	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	4-Methylphenol(p-cresol)	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	4-Methylphenol(p-cresol)	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	4-Nitroaniline	8270SNT1	mg/Nm3	< 0.0158	< 0.0152		< 0.0171		
FGD inlet gas	4-Nitroaniline	8270SNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	4-Nitroaniline	8270SNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0136		
high dust gas	4-Nitrophenol	8270SNT1	mg/Nm3	< 0.0158	< 0.0152		< 0.0171		
FGD inlet gas	4-Nitrophenol	8270SNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	4-Nitrophenol	8270SNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0136		
high dust gas	4,6-Dinitro-2-methylphenol	8270SNT1	mg/Nm3	< 0.0158	< 0.0152		< 0.0171		
FGD inlet gas	4,6-Dinitro-2-methylphenol	8270SNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	4,6-Dinitro-2-methylphenol	8270SNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0136		
high dust gas, vapor phase	Acetaldehyde	ALDELKAS	mg/Nm3	< 0.00542	< 0.00781		< 0.00932		
FGD inlet gas, vapor phase	Acetaldehyde	ALDELKAS	mg/Nm3	< 0.00758	< 0.00745				
stack gas, vapor phase	Acetaldehyde	ALDELKAS	mg/Nm3	< 0.00848			0.044 @		
stack gas	Acetone	8240	mg/Nm3	< 0.005	< 0.005		< 0.005		
high dust gas	Acetophenone	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Acetophenone	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Acetophenone	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas, vapor phase	Acrolein	ALDELKAS	mg/Nm3	< 0.00659	< 0.00951		< 0.0112		
FGD inlet gas, vapor phase	Acrolein	ALDELKAS	mg/Nm3	< 0.00923	< 0.00907				
stack gas, vapor phase	Acrolein	ALDELKAS	mg/Nm3	< 0.0103			< 0.0136		
limestone	Aluminum	I39RSN00	mg/kg					500	
limestone	Aluminum	D4326	mg/kg	474	416		416	446	
limestone	Aluminum	NAA	mg/kg		383				
bottom ash	Aluminum	I39RSN00	mg/kg	96000	92000		99000		91000
bottom ash	Aluminum	NAA	mg/kg		122000				
collected fly ash	Aluminum	ICPSSN00	mg/kg	105000	125000		104000		
collected fly ash (baghouse)	Aluminum	NAA	mg/kg		125000				
collected fly ash (baghouse)	Aluminum	ICPSSN00	mg/kg	111000	93800		70200		91300
FGD solids	Aluminum	NAA	mg/kg		427				
FGD solids	Aluminum	ICPSSN00	mg/kg	287 @	1890 @	1770	< 200		
high dust gas	Aniline	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Aniline	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Aniline	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Antimony	NAA	mg/kg	0.238	0.285		0.313		
limestone	Antimony	I39RSN00	mg/kg					< 47	

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
limestone	Antimony	ICPSSN00	mg/kg	< 52	< 270		< 49		
limestone	Antimony	NAA	mg/kg		0.132				
bottom ash	Antimony	I39RSN00	mg/kg	< 52	< 59		< 57		< 49
bottom ash	Antimony	NAA	mg/kg		1.37				
collected fly ash	Antimony	ICPSSN00	mg/kg	< 49	< 240		< 51		
collected fly ash (baghouse)	Antimony	NAA	mg/kg		2.97				
collected fly ash (baghouse)	Antimony	ICPSSN00	mg/kg	< 500	< 50		< 260		< 50
high dust gas particulate	Antimony	ICPSWN00	mg/kg	< 17.5	< 16.1		< 20.4		
FGD inlet particulate	Antimony	ICPSWN00	mg/kg	< 75.8	< 59				
stack gas particulate	Antimony	ICPSWN00	mg/kg	< 467			< 752		
FGD solids	Antimony	ICPSSN00	mg/kg	< 100	< 250	< 47	< 100		
FGD solids	Antimony	NAA	mg/kg		0.161				
high dust gas, solid phase	Antimony	ICPSWN00	mg/Nm3	< 0.135	< 0.0763		< 0.155		
high dust gas, vapor phase	Antimony	ICPSWN00	mg/Nm3	< 0.0456	< 0.0426		< 0.0445		
FGD inlet gas, solid phase	Antimony	ICPSWN00	mg/Nm3	< 0.00739	< 0.00765				
FGD inlet gas, vapor phase	Antimony	ICPSWN00	mg/Nm3	< 0.0365	< 0.0403				
stack gas, solid phase	Antimony	ICPSWN00	mg/Nm3	< 0.00746			< 0.00922		
stack gas, vapor phase	Antimony	ICPSWN00	mg/Nm3	< 0.0373			< 0.0548		
makeup water	Antimony	I39RWN00	mg/L	< 0.1	< 0.1		< 0.1		
wastewater treatment effluent	Antimony	I39RWN00	mg/L	< 0.1	< 0.1	< 0.1			
coal	Arsenic	NAA	mg/kg	3.31	4.24		4.26		
limestone	Arsenic	NAA	mg/kg		0.875				
bottom ash	Arsenic	NAA	mg/kg		7.28				
collected fly ash (baghouse)	Arsenic	NAA	mg/kg		59.3				
FGD solids	Arsenic	NAA	mg/kg		< 1.15				
FGD solids	Arsenic	ASGSSA00	mg/kg	4.02 @					
high dust gas, vapor phase	Arsenic	ICPSWN00	mg/Nm3	< 0.076	< 0.0662		< 0.0768		
FGD inlet gas, vapor phase	Arsenic	ICPSWN00	mg/Nm3	< 0.0595	< 0.0668				
stack gas, vapor phase	Arsenic	ICPSWN00	mg/Nm3	< 0.0565			< 0.0961		
limestone	Barium	NAA	mg/kg		22.4				
limestone	Barium	I39RSN00	mg/kg					6.2 @	
bottom ash	Barium	D4326	mg/kg		984		434		
bottom ash	Barium	NAA	mg/kg		764				
collected fly ash	Barium	D4326	mg/kg	868	762		1130		
collected fly ash (baghouse)	Barium	NAA	mg/kg		855				
collected fly ash (baghouse)	Barium	D4326	mg/kg	1220	944		869		
FGD solids	Barium	NAA	mg/kg		25.5				
FGD solids	Barium	D4326	mg/kg			66			
limestone	Barium oxide	D4326	mg/kg	< 50	< 50		< 50	< 50	
bottom ash	Barium oxide	D4326	mg/kg	< 50					
FGD solids	Barium oxide	D4326	mg/kg	< 50	< 50		< 50		
high dust gas, vapor phase	Benzaldehyde	ALDELKAS	mg/Nm3	< 0.0106	< 0.0153		< 0.018		
FGD inlet gas, vapor phase	Benzaldehyde	ALDELKAS	mg/Nm3	< 0.0146	< 0.0146				
stack gas, vapor phase	Benzaldehyde	ALDELKAS	mg/Nm3	< 0.0186			< 0.0218		
high dust gas	Benzidine	8278SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Benzidine	8278SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Benzidine	8278SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Benzoic acid	8278SNT1	mg/Nm3	< 0.0156	< 0.0152		< 0.0171		
FGD inlet gas	Benzoic acid	8278SNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	Benzoic acid	8278SNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0136		
high dust gas	Benzyl alcohol	8278SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Benzyl alcohol	8278SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Benzyl alcohol	8278SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
limestone	Beryllium	I39RSN00	mg/kg					< 0.94	
limestone	Bismuth	I39RSN00	mg/kg	< 77	< 78		< 52	< 380	
bottom ash	Bismuth	I39RSN00	mg/kg	< 420	< 470		< 460		< 390

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
collected fly ash	Bismuth	I39RSN00	mg/kg	< 57	< 69		< 63		
collected fly ash (baghouse)	Bismuth	I39RSN00	mg/kg	< 76	< 64		< 73		< 70
FGD solids	Bismuth	I39RSN00	mg/kg	< 400	< 64	< 74	< 72		
makeup water	Bismuth	I38RWN00	mg/L	< 0.8	< 0.8		< 0.8		
wastewater treatment effluent	Bismuth	I39RWN00	mg/L	< 0.8	< 0.8	< 0.8			
high dust gas	bis(2-Chloroethoxy) methane	627SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	bis(2-Chloroethoxy) methane	627SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	bis(2-Chloroethoxy) methane	627SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	bis(2-Chloroethyl)ether	627SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	bis(2-Chloroethyl)ether	627SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	bis(2-Chloroethyl)ether	627SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	bis(2-Chloroisopropyl)ether	627SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	bis(2-Chloroisopropyl)ether	627SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	bis(2-Chloroisopropyl)ether	627SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	bis(2-Ethylhexyl)phthalate	627SSNT1	mg/Nm3	0.00317 @	< 0.00304		< 0.00342		
FGD inlet gas	bis(2-Ethylhexyl)phthalate	627SSNT1	mg/Nm3	0.0044 @	0.00432 @		0.00291 @		
stack gas	bis(2-Ethylhexyl)phthalate	627SSNT1	mg/Nm3	0.0217	0.0033 @		0.0038 @		
limestone	Boron	B_ESSN00	mg/kg	< 120	< 120		< 120		
collected fly ash	Boron	B_ESSN00	mg/kg	190 @	220 @		180 @		
collected fly ash (baghouse)	Boron	B_ESSN00	mg/kg	160 @	140 @		< 120		200 @
FGD solids	Boron	ICPSSN00	mg/kg				< 600		
FGD solids	Boron	B_ESSN00	mg/kg	180 @	230 @	240 @	260 @		
high dust gas, vapor phase	Boron	ICPSWN00	mg/Nm3	2.79	3.09		4.05		
FGD inlet gas, vapor phase	Boron	ICPSWN00	mg/Nm3	2.38	3.78				
stack gas, vapor phase	Boron	ICPSWN00	mg/Nm3	0.697			0.307 @		
makeup water	Boron	I39RWN00	mg/L	< 0.8	< 0.8		< 0.8		
wastewater treatment effluent	Boron	I39RWN00	mg/L	9.04	8.76	8.92			
coal	Bromine	NAA	mg/kg	13.6	13.8		15		
limestone	Bromine	NAA	mg/kg		4.11				
bottom ash	Bromine	NAA	mg/kg		< 3.55				
collected fly ash (baghouse)	Bromine	NAA	mg/kg		< 3.61				
FGD solids	Bromine	NAA	mg/kg		73.8				
stack gas	Bromodichloromethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	Bromoform	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
high dust gas	Butylbenzylphthalate	627SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Butylbenzylphthalate	627SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Butylbenzylphthalate	627SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
limestone	Cadmium	NAA	mg/kg		< 0.936				
bottom ash	Cadmium	NAA	mg/kg		< 25.8				
collected fly ash (baghouse)	Cadmium	NAA	mg/kg		< 26.6				
FGD solids	Cadmium	NAA	mg/kg		< 6.69				
high dust gas, vapor phase	Cadmium	ICPSWN00	mg/Nm3	< 0.00127	< 0.0011		< 0.00128		
FGD inlet gas, vapor phase	Cadmium	ICPSWN00	mg/Nm3	< 0.000991	< 0.00111				
stack gas, vapor phase	Cadmium	ICPSWN00	mg/Nm3	< 0.000942			< 0.0016		
limestone	Calcium	I39RSN00	mg/kg					380000	
limestone	Calcium	ICPSSN00	mg/kg	332000	375000		337000		
bottom ash	Calcium	I39RSN00	mg/kg	33000	35000		34000		34000
collected fly ash	Calcium	ICPSSN00	mg/kg	33100	36500		33200		
collected fly ash (baghouse)	Calcium	ICPSSN00	mg/kg	38700	32500		28000		35900
FGD solids	Calcium	ICPSSN00	mg/kg	136000	71700	160000	78400		
coal	Carbon	ultimate	%	75.3	75	75.4	77		
stack gas	Carbon disulfide	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	Carbon tetrachloride	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
coal	Cerium	NAA	mg/kg	20.5	14.2		19		
limestone	Cerium	NAA	mg/kg		1.67				
bottom ash	Cerium	NAA	mg/kg		104				

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
collected fly ash (baghouse)	Cerium	NAA	mg/kg		99.4				
FGD solids	Cerium	NAA	mg/kg		1.66				
coal	Cesium	NAA	mg/kg	1.16	0.69		0.667		
limestone	Cesium	NAA	mg/kg		< 0.0392				
bottom ash	Cesium	NAA	mg/kg		6.46				
collected fly ash (baghouse)	Cesium	NAA	mg/kg		7.25				
FGD solids	Cesium	NAA	mg/kg		< 0.0618				
coal	Chlorine	NAA	mg/kg	853	918		967		
limestone	Chlorine	NAA	mg/kg		403				
bottom ash	Chlorine	NAA	mg/kg		475				
collected fly ash (baghouse)	Chlorine	NAA	mg/kg		< 543				
FGD solids	Chlorine	NAA	mg/kg		4700				
stack gas	Chlorobenzene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	Chloroethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	Chloroform	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	Chloromethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
limestone	Chromium	I39RSN00	mg/kg					32	
limestone	Chromium	NAA	mg/kg		1.38				
bottom ash	Chromium	NAA	mg/kg		85.7				
collected fly ash (baghouse)	Chromium	NAA	mg/kg		114				
FGD solids	Chromium	NAA	mg/kg		5.2				
stack gas	cis-1,2-Dichloroethene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	cis-1,3-Dichloropropene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
limestone	Cobalt	NAA	mg/kg		0.275				
limestone	Cobalt	I39RSN00	mg/kg					< 4.7	
bottom ash	Cobalt	NAA	mg/kg		26.7				
collected fly ash (baghouse)	Cobalt	NAA	mg/kg		26.9				
FGD solids	Cobalt	NAA	mg/kg		0.324				
limestone	Copper	I39RSN00	mg/kg					17 @	
limestone	Copper	NAA	mg/kg		< 43.1				
bottom ash	Copper	NAA	mg/kg		< 333				
collected fly ash (baghouse)	Copper	NAA	mg/kg		< 401				
FGD solids	Copper	NAA	mg/kg		< 55.6				
stack gas	Dibromochloromethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
high dust gas	Dibutylphthalate	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Dibutylphthalate	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Dibutylphthalate	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Diethylphthalate	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Diethylphthalate	8270SNT1	mg/Nm3	< 0.00259	0.00432 @		< 0.00265		
stack gas	Diethylphthalate	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Dimethylphenethylamine	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Dimethylphenethylamine	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Dimethylphenethylamine	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Dimethylphthalate	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Dimethylphthalate	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Dimethylphthalate	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Di-n-octylphthalate	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Di-n-octylphthalate	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Di-n-octylphthalate	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		0.00298 @		
coal	Dysprosium	NAA	mg/kg	0.61	0.535		0.481		
high dust gas	Ethyl methanesulfonate	8270SNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Ethyl methanesulfonate	8270SNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Ethyl methanesulfonate	8270SNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
stack gas	Ethylbenzene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
coal	Europium	NAA	mg/kg	0.233	0.239		0.194		
limestone	Europium	NAA	mg/kg		0.0127				

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
bottom ash	Europium	NAA	mg/kg		1.51				
collected fly ash (baghouse)	Europium	NAA	mg/kg		1.47				
FGD solids	Europium	NAA	mg/kg		0.0202				
coal	Fixed carbon	proximat	%	53.1	53.1	53.4	54.4		
limestone	Fluoride	NaOH fus	mg/kg		298		34.3 @	40 @	
FGD solids	Fluoride	NaOH fus	mg/kg	736	716	764	828		
limestone	Gold	I39RSN00	mg/kg	< 19	< 19		< 13	< 94	
bottom ash	Gold	I39RSN00	mg/kg	< 100	< 120		< 110		< 98
collected fly ash	Gold	I39RSN00	mg/kg	< 14	< 17		< 16		
collected fly ash (baghouse)	Gold	I39RSN00	mg/kg	< 19	< 16		< 16		< 17
FGD solids	Gold	I39RSN00	mg/kg	< 100	< 16	< 19	< 16		
makeup water	Gold	I39RWN00	mg/L	< 0.2	< 0.2		< 0.2		
wastewater treatment effluent	Gold	I39RWN00	mg/L	< 0.2	< 0.2	< 0.2			
coal	Hafnium	NAA	mg/kg	1.05	0.641		0.625		
limestone	Hafnium	NAA	mg/kg		0.128				
bottom ash	Hafnium	NAA	mg/kg		5.6				
collected fly ash (baghouse)	Hafnium	NAA	mg/kg		5.83				
FGD solids	Hafnium	NAA	mg/kg		< 0.0716				
high dust gas	Hexachlorobenzene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Hexachlorobenzene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Hexachlorobenzene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Hexachlorobutadiene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Hexachlorobutadiene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Hexachlorobutadiene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Hexachlorocyclopentadiene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Hexachlorocyclopentadiene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Hexachlorocyclopentadiene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Hexachloroethane	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Hexachloroethane	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Hexachloroethane	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Hydrogen	ultimate	%	5.12	5.07	5.1	5.1		
limestone	Indium	I39RSN00	mg/kg	< 19	< 19		< 13	< 94	
bottom ash	Indium	I39RSN00	mg/kg	< 100	< 120		< 110		< 98
collected fly ash	Indium	I39RSN00	mg/kg	27.4 @	< 17		17.2 @		
collected fly ash (baghouse)	Indium	I39RSN00	mg/kg	< 19	16.7 @		22 @		30.6 @
FGD solids	Indium	I39RSN00	mg/kg	< 100	< 16	< 19	< 16		
makeup water	Indium	I39RWN00	mg/L	0.332 @	0.294 @		0.332 @		
wastewater treatment effluent	Indium	I39RWN00	mg/L	< 0.2	< 0.2	< 0.2			
coal	Iodine	NAA	mg/kg	< 1.56	< 1.57		< 1.56		
limestone	Iodine	NAA	mg/kg		< 3.07				
bottom ash	Iodine	NAA	mg/kg		22				
collected fly ash (baghouse)	Iodine	NAA	mg/kg		< 23.4				
FGD solids	Iodine	NAA	mg/kg		5.8				
limestone	Iron	ICPSSN00	mg/kg	1890	778		706		
limestone	Iron	I39RSN00	mg/kg					980	
limestone	Iron	NAA	mg/kg		891				
bottom ash	Iron	I39RSN00	mg/kg	140000	160000		150000		160000
bottom ash	Iron	NAA	mg/kg		163000				
collected fly ash	Iron	ICPSSN00	mg/kg	98800	117000		104000		
collected fly ash (baghouse)	Iron	ICPSSN00	mg/kg	133000	116000		91500		151000
collected fly ash (baghouse)	Iron	NAA	mg/kg		139000				
FGD solids	Iron	ICPSSN00	mg/kg	718	755	741	< 40		
FGD solids	Iron	NAA	mg/kg		1410				
high dust gas	Isophorone	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Isophorone	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Isophorone	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
coal	Lanthanum	NAA	mg/kg	5.51	5.98		6.36		
limestone	Lanthanum	NAA	mg/kg		0.666				
bottom ash	Lanthanum	NAA	mg/kg		78.8				
collected fly ash (baghouse)	Lanthanum	NAA	mg/kg		73.4				
FGD solids	Lanthanum	NAA	mg/kg		1.14				
high dust gas, vapor phase	Lead	ICPSWN00	mg/Nm3	< 0.0127	< 0.011		< 0.0126		
high dust gas, vapor phase	Lead	PBGSWO00	mg/Nm3	0.00267 R@	< 0.00128 R		< 0.00133 R		
FGD inlet gas, vapor phase	Lead	ICPSWN00	mg/Nm3	< 0.00991	< 0.0111				
FGD inlet gas, vapor phase	Lead	PBGSWO00	mg/Nm3	< 0.0011 R	< 0.00121 R				
stack gas, vapor phase	Lead	ICPSWN00	mg/Nm3	< 0.00942			< 0.016		
stack gas, vapor phase	Lead	PBGSWO00	mg/Nm3	< 0.00112 R			0.00498 R@		
limestone	Lithium	I39RSN00	mg/kg	4.3 @	4.01 @		8.33 @	12 @	
bottom ash	Lithium	I39RSN00	mg/kg	84	88		84		86
collected fly ash	Lithium	I39RSN00	mg/kg	37.6	34.8		37.3		
collected fly ash (baghouse)	Lithium	I39RSN00	mg/kg	26.6	22.7		28		20.4
FGD solids	Lithium	I39RSN00	mg/kg	< 1000	3.5 @	3.8 @	3.83 @		
makeup water	Lithium	I39RWN00	mg/L	< 0.02	< 0.02		< 0.02		
wastewater treatment effluent	Lithium	I39RWN00	mg/L	0.082 @	0.082 @	0.081 @			
coal	Lutetium	NAA	mg/kg	0.0906	0.0732		0.0521		
limestone	Lutetium	NAA	mg/kg		0.0133				
bottom ash	Lutetium	NAA	mg/kg		0.474				
collected fly ash (baghouse)	Lutetium	NAA	mg/kg		0.302				
FGD solids	Lutetium	NAA	mg/kg		0.0309				
limestone	Magnesium	ICPBSN00	mg/kg	2770	2880 @		2890		
limestone	Magnesium	NAA	mg/kg		588				
limestone	Magnesium	I39RSN00	mg/kg					4100	
bottom ash	Magnesium	NAA	mg/kg		4870				
bottom ash	Magnesium	I39RSN00	mg/kg	4700	4200		5000		4200
collected fly ash	Magnesium	ICPSSN00	mg/kg	5330	6070 @		5230		
collected fly ash (baghouse)	Magnesium	NAA	mg/kg		4590				
collected fly ash (baghouse)	Magnesium	ICPBSN00	mg/kg	5700 @	4730		3770 @		4810
FGD solids	Magnesium	ICPBSN00	mg/kg	1330 @	< 2500	1630 @	1310 @		
FGD solids	Magnesium	NAA	mg/kg		485				
limestone	Manganese	D4326	mg/kg	80.7	40.5		40.4	40.5	
limestone	Manganese	NAA	mg/kg		73.1				
limestone	Manganese	I39RSN00	mg/kg					74	
bottom ash	Manganese	NAA	mg/kg		256				
bottom ash	Manganese	D4326	mg/kg	1080	884		837		
collected fly ash	Manganese	D4326	mg/kg	838	909		841		
collected fly ash (baghouse)	Manganese	D4326	mg/kg	910	966		839		
collected fly ash (baghouse)	Manganese	NAA	mg/kg		241				
FGD solids	Manganese	D4326	mg/kg	52.8	52.6	53.1	52.1		
FGD solids	Manganese	NAA	mg/kg		63.7				
high dust gas	Methyl methanesulfonate	827SNT1	mg/Nm3	< 0.00156	< 0.00152		< 0.00171		
FGD inlet gas	Methyl methanesulfonate	827SNT1	mg/Nm3	< 0.00129	< 0.0012		< 0.00132		
stack gas	Methyl methanesulfonate	827SNT1	mg/Nm3	< 0.00126	< 0.00127		< 0.00138		
coal	Moisture	oven dry	%	5.8	1.77		5.67	5.41	3.05
coal	Moisture	D3302	%	6.34	1.95		5.46	5.32	3.52
limestone	Molybdenum	I39RSN00	mg/kg					< 24	
limestone	Molybdenum	NAA	mg/kg		3.46				
bottom ash	Molybdenum	NAA	mg/kg		< 10.7				
collected fly ash (baghouse)	Molybdenum	NAA	mg/kg		< 11				
FGD solids	Molybdenum	NAA	mg/kg		4.76				
coal	Neodymium	NAA	mg/kg	7.13	7.84		< 6.46		
limestone	Neodymium	NAA	mg/kg		2.46				
bottom ash	Neodymium	NAA	mg/kg		56.7				

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
collected fly ash (baghouse)	Neodymium	NAA	mg/kg		58.7				
FGD solids	Neodymium	NAA	mg/kg		< 4.66				
limestone	Nickel	I39RSN00	mg/kg					17 @	
limestone	Nickel	NAA	mg/kg		6.76				
bottom ash	Nickel	NAA	mg/kg		126				
collected fly ash (baghouse)	Nickel	NAA	mg/kg		125				
FGD solids	Nickel	NAA	mg/kg		< 10.8				
high dust gas	Nitrobenzene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Nitrobenzene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Nitrobenzene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Nitrogen	ultimate	%	1.41	1.37	1.38	1.41		
high dust gas	N-Nitrosodimethylamine	827SSNT1	mg/Nm3	< 0.00158	< 0.00152		< 0.00171		
FGD inlet gas	N-Nitrosodimethylamine	827SSNT1	mg/Nm3	< 0.00129	< 0.0012		< 0.00132		
stack gas	N-Nitrosodimethylamine	827SSNT1	mg/Nm3	< 0.00126	< 0.00127		< 0.00136		
high dust gas	N-Nitroso-di-n-butylamine	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	N-Nitroso-di-n-butylamine	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	N-Nitroso-di-n-butylamine	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	N-Nitrosopiperidine	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	N-Nitrosopiperidine	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	N-Nitrosopiperidine	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
coal	Oxygen	ultimate	%	5.57	5.45	5.43	5.69		
stack gas	o-Xylene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
high dust gas	p-Chloroaniline	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	p-Chloroaniline	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	p-Chloroaniline	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	p-Dimethylaminoazobenzene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	p-Dimethylaminoazobenzene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	p-Dimethylaminoazobenzene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Pentachlorobenzene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Pentachlorobenzene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Pentachlorobenzene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Pentachloronitrobenzene	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Pentachloronitrobenzene	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Pentachloronitrobenzene	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Pentachlorophenol	827SSNT1	mg/Nm3	< 0.0156	< 0.0152		< 0.0171		
FGD inlet gas	Pentachlorophenol	827SSNT1	mg/Nm3	< 0.0129	< 0.012		< 0.0132		
stack gas	Pentachlorophenol	827SSNT1	mg/Nm3	< 0.0126	< 0.0127		< 0.0136		
high dust gas	Phenacetin	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Phenacetin	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Phenacetin	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Phenol	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Phenol	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Phenol	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		0.0157		
limestone	Phosphorus	acid dig	mg/kg	< 25	< 25		< 25	< 25	
limestone	Phosphorus	I39RSN00	mg/kg	< 29	< 29		< 20	< 140	
bottom ash	Phosphorus	I39RSN00	mg/kg	600 @	740 @		720 @		770
collected fly ash	Phosphorus	I39RSN00	mg/kg	1490	1510		1650		
collected fly ash (baghouse)	Phosphorus	I39RSN00	mg/kg	1060	943		991		827
FGD solids	Phosphorus	I39RSN00	mg/kg	900	24.6 @	< 28	< 27		
FGD solids	Phosphorus	acid dig	mg/kg	< 25	< 25	< 25	< 25		
makeup water	Phosphorus	I39RWN00	mg/L	< 0.3	< 0.3		< 0.3		
wastewater treatment effluent	Phosphorus	I39RWN00	mg/L	< 0.3	< 0.3	< 0.3			
limestone	Platinum	I39RSN00	mg/kg	< 19	< 19		20 @	< 94	
bottom ash	Platinum	I39RSN00	mg/kg	< 100	< 120		< 110		< 98
collected fly ash	Platinum	I39RSN00	mg/kg	41.4 @	37.9 @		35.7 @		
collected fly ash (baghouse)	Platinum	I39RSN00	mg/kg	39.7 @	34.2 @		36.5 @		45.6 @

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
FGD solids	Platinum	I39RSN00	mg/kg	< 100	< 16	< 19	< 18		
makeup water	Platinum	I39RWN00	mg/L	0.366 @	0.328 @		0.343 @		
wastewater treatment effluent	Platinum	I39RWN00	mg/L	< 0.2	0.2 @	< 0.2			
limestone	Potassium	ICPSSN00	mg/kg	< 1600	< 6100		< 1500		
limestone	Potassium	NAA	mg/kg		< 1530				
limestone	Potassium	I39RSN00	mg/kg					< 1400	
bottom ash	Potassium	I39RSN00	mg/kg	9900	10000		11000		10000
bottom ash	Potassium	NAA	mg/kg		16000				
collected fly ash	Potassium	ICPSSN00	mg/kg	12400	14100 @		12000		
collected fly ash (baghouse)	Potassium	NAA	mg/kg		16800				
collected fly ash (baghouse)	Potassium	ICPSSN00	mg/kg	< 15000	10600		8070 @		9870
FGD solids	Potassium	NAA	mg/kg		< 3440				
FGD solids	Potassium	ICPSSN00	mg/kg	149 @	< 7600	< 1400	< 3000		
bottom ash	poured bulk density	bulk den	g/cm3	1.16	1.11		0.99		1.07
FGD solids	poured bulk density	bulk den	g/cm3	0.63	0.58	0.6	0.58		
high dust gas	Pronamide	827SSNT1	mg/Nm3	< 0.00317	< 0.00304		< 0.00342		
FGD inlet gas	Pronamide	827SSNT1	mg/Nm3	< 0.00259	< 0.0024		< 0.00265		
stack gas	Pronamide	827SSNT1	mg/Nm3	< 0.00252	< 0.00254		< 0.00271		
high dust gas	Pyridine	827SSNT1	mg/Nm3	< 0.00158	< 0.00152		< 0.00171		
FGD inlet gas	Pyridine	827SSNT1	mg/Nm3	< 0.00129	< 0.0012		< 0.00132		
stack gas	Pyridine	827SSNT1	mg/Nm3	< 0.00126	< 0.00127		< 0.00136		
coal	Rubidium	NAA	mg/kg	18.6	13.1		11.2		
limestone	Rubidium	NAA	mg/kg		1.3				
bottom ash	Rubidium	NAA	mg/kg		93.8				
collected fly ash (baghouse)	Rubidium	NAA	mg/kg		84.9				
FGD solids	Rubidium	NAA	mg/kg		< 2.11				
coal	Samarium	NAA	mg/kg	1.02	1.12		1.1		
limestone	Samarium	NAA	mg/kg		0.551				
bottom ash	Samarium	NAA	mg/kg		10				
collected fly ash (baghouse)	Samarium	NAA	mg/kg		9.71				
FGD solids	Samarium	NAA	mg/kg		0.413				
coal	Scandium	NAA	mg/kg	2.56	3		2.42		
limestone	Scandium	NAA	mg/kg		0.102				
bottom ash	Scandium	NAA	mg/kg		23.2				
collected fly ash (baghouse)	Scandium	NAA	mg/kg		23.5				
FGD solids	Scandium	NAA	mg/kg		0.119				
coal	Selenium	NAA	mg/kg	0.954	1.02		1.45		
limestone	Selenium	NAA	mg/kg		< 0.164				
bottom ash	Selenium	NAA	mg/kg		< 5.68				
collected fly ash (baghouse)	Selenium	NAA	mg/kg		6.29				
FGD solids	Selenium	NAA	mg/kg		2.36				
high dust gas, vapor phase	Selenium	ICPSWN00	mg/Nm3	0.0983 @	0.137 @		0.146 @		
FGD inlet gas, vapor phase	Selenium	ICPSWN00	mg/Nm3	0.151 @	0.0979 @				
stack gas, vapor phase	Selenium	ICPSWN00	mg/Nm3	< 0.0585			< 0.0981		
limestone	Silicon	D4326	mg/kg	1760	1180		1150	1100	
bottom ash	Silicon	D4326	mg/kg	206000	207000		202000		
collected fly ash	Silicon	D4326	mg/kg	209000	206000		204000		
collected fly ash (baghouse)	Silicon	D4326	mg/kg	202000	196000		198000		
high dust gas particulate	Silicon	ICPSWN00	mg/kg	< 17.5	< 161		1820 R		
FGD inlet particulate	Silicon	ICPSWN00	mg/kg	< 19700	< 590				
stack gas particulate	Silicon	ICPSWN00	mg/kg	< 4670			< 97000		
FGD solids	Silicon	ICPSSN00	mg/kg				< 1000		
FGD solids	Silicon	D4326	mg/kg	1810	5090	9370	1550		
high dust gas, solid phase	Silicon	ICPSWN00	mg/Nm3	< 0.135	< 0.783		13.9 R		
high dust gas, vapor phase	Silicon	ICPSWN00	mg/Nm3	1.94 @	2.55		3.25		
FGD inlet gas, solid phase	Silicon	ICPSWN00	mg/Nm3	< 1.92	< 0.0785				

Site 12 Data Not Used In Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
FGD inlet gas, vapor phase	Silicon	ICPSWN00	mg/Nm3	3.06	5.36				
stack gas, solid phase	Silicon	ICPSWN00	mg/Nm3	< 0.0746			< 1.19		
stack gas, vapor phase	Silicon	ICPSWN00	mg/Nm3	0.654 @			1.14 @		
makeup water	Silicon	I39RWN00	mg/L	< 1	< 1		< 1		
wastewater treatment effluent	Silicon	I39RWN00	mg/L	1.51 @	1.7 @	1.69 @			
coal	Silver	NAA	mg/kg	< 0.709	< 1.2		< 1.25		
limestone	Silver	ICPSSN00	mg/kg	< 5.2	< 27		< 4.9		
limestone	Silver	I39RSN00	mg/kg					< 4.7	
limestone	Silver	NAA	mg/kg		< 0.138				
bottom ash	Silver	I39RSN00	mg/kg	< 5.2	< 5.9		< 5.7		< 4.9
bottom ash	Silver	NAA	mg/kg		< 4.92				
collected fly ash	Silver	ICPSSN00	mg/kg	< 4.9	< 24		< 5.1		
collected fly ash (baghouse)	Silver	NAA	mg/kg		< 4.93				
collected fly ash (baghouse)	Silver	ICPSSN00	mg/kg	< 50	< 5		< 26		< 5
high dust gas particulate	Silver	ICPSWN00	mg/kg	< 1.75	< 1.81		< 2.04		
FGD inlet particulate	Silver	ICPSWN00	mg/kg	< 7.58	< 5.9				
stack gas particulate	Silver	ICPSWN00	mg/kg	< 46.7			< 75.2		
FGD solids	Silver	NAA	mg/kg		< 0.341				
FGD solids	Silver	ICPSSN00	mg/kg	1.48 @	< 25	6.67 @	< 10		
high dust gas, solid phase	Silver	ICPSWN00	mg/Nm3	< 0.0135	< 0.0763		< 0.0155		
high dust gas, vapor phase	Silver	ICPSWN00	mg/Nm3	< 0.00456	< 0.00426		< 0.00445		
FGD inlet gas, solid phase	Silver	ICPSWN00	mg/Nm3	< 0.000739	< 0.000785				
FGD inlet gas, vapor phase	Silver	ICPSWN00	mg/Nm3	< 0.00365	< 0.00403				
stack gas, solid phase	Silver	ICPSWN00	mg/Nm3	< 0.000746			< 0.000922		
stack gas, vapor phase	Silver	ICPSWN00	mg/Nm3	< 0.00373			< 0.00548		
makeup water	Silver	I39RWN00	mg/L	< 0.01	< 0.01		< 0.01		
wastewater treatment effluent	Silver	I39RWN00	mg/L	< 0.01	< 0.01	< 0.01			
limestone	Sodium	ICPSSN00	mg/kg	< 520	< 2700		< 490		
limestone	Sodium	I39RSN00	mg/kg					< 470	
limestone	Sodium	NAA	mg/kg		268				
bottom ash	Sodium	I39RSN00	mg/kg	5200	6100		7000		6800
bottom ash	Sodium	NAA	mg/kg		6060				
collected fly ash	Sodium	ICPSSN00	mg/kg	6630	33000		6930		
collected fly ash (baghouse)	Sodium	ICPSSN00	mg/kg	19100 @	6370		4460 @		5100
collected fly ash (baghouse)	Sodium	NAA	mg/kg		6340				
FGD solids	Sodium	ICPSSN00	mg/kg	327 @	4470 @	4030	< 1000		
FGD solids	Sodium	NAA	mg/kg		614				
coal	Strontium	NAA	mg/kg	186	209		157		
limestone	Strontium	I39RSN00	mg/kg					160	
limestone	Strontium	ICPSSN00	mg/kg	144	157		147		
limestone	Strontium	D4326	mg/kg	237	236		190	237	
bottom ash	Strontium	D4326	mg/kg	760	760		737		
bottom ash	Strontium	I39RSN00	mg/kg	1000	1100		1100		1000
collected fly ash	Strontium	ICPSSN00	mg/kg	1380	1560		1450		
collected fly ash	Strontium	D4326	mg/kg	1070	1070		1070		
collected fly ash (baghouse)	Strontium	D4326	mg/kg	904	810		821		
collected fly ash (baghouse)	Strontium	ICPSSN00	mg/kg	1260	1130		863		1060
high dust gas particulate	Strontium	ICPSWN00	mg/kg	934 R	1810 R		932 R		
FGD inlet particulate	Strontium	ICPSWN00	mg/kg	106 R	17 R				
stack gas particulate	Strontium	ICPSWN00	mg/kg	15.4 @R			156 R		
FGD solids	Strontium	ICPSSN00	mg/kg	80.4	102	120	42.1		
FGD solids	Strontium	D4326	mg/kg	82	81.8	82.3	81.1		
high dust gas, solid phase	Strontium	ICPSWN00	mg/Nm3	7.22 R	7.65 R		7.1 R		
high dust gas, vapor phase	Strontium	ICPSWN00	mg/Nm3	0.0623	0.00766 @		0.00898 @		
FGD inlet gas, solid phase	Strontium	ICPSWN00	mg/Nm3	0.0104 R	0.00226 R				
FGD inlet gas, vapor phase	Strontium	ICPSWN00	mg/Nm3	0.0244	0.0164 @				

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
stack gas, solid phase	Strontium	ICPSWN00	mg/Nm3	0.000246 @R			0.00191 R		
stack gas, vapor phase	Strontium	ICPSWN00	mg/Nm3	< 0.00112			< 0.00164		
makeup water	Strontium	I39RWN00	mg/L	0.163	0.165		0.129		
wastewater treatment effluent	Strontium	I39RWN00	mg/L	1.2	1.19	1.21			
limestone	Sulfate	SFIFWN00	mg/L	< 2.4	< 2.4		< 2.4	< 2.4	
limestone	Sulfate	SFIFWN00	mg/kg	< 1180	< 1190		< 1160	< 1160	
FGD solids	Sulfate	SFIFWN00	mg/L	1300	1300	800	1300		
FGD solids	Sulfate	SFIFWN00	mg/kg	655000	647000	400000	649000		
makeup water	Sulfate	SFIFWN00	mg/L	26	25		25		
wastewater treatment effluent	Sulfate	SFIFWN00	mg/L	1100	1200				
limestone	Sulfur	D4326	mg/kg	536	675		697	562	
limestone	Sulfur	I39RSN00	mg/kg	593 @	601 @		601 @	< 2400	
bottom ash	Sulfur	D4326	mg/kg	1120	1360		2090		
bottom ash	Sulfur	I39RSN00	mg/kg	< 2800	< 3000		< 2800		< 2400
collected fly ash	Sulfur	D4326	mg/kg	3300	3980		3970		
collected fly ash	Sulfur	I39RSN00	mg/kg	5510	4790		5100		
collected fly ash (baghouse)	Sulfur	I39RSN00	mg/kg	6250	5290		5950		4180
collected fly ash (baghouse)	Sulfur	D4326	mg/kg	5280	4180		4280		
FGD solids	Sulfur	D4326	mg/kg	159000	150000	151000	159000		
FGD solids	Sulfur	I39RSN00	mg/kg	< 250000	123000	171000	199000		
coal	Tantalum	NAA	mg/kg	0.26	0.174		0.156		
limestone	Tantalum	NAA	mg/kg		< 0.0196				
bottom ash	Tantalum	NAA	mg/kg		1.54				
collected fly ash (baghouse)	Tantalum	NAA	mg/kg		1.4				
FGD solids	Tantalum	NAA	mg/kg		< 0.0442				
bottom ash	tapped bulk density	bulk den	g/cm3	1.28	1.29		1.23		1.3
FGD solids	tapped bulk density	bulk den	g/cm3	0.87	0.9	0.9	0.91		
limestone	Tellurium	I39RSN00	mg/kg	< 19	< 19		< 13	< 94	
bottom ash	Tellurium	I39RSN00	mg/kg	< 100	< 120		< 110		< 98
collected fly ash	Tellurium	I39RSN00	mg/kg	20.2 @	< 17		19.6 @		
collected fly ash (baghouse)	Tellurium	I39RSN00	mg/kg	27.4 @	< 16		< 18		< 17
FGD solids	Tellurium	I39RSN00	mg/kg	< 100	< 16	< 19	< 18		
makeup water	Tellurium	I39RWN00	mg/L	< 0.2	< 0.2		< 0.2		
wastewater treatment effluent	Tellurium	I39RWN00	mg/L	< 0.2	< 0.2	< 0.2			
coal	Terbium	NAA	mg/kg	0.158	0.154		0.101		
limestone	Terbium	NAA	mg/kg		0.0157				
bottom ash	Terbium	NAA	mg/kg		1.16				
collected fly ash (baghouse)	Terbium	NAA	mg/kg		1.06				
FGD solids	Terbium	NAA	mg/kg		< 0.0174				
stack gas	Tetrachloroethene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
limestone	Thallium	ICPSSN00	mg/kg	< 52	< 270		< 49		
limestone	Thallium	I39RSN00	mg/kg					< 47	
bottom ash	Thallium	I39RSN00	mg/kg	< 52	< 58		< 57		< 49
collected fly ash	Thallium	ICPSSN00	mg/kg	< 49	< 240		< 51		
collected fly ash (baghouse)	Thallium	ICPSSN00	mg/kg	< 500	< 50		< 260		< 50
high dust gas particulate	Thallium	ICPSWN00	mg/kg	< 17.5	< 16.1		< 20.4		
FGD inlet particulate	Thallium	ICPSWN00	mg/kg	< 75.8	< 59				
stack gas particulate	Thallium	ICPSWN00	mg/kg	< 467			< 752		
FGD solids	Thallium	ICPSSN00	mg/kg	21.5 @	< 250	< 47	< 100		
high dust gas, solid phase	Thallium	ICPSWN00	mg/Nm3	< 0.135	< 0.783		< 0.155		
high dust gas, vapor phase	Thallium	ICPSWN00	mg/Nm3	< 0.0456	< 0.0426		0.0898 J		
FGD inlet gas, solid phase	Thallium	ICPSWN00	mg/Nm3	< 0.00739	< 0.00785				
FGD inlet gas, vapor phase	Thallium	ICPSWN00	mg/Nm3	< 0.0365	< 0.0403				
stack gas, solid phase	Thallium	ICPSWN00	mg/Nm3	< 0.00746			< 0.00922		
stack gas, vapor phase	Thallium	ICPSWN00	mg/Nm3	< 0.0373			< 0.0548		
makeup water	Thallium	I39RWN00	mg/L	< 0.1	< 0.1		< 0.1		

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
wastewater treatment effluent	Thallium	I39RWN00	mg/L	< 0.1	< 0.1	< 0.1			
coal	Thorium	NAA	mg/kg	2.17	1.8		1.56		
limestone	Thorium	NAA	mg/kg		0.0839				
bottom ash	Thorium	NAA	mg/kg		13.8				
collected fly ash (baghouse)	Thorium	NAA	mg/kg		14.7				
FGD solids	Thorium	NAA	mg/kg		0.107				
coal	Tin	NAA	mg/kg	< 10.4	< 10.5		< 10.4		
limestone	Tin	I39RSN00	mg/kg	< 230	< 230		< 390	< 260	
limestone	Tin	NAA	mg/kg		< 10				
bottom ash	Tin	I39RSN00	mg/kg	< 310	< 350		< 340		< 290
bottom ash	Tin	NAA	mg/kg		< 10				
collected fly ash	Tin	I39RSN00	mg/kg	< 43	< 52		< 47		
collected fly ash (baghouse)	Tin	I39RSN00	mg/kg	< 57	< 48		< 55		< 52
collected fly ash (baghouse)	Tin	NAA	mg/kg		< 12.5				
FGD solids	Tin	NAA	mg/kg		< 10				
FGD solids	Tin	I39RSN00	mg/kg	< 30000	< 190	< 220	< 220		
makeup water	Tin	I39RWN00	mg/L	< 0.6	< 0.6		< 0.6		
wastewater treatment effluent	Tin	I39RWN00	mg/L	< 0.6	< 0.6	< 0.6			
limestone	Titanium	NAA	mg/kg		< 158				
limestone	Titanium	I39RSN00	mg/kg					< 24	
limestone	Titanium	TIESSN00	mg/kg	< 26	< 140		< 25		
bottom ash	Titanium	NAA	mg/kg		4840				
bottom ash	Titanium	I39RSN00	mg/kg	4600	5500		5100		5300
collected fly ash	Titanium	TIESSN00	mg/kg	5640	6310		5590		
collected fly ash (baghouse)	Titanium	NAA	mg/kg		5570				
collected fly ash (baghouse)	Titanium	TIESSN00	mg/kg	5630	5080		3430		4760
FGD solids	Titanium	TIESSN00	mg/kg	12 @	< 130	< 23	< 50		
FGD solids	Titanium	NAA	mg/kg		< 146				
stack gas	trans-1,2-Dichloroethene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	trans-1,3-Dichloropropene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	Trichloroethene	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
stack gas	Trichlorofluoromethane	8240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
coal	Tungsten	NAA	mg/kg	< 5.21	< 5.23		< 5.21		
limestone	Tungsten	NAA	mg/kg		< 5				
limestone	Tungsten	I39RSN00	mg/kg	< 38	< 38		< 65	< 47	
bottom ash	Tungsten	I39RSN00	mg/kg	< 52	< 59		< 57		< 49
bottom ash	Tungsten	NAA	mg/kg		< 7.5				
collected fly ash	Tungsten	I39RSN00	mg/kg	< 7.1	< 8.6		< 7.9		
collected fly ash (baghouse)	Tungsten	NAA	mg/kg		< 5				
collected fly ash (baghouse)	Tungsten	I39RSN00	mg/kg	< 9.5	< 8.1		< 9.1		< 8.7
FGD solids	Tungsten	NAA	mg/kg		< 5				
FGD solids	Tungsten	I39RSN00	mg/kg	< 5000	< 7.9	< 37	< 36		
makeup water	Tungsten	I39RWN00	mg/L	< 0.1	< 0.1		< 0.1		
wastewater treatment effluent	Tungsten	I39RWN00	mg/L	< 0.1	< 0.1	< 0.1			
coal	Uranium	NAA	mg/kg	0.463	0.42		0.573		
limestone	Uranium	NAA	mg/kg		3.51				
limestone	Uranium	I39RSN00	mg/kg	< 190	< 190		< 330	< 240	
bottom ash	Uranium	NAA	mg/kg		6.16				
bottom ash	Uranium	I39RSN00	mg/kg	< 260	< 300		< 260		< 240
collected fly ash	Uranium	I39RSN00	mg/kg	< 38	< 43		< 40		
collected fly ash (baghouse)	Uranium	I39RSN00	mg/kg	< 48	< 40		< 48		< 44
collected fly ash (baghouse)	Uranium	NAA	mg/kg		6.26				
FGD solids	Uranium	I39RSN00	mg/kg	< 25000	< 160	< 160	< 160		
FGD solids	Uranium	NAA	mg/kg		3.22				
makeup water	Uranium	I39RWN00	mg/L	< 0.5	< 0.5		< 0.5		
wastewater treatment effluent	Uranium	I39RWN00	mg/L	< 0.5	< 0.5	< 0.5			

Site 12 Data Not Used in Calculations

Stream	Substance	Method	UOM	Run 1	Run 2	Run 2D	Run 3	Run 3D	Run 4
limestone	Vanadium	I39RSN00	mg/kg					< 9.4	
limestone	Vanadium	NAA	mg/kg		4.6				
bottom ash	Vanadium	NAA	mg/kg		158				
collected fly ash (baghouse)	Vanadium	NAA	mg/kg		211				
FGD solids	Vanadium	NAA	mg/kg		5.36				
stack gas	Vinyl acetate	6240	mg/Nm3	< 0.005	< 0.005		< 0.005		
stack gas	Vinyl chloride	6240	mg/Nm3	< 0.0005	< 0.0005		< 0.0005		
coal	Volatile carbon	proximat	%	37.2	36.6	36.6	37.5		
coal	Ytterbium	NAA	mg/kg	0.69	0.629		0.459		
limestone	Ytterbium	NAA	mg/kg		< 0.0468				
bottom ash	Ytterbium	NAA	mg/kg		3.91				
collected fly ash (baghouse)	Ytterbium	NAA	mg/kg		3.4				
FGD solids	Ytterbium	NAA	mg/kg		< 0.171				
limestone	Yttrium	I39RSN00	mg/kg	1.76 @	2.07 @		2.26 @	< 4.2	
bottom ash	Yttrium	I39RSN00	mg/kg	31	13 @		29		16 @
collected fly ash	Yttrium	I39RSN00	mg/kg	19.4	18		19		
collected fly ash (baghouse)	Yttrium	I39RSN00	mg/kg	15.3	13		13.8		12.7
FGD solids	Yttrium	I39RSN00	mg/kg	< 4.5	1.2 @	1.12 @	1.12 @		
makeup water	Yttrium	I39RWN00	mg/L	0.022 @	0.02 @		0.021 @		
wastewater treatment effluent	Yttrium	I39RWN00	mg/L	< 0.009	0.009 @	< 0.009			
coal	Zinc	NAA	mg/kg	9.4	11.1		4.58		
limestone	Zinc	ICPSSN00	mg/kg	15.5 @	< 54		17.8 @		
limestone	Zinc	I39RSN00	mg/kg					19 @	
limestone	Zinc	NAA	mg/kg		5.91				
bottom ash	Zinc	NAA	mg/kg		119				
bottom ash	Zinc	I39RSN00	mg/kg	56	54 @		55		49
collected fly ash	Zinc	ICPSSN00	mg/kg	106	143 @		99.6		
collected fly ash (baghouse)	Zinc	ICPSSN00	mg/kg	169 @	77.3		111 @		60.7
collected fly ash (baghouse)	Zinc	NAA	mg/kg		116				
high dust gas particulate	Zinc	ICPSWN00	mg/kg	396 R	386 R		588 R		
FGD inlet particulate	Zinc	ICPSWN00	mg/kg	232 R	119 R				
stack gas particulate	Zinc	ICPSWN00	mg/kg	2640 R			9100 R		
FGD solids	Zinc	ICPSSN00	mg/kg	22.1 @	< 51	22.7 @	< 20		
FGD solids	Zinc	NAA	mg/kg		19.6				
high dust gas, solid phase	Zinc	ICPSWN00	mg/Nm3	3.06 R	1.88 R		4.48 R		
high dust gas, vapor phase	Zinc	ICPSWN00	mg/Nm3	0.886	< 0.00852		< 0.0089		
FGD inlet gas, solid phase	Zinc	ICPSWN00	mg/Nm3	0.0226 R	0.0159 R				
FGD inlet gas, vapor phase	Zinc	ICPSWN00	mg/Nm3	0.259	0.155 @				
stack gas, solid phase	Zinc	ICPSWN00	mg/Nm3	0.042 R			0.112 R		
stack gas, vapor phase	Zinc	ICPSWN00	mg/Nm3	< 0.00746			< 0.011		
makeup water	Zinc	I39RWN00	mg/L	< 0.02	0.021 @		< 0.02		
wastewater treatment effluent	Zinc	I39RWN00	mg/L	< 0.02	< 0.02	< 0.02			
coal	Zirconium	NAA	mg/kg	18.6	33.5		38.8		
limestone	Zirconium	NAA	mg/kg		13.6				
bottom ash	Zirconium	NAA	mg/kg		238				
collected fly ash (baghouse)	Zirconium	NAA	mg/kg		236				
FGD solids	Zirconium	NAA	mg/kg		< 17.5				

Appendix D

Measured and Calculated Process Stream Flows

Table D-1 summarizes process stream flow rates for Site 12. Additional tables summarize the gas stream field measurement data. Process data that could not be accurately estimated from plant operating records were the bottom ash generation rate and the collected fly ash rate. These stream flows were estimated as follows:

- The bottom ash was collected in hydro-bins over the course of the sampling event. The total volume of material collected was normalized by the electrical generation and expressed on an hourly basis at the load during the sampling events. This value was used for all sample events.

- The collected fly ash was calculated by difference from the coal ash analysis and the bottom ash value (above) and the ESP outlet mass rate of particulates.

Table D-1

Stream	Source	UOM	7/30	7/31	8/1	8/2	Average	Std. Dev.
Coal (dry basis)	M	lb/hr	412,800	419,200	419,200	441,300	426,567	12,759
Coal Ash	M	%		9.7%	10.3%	8.1%		
Inlet Ash	C	lb/hr		40,495	43,178	35,745	39,806	3,764
Bottom Ash*	M	lb/hr		4,630	4,630	4,630	4,630	460
Suspended ash	C	lb/hr		35,865	38,548	31,115	35,176	3,764
ESP Inlet Gas Flow (dry)	M	scfm	1,250,000	1,347,088	1,381,988	1,423,220	1,384,099	38,110
ESP Grain Loading	M	gr/scf		3.15	1.99	2.99	2.71	0.63
Suspended Ash	M	lb/hr		36,371	23,573	36,475	32,140	7,419
ESP Inlet Oxygen	M	%		5.3%	5.4%	5.4%		
FGD Inlet Gas Flow (dry)	M	scfm	1,594,700	1,526,952	1,554,976	1,427,564	1,503,164	66,954
FGD Inlet Grain Loading	M	gr/scf		0.04	0.054	0.0055	0.0332	0.0250
Suspended Ash	M	lb/hr		505	690	69	421	319
FGD Inlet Oxygen	M	%		6.5%	7.0%	6.5%		
Collected Fly Ash	C	lb/hr		35,360	37,857	31,046	34,754	3,446
Stack Gas Flow (dry)	M	scfm	1,453,772	1,472,615	1,491,166	1,470,382	1,478,054	11,410
Stack Grain Loading	M	gr/scf		0.0065	0.0389	0.00499	0.0168	0.0192
Emitted Ash	C	lb/hr		82	497	63	214	245
Stack Oxygen	M	%		6.3%	7.0%	7.0%		
Limestone*	M	lb/hr		34,700	34,700	34,700	34,700	3,470
FGD Solids*	M	lb/hr		39,800	39,800	39,800	39,800	3,980

* - Value was obtained over test period, 10% deviation assumed.

M - Measured

C - Calculated

MULTI-METALS

PARAMETER	INLET		OUTLET		STACK	
Date	7/31/90		7/31/90		7/31/90	
Dry Standard Meter Volume	41.992	DSCF	51.256	DSCF	50.835	DSCF
Percent Flue Gas Moisture	6.5	%	6.5	%	13.7	%
Flue Gas Molecular Weight (wet)	29.6	g/g-mole	29.51	g/g-mole	28.62	g/g-mole
Average Gas Velocity	54.26	ft/sec	48.1	ft/sec	42.81	ft/sec
Average Flue Gas Flow Rate	336,772	DSCFM	381,738	DSCFM	1,472,615	DSCFM
Isokinetic Sampling Rate	94.6	%	99.1	%	105.6	%
Oxygen Concentration	5.3	%	6.50	%	6.3	%
Total Mass of Particulate Solids	8.5657	grams	0.132	grams	0.0214	grams
Particulate Concentration	3.15	gr/DSCF	0.04	gr/DSCF	0.0065	gr/DSCF
Particulate Emissions	9088.42	lb/hr	130.06	lb/hr	82.00	lb/hr

PARAMETER	INLET		OUTLET		STACK	
Date	8/1/90		8/1/90		8/1/90	
Dry Standard Meter Volume	44.036	DSCF	48.289	DSCF	42.194	DSCF
Percent Flue Gas Moisture	6.21	%	6.27	%	12.30	%
Flue Gas Molecular Weight (wet)	29.59	g/g-mole	29.41	g/g-mole	28.76	g/g-mole
Average Gas Velocity	56.77	ft/sec	49.54	ft/sec	42.47	ft/sec
Average Flue Gas Flow Rate	345,497	DSCFM	388,744	DSCFM	1,491,166	DSCFM
Isokinetic Sampling Rate	96.3	%	95.6	%	103.9	%
Oxygen Concentration	5.4	%	7	%	7	%
Total Mass of Particulate Solids	5.6665	grams	0.1694	grams	0.1063	grams
Particulate Concentration	1.99	gr/DSCF	0.054	gr/DSCF	0.0389	gr/DSCF
Particulate Emissions	5881.76	lb/hr	180.42	lb/hr	497.00	lb/hr

PARAMETER	INLET		OUTLET		STACK	
Date	8/2/90		8/2/90		8/2/90	
Dry Standard Meter Volume	46.41	DSCF	53.469	DSCF	41.105	DSCF
Percent Flue Gas Moisture	8.21	%	5.47	%	12.92	%
Flue Gas Molecular Weight (wet)	29.35	g/g-mole	29.64	g/g-mole	28.68	g/g-mole
Average Gas Velocity	58.38	ft/sec	44.63	ft/sec	42.38	ft/sec
Average Flue Gas Flow Rate	355,805	DSCFM	356,891	DSCFM	1,470,382	DSCFM
Isokinetic Sampling Rate	98.6	%	115.3	%	102.7	%
Oxygen Concentration	5.4	%	6.5	%	7	%
Total Mass of Particulate Solids	9.3342	grams	0.0189	grams	0.0133	grams
Particulate Concentration	2.99	gr/DSCF	0.0055	gr/DSCF	0.00499	gr/DSCF
Particulate Emissions	9111.45	lb/hr	16.9	lb/hr	63	lb/hr

FCEM Site 12 - Power Plant Multi-Metals Sampling Train
Filter Weight Gain Data (grams)

Sample Location	Run Number	Filter I.D.	Tare Weight	Field Weighing	Replicate Laboratory Weighings One	Two	Three	Average Stable Weight	Net Weight Gain	Blank Corrected Weight Gain
BLANK		B033	0.9002	0.8971	0.8985	0.8979		0.8978	-0.0024	
BLANK		A033	0.7215	0.7209	0.7214	0.721		0.7211	-0.0004	
BLANK		B033	0.6916	0.6933	0.6934	0.6933		0.6933	0.0017	
BLANK		A040	0.7497	0.7494	0.7497	0.7497		0.7496	-0.0001	
ESP IN	1	A133	0.9012	8.9754	8.9771	8.9782		8.9776	8.0764	8.0757
	2	A233	0.7501	5.8988	5.8975	5.8971		5.8973	5.1472	5.1465
	3	A333	0.8827	9.827	9.8296	9.8256		9.8276	8.9449	8.9442
ESP OUT	1	B133	0.7384	0.8262	0.8318	0.8284		0.8301	0.0917	0.091
	2	B233	0.8774	1.0138	1.0242	1.0188		1.0215	0.1441	0.1434
	3	B333	0.7444	0.7516	0.7532	0.7527		0.753	0.0086	0.0079
STACK	1	C133	0.8739	0.8946	0.8954	0.8938		0.8946	0.0207	0.02
	2	C233	0.8779	0.9778	0.9849	0.983		0.984	0.1061	0.1054
	3	C333	0.883	0.8927	0.8941	0.8928		0.8934	0.0104	0.0097

FCEM Site 12 - Power Plant Multi-Metals Sampling Train
Filter Plus Probe and Nozzle Weight Gain Data (grams)

Sample Location	Run Number	BLANK CORRECTED FILTER WEIGHT GAIN	BLANK CORRECTED P&R RINSE WEIGHT GAIN	TOTAL WEIGHT GAIN
ESP IN	1	8.0757	0.49	8.5657
	2	5.1465	0.52	5.6665
	3	8.9442	0.39	9.3342
ESP OUT	1	0.091	0.041	0.132
	2	0.1434	0.026	0.1694
	3	0.0079	0.011	0.0189
STACK	1	0.02	0.0014	0.0214
	2	0.1054	0.0009	0.1063
	3	0.0097	0.0036	0.0133

MODIFIED METHOD 5

PARAMETER	INLET		OUTLET		STACK	
Date	7/30/90		7/30/90		7/30/90	
Dry Standard Meter Volume	119.582	DSCF	146.355	DSCF	150.219	DSCF
Percent Flue Gas Moisture	6.5	%	6.5	%	13.7	%
Flue Gas Molecular Weight (wet)	29.63	g/g-mole	28.44	g/g-mole	28.6	g/g-mole
Average Gas Velocity	56.47	ft/sec	50.58	ft/sec	42.68	ft/sec
Average Flue Gas Flow Rate	336,211	DSCFM	398,675	DSCFM	1,453,772	DSCFM
Isokinetic Sampling Rate	98.2	%	99.4	%	100.0	%

PARAMETER	INLET		OUTLET		STACK	
Date	7/31/90		7/31/90		7/31/90	
Dry Standard Meter Volume	124.657	DSCF	158.07	DSCF	149.383	DSCF
Percent Flue Gas Moisture	6.21	%	6.27	%	12.3	%
Flue Gas Molecular Weight (wet)	29.63	g/g-mole	29.54	g/g-mole	28.79	g/g-mole
Average Gas Velocity	56.26	ft/sec	48.71	ft/sec	41.65	ft/sec
Average Flue Gas Flow Rate	351,030	DSCFM	389,531	DSCFM	1,454,576	DSCFM
Isokinetic Sampling Rate	97.8	%	112.6	%	99.4	%

PARAMETER	INLET		OUTLET		STACK	
Date	8/01/90		8/01/90		8/01/90	
Dry Standard Meter Volume	110.778	DSCF	143.172	DSCF	139.697	DSCF
Percent Flue Gas Moisture	8.21	%	5.67	%	12.92	%
Flue Gas Molecular Weight (wet)	29.35	g/g-mole	29.48	g/g-mole	28.68	g/g-mole
Average Gas Velocity	52.84	ft/sec	47.07	ft/sec	40.53	ft/sec
Average Flue Gas Flow Rate	321,365	DSCFM	376,899	DSCFM	1,414,620	DSCFM
Isokinetic Sampling Rate	103.8	%	105.4	%	101.9	%

ANIONS

	INLET	OUTLET	STACK
	Dry Standard Meter Volume	Dry Standard Meter Volume	Dry Standard Meter Volume
7/31/90	70.947 DSCF	78.702 DSCF	106.21 DSCF
7/31/90	70.726 DSCF	74.697 DSCF	75.367 DSCF
8/1/90	69.338 DSCF	72.798 DSCF	73.587 DSCF
	Filter Weight Gain	Filter Weight Gain	Filter Weight Gain
7/31/90	0.4872 gms	0.1133 gms	0.1703 gms
7/31/90	0.4543 gms	0.2110 gms	0.1322 gms
8/1/90	0.3861 gms	0.2224 gms	0.0506 gms
	Impinger volume	Impinger volume	Impinger volume
7/31/90	0.0000 g	0.0 g	0.0 g
7/31/90	0 g	0.0 g	0.0 g
8/1/90	0 g	0.0 g	0.0 g

ALDEHYDES

		INLET	OUTLET	STACK
		Dry Standard Meter Volume	Dry Standard Meter Volume	Dry Standard Meter Volume
7/31/90		16.094 DSCF	11.496 DSCF	10.302 DSCF
7/31/90		11.159 DSCF	11.698 DSCF	10.083 DSCF
8/1/90		11.796 DSCF	11.318 DSCF	9.731 DSCF
		Impinger volume	Impinger volume	Impinger volume
7/31/90	imp#1	0.0000 g	0.0 g	0.0 g
	imp#2	0 g	0.0 g	0.0 g
	total	0 g	0.0 g	0.0 g
7/31/90	imp#1	0.0 g	0.0 g	0.0 g
	imp#2	0.0 g	0.0 g	0.0 g
	total	0.0 g	0.0 g	0.0 g
8/1/90	imp#1	0.0 g	0.0 g	0.0 g
	imp#2	0.0 g	0.0 g	0.0 g
	total	0.0 g	0.0 g	0.0 g

FCEM Site 12 - Power Plant Method 5 Anions/Aldehydes
Sampling Train Filter Weight Gain Data (grams)

Sample Location	Run Number	Filter I.D.	Tare Weight	Field Weighing	Replicate Laboratory Weighings			Average Stable Weight	Net Weight Gain	Blank Corrected Weight Gain
					One	Two	Three			
BLANK		B033	0.9002	0.8971	0.8985	0.8979		0.8978	-0.0024	
BLANK		A033	0.7215	0.7209	0.7214	0.721		0.7211	-0.0004	
BLANK		B033	0.6916	0.6933	0.6934	0.6933		0.6933	0.0017	
BLANK		A040	0.7497	0.7494	0.7497	0.7497		0.7496	-0.0001	
ESP IN	1	A140	0.7475	1.2342	1.2361	1.2347		1.2354	0.4879	0.4872
	2	A240	0.9056	1.3606	1.3625	1.3607		1.3606	0.455	0.4543
	3	A340	0.8927	1.2757	1.2813	1.2777		1.2795	0.3868	0.3861
ESP OUT	1	B140	0.734	0.8437	0.8508	0.8496		0.848	0.114	0.1133
	2	B240	0.8518	1.0079	1.0195	1.1075		1.0635	0.2117	0.211
	3	B340	0.9032	1.1156	1.1343	1.1291		1.1263	0.2231	0.2224
STACK	1	C140	0.9063	1.0677	1.0827	1.0815		1.0773	0.171	0.1703
	2	C240	0.9042	1.0248	1.0389	1.0353		1.0371	0.1329	0.1322
	3	C340	0.8999	0.9471	0.9514	0.9509		0.9512	0.0513	0.0506

FCEM Site 12 VOST Resample Gas Volumes

Run No.	Pair No.	Date	Start Time	Stop Time	Volume at Meter (L)	DGMCF	Meter Temp. (°F)	Probe Temp. (°F)	Bar. Pressure (in. Hg)	Gas Volume Collected (Std L)
Stack Run No. 1	1	8/17/92	1300	1326	20.60	1.037	83	278	29.77	20.67
	2	8/17/92	1350	1423	19.98	1.037	89	279	29.77	19.83
	3	8/17/92	1428	1455	20.09	1.037	92	277	29.77	19.82
	4	8/17/92	1504	1529	20.00	1.037	94	279	29.77	19.66
Stack Run No. 2	1	8/17/92	1543	1608	20.02	1.037	92	278	29.77	19.76
	2	8/17/92	1621	1646	19.98	1.037	89	278	29.77	19.83
	3	8/17/92	1653	1718	19.99	1.037	85	277	29.77	19.98
	4	8/17/92	1724	1749	20.00	1.037	82	278	29.77	20.10
Stack Run No. 3	1	8/17/92	1756	1821	19.93	1.037	81	278	29.77	20.06
	2	8/17/92	1827	1852	19.98	1.037	85	278	29.77	19.97
	3	8/17/92	1857	1922	20.00	1.037	83	278	29.77	20.07
	4	8/17/92	1928	1953	19.98	1.037	83	278	29.77	20.04

Appendix E

Error Analysis Tables

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 into the calculation of the results. This uncertainty does not represent the total uncertainty in the result since many important bias errors are unknown and have been assigned a value of zero for this analysis. Also, this uncertainty is only the uncertainty in the result for the period of time that the measurements were taken.

This method is based on ANSI/ASME PTC 19.1-1985, "Measurement Uncertainty."

Nomenclature

r	=	Calculated result;
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 uncert.;
β_r	=	Bias component of result uncert;
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:

$$U_r = \sqrt{\beta_r^2 + (S_r * t)^2} \qquad (1)$$

The components are calculated by combining the errors in the parameters used in the result calculation.

$$\beta_r = \sqrt{\sum_{i=1}^{j} (\theta_i * \beta_{\overline{pi}})^2} \quad (2)$$

$$S_r = \sqrt{\sum_{i=1}^{j} (\theta_i * S_{\overline{pi}})^2} \quad (3)$$

The sensitivity of the result to each parameter is found from a Taylor series estimation method:

$$\theta_i = \frac{\partial r}{\partial pi} \quad (4)$$

Or using a perturbation method (useful in computer applications):

$$\theta_i = \frac{r(P_i + \Delta P_i) - r(P_i)}{\Delta P_i} \quad (5)$$

The standard deviation of the average for each parameter is calculated as:

$$S_{\overline{pi}} = \frac{S_{pi}}{\sqrt{N}} \quad (6)$$

The degrees of freedom for each parameter is found from

$$v_i = N_i - 1 \quad (7)$$

and the degrees of freedom for the result is found by weighing the sensitivity and precision error in each parameter.

$$v_r = \frac{S_r^4}{\sum_{i=1}^{j} \left[\frac{(S_{\overline{pi}} \times \theta_i)^4}{v_i} \right]} \quad (8)$$

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. When calculating the $S_{\overline{p}}$, care is taken in assigning degrees of freedom to each parameter. For example, if a 15-minute average coal data are used to generate a mean coal feed rate for each of three days, the degrees of freedom in the average coal feed rate for the trip should reflect all of the 15 minute averages and not just the three daily averages. However, as another example, running duplicate analyses does not increase the degrees of freedom in analytical results.

The bias error terms are more difficult to quantify. The following conventions were used for this report:

- 5% bias on coal and ash;
- No bias in gas flow rate; and
- No bias in analytical results unless the result is less than reporting limit. Then one-half the reporting limit is used for both the parameter value and its bias in calculations.

The flow rate bias values are assigned using engineering judgment. No bias is assigned to the analytical results (above the reporting limit) or gas flow rate since a good estimate for magnitude of these terms is unknown. These bias terms may be very large (relative to the mean values of the parameters) and may represent a large amount of unaccounted uncertainty in each result. Analytical bias near the instrument detection limit may be especially large. Therefore, the uncertainty values calculated for this report should be used with care.

In addition to the assumptions about bias errors referred to above, the calculations also assume that the population distribution of each measurement is normal 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.

An example illustrating the calculation of confidence intervals is shown below.

Confidence Interval Calculations

Confidence intervals (CIs) were calculated for the mean concentrations in the coal and all gas streams. In addition, confidence intervals were determined for the stack gas emission factors presented in Table 3-4b.

CIs for Stream Concentrations

The 95% CI about the total mean for the sum of two values can be represented by:

$$U_{r_{TOT}} = \sqrt{\left(U_{r_{PART}}\right)^2 + \left(U_{r_{VAPOR}}\right)^2} \quad (9)$$

where

$U_{r\,TOT}$ = 95% CI for the total concentration;

$U_{r\,PART}$ = 95% CI for the particulate phase; and

$U_{r\,VAPOR}$ = 95% CI for the vapor phase.

The 95% CI for each phase is given by:

$$U_r = \sqrt{\beta^2 + \left(t * \frac{S_r}{\sqrt{N}}\right)^2} \quad (10)$$

where

U_r = 95% CI for each phase;

β = Bias component;

t = Student's t factor for 97.5 percentile (one-tail) and N-1 degrees of freedom;

S_t = Standard deviation of the individual run measurements; and

N = Number of measurements.

The two sets of concentration data for copper in the stack gas shown in Table 3-4a expressed in $\mu g/Nm^3$ were:

	Run 1	Run 3
Particulate	NR(2.5)	9.2
Vapor	NR(7.5)	NR(11)

All of the vapor phase concentrations are below the reporting limit for this set of data. Thus, by our conventions, the total copper concentration measured during Run 1 is assumed to be the reporting limit in the solid phase, i.e., NR(2.5). The total concentration measured during Run 3 is 9.2 $\mu g/Nm^3$. The average value was calculated by adding one-half the reporting limit of Run 1 to the concentration measured in Run 3 and obtaining the mean [(1.25 + 9.2)/2 = 5.2]. This value is greater than the largest reporting limit; therefore, a confidence interval is calculated next.

A bias is attached to each concentration that is one-half the "less than" value. Zero bias is assumed for reported quantities.

	Run 1	Run 3
β_p	1.25	0

The resulting total bias is then calculated from the bias in each run, and the sensitivity of that run to the mean

$$\beta_r = \sqrt{\left(\frac{1.25}{2}\right)^2 + \left(\frac{0}{2}\right)^2} \qquad (11)$$

$$= 0.63$$

The sample standard deviation (S_r) is found from the two values used to calculate the average concentration.

$$S_r = 5.62$$

Substituting these values into Equation 10

$$U_r = \sqrt{(0.63)^2 + \left[12.7 * \frac{5.62}{\sqrt{2}}\right]^2} \qquad (12)$$

$$= 51\ \mu g/Nm^3$$

This is the 95% CI shown in Table 3-4a for copper. Similar calculations were performed to determine the confidence intervals for all other values.

Improvements in bias estimates will be made as more data is collected and the QA/QC database is expanded. Spike and standard recoveries can be used to estimate analytical bias. Also, as the analytical methods improve, accuracy will improve, resulting in the true bias of the analytical results being closer to the zero bias now assigned.

Accounting for long-term system variability will require repeated sampling trips to the same location.

The tables which follow this discussion are the computer-generated results from the material balance error propagation. Each table provides the results for an individual element (e.g., pp. E-11 provides error propagation results for aluminum). The tables present the material balance closure as the average value (115% for aluminum) with an absolute total uncertainty of 22 percent. The program sorts the input variables in decreasing order of error contribution. For aluminum, the coal and collected fly ash stream flows are the two largest sources of uncertainty. On subsequent calculations, concentration variability is usually responsible for most of the uncertainty.

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	ALUMINUM out/in MB closur	e	114.6224	7.44E+00	2.05E+01	2.2E+01	2.00E+00	1.3E+03

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	3.99E+02	6.36E-03	3.14E+03	1
2)	FC	coal flowrate	kg/hr	193900	BIAS	2.96E+01	-5.61E-04	9.70E+03	-
3)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	2.53E+01	6.36E-03	7.90E+02	-
4)	XC	coal conc	mg/kg	9477	PREC	1.60E+01	-1.18E-02	5.86E+02	3
5)	XCFA	col. fly ash conc	mg/kg	117333	PREC	2.28E+00	8.57E-04	3.06E+03	3
6)	XFGD	FGD solids conc	mg/kg	1533	PREC	1.25E+00	9.81E-04	1.97E+03	3
7)	FC	coal flowrate	kg/hr	193900	PREC	8.82E-01	-5.61E-04	1.16E+04	48
8)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	3.97E-01	6.00E-03	1.05E+02	-
9)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	9.05E-02	8.31E-05	3.62E+03	-
10)	XBA	bottom ash conc	mg/kg	110667	PREC	3.03E-02	1.14E-04	3.06E+03	4
11)	XL	limestone conc	mg/kg	446	PREC	1.04E-02	-9.81E-04	1.80E+02	3
12)	FL	limestone flowrate	kg/hr	15800	BIAS	7.66E-03	-2.77E-05	3.16E+03	-
13)	XS	stack gas conc	mg/Nm3	.15	PREC	1.79E-04	1.29E-01	1.80E-01	3
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	2.33E-08	7.22E-09	3.66E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	ARSENIC out/in MB closur		41.56277	1.01E+01	6.04E+01	6.1E+01	4.30E+00	2.4E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XCFA	col. fly ash conc	mg/kg	24	PREC	3.33E+03	1.29E+00	7.75E+01	3
2)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	1.76E+02	1.96E-03	6.76E+03	1
3)	XC	coal conc	mg/kg	6.2	PREC	1.33E+02	-6.16E+00	3.74E+00	4
4)	XFGD	FGD solids conc	mg/kg	6.5	BIAS	9.25E+01	1.48E+00	6.50E+00	-
5)	FC	coal flowrate	kg/hr	193900	BIAS	3.79E+00	-2.01E-04	9.70E+03	-
6)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	3.70E+00	5.31E-04	3.62E+03	-
7)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	2.40E+00	1.96E-03	7.90E+02	-
8)	FC	coal flowrate	kg/hr	193900	PREC	5.23E-01	-2.01E-04	2.50E+04	48
9)	XL	limestone conc	mg/kg	1.35	BIAS	5.07E-01	-5.28E-01	1.35E+00	-
10)	XBA	bottom ash conc	mg/kg	4.8	PREC	3.14E-02	1.72E-01	2.07E+00	4
11)	FL	limestone flowrate	kg/hr	15800	BIAS	2.09E-02	-4.57E-05	3.16E+03	-
12)	XS	stack gas conc	mg/Nm3	.00067	PREC	1.83E-02	1.95E+02	1.20E-03	3
13)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	1.70E-03	3.92E-04	1.05E+02	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	6.14E-06	5.45E-08	7.87E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	BARIUM out/in MB closur	e	78.17858	5.17E+00	1.57E+01	1.6E+01	2.00E+00	1.0E+02

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	1.97E+02	4.47E-03	3.14E+03	1
2)	XCFA	col. fly ash conc	mg/kg	966	PREC	2.92E+01	7.31E-02	1.28E+02	3
3)	XC	coal conc	mg/kg	111	PREC	1.87E+01	-6.82E-01	1.10E+01	3
4)	FC	coal flowrate	kg/hr	193900	BIAS	1.38E+01	-3.82E-04	9.70E+03	-
5)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.25E+01	4.47E-03	7.90E+02	-
6)	FC	coal flowrate	kg/hr	193900	PREC	4.10E-01	-3.82E-04	1.16E+04	48
7)	XFGD	FGD solids conc	mg/kg	6	BIAS	2.52E-01	8.37E-02	6.00E+00	-
8)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	1.23E-01	3.34E-03	1.05E+02	-
9)	XL	limestone conc	mg/kg	6	BIAS	1.17E-01	-5.69E-02	6.00E+00	-
10)	XBA	bottom ash conc	mg/kg	723	PREC	5.90E-02	9.71E-03	5.00E+01	4
11)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.01E-02	2.78E-05	3.62E+03	-
12)	FL	limestone flowrate	kg/hr	15800	BIAS	4.69E-03	-2.17E-05	3.16E+03	-
13)	XS	stack gas conc	mg/Nm3	.0045	BIAS	2.45E-03	1.10E+01	4.50E-03	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	2.10E-07	2.17E-08	3.66E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	BERYLLIUM out/in MB closu	re	83.77568	2.06E+01	1.94E+01	2.8E+01	2.09E+00	1.9E+01

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XL	limestone conc	mg/kg	2.7	BIAS	2.76E+02	-6.15E+00	2.70E+00	-
2)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	1.93E+02	4.23E-03	3.29E+03	1
3)	XC	coal conc	mg/kg	.67	PREC	1.42E+02	-8.77E+01	2.72E-01	4
4)	XFGD	FGD solids conc	mg/kg	1	BIAS	1.10E+02	1.05E+01	1.00E+00	-
5)	XCFA	col. fly ash conc	mg/kg	7.3	PREC	3.84E+01	9.16E+00	1.17E+00	3
6)	FL	limestone flowrate	kg/hr	15800	BIAS	1.56E+01	-1.25E-03	3.16E+03	-
7)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.12E+01	4.23E-03	7.90E+02	-
8)	FC	coal flowrate	kg/hr	193900	BIAS	9.24E+00	-3.13E-04	9.70E+03	-
9)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	4.40E+00	5.79E-04	3.62E+03	-
10)	FC	coal flowrate	kg/hr	193900	PREC	3.02E-01	-3.13E-04	1.21E+04	48
11)	XBA	bottom ash conc	mg/kg	5.2	PREC	1.36E-01	1.22E+00	6.07E-01	4
12)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	1.00E-01	3.01E-03	1.05E+02	-
13)	XS	stack gas conc	mg/Nm3	.00009	BIAS	1.54E-02	1.38E+03	9.00E-05	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	1.36E-06	5.27E-08	3.83E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	CALCIUM out/in MB closur	e	72.07338	1.68E+01	2.83E+00	1.7E+01	2.20E+00	1.1E+01

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.52E+02	3.41E-03	3.62E+03	-
2)	FL	limestone flowrate	kg/hr	15800	BIAS	1.30E+02	-3.61E-03	3.16E+03	-
3)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	4.10E+00	5.86E-04	3.46E+03	1
4)	XC	coal conc	mg/kg	2030	PREC	3.46E+00	-2.11E-03	1.53E+03	3
5)	XFGD	FGD solids conc	mg/kg	223667	PREC	2.87E-01	2.76E-04	3.36E+03	3
6)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	2.15E-01	5.86E-04	7.90E+02	-
7)	XCFA	col. fly ash conc	mg/kg	38467	PREC	9.59E-02	2.41E-04	2.23E+03	3
8)	XL	limestone conc	mg/kg	390333	PREC	6.47E-02	-1.73E-04	2.54E+03	3
9)	FC	coal flowrate	kg/hr	193900	BIAS	4.65E-02	-2.22E-05	9.70E+03	-
10)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	2.96E-03	5.18E-04	1.05E+02	-
11)	FC	coal flowrate	kg/hr	193900	PREC	1.68E-03	-2.22E-05	1.28E+04	48
12)	XBA	bottom ash conc	mg/kg	34000	PREC	8.26E-04	3.20E-05	1.80E+03	4
13)	XS	stack gas conc	mg/Nm3	.46	BIAS	2.78E-04	3.63E-02	4.60E-01	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	2.28E-08	6.50E-09	4.03E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	CHLORIDE out/in MB closur	e	52.20436	9.88E+00	9.77E+00	1.4E+01	3.18E+00	3.3E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	9.16E+01	2.64E-03	3.62E+03	-
2)	XC	coal conc	mg/kg	830	PREC	7.09E+01	-5.88E-02	2.48E+02	3
3)	XFGD	FGD solids conc	mg/kg	4323	PREC	2.32E+01	1.11E-02	7.54E+02	3
4)	FC	coal flowrate	kg/hr	193900	BIAS	6.00E+00	-2.53E-04	9.70E+03	-
5)	XS	stack gas conc	mg/Nm3	2.8	PREC	7.33E-01	1.46E+00	1.02E+00	3
6)	FC	coal flowrate	kg/hr	193900	PREC	4.53E-01	-2.53E-04	1.85E+04	48
7)	XCFA	col. fly ash conc	mg/kg	24	PREC	8.07E-02	9.66E-03	5.09E+01	3
8)	FL	limestone flowrate	kg/hr	15800	BIAS	2.62E-02	-5.13E-05	3.16E+03	-
9)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	5.38E-03	1.47E-05	5.00E+03	1
10)	XL	limestone conc	mg/kg	161	PREC	5.22E-03	-5.04E-03	2.48E+01	3
11)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	3.32E-03	1.71E-06	5.82E+04	3
12)	XBA	bottom ash conc	mg/kg	26	PREC	9.40E-04	1.28E-03	4.77E+01	4
13)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.35E-04	1.47E-05	7.90E+02	-
14)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	2.79E-06	1.59E-05	1.05E+02	-

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	CHROMIUM out/in MB closur	e	76.15939	9.21E+00	1.68E+01	1.9E+01	2.06E+00	2.4E+01

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	1.67E+02	3.99E-03	3.24E+03	1
2)	XC	coal conc	mg/kg	17	PREC	5.83E+01	-4.00E+00	3.30E+00	3
3)	XCFA	col. fly ash conc	mg/kg	140	PREC	5.64E+01	4.50E-01	2.89E+01	3
4)	XFGD	FGD solids conc	mg/kg	12.5	BIAS	4.16E+01	5.16E-01	1.25E+01	-
5)	XL	limestone conc	mg/kg	13.5	BIAS	1.90E+01	-3.23E-01	1.35E+01	-
6)	FC	coal flowrate	kg/hr	193900	BIAS	1.17E+01	-3.52E-04	9.70E+03	-
7)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	9.93E+00	3.99E-03	7.90E+02	-
8)	XS	stack gas conc	mg/Nm3	.013	PREC	1.67E+00	6.78E+01	3.30E-02	3
9)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.66E+00	3.56E-04	3.62E+03	-
10)	FL	limestone flowrate	kg/hr	15800	BIAS	8.37E-01	-2.89E-04	3.16E+03	-
11)	FC	coal flowrate	kg/hr	193900	PREC	3.71E-01	-3.52E-04	1.20E+04	48
12)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	8.42E-02	2.76E-03	1.05E+02	-
13)	XBA	bottom ash conc	mg/kg	97	PREC	4.41E-02	5.98E-02	7.02E+00	4
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	6.53E-05	3.70E-07	3.78E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	COBALT out/in MB closur	e	109.8062	3.80E+01	3.92E+01	5.5E+01	2.78E+00	3.5E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XC	coal conc	mg/kg	3	PREC	1.15E+03	-2.38E+01	2.47E+00	3
2)	XFGD	FGD solids conc	mg/kg	12.5	BIAS	8.10E+02	2.28E+00	1.25E+01	-
3)	XL	limestone conc	mg/kg	13.5	BIAS	5.40E+02	-1.72E+00	1.35E+01	-
4)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	3.68E+02	4.40E-03	4.36E+03	1
5)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	3.24E+01	1.57E-03	3.62E+03	-
6)	FL	limestone flowrate	kg/hr	15800	BIAS	3.13E+01	-1.77E-03	3.16E+03	-
7)	FC	coal flowrate	kg/hr	193900	BIAS	1.50E+01	-4.00E-04	9.70E+03	-
8)	XCFA	col. fly ash conc	mg/kg	35	PREC	1.23E+01	1.99E+00	3.05E+00	3
9)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.21E+01	4.40E-03	7.90E+02	-
10)	XS	stack gas conc	mg/Nm3	.00055	BIAS	2.71E+00	2.99E+02	5.50E-03	-
11)	FC	coal flowrate	kg/hr	193900	PREC	8.63E-01	-4.00E-04	1.61E+04	48
12)	XBA	bottom ash conc	mg/kg	44	PREC	3.88E-01	2.64E-01	4.72E+00	4
13)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	3.38E-01	5.53E-03	1.05E+02	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	4.05E-06	6.86E-08	5.08E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	FLUORIDE out/in MB closur	e	92.12299	1.85E+01	2.07E+01	2.8E+01	3.18E+00	2.6E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XC	coal conc	mg/kg	69	PREC	3.73E+02	-1.14E+00	2.93E+01	3
2)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	3.24E+02	4.97E-03	3.62E+03	-
3)	XFGD	FGD solids conc	mg/kg	726	PREC	4.06E+01	1.24E-01	8.91E+01	3
4)	FC	coal flowrate	kg/hr	193900	BIAS	1.63E+01	-4.16E-04	9.70E+03	-
5)	XCFA	col. fly ash conc	mg/kg	15	PREC	1.14E+01	1.08E-01	5.41E+01	3
6)	FL	limestone flowrate	kg/hr	15800	BIAS	2.34E+00	-4.84E-04	3.16E+03	-
7)	FC	coal flowrate	kg/hr	193900	PREC	1.23E+00	-4.16E-04	1.85E+04	48
8)	XL	limestone conc	mg/kg	78	PREC	1.04E+00	-9.93E-02	1.78E+01	3
9)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	2.63E-01	1.03E-04	5.00E+03	1
10)	XS	stack gas conc	mg/Nm3	.03	PREC	7.09E-02	1.63E+01	2.83E-02	3
11)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	6.58E-03	1.03E-04	7.90E+02	-
12)	XBA	bottom ash conc	mg/kg	5.5	PREC	1.02E-03	1.44E-02	4.45E+00	4
13)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	4.75E-05	2.05E-07	5.82E+04	3
14)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	1.56E-05	3.76E-05	1.05E+02	-

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION		UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	IRON	out/in MB closur	e	76.81531	4.89E+00	2.93E+01	3.0E+01	2.57E+00	4.6E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XC	coal conc	mg/kg	15467	PREC	5.62E+02	-4.36E-03	9.43E+03	3
2)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	2.66E+02	4.04E-03	4.04E+03	1
3)	XCFA	col. fly ash conc	mg/kg	121667	PREC	2.57E+01	5.25E-04	1.67E+04	3
4)	FC	coal flowrate	kg/hr	193900	BIAS	1.33E+01	-3.76E-04	9.70E+03	-
5)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.02E+01	4.04E-03	7.90E+02	-
6)	XFGD	FGD solids conc	mg/kg	2243	PREC	1.70E+00	6.02E-04	3.76E+03	3
7)	FC	coal flowrate	kg/hr	193900	PREC	6.55E-01	-3.76E-04	1.49E+04	48
8)	XBA	bottom ash conc	mg/kg	165667	PREC	4.76E-01	6.98E-05	1.71E+04	3
9)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	3.34E-01	5.51E-03	1.05E+02	-
10)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	7.28E-02	7.46E-05	3.62E+03	-
11)	FL	limestone flowrate	kg/hr	15800	BIAS	2.46E-03	-1.57E-05	3.16E+03	-
12)	XL	limestone conc	mg/kg	615	PREC	1.29E-03	-4.03E-04	1.54E+02	3
13)	XS	stack gas conc	mg/Nm3	.15	PREC	1.25E-04	7.91E-02	2.44E-01	3
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	1.89E-08	5.05E-09	4.70E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	LEAD out/in MB closur	e	151.3949	9.88E+00	5.09E+01	5.2E+01	2.45E+00	6.3E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XCFA	col. fly ash conc	mg/kg	42	PREC	1.45E+03	3.21E+00	2.06E+01	3
2)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	1.07E+03	8.53E-03	3.84E+03	1
3)	FC	coal flowrate	kg/hr	193900	BIAS	4.67E+01	-7.05E-04	9.70E+03	-
4)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	4.54E+01	8.53E-03	7.90E+02	-
5)	XFGD	FGD solids conc	mg/kg	2.2	PREC	3.27E+01	3.68E+00	2.69E+00	3
6)	XC	coal conc	mg/kg	2.4	PREC	1.75E+01	-5.90E+01	1.42E-01	4
7)	XS	stack gas conc	mg/Nm3	.0052	PREC	6.05E+00	4.84E+02	8.81E-03	3
8)	FL	limestone flowrate	kg/hr	15800	BIAS	2.67E+00	-5.17E-04	3.16E+03	-
9)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	2.62E+00	4.47E-04	3.62E+03	-
10)	FC	coal flowrate	kg/hr	193900	PREC	2.08E+00	-7.05E-04	1.42E+04	48
11)	XBA	bottom ash conc	mg/kg	14	PREC	1.20E+00	4.27E-01	5.14E+00	4
12)	XL	limestone conc	mg/kg	1.7	PREC	6.76E-01	-4.85E+00	2.94E-01	3
13)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	8.92E-02	2.84E-03	1.05E+02	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	7.47E-04	1.06E-06	4.48E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	MAGNESIUM out/in MB closu	re	136.0037	1.55E+01	1.82E+01	2.4E+01	2.00E+00	3.9E+01

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	2.23E+02	4.76E-03	3.14E+03	1
2)	FL	limestone flowrate	kg/hr	15800	BIAS	1.07E+02	-3.28E-03	3.16E+03	-
3)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.04E+02	2.81E-03	3.62E+03	-
4)	XC	coal conc	mg/kg	390	PREC	7.19E+01	-1.99E-01	7.40E+01	3
5)	XCFA	col. fly ash conc	mg/kg	6127	PREC	1.89E+01	1.23E-02	6.14E+02	3
6)	FC	coal flowrate	kg/hr	193900	BIAS	1.51E+01	-4.00E-04	9.70E+03	-
7)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.41E+01	4.76E-03	7.90E+02	-
8)	XL	limestone conc	mg/kg	3360	PREC	1.02E+01	-1.65E-02	3.36E+02	3
9)	XFGD	FGD solids conc	mg/kg	3620	PREC	7.62E+00	1.41E-02	3.40E+02	3
10)	FC	coal flowrate	kg/hr	193900	PREC	4.49E-01	-4.00E-04	1.16E+04	48
11)	XS	stack gas conc	mg/Nm3	.28	BIAS	2.68E-01	1.85E+00	2.80E-01	-
12)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	2.19E-01	4.46E-03	1.05E+02	-
13)	XBA	bottom ash conc	mg/kg	5740	PREC	6.86E-02	1.63E-03	2.78E+02	3
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	2.12E-05	2.18E-07	3.66E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	MANGANESE out/in MB closu	re	102.9664	8.12E+00	2.14E+01	2.3E+01	2.06E+00	2.6E+01

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	2.39E+02	4.79E-03	3.23E+03	1
2)	XCFA	col. fly ash conc	mg/kg	220	PREC	8.81E+01	3.44E-01	4.73E+01	3
3)	XC	coal conc	mg/kg	18	PREC	7.91E+01	-4.16E+00	3.70E+00	3
4)	XFGD	FGD solids conc	mg/kg	49	PREC	4.28E+01	3.94E-01	2.88E+01	3
5)	FL	limestone flowrate	kg/hr	15800	BIAS	2.24E+01	-1.50E-03	3.16E+03	-
6)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.49E+01	1.07E-03	3.62E+03	-
7)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.43E+01	4.79E-03	7.90E+02	-
8)	FC	coal flowrate	kg/hr	193900	BIAS	1.42E+01	-3.88E-04	9.70E+03	-
9)	XL	limestone conc	mg/kg	70	PREC	8.65E+00	-3.49E-01	1.46E+01	3
10)	FC	coal flowrate	kg/hr	193900	PREC	4.47E-01	-3.88E-04	1.19E+04	48
11)	XBA	bottom ash conc	mg/kg	175	PREC	2.21E-01	4.57E-02	2.06E+01	4
12)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	1.60E-01	3.81E-03	1.05E+02	-
13)	XS	stack gas conc	mg/Nm3	.0009	BIAS	2.17E-03	5.18E+01	9.00E-04	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	1.79E-07	1.95E-08	3.76E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	MERCURY out/in MB closu	re	37.72531	7.40E+00	1.15E+01	1.4E+01	2.57E+00	5.0E+00

INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1) XC	coal conc	mg/kg	.15	PREC	6.70E+01	-2.27E+02	7.20E-02	4
2) XFGD	FGD solids conc	mg/kg	.57	PREC	6.30E+01	6.15E+01	2.24E-01	3
3) FFGD	FGD solids flowrate	kg/hr	18100	BIAS	4.91E+01	1.94E-03	3.62E+03	-
4) FC	coal flowrate	kg/hr	193900	BIAS	3.15E+00	-1.83E-04	9.70E+03	-
5) XCFA	col. fly ash conc	mg/kg	.023	BIAS	2.10E+00	5.37E+01	2.70E-02	-
6) XS	stack gas conc	mg/Nm3	.00016	PREC	1.44E+00	8.08E+03	2.57E-04	3
7) XL	limestone conc	mg/kg	.023	BIAS	2.90E-01	-2.00E+01	2.70E-02	-
8) FC	coal flowrate	kg/hr	193900	PREC	1.55E-01	-1.83E-04	1.49E+04	48
9) FCFA	col. fly ash flowrate	kg/hr	15800	PREC	9.94E-02	7.81E-05	4.04E+03	1
10) XBA	bottom ash conc	mg/kg	.023	BIAS	3.71E-02	7.13E+00	2.70E-02	-
11) FL	limestone flowrate	kg/hr	15800	BIAS	8.63E-03	-2.94E-05	3.16E+03	-
12) FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	3.81E-03	7.81E-05	7.90E+02	-
13) FS	stack gas flowrate	Nm3/hr	2380000	PREC	2.18E-04	5.43E-07	4.70E+04	3
14) FBA	bottom ash flowrate	kg/hr	2100	BIAS	6.73E-05	7.81E-05	1.05E+02	-

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	PHOSPHORUS out/in MB clos	ure	550.8802	5.09E+01	2.70E+02	2.7E+02	2.78E+00	3.8E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XC	coal conc	mg/kg	25	PREC	5.32E+04	-1.11E+01	3.61E+01	3
2)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	1.79E+04	3.07E-02	4.36E+03	1
3)	FL	limestone flowrate	kg/hr	15800	BIAS	1.73E+03	-1.32E-02	3.16E+03	-
4)	XCFA	col. fly ash conc	mg/kg	2513	PREC	1.18E+03	1.93E-01	3.08E+02	3
5)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	5.87E+02	3.07E-02	7.90E+02	-
6)	XL	limestone conc	mg/kg	212	PREC	5.50E+02	-1.05E+00	3.89E+01	3
7)	FC	coal flowrate	kg/hr	193900	BIAS	2.51E+02	-1.63E-03	9.70E+03	-
8)	XFGD	FGD solids conc	mg/kg	85	PREC	4.06E+01	2.21E-01	5.00E+01	3
9)	XS	stack gas conc	mg/Nm3	.12	PREC	3.12E+01	2.90E+01	3.33E-01	3
10)	FC	coal flowrate	kg/hr	193900	PREC	1.44E+01	-1.63E-03	1.61E+04	48
11)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.41E+01	1.04E-03	3.62E+03	-
12)	XBA	bottom ash conc	mg/kg	1727	PREC	6.27E+00	2.56E-02	1.69E+02	3
13)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	4.89E+00	2.11E-02	1.05E+02	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	1.84E-03	1.46E-06	5.08E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	SELENIUM out/in MB closure		95.86342	4.80E+01	2.10E+01	5.2E+01	2.78E+00	3.7E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	XFGD	FGD solids conc	mg/kg	6.5	BIAS	2.13E+03	7.10E+00	6.50E+00	-
2)	XS	stack gas conc	mg/Nm3	.022	PREC	3.23E+02	9.34E+02	3.33E-02	3
3)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	8.53E+01	2.55E-03	3.62E+03	-
4)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	5.92E+01	1.77E-03	4.36E+03	1
5)	XL	limestone conc	mg/kg	1.4	BIAS	5.86E+01	-5.47E+00	1.40E+00	-
6)	XCFA	col. fly ash conc	mg/kg	4.5	PREC	3.21E+01	6.20E+00	1.58E+00	3
7)	XC	coal conc	mg/kg	1.2	PREC	2.57E+01	-7.16E+01	1.42E-01	4
8)	FC	coal flowrate	kg/hr	193900	BIAS	1.75E+01	-4.32E-04	9.70E+03	-
9)	FL	limestone flowrate	kg/hr	15800	BIAS	2.68E+00	-5.18E-04	3.16E+03	-
10)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.95E+00	1.77E-03	7.90E+02	-
11)	XBA	bottom ash conc	mg/kg	1.5	BIAS	1.53E+00	8.24E-01	1.50E+00	-
12)	FC	coal flowrate	kg/hr	193900	PREC	1.01E+00	-4.32E-04	1.61E+04	48
13)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	6.41E-02	8.63E-06	5.08E+04	3
14)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	3.82E-03	5.89E-04	1.05E+02	-

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	SODIUM out/in MB clos	ure	103.8935	6.70E+00	2.65E+01	2.7E+01	2.18E+00	1.2E+01

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	3.62E+02	5.56E-03	3.42E+03	1
2)	XC	coal conc	mg/kg	667	PREC	2.77E+02	-1.42E-01	2.03E+02	3
3)	XCFA	col. fly ash conc	mg/kg	7300	PREC	5.68E+01	1.20E-02	1.09E+03	3
4)	FC	coal flowrate	kg/hr	193900	BIAS	2.38E+01	-5.03E-04	9.70E+03	-
5)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.93E+01	5.56E-03	7.90E+02	-
6)	XFGD	FGD solids conc	mg/kg	396	PREC	3.84E+00	1.38E-02	2.46E+02	3
7)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.19E+00	3.02E-04	3.62E+03	-
8)	FC	coal flowrate	kg/hr	193900	PREC	8.42E-01	-5.03E-04	1.26E+04	48
9)	XS	stack gas conc	mg/Nm3	.28	BIAS	2.58E-01	1.81E+00	2.80E-01	-
10)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	2.54E-01	4.80E-03	1.05E+02	-
11)	XBA	bottom ash conc	mg/kg	6307	PREC	1.48E-01	1.60E-03	4.16E+02	3
12)	FL	limestone flowrate	kg/hr	15800	BIAS	9.71E-02	-9.86E-05	3.16E+03	-
13)	XL	limestone conc	mg/kg	125	PREC	2.47E-04	-1.25E-02	2.18E+00	3
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	2.41E-05	2.13E-07	3.99E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	SULFUR out/in MB closu	re	87.28274	1.46E+01	1.04E+01	1.8E+01	2.78E+00	4.1E+00

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	1.96E+02	3.86E-03	3.62E+03	-
2)	XFGD	FGD solids conc	wt%	21	PREC	6.41E+01	3.33E+00	4.16E+00	3
3)	XC	coal conc	wt%	2.8	PREC	3.99E+01	-3.03E+01	3.61E-01	3
4)	FC	coal flowrate	kg/hr	193900	BIAS	1.73E+01	-4.28E-04	9.70E+03	-
5)	XS	stack gas conc	mg/Nm3	362	PREC	3.59E+00	4.38E-02	7.50E+01	3
6)	FC	coal flowrate	kg/hr	193900	PREC	9.91E-01	-4.28E-04	1.61E+04	48
7)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	1.61E-01	9.20E-05	4.36E+03	1
8)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	3.82E-02	6.66E-06	5.08E+04	3
9)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	5.28E-03	9.20E-05	7.90E+02	-
10)	XCFA	col. fly ash conc	wt%	.5	PREC	2.04E-03	2.91E+00	2.69E-02	3
11)	XBA	bottom ash conc	wt%	.0976	PREC	1.37E-03	3.87E-01	1.92E-01	4
12)	XL	limestone conc	wt%	.0352	PREC	9.29E-04	-2.54E+00	2.08E-02	3
13)	FL	limestone flowrate	kg/hr	15800	BIAS	3.19E-04	-5.65E-06	3.16E+03	-
14)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	3.58E-06	1.80E-05	1.05E+02	-

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	TITANIUM out/in MB closure		101.9106	6.55E+00	1.85E+01	2.0E+01	2.00E+00	5.0E+02

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	3.09E+02	5.60E-03	3.14E+03	1
2)	XC	coal conc	mg/kg	518	PREC	2.00E+01	-1.76E-01	4.40E+01	3
3)	FC	coal flowrate	kg/hr	193900	BIAS	1.99E+01	-4.60E-04	9.70E+03	-
4)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.96E+01	5.60E-03	7.90E+02	-
5)	XL	limestone conc	mg/kg	594	PREC	7.68E+00	-1.45E-02	3.32E+02	3
6)	FL	limestone flowrate	kg/hr	15800	BIAS	2.93E+00	-5.42E-04	3.16E+03	-
7)	XCFA	col. fly ash conc	mg/kg	6150	PREC	1.86E+00	1.44E-02	1.64E+02	3
8)	XFGD	FGD solids conc	mg/kg	161	PREC	1.67E+00	1.65E-02	1.36E+02	3
9)	FC	coal flowrate	kg/hr	193900	PREC	5.92E-01	-4.60E-04	1.16E+04	48
10)	XBA	bottom ash conc	mg/kg	5613	PREC	3.88E-01	1.91E-03	5.64E+02	3
11)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	2.88E-01	5.11E-03	1.05E+02	-
12)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	2.82E-01	1.47E-04	3.62E+03	-
13)	XS	stack gas conc	mg/Nm3	.022	PREC	2.80E-04	2.16E+00	1.34E-02	3
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	1.46E-07	1.81E-08	3.66E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

OUTPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ABSOLUTE BIAS COMPONENT	ABSOLUTE PRECISION COMPONENT*	ABSOLUTE TOTAL UNC	STUDENT t	DEGREES OF FREEDOM
CLOSURE	VANADIUM out/in MB clos ure		99.96621	1.77E+01	1.89E+01	2.6E+01	2.00E+00	4.1E+01

	INPUT VARIABLE NAME	DESCRIPTION	UNITS	AVERAGE VALUE	ERROR TYPE	ABSOLUTE CONTRIBUTION **	ABSOLUTE SENSITIVITY (SIGMAp)	ABSOLUTE ERROR OF INPUT***	NUMBER OF SAMPLES
1)	FCFA	col. fly ash flowrate	kg/hr	15800	PREC	2.65E+02	5.18E-03	3.14E+03	1
2)	XFGD	FGD solids conc	mg/kg	26	BIAS	1.60E+02	4.86E-01	2.60E+01	-
3)	XL	limestone conc	mg/kg	27	BIAS	1.06E+02	-3.81E-01	2.70E+01	-
4)	XCFA	col. fly ash conc	mg/kg	193	PREC	7.78E+01	4.24E-01	3.60E+01	3
5)	FC	coal flowrate	kg/hr	193900	BIAS	1.80E+01	-4.37E-04	9.70E+03	-
6)	FCFA	col. fly ash flowrate	kg/hr	15800	BIAS	1.68E+01	5.18E-03	7.90E+02	-
7)	XC	coal conc	mg/kg	17	PREC	1.43E+01	-5.11E+00	1.28E+00	3
8)	FFGD	FGD solids flowrate	kg/hr	18100	BIAS	6.39E+00	6.98E-04	3.62E+03	-
9)	FL	limestone flowrate	kg/hr	15800	BIAS	5.02E+00	-7.09E-04	3.16E+03	-
10)	FC	coal flowrate	kg/hr	193900	PREC	5.36E-01	-4.37E-04	1.16E+04	48
11)	XBA	bottom ash conc	mg/kg	95	PREC	1.10E-01	5.64E-02	1.02E+01	3
12)	FBA	bottom ash flowrate	kg/hr	2100	BIAS	7.18E-02	2.55E-03	1.05E+02	-
13)	XS	stack gas conc	mg/Nm3	.0009	BIAS	3.31E-03	6.39E+01	9.00E-04	-
14)	FS	stack gas flowrate	Nm3/hr	2380000	PREC	2.54E-07	2.38E-08	3.66E+04	3

* PRECISION COMPONENT = t*Srbar

** (Bp*SIGMAp)^2 FOR BIAS ERRORS; (t*Spbar*SIGMAp)^2 FOR PRECISION ERRORS
-WHERE Spbar=PRECISION INDEX OF THE MEAN, Sp/(NUMBER OF SAMPLES)^.5
-THE SQUARE ROOT OF THE SUM OF THE ABSOLUTE CONTRIBUTIONS IS EQUAL TO THE TOTAL UNCERTAINTY

*** Bp FOR BIAS ERRORS; Sp FOR PRECISION ERRORS

Appendix F

Quality Assurance/Quality Control Data

As part of the FCEM project, quality assurance/quality control (QA/QC) procedures are conducted to ensure that specific data needs of the project are met. The primary objectives of the QA/QC effort are to control, assess, and document data quality. To achieve these objectives, the QA/QC program is used to assess data quality in terms of precision and accuracy and to control data quality within prescribed limits of acceptability.

To assess and control data quality, the QA/QC approach has three key elements:

- Data quality objectives;
- QA/QC in sample collection, analysis, and data analysis; and
- Corrective action when specifications were not met.

Based on this general QA/QC approach, a project-specific QA/QC program was developed for the FCEM project. The following sections describe the details of the QA/QC program and summarize the results for the tests conducted at Site 12. The tables located at the end of this appendix contain details of the QA/QC analyses summarized in the text below.

Data Quality Objectives

Data quality objectives for Site 12 were defined in the site test plan. These objectives pertain to laboratory performance indicators and to project-specific performance indicators. The objectives for laboratory performance, which include frequencies for performing each type of QC check as well as acceptance criteria and corrective action, are based on method-specific requirements or historical laboratory performance characteristics. Meeting these objectives defines the analytical system in a state of control. As a rule, adherence to these criteria is mandatory for valid data.

Project-specific objectives address precision, accuracy, completeness, representativeness, and comparability. As opposed to laboratory-controllable quality control specifications, the project precision and accuracy objectives consider the effectiveness of the analytical methods in the actual sample matrices, the significance of matrix interferences or other effects, and sample or process variability.

Completeness is a measure of valid results collected, expressed as a percentage of the amount planned. Completeness objectives generally refer to the minimum amount of valid data required to make valid decisions or conclusions, but since it is often impossible to collect additional samples after the sampling campaign, it becomes more important to qualify the uncertainty of the conclusions. From a sampling perspective, completeness is best addressed by collecting all samples as planned. Representativeness and comparability are qualitative concepts that address the validity of decisions or conclusions derived from the measurement data and the ability to compare the results of the study with other similar studies. Representativeness is a function of sampling strategy which considers, in addition to correlation with specific process conditions, factors such as compositing of samples to mitigate sample variability, multipoint traverse stack sampling, integrated gas sampling, and isokinetic sampling. Comparability is achieved through the use of accepted, standard reference methods, reporting units, and calibration against reference materials.

Data Validation and Corrective Action

The control and assessment procedures were applied in three areas of the program: sampling, analysis, and data validation. In the beginning, all sample collection equipment was calibrated according to method specifications prior to being used in the field. Sampling procedures, particularly collection of integrated gaseous phase samples, were performed according to strict protocols which define requirements for sampling points, rates and volumes, isokinetic conditions, leak checks, and temperatures. All sampling performance requirements, including acceptance criteria for equipment

calibration as well as criteria for sampling parameters, were reviewed and validated while on site by the sampling task leader. The sampling plan also addressed collection of field blanks and replicate samples. Equipment calibration records and sample collection data sheets are kept on file in a secure location.

Analytical quality control procedures were performed as described in the reference methods and include specific requirements for instrument calibrations and on-going performance checks. These include checks of instrumental performance, such as continuing calibration checks and system blanks, as well as checks of the entire analytical method, which includes preparation (e.g., digestion or extraction) of the sample for introduction to the instrument. QC samples used to monitor control of the entire method include analysis of blanks and reference materials that are handled in the same fashion as routine field samples. The analytical systems were required to meet specific criteria for acceptance before analysis results were validated by the laboratory supervisors. Detailed laboratory quality control data and laboratory analytical reports are kept on file in a secure location.

The third area of quality assessment was performed by the project team and involved evaluation of all measurement results in the context of the needs of the project. This included an extensive review of all components contributing to the final results. This process included a review of sampling and analysis quality control results to ensure that the sampling and analysis systems were in control, but moreover, to assess the effectiveness of the methods in the sample matrices, and the significance of sample or process variability on the reliability of conclusions derived from the data.

Finally, the data were reviewed from an engineering perspective to verify the reasonableness and representativeness of the results, to assess comparability with similar well-characterized materials or trends, and to identify outliers. Alternative methods or techniques were used or developed as necessary to meet the quality objectives for the

project. The results and outcome of project data review activities are documented in internal project memoranda.

The impact of not meeting project data quality objectives was evaluated on a case-by-case basis. In all cases, control of the analytical system would first be verified. If necessary, samples were reanalyzed. If the quality control data indicate that the method was ineffective in the particular sample matrix, modifications or alternate methods were used. If these actions were not able to mitigate the matrix effects or produce better yields, the bias or imprecision was noted and considered or factored into the conclusions derived from the measurement results.

Sampling and Analytical Quality Control Approach

Specific quality control procedures associated with the various sampling and analytical efforts that provide the basis for control and assessment of data quality are detailed in the Site 12 sampling and analytical plan.

The objective of quality assurance and quality control (QA/QC) efforts associated with the sampling and analysis activities was to ensure that data collected were technically sound, defensible, and of known and acceptable quality. Two primary aspects of the overall QA/QC effort were related to achievement of this objective. First, the QA/QC program provided a framework for controlling data quality within established limits during execution of the sampling and analytical efforts. Second, the QA/QC program provided the basis for identifying and defining limitations associated with these data.

In implementing the QA/QC program, procedures were defined or developed to address the critical aspects of the sampling and analysis program, including:

- Sample collection, preservation, and storage;
- Sample analysis;

- Calibration of instrumentation and apparatus;
- Data reduction, validation, and reporting;
- Documentation and sample custody; and
- Internal quality control.

This program was designed to control sampling and analytical performance within limits that are, in most cases, specified in the reference methods. In addition, the program provided for the collection and analysis of samples to evaluate the overall effectiveness of the analytical methods used in the types of sample matrices actually collected. The following key types of QC samples were used in addition to routine field samples:

- Laboratory and field blank samples;
- Laboratory spiked samples;
- Duplicate samples; and
- Reference samples.

Quality assurance/quality control data associated with the sampling and analytical procedures for this study indicate that, with a few exceptions to be discussed below, the data quality objectives were achieved for all variables. For this reason the data may be considered valid and usable for project needs.

Blank Samples

Blank samples consist of laboratory pure matrices that are subjected to routine sampling and analytical procedures. For this site, field blanks and laboratory blanks were analyzed. Field blanks are blank sampling media that are placed in the sampling equipment, transported to the sampling location, leak checked, and then recovered immediately into sampling containers. Laboratory blanks consist of laboratory water or sampling media that are prepared and/or digested in the same manner as the samples.

Laboratory blank samples are used to control laboratory contamination because corrective action is initiated when results are above acceptable limits. Field blank samples are used to assess sampling contamination.

One set of field blank samples was collected for each gas collection technique. Laboratory blanks were analyzed at a frequency of 10% or with each batch of samples analyzed (whichever was greater). Blank results are compared with quality control (QC) limits that are five times the reported method reporting limits (MRL) for most analyses. Method reporting limits are specified by the laboratory for each method performed based on the method, EPA, or other requirements. All instrument-specific method detection limits must be less than or equal to the corresponding method reporting limits. Generally, if laboratory blank results are found above the QC limit, analytical procedures could be contaminating field samples. Similarly, field blank results above the QC limits indicate that sampling procedures may be contaminating field samples.

Table F-1 summarizes the laboratory blank and field blank results. This table shows the total number of blank samples for each method, any compounds detected, and the range of results detected in the blanks. Low levels of fluoride and phosphate were found in the impinger field blank at concentrations less than five times the reporting limit. Fluoride was also found at low levels in the impinger lab blank. Cadmium, chromium, copper, iron, lead, nickel, silicon, and zinc were found in the impinger field blanks, all at levels below five times the reporting limit. Copper, lead, and zinc were seen in the laboratory blank. All of these substances were present at less than five times the reporting limit.

Aluminum, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, sodium, silicon, strontium, and zinc were found in the field blank associated with the probe and nozzle and filter samples from the metals sampling train. These analytes were mostly detected at low levels (less than five times the sample reporting limit) except for aluminum, calcium, iron, molybdenum, silicon, and strontium

that were found at greater than five times the reporting levels. Chromium, iron, manganese, molybdenum, and titanium were also found in the preparation blanks analyzed with the ash samples.

In the original VOST samples, benzene and toluene contamination was seen at significant levels in both field and trip blanks. During the retest, only methylene chloride, trichlorofluoromethane, and chloroform were detected in the blanks. The high levels of methylene chloride observed indicate that the gas phase concentrations are not accurate. Therefore, concentrations for methylene chloride are not presented.

Spiked Samples

Spiked samples are field samples to which known amounts of the analyte of interest have been added. A spiked and unspiked aliquot were analyzed for this project. The differences in the measured concentrations between the spiked and unspiked aliquots are calculated and compared to the amount of spike added. Since actual samples are used for the determination, any matrix effects can be identified. Spiked sample analyses may be used to estimate analytical bias. The bias estimate generated from the spiked sample analyses includes systematic bias contributed by the sample matrix.

Tables F-2, F-3, and F-4 summarize the spiked sample results. Table F-2 is a summary of matrix spike results for volatile organics, semivolatile organics, formaldehyde, metals, and anions. This table shows the number of spiked samples analyzed, the mean percent recovery, and the mean relative percent difference between matrix spike duplicate recoveries. Spike recovery results were not used if the spike amount was less than one-fourth the amount measured in the unspiked sample. The recovery estimates in this table also include results for matrix-spiked samples from a different FCEM site that were analyzed with batches of similar samples from Site 12.

The mean percent recovery was within acceptable limits for all organic compounds. Mean recoveries for sodium and potassium spikes into bottom ash samples and for selenium spikes into limestone samples analyzed by ICP were below the 75-125 % QC limits. Mean recoveries of lead by AAS analysis of the WW effluent to FGD were also below the QC limits. Mean recoveries for arsenic by ICP analysis were above the QC limits for the makeup water and WW effluent samples. Calcium recoveries for the WW effluent to FGD were below the QC limits. Fluoride, chloride, sulfate, and phosphate spikes into aqueous and solid samples all showed recoveries within the QC limits.

Surrogate spiked samples are a special type of spiked sample used as a part of the analytical protocol for organic analyses to monitor method performance with each sample. (Surrogate compounds are not expected to be found in the sample and are added to each sample, blank, and standard before sample extraction). Surrogate spike results for the semivolatile organic analyses are summarized in Table F-3. All surrogate recoveries were within the QC acceptance limits for all the semivolatile analyses performed. Table F-4 presents surrogate recoveries for the VOST retest period. All recoveries were within the QC acceptance limits (70-130% recovery).

Duplicate Samples

Duplicate samples analyses are used as indicators of measurement data precision. Precision is a measure of mutual agreement among individual measurements of the same property made under similar conditions. Variability among the measurements is attributable to random error. In the case of duplicate analyses, the analytical process is replicated for separate aliquots of a single sample with prescribed elements of the process held constant. For example, duplicate analyses are usually performed on the same day, by the same analyst, using the same instrument and same calibration. Differences in results for duplicate analyses are attributable to random variability in the analytical process and are a measure of analytical precision.

Duplicate samples provide another measure of precision. Collecting and analyzing duplicate samples involves replicating sample collection (and associated sample handling activities) and analysis. Therefore, precision estimates based on duplicate sample results take both sampling variability and analytical variability into account.

Duplicate samples and duplicate analysis results provide data for precision estimates. Generally, however, duplicate sample data are used in different ways than the results for duplicate analyses. Since analytical precision is primarily a function of the analytical procedures used, precision data for duplicate analysis may be used as an ongoing quality control check, and corrective action can be initiated when results indicate that analytical precision is not within acceptable limits.

Results for duplicate samples, on the other hand, are more often used merely as a data quality assessment tool. There is a lag between sample collection and the availability of analytical results, and it is usually not possible to initiate corrective action based on duplicate sample data because the sampled process would probably no longer be at exactly the same conditions. Variability in duplicate sample results may also include a component of variability attributable to inherent nonhomogeneity of the sample matrix.

Both types of duplicate data are useful as indicators of the degree to which results may be expected to vary by chance alone. This information is important whenever comparisons are made between measured values. Without this information it is difficult to know when to attribute observed differences to measurement error and when to attribute them to real differences.

Makeup water and WWT effluent samples were collected in duplicate once during the test program. These samples were collected virtually simultaneously into separate containers during the sampling event. One duplicate coal sample was generated from one of the coal samples by splitting the 24-hour composite into two fractions. One duplicate sample of limestone was collected during the three-day sampling program.

This sample was prepared by placing alternating scoops into separate containers. A duplicate filter cake sample was generated once during the sampling program by placing alternating scoops into separate containers.

Table F-5 summarizes the results for analyses of duplicate field samples. Shown are the number of duplicate pairs analyzed, the mean measured value in the duplicate pairs, and the mean relative percent difference between results. The results for the duplicate analyses are presented in Table F-2. The precision objectives were met for duplicate field sample and duplicate matrix spike analyses for most analytes. Exceptions and limitations are discussed in the section titled Summary of Quality Control Results.

Reference Samples

Reference samples are samples of known composition which provide a point-in-time assessment of analytical performance. For this program, reference materials traceable to the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards) were submitted and analyzed with routine samples to evaluate the performance of the metals analyses for each sample matrix and each of the analytical techniques used.

Table F-6 shows the results for the analyses of metals in NIST-certified limestone, fly ash, coal, river sediment, and oil standards using x-ray fluorescence (XRF), neutron activation (NAA), inductively coupled argon plasma emission spectrometry (ICP), hydride generation AA (HGAAS), graphite furnace AA (GFAAS), and cold vapor AA (CVAAS). Table F-7 summarizes the results for the analyses of seven replicate samples of NIST fly ash by microwave digestion followed by ICP and atomic absorption analysis. These results are discussed in detail in the following sections.

Summary of Quality Control Results

Metals

All quality control data for metals analyses point to accurate calibration and instrument control. Limitations based on matrix effects and sample preparation techniques are discussed below.

Bottom Ash

Matrix spike data for bottom ash elements indicate that measurements of arsenic concentrations using hydride generation atomic absorption spectrophotometry may be biased slightly high. Spike recovery data for the major elements of aluminum, calcium, iron, and titanium were not meaningful because the spike concentrations were too low compared with levels in the samples. Recoveries of sodium and potassium were below the objective of 75 percent. The amount of spike material added was greater than one-fourth of the material actually present, but less than the natural levels of sodium and potassium in these samples, so the recovery estimates may be confounded by sample variability.

Precision estimates based on matrix spike duplicates were within the 20% (RPD) objective for all target elements except sodium and potassium, although these estimates, as mentioned above, are questionable because of the relatively low spike concentrations.

Limestone

Matrix spike results point to no major problems, except that potassium recoveries were only about 50 percent. The spiked amount in this case was high enough to reliably infer that potassium concentrations are biased low in these samples. Repeatability for these analyses was within the project objectives.

FGD Solids and Fly Ash

These solids were initially digested using EPA Method 3050 rather than the microwave procedure. The QC data indicated a number of problems. Matrix spike recoveries in FGD solids were outside the 75 to 125% recovery objectives for antimony, titanium, and lead (by GFAAS). Duplicate RPDs (relative percent differences) were outside the 20% objective for iron and manganese. The spiked amounts of calcium and sulfur spike were too low to be meaningful. In fly ash samples, recoveries of antimony, lead (by GFAAS), and selenium (by HGAAS) were outside the 75 to 125% objectives. RPDs for antimony and arsenic were also greater than the 20% objective. Sodium and lead were detected in the preparation blank, with the potential for significantly affecting results for sodium and lead in FGD solids.

Metals Train Particulate Samples

A standard fly ash sample (1633a) obtained from the National Institute of Standards and Technology was digested and analyzed in conjunction with the analysis of particulates from the filter and probe and nozzle rinses of the metals train. Recoveries below 75% for chromium and selenium (by HGAAS) indicate that these metal concentrations may be biased low. Recoveries greater than 125% were observed for molybdenum and cadmium. Of particular concern were results for molybdenum, which are considered unreliable in these samples because of spectral interferences with aluminum and iron. This is consistent with method development data previously generated for the microwave digestion procedures.

Metals Train Impinger Solutions

Spike recoveries for barium (by ICP-AES) and selenium (by HGAAS) were outside control limits in the impinger field blank samples. Recovery of barium was low and recovery of selenium was high. Spike recoveries were also high for arsenic and selenium

in one impinger sample. A review of laboratory calibration check results found a consistently high bias for arsenic and selenium. The calibration error was corrected and the samples were reanalyzed within acceptable quality control limits.

Boron was found at a low level (within five times the method reporting limit) in a method blank prepared with impinger samples, indicating the possibility of contamination in field samples, although no impact has been identified.

Makeup Water and WWT Effluent

Lead was detected within five times the method reporting limit in the method blank. Lead concentrations in makeup water and WWT effluent were similar to levels found in the method blank are consequently considered suspect.

Spike recovery data for the WWT effluent show low recoveries (70%) for lead, which may indicate a related bias in field samples.

Analysis of NIST Standards for Metals

It is often difficult to obtain credible recovery estimates for solids samples spiked prior to digestion. Post-digestion spikes can be used to evaluate recoveries in the aqueous digestates, but do not address the effectiveness of the digestion procedure. Recoveries of pre-digestion spikes in solid materials can also be misleading as a result of sample heterogeneity. To obtain estimates of measurement accuracy and to compare results between different analytical methods, and thereby to establish a basis for selecting the most accurate and representative measurement data, NIST standard materials were submitted and analyzed with routine samples using ICP-AES, atomic absorption, x-ray fluorescence, and neutron activation methods. A discrete study (based on preparation and analysis of seven replicate fly ash standards) was also conducted to evaluate the effectiveness of the microwave digestion procedure. The results for analysis of these

standards, summarized in Tables F-6 and F-7, reflect acceptable measurement processes, with certain limitations, as discussed below.

The data in Table F-7, summarizing the results for microwave digestion and subsequent analysis using ICP-AES and atomic absorption, show unreliable results for silicon and sodium, attributed to very large and variable sodium and silicon levels occurring as artifacts of the method. The aluminum level in the blank was also very high (5,500 mg/kg), but was less than 5% of the certified concentration in the NIST fly ash standard and so, in those samples, did not significantly affect recovery. High molybdenum recoveries (380%) were thought to be related to spectral interferences and suggest that the molybdenum results are also not reliable.

Atomic absorption analyses for arsenic showed biased and variable results (69 ±48% recovery) in the fly ash samples, although arsenic results can be meaningful if used with some caution. Atomic absorption results for lead (119 ±24% recovery) and selenium (76 ±12% recovery) also show a degree of inaccuracy that does not invalidate the usefulness of the data, but qualifies the confidence in the measurements as they do not meet the project objective of 75 to 125% recovery for individual measurements.

The data in Table F-6 similarly show the effectiveness of selected methods using NIST standard limestone, fly ash, coal, river sediment, and oil. These standards were analyzed with routine samples.

X-ray fluorescence results for manganese were inaccurate in both limestone and fly ash samples (ranging from 50% to 400% recovery), although the concentrations were relatively low. Recoveries were consistently low for sulfur (60%) in fly ash and high for titanium (205%) in limestone.

Results for analysis of argillaceous limestone using ICP-AES were mostly within expected limits. Measurements were low for aluminum (57%), titanium (52%), potassium (69%), and manganese (72%), compared with the NIST-certified values.

Results for analysis of NIST bituminous coal, river sediment, and oil are all within the 75 to 125% accuracy objectives.

Aldehydes

A number of aldehyde results were reported within five times the method reporting limit. It has been observed that the relative imprecision increases in this range, hence measurement results should not be expected to meet the precision goal of 20 percent.

Polynuclear Aromatic Hydrocarbons

All surrogate recoveries associated with PNAs were within control limits. Surrogate recoveries are summarized in Table F-3. No contamination problems were identified for target compounds. Recoveries for nine routine matrix spike compounds in FGD solids ranged from 67% to 113%, all within EPA Method 8270 specifications. Recoveries for acenaphthene and pyrene, two of the nine spike compounds that are target analytes, averaged 67% and 81%, respectively.

No target compounds were detected in FGD solids and WWT effluent duplicate sample pairs analyzed for semivolatile organics. The repeatability for these samples is shown in Table F-5 as the relative percent difference between surrogate recovery values in duplicate samples. These results show good repeatability, ranging from 1% to 32% relative difference.

Anions

Quality control sample results for analyses of fluoride, chloride, sulfate, and phosphorus show acceptable calibration and instrument control. Limitations in the data are discussed below.

Routine quality control data for fluoride analyses were within expected limits. Matrix spike recoveries averaged 96% for aqueous samples. Fluoride recovery in a spiked limestone sample prepared by sodium hydroxide fusion was 93%, but the spike was added after the fusion and so does not reflect the effectiveness of the preparation procedure in recovering fluoride. Fluoride concentrations measured in acid dissolutions of limestone were higher than those measured using sodium hydroxide fusions and were more consistent.

A low recovery of 74% was obtained for fluoride in a fly ash sample using the hydroxide fusion dissolution. Fluoride concentrations in fly ash and bottom ash were all less than five times the sample reporting limit or not detected. Although the fusion dissolution results are suspected of being biased low, these results should be acceptable for material balance calculations.

Quality control data for sulfates, chlorides, and phosphates were within expected limits. Inappropriate spike levels precluded recovery estimates for phosphate, except in coal, in which the recovery averaged 99 percent.

Process Data. The process data are reviewed in conjunction with the sampling schedule to determine if any fluctuations in the process may have impacted the data.

Plant Instrumentation Calibration Records. To ensure that process data collected are representative, calibration records for coal weigh scales and annual RATA results were

inspected. Any raw material shipment records (coal and limestone) were collected to provide a quality assurance check for chemical analysis:

- Historical records were gathered to assure the quality of the above data (coal, limestone, bottom ash rate);
- Operator logs (main control room and FGD control room) were collected to provide access to any process problems;
- Records of the RATA performed before the test; and
- Records of coal mill calibration.

Table F-1

Blank Summary

Method	Number of Blanks Analyzed	Number of Detects	Range of Compounds Detected			Reporting Limit[a]
Semivolatile Organics						
Field Blank - MM5	1	0				
Lab Blank - MM5	1	0				
Lab Blank - Solid	2	0				
Lab Blank - Water	1	0				
VOST (Original)						
Field Blank - High Dust Gas	3					
Carbon disulfide		3	8.7	26	ng	5
Methylene chloride		2	11	27	ng	5
Benzene		1	8.4		ng	3
Field Blank - FGD Inlet Gas	3					
Acetone		1	49		ng	15
Carbon disulfide		1	32		ng	5
Methylene chloride		2	14	92	ng	5
Toluene		1	7.8		ng	5
Field Blank - Stack Gas	2					
Methylene chloride		1	24		ng	5
Carbon disulfide		2	5.2	10	ng	5
Toluene		1	10		ng	5
Lab Blank	2					
Methylene chloride		2	3.2	8.4	ng	5
Trip Blank	1					
Carbon disulfide		1	9.9		ng	5
Toluene		1	9.1		ng	5
Benzene		1	360		ng	3
VOST (Retest)						
Field Blank - Stack Gas	3					
Trichlorfluoromethane		1	13		ng	10
Methylene chloride		1	16		ng	10
Field Blank - Condensate	3					
Methylene chloride		3	40	2,200	ng	2
Chloroform		3	3.2	15	ng	2
Trip Blank	1	0				

Table F-1 (Continued)

Method	Number of Blanks Analyzed	Number of Detects	Range of Compounds Detected			Reporting Limit[a]
Iron		1	0.086		mg/L	0.04
Nickel		1	0.021		mg/L	0.02
Silicon		2	1.7	3.8	mg/L	1
Zinc		1	0.032		mg/L	0.02
Lab Blank	1					
Copper		1	0.022		mg/L	0.02
Zinc		1	0.022		mg/L	0.02
Metals (GFAA, CVAA, HGAA)						
Impinger Solutions						
Field Blank	2					
Cadmium		1	0.001		mg/L	0.001
Lead		2	0.006	0.014	mg/L	0.003
Lab Blank	1					
Lead		1	0.006		mg/L	0.003
Metals (ICP-AES) - Probe & Nozzle Rinse + Filter						
Field Blank	1					
Aluminum		1	290		µg	20
Barium		1	10		µg	1
Calcium		1	1,500		µg	100
Chromium		1	3.6		µg	1
Cobalt		1	1.2		µg	1
Copper		1	3.4		µg	2
Iron		1	210		µg	4
Manganese		1	2.9		µg	1
Molybdenum		1	31		µg	5
Nickel		1	2.3		µg	2
Silicon		1	11,000		µg	100
Sodium		1	430		µg	100
Strontium		1	3.2		µg	0.3
Zinc		1	10		µg	2
Lab Blank	1					
Barium		1	3		µg	1
Chromium		1	1.9		µg	1
Iron		1	230		µg	4
Manganese		1	1.2		µg	1
Molybdenum		1	9.1		µg	5

Table F-1 (Continued)

Method	Number of Blanks Analyzed	Number of Detects	Range of Compounds Detected			Reporting Limit[a]
Lab Blank	6	0				
Aldehydes						
Lab Blanks	1	0				
Field Blanks	1	0				
Chloride						
Lab Blank - Coal	1	0				
Lab Blank - Solid	2	0				
Lab Blank - Water	2	0				
Field Blank - Impinger	1	0				
Lab Blank - Impinger	1	0				
Fluoride						
Lab Blank - Coal	1	0				
Lab Blank - Solid	4	0				
Lab Blank - Water	1	0				
Field Blank - Impinger	1	1	0.0363		mg/L	0.1
Lab Blank - Impinger	4	4	0.0095	0.0363	mg/L	0.05 - 0.1
Sulfate						
Lab Blank - Solid	1	0				
Lab Blank - Water	1	0				
Field Blank - Impinger	1	0				
Lab Blank - Impinger	1	0				
Phosphate						
Lab Blank - Solid	1	0				
Lab Blank - Water	1	0				
Field Blank - Impinger	1	1	0.019		mg/L	0.01
Metals (ICP-AES)						
Aqueous Samples						
Lab Blank	1	0				
Metals (GFAA, CVAA, HGAA)						
Aqueous Samples						
Lab Blank	1					
Lead		1	0.0037		mg/L	0.003
Metals (ICP-AES)						
Impinger Solutions						
Field Blank	2					
Chromium		2	0.01	0.018	mg/L	0.01
Copper		1	0.022		mg/L	0.02

TABLE F-2

SUMMARY OF MATRIX SPIKE DUPLICATE ANALYSES

	No. of Spikes	Mean % Recovery	MSD RPD	QC Limits %
Semivolatile Organics in FGD Solids				
1,4-Dichlorobenzene	2	81	4.9	
2-Chlorophenol	2	85	9.4	
2,4-Dinitrotoluene	2	89	1.1	
4-Nitrophenol	2	113	9.8	
Acenaphthene	2	67	9.0	
N-Nitrosodipropylamine	2	77	7.8	
Pentachlorophenol	2	94	5.3	
Phenol	2	82	11.0	
Pyrene	2	81	24.7	
Volatile Organics in Bottom Ash/Sluice				
Benzene	2	98	3.1	
Toluene	2	99	2.0	
Formaldehyde in FGD Solids				
Formaldehyde	10	102	7.0	
Metals by AAS in Bottom Ash				
Arsenic	2	127	1.6	75-125
Lead	2	105	0.0	75-125
Mercury	2	108	7.4	75-125
Selenium	2	95	13.8	75-125
Metals by ICP in Bottom Ash				
Aluminum	0			75-125
Arsenic	0			75-125
Barium	2	104	15.4	75-125
Beryllium	2	90	1.1	75-125
Cadmium	2	91	1.1	75-125
Calcium	0			75-125
Chromium	2	95	3.2	75-125
Cobalt	2	92	2.2	75-125
Copper	2	94	2.1	75-125
Iron	0			75-125

Table F-1 (Continued)

Method	Number of Blanks Analyzed	Number of Detects	Range of Compounds Detected		Reporting Limit[a]
Strontium		1	0.35	µg	0.3
Zinc		1	3.5	µg	2
Metals (GFAA, CVAA, HGAA)					
Probe & Nozzle Rinse + Filter					
Field Blank	1				
Cadmium		1	0.16	µg	0.1
Lead		1	1.8	µg	0.3
Metals (ICP-AES)					
FGD Solids					
Lab Blank	1				
Aluminum		1	74	mg/kg	200
Calcium		1	17	mg/kg	1,000
Iron		1	39	mg/kg	40
Magnesium		1	32	mg/kg	1,000
Manganese		1	12	mg/kg	10
Molybdenum		1	36	mg/kg	50
Nickel		1	10	mg/kg	20
Potassium		1	103	mg/kg	3,000
Silicon		1	168,000	mg/kg	10,000
Titanium		1	3	mg/kg	50
Zinc		1	14	mg/kg	20
Metals (GFAA, CVAA, HGAA)					
FGD Solids					
Lab Blank	1				
Arsenic		1	2.45	mg/kg	2
Metals (ICP-AES) - Solids					
Lab Blank	1				
Chromium		1	8	mg/kg	5
Iron		1	87.5	mg/kg	20
Manganese		1	6.5	mg/kg	5
Molybdenum		1	45	mg/kg	25
Titanium		1	62.5	mg/kg	25

[a]Reporting limits for aqueous and impinger samples are generally the method reporting limits which may be greater than or equal to the instrument-specific method detection limits. Reporting limits for solid samples and probe and nozzle rinses plus the filter samples are samples or matrix reporting limits. These limits are calculated by multiplying the method reporting limits for a particular analyte by the dilution factor for that sample.

Table F-2 (Continued)

	No. of Spikes	Mean % Rec	MSD RPD	QC Limits %
Metals by AAS in Makeup Water				
Cadmium	2	100	4.0	75-125
Lead	2	95	0.0	75-125
Mercury	4	98	3.1	75-125
Metals by AAS in WW eff to FGD				
Cadmium	2	100	4.0	75-125
Lead	2	70	4.3	75-125
Mercury	2	97	2.1	75-125
Metals by ICP in Makeup Water				
Aluminum	2	104	0.0	75-125
Arsenic	2	139	2.9	75-125
Barium	2	102	1.0	75-125
Beryllium	2	103	0.0	75-125
Cadmium	2	99	0.0	75-125
Calcium	2	103	3.9	75-125
Chromium	2	101	0.0	75-125
Cobalt	2	100	0.0	75-125
Copper	2	100	0.0	75-125
Iron	2	96	0.0	75-125
Lead	2	99	5.1	75-125
Magnesium	2	102	1.0	75-125
Manganese	2	100	0.0	75-125
Molybdenum	2	101	1.0	75-125
Nickel	2	101	2.0	75-125
Potassium	2	90	3.4	75-125
Selenium	2	93	3.2	75-125
Silicon	2	101	1.0	75-125
Sodium	2	102	1.0	75-125
Titanium	2	104	4.8	75-125
Vanadium	2	101	1.0	75-125
Zinc	2	98	0.0	75-125
Metals by ICP in WW eff to FGD				
Aluminum	2	103	1.0	75-125
Arsenic	2	135	3.0	75-125
Barium	2	99	0.0	75-125
Beryllium	2	100	0.0	75-125
Cadmium	2	96	0.0	75-125

Table F-2 (Continued)

	No. of Spikes	Mean % Rec	MSD RPD	QC Limits %
Lead	2	93	8.6	75-125
Magnesium	2	113	8.0	75-125
Manganese	2	93	4.3	75-125
Molybdenum	2	95	2.1	75-125
Nickel	2	92	1.1	75-125
Potassium	2	64	42.5	75-125
Selenium	2	103	2.9	75-125
Silicon	0			75-125
Sodium	2	62	41.9	75-125
Titanium	0			75-125
Vanadium	2	95	3.2	75-125
Zinc	2	90	2.2	75-125
Metals by ICP in Limestone				
Aluminum	2	97	1.0	75-125
Arsenic	2	101	3.0	75-125
Barium	2	92	0.0	75-125
Beryllium	2	90	1.1	75-125
Cadmium	2	90	0.0	75-125
Calcium	0			75-125
Chromium	2	89	0.0	75-125
Cobalt	2	87	1.2	75-125
Copper	2	94	0.0	75-125
Iron	2	90	0.0	75-125
Lead	2	83	3.6	75-125
Magnesium	2	98	8.2	75-125
Manganese	2	88	1.1	75-125
Molybdenum	2	88	0.0	75-125
Nickel	2	87	2.3	75-125
Potassium	2	76	46.4	75-125
Selenium	2	63	4.8	75-125
Silicon	0			75-125
Sodium	2	92	0.0	75-125
Titanium	2	86	1.2	75-125
Vanadium	2	92	0.0	75-125
Zinc	2	95	14.7	75-125

Table F-2 (Continued)

	No. of Spikes	Mean % Rec	MSD RPD	QC Limits %
Chloride, Fluoride, and Phosphate in Coal				
Chloride	1	87	NA	
Fluoride	1	98	NA	
Phosphate	2	99	1.0	

NA - Duplicate matrix spikes not performed. RPD calculation not available.

MSD - Matrix Spike Duplicate

RPD - Relative Percent Difference

Table F-2 (Continued)

	No. of Spikes	Mean % Rec	MSD RPD	QC Limits %
Calcium	2	50	0.0	75-125
Chromium	2	98	1.0	75-125
Cobalt	2	96	1.0	75-125
Copper	2	97	0.0	75-125
Iron	2	93	2.2	75-125
Lead	2	91	0.0	75-125
Magnesium	2	90	1.1	75-125
Manganese	2	96	0.0	75-125
Molybdenum	2	103	1.0	75-125
Nickel	2	96	2.1	75-125
Potassium	2	96	7.3	75-125
Selenium	2	83	9.6	75-125
Silicon	2	96	0.0	75-125
Sodium	0			75-125
Titanium	2	96	0.0	75-125
Vanadium	2	99	1.0	75-125
Zinc	2	97	0.0	75-125
Lead by AAS in Stack Gas Vapor Phase				
Lead	2	90	40.0	75-125
Chloride and Sulfate in High Dust and Stack Gas				
Chloride	4	87	9.9	
Sulfate	4	101	0.5	
Chloride, Fluoride and Sulfate in Makeup Water and WW eff to FGD				
Chloride	4	111	0.4	
Fluoride	2	96	1.0	
Sulfate	7	101	1.0	
Chloride in Atomizer Feed Solids, Ashes, and Limestone				
Chloride	3	92	NA	
Fluoride	2	84	NA	

Table F-3 (Continued)

	No. of Analyses	Mean % Rec	Std Dev (% Rec)	QC Limits %
FGD Inlet Gas				
2-Fluorobiphenyl	4	87	17.6	30-115
2-Fluorophenol	4	71	4.2	25-121
2,4,6-Tribromophenol	4	66	11.1	19-122
Nitrobenzene-d5	4	82	2.6	23-120
Phenol-d5	4	73	5.3	24-114
Terphenyl-d14	4	89	8.2	18-137
Stack Gas				
2-Fluorobiphenyl	3	74	4.5	30-115
2-Fluorophenol	3	68	8.0	25-121
2,4,6-Tribromophenol	3	70	0.0	19-122
Nitrobenzene-d5	3	75	1.5	23-120
Phenol-d5	3	78	6.1	24-114
Terphenyl-d14	3	93	7.8	18-137
High Dust Gas				
2-Fluorobiphenyl	3	94	14.3	30-115
2-Fluorophenol	3	76	4.4	25-121
2,4,6-Tribromophenol	3	73	2.5	19-122
Nitrobenzene-d5	3	86	2.6	23-120
Phenol-d5	3	83	11.6	24-114
Terphenyl-d14	3	80	6.0	18-137
FGD solids				
2-Fluorobiphenyl	3	103	11.0	30-115
2-Fluorophenol	3	79	14.2	25-121
2,4,6-Tribromophenol	3	80	2.6	19-122
Nitrobenzene-d5	3	83	9.0	23-120
Phenol-d5	3	75	11.3	24-114
Terphenyl-d14	3	94	3.8	18-137

TABLE F-3

SUMMARY OF SURROGATE RECOVERIES
FOR SEMIVOLATILE ORGANIC ANALYSES

	No. of Analyses	Mean % Rec	Std Dev (% Rec)	QC Limits %
Solid Blanks				
2-Fluorobiphenyl	2	83	2.1	30-115
2-Fluorophenol	2	71	12.0	25-121
2,4,6-Tribromophenol	2	69	2.1	19-122
Nitrobenzene-d5	2	78	5.7	23-120
Phenol-d5	2	72	5.7	24-114
Terphenyl-d14	2	98	6.4	18-137
Bottom Ash Sluice Water				
2-Fluorobiphenyl	1	62	NA	43-116
2-Fluorophenol	1	52	NA	21-100
2,4,6-Tribromophenol	1	64	NA	10-123
Nitrobenzene-d5	1	67	NA	35-114
Phenol-d5	1	55	NA	10-94
Terphenyl-d14	1	105	NA	33-141
Makeup Water				
2-Fluorobiphenyl	3	69	7.4	43-116
2-Fluorophenol	3	59	8.3	21-100
2,4,6-Tribromophenol	3	64	8.2	10-123
Nitrobenzene-d5	3	75	7.2	35-114
Phenol-d5	3	63	9.0	10-94
Terphenyl-d14	3	108	10.1	33-141
WWT Eff to FGD				
2-Fluorobiphenyl	3	69	6.2	43-116
2-Fluorophenol	3	53	6.6	21-100
2,4,6-Tribromophenol	3	58	2.1	10-123
Nitrobenzene-d5	3	76	10.4	35-114
Phenol-d5	3	59	5.9	10-94
Terphenyl-d14	3	101	3.2	33-141

TABLE F-5. SUMMARY OF DUPLICATE SAMPLE RESULTS

Parameter	No. of Pairs	Mean Meas'd	Mean RPD
Volatile Organics in FGD Solids			
No target analytes detected, except surrogates			
Surrogates (% Recovery)			
1,2-Dichloroethane-d4	1	104	3.8%
1,4-Bromofluorobenzene	1	92	15.2%
Toluene-d8	1	102	3.0%
Volatile Organics in WWT eff to FGD (ug/L)			
Acetone	1	150	13.3%
Surrogates (% Recovery)			
Toluene-d8	1	102	1.0%
1,4-Bromofluorobenzene	1	102	4.9%
1,2-Dichloroethane-d4	1	104	2.9%
Semivolatile Organics in FGD Solids			
Surrogates (% Recovery)			
2,4,6-Tribromophenol	1	79	1.3%
Phenol-d5	1	72	27.8%
2-Fluorophenol	1	75	32.0%
Nitrobenzene-d5	1	81	19.8%
Terphenyl-d14	1	95	7.4%
2-Fluorobiphenyl	1	108	11.1%
Semivolatile Organics in WWT eff to FGD (ug/L)			
Surrogates (% Recovery)			
2,4,6-Tribromophenol	1	60	1.7%
Phenol-d5	1	62	3.2%
2-Fluorophenol	1	56	14.3%
Nitrobenzene-d5	1	80	21.4%
Terphenyl-d14	1	103	4.9%
2-Fluorobiphenyl	1	73	4.1%

Table F-4

Summary of Surrogate Recoveries for VOST Analyses

FCEM 12	No. of Analyses	Mean % Rec	Std. Dev. (% Rec)
Original Series			
FGD Inlet Gas			
1,2-Dichloroethane-d4	11	98	10.2
1,4-Bromofluorobenzene	11	116	13.3
Toluene-d8	11	104	2.1
High Dust Gas			
1,2-Dichloroethane-d4	11	89	20.6
1,4-Bromofluorobenzene	11	107	42.7
Toluene-d8	11	127	50.3
Stack Gas			
1,2-Dichloroethane-d4	11	97	13.7
1,4-Bromofluorobenzene	11	115	11.6
Toluene-d8	11	104	2.3
Reagent Blank			
1,2-Dichloroethane-d4	7	102	9.6
1,4-Bromofluorobenzene	6	107	10.7
Toluene-d8	7	103	4.5
Retest Series			
Stack Gas			
1,2-Dichloroethane-d4	12	100	2.6
1,4-Bromofluorobenzene	12	94	6.9
Toluene-d8	12	106	6.2
Trip and Field Blanks			
1,2-Dichloroethane-d4	7	102	2.6
1,4-Bromofluorobenzene	7	98	2.5
Toluene-d8	7	100	2.8
Lab Blanks			
1,2-Dichloroethane-d4	6	100	2.3
1,4-Bromofluorobenzene	6	98	1.2
Toluene-d8	6	101	4.7

Table F-5 (Continued)

Parameter	No. of Pairs	Mean Meas'd	Mean RPD
Ferric oxide, Fe2O3	2	0.59	34.6%
Alumina, Al2O3	2	0.58	34.8%
Silica, SiO2	2	1.27	31.5%
Calcium oxide, CaO	2	69.8	1.4%
Sulfur trioxide, SO3	2	25.8	10.9%
Mercury by CVAAS in FGD Solids and Limestone (mg/Kg)			
Mercury	1	0.68	23.5%
Mercury by CVAAS in WWT eff to FGD			
Not detected in duplicate pair			
ICPES Metals in FGD Solids and Limestone (mg/Kg)			
Aluminum	2	250	69.1%
Barium	2	2.8	73.3%
Calcium	2	346000	20.0%
Chromium	1	19	132.5%
Copper	1	15	26.7%
Iron	2	879	25.8%
Lithium	2	6.9	22.2%
Magnesium	2	2705	23.8%
Manganese	2	58	15.3%
Nickel	1	15	26.7%
Potassium	1	83	37.0%
Selenium	1	170	35.3%
Sodium	1	440	13.0%
Strontium	2	134	7.4%
Sulfur	1	147000	32.7%
Yttrium	1	1.2	6.9%
Zinc	2	17	23.8%
ICPES Metals in WWT eff to FGD (mg/L)			
Manganese	1	0.02	6.5%
Barium	1	0.05	2.2%
Iron	1	0.05	44.7%
Lithium	1	0.08	1.2%

Table F-5 (Continued)

Parameter	No. of Pairs	Mean Meas'd	Mean RPD
Aldehydes in FGD Inlet Gas (total ug)			
Acrolein	1	17	7.0%
Formaldehyde	1	79	0.5%
Bulk Density in FGD Solids (g/cm^3)			
Poured bulk density	1	1	3.4%
Tapped bulk density	1	1	0.0%
Higher Heating Value in Coal (Btu/lb)			
HHV	1	13013	0.0%
Chloride in WW eff to FGD			
Chloride	1	240	0.0%
Arsenic by AAS in FGD Solids and Limestone			
Not detected in duplicate pairs			
Boron by ICPES in FGD Solids and Limestone (mg/Kg)			
Boron	1	235	4.3%
Cadmium by AAS in WW eff to FGD			
None detected in duplicate pair			
Metal Oxides in FGD Solids and Limestone (wt. %)			
Barium oxide, BaO	2	0.01	0.0%
Manganese oxide, Mn3O4	2	0.01	0.0%
Strontium oxide, SrO	2	0.03	11.1%
Phosphorus pentoxide, P2O5	2	0.06	5.9%
Potassium oxide, K2O	2	0.04	27.3%
Titania, TiO2	2	0.10	47.3%
Sodium oxide, Na2O	2	0.05	28.6%
Magnesia, MgO	2	0.96	12.7%

Table F-5 (Continued)

Parameter	No. of Pairs	Mean Meas'd	Mean RPD
Strontium	1	1.20	1.7%
Silicon	1	1.70	0.6%
Potassium	1	4.87	0.0%
Boron	1	8.84	1.8%
Magnesium	1	34	1.5%
Calcium	1	196	1.0%
Sulfur	1	397	1.3%
Sodium	1	444	1.1%
Chloride in FGD Solids, Limestone, and Bottom Ash (mg/Kg)			
Chloride	4	1031	6.9%
NAA Metals in Coal (mg/Kg)			
Aluminum	1	9015	0.1%
Antimony	1	0.28	3.6%
Arsenic	1	4.2	6.0%
Barium	1	111	0.9%
Bromine	1	14	5.9%
Calcium	1	2120	52.8%
Cerium	1	15	12.4%
Cesium	1	0.59	22.2%
Chlorine	1	898	4.3%
Chromium	1	16	3.7%
Cobalt	1	3.4	15.7%
Dysprosium	1	0.50	6.7%
Europium	1	0.21	17.1%
Hafnium	1	0.61	2.3%
Iron	1	13150	6.8%
Lanthanum	1	5.9	7.1%
Lutetium	1	0.06	25.8%
Magnesium	1	377	1.6%
Manganese	1	19	39.1%
Neodymium	1	6.5	32.6%
Rubidium	1	11	24.9%
Samarium	1	1.1	8.9%
Scandium	1	2.6	17.8%
Selenium	1	1.1	14.9%
Sodium	1	634	5.5%

Table F-5 (Continued)

Parameter	No. of Pairs	Mean Meas'd	Mean RPD
Strontium	1	197	3.0%
Tantalum	1	0.15	15.6%
Thorium	1	1.7	8.5%
Titanium	1	504	6.6%
Uranium	1	0.55	54.9%
Vanadium	1	17	4.8%
Ytterbium	1	0.52	32.7%
Zinc	1	10	10.5%
Zirconium	1	26	48.1%
Lead by AAS in FGD Solids and Limestone (mg/Kg)			
Lead	2	1.2	77.1%
Lead by AAS in WWT eff to FGD			
Not detected in duplicate pair			
Proximate Analysis in Coal (%)			
Moisture	1	5	7.5%
Ash	1	10	3.8%
Volatile carbon	1	35	0.3%
Fixed carbon	1	51	0.2%
Selenium in FGD Solids and Limestone			
Not detected in duplicate pairs			
Sulfate in FGD Solids (mg/L)			
Sulfate	1	1050	47.6%
Sulfate in WWT eff to FGD (mg/L)			
Sulfate	1	1200	0.0%
Fluoride by SIE in FGD Inlet Gas and High Dust Gas (mg/L)			
Fluoride	2	1.0	1.5%

Table F-5 (Continued)

Parameter	No. of Pairs	Mean Meas'd	Mean RPD
Sulfur in Bottom Ash and Baghouse Fly Ash (%)			
Sulfur	2	0.32	6.7%
Ultimate Analysis in Coal (%)			
Nitrogen	1	1.3	0.8%
Sulfur	1	2.6	2.3%
Hydrogen	1	4.9	0.2%
Oxygen	1	5.2	0.6%
Carbon	1	72	0.1%

TABLE F-6

SUMMARY OF RESULTS FOR ANALYSIS OF NBS STANDARDS FOR METALS

Substance	Cited name	Method	Units	Meas'd Value	Reference Value	Recovery (%)
Alumina, Al2O3	NBS Limestone	XRF	wt. %	2.13	2.17	98%
Calcium oxide, CaO	NBS Limestone	XRF	wt. %	83.45	84.00	99%
Ferric oxide, Fe2O3	NBS Limestone	XRF	wt. %	0.91	0.918	99%
Magnesia, MgO	NBS Limestone	XRF	wt. %	0.55	0.701	78%
Manganese oxide, Mn3O4	NBS Limestone	XRF	wt. %	0.02	0.0418	48%
Phosphorus pentoxide, P2O5	NBS Limestone	XRF	wt. %	0.09	0.0668	135%
Potassium oxide, K2O	NBS Limestone	XRF	wt. %	0.46	0.4676	98%
Silica, SiO2	NBS Limestone	XRF	wt. %	11.11	11.42	97%
Sodium oxide, Na2O	NBS Limestone	XRF	wt. %	0.03	0.0334	90%
Strontium oxide, SrO	NBS Limestone	XRF	wt. %	0.06	0.0501	120%
Titania, TiO2	NBS Limestone	XRF	wt. %	0.24	0.117	205%
Loss on Ignition	NBS Limestone	XRF	wt. %	39.81	39.9	100%
Alumina, Al2O3	NBS Fly Ash	XRF	wt. %	27.22	27.02	101%
Barium oxide, BaO	NBS Fly Ash	XRF	wt. %	0.19	0.17	112%
Calcium oxide, CaO	NBS Fly Ash	XRF	wt. %	1.7	1.55	110%
Ferric oxide, Fe2O3	NBS Fly Ash	XRF	wt. %	14.32	13.4	107%
Magnesia, MgO	NBS Fly Ash	XRF	wt. %	0.8	0.75	107%
Manganese oxide, Mn3O4	NBS Fly Ash	XRF	wt. %	0.1	0.025	400%
Potassium oxide, K2O	NBS Fly Ash	XRF	wt. %	2.29	2.26	101%
Silica, SiO2	NBS Fly Ash	XRF	wt. %	49.99	48.78	102%

Table F-6 (Continued)

Substance	Cited name	Method	Units		Meas'd Value		Reference Value	Recovery (%)
Sodium oxide, Na2O	NBS Fly Ash	XRF	wt. %		0.39		0.23	170%
Strontium oxide, SrO	NBS Fly Ash	XRF	wt. %		0.07		0.098	71%
Sulfur trioxide, SO3	NBS Fly Ash	XRF	wt. %		0.28		0.45	62%
Titania, TiO2	NBS Fly Ash	XRF	wt. %		1.37		1.33	103%
Aluminum	NBS Limestone	ICPES	mg/kg		3900		6880	57%
Calcium	NBS Limestone	ICPES	mg/kg		320000		359490	89%
Iron	NBS Limestone	ICPES	mg/kg		3300		3847	86%
Magnesium	NBS Limestone	ICPES	mg/kg		2000	@	2533	79%
Manganese	NBS Limestone	ICPES	mg/kg		140		194	72%
Phosphorus	NBS Limestone	ICPES	mg/kg	<	160		175	91%
Potassium	NBS Limestone	ICPES	mg/kg	<	1600		2324	69%
Sodium	NBS Limestone	ICPES	mg/kg	<	520		148	NC
Strontium	NBS Limestone	ICPES	mg/kg		230		254	91%
Titanium	NBS Limestone	ICPES	mg/kg	<	26		50	52%
Aluminum	NBS Fly Ash	ICPES	mg/kg		120000		143000	84%
Antimony	NBS Fly Ash	ICPES	mg/kg	<	48		6.8	NC
Arsenic	NBS Fly Ash	AAS	mg/kg		120		145	83%
Arsenic	NBS Fly Ash	ICPES	mg/kg	<	140		145	97%
Barium	NBS Fly Ash	ICPES	mg/kg		1200		1500	80%
Beryllium	NBS Fly Ash	ICPES	mg/kg		11		12	92%
Cadmium	NBS Fly Ash	ICPES	mg/kg		7.8	@	1.0	780%
Calcium	NBS Fly Ash	ICPES	mg/kg		8500		11100	77%
Chromium	NBS Fly Ash	ICPES	mg/kg		180		196	92%
Cobalt	NBS Fly Ash	ICPES	mg/kg		59		46	128%

Table F-6 (Continued)

Substance	Cited name	Method	Units		Meas'd Value		Reference Value	Recovery (%)
Copper	NBS Fly Ash	ICPES	mg/kg		110		118	93%
Iron	NBS Fly Ash	ICPES	mg/kg		87000		94000	93%
Lead	NBS Fly Ash	ICPES	mg/kg		100	@	72.4	138%
Lead	NBS Fly Ash	AAS	mg/kg		57		72.4	79%
Magnesium	NBS Fly Ash	ICPES	mg/kg		3400		4550	75%
Manganese	NBS Fly Ash	ICPES	mg/kg		130		179	73%
Mercury	NBS Fly Ash	AAS	mg/kg		0.13	@	0.16	81%
Molybdenum	NBS Fly Ash	ICPES	mg/kg		50	@	29	172%
Nickel	NBS Fly Ash	ICPES	mg/kg		120		127	94%
Potassium	NBS Fly Ash	ICPES	mg/kg		17000		18800	90%
Selenium	NBS Fly Ash	AAS	mg/kg		8.9	@	10.3	86%
Selenium	NBS Fly Ash	ICPES	mg/kg	<	140		10.3	NC
Sodium	NBS Fly Ash	ICPES	mg/kg		3400		1700	200%
Strontium	NBS Fly Ash	ICPES	mg/kg		700		830	84%
Sulfur	NBS Fly Ash	ICPES	mg/kg	<	2400		1800	NC
Thallium	NBS Fly Ash	ICPES	mg/kg	<	48		5.7	NC
Titanium	NBS Fly Ash	ICPES	mg/kg		7700		8000	96%
Uranium	NBS Fly Ash	ICPES	mg/kg	<	240		10.2	NC
Vanadium	NBS Fly Ash	ICPES	mg/kg		260		297	88%
Zinc	NBS Fly Ash	ICPES	mg/kg		210		220	95%
Sulfur	NBS Fly Ash	Comb/NDIR	%		0.156		0.18	87%
Sulfur	NBS Fly Ash	Comb/NDIR	%		0.16		0.18	89%
Alumina, Al2O3	NBS Fly Ash	XRF	wt. %		27.97		27.02	104%
Barium oxide, BaO	NBS Fly Ash	XRF	wt. %		0		0.17	0%
Calcium oxide, CaO	NBS Fly Ash	XRF	wt. %		1.73		1.55	112%

Table F-6 (Continued)

Substance	Cited name	Method	Units	Meas'd Value	Reference Value	Recovery (%)
Ferric oxide, Fe2O3	NBS Fly Ash	XRF	wt. %	13.68	13.4	102%
Magnesia, MgO	NBS Fly Ash	XRF	wt. %	0.78	0.75	104%
Manganese oxide, Mn3O4	NBS Fly Ash	XRF	wt. %	0.11	0.025	440%
Potassium oxide, K2O	NBS Fly Ash	XRF	wt. %	2.31	2.26	102%
Silica, SiO2	NBS Fly Ash	XRF	wt. %	50.71	48.78	104%
Sodium oxide, Na2O	NBS Fly Ash	XRF	wt. %	0.22	0.23	96%
Strontium oxide, SrO	NBS Fly Ash	XRF	wt. %	0.28	0.098	286%
Sulfur trioxide, SO3	NBS Fly Ash	XRF	wt. %	0.26	0.45	58%
Titania, TiO2	NBS Fly Ash	XRF	wt. %	1.47	1.33	111%
Aluminum	NBS Coal	NAA	mg/kg	28404.6	29500	96
Antimony	NBS Coal	NAA	mg/kg	0.5947	0.6	99
Arsenic	NBS Coal	NAA	mg/kg	9.2186	9.3	99
Barium	NBS Coal	NAA	mg/kg	116.05	120	97
Bromine	NBS Coal	NAA	mg/kg	40.641	41	99
Cadmium	NBS Coal	NAA	mg/kg	<5.8804	0.17	NC
Calcium	NBS Coal	NAA	mg/kg	2393.8	2410	99
Cerium	NBS Coal	NAA	mg/kg	28.805	29	99
Cesium	NBS Coal	NAA	mg/kg	2.4105	2.3	105
Chlorine	NBS Coal	NAA	mg/kg	727.94	756	96
Chromium	NBS Coal	NAA	mg/kg	34.069	34.3	99
Cobalt	NBS Coal	NAA	mg/kg	6.6549	6.7	99
Copper	NBS Coal	NAA	mg/kg	<35	16.5	NC
Dysprosium	NBS Coal	NAA	mg/kg	1.984	2.06	96
Europium	NBS Coal	NAA	mg/kg	0.5032	0.52	97
Hafnium	NBS Coal	NAA	mg/kg	1.6091	1.62	99

Table F-6 (Continued)

Substance	Cited name	Method	Units	Meas'd Value	Reference Value	Recovery (%)
Iron	NBS Coal	NAA	mg/kg	11025	11100	99
Lanthanum	NBS Coal	NAA	mg/kg	14.869	15	99
Lutetium	NBS Coal	NAA	mg/kg	0.1689	0.17	99
Magnesium	NBS Coal	NAA	mg/kg	1107.33	1150	96
Manganese	NBS Coal	NAA	mg/kg	26.961	28	96
Mercury	NBS Coal	NAA	mg/kg	<.25	0.13	NC
Molybdenum	NBS Coal	NAA	mg/kg	<4.5	3.85	NC
Neodymium	NBS Coal	NAA	mg/kg	11.919	12	99
Nickel	NBS Coal	NAA	mg/kg	23.075	19.4	119
Rubidium	NBS Coal	NAA	mg/kg	29.798	30	99
Samarium	NBS Coal	NAA	mg/kg	2.379	2.4	99
Scandium	NBS Coal	NAA	mg/kg	6.2576	6.3	99
Selenium	NBS Coal	NAA	mg/kg	2.5825	2.6	99
Silver	NBS Coal	NAA	mg/kg	<.9412	0.3	NC
Sodium	NBS Coal	NAA	mg/kg	820.75	828	99
Strontium	NBS Coal	NAA	mg/kg	89.154	85	105
Tantalum	NBS Coal	NAA	mg/kg	0.4172	0.42	99
Terbium	NBS Coal	NAA	mg/kg	<.5	0.311	NC
Thorium	NBS Coal	NAA	mg/kg	4.4697	4.5	99
Tin	NBS Coal	NAA	mg/kg	<10	4	NC
Titanium	NBS Coal	NAA	mg/kg	1569.54	1630	96
Tungsten	NBS Coal	NAA	mg/kg	<5	0.88	NC
Uranium	NBS Coal	NAA	mg/kg	1.2688	1.28	99
Vanadium	NBS Coal	NAA	mg/kg	42.366	44	96
Yttervium	NBS Coal	NAA	mg/kg	1.01	1.08	94
Zinc	NBS Coal	NAA	mg/kg	27.812	28	99
Zirconium	NBS Coal	NAA	mg/kg	54.82	53	103

Table F-6 (Continued)

Substance	Cited name	Method	Units	Meas'd Value	Reference Value	Recovery (%)
Aluminum	NBS Oil	NAA	mg/kg	100.39	98	102
Copper	NBS Oil	NAA	mg/kg	96.914	98	99
Molybdenum	NBS Oil	NAA	mg/kg	98.469	97	102
Nickel	NBS Oil	NAA	mg/kg	100.19	101	99
Silver	NBS Oil	NAA	mg/kg	101.18	102	99
Barium	NBS River Sediment	NAA	mg/kg	409.95	414	99
Calcium	NBS River Sediment	NAA	mg/kg	25745	26000	99
Cerium	NBS River Sediment	NAA	mg/kg	71.295	72	99
Cesium	NBS River Sediment	NAA	mg/kg	5.9412	6	99
Chromium	NBS River Sediment	NAA	mg/kg	133.68	135	99
Cobalt	NBS River Sediment	NAA	mg/kg	13.863	14	99
Europium	NBS River Sediment	NAA	mg/kg	1.2873	1.3	99
Hafnium	NBS River Sediment	NAA	mg/kg	7.9216	8	99
Iron	NBS River Sediment	NAA	mg/kg	40697	41100	99
Lutetium	NBS River Sediment	NAA	mg/kg	0.5941	0.6	99
Rubidium	NBS River Sediment	NAA	mg/kg	99.021	100	99
Scandium	NBS River Sediment	NAA	mg/kg	11.882	12	99
Selenium	NBS River Sediment	NAA	mg/kg	1.1377	1.12	102
Thorium	NBS River Sediment	NAA	mg/kg	9.1099	9.2	99
Ytterbium	NBS River Sediment	NAA	mg/kg	2.7726	2.8	99
Zinc	NBS River Sediment	NAA	mg/kg	433.71	438	99
Zirconium	NBS River Sediment	NAA	mg/kg	297.06	300	99
Aluminum	NBS Coal	NAA	mg/kg	29128	29500	99
Antimony	NBS Coal	NAA	mg/kg	0.576	0.6	96
Arsenic	NBS Coal	NAA	mg/kg	8.9277	9.3	96

Table F-6 (Continued)

Substance	Cited name	Method	Units	Meas'd Value	Reference Value	Recovery (%)
Bromine	NBS Coal	NAA	mg/kg	39.359	41	96
Calcium	NBS Coal	NAA	mg/kg	2485.2	2410	103
Cerium	NBS Coal	NAA	mg/kg	31.867	29	110
Cesium	NBS Coal	NAA	mg/kg	2.1419	2.3	93
Chlorine	NBS Coal	NAA	mg/kg	746.47	756	99
Chromium	NBS Coal	NAA	mg/kg	33.133	34.3	97
Europium	NBS Coal	NAA	mg/kg	0.4956	0.52	95
Hafnium	NBS Coal	NAA	mg/kg	1.4575	1.62	90
Iodine	NBS Coal	NAA	mg/kg	1.9427	1.8	108
Iron	NBS Coal	NAA	mg/kg	10981.15	11100	99
Lanthanum	NBS Coal	NAA	mg/kg	14.399	15	96
Lutetium	NBS Coal	NAA	mg/kg	0.182	0.17	107
Magnesium	NBS Coal	NAA	mg/kg	1135.5	1150	99
Manganese	NBS Coal	NAA	mg/kg	27.647	28	99
Neodymium	NBS Coal	NAA	mg/kg	11.746	12	98
Nickel	NBS Coal	NAA	mg/kg	20.057	19.4	103
Potassium	NBS Coal	NAA	mg/kg	3945.5	4110	96
Samarium	NBS Coal	NAA	mg/kg	2.3039	2.4	96
Scandium	NBS Coal	NAA	mg/kg	6.2155	6.3	99
Selenium	NBS Coal	NAA	mg/kg	2.5449	2.6	98
Sodium	NBS Coal	NAA	mg/kg	794.85	828	96
Tantalum	NBS Coal	NAA	mg/kg	0.4111	0.42	98
Terbium	NBS Coal	NAA	mg/kg	0.3044	0.311	98
Thorium	NBS Coal	NAA	mg/kg	4.3673	4.5	97
Titanium	NBS Coal	NAA	mg/kg	1609.5	1630	99
Uranium	NBS Coal	NAA	mg/kg	1.2688	1.28	99
Vanadium	NBS Coal	NAA	mg/kg	43.446	44	99

Table F-6 (Continued)

Substance	Cited name	Method	Units	Meas'd Value	Reference Value	Recovery (%)
Zinc	NBS Coal	NAA	mg/kg	29.866	28	107
Zirconium	NBS Coal	NAA	mg/kg	51.193	53	97
Chromium	NBS Oil	NAA	mg/kg	99.397	100	99
Copper	NBS Oil	NAA	mg/kg	97.154	98	99
Molybdenum	NBS Oil	NAA	mg/kg	97.823	97	101
Nickel	NBS Oil	NAA	mg/kg	101.77	101	101
Silver	NBS Oil	NAA	mg/kg	102.78	102	101
Barium	NBS Coal	NAA	mg/kg	316.01	326	97
Calcium	NBS Coal	NAA	mg/kg	4494.4	4180	108
Cerium	NBS Coal	NAA	mg/kg	23.261	20.7	112
Cesium	NBS Coal	NAA	mg/kg	1.395	1.5	93
Chromium	NBS Coal	NAA	mg/kg	18.914	20.2	94
Cobalt	NBS Coal	NAA	mg/kg	5.3825	5.6	96
Iron	NBS Coal	NAA	mg/kg	8878.3	8700	102
Neodymium	NBS Coal	NAA	mg/kg	8.5551	9	95
rubidium	NBS Coal	NAA	mg/kg	19.51	20.5	95
Scandium	NBS Coal	NAA	mg/kg	3.6509	3.8	96
Selenium	NBS Coal	NAA	mg/kg	2.8293	2.9	98
Tantalum	NBS Coal	NAA	mg/kg	0.2478	0.25	99
Terbium	NBS Coal	NAA	mg/kg	0.2286	0.28	82
Thorium	NBS Coal	NAA	mg/kg	3.1074	3.14	99
Zirconium	NBS Coal	NAA	mg/kg	40.368	34	119

TABLE F-7

RESULTS OF MICROWAVE DIGESTION PROCEDURE ON NBS FLY ASH 1633a

Element	MW101	MW202	MW203	MW301	MW302	MW303	MW304	Mean	Certified Value	Mean % Rec	% CV	Blank
ICPES (mg/Kg)												
Al	136000	103000	137000	133000	140000	145000	145000	134143	143000	89.9%*	10.8%	5530
Ba	1290	902	1340	1280	1300	1350	1310	1253	1500	83.5%	12.5%	
Be	10.84	10.95	11.12	11.48	10.66	10.72	11.27	11	12	91.7%	2.7%	
Ca	10700	9310	11000	10500	10700	10900	11000	10587	11110	95.3%	5.6%	
Cr	182	195	197	190	190	191	195	191	196	97.7%	2.6%	
Co	51.2	57.3	53.1	51.9	55.4	50.5	53.2	53	46	115.7%	4.5%	
Cu	123	161	125	103	105	107	111	119	118	101.1%	17.0%	
Fe	85800	88200	88900	86200	86800	88900	89500	87757	94000	93.4%	1.7%	
Mg	4310		4310	3960	4230	4290	4440	4257	1555	273.7%	3.8%	
Mn	131	167	164	170	177	167	171	164	179	91.5%	9.2%	
Mo	108	96	107	115	118	120	115	111	29	383.7%	7.4%	
Ni	135	118	131	112	128	121	136	126	127	99.1%	7.2%	
K	17200	15900	18300	16500	17200	17200	18300	17229	18800	91.6%	5.1%	
Si	345000	353000	533000	516000	659000	690000	628000	532000	228000	131.1%*	26.3%	233000
Na	7320	4060	11000	17900	23300	28500	21800	16269	1700	174.6%*	55.5%	13300
Sr	769.6	478.6	792.9	753.1	789.7	805.6	811.3	743	830	89.5%	15.9%	
Ti	7870	8010	8040	7860	7930	8090	8200	8000	8000	100.0%	1.5%	
V	263	273	270	260	262	268	271	267	300	88.9%	1.9%	
Zn	218	214	284	263	226	287	239	247	220	112.4%	12.4%	
Hydride and GFAA (mg/Kg)												
As	212	57.2	91.1	92.5	69.4	106.7	70.8	100	145	68.9%	52.2%	
Pb	138	75.6	78.4	77.1	79.2	78.9	77.5	86	72.4	119.3%	26.4%	
Se	9.68			7.71	7.59	6.67	7.75	8	10.3	76.5%	14.0%	

*Blank corrected recovery.

Appendix G

Blank Correction Data

For most of the metallic elements of interest to this program, small traces are present in both reagents and filter media. In many instances, the total mass present prior to sampling is equivalent to that measured after sampling. Consequently, we routinely use a blank correction in the calculation of gas stream concentrations for metals and anions. Semivolatile gas analysis have not indicated the presence of compounds in the blanks. Aldehydes occasionally require blank correction. In the following tables, the mass or concentrations reported by the laboratory are presented for substances that had reported concentrations in the blank. The ratio of the blank to measured value is then calculated, values equal or greater than 50% are denoted with a "B", and no value is included in the summary tables of Section 3. This approach was selected because we cannot conclude with any degree of confidence that the measured value is not due to variability in blank levels. As shown in Appendix F, for the large majority of substances, the blank levels detected are within five times the reporting limit, indicating that the reagent and filter media are acceptable.

Table G-1 presents the probe and nozzle rinse and filter blank corrections for Site 12. Nine elements were reported on the blank. Blank corrections of 50% or more were made to 21 of the 63 measured concentrations. Corrections to the ESP inlet gas were minimal for all elements. The FGD inlet gas and stack gas corrections result in no valid values for barium and molybdenum.

Table G-2 presents the metal impinger blank corrections for Site 12. Five metals were detected in the blank impinger solution. Many of the sample train impingers had concentrations that were below the reporting limit. (Specific reporting limits vary based on the amount of liquid in each impinger analyzed, since the reporting limit for these instruments is expressed in mg/L.) Of the 35 values on this table, only three are present at concentrations where the blank correction is less than 50 percent. This indicates that the likelihood of these metals being present in the vapor phase at these levels is very low.

Table G-3 presents the blank corrections for the anion impingers. Low levels of fluoride and phosphorus were seen in the blank. Only one phosphorus value has a blank correction above 50 percent.

Table G-1

Site 12 Probe and Nozzle Rinse and Filter Blank Corrections

Sample	Substance	Run 1, µg		Blank/ Run 1	Run 2, µg		Blank/ Run 2	Run 3, µg		Blank/ Run 3	Blank, µg
ESP Inlet Gas, Solid Phase	Barium	6,000		0%	7,400		0%	12,000		0%	10
FGD Inlet Gas, Solid Phase	Barium	19	B	53%	11	B	91%				10
Stack Gas, Solid Phase	Barium	9.4	B	106%				11	B	91%	10
ESP Inlet Gas, Solid Phase	Cadmium	25		1%	46		0%	63		0%	0.16
FGD Inlet Gas, Solid Phase	Cadmium	2.6		6%	3.3		5%				0.16
Stack Gas, Solid Phase	Cadmium	0.34		47%				1.9		8%	0.16
ESP Inlet Gas, Solid Phase	Chromium	1,000		0%	1,400		0%	2,600		0%	3.6
FGD Inlet Gas, Solid Phase	Chromium	10		36%	7.2	B	50%				3.6
Stack Gas, Solid Phase	Chromium	7.1	B	51%				10		36%	3.6
ESP Inlet Gas, Solid Phase	Cobalt	250		0%	12,000		0%	700		0%	1.2
FGD Inlet Gas, Solid Phase	Cobalt	1.8	B	67%	8.6		14%				1.2
Stack Gas, Solid Phase	Cobalt	1	B	120%				1.1	B	109%	1.2
ESP Inlet Gas, Solid Phase	Copper	520		1%	45,000		0%	1,300		0%	3.4
FGD Inlet Gas, Solid Phase	Copper	5.7	B	60%	3.7	B	92%				3.4
Stack Gas, Solid Phase	Copper	3.6	B	94%				14		24%	3.4
ESP Inlet Gas, Solid Phase	Lead	310		1%	370		0%	830		0%	1.8
FGD Inlet Gas, Solid Phase	Lead	8.1		22%	15		12%				1.8
Stack Gas, Solid Phase	Lead	1.5	B	120%				2.8	B	64%	1.8
ESP Inlet Gas, Solid Phase	Manganese	1,500		0%	1,700		0%	3,600		0%	2.9
FGD Inlet Gas, Solid Phase	Manganese	31		9%	1	B	290%				2.9
Stack Gas, Solid Phase	Manganese	2.6	B	112%				6.2		47%	2.9
ESP Inlet Gas, Solid Phase	Molybdenum	1,100		3%	1,200		3%	1,900		2%	31
FGD Inlet Gas, Solid Phase	Molybdenum	37	B	84%	44	B	70%				31
Stack Gas, Solid Phase	Molybdenum	36	B	86%				40	B	78%	31
ESP Inlet Gas, Solid Phase	Nickel	600		0%	690		0%	1,400		0%	2.3
FGD Inlet Gas, Solid Phase	Nickel	7.4		31%	6.3		37%				2.3
Stack Gas, Solid Phase	Nickel	4.2	B	55%				14		16%	2.3

B = Blank correction of 50% or more.

Table G-2

Site 12 Metal Impinger Blank Corrections

Stream	Substance	Run 1, mg		Blank/ Run 1	Run 2, mg		Blank/ Run 2	Run 3, mg		Blank/ Run 3	Blank, mg
ESP Inlet Gas, Vapor Phase	Cadmium	<0.000281	B	79%	<0.000256	B	86%	0.000627		35%	0.000221
FGD Inlet Gas, Vapor Phase	Cadmium	<0.000268	B	82%	<0.000284	B	78%				0.000221
Stack Gas, Vapor Phase	Cadmium	0.000354	B	62%				0.000941		47%	0.000221
ESP Inlet Gas, Vapor Phase	Chromium	<0.002807	B	79%	0.008484	B	52%	0.008148		27%	0.002211
FGD Inlet Gas, Vapor Phase	Chromium	0.004021	B	55%	<0.002835	B	78%				0.002211
Stack Gas, Vapor Phase	Chromium	<0.002528	B	87%				<0.003473	B	64%	0.002211
ESP Inlet Gas, Vapor Phase	Copper	<0.005614	B	87%	<0.005128	B	95%	<0.006268	B	78%	0.004863
FGD Inlet Gas, Vapor Phase	Copper	<0.005362	B	91%	<0.00567	B	86%				0.004863
Stack gas, Vapor Phase	Copper	<0.005056	B	96%				<0.006946	B	70%	0.004863
ESP Inlet Gas, Vapor Phase	Lead	0.009143	B	68%	0.005151	B	120%	0.003501	B	177%	0.003095
FGD Inlet Gas, Vapor Phase	Lead	0.005776	B	107%	0.003767	B	164%				0.003095
Stack Gas, Vapor Phase	Lead	0.004019	B	154%				0.011589	B	53%	0.003095
ESP Inlet Gas, Vapor Phase	Nickel	<0.005614	B	83%	<0.005128	B	91%	<0.006268	B	74%	0.004642
FGD Inlet Gas, Vapor Phase	Nickel	<0.005362	B	87%	<0.00567	B	82%				0.004642
Stack Gas, Vapor Phase	Nickel	<0.005056	B	92%				<0.006946	B	67%	0.004642

B = Blank correction of 50% or more.

Table G-3

Site 12 Anion Impinger Blank Corrections

Sample	Substance	Run 1 (mg/L)	Blank/ Run 1	Run 2 (mg/L)	Blank/ Run 2	Run 3 (mg/L)		Blank/ Run 3	Blank (mg/L)
High Dust Gas, Vapor Phase	Fluoride	0.79	5%	1.31	3%	3.01		1%	0.03626
FGD Inlet Gas, Vapor Phase	Fluoride	0.71	5%	0.92	4%				0.03626
Stack Gas, Vapor Phase	Fluoride	0.12	31%			0.11		32%	0.03626
High Dust Gas, Vapor Phase	Phosphorus	0.09	20%	0.08	24%	0.08		24%	0.019
FGD Inlet Gas, Vapor Phase	Phosphorus	0.08	24%	0.08	23%				0.019
Stack Gas, Vapor Phase	Phosphorus	0.14	14%			<0.01	B	190%	0.019

B = Blank correction of 50% or more.