AP-42 Section Number: 1.3

Reference Number: 67

Title: Field Chemical Emissions Monitoring Project: Site 118 Emissions Report, Preliminary Draft

EPRI Report

Radian Corporation

January 1994

EPRI

Preliminary Draft

FIELD CHEMICAL EMISSIONS MONITORING PROJECT

SITE 118 EMISSIONS REPORT

January 20, 1994

Prepared By:

CARNOT
Tustin, California

Prepared For:

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

TEST REPORT TITLE:

FIELD CHEMICAL EMISSIONS MONITORING PROJECT: SITE 118 EMISSIONS REPORT. CARNOT, Tustin, California. January 20, 1994.

OIL EF DATABASE REFERENCE NO.	4
FILENAME	SITE118.WK1
FACILITY:	EPRI SITE 118

PROCESS DATA

Oil Type a	Residual (assume No. 6)
Boiler configuration a	Front-fired (normal)
SCC	10100401
Control device 1 a	Over-fire Air, Flue Gas Recirculation
Control device 2 a	ESP
Data Quality	D (high blank values)
Process Parameters a	118 MW
Test methods b	EPA, or EPA-approved, test methods
Number of test runs c	3
Fuel Heating Value (Btu/lb) d	18,756
Oil density (lb/gal) e	7.88
Fuel Heating Value (Btu/gal)	147,797
Fuel Heating Value (Btu/1000 gal)	147,797,280
Fuel Heating Value (MMBtu/1000 gal)	147.80

a Page 7
b Page 15
c Page 25, 26, 27, 28
d Page 18, mean value
e Appendix A of Ap-42, residual oil density.

EMISSION FACTORS

Pollutant	Emission Factor (lb/10^12 Btu)	Emission Factor (lb/MMBtu)	Emission Factor (lb/1000 gal)
Filterable PM a	---	0.0041	6.06E-01
METALS, ANIONS a			
Arsenic	0.55	5.50E-07	8.13E-05
Barium	7.16	7.16E-06	1.06E-03
Beryllium d	0.06	6.00E-08	8.87E-06
Cadmium d	0.18	1.80E-07	2.66E-05
Chromium	3.30	3.30E-06	4.88E-04

Cobalt	1.94	1.94E-06	2.87E-04
Copper	2.79	2.79E-06	4.12E-04
Lead b	1.78	1.78E-06	2.63E-04
Manganese	18.5	1.85E-05	2.73E-03
Mercury	0.50	5.00E-07	7.39E-05
Molybdenum	0.40	4.00E-07	5.91E-05
Nickel	46.0	4.60E-05	6.80E-03
Phosphorous b	2.70	2.70E-06	3.99E-04
Selenium	1.25	1.25E-06	1.85E-04
Vanadium	42.2	4.22E-05	6.24E-03
Chloride	3,590	3.59E-03	5.31E-01
PAHs e			
Naphthalene	0.31	3.10E-07	4.58E-05
Phenanthrene	0.012	1.20E-08	1.77E-06
2-Methylnaphthalene	0.027	2.70E-08	3.99E-06
PCDD/PCDF f			
2,3,7,8-TCDD d	4.3E-06	4.30E-12	6.36E-10
Total TCDD d	4.3E-06	4.30E-12	6.36E-10
Total PeCDD c	4.6E-06	4.60E-12	6.80E-10
Total HxCDD c	6.8E-06	6.80E-12	1.01E-09
Total HpCDD d	2.5E-05	2.50E-11	3.69E-09
OCDD b	2.1E-05	2.10E-11	3.10E-09
2,3,7,8-TCDF d	1.8E-06	1.80E-12	2.66E-10
Total TCDF d	1.8E-06	1.80E-12	2.66E-10
Total PeCDF d	2.6E-06	2.60E-12	3.84E-10
Total HxCDF d	5.0E-06	5.00E-12	7.39E-10
Total HpCDF d	3.4E-05	3.40E-11	5.03E-09
OCDF d	1.6E-05	1.60E-11	2.36E-09
PCBs d	---	---	---
VOCs g			
Benzene	0.53	5.30E-07	7.83E-05
Toluene	7.6	7.60E-06	1.12E-03
Vinyl Chloride d	1.43	1.43E-06	2.11E-04
1,3-Butadiene d	0.16	1.60E-07	2.36E-05
Methyl Bromide d	1.74	1.74E-06	2.57E-04
Chloroform d	1.09	1.09E-06	1.61E-04
1,2-Dichloroethane (Ethylene Dichloride) d	2.11	2.11E-06	3.12E-04
1,1,1-Trichloroethane	1.6	1.60E-06	2.36E-04
Carbon Tetrachloride d	0.94	9.40E-07	1.39E-04
1,2-Dichloropropane (Propylene Dichloride) d	2.41	2.41E-06	3.56E-04

Trichloroethene d	1.20	1.20E-06	1.77E-04
Perchloroethylene d	1.01	1.01E-06	1.49E-04
Chlorobenzene d	0.69	6.90E-07	1.02E-04
Ethylbenzene	0.43	4.30E-07	6.36E-05
o-Xylene	0.74	7.40E-07	1.09E-04
Formaldehyde	5.4	5.40E-06	7.98E-04

a Page 29. Individual run data on page 25.

b Detection limit value (1/2) for one run used in developing EF.

c Detection limit values (1/2) for two runs used in developing EF.

d Pollutant not detected in any sampling run.

e Page 30. Individual run data on page 26.

f Page 30. Individual run data on page 27.

g Page 31. Individual run data on page 27 (formaldehyde) and page 28.

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December 23, 1993

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 29 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 118. Site 118 consists of a 850 MW residual oil-fired boiler with an electrostatic precipitator (ESP). **It should be noted that the results presented in this report are considered PRELIMINARY.** EPRI is continuing to review the Site 118 data. As additional data from other sites are collected and evaluated, 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 Site 118 sampling and analytical plan included some differences from the standard sampling and analytical plans at other FCEM sites. Specifically, the California Air Regulatory Board (CARB) methods were used to sample for the volatile organic compounds (VOCs) and the polycyclic aromatic hydrocarbons (PAHs). A 10 μm cyclone separator was used in conjunction with the multi-metals trains, thus providing metal concentrations for the < and > 10 μm fractions.

The primary objective of this report is to transmit the preliminary results from Site 118 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

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explanations for the questionable data. This report does not compare the results from Site 118 with the results from previous utility sites. Generic conclusions and recommendations were not drawn concerning the effectiveness of the electrostatic precipitator as a potential control technology for particulate phase trace metals; 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.

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 Characterization
Environment Division

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SECTION 1.0

INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

This report summarizes data gathered by Carnot at a power plant designated Site 118 for a program sponsored by the Electric Power Research Institute (EPRI) and the host utility. The objective of the Field Chemical Emissions Monitoring Project (FCEM) sponsored by EPRI is to measure the concentrations of selected inorganic and organic substances in the process and discharge streams of power plants. These data are being used to determine the fate and control of these substances.

The primary objectives of this report are to provide information on fuel composition and stack emissions and to evaluate these data according to the criteria outlined below. The information is presented in a format suitable for the U.S. Environmental Protection Agency (EPA) to use to study emissions from fossil fuel fired power plants, as mandated by the Clean Air Act Amendments (CAAA) of 1990. This report summarizes fuel and stack gas concentration data measured during the operation of a front wall-fired boiler firing residual oil. Particulate emissions were controlled by electrostatic precipitators. Sampling was conducted during January 1993.

Table 1-1 lists the substances of interest to the FCEM project. The target analyte list and additional speciation tests for nickel and chromium were chosen for study at Site 118. Carnot conducted the testing and has prepared this report using the following procedures to evaluate the data:

- The type and quantity of quality assurance samples were reviewed to determine the confidence that can be placed in the results; and

- The QA/QC results were compared with data quality objectives to evaluate precision and accuracy.

Results are presented for each substance by individual run and as an averaged total. To demonstrate data variability, the 95% confidence interval about the mean is also presented. The confidence interval incorporates the combined process, sampling, and analytical variabilities.

TABLE 1-1
FCEM SUBSTANCES OF INTEREST
SITE 118

Elements	Organic Compounds
Arsenic	Benzene
Barium	Toluene
Beryllium	Formaldehyde
Cadmium	Naphthalene
Chlorine (as chloride)	Acenaphthylene
Chromium	Acenaphthene
Cobalt	Fluorene
Copper	Phenanthrene
Fluorine (as fluoride)	Anthracene
Lead	Fluoranthene
Manganese	Pyrene
Mercury	Benz(a)anthracene
Molybdenum	Chrysene
Nickel	Benzo(b)fluoranthene
Phosphorus	Benzo(k)fluoranthene
Selenium	Benzo(a)pyrene
Vanadium	Indeno(1,2,3-cd)pyrene
	Dibenzo(a,h)anthracene
	Benzo(g,h,i)perylene
	2-Methylnaphthalene
	7,12-Dimethylbenz(a)anthracene
	3-Methylcholanthrene

(continued)

TABLE 1-1 (continued)
FCEM SUBSTANCES OF INTEREST
SITE 118

Additional Substances	
1,3-Butadiene	Polychlorinated Dibenzo-p-dioxins and
Vinyl Chloride	Polychlorinated Dibenzofurans:
Methyl Bromide	Total and 2, 3, 7, 8 substituted isomers
Trichlorofluoromethane	tetra- through octa-chlorinated
Dichloromethane	PCDD/PCDF
Chloroform	Polychlorinated Biphenyls:
1,2-Dichloroethane	Total mono-decachlorobiphenyls
1,1,1-Trichloroethane	Radionuclides:
Carbon Tetrachloride	Ra^{226}
1,2-Dichloropropane	Ra^{228}
Trichloroethene	Th^{232}
Perchloroethylene	Th^{230}
Dibromoethane	Th^{228}
Chlorobenzene	U^{238}
Ethylbenzene	U^{235}
o-Xylene	$U^{233 \& 234}$
Chromium (total and hexavalent)[1]	Po^{210}
Nickel (soluble, sulfidic, metallic, oxidic)[2]	Pb^{210}

Notes:
[1] Determination of Hexavalent Chromium Emissions from Stationary Sources, Method Manual for Compliance with the BIF Regulations, EPA/530-SW-91-010.
[2] Nickel species were collected in a Modified EPA Method 5 train and separated by the Inco Ltd. Sequential Leaching procedure.

1.2 SAMPLING AND ANALYSIS PROTOCOL

The sampling and analysis protocol for Site 118 is described in Appendix A. The technical approach used in the FCEM project has been to employ standard sampling and analytical procedures when possible. The methods used are comparable to those used at other FCEM sites with the following major exceptions:

- Benzene, toluene, and other VOC samples listed in Table 1-1 were collected in tedlar bags according to California Air Resources Board (CARB) methodology rather than using VOST sampling.
- Flue gas metals were determined using a cyclone separator to separate metals contained in particulate matter $>10\ \mu m$ and metals contained in particulate matter $<10\ \mu m$. Vapor phase metals were combined with particulate metals $<10\ \mu m$. The total metals per sample train are reported.
- Fuel oil samples were analyzed for metals by INAA where possible and by ICP-AES to complete the analysis of target metal species.
- Metals speciation tests were performed for chromium using the draft EPA method and for nickel using a modified EPA 5 train with sequential leaching of the particulate sample.
- Polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzo-furans (PCDF), polychlorinated biphenyls (PCB), and radionuclides were added to the FCEM list of species included for this program.

1.3 QUALITY ASSURANCE/QUALITY CONTROL

The completeness of the quality assurance data was reviewed to judge whether the quality of the measurement data could be evaluated with the available information. In general, the results of the QC checks available for Site 118 indicate that the sample results are well characterized. An evaluation of the accuracy, precision, and uncertainty of the data, even if only qualitative, is considered to be an important part of the data evaluation. A full discussion of each of these components of data quality can be found in Section 5.0.

Standard QA/QC checks for this type of sampling program involve the use of: 1) duplicate field samples and lab analyses, matrix spike and lab control duplicates and replicate tests to determine precision; 2) matrix spikes, surrogate spikes, and laboratory control samples to determine accuracy; and 3) field blanks, trip blanks, method blanks, and reagent blanks to determine if any of the samples were contaminated during collection or analysis. Most of these standard QA/QC checks were used on samples from Site 118. Some QA/QC checks do not apply to some types of analyses, for example, surrogate spikes do not apply to metals and anion analysis. The absence of any of these "standard" quality control checks from the Site 118 report does not necessarily reflect poorly on the quality of the data but does limit the ability to quantify the various components of measurement error.

1.4 DATA QUALITY

The available QA/QC results were compared to the data quality objectives shown in Section 5.0. QA/QC results outside the data quality objectives are noted and discussed, other quality assurance values are evaluated, and the potential effect on data quality is noted. The detailed information presented in Section 5.0 supports the conclusion that the data quality objectives were met, with the following major exceptions:

- There are concerns that arsenic emission levels were not adequately quantified. Spike recovery of arsenic in the stack samples was low at 47%. This indicates a possible negative interference from the sample matrix. Other concerns are that blank concentrations were high. The field blanks were 150%, and the laboratory blanks were 179% of the average sample level. This indicates a possible contribution to the sample values from field and laboratory conditions. There is higher confidence in the fuel analysis of arsenic by INAA.

- The blank correction contribution was high for mercury on the $>10\ \mu m$ fraction at both the ESP inlet (81%) and the stack (81%). Field blanks were also high at 68% of the ESP inlet sample values and 258% of the stack sample values.

- There are concerns with the molybdenum results. The $<10\ \mu m$ reagent blank was greater than the stack samples. For this fraction, the reagent blank correction resulted in a value less than the reporting limit so the final concentration was presented as detected at the reporting limit. Section 3.2 presents a complete discussion on data treatment. In addition, field blank levels for both the $<10\ \mu m$ and $>10\ \mu m$ fractions at the stack were similar to sample levels.

- The $>10\ \mu m$ fraction of manganese in the stack was higher than expected by mass balance. The reason for this is not clear, and there is concern with the stack emission results.

- There are concerns that certain VOC were not adequately quantified: these species are dichloromethane, vinyl chloride, toluene and 1,1,1-trichloroethane. The sample spike recovery for vinyl chloride was low at 17% indicating a possible low bias in the sample results. Vinyl chloride was not detected in the exhaust samples. Dichloromethane and toluene concentrations in a Tedlar bag blank were two times greater than the average exhaust gas levels. A sample of ambient air at Site 118 showed a background level of 1,1,1-trichloroethane that was 155% the average exhaust gas level. These blanks indicate possible contributions to the sample from the field conditions. In addition, toluene may be subject to a possible high bias due to a high sample spike recovery of 147%.

- Formaldehyde field blank levels were approximately three times higher than the average ESP inlet sample value and four times higher than the average stack sample value. The impact on actual emissions results is unclear, but there is a concern that all samples may be subject to random positive biases.

- Results for lead-210 at the stack are not reported because the laboratory experienced analytical difficulties with initial sample analysis and there was insufficient sample to rerun the analysis. Internal spike recoveries for uranium, polonium, and thorium were low for stack samples.

- Reagent blank levels for uranium-238, thorium-228, and radium-228 were similar to stack sample levels. Laboratory blank levels for uranium-233 and -234, uranium-238, thorium-228, and thorium-232 were higher than sample levels in fuel oil.

1.5 REPORT ORGANIZATION

Section 2.0 of this report briefly describes the boiler, the particulate collection device, and the sample locations. Section 3.0 discusses the results of the chemical analysis of the oil and flue gas streams. Section 4.0 discusses the results of the chromium and nickel speciation tests. Section 5.0 presents QA/QC and engineering evaluations of the data. Section 6.0 presents example calculations, and a glossary of terms is provided in Section 7.0. The appendices contain information on sampling and analytical methods, stream concentrations, sampling data, process operation, error propagation equations, and detailed QA/QC data.

SECTION 2.0

SITE DESCRIPTION

This section presents a description of the test site, designated Site 118, and the sampling locations at this site.

2.1 FACILITY INFORMATION

Site 118 is a front-fired Foster Wheeler boiler commissioned in 1980. The maximum rated capacity on this unit is 850 gross MW. This balanced-draft unit currently fires residual fuel oil. The oil used during testing contained approximately 0.75% sulfur. The configuration of the unit is summarized in Table 2-1. Figure 2-1 presents a process flow diagram of Site 118.

2.2 EMISSIONS CONTROL

Site 118 uses electrostatic precipitators (ESP) for particulate control. The ESPs have 16 cells placed on two floors with 8 cells per floor. Char from the ESP hoppers is collected in an on-site storage silo; it is not reinjected into the furnace. The unit uses overfire air ports and flue gas recirculation (FGR) to the windbox for NO_x control.

2.3 ASH REMOVAL FACILITY

The ash collected in the ESPs is conveyed to a storage silo which is periodically dumped to ash hauling trucks.

2.4 SAMPLING LOCATIONS

Samples were collected at the four locations identified in Figure 2-1. Fuel oil was the only feed stream sampled. One internal stream, the inlet gas to the ESPs, was sampled. Two discharge streams were sampled: the stack exhaust gas and the ash from the ESPs.

TABLE 2-1
SITE 118 CONFIGURATION

Maximum Gross Electrical Output, (MW)	850
Particulate Emission Limits (lb/10^6 Btu)	0.03
Particulate Control[(1)]	ESPs without char-reinjection
NO_x Control	FGR, Overfire Air
Boiler Type	Front-fired
Fuel Type	Residual Oil
Fuel Sulfur Content (%)[(2)]	0.75
Fuel Ash (%)[(2)]	0.06
Fuel Heating Value (Btu/lb)[(2)]	18,756
ESP Ash Disposal	Storage silo

[(1)] The ESP has a 99.5% design particulate removal efficiency.
[(2)] Average values measured during sampling.

- Fuel samples were collected at the beginning, middle, and end of each test day. A total composite of 1500 mℓ in three separate containers was obtained for each test day. Fuel oil usage rates were determined using a fuel oil totalizer. Calibration of the totalizers was performed using tank drop measurements of the Site 118 day tank. Fuel oil was sampled at the suction to the fuel oil supply pumps.

- Flue gas entering the ESPs was sampled at the available test ports on the two ESP inlet ducts. This location did not meet the EPA Method 1 criteria for minimum distances from flow disturbance. Four ports were installed in each duct; however, one port on the east duct was inaccessible. Since the east duct had one fewer useable port than the west, the east duct ports were sampled for a proportionally longer period during the multipoint isokinetic traverses so that the total sample time was equal between the east and west ducts. In addition, a 28-point traverse was used for the multi-metals tests while a 35-point traverse was used for

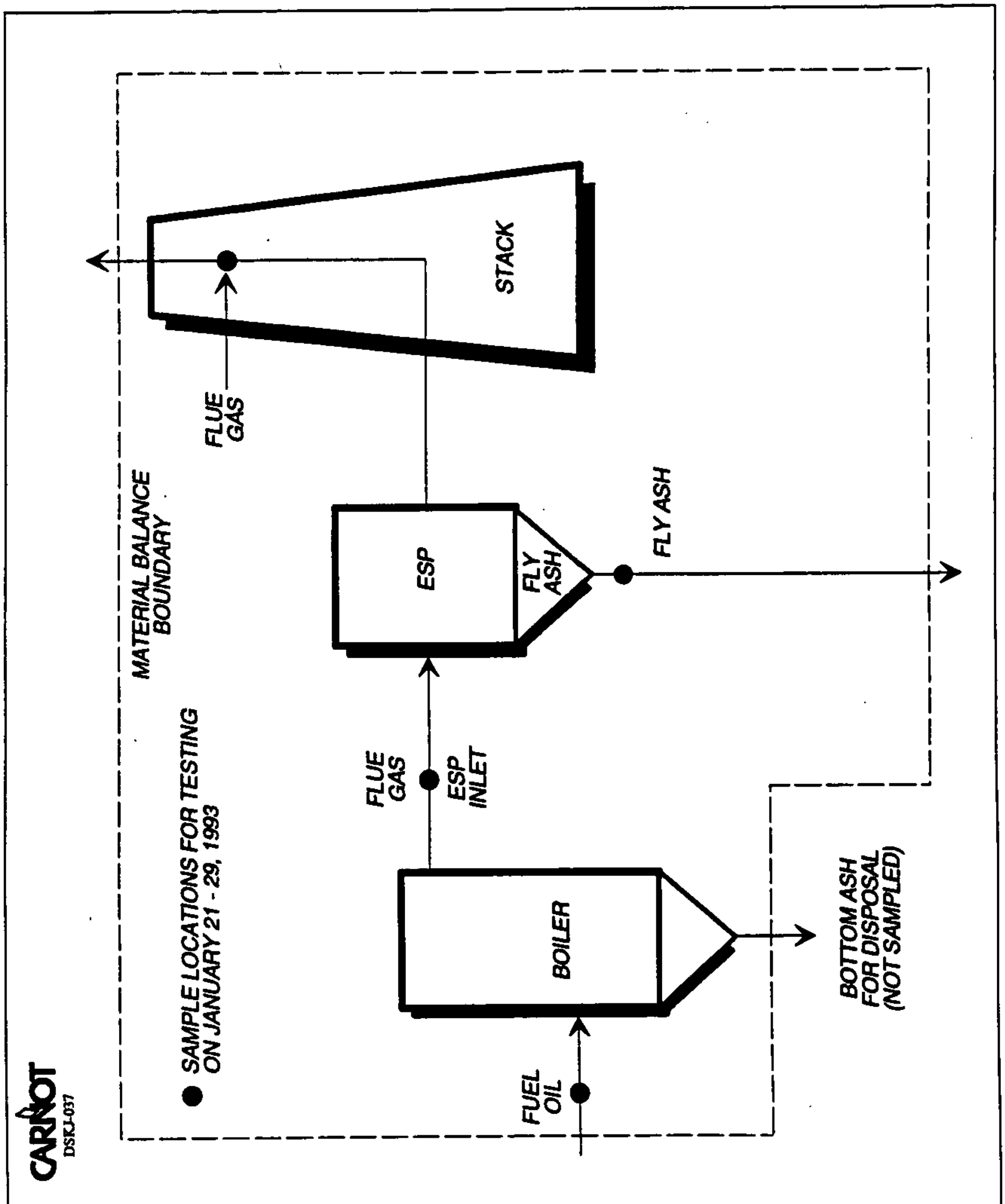


Figure 2-1. Process Flow Diagram of Site 118

other isokinetic tests. The 28 points were chosen to meet the constant flow rate (through the cyclone) requirement of Method 201A while using one nozzle for the entire test.

- Flue gas at the stack was sampled at the four available test ports. A total of 12 points were sampled for isokinetic tests. Formaldehyde and VOC samples were collected at a single point non-isokinetically. Nickel speciation tests were isokinetic, but were collected at a single point at both the ESP inlet and the stack. Chromium speciation tests were performed isokinetically at a single point at the stack only.

- The ash from the ESPs was the only point in the ash handling process that was sampled. The ash collected in the ESPs is conveyed to a storage silo which is periodically dumped to ash hauling trucks. Fuel totalizer readings were periodically recorded so that the total amount of ash collected by the ESPs could be correlated with fuel input. Ash deposited in the economizer and furnace hoppers, and ash deposited on boiler surfaces could not be quantified for this project.

The procedures for sample collection, preparation, and analysis are discussed in Appendix A. Table 2-2 presents an overview of the types of analyses performed on these streams.

2.5 PROCESS OPERATION DURING TESTING

Most of the tests were conducted at an average nominal full load of 840 MW, which is 98.8% of the maximum rated load of 850 MW. The load for tests 8 through 13 was reduced to 92.7% of maximum due to excessive boiler tube metal temperatures and high FD fan motor vibration. The average load for the test program was 818 MW, or 96.2% of maximum rated load. The average fuel flow was 401,900 lb/hr. Process operation data are presented in Appendix E.

TABLE 2-2
PROCESS STREAM ANALYSES PERFORMED
SITE 118

Stream	Metals[a]	Anions[b] and anion precursors	Semi Volatile[c] Organics	Volatile[d] Organics	Particulate	Radionuclides[e]	Nickel[f] Speciation	Chromium[g] Speciation	Composition[h]
Oil	✓	✓				✓			✓
ESP Inlet Gas	✓	✓	✓	✓	✓		✓		
Stack Gas	✓	✓	✓	✓	✓	✓	✓	✓	
ESP Ash	✓	✓				✓			

(a) = Metals include the target species: arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, phosphorus, selenium and vanadium.

(b) = Anions include the target analytes: chloride, fluoride, phosphate, and sulfate. Exhaust gas anions were collected in conjunction with particulate tests.

(c) = Semi-Volatile Organics include 19 PAH species, tetra-octa PCDD and PCDF isomers and mono-deca PCB species.

(d) = Volatile Organics are benzene, toluene, formaldehyde and 16 other VOCs.

(e) = Radionuclides include uranium (4 isotopes), radium (2 isotopes), lead (1 isotope), polonium (1 isotope) and thorium (3 isotopes). Radionuclides were analyzed in the fuel oil and ESP ash and collected in the particulate train.

(f) = Nickel compounds were separated into four categories: soluble, sulfidic, oxidic and metallic. Nickel speciation evaluation performed using modified EPA Method 5 and Inco sequential leaching procedure.

(g) = Chromium speciation evaluation performed using EPA recirculation train.

(h) = Composition for fuel oil analysis is carbon, hydrogen, nitrogen, sulfur, oxygen (by difference), moisture, ash, and higher heating value.

SECTION 3.0

RESULTS

This section summarizes the data collected at Site 118. Because the focus of this report is on exhaust gas emissions, only oil characterization data and gas stream data are presented here in detail. Sampling, preparation and analytical methods are summarized in Appendix A. Detailed analytical data can be found in Appendices B and C.

3.1 SAMPLING SCHEDULE

Sampling at Site 118 was performed from January 20 through 29, 1993. Figure 3-1 presents the sampling schedule. Test numbers have been assigned sequentially and all tests conducted simultaneously have the same number. Additional designators indicate the sample train type and sampling location.

Five types of sampling trains were used to collect flue gas samples for the FCEM species of interest at the ESP inlet and at the stack. These trains were: metals/PM_{10} trains, semi-volatile organics trains, particulate/anion/radionuclide trains, tedlar bag samples for volatile organic compounds, and formaldehyde trains. The isokinetic metals, semi-volatile, and particulate/anion/radionuclide tests required 12-point traverses of the stack location. Formaldehyde samples and tedlar bag samples for volatile organic compounds were collected at a single point. Radionuclides were collected at the stack only.

The multi-metals train was modified by use of a teflon coated cyclone preseparator with a cut size of 10 ± 1 μm. The filter that collected PM<10 μm was ultra-pure quartz fiber to minimize interferences. A teflon probe was used to eliminate metal contamination of the sample. The sampling train was run isokinetically at a constant flow rate according to EPA Method 201A.

A nickel speciation test series was performed at both the ESP inlet and stack locations using an EPA Method 5 train with the filter and probe heated to 550°F to prevent formation of $NiSO_4$ in the sample train. Sampling was isokinetic at a single point. A sequential leaching procedure developed by Inco, Ltd. was used to separate nickel into four categories: water soluble, sulfidic, metallic, and oxidic. Analysis was by atomic absorption.

Chromium speciation testing was performed at the stack using an EPA draft method. In this method, the samples were collected with a recirculating train where the first impinger reagent was continuously recirculated to the nozzle to prevent Cr^{+6} reduction between the nozzle

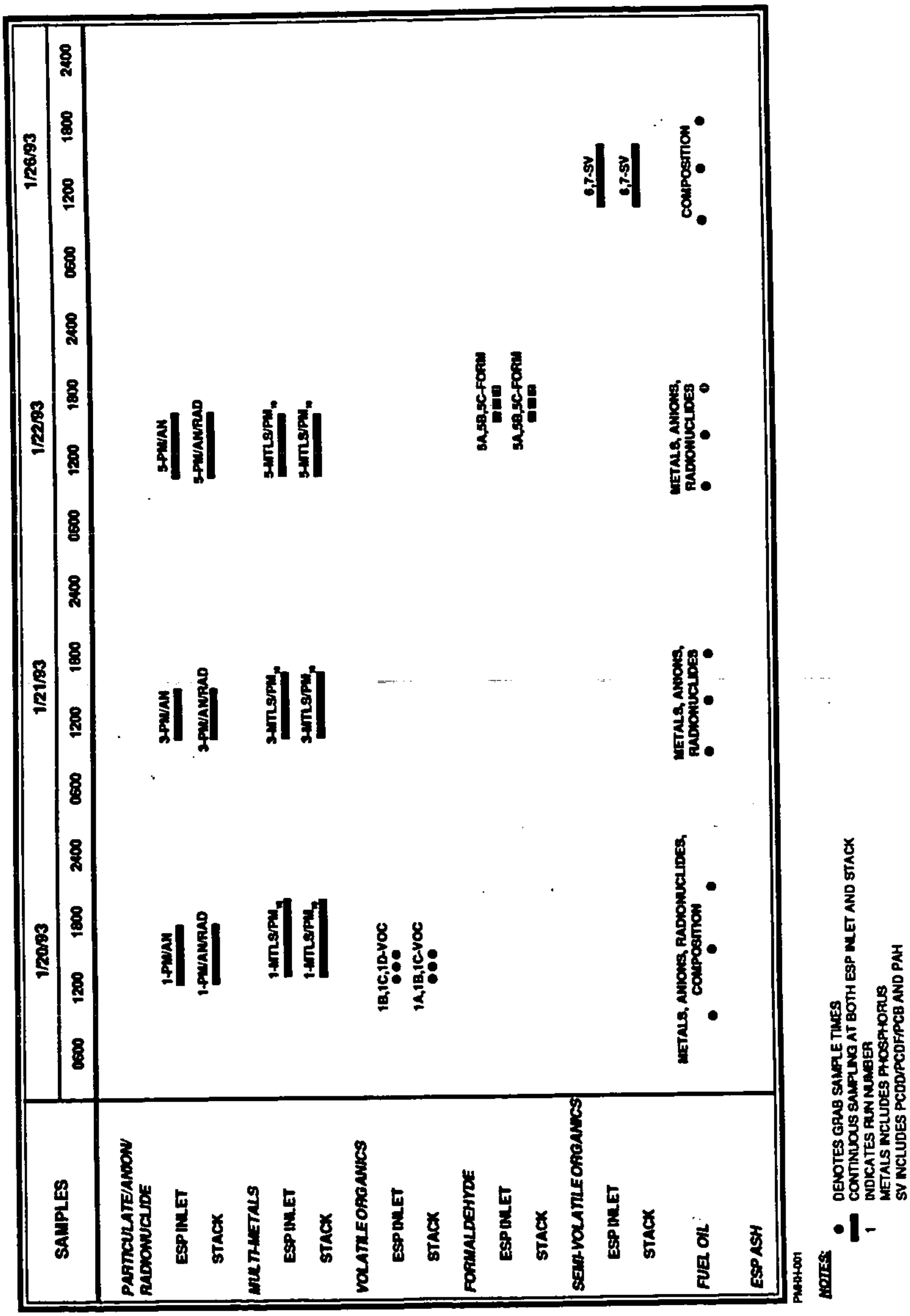
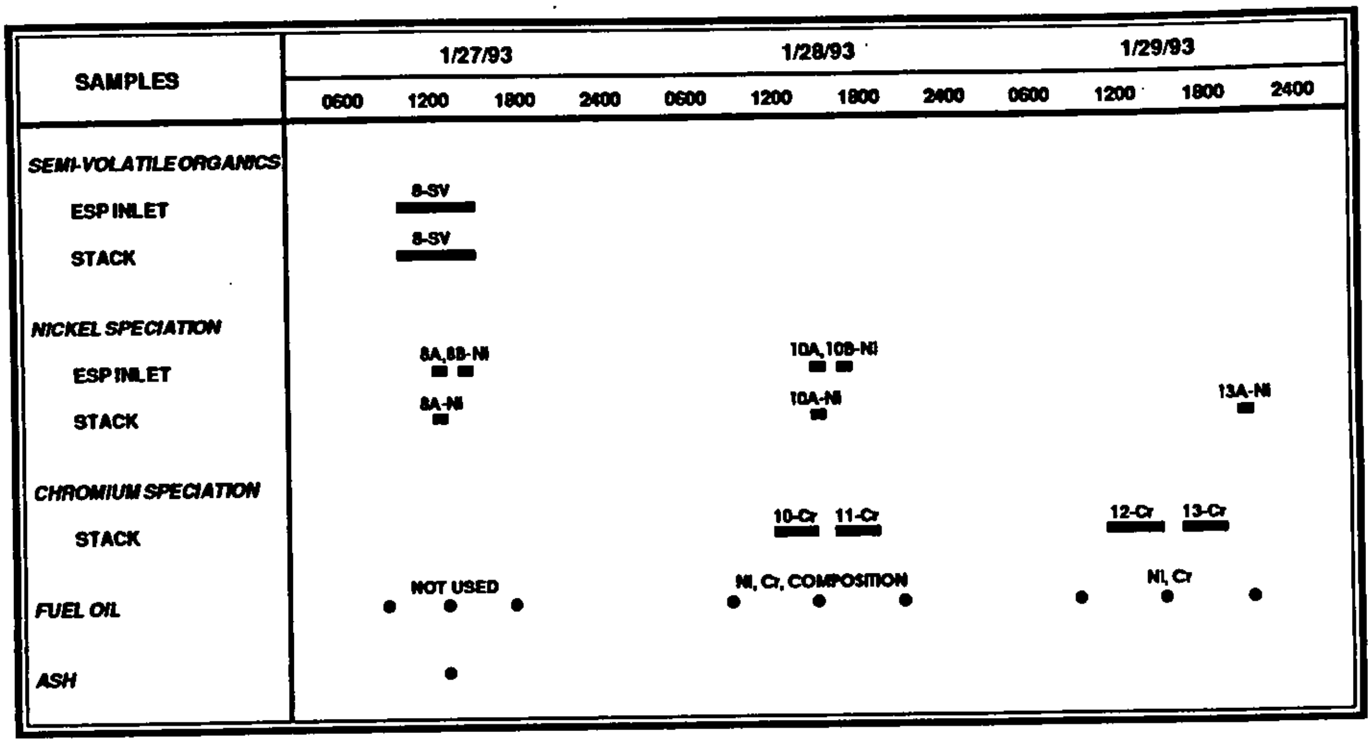


Figure 3-1. Sampling Schedule for Site 118



PMH-001

NOTES:

● DENOTES GRAB SAMPLE TIMES.
▬ CONTINUOUS SAMPLING AT BOTH ESP INLET AND STACK.
1 INDICATES RUN NUMBER.
NICKEL SPECIATION:
4 TESTS AT INLET, 3 TESTS AT STACK DUE TO TIME CONSTRAINT.
ONE ESP ASH COMPOSITE FROM THE TEST PERIOD WAS ANALYZED IN TRIPLICATE. THE ASH COLLECTION PROCEDURE BRACKETS ASH PRODUCED FROM FUEL BURNED DURING THE TEST PROGRAM.

Figure 3-1. Sampling Schedule for Site 118 (Continued) and impinger. Sampling was isokinetic at a single point. The impinger train samples were analyzed for Cr^{+6} by ion chromatography (IC) equipped with a post-column reactor (PCR) and a visible wavelength detector. Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) was used to analyze the samples for total chromium.

3.2 DATA TREATMENT

Several conventions were developed for treating the test data and developing average concentrations of substances in the oil and flue gas streams. The conventions used in this report are consistent with the FCEM data treatment procedures.

3.2.1 Blank Corrections

The individual run measurements were corrected for the reagent blank analysis when it was available and when it is allowed by the reference method. If a reagent blank was not analyzed or was considered nonrepresentative, the measurement was corrected for a laboratory blank. The laboratory blank is not exposed to field conditions and contains only the chemicals needed for analysis, so it is expected to be lower than the reagent blank. Field blank analyses are used to provide information on sample collection conditions but not to correct the results. When the blank correction is equal to or greater than 50% of the uncorrected measurement, the concentration is flagged with a "B." When the blank correction results in a value less than the reporting limit, the concentration is presented as detected at the reporting limit. Sample levels which are less than 5 times the reporting limit are flagged with an "@." Appendix H presents blank correction data, and an example of how the blank correction contribution is calculated.

3.2.2 Average Concentrations

The following criteria were used to average data from the individual runs.

- When all values are above the detection limit, the mean arithmetic concentration is calculated using the reported quantities.

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

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

By our convention, the calculated mean cannot be smaller that the largest reporting limit value. In the following example, the calculated mean is 2.8. This is less than the largest reporting limit, so the reported mean becomes ND(4).

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

- When all analytical results are less than the reporting limit, the presented value is the largest reporting limit value expressed as ND (largest reporting limit value).

3.2.3 Summation of Metal Fractions >10 μm and <10 μm

If both fractions were detected, total metal emissions were reported as the sum of the two measurements. If both fractions were not detected, total emissions were reported as not detect, less than the sum of the detection limits of the two fractions. If one fraction was detected and one was not, the total is reported as the sum of the detected value and one-half of the detection limit for the non-detected value.

3.2.4 Summation of Multiple Train Fractions

Some sample trains, such as the anions, are analyzed in multiple fractions. If all fractions were detected, the total emissions were reported as the sum of the measurements. If all fractions were not detected, total emissions were reported as not detect, less than the sum of the reporting limits of the fractions. If one or more, but not all fractions were not detected, the total is reported as the sum of the detected values and one-half of the reporting limit for the non-detected values.

3.2.5 Method Detection Limit and Reporting Limit

The method detection limit (MDL) is defined by 40 CFR 136, Appendix B - Definition and Procedure for the Determination of the Method Detection Limit - Revision 1. It states, "The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte." The MDL is determined by seven replicate analyses of an analyte in a given matrix at one to five times the estimated MDL. It is calculated as:

$$MDL = 3.143\ S$$

where:

S is the standard deviation of the replicate analyses, and

3.143 is the student "t" value corresponding to seven replicates with n-1 degrees of freedom at the 99% confidence level.

Additional criteria are imposed by the procedure for calculating subsequent method detection limits. In practice, the method detection limit can be impacted by variability in performing the analytical procedure, the sample matrix and the analyte concentration of the sample. Because the method detection limit may not completely specify the confidence an analytical laboratory has in reporting a result, a laboratory typically presents a reporting limit or quantitation limit. The numerical difference between the method detection limit as defined by the CFR and a laboratory's reporting limit varies for different types of analyses and sample matrices but generally varies from the MDL value to approximately three times greater than the MDL. The values presented in this report are all based on individual laboratories' stated reporting limits.

3.2.6 Assignment of Bias and Uncertainty Estimates

In calculating uncertainties that are presented in this report, procedures were followed that have been previously established for PISCES data treatment. This procedure involved calculating an overall uncertainty for each result using standard statistical techniques and known measurement biases. 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.

Example calculations and bias and uncertainty estimates are presented in Appendix F.

3.3 OIL

This section presents analytical results for fuel oil samples. Complete results are included in Appendix B for all samples. Appendix A presents the analytical methodology. Table 3-1 presents the fuel metals results from the composited oil samples corresponding to the multimetals train sampling times (Runs 1, 3 and 5), and chlorine, fluorine, radionuclides, and fuel composition results. Chromium and molybdenum concentrations in oil composite 2 were 27.0 and 4.0 mg/kg, respectively. However, the average concentrations of these metals in composites 1 and 3 were 0.2 and 0.08 mg/kg, respectively. The chromium and molybdenum results for composite 2 were not considered representative and therefore were not included in the mean presented in Table 3-1. Table 3-1 also shows the mean value and the uncertainty in the results calculated at the 95% confidence interval about the mean. The confidence interval is the range about the mean in which the true mean lies within a given probability. For example, it is 95% certain that the true mean barium concentration in the oil is between 0.22 and 0.56 mg/kg. The confidence interval calculation is discussed in Section 5.0.

Measurements of the analyte concentrations in fuel oil reported here were made using what Carnot considered to be the most applicable method. The method chosen was an accepted analytical method for the sample matrix, had an acceptably low reporting limit and demonstrated acceptable precision and accuracy.

Instrumental neutron activation analysis (INAA) was used for the determination of arsenic, chromium, mercury, molybdenum, selenium, and chlorine. Inductively coupled plasma

TABLE 3-1
FUEL OIL ANALYSIS FOR SITE 118

Parameter	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5	Mean	95% C.I.
Date	01/20/93	01/21/93	01/22/93	01/28/93	01/29/93		
Test Run Number	1	3	5	10, 11	12, 13		
Fuel Flow, klb/hr	407.7	407.8	408.5	395.3	395.0	403	9
Sulfur, (%, dry)	0.71	NA	0.83	0.73		0.75	0.16
Ash (%, dry)	0.06	NA	0.06	0.07		0.06	0.014
HHV; Btu/lb	18,711	NA	18,883	18,674		18,756	277
Trace Metals, mg/kg							
Arsenic	0.10	0.26	0.10			0.15	0.23
Barium	0.42	0.44	0.31			0.39	0.17
Beryllium	0.008@	0.008@	0.006@			0.007@	0.003
Cadmium	ND(0.007)	ND(0.007)	ND(0.006)			ND(0.007)	NC
Chromium	0.2	27.0*	0.2			0.16	0.1
Cobalt	1.5	2.2	1.3			1.7	1.2
Copper	0.3	0.2	0.2			0.24	0.12
Lead	0.27	0.29	0.19			0.25	0.13
Manganese	0.17	0.16	0.09 @			0.14	0.11
Mercury	0.0035	0.0047	0.0037			0.0040	0.0016
Molybdenum	0.08	4.0*	0.072			0.076	0.051
Nickel	19.0	25.0	17.0			20.3	10.4
Selenium	0.081	NA	0.093			0.087	0.077
Phosphorus	ND(5.0)	8.4@	5.3@			5.4@	7.4
Vanadium	23.0	26.0	16.0			21.7	12.8
Chromium				ND(0.5)	ND(0.5)	ND(0.5)	NC
Nickel				33.0	31.0	32.0	12.7
Anions, mg/kg							
Chlorine	56	54.5	52			54	5
Fluorine	ND(20)	ND(20)	ND(20)			ND(20)	NC

(continued)

TABLE 3-1 (continued)
FUEL OIL ANALYSIS FOR SITE 118

Parameter	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5	Mean	95% C.I.
Radionuclides, pCi/g							
Uranium-233 & -234	ND(0.005)	ND(0.006)	ND(0.002)			ND(0.006)	NC
Uranium-235	ND(0.003)	ND(0.003)	ND(0.002)			ND(0.003)	NC
Uranium-238	ND(0.003)	ND(0.007)	ND(0.001)			ND(0.007)	NC
Radium-226	0.02	0.01	0.01			0.01	0.01
Radium-228	0.04	0.04	0.02			0.03	0.03
Lead-210	0.06	ND(0.0001)	0.04			0.033	0.076
Polonium-210	ND(0.09)	ND(0.11)	ND(0.14)			ND(0.14)	NC
Thorium-228	0.02	0.02	0.01			0.02	0.01
Thorium-230	ND(0.01)	0.01	0.02			0.012	0.02
Thorium-232	ND(0.004)	ND(0.001)	ND(0.001)			ND(0.004)	NC

Notes:
INAA was used for the determination of arsenic, chromium, mercury, molybdenum, selenium, and chlorine.
ICP-AES was used for the determination of barium, beryllium, cadmium, cobalt, copper, lead, manganese, nickel, phosphorus and vanadium.
GFAAS was used for the determination of lead.
Mean fuel flow rate is based on values from the 5 test days presented in this table.
ND - species not detected at the reporting limit
@ - Concentration is less than five times the reporting limit.
* - Chromium and molybdenum results for Composite 2 not used in average because of large variation in these values from Runs 1 and 3
NA - Not analyzed
NC - Not calculated

atomic emission spectroscopy (ICP-AES) was used for the determination of barium, beryllium, cadmium, cobalt, copper, manganese, nickel, phosphorus and vanadium. INAA analysis was used where possible because the results exhibit good precision and low detection limits for most elements. Additionally INAA analysis involves few handling procedures and no wet chemical digestions. This eliminates most analytical difficulties associated with contamination or volatilization of some elements. Graphite Furnace Atomic Absorption Spectroscopy (GFAAS) was used for the determination of lead. Appendix G contains an analysis of NIST fuel oil standard 1634B by INAA and ICP-AES, GFAAS or CVAAS. Arsenic, mercury and selenium were quantitated more accurately by INAA because of INAA's lower detection limit. Chlorine results by INAA were used instead of chlorine results obtained by ASTM D-808 because of the better precision exhibited by INAA analysis.

Fluorine concentrations were measured using an ion selective electrode; sulfur concentrations were measured by LECO SC-132. Radionuclides were measured by alpha spectrometry. Carbon, hydrogen, and nitrogen were measured with a LECO CHN/600 analyzer. The higher heating value of the fuel was measured by calorimetry by ASTM D-240-87. The fuel ash content was measured gravimetrically using ASTM D482.

3.4 ESP INLET GAS

Table 3-2 summarizes the concentrations of the species in the flue gas. Additional data are presented in Appendix B. The metals trains were analyzed in two fractions: 1) the cyclone catch (>10 μm fraction) and 2) the combined probe rinse, filter, and nitric acid/hydrogen peroxide impinger catch (<10 μm fraction). The data represent the total (particulate plus vapor phase) concentration in the flue gas. The results from the >10 μm and <10 μm fractions are presented in Appendix B. Mercury results were obtained by analyzing the permanganate impinger solution, an aliquot from the >10 μm fraction, and an aliquot from the combined probe rinse, filter, and nitric acid/hydrogen peroxide impinger solution. Anion results are the sum of analyses of each sample train portion.

Only three PAH and seven VOC species were detected at the ESP inlet. Levels of the detected dioxins and furans were less than five times the reporting limit; no PCB species were detected. VOC results from Run 1B were not reported due to air in-leakage into the bag sample during transit to the laboratory.

The total concentrations from each run were averaged according to the convention outlined previously to obtain an overall mean concentration and uncertainty at the 95% confidence interval. Detailed uncertainty calculations are presented in Appendix F.

3.5 STACK GAS

Table 3-3 summarizes the concentrations of the species in the flue gas emitted from the stack. The particulate and vapor fractions of the metals train were combined and analyzed as described previously for the ESP inlet gas. For radionuclide emissions, only Radium-228 and Thorium-230 were detected at more than five times the detection limit. Only three PAH and six VOC species were detected. These were naphthalene, phenanthrene, 2-methylnaphthalene, benzene, toluene, dichloromethane, 1,1,1-trichloroethane, ethylbenzene, and o-xylene. No dioxin, furan, or PCB species were detected at the stack. Uncertainty calculations for the stack samples are as described for the ESP inlet samples.

3.6 EMISSION FACTORS

Table 3-4 presents mean emission factors, expressed as lb/10^{12} Btu, for the stack emissions. Mean particulate emissions at the stack were 0.0041 lb/10^6 Btu. Emission factors for the detected metals ranged from 0.4 to 46.0 lb/10^{12} Btu. Beryllium and cadmium were not detected.

Of the radionuclides, radium-228 had the highest emission factor at 259 μCi/10^{12} Btu. The reagent blank represented 73% of this value. Radionuclide results were corrected for instrument background radiation levels but not for reagent blanks. Of the PAH target species, only naphthalene, phenanthrene, and 2-methylnaphthalene were detected. Their emission levels ranged from 0.012 to 0.314 lb/10^{12} Btu. Other PAH species were not detected in the range of 0.006 to 0.021 lb/10^{12} Btu. Detected VOC species had emission factors ranging from 0.53 to 35.6 lb/10^{12} Btu.

3.7 ESP PERFORMANCE

The removal efficiency of the ESP with respect to the target inorganic substances is presented in Table 3-5. Removal efficiency was calculated from the average ESP inlet and stack concentrations of the element. The removal efficiencies of metal species ranged from 14 to 95%. The ESP had a particulate removal efficiency of 92%. Particulate phase trace metals tend to be generally well controlled.

TABLE 3-2
ESP INLET GAS COMPOSITION DATA AT SITE 118

	Run 1	Run 3	Run 5	Run 6	Run 7	Run 8	Average	95% C.I.
Gas Stream Flow Rates								
dscfm	1,400,000	1,450,000	1,420,000	1,460,000	1,460,000	1,360,000	1,425,000	41,853
Nm^3/Hr	2,216,371	2,295,527	2,248,033	2,311,358	2,311,358	2,153,046	2,255,949	66,258
Substance								
Particulate Loading, mg/nm^3	80.1	71.8	85.3				79.1	23.3
Metals, $\mu g/Nm^3$								
Arsenic	1.36 F	1.60 F	1.6 F				1.5 F	0.5
Barium	24.5	27.8	28.0				26.8	7.3
Beryllium	0.90	0.8	0.9				0.9	0.2
Cadmium	ND(0.21)	ND(0.22)	ND(0.25)				ND(0.25)	NC
Chromium	9.3	10.6	14.2				11.3	6.7
Cobalt	42.2	28.7	38.2				36.4	18.8
Copper	12.4	12.5	13.7				12.9	3.2
Lead	10.2@	6.1@	14.7@				10.3@	10.8
Manganese	40.8	13.1	45.7				33.2	44.1
Mercury	1.59 F@	1.30 F@	1.01 F@				1.30 F@	0.77
Molybdenum	5.1B, F	4.8B, F	5.7B, F				5.2B, F	1.5
Nickel	1,055	752	1,040				949	466
Phosphorus	79.3	68.3	80.6				76.1	22.8
Selenium	2.0	3.1	3.6				2.9	2.1
Vanadium	1,219	1,021	1,167				1,136	344
Anions, $\mu g/Nm^3$								
Chloride	5,766	4,728	4,984				5,159	1,705
Fluoride	92@	95@	86@				91@	21.3
		Run 5A	Run 5B	Run 5C				
Formaldehyde, $\mu g/Nm^3$		11.81	12.95	6.01			10.25	9.25
PAH, $\mu g/Nm^3$								
Naphthalene				0.62 F	0.60 F	0.64 F	0.62 F	0.132
Phenanthrene				0.016@	0.020@	0.018@	0.018@	0.06
2-Methylnaphthalene				0.035@	0.040@	0.027@	0.034@	0.018

(continued)

Notes:
Runs 5A, 5B and 5C performed during Run 5
F - Field blank greater than 50% of average uncorrected sample measurement
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - not detected at less than the reporting limit
NC - Not calculated

TABLE 3-2 (continued)
ESP INLET GAS COMPOSITION DATA AT SITE 118

	Run 1	Run 3	Run 5	Run 6	Run 7	Run 8	Average	95% C.I.
Gas Stream Flow Rates								
dscfm	1,400,000	1,450,000	1,420,000	1,460,000	1,460,000	1,360,000	1,425,000	41,853
Nm^3/Hr	2,216,371	2,295,527	2,248,033	2,311,358	2,311,358	2,153,046	2,255,949	66,258
Substance								
PCDD/PCDF, ng/Nm^3								
2378-TCDD				ND(0.0032)	ND(0.0086)	ND(0.0070)	ND(0.0086)	NC
12378 PeCDD				ND(0.0048)	ND(0.0057)	ND(0.0037)	ND(0.0057)	NC
123478 HxCDD				0.008@F	ND(0.0093)	0.009@F	0.007@, F	0.0065
123678 HxCDD				0.003@	ND(0.0040)	ND(0.0034)	ND(0.0040)	NC
123789 HxCDD				0.003@	ND(0.0066)	ND(0.0055)	ND(0.0066)	NC
1234678 HpCDD				0.014@	ND(0.0153)	0.014@	ND(0.0153)	NC
OCDD				0.019@F	0.018@F	0.034@	0.024@, F	0.0222
2378 TCDF				ND(0.0032)	ND(0.0043)	ND(0.0055)	ND(0.0055)	NC
12378 PeCDF				0.0070@	0.0033@	0.0031@	0.0045@	0.0055
23478 PeCDF				0.0094@	0.0057@	0.0061@	0.0071@	0.0053
123478 HxCDF				0.0081@	ND(0.0053)	0.0061@	0.0056@	0.0070
123678 HxCDF				0.0032@	ND(0.0027)	ND(0.0019)	ND(0.0027)	NC
234678 HxCDF				ND(0.0038)	ND(0.0053)	ND(0.0034)	ND(0.0053)	NC
123789 HxCDF				ND(0.0054)	ND(0.0076)	ND(0.0046)	ND(0.0076)	NC
1234678 HpCDF				ND(0.0078)	ND(0.0140)	0.011@	ND(0.0140)	NC
1234789 HpCDF				ND(0.0151)	ND(0.0269)	ND(0.0202)	ND(0.0269)	NC
OCDF				ND(0.0153)	ND(0.0206)	ND(0.0183)	ND(0.0206)	NC
Total TCDD				0.020@	ND(0.0086)	ND(0.0070)	0.0092@	0.0231
Total PeCDD				ND(0.0048)	ND(0.0057)	ND(0.0037)	ND(0.0057)	NC
Total HxCDD				0.026@	ND(0.0057)	0.021@	0.017@	0.0304
Total HpCDD				0.014@	ND(0.0153)	0.028@	0.016@	0.0256
Total TCDF				0.013@	0.0050@	0.0037@	0.0071@	0.0121
Total PeCDF				0.040@	0.014@	0.021@	0.025@	0.343
Total HxCDF				0.012@	ND(0.0047)	0.0052@	0.0065@	0.0126
Total HpCDF				ND(0.0116)	ND(0.0209)	0.016@	ND(0.0209)	NC

(continued)

Notes:
F - Field blank greater than 50% of average uncorrected sample measurement
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - not detected at less than the reporting limit
NC - Not calculated

TABLE 3-2 (continued)
ESP INLET GAS COMPOSITION DATA AT SITE 118

	Run 1	Run 3	Run 5	Run 6	Run 7	Run 8	Average	95% C.I.
Gas Stream Flow Rates								
dscfm	1,400,000	1,450,000	1,420,000	1,460,000	1,460,000	1,360,000	1,425,000	41,853
Nm^3/Hr	2,216,371	2,295,527	2,248,033	2,311,358	2,311,358	2,153,046	2,255,949	66,258
Substance								
PCB, $\mu g/Nm^3$								
Total Chlorobiphenyls				ND(0.003)	ND(0.003)	ND(0.003)	ND(0.003)	NC
Total Dichlorobiphenyls				ND(0.006)	ND(0.007)	ND(0.005)	ND(0.007)	NC
Total Trichlorobiphenyls				ND(0.006)	ND(0.007)	ND(0.004)	ND(0.007)	NC
Total Tetrachlorobiphenyls				ND(0.009)	ND(0.010)	ND(0.006)	ND(0.010)	NC
Total Pentachlorobiphenyls				ND(0.13)	ND(0.17)	ND(0.18)	ND(0.18)	NC
Total Hexachlorobiphenyls				ND(0.006)	ND(0.013)	ND(0.005)	ND(0.013)	NC
Total Heptachlorobiphenyls				ND(0.006)	ND(0.009)	ND(0.007)	ND(0.009)	NC
Total Octachlorobiphenyls				ND(0.005)	ND(0.011)	ND(0.006)	ND(0.011)	NC
Total Nonachlorobiphenyls				ND(0.005)	ND(0.020)	ND(0.006)	ND(0.020)	NC
Decachlorobiphenyl				ND(0.017)	ND(0.016)	ND(0.023)	ND(0.023)	NC
VOC, $\mu g/Nm^3$	Run 1B[1]	Run 1C	Run 1D					
Benzene	–	0.98@	0.52@				0.75@	2.88
Toluene[3]	–	11.90	4.08				7.99	49.70
Vinyl Chloride[2]	–	ND(1.1)	ND(1.1)				ND(1.1)	NC
1,3-Butadiene		ND(0.2)	ND(0.2)				ND(0.2)	NC
Methyl Bromide	–	ND(1.7)	ND(1.7)				ND(1.7)	NC
Trichlorofluoromethane	–	2.3@	ND(0.5)				1.3@	12.9
Dichloromethane[3]	–	60.0	28.4				44.2	201
Chloroform	–	ND(1.1)	ND(1.1)				ND(1.1)	NC
1,2-Dichloroethane	–	ND(1.8)	ND(1.8)				ND(1.8)	NC
1,1,1-Trichloroethane[3]	–	1.5@	0.7@				1.1@	4.9
Carbon Tetrachloride	–	ND(0.7)	ND(0.7)				ND(0.7)	NC
1,2-Dichloropropane	–	ND(2.0)	ND(2.0)				ND(2.0)	NC
Trichloroethene	–	ND(1.2)	ND(1.2)				ND(1.2)	NC
1,2-Dibromoethane	–	ND(2.5)	ND(2.5)				ND(2.5)	NC
Perchloroethylene	–	ND(0.6)	ND(0.6)				ND(0.6)	NC
Chlorobenzene	–	ND(0.5)	ND(0.5)				ND(0.5)	NC
Ethylbenzene	–	0.5@	0.3@				0.4@	1.5
o-Xylene	–	0.5@	0.5@				0.05@	0.02

Notes:
[1] Results from Run 1B not reported due to air in-leakage into the bag sample during transit to the laboratory.
[2] Sample spike recovery was low (17%) indicating a possible low bias to sample value.
[3] Tedlar bag blank or ambient air blank greater than 50% of the average sample value.
Runs 1B, 1C, and 1D performed during Run 1
F - Field blank greater than 50% of average uncorrected sample measurement
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - not detected at less than the reporting limit
NC - Not calculated

TABLE 3-3
STACK GAS COMPOSITION DATA AT SITE 118

	Run 1	Run 3	Run 5	Run 6	Run 7	Run 8	Average	95% C.I.
Gas Stream Flow Rates,								
dscfm	1,520,000	1,520,000	1,510,000	1,530,000	1,520,000	1,410,000	1,501,667	47,600
Nm^3/hr	2,406,345	2,406,345	2,390,514	2,422,176	2,406,345	2,232,202	2,377,321	75,357
Substance								
Particulate Loading, mg/Nm3	4.9	8.4	5.3				6.2	4.9
Metals, μg/Nm^3								
Arsenic	0.90 F	0.90 F	0.58 F				0.80 F	0.5
Barium	4.52 F	18.63 F	7.87 F				10.34 F	18.3
Beryllium	ND(0.08)	0.08@	ND(0.09)				ND(0.09)	NC
Cadmium	ND(0.23)	ND(0.24)	ND(0.26)				ND(0.26)	NC
Chromium	4.10 F	4.20 F	6.03 F				4.78 F	2.7
Cobalt	2.07	3.34	2.99				2.80	1.7
Copper	6.52 F	3.99 F	1.58B, F				4.03 F	6.1
Lead	1.42@	4.16@F	ND(4.28)				2.57@, F	3.6
Manganese	33.6	24.4	22.1				26.7	15.3
Mercury	0.56 F@	0.53 F@	1.09 F@				0.73 F	0.8
Molybdenum	0.44B, F	0.82B, F	0.49B, F				0.58B, F	0.5
Nickel	43.3	76.6	79.5				66.5	50.5
Phosphorus	ND(4.22)	4.08@	5.56@				3.91@	4.4
Selenium	1.47	2.37	1.59				1.81	1.2
Vanadium	39.5	74.2	69.3				61.0	47.1
Anions, μg/Nm^3								
Chloride	5,108	6,126	4,976				5,403	1665.1
Fluoride	ND(301)	120@	114@				128@	71.3

(continued)

Notes:
The lead concentration in Run 5 was used at one-half its reporting limit to calculate the average. Since lead was reported at low levels in two of the three samples, using the highest not detect value would obscure the results. A similar situation occurred for the fluoride concentration of Run 1; thus one-half of its reporting limit was used to calculate the average.
F - Field blank greater than 50% of average uncorrected sample measurement
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - Not detected at less than the reporting limit
NC - Not calculated
NA - Not analyzed

TABLE 3-3 (continued)
STACK GAS COMPOSITION DATA AT SITE 118

	Run 1	Run 3	Run 5	Run 6	Run 7	Run 8	Average	95% C.I.
Gas Stream Flow Rates,								
dscfm	1,520,000	1,520,000	1;510,000	1,530,000	1,520,000	1,410,000	1,501,667	47,600
Nm3/hr	2,406,345	2,406,345	2,390,514	2,422,176	2,406,345	2,232,202	2,377,321	75,357
Substance								
Radionuclides, pCi/Nm^3								
Uranium-233 & -234	ND(0.05)	ND(0.05)	ND(0.05)				ND(0.054)	NC
Uranium-235	ND(0.05)	ND(0.05)	ND(0.05)				ND(0.054)	NC
Uranium-238	0.05@	ND(0.05)	ND(0.05)				ND(0.054)	NC
Radium-226	0.11@	ND(0.11)	0.05@				0.07@	0.08
Radium-228	0.86	0.91	0.81				0.86	0.16
Lead-210	NA	NA	NA				NC	NC
Polonium-210	ND(0.11)	0.05@	0.10@				0.07@	0.07
Thorium-228	0.21@	ND(0.86)	0.15@				0.26@	0.39
Thorium-230	0.32	0.64	0.10				0.36	0.68
Thorium-232	0.05@	ND(0.32)	0.10@				0.10@	0.15
		Run 5A	Run 5B	Run 5C				
Formaldehyde, $\mu g/Nm^3$		5.83	9.57	8.61			8.00 F	4.8
PAHs, $\mu g/Nm^3$								
Naphthalene				0.41 F	0.44 F	0.53 F	0.46 F	0.162
Phenanthrene				0.01@	0.02@	0.02@	0.02@	0.018
2-Methylnaphthalene				0.02@	0.03@	0.06@	0.04@	0.048

(continued)

Notes:
Runs 5A, 5B, and 5C performed during Run 5
F - Field blank greater than 50% of average uncorrected sample measurement
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - Not detected at less than the reporting limit
NC - Not calculated
NA - Not analyzed

TABLE 3-3 (continued)
STACK GAS COMPOSITION DATA AT SITE 118

	Run 1	Run 3	Run 5	Run 6	Run 7	Run 8	Average	95% C.I.
Gas Stream Flow Rates,								
dscfm	1,520,000	1,520,000	1,510,000	1,530,000	1,520,000	1,410,000	1,501,667	47,600
Nm^3/hr	2,406,345	2,406,345	2,390,514	2,422,176	2,406,345	2,232,202	2,377,321	75,357
Substance								
PCDD/PCDF, ng/Nm^3								
2378-TCDD				ND(0.0059)	ND(0.0063)	ND(0.0050)	ND(0.0063)	NC
12378 PeCDD				ND(0.0066)	0.003@	ND(0.0047)	ND(0.0066)	NC
123478 HxCDD				ND(0.0163)	0.008@	ND(0.0122)	ND(0.0163)	NC
123678 HxCDD				ND(0.0069)	ND(0.0024)	ND(0.0053)	ND(0.0069)	NC
123789 HxCDD				ND(0.0115)	ND(0.0041)	ND(0.0086)	ND(0.0115)	NC
1234678 HpCDD				ND(0.0224)	ND(0.0173)	ND(0.0361)	ND(0.0361)	NC
OCDD				0.026@	0.023@	ND(0.0306)	ND(0.0306)@	NC
2378 TCDF				ND(0.0026)	ND(0.0026)	ND(0.0026)	ND(0.0026)	NC
12378 PeCDF				ND(0.0038)	ND(0.0030)	ND(0.0036)	ND(0.0038)	NC
23478 PeCDF				ND(0.0041)	ND(0.0031)	ND(0.0039)	ND(0.0041)	NC
123478 HxCDF				ND(0.0071)	ND(0.0044)	ND(0.0083)	ND(0.0083)	NC
123678 HxCDF				ND(0.0036)	ND(0.0023)	ND(0.0044)	ND(0.0044)	NC
234678 HxCDF				ND(0.0071)	ND(0.0044)	ND(0.0083)	ND(0.0083)	NC
123789 HxCDF				ND(0.0099)	ND(0.0063)	ND(0.0120)	ND(0.0120)	NC
1234678 HpCDF				ND(0.0150)	ND(0.0098)	ND(0.0334)	ND(0.0334)	NC
1234789 HpCDF				ND(0.0281)	ND(0.0189)	ND(0.0639)	ND(0.0370)	NC
OCDF				ND(0.0237)	ND(0.0189)	ND(0.0200)	ND(0.0237)	NC
Total TCDD				ND(0.0059)	ND(0.0063)	ND(0.0050)	ND(0.0063)	NC
Total PeCDD				ND(0.0066)	0.003@	ND(0.0047)	ND(0.0066)	NC
Total HxCDD				ND(0.0099)	0.005@	ND(0.0075)	ND(0.0099)	NC
Total HpCDD				ND(0.0224)	ND(0.0173)	ND(0.0361)	ND(0.0361)	NC
Total TCDF				ND(0.0026)	ND(0.0026)	ND(0.0026)	ND(0.0026)	NC
Total PeCDF				ND(0.0038)	ND(0.0031)	ND(0.0036)	ND(0.0038)	NC
Total HxCDF				ND(0.0061)	ND(0.0038)	ND(0.0072)	ND(0.0072)	NC
Total HpCDF				ND(0.0227)	ND(0.0148)	ND(0.0500)	ND(0.0500)	NC

(continued)

Notes:
F - Field blank greater than 50% of average uncorrected sample measurement
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - Not detected at less than the reporting limit
NC - Not calculated
NA - Not analyzed

TABLE 3-3 (continued)
STACK GAS COMPOSITION DATA AT SITE 118

	Run 1	Run 3	Run 5	Run 6	Run 7	Run 8	Average	95% C.I.
Gas Stream Flow Rates,								
dscfm	1,520,000	1,520,000	1,510,000	1,530,000	1,520,000	1,410,000	1,501,667	47,600
Nm^3/hr	2,406,345	2,406,345	2,390,514	2,422,176	2,406,345	2,232,202	2,377,321	75,357
Substance								
PCBs, $\mu g/Nm^3$								
Total Chlorobiphenyls				ND(0.003)	ND(0.003)	ND(0.003)	ND(0.003)	NC
Total Dichlorobiphenyls				ND(0.005)	ND(0.006)	ND(0.006)	ND(0.006)	NC
Total Trichlorobiphenyls				ND(0.006)	ND(0.014)	ND(0.010)	ND(0.014)	NC
Total Tetrachlorobiphenyls				ND(0.005)	ND(0.011)	ND(0.007)	ND(0.011)	NC
Total Pentachlorobiphenyls				ND(0.14)	ND(0.26)	ND(0.19)	ND(0.26)	NC
Total Hexachlorobiphenyls				ND(0.005)	ND(0.011)	ND(0.009)	ND(0.011)	NC
Total Heptachlorobiphenyls				ND(0.006)	ND(0.011)	ND(0.009)	ND(0.011)	NC
Total Octachlorobiphenyls				ND(0.005)	ND(0.008)	ND(0.006)	ND(0.008)	NC
Total Nonachlorobiphenyls				ND(0.004)	ND(0.006)	ND(0.008)	ND(0.008)	NC
Decachlorobiphenyl				ND(0.018)	ND(0.021)	ND(0.014)	ND(0.021)	NC
VOC, $\mu g/Nm^3$	Run 1A	Run 1B	Run 1C					
Benzene	1.05@	0.73@	0.56@				0.78@	0.6
Toluene[2]	16.76	9.19	7.29				11.08	12.5
Vinyl Chloride[1]	ND(2.1)	ND(2.1)	ND(1.1)				ND(2.1)	NC
1,3-Butadiene	ND(0.2)	ND(0.2)	ND(0.2)				ND(0.2)	NC
Methyl Bromide	ND(2.5)	ND(2.5)	ND(1.7)				ND(2.5)	NC
Trichlorofluoromethane	ND(1.2)	ND(1.2)	ND(0.5)				ND(1.2)	NC
Dichloromethane[2]	78.6	44.4	33.5				52.2	58.5
Chloroform	ND(1.6)	ND(1.6)	ND(1.1)				ND(1.6)	NC
1,2-Dichloroethane	ND(3.1)	ND(3.1)	ND(1.8)				ND(3.1)	NC
1,1,1-Trichloroethane[2]	2.9@	2.3@	1.7@				2.3@	1.5
Carbon Tetrachloride	ND(1.4)	ND(1.4)	ND(0.7)				ND(1.4)	NC
1,2-Dichloropropane	ND(3.5)	ND(3.5)	ND(2.0)				ND(3.5)	NC
Trichloroethene	ND(1.8)	ND(1.8)	ND(1.2)				ND(1.8)	NC
1,2-Dibromoethane	ND(4.2)	ND(4.2)	ND(2.5)				ND(4.2)	NC
Perchloroethylene	ND(1.5)	ND(1.5)	ND(0.6)				ND(1.5)	NC
Chlorobenzene	ND(1.0)	ND(1.0)	ND(0.5)				ND(1.0)	NC
Ethylbenzene	0.85@	0.57@	0.47@				0.63@	0.5
o-Xylene	1.71@	0.85@	0.71@				1.09@	1.3

Notes:
Runs 1A, 1B, and 1C performed during Run 1
[1] Sample spike recovery was low (17%) indicating a possible low bias to sample value.
[2] Tedlar bag blank or ambient air blank greater than 50% of the average sample value.
F - Field blank greater than 50% of average uncorrected sample measurement
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - Not detected at less than the reporting limit
NC - Not calculated
NA - Not analyzed

TABLE 3-4
STACK GAS EMISSION FACTORS AT SITE 118
(lb/10^{12} Btu unless noted)

Substance	Mean	95% C.I.
Gas Flow ,dscfm	1,501,700	47,600
Oil Flow, Klb/hr	402	11
Heating Value, Btu/lb	18,756	277
Particulate Loading, lb/10^6 Btu	0.0041	0.0033
Metals		
Arsenic	0.55 F	0.3
Barium	7.16 F	12.7
Beryllium	ND(0.06)	NC
Cadmium	ND(0.18)	NC
Chromium	3.30 F	1.9
Cobalt	1.94	1.1
Copper	2.79 F	4.3
Lead	1.78@, F	2.5
Manganese	18.5	10.6
Mercury	0.50 F	0.55
Molybdenum	0.40B, F	0.4
Nickel	46.0	35
Phosphorus	2.70@	3.0
Selenium	1.25	0.9
Vanadium	42.2	33
Anions		
Chloride	3,590	1,106
Fluoride	85@	47
Radionuclides, μCi/10^{12} Btu		
Uranium-233 & -234	ND(16.4)	NC
Uranium-235	ND(16.4)	NC
Uranium-238	ND(16.1)	NC
Radium-226	21@	25
Radium-228	259@	48
Lead-210	NA	NC
Polonium-210	21@	21
Thorium-228	80@	118
Thorium-230	107@	205
Thorium-232	19@	26

(continued)

Notes:
F - Field blank greater than 50% of average uncorrected result
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - Not detected at less than the reporting limit
Mean gas flow rate from Runs 1, 3, 5, 6, 7 and 8
Mean oil flow rate from Runs 1, 3, 5, 6, 7, 8, 10, 11, 12, and 13
NC - Not calculated
NA - Not analyzed

TABLE 3-4 (continued)
STACK GAS EMISSION FACTORS AT SITE 118
(lb/10^{12} Btu unless noted)

Substance	Mean	95% C.I.
PAH		
Naphthalene	0.31 F	0.11
Phenanthrene	0.012@	0.012
2-Methylnaphthalene	0.027@	0.033
PCDD/PCDF		
2378 TCDD	ND(4.3×10^{-6})	NC
12378 PeCDD	ND(4.6×10^{-6})	NC
123478 HxCDD	ND(1.1×10^{-5})	NC
123678 HxCDD	ND(4.7×10^{-6})	NC
123789 HxCDD	ND(7.9×10^{-6})	NC
1234678 HpCDD	ND(2.5×10^{-5})	NC
OCDD	ND(2.1×10^{-5})@	NC
2378 TCDF	ND(1.8×10^{-6})	NC
12378 PeCDF	ND(2.6×10^{-6})	NC
23478 PeCDF	ND(2.8×10^{-6})	NC
123478 HxCDF	ND(5.7×10^{-6})	NC
123678 HxCDF	ND(3.0×10^{-6})	NC
234678 HxCDF	ND(5.7×10^{-6})	NC
123789 HxCDF	ND(8.2×10^{-6})	NC
1234678 HpCDF	ND(2.3×10^{-5})	NC
1234789 HpCDF	ND(4.4×10^{-5})	NC
OCDF	ND(1.6×10^{-5})	NC
Total TCDD	ND(4.3×10^{-6})	NC
Total PeCDD	ND(4.6×10^{-6})	NC
Total HxCDD	ND(6.8×10^{-6})	NC
Total HpCDD	ND(2.5×10^{-5})	NC
Total TCDF	ND(1.8×10^{-6})	NC
Total PeCDF	ND(2.6×10^{-6})	NC
Total HxCDF	ND(5.0×10^{-6})	NC
Total HpCDF	ND(3.4×10^{-5})	NC
PCB		
Total Chlorobiphenyls	ND(0.002)	NC
Total Dichlorobiphenyls	ND(0.004)	NC
Total Trichlorobiphenyls	ND(0.009)	NC
Total Tetrachlorobiphenyls	ND(0.007)	NC
Total Pentachlorobiphenyls	ND(0.18)	NC
Total Hexachlorobiphenyls	ND(0.008)	NC
Total Heptachlorobiphenyls	ND(0.007)	NC
Total Octachlorobiphenyls	ND(0.005)	NC
Total Nonachlorobiphenyls	ND(0.005)	NC
Decachlorobiphenyl	ND(0.014)	NC

Notes:
F - Field blank greater than 50% of average uncorrected result
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - Not detected at less than the reporting limit
NC - Not calculated
NA - Not analyzed

(continued)

TABLE 3-4 (continued)
STACK GAS EMISSION FACTORS AT SITE 118
(lb/10^{12} Btu unless noted)

Substance	Mean	95% C.I.
VOC		
Benzene	0.53@	0.42
Toluene	7.6	8.50
Vinyl Chloride	ND(1.43)	NC
1,3-Butadiene	ND(0.16)	NC
Methyl Bromide	ND(1.74)	NC
Trichlorofluoromethane	ND(0.84)	NC
Dichloromethane	35.6	39.9
Chloroform	ND(1.09)	NC
1,2-Dichloroethane	ND(2.11)	NC
1,1,1-Trichloroethane	1.6@	1.0
Carbon Tetrachloride	ND(0.94)	NC
1,2-Dichloropropane	ND(2.41)	NC
Trichloroethene	ND(1.20)	NC
1,2-Dibromoethane	ND(2.87)	NC
Perchloroethylene	ND(1.01)	NC
Chlorobenzene	ND(0.69)	NC
Ethylbenzene	0.43@	0.34
o-Xylene	0.74@	0.91
Formaldehyde	5.4 F	3.3

Notes:
F - Field blank greater than 50% of average uncorrected result
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
ND - Not detected at less than the reporting limit
NC - Not calculated
NA - Not analyzed

TABLE 3-5
ESP REMOVAL EFFICIENCY
SITE 118

Species	Removal Efficiency, %	Uncertainty, %
Total Particulate	92	6
Arsenic(F)	44	10
Barium(F)	59	18
Beryllium	NC	NC
Cadmium	NC	NC
Chromium(F)	55	16
Cobalt	92	14
Copper(F)	67	13
Lead(@,F)	73	16
Manganese(1)	14	32
Mercury(F)	41	20
Molybdenum(B,F)	88	6
Nickel	93	13
Selenium	33	20
Phosphorus(@)	95	6
Vanadium	94	6

Notes:
NC - not calculated Beryllium was not detected at the stack. Cadmium was not detected at the ESP inlet or the stack.
F - Field blank greater than 50% of average uncorrected result
@ - Concentration is less than five times the reporting limit
B - Blank correction exceeded 50% of uncorrected result
(1) - Manganese > 10 μm fraction at the stack was higher than expected. The reason for this is not clear.

SECTION 4.0

METALS SPECIATION

4.1 CHROMIUM SPECIATION TESTS

For this program, the EPA recirculating train method was used for chromium speciation. Samples were collected at a single point at the stack. The primary objective of this testing was to determine the fraction of total chromium emissions that is hexavalent chromium. Since the mechanical complexity of the sample train precluded a complete traverse, actual hexavalent chromium emission rates could not be measured. However, it is likely that the ratio of hexavalent to total chromium does not vary across the sample plane, and the measured fraction can be applied to other total chromium results (e.g., from the multi-metals tests) to calculate a hexavalent chromium emission rate.

The results of the hexavalent and total chromium tests are presented in Table 4-1. Four replicate tests were performed on two consecutive days at an average unit load of 788 MW gross. All samples were analyzed for hexavalent chromium by two laboratories. A comparison of their analyses showed some differences, but not outside the uncertainty of the method. Since there are no indications of analytical difficulties to invalidate either set of data, hexavalent chromium results are an average of the two sets of laboratory analyses.

Hexavalent chromium was detected for all four tests at an average level of 0.280 $\mu g/Nm^3$. The average ratio of hexavalent to total chromium is 15.5% (with a range of 8 to 25%). Total chromium results are the sum of analysis results for all fractions of the sample train. Total chromium was detected in the sodium hydroxide fraction of the train, however, the results are considered biased high since it is unlikely that $^{51}Cr^{3+}$ would be soluble in sodium hydroxide. These results were not used, instead hexavalent chromium results for the sodium hydroxide fraction were used to calculate total chromium. Total chromium averaged 1.97 $\mu g/Nm^3$ for the four tests and was detected in all samples.

Total chromium from the multi-metals tests averaged 4.8 $\mu g/Nm^3$ which is 144% higher than the value from the speciation tests. Two important factors may have contributed to this difference: 1) the field blank level for the chromium analyses from multi-metals tests was 62% of the average chromium sample level; the multi-metals train used a teflon coated stainless steel cyclone while the chromium speciation train was teflon with no filter; 2) the recirculation tests were conducted at a single point, while the multi-metals testing involved a full traverse.

Radioactively labeled $^{51}Cr^{6+}$ was added to the NaOH impinger solution for all tests to determine the conversion of $^{51}Cr^{6+}$ to $^{51}Cr^{3+}$ in the sample train. The average conversion was

TABLE 4-1
STACK CONCENTRATIONS OF
TOTAL AND HEXAVALENT CHROMIUM AT SITE 118

Run No.	10-Cr-C	11-Cr-C	12-Cr-C	13-Cr-C	Average	95% C.I.
Gas Stream Flow Rate, dscfm	1,420,000	1,390,000	1,470,000	1,470,000	1,440,000	63,000
Nm^3/hr	2,250,000	2,200,000	2,330,000	2,330,000	2,280,000	99,000
	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	%
Total Chromium	1.71	3.25	1.90	1.02	1.97	1.50
Hexavalent Chromium	0.21	0.28	0.47	0.17	0.28	0.21
Cr^{6+}/Total Cr, %	12.3	8.4	24.7	16.5	15.5	
Hexavalent to tri-valent conversion, %[1]	24.6	24.3	20.4	2.04	17.8	

Note:

[1] Hexavalent to trivalent conversion is the percentage of a radioactively labeled pre-test spike of hexavalent chromium ($^{51}Cr^{6+}$) that was converted to trivalent chromium.

17.8% with a range of 2% to 25%. These conversions are consistent with data from previous programs using the recirculation method, and indicate hexavalent chromium results may be biased low.

4.2 NICKEL SPECIATION TESTS

Nickel speciation sampling was performed using a modified EPA Method 5 train with the filter heated to 550°F to prevent the formation of $NiSO_4$ in the sample train. Testing was performed isokinetically at a single point at the ESP inlet and stack. The front half of the train was analyzed using the Inco sequential leaching procedure to separate nickel compounds into four categories: soluble (water soluble salts such as nickel sulfate and nickel chloride), sulfidic (nickel sulfides including Ni_3S_2, NiS, Ni_3S_4), metallic (Ni, nickel alloys, steel), and oxidic (NiO, complex oxides, silicates).

The results of the nickel speciation tests are presented in Tables 4-2 and 4-3. The results, when expressed as percent of total nickel, are consistent for each replicate. Nickel is 37% soluble and 54% oxidic at the ESP inlet. A small percentage (8%) is sulfidic and the metallic nickel level is near the detection limit. At the stack, nickel is 64% soluble and 27% oxidic. The distribution of sulfidic and metallic nickel is essentially unchanged across the ESP.

The change in soluble and oxidic nickel distribution across the ESP is likely to be due to conversion of nickel oxide to nickel sulfate in the presence of SO_3.

The difference between total nickel results from the nickel speciation tests and total nickel from the multimetals tests varies greatly between the ESP inlet and stack locations. At the ESP inlet, nickel speciation total nickel is 66% higher than multimetals total nickel. At the stack, nickel speciation total nickel is 25% lower than the multimetals nickel results. The relatively large differences between these total nickel results are attributable to the differences in the sampling techniques. Multimetals testing involves multipoint instead of single point sampling, and a larger sample volume. In addition, the entire multimetals sample train is analyzed for nickel. It is likely the distribution of nickel compounds does not vary across the sample plane, therefore, the nickel speciation results can be considered representative. However, the total nickel values from the nickel speciation tests cannot be considered representative of the source.

TABLE 4-2
ESP INLET NICKEL SPECIATION RESULTS AT SITE 118

Run No.	8A	8B	10A	10B	Average	95% C.I.
Gas Stream Flow Rate, dscfm	1,360,000	1,360,000	1,360,000	1,380,000	1,365,000	16,000
Nm^3/hr	2,153,000	2,153,000	2,153,000	2,185,000	2,161,000	25,000
Total Ni, $\mu g/Nm^3$	1,420	1,533	1,730	1,632	1,579	211
Percent Distribution of Nickel Forms:						
Soluble	38.8	37.5	34.5	35.4	36.6	7.8
Sulfidic	9.3	8.9	7.3	6.0	7.9	2.9
Metallic	ND(1.0)	ND(0.3)	2.1	1.8	1.1	1.5
Oxidic	51.4	53.4	56.1	56.7	54.4	11.5

Note: Results are from single-point tests. Nickel species concentrations are not representative of total nickel emissions from the source.

TABLE 4-3
STACK NICKEL SPECIATION RESULTS AT SITE 118

Run No.	8A	10A	13A	Average	95% C.I.
Gas Stream Flow Rate, dscfm	1,410,000	1,360,000	1,480,000	1,417,000	150,000
Nm^3/hr	2,232,000	2,153,000	2,343,000	2,243,000	237,000
Total Ni, $\mu g/Nm^3$	30.1	63.0	55.8	49.6	43.0
Percent Distribution of Nickel Forms:					
Soluble	68.0	62.5	60.9	63.8	11.5
Sulfidic	7.3	8.1	7.9	7.8	1.3
Metallic	ND(3.6)	ND(1.6)	ND(3.8)	ND(3.0)	-
Oxidic	22.9	28.6	29.3	26.9	9.2

Note: Results are from single-point tests. Nickel species concentrations are not representative of total nickel emissions from the source.

SECTION 5.0

DATA EVALUATION

Several procedures can be used to evaluate the information developed during a field sampling program. In the case of Site 118, three methods were used to evaluate data quality. First, the process data were examined to determine if the unit operated at normal, steady-state conditions during the sampling periods. Second, the QA/QC protocol for sampling and analytical procedures used at Site 118 (i.e., equipment calibration and leak checks, duplicates, blanks, spikes, standards, etc.) were evaluated. Site 118 QA/QC data were compared with FCEM project objectives. Third, material balances were calculated around the boiler system. Material balances involve the summation and comparison of mass flow rates in several streams, often sampled and analyzed by different methods. Closure within an acceptable range can be used as an indicator of accurate results for streams that contribute significantly to the overall inlet or outlet mass rates, such as the fuel oil, ESP fly ash, and stack outlet streams.

5.1 PROCESS OPERATION

Process operating data were examined to ensure that operation was stable during sampling periods. Measurements were available from control room instrumentation. Table 5-1 shows the key unit operating parameters and conditions. The coefficient of variation (CV) was calculated for each parameter to evaluate process variability over the test program.

As stated in Section 2.5, Tests 1 through 7 were conducted at 99% of maximum load. The load for Tests 8 through 13 was reduced to 93% of maximum due to excessive boiler tube metal temperatures and high FD fan motor vibration.

5.2 SAMPLE COLLECTION

Several factors indicate the acceptable collection of gas samples. Key components of the sampling equipment -- pitot tubes, thermocouples, dry gas meters, and sampling nozzles were calibrated before use in the field. Dry gas meter calibrations were checked at the end of sampling. These and additional periodic equipment calibrations are on file at Carnot. The methods used to collect metals, particulate/anion, radionuclide, PAH, dioxin, furan, PCB, VOC, and formaldehyde samples were comparable to those used at other FCEM sites. The sampling runs were well documented, and these flue gas samples were collected at rates between 90 and 100% isokinetic. Flue gas conditions during this test series were 4% oxygen, 6 to 11% moisture, 290 to 340°F and flow rates of approximately 1,502,000 dscfm. These values are representative of an oil-fired utility boiler of this size.

TABLE 5-1
SUMMARY OF UNIT OPERATION
SITE 118

								Mean	C.V. %
Date	1/20/93	1/21/93	1/22/93	1/26/93	1/27/93	1/28/93	1/29/93		
Test No.	1	3	5	6,7	8	10,11	12,13		
Unit Load									
MW gross	844	836	841	839	789	788	788	818	3.4
MW net	806	800	804	802	756	757	753	783	3.3
Steam flow, 10^6 lb/hr	5.54	5.45	5.35	5.60	5.00	5.00	5.00	5.28	5.1
Fuel Flow, klb/hr	407.7	407.8	408.5	415.0	383.7	395.3	395.0	401.9	2.7
Boiler O_2, % E/W	3.4/2.4	3.15/2.15	2.9/2.5	3.5/2.4	3.0/2.0	1.8/1.8	2.9/1.9	3.0/2.2	19/13
Opacity, %	0.8	1.2	0.9	1.7	0.4	1.3	1.3	1.1	39

NOTES:

(1) The coefficient of variation (CV) is the standard of deviation divided by the mean.
(2) Load on 1/26 through 1/29 was decreased due to excessive boiler tube temperatures and FD fan vibrations.

Sufficient data were collected using standard sampling and analysis methods to ensure acceptable data completeness and the comparability of measurements. Major differences from many other FCEM programs were that the VOC samples were collected according to CARB Method 410A in tedlar bags and formaldehyde samples were collected non-isokinetically according to CARB Method 430 in midget impingers containing 2,4-dinitrophenylhydrazine.

Flue gas was sampled at the seven available test ports at the ESP inlet. The duct with three ports was sampled proportionally longer than the duct with four ports. This location did not meet the EPA Method 1 criteria for minimum distances from flow disturbances. Three-dimensional testing was not performed to determine flow angles at this location. However, a preliminary velocity traverse was conducted. This preliminary velocity traverse using an S-type pitot probe and a 7 x 7 sample point matrix indicated very low flow at points near the duct walls. Subsequent isokinetic tests used a 7 x 5 sample point matrix. The number of sample points at this location was reduced to 28 for metals tests in order to meet the sampling requirements of Method 201A. In Method 201A a constant sampling flow rate is maintained through the cyclone. The 28 points were chosen so that one nozzle could be used for the entire test. The differential pressures measured at these selected points were similar to the average differential pressure obtained from a full traverse. Flue gas was also sampled at the four available stack test ports. A total of 12 points were sampled for isokinetic tests. The stack sampling location met the EPA Method 1 criteria for minimum distances from flow disturbances. A cyclonic flow check was performed at the stack location. No yaw angles were greater than 10 degrees.

Oil samples are considered to be representative of the oil fired during the flue gas sampling. Each oil sample analyzed was a composite of oil samples collected during flue gas sampling periods.

Calculated exhaust gas flow rates for this site are representative of typical oil fired units. The flow rates for this site are calculated from the oil flow rate and F-factor as:

$$\text{Flow rate (dscfm)} = \text{Oil flow (lb/hr)} * \text{HHV (Btu/lb)} * \text{F-factor (dscf/MMBtu)} * \text{MMBtu}/10^6\ \text{Btu} * \text{hr}/60\ \text{min} * 20.9/(20.9 - \%O_2)$$

where HHV = 18,756 Btu/lb,

and F-factor = 9,200 dscf/MMBtu @ 0% O_2

This calculation was used to determine the ESP inlet flow rate because it was subject to less uncertainty than the pitot traverse measurements. Factors that contributed to not being able to accurately measure the flow rate directly in the ESP inlet ducts are: proximity to flow disturbances, the large range of differential pressures in the duct, and the necessity of sampling only selected points for isokinetic tests. The fuel flow rate was determined from fuel oil totalizers. Calibration of the fuel oil totalizers was performed using tank drop measurements of the Site 118 day tank. On average, the stack pitot traverse flow rate results were 10% higher than the F-factor based flow rate results.

Details on sample collection are contained in Appendix A (sampling and analytical summary). Process stream flow rates and conditions during testing are presented in Appendix D.

5.3 EVALUATION OF MEASUREMENT DATA QUALITY

An evaluation of the quality of the measurement data is based on quality control data obtained experimentally during sampling and analysis. Generally, the type of quality control information obtained pertains to measurement precision, accuracy, and blank effects, determined using various types of replicate, spiked, and blank samples. The specific characteristics evaluated depend on the type of quality control checks performed. For example, blanks may be prepared at different stages in the sampling and analysis process to isolate the source of a blank effect. Similarly, replicate samples may be generated at different stages to isolate and measure sources of variability. The QA/QC measures commonly used as part of the FCEM data assessment protocol, and the characteristic information obtained, are summarized in Table 5-2. The absence of any of these types of quality control checks from the data reports does not necessarily reflect poorly on the quality of the data, but does limit the ability to measure the various components of measurement error.

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

These DQOs are not intended to be used as validation criteria, but they can be used as empirical estimates of the precision and accuracy that would be expected from existing reference measurement methods and that would be considered acceptable. The precision and accuracy objectives are not necessarily derived from analyses of the same types of samples being investigated. Although analytical precision and accuracy are relatively easy to quantify and control, sampling precision and accuracy are unique to each site and each sample matrix. Data that do not meet these objectives are not necessarily unacceptable. Rather, the intent is to document the precision and accuracy actually obtained, and the objectives serve as benchmarks for comparison. The effects of not meeting the objectives should be considered in light of the intended use of the data.

TABLE 5-2
· TYPES OF QUALITY CONTROL SAMPLES

QC Activity	Characteristic Measured
Precision	
Replicate samples collected over time under the same conditions	Total variability, including process or temporal, sampling and analytical.
Duplicate field samples collected simultaneously	Sampling plus analytical variability at the actual sample concentrations.
Duplicate analyses of a single sample	Analytical variability at the actual sample concentrations.
Matrix- or media-spiked duplicates	Sampling plus analytical variability at an established concentration.
Laboratory control sample duplicates	Analytical variability in the absence of sample matrix effects
Surrogate-spiked sample sets	Analytical variability in the sample matrix but at an established concentration.
Accuracy	
Matrix-spiked samples	Analyte recovery in the sample matrix, indicating possible matrix interferences and other effects. *In a single sample*, includes both random error (imprecision) and systematic error (bias)
Media-spiked samples	Same as matrix-spiked samples. Used where a matrix-spiked sample is not feasible, such as certain stack sampling methods.
Surrogate-spiked samples	Analyte recovery in the sample matrix, to the extent that the surrogate compounds are chemically similar to the compounds of interest. Primarily used as an indicator of analytical efficacy.
Laboratory control standards (LCS)	Analyte recovery in the absence of actual sample matrix effects. Used as an indicator of analytical control.
Standard Reference Material	Analyte recovery in a matrix similar to the actual samples
Blank Effects	
Field Blank	Total sampling plus analytical blank effect, including sampling equipment and reagents, sample transport and storage, and analytical reagents and equipment.
Trip Blank	Blank effects arising from sample transport and storage. Typically used only for volatile organic compound analyses.
Method Blank	Blank effects inherent in analytical method, including laboratory reagents and equipment.
Reagent Blank or Field Reagent Blank	Blank effects from reagents used during sampling and analysis.

5.4 ANALYTICAL QUALITY CONTROL RESULTS

Table 5-3 summarizes the types of quality control data reported for Site 118. The results of these analyses are summarized in Appendices G and H. Table 5-4 presents a summary of precision and accuracy measurements. Accuracy measures in this table represent laboratory recovery not accuracy in the sampling procedure. Based on the quality control data evaluated, the majority of the results met the project objectives. The absence of a particular quality control measurement does not indicate that the data reported are unacceptable, but does indicate that not enough information is available to unequivocally validate the data.

The following potential problems were highlighted by the quality control data:

- There are concerns that arsenic emission levels were not adequately quantified. Spike recovery of arsenic in the stack samples was low at 47%. This indicates a possible negative interference from the sample matrix. Other concerns are that blank concentrations were high. The field blanks were 150%, and the laboratory blanks were 179% of the average sample level. This indicates a possible contribution to the sample values from field and laboratory conditions. There is higher confidence in the fuel analysis of arsenic by INAA.

- The blank correction contribution was high for mercury on the >10 μm fraction at both the ESP inlet (81%) and the stack (81%). Field blanks were also high at 68% of the ESP inlet sample values and 258% of the stack sample values.

- There are concerns with the molybdenum results. The <10 μm reagent blank was greater than the stack samples. Because a reagent blank correction was made, the final result for this fraction was reported at the reporting limit. Section 3.2 presents a complete discussion on data treatment. In addition, field blank levels for both the <10 μm and >10 μm fractions at the stack were similar to sample levels.

- The >10 μm fraction of manganese in the stack was higher than expected by mass balance. The reason for this is not clear, and there is concern with the emissions results.

- Analytical precision was poor for the following metals in fuel oil: arsenic (26% RPD), barium (15% RPD), beryllium (20% RPD), copper (22% RPD), manganese (26% RPD), and vanadium (17% RPD).

- Field blank levels for naphthalene at both the ESP inlet and the stack were 58% and 86% of sample levels, respectively, indicating a possible high bias in the sample results. Naphthalene is a suspected degradation product of a common contaminant to the XAD-2 resin used in the sampling train. (Thomson, R.D., Foster, M.G., "Degradation of XAD-2 Resin in Dry Storage and Its Impact on PAH Analysis," AWMA 1991.)

- Field blank levels for 123478 HxCDD and OCDD at the ESP inlet were 96% and 58% of sample levels, respectively. The field blank level for OCDD at the stack was 51% of the sample level. Sample results for these isomers may be biased high.

- There are concerns that certain VOC were not adequately quantified; these species are dichloromethane, vinyl chloride, toluene and 1,1,1-trichloroethane. The sample spike recovery for vinyl chloride was low at 17% indicating a possible low bias in the sample results. Vinyl chloride was not detected in the exhaust samples. Dichloromethane and toluene concentrations in a Tedlar bag blank were two times greater than the average exhaust gas levels. A sample of ambient air at Site 118 showed a background level of 1,1,1-trichloroethane that was 155% the average exhaust gas level. These blanks indicate possible contributions to the sample from the field conditions. In addition, toluene may be subject to a possible high bias due to a high sample spike recovery of 147%.

- Formaldehyde field blank levels were approximately three times higher than the average ESP inlet sample value and four times higher than the average stack sample value. The impact on actual emissions results is unclear, but there is a concern that all samples may be subject to random positive biases.

- Results for lead-210 at the stack are not reported because the laboratory experienced analytical difficulties and there was insufficient sample to rerun the analysis. Internal spike recoveries for uranium, polonium, and thorium were low for stack samples.

- Blank levels for uranium-238, thorium-228, and radium-228 were similar to stack sample levels. Blank levels for uranium-233 and -234, uranium-238, thorium-228, and thorium-232 were higher than sample levels in fuel oil.

TABLE 5-3
TYPES OF QUALITY CONTROL DATA REPORTED
SITE 118

	Precision				Accuracy				Blank			
Analysis	Replicate Runs	Duplicate Field Samples	Duplicate Laboratory Analysis	Matrix or Media Spiked Duplicate	Laboratory Control Sample Duplicate	Matrix or Media Spike	Surrogate Spike	Laboratory Control Sample	Standard Reference Material	Field Blank	Trip Blank	Laboratory Method Blank	Reagent Blank (Field)
Exhaust Gas													
ESP Inlet and Stack:													
Metals	✓		✓		✓	✓		✓		✓		✓	✓
Particulate	✓												✓
Anions	✓		✓		✓	✓		✓				✓	✓
PAH	✓			✓		✓	✓			✓		✓	
PCB	✓			✓		✓	✓			✓		✓	
PCDD/PCDF	✓			✓		✓	✓			✓		✓	
Volatile Organic Compounds	✓		✓			✓						✓	
Formaldehyde	✓		✓			✓				✓	✓		✓
Total and Hexavalent Chromium	✓		✓		✓	✓	✓	✓				✓	✓
Nickel Speciation	✓		✓			✓				✓			
Radionuclides	✓				✓	✓	✓	✓				✓	✓
Fuel Oil:													
Metals by ICP-AES, GFAAS, and CVAAS	✓		✓		✓	✓		✓	✓			✓	
Metals by INAA	✓		✓						✓				
Fluorine	✓												
Sulfur	✓		✓										
Ultimate and Heating Value	✓		✓										
Radionuclides	✓				✓	✓	✓	✓				✓	
ESP Hopper Ash:													
Metals by ICP-AES, GFAAS, and CVAAS	✓		✓		✓	✓		✓				✓	
Chloride, Fluoride, Sulfate	✓		✓		✓	✓		✓				✓	
Radionuclides	✓		✓		✓	✓	✓	✓				✓	

Notes:
Radionuclides were collected at the stack only.

TABLE 5-4
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 1 of 13)

Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
Metals in ESP Inlet Gas (PM<10 μm)	Precision - Duplicate Analysis Accuracy - Spiked Samples				
Arsenic		10% RPD	75-125%	NP	NP
Barium		10% RPD	75-125%	1% RPD	82%
Beryllium		10% RPD	75-125%	0% RPD	87%
Cadmium		10% RPD	75-125%	NC	61%
Chromium		10% RPD	75-125%	0% RPD	70%
Cobalt		10% RPD	75-125%	0% RPD	63%
Copper		10% RPD	75-125%	1% RPD	87%
Lead		10% RPD	75-125%	NP	MSA
Manganese		10% RPD	75-125%	1% RPD	68%
Mercury		10% RPD	75-125%	0% RPD	99%
Molybdenum		10% RPD	75-125%	1% RPD	71%
Nickel		10% RPD	75-125%	1% RPD	114%
Phosphorus		10% RPD	75-125%	6% RPD	75%
Selenium		10% RPD	75-125%	NP	NP
Vanadium		10% RPD	75-125%	1% RPD	72%
Metals in ESP Inlet Gas (PM>10 μm)					
Arsenic		10% RPD	75-125%	NP	NP
Barium		10% RPD	75-125%	0% RPD	99%
Beryllium		10% RPD	75-125%	20% RPD	94%
Cadmium		10% RPD	75-125%	NC	90%
Chromium		10% RPD	75-125%	1% RPD	90%
Cobalt		10% RPD	75-125%	0% RPD	88%
Copper		10% RPD	75-125%	0% RPD	96%
Lead		10% RPD	75-125%	NP	MSA
Manganese		10% RPD	75-125%	1% RPD	87%
Mercury		10% RPD	75-125%	25% RPD	73%
Molybdenum		10% RPD	75-125%	0% RPD	88%
Nickel		10% RPD	75-125%	0% RPD	78%
Phosphorus		10% RPD	75-125%	8% RPD	93%
Selenium		10% RPD	75-125%	NP	NP
Vanadium		10% RPD	75-125%	0% RPD	86%

(continued)

Precision for metals was measured as duplicate analysis and replicate runs. Replicate run precision results are contained in Appendix F. Accuracy for metals was assessed by post-digestion and pre-digestion laboratory spikes. This table is based on post-digestion laboratory spikes. Additional information is contained in Appendix G.

RPD = Relative Percent Difference.
NC = Not calculated, analyte reported as not detected in two or more runs.
MSA = Sample analysis performed by method of standard additions.
NP = Not performed.

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 2 of 13)

Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
Metals in ESP Inlet Gas (total)	Precision - Replicate Sample Runs Accuracy - Spiked Samples				
Arsenic		20% CV	75-125%	9% CV	NC
Barium		20% CV	75-125%	7% CV	NC
Beryllium		20% CV	75-125%	7% CV	NC
Cadmium		20% CV	75-125%	NC	NC
Chromium		20% CV	75-125%	22% CV	NC
Cobalt		20% CV	75-125%	19% CV	NC
Copper		20% CV	75-125%	6% CV	NC
Lead		20% CV	75-125%	42% CV	NC
Manganese		20% CV	75-125%	53% CV	NC
Mercury		20% CV	75-125%	23% CV	NC
Molybdenum		20% CV	75-125%	8% CV	NC
Nickel		20% CV	75-125%	18% CV	NC
Phosphorus		20% CV	75-125%	9% CV	NC
Selenium		20% CV	75-125%	28% CV	NC
Vanadium		20% CV	75-125%	9% CV	NC

Precision for total metals was measured as replicate runs. Replicate run analysis results are contained in Appendix F.
Accuracy for metals calculated independently for PM < 10 μm and PM > 10μm fractions and thus not calculated for total metals.
CV = Coefficient of Variation
NC = Not calculated.
NP = Not performed.

(continued)

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 3 of 13)

Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
Metals in Stack Gas (PM<10 μm)	Precision - Duplicate Analysis Accuracy - Spiked Samples				
Arsenic		10% RPD	75-125%	11% RPD	47%
Barium		10% RPD	75-125%	0% RPD	87%
Beryllium		10% RPD	75-125%	NC	94%
Cadmium		10% RPD	75-125%	NC	76%
Chromium		10% RPD	75-125%	0% RPD	80%
Cobalt		10% RPD	75-125%	3% RPD	72%
Copper		10% RPD	75-125%	1% RPD	89%
Lead		10% RPD	75-125%	NP	MSA
Manganese		10% RPD	75-125%	0% RPD	74%
Mercury		10% RPD	75-125%	NC	101%
Molybdenum		10% RPD	75-125%	2% RPD	77%
Nickel		10% RPD	75-125%	1% RPD	66%
Phosphorus		10% RPD	75-125%	NC	82%
Selenium		10% RPD	75-125%	8% RPD	111%
Vanadium		10% RPD	75-125%	0% RPD	81%
Metals in Stack Gas (PM>10 μm)					
Arsenic		10% RPD	75-125%	NP	NP
Barium		10% RPD	75-125%	1% RPD	101%
Beryllium		10% RPD	75-125%	NC	92%
Cadmium		10% RPD	75-125%	NC	94%
Chromium		10% RPD	75-125%	3% RPD	93%
Cobalt		10% RPD	75-125%	9% RPD	92%
Copper		10% RPD	75-125%	1% RPD	100%
Lead		10% RPD	75-125%	NP	MSA
Manganese		10% RPD	75-125%	0% RPD	88%
Mercury		10% RPD	75-125%	18% RPD	117%
Molybdenum		10% RPD	75-125%	NC	94%
Nickel		10% RPD	75-125%	2% RPD	87%
Phosphorus		10% RPD	75-125%	NC	99%
Selenium		10% RPD	75-125%	NP	NP
Vanadium		10% RPD	75-125%	1% RPD	93%

Precision for metals was measured as duplicate analysis and replicate runs. Replicate run analysis results are contained in Appendix F. (continued)
Accuracy for metals was assessed by post-digestion and pre-digestion laboratory spikes. This table is based on post-digestion laboratory spikes. Additional information is contained in Appendix G.
RPD = Relative Percent Difference.
NC = Not calculated, analyte reported as not detected in two or more runs.
NP = Not performed.

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 4 of 13)

Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
Metals in Stack Gas (total)	Precision - Replicate Sample Runs Accuracy - Spiked Samples				
Arsenic		20% CV	75-125%	23% CV	NC
Barium		20% CV	75-125%	72% CV	NC
Beryllium		20% CV	75-125%	NC	NC
Cadmium		20% CV	75-125%	NC	NC
Chromium		20% CV	75-125%	23% CV	NC
Cobalt		20% CV	75-125%	23% CV	NC
Copper		20% CV	75-125%	61% CV	NC
Lead		20% CV	75-125%	55% CV	NC
Manganese		20% CV	75-125%	23% CV	NC
Mercury		20% CV	75-125%	44% CV	NC
Molybdenum		20% CV	75-125%	35% CV	NC
Nickel		20% CV	75-125%	30% CV	NC
Phosphorus		20% CV	75-125%	44% CV	NC
Selenium		20% CV	75-125%	27% CV	NC
Vanadium		20% CV	75-125%	31% CV	NC

Precision for total metals was measured as replicate runs. Replicate run analysis results are contained in Appendix F.
Accuracy for metals calculated independently for PM < 10 μm and PM > 10 μm fractions and thus not calculated for total metals.
Beryllium and cadmium precision not calculated because these species were not detected.
CV = Coefficient of Variation
NC = Not calculated.
NP = Not performed.

(continued)

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 5 of 13)

Measured Parameter	How Measured	Objectives		Measured	
		Precision	Accuracy	Precision	Accuracy
PAH in ESP Inlet Gas (detected species)	Precision - Duplicate Matrix Spikes Accuracy - Pre-extraction Surrogate Spikes				
Naphthalene		50% RPD	50-150%	7% RPD	52%
Phenanthrene		50% RPD	50-150%	3% RPD	94%
2-methylnaphthalene		50% RPD	50-150%	NP	NP
PAH in Stack Gas (detected species)	Precision - Duplicate Matrix Spikes Accuracy - Pre-extraction Surrogate Spikes				
Naphthalene		50% RPD	50-150%	7% RPD	70%
Phenanthrene		50% RPD	50-150%	3% RPD	95%
2-methylnaphthalene		50% RPD	50-150%	NP	NP
PCDD and PCDF in ESP Inlet Gas	Precision - Duplicate Matrix Spikes Accuracy - Pre-extraction Surrogate Spikes				
TCDD (Total)		50% RPD	50-150%	4% RPD	63%
PeCDD (not detected)		50% RPD	50-150%	1% RPD	87%
HxCDD (123478)		50% RPD	50-150%	0% RPD	49%
HpCDD (Total)		50% RPD	50-150%	2% RPD	77%
OCDD		50% RPD	50-150%	7% RPD	90%
TCDF (Total)		50% RPD	50-150%	12% RPD	86%
PeCDF (12378, 23478)		50% RPD	50-150%	2% RPD	88%
HxCDF (123478)		50% RPD	50-150%	1% RPD	47%
HpCDF (Not detected)		50% RPD	50-150%	7% RPD	42%
OCDF		50% RPD	50-150%	1% RPD	100%

(continued)

Notes:
Precision for PAH and PCDD/PCDF analyses also determined by replicate runs (Appendix F).
Accuracy for PAH and PCDD/PCDF analyses also determined by pre-sampling surrogate spikes (field spikes) and blank matrix spikes (Appendix G).
RPD = Relative Percent Difference.
NP = Not Performed

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 6 of 13)

Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
PCDD and PCDF in Stack Gas (no isomers were detected)	Precision - Duplicate Matrix Spike Accuracy - Pre-extraction Surrogate Spikes				
TCDD		50% RPD	50-150%	See ESP Inlet for duplicate matrix spike	67%
PeCDD		50% RPD	50-150%		74%
HxCDD		50% RPD	50-150%		48%
HpCDD		50% RPD	50-150%		50%
OCDD		50% RPD	50-150%		75%
TCDF		50% RPD	50-150%		80%
PeCDF		50% RPD	50-150%		74%
HxCDF		50% RPD	50-150%		48%
HpCDF		50% RPD	50-150%		30%
OCDF		50% RPD	50-150%		100%
PCBs in ESP Inlet and Stack Gases (no species were detected)	Precision - Duplicate Matrix Spike Accuracy - Matrix Spike				
Total Chlorobiphenyls		50% RPD	50-150%	2% RPD	110%
Total Dichlorobiphenyls		50% RPD	50-150%	11% RPD	107%
Total Trichlorobiphenyls		50% RPD	50-150%	1% RPD	109%
Total Tetrachlorobiphenyls		50% RPD	50-150%	32% RPD	105%
Total Pentachlorobiphenyls		50% RPD	50-150%	8% RPD	94%
Total Hexachlorobiphenyls		50% RPD	50-150%	10% RPD	96%
Total Heptachlorobiphenyls		50% RPD	50-150%	16% RPD	101%
Total Octachlorobiphenyls		50% RPD	50-150%	32% RPD	90%
Total Nonachlorobiphenyls		50% RPD	50-150%	21% RPD	98%
Decachlorobiphenyls		50% RPD	50-150%	9% RPD	100%
Total PCB		50% RPD	50-150%	13% RPD	102%

(continued)

Notes:
Precision for PCDD/PCDF and PCB analyses also determined by replicate runs (Appendix F).
Accuracy for PCDD/PCDF and PCB analyses also determined by pre-sampling surrogate spikes (field spikes) and blank matrix spikes (Appendix G).
RPD = Relative Percent Difference.
NP = Not Performed

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
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Measured Parameter	How Measured	Objectives		Measured	
		Precision	Accuracy	Precision	Accuracy
VOC in ESP Inlet Gas	Precision - Duplicate Analyses Accuracy - Spiked Samples				
Vinyl Chloride		20% RPD	70-130%	See stack samples	18%
1,3-Butadiene		20% RPD	70-130%	for duplicate	48%
Methyl Bromide		20% RPD	70-130%	analyses	89%
Trichlorofluoromethane		20% RPD	70-130%		84%
Dichloromethane		20% RPD	70-130%		116%
Chloroform		20% RPD	70-130%		105%
1,2-Dichloroethane		20% RPD	70-130%		131%
1,1,1-Trichloroethane		20% RPD	70-130%		102%
Carbon Tetrachloride		20% RPD	70-130%		97%
1,2-Dichloropropane		20% RPD	70-130%		102%
Trichloroethene		20% RPD	70-130%		129%
1,2-Dibromoethane		20% RPD	70-130%		127%
Perchloroethylene		20% RPD	70-130%		131%
Chlorobenzene		20% RPD	70-130%		139%
Ethylbenzene		20% RPD	70-130%		117%
o-Xylene		20% RPD	70-130%		112%
Benzene		20% RPD	70-130%		105%
Toluene		20% RPD	70-130%		147%
VOC in Stack Gas	Precision - Duplicate Analyses Accuracy - Spiked Samples				
Benzene		20% RPD	70-130%	30% RPD	Only ESP Inlet
Toluene		20% RPD	70-130%	24% RPD	samples were spiked

(continued)

Notes:

Precision for VOC and Formaldehyde also assessed by replicate runs (Appendix F).

VOC spike performed on ESP inlet sample only and VOC duplicate was performed on the stack sample only. Flue gas should not be substantially different at the stack.

Accuracy for Formaldehyde also determined from field and trip spikes (Appendix G).

Precision for Particulate includes EPA accepted variance of 0.5 mg for duplicate weights.

Accuracy of 95-105% for Particulate assumes maximum EPA allowance variance of 0.5 mg. Actual use of NBS traceable weights requires 99-101% accuracy.

RPD = Relative Percent Difference.

CV = Coefficient of Variation

NC = Not calculated: species were not detected.

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
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Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
VOC in Stack Gas	Precision - Duplicate Analyses				
Dichloromethane	Accuracy - Spiked Samples	20% RPD	70-130%	20% RPD	See ESP Inlet samples for spike results
1,1,1,-Trichloroethane		20% RPD	70-130%	32% RPD	
Ethylbenzene		20% RPD	70-130%	25% RPD	
0-xylene		20% RPD	70-130%	37% RPD	
Vinyl Chloride		20% RPD	70-130%	NC	
1,3-Butadiene		20% RPD	70-130%	NC	
Methyl Bromide		20% RPD	70-130%	NC	
Trichlorofluoromethane		20% RPD	70-130%	NC	
Chloroform		20% RPD	70-130%	NC	
1,2-Dichloroethane		20% RPD	70-130%	NC	
Carbon Tetrachloride		20% RPD	70-130%	NC	
1,2-Dichloropropane		20% RPD	70-130%	NC	
Trichloroethene		20% RPD	70-130%	NC	
1,2-Dibromoethane		20% RPD	70-130%	NC	
Perchloroethylene		20% RPD	70-130%	NC	
Chlorobenzene		20% RPD	70-130%	NC	
Formaldehyde in ESP Inlet Gas	Precision - Duplicate Analysis Accuracy - Spiked Samples	10% RPD	60-140%	9% RPD	116%
Formaldehyde in Stack Gas	Precision - Duplicate Analysis Accuracy - Spiked Samples	10% RPD	60-140%	11% RPD	108%
Particulate in ESP Inlet Gas	Precision - Replicate Runs Accuracy - NBS Traceable Weights	20% CV	95-105%	9% CV	95-105%

(continued)

Notes:
Precision for VOC and Formaldehyde also assessed by replicate runs (Appendix F).
VOC spike performed on ESP inlet sample only and VOC duplicate was performed on the stack sample only. Flue gas should not be substantially different at the stack.
Accuracy for Formaldehyde also determined from field and trip spikes (Appendix G).
Precision for Particulate includes EPA accepted variance of 0.5 mg for duplicate weights.
Accuracy of 95-105% for Particulate assumes maximum EPA allowance variance of 0.5 mg. Actual use of NBS traceable weights requires 99-101% accuracy.
RPD = Relative Percent Difference.
CV = Coefficient of Variation
NC = Not calculated: species were not detected.

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
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Measured Parameter	How Measured	Objectives		Measured	
		Precision	Accuracy	Precision	Accuracy
Particulate in Stack Gas	Precision - Replicate Runs	20% CV	95-105%	31% CV	95-105%
	Accuracy - NBS Traceable Weights				
Anions in ESP Inlet Gas	Precision - Duplicate Analyses				
Chloride	Accuracy - Spiked Samples	15% RPD	80-120%	NC	99%
Fluoride		15% RPD	80-120%	NC	106%
Phosphate		15% RPD	80-120%	NC	71%
Sulfate		15% RPD	80-120%	15% RPD	132%
Anions in Stack Gas	Precision - Duplicate Analyses				
Chloride	Accuracy - Spiked Samples	15% RPD	80-120%	0% RPD	81%
Fluoride		15% RPD	80-120%	NC	103%
Phosphate		15% RPD	80-120%	NC	109%
Sulfate		15% RPD	80-120%	0% RPD	82%
Radionuclides in Stack Gas	Precision - Replicate Laboratory Control Samples				
	Accuracy - Spiked Sample				
Uranium-232 & 234, 238		20% RPD	50-150%	9-13% RPD	33%
Radium-226		20% RPD	50-150%	11% RPD	98%
Thorium-228, 230, 232		20% RPD	50-150%	18% RPD	7%

(continued)

Notes:
Precision for Particulate includes EPA accepted variance of 0.5 mg for duplicate weights.
Accuracy of 95-105% for Particulate assumes maximum EPA accepted variance of 0.5 mg for duplicate weights. Actual use of NBS traceable weights requires 99-101% accuracy.
Precision for anions and radionuclides also determined by replicate runs.
Accuracy for radionuclides also determined by laboratory control sample results (Appendix G).
CV = Coefficient of Variation RPD = Relative Percent Difference
NC = Not Calculated; analyte reported as not detected NP = Not Performed

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
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Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
Nickel Speciation Tests, ESP Inlet and Stack Gas	Precision - Duplicate Analyses Accuracy - Spiked Sample				
Soluble Nickel		10% RPD	75-125%	1% RPD	90%
Sulfidic Nickel		10% RPD	75-125%	21% RPD	NP
Metallic Nickel		10% RPD	75-125%	NC	NP
Oxidic Nickel		10% RPD	75-125%	4% RPD	NP
Chromium Speciation Tests, Stack Gas	Precision - Duplicate Analyses Accuracy - Spiked Samples % Conversion - $^{51}Cr^{6+}$ to $^{51}Cr^{3+}$				
Hexavalent chromium		15% RPD	80-120%	10% RPD	105%
Total chromium		10% RPD	75-125%	3% RPD	74%
Metals in Oil by ICP-AES or GFAAS	Precision - Duplicate Analysis Accuracy - Spiked Samples				
Barium		10% RPD	75-125%	15% RPD	95%
Beryllium		10% RPD	75-125%	20% RPD	97%
Cadmium		10% RPD	75-125%	NC	104%
Copper		10% RPD	75-125%	22% RPD	97%
Lead		10% RPD	75-125%	7% RPD	99%
Manganese		10% RPD	75-125%	26% RPD	88%
Nickel		10% RPD	75-125%	1% RPD	84%
Phosphorus		10% RPD	75-125%	NC	98%
Vanadium		10% RPD	75-125%	17% RPD	83%

(continued)

Notes:
Precision for nickel speciation also assessed from replicate runs (Appendix F).
Precision and accuracy estimates for Cr and Cr^{6+} provided by Laboratory #1.
Precision for Cr and Cr^{6+} also assessed from replicate runs and duplicate spike analysis. Accuracy for total chromium in filtrate only. Conversion is a range for all samples.
Fuel oil metals quality assurance data is presented here based on results used in the final calculations. Additional metals data is presented in Appendices C, G, and H.
Precision for fuel oil metals by ICP-AES and GFAAS also determined by replicate runs (Appendix F).
Accuracy for fuel oil metals by ICP-AES and GFAAS also determined by pre-digestion organometallic spikes in fuel oil and pre-digestion laboratory spikes (Appendix G). Results presented are for post-digestion sample spikes.
RPD = Relative Percent Difference
NC = Not Calculated; analyte reported as not detected
NP = Not Performed.

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 11 of 13)

Measured Parameter	How Measured	Objectives		Measured	
		Precision	Accuracy	Precision	Accuracy
Metals in Oil by INAA	Precision - Replicate Runs Accuracy - Standard Reference Material NIST 1634b				
Arsenic		10% RPD	75-125%	26% RPD	125%
Chromium		10% RPD	75-125%	6% RPD	106%
Cobalt		10% RPD	15-125%	0% RPD	113%
Mercury		10% RPD	75-125%	NP	135%
Molybdenum		10% RPD	75-125%	1% RPD	NA
Selenium		10% RPD	75-125%	7% RPD	78%
Anions in Fuel Oil	Precision - Replicate Runs Accuracy - NA				
Chlorine		20% CV	75-125%	4% CV	NA
Fluorine		20% CV	80-120%	NC	NA
Sulfur		20% CV	90-100%	11% CV	NA
Radionuclides in Fuel Oil	Precision - Replicate Laboratory Control Samples Accuracy - Spiked Samples				
Uranium-233 & 234, 238		20% RPD	50-150%	7-11% RPD	52%
Radium-226		20% RPD	50-150%	9% RPD	93%
Polonium-210		20% RPD	50-150%	7% RPD	26%
Thorium-228, 230, 232		20% RPD	50-150%	4-5% RPD	61%

(continued)

Notes:
Fuel oil metals quality assurance data is presented here based on results used in the final calculations. Additional metals data is presented in Appendices C, G, and H.
Precision for Radionuclides and composition also determined by replicate runs (Appendix F).
Accuracy for Radionuclides also determined from laboratory control sample results (Appendix G).
NA: not available
NC: not calculated, analyte reported as not detected
NP = Not Performed
RPDM = Average Relative Percent Difference from the Mean.
RPD = Relative Percent Difference.
Accuracy estimates for anion precursors in fuel were not reported; however, laboratory check samples are routinely verified during these analyses.

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
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Measured Parameter	How Measured	Objectives Precision	Objectives Accuracy	Measured Precision	Measured Accuracy
Fuel Oil Composition	Precision - Duplicate Analyses Accuracy - Laboratory Check Standards				
Moisture		10% RPD	90-110%	3% RPD	NA
Carbon		10% RPD	90-110%	1% RPD	NA
Hydrogen		10% RPD	90-110%	4%	NA
Nitrogen		10% RPD	90-110%	13%	NA
Sulfur		10% RPD	90-110%	5%	NA
Ash		10% RPD	90-110%	1% RPD	NA
HHV		10% RPD	90-110%	0% RPD	100%
Metals in ESP Ash by ICP-AES	Precision - Duplicate Analysis Accuracy - Spiked Samples				
Beryllium		10% RPD	75-125%	4% RPD	91%
Cadmium		10% RPD	75-125%	10% RPD	100%
Copper		10% RPD	75-125%	8% RPD	101%
Lead		10% RPD	75-125%	9% RPD	13%
Manganese		10% RPD	75-125%	17% RPD	92%
Nickel		10% RPD	75-125%	2% RPD	86%
Phosphorus		10% RPD	75-125%	3% RPD	NP
Vanadium		10% RPD	75-125%	1% RPD	79%

(continued)

Notes:
Flyash metals quality assurance data is presented based on results used in final calculations. Additional metals data is presented in Appendices C, G and H
Precision for flyash metals by ICP-AES also determined by replicate runs (Appendix F).
Accuracy for flyash by ICP-AES also determined by pre-digestion flyash spikes and pre-digestion laboratory spikes (Appendix G).
Results presented are for post-digestion sample spikes.
NA = Not Available RPD = Relative Percent Difference
NP = Not Performed
Accuracy for fuel oil composition are not reported; however, laboratory check standards are routinely verified during these analyses.

TABLE 5-4 (continued)
SUMMARY OF PRECISION AND ACCURACY ESTIMATES
SITE 118
(Page 13 of 13)

Measured Parameter	How Measured	Objectives		Measured	
		Precision	Accuracy	Precision	Accuracy
Metals in ESP Ash by INAA	Precision - Duplicate Analysis Accuracy - Laboratory Check Standards				
Arsenic		10% RPD	75-125%	0% RPD	110%
Barium		10% RPD	75-125%	2% RPD	109%
Chromium		10% RPD	75-125%	33% RPD	112%
Cobalt		10% RPD	75-125%	6% RPD	NP
Mercury		10% RPD	75-125%	NC	90%
Molybdenum		10% RPD	75-125%	23% RPD	NP
Selenium		10% RPD	75-125%	21% RPD	NP
Anions in ESP Ash	Precision - Duplicate Analysis Accuracy - Matrix Spike				
Chloride		15% RPD	80-120%	NC	129%
Fluoride		15% RPD	80-120%	NC	55%
Sulfate		15% RPD	80-120%	2% RPD	91%
Radionuclides in ESP Ash	Precision - Replicate Laboratory Control Samples Accuracy - Spiked Sample				
Uranium-233 & 234, 238		50% RPD	50-150%	7-11% RPD	31%
Radium-226		20 RPD	50-150%	9% RPD	80%
Polonium-210		50% RPD	50-150%	7% RPD	24%
Thorium-228, 230, 232		50% RPD	50-150%	4-5% RPD	47%

Notes:
Precision for flyash metals by ICP-AES also determined by replicate runs (Appendix F).
Accuracy for flyash by ICP-AES also determined by pre-digestion flyash spikes and pre-digestion laboratory spikes (Appendix G).
Accuracy for radionuclides in flyash also determined from laboratory control sample results (Appendix G).
Results presented are for post-digestion sample spikes.
NC = not calculated, analyte reported as not detected
NP = not performed
RPD = Relative Percent Difference.

Definition of Quality Assurance Terms

Presented below is a general discussion of considerations to be used when evaluating data and definitions of terms used to describe quality assurance indicators.

Precision is a measure of the reproducibility of measurements under a given set of conditions. It is expressed in terms of the distribution, or scatter, of the data, calculated as the standard deviation or coefficient of variation (CV, standard deviation divided by the mean). For duplicate analysis, precision is expressed as the relative percent difference (RPD).

$$RPD = \frac{|x_1 - x_2|}{\bar{x}} \times 100$$

Accuracy is a measure of the degree of conformity of a value generated by a specific procedure to the assumed or accepted true value; it includes both precision and bias. Bias is the persistent positive or negative deviation of the method average value from the assumed or accepted true value.

The efficacy of the analytical procedure for a given sample matrix is quantified by the analysis of spiked samples containing target or indicator analytes or other quality assurance measures, as necessary. However, all spikes, unless made to the flowing stream ahead of the sampling, produce only estimates of recovery of the analyte through all of the measurement steps occurring after the addition of the spike. A good spike recovery tells little about the true value of the sample before spiking.

Representativeness expresses the degree to which sampling data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. The representativeness criterion is based on making certain that sampling locations are properly selected and that a sufficient number of samples are collected.

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sampling data should be comparable with other measurement data for similar samples collected under similar conditions. This goal is achieved using standard techniques to collect and analyze representative samples and by reporting analytical results in appropriate units. Data sets can be compared with confidence when the precision and accuracy are known.

Completeness is an expression of the number of valid measurements obtained compared with the number planned for a given study. The goal is to generate a sufficient amount of valid data.

A discussion of the overall measurement precision, accuracy, and blank effects is presented below for each measurement type. Complete QA/QC data is presented in

Appendix G. Appendix H presents analytical and blank correction data. Table H-12 contains a summary of blank correction contributions to the sample values.

5.4.1 Metals

Precision

The precision of metals analyses of flue gas samples can be estimated by the results of duplicate laboratory analyses. The precision data on duplicate analyses were compared to the precision objective of 10% RPD.

At the ESP inlet, the <10 μm fraction duplicate results for all detected metals met the 10% RPD objective. The >10 μm fraction duplicate also met this objective except for beryllium (20%) and mercury (25%). Duplicate analyses for arsenic, lead, and selenium were not performed for metals at the ESP inlet. Cadmium was not detected in the fractions analyzed and thus precision was not calculated.

At the stack both fractions met the 10% RPD objective for all detected metals except for arsenic in the <10 μm fraction (11%) and mercury in the >10 μm fraction (18%). Duplicate analyses for arsenic, lead, and selenium were not performed. Beryllium, cadmium, mercury, and molybdenum, and phosphorus were not detected and thus precision was not calculated for these species.

Precision for total metals was also calculated based on replicate runs. This type of precision estimate should be more variable than that obtained from duplicate analyses due to variability in the process and sampling. The total precision data on replicate runs were compared to a typical CV objective of 20%. Of the detected metals, ESP inlet chromium, lead, manganese, mercury and selenium did not meet this objective. None of the stack metals met this objective.

Precision of fuel oil metals analyzed by ICP-AES (barium, beryllium, cadmium, copper, manganese, nickel, phosphorus, and vanadium) and GFAAS (lead) was calculated from duplicate analyses. Of these only lead (7%) and nickel (1%) met the 10% RPD objective. Cadmium and phosphorus were not detected. Precision for the remaining species ranged from 15 to 26% RPD. Precision for the metals analyzed by INAA (arsenic, chromium, cobalt, mercury, molybdenum, and selenium) was calculated by duplicate analysis. Of these, only arsenic (26%) did not meet the 10% RPD objective.

Precision for the ESP ash metals analyzed by ICP-AES (beryllium, cadmium, copper, lead, manganese, nickel, phosphorus, and vanadium) was calculated by duplicate analysis. All of these metals met the 10% RPD objective except for manganese (17%). Precision for the ESP ash metals analyzed by INAA (arsenic, barium, chromium, cobalt, mercury, molybdenum, and selenium) was calculated by duplicate analysis. Of these, chromium (33%), molybdenum (23%) and selenium (21%) did not meet the 10% RPD objective.

Accuracy

The accuracy of metals analyses in flue gas was determined from spiked samples. A spike recovery objective of 75-125% is specified by the multi-metals method. One ESP inlet and one stack sample were spiked after digestion and before analysis. Typically if the recovery is not within $\pm 25\%$ of nominal and matrix interferences are suspected, the laboratory attempts to analyze the sample using either an alternate instrumental technique or by the method of standard additions (MSA). For most samples, lead recovery was poor and graphite furnace analysis using the method of standard additions was performed.

Spike recoveries for most metals at the ESP inlet met the accuracy objective. For the < 10 μm fraction, cadmium, cobalt, manganese, and vanadium did not meet the objective. Their recoveries ranged from 61 to 78%. For the > 10 μm fractions, only mercury was below the objective at 73%.

Spike recoveries for all metals at the stack (both < 10 μm and > 10 μm fractions) met the accuracy objective except for arsenic (47%) and nickel (66%) in the < 10 μm fraction. Recovery for a pre-digestion laboratory spike of arsenic was good at 91%. This indicates that the low sample spike recovery could be due to interference from high concentrations of other metals in the sample.

The accuracy of metals analysis in fuel oil was estimated from post-digestion sample spikes for ICP-AES analysis and from standard reference material NIST 1634b (metals in fuel oil) analysis for INAA. The ICP-AES spike recoveries ranged from 83 to 99%. A pre-digestion organometallic fuel oil spike was performed for arsenic, cadmium, lead, mercury, selenium, and phosphorus. Recoveries were 14, 43, 61, 22, 44, and 78%, respectively. INAA results on NIST 1634b ranged from 78-125% for all metals except mercury. Mercury results were 0.0014 μg/g or 135% of the uncertified recommended NIST value of ND$<$0.001 μg/g

The accuracy of metals analysis by ICP-AES in ESP fly ash was calculated from post-digestion spike recovery. All metals met the objective of 75-125% recovery except for barium (27%) and lead (13%). Accuracy for ESP ash metals analyzed by INAA was based on laboratory check standard results. All of these metals met the recovery objective of 90-110%, except for chromium (112%). Check standard analysis was not performed for cobalt, molybdenum, and selenium.

Blank Effects

Typically, low levels of metals were found in the laboratory and reagent blanks, and in the sampling filters. Blank correction contributions for the ESP inlet metals were low except for molybdenum (67%) in the < 10 μm fraction and mercury (81%) in the > 10 μm fraction. Field blanks were higher than 50% of the measurements for total arsenic (76%), mercury (68%), and molybdenum (52%) at the ESP inlet. Blank correction contributions of the stack metals were also low except for copper (58%) and molybdenum (100%) in the < 10 μm fraction and mercury (81%) in the > 10 μm fraction. Field blanks were higher than 50% of the uncorrected measurements for the following total metals at the stack: arsenic (150%), barium (79%), chromium (62%), copper (56%), lead (75%), mercury (258%), and molybdenum (104%). High laboratory blank levels for arsenic (228% of the average total arsenic value) and mercury (54% of the average total mercury value) indicate a possibility of laboratory contamination. Field blank levels for molybdenum at the stack were similar to sample levels, suggesting field contamination. The high field blank levels for the other metals could be due to a combination of sample handling and ambient conditions. None of the metal species was detected in the fuel oil laboratory blank that consisted only of laboratory reagents.

Conclusions

ESP inlet cadmium, cobalt, manganese, mercury, and vanadium and stack arsenic and nickel indicated spike recoveries lower than the objective. Field blanks were higher than 50% of ESP inlet measurements for total arsenic, mercury, and molybdenum. Field blanks were higher than 50% of stack measurements for total arsenic, barium, chromium, copper, lead, mercury, and molybdenum. There is a concern that the arsenic emission levels are not adequately quantified. There is higher confidence in the arsenic level in fuel oil analyzed by INAA. Precision in fuel oil was poor for arsenic, barium, beryllium, copper, manganese, and vanadium.

5.4.2 Polycyclic Aromatic Hydrocarbons

Precision

Three PAH species were detected in the flue gas stream: naphthalene, phenanthrene, and 2-methylnaphthalene. Precision was determined by duplicate blank matrix spikes. A DQO of 50% RPD was set for PAH samples because of the high relative uncertainties inherent in the analysis of extremely trace species. Naphthalene and phenanthrene met the 50% criterion. Duplicate matrix spikes were not performed for 2-methylnaphthalene.

Accuracy

The accuracy of the PAH analyses was assessed by the internal recovery of deuterated standards added to each sample before extraction. Acceptable recovery is 50-150%. The recoveries of all detected PAH species from the ESP inlet and the stack were acceptable, ranging from 52-95%. Other species not detected from the stack were also within the objective accuracy range.

Blank Effects

All PAH species from the stack, except for naphthalene and 2-methylnaphthalene, were not detected in the method blank at 0.03-0.27 μg per sample. Naphthalene was detected in the method blank at 1.2 μg per sample and 2-methylnaphthalene was detected in the method blank at 0.012 μg per sample which are 74% and 9% of the average sample values, respectively. Of the detected PAH species at the ESP inlet, naphthalene had a field blank level which was 58% of the average uncorrected sample measurements. At the stack, the field blank level of naphthalene was 86% of the average uncorrected sample measurements. Naphthalene is a suspected degradation product of a common contaminant to the XAD-2 resin used in the sampling train. Typically, all samples using this resin are biased high for naphthalene, though it is difficult to evaluate the extent of the high bias.

Conclusion

PAH results are acceptable, however naphthalene field blank levels are greater than 50% of the sample levels which may indicate a high bias in sample results.

5.4.3 Polychlorinated Dibenzo-p-dioxins and Dibenzofurans

Precision

Precision for PCDD/PCDF analyses was based on duplicate blank resin spikes. The DQO of 50% RPD was met for all PCDD and PCDF homologue classes and RPD values ranged from 0 to 12%.

Accuracy

The accuracy of the PCDD/PCDF analyses was based on recoveries for labelled surrogate compounds added to each sample before extraction. The DQO for surrogate recoveries was 50-150%. Recoveries were low for ESP inlet sample for HxCDD (49%), HxCDF (47%), and HpCDF (42%). Recoveries were also low for HxCDD (48%), HxCDF (48%), and HpCDF (30%) in the stack sample. However, all isomers met the DQO for recovery of the method blank spike.

Blank Effects

The method blank contained no detectable PCDD or PCDF. Of the detected isomers at the ESP inlet, 123478 HxCDD and OCDD field blank levels were 96% and 58% of the average uncorrected concentrations, respectively. OCDD in the field blank at the stack was 51% of sample levels.

Conclusion

PCDD/PCDF analytical quality assurance results for ESP inlet and stack gas samples are acceptable except for surrogate spike recoveries ranging from 30-49% for HxCDD, HxCDF, and HpCDF. The low surrogate recoveries do not significantly bias the sample data since results are recovery corrected.

5.4.4 Polychlorinated Biphenyls

Precision

Precision for PCB gas samples was determined by duplicate blank matrix spike results. Precision for all PCB species met the objective of 50% RPD, ranging from 1 to 32%.

Accuracy

Blank matrix spike recoveries for all PCB species ranged from 90 to 110%, meeting the recovery objective of 50-150%.

Blank Effects

No PCB species were detected in the method blank, field blank, or gas samples.

Conclusion

PCB analytical quality assurance results for flue gas are considered acceptable.

5.4.5 Volatile Organic Compounds

Precision

Precision for VOC compounds was calculated based on duplicate analyses of two stack samples. All of the detected species except for dichloromethane exceeded the acceptance criteria of 20% with a range of 24-37% RPD. The high RPDs are typical when the species of interest are present at concentrations at a near the reporting limit.

Accuracy

Accuracy for flue gas VOC compounds was estimated from an ESP inlet spiked sample. All of the detected compounds met the accuracy criteria of 70-130% with the exception of toluene (147%). Recoveries for most non-detected VOC compounds were acceptable and ranged from 84 to 139%. Recovery for vinyl chloride is a concern because it was low at 18%.

Blank Effects

No VOC species were detected in a Tedlar bag blank except for dichloromethane, 1,1,1-trichloroethane, O-xylene, and toluene. Dichloromethane and toluene levels in the Tedlar bag blank exceeded QC requirements and were twice the average concentration levels. Blank levels were not subtracted to obtain final sample results. An ambient air sample was also analyzed and the following species were detected at the same or higher levels than the stack samples: trichlorofluoromethane, dichloromethane, 1,1,1-trichloroethane, ethylbenzene, o-xylene, benzene, and toluene.

Conclusion

Precision for VOC analysis was poor due to the low concentration of most species. Spike recovery of toluene exceeded the criteria at 147%. Spike recovery of vinyl chloride was low at 18%. Tedlar bag blank levels for dichloromethane and toluene were high, at 181% and 132% of the stack sample values, respectively. Ambient levels of the detected species were at similar or higher levels than sample values. The emission results for dichloromethane, toluene, vinyl chloride and 1,1,1-trichloroethane appear to be suspect.

5.4.6 Formaldehyde

Precision

Duplicate analysis determined the precision for ESP inlet formaldehyde results at 9% RPD, and for stack formaldehyde results at 11% RPD. The precision objective for formaldehyde was 10% RPD.

Accuracy

Accuracy was estimated from sample matrix spikes. Spike recovery was 102% for the ESP inlet and 91% for the stack. Field and trip spikes were also collected. A field spike is a vial of DNPH solution spiked with formaldehyde that is connected to the sampling equipment, leak checked and recovered. Field spike recovery was 116% at the ESP inlet and 108% at the stack. Recovery from a trip spike (spiked DNPH that is never opened) was 138%. All spike recoveries met the method specification of 60-140% recovery.

Blank Effects

Field blanks were approximately three times higher than the average sample concentration at the ESP inlet and four times the average sample concentration at the stack. The samples had low formaldehyde levels ranging from one to two times the expected reagent blank level. Sample values have not been corrected for blank values of DNPH solution or for field blank levels.

Conclusion

Field blank concentrations were approximately three times higher than measured sample concentrations at the ESP inlet and four times that at the stack. The impact on actual emissions results is unclear, but there is a concern that all samples may be subject to random positive biases.

5.4.7 Particulate

Precision

Measured precision for ESP inlet particulate samples was 9% CV and for stack particulate samples was 31% CV yielding an average precision of 20% CV. The precision objective for particulate is 20% CV.

Accuracy

EPA Method 5 procedures for gravimetric analysis were used. These procedures generally have laboratory accuracy of 95-105% and overall accuracy of 85-115%.

Blank Effects

Particulate sample results were corrected for the acetone blank level. The acetone blank met EPA acceptance criteria of a maximum of 0.008 mg/ml at 0.007 mg/ml.

Conclusion

Quality assurance for the particulate tests met standard criteria for acceptability.

5.4.8 Anions

Precision

Duplicate analysis of an ESP inlet sample for sulfate resulted in a 15% RPD, meeting the specified RPD objective. Chloride, fluoride, and phosphate were not detected in the ESP inlet sample duplicate. Duplicate analysis of a stack sample resulted in 0.4% RPD for both chloride and sulfate, well within the objective. Fluoride and phosphate at the stack were not detected in the stack duplicate.

Precision in oil samples for chlorine and sulfur were 4% and 11% CV, respectively, meeting the 20% CV objective.

Precision of anions in the ESP fly ash was determined by duplicate analysis. Precision could not be calculated for chloride and fluoride because the concentrations were below the detection limits. Sulfate met the 15% RPD objective.

Accuracy

Spike recovery for ESP inlet sulfate did not meet the objective of 80-120%. Spike recovery for ESP inlet sulfate samples was high at 132%. Spike recoveries for all anions in the stack samples were acceptable. Accuracy estimates for anions in fuel oil were not reported; however, laboratory check samples are routinely verified during these analyses.

Blank Effects

Anion results except for sulfate were not corrected for reagent blank levels. Low reagent blank levels were subtracted from the sulfate values. Blank levels of chloride and fluoride were below the reporting limits.

Conclusion

In general, anion results are considered acceptable. Phosphate analyses in stack, and ash samples were not used for mass balance purposes because the multi-metals phosphorus results were more sensitive.

5.4.9 Radionuclides

Precision

Precision for radionuclides in the stack samples was based on replicate analyses of laboratory control standards (LCS). The LCS that was analyzed with the stack samples was compared to the mean of the previous thirty runs of the same control sample to calculate precision. All of the detected species at the stack met the DQO of 20% RPD. Precision analysis for polonium-210, thorium-228, or thorium-232 was not performed on the stack samples. Precision for fuel and fly ash samples was based on replicate runs of a different LCS and on duplicate analysis of the fly ash itself. All species in the fly ash met the DQO of 25% RPD except for radium-226 (42% RPD) and uranium-235 which was not analyzed in duplicate. All the detected species in the fuel met the DQO of 20% RPD.

Accuracy

Accuracy for uranium, radium, polonium, and thorium in stack gas was determined from internal spike recoveries. Alternate isotope standards were added to each sample prior to preparation and analysis. Uranium (28-40%) and polonium (19-22%) recoveries are consistent with oil and ash samples, however thorium recoveries are low (4-11%). Analytical accuracy for radionuclides analysis was also based on laboratory control sample recoveries. All recoveries for stack samples met the DQO of 80-120%. Internal recoveries for stack samples were acceptable for radium.

Accuracy for uranium, radium, polonium, and thorium in oil was determined from internal spike recoveries. Recoveries for uranium (51-54%), radium (92-94%), and thorium (49-68%) met the acceptance criteria. Polonium recoveries were low (24-28%) but consistent with stack gas and ash samples. All recoveries for oil samples based on laboratory control sample recoveries met the DQO.

Internal spike recoveries for uranium, polonium, and thorium in ash were low at 31, 24, and 47%, respectively. All recoveries for ash samples based on laboratory control sample recoveries met the DQO.

Blank Effects

Of the detected radionuclides at the stack, radium-228 and thorium-228 reagent blank levels were 73% and 66% of the sample levels, respectively. Uranium-238 reagent blank was at the same level as the stack sample. This reagent blank consisted of the filter and reagents used in sample recovery. For fuel oil, laboratory blank level of radium-228 represent 30% of sample levels. Laboratory blank levels for uranium-233, -234, uranium-238, thorium-228 and thorium-232 were higher than the fuel samples. Laboratory blank levels for the detected radionuclides in the fly ash ranged from less than 1 to 7%. Sample results were not blank corrected.

Conclusion

For lead-210, the laboratory reported problems with sample analysis, and there was insufficient sample to rerun analysis. Thus, lead-210 results were not reported. All laboratory control sample recoveries for stack, oil, and ESP ash samples met the DQO. However, internal recoveries were low for uranium, polonium, and thorium for stack and ash samples. Internal recoveries were low for polonium in oil. Blank levels for uranium-238, thorium-228, and radium-228 were similar to stack sample levels. Blank levels for uranium-223 and -234, uranium-238, thorium-228, and thorium-232 were higher than sample levels in fuel oil. Overall, the fuel oil and stack samples were on the same order of magnitude as the reagent blanks, the laboratory blanks and the laboratory background. This suggested that sample levels were low and close to the quantifiable limits of the analytical procedure used.

5.4.10 Nickel Speciation Evaluation

Precision

Precision for nickel speciation was based on duplicate analysis of an ESP inlet sample. Soluble and oxidic nickel met the precision objective of 20% RPD. RPD for sulfidic nickel was higher than the objective at 21%. Metallic nickel was not detected in the sample.

Accuracy

Accuracy for nickel speciation analysis was based on recovery from a spiked sample. Recovery for soluble nickel was 90%, meeting the DQO of 70-130% recovery. Spiking with other nickel compounds was not possible because these spiking materials are difficult to add at the appropriate level in the solid form.

Blank Effects

Reagent blanks were not collected for the ESP inlet and stack nickel speciation tests. Field blanks were collected and analyzed for total nickel, and the results were acceptably low at 16% of the average stack sample value. Nickel was not detected in the ESP inlet field blank.

Conclusion

Quality assurance results indicate that nickel speciation data are acceptable. However, total nickel concentrations from these speciation tests are considered to be representative of the ratio of each species to the total but are not considered representative of emissions as discussed in Section 4 primarily because of the single point sampling used.

5.4.11 Chromium Speciation Evaluation

The chromium speciation tests were run at the stack only. Two laboratories performed the analyses for hexavalent chromium. One of these laboratories performed all analyses for total chromium. Hexavalent chromium results presented in this report are an average of the results from both laboratories.

Precision

Precision for total chromium was based on duplicate analyses by Laboratory #1 of NaOH and nitric/filter laboratory control samples; the average RPD was 3%, meeting the precision objective of 10% RPD. Precision for hexavalent chromium was determined by laboratory #1 by duplicate analyses of four samples (NaOH fractions); the average RPD was 10%, meeting the precision objective of 15% RPD.

Accuracy

Accuracy for total chromium was calculated from sample spike recoveries for the NaOH fraction and laboratory spike recoveries for the nitric/filter fraction. Average recovery for the NaOH fraction was 74%, slightly lower than the objective of 75-125%. Recovery for the nitric/filter fraction was 88% which meets the objective. Laboratory #1 obtained 10% recovery for hexavalent chromium in a laboratory spike. Laboratory #2 obtained an average of 102% recovery of hexavalent chromium from four control samples. Both laboratories met the DQO of 80-120%.

Blank Effects

Total chromium was not detected in either the NaOH or nitric/filter reagent blank fractions; hexavalent chromium was not detected in the NaOH reagent blank fraction. Hexavalent chromium results are averages of the values obtained from the two laboratories. Method blanks were also analyzed by both laboratories. Field blanks were not collected.

Conclusion

Quality assurance results for total and hexavalent chromium analysis were acceptable.

5.4.12 Fuel Oil Composition

Precision

Precision for ultimate analysis of fuel oil was based on RPDs for duplicate laboratory check standards. Only nitrogen (13%) exceeded the objective of 10% RPD.

Accuracy

Accuracy for fuel oil ultimate analysis was based on recoveries for laboratory check standards. The only accuracy information available is for the higher heating value which met the DQO at 100%. Accuracy estimates for other parameters were not reported. However, laboratory check standards are routinely used to verify these analyses.

Blank Effects

Blank analysis was not required for fuel oil ultimate analysis.

Conclusion

Quality assurance results for fuel oil composition are acceptable. Nitrogen had a slightly higher RPD which is a reflection of the low concentrations in the samples and does not indicate a problem with the sample results.

5.5 STACK SAMPLING QUALITY CONTROL RESULTS

Sampling quality control was well documented in this program. It included calibration sheets for most of the equipment used, including the gas meters, portable O_2 meters and CEM calibration. Also on file are calibrations for temperature indicators and pitot assemblies. Gas meters are calibrated before and after sampling and can differ no more than 3% from the original meter calibration. The sampling data were evaluated and comments were made on the sampling data sheets about the sampling locations, techniques used, and specific tests comments. In general, a methodical and conservative approach was employed to collect the samples according to the specifications.

The precision of the sampling can be estimated by comparing results for various parameters of the replicate samples, notably velocity, moisture content, and gas composition. These were fairly constant for each sample location. Comparisons of measured flow rate at each location to calculated flow rates from the unit heat input and F-factor were made. Average measured flow rates were 10% higher than the calculated values.

The accuracy of the sampling is usually assumed from the calibration and proper operation of the equipment and from historical validation of the methods. Field blanks were used to assess any biases that may be caused by contamination of the equipment, location, or operator errors. Field blank values were not subtracted from tests results. Field blanks were performed for all tests except the particulate/anions and chromium speciation. Reagent blanks were collected for all tests except semivolatile organics and nickel speciation.

5.6 MATERIAL BALANCE RESULTS

At Site 118, three key streams were used to define the material balance: fuel oil, ESP fly ash, and stack exhaust gas. Table 5-5 lists all of the possible streams for solid removal from the boiler, along with information on whether or not they were sampled.

TABLE 5-5
EXIT STREAMS FROM SITE 118

Stream	Operational Time Frame	Sampling Time Frame
Stack exhaust gas	Continuous	Three to four hours
ESP fly ash	Dumped from storage silo when full.	Collected periodically and composited into one sample.
Off-line boiler cleaning	Every scheduled unit outage.	Not sampled
Furnace bottom ash	As specified by facility.	Not sampled

Stream flow rates and concentrations, and the bias and precision errors associated with those measurements, were entered into a statistical error propagation model to estimate the overall material balance closure. A detailed discussion of this statistical error propagation analysis is presented in Section 6.0.

Closure is defined as the ratio of outlet to inlet mass. A 100% closure indicates perfect agreement of the measured inlet and outlet mass flow rates. Closures of 70-130% have been set as a goal for the FCEM project. This range reflects the typical level of analytical uncertainty. Closures outside this range may indicate measurement problems in one or more of the sample matrices or a systematic bias imposed by the experimental design.

Exhaust gas flow rates and fuel oil flow rates were consistent with unit load and have a high confidence level. The highest degree of uncertainty was associated with measuring solid ash removal rate. There were several areas where additional ash could collect but could not be sampled such as the economizer hoppers, the furnace bottom, and the boiler tube and air preheater surfaces. In addition, the mechanisms by which particulate species are collected and removed from the boiler may involve equilibrium time frames on the order of weeks. Emission tests and ESP fly ash samples that are collected in time frames of hours (such as those in this program) may not be sufficient to characterize the mass balance completely.

Table 5-6 presents the material balance results for elements measured in fuel, ash and exhaust gas samples and the uncertainty interval calculated from the error propagation analysis. The table shows that the elements fell into four groups: two volatile elements within the target range (sulfur and chlorine), one volatile element outside the target range (mercury), eight particulate phase elements within the target range (chromium, cobalt, copper, lead, molybdenum, nickel, selenium, and vanadium), and five particulate phase elements outside the target range (arsenic, barium, beryllium, manganese, and phosphorus). Closures on fluorine and cadmium were not calculated because they were not detected in either the fuel or the stack gas. Results from the multi-metals testing were used instead of the speciation testing to calculate closures for chromium and nickel. Specific discussions on individual species outside the target range are presented below.

Volatile Elements Outside Target Range

The mass balance for mercury was 240±62%. There is a concern that a high bias exists in the stack measurements of mercury. There are also concerns that the stack mercury results from the multi-metals train are near the reporting limit and thus are known with less certainty and do not completely characterize mercury emissions from this source. The mercury value considered to have the lowest uncertainty from this test program is the fuel mercury value of INAA. This is due to the minimal number of sample handling and preparation steps required for analysis.

Particulate Phase Elements Outside Target Range

The mass balance for arsenic was 40±18%. This low percentage reflects the low absolute levels of arsenic in the input and output streams. Low sample levels also cause the precision and uncertainty to be high. The mass balance for barium was 151±41%. This can be attributed to a possible high bias in the stack results. The field blank levels for barium were 44% of the stack sample. Manganese has a high mass balance of 344±76%. The average manganese level at the ESP inlet was 33.2 $\mu g/Nm^3$ while that at the stack was 26.7$\mu g/Nm^3$. However, 75% of the outlet manganese level was in the >10 μm fraction. This is unusual and the cause is not clear because the stack samples were not likely to be contaminated in the field. The 30% phosphorus mass balance is due to the high detection limit for the stack value.

TABLE 5-6
MATERIAL BALANCES
SITE 118

Substance	Out/In, %	Uncertainty, % Closure
Arsenic	40	18
Barium	151	41
Beryllium(1)	60	15
Cadmium(2)	NC	NC
Chlorine	125	9
Chromium	113	23
Cobalt	101	31
Copper	102	28
Fluorine(3)	NC	NC
Lead	123	37
Manganese	344	76
Mercury	240	62
Molybdenum	76	20
Nickel	96	30
Phosphorus	30	13
Selenium	73	15
Sulfur	89	9
Vanadium	101	32

Notes:
NC - not calculated
(1) Beryllium not detected at the stack. Closure is calculated using the reporting limit.
(2) Cadmium not detected in fuel oil or at the stack.
(3) Fluorine not detected in fuel oil, ESP fly ash, and at the stack.

SECTION 6.0

EXAMPLE CALCULATIONS

This section presents the methodology and sample calculations used to develop the results presented in Sections 3.0 and 4.0. Specifically, the calculation of stream flow rates, unit-energy-based results, and confidence intervals are discussed.

6.1 STREAM FLOW RATES

Appendix D presents information about the stream flow rates measured or calculated at Site 118 during the sampling period.

Stack gas flow rates were calculated from the fuel flow, higher heating value, and F-factor as described in Section 4.2. Although flue gas flow rates were measured directly during sampling the calculated flow rate is considered to be more accurate for this sampling location.

Fuel oil flow rates were determined using a calibrated totalizer. Calibration of the totalizers was performed using tank drop measurements of the Site 118 day tank.

ESP ash flow for the duration of the testing program (Jan. 19-Jan. 25) was determined from average oil flow rate, total oil used, total ash collected over the testing period, and ash specific gravity. The ESP ash silo was emptied prior to the start of the project and was not emptied again until after the completion of the metals and particulate tests. Fuel oil totalizer readings were recorded periodically in order to develop an average ESP ash flow per unit input of fuel. The calculation of the ESP ash flow is presented below.

Average oil flow rate (Average from 1/20-1/22)	408,000 lb/hr
Total oil used (Between 1/19-1/22)	21,025,000 lb
Volume ash collected (12.25 ft from top of silo)	1,618 ft^3
Ash specific gravity (Average of three determinations)	0.20

$$\text{Total ash, lb} = 1{,}618\ ft^3 \times 0.20 \times 62.4\ lb/ft^3$$
$$= 20{,}193\ \text{lb ash}$$

lb ash/lb oil	=	20,193 lb ash/21,025,000 lb oil
	=	0.00096 lb ash/lb oil
Ash flow rate, lb ash/hr	=	0.00096 lb ash/lb oil x 408,000 lb oil/hr
	=	391.8 lb ash/hr.

6.2 MEANS AND CONFIDENCE INTERVALS FOR STREAM CONCENTRATIONS

The mean concentrations and 95% confidence intervals (CIs) about the mean were calculated for each target substance in the streams sampled. The means were calculated according to the conventions listed in Section 3.0. The equations used to calculate the 95% confidence intervals are presented in Appendix F. The error propagation equations used to calculate uncertainties for mass balance results are also presented in this section.

Example calculations for naphthalene in the stack gas follow here; these results were shown in Table 3-2.

The stack concentration data (in $\mu g/Nm^3$) given for naphthalene in Table 3-3 are:

Run 1	Run 2	Run 3
0.41	0.44	0.53

The mean is calculated from the individual run totals:

$$\text{Mean} = (0.41 + 0.44 + 0.53)/3$$

$$= 0.46$$

The sample standard deviation of the individual run totals is calculated:

$$S_p = \sqrt{[(0.41-0.46)^2 + (0.44-0.46)^2 + (0.53-0.46)^2]/2}$$

$$= 0.062$$

The standard deviation of the average is calculated according to the equation in Appendix F for N = 3:

$$S_{\overline{pi}} = 0.062/\sqrt{3}$$

$$= 0.036$$

The bias error is found by root-sum-squaring the product of the bias error and the sensitivity from each run (see Appendix F). According to the conventions listed in Section 3.0, no bias error is assigned to values above reporting limits, whereas a bias error of one-half the reporting limit is assigned to values below reporting limits. The sensitivity of the mean to each run in this case is 1/3. An additional uncertainty of 10% of the sample value or 0.046 is introduced because of the difference in particle collection from ideal conditions during isokinetic tests.

$$\beta_r = \sqrt{((1/3 \; x \; 0)^2 + (1/3 \; x \; 0)^2 + (1/3 \; x \; 0)^2)^2 + (0.046)^2}$$

$$= \sqrt{(0)^2 + (0.046)^2}$$

$$= 0.046$$

The total uncertainty in the result is found from:

$$U_r = \sqrt{\beta_r^2 + (t \; x \; S_p)^2}$$

$$= \sqrt{(0.046)^2 + (4.303 \; x \; 0.036)^2}$$

$$= 0.16$$

Thus, the result is reported as 0.46 ± 0.16 μg/Nm^3.

For ESP removal efficiencies the uncertainty as % efficiency is calculated from the following standard error propagation equations:

$$ESP \; inlet \; value = A \pm \delta A \; where \; \delta A = Sp/\sqrt{N}$$

$$Stack \; value = B \pm \delta B$$

$$ESP\ inlet\ -\ stack = C \pm \sqrt{(\delta A)^2 + (\delta B)^2}$$

$$ESP\ efficiency = \frac{ESP_{inlet} - Stack}{ESP_{inlet}} = efficiency \pm \sqrt{\left(\frac{(\delta A)^2 + (\delta B)^2}{C}\right)^2 + \left(\frac{\delta A}{A}\right)^2} * efficiency$$

Using the example of ESP efficiency for vanadium, the following calculations were performed:

	Mean	Sp	$Sp/\sqrt{N}$
ESP inlet, lb/10^{12} Btu	737	54	31
Stack, lb/10^{12} Btu	42	13	7

$$ESP\ inlet\ -\ stack = 695 \pm \sqrt{(31)^2 + (7)^2} = 695 \pm 0.32$$

$$ESP\ effeciency = \frac{inlet\ -\ stack}{inlet} = 0.94 \pm \sqrt{\left(\frac{32}{695}\right)^2 + \left(\frac{31}{737}\right)^2} * 0.94$$

$$= 0.94 \pm 0.06$$

or the ESP was 94 $\pm$ 6% efficient for the removal of vanadium.

For mass balance results, the uncertainty as % closure is calculated using standard error propagation equations:

closure = D (out/in) = (B+C)/A,
A = oil input,
B = stack samples,
C = ESP fly ash,

where δA, δA, δC are the uncertainties in these measurements, $\left(\frac{Sp}{\sqrt{N}}\right)$, and all values are in lb/10^{12} Btu.

The uncertainty in the outputs (B+C) is calculated as:

$$\delta(B+C) = \sqrt{(\delta B)^2 + (\delta C)^2},$$

and the uncertainty in the output/input is calculated as:

$$\delta D = D\,x\,\sqrt{\left(\frac{\delta(B+C)}{B+C}\right)^2 + \left(\frac{\delta A}{A}\right)^2}$$

The uncertainly in each stream is calculated as:

Uncertainty in A (fuel oil) = $\frac{Sp}{\sqrt{N}}$, where Sp = sample standard deviation.

Uncertainty in B (stack samples) = $\frac{Sp}{\sqrt{N}}$

Uncertainty in C (ESP fly ash) = 30%. This uncertainty is based on the variability in ash flow and oil usage.

As an example, using the cobalt values expressed as lb/10^{12} Btu, the mass balance uncertainty is calculated as:

$$\delta(B+C) = \sqrt{\left(\frac{0.45}{\sqrt{3}}\right)^2 + (0.30 \times 37.89)^2} = 11.37\ lb/10^{12}\ Btu$$

$$\delta D = 101\%\ x\ \sqrt{\left(\frac{11.37}{39.79}\right)^2 + \left(\frac{6.86/\sqrt{3}}{39.3}\right)^2} = 31\%$$

6.3 UNIT ENERGY EMISSION FACTORS

In addition to the gas-phase concentrations, unit-energy-based emission factors expressed as lb/10^{12} Btu have been developed for each target substance. These values were determined by calculating the concentration of a substance in the flue gas (lb/ft^3) and multiplying by the fuel F-factor and O_2 correction, according to EPA Method 19.

The equation used for trace species emissions is:

$$lb/10^{12}\ Btu = \mu g/m^3 \times m^3/35.31\ ft^3 \times lb/454g \times F\text{-}factor\ @\ 0\%\ O_2,\ dscf/MMBtu$$

$$\times\ 20.9/(20.9 - \%\ O_2) \times 10^6\ \mu g/g \times 10^{-6}$$

The 95% confidence intervals for emission factors were calculated according to the equations presented in Appendix F. For each parameter (concentration, unit heat rate, and unit load) the mean, standard deviation, number of points, and bias estimates were used to calculate the combined uncertainty in the mean emission factors.

SECTION 7.0

GLOSSARY

ASTM	American Society for Testing and Materials
Btu	British Thermal Unit
CAAA	Clean Air Act Amendments of 1990
CI	Confidence Interval
CV	Coefficient of Variation
DL	Detection Limit
DQO	Data Quality Objective
dscfm	Dry Standard Cubic Feet per Minute (1atm, 68°F)
EPA	U.S. Environmental Protection Agency
EPAREC/ICP	EPA Recirculation train for total Chromium with ICP-AES Analysis
EPAREC/IC-PCR	EPA Recirculation Train for Hexavalent Chromium with Analysis by Ion Chromatography with Post Column Reaction
ESP	Electrostatic Precipitator
FCEM	Field Chemical Emissions Monitoring
FD	Forced Draft
GC/MS	Gas Chromatography with Mass Spectrometer
GFAAS	Graphite Furnace Atomic Absorption Spectrophotometry
GRAV	Gravimetric Analysis
HHV	Higher Heating Value
HPLC	High Pressure Liquid Chromatography
HRGC/HRMS	High Resolution Gas Chromatography/High Resolution Mass Spectrometry
HRGC/LRMS-SIM	High Resolution Gas Chromatography/Low Resolution Mass Spectrometry with Selected Ion Monitoring
IC	Ion Chromatography
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
ID	Induced Draft
LECO-CHN	Leco Carbon, Hydrogen, Nitrogen Analyzer
LECO-SC132	Leco Sulfur Analyzer
LCS	Laboratory Check Standards
MMBtu	Million British Thermal Units
MW	Megawatt
NC	Not Calculated
ND	Not Detected
NIST	National Institute of Standards and Technology
Nm^3	Dry Normal Cubic Meter (0°C, 1atm)
NM	Not Measurable

NP	Not Performed
NR	Not Reported
PAH	Polycyclic Aromatic Hydrocarbons
PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dibenzo-furans
PCB	Polychlorinated biphenyls
PISCES	Power Plant Integrated Systems Chemical Emission Study
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
RPDM	Relative Percent Difference from the Mean
SL/AAS	Sequential Leaching/Atomic Absorption Spectroscopy
UOM	Unit of Measure
VOC	Volatile Organic Compounds

APPENDIX A

SAMPLING AND ANALYTICAL SUMMARY

This appendix presents the methods used to collect, preserve and analyze each type of sample collected at Site 118. Summary tables presented include the following:

A-1	Reference Table for Sampling Methods
A-2	ESP Inlet and Stack Test Schedule and Sampling Comments
A-3	Sampling Train Configurations for ESP Inlet and Stack Samples
A-4	Sampling and Analytical Methods for ESP Inlet and Stack Samples
A-5	Sampling Schedule for Fuel Oil and ESP Hopper Ash Samples
A-6	Analytical Methods for Fuel Oil Samples
A-7	Analytical Methods for ESP Hopper Ash Samples
A-8	Sample Handling and Preparation Procedures

Descriptions of the exhaust gas sampling trains and process sample collection methods follow the summary tables.

TABLE A-1
REFERENCE TABLE FOR SAMPLING METHODS
SITE 118

Stream	Target Substances	Collection Method
ESP Inlet and Stack	Metals: As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, P, Pb, Se, V	EPA Multi-metals/ EPA 201A
	Polycyclic Aromatic Hydrocarbons*	CARB 429
	Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans*	EPA 23
	Polychlorinated Biphenyls*	CARB 428
	Volatile Organic Compounds	CARB 410A (bags)
	Particulate**, SO_2, Cl-, F-	EPA 5, 6/8, CARB 421
	Radionuclides (outlet only)	EPA 114
	Formaldehyde	CARB 430
	Total Chromium and Hexavalent Chromium	EPA Recirculation Method
	Nickel Speciation: Soluble Nickel Sulfidic Nickel Metallic Nickel Oxidic Nickel	modified EPA Method 5
Oil	Metals, anion precursors, composition, heating value, radionuclides	Composited Grab Samples
ESP Hopper Ash	Metals, anions, radionuclides, semi-volatiles	Composited Grab Samples

* PAH/PCDD/PCDF/PCB were collected and analyzed from the same train.
** Radionuclides were analyzed from the front-half of the outlet particulate train.

TABLE A-2
ESP INLET AND STACK TEST SCHEDULE AND SAMPLING COMMENTS
SITE 118

Test No.	Date	Time	Unit Load, MW gross	Type of Test
1-PM/AN-IN	01/20/93	1130/1700	844	Particulate/Anions/Radionuclides
1-PM/AN-STK	01/20/93	1130/1700	844	Particulate/Anions/Radionuclides
1-MTLS-IN	01/20/93	1223/1756	844	Metals/ PM_{10} metals
1-MTLS-STK	01/20/93	1352/1953	844	Metals/ PM_{10} metals
1B-VOC-IN	01/20/93	1322/1400	844	Volatile organic compounds
1C-VOC-IN	01/20/93	1425/1450	844	Volatile organic compounds
1D-VOC-IN	01/20/93	1455/1515	844	Volatile organic compounds
1A-VOC-STK	01/20/93	1135/1155	844	Volatile organic compounds
1B-VOC-STK	01/20/93	1230/1300	844	Volatile organic compounds
1C-VOC-STK	01/20/93	1305/1355	844	Volatile organic compounds
3-PM/AN-IN	01/21/93	1030/1508	836	Particulate/Anions/Radionuclides
3-PM/AN-STK	01/21/93	1030/1515	836	Particulate/Anions/Radionuclides
3-MTLS-STK	01/21/93	1044/1528	836	Metals/ PM_{10} metals
3-MTLS-IN	01/21/93	1124/1649	836	Metals/ PM_{10} metals
5-PM/AN-STK	01/22/93	1030/1520	841	Particulate/Anions/Radionuclides
5-PM/AN-IN	01/22/93	1031/1723	841	Particulate/Anions/Radionuclides
5-MTLS-STK	01/22/93	1040/1545	841	Metals/ PM_{10} Metals
5-MTLS-IN	01/22/93	1114/1603	841	Metals/ PM_{10} Metals
5A-FORM-IN	01/22/93	1421/1525	841	Formaldehyde
5B-FORM-IN	01/22/93	1547/1647	841	Formaldehyde
5C-FORM-IN	01/22/93	1705/1807	841	Formaldehyde
5A-FORM-STK	01/22/93	1410/1510	841	Formaldehyde
5B-FORM-STK	01/22/93	1537/1637	841	Formaldehyde
5C-FORM-STK	01/22/93	1651/1751	841	Formaldehyde

(continued)

Notes: ESP inlet sampling used 28 traverse points for metals tests and 35 points for particulate tests.
Formaldehyde and VOC tests are single point tests.

TABLE A-2 (Continued)
ESP INLET AND STACK TEST SCHEDULE AND SAMPLING COMMENTS
SITE 118

Test No.	Date	Time	Unit Load	Type of Test
6-SV-STK	01/26/93	1030/1500	839	PAH/Dioxin/Furan/PCB
6-SV-IN	01/26/93	1031/1519	839	PAH/Dioxin/Furan/PCB
7-SV-STK	01/26/93	1200/1615	839	PAH/Dioxin/Furan/PCB
7-SV-IN	01/26/93	1222/1616	839	PAH/Dioxin/Furan/PCB
8-SV-STK	01/27/93	1000/1508	789	PAH/Dioxin/Furan/PCB
8-SV-IN	01/27/93	1025/1515	789	PAH/Dioxin/Furan/PCB
8A-Ni-STK	01/27/93	1133/1233	789	Nickel Speciation
8A-Ni-IN	01/27/93	1145/1245	789	Nickel Speciation
8B-Ni-STK	01/27/93	1415/1515	789	Nickel Speciation
8B-Ni-IN	01/27/93	1416/1516	789	Nickel Speciation
10A-Ni-IN	01/28/93	1558/1628	788	Nickel Speciation
10-Ni-STK	01/28/93	1605/1705	788	Nickel Speciation
10B-Ni-IN	01/28/93	1740/1810	788	Nickel Speciation
10-Cr-C-Unspiked	01/28/93	1200/1500	788	Chrome/Hex chrome
11-Cr-C-Unspiked	01/28/93	1645/2025	788	Chrome/Hex chrome
12-Cr-C-Unspiked	01/29/93	1125/1510	788	Chrome/Hex chrome
13-Cr-C-Unspiked	01/29/93	1715/2015	788	Chrome/Hex chrome
13-Ni-STK	01/29/93	2013/2043	788	Nickel Speciation

Note: Semi-volatiles tests at inlet used 35 traverse points

TABLE A-3
SAMPLING TRAIN CONFIGURATIONS FOR ESP INLET AND STACK
SITE 118

Sample Train	Nozzle	Probe	Filter	Filter Holder	Sample Line	Impinger Contents				
						#1	#2	#3	#4	#5
EPA Method 29/ PM_{10} Metals	Glass	Inlet: teflon Stack: glass	Teflon coated cyclone preseparator before a Method 5 ultrapure 110 mm filter	Method 5 glass	Teflon	100 ml 5% HNO_3/ 10% H_2O_2	100 ml 5% HNO_3/ 10% H_2O_2	Empty	100 ml 4% $KMnO_4$/ 10% H_2SO_4	300-400g silica gel
Semi-VOST CARB 429 CARB 428 EPA 23	Glass	Inlet: teflon Stack: glass	Method 5 Toluene-rinsed 110 mm filter	Method 5 glass	Teflon to XAD-2 resin column	Empty-stub stem	100 ml organic free DI H_2O	Empty	300-400g silica gel	N/A
VOC CARB 422	N/A	Glass	N/A	N/A	Teflon, 1/4"	Sample collected over 30 minutes with Tedlar bag				
Solid Particulate/ Anions/ Radionuclides	Glass	Inlet: teflon Stack: glass	Method 5 fiberglass 110 mm filter	Method 5 glass	Teflon	100 ml $NaHCO_3$/ Na_2CO_3	100 ml $NaHCO_3$/ Na_2CO_3	100 ml 3% H_2O_2	100 ml 3% H_2O_2	300-400g silica gel
						Midget Impingers				
Formaldehyde	N/A	Glass	47 mm in-stack fiberglass filter to prevent particulate interference	Method 17 stainless steel	Teflon, 1/8"	10 ml DNPH	10 ml DNPH	Empty	10-20 ml silica gel	N/A
Cr/Cr^{+6}	Glass	Teflon with recirculating peristaltic pump teflon line	N/A	N/A	Teflon	250 ml 0.1N NaOH (Teflon-coated glass Impinger)	75 ml 0.1N NaOH (Teflon Impinger - 2 in Series)	Empty - 2 in Series (one teflon, then one glass)	100 ml 0.1N HNO_3 (glass impinger)	300-400g silica gel
Nickel Speciation	Glass	Glass-heated to 550°F	37 mm quartz-fiber filter heated to 550°F	Glass	Teflon	100 ml DI H_2O	100 ml DI H_2O	Empty	300-400g silica gel	N/A
CEM	N/A	Stainless Steel	N/A	N/A	Teflon	Water knockout only				

N/A = Not Applicable

TABLE 4-A
SAMPLING AND ANALYTICAL METHODS FOR FLUE GAS SAMPLES
SITE 118

Parameter	No. of Replicates	Duration of Test (Minutes)	Sample Rate	Collection and Preparation Reference Method	Measurement Principle	Analytical Reference Method	Method Detection Limit	Comments
Metals/PM10 Metals	3	240	0.7 m3/hr	EPA Multimetals/ EPA 201A				Method of standard additions (MSA) used with GFAAS analysis whenever interferences and low spike recoveries occur. >PM10 fraction and <PM10 fraction Parr bomb digested. 10% of each fraction removed for mercury analysis.
Arsenic					ICP-AES w/hydride generation	EPASW846 6010/7061	0.2 μg/m3	
Barium					ICP-AES		0.4 μg/m3	
Beryllium					ICP-AES		0.08 μg/m3	
Cadmium					ICP-AES		0.2 μg/m3	
Chromium					ICP-AES		0.4 μg/m3	
Cobalt					ICP-AES		0.7 μg/m3	
Copper					ICP-AES		0.4 μg/m3	
Lead					GFAAS		3 μg/m3	
Manganese					ICP-AES		0.6 μg/m3	
Mercury					ICP-AES		0.2 μg/m3	
Molybdenum					ICP-AES		0.6 μg/m3	
Nickel					ICP-AES		1.5 μg/m3	
Phosphorus					ICP-AES		4.1 μg/m3	
Selenium					ICP-AES w/hydride generation		0.2 μg/m3	
Vanadium					ICP-AES		0.4 μg/m3	
Polycyclic Aromatic Hydrocarbons	3	240	1 m3/hr	CARB 429	HRGC/LRMS-SIM	CARB 429		All sample fractions combined for analysis. Sample was split after extraction for PAH/PCB and PCDD/PCDF analysis. Used isotope dilution were isotopically labeled standards were available. Used method of internal standardization for 2-Methylnaphthalene, 3-Methylcholanthrene, and 7,12-Dimethylbenz(a)anthracene.
2-Methylnaphthalene							0.003 μg/m3	
7,12-Dimethylbenz(a)anthracene							0.008 μg/m3	
3-Methylcholanthrene							0.003 μg/m3	
Acenaphthylene							0.005 μg/m3	
Acenaphthene							0.005 μg/m3	
Anthracene							0.003 μg/m3	
Benz(a)anthrace							0.003 μg/m3	
Benzo(a)pyrene							0.004 μg/m3	
Benzo(b)fluoranthene							0.008 μg/m3	
Benzo(g,h,i)perylene							0.005 μg/m3	
Benzo(k)fluoranthene							0.004 μg/m3	
Chrysene							0.028 μg/m3	
Dibenzo(a,h)anthracene							0.007 μg/m3	
Fluoranthene							0.003 μg/m3	
Fluorene							0.003 μg/m3	
Indeno(1,2,3-cd)pyrene							0.005 μg/m3	
Naphthalene							0.27 μg/m3	
Phenanthrene							0.003 μg/m3	
Pyrene							0.003 μg/m3	

Notes:
Method detection limit for metals is for total train (>PM10 + <PM10).
PAH samples were collected isokinetically at the ESP inlet and stack using a complete traverse of the duct.

Preliminary

TABLE A-4 (continued)
SAMPLING AND ANALYTICAL METHODS FOR FLUE GAS SAMPLES
SITE 118

Parameter	No. of Replicates	Duration of Test (Minutes)	Sample Rate	Collection and Preparation Reference Method	Measurement Principle	Analytical Reference Method	Method Detection Limit	Comments
PCDD/PCDF Total tetra- through octa- and all 2,3,7,8- substituted isomer	3	240	1 m3/hr	EPA 23	HRGC/HRMS	EPA 23	0.0024 - 0.034 ng/m3	Analysis from PAH train
PCB Total mono-decachlorobiphenyls	3	240	1m3/hr	CARB 428	HRGC/LRMS-SIM	CARB 428	0.003-0.18 ug/m3	Analysis from PAH train
Volatile Organics:	3	30	0.2 l/min	CARB 410A		EPA TO-14		Collected in Tedlar bags
Benzene					GC/MS		0.5 ug/m3	
Toluene					GC/MS		0.6 ug/m3	
1,3-Butadiene					GC/FID		0.2 ug/m3	
Vinyl Chloride					GC/MS		1.6 ug/m3	
Methyl Bromide					GC/MS		2.0 ug/m3	
Trichlorofluoromethane					GC/MS		1.1 ug/m3	
Dichloromethane					GC/MS		0.7 ug/m3	
Chloroform					GC/MS		1.5 ug/m3	
1,2-Dichloroethane					GC/MS		2.5 ug/m3	
1,1,1-Trichloroethane					GC/MS		1.1 ug/m3	
Carbon Tetrachloride					GC/MS		1.3 ug/m3	
1,2-Dichloropropane					GC/MS		2.8 ug/m3	
Trichloroethene					GC/MS		1.6 ug/m3	
Perchloroethylene					GC/MS		1.1 ug/m3	
1,2-Dibromoethane					GC/MS		3.1 ug/m3	
Chlorobenzene					GC/MS		0.8 ug/m3	
Ethylbenzene					GC/MS		0.2 ug/m3	
o-Xylene					GC/MS		0.4 ug/m3	
Formaldehyde	3	60	1 LPM	CARB 430	HPLC	CARB 430	1.5 ug/m3	Collect in midget impingers

(continued)

Notes:
VOCs and Formaldehyde samples were collected at the ESP inlet and stack nonisokinetically at a single point.

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Preliminary

TABLE A-4 (continued)
SAMPLING AND ANALYTICAL METHODS FOR FLUE GAS SAMPLES
SITE 118

Parameter	No. of Replicates	Duration of Test (Minutes)	Sample Rate	Collection and Preparation Reference Method	Measurement Principle	Analytical Reference Method	Method Detection Limit	Comments
Solid Particulate:	3	240	1 m3/hour	EPA 5	Filtration/Gravimetric	EPA 5	0.0002 gr/dscf	
Anions:	3	240	1 m3/hour					Combined with particulate train
Sulfate				EPA 6/8	Ion chromatography	EPA 300.0	0.04 ug/m3	
Chloride				CARB 421	Ion chromatography	EPA 300.0	0.04 ug/m3	Cl confirmed by mercuric nitrate titration
Fluoride				CARB 421	Ion chromatography	EPA 300.0	0.04 ug/m3	
Phosphate				—	Ion chromatography	EPA 300.0	0.12 ug/m3	Also measure P in metals train
Radionuclides: Uranium-233&234, 238; Radium-226, 228; Polonium-210; Lead-210; Thorium-228, 230, 232	3	240	1 m3/hour	EPA 114	Alpha Spectrometry	EPA 114	0.05-0.86 pCi/Nm3	Analyzed from the front half of the stack particulate/anions train only
Chromium Speciation	4	180	1 m3/hr	EPA Recirculation Method				ESP inlet only
Total Cr					GFAAS	EPA SW846 7191	0.03 ug/m3	
Hexavalent Cr					IC/PCR	GEL/RTI	0.05 ug/m3	Used preconcentration to improve detection limit for hexavalent chromium
Nickel Speciation: Soluble Nickel; Sulfidic Nickel; Metallic Nickel; Oxidic Nickel	3	30/60	1m3/hr	modified EPA 5	Sequential leaching/AAS	Inco, Ltd.*	2 ug/m3	Probe and filter heated to 550 F during sampling. Front half rinse filtered. Filters analyzed for nickel compounds. Filtrate analyzed for total nickel.
O2, CO2	in conjunction with all tests by EPA method 3A							
Velocity, Moisture	in conjunction with all isokinetic tests by EPA Methods 2 and 4							

Notes:
Particulate/anion samples were collected at the ESP inlet and stack isokinetically with a complete traverse of the duct.
Chromium and nickel speciation samples were collected isokinetically at a single point. Nickel speciation samples were collected at the ESP inlet and stack.
*Ref.: Chemical Speciation of Nickel in Airborne Dusts: Analytical Method and Results of an Interlaboratory Test Program, Vladimir J. Zatka, et al, Environ. Sci. Technol., Vol 26, No. 1, p 138

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TABLE A-5
SAMPLING SCHEDULE FOR FUEL OIL AND ESP HOPPER ASH* SAMPLES SITE 118

Run No.	Date	Time	Analysis
1	1/20/93	AM	Metals, Cl, F, S
		MID	Composition, HHV, and
		PM	Radionuclides
3	1/21/93	AM	Metals, Cl, F, S
		MID	Radionuclides
		PM	
5	1/22/93	AM	Metals, Cl, F, S
		MID	Composition, HHV, and
		PM	Radionuclides
6,7	1/26/93	AM	
		MID	Composition, HHV
		PM	
8	1/27/93	AM	
		MID	Not used, archived
		PM	
10	1/28/93	AM	Chromium and Nickel
		MID	Composition, HHV
		PM	
12, 13	1/29/93	AM	
		MID	Chromium and Nickel
		PM	
14, 15	1/30/93	AM	
		MID	Chromium and Nickel
		PM	

Notes:
The fuel oil samples were composited daily then analyzed.
* ESP hopper ash samples were collected daily from 1/21/93-1/27/93. These samples were composited, then the composite sample was analyzed in triplicate for the target components.

TABLE A-6
ANALYTICAL METHODS FOR FUEL OIL SAMPLES
SITE 118

Parameter	Measurement Principle	Reference Method	Method Detection Limit	Comments
Fuel Oil:				
Carbon	CHN Analyzer	LECO CHN/600	0.1 %	
Hydrogen	CHN Analyzer	LECO CHN/600	0.1 %	
Nitrogen	CHN Analyzer	LECO CHN/600	0.01 %	
Oxygen	Difference	–	0.1 %	
Moisture	Distillation	ASTM D-95-83	0.01 %	
Ash	Gravimetric	ASTM D-482-87	0.01 %	
Heating Value	Calorimetry	ASTM D-240-87	10 Btu/lb	
Specific gravity	Gravimetric	ASTM D-287-82	0.001 lb/gallon	
Chlorine	INAA	–	0.1 μg/g	Also by ASTM D-808
Fluorine	Ion-selective electrode	ASTM D-3761	10 μg/g	
Sulfur	LECO SC-132	ASTM D-4294	0.01 μg/g	
Arsenic	INAA	–	0.01 μg/g	Also by EPA SW846 7060
Barium	ICP-AES	EPA SW846 6010	0.01 μg/g	
Beryllium	ICP-AES	EPA SW846 6010	0.003 μg/g	
Cadmium	ICP-AES	EPA SW846 6010	0.006 μg/g	Also by EPA SW846 6010
Chromium	INAA	–	0.01 μg/g	Also by EPA SW846 6010
Cobalt	ICP-AES	EPA SW846 6010	0.02 μg/g	Also by INAA
Copper	ICP-AES	EPA SW846 6010	0.1 μg/g	
Lead	GFAAS	EPA SW846 7420	0.04 μg/g	
Manganese	ICP-AES	EPA SW846 6010	0.02 μg/g	
Mercury	INAA	–	0.001 μg/g	Also by EPA SW846 6010
Molybdenum	INAA	–	0.01 μg/g	Also by EPA SW846 6010
Nickel	ICP-AES	EPA SW846 6010	0.04 μg/g	
Phosphorus	ICP-AES	EPA SW846 6010	5 μg/g	
Selenium	INAA	–	0.001 μg/g	Also by EPA SW846 7740
Vanadium	ICP-AES	EPA SW846 6010	0.01 μg/g	
Radionuclides: Isotopic Uranium; Ra-226,-228 Isotopic Thorium; Po-210; Pb-210	Alpha Spectrometry	EPA 114	0.1-0.01 pCi/g	

TABLE A-7
ANALYTICAL METHODS FOR ESP HOPPER ASH SAMPLES
SITE 118

Parameter	Measurement Principle	Reference Method	Method Detection Limit	Comments
ESP Hopper Ash:				
Chloride	INAA	–	0.1 ug/g	
Fluoride	IC	EPA 300.0	3 ug/g	
Phosphate	IC	EPA 300.0	20 ug/g	
Sulfate	IC	EPA 300.0	6000 ug/g	
Arsenic	INAA	–	0.01 ug/g	Also by EPA SW846 7060
Barium	INAA	–	0.01 ug/g	Also by EPA SW846 6010
Beryllium	ICP-AES	EPA SW846 6010	0.2 ug/g	
Cadmium	ICP-AES	EPA SW846 6010	0.5 ug/g	
Chromium	INAA	–	0.01 ug/g	Also by EPA SW846 6010
Cobalt	INAA	–	0.02 ug/g	Also by EPA SW846 6010
Copper	ICP-AES	EPA SW846 6010	1 ug/g	
Lead	GFAAS	EPA SW846 7420	2.5 ug/g	
Manganese	ICP-AES	EPA SW846 6010	2 ug/g	
Mercury	INAA	–	0.001 ug/g	Also by EPA SW846 7471
Molybdenum	INAA	–	0.01 ug/g	Also by EPA SW846 6010
Nickel	ICP-AES	EPA SW846 6010	3 ug/g	
Phosphorus	ICP-AES	EPA SW846 6010	5 ug/g	
Selenium	INAA	–	0.001 ug/g	Also by EPA SW846 6010
Vanadium	ICP-AES	EPA SW846 6010	1 ug/g	
Radionuclides: Isotopic Uranium; Ra-226,-228 Isotopic Thorium; Po-210; Pb-210	Alpha Spectrometry	*EPA 114*	*0.1-0.01 ug/g*	

TABLE A-8
SAMPLING HANDLING AND PREPARATION PROCEDURES
SITE 118

Sample Type	Parameter	Sample Fraction Description	Sample Containers	Sample Handling and Preservation	Laboratory Preparation Procedure
Exhaust Gas Samples	Particulate/Anions/ Radionuclides	Filter	Petri dish	Seal	Dry at 105°C, desiccate
		Front half acetone rinse	500 ml amber glass lined bath with teflon lined lid	Seal and mark liquid levels	Evaporate at ambient temperature, desiccate
		$Na_2CO_3/NaHCO_3$ impinger rinse	1000 ml Nalgene HDPE bottle	Seal and mark liquid levels	none
		3% H_2O_2 impinger rinse	1000 ml Nalgene HDPE bottle	Seal and mark liquid levels	none
		One-half of filter, one-half of front half acetone rinse	Petri dish 500 ml acid washed HDPE Nalgene bottle	Seal Seal and mark liquid levels	Acid digestion, fusion or precipitation - varies by isotope
		Front half acetone rinse	500 ml amber glass bottle with teflon lined lid	Seal and mark liquid levels	Evaporate at ambient temperature, desiccate
	Semi-VOST: PAH, PCB, PCDD/PCDF	Filter	Hexane-rinsed foil lined petri dish	Seal, Store at ≤ 4°C	Soxhlett extraction
		XAD-2 column	--	Wrap with foil to keep XAD-2 from exposure to light. Store at ≤ 4°C	Soxhlett extraction
		Front-half organic rinse	500 ml organic free amber glass bottle with teflon lined lid	Seal and mark liquid level Store at ≤ 4°C	Soxhlett extraction
		Back-half organic rinse	500 ml organic free amber glass bottle with teflon lined lid	Seal and mark liquid level Store at ≤ 4°C	Soxhlett extraction
		Back-half water impinger rinse	500 ml organic free amber glass bottle with teflon lined lid	Seal and mark liquid level Store at ≤ 4°C	Soxhlett extraction
				All fractions: Sample to be extracted within 7 days of sampling; analysis to be performed within 40 days. Ship at conclusion of PAH tests.	

(continued)

TABLE A-8 (continued)
SAMPLING HANDLING AND PREPARATION PROCEDURES
SITE 118

Sample Type	Parameter	Sample Fraction Description	Sample Containers	Sample Handling and Preservation	Laboratory Preparation Procedure
Exhaust Gas Samples	Metals/PM_{10}	$>PM_{10}$ cyclone aqueous rinse	500 ml acid washed amber HDPE Nalgene	Seal and mark liquid level	Parr Bomb HF/HNO_3 digestion.
		Filter	Petri dish	Seal	
		Front-half nitric/peroxide rinse	500 ml acid washed amber HDPE Nalgene	Seal and mark liquid level	Parr Bomb HF/HNO_3 digestion combine with filter, HF/HNO_3 digestion
		5% HNO_3/10% H_2O_2 impinger rinse	1000 ml acid washed amber HDPE Nalgene	Seal and mark liquid level	Remove Hg fraction, evaporate remainder at 70°C with excess HNO_3 (pH 1)
		4% $KmNO_4$/10% H_2SO_4 impinger rinse	500 ml acid washed amber HDPE Nalgene	Seal and mark liquid level	Digest with H_2SO_4
				All fractions: Ship at conclusion of metal tests	
	Formaldehyde	DNPH solution and line rinse	Organic free DI H_2O washed 40 ml glass sample vials with teflon lined lid	Seal and mark liquid level. Store at $\leq$ 4°C. Analyze within 7 days. Ship at conclusion of formaldehyde tests.	Extraction
	Total Chromium Hexavalent Chromium	Filtered NaOH impinger and probe rinse	1000 ml acid washed HDPE Nalgene bottle	Check total pH $\geq$ 8.5 Seal and mark liquid level	None for Cr^{6+}, concentrated and acid digestion for Cr total
		Nitric acid impinger/train rinse	500 ml acid washed HDPE Nalgene bottle	Seal and mark liquid level	Concentrate and acid digestion for Cr; combine with filter
		Filtrant (filter)	Petri dish	Seal	Acid digestion for Cr total; combine with nitric rinse
				All fractions: ship at conclusion of Cr testing	
	Nickel Speciation	Sample filter	Petri dish	Seal and ship under N_2 atmosphere	Selective leaching, acid digestion
		Filtration filter	Petri dish	Seal and ship under N_2 atmosphere	Selective leaching, acid digestion
		Acetone filtrate	500 ml amber glass bottle with Teflon lined lid	Seal and mark liquid level	Dry at ambient temperature, acid digestion

(continued)

TABLE A-8 (continued)
SAMPLING HANDLING AND PREPARATION PROCEDURES
SITE 118

Sample Type	Parameter	Sample Fraction Description	Sample Containers	Sample Handling and Preservation	Laboratory Preparation Procedure
<u>Fuel Oil</u>	Ultimate, HHV, anion precursors	400 g composite	500 ml amber glass bottles with teflon lined lids	Seal	None
	Metals	400 g composite	500 ml amber glass bottles with teflon lined lids	Seal	Ash and acid digest for ICP-AES, GFAAS, or AA by modified EPA 3050. Transfer to teflon INAA vessel for INAA analysis.
	Radionuclides	400g composite	500 ml amber glass bottles with teflon lined lids	Seal	Ash in furnace, acid digestion, fusion or precipitation - varies by isotope.
<u>ESP Hopper Ash</u>	Anions	200g composite	500 ml acid washed amber HDPE Nalgene bottle	Seal	
	Metals	200g composite	500 ml acid washed amber HDPE Nalgene bottle	Seal	Acid digest for ICP-AES, GFAAS, or AA by modified EPA 3050. Transfer to teflon INAA vessel for INAA analysis.
	LOI	200g composite	500 ml HDPE Nalgene bottle	Seal	
	Radionuclides	200g composite	500 ml acid washed amber HDPE Nalgene bottle	Seal	Acid digestion, fusion or precipitation - varies by isotope

Fuel Oil Collection Procedures

Fuel Oil

Fuel oil samples were collected at the beginning, middle and end of each test day. A total of 1500 ml in three separate containers was obtained for each test day. Aliquots from each sample were combined to form a 500 ml composite sample for each type of analysis performed. Fuel oil usage rates were determined using a calibrated totalizer. Fuel oil was sampled at the suction to the fuel oil supply pumps.

ESP Hopper Ash

After each test day, the ESP Silo was sampled at the top and the ash level was noted. Daily samples collected from 1/21 - 1/27/93 were combined to form one composite representative of the program. Splits from this composite were then analyzed in triplicate for target species. Ash deposited in the economizer, bottom ash for the furnace, and ash deposited on boiler surfaces could not be quantified for this project.

Sample Train Procedures

Semi-Volatile Species

Triplicate samples for PAHs and PCB and PCDD/PCDF were collected according to CARB Method 429 - September 12, 1989 version, CARB Method 428 and EPA Method 23. Samples were collected isokinetically through a heated filter followed by an XAD-2 sorbent module in a water-cooled condenser. The sorbent module was followed by an impinger train to collect moisture and any species that might pass through the resin.

Prior to release to the field, each XAD-2 resin trap was spiked with labeled standards to assess field losses or gains. The standards used were benzo(e)pyrene-d_{12}, terphenyl d_{14}, $^{13}C_{12}$-2378-TCDD, $^{13}C_{12}$-23478-PeCDF, $^{13}C_{12}$-123478-HxDCF, $^{13}C_{12}$-123478-HxCDD and $^{13}C_{12}$-1234789-HpCDF 2,21,3,4^1,5,5^1,6-Heptachlorobiphenyl, $^{13}C_{12}$. In addition, sixteen labeled PAH standards and nine labeled PCDD/PCDF standards, 4 labeled PCB standards were added to each sample prior to the extraction step to provide recovery corrected results. Labeled standards were not available for 2-Methylnapthalene, 3-Methylcholanthrene, or 7,12-Dimethylbenzo(a)anthracene; the method of internal standardization was used for these species.

At each sample location a full field blank train was assembled, recovered and analyzed. During the recovery procedure all glassware was rinsed three times each with organic free methanol, acetone, toluene and methylene chloride. The solvent rinses were combined with the filter and sorbent module for extraction and final analysis for each train. Following extraction, the extract was split and analyzed for PAH and PCB by HRGC/LRMS-SIM and for PCDD/PCDF by HRGC/HRMS. A confirmation analysis was performed on samples containing detectable levels of 2,3,7,8 TCDF.

Volatile Organic Compounds

Tedlar bag samples were drawn simultaneously at a single point at the ESP inlet and stack. The samples were collected according to CARB Method 410A. 1,3 Butadiene was analyzed by GC/FID; the remaining VOC compounds were analyzed by GC/MS. Duplicate analyses were performed on two samples. Two samples were then spiked with the target compounds then reanalyzed to assess recovery.

Combined Metals/ PM_{10} Metals

The stack samples were withdrawn isokinetically from the source according to EPA Method 201A with particulate emissions greater than 10 μm collected in a cyclone and particulate emissions less than 10 μm on a heated filter and series of impingers according to the EPA multimetals method. The series of impingers were 5% HNO_3/10% H_2O_2 in the first two, empty for the third and 4% $KMNO_4$/10% H_2SO_4 in the fourth. Decomposition of each sample fraction was per the EPA multimetals method. Whenever possible, decomposed sample portions were concentrated and combined with regard to preventing loss of volatile metals, to achieve the lowest detection limits possible for these samples. Materials collected in the sampling train were digested with acid solutions to solubilize inorganic target species and to remove organic constituents that may create analytical interferences. Acid digestion of both the greater than 10 μm and less than 10 μm fractions was performed using conventional Parr Bomb digestion techniques.

Reagent and filter blanks were analyzed for all trace metals. A spiked reagent blank for all metals was analyzed to assess analytical recovery methods and to ensure that the decomposition procedure was accurate. Following the analysis of the samples and field blanks, a mandatory check for matrix effects and interferences was performed for each metal by spiking one sample. If the recovery was less than $\pm$25% of nominal, the sample was run using the method of standard additions or an alternate technique if possible. One duplicate analysis was performed for each metal. A field blank was collected and analyzed from the stack location. Analyses for the trace metals was performed by ICP-AES, GFAAS, or CVAAS depending upon the metal of interest.

Total Solid Particulate/ Anions/ Radionuclides

Particulate/Anion/radionuclide samples were collected isokinetically at the ESP inlet and stack. The solid particulate was collected and analyzed according to EPA Method 5, then solubilized in water and analyzed for Cl^-, F^-, PO_4^{3-} and SO_4^{2-}. The first two impingers contained a solution of sodium carbonate/sodium bicarbonate to collect Cl^- and F^-. The third and fourth impingers contained 3% H_2O_2 to collect SO_2. Each sample fraction was also analyzed for PO_4^{3-}. The analysis was by ion chromatography per EPA Method 300.0.

The solid particulate portions of the samples were also analyzed for radionuclides. One half of the Method 5 filter plus one half of the probe rinse was analyzed by EPA Method 114 using alpha spectrometry. Samples were spiked with Uranium-232, and Thorium-229 prior to acid digestion, fusion or precipitation and analysis.

O_2 and CO_2

O_2 and CO_2 were measured at the outlet of the economizer using a 30 point sampling grid using Carnot's Continuous Emission Monitoring System. This system was used in conjunction with all tests to provide O_2 and CO_2 data for molecular weight and dilution calculations. Additionally, portable O_2 meters were used with each sample train to provide sample-specific O_2 data. Concentrations of CO_2 at the ESP inlet and stack were calculated given percent O_2 and CO_2 at the economizer outlet and percent O_2 at the ESP inlet and stack.

Velocity and Moisture

Stack gas velocity and moisture content were measured by EPA Methods 2 and 4 in conjunction with every isokinetic test.

Nickel Speciation

Nickel speciation samples were collected isokinetically at a single point at both the ESP inlet and stack using a modified EPA Method 5 train. The nozzle, probe and filter were heated to 550° F to prevent the formation of $NiSO_4$ in the train. A high purity quartz filter was used. A set of impingers containing D.I. water were used for moisture determination and were not recovered. Field blank trains were collected for each sampling location.

The nozzle, probe and filter holder were recovered with acetone and the acetone rinse was filtered through a high purity quartz filter. The sample and filtration filters were stored under nitrogen until analysis. Inco performed a sequential leaching procedure to separate soluble, sulfidic, metallic and oxidic nickel compounds. Total nickel in each fraction was determined by flame atomic absorption spectrophotometry.

Total Chromium and Hexavalent Chromium Speciation

Total and hexavalent chromium samples were collected isokinetically at a single point at the stack using the EPA recirculating train. To eliminate the possibility of Cr^{6+} reduction between the nozzle and impingers, liquid from the first impinger was continuously recirculated to the probe trip. There were seven impingers in this train. The first four were teflon, the last three were glass.

Impinger 1, 2 and 3: 0.1 N NaOH
Impinger 4: Empty (teflon)
Impinger 5: Empty (glass)
Impinger 6: 0.1 N HNO_3
Impinger 7: Silica Gel

5N NaOH was added to the first impinger as necessary to keep the solution pH above 8.5. The sample train was purged with nitrogen and the NaOH impinger contents were filtered immediately after sampling. The NaOH impinger solution was analyzed for Cr^{6+} by ion chromatography with a post-column reactor (IC/PCR). Total chromium was measured in the NaOH fraction by GFAAS and in the filter fraction and nitric acid rinse of the train by ICP-AES.

APPENDIX B

FCEM SITE 118 INDIVIDUAL STREAM CONCENTRATIONS

This appendix presents the Site 118 sampling results that were used to calculate the emissions and mass balances presented in this report. Provided here are results for the following streams: stack exhaust gases, fuel oil, and economizer hopper ash.

Following are the data flags used in this table:

@	Concentration is less than five times the reporting limit
E	Estimated analyte result
NA	Not analyzed
ND<	Not detected at less than the reporting limit
B	Blank correction exceeded 50% of uncorrected result
F	Field blank exceeds 50% of uncorrected result

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 1		Run 3		Run 5		Average Used
Stack Gas, PM<10 Metals	Arsenic	ICP-HYDRIDE	ug/Nm3		0.59 F		0.55 F		0.53 F		0.56 F
Stack Gas, PM<10 Metals	Barium	ICP-AES	ug/Nm3		3.30 F		12.07		7.52 F		7.63 F
Stack Gas, PM<10 Metals	Beryllium	ICP-AES	ug/Nm3	ND<	0.04		0.04@	ND<	0.04	ND<	0.04
Stack Gas, PM<10 Metals	Cadmium	ICP-AES	ug/Nm3	ND<	0.12	ND<	0.12	ND<	0.13	ND<	0.13
Stack Gas, PM<10 Metals	Chromium	ICP-AES	ug/Nm3		1.80 F		1.55 F		0.90 B F		1.42 F
Stack Gas, PM<10 Metals	Cobalt	ICP-AES	ug/Nm3		1.53@		2.16		1.97@		1.89@
Stack Gas, PM<10 Metals	Copper	ICP-AES	ug/Nm3		5.52 F		2.20 B F		0.73 B F		2.8 B F
Stack Gas, PM<10 Metals	Lead	GFAAS	ug/Nm3	ND<	0.77		1.10@	ND<	0.86	ND<	0.86
Stack Gas, PM<10 Metals	Manganese	ICP-AES	ug/Nm3		3.3		4.0		13.2		6.82
Stack Gas, PM<10 Metals	Mercury	CVAAS	ug/Nm3		0.48@ F		0.45@ F		1.00@ F		0.64@ F
Stack Gas, PM<10 Metals	Molybdenum	ICP-AES	ug/Nm3		0.31 B F		0.33 B F		0.34 B F		0.32 B F
Stack Gas, PM<10 Metals	Nickel	ICP-AES	ug/Nm3		30.7		47.7		50.0		42.8
Stack Gas, PM<10 Metals	Selenium	ICP-HYDRIDE	ug/Nm3		1.42		2.32		1.54		1.76
Stack Gas, PM<10 Metals	Phosphorus	ICP-AES	ug/Nm3	ND<	2.30	ND<	2.45		2.57@	ND<	2.45
Stack Gas, PM<10 Metals	Vanadium	ICP-AES	ug/Nm3		29.5		48.9		51.3		43.2
Stack Gas, PM>10 Metals	Arsenic	ICP-HYDRIDE	ug/Nm3		0.31@ F		0.36@ F	ND<	0.11		0.24@ F
Stack Gas, PM>10 Metals	Barium	ICP-AES	ug/Nm3		1.2 F		6.6 F		0.34 B F		2.7 F
Stack Gas, PM>10 Metals	Beryllium	ICP-AES	ug/Nm3	ND<	0.04		0.04@	ND<	0.04	ND<	0.04
Stack Gas, PM>10 Metals	Cadmium	ICP-AES	ug/Nm3	ND<	0.12	ND<	0.12	ND<	0.13	ND<	0.13
Stack Gas, PM>10 Metals	Chromium	ICP-AES	ug/Nm3		2.30		2.65		5.13		3.36
Stack Gas, PM>10 Metals	Cobalt	ICP-AES	ug/Nm3		0.54@		1.18@		1.03@		0.91@
Stack Gas, PM>10 Metals	Copper	ICP-AES	ug/Nm3		1.00 F		1.79		0.86 F		1.22 F
Stack Gas, PM>10 Metals	Lead	GFAAS	ug/Nm3		1.04@		3.06@	ND<	3.42		1.93@
Stack Gas, PM>10 Metals	Manganese	ICP-AES	ug/Nm3		30.3		20.4		9.0		19.9
Stack Gas, PM>10 Metals	Mercury	CVAAS	ug/Nm3		0.08@ B F		0.08@ B F		0.09@ B F		0.08@ B F
Stack Gas, PM>10 Metals	Molybdenum	ICP-AES	ug/Nm3	ND<	0.27		0.49@ F	ND<	0.30	ND<	0.30
Stack Gas, PM>10 Metals	Nickel	ICP-AES	ug/Nm3		12.7		28.9		29.5		23.7
Stack Gas, PM>10 Metals	Selenium	ICP-HYDRIDE	ug/Nm3	ND<	0.10	ND<	0.10	ND<	0.11	ND<	0.11
Stack Gas, PM>10 Metals	Phosphorus	ICP-AES	ug/Nm3	ND<	1.92		2.85@		2.99@		2.27@
Stack Gas, PM>10 Metals	Vanadium	ICP-AES	ug/Nm3		10.0		25.3		18.0		17.7

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 1		Run 3		Run 5		Average Used
Stack Gas, Total Metals	Arsenic	ICP-HYDRIDE	ug/Nm3		0.90 F		0.90 F		0.58 F		0.80 F
Stack Gas, Total Metals	Barium	ICP-AES	ug/Nm3		4.52 F		18.6 F		7.87 F		10.3 F
Stack Gas, Total Metals	Beryllium	ICP-AES	ug/Nm3	ND<	0.08		0.08@	ND<	0.09	ND<	0.09
Stack Gas, Total Metals	Cadmium	ICP-AES	ug/Nm3	ND<	0.23	ND<	0.24	ND<	0.26	ND<	0.26
Stack Gas, Total Metals	Chromium	ICP-AES	ug/Nm3		4.10 F		4.20 F		6.03 F		4.78 F
Stack Gas, Total Metals	Cobalt	ICP-AES	ug/Nm3		2.07		3.34		2.99		2.80
Stack Gas, Total Metals	Copper	ICP-AES	ug/Nm3		6.52 F		3.99 F		1.58 B F		4.03 F
Stack Gas, Total Metals	Lead	GFAAS	ug/Nm3		1.42@ F		4.16@ F	ND<	4.28		2.57@ F
Stack Gas, Total Metals	Manganese	ICP-AES	ug/Nm3		33.6		24.4		22.1		26.7
Stack Gas, Total Metals	Mercury	CVAAS	ug/Nm3		0.56@ F		0.53@ F		1.09@ F		0.73@ F
Stack Gas, Total Metals	Molybdenum	ICP-AES	ug/Nm3		0.44 B F		0.82 B F		0.49 B F		0.58 B F
Stack Gas, Total Metals	Nickel	ICP-AES	ug/Nm3		43.3		76.6		79.5		66.5
Stack Gas, Total Metals	Selenium	ICP-HYDRIDE	ug/Nm3		1.47		2.37		1.59		1.81
Stack Gas, Total Metals	Phosphorus	ICP-AES	ug/Nm3	ND<	4.22		4.08@		5.56@		3.91@
Stack Gas, Total Metals	Vanadium	ICP-AES	ug/Nm3		39.5		74.2		69.3		61.0
Stack Gas, Particulate	Particulate, total	GRAV	mg/Nm3		4.9		8.4		5.3		6.2
Stack Gas, Anions	Chloride	IC	ug/Nm3		5,108		6,126		4,976		5,403
Stack Gas, Anions	Fluoride	IC	ug/Nm3	ND<	301		120@		114@		128@
Stack Gas, Anions	Sulfate	IC	ug/Nm3		1,484,703		1,772,541		1,388,237		1,548,494
Stack Gas, Radionuclides	Uranium-233 & -234	Alpha Spectrometry	pCi/Nm^3	ND<	0.05	ND<	0.05	ND<	0.05	ND<	0.054
Stack Gas, Radionuclides	Uranium-235	Alpha Spectrometry	pCi/Nm^3	ND<	0.05	ND<	0.05	ND<	0.05	ND<	0.054
Stack Gas, Radionuclides	Uranium-238	Alpha Spectrometry	pCi/Nm^3		0.05@	ND<	0.05	ND<	0.05	ND<	0.054
Stack Gas, Radionuclides	Radium-226	Alpha Spectrometry	pCi/Nm^3		0.11@	ND<	0.11		0.05@		0.07@
Stack Gas, Radionuclides	Radium-228	Alpha Spectrometry	pCi/Nm^3		0.86		0.91		0.81		0.86
Stack Gas, Radionuclides	Lead-210	Alpha Spectrometry	pCi/Nm^3		--		--		--		--
Stack Gas, Radionuclides	Polonium-210	Alpha Spectrometry	pCi/Nm^3	ND<	0.11		0.05@		0.10@		0.07@
Stack Gas, Radionuclides	Thorium-228	Alpha Spectrometry	pCi/Nm^3		0.21@	ND<	0.86		0.15@		0.26@
Stack Gas, Radionuclides	Thorium-230	Alpha Spectrometry	pCi/Nm^3		0.32		0.64		0.10		0.36
Stack Gas, Radionuclides	Thorium-232	Alpha Spectrometry	pCi/Nm^3		0.05@	ND<	0.32		0.10@		0.10@

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 6		Run 7		Run 8		Average Used
Stack Gas, PAH	Naphthalene	HRGC/LRMS-SIM	ug/Nm3		0.41 F		0.44 F		0.53 F		0.46 F
Stack Gas, PAH	Acenaphthylene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.020	ND<	0.022	ND<	0.019	ND<	0.022
Stack Gas, PAH	Acenaphthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.009	ND<	0.009	ND<	0.008	ND<	0.009
Stack Gas, PAH	Fluorene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.008	ND<	0.009	ND<	0.011	ND<	0.011
Stack Gas, PAH	Phenanthrene	HRGC/LRMS-SIM	ug/Nm3		0.01@		0.02@		0.02@		0.02@
Stack Gas, PAH	Anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.011	ND<	0.013	ND<	0.011	ND<	0.013
Stack Gas, PAH	Fluoranthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.010	ND<	0.011	ND<	0.009	ND<	0.011
Stack Gas, PAH	Pyrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.010	ND<	0.011	ND<	0.009	ND<	0.011
Stack Gas, PAH	Benz(a)anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.015	ND<	0.016	ND<	0.013	ND<	0.016
Stack Gas, PAH	Chrysene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.025	ND<	0.031	ND<	0.024	ND<	0.031
Stack Gas, PAH	Benzo(b)fluoranthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.008	ND<	0.009	ND<	0.008	ND<	0.009
Stack Gas, PAH	Benzo(k)fluoranthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.010	ND<	0.013	ND<	0.011	ND<	0.013
Stack Gas, PAH	Benzo(a)pyrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.016	ND<	0.020	ND<	0.016	ND<	0.020
Stack Gas, PAH	Indeno(1,2,3-cd)pyrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.014	ND<	0.018	ND<	0.013	ND<	0.018
Stack Gas, PAH	Dibenzo(a,h)anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.019	ND<	0.022	ND<	0.018	ND<	0.022
Stack Gas, PAH	Benzo(g,h,i)perylene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.009	ND<	0.011	ND<	0.008	ND<	0.011
Stack Gas, PAH	2-Methylnaphthalene	HRGC/LRMS-SIM	ug/Nm3		0.02@		0.03@		0.06@		0.04@
Stack Gas, PAH	7,12-Dimethylbenz(a)anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.013	ND<	0.015	ND<	0.012	ND<	0.015
Stack Gas, PAH	3-Methylcholanthrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.009	ND<	0.011	ND<	0.008	ND<	0.011

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 6		Run 7		Run 8		Average Used
Stack Gas, PCDD/PCDF	2378-TCDD	HRGC/HRMS	ng/Nm3	ND<	0.0059	ND<	0.0063	ND<	0.0050	ND<	0.0063
Stack Gas, PCDD/PCDF	12378 PeCDD	HRGC/HRMS	ng/Nm3	ND<	0.0066		0.003@	ND<	0.0047	ND<	0.0066
Stack Gas, PCDD/PCDF	123478 HxCDD	HRGC/HRMS	ng/Nm3	ND<	0.0163		0.008@	ND<	0.0122	ND<	0.0163
Stack Gas, PCDD/PCDF	123678 HxCDD	HRGC/HRMS	ng/Nm3	ND<	0.0069	ND<	0.0024	ND<	0.0053	ND<	0.0069
Stack Gas, PCDD/PCDF	123789 HxCDD	HRGC/HRMS	ng/Nm3	ND<	0.0115	ND<	0.0041	ND<	0.0086	ND<	0.0115
Stack Gas, PCDD/PCDF	1234678 HpCDD	HRGC/HRMS	ng/Nm3	ND<	0.0224	ND<	0.0173	ND<	0.0361	ND<	0.0361
Stack Gas, PCDD/PCDF	OCDD	HRGC/HRMS	ng/Nm3		0.026@		0.023@	ND<	0.0306	ND<	0.0306
Stack Gas, PCDD/PCDF	2378 TCDF	HRGC/HRMS	ng/Nm3	ND<	0.0026	ND<	0.0026	ND<	0.0026	ND<	0.0026
Stack Gas, PCDD/PCDF	12378 PeCDF	HRGC/HRMS	ng/Nm3	ND<	0.0038	ND<	0.0030	ND<	0.0036	ND<	0.0038
Stack Gas, PCDD/PCDF	23478 PeCDF	HRGC/HRMS	ng/Nm3	ND<	0.0041	ND<	0.0031	ND<	0.0039	ND<	0.0041
Stack Gas, PCDD/PCDF	123478 HxCDF	HRGC/HRMS	ng/Nm3	ND<	0.0071	ND<	0.0044	ND<	0.0083	ND<	0.0083
Stack Gas, PCDD/PCDF	123678 HxCDF	HRGC/HRMS	ng/Nm3	ND<	0.0036	ND<	0.0023	ND<	0.0044	ND<	0.0044
Stack Gas, PCDD/PCDF	234678 HxCDF	HRGC/HRMS	ng/Nm3	ND<	0.0071	ND<	0.0044	ND<	0.0083	ND<	0.0083
Stack Gas, PCDD/PCDF	123789 HxCDF	HRGC/HRMS	ng/Nm3	ND<	0.0099	ND<	0.0063	ND<	0.0120	ND<	0.0120
Stack Gas, PCDD/PCDF	1234678 HpCDF	HRGC/HRMS	ng/Nm3	ND<	0.0150	ND<	0.0098	ND<	0.0334	ND<	0.0334
Stack Gas, PCDD/PCDF	1234789 HpCDF	HRGC/HRMS	ng/Nm3	ND<	0.0281	ND<	0.0189	ND<	0.0639	ND<	0.0370
Stack Gas, PCDD/PCDF	OCDF	HRGC/HRMS	ng/Nm3	ND<	0.0237	ND<	0.0189	ND<	0.0200	ND<	0.0237
Stack Gas, PCDD/PCDF	Total TCDD	HRGC/HRMS	ng/Nm3	ND<	0.0059	ND<	0.0063	ND<	0.0050	ND<	0.0063
Stack Gas, PCDD/PCDF	Total PeCDD	HRGC/HRMS	ng/Nm3	ND<	0.0066		0.003@	ND<	0.0047	ND<	0.0066
Stack Gas, PCDD/PCDF	Total HxCDD	HRGC/HRMS	ng/Nm3	ND<	0.0099		0.005@	ND<	0.0075	ND<	0.0099
Stack Gas, PCDD/PCDF	Total HpCDD	HRGC/HRMS	ng/Nm3	ND<	0.0224	ND<	0.0173	ND<	0.0361	ND<	0.0361
Stack Gas, PCDD/PCDF	Total TCDF	HRGC/HRMS	ng/Nm3	ND<	0.0026	ND<	0.0026	ND<	0.0026	ND<	0.0026
Stack Gas, PCDD/PCDF	Total PeCDF	HRGC/HRMS	ng/Nm3	ND<	0.0038	ND<	0.0031	ND<	0.0036	ND<	0.0038
Stack Gas, PCDD/PCDF	Total HxCDF	HRGC/HRMS	ng/Nm3	ND<	0.0061	ND<	0.0038	ND<	0.0072	ND<	0.0072
Stack Gas, PCDD/PCDF	Total HpCDF	HRGC/HRMS	ng/Nm3	ND<	0.0227	ND<	0.0148	ND<	0.0500	ND<	0.0500

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 6		Run 7		Run 8		Average Used
Stack Gas, PCB	Total Chlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.003	ND<	0.003	ND<	0.003	ND<	0.003
Stack Gas, PCB	Total Dichlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.005	ND<	0.006	ND<	0.006	ND<	0.006
Stack Gas, PCB	Total Trichlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.006	ND<	0.014	ND<	0.010	ND<	0.014
Stack Gas, PCB	Total Tetrachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.005	ND<	0.011	ND<	0.007	ND<	0.011
Stack Gas, PCB	Total Pentachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.14	ND<	0.26	ND<	0.19	ND<	0.26
Stack Gas, PCB	Total Hexachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.005	ND<	0.011	ND<	0.009	ND<	0.011
Stack Gas, PCB	Total Heptachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.006	ND<	0.011	ND<	0.009	ND<	0.011
Stack Gas, PCB	Total Octachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.005	ND<	0.008	ND<	0.006	ND<	0.008
Stack Gas, PCB	Total Nonachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.004	ND<	0.006	ND<	0.008	ND<	0.008
Stack Gas, PCB	Decachlorobiphenyl	HRGC/LRMS-SIM	ug/Nm3	ND<	0.018	ND<	0.021	ND<	0.014	ND<	0.021

Stream	Substance	Method	UOM		Run 1A		Run 1B		Run 1C		Average Used
Stack Gas, VOC	Benzene	GC/PID	ug/Nm3		1.05@		0.73@		0.56@		0.78@
Stack Gas, VOC	Toluene	GC/PID	ug/Nm3		16.76		9.19		7.29		11.08
Stack Gas, HC	Vinyl Chloride	GC/MS	ug/Nm3	ND<	2.1	ND<	2.1	ND<	1.1	ND<	2.1
Stack Gas, HC	1,3-Butadiene	GC/FID	ug/Nm3	ND<	0.2	ND<	0.2	ND<	0.2	ND<	0.2
Stack Gas, HC	Methyl Bromide	GC/MS	ug/Nm3	ND<	2.5	ND<	2.5	ND<	1.7	ND<	2.5
Stack Gas, HC	Trichlorofluoromethane	GC/MS	ug/Nm3	ND<	1.2	ND<	1.2	ND<	0.5	ND<	1.2
Stack Gas, HC	Dichloromethane	GC/MS	ug/Nm3		78.6		44.4		33.5		52.2
Stack Gas, HC	Chloroform	GC/MS	ug/Nm3	ND<	1.6	ND<	1.6	ND<	1.1	ND<	1.6
Stack Gas, HC	1,2-Dichloroethane	GC/MS	ug/Nm3	ND<	3.1	ND<	3.1	ND<	1.8	ND<	3.1
Stack Gas, HC	1,1,1-Trichloroethane	GC/MS	ug/Nm3		2.9@		2.3@		1.7@		2.3@
Stack Gas, HC	Carbon Tetrachloride	GC/MS	ug/Nm3	ND<	1.4	ND<	1.4	ND<	0.7	ND<	1.4
Stack Gas, HC	1,2-Dichloropropane	GC/MS	ug/Nm3	ND<	3.5	ND<	3.5	ND<	2.0	ND<	3.5
Stack Gas, HC	Trichloroethene	GC/MS	ug/Nm3	ND<	1.8	ND<	1.8	ND<	1.2	ND<	1.8
Stack Gas, HC	1,2-Dibromoethane	GC/MS	ug/Nm3	ND<	4.2	ND<	4.2	ND<	2.5	ND<	4.2
Stack Gas, HC	Perchloroethylene	GC/MS	ug/Nm3	ND<	1.5	ND<	1.5	ND<	0.6	ND<	1.5
Stack Gas, HC	Chlorobenzene	GC/MS	ug/Nm3	ND<	1.0	ND<	1.0	ND<	0.5	ND<	1.0
Stack Gas, HC	Ethylbenzene	GC/MS	ug/Nm3		0.85@		0.57@		0.47@		0.63@
Stack Gas, HC	o-Xylene	GC/MS	ug/Nm3		1.71@		0.85@		0.71@		1.09@

Stream	Substance	Method	UOM	Run 5A	Run 5B	Run 5C	Average Used
Stack Gas, Aldehyde	Formaldehyde	HPLC	ug/Nm3	5.83	9.57	8.61	8.00

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 1		Run 3		Run 5		Average Used
ESP, Inlet Gas, PM<10 Metals	Arsenic	ICP-HYDRIDE	ug/Nm3		0.88 F		1.34		1.07 F		1.09 F
ESP, Inlet Gas, PM<10 Metals	Barium	ICP-AES	ug/Nm3		13.4		18.2		23.8		18.4
ESP, Inlet Gas, PM<10 Metals	Beryllium	ICP-AES	ug/Nm3		0.83		0.73		0.84		0.80
ESP, Inlet Gas, PM<10 Metals	Cadmium	ICP-AES	ug/Nm3	ND<	0.10	ND<	0.11	ND<	0.13	ND<	0.13
ESP, Inlet Gas, PM<10 Metals	Chromium	ICP-AES	ug/Nm3		4.4		6.5		6.2		5.7
ESP, Inlet Gas, PM<10 Metals	Cobalt	ICP-AES	ug/Nm3		34.6		23.9		31.1		29.9
ESP, Inlet Gas, PM<10 Metals	Copper	ICP-AES	ug/Nm3		8.8		9.7		8.6		9.0
ESP, Inlet Gas, PM<10 Metals	Lead	GFAAS	ug/Nm3		6.8@		4.7@		13.3@		8.3@
ESP, Inlet Gas, PM<10 Metals	Manganese	ICP-AES	ug/Nm3		33.5		8.0		37.7		26.4
ESP, Inlet Gas, PM<10 Metals	Mercury	CVAAS	ug/Nm3		1.52@		1.23@ F		0.92@ F		1.23@ F
ESP, Inlet Gas, PM<10 Metals	Molybdenum	ICP-AES	ug/Nm3		3.12 B F		3.31 B F		3.78 B F		3.40 B F
ESP, Inlet Gas, PM<10 Metals	Nickel	ICP-AES	ug/Nm3		865		623		838		775
ESP, Inlet Gas, PM<10 Metals	Selenium	ICP-HYDRIDE	ug/Nm3		1.9		3.0		3.5		2.8
ESP, Inlet Gas, PM<10 Metals	Phosphorus	ICP-AES	ug/Nm3		69.3		62.4		67.1		66.3
ESP, Inlet Gas, PM<10 Metals	Vanadium	ICP-AES	ug/Nm3		1,004		882		965		950
ESP, Inlet Gas, PM>10 Metals	Arsenic	ICP-HYDRIDE	ug/Nm3		0.48 F		0.26@ F		0.55 F		0.43@ F
ESP, Inlet Gas, PM>10 Metals	Barium	ICP-AES	ug/Nm3		11.1		9.6		4.2 F		8.3
ESP, Inlet Gas, PM>10 Metals	Beryllium	ICP-AES	ug/Nm3		0.07@		0.07@		0.08@		0.08@
ESP, Inlet Gas, PM>10 Metals	Cadmium	ICP-AES	ug/Nm3	ND<	0.10	ND<	0.11	ND<	0.13	ND<	0.13
ESP, Inlet Gas, PM>10 Metals	Chromium	ICP-AES	ug/Nm3		4.8		4.0		8.0		5.6
ESP, Inlet Gas, PM>10 Metals	Cobalt	ICP-AES	ug/Nm3		7.6		4.8		7.1		6.5
ESP, Inlet Gas, PM>10 Metals	Copper	ICP-AES	ug/Nm3		3.6		2.8		5.2		3.9
ESP, Inlet Gas, PM>10 Metals	Lead	GFAAS	ug/Nm3		3.4@	ND<	2.9		1.4		2.1@
ESP, Inlet Gas, PM>10 Metals	Manganese	ICP-AES	ug/Nm3		7.3		5.1		8.0		6.8
ESP, Inlet Gas, PM>10 Metals	Mercury	CVAAS	ug/Nm3		0.07@ B F		0.07@ B F		0.08@ B F		0.08@ B F
ESP, Inlet Gas, PM>10 Metals	Molybdenum	ICP-AES	ug/Nm3		1.94		1.5		1.9		1.8
ESP, Inlet Gas, PM>10 Metals	Nickel	ICP-AES	ug/Nm3		190.5		128.6		201.4		173.5
ESP, Inlet Gas, PM>10 Metals	Selenium	ICP-HYDRIDE	ug/Nm3	ND<	0.09	ND<	0.09	ND<	0.10	ND<	0.10
ESP, Inlet Gas, PM>10 Metals	Phosphorus	ICP-AES	ug/Nm3		10.0		5.9@		13.4		9.8
ESP, Inlet Gas, PM>10 Metals	Vanadium	ICP-AES	ug/Nm3		214.7		139.6		201.4		185.2

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 1		Run 3		Run 5		Average Used
ESP, Inlet Gas, Total Metals	Arsenic	ICP-HYDRIDE	ug/Nm3		1.36 F		1.60 F		1.61 F		1.53 F
ESP, Inlet Gas, Total Metals	Barium	ICP-AES	ug/Nm3		24.5		27.8		28.0		26.8
ESP, Inlet Gas, Total Metals	Beryllium	ICP-AES	ug/Nm3		0.90		0.8		0.9		0.9
ESP, Inlet Gas, Total Metals	Cadmium	ICP-AES	ug/Nm3	ND<	0.21	ND<	0.22	ND<	0.25	ND<	0.25
ESP, Inlet Gas, Total Metals	Chromium	ICP-AES	ug/Nm3		9.3		10.6		14.2		11.3
ESP, Inlet Gas, Total Metals	Cobalt	ICP-AES	ug/Nm3		42.2		28.7		38.2		36.4
ESP, Inlet Gas, Total Metals	Copper	ICP-AES	ug/Nm3		12.4		12.5		13.7		12.9
ESP, Inlet Gas, Total Metals	Lead	GFAAS	ug/Nm3		10.2@		6.1@		14.7@		10.3@
ESP, Inlet Gas, Total Metals	Manganese	ICP-AES	ug/Nm3		40.8		13.1		45.7		33.2
ESP, Inlet Gas, Total Metals	Mercury	CVAAS	ug/Nm3		1.59@ F		1.30@ F		1.01@ F		1.30@ F
ESP, Inlet Gas, Total Metals	Molybdenum	ICP-AES	ug/Nm3		5.06 B F		4.81 B F		5.67 B F		5.18 B F
ESP, Inlet Gas, Total Metals	Nickel	ICP-AES	ug/Nm3		1,055		752		1,040		949
ESP, Inlet Gas, Total Metals	Selenium	ICP-HYDRIDE	ug/Nm3		2.0		3.1		3.6		2.9
ESP, Inlet Gas, Total Metals	Phosphorus	ICP-AES	ug/Nm3		79.3		68.3		80.6		76.1
ESP, Inlet Gas, Total Metals	Vanadium	ICP-AES	ug/Nm3		1,219		1,021		1,167		1,136
ESP, Inlet Gas, Particulate	Particulate, total	GRAV	mg/Nm3		80.1		71.8		85.3		79.1
ESP, Inlet Gas, Anions	Chloride	IC	ug/Nm3		5,766		4,728		4,984		5,159
ESP, Inlet Gas, Anions	Fluoride	IC	ug/Nm3		92@		95@		86@		91@
ESP, Inlet Gas, Anions	Sulfate	IC	ug/Nm3		1,570,823		1,573,396		1,514,294		1,552,837

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 6		Run 7		Run 8		Average Used
ESP, Inlet Gas, PAH	Naphthalene	HRGC/LRMS-SIM	ug/Nm3		0.62 F		0.60 F		0.64 F		0.62 F
ESP, Inlet Gas, PAH	Acenaphthylene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.023	ND<	0.027	ND<	0.040	ND<	0.040
ESP, Inlet Gas, PAH	Acenaphthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.010	ND<	0.011	ND<	0.012	ND<	0.012
ESP, Inlet Gas, PAH	Fluorene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.007	ND<	0.009	ND<	0.024	ND<	0.024
ESP, Inlet Gas, PAH	Phenanthrene	HRGC/LRMS-SIM	ug/Nm3		0.016@		0.020@		0.018@		0.018@
ESP, Inlet Gas, PAH	Anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.012	ND<	0.015	ND<	0.017	ND<	0.017
ESP, Inlet Gas, PAH	Fluoranthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.011	ND<	0.014	ND<	0.012	ND<	0.014
ESP, Inlet Gas, PAH	Pyrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.011	ND<	0.014	ND<	0.012	ND<	0.014
ESP, Inlet Gas, PAH	Benz(a)anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.016	ND<	0.021	ND<	0.019	ND<	0.021
ESP, Inlet Gas, PAH	Chrysene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.03	ND<	0.04	ND<	0.03	ND<	0.04
ESP, Inlet Gas, PAH	Benzo(b)fluoranthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.009	ND<	0.013	ND<	0.012	ND<	0.013
ESP, Inlet Gas, PAH	Benzo(k)fluoranthene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.013	ND<	0.017	ND<	0.015	ND<	0.017
ESP, Inlet Gas, PAH	Benzo(a)pyrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.017	ND<	0.028	ND<	0.031	ND<	0.028
ESP, Inlet Gas, PAH	Indeno(1,2,3-cd)pyrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.016	ND<	0.027	ND<	0.024	ND<	0.027
ESP, Inlet Gas, PAH	Dibenzo(a,h)anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.021	ND<	0.037	ND<	0.029	ND<	0.037
ESP, Inlet Gas, PAH	Benzo(g,h,i)perylene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.009	ND<	0.017	ND<	0.014	ND<	0.017
ESP, Inlet Gas, PAH	2-Methylnaphthalene	HRGC/LRMS-SIM	ug/Nm3		0.035@		0.040@		0.027@		0.034@
ESP, Inlet Gas, PAH	7,12-Dimethylbenz(a)anthracene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.011	ND<	0.016	ND<	0.013	ND<	0.016
ESP, Inlet Gas, PAH	3-Methylcholanthrene	HRGC/LRMS-SIM	ug/Nm3	ND<	0.010	ND<	0.016	ND<	0.012	ND<	0.016

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 6		Run 7		Run 8		Average Used
ESP, Inlet Gas, PCDD/PCDF	2378-TCDD	HRGC/HRMS	ng/Nm3	ND<	0.0032	ND<	0.0086	ND<	0.0070	ND<	0.0086
ESP, Inlet Gas, PCDD/PCDF	12378 PeCDD	HRGC/HRMS	ng/Nm3	ND<	0.0048	ND<	0.0057	ND<	0.0037	ND<	0.0057
ESP, Inlet Gas, PCDD/PCDF	123478 HxCDD	HRGC/HRMS	ng/Nm3		0.0081@ F	ND<	0.0093		0.0095@ F		0.0074@ F
ESP, Inlet Gas, PCDD/PCDF	123678 HxCDD	HRGC/HRMS	ng/Nm3		0.003@	ND<	0.0040	ND<	0.0034	ND<	0.0040
ESP, Inlet Gas, PCDD/PCDF	123789 HxCDD	HRGC/HRMS	ng/Nm3		0.003@	ND<	0.0066	ND<	0.0055	ND<	0.0066
ESP, Inlet Gas, PCDD/PCDF	1234678 HpCDD	HRGC/HRMS	ng/Nm3		0.014@	ND<	0.0153		0.014@	ND<	0.0153
ESP, Inlet Gas, PCDD/PCDF	OCDD	HRGC/HRMS	ng/Nm3		0.019@ F		0.018@ F		0.034@		0.024@ F
ESP, Inlet Gas, PCDD/PCDF	2378 TCDF	HRGC/HRMS	ng/Nm3	ND<	0.0032	ND<	0.0043	ND<	0.0055	ND<	0.0055
ESP, Inlet Gas, PCDD/PCDF	12378 PeCDF	HRGC/HRMS	ng/Nm3		0.0070@		0.0033@		0.0031@		0.0045@
ESP, Inlet Gas, PCDD/PCDF	23478 PeCDF	HRGC/HRMS	ng/Nm3		0.0094@		0.0057@		0.0061@		0.0071@
ESP, Inlet Gas, PCDD/PCDF	123478 HxCDF	HRGC/HRMS	ng/Nm3		0.0081@	ND<	0.0053		0.0061@		0.0056@
ESP, Inlet Gas, PCDD/PCDF	123678 HxCDF	HRGC/HRMS	ng/Nm3		0.0032@	ND<	0.0027	ND<	0.0019	ND<	0.0027
ESP, Inlet Gas, PCDD/PCDF	234678 HxCDF	HRGC/HRMS	ng/Nm3	ND<	0.0038	ND<	0.0053	ND<	0.0034	ND<	0.0053
ESP, Inlet Gas, PCDD/PCDF	123789 HxCDF	HRGC/HRMS	ng/Nm3	ND<	0.0054	ND<	0.0076	ND<	0.0046	ND<	0.0076
ESP, Inlet Gas, PCDD/PCDF	1234678 HpCDF	HRGC/HRMS	ng/Nm3	ND<	0.0078	ND<	0.0140		0.011@	ND<	0.0140
ESP, Inlet Gas, PCDD/PCDF	1234789 HpCDF	HRGC/HRMS	ng/Nm3	ND<	0.0151	ND<	0.0269	ND<	0.0202	ND<	0.0269
ESP, Inlet Gas, PCDD/PCDF	OCDF	HRGC/HRMS	ng/Nm3	ND<	0.0153	ND<	0.0206	ND<	0.0183	ND<	0.0206
ESP, Inlet Gas, PCDD/PCDF	Total TCDD	HRGC/HRMS	ng/Nm3		0.020@	ND<	0.0086	ND<	0.0070		0.0092@
ESP, Inlet Gas, PCDD/PCDF	Total PeCDD	HRGC/HRMS	ng/Nm3	ND<	0.0048	ND<	0.0057	ND<	0.0037	ND<	0.0057
ESP, Inlet Gas, PCDD/PCDF	Total HxCDD	HRGC/HRMS	ng/Nm3		0.026@	ND<	0.0057		0.021@		0.017@
ESP, Inlet Gas, PCDD/PCDF	Total HpCDD	HRGC/HRMS	ng/Nm3		0.014@	ND<	0.0153		0.028@		0.016@
ESP, Inlet Gas, PCDD/PCDF	Total TCDF	HRGC/HRMS	ng/Nm3		0.013@		0.0050@		0.0037@		0.0071@
ESP, Inlet Gas, PCDD/PCDF	Total PeCDF	HRGC/HRMS	ng/Nm3		0.040@		0.014@		0.021@		0.025@
ESP, Inlet Gas, PCDD/PCDF	Total HxCDF	HRGC/HRMS	ng/Nm3		0.012@	ND<	0.0047		0.0052@		0.0065@
ESP, Inlet Gas, PCDD/PCDF	Total HpCDF	HRGC/HRMS	ng/Nm3	ND<	0.0116	ND<	0.0209		0.016@	ND<	0.0209

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Run 6		Run 7		Run 8		Average Used
ESP, Inlet Gas, PCB	Total Chlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.003	ND<	0.003	ND<	0.003	ND<	0.003
ESP, Inlet Gas, PCB	Total Dichlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.006	ND<	0.007	ND<	0.005	ND<	0.007
ESP, Inlet Gas, PCB	Total Trichlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.006	ND<	0.007	ND<	0.004	ND<	0.007
ESP, Inlet Gas, PCB	Total Tetrachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.009	ND<	0.010	ND<	0.006	ND<	0.010
ESP, Inlet Gas, PCB	Total Pentachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.13	ND<	0.17	ND<	0.18	ND<	0.18
ESP, Inlet Gas, PCB	Total Hexachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.006	ND<	0.013	ND<	0.005	ND<	0.013
ESP, Inlet Gas, PCB	Total Heptachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.006	ND<	0.009	ND<	0.007	ND<	0.009
ESP, Inlet Gas, PCB	Total Octachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.005	ND<	0.011	ND<	0.006	ND<	0.011
ESP, Inlet Gas, PCB	Total Nonachlorobiphenyls	HRGC/LRMS-SIM	ug/Nm3	ND<	0.005	ND<	0.020	ND<	0.006	ND<	0.020
ESP, Inlet Gas, PCB	Decachlorobiphenyl	HRGC/LRMS-SIM	ug/Nm3	ND<	0.017	ND<	0.016	ND<	0.023	ND<	0.023

Stream	Substance	Method	UOM		Run 1B		Run 1C		Run 1D		Average Used
ESP, Inlet Gas, VOC	Benzene	GC/PID	ug/Nm3		--		0.98@		0.52@		0.75@
ESP, Inlet Gas, VOC	Toluene	GC/PID	ug/Nm3		--		11.90		4.08		7.99
ESP, Inlet Gas, HC	Vinyl Chloride	GC/MS	ug/Nm3		--	ND<	1.1	ND<	1.1	ND<	1.1
ESP, Inlet Gas, HC	1,3-Butadiene	GC/FID	ug/Nm3	ND<	0.2	ND<	0.2	ND<	0.2	ND<	0.2
ESP, Inlet Gas, HC	Methyl Bromide	GC/MS	ug/Nm3		--	ND<	1.7	ND<	1.7	ND<	1.7
ESP, Inlet Gas, HC	Trichlorofluoromethane	GC/MS	ug/Nm3		--		2.3@	ND<	0.5		1.3@
ESP, Inlet Gas, HC	Dichloromethane	GC/MS	ug/Nm3		--		60.0		28.4		44.2
ESP, Inlet Gas, HC	Chloroform	GC/MS	ug/Nm3		--	ND<	1.1	ND<	1.1	ND<	1.1
ESP, Inlet Gas, HC	1,2-Dichloroethane	GC/MS	ug/Nm3		--	ND<	1.8	ND<	1.8	ND<	1.8
ESP, Inlet Gas, HC	1,1,1-Trichloroethane	GC/MS	ug/Nm3		--		1.5@		0.7@		1.1@
ESP, Inlet Gas, HC	Carbon Tetrachloride	GC/MS	ug/Nm3		--	ND<	0.7	ND<	0.7	ND<	0.7
ESP, Inlet Gas, HC	1,2-Dichloropropane	GC/MS	ug/Nm3		--	ND<	2.0	ND<	2.0	ND<	2.0
ESP, Inlet Gas, HC	Trichloroethene	GC/MS	ug/Nm3		--	ND<	1.2	ND<	1.2	ND<	1.2
ESP, Inlet Gas, HC	1,2-Dibromoethane	GC/MS	ug/Nm3		--	ND<	2.5	ND<	2.5	ND<	2.5
ESP, Inlet Gas, HC	Perchloroethylene	GC/MS	ug/Nm3		--	ND<	0.6	ND<	0.6	ND<	0.6
ESP, Inlet Gas, HC	Chlorobenzene	GC/MS	ug/Nm3		--	ND<	0.5	ND<	0.5	ND<	0.5
ESP, Inlet Gas, HC	Ethylbenzene	GC/MS	ug/Nm3		--		0.5@		0.3@		0.4@
ESP, Inlet Gas, HC	o-Xylene	GC/MS	ug/Nm3		--		0.5@		0.5@		0.5@

Stream	Substance	Method	UOM	Run 5A	Run 5B	Run 5C	Average Used
ESP, Inlet Gas, Aldehyde	Formaldehyde	HPLC	ug/Nm3	11.81	12.95	6.01	10.25

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Oil 1/20 Run 1		Oil 1/21 Run 3		Oil 1/22 Run 5		Average Used
Fuel Oil, Metals	Arsenic	INAA	mg/Kg		0.10		0.26		0.097		0.15
Fuel Oil, Metals	Barium	ICP-AES	mg/Kg		0.42		0.44		0.31		0.39
Fuel Oil, Metals	Beryllium	ICP-AES	mg/Kg		0.008@		0.008@		0.006@		0.007@
Fuel Oil, Metals	Cadmium	ICP-AES	mg/Kg	ND<	0.01	ND<	0.01	ND<	0.006	ND<	0.007
Fuel Oil, Metals	Chromium	INAA	mg/Kg		0.16		27		0.15		0.16
Fuel Oil, Metals	Cobalt	ICP-AES	mg/Kg		0.8		0.8		0.6		0.7
Fuel Oil, Metals	Copper	ICP-AES	mg/Kg		0.3		0.2		0.19		0.24
Fuel Oil, Metals	Lead	GFAAS	mg/Kg		0.27		0.29		0.19		0.25
Fuel Oil, Metals	Manganese	ICP-AES	mg/Kg		0.17		0.16		0.09@		0.14
Fuel Oil, Metals	Mercury	INAA	mg/Kg		0.0035		0.0047		0.0037		0.0040
Fuel Oil, Metals	Molybdenum	INAA	mg/Kg		0.08		4.0		0.072		0.076
Fuel Oil, Metals	Nickel	ICP-AES	mg/Kg		19.0		25.0		17.0		20.3
Fuel Oil, Metals	Selenium	INAA	mg/Kg		0.081		NA		0.093		0.087
Fuel Oil, Metals	Phosphorus	ICP-AES	mg/Kg	ND<	5.0		8.4@		5.3@		5.4@
Fuel Oil, Metals	Vanadium	ICP-AES	mg/Kg		23.0		26.0		16.0		21.7
Fuel Oil, Metals-Anions	Chlorine	INAA	mg/Kg		56		54.5		52		54
Fuel Oil, Ult- Anions	Fluorine	ASTM D3761/ISE	mg/Kg	ND<	20.00	ND<	20.00	ND<	20.00	ND<	20.00
Fuel Oil, Ult- Anions	Sulfur	LECO-SC132/ ASTM D 4294	%		0.71		0.83		0.73		0.75
Fuel Oil, Radionuclides	Uranium-233 & -234	Alpha Spectrometry	pCi/g	ND<	0.005	ND<	0.006	ND<	0.002	ND<	0.006
Fuel Oil, Radionuclides	Uranium-235	Alpha Spectrometry	pCi/g	ND<	0.003	ND<	0.003	ND<	0.002	ND<	0.003
Fuel Oil, Radionuclides	Uranium-238	Alpha Spectrometry	pCi/g	ND<	0.003	ND<	0.007	ND<	0.001	ND<	0.007
Fuel Oil, Radionuclides	Radium-226	Alpha Spectrometry	pCi/g		0.02		0.01		0.01		0.01
Fuel Oil, Radionuclides	Radium-228	Alpha Spectrometry	pCi/g		0.04		0.04		0.02		0.03
Fuel Oil, Radionuclides	Lead-210	Alpha Spectrometry	pCi/g		0.06	ND<	0.0001		0.04		0.033
Fuel Oil, Radionuclides	Polonium-210	Alpha Spectrometry	pCi/g	ND<	0.09	ND<	0.11	ND<	0.14	ND<	0.140
Fuel Oil, Radionuclides	Thorium-228	Alpha Spectrometry	pCi/g		0.02		0.02		0.01		0.02
Fuel Oil, Radionuclides	Thorium-230	Alpha Spectrometry	pCi/g	ND<	0.01		0.01		0.02		0.01
Fuel Oil, Radionuclides	Thorium-232	Alpha Spectrometry	pCi/g	ND<	0.004	ND<	0.001	ND<	0.001	ND<	0.004

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM	Oil 1/20 Run 1	Oil 1/21 Run 3	Oil 1/22 Run 5	Oil 1/28 Runs 10, 11	Oil 1/29 Runs 12,13	Average Used
Fuel Oil, Ultimate	Moisture	Draft ASTM	%	0.85	--	0.84	0.84		0.84
Fuel Oil, Ultimate	Carbon	Draft ASTM	%	87.44	--	88.27	87.39		87.70
Fuel Oil, Ultimate	Hydrogen	Draft ASTM	%	10.98	--	10.36	10.07		10.47
Fuel Oil, Ultimate	Oxygen	Draft ASTM	%	0.31	--	0.02	1.26		0.53
Fuel Oil, Ultimate	Nitrogen	Draft ASTM	%	0.49	--	0.46	0.47		0.48
Fuel Oil, Ultimate	Ash	Draft ASTM	%	0.06	--	0.06	0.07		0.06
Fuel Oil, Ultimate	HHV	Draft ASTM	Btu/lb	18,711	--	18,883	18,674		18,756
Fuel Oil, Physical Property	Specific Gravity @ 60 F	ASTM D-287-82	--	0.974	0.975	0.975	0.982	0.983	0.977
Fuel Oil, Physical Property	API Gravity @ 60 F	ASTM D-287-82	--	13.7	--	13.6	12.6	--	13.3

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APPENDIX B
SITE 118 DATA USED IN CALCULATIONS

Stream	Substance	Method	UOM		Ash Comp#1 1/21 - 1/27 Runs 1 - 8		Ash Comp#2 1/21 - 1/27 Runs 1 - 8		Ash Comp#3 1/21 - 1/27 Runs 1 - 8		Average Used
ESP Fly Ash, Metals	Arsenic	INAA	mg/Kg		50		50		60		53
ESP Fly Ash, Metals	Barium	INAA	mg/Kg		430		440		550		473
ESP Fly Ash, Metals	Beryllium	ICP-AES	mg/Kg		7.6		2.2@		2.3@		4.0
ESP Fly Ash, Metals	Cadmium	ICP-AES	mg/Kg	ND<	0.5		4.1		3.7		2.8
ESP Fly Ash, Metals	Chromium	INAA	mg/Kg		100		140		115		118
ESP Fly Ash, Metals	Cobalt	INAA	mg/Kg		690		730		800		740
ESP Fly Ash, Metals	Copper	ICP-AES	mg/Kg		180		220		200		200
ESP Fly Ash, Metals	Lead	GFAAS	mg/Kg		340		250		270		287
ESP Fly Ash, Metals	Manganese	ICP-AES	mg/Kg		170		141		111		141
ESP Fly Ash, Metals	Mercury	INAA	mg/Kg	ND<	0.15	ND<	0.22		NA	ND<	0.19
ESP Fly Ash, Metals	Molybdenum	INAA	mg/Kg		54		43		60		52
ESP Fly Ash, Metals	Nickel	ICP-AES	mg/Kg		18,000		19,996		19,996		19,331
ESP Fly Ash, Metals	Selenium	INAA	mg/Kg		43		53		30		42
ESP Fly Ash, Metals	Phosphorus	ICP-AES	mg/Kg		1,600		1,600		1,700		1,633
ESP Fly Ash, Metals	Vanadium	ICP-AES	mg/Kg		20,000		22,990		22,990		21,993
ESP Fly Ash, Anions	Chloride	IC	mg/Kg	ND<	250	ND<	100	ND<	100	ND<	250
ESP Fly Ash, Anions	Fluoride	IC	mg/Kg	ND<	2.5	ND<	3.0	ND<	3.0	ND<	3.0
ESP Fly Ash, Anions	Sulfate	IC	mg/Kg		140,000		250,000		250,000		213,333

Stream	Substance	Method	UOM	Ash Comp. 1/20-1/22 Runs 1,3,5	Average Used
ESP Fly Ash, Radionuclides	Uranium-233 & -234	Alpha Spectrometry	pCi/g	4.0	4.0
ESP Fly Ash, Radionuclides	Uranium-235	Alpha Spectrometry	pCi/g	0.1	0.1
ESP Fly Ash, Radionuclides	Uranium-238	Alpha Spectrometry	pCi/g	3.0	3.0
ESP Fly Ash, Radionuclides	Radium-226	Alpha Spectrometry	pCi/g	1.7	1.7
ESP Fly Ash, Radionuclides	Radium-228	Alpha Spectrometry	pCi/g	2.5	2.5
ESP Fly Ash, Radionuclides	Lead-210	Alpha Spectrometry	pCi/g	18	18
ESP Fly Ash, Radionuclides	Polonium-210	Alpha Spectrometry	pCi/g	16	16
ESP Fly Ash, Radionuclides	Thorium-228	Alpha Spectrometry	pCi/g	9.0	9.0
ESP Fly Ash, Radionuclides	Thorium-230	Alpha Spectrometry	pCi/g	2.9	2.9
ESP Fly Ash, Radionuclides	Thorium-232	Alpha Spectrometry	pCi/g	0.3	0.3

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APPENDIX C

DATA NOT USED IN CALCULATIONS

This appendix contains data that was not used in emissions or mass balance calculations for the Site 118.

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APPENDIX C
SITE 118 DATA NOT USED IN CALCULATIONS

Stream	Substance	Method	UOM	Run 1	Run 3	Run 5		Average Used
Stack Gas, Anions	Phosphate	IC	ug/Nm3	ND< 2,036	ND< 442	ND< 422		ND< 2,036
ESP, Inlet Gas, Anions	Phosphate	IC	ug/Nm3	362@	1,110@	1,129@		867@

Stream	Substance	Method	UOM	Run 10	Run 11	Run 12	Run 13	Average Used
Stack Gas,Chrome	Chromium, total	EPAREC/ICP	ug/Nm3	1.71	3.25	1.90	1.02	1.97
Stack Gas,Chrome	Hexavalent Chromium	EPAREC/IC-PCR	ug/Nm3	0.21@	0.27@	0.47	0.17@	0.28@

Stream	Substance	Method	UOM	Run 8B	Run 10A	Run 13		Average Used
Stack Gas, Ni Speciation	Nickel, Soluble	SL/AAS	%	68.0	62.5	60.9		63.8%
Stack Gas, Ni Speciation	Nickel, Sulfidic	SL/AAS	%	7.3	8.1	7.9		7.8%
Stack Gas, Ni Speciation	Nickel, Metallic	SL/AAS	%	ND < 3.6	ND < 1.6	ND < 3.8		ND < 3.8%
Stack Gas, Ni Speciation	Nickel, Oxidic	SL/AAS	%	22.9	28.6	29.3		26.9%

Stream	Substance	Method	UOM	Run 8A	Run 8B	Run 10A	Run 10B	Average Used
ESP, Inlet Gas, Ni Speciation	Nickel, Soluble	SL/AAS	%	38.8	37.5	34.5	35.4	36.6%
ESP, Inlet Gas, Ni Speciation	Nickel, Sulfidic	SL/AAS	%	9.3	8.9	7.3	6.0	7.9%
ESP, Inlet Gas, Ni Speciation	Nickel, Metallic	SL/AAS	%	ND < 1.0	ND < 0.3	2.1	1.8	1.1%
ESP, Inlet Gas, Ni Speciation	Nickel, Oxidic	SL/AAS	%	51.4	53.4	56.1	56.7	54.4%

Stream	Substance	Method	UOM	Oil 1/20 Run 1	Oil 1/21 Run 3	Oil 1/22 Run 5		Average Used
Fuel Oil, Metals	Arsenic	GFAAS	mg/Kg	0.27@	ND< 0.25	ND< 0.23		ND< 0.25
Fuel Oil, Metals	Chromium	ICP-AES	mg/Kg	0.1	0.1	0.1		0.1
Fuel Oil, Metals	Mercury	CVAAS	mg/Kg	ND< 0.1	ND< 0.1	ND< 0.1		ND< 0.1
Fuel Oil, Metals	Molybdenum	ICP-AES	mg/Kg	0.13	0.11	0.06@		0.10
Fuel Oil, Metals	Selenium	GFAAS	mg/Kg	ND< 0.007	ND< 0.007	ND< 0.006		ND< 0.007
Fuel Oil, Metals	Cobalt	INAA	mg/Kg	1.5	2.2	1.3		1.7
Fuel Oil, Metals-Anions	Chlorine	ASTM	mg/Kg	1,000	800	800		867

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APPENDIX C
SITE 118 DATA NOT USED IN CALCULATIONS

Stream	Substance	Method	UOM		Oil 1/28 Runs 10, 11		Oil 1/29 Runs 12,13		Average Used
Fuel Oil, Metals	Chromium	ICP-AES	mg/Kg	ND<	0.5	ND<	0.5	ND<	0.5
Fuel Oil, Metals	Nickel	ICP-AES	mg/Kg		33.0		31.0		32.0

Stream	Substance	Method	UOM		Ash Comp#1 1/21 - 1/27 Runs 1 - 8		Ash Comp#2 1/21 - 1/27 Runs 1 - 8		Ash Comp#3 1/21 - 1/27 Runs 1 - 8		Average Used
ESP Fly Ash, Metals	Arsenic	GFAAS	mg/Kg		39		60		54		51
ESP Fly Ash, Metals	Barium	ICP-AES	mg/Kg		10		62		65		46
ESP Fly Ash, Metals	Chromium	ICP-AES	mg/Kg		105		118		108		110
ESP Fly Ash, Metals	Cobalt	ICP-AES	mg/Kg		670		720		730		707
ESP Fly Ash, Metals	Mercury	CVAAS	mg/Kg	ND<	0.1	ND<	0.1	ND<	0.1	ND<	0.1
ESP Fly Ash, Metals	Molybdenum	ICP-AES	mg/Kg		110		130		130		123
ESP Fly Ash, Metals	Selenium	GFAAS	mg/Kg	ND<	0.05	ND<	5.00	ND<	5.00	ND<	5.00
ESP Fly Ash, Anions	Phosphate	IC	mg/Kg	ND<	1,000	ND<	20	ND<	20	ND<	1,000

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APPENDIX D

PROCESS STREAM FLOW RATES AND CALCULATION PROCEDURES

The tables in Appendix D summarize the following information:

Table D-1:	Mean process stream flows at Site 118
Table D-2:	ESP inlet and ESP outlet gas conditions and flow rate summary, including comparison of the measured flow rate to the calculated flow rate
Table D-3:	Sample train test summaries including sample volumes and isokinetic ratios
Table D-4:	Summary of ESP fly ash collection
Table D-5:	Calculations

TABLE D-1
MEAN PROCESS STREAM FLOWS AT SITE 118

Stream		Mean Flow Rate	Standard Deviation	Source
Oil (lb/hr)		402,000	11,000	Measured*
ESP Fly Ash	(lb/hr, dry)	392	NC	Calculated**
	(lb/MMBtu)	0.051	NC	
ESP Outlet Gas (dscfm)		1,411,515	36,440	Calculated***
ESP Inlet Gas (dscfm)		1,463,001	43,373	Calculated***

* Measured by fuel oil totalizers. Calibration of the totalizers was performed using tank drop measurements of the Site 118 day tank.

** Calculated from mass of ash collected in the silo, mass of oil fired, and oil flow rate.

*** Calculated from oil flow and F-factor. (F-factor = 9,200 dscf/MMBtu)

Mean oil and gas flow rates are from Runs 1, 3, 5, 6 & 7, 8, 10 & 11, and 12 & 13

NC - not calculated. Average values of fuel flow and ash properties were used to generate one ash flow value.

TABLE D-2
SUMMARY OF EXHAUST GAS CONDITIONS AND FLOW RATES FOR ISOKINETIC TESTS
SITE 118

Test No.	Date	Time	O_2,(1) %	CO_2, %	H_2O, %	Stack Temp. °F	Vm std, dscf	Flow (2) Rate (Pitot) dscfm	Load, MW	Flow(3) Rate (F-factor) dscfm	Isokinetic Ratio %
1-PM/AN-IN	01/20/93	1130/1700	3.53	13.52	9.3	320	124.61	NA	844	1.41×10^{06}	104.1
1-PM/AN-STK	01/20/93	1130/1700	4.27	12.94	9.0	331	140.35	1.65×10^{06}	844	1.47×10^{06}	95.0
1-MTLS-IN	01/20/93	1223/1756	3.45	14.07	9.3	315	109.43	NA	844	1.40×10^{06}	98.6
1-MTLS-STK	01/20/93	1352/1953	4.80	12.98	9.3	330	98.85	1.67×10^{06}	844	1.52×10^{06}	111.1
3-PM/AN-IN	01/21/93	1030/1508	3.97	13.17	9.3	321	120.65	NA	836	1.45×10^{06}	103.8
3-PM/AN-STK	01/21/93	1030/1515	4.05	13.11	9.0	330	142.08	1.63×10^{06}	836	1.45×10^{06}	97.1
3-MTLS-STK	01/21/93	1044/1528	4.80	12.53	9.0	328	92.96	1.68×10^{06}	836	1.52×10^{06}	105.9
3-MTLS-IN	01/21/93	1124/1649	4.03	13.15	9.3	316	103.16	NA	836	1.45×10^{06}	97.9
5-PM/AN-STK	01/22/93	1030/1520	3.91	13.00	9.4	333	147.55	1.62×10^{06}	841	1.45×10^{06}	101.6
5-PM/AN-IN	01/22/93	1031/1723	3.62	13.29	9.7	322	121.85	NA	841	1.42×10^{06}	100.4
5-MTLS-STK	01/22/93	1040/1545	4.64	12.44	9.6	333	88.64	1.65×10^{06}	841	1.51×10^{06}	104.0
5-MTLS-IN	01/22/93	1114/1603	3.60	13.30	9.8	317	90.30	NA	841	1.42×10^{06}	97.9
6-SV-STK	01/26/93	1030/1500	4.62	12.35	8.9	336	148.58	1.69×10^{06}	839	1.53×10^{06}	97.9
6-SV-IN	01/26/93	1031/1519	3.81	12.96	8.8	321	140.84	NA	839	1.46×10^{06}	98.0
7-SV-STK	01/26/93	1200/1615	4.48	12.51	8.8	334	120.35	1.66×10^{06}	839	1.52×10^{06}	98.1
7-SV-IN	01/26/93	1222/1616	3.81	13.02	9.0	316	114.01	NA	839	1.46×10^{06}	99.5
8-SV-STK	01/27/93	1000/1508	4.60	13.01	8.9	304	136.34	1.55×10^{06}	789	1.41×10^{06}	100.2
8-SV-IN	01/27/93	1025/1515	3.98	13.50	8.9	297	123.93	NA	789	1.36×10^{06}	100.4
8A-Ni-STK	01/27/93	1133/1233	4.60	13.01	9.7	306	35.28	SP	789	1.41×10^{06}	93.7
8A-Ni-IN	01/27/93	1145/1245	3.98	13.50	10.1	303	14.36	SP	789	1.36×10^{06}	97.1
8B-Ni-STK	01/27/93	1415/1515	4.60	13.01	9.1	306	35.01	SP	789	1.41×10^{06}	93.4
8B-Ni-IN	01/27/93	1416/1516	3.98	13.50	8.1	293	16.02	SP	789	1.36×10^{06}	93.1
10A-Ni-IN	01/28/93	1558/1628	3.47	13.17	9.3	297	7.87	SP	788	1.36×10^{06}	93.0
10-Ni-STK	01/28/93	1605/1705	3.80	12.92	8.7	303	38.95	SP	788	1.39×10^{06}	101.7
10B-Ni-IN	01/28/93	1740/1810	3.67	13.02	8.5	294	8.63	SP	788	1.38×10^{06}	93.1
10-Cr-C-Unspiked	01/28/93	1200/1500	4.16	12.67	6.9	307	106.39	SP	788	1.42×10^{06}	93.4
11-Cr-C-Unspiked	01/28/93	1645/2025	3.80	12.97	9.0	309	110.70	SP	788	1.39×10^{06}	99.2
12-Cr-C-Unspiked	01/29/93	1125/1510	4.44	13.44	10.7	307	111.29	SP	788	1.47×10^{06}	101.2
13-Cr-C-Unspiked	01/29/93	1715/2015	4.45	12.82	6.4	308	109.87	SP	788	1.47×10^{06}	96.1
13-Ni-STK	01/29/93	2013/2043	4.56	13.27	9.6	275	18.41	SP	788	1.48×10^{06}	105.0
AVERAGE INLET			3.76	13.32	9.18	310		NA		1,408,173	
AVERAGE OUTLET**			4.39	12.88	8.94	316		1,645,717		1,461,852	
STANDARD DEVATION INLET			0.21	0.30	0.54	11.5		NA		38,926	
STANDARD DEVATION OUTLET**			0.33	0.30	0.99	16.9		43,042		48,708	

Notes:
SP: Single point test
NA: Not applicable
(1) O_2 for multi-point tests taken for portable O_2 meter, O_2 for single-point tests calculated from the average of concurrent multi-point tests. EXCEPTION: For single-point nickel and chromium tests 10-15, O_2 from portable meter was used.
(2) Pitot traverse from the inlet not valid, location does not meet EPA Method 1. One port was unavailable for sampling and points were skipped due to lack of flow.
(3) F-Factor Flow rate calculated for Unit 6 using:
DSCFM = Fuel flow, lb/hr * HHV, Btu/lb * F-factor @ 0% O_2, dscf/mmBtu * 10 ^-6 * 20.9/(20.9-%O_2 (test)) * hr/60 min.
** – Does not include Runs 14 and 15 which were at low load (169 MW)

TABLE D-3
SAMPLE TRAIN TEST SUMMARY
SITE 118

Parameter	MULTI-METAL ESP Inlet	Stack
Date	1/20/93	1/20/93
Test No	1-MTLS-IN	1-MTLS-STK
Std Sample Vol (SCF)	109.4	98.8
Std Sample Vol (Nm^3)	2.89	2.61
Moisture Fraction	0.093	0.093
Stack Gas Mol Wt	29.23	29.13
Stack Gas Velocity (ft/sec)	46.49	102.17
Stack Flow Rate (wacfm)	–	2,773,322
Stack Flow Rate (dscfm)	–	1,671,180
Isokinetic Ratio (%)	98.63	111.14
Date	1/21/93	1/21/93
Test No	3-MTLS-IN	3-MTLS-STK
Std Sample Vol (SCF)	103.2	93.0
Std Sample Vol (Nm^3)	2.72	2.45
Moisture Fraction	0.093	0.090
Stack Gas Mol Wt	29.12	29.09
Stack Gas Velocity (ft/sec)	46.61	102.63
Stack Flow Rate (wacfm)	–	2,785,780
Stack Flow Rate (dscfm)	–	1,683,074
Isokinetic Ratio (%)	97.85	105.93
Date	1/22/93	1/22/93
Test No	5-MTLS-IN	5-MTLS-STK
Std Sample Vol (SCF)	90.3	88.6
Std Sample Vol (Nm^3)	2.38	2.34
Moisture Fraction	0.098	0.096
Stack Gas Mol Wt	29.06	29.01
Stack Gas Velocity (ft/sec)	47.06	103.86
Stack Flow Rate (wacfm)	–	2,819,172
Stack Flow Rate (dscfm)	–	1,652,145
Isokinetic Ratio (%)	97.93	104.00

Note:
Flow rates provided here are as measured by S-type pitot traverse.

(continued)

TABLE D-3 (continued)
SAMPLE TRAIN TEST SUMMARY
SITE 118

Parameter	SEMI-VOST ESP Inlet	Stack
Date	1/26/93	1/26/93
Test No	6-SV-IN	6-SV-STK
Std Sample Vol (SCF)	140.8	148.6
Std Sample Vol (Nm^3)	3.72	3.92
Moisture Fraction	0.088	0.089
Stack Gas Mol Wt	29.15	29.08
Stack Gas Velocity (ft/sec)	45.08	105.42
Stack Flow Rate (wacfm)	–	2,861,557
Stack Flow Rate (dscfm)	–	1,692,610
Isokinetic Ratio (%)	97.9	97.90
Date	1/26/93	1/26/93
Test No	7-SV-IN	7-SV-STK
Std Sample Vol (SCF)	114.0	120.3
Std Sample Vol (Nm^3)	3.01	3.18
Moisture Fraction	0.090	0.088
Stack Gas Mol Wt	29.14	29.11
Stack Gas Velocity (ft/sec)	50.25	103.29
Stack Flow Rate (wacfm)	–	2,803,556
Stack Flow Rate (dscfm)	–	1,664,405
Isokinetic Ratio (%)	99.48	98.14
Date	1/27/93	1/27/93
Test No	8-SV-IN	8-SV-STK
Std Sample Vol (SCF)	123.9	136.3
Std Sample Vol (Nm^3)	3.27	3.60
Moisture Fraction	0.089	0.089
Stack Gas Mol Wt	29.22	29.18
Stack Gas Velocity (ft/sec)	41.87	93.26
Stack Flow Rate (wacfm)	–	2,531,387
Stack Flow Rate (dscfm)	–	1,549,319
Isokinetic Ratio (%)	100.35	100.23

Note:
Flow rates provided here are as measured by S-type pitot traverse.

(continued)

TABLE D-3 (continued)
SAMPLE TRAIN TEST SUMMARY
SITE 118

Parameter	PARTICULATES/ANIONS/RADIONUCLIDES ESP Inlet	Stack
Date	1/20/93	1/20/93
Test No	1-PM/AN-IN	1-PM/AN-STK
Std Sample Vol (SCF)	124.6	140.3
Std Sample Vol (Nm^3)	3.29	3.70
Moisture Fraction	0.093	0.090
Stack Gas Mol Wt	29.16	29.14
Stack Gas Velocity (ft/sec)	46.48	100.71
Stack Flow Rate (wacfm)	–	2,733,593
Stack Flow Rate (dscfm)	–	1,647,433
Isokinetic Ratio (%)	104.1	95.01
Date	1/21/93	1/21/93
Test No	3-PM/AN-IN	3-PM/AN-STK
Std Sample Vol (SCF)	120.6	142.1
Std Sample Vol (Nm^3)	3.18	3.75
Moisture Fraction	0.093	0.090
Stack Gas Mol Wt	29.13	29.15
Stack Gas Velocity (ft/sec)	45.13	100.07
Stack Flow Rate (wacfm)	–	2,716,356
Stack Flow Rate (dscfm)	–	1,632,193
Isokinetic Ratio (%)	103.76	97.08
Date	1/22/93	1/22/93
Test No	5-PM/AN-IN	5-PM/AN-STK
Std Sample Vol (SCF)	121.9	147.6
Std Sample Vol (Nm^3)	3.22	3.89
Moisture Fraction	0.097	0.094
Stack Gas Mol Wt	29.08	29.09
Stack Gas Velocity (ft/sec)	48.34	101.71
Stack Flow Rate (wacfm)	–	2,760,691
Stack Flow Rate (dscfm)	–	1,619,091
Isokinetic Ratio (%)	100.36	101.64

<u>Note:</u>
Flow rates provided here are as measured by S-type pitot traverse.

(continued)

TABLE D-3 (continued)
SAMPLE TRAIN TEST SUMMARY
SITE 118

Parameter	NICKEL ESP Inlet	Stack
Date	1/27/93	1/27/93
Test No	8A-Ni-IN	8A-Ni-STK
Std Sample Vol (SCF)	14.4	35.3
Std Sample Vol (Nm^3)	0.38	0.93
Moisture Fraction	0.101	0.097
Stack Gas Mol Wt	29.07	29.08
Stack Gas Velocity (ft/sec)	41.30	91.50
Stack Flow Rate (wacfm)	–	–
Stack Flow Rate (dscfm)	–	–
Isokinetic Ratio (%)	97.1	93.69
Date	1/27/93	1/27/93
Test No	8B-Ni-IN	8B-Ni-STK
Std Sample Vol (SCF)	16.0	35.0
Std Sample Vol (Nm^3)	0.42	0.92
Moisture Fraction	0.081	0.091
Stack Gas Mol Wt	29.32	29.15
Stack Gas Velocity (ft/sec)	46.36	90.53
Stack Flow Rate (wacfm)	–	–
Stack Flow Rate (dscfm)	–	–
Isokinetic Ratio (%)	93.05	93.35
Date	1/28/93	1/28/93
Test No	10A-Ni-IN	10-Ni-STK
Std Sample Vol (SCF)	7.9	38.9
Std Sample Vol (Nm^3)	0.21	1.03
Moisture Fraction	0.093	0.087
Stack Gas Mol Wt	29.11	29.15
Stack Gas Velocity (ft/sec)	46.21	91.46
Stack Flow Rate (wacfm)	–	–
Stack Flow Rate (dscfm)	–	–
Isokinetic Ratio (%)	92.95	101.66

Note:
These tests were conducted at a single point in the gas stream.

(continued)

TABLE D-3 (continued)
SAMPLE TRAIN TEST SUMMARY
SITE 118

Parameter	NICKEL ESP Inlet	Stack
Date	1/28/93	1/29/93
Test No	10B-Ni-IN	13-Ni-STK
Std Sample Vol (SCF)	8.6	18.4
Std Sample Vol (Nm^3)	0.23	0.49
Moisture Fraction	0.085	0.096
Stack Gas Mol Wt	29.19	29.13
Stack Gas Velocity (ft/sec)	49.94	81.44
Stack Flow Rate (wacfm)	–	–
Stack Flow Rate (dscfm)	–	–
Isokinetic Ratio (%)	93.07	104.95

(continued)

Note:
These tests were conducted at a single point in the gas stream.

TABLE D-3 (continued)
SAMPLE TRAIN TEST SUMMARY
SITE 118

Parameter	FORMALDEHYDE ESP Inlet	Stack
Date	1/22/93	1/22/93
Test No	5A-FORM-IN	5A-FORM-STK
Std Sample Vol (DSCF)	3.5	4.8
Std Sample Vol (Nm^3)	0.092	0.13
% O_2	3.6	4.3
Date	1/22/93	1/22/93
Test No	5B-FORM-IN	5B-FORM-STK
Std Sample Vol (DSCF)	3.6	4.5
Std Sample Vol (Nm^3)	0.094	0.12
% O_2	3.6	4.3
Date	1/22/93	1/22/93
Test No	5C-FORM-IN	5C-FORM-STK
Std Sample Vol (DSCF)	3.5	4.5
Std Sample Vol (Nm^3)	0.093	0.12
% O_2	3.6	4.3

(continued)

Note:
% O_2 values from 5-MTLS-IN and 5-MTLS-STK.

TABLE D-3 (continued)
SAMPLE TRAIN TEST SUMMARY
SITE 118

Parameter	BENZENE AND TOLUENE ESP Inlet	Stack
Date	01/20/93	01/20/93
Test No	1B-VOC-IN	1B-VOC-STK
% O_2	3.5	4.5
Date	01/20/93	01/20/93
Test No	1C-VOC-IN	1C-VOC-STK
% O_2	3.5	4.5
Date	01/20/93	01/20/93
Test No	1D-VOC-IN	1D-VOC-STK
% O_2	3.490	4.5

(continued)

Note:
% O_2 values from 1-MTLS-IN and 1-MTLS-STK.

TABLE D-3 (continued)
SAMPLE TRAIN TEST SUMMARY
SITE 118

CHROMIUM

Parameter	Stack	Stack
Date	1/28/93	1/28/93
Test No	10-Cr-C-Unspike	11-Cr-C-Unspike
Std Sample Vol (SCF)	106.4	110.7
Std Sample Vol (Nm^3)	2.81	2.92
Moisture Fraction	0.069	0.090
Stack Gas Mol Wt	29.35	29.12
Stack Gas Velocity (ft/sec)	88.41	88.89
Stack Flow Rate (wacfm)	–	–
Stack Flow Rate (dscfm)	–	–
Isokinetic Ratio (%)	93.36	99.15
Date	1/29/93	1/29/93
Test No	12-Cr-C-Unspike	13-Cr-C-Unspike
Std Sample Vol (SCF)	111.3	109.9
Std Sample Vol (Nm^3)	2.94	2.90
Moisture Fraction	0.107	0.064
Stack Gas Mol Wt	29.01	29.45
Stack Gas Velocity (ft/sec)	88.93	88.33
Stack Flow Rate (wacfm)	–	–
Stack Flow Rate (dscfm)	–	–
Isokinetic Ratio (%)	101.20	96.08

Note:
These tests were conducted at a single point in the gas stream.

TABLE D-4
COMPUTATION OF ESP ASH MASS FLOW RATE
SITE 118

(1) Fuel flow	408,000 lb/hr	Average from 1/20, 1/21, 1/22
(2) Total fuel	2,585,966 gal.	Between 1/19 and 1/22
(3) Specific gravity	0.9746	Average from 1/20, 1/21, 1/22
(4) Mass of fuel	21,025,000 lb	Computed from (2) and (3)
(5) End volume of ash in silo	1,618 ft^3	12.25 ft from top of silo
(6) Specific gravity of ash	0.20[(1)]	Average of three determinations
(7) Mass of ash	20,193 lb	Computed from (5) and (6)
(8) Mass of ash/mass of fuel	.00096 lb ash/lb fuel	[(7)/(4)]
Calculated ESP ash flow	392 lb/hr	[(8) x (1)]

Notes:
(1) Specific gravity of ash depends on compaction: "loose" bulk specific gravity measured 0.16, "compacted" bulk specific gravity measured 0.25.

TABLE D-5
SAMPLE TRAIN CALCULATION PROCEDURES
SITE 112

1. <u>To Calculate Sample Volume, Actual Exhaust Flow Rate and Isokinetics for Each Sample Train</u>

a. Sample gas volume, dscf

$$V_{m\ std} = 0.03342\ V_m \left(P_{bar} + \frac{H}{13.6}\right)\left(\frac{T_{ref}}{T_m}\right)(Y)$$

b. Water vapor volume, scf

$$V_{w\ std} = 0.0472\ V_{lc}\left(\frac{T_{ref}}{528\ {}^\circ R}\right)$$

c. Moisture content, nondimensional

$$B_{wo} = \frac{V_{w\ std}}{V_{m\ std} + V_{w\ std}}$$

d. Stack gas molecular weight, lb/lb mole

$$MW_{dry} = 0.44\ (\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2)$$

$$MW_{wet} = MW_{dry}\ (1 - B_{wo}) + 18\ (B_{wo})$$

e. Absolute stack pressure, in Hg

$$P_s = P_{bar} + \frac{P_{sg}}{13.6}$$

f. Stack velocity, ft/sec

$$V_s = 2.90\ C_p\ \sqrt{\Delta P T_s}\ \sqrt{\left(\frac{29.92}{P_s}\right)\left(\frac{28.95}{MW_{wet}}\right)}$$

g. Actual stack flow rate, wacfm

$$Q = (V_s)(A_s)(60)$$

h. Standard stack gas flow rate, dscfm

$$Q_{sd} = Q\ (1 - B_{wo})\left(\frac{T_{ref}}{T_s}\right)\left(\frac{P_s}{29.92}\right)$$

i. Percent isokinetic

$$I = \left(\frac{17.32 (T_s)(V_{m\ std})}{(1 - B_{wo})(\Theta)(V_s)(P_s)(D_n^2)} \right) \left(\frac{528\ ^\circ R}{T_{ref}} \right)$$

2. <u>To Calculate Particulate Emissions</u>

a. Grain loading, gr/dscf

$$C = 0.01543 \left(\frac{M_n}{V_{m\ std}} \right)$$

b. Grain loading at 12% CO_2, gr/dscf

$$C_{12\% CO_2} = C \left(\frac{12}{\% CO_2} \right)$$

c. Mass emissions, lb/hr

$$M = C(Q_{sd}) \frac{(60\ min/hr)}{(7000\ gr/lb)}$$

3. <u>To Calculate Gaseous Emissions, lb/hr</u>

$$M = (ppm)(10^{-6}) \left(\frac{MW_i\ lb/lb\ mole}{SV} \right) (Q_{sd})(60\ min/hr)$$

where,

SV = specific molar volume of an ideal gas:

$SV = 385.3\ ft^3/lb\ mole \quad for\ T_{ref} = 528\ ^\circ R$

$SV = 379.5\ ft^3/lb\ mole \quad for\ T_{ref} = 520\ ^\circ R$

4. <u>To Estimate Emissions Rates in lb/10^6 Btu Using EPA Method 19 and Given Fuel Analysis</u>

a. Fuel factor at 68 °F, dscf/10^6 Btu at 0% O_2

$$F_{68} = \frac{10^6[3.64(\%H) + 1.53(\%C) + 0.14\ (\%N) + 0.57(\%S) - 0.46(\%O_2,fuel)]}{HHV,\ Btu/lb}$$

b. Fuel factor at 60 °F

$$F_{60} = F_{68}\left(\frac{520\ {}^\circ R}{528\ {}^\circ R}\right)$$

c. Gaseous Emissions factor, lb/10^6 Btu

$$\left(\frac{lb}{10^6\ Btu}\right)_i = (ppm)_i\ (10^{-6})\left(\frac{MW_i\ lb}{lb\ mole}\right)\left(\frac{1}{SV}\right)(F)\left(\frac{20.9}{20.9\ -\ \%O_2}\right)$$

d. Gaseous Emissions factor, lb/10^{12} Btu

$$\left(\frac{lb}{10^{12}\ Btu}\right)_i = \left(\frac{lb}{10^6\ Btu}\right)_i \times 10^6$$

e. Particulate emission factor, lb/10^6 Btu

$$\left(\frac{lb}{10^6\ Btu}\right) = C\left(\frac{1\ lb}{7000\ gr}\right)(F)\left(\frac{20.9}{20.9\ -\ \%O_2}\right)$$

f. Particulate emission factor, lb/10^{12} Btu

$$\left(\frac{lb}{10^{12}\ Btu}\right) = \left(\frac{lb}{10^6\ Btu}\right) \times 10^6$$

5. <u>To Calculate Trace Species Emissions Given Laboratory Results</u>

a. ng/sample train = (ng detected) - (ng in field or reagent blank)

b. ng/dscm = ng sample train x ($35.31/V_{m\ std}$)

c. ng/Nm^3 = ng/sample train x ($35.31/V_{m\ std\ dscf}$) x 492/Tref

d. lb/hr = ng/dscm x (1 g/10^9 ng) x (1 lb 454 g) x (1 m^3/35.31 ft^3) x Q_{sd} x (60 min/hr)
where Q_{sd} = standard flow rate, dscfm and Nm^3 = normal cubic meter (0°C, 1 atm)

e. For Formaldehyde Results
$ppb = (\mu g/\text{sample train}) \times 1/V_{m\,std}) \times (1\ lb/454\ g) \times (1\ g/10^6\ \mu g) \times SV/MW_i \times 10^9$
$lb/hr = ppb \times 10^{-9}\ MW_i/SV \times Q_{sd} \times 60\ min/hr$

f. For Anion Results
$ppm = (mg/\text{sample train}) \times (1/V_{m\,std}) \times (1\ lb/454\ g) \times (1\ g/10^3\ mg) \times SV/MW_i$
$\times 10^6$

$lb/hr - ppm \times 10^{-6}\ MW_i/SV \times Q_{sd} \times 60\ min/hr$

Notes: Laboratory results could be in either μg or mg. PAH, metals, chromium and formaldehyde results will be in μg and anion results will be in mg.

Field and reagent blank values must be evaluated before subtracting them. For example, very low blanks may merely indicate "noise" and might be disregarded. On the other hand, very high blank values may indicate sampling or analysis problems which should be investigated. It may be acceptable to use a blank correction on some projects or with some reference methods. Typically a reagent blank is a more appropriate indicator of blank levels than a field blank.

6. To Calculate CO_2, % for Each Sample Train

a. Given CEM results for O_2, % and CO_2, % at the outlet and the portable O_2 meter results at each sample train.

b. $$Test\ CO_2 = CEM\ CO_2 \times \frac{20.9 - test\ O_2}{20.9 - CEM\ O_2}$$

7. To Construct a Mass Balance Around the Boiler-ESP-Stack System for a Given Parameter, *i*

a. Given stack gas ash and fuel sample results.

b. M_i (fuel) = M_i (stack gas) + M_i (ash)
where M_i is in units of either lb_i/day or $lb_i/10^{12}$ Btu and *i* denotes the particular parameter of interest.

c. Mass balance$_i$ = (M_i (air) + M_i (ash))/M_i (fuel), expressed as %

8. To Calculate Exhaust Gas Flow Rate from Heat Rate and F-factor:

Flow rate, dscfm = Oil flow (lb/hr) x HHV (Btu/lb) x F-factor @ 0% O_2, dscf/MMBtu x MMBtu/ x 10^6Btu x 20.9/(20.9-%O_2) x hr/60 mi

9. To Calculate Ash Flow Rate and lb ash/10^6 Btu

total ash, lb/hr = mass of ash, lb/mass of fuel, lb x fuel flow, lb/hr

lb ash/10^6 Btu = mass of ash, lb/mass of fuel, lb ÷ MMBtu/lb fuel

10. To Calculate lb/10^{12} Btu of Trace Species in Ash

i = trace species, i
a = ash
f = fuel oil
lb(i)/10^{12} Btu(f) - μg(i)/gram(a) x g(a)/cm^3
x total ash volume, cm^3 x lb(i)/454g(i) x g/$10^6\mu$g
x 1/HHV, Btu/lb(f) x 1/total fuel burned, lb(f)
x 10^{12}

11. To Calculate lb/10^{12} Btu of Trace Species in Fuel

lb/10^{12} Btu = μg/g x 1/HHV, Btu/lb x 10^6

12. Nomenclature:

A_s	=	stack area, ft^2
B_{wo}	=	flue gas moisture content
$C_{12\%\ CO_2}$	=	particulate grain loading, gr/dscf corrected to 12% CO_2
C	=	particulate grain loading, gr/dscf
C_p	=	pitot calibration factor, dimensionless

Dn	=	nozzle diameter, in.
F	=	fuel F factor, dscf/10^6 Btu at 0% O_2
H	=	orifice pressure differential, iwg
I	=	% isokinetics
M_n	=	mass of collected particulate, mg
M_i	=	mass emissions of species i, lb/hr
MW	=	molecular weight of flue gas
MW_i	=	molecular weight of species i:

NO_x	:	46
CO	:	28
SO_x	:	64
HC	:	16

θ	=	sample time, min.
ΔP	=	average velocity head, iwg = $\left(\overline{\sqrt{\Delta P}}\right)^2$
P_{bar}	=	barometric pressure, in.Hg
P_s	=	stack absolute pressure, in.Hg
P_{sg}	=	stack static pressure, iwg
Q	=	wet stack gas flow rate at actual conditions, wacfm
Qsd	=	dry stack gas flow rate at standard conditions, dscfm
SV	=	specific molar volume of an ideal gas at standard conditions, ft^3/lb mole
Tm	=	meter temperature, °R
T_{ref}	=	reference temperature, °R

Ts	=	stack temperature, °R
V_s	=	stack velocity, ft/sec
V_{lc}	=	volume of liquid collected in impingers, ml
Vm	=	dry meter volume uncorrected, dcf
$V_{m\,std}$	=	dry meter volume at standard conditions, dscf
$V_{w\,std}$	=	volume of water vapor at standard conditions, scf
Y	=	meter calibration coefficient

APPENDIX E

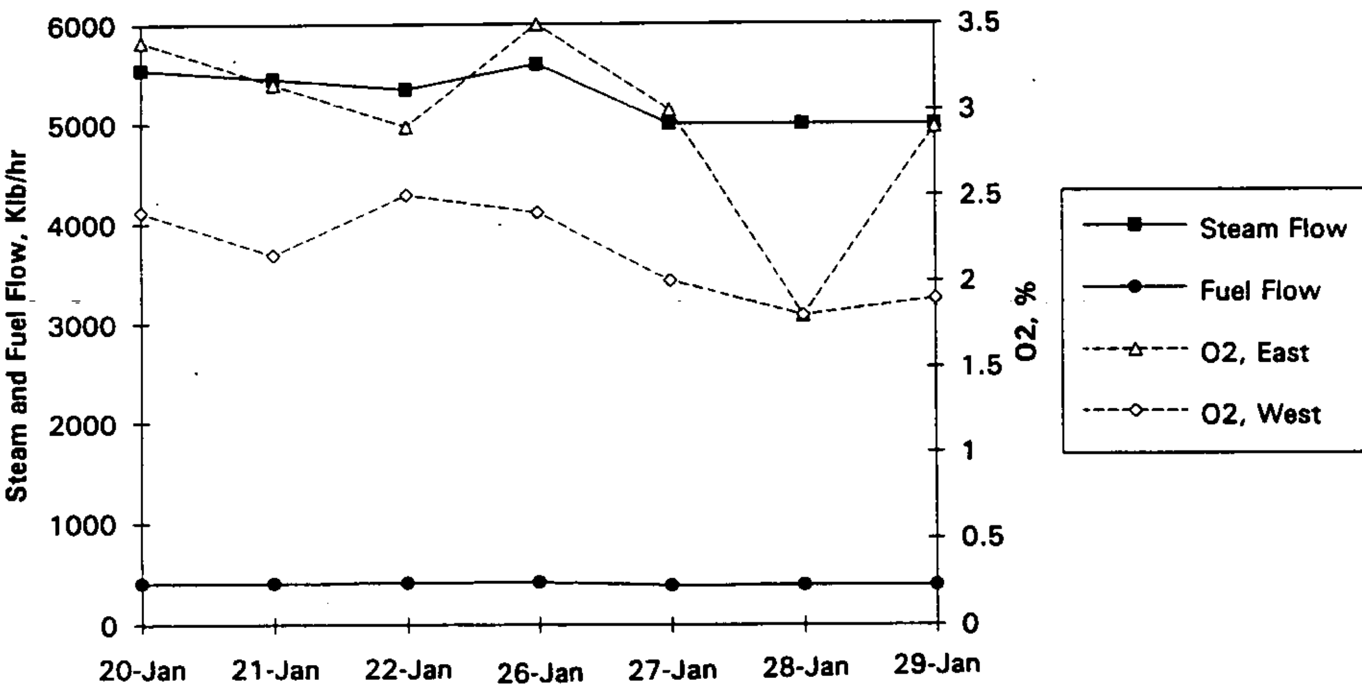
PROCESS OPERATION

TABLE E-1
SUMMARY OF UNIT OPERATING CONDITIONS
SITE 118

Date	01/20/93	01/21/93	01/22/93	01/26/93	01/27/93	01/28/93	01/29/30
Test No.	1	3	5	6,7	8	10,11	12,13
Unit Load, MW							
Gross	844	836	841	839	789	788	788
Net	806	800	804	802	756	757	753
Steam Flow, 10^6 lb/hr	5.54	5.45	5.35	5.60	5.00	5.00	5.00
Air Flow, 10^6 lb/hr	6.05	5.95	6.10	6.10	5.80	5.60	5.70
Fuel Flow, 10^3 lb/hr	407.7	407.8	408.5	415.0	383.7	395.3	395
Boiler O_2 %, E/W	3.4/2.4	3.15/2.15	2.9/2.5	3.5/2.4	3.0/2.0	1.8/1.8	2.9/1.9
Opacity, %	0.8	1.2	0.9	1.7	0.4	1.3	1.3
Fuel Oil Properties							
Fuel Oil Temp at burners	231	228	239	223	228	227	227
Fuel Oil Viscosity @122°F, cSt	372	360	368	438	362	413	422.8
Fuel Oil Specific Gravity 60°F	0.9743	0.9746	0.975	0.9771	0.9781	0.9818	0.9831
Fuel Oil Coke Index, %	5.91	5.49	5.61	4.91	4.67	6.13	4.53

Note: (1) Unit sootblowing was reduced to once per day. Sootblowing was performed after each test period.
(2) Load on 1/26 through 1/29 was decreased due to excessive boiler tube temperatures and FD fan vibrations.

Figure E-1
Unit Operation Parameters
Site 118



APPENDIX F
UNCERTAINTY ANALYSIS

Because the data generated in this program may be used in conducting risk assessments and in making policy and regulatory decisions, consideration of the uncertainties in the results generated in the program are important. Assessment of the uncertainty level of a measurement is especially important when the measured results are near the detection level of the methods.

In calculating uncertainties that are presented in this report, procedures were followed that have been previously established for PISCES data treatment. This procedure involved calculating an overall uncertainty for each result using standard statistical techniques and known measurement biases. 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 in 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. This uncertainty is only the uncertainty in the result for the period of time that the measurements were taken and does not represent long-term process variations. In addition, the following calculations assume that the population distribution of each measurement is normally distributed and that the samples collected reflect the true population.

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

Nomenclature

- r = Calculated result;
- S_{pi} = Sample standard deviation of parameter i;
- $S_{\overline{pi}}$ = Standard deviation of the average of parameter i;
- Θ_i = Sensitivity of the result to parameter i;
- B_{pi} = Bias error estimate for parameter i;
- v_i = Degrees of freedom in parameter i;
- v_r = Degrees of freedom in result;
- S_r = Precision component of result uncertainty;
- B_r = Bias component of result uncertainty;
- t = Student "t" factor (two-tailed distribution at 95%);
- U_r = Uncertainty in r;
- P_i = Parameter i;
- ΔP_i = Perturbation in parameter i;
- N_i = Number of measurements of parameter i; and
- E = Emission rate

For a result, r, the uncertainty in r is calculated as:

$$U_r = \sqrt{B_r^2 + (S_r * t)^2}$$

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

$$B_r = \sqrt{\sum_{i=1}^{j} (\theta_i * B_{pi})^2}$$

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

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

$$\theta_1 = \frac{\partial r}{\partial pi}$$

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

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

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

$$S_{\overline{pi}} = \frac{S_{pi}}{\sqrt{N_i}}$$

The degrees of freedom for each parameter is found from

$$\nu_i = N_i - 1$$

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

$$\nu_r = \frac{S_r^4}{\sum_{i=1}^{j} \left[\frac{(S_{\overline{pi}} * \theta_i)^4}{\nu_i} \right]}$$

The Student "t" in the first equation is associated with the degrees of freedom in the result.

The precision error terms are generated using collected data, and assigning degrees of freedom to each parameter. Bias errors are more qualitative in nature. Bias values are assigned based on observation of the process and engineering judgment.

For this report the following sources of bias were considered:

- No bias was assigned to analytical results unless the result is less than the detection limit. Then one-half the detection limit is used for both the parameter value and its bias in calculations.

  This bias component for results below the detection limit is calculated as:

$$B_{pi} = \sqrt{\sum_{i=1}^{N_i} \left(B_i * \frac{1}{N_i}\right)^2}$$

- The stack location met EPA Method 1 requirements for distances from flow disturbances. A cyclonic flow check was performed and all yaw angles were < 10°. The gas flow rates at the stack location measured by the S-type pitot probes were 10% higher than flow rates calculated from fuel flow and F-factor. During all isokinetic tests, sample flow rate was set based on the velocity measured by the pitot probe, as specified in EPA Methods 1, 2 and 5. This means that "true" isokinetic sampling rates may have been 10% low. Estimating errors induced by nonisokinetic sampling would correspond to an uncertainty of 10% in the concentrations of particulate species. Thus an uncertainty of 10% was applied to all particulate species measured from isokinetic tests.

- The inlet location did not meet EPA Method 1 for a suitable sampling location. In addition, one port was unavailable for sampling and points were skipped due to lack of flow. As a result, no attempt was made to calculate the S-type pitot flow rate. A value of 20% was applied to all inlet particulate species.

- No bias was used on fuel flow rates for this unit. Fuel flow rate was determined from fuel oil totalizers. Calibration of the totalizers was performed using tank drop measurements of the Site 118 day tank.

- An uncertainty of 30% was used on ESP fly ash rates and on species detected in the ash. This was based on the uncertainty of the ash density determination.

In interpreting and understanding the uncertainty values, it should be pointed out that when two levels of uncertainty are combined using a root-sum-squared process, the larger uncertainty predominates. A few examples are presented below:

- Combining two uncertainties of 10% results in a total uncertainty of 14%.

- Combining uncertainties of 50% and 8% results in a total uncertainty of 51%.

- Combining uncertainties of 90% and 10% results in an uncertainty of 90.5%.

Confidence Interval Calculations

In this report the confidence interval as a percent uncertainty is reported with the sample results. The uncertainty values calculated for this report are based on the 95% confidence interval calculated for mass emissions of the target species. This confidence interval equation propagates the error associated with the parameters required to determine concentration, mass emissions, and emission factors. The uncertainty is then expressed as a percentage so that it may be applied to an average result expressed in the required units.

Emission factors are calculated in units of $lb/10^{12}$ Btu. However, the equations used for uncertainty calculations are in mass emission units of lb/hr since these equations allow for an estimate of overall uncertainty incorporating all parameters. Uncertainty calculations for ash are in units of $lb/10^{12}$ Btu.

The following are sample calculations for the 95% confidence interval around the mean emission rate for air, fuel and ash samples. This procedure utilized the same method outlined earlier in this section and used in the computer program.

FLUE GAS

$$E,\ lb/hr = Concentration,\ \frac{\mu g}{Nm^3} \times Heat\ Rate,\ \frac{Btu}{MW-hr} \times F-Factor,\ \frac{dscf}{MMBtu} \times$$

$$\frac{20.9}{20.9-0_2(test),\%} \times Load,\ MW \times 5.8127 \times 10^{-17},$$

where

$$Heat\ Rate, \frac{Btu}{MW-hr} = HHV\ of\ fuel,\ Btu/lb \times Fuel\ Flow,\ lb/hr \div Load,\ MW$$

FUEL

$$E,\ lb/hr = Concentration,\ \frac{mg}{kg} \times Heat\ Rate,\ \frac{Btu}{MW-hr} \times 10^{-6} \times Load,\ MW \times \frac{1}{HHV,\ Btu/lb}$$

ASH

$$E,\ lb/10^{12}\ Btu = Concentration,\ \frac{mg}{kg} \times 10^6 \times \frac{1}{HHV,\ Btu/lb} \times \left(\frac{Ash\ Flow\ Rate}{Fuel\ Flow\ Rate}\right), \frac{lb\ (ash)}{lb\ (fuel)}$$

The following example calculation shows how the overall uncertainty of the stack PM<10 vanadium value from this program was determined.

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	$\mu g/Nm^3$	29.5	48.9	51.3	43.2
Heat Rate	Btu/MW-hr	9.04×10^6	9.21×10^6	9.07×10^6	9.11×10^6
F-Factor	dscf/MMBtu	9304	9177	9119	9200
O_2 (test)	%	4.80	4.80	4.64	4.75
Load (net)	MW	844	836	841	840

The sensitivity of each variable is calculated with a perturbation for each parameter that is equal to the larger value of the standard deviation of the average, $S_{\overline{pi}}$, or the bias error, B_{pi}. For the concentration variable:

$$S_{\overline{pc}} = \frac{S_{pi}}{\sqrt{N_i}} = \frac{11.9}{\sqrt{3}} = 6.90$$

$$E_{(c\,=\,43.2)} = 43.2 \times 9.11 \times 10^6 \times 9200 \times \frac{20.9}{20.9-4.75} \times 840 \times 5.8127 \times 10^{-17} = 0.229$$

$$E_{(c\,=\,50.1)} = 50.1 \times 9.11 \times 10^6 \times 9200 \times \frac{20.9}{20.9-4.75} \times 840 \times 5.8127 \times 10^{-17} = 0.266$$

$$\theta_c = \frac{E_{(Pi+\Delta Pi)} - E_{Pi}}{\Delta P_i} = \frac{E_{(c=43.2)} - E_{(c=50.1)}}{6.9}$$

$$\theta_c = \frac{0.266 - 0.229}{6.9} = 0.0053$$

Similar calculations for each parameter produce the following results:

	PARAMETER		
	Concentration, $\mu g/Nm^3$	Heat Rate, Btu/MW-hr	F-Factor, dscf/MMBtu
Mean	43.2	9.11×10^6	9200
S_{pi}	11.9	9.11×10^4	94.6
$S_{\overline{pi}}$	6.9	5.26×10^4	54.6
N_i	3	3	3
B_{pi}*	4.32	0	0
Θ_i	5.3×10^{-3}	2.5×10^{-8}	2.5×10^{-5}
v_i	2	2	2
ΔP_i	6.9	5.26×10^4	54.6

Notes: The bias estimate for concentration includes no bias for analytical results and a 10% collection bias.

The precision and bias components are then calculated by root-sum-squaring the product of the parameter $S_{\overline{pi}}$ or B_{pi} and the sensitivity:

$$S_r = \sqrt{(\theta_c * S_{\overline{pc}})^2 + (\theta_{hr} * S_{\overline{phr}})^2 + (\theta_{ff} * S_{\overline{pff}})^2}$$

$$S_r = 3.7 \times 10^{-2}$$

$$B_r = \sqrt{(\theta_c * B_{pc})^2 + (\theta_{hr} * B_{phr})^2 + (\theta_{ff} * B_{pff})^2}$$

$$B_r = 2.3 \times 10^{-2}$$

The Student "t" factor for two degrees of freedom and a 95% confidence interval is 4.3.

The uncertainty in the result is then

$$U_r = \sqrt{B_r^2 = (S_r * t)^2} = \sqrt{(2.3 \times 10^{-2})^2 + (3.7 \times 10^{-2} \times 4.3)^2} = 0.159$$

The overall emission rate is reported as

0.229 ± 0.159 lb/hr or 69% uncertainty.

PM < 10 METALS
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SPECIES	LOC		RUN #1		RUN #2 in ug/Nm3		RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)		ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
PM<10:																		
ARSENIC	IN		0.88		1.34		1.07		1.09E+00	2.30E-01	52.4%	20.0%	56.0%		5.44E-03	3.0E-03	14.80%	0.0%
BARIUM			13.4		18.2		23.8		1.84E+01	5.20E+00	70.1%	20.0%	72.9%		9.17E-02	6.7E-02	19.18%	0.0%
BERYLLIUM			0.83		0.73		0.84		8.02E-01	5.82E-02	18.4%	20.0%	27.2%		3.99E-03	1.1E-03	5.58%	0.0%
CADMIUM		ND<	0.10	ND<	0.11	ND<	0.13	ND<	1.13E-01	1.13E-02	25.1%	35.2%	43.2%	ND<	5.63E-04	2.4E-04	7.40%	100.0%
CHROMIUM			4.4		6.5		6.2		5.73E+00	1.13E+00	49.3%	20.0%	53.2%		2.85E-02	1.5E-02	15.07%	0.0%
COBALT			34.6		23.9		31.1		2.99E+01	5.48E+00	45.7%	20.0%	49.9%		1.48E-01	7.4E-02	13.35%	0.0%
COPPER			8.8		9.7		8.6		9.02E+00	6.00E-01	16.9%	20.0%	26.2%		4.48E-02	1.2E-02	5.02%	0.0%
LEAD			6.8		4.7		13.3		8.26E+00	4.50E+00	135.2%	20.0%	136.7%		4.11E-02	5.6E-02	40.66%	0.0%
MANGANESE			33.5		8.0		37.7		2.64E+01	1.61E+01	151.2%	20.0%	152.5%		1.31E-01	2.0E-01	46.45%	0.0%
MERCURY			1.52		1.23		0.92		1.23E+00	3.00E-01	60.9%	20.0%	64.1%		6.09E-03	3.9E-03	16.45%	0.0%
MOLYBDENUM			3.12		3.3		3.8		3.40E+00	3.40E-01	25.1%	20.0%	32.1%		1.69E-02	5.4E-03	7.40%	0.0%
NICKEL			864.7		623.3		838.1		7.75E+02	1.32E+02	42.5%	20.0%	47.0%		3.85E+00	1.8E+00	13.07%	0.0%
SELENIUM			1.9		3.0		3.5		2.83E+00	8.09E-01	71.2%	20.0%	74.0%		1.40E-02	1.0E-02	20.91%	0.0%
PHOSPHORUS			69.3		62.4		67.1		6.63E+01	3.49E+00	13.5%	20.0%	24.2%		3.30E-01	8.0E-02	3.86%	0.0%
VANADIUM			1004.2		881.6		965.2		9.50E+02	6.27E+01	16.8%	20.0%	26.1%		4.72E+00	1.2E+00	4.82%	0.0%
										AVERAGES:	53.0%	21.0%	59.0%		6.29E-01	2.4E-01	15.60%	
PM<10:																		
ARSENIC	STK		0.59		0.55		0.53		5.56E-01	3.12E-02	14.4%	10.0%	17.5%		2.94E-03	5.2E-04	4.18%	0.0%
BARIUM			3.30		12.07		7.52		7.63E+00	4.39E+00	142.9%	10.0%	143.2%		4.04E-02	5.8E-02	38.77%	0.0%
BERYLLIUM		ND<	0.04		0.04	ND<	0.04	@ ND<	4.28E-02	2.21E-03	13.3%	24.5%	27.9%	ND<	2.26E-04	6.3E-05	4.99%	100.0%
CADMIUM		ND<	0.12	ND<	0.12	ND<	0.13	ND<	1.22E-01	6.63E-03	14.0%	30.6%	33.6%	ND<	6.45E-04	2.2E-04	3.74%	100.0%
CHROMIUM			1.80		1.55		0.90		1.42E+00	4.66E-01	81.9%	10.0%	82.5%		7.50E-03	6.2E-03	24.40%	0.0%
COBALT			1.53		2.16		1.97		1.89E+00	3.21E-01	42.4%	10.0%	43.6%		9.99E-03	4.4E-03	12.49%	0.0%
COPPER			5.52		2.20		0.73		2.82E+00	2.46E+00	216.6%	10.0%	216.9%		1.49E-02	3.2E-02	64.02%	0.0%
LEAD		ND<	0.77		1.10	ND<	0.86	@ ND<	8.55E-01	1.73E-01	50.4%	24.5%	56.0%	ND<	4.53E-03	2.5E-03	13.02%	100.0%
MANGANESE			3.3		4.0		13.2		6.82E+00	5.51E+00	200.7%	10.0%	200.9%		3.61E-02	7.3E-02	62.05%	0.0%
MERCURY			0.48		0.45		1.00		6.44E-01	3.13E-01	120.6%	10.0%	121.1%		3.41E-03	4.1E-03	37.32%	0.0%
MOLYBDENUM			0.31		0.33		0.34		3.25E-01	1.77E-02	14.0%	10.0%	17.2%		1.72E-03	3.0E-04	3.74%	0.0%
NICKEL			30.7		47.7		50.0		4.28E+01	1.06E+01	61.4%	10.0%	62.2%		2.27E-01	1.4E-01	18.89%	0.0%
SELENIUM			1.42		2.32		1.54		1.76E+00	4.91E-01	69.4%	10.0%	70.2%		9.32E-03	6.5E-03	21.33%	0.0%
PHOSPHORUS		ND<	2.30	ND<	2.45		2.57	@ ND<	2.45E+00	1.33E-01	13.9%	25.0%	28.6%	ND<	1.29E-02	3.7E-03	3.61%	100.0%
VANADIUM			29.5		48.9		51.3		4.32E+01	1.19E+01	68.7%	10.0%	69.4%		2.29E-01	1.6E-01	21.16%	0.0%
										AVERAGES:	75.0%	14.3%	79.4%		4.00E-02	3.3E-02	22.25%	

Preliminary

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[UNNIAIR XLW]UNPM10.XLS
9:05 PM
10/8/93

PM < 10 METALS
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PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
METALS PM<10 IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	3.45	4.03	3.60	3.69	3.01E-01	8.15%	0.00	0.00%	0.00
O2 Correction Factor	1.198	1.239	1.208	1.215	2.14E-02	1.76%	0	0.00%	0.00
Particle Collection Bias								20%	

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV	%STDEV	N STDEV	% BIAS	BIAS
METALS PM<10 STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	4.80	4.80	4.64	4.75	9.24E-02	1.95%	0.00	0.00%	0.00
O2 Correction Factor	1.298	1.298	1.285	1.294	7.37E-03	0.57%	0	0.00%	0.00
Particle Collection Bias								10%	

Degrees FREEDOM	T-VALUE
1	12.71
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.37
8	2.31

[UNNIAIR.XLW]UNPM10.XLS
9:06 PM
10/8/93

Preliminary

PM < 10 METALS
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SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
PM<10:															
ARSENIC	IN	1.33E-01	0.00E+00	**BIAS**	2.19E-01	5.0E-03	6.0E-10	5.9E-07	6.6E-04	1.1E-03	2.02	2	4.3	3.0E-03	56.0%
BARIUM		3.00E+00	0.00E+00	**BIAS**	3.69E+00	5.0E-03	1.0E-08	1.0E-05	1.5E-02	1.8E-02	2.01	2	4.3	6.7E-02	72.9%
BERYLLIUM		3.36E-02	0.00E+00	**BIAS**	1.60E-01	5.0E-03	4.4E-10	4.3E-07	1.7E-04	8.0E-04	2.16	2	4.3	1.1E-03	27.2%
CADMIUM		6.55E-03	3.28E-02	**BIAS**	2.27E-02	5.0E-03	6.2E-11	6.1E-08	3.3E-05	2.0E-04	2.08	2	4.3	2.4E-04	43.2%
CHROMIUM		6.54E-01	0.00E+00	**BIAS**	1.15E+00	5.0E-03	3.1E-09	3.1E-06	3.3E-03	5.7E-03	2.02	2	4.3	1.5E-02	53.2%
COBALT		3.16E+00	0.00E+00	**BIAS**	5.97E+00	5.0E-03	1.6E-08	1.6E-05	1.6E-02	3.0E-02	2.02	2	4.3	7.4E-02	49.9%
COPPER		3.46E-01	0.00E+00	**BIAS**	1.80E+00	5.0E-03	4.9E-09	4.9E-06	1.8E-03	9.0E-03	2.19	2	4.3	1.2E-02	26.2%
LEAD		2.60E+00	0.00E+00	NSTDV	1.65E+00	5.0E-03	4.5E-09	4.5E-06	1.3E-02	8.2E-03	2.00	2	4.3	5.6E-02	136.7%
MANGANESE		9.28E+00	0.00E+00	NSTDV	5.28E+00	5.0E-03	1.4E-08	1.4E-05	4.6E-02	2.6E-02	2.00	2	4.3	2.0E-01	152.5%
MERCURY		1.73E-01	0.00E+00	**BIAS**	2.45E-01	5.0E-03	6.7E-10	6.6E-07	8.6E-04	1.2E-03	2.01	2	4.3	3.9E-03	64.1%
MOLYBDENUM		1.96E-01	0.00E+00	**BIAS**	6.80E-01	5.0E-03	1.9E-09	1.8E-06	9.9E-04	3.4E-03	2.08	2	4.3	5.4E-03	32.1%
NICKEL		7.64E+01	0.00E+00	**BIAS**	1.55E+02	5.0E-03	4.2E-07	4.2E-04	3.8E-01	7.7E-01	2.03	2	4.3	1.8E+00	47.0%
SELENIUM		4.67E-01	0.00E+00	**BIAS**	5.65E-01	5.0E-03	1.5E-09	1.5E-06	2.3E-03	2.8E-03	2.01	2	4.3	1.0E-02	74.0%
PHOSPHORUS		2.01E+00	0.00E+00	**BIAS**	1.33E+01	5.0E-03	3.6E-08	3.6E-05	1.0E-02	6.6E-02	2.30	2	4.3	8.0E-02	24.2%
VANADIUM		3.62E+01	0.00E+00	**BIAS**	1.90E+02	5.0E-03	5.2E-07	5.1E-04	1.8E-01	9.4E-01	2.19	2	4.3	1.2E+00	26.1%
															59.0%

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV	ND BIAS	> OF NSTD OR BIAS	Particle Coll. Eff. Bias	THETA CALCULATIONS FOR: CONC.	HEAT RT	F-factor	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
PM<10:															
ARSENIC	STK	1.80E-02	0.00E+00	**BIAS**	5.56E-02	5.3E-03	3.2E-10	3.2E-07	9.8E-05	2.9E-04	2.27	2	4.3	5.2E-04	17.5%
BARIUM		2.53E+00	0.00E+00	NSTDV	7.63E-01	5.3E-03	4.4E-09	4.4E-06	1.3E-02	4.0E-03	2.00	2	4.3	5.8E-02	143.2%
BERYLLIUM		1.28E-03	9.57E-03	**BIAS**	4.28E-03	5.3E-03	2.5E-11	2.5E-08	7.0E-06	5.5E-05	2.32	2	4.3	6.3E-05	27.9%
CADMIUM		3.83E-03	3.52E-02	**BIAS**	1.22E-02	5.3E-03	7.1E-11	7.0E-08	2.1E-05	2.0E-04	2.29	2	4.3	2.2E-04	33.6%
CHROMIUM		2.69E-01	0.00E+00	NSTDV	1.42E-01	5.3E-03	8.2E-10	8.2E-07	1.4E-03	7.5E-04	2.01	2	4.3	6.2E-03	82.5%
COBALT		1.85E-01	0.00E+00	**BIAS**	1.89E-01	5.3E-03	1.1E-09	1.1E-06	9.8E-04	1.0E-03	2.03	2	4.3	4.4E-03	43.6%
COPPER		1.42E+00	0.00E+00	NSTDV	2.82E-01	5.3E-03	1.6E-09	1.6E-06	7.5E-03	1.5E-03	2.00	2	4.3	3.2E-02	216.9%
LEAD		9.99E-02	1.91E-01	**BIAS**	8.55E-02	5.3E-03	5.0E-10	4.9E-07	5.3E-04	1.1E-03	2.02	2	4.3	2.5E-03	56.0%
MANGANESE		3.18E+00	0.00E+00	NSTDV	6.82E-01	5.3E-03	4.0E-09	3.9E-06	1.7E-02	3.6E-03	2.00	2	4.3	7.3E-02	200.9%
MERCURY		1.81E-01	0.00E+00	NSTDV	6.44E-02	5.3E-03	3.7E-10	3.7E-07	9.6E-04	3.4E-04	2.00	2	4.3	4.1E-03	121.1%
MOLYBDENUM		1.02E-02	0.00E+00	**BIAS**	3.25E-02	5.3E-03	1.9E-10	1.9E-07	5.6E-05	1.7E-04	2.29	2	4.3	3.0E-04	17.2%
NICKEL		6.10E+00	0.00E+00	NSTDV	4.28E+00	5.3E-03	2.5E-08	2.5E-05	3.2E-02	2.3E-02	2.01	2	4.3	1.4E-01	62.2%
SELENIUM		2.84E-01	0.00E+00	NSTDV	1.76E-01	5.3E-03	1.0E-09	1.0E-06	1.5E-03	9.3E-04	2.01	2	4.3	6.5E-03	70.2%
PHOSPHORUS		7.66E-02	5.60E-01	**BIAS**	2.45E-01	5.3E-03	1.4E-09	1.4E-06	4.2E-04	3.2E-03	2.29	2	4.3	3.7E-03	28.6%
VANADIUM		6.90E+00	0.00E+00	NSTDV	4.32E+00	5.3E-03	2.5E-08	2.5E-05	3.7E-02	2.3E-02	2.01	2	4.3	1.6E-01	69.4%
															79.4%

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[UNNIAIR.XLW]UNPM10.XLS
9:11 PM
10/8/93

PM > 10 METALS
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SPECIES	LOC	RUN #1	RUN #2 in ug/Nm3	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
PM>10:													
ARSENIC	IN	0.48	0.26	0.55	4.32E-01	1.48E-01	85.2%	20.0%	87.5%	0.0021	1.9E-03	25.82%	0.0%
BARIUM		11.1	9.6	4.2	8.31E+00	3.61E+00	108.0%	20.0%	109.8%	0.0413	4.5E-02	32.68%	0.0%
BERYLLIUM		0.07	0.07	0.08	7.56E-02	7.56E-03	25.1%	20.0%	32.1%	0.0004	1.2E-04	7.40%	0.0%
CADMIUM		ND< 0.10	ND< 0.11	ND< 0.13	ND< 1.13E-01	1.13E-02	25.1%	35.2%	43.2%	ND< 0.0006	2.4E-04	7.40%	100.0%
CHROMIUM		4.8	4.0	8.0	5.62E+00	2.08E+00	91.9%	20.0%	94.0%	0.0279	2.6E-02	27.91%	0.0%
COBALT		7.6	4.8	7.1	6.51E+00	1.52E+00	58.2%	20.0%	61.5%	0.0324	2.0E-02	17.76%	0.0%
COPPER		3.6	2.8	5.2	3.85E+00	1.19E+00	77.0%	20.0%	79.6%	0.0192	1.5E-02	22.66%	0.0%
LEAD		3.4	ND< 2.9	1.4	# 2.1E+00	1.12E+00	125.8%	29.1%	129.1%	0.0110	1.4E-02	41.46%	23.6%
MANGANESE		7.3	5.1	8.0	6.80E+00	1.47E+00	54.0%	20.0%	57.6%	0.0338	1.9E-02	16.22%	0.0%
MERCURY		0.07	0.07	0.08	7.56E-02	7.56E-03	25.1%	20.0%	32.1%	0.0004	1.2E-04	7.40%	0.0%
MOLYBDENUM		1.94	1.5	1.9	1.78E+00	2.37E-01	33.3%	20.0%	38.8%	0.0088	3.4E-03	10.20%	0.0%
NICKEL		190.5	128.6	201.4	1.73E+02	3.93E+01	56.4%	20.0%	59.8%	0.8625	5.2E-01	17.26%	0.0%
SELENIUM		ND< 0.09	ND< 0.09	ND< 0.10	ND< 9.44E-02	9.45E-03	25.1%	35.2%	43.2%	ND< 0.0005	2.0E-04	7.40%	100.0%
PHOSPHORUS		10.0	5.9	13.4	9.78E+00	3.78E+00	96.1%	20.0%	98.2%	0.0486	4.8E-02	26.62%	0.0%
VANADIUM		214.7	139.6	201.4	1.85E+02	4.01E+01	53.9%	20.0%	57.5%	0.9209	5.3E-01	16.43%	0.0%
						AVERAGES:	62.7%	22.6%	68.3%	0.1340	8.3E-02	18.97%	

SPECIES	LOC	RUN #1	RUN #2 in ug/Nm3	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
PM>10:													
ARSENIC	STK	0.31	0.36	ND< 0.11	2.40E-01	1.63E-01	169.4%	12.5%	169.8%	0.0013	2.2E-03	51.80%	7.4%
BARIUM		1.23	6.56	0.34	2.71E+00	3.37E+00	308.5%	10.0%	308.6%	0.0144	4.4E-02	94.75%	0.0%
BERYLLIUM		ND< 0.04	0.04	ND< 0.04	@ ND< 4.28E-02	2.21E-03	13.3%	24.5%	27.9%	ND< 0.0002	6.3E-05	4.99%	100.0%
CADMIUM		ND< 0.12	ND< 0.12	ND< 0.13	ND< 1.22E-01	6.63E-03	14.0%	30.6%	33.6%	ND< 0.0006	2.2E-04	3.74%	100.0%
CHROMIUM		2.30	2.65	5.13	3.36E+00	1.54E+00	114.1%	10.0%	114.6%	0.0178	2.0E-02	35.12%	0.0%
COBALT		0.54	1.18	1.03	9.15E-01	3.37E-01	91.5%	10.0%	92.0%	0.0048	4.5E-03	27.56%	0.0%
COPPER		1.00	1.79	0.86	1.22E+00	5.06E-01	103.5%	10.0%	104.0%	0.0064	6.7E-03	31.74%	0.0%
LEAD		1.04	3.06	ND< 3.42	# 1.9E+00	1.03E+00	132.3%	31.1%	135.9%	0.0102	1.4E-02	38.71%	29.5%
MANGANESE		30.3	20.4	9.0	1.99E+01	1.07E+01	133.3%	10.0%	133.7%	0.1053	1.4E-01	36.56%	0.0%
MERCURY		0.08	0.08	0.09	8.12E-02	4.42E-03	14.0%	10.0%	17.2%	0.0004	7.4E-05	3.74%	0.0%
MOLYBDENUM		ND< 0.27	0.49	ND< 0.30	@ ND< 2.99E-01	1.20E-01	99.3%	24.5%	102.3%	ND< 0.0016	1.6E-03	24.59%	100.0%
NICKEL		12.7	28.9	29.5	2.37E+01	9.57E+00	100.4%	10.0%	100.9%	0.1255	1.3E-01	31.08%	0.0%
SELENIUM		ND< 0.10	ND< 0.10	ND< 0.11	ND< 1.02E-01	5.53E-03	14.0%	30.6%	33.6%	ND< 0.0005	1.8E-04	3.74%	100.0%
PHOSPHORUS		ND< 1.92	2.85	2.99	2.27E+00	1.14E+00	124.5%	17.3%	125.7%	0.0120	1.5E-02	38.50%	14.1%
VANADIUM		10.0	25.3	18.0	1.77E+01	7.66E+00	107.3%	10.0%	107.8%	0.0939	1.0E-01	29.19%	0.0%
						AVERAGES:	102.6%	16.7%	107.2%	0.0263	3.2E-02	30.39%	

Preliminary

Do Not Cite or Quote

PM > 10 METALS
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
METALS PM>10 IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	3.45	4.03	3.60	3.69	3.01E-01	8.15%	0.00	0.00%	0.00
O2 Correction Factor	1.198	1.239	1.208	1.215	2.14E-02	1.76%	0	0.00%	0.00
Particle Collection Bias								20%	

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV	%STDEV	N STDEV	% BIAS	BIAS
METALS PM>10 STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	4.80	4.80	4.64	4.75	9.24E-02	1.95%	0.00	0.00%	0.00
O2 Correction Factor	1.298	1.298	1.285	1.294	7.37E-03	0.57%	0	0.00%	0.00
Particle Collection Bias				Degrees				10%	
				FREEDOM	T-VALUE				
				1	12.71				
				2	4.30				
				3	3.18				
				4	2.78				
				5	2.57				
				6	2.45				
				7	2.37				
				8	2.31				

[UNNIAIR.XLW]UNMTLS10.XLS
9:25 PM
10/8/93

Preliminary

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t:	Ur	% Ur
PM>10:															
ARSENIC	IN	8.54E-02	0.00E+00	**BIAS**	8.63E-02	5.0E-03	2.4E-10	2.3E-07	4.2E-04	4.3E-04	2.01	2	4.3	1.9E-03	87.5%
BARIUM		2.08E+00	0.00E+00	NSTDV	1.66E+00	5.0E-03	4.5E-09	4.5E-06	1.0E-02	8.3E-03	2.00	2	4.3	4.5E-02	109.8%
BERYLLIUM		4.36E-03	0.00E+00	**BIAS**	1.51E-02	5.0E-03	4.1E-11	4.1E-08	2.2E-05	7.5E-05	2.08	2	4.3	1.2E-04	32.1%
CADMIUM		6.55E-03	3.28E-02	**BIAS**	2.27E-02	5.0E-03	6.2E-11	6.1E-08	3.3E-05	2.0E-04	2.08	2	4.3	2.4E-04	43.2%
CHROMIUM		1.20E+00	0.00E+00	NSTDV	1.12E+00	5.0E-03	3.1E-09	3.0E-06	6.0E-03	5.6E-03	2.01	2	4.3	2.6E-02	94.0%
COBALT		8.78E-01	0.00E+00	**BIAS**	1.30E+00	5.0E-03	3.6E-09	3.5E-06	4.4E-03	6.5E-03	2.02	2	4.3	2.0E-02	61.5%
COPPER		6.89E-01	0.00E+00	**BIAS**	7.70E-01	5.0E-03	2.1E-09	2.1E-06	3.4E-03	3.8E-03	2.01	2	4.3	1.5E-02	79.6%
LEAD		6.44E-01	4.90E-01	NSTDV	4.14E-01	5.0E-03	1.1E-09	1.1E-06	3.2E-03	3.2E-03	2.00	2	4.3	1.4E-02	129.1%
MANGANESE		8.51E-01	0.00E+00	**BIAS**	1.36E+00	5.0E-03	3.7E-09	3.7E-06	4.2E-03	6.8E-03	2.02	2	4.3	1.9E-02	57.6%
MERCURY		4.36E-03	0.00E+00	**BIAS**	1.51E-02	5.0E-03	4.1E-11	4.1E-08	2.2E-05	7.5E-05	2.08	2	4.3	1.2E-04	32.1%
MOLYBDENUM		1.37E-01	0.00E+00	**BIAS**	3.56E-01	5.0E-03	9.7E-10	9.6E-07	6.8E-04	1.8E-03	2.05	2	4.3	3.4E-03	38.8%
NICKEL		2.27E+01	0.00E+00	**BIAS**	3.47E+01	5.0E-03	9.5E-08	9.4E-05	1.1E-01	1.7E-01	2.02	2	4.3	5.2E-01	59.8%
SELENIUM		5.45E-03	2.74E-02	**BIAS**	1.89E-02	5.0E-03	5.2E-11	5.1E-08	2.7E-05	1.7E-04	2.08	2	4.3	2.0E-04	43.2%
PHOSPHORUS		2.18E+00	0.00E+00	NSTDV	1.96E+00	5.0E-03	5.3E-09	5.3E-06	1.1E-02	9.7E-03	2.01	2	4.3	4.8E-02	98.2%
VANADIUM		2.31E+01	0.00E+00	**BIAS**	3.70E+01	5.0E-03	1.0E-07	1.0E-04	1.2E-01	1.8E-01	2.02	2	4.3	5.3E-01	57.5%
															68.3%

	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV	ND BIAS	> OF NSTD OR BIAS	Particle Coll. Eff. Bias	THETA CALCULATIONS FOR: CONC.	HEAT RT	F-factor	RESULTS: Sr	Br	vr	vr	t:	Ur	% Ur
PM>10:															
ARSENIC	STK	9.43E-02	1.78E-02	NSTDV	2.40E-02	5.3E-03	1.4E-10	1.4E-07	5.0E-04	1.6E-04	2.00	2	4.3	2.2E-03	169.8%
BARIUM		1.94E+00	0.00E+00	NSTDV	2.71E-01	5.3E-03	1.6E-09	1.6E-06	1.0E-02	1.4E-03	2.00	2	4.3	4.4E-02	308.6%
BERYLLIUM		1.28E-03	9.57E-03	**BIAS**	4.28E-03	5.3E-03	2.5E-11	2.5E-08	7.0E-06	5.5E-05	2.32	2	4.3	6.3E-05	27.9%
CADMIUM		3.83E-03	3.52E-02	**BIAS**	1.22E-02	5.3E-03	7.1E-11	7.0E-08	2.1E-05	2.0E-04	2.29	2	4.3	2.2E-04	33.6%
CHROMIUM		8.91E-01	0.00E+00	NSTDV	3.36E-01	5.3E-03	2.0E-09	1.9E-06	4.7E-03	1.8E-03	2.00	2	4.3	2.0E-02	114.6%
COBALT		1.94E-01	0.00E+00	NSTDV	9.15E-02	5.3E-03	5.3E-10	5.3E-07	1.0E-03	4.8E-04	2.01	2	4.3	4.5E-03	92.0%
COPPER		2.92E-01	0.00E+00	NSTDV	1.22E-01	5.3E-03	7.1E-10	7.0E-07	1.5E-03	6.4E-04	2.00	2	4.3	6.7E-03	104.0%
LEAD		5.94E-01	5.70E-01	**BIAS**	1.93E-01	5.3E-03	1.1E-09	1.1E-06	3.1E-03	3.2E-03	2.00	2	4.3	1.4E-02	135.9%
MANGANESE		6.16E+00	0.00E+00	NSTDV	1.99E+00	5.3E-03	1.2E-08	1.1E-05	3.3E-02	1.1E-02	2.00	2	4.3	1.4E-01	133.7%
MERCURY		2.55E-03	0.00E+00	**BIAS**	8.12E-03	5.3E-03	4.7E-11	4.7E-08	1.4E-05	4.3E-05	2.29	2	4.3	7.4E-05	17.2%
MOLYBDENUM		6.90E-02	6.70E-02	**BIAS**	2.99E-02	5.3E-03	1.7E-10	1.7E-07	3.7E-04	3.9E-04	2.01	2	4.3	1.6E-03	102.3%
NICKEL		5.53E+00	0.00E+00	NSTDV	2.37E+00	5.3E-03	1.4E-08	1.4E-05	2.9E-02	1.3E-02	2.01	2	4.3	1.3E-01	100.9%
SELENIUM		3.19E-03	2.93E-02	**BIAS**	1.02E-02	5.3E-03	5.9E-11	5.8E-08	1.7E-05	1.6E-04	2.29	2	4.3	1.8E-04	33.6%
PHOSPHORUS		6.56E-01	3.19E-01	NSTDV	2.27E-01	5.3E-03	1.3E-09	1.3E-06	3.5E-03	2.1E-03	2.00	2	4.3	1.5E-02	125.7%
VANADIUM		4.42E+00	0.00E+00	NSTDV	1.77E+00	5.3E-03	1.0E-08	1.0E-05	2.3E-02	9.4E-03	2.00	2	4.3	1.0E-01	107.8%
															107.2%

Do Not Cite or Quote

[UNNIAIR.XLW]UNMTLS10.XLS
9:38 PM
10/8/93

Preliminary

TOTAL METALS
UNCERTAINTY ANALYSIS
SITE 118
PAGE 1 OF 3

SPECIES	LOC		RUN #1		RUN #2 in ug/Nm3		RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)		ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
TOT MTLS:																		
ARSENIC	IN		1.36		1.60		1.6		1.53E+00	1.40E-01	23.1%	20.0%	30.5%		7.59E-03	2.3E-03	7.05%	0.0%
BARIUM			24.5		27.8		28.0		2.68E+01	1.97E+00	18.7%	20.0%	27.4%		1.33E-01	3.6E-02	5.67%	0.0%
BERYLLIUM			0.90		0.8		0.9		8.77E-01	6.10E-02	17.6%	20.0%	26.7%		4.36E-03	1.2E-03	5.25%	0.0%
CADMIUM		ND<	0.21	ND<	0.22	ND<	0.25	ND<	2.27E-01	2.27E-02	25.1%	35.2%	43.2%	ND<	1.13E-03	4.9E-04	7.40%	100.0%
CHROMIUM			9.3		10.6		14.2		1.13E+01	2.54E+00	55.7%	20.0%	59.2%		5.64E-02	3.3E-02	16.67%	0.0%
COBALT			42.2		28.7		38.2		3.64E+01	6.98E+00	47.8%	20.0%	51.8%		1.81E-01	9.4E-02	14.14%	0.0%
COPPER			12.4		12.5		13.7		1.29E+01	7.43E-01	14.8%	20.0%	24.9%		6.40E-02	1.6E-02	4.42%	0.0%
LEAD			10.2		6.1		14.7		1.03E+01	4.28E+00	102.9%	20.0%	104.9%		5.14E-02	5.4E-02	28.09%	0.0%
MANGANESE			40.8		13.1		45.7		3.32E+01	1.75E+01	131.3%	20.0%	132.8%		1.65E-01	2.2E-01	40.26%	0.0%
MERCURY			1.59		1.30		1.01		1.30E+00	2.93E-01	56.0%	20.0%	59.5%		6.47E-03	3.8E-03	15.07%	0.0%
MOLYBDENUM			5.06		4.8		5.7		5.18E+00	4.40E-01	21.4%	20.0%	29.3%		2.57E-02	7.5E-03	6.28%	0.0%
NICKEL			1055.1		751.9		1039.5		9.49E+02	1.71E+02	44.8%	20.0%	49.1%		4.72E+00	2.3E+00	13.84%	0.0%
SELENIUM			2.0		3.1		3.6		2.87E+00	8.14E-01	70.4%	20.0%	73.2%		1.43E-02	1.0E-02	20.66%	0.0%
PHOSPHORUS			79.3		68.3		80.6		7.61E+01	6.74E+00	22.3%	20.0%	29.9%		3.78E-01	1.1E-01	6.79%	0.0%
VANADIUM			1218.9		1021.1		1166.7		1.14E+03	1.02E+02	22.7%	20.0%	30.3%		5.65E+00	1.7E+00	6.72%	0.0%
										AVERAGES:	45.0%	21.0%	51.5%		7.63E-01	3.1E-01	13.22%	

SPECIES	LOC		RUN #1		RUN #2 in ug/Nm3		RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)		ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
TOT MTLS:																		
ARSENIC	STK		0.90		0.90		0.58		7.95E-01	1.83E-01	57.4%	10.0%	58.2%		4.21E-03	2.5E-03	17.74%	0.0%
BARIUM			4.52		18.63		7.87		1.03E+01	7.37E+00	177.1%	10.0%	177.4%		5.47E-02	9.7E-02	53.45%	0.0%
BERYLLIUM		ND<	0.08		0.08	ND<	0.09	@ ND<	8.55E-02	4.42E-03	13.3%	24.5%	27.9%	ND<	4.53E-04	1.3E-04	4.99%	100.0%
CADMIUM		ND<	0.23	ND<	0.24	ND<	0.26	ND<	2.44E-01	1.33E-02	14.0%	30.6%	33.6%	ND<	1.29E-03	4.3E-04	3.74%	100.0%
CHROMIUM			4.10		4.20		6.03		4.78E+00	1.09E+00	56.6%	10.0%	57.4%		2.53E-02	1.5E-02	17.47%	0.0%
COBALT			2.07		3.34		2.99		2.80E+00	6.57E-01	58.4%	10.0%	59.2%		1.48E-02	8.8E-03	17.41%	0.0%
COPPER			6.52		3.99		1.58		4.03E+00	2.47E+00	152.1%	10.0%	152.5%		2.13E-02	3.3E-02	41.11%	0.0%
LEAD			1.42		4.16	ND<	4.28	#	2.6E+00	1.42E+00	137.3%	29.5%	140.4%		1.36E-02	1.9E-02	41.13%	27.7%
MANGANESE			33.6		24.4		22.1		2.67E+01	6.06E+00	56.5%	10.0%	57.4%		1.41E-01	8.1E-02	17.18%	0.0%
MERCURY			0.56		0.53		1.09		7.25E-01	3.16E-01	108.4%	10.0%	108.8%		3.84E-03	4.2E-03	33.53%	0.0%
MOLYBDENUM			0.44		0.82		0.49		5.83E-01	2.03E-01	86.7%	10.0%	87.3%		3.08E-03	2.7E-03	26.62%	0.0%
NICKEL			43.3		76.6		79.5		6.65E+01	2.01E+01	75.3%	10.0%	75.9%		3.52E-01	2.7E-01	23.23%	0.0%
SELENIUM			1.47		2.37		1.59		1.81E+00	4.92E-01	67.6%	10.0%	68.3%		9.59E-03	6.6E-03	20.74%	0.0%
PHOSPHORUS		ND<	4.22		4.08		5.56	#	3.9E+00	1.73E+00	109.9%	20.6%	111.8%		2.07E-02	2.3E-02	30.75%	18.0%
VANADIUM			39.5		74.2		69.3		6.10E+01	1.88E+01	76.6%	10.0%	77.2%		3.23E-01	2.5E-01	23.50%	0.0%
										AVERAGES:	83.1%	14.3%	86.2%		6.60E-02	5.4E-02	24.84%	

Do Not Cite or Quote

[UNNIAIR.XLW]UNMTLSTOT.XLS
9:30 PM
10/8/93

TOTAL METALS
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spl)	%STDEV (Spl,%)	N STDEV (Spl')	% BIAS (Bpl,%)	BIAS (Bpl)
METALS TOTAL IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	3.45	4.03	3.60	3.69	3.01E-01	8.15%	0.00	0.00%	0.00
O2 Correction Factor	1.198	1.239	1.208	1.215	2.14E-02	1.76%	0	0.00%	0.00
Particle Collection Bias								20%	

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV	%STDEV	N STDEV	% BIAS	BIAS
METALS TOTAL STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	4.80	4.80	4.64	4.75	9.24E-02	1.95%	0.00	0.00%	0.00
O2 Correction Factor	1.298	1.298	1.285	1.294	7.37E-03	0.57%	0	0.00%	0.00
Particle Collection Bias								10%	

Degrees FREEDOM	T-VALUE
1	12.71
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.37
8	2.31

[UNNIAIR.XLW]UNMTLSTOT.XLS
9:30 PM
10/8/93

Preliminary

Do Not Cite or Quote

TOTAL METALS
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
TOT MTLS:															
ARSENIC	IN	8.08E-02	0.00E+00	**BIAS**	3.05E-01	5.0E-03	8.3E-10	8.2E-07	4.1E-04	1.5E-03	2.10	2	4.3	2.3E-03	30.5%
BARIUM		1.14E+00	0.00E+00	**BIAS**	5.35E+00	5.0E-03	1.5E-08	1.4E-05	5.8E-03	2.7E-02	2.15	2	4.3	3.6E-02	27.4%
BERYLLIUM		3.52E-02	0.00E+00	**BIAS**	1.75E-01	5.0E-03	4.8E-10	4.7E-07	1.8E-04	8.7E-04	2.17	2	4.3	1.2E-03	26.7%
CADMIUM		1.31E-02	6.56E-02	**BIAS**	4.53E-02	5.0E-03	1.2E-10	1.2E-07	6.6E-05	4.0E-04	2.08	2	4.3	4.9E-04	43.2%
CHROMIUM		1.47E+00	0.00E+00	**BIAS**	2.27E+00	5.0E-03	6.2E-09	6.1E-06	7.3E-03	1.1E-02	2.02	2	4.3	3.3E-02	59.2%
COBALT		4.03E+00	0.00E+00	**BIAS**	7.27E+00	5.0E-03	2.0E-08	2.0E-05	2.0E-02	3.6E-02	2.02	2	4.3	9.4E-02	51.8%
COPPER		4.29E-01	0.00E+00	**BIAS**	2.57E+00	5.0E-03	7.0E-09	7.0E-06	2.2E-03	1.3E-02	2.25	2	4.3	1.6E-02	24.9%
LEAD		2.47E+00	0.00E+00	NSTDV	2.07E+00	5.0E-03	5.6E-09	5.6E-06	1.2E-02	1.0E-02	2.00	2	4.3	5.4E-02	104.9%
MANGANESE		1.01E+01	0.00E+00	NSTDV	6.64E+00	5.0E-03	1.8E-08	1.8E-05	5.0E-02	3.3E-02	2.00	2	4.3	2.2E-01	132.8%
MERCURY		1.69E-01	0.00E+00	**BIAS**	2.60E-01	5.0E-03	7.1E-10	7.0E-07	8.4E-04	1.3E-03	2.02	2	4.3	3.8E-03	59.5%
MOLYBDENUM		2.54E-01	0.00E+00	**BIAS**	1.04E+00	5.0E-03	2.8E-09	2.8E-06	1.3E-03	5.1E-03	2.11	2	4.3	7.5E-03	29.3%
NICKEL		9.86E+01	0.00E+00	**BIAS**	1.90E+02	5.0E-03	5.2E-07	5.1E-04	4.9E-01	9.4E-01	2.03	2	4.3	2.3E+00	49.1%
SELENIUM		4.70E-01	0.00E+00	**BIAS**	5.75E-01	5.0E-03	1.6E-09	1.6E-06	2.3E-03	2.9E-03	2.01	2	4.3	1.0E-02	73.2%
PHOSPHORUS		3.89E+00	0.00E+00	**BIAS**	1.52E+01	5.0E-03	4.2E-08	4.1E-05	2.0E-02	7.6E-02	2.11	2	4.3	1.1E-01	29.9%
VANADIUM		5.92E+01	0.00E+00	**BIAS**	2.27E+02	5.0E-03	6.2E-07	6.1E-04	3.0E-01	1.1E+00	2.10	2	4.3	1.7E+00	30.3%
															51.5%

TOT MTLS:	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV	ND BIAS	> OF NSTD OR BIAS	Particle Coll. Eff. Bias	THETA CALCULATIONS FOR: CONC.	HEAT RT	F-factor	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
ARSENIC	STK	1.06E-01	0.00E+00	NSTDV	7.95E-02	5.3E-03	4.6E-10	4.6E-07	5.6E-04	4.2E-04	2.02	2	4.3	2.5E-03	58.2%
BARIUM		4.26E+00	0.00E+00	NSTDV	1.03E+00	5.3E-03	6.0E-09	6.0E-06	2.3E-02	5.5E-03	2.00	2	4.3	9.7E-02	177.4%
BERYLLIUM		2.55E-03	1.91E-02	**BIAS**	8.55E-03	5.3E-03	5.0E-11	4.9E-08	1.4E-05	1.1E-04	2.32	2	4.3	1.3E-04	27.9%
CADMIUM		7.66E-03	7.04E-02	**BIAS**	2.44E-02	5.3E-03	1.4E-10	1.4E-07	4.2E-05	3.9E-04	2.29	2	4.3	4.3E-04	33.6%
CHROMIUM		6.27E-01	0.00E+00	NSTDV	4.78E-01	5.3E-03	2.8E-09	2.7E-06	3.3E-03	2.5E-03	2.02	2	4.3	1.5E-02	57.4%
COBALT		3.79E-01	0.00E+00	NSTDV	2.80E-01	5.3E-03	1.6E-09	1.6E-06	2.0E-03	1.5E-03	2.01	2	4.3	8.8E-03	59.2%
COPPER		1.42E+00	0.00E+00	NSTDV	4.03E-01	5.3E-03	2.3E-09	2.3E-06	7.5E-03	2.1E-03	2.00	2	4.3	3.3E-02	152.5%
LEAD		8.20E-01	7.13E-01	NSTDV	2.57E-01	5.3E-03	1.5E-09	1.5E-06	4.3E-03	4.0E-03	2.00	2	4.3	1.9E-02	140.4%
MANGANESE		3.50E+00	0.00E+00	NSTDV	2.67E+00	5.3E-03	1.6E-08	1.5E-05	1.9E-02	1.4E-02	2.02	2	4.3	8.1E-02	57.4%
MERCURY		1.83E-01	0.00E+00	NSTDV	7.25E-02	5.3E-03	4.2E-10	4.2E-07	9.7E-04	3.8E-04	2.00	2	4.3	4.2E-03	108.8%
MOLYBDENUM		1.17E-01	0.00E+00	NSTDV	5.83E-02	5.3E-03	3.4E-10	3.4E-07	6.2E-04	3.1E-04	2.01	2	4.3	2.7E-03	87.3%
NICKEL		1.16E+01	0.00E+00	NSTDV	6.65E+00	5.3E-03	3.9E-08	3.8E-05	6.2E-02	3.5E-02	2.01	2	4.3	2.7E-01	75.9%
SELENIUM		2.84E-01	0.00E+00	NSTDV	1.81E-01	5.3E-03	1.1E-09	1.0E-06	1.5E-03	9.6E-04	2.01	2	4.3	6.6E-03	68.3%
PHOSPHORUS		9.99E-01	7.03E-01	NSTDV	3.91E-01	5.3E-03	2.3E-09	2.3E-06	5.3E-03	4.3E-03	2.00	2	4.3	2.3E-02	111.8%
VANADIUM		1.08E+01	0.00E+00	NSTDV	6.10E+00	5.3E-03	3.5E-08	3.5E-05	5.7E-02	3.2E-02	2.01	2	4.3	2.5E-01	77.2%
															86.2%

Preliminary

PAH
UNCERTAINTY ANALYSIS
SITE 118
PAGE 1 OF 3

SPECIES	LOC	RUN #1	RUN #2 in ug/Nm3	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
Naphthalene	IN	0.62	0.60	0.64	6.20E-01	2.19E-02	7.3%	20.0%	21.3%	3.09E-03	6.6E-04	2.41%	0.0%
Acenaphthylene		ND< 0.023	ND< 0.027	ND< 0.040	ND< 2.98E-02	8.77E-03	73.1%	35.8%	81.4%	ND< 1.49E-04	1.2E-04	22.18%	100.0%
Acenaphthene		ND< 0.010	ND< 0.011	ND< 0.012	ND< 1.10E-02	8.83E-04	20.5%	35.2%	40.7%	ND< 5.46E-05	2.2E-05	6.10%	100.0%
Fluorene		ND< 0.007	ND< 0.009	ND< 0.024	ND< 1.31E-02	9.13E-03	173.4%	38.8%	177.7%	ND< 6.51E-05	1.2E-04	53.32%	100.0%
Phenanthrene		0.016	0.020	0.018	1.83E-02	1.93E-03	26.5%	20.0%	33.2%	9.13E-05	3.0E-05	7.02%	0.0%
Anthracene		ND< 0.012	ND< 0.015	ND< 0.017	ND< 1.45E-02	2.07E-03	35.7%	35.3%	50.2%	ND< 7.22E-05	3.6E-05	9.78%	100.0%
Fluoranthene		ND< 0.011	ND< 0.014	ND< 0.012	ND< 1.22E-02	1.55E-03	31.8%	35.2%	47.5%	ND< 6.08E-05	2.9E-05	9.59%	100.0%
Pyrene		ND< 0.011	ND< 0.014	ND< 0.012	ND< 1.20E-02	1.47E-03	30.8%	35.2%	46.8%	ND< 5.98E-05	2.8E-05	9.02%	100.0%
Benz(a)anthracene		ND< 0.016	ND< 0.021	ND< 0.019	ND< 1.88E-02	2.73E-03	36.3%	35.3%	50.6%	ND< 9.36E-05	4.7E-05	10.38%	100.0%
Chrysene		ND< 0.03	ND< 0.04	ND< 0.03	ND< 3.34E-02	5.68E-03	42.5%	35.3%	55.3%	ND< 1.66E-04	9.2E-05	13.06%	100.0%
Benzo(b)fluoranthene		ND< 0.009	ND< 0.013	ND< 0.012	ND< 1.14E-02	2.09E-03	45.9%	35.4%	57.9%	ND< 5.65E-05	3.3E-05	12.95%	100.0%
Benzo(k)fluoranthene		ND< 0.013	ND< 0.017	ND< 0.015	ND< 1.51E-02	2.33E-03	38.6%	35.3%	52.3%	ND< 7.50E-05	3.9E-05	10.73%	100.0%
Benzo(a)pyrene		ND< 0.017	ND< 0.028	ND< 0.031	ND< 2.53E-02	6.92E-03	68.0%	35.7%	76.8%	ND< 1.26E-04	9.7E-05	20.63%	100.0%
Indeno(1,2,3-cd)pyrene		ND< 0.016	ND< 0.027	ND< 0.024	ND< 2.23E-02	5.55E-03	62.0%	35.6%	71.5%	ND< 1.11E-04	7.9E-05	18.42%	100.0%
Dibenzo(a,h)anthracene		ND< 0.021	ND< 0.037	ND< 0.029	ND< 2.90E-02	7.79E-03	67.0%	35.7%	75.9%	ND< 1.44E-04	1.1E-04	18.37%	100.0%
Benzo(g,h,i)perylene		ND< 0.009	ND< 0.017	ND< 0.014	ND< 1.34E-02	3.65E-03	68.0%	35.7%	76.8%	ND< 6.66E-05	5.1E-05	19.70%	100.0%
2-Methylnaphthalene		0.03	0.04	0.03	3.38E-02	6.72E-03	49.5%	20.0%	53.4%	1.68E-04	9.0E-05	14.23%	0.0%
7,12-Dimethbenz(a)anth		ND< 0.011	ND< 0.016	ND< 0.013	ND< 1.34E-02	2.47E-03	46.1%	35.4%	58.1%	ND< 6.66E-05	3.9E-05	12.84%	100.0%
3-Methylcholanthrene		ND< 0.010	ND< 0.016	ND< 0.012	ND< 1.25E-02	2.98E-03	59.3%	35.6%	69.1%	ND< 6.23E-05	4.3E-05	16.56%	100.0%
						AVERAGES	51.7%	33.2%	63.0%	2.51E-04	9.26E-05	15.1%	

SPECIES	LOC	RUN #1	RUN #2 in ug/Nm3	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
Naphthalene	STK	0.41	0.44	0.53	4.59E-01	6.20E-02	33.9%	10.0%	35.3%	2.38E-03	8.4E-04	10.04%	0.0%
Acenaphthylene		ND< 0.020	ND< 0.022	ND< 0.019	ND< 2.01E-02	1.47E-03	18.6%	30.6%	35.8%	ND< 1.04E-04	3.7E-05	5.43%	100.0%
Acenaphthene		ND< 0.009	ND< 0.009	ND< 0.008	ND< 8.73E-03	6.94E-04	20.3%	30.6%	36.7%	ND< 4.53E-05	1.7E-05	5.50%	100.0%
Fluorene		ND< 0.008	ND< 0.009	ND< 0.011	ND< 9.50E-03	1.87E-03	49.2%	30.9%	58.1%	ND< 4.93E-05	2.9E-05	13.32%	100.0%
Phenanthrene		0.010	0.024	0.020	1.79E-02	7.08E-03	98.6%	10.0%	99.2%	9.27E-05	9.2E-05	29.53%	0.0%
Anthracene		ND< 0.011	ND< 0.013	ND< 0.011	ND< 1.14E-02	1.08E-03	23.9%	30.6%	38.9%	ND< 5.91E-05	2.3E-05	7.15%	100.0%
Fluoranthene		ND< 0.010	ND< 0.011	ND< 0.009	ND< 1.03E-02	9.49E-04	23.2%	30.6%	38.4%	ND< 5.36E-05	2.1E-05	6.49%	100.0%
Pyrene		ND< 0.010	ND< 0.011	ND< 0.009	ND< 1.02E-02	1.10E-03	27.2%	30.7%	41.0%	ND< 5.27E-05	2.2E-05	7.77%	100.0%
Benz(a)anthracene		ND< 0.015	ND< 0.016	ND< 0.013	ND< 1.50E-02	1.54E-03	25.8%	30.6%	40.1%	ND< 7.79E-05	3.1E-05	7.40%	100.0%
Chrysene		ND< 0.025	ND< 0.031	ND< 0.024	ND< 2.67E-02	3.69E-03	34.6%	30.7%	46.3%	ND< 1.38E-04	6.4E-05	10.47%	100.0%
Benzo(b)fluoranthene		ND< 0.008	ND< 0.009	ND< 0.008	ND< 8.44E-03	6.75E-04	20.3%	30.6%	36.7%	ND< 4.38E-05	1.6E-05	5.43%	100.0%
Benzo(k)fluoranthene		ND< 0.010	ND< 0.013	ND< 0.011	ND< 1.14E-02	1.32E-03	29.1%	30.7%	42.3%	ND< 5.92E-05	2.5E-05	8.81%	100.0%
Benzo(a)pyrene		ND< 0.016	ND< 0.020	ND< 0.016	ND< 1.74E-02	2.43E-03	35.0%	30.7%	46.6%	ND< 9.01E-05	4.2E-05	10.75%	100.0%
Indeno(1,2,3-cd)pyrene		ND< 0.014	ND< 0.018	ND< 0.013	ND< 1.50E-02	2.31E-03	38.4%	30.8%	49.2%	ND< 7.79E-05	3.8E-05	11.70%	100.0%
Dibenzo(a,h)anthracene		ND< 0.019	ND< 0.022	ND< 0.018	ND< 1.97E-02	2.33E-03	29.8%	30.7%	42.8%	ND< 1.02E-04	4.4E-05	9.06%	100.0%
Benzo(g,h,i)perylene		ND< 0.009	ND< 0.011	ND< 0.008	ND< 9.05E-03	1.50E-03	41.4%	30.8%	51.6%	ND< 4.70E-05	2.4E-05	12.17%	100.0%
2-Methylnaphthalene		0.02	0.03	0.06	3.91E-02	1.93E-02	122.9%	10.0%	123.3%	2.03E-04	2.5E-04	37.58%	0.0%
7,12-Dimethylbenz(a)anthracene		ND< 0.013	ND< 0.015	ND< 0.012	ND< 1.32E-02	1.47E-03	28.0%	30.7%	41.6%	ND< 6.84E-05	2.8E-05	8.26%	100.0%
3-Methylcholanthrene		ND< 0.009	ND< 0.011	ND< 0.008	ND< 9.49E-03	1.18E-03	31.3%	30.7%	43.8%	ND< 4.93E-05	2.2E-05	8.51%	100.0%
						AVERAGES	38.5%	27.4%	49.9%	2.00E-04	8.77E-05	11.3%	

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[UNSVOST.XLW]UNPAH.XLS
10:00 PM
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PAH
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
PAH IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	415,021	415,021	383,654	404,565	18109.75	4.48%	10455.67	0.00%	0.00
LOAD, MW	839	839	789	822		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.26E+06	9.34E+06	9.08E+06	9.23E+06	1.33E+05	1.44%	7.67E+04	0.00%	0.00E+00
%O2	3.81	3.81	3.98	3.87	9.81E-02	2.54%	0.00	0.00%	0.00
O2 Correction Factor	1.223	1.223	1.235	1.227	7.09E-03	0.58%	0	0.00%	0.00
Particle Collection Bias								20%	

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
PAH STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	415,021	415,021	383,654	404,565	18109.75	4.48%	10455.67	0.00%	0.00
LOAD, MW	839	839	789	822		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.26E+06	9.34E+06	9.08E+06	9.23E+06	1.33E+05	1.44%	7.67E+04	0.00%	0.00E+00
%O2	4.62	4.48	4.60	4.57	7.57E-02	1.66%	0.00	0.00%	0.00
O2 Correction Factor	1.284	1.273	1.282	1.280	5.92E-03	0.46%	0	0.00%	0.00
Particle Collection Bias								10%	

DEGREES FREEDOM	T-VALUE
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.37
8	2.31

[UNSVOST.XLW]UNPAH.XLS
10:05 PM
10/8/93

Preliminary

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Preliminary

PAH
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
Naphthalene	IN	1.27E-02	0.00E+00	**BIAS**	1.24E-01	5.0E-03	3.3E-10	3.4E-07	7.0E-05	6.2E-04	3.02	3	3.2	6.6E-04	21.3%
Acenaphthylene		5.06E-03	8.85E-03	**BIAS**	5.97E-03	5.0E-03	1.6E-11	1.6E-08	2.5E-05	5.3E-05	2.01	2	4.3	1.2E-04	81.4%
Acenaphthene		5.10E-04	3.17E-03	**BIAS**	2.19E-03	5.0E-03	5.9E-12	5.9E-09	2.6E-06	1.9E-05	2.19	2	4.3	2.2E-05	40.7%
Fluorene		5.27E-03	4.35E-03	NSTDV	2.62E-03	5.0E-03	7.1E-12	7.1E-09	2.6E-05	2.5E-05	2.00	2	4.3	1.2E-04	177.7%
Phenanthrene		1.11E-03	0.00E+00	**BIAS**	3.67E-03	5.0E-03	9.9E-12	9.9E-09	5.6E-06	1.8E-05	2.11	2	4.3	3.0E-05	33.2%
Anthracene		1.20E-03	4.22E-03	**BIAS**	2.90E-03	5.0E-03	7.8E-12	7.8E-09	6.0E-06	2.5E-05	2.06	2	4.3	3.6E-05	50.2%
Fluoranthene		8.94E-04	3.54E-03	**BIAS**	2.44E-03	5.0E-03	6.6E-12	6.6E-09	4.5E-06	2.1E-05	2.08	2	4.3	2.9E-05	47.5%
Pyrene		8.49E-04	3.48E-03	**BIAS**	2.40E-03	5.0E-03	6.5E-12	6.5E-09	4.3E-06	2.1E-05	2.08	2	4.3	2.8E-05	46.8%
Benz(a)anthracene		1.57E-03	5.47E-03	**BIAS**	3.76E-03	5.0E-03	1.0E-11	1.0E-08	7.9E-06	3.3E-05	2.06	2	4.3	4.7E-05	50.6%
Chrysene		3.28E-03	9.72E-03	**BIAS**	6.67E-03	5.0E-03	1.8E-11	1.8E-08	1.6E-05	5.9E-05	2.04	2	4.3	9.2E-05	55.3%
Benzo(b)fluoranthene		1.20E-03	3.31E-03	**BIAS**	2.27E-03	5.0E-03	6.1E-12	6.1E-09	6.0E-06	2.0E-05	2.04	2	4.3	3.3E-05	57.9%
Benzo(k)fluoranthene		1.34E-03	4.39E-03	**BIAS**	3.01E-03	5.0E-03	8.1E-12	8.2E-09	6.7E-06	2.6E-05	2.05	2	4.3	3.9E-05	52.3%
Benzo(a)pyrene		3.99E-03	7.49E-03	**BIAS**	5.07E-03	5.0E-03	1.4E-11	1.4E-08	2.0E-05	4.5E-05	2.02	2	4.3	9.7E-05	76.8%
Indeno(1,2,3-cd)pyrene		3.21E-03	6.57E-03	**BIAS**	4.46E-03	5.0E-03	1.2E-11	1.2E-08	1.6E-05	4.0E-05	2.02	2	4.3	7.9E-05	71.5%
Dibenzo(a,h)anthracene		4.50E-03	8.56E-03	**BIAS**	5.79E-03	5.0E-03	1.6E-11	1.6E-08	2.2E-05	5.1E-05	2.02	2	4.3	1.1E-04	75.9%
Benzo(g,h,i)perylene		2.11E-03	3.95E-03	**BIAS**	2.67E-03	5.0E-03	7.2E-12	7.2E-09	1.1E-05	2.4E-05	2.02	2	4.3	5.1E-05	76.8%
2-Methylnaphthalene		3.88E-03	0.00E+00	**BIAS**	6.76E-03	5.0E-03	1.8E-11	1.8E-08	1.9E-05	3.4E-05	2.03	2	4.3	9.0E-05	53.4%
7,12-Dimethbenz(a)anth		1.43E-03	3.91E-03	**BIAS**	2.68E-03	5.0E-03	7.2E-12	7.2E-09	7.1E-06	2.4E-05	2.04	2	4.3	3.9E-05	58.1%
3-Methylcholanthrene		1.72E-03	3.68E-03	**BIAS**	2.50E-03	5.0E-03	6.8E-12	6.8E-09	8.6E-06	2.2E-05	2.02	2	4.3	4.3E-05	69.1%

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
Naphthalene	STK	3.58E-02	0.00E+00	**BIAS**	4.59E-02	5.2E-03	2.6E-10	2.6E-07	1.9E-04	2.4E-04	2.1	2	4.3	8.4E-04	35.3%
Acenaphthylene		8.46E-04	5.81E-03	**BIAS**	2.01E-03	5.2E-03	1.1E-11	1.1E-08	4.5E-06	3.2E-05	2.2	2	4.3	3.7E-05	35.8%
Acenaphthene		4.01E-04	2.52E-03	**BIAS**	8.73E-04	5.2E-03	4.9E-12	4.9E-09	2.1E-06	1.4E-05	2.2	2	4.3	1.7E-05	36.7%
Fluorene		1.08E-03	2.78E-03	**BIAS**	9.50E-04	5.2E-03	5.3E-12	5.4E-09	5.6E-06	1.5E-05	2.0	2	4.3	2.9E-05	58.1%
Phenanthrene		4.09E-03	0.00E+00	NSTDV	1.79E-03	5.2E-03	1.0E-11	1.0E-08	2.1E-05	9.3E-06	2.0	2	4.3	9.2E-05	99.2%
Anthracene		6.21E-04	3.29E-03	**BIAS**	1.14E-03	5.2E-03	6.4E-12	6.4E-09	3.3E-06	1.8E-05	2.1	2	4.3	2.3E-05	38.9%
Fluoranthene		5.48E-04	2.99E-03	**BIAS**	1.03E-03	5.2E-03	5.8E-12	5.8E-09	2.9E-06	1.6E-05	2.1	2	4.3	2.1E-05	38.4%
Pyrene		6.33E-04	2.94E-03	**BIAS**	1.02E-03	5.2E-03	5.7E-12	5.7E-09	3.3E-06	1.6E-05	2.1	2	4.3	2.2E-05	41.0%
Benz(a)anthracene		8.88E-04	4.35E-03	**BIAS**	1.50E-03	5.2E-03	8.4E-12	8.5E-09	4.7E-06	2.4E-05	2.1	2	4.3	3.1E-05	40.1%
Chrysene		2.13E-03	7.75E-03	**BIAS**	2.67E-03	5.2E-03	1.5E-11	1.5E-08	1.1E-05	4.3E-05	2.1	2	4.3	6.4E-05	46.3%
Benzo(b)fluoranthene		3.90E-04	2.44E-03	**BIAS**	8.44E-04	5.2E-03	4.8E-12	4.8E-09	2.1E-06	1.3E-05	2.2	2	4.3	1.6E-05	36.7%
Benzo(k)fluoranthene		7.62E-04	3.31E-03	**BIAS**	1.14E-03	5.2E-03	6.4E-12	6.4E-09	4.0E-06	1.8E-05	2.1	2	4.3	2.5E-05	42.3%
Benzo(a)pyrene		1.40E-03	5.04E-03	**BIAS**	1.74E-03	5.2E-03	9.8E-12	9.8E-09	7.3E-06	2.8E-05	2.1	2	4.3	4.2E-05	46.6%
Indeno(1,2,3-cd)pyrene		1.33E-03	4.36E-03	**BIAS**	1.50E-03	5.2E-03	8.4E-12	8.5E-09	7.0E-06	2.4E-05	2.1	2	4.3	3.8E-05	49.2%
Dibenzo(a,h)anthracene		1.35E-03	5.71E-03	**BIAS**	1.97E-03	5.2E-03	1.1E-11	1.1E-08	7.1E-06	3.1E-05	2.1	2	4.3	4.4E-05	42.8%
Benzo(g,h,i)perylene		8.65E-04	2.64E-03	**BIAS**	9.05E-04	5.2E-03	5.1E-12	5.1E-09	4.5E-06	1.4E-05	2.0	2	4.3	2.4E-05	51.6%
2-Methylnaphthalene		1.12E-02	0.00E+00	NSTDV	3.91E-03	5.2E-03	2.2E-11	2.2E-08	5.8E-05	2.0E-05	2.0	2	4.3	2.5E-04	123.3%
7,12-Dimethylbenz(a)anthracene		8.48E-04	3.82E-03	**BIAS**	1.32E-03	5.2E-03	7.4E-12	7.4E-09	4.5E-06	2.1E-05	2.1	2	4.3	2.8E-05	41.6%
3-Methylcholanthrene		6.84E-04	2.75E-03	**BIAS**	9.49E-04	5.2E-03	5.3E-12	5.4E-09	3.6E-06	1.5E-05	2.1	2	4.3	2.2E-05	43.8%

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Preliminary

PCDD/PCDF
UNCERTAINTY ANALYSIS, SITE 118, PAGE 1 OF 3

SPECIES	LOC	RUN #1	RUN #2 in ng/Nm3	RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
2378-TCDD	IN	ND< 0.0032	ND< 0.0086	ND< 0.0070		ND< 6.30E-03	2.78E-03	109.7%	36.6%	115.6%	ND< 3.1E-08	3.6E-08	32.51%	100.0%
12378 PeCDD		ND< 0.0048	ND< 0.0057	ND< 0.0037		ND< 4.72E-03	9.96E-04	52.6%	35.5%	63.4%	ND< 2.4E-08	1.5E-08	14.85%	100.0%
123478 HxCDD		0.0081	ND< 0.0093	0.0095	#	7.4E-03	2.48E-03	83.4%	29.0%	88.3%	3.7E-08	3.3E-08	24.75%	21.0%
123678 HxCDD		0.0032	ND< 0.0040	ND< 0.0034	@	ND< 3.99E-03	4.05E-04	25.6%	29.6%	39.1%	ND< 2.0E-08	7.8E-09	11.57%	100.0%
123789 HxCDD		0.0035	ND< 0.0066	ND< 0.0055	@	ND< 6.65E-03	1.59E-03	59.7%	29.5%	66.6%	ND< 3.3E-08	2.2E-08	21.53%	100.0%
1234678 HpCDD		0.0137	ND< 0.0153	0.0141	#	1.2E-02	3.61E-03	76.1%	29.4%	81.6%	5.9E-08	4.8E-08	23.52%	21.6%
OCDD		0.0188	0.0183	0.0336		2.36E-02	8.71E-03	91.9%	20.0%	94.0%	1.2E-07	1.1E-07	28.41%	0.0%
2378 TCDF		ND< 0.0032	ND< 0.0043	ND< 0.0055		ND< 4.35E-03	1.14E-03	65.1%	35.7%	74.2%	ND< 2.2E-08	1.6E-08	17.66%	100.0%
12378 PeCDF		0.0070	0.0033	0.0031		4.46E-03	2.20E-03	122.7%	20.0%	124.3%	2.2E-08	2.8E-08	37.92%	0.0%
23478 PeCDF		0.0094	0.0057	0.0061		7.06E-03	2.05E-03	72.4%	20.0%	75.1%	3.5E-08	2.6E-08	22.25%	0.0%
123478 HxCDF		0.0081	ND< 0.0053	0.0061		5.62E-03	2.74E-03	121.3%	25.5%	124.0%	2.8E-08	3.5E-08	35.10%	15.8%
123678 HxCDF		0.0032	ND< 0.0027	ND< 0.0019	@	ND< 2.73E-03	6.89E-04	63.0%	28.4%	69.1%	ND< 1.4E-08	9.4E-09	16.68%	100.0%
234678 HxCDF		ND< 0.0038	ND< 0.0053	ND< 0.0034		ND< 4.15E-03	1.03E-03	61.9%	35.6%	71.4%	ND< 2.1E-08	1.5E-08	18.77%	100.0%
123789 HxCDF		ND< 0.0054	ND< 0.0076	ND< 0.0046		ND< 5.87E-03	1.59E-03	67.3%	35.7%	76.2%	ND< 2.9E-08	2.2E-08	20.14%	100.0%
1234678 HpCDF		ND< 0.0078	ND< 0.0140	0.0107	@	ND< 1.40E-02	3.08E-03	55.0%	27.7%	61.6%	ND< 7.0E-08	4.3E-08	22.48%	100.0%
1234789 HpCDF		ND< 0.0151	ND< 0.0269	ND< 0.0202		ND< 2.07E-02	5.95E-03	71.4%	35.8%	79.9%	ND< 1.0E-07	8.2E-08	19.94%	100.0%
OCDF		ND< 0.0153	ND< 0.0206	ND< 0.0183		ND< 1.81E-02	2.64E-03	36.6%	35.3%	50.8%	ND< 9.0E-08	4.6E-08	10.17%	100.0%
Total TCDD		0.0199	ND< 0.0086	ND< 0.0070		9.25E-03	9.24E-03	248.3%	28.3%	249.9%	4.6E-08	1.2E-07	76.84%	28.2%
Total PeCDD		ND< 0.0048	ND< 0.0057	ND< 0.0037		ND< 4.72E-03	9.96E-04	52.6%	35.5%	63.4%	ND< 2.4E-08	1.5E-08	14.85%	100.0%
Total HxCDD		0.0258	ND< 0.0057	0.0211		1.66E-02	1.21E-02	182.0%	20.8%	183.2%	8.3E-08	1.5E-07	55.31%	5.7%
Total HpCDD		0.0137	ND< 0.0153	0.0275		1.63E-02	1.02E-02	155.3%	25.4%	157.4%	8.1E-08	1.3E-07	45.92%	15.6%
Total TCDF		0.0126	0.0050	0.0037		7.10E-03	4.85E-03	169.7%	20.0%	170.8%	3.5E-08	6.0E-08	52.07%	0.0%
Total PeCDF		0.0404	0.0140	0.0211		2.51E-02	1.37E-02	135.0%	20.0%	136.5%	1.3E-07	1.7E-07	40.36%	0.0%
Total HxCDF		0.0121	ND< 0.0047	0.0052		6.54E-03	5.03E-03	190.9%	23.2%	192.3%	3.3E-08	6.3E-08	56.68%	11.9%
Total HpCDF		ND< 0.0116	ND< 0.0209	0.0159	@	ND< 2.09E-02	4.69E-03	55.8%	27.6%	62.3%	ND< 1.0E-07	6.5E-08	22.94%	100.0%
Total PCDD/PCDF		0.159	0.078	0.143		1.27E-01	4.30E-02	84.4%	20.0%	86.8%	6.3E-07	5.5E-07	25.63%	0.0%
							AVERAGES	97.0%	28.4%	102.8%	5.1E-08	5.45E-08	29.7%	

SPECIES	LOC	RUN #1	RUN #2 in ng/Nm3	RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
2378-TCDD	STK	ND< 0.0059	ND< 0.0063	ND< 0.0050		ND< 5.72E-03	6.59E-04	29.0%	30.7%	42.2%	ND< 3.0E-08	1.3E-08	8.38%	100.0%
12378 PeCDD		ND< 0.0066	0.0035	ND< 0.0047	@	ND< 6.63E-03	1.59E-03	59.9%	22.8%	64.1%	ND< 3.4E-08	2.2E-08	25.51%	100.0%
123478 HxCDD		ND< 0.0163	0.0076	ND< 0.0122	@	ND< 1.63E-02	4.39E-03	66.9%	23.1%	70.8%	ND< 8.5E-08	6.0E-08	26.26%	100.0%
123678 HxCDD		ND< 0.0069	ND< 0.0024	ND< 0.0053		ND< 4.86E-03	2.26E-03	115.5%	32.5%	120.0%	ND< 2.5E-08	3.0E-08	33.44%	100.0%
123789 HxCDD		ND< 0.0115	ND< 0.0041	ND< 0.0086		ND< 8.06E-03	3.72E-03	114.8%	32.4%	119.3%	ND< 4.2E-08	5.0E-08	32.82%	100.0%
1234678 HpCDD		ND< 0.0224	ND< 0.0173	ND< 0.0361		ND< 2.53E-02	9.73E-03	95.6%	31.9%	100.8%	ND< 1.3E-07	1.3E-07	28.55%	100.0%
OCDD		0.0255	0.0230	ND< 0.0306	@	ND< 3.06E-02	3.86E-03	31.7%	19.4%	37.2%	ND< 1.6E-07	5.9E-08	13.80%	100.0%
2378 TCDF		ND< 0.0026	ND< 0.0026	ND< 0.0026		ND< 2.55E-03	3.81E-06	2.8%	30.6%	30.7%	ND< 1.3E-08	4.1E-09	0.11%	100.0%
12378 PeCDF		ND< 0.0038	ND< 0.0030	ND< 0.0036		ND< 3.48E-03	4.34E-04	31.3%	30.7%	43.8%	ND< 1.8E-08	7.9E-09	9.31%	100.0%
23478 PeCDF		ND< 0.0041	ND< 0.0031	ND< 0.0039		ND< 3.71E-03	4.93E-04	33.3%	30.7%	45.3%	ND< 1.9E-08	8.7E-09	10.04%	100.0%
123478 HxCDF		ND< 0.0071	ND< 0.0044	ND< 0.0083		ND< 6.63E-03	2.01E-03	75.6%	31.4%	81.9%	ND< 3.4E-08	2.8E-08	22.34%	100.0%
123678 HxCDF		ND< 0.0036	ND< 0.0023	ND< 0.0044		ND< 3.45E-03	1.06E-03	76.7%	31.4%	82.9%	ND< 1.8E-08	1.5E-08	21.63%	100.0%
234678 HxCDF		ND< 0.0071	ND< 0.0044	ND< 0.0083		ND< 6.63E-03	2.01E-03	75.6%	31.4%	81.9%	ND< 3.4E-08	2.8E-08	22.34%	100.0%
123789 HxCDF		ND< 0.0099	ND< 0.0063	ND< 0.0120		ND< 9.40E-03	2.87E-03	75.9%	31.4%	82.1%	ND< 4.9E-08	4.0E-08	22.00%	100.0%
1234678 HpCDF		ND< 0.0150	ND< 0.0098	ND< 0.0334		ND< 1.94E-02	1.24E-02	158.7%	34.1%	162.3%	ND< 1.0E-07	1.6E-07	48.02%	100.0%
1234789 HpCDF		ND< 0.0281	ND< 0.0189	ND< 0.0639		ND< 3.70E-02	2.38E-02	160.0%	34.1%	163.6%	ND< 1.9E-07	3.1E-07	48.65%	100.0%
OCDF		ND< 0.0237	ND< 0.0189	ND< 0.0200		ND< 2.09E-02	2.53E-03	30.4%	30.7%	43.2%	ND< 1.1E-07	4.7E-08	9.09%	100.0%
Total TCDD		ND< 0.0059	ND< 0.0063	ND< 0.0050		ND< 5.72E-03	6.59E-04	29.0%	30.7%	42.2%	ND< 3.0E-08	1.3E-08	8.38%	100.0%
Total PeCDD		ND< 0.0066	0.0031	ND< 0.0047	@	ND< 6.63E-03	1.77E-03	66.6%	22.8%	70.4%	ND< 3.4E-08	2.4E-08	27.41%	100.0%
Total HxCDD		ND< 0.0099	0.0047	ND< 0.0075	@	ND< 9.95E-03	2.61E-03	65.4%	23.1%	69.4%	ND< 5.2E-08	3.6E-08	25.69%	100.0%
Total HpCDD		ND< 0.0224	ND< 0.0173	ND< 0.0361		ND< 2.53E-02	9.73E-03	95.6%	31.9%	100.8%	ND< 1.3E-07	1.3E-07	28.55%	100.0%
Total TCDF		ND< 0.0026	ND< 0.0026	ND< 0.0026		ND< 2.55E-03	3.81E-06	2.8%	30.6%	30.7%	ND< 1.3E-08	4.1E-09	0.11%	100.0%
Total PeCDF		ND< 0.0038	ND< 0.0031	ND< 0.0036		ND< 3.51E-03	3.81E-04	27.3%	30.7%	41.1%	ND< 1.8E-08	7.5E-09	8.03%	100.0%
Total HxCDF		ND< 0.0061	ND< 0.0038	ND< 0.0072		ND< 5.71E-03	1.76E-03	76.7%	31.4%	82.9%	ND< 3.0E-08	2.5E-08	22.54%	100.0%
Total HpCDF		ND< 0.0227	ND< 0.0148	ND< 0.0500		ND< 2.92E-02	1.85E-02	157.5%	34.0%	161.1%	ND< 1.5E-07	2.4E-07	47.65%	100.0%
Total PCDD/PCDF		0.077	0.064	ND< 0.167	@	ND< 1.67E-01	5.62E-02	83.5%	19.4%	85.7%	ND< 8.7E-07	7.4E-07	38.47%	100.0%
							AVERAGES	70.2%	29.8%	78.8%	6.2E-08	6.03E-08	22.0%	

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PCDD/PCDF -
UNCERTAINTY ANALYSIS
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PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
PCDD/PCDF IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	415,021	415,021	383,654	404,565	18109.75	4.48%	10455.67	0.00%	0.00
LOAD, MW	839	839	789	822		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.26E+06	9.34E+06	9.08E+06	9.23E+06	1.33E+05	1.44%	7.67E+04	0.00%	0.00E+00
%O2	3.81	3.81	3.98	3.87	9.81E-02	2.54%	0.00	0.00%	0.00
O2 Correction Factor	1.223	1.223	1.235	1.227	7.09E-03	0.58%	0	0.00%	0.00
Particle Collection Bias								20%	

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
PCDD/PCDF STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	415,021	415,021	383,654	404,565	18109.75	4.48%	10455.67	0.00%	0.00
LOAD, MW	839	839	789	822		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.26E+06	9.34E+06	9.08E+06	9.23E+06	1.33E+05	1.44%	7.67E+04	0.00%	0.00E+00
%O2	4.62	4.48	4.60	4.57	7.57E-02	1.66%	0.00	0.00%	0.00
O2 Correction Factor	1.284	1.273	1.282	1.280	5.92E-03	0.46%	0	0.00%	0.00
Particle Collection Bias								10%	

DEGREES FREEDOM	T-VALUE
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.37

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PCDD/PCDF
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SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
2378-TCDD	IN	1.60E-03	1.93E-03	**BIAS**	1.26E-03	5.0E-06	3.4E-15	3.4E-12	8.0E-09	1.1E-08	2.01	2	4.3	3.6E-08	115.6%
12378 PeCDD		5.75E-04	1.38E-03	**BIAS**	9.44E-04	5.0E-06	2.5E-15	2.6E-12	2.9E-09	8.3E-09	2.03	2	4.3	1.5E-08	63.4%
123478 HxCDD		1.43E-03	1.55E-03	**BIAS**	1.48E-03	5.0E-06	4.0E-15	4.0E-12	7.1E-09	1.1E-08	2.01	2	4.3	3.3E-08	88.3%
123678 HxCDD		2.34E-04	8.70E-04	**BIAS**	7.98E-04	5.0E-06	2.2E-15	2.2E-12	1.2E-09	5.9E-09	2.12	2	4.3	7.8E-09	39.1%
123789 HxCDD		9.21E-04	1.44E-03	**BIAS**	1.33E-03	5.0E-06	3.6E-15	3.6E-12	4.6E-09	9.8E-09	2.02	2	4.3	2.2E-08	66.6%
1234678 HpCDD		2.09E-03	2.55E-03	**BIAS**	2.36E-03	5.0E-06	6.4E-15	6.4E-12	1.0E-08	1.7E-08	2.01	2	4.3	4.8E-08	81.6%
OCDD		5.03E-03	0.00E+00	NSTDV	4.72E-03	5.0E-06	1.3E-14	1.3E-11	2.5E-08	2.3E-08	2.01	2	4.3	1.1E-07	94.0%
2378 TCDF		6.57E-04	1.28E-03	**BIAS**	8.70E-04	5.0E-06	2.3E-15	2.4E-12	3.3E-09	7.7E-09	2.02	2	4.3	1.6E-08	74.2%
12378 PeCDF		1.27E-03	0.00E+00	NSTDV	8.92E-04	5.0E-06	2.4E-15	2.4E-12	6.3E-09	4.4E-09	2.01	2	4.3	2.8E-08	124.3%
23478 PeCDF		1.19E-03	0.00E+00	**BIAS**	1.41E-03	5.0E-06	3.8E-15	3.8E-12	5.9E-09	7.0E-09	2.01	2	4.3	2.6E-08	75.1%
123478 HxCDF		1.58E-03	8.86E-04	NSTDV	1.12E-03	5.0E-06	3.0E-15	3.0E-12	7.9E-09	7.1E-09	2.01	2	4.3	3.5E-08	124.0%
123678 HxCDF		3.98E-04	5.50E-04	**BIAS**	5.45E-04	5.0E-06	1.5E-15	1.5E-12	2.0E-09	3.9E-09	2.02	2	4.3	9.4E-09	69.1%
234678 HxCDF		5.96E-04	1.22E-03	**BIAS**	8.30E-04	5.0E-06	2.2E-15	2.2E-12	3.0E-09	7.4E-09	2.02	2	4.3	1.5E-08	71.4%
123789 HxCDF		9.16E-04	1.74E-03	**BIAS**	1.17E-03	5.0E-06	3.2E-15	3.2E-12	4.6E-09	1.0E-08	2.02	2	4.3	2.2E-08	76.2%
1234678 HpCDF		1.78E-03	2.67E-03	**BIAS**	2.79E-03	5.0E-06	7.5E-15	7.6E-12	8.9E-09	1.9E-08	2.03	2	4.3	4.3E-08	61.6%
1234789 HpCDF		3.43E-03	6.14E-03	**BIAS**	4.14E-03	5.0E-06	1.1E-14	1.1E-11	1.7E-08	3.7E-08	2.02	2	4.3	8.2E-08	79.9%
OCDF		1.53E-03	5.26E-03	**BIAS**	3.62E-03	5.0E-06	9.8E-15	9.8E-12	7.7E-09	3.2E-08	2.06	2	4.3	4.6E-08	50.8%
Total TCDD		5.34E-03	1.86E-03	NSTDV	1.85E-03	5.0E-06	5.0E-15	5.0E-12	2.7E-08	1.3E-08	2.00	2	4.3	1.2E-07	249.9%
Total PeCDD		5.75E-04	1.38E-03	**BIAS**	9.44E-04	5.0E-06	2.5E-15	2.6E-12	2.9E-09	8.3E-09	2.03	2	4.3	1.5E-08	63.4%
Total HxCDD		7.01E-03	9.42E-04	NSTDV	3.32E-03	5.0E-06	8.9E-15	9.0E-12	3.5E-08	1.7E-08	2.00	2	4.3	1.5E-07	183.2%
Total HpCDD		5.88E-03	2.55E-03	NSTDV	3.26E-03	5.0E-06	8.8E-15	8.8E-12	2.9E-08	2.1E-08	2.00	2	4.3	1.3E-07	157.4%
Total TCDF		2.80E-03	0.00E+00	NSTDV	1.42E-03	5.0E-06	3.8E-15	3.8E-12	1.4E-08	7.1E-09	2.00	2	4.3	6.0E-08	170.8%
Total PeCDF		7.88E-03	0.00E+00	NSTDV	5.03E-03	5.0E-06	1.4E-14	1.4E-11	3.9E-08	2.5E-08	2.00	2	4.3	1.7E-07	136.5%
Total HxCDF		2.90E-03	7.76E-04	NSTDV	1.31E-03	5.0E-06	3.5E-15	3.5E-12	1.4E-08	7.6E-09	2.00	2	4.3	6.3E-08	192.3%
Total HpCDF		2.71E-03	3.99E-03	**BIAS**	4.19E-03	5.0E-06	1.1E-14	1.1E-11	1.4E-08	2.9E-08	2.02	2	4.3	6.5E-08	62.3%
Total PCDD/PCDF		2.48E-02	0.00E+00	**BIAS**	2.53E-02	5.0E-06	6.8E-14	6.9E-11	1.2E-07	1.3E-07	2.01	2	4.3	5.5E-07	86.8%

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
2378-TCDD	STK	3.81E-04	1.66E-03	**BIAS**	5.72E-04	5.2E-06	3.2E-15	3.2E-12	2.0E-09	9.1E-09	2.1	2	4.3	1.3E-08	42.2%
12378 PeCDD		9.21E-04	1.36E-03	**BIAS**	6.63E-04	5.2E-06	3.7E-15	3.7E-12	4.8E-09	7.8E-09	2.0	2	4.3	2.2E-08	64.1%
123478 HxCDD		2.53E-03	3.40E-03	**BIAS**	1.63E-03	5.2E-06	9.2E-15	9.2E-12	1.3E-08	2.0E-08	2.0	2	4.3	6.0E-08	70.8%
123678 HxCDD		1.30E-03	1.50E-03	**BIAS**	4.86E-04	5.2E-06	2.7E-15	2.7E-12	6.8E-09	8.2E-09	2.0	2	4.3	3.0E-08	120.0%
123789 HxCDD		2.15E-03	2.49E-03	**BIAS**	8.06E-04	5.2E-06	4.5E-15	4.6E-12	1.1E-08	1.4E-08	2.0	2	4.3	5.0E-08	119.3%
1234678 HpCDD		5.62E-03	7.65E-03	**BIAS**	2.53E-03	5.2E-06	1.4E-14	1.4E-11	2.9E-08	4.2E-08	2.0	2	4.3	1.3E-07	100.8%
OCDD		2.23E-03	5.10E-03	**BIAS**	3.06E-03	5.2E-06	1.7E-14	1.7E-11	1.2E-08	3.1E-08	2.1	2	4.3	5.9E-08	37.2%
2378 TCDF		2.20E-06	7.37E-04	**BIAS**	2.55E-04	5.2E-06	1.4E-15	1.4E-12	1.4E-10	4.0E-09	3.7	4	2.8	4.1E-09	30.7%
12378 PeCDF		2.50E-04	1.01E-03	**BIAS**	3.48E-04	5.2E-06	2.0E-15	2.0E-12	1.3E-09	5.5E-09	2.1	2	4.3	7.9E-09	43.8%
23478 PeCDF		2.84E-04	1.08E-03	**BIAS**	3.71E-04	5.2E-06	2.1E-15	2.1E-12	1.5E-09	5.9E-09	2.1	2	4.3	8.7E-09	45.3%
123478 HxCDF		1.16E-03	1.97E-03	**BIAS**	6.63E-04	5.2E-06	3.7E-15	3.7E-12	6.0E-09	1.1E-08	2.0	2	4.3	2.8E-08	81.9%
123678 HxCDF		6.14E-04	1.03E-03	**BIAS**	3.45E-04	5.2E-06	1.9E-15	1.9E-12	3.2E-09	5.6E-09	2.0	2	4.3	1.5E-08	82.9%
234678 HxCDF		1.16E-03	1.97E-03	**BIAS**	6.63E-04	5.2E-06	3.7E-15	3.7E-12	6.0E-09	1.1E-08	2.0	2	4.3	2.8E-08	81.9%
123789 HxCDF		1.66E-03	2.80E-03	**BIAS**	9.40E-04	5.2E-06	5.3E-15	5.3E-12	8.6E-09	1.5E-08	2.0	2	4.3	4.0E-08	82.1%
1234678 HpCDF		7.15E-03	6.31E-03	NSTDV	1.94E-03	5.2E-06	1.1E-14	1.1E-11	3.7E-08	3.4E-08	2.0	2	4.3	1.6E-07	162.3%
1234789 HpCDF		1.37E-02	1.21E-02	NSTDV	3.70E-03	5.2E-06	2.1E-14	2.1E-11	7.1E-08	6.5E-08	2.0	2	4.3	3.1E-07	163.6%
OCDF		1.46E-03	6.06E-03	**BIAS**	2.09E-03	5.2E-06	1.2E-14	1.2E-11	7.7E-09	3.3E-08	2.1	2	4.3	4.7E-08	43.2%
Total TCDD		3.81E-04	1.66E-03	**BIAS**	5.72E-04	5.2E-06	3.2E-15	3.2E-12	2.0E-09	9.1E-09	2.1	2	4.3	1.3E-08	42.2%
Total PeCDD		1.02E-03	1.36E-03	**BIAS**	6.63E-04	5.2E-06	3.7E-15	3.7E-12	5.3E-09	7.8E-09	2.0	2	4.3	2.4E-08	70.4%
Total HxCDD		1.51E-03	2.08E-03	**BIAS**	9.95E-04	5.2E-06	5.6E-15	5.6E-12	7.9E-09	1.2E-08	2.0	2	4.3	3.6E-08	69.4%
Total HpCDD		5.62E-03	7.65E-03	**BIAS**	2.53E-03	5.2E-06	1.4E-14	1.4E-11	2.9E-08	4.2E-08	2.0	2	4.3	1.3E-07	100.8%
Total TCDF		2.20E-06	7.37E-04	**BIAS**	2.55E-04	5.2E-06	1.4E-15	1.4E-12	1.4E-10	4.0E-09	3.7	4	2.8	4.1E-09	30.7%
Total PeCDF		2.20E-04	1.02E-03	**BIAS**	3.51E-04	5.2E-06	2.0E-15	2.0E-12	1.2E-09	5.6E-09	2.1	2	4.3	7.5E-09	41.1%
Total HxCDF		1.02E-03	1.70E-03	**BIAS**	5.71E-04	5.2E-06	3.2E-15	3.2E-12	5.3E-09	9.3E-09	2.0	2	4.3	2.5E-08	82.9%
Total HpCDF		1.07E-02	9.48E-03	NSTDV	2.92E-03	5.2E-06	1.6E-14	1.6E-11	5.5E-08	5.2E-08	2.0	2	4.3	2.4E-07	161.1%
Total PCDD/PCDF		3.24E-02	2.79E-02	**BIAS**	1.67E-02	5.2E-06	9.4E-14	9.4E-11	1.7E-07	1.7E-07	2.0	2	4.3	7.4E-07	85.7%

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SPECIES	LOC		RUN #1		RUN #2 in ug/Nm3		RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)		ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
total Chlorobiphenyls	IN	ND<	0.003	ND<	0.003	ND<	0.003	ND<	3.01E-03	2.89E-04	24.3%	35.2%	42.8%	ND<	1.50E-05	6.4E-06	6.91%	100.0%
total Dichlorobiphenyls		ND<	0.006	ND<	0.007	ND<	0.005	ND<	6.04E-03	1.21E-03	50.1%	35.4%	61.4%	ND<	3.01E-05	1.8E-05	14.03%	100.0%
total Trichlorobiphenyls		ND<	0.006	ND<	0.007	ND<	0.004	ND<	5.62E-03	1.21E-03	53.8%	35.5%	64.5%	ND<	2.80E-05	1.8E-05	15.85%	100.0%
total Tetrachlorobiphenyls		ND<	0.009	ND<	0.010	ND<	0.006	ND<	8.31E-03	2.20E-03	66.0%	35.7%	75.1%	ND<	4.14E-05	3.1E-05	20.06%	100.0%
total Pentachlorobiphenyls		ND<	0.13	ND<	0.17	ND<	0.18	ND<	1.60E-01	2.92E-02	45.6%	35.4%	57.7%	ND<	7.96E-04	4.6E-04	13.94%	100.0%
total Hexachlorobiphenyls		ND<	0.006	ND<	0.013	ND<	0.005	ND<	7.72E-03	4.27E-03	137.3%	37.5%	142.3%	ND<	3.85E-05	5.5E-05	42.34%	100.0%
total Heptachlorobiphenyls		ND<	0.006	ND<	0.009	ND<	0.007	ND<	7.50E-03	1.57E-03	52.3%	35.5%	63.2%	ND<	3.73E-05	2.4E-05	16.09%	100.0%
total Octachlorobiphenyls		ND<	0.005	ND<	0.011	ND<	0.006	ND<	7.17E-03	3.00E-03	104.0%	36.5%	110.2%	ND<	3.57E-05	3.9E-05	32.18%	100.0%
total Nonachlorobiphenyls		ND<	0.005	ND<	0.020	ND<	0.006	ND<	9.99E-03	8.34E-03	207.6%	40.3%	211.4%	ND<	4.97E-05	1.1E-04	64.26%	100.0%
Decachlorobiphenyl		ND<	0.017	ND<	0.016	ND<	0.023	ND<	1.88E-02	3.89E-03	51.6%	35.5%	62.6%	ND<	9.36E-05	5.9E-05	15.72%	100.0%
TOTAL PCB		ND<	0.13	ND<	0.17	ND<	0.18	ND<	1.60E-01	2.92E-02	45.6%	35.4%	57.7%	ND<	7.96E-04	4.6E-04	13.94%	100.0%
										AVERAGES	79.3%	36.3%	89.1%		1.17E-04	8.15E-05	24.1%	

SPECIES	LOC		RUN #1		RUN #2 in ug/Nm3		RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)		ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
total Chlorobiphenyls	STK	ND<	0.003	ND<	0.003	ND<	0.003	ND<	3.02E-03	4.57E-04	37.8%	30.8%	48.8%	ND<	1.57E-05	7.7E-06	10.43%	100.0%
total Dichlorobiphenyls		ND<	0.005	ND<	0.006	ND<	0.006	ND<	5.73E-03	3.28E-04	14.9%	30.6%	34.0%	ND<	2.97E-05	1.0E-05	4.30%	100.0%
total Trichlorobiphenyls		ND<	0.006	ND<	0.014	ND<	0.010	ND<	1.01E-02	3.87E-03	95.4%	31.9%	100.6%	ND<	5.24E-05	5.3E-05	26.21%	100.0%
total Tetrachlorobiphenyls		ND<	0.005	ND<	0.011	ND<	0.007	ND<	7.67E-03	2.75E-03	89.1%	31.7%	94.5%	ND<	3.98E-05	3.8E-05	26.38%	100.0%
total Pentachlorobiphenyls		ND<	0.14	ND<	0.26	ND<	0.19	ND<	1.97E-01	5.91E-02	74.8%	31.4%	81.1%	ND<	1.02E-03	8.3E-04	20.82%	100.0%
total Hexachlorobiphenyls		ND<	0.005	ND<	0.011	ND<	0.009	ND<	8.35E-03	3.13E-03	93.1%	31.8%	98.4%	ND<	4.34E-05	4.3E-05	25.94%	100.0%
total Heptachlorobiphenyls		ND<	0.006	ND<	0.011	ND<	0.009	ND<	8.49E-03	2.44E-03	71.7%	31.3%	78.2%	ND<	4.41E-05	3.4E-05	20.60%	100.0%
total Octachlorobiphenyls		ND<	0.005	ND<	0.008	ND<	0.006	ND<	6.27E-03	1.44E-03	57.0%	31.0%	64.9%	ND<	3.26E-05	2.1E-05	17.03%	100.0%
total Nonachlorobiphenyls		ND<	0.004	ND<	0.006	ND<	0.008	ND<	6.03E-03	1.72E-03	71.1%	31.3%	77.7%	ND<	3.13E-05	2.4E-05	19.32%	100.0%
Decachlorobiphenyl		ND<	0.018	ND<	0.021	ND<	0.014	ND<	1.79E-02	3.33E-03	46.4%	30.9%	55.7%	ND<	9.29E-05	5.2E-05	12.80%	100.0%
TOTAL PCB		ND<	0.14	ND<	0.26	ND<	0.19	ND<	1.97E-01	5.91E-02	74.8%	31.4%	81.1%	ND<	1.02E-03	8.3E-04	20.82%	100.0%
										AVERAGES	65.1%	31.3%	73.4%		1.40E-04	1.11E-04	18.4%	

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Preliminary

PCB-
UNCERTAINTY ANALYSIS
SITE 118
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PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
PCB IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	415,021	415,021	383,654	404,565	18109.75	4.48%	10455.67	0.00%	0.00
LOAD, MW	839	839	789	822		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.26E+06	9.34E+06	9.08E+06	9.23E+06	1.33E+05	1.44%	7.67E+04	0.00%	0.00E+00
%O2	3.81	3.81	3.98	3.87	9.81E-02	2.54%	0.00	0.00%	0.00
O2 Correction Factor	1.223	1.223	1.235	1.227	7.09E-03	0.58%	0	0.00%	0.00
Particle Collection Bias								20%	

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
PCB STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	415,021	415,021	383,654	404,565	18109.75	4.48%	10455.67	0.00%	0.00
LOAD, MW	839	839	789	822		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.26E+06	9.34E+06	9.08E+06	9.23E+06	1.33E+05	1.44%	7.67E+04	0.00%	0.00E+00
%O2	4.62	4.48	4.60	4.57	7.57E-02	1.66%	0.00	0.00%	0.00
O2 Correction Factor	1.284	1.273	1.282	1.280	5.92E-03	0.46%	0	0.00%	0.00
Particle Collection Bias								10%	

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PCB-
UNCERTAINTY ANALYSIS
SITE 118
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SPECIES	LOC	CONC. DELTA P DETERMINATION: NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
total Chlorobiphenyls	IN	1.67E-04	8.72E-04	**BIAS**	6.02E-04	5.0E-03	1.6E-12	1.6E-09	8.5E-07	5.3E-06	2.14	2	4.3	6.4E-06	42.8%
total Dichlorobiphenyls		7.01E-04	1.77E-03	**BIAS**	1.21E-03	5.0E-03	3.3E-12	3.3E-09	3.5E-06	1.1E-05	2.03	2	4.3	1.8E-05	61.4%
total Trichlorobiphenyls		7.00E-04	1.65E-03	**BIAS**	1.12E-03	5.0E-03	3.0E-12	3.0E-09	3.5E-06	9.9E-06	2.03	2	4.3	1.8E-05	64.5%
total Tetrachlorobiphenyls		1.27E-03	2.45E-03	**BIAS**	1.66E-03	5.0E-03	4.5E-12	4.5E-09	6.3E-06	1.5E-05	2.02	2	4.3	3.1E-05	75.1%
total Pentachlorobiphenyls		1.69E-02	4.67E-02	**BIAS**	3.20E-02	5.0E-03	8.6E-11	8.7E-08	8.4E-05	2.8E-04	2.04	2	4.3	4.6E-04	57.7%
total Hexachlorobiphenyls		2.46E-03	2.45E-03	**BIAS**	1.54E-03	5.0E-03	4.2E-12	4.2E-09	1.2E-05	1.4E-05	2.00	2	4.3	5.5E-05	142.3%
total Heptachlorobiphenyls		9.08E-04	2.20E-03	**BIAS**	1.50E-03	5.0E-03	4.0E-12	4.1E-09	4.5E-06	1.3E-05	2.03	2	4.3	2.4E-05	63.2%
total Octachlorobiphenyls		1.73E-03	2.19E-03	**BIAS**	1.43E-03	5.0E-03	3.9E-12	3.9E-09	8.6E-06	1.3E-05	2.01	2	4.3	3.9E-05	110.2%
total Nonachlorobiphenyls		4.82E-03	3.49E-03	NSTDV	2.00E-03	5.0E-03	5.4E-12	5.4E-09	2.4E-05	2.0E-05	2.00	2	4.3	1.1E-04	211.4%
Decachlorobiphenyl		2.25E-03	5.51E-03	**BIAS**	3.76E-03	5.0E-03	1.0E-11	1.0E-08	1.1E-05	3.3E-05	2.03	2	4.3	5.9E-05	62.6%
TOTAL PCB		1.69E-02	4.67E-02	**BIAS**	3.20E-02	5.0E-03	8.6E-11	8.7E-08	8.4E-05	2.8E-04	2.04	2	4.3	4.6E-04	57.7%

SPECIES	LOC	CONC. DELTA P DETERMINATION: NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
total Chlorobiphenyls	STK	2.64E-04	8.80E-04	**BIAS**	3.02E-04	5.2E-03	1.7E-12	1.7E-09	1.4E-06	4.8E-06	2.1	2	4.3	7.7E-06	48.8%
total Dichlorobiphenyls		1.89E-04	1.65E-03	**BIAS**	5.73E-04	5.2E-03	3.2E-12	3.2E-09	1.0E-06	9.1E-06	2.4	2	4.3	1.0E-05	34.0%
total Trichlorobiphenyls		2.23E-03	3.05E-03	**BIAS**	1.01E-03	5.2E-03	5.7E-12	5.7E-09	1.2E-05	1.7E-05	2.0	2	4.3	5.3E-05	100.6%
total Tetrachlorobiphenyls		1.59E-03	2.31E-03	**BIAS**	7.67E-04	5.2E-03	4.3E-12	4.3E-09	8.2E-06	1.3E-05	2.0	2	4.3	3.8E-05	94.5%
total Pentachlorobiphenyls		3.41E-02	5.85E-02	**BIAS**	1.97E-02	5.2E-03	1.1E-10	1.1E-07	1.8E-04	3.2E-04	2.0	2	4.3	8.3E-04	81.1%
total Hexachlorobiphenyls		1.80E-03	2.52E-03	**BIAS**	8.35E-04	5.2E-03	4.7E-12	4.7E-09	9.4E-06	1.4E-05	2.0	2	4.3	4.3E-05	98.4%
total Heptachlorobiphenyls		1.41E-03	2.52E-03	**BIAS**	8.49E-04	5.2E-03	4.8E-12	4.8E-09	7.3E-06	1.4E-05	2.0	2	4.3	3.4E-05	78.2%
total Octachlorobiphenyls		8.29E-04	1.84E-03	**BIAS**	6.27E-04	5.2E-03	3.5E-12	3.5E-09	4.3E-06	1.0E-05	2.0	2	4.3	2.1E-05	64.9%
total Nonachlorobiphenyls		9.95E-04	1.79E-03	**BIAS**	6.03E-04	5.2E-03	3.4E-12	3.4E-09	5.2E-06	9.8E-06	2.0	2	4.3	2.4E-05	77.7%
Decachlorobiphenyl		1.92E-03	5.22E-03	**BIAS**	1.79E-03	5.2E-03	1.0E-11	1.0E-08	1.0E-05	2.9E-05	2.0	2	4.3	5.2E-05	55.7%
TOTAL PCB		3.41E-02	5.85E-02	**BIAS**	1.97E-02	5.2E-03	1.1E-10	1.1E-07	1.8E-04	3.2E-04	2.0	2	4.3	8.3E-04	81.1%

Preliminary

Do Not Cite or Quote

Preliminary

VOC
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	RUN #1	RUN #2 In ppb	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE In lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
BENZENE	IN	0.28	0.15		2.15E-01	9.19E-02	384.1%	0.0%	384.1%	3.7E-03	1.4E-02	60.47%	0.0%
TOLUENE		2.89	0.99		1.94E+00	1.34E+00	622.0%	0.0%	622.0%	3.9E-02	2.4E-01	97.94%	0.0%
Vinyl Chloride		ND< 0.4	ND< 0.4		ND< 4.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 5.5E-03	1.3E-03	0.00%	100.0%
1,3-Butadiene		ND< 0.1	ND< 0.1	ND< 0.1	ND< 1.00E-01	0.00E+00	2.2%	28.9%	28.9%	ND< 1.2E-03	3.4E-04	0.00%	100.0%
Methyl Bromide		ND< 0.4	ND< 0.4		ND< 4.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 8.3E-03	2.0E-03	0.00%	100.0%
Trichlorofluoromethane		0.37	ND< 0.08		2.05E-01	2.33E-01	1022.2%	6.5%	1022.3%	6.2E-03	6.3E-02	141.46%	9.8%
Dichloromethane		15.8	7.47		1.16E+01	5.89E+00	454.7%	0.0%	454.7%	2.2E-01	9.8E-01	71.59%	0.0%
Chloroform		ND< 0.2	ND< 0.2		ND< 2.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 5.2E-03	1.2E-03	0.00%	100.0%
1,2-Dichloroethane		ND< 0.4	ND< 0.4		ND< 4.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 8.7E-03	2.1E-03	0.00%	100.0%
1,1,1-Trichloroethane		0.25	0.12		1.85E-01	9.19E-02	446.3%	0.0%	446.3%	5.4E-03	2.4E-02	70.27%	0.0%
Carbon Tetrachloride		ND< 0.1	ND< 0.1		ND< 1.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 3.4E-03	8.0E-04	0.00%	100.0%
1,2-Dichloropropane		ND< 0.4	ND< 0.4		ND< 4.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 9.9E-03	2.4E-03	0.00%	100.0%
Trichloroethene		ND< 0.2	ND< 0.2		ND< 2.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 5.8E-03	1.4E-03	0.00%	100.0%
1,2-Dibromoethane		ND< 0.3	ND< 0.3		ND< 3.00E-01	0.00E+00	3.0%	23.6%	23.8%	ND< 1.2E-02	2.9E-03	0.00%	100.0%
Perchloroethylene		ND< 0.08	ND< 0.08		ND< 8.00E-02	0.00E+00	3.0%	23.6%	23.8%	ND< 2.9E-03	6.9E-04	0.00%	100.0%
Chlorobenzene		ND< 0.09	ND< 0.09		ND< 9.00E-02	0.00E+00	3.0%	23.6%	23.8%	ND< 2.2E-03	5.3E-04	0.00%	100.0%
Ethylbenzene		0.11	0.06		8.50E-02	3.54E-02	373.6%	0.0%	373.6%	2.0E-03	7.4E-03	58.82%	0.0%
o-Xylene		0.11	0.11		1.10E-01	0.00E+00	3.0%	0.0%	3.0%	2.6E-03	7.6E-05	0.00%	0.0%
						Average:	185.4%	15.1%	198.5%	1.9E-02	7.5E-02	27.81%	

SPECIES	LOC	RUN #1	RUN #2 In ppb	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE In lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
BENZENE	STK	0.30	0.21	0.16	2.23E-01	7.09E-02	79.0%	0.0%	79.0%	4.1E-03	3.2E-03	22.89%	0.0%
TOLUENE		4.07	2.23	1.77	2.69E+00	1.22E+00	112.4%	0.0%	112.4%	5.8E-02	6.5E-02	34.20%	0.0%
Vinyl Chloride		ND< 0.75	ND< 0.75	ND< 0.4	ND< 6.33E-01	2.02E-01	79.3%	29.8%	84.7%	ND< 9.2E-03	7.8E-03	24.56%	100.0%
1,3-Butadiene		ND< 0.1	ND< 0.1	ND< 0.1	ND< 1.00E-01	0.00E+00	2.2%	28.9%	28.9%	ND< 1.3E-03	3.7E-04	0.00%	100.0%
Methyl Bromide		ND< 0.6	ND< 0.6	ND< 0.4	ND< 5.33E-01	1.15E-01	53.9%	29.3%	61.3%	ND< 1.2E-02	7.2E-03	16.67%	100.0%
Trichlorofluoromethane		ND< 0.2	ND< 0.2	ND< 0.08	ND< 1.60E-01	6.93E-02	107.6%	30.6%	111.9%	ND< 5.1E-03	5.7E-03	33.33%	100.0%
Dichloromethane		20.7	11.7	8.83	1.37E+01	6.19E+00	112.0%	0.0%	112.0%	2.7E-01	3.0E-01	33.75%	0.0%
Chloroform		ND< 0.3	ND< 0.3	ND< 0.2	ND< 2.67E-01	5.77E-02	53.9%	29.3%	61.3%	ND< 7.4E-03	4.6E-03	16.67%	100.0%
1,2-Dichloroethane		ND< 0.7	ND< 0.7	ND< 0.4	ND< 6.00E-01	1.73E-01	71.8%	29.7%	77.7%	ND< 1.4E-02	1.1E-02	22.22%	100.0%
1,1,1-Trichloroethane		0.49	0.39	0.29	3.90E-01	1.00E-01	63.8%	0.0%	63.8%	1.2E-02	7.7E-03	17.09%	0.0%
Carbon Tetrachloride		ND< 0.2	ND< 0.2	ND< 0.1	ND< 1.67E-01	5.77E-02	86.1%	30.0%	91.2%	ND< 6.0E-03	5.5E-03	26.67%	100.0%
1,2-Dichloropropane		ND< 0.7	ND< 0.7	ND< 0.4	ND< 6.00E-01	1.73E-01	71.8%	29.7%	77.7%	ND< 1.6E-02	1.2E-02	22.22%	100.0%
Trichloroethene		ND< 0.3	ND< 0.3	ND< 0.2	ND< 2.67E-01	5.77E-02	53.9%	29.3%	61.3%	ND< 8.2E-03	5.0E-03	16.67%	100.0%
1,2-Dibromoethane		ND< 0.5	ND< 0.5	ND< 0.3	ND< 4.33E-01	1.15E-01	66.3%	29.5%	72.6%	ND< 1.9E-02	1.4E-02	20.51%	100.0%
Perchloroethylene		ND< 0.2	ND< 0.2	ND< 0.08	ND< 1.60E-01	6.93E-02	107.6%	30.6%	111.9%	ND< 6.2E-03	6.9E-03	33.33%	100.0%
Chlorobenzene		ND< 0.2	ND< 0.2	ND< 0.09	ND< 1.63E-01	6.35E-02	96.6%	30.3%	101.3%	ND< 4.3E-03	4.3E-03	29.93%	100.0%
Ethylbenzene		0.18	0.12	0.1	1.33E-01	4.16E-02	77.6%	0.0%	77.6%	3.3E-03	2.6E-03	23.33%	0.0%
o-Xylene		0.36	0.18	0.15	2.30E-01	1.14E-01	122.7%	0.0%	122.7%	5.7E-03	7.0E-03	37.68%	0.0%

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VOC
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
VOC IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,696	407,696	407,696	0.00	0.00%	0.00	0.00%	0.00
LOAD, MW	844	844	844	844		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.12E+06	9.02E+06	9.06E+06	5.39E+04	0.59%	3.11E+04	0.00%	0.00E+00
%O2 INLET	3.49	3.49	3.49	3.49	0.00E+00	0.00%	0.00	0.00%	0.00
O2 Correction Factor	1.200	1.200	1.200	1.200	0.00E+00	0.00%	0	0.00%	0.00
								0%	
Particle Collection Bias									

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
VOC STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,696	407,696	407,696	0.00	0.00%	0.00	0.00%	0.00
LOAD, MW	844	844	844	844		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.12E+06	9.02E+06	9.06E+06	5.39E+04	0.59%	3.11E+04	0.00%	0.00E+00
%O2 OUTLET	4.54	4.54	4.54	4.54	0.00E+00	0.00%	0.00	0.00%	0.00
O2 Correction Factor	1.278	1.278	1.278	1.278	2.11E-08	0.00%	0	0.00%	0.00
								0%	
Particle Collection Bias									

{UNNIAIR.XLW}UNVOC.XLS
9:21 PM
10/8/93

VOC
UNCERTAINTY ANALYSIS
SITE 118
PAGE 3 OF 3

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAf)	RESULTS: Sr	Br	vr	vr	t:	Ur	% Ur
BENZENE	IN	6.50E-02	0.00E+00	NSTDV	0.00E+00	1.7E-02	4.1E-10	4.0E-07	1.1E-03	0.0E+00	1.00	1	13	1.4E-02	384.1%
TOLUENE		9.50E-01	0.00E+00	NSTDV	0.00E+00	2.0E-02	4.3E-09	4.3E-06	1.9E-02	0.0E+00	1.00	1	13	2.4E-01	622.0%
Vinyl Chloride		0.00E+00	9.43E-02	**BIAS**	0.00E+00	1.4E-02	6.0E-10	6.0E-07	3.8E-05	1.3E-03	1.60	2	4.3	1.3E-03	23.8%
1,3-Butadiene		0.00E+00	2.89E-02	**BIAS**	0.00E+00	1.2E-02	1.3E-10	1.3E-07	8.1E-06	3.4E-04	3.20	3	3.2	3.4E-04	28.9%
Methyl Bromide		0.00E+00	9.43E-02	**BIAS**	0.00E+00	2.1E-02	9.2E-10	9.0E-07	5.7E-05	2.0E-03	1.60	2	4.3	2.0E-03	23.8%
Trichlorofluoromethane		1.65E-01	1.33E-02	NSTDV	0.00E+00	3.0E-02	6.8E-10	6.7E-07	5.0E-03	4.0E-04	1.00	1	13	6.3E-02	1022.3%
Dichloromethane		4.17E+00	0.00E+00	NSTDV	0.00E+00	1.9E-02	2.4E-08	2.4E-05	7.8E-02	0.0E+00	1.00	1	13	9.8E-01	454.7%
Chloroform		0.00E+00	4.71E-02	**BIAS**	0.00E+00	2.6E-02	5.8E-10	5.7E-07	3.6E-05	1.2E-03	1.60	2	4.3	1.2E-03	23.8%
1,2-Dichloroethane		0.00E+00	9.43E-02	**BIAS**	0.00E+00	2.2E-02	9.6E-10	9.4E-07	6.0E-05	2.0E-03	1.60	2	4.3	2.1E-03	23.8%
1,1,1-Trichloroethane		6.50E-02	0.00E+00	NSTDV	0.00E+00	2.9E-02	6.0E-10	5.9E-07	1.9E-03	0.0E+00	1.00	1	13	2.4E-02	446.3%
Carbon Tetrachloride		0.00E+00	2.36E-02	**BIAS**	0.00E+00	3.4E-02	3.7E-10	3.7E-07	2.3E-05	7.9E-04	1.60	2	4.3	8.0E-04	23.8%
1,2-Dichloropropane		0.00E+00	9.43E-02	**BIAS**	0.00E+00	2.5E-02	1.1E-09	1.1E-06	6.8E-05	2.3E-03	1.60	2	4.3	2.4E-03	23.8%
Trichloroethene		0.00E+00	4.71E-02	**BIAS**	0.00E+00	2.9E-02	6.4E-10	6.3E-07	4.0E-05	1.4E-03	1.60	2	4.3	1.4E-03	23.8%
1,2-Dibromoethane		0.00E+00	7.07E-02	**BIAS**	0.00E+00	4.1E-02	1.4E-09	1.3E-06	8.5E-05	2.9E-03	1.60	2	4.3	2.9E-03	23.8%
Perchloroethylene		0.00E+00	1.89E-02	**BIAS**	0.00E+00	3.6E-02	3.2E-10	3.2E-07	2.0E-05	6.9E-04	1.60	2	4.3	6.9E-04	23.8%
Chlorobenzene		0.00E+00	2.12E-02	**BIAS**	0.00E+00	2.5E-02	2.5E-10	2.4E-07	1.5E-05	5.2E-04	1.60	2	4.3	5.3E-04	23.8%
Ethylbenzene		2.50E-02	0.00E+00	NSTDV	0.00E+00	2.3E-02	2.2E-10	2.1E-07	5.8E-04	0.0E+00	1.00	1	13	7.4E-03	373.6%
o-Xylene		0.00E+00	0.00E+00	**BIAS**	0.00E+00	2.3E-02	2.8E-10	2.8E-07	1.8E-05	0.0E+00	1.60	2	4.3	7.6E-05	3.0%
															198.5%

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAf)	RESULTS: Sr	Br	vr	vr	t:	Ur	% Ur
BENZENE	STK	4.10E-02	0.00E+00	NSTDV	0.00E+00	1.8E-02	4.5E-10	4.4E-07	7.5E-04	0.0E+00	2.01	2	4.3	3.2E-03	79.0%
TOLUENE		7.03E-01	0.00E+00	NSTDV	0.00E+00	2.1E-02	6.4E-09	6.3E-06	1.5E-02	0.0E+00	2.00	2	4.3	6.5E-02	112.4%
Vinyl Chloride		1.17E-01	1.89E-01	**BIAS**	0.00E+00	1.5E-02	1.0E-09	1.0E-06	1.7E-03	2.8E-03	2.01	2	4.3	7.8E-03	84.7%
1,3-Butadiene		0.00E+00	2.89E-02	**BIAS**	0.00E+00	1.3E-02	1.4E-10	1.4E-07	8.7E-06	3.6E-04	3.20	3	3.2	3.7E-04	28.9%
Methyl Bromide		6.67E-02	1.56E-01	**BIAS**	0.00E+00	2.2E-02	1.3E-09	1.3E-06	1.5E-03	3.5E-03	2.01	2	4.3	7.2E-03	61.3%
Trichlorofluoromethane		4.00E-02	4.90E-02	**BIAS**	0.00E+00	3.2E-02	5.7E-10	5.6E-07	1.3E-03	1.6E-03	2.00	2	4.3	5.7E-03	111.9%
Dichloromethane		3.58E+00	0.00E+00	NSTDV	0.00E+00	2.0E-02	3.0E-08	3.0E-05	7.1E-02	0.0E+00	2.00	2	4.3	3.0E-01	112.0%
Chloroform		3.33E-02	7.82E-02	**BIAS**	0.00E+00	2.8E-02	8.2E-10	8.1E-07	9.3E-04	2.2E-03	2.01	2	4.3	4.6E-03	61.3%
1,2-Dichloroethane		1.00E-01	1.78E-01	**BIAS**	0.00E+00	2.3E-02	1.5E-09	1.5E-06	2.3E-03	4.1E-03	2.01	2	4.3	1.1E-02	77.7%
1,1,1-Trichloroethane		5.77E-02	0.00E+00	NSTDV	0.00E+00	3.1E-02	1.3E-09	1.3E-06	1.8E-03	0.0E+00	2.01	2	4.3	7.7E-03	63.8%
Carbon Tetrachloride		3.33E-02	5.00E-02	**BIAS**	0.00E+00	3.6E-02	6.6E-10	6.5E-07	1.2E-03	1.8E-03	2.00	2	4.3	5.5E-03	91.2%
1,2-Dichloropropane		1.00E-01	1.78E-01	**BIAS**	0.00E+00	2.6E-02	1.7E-09	1.7E-06	2.6E-03	4.7E-03	2.01	2	4.3	1.2E-02	77.7%
Trichloroethene		3.33E-02	7.82E-02	**BIAS**	0.00E+00	3.1E-02	9.0E-10	8.9E-07	1.0E-03	2.4E-03	2.01	2	4.3	5.0E-03	61.3%
1,2-Dibromoethane		6.67E-02	1.28E-01	**BIAS**	0.00E+00	4.4E-02	2.1E-09	2.1E-06	2.9E-03	5.6E-03	2.01	2	4.3	1.4E-02	72.6%
Perchloroethylene		4.00E-02	4.90E-02	**BIAS**	0.00E+00	3.9E-02	6.8E-10	6.7E-07	1.5E-03	1.9E-03	2.00	2	4.3	6.9E-03	111.9%
Chlorobenzene		3.67E-02	4.95E-02	**BIAS**	0.00E+00	2.6E-02	4.7E-10	4.7E-07	9.6E-04	1.3E-03	2.00	2	4.3	4.3E-03	101.3%
Ethylbenzene		2.40E-02	0.00E+00	NSTDV	0.00E+00	2.5E-02	3.6E-10	3.6E-07	6.0E-04	0.0E+00	2.01	2	4.3	2.6E-03	77.6%
o-Xylene		6.56E-02	0.00E+00	NSTDV	0.00E+00	2.5E-02	6.3E-10	6.2E-07	1.6E-03	0.0E+00	2.00	2	4.3	7.0E-03	122.7%

[UNNIAIR.XLW]UNVOC.XLS
9:35 PM
10/8/93

Preliminary

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FORM
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	RUN #1	RUN #2 in ppb	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spi)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE In lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
FORMALDEHYDE	IN	8.8	9.7	4.5	7.65E+00	2.78E+00	90.2%	0.0%	90.2%	5.1E-02	4.6E-02	27.61%	0.0%
FORMALDEHYDE	STK	4.3	7.1	6.4	5.97E+00	1.45E+00	60.5%	0.0%	60.5%	4.1E-02	2.5E-02	18.13%	0.0%

FORM
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
FORMALDEHYDE IN/STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	408,537	408,537	408,537	408,537	0.00	0.00%	0.00	0.00%	0.00
LOAD, MW	841	841	841	841		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.09E+06	9.17E+06	9.07E+06	9.11E+06	5.42E+04	0.59%	3.13E+04	0.00%	0.00E+00
%O2 INLET	3.61	3.61	3.61	3.61	0.00E+00	0.00%	0.00	0.00%	0.00
O2 Correction Factor IN	1.209	1.209	1.209	1.209	2.11E-08	0.00%	0	0.00%	0.00
%O2 OUTLET	4.28	4.28	4.28	4.28	0.00	0.00%	0.00	0.00%	0.00
O2 Correction Factor OUT	1.258	1.258	1.258	1.258	0.00E+00	0.00%	0	0.00%	0.00

[UNNIAIR.XLW]UNFORMPSD.XLS
9:26 PM
10/8/93

FORM
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
FORMALDEHYDE	IN	1.60E+00	0.00E+00	NSTDV	0.00E+00	6.6E-03	5.6E-09	5.5E-06	1.1E-02	0.0E+00	2.00	2	4.3	4.6E-02	90.2%
FORMALDEHYDE	STK	8.38E-01	0.00E+00	NSTDV	0.00E+00	6.9E-03	4.5E-09	4.5E-06	5.8E-03	0.0E+00	2.01	2	4.3	2.5E-02	60.5%

[UNNIAIR.XLW]UNFORMPSD.XLS
9:41 PM
10/8/93

Preliminary

PM/ANIONS
UNCERTAINTY ANALYSIS
SITE 118
PAGE 1 OF 3

SPECIES	LOC	RUN #1	RUN #2 in ppm	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
CHLORIDE	IN	3.6	3.0	3.1	3.26E+00	3.42E-01	26.3%	20.0%	33.0%	2.57E+01	8.48E+00	7.84%	0.0%
FLOURIDE		0.11	0.11	0.10	1.07E-01	5.07E-03	12.3%	20.0%	23.5%	4.52E-01	1.06E-01	3.43%	0.0%
PHOSPHORUS		0.09	0.26	0.27	2.04E-01	1.03E-01	125.5%	20.0%	127.1%	4.31E+00	5.48E+00	38.86%	0.0%
SULFATE		366	367	353	3.62E+02	7.79E+00	4.1%	20.0%	20.4%	7.72E+03	1.58E+03	1.65%	0.0%
					AVERAGE:	2.06E+00	42.1%	20.0%	51.0%	1.94E+03	3.98E+02	12.95%	
CHLORIDE	STK	3.2	3.9	3.1	3.41E+00	3.97E-01	29.1%	10.0%	30.8%	2.75E+01	8.46E+00	8.91%	0.0%
FLOURIDE	ND	0.35	0.14	0.13 #	1.5E-01	2.31E-02	38.3%	40.4%	55.7%	6.51E-01	3.62E-01	11.67%	39.2%
PHOSPHORUS	ND	0.48	ND 0.10	ND 0.10	ND< 2.28E-01	2.18E-01	238.1%	38.0%	241.1%	ND< 4.91E+00	1.18E+01	73.75%	100.0%
SULFATE		346	413	324	3.61E+02	4.66E+01	32.3%	10.0%	33.8%	7.87E+03	2.66E+03	9.65%	0.0%
					AVERAGE:	1.18E+01	84.4%	24.6%	90.3%	1.98E+03	6.70E+02	26.00%	

SPECIES	LOC	RUN #1	RUN #2 in ug/Nm3	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
PM-AN	IN	80.1	71.8	85.3	7.91E+01	6.81E+00	21.7%	20.0%	30%	3.93E+02	1.16E+02	6.14%	0.0%
PM-AN	OUT	4.9	8.4	5.3	6.18E+00	1.95E+00	78.6%	10.0%	79%	3.14E+01	2.49E+01	24.19%	0.0%
					AVERAGE:	4.38E+00	50.1%	15.0%	54.4%	2.12E+02	7.05E+01	15.16%	

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[UNNIAIR.XLW]UNPMAN.XLS
9:17 PM
10/8/93

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
ANIONS IN:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	3.53	3.97	3.62	3.71	2.32E-01	6.27%	0.00	0.00%	0.00
O2 Correction Factor	1.203	1.234	1.209	1.216	1.65E-02	1.36%	0	0.00%	0.00
Particle Collection Bias								20%	
ANIONS STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	4.27	4.05	3.91	4.08	1.81E-01	4.45%	0.00	0.00%	0.00
O2 Correction Factor	1.257	1.240	1.230	1.242	1.34E-02	1.08%	0	0.00%	0.00
Particle Collection Bias								10%	

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
PM:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2 inlet	3.53	3.97	3.62	3.71	2.32E-01	6.27%	0.00	0.00%	0.00
O2 Correction Factor	1.203	1.234	1.209	1.216	1.65E-02	1.36%	0	0.00%	0.00
%O2 outlet	4.27	4.05	3.91	4.08	1.81E-01	4.45%	0.00	0.00%	0.00
O2 Correction Factor	1.257	1.240	1.230	1.242	1.34E-02	1.08%	0	0.00%	0.00
Particle Collection Bias Inlet								20%	
Particle Collection Bias Outlet								10%	

[UNNIAIR.XLW]UNPMAN.XLS
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SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
CHLORIDE	IN	1.97E-01	0.00E+00	**BIAS**	6.52E-01	7.9E+00	2.8E-06	2.8E-03	1.6E+00	5.1E+00	2.1	2	4.3	8.5E+00	33.0%
FLOURIDE		2.93E-03	0.00E+00	**BIAS**	2.14E-02	4.2E+00	5.0E-08	4.9E-05	1.3E-02	9.0E-02	2.4	2	4.3	1.1E-01	23.5%
PHOSPHORUS		5.96E-02	0.00E+00	NSTDV	4.09E-02	2.1E+01	4.7E-07	4.7E-04	1.3E+00	8.6E-01	2.0	2	4.3	5.5E+00	127.1%
SULFATE		4.50E+00	0.00E+00	**BIAS**	7.24E+01	2.1E+01	8.5E-04	8.4E-01	1.2E+02	1.5E+03	3.8	4	2.8	1.6E+03	20.4%

CHLORIDE	STK	2.29E-01	0.00E+00	**BIAS**	3.41E-01	8.0E+00	3.0E-06	3.0E-03	1.9E+00	2.7E+00	2.1	2	4.3	8.5E+00	30.8%
FLOURIDE		1.34E-02	5.91E-02	**BIAS**	1.51E-02	4.3E+00	7.1E-08	7.1E-05	5.8E-02	2.6E-01	2.0	2	4.3	3.6E-01	55.7%
PHOSPHORUS		1.26E-01	8.36E-02	NSTDV	2.28E-02	2.2E+01	5.4E-07	5.3E-04	2.7E+00	1.9E+00	2.0	2	4.3	1.2E+01	241.1%
SULFATE		2.69E+01	0.00E+00	**BIAS**	3.61E+01	2.2E+01	8.6E-04	8.6E-01	5.9E+02	7.9E+02	2.0	2	4.3	2.7E+03	33.8%

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
PM-AN	IN	3.93E+00	0.00E+00	**BIAS**	1.58E+01	5.0E+00	4.3E-05	4.3E-02	2.0E+01	7.9E+01	2.1	2	4.3	1.2E+02	29.5%
PM-AN	OUT	1.13E+00	0.00E+00	NSTDV	6.18E-01	5.1E+00	3.5E-06	3.4E-03	5.7E+00	3.1E+00	2.0	2	4.3	2.5E+01	79.2%

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NICKEL/CR SPECIATON TESTS
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	RUN #1	RUN #2 In %	RUN #3	RUN #4	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE In lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
NICKEL - Soluble	IN	38.8%	37.5%	34.5%	35.4%	3.66E-01	1.93E-02	7.7%	20.0%	21.4%	1.73E+00	3.70E-01	4.32%	0.0%
Sulfidic		9.3%	8.9%	7.3%	6.0%	7.9E-02	1.51E-02	30.5%	20.0%	36.5%	3.72E-01	1.36E-01	15.37%	0.0%
Metallic		ND < 1.0%	ND < 0.3%	2.1%	1.8%	1.1E-02	9.46E-03	132.4%	25.4%	134.8%	5.36E-02	7.23E-02	70.80%	14.6%
Oxidic		51.4%	53.4%	56.1%	56.7%	5.44E-01	2.46E-02	6.7%	20.0%	21.1%	2.57E+00	5.41E-01	3.65%	0.0%
						TOTAL/AVERAGE:		44.3%	21.3%	53.5%	4.72E+00	1.12E+00		

SPECIES	LOC	RUN #1	RUN #2	RUN #3	RUN #4	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE In lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
NICKEL - Soluble	STK	68.0%	62.5%	60.9%		6.38E-01	3.72E-02	14.9%	10.0%	18.0%	2.25E-01	4.03E-02	4.38%	0.0%
Sulfidic		7.3%	8.1%	7.9%		7.8E-02	4.26E-03	14.1%	10.0%	17.3%	2.73E-02	4.72E-03	4.12%	0.0%
Metallic		ND < 3.6%	ND < 1.6%	ND < 3.8%		ND< 3.0E-02	1.24E-02	103.2%	32.1%	108.1%	ND< 1.05E-02	1.14E-02	31.92%	100.0%
Oxidic		22.9%	28.6%	29.3%		2.69E-01	3.52E-02	32.6%	10.0%	34.1%	9.49E-02	3.24E-02	9.99%	0.0%
						TOTAL/AVERAGE:		41.2%	15.5%	44.4%	3.57E-01	8.88E-02		

SPECIES	LOC	RUN #1	RUN #2 In ug/Nm3	RUN #3	RUN #4	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE In lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
Total Chrome	STK	1.71	3.25	1.90	1.02	1.97E+00	9.35E-01	75.6%	10.0%	76.3%	9.9E-03	7.5E-03	32.61%	0.0%
Hexavalent Chrome		0.209	0.275	0.469	0.169	2.80E-01	1.33E-01	75.5%	10.0%	76.2%	1.4E-03	1.1E-03	33.61%	0.0%

NICKEL/CR SPECIATON TESTS
UNCERTAINTY ANALYSIS
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PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
NICKEL IN/STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2 -- INLET	3.45	4.03	3.60	3.69	3.01E-01	8.15%	0.00	0.00%	0.00
O2 Correction Factor	1.198	1.239	1.208	1.215	2.14E-02	1.76%	0	0.00%	0.00
%O2 -- OUTLET	4.80	4.80	4.64	4.75	9.24E-02	1.95%	0.00	0.00%	0.00
O2 Correction Factor	1.298	1.298	1.285	1.294	7.37E-03	0.57%	0	0.00%	0.00
Particle Collection Bias Inlet								20%	
Particle Collection Bias Outlet								10%	
Total Nickel, ug/Nm^3				948.8					
Total Nickel, ug/Nm^3				66.5					

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
CHROMIUM SPEC STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	395,318	395,318	403,256	399,287	4583.01	1.15%	2646.00	0.00%	0.00
LOAD, MW	788	788	788	788		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.39E+06	9.47E+06	9.56E+06	9.50E+06	8.48E+04	0.89%	4.89E+04	0.00%	0.00E+00
%O2 -- STACK	4.16	3.80	4.44	4.21	3.21E-01	7.62%	0.00	0.00%	0.00
O2 Correction Factor	1.249	1.222	1.270	1.253	2.38E-02	1.90%	0	0.00%	0.00
Particle Collection Bias								10%	

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Preliminary

NICKEL/CR SPECIATON TESTS
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SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
NICKEL - Soluble	IN	9.18E+00	0.00E+00	**BIAS**	6.94E+01	4.97E-03	1.89E-07	1.88E-04	4.8E-02	3.5E-01	3.60	4	2.8	3.7E-01	21.4%
Sulfidic		7.15E+00	0.00E+00	**BIAS**	1.50E+01	4.97E-03	4.09E-08	4.04E-05	3.6E-02	7.4E-02	3.05	3	3.2	1.4E-01	36.5%
Metallic		4.49E+00	1.68E+00	NSTDV	2.16E+00	4.97E-03	5.89E-09	5.83E-06	2.2E-02	1.4E-02	3.00	3	3.2	7.2E-02	134.8%
Oxidic		1.16E+01	0.00E+00	**BIAS**	1.03E+02	4.97E-03	2.82E-07	2.79E-04	6.2E-02	5.1E-01	3.83	4	2.8	5.4E-01	21.1%
		****	****												

SPECIES	LOC	NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Bias (Bpc2)	CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	Sr	Br	vr	vr	t-	Ur	% Ur
NICKEL - Soluble	STK	1.43E+00	0.00E+00	**BIAS**	4.24E+00	5.29E-03	2.47E-08	2.44E-05	7.8E-03	2.2E-02	2.25	2	4.3	4.0E-02	18.0%
Sulfidic		1.63E-01	0.00E+00	**BIAS**	5.15E-01	5.29E-03	3.00E-09	2.97E-06	8.9E-04	2.7E-03	2.28	2	4.3	4.7E-03	17.3%
Metallic		4.75E-01	6.05E-01	**BIAS**	1.98E-01	5.29E-03	1.15E-09	1.14E-06	2.5E-03	3.4E-03	2.00	2	4.3	1.1E-02	108.1%
Oxidic		1.35E+00	0.00E+00	**BIAS**	1.79E+00	5.29E-03	1.04E-08	1.03E-05	7.2E-03	9.5E-03	2.05	2	4.3	3.2E-02	34.1%
		****	****												

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
Total Chrome	STK	4.67E-01	0.00E+00	NSTDV	1.97E-01	5.0E-03	1.0E-09	1.1E-06	2.3E-03	9.9E-04	3.01	3	3.2	7.5E-03	76.3%
Hexavalent Chrome		6.65E-02	0.00E+00	NSTDV	2.80E-02	5.0E-03	1.5E-10	1.5E-07	3.3E-04	1.4E-04	3.01	3	3.2	1.1E-03	76.2%

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RADIONUCLIDES
UNCERTAINTY ANALYSIS
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SPECIES	LOC	RUN #1	RUN #2 in pCi/Nm3	RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spi)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in uCi/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
Uranium-233 & -234	STK	ND< 0.05	ND< 0.05	ND< 0.05		ND< 5.3E-02	1.92E-03	7.2%	30.6%	31.4%	ND< 0.12	3.8E-02	2.82%	100.0%
Uranium-235		ND< 0.05	ND< 0.05	ND< 0.05		ND< 5.3E-02	1.92E-03	7.2%	30.6%	31.4%	ND< 0.12	3.8E-02	2.82%	100.0%
Uranium-238		0.05	ND< 0.05	ND< 0.05	@	ND< 5.4E-02	1.92E-03	7.1%	25.0%	25.9%	ND< 0.12	3.2E-02	2.11%	100.0%
Radium-226		0.11	ND< 0.11	0.05	#	7.0E-02	3.21E-02	113.1%	27.3%	116.4%	0.16	1.9E-01	35.00%	25.4%
Radium-228		0.86	0.91	0.81		8.6E-01	5.30E-02	15.7%	10.0%	18.6%	2.0	3.7E-01	4.15%	0.0%
Lead-210		(1)	(1)	(1)										
Polonium-210		ND< 0.11	0.05	0.10	#	6.9E-02	2.71E-02	97.3%	27.7%	101.2%	0.16	1.6E-01	30.13%	25.8%
Thorium-228		0.21	ND< 0.86	0.15	#	2.6E-01	1.46E-01	136.5%	54.9%	147.1%	0.61	9.0E-01	41.25%	54.0%
Thorium-230		0.32	0.64	0.10		3.6E-01	2.73E-01	190.7%	10.0%	191.0%	0.82	1.6E+00	53.99%	0.0%
Thorium-232		0.05	ND< 0.32	0.10	#	1.0E-01	5.42E-02	128.7%	52.4%	139.0%	0.24	3.4E-01	36.28%	51.5%
							AVERAGES:	62.6%	23.0%	73.7%	5.0E-01	3.4E-01	18.7%	

(1) Results not reported.

RADIONUCLIDES
UNCERTAINTY ANALYSIS
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PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
RADIONUCLIDES STK:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
GROSS LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
%O2	4.27	4.05	3.91	4.08	1.81E-01	4.45%	0.00	0.00%	0.00
O2 Correction Factor	1.257	1.240	1.230	1.242	1.34E-02	1.08%	0	0.00%	0.00
Particle Collection Bias								10%	

[UNNIRAD.XLW]UNairRAD.xls
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10/8/93

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RADIONUCLIDES
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc1)	> OF NSTD OR BIAS	Particle Coll. Eff. Bias (Bpc2)	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	F-factor (THETAff)	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
Uranium-233 & -23	STK	1.11E-03	1.52E-02	**BIAS**	5.26E-03	2.3E+00	1.3E-08	1.3E-05	2.8E-03	3.7E-02	2.63	3	3.2	3.8E-02	31.4%
Uranium-235		1.11E-03	1.52E-02	**BIAS**	5.26E-03	2.3E+00	1.3E-08	1.3E-05	2.8E-03	3.7E-02	2.63	3	3.2	3.8E-02	31.4%
Uranium-238		1.11E-03	1.23E-02	**BIAS**	5.36E-03	2.3E+00	1.4E-08	1.3E-05	2.8E-03	3.1E-02	2.66	3	3.2	3.2E-02	25.9%
Radium-226		1.85E-02	1.79E-02	**BIAS**	7.05E-03	2.3E+00	1.8E-08	1.8E-05	4.3E-02	4.4E-02	2.00	2	4.3	1.9E-01	116.4%
Radium-228		3.06E-02	0.00E+00	**BIAS**	8.59E-02	2.3E+00	2.2E-07	2.2E-04	7.2E-02	2.0E-01	2.22	2	4.3	3.7E-01	18.6%
Lead-210 (1)															
Polonium-210		1.57E-02	1.79E-02	**BIAS**	6.93E-03	2.3E+00	1.8E-08	1.7E-05	3.6E-02	4.4E-02	2.01	2	4.3	1.6E-01	101.2%
Thorium-228		8.40E-02	1.43E-01	**BIAS**	2.65E-02	2.3E+00	6.7E-08	6.6E-05	1.9E-01	3.4E-01	2.00	2	4.3	9.0E-01	147.1%
Thorium-230		1.58E-01	0.00E+00	NSTDV	3.55E-02	2.3E+00	9.0E-08	8.9E-05	3.6E-01	8.2E-02	2.00	2	4.3	1.6E+00	191.0%
Thorium-232		3.13E-02	5.39E-02	**BIAS**	1.05E-02	2.3E+00	2.7E-08	2.6E-05	7.2E-02	1.3E-01	2.00	2	4.3	3.4E-01	139.0%

(1) Results not reported.

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RADIONUCLIDES - FUEL OIL
UNCERTAINTY ANALYSIS
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SPECIES	LOC		RUN #1		RUN #2 in pCi/g		RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)		ABSOL. VALUE in uCi/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
Uranium-233 & -234	OIL	ND<	0.005	ND<	0.006	ND<	0.002	ND<	4.3E-03	2.08E-03	119.4%	31.0%	123.3%	ND<	0.80	9.9E-01	35.90%	100.0%
Uranium-235		ND<	0.003	ND<	0.003	ND<	0.002	ND<	2.7E-03	5.77E-04	53.8%	29.3%	61.3%	ND<	0.49	3.0E-01	16.67%	100.0%
Uranium-238		ND<	0.003	ND<	0.007	ND<	0.001	ND<	3.7E-03	3.06E-03	207.0%	34.9%	209.9%	ND<	0.68	1.4E+00	60.61%	100.0%
Radium-226			0.02		0.01		0.01		1.3E-02	5.77E-03	107.6%	0.0%	107.6%		2.5	2.7E+00	33.33%	0.0%
Radium-228			0.04		0.04		0.02		3.3E-02	1.15E-02	86.1%	0.0%	86.1%		6.2	5.3E+00	26.67%	0.0%
Lead-210			0.06	ND<	0.0001		0.04		3.3E-02	3.05E-02	227.4%	0.0%	227.4%		6.2	1.4E+01	66.57%	0.0%
Polonium-210		ND<	0.09	ND<	0.11	ND<	0.14	ND<	1.1E-01	2.52E-02	55.2%	29.3%	62.5%	ND<	21.0	1.3E+01	15.69%	100.0%
Thorium-228			0.02		0.02		0.01		1.7E-02	5.77E-03	86.1%	0.0%	86.1%		3.1	2.7E+00	26.67%	0.0%
Thorium-230		ND<	0.01		0.01		0.02		1.2E-02	7.64E-03	162.7%	14.3%	163.3%		2.2	3.5E+00	47.62%	14.3%
Thorium-232		ND<	0.004	ND<	0.001	ND<	0.001	ND<	2.0E-03	1.73E-03	215.2%	35.4%	218.0%	ND<	0.37	8.1E-01	66.67%	100.0%
										AVERAGES:	127.4%	17.4%	130.2%		5.0E+00	5.2E+00	37.9%	

Preliminary

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[UNNIRAD.XLW]UNoilRAD.XLS
10:26 PM
10/8/93

RADIONUCLIDES - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
RADIONUCLIDES FUEL:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00

DEGREES FREEDOM	T-VALUE
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.37
8	2.31

{UNNIRAD.XLW}UNoilRAD.XLS
10:28 PM
10/8/93

Preliminary

RADIONUCLIDES - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpcl)	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	XXXXX	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
Uranium-233 & -234	OIL	1.20E-03	1.34E-03	*ND BIAS*	1.9E+02	8.8E-08	0.0E+00	2.2E-01	2.5E-01	2.00	2	4.3	9.9E-01	123.3%
Uranium-235		3.33E-04	7.82E-04	*ND BIAS*	1.9E+02	5.4E-08	0.0E+00	6.2E-02	1.4E-01	2.01	2	4.3	3.0E-01	61.3%
Uranium-238		1.76E-03	1.28E-03	NSTDV	1.9E+02	7.5E-08	0.0E+00	3.3E-01	2.4E-01	2.00	2	4.3	1.4E+00	209.9%
Radium-226		3.33E-03	0.00E+00	NSTDV	1.9E+02	2.7E-07	0.0E+00	6.2E-01	0.0E+00	2.00	2	4.3	2.7E+00	107.6%
Radium-228		6.67E-03	0.00E+00	NSTDV	1.9E+02	6.8E-07	0.0E+00	1.2E+00	0.0E+00	2.00	2	4.3	5.3E+00	86.1%
Lead-210		1.76E-02	1.67E-05	NSTDV	1.9E+02	6.8E-07	0.0E+00	3.3E+00	3.1E-03	2.00	2	4.3	1.4E+01	227.4%
Polonium-210		1.45E-02	3.32E-02	*ND BIAS*	1.9E+02	2.3E-06	0.0E+00	2.7E+00	6.2E+00	2.01	2	4.3	1.3E+01	62.5%
Thorium-228		3.33E-03	0.00E+00	NSTDV	1.9E+02	3.4E-07	0.0E+00	6.2E-01	0.0E+00	2.00	2	4.3	2.7E+00	86.1%
Thorium-230		4.41E-03	1.67E-03	NSTDV	1.9E+02	2.4E-07	0.0E+00	8.2E-01	3.1E-01	2.00	2	4.3	3.5E+00	163.3%
Thorium-232		1.00E-03	7.07E-04	NSTDV	1.9E+02	4.1E-08	0.0E+00	1.9E-01	1.3E-01	2.00	2	4.3	8.1E-01	218.0%
														134.6%

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RADIONUCLIDES - FLY ASH
UNCERTAINTY ANALYSIS
SITE 118
PAGE 1 OF 3

SPECIES	LOC	RUN #1	RUN #2 in pCi/g	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in uCi/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
Uranium-233 & -234	FLY	4.0	4.0	4.0	4.0E+00	0.00E+00	2.5%	30.0%	30.1%	0.71	2.1E-01	0.00%	0.0%
Uranium-235	ASH	0.1	0.1	0.1	1.0E-01	0.00E+00	2.5%	30.0%	30.1%	0.02	5.4E-03	0.00%	0.0%
Uranium-238		3.0	3.0	3.0	3.0E+00	0.00E+00	2.5%	30.0%	30.1%	0.53	1.6E-01	0.00%	0.0%
Radium-226		1.7	1.7	1.7	1.7E+00	0.00E+00	2.5%	30.0%	30.1%	0.30	9.1E-02	0.00%	0.0%
Radium-228		2.5	2.5	2.5	2.5E+00	0.00E+00	2.5%	30.0%	30.1%	0.44	1.3E-01	0.00%	0.0%
Lead-210		18	18	18	1.8E+01	0.00E+00	2.5%	30.0%	30.1%	3.2	9.6E-01	0.00%	0.0%
Polonium-210		16	16	16	1.6E+01	0.00E+00	2.5%	30.0%	30.1%	2.8	8.6E-01	0.00%	0.0%
Thorium-228		9.0	9.0	9.0	9.0E+00	0.00E+00	2.5%	30.0%	30.1%	1.6	4.8E-01	0.00%	0.0%
Thorium-230		2.9	2.9	2.9	2.9E+00	5.96E-08	2.5%	30.0%	30.1%	0.52	1.6E-01	0.00%	0.0%
Thorium-232		0.3	0.3	0.3	3.0E-01	5.27E-09	2.5%	30.0%	30.1%	0.05	1.6E-02	0.00%	0.0%
						AVERAGES:	2.5%	30.0%	30.1%	1.1E+00	3.2E-01	0.0%	

Note: Since only one ash sample was analyzed for radionuclides, uncertainty estimated by random error in process variables and ash flow rate bias.

Preliminary

Do Not Cite or Quote

RADIONUCLIDES - FLY ASH
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
RADIONUCLIDES ASH:									
Norm. Ash Flow, lba/lbf	0.00096	0.00096	0.00096	0.00096	1.10E-06	0.11%	6.37E-07	30.00%	0.00029
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.4	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840	4.04	0.48%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
Ash Flow Rate, lb/hr	391.8	391.8	391.8	391.8	5.39E-06	0.00%	0.00	0.00%	0.00
				DEGREES					
				FREEDOM	T-VALUE				
				2	4.30				
				3	3.18				
				4	2.78				
				5	2.57				
				6	2.45				
				7	2.37				
				8	2.31				

RADIONUCLIDES - FLY ASH
UNCERTAINTY ANALYSIS
SITE 118
PAGE 3 OF 3

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpcl)	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	Ash Flow (THETAaf)	RESULTS: Sr	Br	vr	vr	t:	Ur	% Ur
Uranium-233 & -234	FLY	0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	7.8E-08	7.4E+02	4.1E-03	2.1E-01	2.05	2	4.3	2.1E-01	30.1%
Uranium-235	ASH	0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	2.0E-09	1.9E+01	1.0E-04	5.3E-03	2.05	2	4.3	5.4E-03	30.1%
Uranium-238		0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	5.9E-08	5.6E+02	3.1E-03	1.6E-01	2.05	2	4.3	1.6E-01	30.1%
Radium-226		0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	3.3E-08	3.1E+02	1.8E-03	9.1E-02	2.05	2	4.3	9.1E-02	30.1%
Radium-228		0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	4.9E-08	4.6E+02	2.6E-03	1.3E-01	2.05	2	4.3	1.3E-01	30.1%
Lead-210		0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	3.5E-07	3.3E+03	1.9E-02	9.6E-01	2.05	2	4.3	9.6E-01	30.1%
Polonium-210		0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	3.1E-07	3.0E+03	1.7E-02	8.5E-01	2.05	2	4.3	8.6E-01	30.1%
Thorium-228		0.00E+00	0.00E+00	*ND BIAS*	1.8E-01	1.8E-07	1.7E+03	9.3E-03	4.8E-01	2.05	2	4.3	4.8E-01	30.1%
Thorium-230		3.44E-08	0.00E+00	NSTDV	1.8E-01	5.7E-08	5.4E+02	3.0E-03	1.5E-01	2.05	2	4.3	1.6E-01	30.1%
Thorium-232		3.04E-09	0.00E+00	NSTDV	1.8E-01	5.9E-09	5.6E+01	3.1E-04	1.6E-02	2.05	2	4.3	1.6E-02	30.1%
														30.1%

Preliminary

METALS/ANIONS - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118
PAGE 1 OF 3

SPECIES	LOC	RUN #1	RUN #2 in mg/Kg	RUN #3		AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)		ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
METALS (C&T):															
ARSENIC	OIL	0.27	ND< 0.25	ND< 0.23	@ ND<	2.5E-01	2.00E-02	20.0%	22.6%	30.2%	ND<	1.02E-01	3.1E-02	5.33%	100.0%
BARIUM		0.42	0.44	0.31		3.9E-01	7.00E-02	44.7%	0.0%	44.7%		1.59E-01	7.1E-02	13.68%	0.0%
BERYLLIUM		0.008	0.008	0.006		7.3E-03	1.15E-03	39.2%	0.0%	39.2%		2.99E-03	1.2E-03	12.12%	0.0%
CADMIUM		ND< 0.007	ND< 0.007	ND< 0.006	ND<	6.7E-03	5.77E-04	21.7%	28.9%	36.1%	ND<	2.72E-03	9.8E-04	6.67%	100.0%
CHROMIUM		0.10	0.11	0.08		9.7E-02	1.53E-02	39.3%	0.0%	39.3%		3.94E-02	1.6E-02	11.49%	0.0%
COBALT		0.79	0.83	0.59		7.4E-01	1.29E-01	43.4%	0.0%	43.4%		3.01E-01	1.3E-01	13.27%	0.0%
COPPER		0.29	0.24	0.19		2.4E-01	5.00E-02	51.8%	0.0%	51.8%		9.79E-02	5.1E-02	13.89%	0.0%
LEAD		0.27	0.29	0.19		2.5E-01	5.29E-02	52.6%	0.0%	52.6%		1.02E-01	5.4E-02	16.00%	0.0%
MANGANESE		0.17	0.16	0.09		1.4E-01	4.36E-02	77.4%	0.0%	77.4%		5.71E-02	4.4E-02	23.81%	0.0%
MERCURY		ND< 0.091	ND< 0.087	ND< 0.074	ND<	8.4E-02	8.89E-03	26.4%	29.0%	39.2%	ND<	3.43E-02	1.3E-02	7.94%	100.0%
MOLYBDENUM		0.13	0.11	0.06		1.0E-01	3.61E-02	89.6%	0.0%	89.6%		4.08E-02	3.7E-02	26.67%	0.0%
NICKEL		19	25	17		2.0E+01	4.16E+00	50.9%	0.0%	50.9%		8.30E+00	4.2E+00	15.30%	0.0%
SELENIUM		ND< 0.007	ND< 0.007	ND< 0.006	ND<	6.7E-03	5.77E-04	21.7%	28.9%	36.1%	ND<	2.72E-03	9.8E-04	6.67%	100.0%
PHOSPHORUS		ND< 5.0	8.4	5.3		5.4E+00	2.95E+00	135.8%	15.4%	136.7%		2.20E+00	3.0E+00	37.04%	15.4%
VANADIUM		23	26	16		2.2E+01	5.13E+00	58.9%	0.0%	58.9%		8.84E+00	5.2E+00	17.44%	0.0%
							AVERAGES:	51.6%	8.3%	55.1%		1.4E+00	8.6E-01	15.15%	
ANIONS:	OIL														
Chlorine, as Cl-		1000	800	800		8.7E+02	1.15E+02	33.2%	0.0%	33.2%		3.5E+02	1.2E+02	10.26%	0.0%
Fluorine, as F-		ND< 20	ND< 20	ND< 20	ND<	2.0E+01	0.00E+00	2.1%	28.9%	28.9%	ND<	8.2E+00	2.4E+00	0.00%	100.0%
Phosphorus, as PO4 3-		ND< 15	26	16		1.7E+01	9.05E+00	135.8%	15.4%	136.7%		6.8E+00	9.2E+00	37.04%	15.4%
Sulfur, as SO4 2-		20,974	20,075	24,569		2.2E+04	2.38E+03	27.2%	0.0%	27.2%		8.9E+03	2.4E+03	8.22%	0.0%
							AVERAGES:	49.6%	11.1%	56.5%		2.3E+03	6.4E+02	13.88%	

Do Not Cite or Quote

[UNNIPROC.XLW]UNOIL.XLS
10:52 PM
10/8/93

METALS/ANIONS - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spl)	%STDEV (Spl,%)	N STDEV (Spl')	% BIAS (Bpl,%)	BIAS (Bpl)
FUEL METALS:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00

DEGREES FREEDOM	T-VALUE
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.37
8	2.31

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV	%STDEV	N STDEV	% BIAS	BIAS
FUEL ANION PRECURSORS:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00

[UNNIPROC.XLW]UNOIL.XLS
10:53 PM
10/8/93

Preliminary

METALS/ANIONS - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc)	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	XXXXX	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
METALS (C&T):														
ARSENIC	OIL	1.15E-02	5.66E-02	*ND BIAS*	4.1E-01	1.1E-08	0.0E+00	4.7E-03	2.3E-02	2.06	2	4.3	3.1E-02	30.2%
BARIUM		4.04E-02	0.00E+00	NSTDV	4.1E-01	1.7E-08	0.0E+00	1.7E-02	0.0E+00	2.01	2	4.3	7.1E-02	44.7%
BERYLLIUM		6.67E-04	0.00E+00	NSTDV	4.1E-01	3.3E-10	0.0E+00	2.7E-04	0.0E+00	2.02	2	4.3	1.2E-03	39.2%
CADMIUM		3.33E-04	1.93E-03	*ND BIAS*	4.1E-01	3.0E-10	0.0E+00	1.4E-04	7.9E-04	2.05	2	4.3	9.8E-04	36.1%
CHROMIUM		8.82E-03	0.00E+00	NSTDV	4.1E-01	4.3E-09	0.0E+00	3.6E-03	0.0E+00	2.02	2	4.3	1.6E-02	39.3%
COBALT		7.42E-02	0.00E+00	NSTDV	4.1E-01	3.3E-08	0.0E+00	3.0E-02	0.0E+00	2.01	2	4.3	1.3E-01	43.4%
COPPER		2.89E-02	0.00E+00	NSTDV	4.1E-01	1.1E-08	0.0E+00	1.2E-02	0.0E+00	2.01	2	4.3	5.1E-02	51.8%
LEAD		3.06E-02	0.00E+00	NSTDV	4.1E-01	1.1E-08	0.0E+00	1.2E-02	0.0E+00	2.01	2	4.3	5.4E-02	52.6%
MANGANESE		2.52E-02	0.00E+00	NSTDV	4.1E-01	6.3E-09	0.0E+00	1.0E-02	0.0E+00	2.00	2	4.3	4.4E-02	77.4%
MERCURY		5.13E-03	2.43E-02	*ND BIAS*	4.1E-01	3.8E-09	0.0E+00	2.1E-03	9.9E-03	2.04	2	4.3	1.3E-02	39.2%
MOLYBDENUM		2.08E-02	0.00E+00	NSTDV	4.1E-01	4.5E-09	0.0E+00	8.5E-03	0.0E+00	2.00	2	4.3	3.7E-02	89.6%
NICKEL		2.40E+00	0.00E+00	NSTDV	4.1E-01	9.1E-07	0.0E+00	9.8E-01	0.0E+00	2.01	2	4.3	4.2E+00	50.9%
SELENIUM		3.33E-04	1.93E-03	*ND BIAS*	4.1E-01	3.0E-10	0.0E+00	1.4E-04	7.9E-04	2.05	2	4.3	9.8E-04	36.1%
PHOSPHORUS		1.70E+00	8.33E-01	NSTDV	4.1E-01	2.4E-07	0.0E+00	7.0E-01	3.4E-01	2.00	2	4.3	3.0E+00	136.7%
VANADIUM		2.96E+00	0.00E+00	NSTDV	4.1E-01	9.7E-07	0.0E+00	1.2E+00	0.0E+00	2.01	2	4.3	5.2E+00	58.9%
														55.1%

ANIONS:	OIL	CONC. DELTA P DETERMINATION NORM. STD DEV	ND BIAS	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC.	HEAT RT	HHV	RESULTS: Sr	Br	vr	vr	t-	Ur	% Ur
Chlorine, as Cl-		6.67E+01	0.00E+00	NSTDV	4.1E-01	3.9E-05	-1.9E-02	2.7E+01	0.0E+00	2.03	2	4.3	1.2E+02	33.2%
Fluorine, as F-		0.00E+00	5.77E+00	*ND BIAS*	4.1E-01	9.0E-07	-4.3E-04	5.5E-02	2.4E+00	3.25	3	3.2	2.4E+00	28.9%
Phosphorus, as PO4 3-		5.23E+00	2.56E+00	NSTDV	4.1E-01	7.4E-07	-3.6E-04	2.1E+00	1.0E+00	2.00	2	4.3	9.2E+00	136.7%
Sulfur, as SO4 2-		1.37E+03	0.00E+00	NSTDV	4.1E-01	9.8E-04	-4.7E-01	5.6E+02	0.0E+00	2.05	2	4.3	2.4E+03	27.2%
														56.5%

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[UNNIPROC.XLW]UNOIL.XLS
11:01 PM
10/8/93

INAA - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	RUN #1	RUN #2 In mg/Kg	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE In lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND. TO AVG
METALS (INAA):													
Arsenic	OIL	0.10	0.26	0.097	1.5E-01	9.33E-02	152.1%	0.0%	152.1%	6.2E-02	9.5E-02	47.12%	0.0%
Chromium (1)		0.16	0.15		1.6E-01	7.07E-03	41.7%	0.0%	41.7%	6.3E-02	2.6E-02	6.45%	0.0%
Cobalt		1.5	2.2	1.3	1.7E+00	4.73E-01	70.5%	0.0%	70.5%	6.8E-01	4.8E-01	21.33%	0.0%
Mercury		0.0035	0.0047	0.0037	4.0E-03	6.43E-04	40.3%	0.0%	40.3%	1.6E-03	6.5E-04	12.32%	0.0%
Molybdenum (1)		0.08	0.072		7.6E-02	5.66E-03	67.3%	0.0%	67.3%	3.1E-02	2.1E-02	10.53%	0.0%
Selenium (2)		0.081	0.093		8.7E-02	8.49E-03	88.0%	0.0%	88.0%	3.5E-02	3.1E-02	13.79%	0.0%
Chloride		56	54.5	52	5.4E+01	2.02E+00	9.6%	0.0%	9.6%	2.2E+01	2.1E+00	2.67%	0.0%
					AVERAGES:		67.1%	0.0%	67.1%	3.3E+00	4.0E-01	16.3%	

Note: (1) Chromium and molybdenum laboratory results for run #3 were not used in average, laboratory reports possible inhomgeneity of the fuel sample as a possible source for the large variation in analytical values.
(2) Result for run#3 not reported

INAA - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118
PAGE 2 OF 3

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spi)	%STDEV (Spi,%)	N STDEV (Spi')	% BIAS (Bpi,%)	BIAS (Bpi)
FUEL INAA METALS:									
F-factor, dscf/mmBtu	9,304	9,177	9,119	9,200	94.62	1.03%	54.63	0.00%	0.00
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.39	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840		0.00%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
				DEGREES FREEDOM	T-VALUE				
				1	12.71				
				2	4.30				
				3	3.18				
				4	2.78				
				5	2.57				
				6	2.45				
				7	2.37				
				8	2.31				

[UNNIPROC.XLW]UNNAAoil
10:56 PM
10/8/93

INAA - FUEL OIL
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc)	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	XXXXX	RESULTS: Sr	Br	vr	vr	t:	Ur	% Ur
METALS (INAA):														
Arsenic	OIL	5.38E-02	0.00E+00	NSTDV	4.1E-01	6.8E-09	0.0E+00	2.2E-02	0.0E+00	2.00	2	4.3	9.5E-02	152.1%
Chromium		5.00E-03	0.00E+00	NSTDV	4.1E-01	6.9E-09	0.0E+00	2.1E-03	0.0E+00	1.06	1	13	2.6E-02	41.7%
Cobalt		2.73E-01	0.00E+00	NSTDV	4.1E-01	7.5E-08	0.0E+00	1.1E-01	0.0E+00	2.00	2	4.3	4.8E-01	70.5%
Mercury		3.71E-04	0.00E+00	NSTDV	4.1E-01	1.8E-10	0.0E+00	1.5E-04	0.0E+00	2.02	2	4.3	6.5E-04	40.3%
Molybdenum		4.00E-03	0.00E+00	NSTDV	4.1E-01	3.4E-09	0.0E+00	1.6E-03	0.0E+00	1.02	1	13	2.1E-02	67.3%
Selenium		6.00E-03	0.00E+00	NSTDV	4.1E-01	3.9E-09	0.0E+00	2.5E-03	0.0E+00	1.01	1	13	3.1E-02	88.0%
Chloride		1.17E+00	0.00E+00	NSTDV	4.1E-01	2.4E-06	0.0E+00	4.9E-01	0.0E+00	2.29	2	4.3	2.1E+00	9.6%
													Average:	67.1%

[UNNIPROC.XLW]UNNAAoil
11:02 PM
10/8/93

Preliminary

Do Not Cite or Quote

Preliminary

INAA - FLYASH
UNCERTAINTY ANALYSIS
SITE 118

SPECIES	LOC	RUN #1	RUN #2 in mg/Kg	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
METALS (INAA):													
Arsenic	FLY	50	50	60	5.3E+01	5.77E+00	27.0%	30.0%	40.4%	0.021	8.4E-03	8.33%	0.0%
Barium	ASH	430	440	550	4.7E+02	6.66E+01	35.0%	30.0%	46.1%	0.185	8.6E-02	10.80%	0.0%
Chromium		100	140	115	1.2E+02	2.02E+01	42.5%	30.0%	52.0%	0.046	2.4E-02	12.21%	0.0%
Cobalt		690	730	800	7.4E+02	5.57E+01	18.9%	30.0%	35.4%	0.290	1.0E-01	5.41%	0.0%
Mercury		ND< 0.15	ND< 0.22		ND< 1.9E-01	4.95E-02	240.6%	38.4%	243.6%	ND< 7.25E-05	1.8E-04	37.84%	100.0%
Molybdenum		54	43	60	5.2E+01	8.62E+00	41.0%	30.0%	50.8%	0.021	1.0E-02	11.89%	0.0%
Selenium		43	53	30	4.2E+01	1.15E+01	68.3%	30.0%	74.6%	0.016	1.2E-02	19.05%	0.0%
						AVERAGES:	67.6%	31.2%	77.6%	8.3E-02	3.5E-02	15.1%	

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[UNNIPROC.XLW]UNINAAash
10:56 PM
10/8/93

INAA - FLYASH
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spl)	%STDEV (Spl,%)	N STDEV (Spl')	% BIAS (Bpl,%)	BIAS (Bpl)
ASH INAA METALS:									
Norm. Ash Flow, lbs/lbf	0.00096	0.00096	0.00096	0.00096	1.10E-06	0.11%	6.37E-07	30.00%	0.00029
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.4	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840	4.04	0.48%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
Ash Flow Rate, lb/hr	391.8	391.8	391.8	391.8	5.39E-06	0.00%	0.00	0.00%	0.00

DEGREES FREEDOM	T-VALUE
1	12.71
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.37
8	2.31

[UNNIPROC.XLW]UNINAAash
10:57 PM
10/8/93

INAA - FLYASH
UNCERTAINTY ANALYSIS
SITE 118
PAGE 3 OF 3

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpc)	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	ASH FLOW (THETAaf)	RESULTS: Sr	Br	vr	vr	t:	Ur	% Ur
METALS (INAA):														
Arsenic	FLY	3.33E+00	0.00E+00	NSTDV	3.9E-04	2.3E-09	2.2E+01	1.3E-03	6.3E-03	2.03	2	4.3	8.4E-03	40.4%
Barium	ASH	3.84E+01	0.00E+00	NSTDV	3.9E-04	2.0E-08	1.9E+02	1.5E-02	5.6E-02	2.02	2	4.3	8.6E-02	46.1%
Chromium		1.17E+01	0.00E+00	NSTDV	3.9E-04	5.1E-09	4.8E+01	4.6E-03	1.4E-02	2.01	2	4.3	2.4E-02	52.0%
Cobalt		3.21E+01	0.00E+00	NSTDV	3.9E-04	3.2E-08	3.0E+02	1.3E-02	8.7E-02	2.07	2	4.3	1.0E-01	35.4%
Mercury		3.50E-02	4.44E-02	*ND BIAS*	3.9E-04	8.0E-12	7.5E-02	1.4E-05	2.8E-05	1.00	1	13	1.8E-04	243.6%
Molybdenum		4.98E+00	0.00E+00	NSTDV	3.9E-04	2.3E-09	2.1E+01	2.0E-03	6.2E-03	2.01	2	4.3	1.0E-02	50.8%
Selenium		6.66E+00	0.00E+00	NSTDV	3.9E-04	1.8E-09	1.7E+01	2.6E-03	4.9E-03	2.01	2	4.3	1.2E-02	74.6%
													Average:	77.6%

Preliminary

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[UNNIPROC.XLW]UNINAAash
11:03 PM
10/8/93

METALS/AN - FLY ASH
UNCERTAINTY ANALYSIS
SITE 118
PAGE 1 OF 3

SPECIES	LOC	RUN #1	RUN #2 in mg/Kg	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
METALS (C&T):													
ARSENIC	FLY	39	60	54	5.1E+01	1.08E+01	52.8%	30.0%	60.7%	2.0E-02	1.2E-02	15.69%	0.0%
BARIUM	ASH	10	62	65	4.6E+01	3.09E+01	168.3%	30.0%	170.9%	1.8E-02	3.1E-02	52.07%	0.0%
BERYLLIUM		7.6	2.2	2.3	4.0E+00	3.09E+00	190.3%	30.0%	192.6%	1.6E-03	3.0E-03	58.95%	0.0%
CADMIUM		ND< 0.5	4.1	3.7	2.7E+00	2.12E+00	196.0%	30.2%	198.3%	1.1E-03	2.1E-03	60.46%	3.1%
CHROMIUM		105	118	108	1.1E+02	6.93E+00	15.8%	30.0%	33.9%	4.3E-02	1.5E-02	4.70%	0.0%
COBALT		670	720	730	7.1E+02	3.21E+01	11.6%	30.0%	32.2%	2.8E-01	8.9E-02	3.46%	0.0%
COPPER		180	220	200	2.0E+02	2.00E+01	25.0%	30.0%	39.0%	7.8E-02	3.1E-02	6.67%	0.0%
LEAD		340	250	270	2.9E+02	4.73E+01	41.0%	30.0%	50.8%	1.1E-01	5.7E-02	12.40%	0.0%
MANGANESE		170	141	111	1.4E+02	2.95E+01	52.2%	30.0%	60.2%	5.5E-02	3.3E-02	14.06%	0.0%
MERCURY		ND< 0.1	ND< 0.1	ND< 0.1	ND< 1.0E-01	0.00E+00	2.5%	41.6%	41.7%	ND< 3.9E-05	1.6E-05	0.00%	100.0%
MOLYBDENUM		110	130	130	1.2E+02	1.16E+01	23.5%	30.0%	38.1%	4.8E-02	1.8E-02	7.25%	0.0%
NICKEL		18,000	19,996	19,996	1.9E+04	1.15E+03	15.0%	30.0%	33.6%	7.6E+00	2.5E+00	4.59%	0.0%
SELENIUM		ND< 0.05	ND< 5.00	ND< 5.00	ND< 3.4E+00	2.86E+00	212.0%	46.2%	216.9%	ND< 1.3E-03	2.8E-03	65.67%	100.0%
PHOSPHORUS		1,600	1,600	1,700	1.6E+03	5.77E+01	9.1%	30.0%	31.4%	6.4E-01	2.0E-01	2.72%	0.0%
VANADIUM		20,000	22,990	22,990	2.2E+04	1.73E+03	19.7%	30.0%	35.9%	8.6E+00	3.1E+00	6.04%	0.0%
						AVERAGES:	69.0%	31.9%	82.4%	1.2E+00	4.1E-01	20.98%	

SPECIES	LOC	RUN #1	RUN #2	RUN #3	AVERAGE (r)	SAMPLE STD. DEV. (Spl)	% SAMPLE RND ERR (Sr,%)	SAMPLE % BIAS (Br,%)	% UNCERT. (Ur,%)	ABSOL. VALUE in lb/hr	ABSOL. UNCERT. (Ur)	% RPDM	% CONTRIB OF ND, TO AVG
ANIONS:	FLY ASH												
Chlorine, as Cl-		ND< 250	ND< 100	ND< 100	ND< 1.5E+02	8.66E+01	143.5%	43.8%	150.0%	ND< 5.9E-02	8.8E-02	44.44%	100.0%
Fluorine, as F-		ND< 2.5	ND< 3.0	ND< 3.0	ND< 2.8E+00	2.89E-01	25.4%	41.7%	48.8%	ND< 1.1E-03	5.4E-04	7.84%	100.0%
Phosphorus, as PO4 3-		ND< 1000	ND< 20	ND< 20	ND< 3.5E+02	5.66E+02	405.5%	56.7%	409.4%	ND< 1.4E-01	5.6E-01	125.64%	100.0%
Sulfur, as SO4 2-		140,000	250,000	250,000	2.1E+05	6.35E+04	74.0%	30.0%	79.8%	8.4E+01	6.7E+01	22.92%	0.0%
						AVERAGES:	162.1%	43.0%	172.0%	2.1E+01	1.7E+01	50.21%	

Preliminary

Do Not Cite or Quote

METALS/AN - FLY ASH
UNCERTAINTY ANALYSIS
SITE 118

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV (Spl)	%STDEV (Spl,%)	N STDEV (Spl')	% BIAS (Bpl,%)	BIAS (Bpl)
ASH METALS:									
Norm. Ash Flow, lba/lbf	0.00096	0.00096	0.00096	0.00096	1.10E-06	0.11%	6.37E-07	30.00%	0.00029
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.4	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840	4.04	0.48%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
Ash Flow Rate, lb/hr	391.8	391.8	391.8	391.8	5.39E-06	0.00%	0.00	0.00%	0.00
				DEGREES					
				FREEDOM	T-VALUE				
				2	4.30				
				3	3.18				
				4	2.78				
				5	2.57				
				6	2.45				
				7	2.37				
				8	2.31				

PARAMETER	RUN #1	RUN #2	RUN #3	AVERAGE	STD DEV	%STDEV	N STDEV	% BIAS	BIAS
ASH ANIONS:									
Norm. Ash Flow, lba/lbf	0.00096	0.00096	0.00096	0.00096	1.10E-06	0.11%	6.37E-07	30.00%	0.00029
HHV, Btu/lb	18,711	18,883	18,674	18,756	111.53	0.59%	64.4	0.00%	0.00
FUEL FLOW, lb/hr	407,696	407,756	408,537	407,996	469.19	0.11%	270.89	0.00%	0.00
LOAD, MW	844	836	841	840	4.04	0.48%	0.00	0.00%	0.00
HEAT RATE, Btu/MWhr	9.04E+06	9.21E+06	9.07E+06	9.11E+06	9.11E+04	1.00%	5.26E+04	0.00%	0.00E+00
Ash Flow Rate, lb/hr	391.8	391.8	391.8	391.8	5.39E-06	0.00%	0.00	0.00%	0.00

[UNNIPROC.XLW]UNASH.XLS
11:00 PM
10/8/93

METALS/AN - FLY ASH
UNCERTAINTY ANALYSIS
SITE 118
PAGE 3 OF 3

SPECIES	LOC	CONC. DELTA P DETERMINATION NORM. STD DEV (Spc')	ND BIAS (Bpe)	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC. (THETAc)	HEAT RT (THETAhr)	ASH FLOW (THETAaf)	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
METALS (C&T):								2.4E-03	6.0E-03	2.01	2	4.3	1.2E-02	60.7%
ARSENIC	FLY	6.24E+00	0.00E+00	NSTDV	3.9E-04	2.2E-09	2.1E+01	7.0E-03	5.4E-03	2.00	2	4.3	3.1E-02	170.9%
BARIUM	ASH	1.79E+01	0.00E+00	NSTDV	3.9E-04	2.0E-09	1.9E+01	7.0E-04	4.7E-04	2.00	2	4.3	3.0E-03	192.6%
BERYLLIUM		1.78E+00	0.00E+00	NSTDV	3.9E-04	1.7E-10	1.6E+00	4.8E-04	3.2E-04	2.00	2	4.3	2.1E-03	198.3%
CADMIUM		1.22E+00	8.33E-02	NSTDV	3.9E-04	1.2E-10	1.1E+00	1.6E-03	1.3E-02	2.10	2	4.3	1.5E-02	33.9%
CHROMIUM		4.00E+00	0.00E+00	NSTDV	3.9E-04	4.7E-09	4.5E+01	7.4E-03	8.3E-02	2.20	2	4.3	8.9E-02	32.2%
COBALT		1.86E+01	0.00E+00	NSTDV	3.9E-04	3.0E-08	2.9E+02	4.5E-03	2.4E-02	2.04	2	4.3	3.1E-02	39.0%
COPPER		1.16E+01	0.00E+00	NSTDV	3.9E-04	8.6E-09	8.2E+01	1.1E-02	3.4E-02	2.01	2	4.3	5.7E-02	50.8%
LEAD		2.73E+01	0.00E+00	NSTDV	3.9E-04	1.2E-08	1.2E+02	6.7E-03	1.7E-02	2.01	2	4.3	3.3E-02	60.2%
MANGANESE		1.70E+01	0.00E+00	NSTDV	3.9E-04	6.1E-09	5.7E+01	2.3E-07	1.6E-05	2.05	2	4.3	1.6E-05	41.7%
MERCURY		0.00E+00	2.89E-02	*ND BIAS*	3.9E-04	4.3E-12	4.1E-02	2.6E-03	1.4E-02	2.05	2	4.3	1.8E-02	38.1%
MOLYBDENUM		6.71E+00	0.00E+00	NSTDV	3.9E-04	5.3E-09	5.0E+01	2.6E-01	2.3E+00	2.11	2	4.3	2.5E+00	33.6%
NICKEL		6.65E+02	0.00E+00	NSTDV	3.9E-04	8.3E-07	7.9E+03	6.5E-04	6.1E-04	2.00	2	4.3	2.8E-03	216.9%
SELENIUM		1.65E+00	1.18E+00	NSTDV	3.9E-04	1.4E-10	1.4E+00	1.4E-02	1.9E-01	2.32	2	4.3	2.0E-01	31.4%
PHOSPHORUS		3.33E+01	0.00E+00	NSTDV	3.9E-04	7.0E-08	6.7E+02	3.9E-01	2.6E+00	2.07	2	4.3	3.1E+00	35.9%
VANADIUM		9.97E+02	0.00E+00	NSTDV	3.9E-04	9.5E-07	9.0E+03							82.4%

ANIONS:	FLY ASH	CONC. DELTA P DETERMINATION NORM. STD DEV	ND BIAS	> OF NSTD OR BIAS	THETA CALCULATIONS FOR: CONC.	HEAT RT	ASH FLOW	RESULTS: Sr	Br	vr	vr	t	Ur	% Ur
								2.0E-02	2.6E-02	2.00	2	4.3	8.8E-02	150.0%
Chlorine, as Cl-		5.00E+01	4.79E+01	NSTDV	3.9E-04	6.5E-09	6.1E+01	6.6E-05	4.6E-04	2.04	2	4.3	5.4E-04	48.8%
Fluorine, as F-		1.67E-01	8.21E-01	*ND BIAS*	3.9E-04	1.2E-10	1.2E+00	1.3E-01	7.7E-02	2.00	2	4.3	5.6E-01	409.4%
Phosphorus, as PO4 3-		3.27E+02	1.67E+02	NSTDV	3.9E-04	1.5E-08	1.4E+02	1.4E+01	2.5E+01	2.00	2	4.3	6.7E+01	79.8%
Sulfur, as SO4 2-		3.67E+04	0.00E+00	NSTDV	3.9E-04	9.2E-06	8.7E+04							172.0%

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ESP UNCERTAINTY CALCULATIONS
FOR
SITE 118

Element	ESP Inlet Gas (A)			ESP Outlet Gas (B)			IN - OUT		ESP eff.	
	BIAS= 0%			BIAS= 0%						
	Average lb/10^12 Btu	Std. Dev.	Del(A)	Average lb/10^12 Btu	Std. Dev.	Del(B)	C=A-B lb/10^12 Btu	Del(C) lb/10^12 Btu	D=C/A %	Del(D)
Arsenic	0.99	0.10	0.06	0.55	0.13	0.07	0.44	0.10	44%	10%
Barium	17.40	1.49	0.86	7.16	5.1	2.96	10	3.1	59%	18%
Beryllium	0.57	0.03	0.02	ND< 0.06	--	--	0.51	--	90%	--
Cadmium	ND< 0.16	--	--	ND< 0.18	--	--	--	--	--	--
Chromium	7.37	1.64	0.95	3.3	0.7	0.42	4.1	1.04	55%	16%
Cobalt	23.6	4.15	2.40	1.9	0.45	0.26	22	2.4	92%	14%
Copper	8.4	0.48	0.28	2.8	1.72	0.99	5.6	1.03	67%	13%
Lead	6.69	1.27	0.7	1.78	1.0	0.57	4.9	0.93	73%	16%
Manganese	21.4	11.16	6.44	18.5	4.27	2.46	3.0	6.90	14%	32%
Mercury	0.84	0.19	0.11	0.50	0.22	0.12	0.34	0.16	41%	20%
Molybdenum	3.4	0.26	0.15	0.4	0.14	0.08	3.0	0.17	88%	6%
Nickel	615	101	58.5	46	14	8	569	59	93%	13%
Selenium	1.87	0.54	0.31	1.25	0.34	0.20	0.62	0.37	33%	20%
Phosphorus	49	3.61	2	3	0.5	0.3	47	2.1	95%	6%
Vanadium	737	54	31	42	13	7	695	32	94%	6%
	lb/10^6 Btu			lb/10^6 Btu			lb/10^6 Btu	lb/10^6 Btu		
Particulates	0.0514	0.004	0.002	0.0041	0.0013	0.00074	0.047	0.0024	92.01%	6.12%
								AVERAGE	68.6%	14.0%

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MASS BALANCE UNCERTAINTY CALCULATIONS
FOR
SITE 118

Element	Fuel Oil (A) BIAS= 0% Average lb/10^12 Btu	Fuel Oil (A) Std. Dev.	Fuel Oil (A) Del(A)	Hopper Ash (C) BIAS= 30% Average lb/10^12 Btu	Hopper Ash (C) Std. Dev.	Hopper Ash (C) Del(C)	Stack Gas (B) BIAS= 0% Average lb/10^12 Btu	Stack Gas (B) Std. Dev.	Stack Gas (B) Del(B)	Total Out (D) B+C lb/10^12 Btu	Total Out (D) Del(D)	(B+C)/A = E	Del(E)
Arsenic (2)(3)	8.1	4.97	2.87	2.730	0.292	0.82	0.6	0.13	0.07	3.28	0.82	40%	18%
Barium (3)	20.8	3.7	2.15	24.232	3.379	7.27	7.2	5.1	2.96	31.4	7.85	151%	41%
Beryllium	0.4	0.1	0.04	0.207	0.1584	0.06	ND< 0.06	--	--	0.24	0.06	60%	15%
Cadmium	ND< 0.4	--	--	0.142	0.108	0.04	ND< 0.18	--	--	0.23	0.04	62%	--
Chromium (2)(3)	8.3	0	0	6.059	1.036	1.82	3.3	0.7	0.42	9.36	1.87	113%	23%
Cobalt (3)	39.3	6.86	3.96	37.886	2.808	11.37	1.9	0.45	0.26	39.8	11.37	101%	31%
Copper	12.8	2.67	1.54	10.240	1.024	3.07	2.8	1.72	0.99	13.0	3.23	102%	28%
Lead	13.3	2.8	1.6	14.678	2.427	4.40	1.8	1.0	0.57	16.5	4.44	123%	37%
Manganese	7.5	2.32	1.34	7.203	1.517	2.16	18.5	4.27	2.46	25.7	3.28	344%	76%
Mercury (2)(3)	0.2	0.03	0.02	ND< 0.011	--	--	0.50	0.22	0.12	0.51	0.12	240%	62%
Molybdenum (2)(3)	4.1	0	0	2.679	0.439	0.80	0.4	0.14	0.08	3.08	0.81	76%	20%
Nickel	1,084	222	128	989.701	58.401	296.9	46	14	7.96	1,036	297.0	96%	30%
Selenium (2)(3)	4.6	0.45	0.26	2.151	0.592	0.65	1.3	0.34	0.20	3.40	0.68	73%	15%
Phosphorus	288	157	91	83.62	2.86	25.09	3	1.2	0.7	86.3	25.1	30%	13%
Vanadium	1,155	274	158	1,126	87.71	337.8	42	13	7	1,168	338	101%	32%
Chlorine, as Cl-	2,888	108	62	ND< 13	--	--	3,590	418	241	3,596	241	125%	9%
Fluorine, as F-	ND< 1,066	--	--	ND< 0.15	--	--	85	14	8	85	8	--	--
Phosphorus, as PO4 3- (2)	883	483	279	ND< 51	--	--	ND< 646	--	--	ND< 698	--	79%	--
Sulfur, as SO4 2-	1,166,170	126,797	73,206	10,921	3,246	3,276	1,028,798	133,966	77,345	1,039,719	7.7E+04	89%	9%
											AVERAGE	111%	29%

Notes:
(2) Fuel from INAA
(3) Ash from INAA

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APPENDIX G
QUALITY ASSURANCE AND QUALITY CONTROL DATA

The tables in Appendix G contain the following information.

TABLE G-1
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND STACK COMBINED METALS/ PM 10 METALS ANALYSES

Duplicate Sample Results

1-MTLS-IN (PM>10)

Element	Method	Sample Value ug/train	Duplicate Value ug/train	RPD	Data Quality Objective for Duplicates	Comments
Arsenic	ICP-Hydride	1.4	NP	–	10	
Barium	ICP-AES	34	34	0.1	10	
Beryllium	ICP-AES	0.2	0.2	20	10	Does not meet DQO
Cadmium	ICP-AES	ND <0.3	ND <0.3	NC	10	
Chromium	ICP-AES	14	14	0.5	10	
Cobalt	ICP-AES	22	22	0.0	10	
Copper	ICP-AES	11	11	0.1	10	
Lead	GFAAS-MSA	10	NP	–	10	
Manganese	ICP-AES	21	20	0.8	10	
Mercury	CVAAS	1.0	1.3	25	10	Does not meet DQO
Molybdenum	ICP-AES	5.6	5.6	0.0	10	
Nickel	ICP-AES	550	547	0.3	10	
Selenium	ICP-Hydride	ND <0.25	NP	–	10	
Phosphorus	ICP-AES	29	27	7.5	10	
Vanadium	ICP-AES	620	610	0.3	10	

5-MTLS-IN (PM<10)

Element	Method	Sample Value ug/train	Duplicate Value ug/train	RPD	Data Quality Objective for Duplicates	Comments
Arsenic	ICP-Hydride	3.1	NP	–	10	
Barium	ICP-AES	65	66	0.7	10	
Beryllium	ICP-AES	2	2	0.0	10	
Cadmium	ICP-AES	ND <0.3	ND <0.3	NC	10	
Chromium	ICP-AES	18	18	0.3	10	
Cobalt	ICP-AES	74	74	0.1	10	
Copper	ICP-AES	28	28	0.6	10	
Lead	GFAAS-MSA	33	NP	–	10	
Manganese	ICP-AES	91	91	0.5	10	
Mercury*						
FH/BH	CVAAS	2.0	2.0	0.0	10	
KMNO4	CVAAS	ND <0.4	ND <0.4	NC	10	
Molybdenum	ICP-AES	27	27	0.5	10	
Nickel	ICP-AES	2000	2000	0.7	10	
Selenium	ICP-Hydride	8.4	NP	–	10	
Phosphorus	ICP-AES	160	150	5.6	10	
Vanadium	ICP-AES	2300	2270	0.6	10	

(continued)

Notes:
*Results are for test no. 3-MTLS-IN
RPD: relative percent difference
NP: not performed
NC: not calculable, no detected values

TABLE G-1 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND STACK COMBINED METALS/ PM 10 METALS ANALYSES

Duplicate Sample Results

Element	Method	Sample Value ug/train	Duplicate Value ug/train	RPD	Data Quality Objective for Duplicates	Comments
1-MTLS-Stack (PM>10)						
Arsenic	ICP-Hydride	0.8	NP	--	10	
Barium	ICP-AES	5.1	5.1	0.7	10	
Beryllium	ICP-AES	ND <0.1	ND<0.1	NC	10	
Cadmium	ICP-AES	ND <0.3	ND <0.3	NC	10	
Chromium	ICP-AES	6	6	3.3	10	
Cobalt	ICP-AES	1.4	1.5	9.2	10	
Copper	ICP-AES	3.3	3.3	1.1	10	
Lead	GFAAS-MSA	3	NP	--	10	
Manganese	ICP-AES	79	79	0.1	10	
Mercury	CVAAS	1.1	1.3	18	10	Does not meet DQO
Molybdenum	ICP-AES	ND <0.7	ND <0.7	NC	10	
Nickel	ICP-AES	33	33	1.5	10	
Selenium	GFAAS	ND <0.25	NP	--	10	
Phosphorus	ICP-AES	ND <5	ND <5	NC	10	
Vanadium	ICP-AES	26	27	0.6	10	
5-MTLS-Stack (PM<10)						
Arsenic*	ICP-Hydride	1.9	1.7	11	10	Does not meet DQO
Barium	ICP-AES	26	26	0.3	10	
Beryllium	ICP-AES	ND<0.1	ND<0.1	NC	10	
Cadmium	ICP-AES	ND <0.3	ND <0.3	NC	10	
Chromium	ICP-AES	5.3	5.4	0.4	10	
Cobalt	ICP-AES	4.6	4.5	3.4	10	
Copper	ICP-AES	9.3	9.2	1.1	10	
Lead	GFAAS-MSA	ND <2	NP	--	10	
Manganese	ICP-AES	32	33	0.4	10	
Mercury*						
FH/BH	CVAAS	2.0	ND <2	NC	10	
KMNO4	CVAAS	ND <0.7	ND<0.7	NC	10	
Molybdenum	ICP-AES	17	17	2.0	10	
Nickel	ICP-AES	120	120	0.6	10	
Selenium*	ICP-Hydride	5.7	6.2	7.7	10	
Phosphorus	ICP-AES	6	ND <5	NC	10	
Vanadium	ICP-AES	120	120	0.3	10	

Notes:
*Results are for test no. 3-MTLS-Stack
RPD: relative percent difference
NP: not performed
NC: not calculable

TABLE G-1 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND STACK COMBINED METALS/ PM 10 METALS ANALYSES

Post-Digestion Sample Spike Recoveries

Element	PM >10 1-MTLS-IN	PM >10 1-MTLS-STACK	Data Quality Objective for Spikes	Comments
Arsenic	NP	NP	75-125	
Barium	99	101	75-125	
Beryllium	94	92	75-125	
Cadmium	90	94	75-125	
Chromium	90	93	75-125	
Cobalt	88	92	75-125	
Copper	96	100	75-125	
Lead	MSA	MSA	75-125	
Manganese	87	88	75-125	
Mercury	73	117	75-125	1-MTLS-IN does not meet DQO
Molybdenum	88	94	75-125	
Nickel	78	87	75-125	
Selenium	NP	NP	75-125	
Phosphorus	93	99	75-125	
Vanadium	86	93	75-125	

Post-Digestion Sample Spike Recoveries

Element	PM <10 5-MTLS-IN	PM <10 5-MTLS-STACK	Data Quality Objective for Spikes	Comments
Arsenic	NP	47**	75-125	5-MTLS-STACK does not meet DQO
Barium	82	87	75-125	
Beryllium	87	94	75-125	
Cadmium	61	76	75-125	5-MTLS-IN does not meet DQO
Chromium	70	80	75-125	5-MTLS-IN does not meet DQO
Cobalt	63	72	75-125	5-MTLS-IN and STACK do not meet DQO
Copper	87	89	75-125	
Lead	MSA	MSA	75-125	
Manganese	68	74	75-125	5-MTLS-IN and STACK do not meet DQO
Mercury				
-FH/BH	96*	93**	75-125	
-KMnO4	101*	109**	75-125	
Molybdenum	71	77	75-125	5-MTLS-IN does not meet DQO
Nickel	114	66	75-125	5-MTLS-STACK does not meet DQO
Selenium	NP	111**	75-125	
Phosphorus	75	82	75-125	
Vanadium	72	81	75-125	5-MTLS-IN does not meet DQO

*Results are for 3-MTLS-IN
**Results are for 3-MTLS-STACK
NP: not performed
MSA: samples analyzed by the Method of Standard Additions.

TABLE G-1 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND STACK COMBINED METALS/ PM 10 METALS ANALYSES

Element	Initial Calibration % Recovery	Continuing Calibration % Recovery		Data Quality Objective for LCS	Comments
Laboratory Check Standards Results: PM ≥10					
Arsenic	100	97	99	90-110	
Barium	102	101	100	90-110	
Beryllium	93	91	91	90-110	
Cadmium	102	96	96	90-110	
Chromium	107	101	100	90-110	
Cobalt	101	97	96	90-110	
Copper	103	100	100	90-110	
Lead	97	106	NP	90-110	
Manganese	104	100	99	90-110	
Mercury	113	107	102	80-120	
Molybdenum	99	95	94	90-110	
Nickel	102	98	99	90-110	
Selenium	102	97	93	90-110	
Phosphorus	101	103	105	90-110	
Vanadium	99	96	96	90-110	
Laboratory Check Standards Results: PM ≤10					
Arsenic	98	98	99	90-110	
Barium	103	102	105	90-110	
Beryllium	95	93	96	90-110	
Cadmium	102	102	104	90-110	
Chromium	109	107	109	90-110	
Cobalt	104	102	104	90-110	
Copper	104	104	105	90-110	
Lead	99	NP	NP	90-110	
Manganese	107	105	107	90-110	
Mercury					
FH/BH	111	107	103	80-120	
KMNO4	93	96	NP	80-120	
Molybdenum	100	99	101	90-110	
Nickel	104	101	105	90-110	
Selenium	107	92	99	90-110	
Phosphorus	98	100	103	90-110	
Vanadium	101	100	102	90-110	

Correlation Coefficients for Lead MSA Data, r^2

Sample ID	Inlet, r^2	Stack , r^2	Data Quality Objective for MSA	Comments
PM≤10				
LAB BLANK	0.9998	0.9998	0.995	
RB-MTLS	0.9958	0.9958	0.995	
FB-MTLS	0.9999	0.9992	0.995	
1-MTLS	0.9997	0.9995	0.995	
2-MTLS	0.9987	0.9959	0.995	
3-MTLS	0.9995	0.9981	0.995	
PM≥10				
FB-MTLS	0.9999	1.0000	0.995	
1-MTLS	0.9998	0.9963	0.995	
2-MTLS	0.9998	0.9984	0.995	
3-MTLS	0.9994	0.9979	0.995	

MSA: samples analyzed by the Method of Standard Additions
NP: Not performed

TABLE G-2
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP INLET AND STACK PAH ANALYSES

Duplicate Matrix Spikes:

Compound	Blank Matrix Spike #1 % Recovery	Blank Matrix Spike #2 % Recovery	RPD	Data Quality Objective for Duplicates	Comments
Naphthalene	130	121	7.2	50	
Acenaphthylene	94	95	1.1	50	
Acenaphthene	94	103	9.1	50	
Fluorene	100	95	5.1	50	
Phenanthrene	100	103	3.0	50	
Anthracene	94	100	6.2	50	
Fluoranthene	100	96	4.1	50	
Pyrene	100	99	1.0	50	
Benz(a)anthracene	94	98	4.2	50	
Chrysene	94	99	5.2	50	
Benzo(b)fluoranthene	81	86	6.0	50	
Benzo(k)fluoranthene	100	98	2.0	50	
Benzo(a)pyrene	94	95	1.1	50	
Indeno(1,2,3-cd)pyrene	87	91	4.5	50	
Dibenzo(a,h)anthracene	106	98	7.8	50	
Benzo(g,h,i)perylene	94	95	1.1	50	
2-Methylnaphthalene	NS	NS	NS	--	
7,12-Dimethylbenz(a)anthracene	NS	NS	NS	--	
3-Methylcholanthrene	NS	NS	NS	--	

Matrix Spike Recovery Results:

Component	Blank Matrix Spike #1 % Recovery	Blank Matrix Spike #2 % Recovery	Average % Recovery	Data Quality Objective for Spikes	Comments
Naphthalene	130	121	126	50-150	
Acenaphthylene	94	95	95	50-150	
Acenaphthene	94	103	99	50-150	
Fluorene	100	95	98	50-150	
Phenanthrene	100	103	102	50-150	
Anthracene	94	100	97	50-150	
Fluoranthene	100	96	98	50-150	
Pyrene	100	99	100	50-150	
Benz(a)anthracene	94	98	96	50-150	
Chrysene	94	99	97	50-150	
Benzo(b)fluoranthene	81	86	84	50-150	
Benzo(k)fluoranthene	100	98	99	50-150	
Benzo(a)pyrene	94	95	95	50-150	
Indeno(1,2,3-cd)pyrene	87	91	89	50-150	
Dibenzo(a,h)anthracene	106	98	102	50-150	
Benzo(g,h,i)perylene	94	95	95	50-150	
2-Methylnaphthalene	NS	NS	--	50-150	
7,12-Dimethylbenz(a)anthracene	NS	NS	--	50-150	
3-Methylcholanthrene	NS	NS	--	50-150	

RPD: Relative Percent Difference
NS: Not Spiked

Preliminary

TABLE G-2 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP INLET AND STACK PAH ANALYSES

PAH Recovery Results	Method Blank	Average Blank Matrix Spike	FB-SV-IN	6-SV-IN	7-SV-IN	8-SV-IN	FB-SV-STK	6-SV-STK	7-SV-STK	8-SV-STK	Data Quality Objective for Spikes
<u>Internal Recoveries, %</u>											
(added pre-extraction)											
Napthalene-2H8	88	80	63	49*	60	46*	62	67	69	75	50-150
Acethenapthylene-2H8	49*	74	85	73	89	48*	81	81	88	89	50-150
Acenapthene--2H10	110	97	85	74	89	72	81	80	87	89	50-150
Fluorene-2H10	110	99	95	80	95	89	88	86	91	97	50-150
Phenanthrene-2H10	110	101	100	86	99	97	94	92	94	100	50-150
Anthracene-2H10	45*	103	120	99	120	83	100	100	110	110	50-150
Fluoranthene-2H10	100	97	100	88	94	94	92	89	93	98	50-150
Pyrene-2H10	110	98	98	89	96	94	93	90	94	100	50-150
Benz(a)anthracene-2H12	86	88	92	86	100	90	88	88	93	88	50-150
Chrysene-2H12	88	80	80	71	84	87	77	81	75	76	50-150
Benzo(b)fluoranthene-2H12	91	81	80	77	85	77	86	82	84	80	50-150
Benzo(k)fluoranthene-2H12	69	75	77	72	85	76	76	86	79	73	50-150
Benzo(a)pyrene-2H12	24*	90	100	96	98	68	92	100	93	92	50-150
Indeno(1,2,3-c,d)pyrene-2H12	94	87	92	79	78	69	91	90	82	85	50-150
Dibenzo(a,h)anthracene-2H14	88	79	87	81	76	74	87	89	84	81	50-150
Benzo(g,h,i)perylene-2H12	82	78	90	80	74	69	86	86	78	83	50-150
<u>Surrogate Recoveries, % (field spikes)</u>											
Benzo(e)pyrene-2H12	NS	NS	82	79	87	75	81	82	78	77	50-150
Terphenyl-2H14	NS	NS	101	93	102	99	97	91	99	104	50-150

Notes:
*Does not meet data quality objective
NS: Not Spiked

Do Not Cite or Quote

TABLE G-3
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP INLET AND STACK PCB ANALYSIS

Duplicate Spike Results: Component	Blank Matrix Spike #1 ug	Blank Matrix Spike #2 ug	RPD	Data Quality Objective for Duplicates	Comments
total Chlorobiphenyls	1.77	1.73	2.3	50	
total Dichlorobiphenyls	0.90	0.81	10.5	50	
total Trichlorobiphenyls	0.86	0.87	1.2	50	
total Tetrachlorobiphenyls	0.97	0.70	32.3	50	
total Pentachlorobiphenyls	0.78	0.72	8.0	50	
total Hexachlorobiphenyls	0.81	0.73	10.4	50	
total Heptachlorobiphenyls	0.87	0.74	16.1	50	
total Octachlorobiphenyls	0.83	0.60	32.2	50	
total Nonachlorobiphenyls	0.86	0.70	20.5	50	
Decachlorobiphenyl	0.83	0.76	8.8	50	
TOTAL PCB	9.49	8.34	12.9	50	

Spike Recovery Results: Component	Blank Matrix Spike #1 % Recovery	Blank Matrix Spike #2 % Recovery	Average % Recovery	Data Quality Objective for Spikes	Comments
total Chlorobiphenyls	111	108	110	50-150	
total Dichlorobiphenyls	113	101	107	50-150	
total Trichlorobiphenyls	108	109	109	50-150	
total Tetrachlorobiphenyls	121	88	105	50-150	
total Pentachlorobiphenyls	98	90	94	50-150	
total Hexachlorobiphenyls	101	91	96	50-150	
total Heptachlorobiphenyls	109	93	101	50-150	
total Octachlorobiphenyls	104	75	90	50-150	
total Nonachlorobiphenyls	108	88	98	50-150	
Decachlorobiphenyl	104	95	100	50-150	
TOTAL PCB	108	95	102	50-150	

(continued)

RPD: Relative Percent Difference

TABLE G-3 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND STACK PCB ANALYSIS

PCB Recovery Results	Method Blank	Average Blank Matrix Spike	FB-SV-IN	6-SV-IN	7-SV-IN	8-SV-IN	FB-SV-STK	6-SV-STK	7-SV-STK	8-SV-STK	Data Quality Objective for Spikes
Internal Recoveries, % (added pre-extraction)											
4-Chlorobiphenyl-13C6	91	93	83	78	91	85	87	85	95	81	50-150
3,3,5,5,-tetrachlorobiphenyl-13C12	97	96	94	93	97	100	95	92	91	86	50-150
2,2,3,3,5,5,6,6,-Octachlorobiphenyl-13C12	90	96	93	83	90	97	91	92	99	86	50-150
Decachlorobiphenyl-13C12	89	95	91	81	89	85	87	76	89	79	50-150
Surrogate Recoveries, % (field spikes)											
2,2',3,3',4',5,5',5-Heptachlorobiphenyl-13C12	NS	NS	87	88	88	89	91	89	94	89	50-150

Notes:
NS: Not Spiked

Preliminary

Do Not Cite or Quote

TABLE G-4
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP INLET AND STACK PCDD/PCDF ANALYSES

Duplicate Spike Results:

Component	Blank Matrix Spike #1 pg	Blank Matrix Spike #2 pg	RPD	Data Quality Objective for Duplicates
Total TCDD	1200	1250	4.1	50
Total PeCDD	2470	2440	1.2	50
Total HxCDD	6450	6450	0.0	50
Total HpCDD	2410	2460	2.1	50
OCDD	2460	2630	6.7	50
Total TCDF	1380	1220	12	50
Total PeCDF	1250	1230	1.6	50
Total HxCDF	4830	4880	1.0	50
Total HpCDF	1262	1180	6.7	50
OCDF	2500	2480	0.8	50

Spike Recovery Results:

Component	Blank Matrix Spike #1 % Recovery	Blank Matrix Spike #2 % Recovery	Average % Recovery	Data Quality Objective for Spikes
Total TCDD	96	100	98	50-150
Total PeCDD	99	98	99	50-150
Total HxCDD	129	129	129	50-150
Total HpCDD	96	98	97	50-150
OCDD	99	106	103	50-150
Total TCDF	110	97	104	50-150
Total PeCDF	100	98	99	50-150
Total HxCDF	129	130	130	50-150
Total HpCDF	101	95	98	50-150
OCDF	100	99	100	50-150

(continued)

RPD: Relative Percent Difference

TABLE G-4 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND STACK PCDD/PCDF ANALYSES

PCDD/PCDF Recovery Results	Method Blank	Average Blank Matrix Spike	FB-SV-IN	6-SV-IN	7-SV-IN	8-SV-IN	FB-SV-STK	6-SV-STK	7-SV-STK	8-SV-STK	Data Quality Objective for Spikes
Internal Recoveries, %											
(added pre-extraction)											
2,3,7,8-TCDF-13C-12	82	91	100	81	85	93	92	66	90	84	50-150
2,3,7,8-TCDD-13C-12	66	80	67	53	64	71	69	60	67	73	50-150
1,2,3,7,8-PeCDF-13C-12	83	92	100	84	90	89	91	49*	110	64	50-150
1,2,3,7,8-PeCDD-13C-12	86	97	93	87	91	84	93	44*	120	58	50-150
1,2,3,6,7,8-HxCDF-13C-12	59	62	100	42*	41*	57	39*	36*	69	40*	50-150
1,2,3,6,7,8-HxCDD-13C-12	51	61	91	48*	47*	53	46*	33*	69	43*	50-150
1,2,3,4,6,7,8-HpCDF-13C-12	97	100	94	40*	40*	45*	44*	31*	41*	19*	50-150
1,2,3,4,6,7,8-HpCDD-13C-12	100	103	97	74	71	86	74	50	60	41*	50-150
OCDD-13C-12	98	102	95	83	78	110	78	57	87	80	50-150
Surrogate Recoveries, %											
(field spikes)											
2,3,7,8-TCDD-37C-14	NS	NS	133	141	133	122	127	132	129	126	50-150
2,3,4,7,8-PeCDF-13C-12	NS	NS	110	101	101	100	99	93	97	96	50-150
1,2,3,4,7,8-HxCDF-13C-12	NS	NS	89	108	113	106	101	95	113	123	50-150
1,2,3,4,7,8-HxCDD-13C-12	NS	NS	89	104	125	136	101	117	128	128	50-150
1,2,3,4,7,8,9-HpCDF-13C-12	NS	NS	105	73	74	97	78	56	52	45*	50-150
Alternate Recoveries,%											
1,2,3,7,8,9-HxCDF-13C-12	99	101	106	86	89	120	85	90	84	120	50-150

Notes:
*Does not meet Data Quality Objective
NS: Not Spiked

Preliminary

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TABLE G-5
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP INLET AND OUTLET VOC ANALYSES

Sample Duplicate Results

Component	Sample ID	Sample ppb, v/v	Duplicate ppb, v/v	RPD	Data Quality Objective for Duplicates	Comments
Vinyl Chloride	1B-VOC-STK	ND <0.75	ND <0.75	NC	20	
1,3-Butadiene		ND <0.1	ND <0.1	NC	20	
Methyl Bromide		ND <0.6	ND <0.6	NC	20	
Trichlorofluoromethane		ND <0.2	ND <0.2	NC	20	
Dichloromethane		14	9.36	40	20	Does not meet DQO
Chloroform		ND <0.3	ND <0.3	NC	20	
1,2-Dichloroethane		ND <0.7	ND <0.7	NC	20	
1,1,1-Trichloroethane		0.47	0.31	41	20	Does not meet DQO
Carbon Tetrachloride		ND <0.2	ND <0.2	NC	20	
1,2-Dichloropropane		ND <0.7	ND <0.7	NC	20	
Trichloroethene		ND <0.3	ND <0.3	NC	20	
1,2-Dibromoethane		ND <0.5	ND <0.5	NC	20	
Perchloroethylene		ND <0.2	ND <0.2	NC	20	
Chlorobenzene		ND <0.2	ND <0.2	NC	20	
Ethylbenzene		0.15	0.1	40	20	Does not meet DQO
o-Xylene		0.21	0.15	33	20	Does not meet DQO
Benzene		0.24	0.17	34	20	Does not meet DQO
Toluene		2.74	1.72	46	20	Does not meet DQO
Vinyl Chloride	1C-VOC-STK	ND <0.4	ND <0.4	NC	20	
1,3-Butadiene		NP	NP	NC	20	
Methyl Bromide		ND <0.4	ND <0.4	NC	20	
Trichlorofluoromethane		ND <0.08	ND <0.08	NC	20	
Dichloromethane		8.84	8.81	0.34	20	
Chloroform		ND <0.2	ND <0.2	NC	20	
1,2-Dichloroethane		ND <0.4	ND <0.4	NC	20	
1,1,1-Trichloroethane		0.25	0.32	25	20	Does not meet DQO
Carbon Tetrachloride		ND <0.1	ND <0.1	NC	20	
1,2-Dichloropropane		ND <0.4	ND <0.4	NC	20	
Trichloroethene		ND <0.2	ND <0.2	NC	20	
1,2-Dibromoethane		ND <0.3	ND <0.3	NC	20	
Perchloroethylene		ND <0.08	ND <0.08	NC	20	
Chlorobenzene		ND <0.09	ND <0.09	NC	20	
Ethylbenzene		0.10	0.09	11	20	
o-Xylene		0.17	0.13	27	20	Does not meet DQO
Benzene		0.18	0.14	25	20	Does not meet DQO
Toluene		1.79	1.74	2.8	20	

(continued)

Notes:
NP: Not performed
NC: Not calculable for not detected species
RPD: Relative Percent Difference

TABLE G-5 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND OUTLET VOC ANALYSES

Matrix Spike Results Component	Sample ID	Expected Value ppb, v/v	Measured Value ppb, v/v	% Recovery	Data Quality Objective for Spikes	Comments
Vinyl Chloride	1C-VOC-IN	987	175	17.7	70-130	Does not meet DQO
1,3-Butadiene		194	190	97.9	70-130	
Methyl Bromide		557	495	88.9	70-130	
Trichlorofluoromethane		562	470	83.6	70-130	
Dichloromethane		556	644	116	70-130	
Chloroform		272	285	105	70-130	
1,2-Dichloroethane		356	467	131	70-130	Does not meet DQO
1,1,1-Trichloroethane		240	244	102	70-130	
Carbon Tetrachloride		314	304	96.8	70-130	
1,2-Dichloropropane		272	277	102	70-130	
Trichloroethene		292	376	129	70-130	
1,2-Dibromoethane		856	1090	127	70-130	
Perchloroethylene		265	346	131	70-130	Does not meet DQO
Chlorobenzene		214	298	139	70-130	Does not meet DQO
Ethylbenzene		173	203	117	70-130	
o-Xylene		180	201	112	70-130	
Benzene		273	288	105	70-130	
Toluene		272	400	147	70-130	Does not meet DQO

TABLE G-6
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP INLET AND STACK FORMALDEHYDE ANALYSIS

Sample Duplicate Analysis

Sample ID	Sample ug/vial	Duplicate ug/vial	RPD	Data Quality Objective for Duplicates	Comments
FB-B-STK #1	2.81	2.98	5.9	10	
5A-FORM-IN #1	0.80	0.87	8.4	10	
5C-FORM-IN #2	0.12	0.11	8.7	10	
5C-FORM-STK #1	0.75	0.67	11	10	

Spike Analysis

Sample ID	Expected Value ug/vial	Measured Value ug/vial	% Recovery	Data Quality Objective for Spikes	Comments
Field Spikes:					
Inlet	5.0	5.82	116	60-140	
Stack	5.0	5.42	108	60-140	
Trip Spike:	5.0	6.91	138	60-140	
Matrix Spikes:					
5A-FORM-IN #1	3.66	3.75	102	60-140	
5C-FORM-STK #1	3.66	3.32	91	60-140	

RPD: Relative Percent Difference

TABLE G-7
SUMMARY OF QUALITY CONTROL RESULTS FOR
SITE 118 ESP INLET AND STACK PARTICULATE ANALYSES

Quality Control	Measured Value or Range	Data Quality Objective	Comments
Acetone Blank, mg/ml	0.0069	< =0.008	
Balance Calibration Check, mg			
Total weight > 20 g	-0.3 to 0.0	+/- 0.3	
Total weight < 20 g	-0.1 to +0.1	+/- 0.1	

Note: NBS traceable weights used for balance calibration check

TABLE G-8
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP INLET AND STACK ANION ANALYSES

Sample Duplicate Analyses

Sample I.D.	Sample value mg/sample	Duplicate value mg/sample	RPD	Data Quality Objectives for Duplicates
1-PM/AN-STK				
front-half:				
Chloride	0.0274	0.0275	0.4	15
Fluoride	ND <0.015	ND <0.015	NC	15
Phosphate	ND <0.1	ND <0.1	NC	15
Sulfate	0.475	0.473	0.4	15
5-PM/AN-IN				
3% H2O2:				
Chloride	ND <9.9	ND <9.9	NC	15
Fluoride	ND <5.9	ND <5.9	NC	15
Phosphate	ND <2.0	ND <2.0	NC	15
Sulfate	2138	2472	14.5	15

Spike Results

Sample I.D.	Measured Value, mg	Expected Value, mg	Matrix Spike % Recovery	Quality Control Objective for Spikes	Comments
1-PM/AN-STK					
front-half:					
Chloride	0.483	0.600	80.5	80-120	
Fluoride	0.410	0.400	103	80-120	
Phosphate	4.35	4.00	109	80-120	
Sulfate	2.47	3.00	82.3	80-120	
5-PM/AN-IN					
3% H2O2:					
Chloride	0.596	0.600	99.3	80-120	
Fluoride	0.422	0.400	106	80-120	
Phosphate	2.83	4.00	70.8	80-120	Does Not Meet DQO
Sulfate	3.95	3.00	132	80-120	Does Not Meet DQO

RPD= relative percent difference

NC: not calculated for species that were not detected

TABLE G-9
SUMMARY OF QUALITY CONTROL RESULTS FOR RADIONUCLIDES ANALYSES: SITE 118 STACK

Replicate Laboratory Control Sample Results(1):

Component	LCS value pCi/ml	Mean LCS value pCi/ml	RPD	Data Quality Objective for Duplicates	Comments
Uranium-234 (LCS#1)	2.68	3.0	11	20	
Uranium-234 (LCS#2)	2.59	3.0	15	20	
Uranium-235	NP	NP	--	20	
Uranium-238 (LCS#1)	2.91	2.9	0.3	20	
Uranium-238 (LCS#2)	2.41	2.9	18	20	
Radium-226 (LCS#1)	2.97	3.2	7	20	
Radium-226 (LCS#2)	2.78	3.2	14	20	
Radium-228 (LCS#1)	2.08	2.1	1	20	
Radium-228 (LCS#2)	2.48	2.1	17	20	
Lead-210	3.43	3.6	5	20	
Polonium-210	NP	NP	--	20	
Thorium-228	NP	0.0	--	20	
Thorium-230	6.12	7.3	17.6	20	
Thorium-232	NP	NP	--	20	

Internal Spike Recoveries:

Sample ID	Uranium-232	Radium-226	Radium-228	Lead-210	Po-209	Thorium-229	Data Quality Objective for Spikes
			% Recovery				
Laboratory Reagent Blank	38*	97	39*	NR	13	3.0	50-150
Laboratory Control Sample (#1,2)	68	96,98	37*,39*	NR	22	31	50-150
Field Reagent Blank	33*	97	39*	NR	29	6.0	50-150
1-PM/AN-STACK	28*	100	54	NR	22	6.0	50-150
3-PM/AN-STACK	31*	93	51	NR	19	4.0	50-150
5-PM/AN-STACK	40*	100	55	NR	20	11	50-150

Laboratory Control Sample Results:

Component	Expected Value pCi/ml	Measured Value pCi/ml	% Recovery	Data Quality Objective for LCS	Comments
Uranium-234	2.86	2.68	94	80-120	
Uranium-235	NP	NP	--	80-120	
Uranium-238	2.86	2.91	102	80-120	
Radium-226	2.97	2.78	94	80-120	
Radium-228	2.08	2.48	119	80-120	
Lead-210	3.46	3.43	99	80-120	
Polonium-210	NP	NP	--	80-120	
Thorium-228	NP	NP	--	80-120	
Thorium-230	6.89	6.12	89	80-120	
Thorium-232	NP	NP	--	80-120	

(continued)

TABLE G-9 (continued)
SUMMARY OF QUALITY CONTROL RESULTS FOR RADIONUCLIDES ANALYSES: SITE 118 FUEL OIL AND FLY ASH

Sample Duplicate Analysis:

Fly ash composite 1/21-1/27/93:

Component	Sample Value pCi/g	Duplicate Value pCi/g	RPD	Data Quality Objective for Duplicates	Comments
Ra-226	10.20	15.64	42.1	20	Does not meet DQO
Po-210	1.70	1.50	12.5	20	
Pb-210	17.80	16.70	6.4	20	

Replicate Laboratory Control Sample Results(1):

Component	LCS value pCi/g	Mean LCS value pCi/g	RPD	Data Quality Objective for Duplicates	Comments
Uranium-234 (LCS#1)	7.59	7.7	1.4	20	
Uranium-234 (LCS#2)	9.42	7.7	20	20	
Uranium-238 (LCS#1)	7.66	7.9	3.1	20	
Uranium-238 (LCS#2)	8.86	7.9	11	20	
Radium-226	2.92	3.2	9.2	20	
Radium-228	2.46	2.2	11	20	
Lead-210	3.43	3.6	4.8	20	
Polonium-210	0.262	0.280	6.6	20	
Thorium-228(LCS#1)	32.95	35	6.0	20	
Thorium-228(LCS#2)	33.69	35	3.8	20	
Thorium-232 (LCS#1)	35.36	34	3.9	20	
Thorium-232 (LCS#2)	32.9	34	3.3	20	

Internal Spike Recoveries:

	Uranium-232	Radium-226	Radium-228	Lead-210	Po-209	Thorium-229	Data Objective for Spikes
Sample ID	% Recovery						
Laboratory Reagent Blank (#1,2)	59,56	91	44*	46*	33*	47*,41*	50-150
Laboratory Control Sample (#1,2)	82,39*	91	43*	79	42*	65,19*	50-150
Fuel oil 1/20	54	92	54	58	28*	66	50-150
Fuel oil 1/21	51	94	53	74	24*	68	50-150
Fuel oil 1/22	51	93	56	90	25*	49*	50-150
Fly ash composite 1/21-1/27/93	31*	80	48*	45*	24*	47*	50-150

Laboratory Control Sample Results:

Component	Expected Value pCi/g	Measured Value pCi/g	% Recovery	Data Quality Objective for LCS	Comments
Uranium-234 (oil)	8.2	7.59	93	80-120	
Uranium-234 (ash)	8.2	9.42	115	80-120	
Uranium-238 (oil)	8.2	7.66	93	80-120	
Uranium-238 (ash)	8.2	8.86	108	80-120	
Radium-226	2.973	2.92	98	80-120	
Radium-228	2.08	2.46	118	80-120	
Lead-210	3.460	3.43	99	80-120	
Polonium-210	0.253	0.262	104	80-120	
Thorium-228 (oil)	35	32.95	94	80-119	
Thorium-228 (ash)	35	33.69	96	80-120	
Thorium-232 (oil)	35	35.36	101	80-120	
Thorium-232 (ash)	35	32.90	94	80-120	

Notes:

(1) Replicate LCS results are based on comparison of current LCS values to mean LCS value for previous 30 runs.

RPD: Relative Percent Difference

NP: Not Performed

NR: Not Reported, lead-210 lost from sample during preparation for analysis

*Result does not meet DQO

TABLE G-10
SUMMARY OF QUALITY CONTROL RESULTS
SITE 118 ESP INLET AND STACK
NICKEL SPECIATION ANALYSES

Sample Duplicate Results,8A-Ni-IN:

Sample filters

Nickel form	Sample value % Distribution	Duplicate value % Distribution	RPD	Data Quality Objectives for Duplicates	Comments
Soluble	39.2	38.8	1.0	10	
Sulfidic	10.2	8.3	21	10	Does not meet DQO
Metallic	ND <1	ND <1	NC	10	
Oxidic	50.7	52.9	4.2	10	

Sample spike results, 8-Ni-IN:

Nickel form	Expected Value ug	Measured Value ug	% Recovery	Data Quality Objective for Spikes
Soluble	9.9	8.9	90	75-125

Notes:
NC: not calculated for species that were not detected
RPD: Relative Percent Difference

TABLE G-11
SUMMARY OF QUALITY CONTROL RESULTS FOR TOTAL AND HEXAVALENT CHROMIUM ANALYSES
SITE 118 STACK

Duplicate Analysis Results: Analyte	Sample ID	Sample Value ng/ml	Duplicate Value ng/ml	RPD	Data Quality Objective for Duplicates	Comments
Total chromium	LCS-NaOH fraction	9.27	9.60	3.5	10	
(Lab #1)	LCS-Nitric/filter fraction	0.856	0.876	2.3	10	
	Blank Matrix Spike	45.37	42.53	6.5	10	
	Matrix Spike/NaOH	34.95	34.79	0.5	10	
Chromium (VI)/	10-Cr-C-NaOH	0.3931	0.4413	12	15	
NaOH fraction	11-Cr-C-NaOH	0.7594	0.7553	0.5	15	
(Lab #1)	12-Cr-C-NaOH	0.0814	0.0951	16	15	Does not meet DQO
	13-Cr-C-NaOH	ND < 0.35	ND < 0.35	NC	15	

Matrix Spike Analysis Results: Analyte	Sample ID	Expected value ng/ml	Measured value ng/ml	% Recovery	Data Quality Objective for Spikes	Comments
Total Chromium/						
NaOH fraction	Blank Matrix Spike-NaOH	20.0	12.8	64.0	75-125	Does not meet DQO
(Lab #1)	10-Cr-C-NaOH	10.0	7.38	73.8	75-125	Does not meet DQO
	11-Cr-C-NaOH	10.0	6.56	65.6	75-125	Does not meet DQO
	12-Cr-C-NaOH	10.0	8.27	82.7	75-125	
	13-Cr-C-NaOH	10.0	7.58	75.8	75-125	
Total Chromium/ Nitric/filter fraction	Laboratory spike	1000	876	87.6	75-125	
Chromium (VI) (Lab #1)	Laboratory Spike	5.00	5.25	105.0	80-120	

Laboratory Check Standard Results: Analyte	Sample ID	Expected value ng/ml	Measured value ng/ml	% Recovery	Data Quality Objective for LCS
Total Chromium/NaOH fraction:					
(Lab #1)					
Cal #1	ICV	10.00	10.430	104	90-110
	CCV #1	10.00	10.680	107	90-110
	CCV #2	10.00	9.420	94	90-110
Cal #2	ICV	10.00	9.830	98	90-110
	CCV #1	10.00	9.760	98	90-110
	CCV #2	10.00	9.720	97	90-110
Cal #3	ICV	10.00	9.960	100	90-110
	CCV	10.00	10.060	101	90-110
Total Chromium/Nitric rinse & filter fraction:					
(Lab #1)	ICV	1000	1020	102	90-110
	CCV #1	500	543	109	90-110
	CCV #2	500	535	107	90-110
	CCV #3	500	525	105	90-110
Chromium (VI)/	QC #1	2.00	2.04	102	95-105
NaOH fraction:	QC #2	2.00	2.14	107	95-105
(Lab #2)	QC #3	2.00	2.00	100	95-105
	QC #4	2.00	1.98	99.0	95-105

Notes:
NC: Not calculable
RPD: Relative Percent Difference
Lab #1 performed the analyses for total chromium.
Both labs #1 and #2 performed the hexavalent chromium analyses.

TABLE G-12
SUMMARY OF QUALITY CONTROL RESULTS FOR METALS BY ICP-AES, GFAAS AND CVAAS IN FUEL OIL

Duplicate Analysis Results
fuel oil 1/20/93

Element	Method	Sample Value ug/g	Duplicate Value ug/g	RPD %	Data Quality Objective for Duplicates	Comments
Arsenic	GFAAS	0.267	0.293	9.3	10	
Barium	ICP-AES	0.42	0.36	15	10	Does not meet DQO
Beryllium	ICP-AES	0.008	0.006	20	10	Does not meet DQO
Cadmium	ICP-AES	ND < 0.007	ND < 0.007	NC	10	
Chromium	ICP-AES	0.098	0.091	7.4	10	
Cobalt	ICP-AES	0.794	0.787	0.9	10	
Copper	ICP-AES	0.294	0.236	22	10	Does not meet DQO
Lead	GFAAS	0.272	0.255	7	10	
Manganese	ICP-AES	0.165	0.128	26	10	Does not meet DQO
Mercury	CVAAS	ND<0.091	ND<0.091	NC	10	
Molybdenum	ICP-AES	0.134	0.092	37	10	Does not meet DQO
Nickel	ICP-AES	18.939	18.8	0.6	10	
Selenium	GFAAS	ND<0.007	ND<0.007	NC	10	
Phosphorus	ICP-AES	ND < 5	7.8	NC	10	
Vanadium	ICP-AES	23.402	19.778	17	10	Does not meet DQO

Spike Results
fuel oil 1/20/93

Element	Pre-digestion Blank Spike % recovery	Pre-digestion Organometallic Spike % recovery	Post-digestion Sample Spike % recovery	Data Quality Objective for Spikes	Comments
Arsenic	71	14	86	75-125	Blank, organometallic spike do not meet DQO
Barium	NP	NP	95	75-125	
Beryllium	NP	NP	97	75-125	
Cadmium	NP	43	104	75-125	Organometallic spike does not meet DQO
Chromium	NP	NP	92	75-125	
Cobalt	NP	NP	84	75-125	
Copper	NP	NP	97	75-125	
Lead	NP	61	99	75-125	Organometallic spike does not meet DQO
Manganese	NP	NP	88	75-125	
Mercury	61	22	NP	75-125	Blank, organometallic spikes do not meet DQO
Molybdenum	NP	NP	89	75-125	
Nickel	NP	NP	84	75-125	
Selenium	NP	44	33	75-125	Organometallic, post spike do not meet DQO
Phosphorus	80	78	98	75-125	
Vanadium	NP	NP	83	75-125	

NP: Not performed

TABLE G-12
SUMMARY OF QUALITY CONTROL RESULTS FOR METALS BY ICP-AES, GFAAS AND CVAAS IN FUEL OIL

Laboratory Check Standards Results

Element	Initial Calibration % Recovery	Continuing Calibration % Recovery		Data Quality Objective for LCS	Comments
Arsenic	110	108	106	90-110	
Barium	104	104	105	90-110	
Beryllium	98	95	95	90-110	
Cadmium	104	102	101	90-110	
Chromium	105	104	105	90-110	
Cobalt	105	103	102	90-110	
Copper	106	106	107	90-110	
Lead	94	94	97	90-110	
Manganese	105	106	106	90-110	
Mercury	109	101	93	80-120	
Molybdenum	102	97	97	90-110	
Nickel	108	102	102	90-110	
Selenium	99	101	-	90-110	
Phosphorus	99	107	108	90-110	
Vanadium	101	101	101	90-110	

TABLE G-13
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 FUEL OIL METALS ANALYSES BY INAA

Duplicate Analysis Results:

Fuel Oil 1/20

Element	Sample Value ug/g	Duplicate Value ug/g	RPD %	Data Quality Objective for Duplicates	Comments
Arsenic	0.10	0.077	26	10	Does not meet DQO
Chromium	0.16	0.17	6.1	10	
Cobalt	1.5	1.5	0.0	10	
Mercury	0.0035	NP	--	10	
Molybdenum	0.080	0.079	1.3	10	
Selenium	0.081	0.087	7.1	10	

RPD: *Relative Percent Difference; not calculated for not detected values*

ND: Not detected

TABLE G-14
SUMMARY OF QUALITY CONTROL RESULTS FOR ULTIMATE ANALYSIS OF FUEL OIL
SITE 118

Duplicate Analysis Results:

QC sample ID# 242289

Parameter	Sample	Duplicate	RPD	Data Quality Objective for Duplicates	Comments
Component, %					
Carbon	69.31	68.52	1.1	10	
Hydrogen	4.77	4.96	3.9	10	
Nitrogen	0.87	0.99	12.9	10	Does not meet DQO
Dry Sulfur	0.59	0.56	5.2	10	
Dry Ash	7.43	7.48	0.7	10	
Moisture	9.97	10.23	2.6	10	
Dry Btu/lb	11868	11892	0.2	10	

Laboratory Check Standard Analysis:

	Expected Value, Btu/lb	Measured Value, Btu/lb	% Recovery
Heating Value	23810.92	23810.42	100.0

TABLE G-15
SUMMARY OF QUALITY CONTROL RESULTS FOR CHLORIDE, FLUORIDE AND SULFATE IN SITE 118 ESP FLYASH

Composite 1/21/-1/27/93

Duplicate Analysis Results:

Anion	Sample mg	Duplicate mg	RPD	Data Quality Objective for Duplicates
Chloride	ND <250	ND <250	NC	15
Fluoride	ND <2.5	ND <2.5	NC	15
Sulfate	140,000	143,000	2	15

Spike Analysis Results:

Anion	Matrix Spike % Recovery	Data Quality Objective for Spikes	Comments
Chloride	129	80-120	Does not meet DQO
Fluoride	55	80-120	Does not meet DQO
Sulfate	118	80-120	

Laboratory Control Standards Results:

Anion	Initial Calibration % Recovery	Continuing Calibration % Recovery	Data Quality Objective for LCS	Comments
Chloride	100	96.5	95-105	
Fluoride	96.6	97.2	95-105	Does not meet DQO
Sulfate	102	99.5	95-105	

NC: Not calculable
RPD: Relative Percent Difference

TABLE G-16
SUMMARY OF QUALITY ASSURANCE RESULTS FOR
METALS BY ICP-AES, GFAAS AND CVAAS
IN SITE 118 ESP FLYASH

Duplicate Analysis Results:

Element	Method	Sample Value ug/g	Duplicate Value ug/g	RPD %	Data Quality Objective for Duplicates	Comments
Composite 1/21-1/27/93, Replicate #1						
Arsenic	GFAAS	62.6	65.2	2	10	
Barium	ICP-AES	96.8	102	5	10	
Beryllium	ICP-AES	2.6	2.7	4	10	
Cadmium	ICP-AES	4.1	3.7	10	10	
Chromium	ICP-AES	119	106	12	10	Does not meet DQO
Cobalt	ICP-AES	718	729	2	10	
Copper	ICP-AES	215	199	8	10	
Lead	ICP-AES	246	269	9	10	
Manganese	ICP-AES	222	188	17	10	Does not meet DQO
Mercury	CVAAS	ND <0.1	ND <0.1	NC	10	
Molybdenum	ICP-AES	130	125	4	10	
Nickel	ICP-AES	19500	19800	2	10	
Selenium	GFAAS	ND <5	ND <5	NC	10	
Phosphorus	ICP-AES	237	230	3	10	
Vanadium	ICP-AES	22600	22800	1	10	
Blank Matrix Spike						
Arsenic		NP	NP	3.1	10	
Barium		109.3	139.1	0.1	10	
Beryllium		101.8	98.4	0.8	10	
Cadmium		124	94.2	0.2	10	
Chromium		101.5	94.1	2.8	10	
Cobalt		101.4	88	1.6	10	
Copper		103.6	95.8	0.7	10	
Lead		102.8	104.7	10.6	10	Does not meet DQO
Manganese		102.1	103	0.5	10	
Mercury		106.4	107.6	5.1	10	
Molybdenum		101.8	92.7	4.0	10	
Nickel		105.3	89.4	2.1	10	
Selenium		98.9	88	1.6	10	
Phosphorus		97.9	99	1.2	10	Result for Replicate #3
Vanadium		100.9	92.8	1.3	10	

Notes:
RPD: Relative Percent Difference

(continued)

TABLE G-16(*continued*)
SUMMARY OF QUALITY ASSURANCE RESULTS FOR
METALS BY ICP-AES, GFAAS AND CVAAS
IN SITE 118 ESP FLYASH

Spike Results:

Element	Average Pre-digestion Blank Spike % Recovery	Pre-digestion Sample Spike % Recovery	Post-digestion Sample Spike % Recovery	Data Quality Objective for Spikes	Comments
Arsenic	NP	58	NM	75-125	Pre-digestion spike does not meet DQO
Barium	124	62	27	75-125	Pre- and post -spike do not meet DQO
Beryllium	100	71	91	75-125	Pre-digestion spike does not meet DQO
Cadmium	109	96	108	75-125	
Chromium	98	NM	91	75-125	
Cobalt	95	NM	91	75-125	
Copper	100	NM	101	75-125	
Lead	104	NM	13	75-125	Post-digestion spike does not meet DQO
Manganese	103	NM	92	75-125	
Mercury	107	101	NP	75-125	
Molybdenum	97	NM	91	75-125	
Nickel	97	NM	86	75-125	
Selenium	93	0	101	75-125	Pre-digestion spike does not meet DQO
Phosphorus	98	93	NP	75-125	
Vanadium	97	NM	79	75-125	

Laboratory Check Standards Results:

Element	Initial Calibration % Recovery	Continuing Calibration % Recovery		Data Quality Objective for LCS
Arsenic	94.6	110.0	NP	90-110
Barium	99.2	99.6	98.0	90-110
Beryllium	96.5	92.3	91.8	90-110
Cadmium	101	103	104	90-110
Chromium	103	100	101	90-110
Cobalt	103	98.6	98.5	90-110
Copper	102	101	99.0	90-110
Lead	99.0	101	99.4	90-110
Manganese	103	103	103	90-110
Mercury	106	106	101	80-120
Molybdenum	100	96.8	96.4	90-110
Nickel	106	101	103	90-110
Selenium	96.0	105	NP	90-110
Phosphorus	96.5	105	109	90-110
Vanadium	99.0	95.3	95.4	90-110

NP: Not performed
NM: Not Meaningful, spike level to low to assess recovery accurately.

TABLE G-17
SUMMARY OF QUALITY CONTROL RESULTS FOR SITE 118 ESP FLYASH METALS INAA ANALYSIS

Duplicate Analysis Results:

Composite 1/21-1/27/93

Element	Sample Value ug/g	Duplicate Value ug/g	RPD %	Data Quality Objective for Duplicates	Comments
Arsenic	50	50	0.0	10	
Barium	430	440	2	10	
Chromium	100	140	33.3	10	Does not meet DQO
Cobalt	690	730.00	5.6	10	
Molybdenum	54.0	43	23	10	Does not meet DQO
Mercury	ND <0.15	ND <0.22	NC	10	
Selenium	43	53	21	10	Does not meet DQO

Laboratory Check Standard Results

NIST SRM 1571:

Element	Reference Value ug/g	Measured Value ug/g	Recovery %	Data Quality Objective for LCS	Comments
Arsenic	10	11	110	90-110	
Barium	44	48	109	90-110	
Chromium	2.6	2.9	112	90-110	Does not meet DQO
Manganese	91	93	102	90-110	
Mercury	0.155	0.14	90	90-110	

Note: *Mercury check standard result is for* SRM 1633A

RPD: Relative Percent Difference; not calculated for not detected values

ND: Not detected

Table G-18
Fuel Oil Analysis of NIST
Standard Reference Material 1634b

Element	ICP-AES, GFAAS, CVAAS Analysis: Method	Replicate 1 ug/g	Replicate 2 ug/g	Average ug/g	INAA Analysis: Replicate 1 ug/g	Replicate 2 ug/g	Average ug/g	NIST 1634b: Certified Value ug/g	Uncertified Informational Value ug/g	% Difference: ICP-AES, GFAAS, CVAAS	INAA	Conclusion
Arsenic	GFAAS	ND<2.5	ND<2.5	ND<2.5	0.15	0.15	0.15	0.12			25%	GFAAS not sensitive enough, INAA used
Barium	ICP-AES	2.5	7.1	4.8	3.1	4.4	3.75		1.3	269%	188%	both are high
Beryllium	ICP-AES	ND<0.010	ND<0.025	ND<0.018								cannot do by INAA
Cadmium	ICP-AES	ND<0.025	ND<0.063	ND<0.044	ND<0.008	ND<0.005	ND<0.007					no result
Chromium	ICP-AES	0.4	0.94	0.67	0.72	0.76	0.74		0.7	-4%	6%	both acceptable
Cobalt	ICP-AES	0.14	0.37	0.26	0.36	0.36	0.36	0.32		-20%	13%	both acceptable
Copper	ICP-AES	0.29	0.79	0.42								no certified value
Lead	ICP-AES	1.4	3.7	2.6					2.8	-9%		ICP-AES acceptable, cannot do by INAA
Manganese	ICP-AES	0.34	0.36	0.35	0.18	0.18	0.18	0.23		52%	-22%	INAA closer to certified value
Mercury	CVAAS	ND<0.10	ND<0.010	ND<0.10	0.0015	0.0012	0.0014		ND<0.001		35%	CVAAS not sensitive enough, INAA used
Molybdenum	ICP-AES	0.12	0.34	0.23								no certified value
Nickel	ICP-AES	15	34	24.5				28		-13%		ICP-AES acceptable, not performed routinely by INAA
Selenium	GFAAS	ND<2.5	ND<2.5	ND<2.5	0.17	0.11	0.14	0.18			-22%	GFAAS not sensitive enough, INAA used
Phosphorus	ICP-AES	ND<5.0	ND<5.0	ND<5.0								no result
Vanadium	ICP-AES	30	66	48	47	51	49	55.4		-13%	-12%	both acceptable
Sodium					95	94	95		90		5%	INAA Acceptable
Aluminum					7.4	7.4	7.4		16		-54%	no conclusion
Iron					25	26	26	31.6			-19%	INAA Acceptable
Zinc					2.2	2.1	2.2	3			-28%	INAA Acceptable

Note: Detection limits for ICP-AES, GFAAS, and CVAAS maybe higher than those obtained for flue gas samples because of the small sample size (10g).
Replicates 1 and 2 used 10 and 5 g samples respectively.

APPENDIX H

ANALYTICAL AND BLANK CORRECTION DATA

This Appendix contains summary tables of the laboratory analysis results for the ESP inlet and outlet gas, fuel samples and bottom ash samples. These tables indicate the analytical results obtained for field blanks, reagent blanks and laboratory preparation blanks. Field blanks are a sampling train that is set-up and recovered at the test site using the same procedure as an actual sample. In general, field blanks are not used to correct the result but do indicate the level of the analyte present in the sample train introduced by the recovery procedures. Reagent blanks are collected in the field and consist of reagents and filters used for each sample train. Laboratory preparation blanks consist only of the chemicals needed to decompose and analyze the samples. All blanks are carried through the entire analytical procedure. Corrections to the data for reagent or preparation blanks are noted. The blank correction contribution is the percentage of an analyte that was subtracted from the original value. For a series of tests the blank correction contribution is calculated as

$$\frac{\sum_{n=1}^{i} \left(\frac{\textit{Amount of blank correction}}{\textit{Original sample value}} \; x \; 100 \right)}{n}$$

For example, the ESP inlet manganese result was corrected for the reagent blank of 9.2 μg. Raw data for the test series was 120, 59 and 45 μg per train. The blank correction contribution is calculated as

$$\frac{\left(\frac{9.2}{120} \; x \; 100\right) + \left(\frac{9.2}{59} \; x \; 100\right) + \left(\frac{9.2}{45} \; x \; 100\right)}{3}$$

or

$$\frac{(7.7\% + 15.6\% + 20.4\%)}{3}$$

or

$$14.6\%$$

Blank corrections in no case bring the sample value below the reporting limit. Tables in this Appendix include:

Table H-1	Trace Metals Analytical Results Summary
Table H-2	PAH Analytical Results Summary
Table H-3	PCB Analytical Results Summary

TABLE H-1
TRACE METALS ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET
PM > 10um FRACTION

Sample I.D.	Laboratory Blank	Field Blank Inlet	1-MTLS-IN	3-MTLS-IN	5-MTLS-IN	Blank Correction Contribution, % (Average)
	ug/train					
Arsenic	1.8	1.8	1.4	0.7	1.3	0.0
Barium	1.9	9.4	34	28	12	9.4
Beryllium	ND<0.1	ND<0.1	0.2	0.2	0.2	0.0
Cadmium	ND<0.3	ND<0.3	ND<0.3	ND<0.3	ND<0.3	0.0
Chromium	ND<0.5	3.7	14	11	19	0.0
Cobalt	ND<0.9	ND<0.9	22	13	17	0.0
Copper	0.7	2.5	11	8.4	13	6.7
Lead	0.3	1.1	10	ND<8	3.6	3.8
Manganese	ND<0.8	4.8	21	14	19	0.0
Mercury	1.0	0.9	1.0	1.1	1.1	81
Molybdenum	ND<0.7	ND<0.7	5.6	4.1	4.5	0.0
Nickel	ND<2	17	550	350	480	0.0
Selenium	ND<0.25	ND<0.25	ND<0.25	ND<0.25	ND<0.25	0.0
Phosphorus	ND<7	ND<5	29	16	32	0.0
Vanadium	ND<0.5	6.8	620	380	480	0.0

(continued)

Notes:
The laboratory method blank was subtracted from the laboratory results to obtain the final results for Hg, Ba, Cu, and Pb .
A reagent blank was not collected for the >10um fraction.
Arsenic and Selenium results are from ICP Hydride data.
Mercury final results reported at the reporting limit--0.2 ug/train.

TABLE H-1 (continued)
TRACE METALS ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET
PM <10um FRACTION

Sample I.D.	Laboratory Blank	Reagent Blank	Field Blank Inlet	1-MTLS-IN	3-MTLS-IN	5-MTLS-IN	Blank Correction Contribution, % (Average)
	ug/train						
Arsenic	4.0	0.56	1.7	3.1	4.2	3.1	16
Barium	7.0	8.4	11	47	58	65	15
Beryllium	ND<0.1	ND<0.1	ND<0.1	2.4	2.0	2.0	0
Cadmium	ND<0.3	ND<0.3	ND<0.3	ND<0.3	ND<0.3	ND<0.3	0
Chromium	1.4	3.2	6.3	16	21	18	18
Cobalt	ND<1.0	ND<0.9	ND<1	100	65	74	0
Copper	3.5	7.6	7.2	33	34	28	24
Lead	1.3	ND<2	ND<8	21	14	33	6.5
Manganese	1.2	ND<0.8	2.7	98	23	91	2.6
Mercury-FHBH	ND<0.4	ND<0.5	1.8	2	3	2	0
KMnO4 Imp.	ND<0.4	ND<0.4	ND<0.6	2.4	ND<0.7	ND<0.4	0
Molybdenum	2.1	18	16	27	27	27	67
Nickel	ND<2	3	16	2500	1700	2000	0.15
Selenium	ND<0.28	ND<0.25	ND<0.28	5.6	8.2	8.4	0
Phosphorus	ND<6	ND<5	ND<6	200	170	160	0
Vanadium	ND<0.6	ND<0.5	9.8	2900	2400	2300	0

Notes:
The Carnot reagent blank was subtracted from the laboratory results to obtain the final results for As, Ba, Cr, Cu, Mo, and Ni.
The laboratory method blank was subtracted from the laboratory results to obtain the final results for Mn and Pb .
Arsenic and Selenium results are from ICP Hydride data.

TABLE H-1
TRACE METALS ANALYTICAL RESULTS SUMMARY
SITE 118 STACK
PM > 10um FRACTION

Sample I.D.	Laboratory Blank	Field Blank Stack	1-MTLS-STK	3-MTLS-STK	5-MTLS-STK	Blank Correction Contribution, % (Average)
			ug/train			
Arsenic	1.8	2.1	0.8	0.9	ND<0.25	0
Barium	1.9	15.0	5.1	18	2.7	39
Beryllium	ND<0.1	ND<0.1	ND<0.1	0.1	ND<0.1	0
Cadmium	ND<0.3	ND<0.3	ND<0.3	ND<0.3	ND<0.3	0
Chromium	ND<0.5	1.4	6.0	6.5	12	0
Cobalt	ND<0.9	ND<0.9	1.4	2.9	2.4	0
Copper	0.7	1.6	3.3	5.1	2.7	20
Lead	0.3	0.9	3	7.7	ND<8	8.3
Manganese	ND<0.8	4.5	79	50	21	0
Mercury	1.0	1.0	1.1	1.1	0.9	81
Molybdenum	ND<0.7	0.7	ND<0.7	1.2	ND<0.7	0
Nickel	ND<2	1.9	33	71	69	0
Selenium	ND<0.25	ND<0.25	ND<0.25	ND<0.25	ND<0.25	0
Phosphorus	ND<7	ND<5	ND<5	7	7	0
Vanadium	ND<0.5	0.6	26	62	42	0

(continued)

Notes:
The laboratory method blank was subtracted from the laboratory results to obtain the final results for Hg, Ba, Cu, and Pb .
A reagent blank was not collected for the >10um fraction.
Arsenic and Selenium results are from ICP Hydride data.
Mercury final results reported at the reporting limit--0.2 ug/train.

TABLE H-1 (continued)
TRACE METALS ANALYTICAL RESULTS SUMMARY
SITE 118 ESP STACK
PM <10um FRACTION

Sample I.D.	Laboratory Blank	Reagent Blank	Field Blank Stack	1-MTLS-STK	3-MTLS-STK	5-MTLS-STK	Blank Correction Contribution, % (Average)
	ug/train						
Arsenic	4.0	0.56	1.7	2.1	1.9	1.8	29
Barium	7.0	8.4	13	17	38	26	35
Beryllium	ND<0.1	ND<0.1	ND<0.1	ND<0.1	0.1	ND<0.1	0
Cadmium	ND<0.3	ND<0.3	ND<0.3	ND<0.3	ND<0.3	ND<0.3	0
Chromium	1.4	3.2	7.9	7.9	7.0	5.3	49
Cobalt	ND<1.0	ND<0.9	ND<1	4	5.3	4.6	0
Copper	3.5	7.6	8.8	22	13	9.3	58
Lead	1.3	ND<2	4.3	ND<2	4	ND<2	10.8
Manganese	1.2	ND<0.8	3.5	9.8	11	32	9.0
Mercury-FHBH	ND<0.4	ND<0.5	1.9	1	ND<1	2	0
KMnO4 Imp.	ND<0.4	ND<0.4	3.8	ND<0.5	0.6	ND<0.7	0
Molybdenum	2.1	18	17	16	16	17	100
Nickel	ND<2	3	13	83	120	120	2.9
Selenium	ND<0.28	ND<0.25	ND<0.28	3.7	5.7	3.6	0
Phosphorus	ND<6	ND<5	ND<6	ND<6	ND<6	6	0
Vanadium	ND<0.6	ND<0.5	4.8	77	120	120	0

Notes:

The Carnot reagent blank was subtracted from the laboratory results to obtain the final results for As, Ba, Cr, Cu, Mo, and Ni.

The laboratory method blank was subtracted from the laboratory results to obtain the final results for Mn and Pb.

Arsenic and Selenium results are from ICP Hydride data.

Molybdenum final results were reported at the reporting limit--0.8 ug/train

TABLE H-2
PAH ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET AND STACK

Compound	Method Blank ug	FB-SV-IN ug	6-SV-IN ug	7-SV-IN ug	8-SV-IN ug	FB-SV-STK ug	6-SV-STK ug	7-SV-STK ug	8-SV-STK ug
Naphthalene	1.2	1.2	2.3	1.8	2.1	1.4	1.6	1.4	1.9
Acenaphthylene	ND< 0.14	ND< 0.083	ND< 0.086	ND< 0.080	ND< 0.13	ND< 0.081	ND< 0.077	ND< 0.069	ND< 0.068
Acenaphthene	ND< 0.04	ND< 0.036	ND< 0.037	ND< 0.034	ND< 0.038	ND< 0.035	ND< 0.034	ND< 0.030	ND< 0.029
Fluorene	ND< 0.15	ND< 0.11	ND< 0.025	ND< 0.027	ND< 0.077	ND< 0.023	ND< 0.03	ND< 0.030	ND< 0.041
Phenanthrene	ND< 0.029	ND< 0.034	0.061	0.061	0.060	ND< 0.035	0.039	0.075	0.072
Anthracene	ND< 0.1	ND< 0.044	ND< 0.046	ND< 0.044	ND< 0.054	ND< 0.047	ND< 0.043	ND< 0.040	ND< 0.038
Fluoranthene	ND< 0.036	ND< 0.039	ND< 0.041	ND< 0.042	ND< 0.038	ND< 0.040	ND< 0.04	ND< 0.036	ND< 0.034
Pyrene	ND< 0.035	ND< 0.04	ND< 0.040	ND< 0.041	ND< 0.038	ND< 0.039	ND< 0.039	ND< 0.036	ND< 0.033
Benz(a)anthracene	ND< 0.062	ND< 0.059	ND< 0.059	ND< 0.064	ND< 0.10	ND< 0.11	ND< 0.06	ND< 0.052	ND< 0.048
Chrysene	ND< 0.092	ND< 0.10	ND< 0.11	ND< 0.12	ND< 0.038	ND< 0.085	ND< 0.099	ND< 0.098	ND< 0.086
Benzo(b)fluoranthene	ND< 0.03	ND< 0.034	ND< 0.034	ND< 0.040	ND< 0.050	ND< 0.030	ND< 0.033	ND< 0.029	ND< 0.028
Benzo(k)fluoranthene	ND< 0.051	ND< 0.046	ND< 0.047	ND< 0.052	ND< 0.10	ND< 0.044	ND< 0.041	ND< 0.041	ND< 0.039
Benzo(a)pyrene	ND< 0.27	ND< 0.067	ND< 0.065	ND< 0.084	ND< 0.078	ND< 0.067	ND< 0.063	ND< 0.064	ND< 0.057
Indeno(1,2,3-cd)pyrene	ND< 0.054	ND< 0.056	ND< 0.06	ND< 0.081	ND< 0.096	ND< 0.052	ND< 0.055	ND< 0.056	ND< 0.048
Dibenzo(a,h)anthracene	ND< 0.075	ND< 0.077	ND< 0.078	ND< 0.11	ND< 0.046	ND< 0.072	ND< 0.073	ND< 0.071	ND< 0.065
Benzo(g,h,i)perylene	ND< 0.036	ND< 0.033	ND< 0.035	ND< 0.050	ND< 0.087	ND< 0.032	ND< 0.034	ND< 0.034	ND< 0.028
2-Methylnaphthalene*	0.012	0.034	0.13	0.12	0.043	0.023	0.098	0.099	0.22
7,12-Dimethylbenz(a)anthracene*	ND< 0.025	ND< 0.041	ND< 0.041	ND< 0.048	ND< 0.043	ND< 0.042	ND< 0.050	ND< 0.047	ND< 0.043
3-Methylcholanthrene*	ND< 0.037	ND< 0.038	ND< 0.036	ND< 0.047	ND< 0.040	ND< 0.035	ND< 0.037	ND< 0.034	ND< 0.030

Note: Napthalene and 2-methylnaphthalene results are corrected for laboratory method blank levels. Inlet blank correction contribution is 37% for napthalene and 13% for 2-methylnaphthalene.
Stack blank correction contribution is 43% for naphthalene and 9% for 2-methylnaphthalene.
ND< -species not detected
*Results are not recovery corrected

TABLE H-3
PCB ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET AND STACK

Species	Method Blank ug	FB-SV-IN ug	6-SV-IN ug	7-SV-IN ug	8-SV-IN ug	FB-SV-STK ug	6-SV-STK ug	7-SV-STK ug	8-SV-STK ug
total Chlorobiphenyls	ND< 0.010	ND< 0.0070	ND< 0.011	ND< 0.010	ND< 0.0090	ND< 0.0070	ND< 0.010	ND< 0.011	ND< 0.011
total Dichlorobiphenyls	ND< 0.022	ND< 0.017	ND< 0.022	ND< 0.022	ND< 0.016	ND< 0.020	ND< 0.021	ND< 0.019	ND< 0.021
total Trichlorobiphenyls	ND< 0.020	ND< 0.012	ND< 0.022	ND< 0.020	ND< 0.014	ND< 0.013	ND< 0.024	ND< 0.044	ND< 0.037
total Tetrachlorobiphenyls	ND< 0.030	ND< 0.013	ND< 0.034	ND< 0.030	ND< 0.019	ND< 0.012	ND< 0.021	ND< 0.034	ND< 0.025
total Pentachlorobiphenyls	ND< 0.52	ND< 0.048	ND< 0.47	ND< 0.52	ND< 0.59	ND< 0.10	ND< 0.55	ND< 0.82	ND< 0.69
total Hexachlorobiphenyls	ND< 0.038	ND< 0.012	ND< 0.021	ND< 0.038	ND< 0.016	ND< 0.0080	ND< 0.020	ND< 0.036	ND< 0.031
total Heptachlorobiphenyls	ND< 0.028	ND< 0.023	ND< 0.024	ND< 0.028	ND< 0.022	ND< 0.033	ND< 0.023	ND< 0.034	ND< 0.032
total Octachlorobiphenyls	ND< 0.032	ND< 0.015	ND< 0.020	ND< 0.032	ND< 0.018	ND< 0.015	ND< 0.020	ND< 0.025	ND< 0.021
total Nonachlorobiphenyls	ND< 0.059	ND< 0.011	ND< 0.018	ND< 0.059	ND< 0.018	ND< 0.012	ND< 0.017	ND< 0.019	ND< 0.028
Decachlorobiphenyl	ND< 0.048	ND< 0.028	ND< 0.064	ND< 0.048	ND< 0.076	ND< 0.027	ND< 0.071	ND< 0.067	ND< 0.052
TOTAL PCB	ND< 0.55	ND< 0.048	ND< 0.47	ND< 0.52	ND< 0.59	ND< 0.10	ND< 0.55	ND< 0.82	ND< 0.69

ND< -species not detected

TABLE II-4
PCDD/PCDF ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET AND STACK

Species	Method Blank pg	FB-SV-IN pg	6-SV-IN pg	7-SV-IN pg	8-SV-IN pg	FB-SV-STK pg	6-SV-STK pg	7-SV-STK pg	8-SV-STK pg
2378 TCDF	ND< 13	ND< 8.2	ND< 12	ND< 13	ND< 18	ND< 11	ND< 10	ND< 8.1	ND< 9.2
2378-TCDD	ND< 17	ND< 12	ND< 12	ND< 26	ND< 23	ND< 15	ND< 23	ND< 20	ND< 18
12378 PeCDF	ND< 14	ND< 7.8	26	10	10	ND< 10	ND< 15	ND< 9.5	ND< 13
23478 PeCDF	ND< 15	ND< 8.4	35	17	20	ND< 11	ND< 16	ND< 10	ND< 14
12378 PeCDD	ND< 19	13	ND< 18	ND< 17	ND< 12	ND< 16	ND< 26	11	ND< 17
123478 HxCDF	ND< 26	ND< 14	30	ND< 16	20	ND< 17	ND< 28	ND< 14	ND< 30
123678 HxCDF	ND< 13	ND< 6.9	12	ND< 8.2	ND< 6.1	ND< 8.9	ND< 14	ND< 7.4	ND< 16
234678 HxCDF	ND< 26	ND< 14	ND< 14	ND< 16	ND< 11	ND< 17	ND< 28	ND< 14	ND< 30
123789 HxCDF	ND< 37	ND< 19	ND< 20	ND< 23	ND< 15	ND< 24	ND< 39	ND< 20	ND< 43
123478 HxCDD	ND< 47	24	30	ND< 28	31	ND< 29	ND< 64	24	ND< 44
123678 HxCDD	ND< 20	ND< 6.9	12	ND< 12	ND< 11	ND< 12	ND< 27	ND< 7.7	ND< 19
123789 HxCDD	ND< 33	ND< 11	13	ND< 20	ND< 18	ND< 20	ND< 45	ND< 13	ND< 31
1234678 HpCDF	ND< 16	ND< 13	ND< 29	ND< 42	35	ND< 29	ND< 59	ND< 31	ND< 120
1234789 HpCDF	ND< 31	ND< 25	ND< 56	ND< 81	ND< 66	ND< 55	ND< 110	ND< 60	ND< 230
1234678 HpCDD	ND< 43	ND< 35	51	ND< 46	46	ND< 48	ND< 88	ND< 55	ND< 130
OCDF	ND< 69	ND< 42	ND< 57	ND< 62	ND< 60	ND< 56	ND< 93	ND< 60	ND< 72
OCDD	ND< 55	45	70	55	110	39	100	73	ND< 110
Total TCDF	ND< 11	ND< 8.3	47	15	12	ND< 11	ND< 10	ND< 8.1	ND< 9.2
Total PeCDF	ND< 15	ND< 8.1	150	42	69	ND< 11	ND< 15	ND< 9.8	ND< 13
Total HxCDF	ND< 22	ND< 12	45	ND< 14	17	ND< 15	ND< 24	ND< 12	ND< 26
Total HpCDF	ND< 24	ND< 20	ND< 43	ND< 63	52	ND< 43	ND< 89	ND< 47	ND< 180
Total TCDD	ND< 17	ND< 23	74	ND< 26	ND< 23	ND< 15	ND< 23	ND< 20	ND< 18
Total PeCDD	ND< 19	13	ND< 18	ND< 17	ND< 12	ND< 16	ND< 26	9.8	ND< 17
Total HxCDD	ND< 29	15	96	ND< 17	69	ND< 18	ND< 39	15	ND< 27
Total HpCDD	ND< 43	ND< 35	51	ND< 46	90	ND< 48	ND< 88	ND< 55	ND< 130

ND<--species not detected

Preliminary

Do Not Cite or Quote

TABLE H-5
VOLATILE ORGANIC COMPOUNDS ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET AND STACK

	INLET, ppbv		STACK, ppbv			Ambient	Tedlar Bag
Component/Sample I.D.	1C-VOC	1D-VOC	1A-VOC	1B-VOC	1C-VOC	Air	Blank
Vinyl Chloride	ND <0.4	ND <0.4	ND <0.75	ND <0.75	ND <0.4	ND <0.08	ND <0.1
1,3-Butadiene	ND <0.1	ND <0.1	ND <0.1	ND <0.1	NP	ND <0.02	ND <0.1
Methyl Bromide	ND <0.4	ND <0.4	ND <0.6	ND <0.6	ND <0.4	ND <0.08	ND <0.06
Trichlorofluoromethane	0.37	0.008	ND <0.2	ND <0.2	ND <0.08	0.26	ND < 0.01
Dichloromethane	15.8	7.47	20.7	14	8.84	11.7	26.3
Chloroform	ND <0.2	ND <0.2	ND <0.3	ND <0.3	ND <0.2	ND <0.3	ND <0.02
1,2-Dichloroethane	ND <0.4	ND <0.4	ND <0.7	ND <0.7	ND <0.4	ND <0.7	ND <0.06
1,1,1-Trichloroethane	0.25	0.12	0.49	0.47	0.25	0.49	0.13
Carbon Tetrachloride	ND <0.1	ND <0.1	ND <0.2	ND <0.2	ND <0.1	ND <0.2	ND <0.02
1,2-Dichloropropane	ND <0.4	ND <0.4	ND <0.7	ND <0.7	ND <0.4	ND <0.7	ND <0.07
Trichloroethene	ND <0.2	ND <0.2	ND <0.3	ND <0.3	ND <0.2	ND <0.3	ND <0.02
1,2-Dibromoethane	ND <0.3	ND <0.3	ND <0.5	ND <0.5	ND <0.3	ND <0.5	ND <0.04
Perchloroethylene	ND <0.08	ND <0.08	ND <0.2	ND <0.2	ND <0.08	ND <0.2	ND <0.01
Chlorobenzene	ND <0.09	ND <0.09	ND <0.2	ND <0.2	ND <0.09	ND <0.2	ND <0.1
Ethylbenzene	0.11	0.06	0.18	0.15	0.10	0.18	ND <0.1
o-Xylene	0.11	0.11	0.36	0.21	0.17	0.36	0.1
Benzene	0.28	0.15	0.3	0.24	0.18	0.3	ND <0.1
Toluene	2.89	0.99	4.07	2.74	1.79	4.07	3.79

ND: Not Detected

The VOC results are not blank corrected.

TABLE H-6
FORMALDEHYDE ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET AND STACK

Sample I.D.	INLET, ug		STACK, ug	
	Field Blank	Sample	Field Blank	Sample
5A-FORM	1.48	1.09	4.38	0.74
5B-FORM	4.26	1.22	4.99	1.13
5C-FORM	1.81	0.56	1.97	1.02
Average Blank Correction Contribution:	Inlet: 0.0%		Stack: 0.0%	

Note: No blank corrections were made to the formaldehyde results.

TABLE H-7
PARTICULATE ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET AND STACK

	INLET, mg				STACK, mg			
	1-PM/AN	3-PM/AN	5-PM/AN	Average	1-PM/AN	3-PM/AN	5-PM/AN	Average
Particulate Catch:								
Filter	194.7	129.6	137.4		13.5	20.9	16	
Probe/nozzle wash	71	101.4	139.4		6.1	12.7	5.3	
Acetone blank	2.2	2.4	2.5		1.6	2.0	0.8	
Total	265.7	231.0	276.8		19.6	33.6	21.3	
Average Blank Correction Contribution:	0.8%	1.0%	0.9%	0.9%	8.2%	6.0%	3.8%	6.0%

TABLE H-8
ANION ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET AND STACK

Sample I.D.	Reagent Blank	1-PM/AN-IN	3-PM/AN-IN	5-PM/AN-IN	Blank Correction Contribution (Average)	1-PM/AN-STK	3-PM/AN-STK	5-PM/AN-STK	Blank Correction Contribution (Average)
Chloride distribution in Sample Train (mg):									
front-half rinse	ND <0.025	0.080	0.120	0.200	0.0%	0.06	0.08	0.06	0.0%
filter	ND <0.025	0.137	0.260	0.106	0.0%	0.06	0.06	0.08	0.0%
bicarbonate/carbonate fraction	ND <0.038	13.9	14.2	15.0	0.0%	17.0	16.1	18.7	0.0%
3% peroxide fraction	ND <0.038	NB	NB	NB	0.0%	NB	NB	NB	0.0%
Fluoride Distribution in Sample Train (mg):									
front-half rinse	ND <0.015	ND <0.03	ND <0.03	ND <0.03	0.0%	ND <0.03	ND <0.03	ND <0.03	0.0%
filter	ND <0.015	ND <0.03	ND <0.03	ND <0.03	0.0%	ND <0.03	ND <0.03	ND <0.03	0.0%
bicarbonate/carbonate fraction	ND <0.023	0.27	0.27	0.25	0.0%	ND <1.1	0.42	0.41	0.0%
3% peroxide fraction	ND <0.023	NB	NB	NB	0.0%	NB	NB	NB	0.0%
Phosphate Distribution in Sample Train (mg):									
front-half rinse	ND <0.1	0.6	1	0.4	0.0%	ND <0.2	ND <0.2	ND <0.2	0.0%
filter	ND <0.1	ND <0.02	0.2	ND <1.0	0.0%	ND <0.2	ND <0.2	ND <0.2	0.0%
bicarbonate/carbonate fraction	ND <0.15	ND <5.98	ND <4.05	ND <4.85	0.0%	ND <7.1	ND <1.3	ND <1.6	0.0%
3% peroxide fraction	ND <0.15	NB	NB	NB	0.0%	NB	NB	NB	0.0%
Sulfate Distribution in Sample Train (mg):									
front-half rinse	ND <0.025	6.6	11.8	13.2	0.0%	0.94	2.0	0.94	0.0%
filter	0.86	56	94	32	1.7%	5.4	8.0	5.8	13.8%
bicarbonate/carbonate fraction	1.2	316	199	285	0.5%	374	387	222	0.4%
3% peroxide fraction	3.74	4800	4712	4547	0.1%	5130	6256	5089	0.1%

TABLE H-9
RADIONUCLIDES ANALYTICAL RESULTS SUMMARY
SITE 118 STACK

Sample ID.	Reagent Blank	1-PM/AN-STK	3-PM/AN-STK	5-PM/AN-STK	Average Reagent Blank / Sample ratio,%
			Activity, pCi/train		
Uranium-233 & -234	ND< 0.4	ND< 0.2	ND< 0.2	ND< 0.2	NC
Uranium-235	ND< 0.2	ND< 0.2	ND< 0.2	ND< 0.2	NC
Uranium-238	0.2	0.2	ND< 0.2	ND< 0.2	100%
Radium-226	ND< 0.4	0.4	ND< 0.4	0.2	NC
Radium-228	2.4	3.2	3.4	3.2	73%
Lead-210	*	*	*	*	--
Polonium-210	ND< 0.2	ND< 0.4	0.2	0.4	NC
Thorium-228	1.6	0.8	ND< 3.2	0.6	66%
Thorium-230	ND< 1.4	1.2	2.4	0.4	NC
Thorium-232	ND< 0.8	0.2	ND< 0.3	0.2	NC

Notes:

Results are recovery corrected but not blank corrected.

ND: Not Detected; results reported by the laboratory as a zero or negative are considered to be not detected.

NC: Not calculable

*Results for Lead-210 not reported by the laboratory due to problems with initial sample analysis and insufficient sample for reanalysis.

TABLE H-10
CHROMIUM SPECIATION
ANALYTICAL RESULTS SUMMARY
SITE 118 STACK

Analyte	Fraction	Sample I.D.	ug/sample
Chromium (VI)	NaOH	Method Blank #1	ND <0.40
(Labs #1 and #2)		Method Blank #2	ND <0.20
		10-Cr-C	0.588
		11-Cr-C	0.802
		12-Cr-C	1.38
		13-Cr-C	0.49
Total Chromium	NaOH	Method Blank	ND <1
(Lab #1)		10-Cr-C	0.59
		11-Cr-C	0.80
		12-Cr-C	1.38
		13-Cr-C	0.49
Total Chromium	Filter/HNO3	Method Blank	ND <4
(Lab #1)		10-Cr-C	4.2
		11-Cr-C	8.7
		12-Cr-C	4.19
		13-Cr-C	2.47

Notes:
Hexavalent chromium results are averages of the values obtained from the two laboratories.The method blanks are identified by labs #1 and #2.
Lab #1 performed the total chromium analysis.
Total chromium and chromium (VI) results are not blank corrected.
ND: Not Detected

TABLE H-11
NICKEL SPECIATION ANALYTICAL RESULTS SUMMARY
SITE 118 ESP INLET

Test No.	FB-NI-IN	8A-NI-IN	8B-NI-IN	10A-NI-IN	10B-NI-IN
Mass of Nickel on SampleFilter, ug:		1/2 sample filter			
	Entire filter	+ 1/2 filtration filter	Entire filter	Entire filter	1/2 Filter
Soluble	ND < 1.0	76.4	161.0	86.0	102.8
Sulfidic	ND < 1.0	18.3	36.0	17.0	16.8
Metallic	ND < 1.0	ND < 2.0	ND < 1.0	ND < 1.0	6.4
Oxidic	ND < 1.0	101.2	194.0	144.0	159.6
Sample Filter Sub-Total, ug:	ND < 4.0	196.9	391.5	247.5	285.6
Total Ni in remaining filter fractions, ug:	0.0	339.9	0.0	0.0	128.0
Mass of Nickel on the Filtration Filte, ug:					
Soluble	ND < 1.0	see above	79.0	36.0	31.0
Sulfidic	ND < 1.0	-	21.0	8.9	5.9
Metallic	ND < 1.0	-	ND < 1.0	6.8	ND < 1.0
Oxidic	ND < 1.0	-	148.0	54.0	64.0
Filtration Filter Sub-Total, ug:	ND < 4.0	0.0	248.5	105.7	101.4
Total Ni in Acetone Rinse, ug:	ND < 1.0	1.4	8.3	6.7	4.9
Total Nickel (all Fractions), ug:	ND < 9.0	538	648	360	520
Percent Distribution of Nickel Phases:					
Soluble	ND < 12.5%	38.8%	37.5%	34.5%	34.9%
Sulfidic	ND < 12.5%	9.3%	8.9%	7.3%	5.9%
Metallic	ND < 12.5%	ND < 1.0%	ND < 0.3%	2.2%	2.0%
Oxidic	ND < 12.5%	51.4%	53.4%	56.1%	57.3%

Notes:
These results were not corrected for blank values.

TABLE H-11 (CONTINUED)
NICKEL SPECIATION ANALYTICAL RESULTS SUMMARY
SITE 118 STACK

Test No.	FB-Ni-STK	8B-Ni-STK	10A-Ni-STK	13-Ni-STK
Mass of Nickel on Filter, ug:				
Soluble	3.1	18.7	40.2	16.2
Sulfidic	1.6	2.0	5.2	2.1
Metallic	ND < 1.0	ND < 1.0	ND < 1.0	ND < 1.0
Oxidic	1.1	6.3	18.4	7.8
Total Mass, ug:	6.3	27.5	64.3	26.6
Percent Distribution of Nickel Phases on Filter:				
Soluble	49.2%	68.0%	62.5%	60.9%
Sulfidic	25.4%	7.3%	8.1%	7.9%
Metallic	15.9%	ND < 3.6%	ND < 1.6%	ND < 3.8%
Oxidic	17.5%	22.9%	28.6%	29.3%
Nickel in Acetone rinse:	ND <1.0	ND< 1.0	ND< 1.0	ND< 1.0

Notes:
These results were not corrected for blank values.

TABLE H-12
FUEL OIL ANALYTICAL RESULTS SUMMARY
SITE 118

Run Sample Date	No. 1 1/20/93	No. 3 1/21/93	No. 5 1/22/93	Laboratory Blank	Average Blank Correction Contribution
Trace Metals, ug/g:					
(ICP-AES, GFAAS, CVAAS)					
Arsenic	0.27	ND <0.25	ND <0.23	ND <0.25	0.0%
Barium	0.42	0.44	0.31	ND <0.01	0.0%
Beryllium	0.008	0.008	0.006	ND <0.003	0.0%
Cadmium	ND <0.007	ND <0.007	ND <0.006	ND <0.006	0.0%
Chromium	0.10	0.11	0.08	ND <0.01	0.0%
Cobalt	0.79	0.83	0.59	ND <0.02	0.0%
Copper	0.29	0.24	0.19	ND <0.01	0.0%
Lead	0.27	0.29	0.19	ND <0.004	0.0%
Manganese	0.17	0.16	0.09	ND <0.02	0.0%
Mercury	ND <0.091	ND <0.087	ND <0.074	ND <0.10	0.0%
Molybdenum	0.13	0.11	0.06	ND <0.02	0.0%
Nickel	19	25	17	ND <0.04	0.0%
Selenium	ND <0.007	ND <0.007	ND <0.006	ND <0.006	0.0%
Phosphorus	ND <5	8.4	5.3	ND <5	0.0%
Vanadium	23	26	16	ND <0.01	0.0%
(INAA)					
Arsenic	0.10	0.26	0.097		
Chromium	0.16	27	0.15		
Cobalt	1.5	2.2	1.3		
Mercury	0.0035	0.0047	0.0037		
Molybdenum	0.08	4	0.072		
Selenium	0.081	NP	0.094		
Chlorine	56	54.5	52		

(continued)

NP: Not performed

TABLE H-12 (continued)
FUEL OIL ANALYTICAL RESULTS SUMMARY
SITE 118

Run Sample Date	No. 1 1/20/93	No. 5 1/22/93	Nos. 10, 11 1/28/93
Ultimate/Proximate:			
% Carbon	86.7	87.53	86.66
% Hydrogen	10.89	10.27	9.99
% Nitrogen	0.49	0.46	0.47
% Sulfur	0.7	0.82	0.72
% Ash	0.06	0.06	0.07
% Water	0.85	0.84	0.84
% Oxygen	0.31	0.02	1.25
Other parameters:			
Fluorine, ug/g	ND <20	ND <20	NP
Specific Gravity @ 60F			
Heating Value, Btu/lb	18711	18,883	18,674

NP: Not performed

TABLE H-12 (continued)
FUEL OIL ANALYTICAL RESULTS SUMMARY
SITE 118

Date		1/20/93	1/21/93	1/22/93
Run	Laboratory Blank	No. 1	No. 3	No.5
Radionuclide	pCi/g	pCi/g	pCi/g	pCi/g
Uranium-233 & -234	0.01	ND< 0.005	ND< 0.006	ND< 0.002
Uranium-235	ND< NA	ND< 0.003	ND< 0.003	ND< 0.002
Uranium-238	0.04	ND< 0.003	ND< 0.007	ND< 0.001
Radium-226	ND< NA	0.02	0.01	0.01
Radium-228	0.01	0.04	0.04	0.02
Lead-210	ND< NA	0.06	ND< 0.0001	0.04
Polonium-210	ND< NA	ND< 0.09	ND< 0.11	ND< 0.14
Thorium-228	0.03	0.02	0.02	0.01
Thorium-230	ND< NA	ND< 0.01	0.01	0.02
Thorium-232	0.02	ND< 0.004	ND< 0.001	ND< 0.001

Note: No blank corrections were made to sample results
NA: Not available

TABLE H-13
ESP FLYASH ANALYTICAL RESULTS SUMMARY
SITE 118

Sample Date	Composite 1/21/93-1/27/93 Replicate #1	Replicate #2	Replicate #3	Laboratory Blank (#1)	Laboratory Blank (#2,3)	Average Blank Correction Contribution
Trace Metals, ug/g:						
(ICP-AES,GFAAS, CVAAS)						
Arsenic	39	60	54	ND <0.005	ND <5	0.0%
Barium	10	97	100	ND <0.01	35	24%
Beryllium	7.6	2.6	2.7	ND <0.002	0.4	4.9%
Cadmium	ND <0.5	4.1	3.7	0.082	ND <0.5	0.0%
Chromium	110	120	110	5.3	2	2.8%
Cobalt	670	720	730	ND <0.018	ND <2	0.0%
Copper	180	220	200	0.02	ND <1	0.0%
Lead	340	250	2,370	ND <2.5	ND <30	0.0%
Manganese	170	220	190	ND <0.015	79	26%
Mercury	ND <0.1	ND <0.1	ND <0.1	ND <0.1	ND <0.1	0.0%
Molybdenum	110	130	130	0.12	ND <1	0.0%
Nickel	18,000	20,000	20,000	ND <0.032	4	0.0%
Selenium	ND <0.05	ND <5	ND <5	ND <0.005	ND <5	0.0%
Phosphorus	1,600	1,600	1,700	ND <5	ND <5	0.0%
Vanadium	20,000	23,000	23,000	ND <0.01	10	0.0%
(INAA)						
Arsenic	50	50	60	•	•	0.0%
Barium	430	440	550			0.0%
Chromium	100	140	115			0.0%
Cobalt	690	730	800			0.0%
Mercury	ND <0.15	ND <0.22	NR			0.0%
Molybdenum	54	43	60			0.0%
Selenium	43	53	30			0.0%
Anions, ug/g:						
Chloride	ND <250	ND <100	ND <100	ND <250	NR	0.0%
Fluoride	ND <2.5	ND <3	ND <3	ND <2.5	NR	0.0%
Sulfate	140,000	250,000	250,000	ND <30000	NR	0.0%

Notes:
Replicates 2 and 3 were submitted for analysis at a later date than replicate 1. For this reason, there are sets of laboratory blanks. Detected values in the laboratory blanks were subtracted from the corresponding samples.
•Laboratory blank not reported by the laboratory.
NR: Not reported

TABLE H-13 (CONTINUED)
ESP FLYASH ANALYTICAL RESULTS SUMMARY
SITE 118

Radionuclide	Laboratory Blank (1) pCi/g	FLYASH COMPOSITE (2) 1/20-1/22 pCi/g
Uranium-233 & -234	0.04	4.0
Uranium-235	ND< NA	0.1
Uranium-238	0.02	3.0
Radium-226	ND< NA	1.7
Radium-228	ND< NA	2.5
Lead-210	ND< NA	18
Polonium-210	ND< NA	16
Thorium-228	ND< NA	9.0
Thorium-230	0.02	2.9
Thorium-232	0.02	0.3

Notes:

(1) No blank corrections were made to sample results.

(2) The fly ash collected for Runs 1, 3, and 5 was composited and analyzed as a single sample.

NA: Not Available

TABLE H-14 (page 1 of 5)
SUMMARY OF BLANK CORRECTIONS
MADE TO ANALYTICAL DATA
SITE 118

Sample Type	Parameter	Type of Blank Correction	Blank Correction Contribution
Exhaust Gas, Inlet	PM >10		
	Arsenic	None	0.0%
	Barium	Laboratory Blank	9.4%
	Beryllium	None	0.0%
	Cadmium	None	0.0%
	Chromium	None	0.0%
	Cobalt	None	0.0%
	Copper	Laboratory Blank	6.7%
	Lead	Laboratory Blank	3.8%
	Manganese	None	0.0%
	Mercury	Laboratory Blank	81%
	Molybdenum	None	0.0%
	Nickel	None	0.0%
	Selenium	None	0.0%
	Phosphorus	None	0.0%
	Vanadium	None	0.0%
Exhaust Gas, Inlet	PM <10		
	Arsenic	Reagent Blank	16.0%
	Barium	Reagent Blank	15.0%
	Beryllium	None	0.0%
	Cadmium	None	0.0%
	Chromium	Reagent Blank	18.0%
	Cobalt	None	0.0%
	Copper	Reagent Blank	24.0%
	Lead	Laboratory Blank	6.5%
	Manganese	Laboratory Blank	2.6%
	Mercury: FH/BH	None	0.0%
	KMnO4 Impinger	None	0.0%
	Molybdenum	Reagent Blank	67.0%
	Nickel	Reagent Blank	0.2%
	Selenium	None	0.0%
	Phosphorus	None	0.0%
	Vanadium	None	0.0%
Exhaust Gas, Inlet	Total Metals (PM >10 + PM <10)		
	Arsenic		12%
	Barium		18%
	Beryllium		0.0%
	Cadmium		0.0%
	Chromium		10%
	Cobalt		0.0%
	Copper		20%
	Lead		6.0%
	Manganese		1.8%
	Mercury		24%
	Molybdenum		57%
	Nickel		<1%
	Selenium		0.0%
	Phosphorus		0.0%
	Vanadium		0.0%

(continued)

SUMMARY OF BLANK CORRECTIONS
MADE TO ANALYTICAL DATA
SITE 118

Sample Type	Parameter	Type of Blank Correction	Blank Correction Contribution
Exhaust Gas, Stack	PM >10		
	Arsenic	None	0.0%
	Barium	Laboratory Blank	39.0%
	Beryllium	None	0.0%
	Cadmium	None	0.0%
	Chromium	None	0.0%
	Cobalt	None	0.0%
	Copper	Laboratory Blank	20.0%
	Lead	Laboratory Blank	8.3%
	Manganese	None	0.0%
	Mercury	Laboratory Blank	81.0%
	Molybdenum	None	0.0%
	Nickel	None	0.0%
	Selenium	None	0.0%
	Phosphorus	None	0.0%
	Vanadium	None	0.0%
Exhaust Gas, Stack	PM <10		
	Arsenic	Reagent Blank	29%
	Barium	Reagent Blank	35%
	Beryllium	None	0.0%
	Cadmium	None	0.0%
	Chromium	Reagent Blank	49%
	Cobalt	None	0.0%
	Copper	Reagent Blank	58%
	Lead	Laboratory Blank	11%
	Manganese	Laboratory Blank	9.0%
	Mercury: FH/BH	None	0.0%
	KMnO4 Impinger	None	0.0%
	Molybdenum	Reagent Blank	100%
	Nickel	Reagent Blank	2.9%
	Selenium	None	0.0%
	Phosphorus	None	0.0%
	Vanadium	None	0.0%
Exhaust Gas, Stack	Total Metals (PM >10 + PM <10)		
	Arsenic		23%
	Barium		24%
	Beryllium		0.0%
	Cadmium		0.0%
	Chromium		22%
	Cobalt		0.0%
	Copper		49%
	Lead		18%
	Manganese		1.9%
	Mercury		40%
	Molybdenum		100%
	Nickel		<1%
	Selenium		0.0%
	Phosphorus		0.0%
	Vanadium		0.0%

(continued)

TABLE H-14 (page 3 of 5)
SUMMARY OF BLANK CORRECTIONS
MADE TO ANALYTICAL DATA
SITE 118

Sample Type	Parameter	Type of Blank Correction	Blank Correction Contribution
Exhaust Gas, Inlet	PAH:		
	naphthalene	Laboratory Blank	37%
	2-methylnaphthalene	Laboratory Blank	13%
Exhaust Gas, Stack	PAH:		
	naphthalene	Laboratory Blank	43%
	2-methylnaphthalene	Laboratory Blank	9.0%
Exhaust Gas, Inlet	PCDD/PCDF (all isomers)	None	0.0%
Exhaust Gas, Stack	PCDD/PCDF (all isomers)	None	0.0%
Exhaust Gas, Inlet	PCB (all compounds)	None	0.0%
Exhaust Gas, Stack	PCB (all compounds)	None	0.0%
Exhaust Gas, Inlet	Chloride (all sample train fractions)	None	0.0%
	Fluoride (all sample train fractions)	None	0.0%
	Phosphate (all sample train fractions)	None	0.0%
	Sulfate: front-half	None	0.0%
	filter	Reagent Blank	1.7%
	carbonate	Reagent Blank	0.5%
	3% peroxide	Reagent Blank	0.1%
Exhaust Gas, Stack	Chloride (all sample train fractions)	None	0.0%
	Fluoride (all sample train fractions)	None	0.0%
	Phosphate (all sample train fractions)	None	0.0%
	Sulfate: front-half	None	0.0%
	filter	Reagent Blank	13.8%
	carbonate	Reagent Blank	0.4%
	3% peroxide	Reagent Blank	0.1%
Exhaust Gas, Inlet	Particulate	Reagent Blank	0.9%
Exhaust Gas, Stack	Particulate	Reagent Blank	6.0%
Exhaust Gas, Inlet	Formaldehyde	None	0.0%
Exhaust Gas, Stack	Formaldehyde	None	0.0%
Exhaust Gas, Inlet	Volatile Organic Compounds	None	0.0%
Exhaust Gas, Stack	Volatile Organic Compounds	None	0.0%
Exhaust Gas, Inlet	Total Chromium and Hexavalent Chromium	None	0.0%
Exhaust Gas, Stack	Total Chromium and Hexavalent Chromium	None	0.0%

(continued)

TABLE H-14 (page 4 of 5)
SUMMARY OF BLANK CORRECTIONS
MADE TO ANALYTICAL DATA
SITE 118

Sample Type	Parameter	Type of Blank Correction	Blank Correction Contribution
Exhaust Gas, Inlet	Nickel Speciation	None	0.0%
Exhaust Gas, Stack	Nickel Speciation	None	0.0%
Exhaust Gas, Inlet	Radionuclides	None	0.0%
Exhaust Gas, Stack	Radionuclides	None	0.0%
Fuel Oil (ICP-AES, GFAAS, CVAAS)	Arsenic	None	0.0%
	Barium	Laboratory Blank	9.7%
	Beryllium	None	0.0%
	Cadmium	None	0.0%
	Chromium	Laboratory Blank	4.6%
	Cobalt	None	0.0%
	Copper	Laboratory Blank	1.6%
	Lead	None	0.0%
	Manganese	Laboratory Blank	10.8%
	Mercury	None	0.0%
	Molybdenum	None	0.0%
	Nickel	Laboratory Blank	0.7%
	Selenium	None	0.0%
	Phosphorus	None	0.0%
	Vanadium	Laboratory Blank	0.1%
Fuel Oil (INAA)	Arsenic	None	0.0%
	Cadmium	None	0.0%
	Chromium	None	0.0%
	Cobalt	None	0.0%
	Mercury	None	0.0%
	Molybdenum	None	0.0%
	Selenium	None	0.0%
	Chlorine	None	0.0%
Fuel Oil	Radionuclides	None	0.0%

(continued)

TABLE H-14 (page 5 of 5)
SUMMARY OF BLANK CORRECTIONS MADE TO ANALYTICAL DATA
SITE 118

Sample Type	Parameter	Type of Blank Correction	Blank Correction Contribution
ESP Hopper Ash	Arsenic	None	0.0%
(ICP-AES, GFAAS, CVAAS)	Barium	Laboratory Blank	24.0%
	Beryllium	Laboratory Blank	4.9%
	Cadmium	None	0.0%
	Chromium	Laboratory Blank	2.8%
	Cobalt	None	0.0%
	Copper	None	0.0%
	Lead	None	0.0%
	Manganese	Laboratory Blank	2.6%
	Mercury	None	0.0%
	Molybdenum	None	0.0%
	Nickel	None	0.0%
	Selenium	None	0.0%
	Phosphorus	None	0.0%
	Vanadium	None	0.0%
ESP Hopper Ash (INAA)	Trace Metals	None	0.0%
ESP Hopper Ash	Anions	None	0.0%
ESP Hopper Ash	Radionuclides	None	0.0%