AP42 Section:	1.1
Reference:	63
Title:	Results of the November 5, 1991 Air Toxic Emission Study on the No. 1, 3 & 4 Boilers at the NSP Black Dog Plant. Interpoll Laboratories, Inc., Circle Pines, Minnesota. January 3, 1992.

Rpt 3

**RESULTS OF THE NOVEMBER 5, 1991
AIR TOXIC EMISSION STUDY ON THE
NO. 1, 3 & 4 BOILERS AT THE
NSP BLACK DOG PLANT**

interpoll

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (612) 786-6020
FAX: (612) 786-7854

RESULTS OF THE NOVEMBER 5, 1991 AIR TOXIC EMISSION STUDY ON THE NO. 1, 3 & 4 BOILERS AT THE NSP BLACK DOG PLANT

Submitted to:

NORTHERN STATES POWER COMPANY
414 Nicollet Mall
Minneapolis, Minnesota 55401

Attention:

Patricia Boyce

Reviewed by:

Perry Lonnes

Perry Lonnes, Ph.D.
Director
Field Testing Department

Report Number 1-3451
January 3, 1992
PL/kce

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ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (^{0}F)	degrees Fahrenheit
DIA.	diameter
FP	finished product for plant
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard cubic meter
HP	horsepower
HRS	hours
IN.	inches
IN.HG.	inches of mercury
IN.WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10^6BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
LTPD	long tons per day
MW	megawatt
mg/DSCM	milligrams per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
ohm-cm	ohm-centimeter
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
ug	micrograms
v/v	percent by volume
w/w	percent by weight
<	$\leq$ (when following a number)

Standard conditions are defined as 68 ^{0}F (20 ^{0}C) and 29.92 IN. of mercury pressure.

Jeff Cole, RTI, says this is a dry bottom boiler, according to the UDI/EEI database. Jeff has been working with the NSP data for five years and, therefore, I am taking his word on this.

Jj

1 INTRODUCTION

On November 11, 1991 Interpoll Laboratories personnel conducted an air toxics emission study on the No. 1, 3 & 4 Boilers at the Northern States Power Company (NSP) Black Dog Plant located in Burnsville, Minnesota. On-site testing was performed by D. Van Hoever, M. Kaehler, E. Trowbridge, D. Brennan, G. Hove, P. O'Neill, J. Bergstrom and C. Mosser. Coordination between testing activities and plant operation was provided by Jim Paris of NSP.

The No. 1, 3 & 4 Boilers are water tube boilers equipped to fire pulverized coal and gas. The steaming capacity of these boilers is 720,000, 775,000 and 1,250,000 LB/HR of superheated steam, respectively. Particulate emissions from each boiler are controlled by a primary (Research-Cottrell 12-section) and secondary (Belco/GE 12-section) electrostatic precipitator. Cleaned flue gas from all three boilers is exhausted to the atmosphere by means of a common 600-foot radial concrete stack with a steel liner which has an internal diameter of 22'-6" at the elevation of the test ports. During the test the boilers were fired with subbituminous coal from the Antelope and North Antelope mines.

An EPA Multi-Metal Modified Method 5 (4M5) sampling train was used to isokinetically collect solid and vapor phase trace metals at the Stack test site. The samples were collected and analyzed as per the EPA Draft Method "Methodology for the Determination of Metals Emissions in Exhaust Gases from Stationary Source Combustion Processes". The aerosol or solid phase trace metal samples were collected on Pallflex® Type 2500 QAT ultra pure filters. The vapor phase trace metals were collected in an all glass impinger train. The first and second impingers each contained 100 cc of a mixture of 5% HNO_3 and 10% H_2O_2. The third and fourth impingers contained 100 cc of a mixture of 4% $KMnO_4$ and 10% H_2SO_4. These impingers collect any elemental mercury which might penetrate the first two impingers.

The recovered four-part samples were returned to the laboratory where the probe rinse, filter and nitric acid impinger catch were combined, dissolved in acid (including the quartz filter) and analyzed by Inductively Coupled Argon Plasma Emission Spectrometry (ICP). In some cases, samples were reanalyzed by graphite furnace atomic absorption spectrometry for greater sensitivity. The permanganate mercury catch and an aliquot of the front half catch were each analyzed by cold vapor atomic absorption spectrometry (CV/AA). Two field-biased blanks were collected and recovered at each test site and analyzed for trace metals with the field samples. The probe rinse and filter catch were conditioned and analyzed gravimetrically prior to processing so that the total particulate weight could be determined.

The combined particulate and trace metal samplings performed at the ESP Inlet test sites were performed using a modified EPA Method 17 sampling train designed to sample sites with high particulate loadings. The samples were collected using an out-stack stainless steel filter holder equipped with a special high efficiency stainless steel filter thimble. The sample gas passes through a pig tail stainless steel nozzle directly into the filter. After sampling is completed and the end-of-the run leak check performed, the sample train is turned on again at 0.75 cfm and the nozzle and filter holder tapped while sampling ambient air. This step carries any flyash deposited inside the nozzle into the filter holder. The filter thimble is then removed; returned to the laboratory; conditioned to remove free moisture and weighed which completes the gravimetric analysis. Samples for elemental analysis are obtained by bouncing the filter thimble on a hard surface which releases the entire filter cake from the mirror-like SS filter thimble walls. Aliquots of known weight are then taken for chemical analysis. No attempt is made to recover the thin layer of flyash remaining on the surface of the filter, since a more than adequate mass of flyash is recovered for chemical analysis and since this layer of flyash is in close contact with the stainless steel filter and might be contaminated to one degree or another with chromium or nickel stemming from decomposition of the stainless steel filtration substrate.

The Inlet sampling trains also included an ice-bath cooled impinger train which contained four impingers (100 cc of acidified permanganate in each of the first two; the third impinger serves as a trap and the fourth contains desiccant). This impinger train collects the elemental mercury vapor which passes through the filter.

PM-10 determinations were performed at the Stack test site using an EPA M5 sampling train equipped with an eight-stage cascade impactor attached to the instack end of the probe. The gold-plated plates were coated with Apiezon H to minimize particle bounce off. Three determinations and one control were performed in accordance with PM-10 SIP Development Guideline USEPA - 450/2-86-001: Appendix C. Four separate impactor sets were used to collect the samples. The samples were returned to the laboratory, conditioned and weighed. The results were calculated in accordance with the impactor manufacturers recommendations using the provided 50% cut point calibration data.

Integrated flue gas samples were extracted simultaneously with each of the above-referenced sample trains from the sampling train exhaust ports using a specially designed gas sampling system as part of the overall project quality assurance . Integrated flue gas samples were collected in 44-liter Tedlar bags housed in a protective aluminum housing. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis. Prior to sampling, the Tedlar bags are leak checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded.

The combined particulate and trace metal testing at the ESP Inlets was conducted from 10 or 12 test ports on each of the respective ESP Inlet Ducts. Each test run was 120 minutes in duration. Testing on the Stack was conducted from four test ports oriented at 90 degrees. These test ports are located approximately 9.8 stack diameters downstream of the breeching inlet and 7.2 diameters upstream of the stack exit. A 12-point traverse was used to extract representative trace metals samples. Each traverse point was sampled ten minutes for the combined particulate and trace metals runs to give a total sampling time of 120 minutes per run.A four-point traverse was used for PM-10 (cascade impactor) testing. Run times varied from 48 minutes for Run 1 to 96 minutes for Run 3.

The important results of the test are summarized in Section 2. Detailed results are presented in Section 3. Field data and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

2.1 Total Particulate Material

The results of the total particulate material mass rate determinations performed at the No. 1, 3 and 4 Boilers ESP Inlets and Common Stack are presented in Tables 1a - 1d. The average mass rates and removal efficiencies were as follows:

Run No.	Mass Rate (LB/HR) (Inlets)	Mass Rate (LB/HR) (Stack)	Removal Efficiency (%)
1	9431	67.9	99.28
2	9986	64.9	99.35
3	8638	80.5	99.07
Avg.	9352	71.1	99.23

In reviewing the particulate mass rate determinations, it should be noted that the sum of the dry standard volumetric flow rates measured at the ESP Inlet test sites was 5 - 11.4% higher than those at the Common Stack test site. This is not unexpected. The Stack test site is aerodynamically ideal for gas velocity measurements inasmuch as the gas stream flow is undisturbed for more than eight stack diameters upstream ensuring that the flow lines are parallel to the stack walls. In the case of the Inlet measurements, the test sites are generally less than one diameter downstream of a flow disturbance and thus nonparallel flow is to be expected. The S-Type pitot tube used in this work, always over estimates the velocity pressure when the pitot tube is not facing directly into the flow (angle of attack <> 0).

Table 1a. Summary of the Results of the November 5, 1991 Particulate Loading Determinations on the No.1 Boiler Inlet at the Northern States Power Blackdog Plant Located in Burnsville, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		11-05-91	11-05-91	11-05-91
Time runs were done	(HRS)	1040/1240	1350/1605	1710/1920
Steam flow	(KLB/HR)	490.0	484.0	506.0
Volumetric flow				
actual	(ACFM)	430922	398014	446950
standard	(DSCFM)	235753	212303	233292
Gas temperature	(DEG-F)	377	376	390
Moisture content	(%V/V)	9.37	11.74	12.10
Gas composition	(%V/V,dry)			
carbon dioxide		10.90	11.10	11.60
oxygen		8.50	8.20	7.70
nitrogen		80.60	80.70	80.70
Isokinetic variation	(%)	100.6	101.6	99.6
Particulate concentration				
actual	(GR/ACF)	0.487	0.541	1.04
standard	(GR/DSCF)	0.891	1.01	2.00
Part. emission rate	(LB/HR)	1801	1846	4001
Emission factor	(LB/MMBTU)	2.10	2.33	4.43

Note: Dry Catch Only

Table 1b. Summary of the Results of the November 5, 1991 Particulate Loading Determinations on the No. 3 Boiler Inlet at the Northern States Power Blackdog Plant Located in Burnsville, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		11-05-91	11-05-91	11-05-91
Time runs were done	(HRS)	1040/1304	1350/1510	1710/1927
Steam flow	(KLB/HR)	560.0	563.0	558.0
Volumetric flow				
actual	(ACFM)	418179	417756	419319
standard	(DSCFM)	240079	236139	238706
Gas temperature	(DEG-F)	327	331	332
Moisture content	(%V/V)	10.04	10.96	10.27
Gas composition	(%V/V,dry)			
carbon dioxide		11.60	12.30	12.20
oxygen		8.00	7.30	7.40
nitrogen		80.40	80.40	80.40
Isokinetic variation	(%)	99.8	100.9	98.5
Particulate concentration				
actual	(GR/ACF)	1.02	1.26	0.673
standard	(GR/DSCF)	1.78	2.23	1.18
Part. emission rate	(LB/HR)	3660	4516	2419
Emission factor	(LB/MMBTU)	4.03	4.79	2.56

Note: Dry Catch Only

Table 1c. Summary of the Results of the November 5, 1991 Particulate Loading Determinations on the No. 4 Boiler Inlet at the Northern States Power Blackdog Plant Located in Burnsville, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		11-05-91	11-05-91	11-05-91
Time runs were done	(HRS)	1040/1255	1350/1602	1710/1922
Steam flow	(KLB/HR)	1172.0	1129.0	1123.0
Volumetric flow				
actual	(ACFM)	786850	748354	754245
standard	(DSCFM)	454883	438199	438492
Gas temperature	(DEG-F)	316	308	314
Moisture content	(%V/V)	10.83	10.62	10.57
Gas composition	(%V/V,dry)			
carbon dioxide		13.40	13.60	13.80
oxygen		6.00	5.80	5.60
nitrogen		80.60	80.60	80.60
Isokinetic variation	(%)	100.3	99.3	99.7
Particulate concentration				
actual	(GR/ACF)	0.588	0.565	0.343
standard	(GR/DSCF)	1.02	0.965	0.590
Part. emission rate	(LB/HR)	3970	3624	2218
Emission factor	(LB/MMBTU)	2.00	1.87	1.13

Note: Dry Catch Only

Table 1d. Summary of the Results of the November 5, 1991 Particulate Emission Test on the No. 1,3 & 4 Boilers Stack at the Northern States Power Blackdog Plant Located in Burnsville, Minnesota.

ITEM		Run 1	Run 2	Run 3
Date of test		11-05-91	11-05-91	11-05-91
Time runs were done	(HRS)	1040/1254	1350/1612	1710/1915
Steam flow	(KLB/HR)	2222.0	2176.0	2187.0
Volumetric flow				
actual	(ACFM)	1423339	1431439	1405036
standard	(DSCFM)	836298	842891	824638
Gas temperature	(DEG-F)	314	313	316
Moisture content	(%V/V)	10.51	10.41	10.35
Gas composition	(%V/V,dry)			
carbon dioxide		12.40	12.80	13.00
oxygen		7.10	6.80	6.60
nitrogen		80.50	80.40	80.40
Isokinetic variation	(%)	101.3	100.1	100.6
Particulate concentration				
actual	(GR/ACF)	.00556	.00529	.00668
standard	(GR/DSCF)	.00947	.00898	.0114
Part. emission rate	(LB/HR)	67.85	64.87	80.50
Emission factor	(LB/MMBTU)	0.020	0.019	0.023

Note: Dry Catch Only

2.2 Elemental Analysis

The results of the elemental analyses performed on the flyash samples collected at the ESP Inlets and the Stack have been used together with the flue gas sample volumes to calculate exhaust gas concentrations of each of the 24 elements of interest (See Table 2a). The elemental concentrations are presented for each of the three two-hour test runs at both the ESP Inlets and Outlet. Table 2b presents the same results except in $LB/10^6 BTU$.

Elemental mass flow rates entering and leaving the ESP have been calculated from the individual element exhaust gas concentrations and the volumetric exhaust gas flow rates. These results are given in Table 3. Mass flow rates of elements entering the ESP were calculated using the volumetric flow rates measured at the Stack test site after correction for the oxygen content (i.e. dilution). This was done to circumvent the deleterious effect of large scale turbulence (known to exist at these sites) on the accuracy of flow measurements. Removal efficiencies for each element were also calculated where possible using the average mass rates at the ESP Inlets and Outlet. The results of these calculations are also presented in Table 3. Elemental removal efficiencies are in good agreement with the total particulate removal efficiencies. Elements that are very volatile and/or not collected efficiently by the electrostatic precipitators exhibit lower removal efficiencies.

The results of the elemental analyses performed on the flyash samples were also used to calculate flyash composition (See Table 4). In the case of major and minor elements, the results are reported as the corresponding mineral form expected to exist in the flyash as is custom in mineral ash analyses. This data shows that the analyses performed accounted for almost 100% of the total composition of the samples in the case of the Inlet samples and 69 - 88% in the case of the of the Stack samples. Silicon, a major component of flyash was not analyzed for in the case of the Stack samples nor was sulfur or carbon.

Table 2a. Results of the November 5, 1991 Trace Metal Determinations Performed at the ESP Inlets to the No. 1, 3 & 4 Boilers and Common Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

Element	Concentration (ug/Nm^3) Run 1 Inlet	Run 1 Stack	Run 2 Inlet	Run 2 Stack	Run 3 Inlet	Run 3 Stack
Aluminum	322000	2810	368000	3080	339000	3530
Antimony	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0
Arsenic	42.9	.7	47.4	.7	40.8	.7
Barium	17800	214	20200	163	18900	71.7
Beryllium	6.86	.1	7.46	.1	5.51	.2
Boron	1330	34.5	1400	31.3	1220	38.3
Cadmium	13.2	.5	52.4	4.2	63.4	.5
Calcium	458000	4010	517000	4830	447000	4280
Chromium	214	2.3	245	4.0	174	2.9
Copper	573	11.9	589	45.1	533	11.0
Iron	123000	990	139000	1200	127000	1320
Potassium	12200	167	12200	295	10600	211
Magnesium	97200	850	110000	1030	96700	1170
Manganese	314	5.9	344	6.7	274	7.1
Molybdenum	39.1	<2.0	41.8	<2.0	28.6	<2.0
Sodium	53200	491	56800	794	50800	617
Nickel	194	3.7	202	16.5	157	3.0
Lead	213	5.3	521	60.9	583	2.7
Selenium	49.6	1.3	45.8	1.3	43.2	1.4
Strontium	6470	73.3	7280	74.3	6410	60.6
Vanadium	549	7.3	559	8.0	485	8.4
Zinc	465	18.8	490	145	388	126
Mercury	6.91	5.3	6.58	2.7	1.71	7.2
Silver	2.74	1.2	<3.06	1.0	<2.82	2.5
Sulfur	19000		22000		19400	
Silicon	454000		521000		459000	
SO_2		477000		516000		473000

Note:
Sulfur could not be analyzed in the ESP Outlet flyash samples since the first two impingers in the 4MS sampling train contain 10% H_2O_2 which retains SO_2. Thus the sulfur results reported for the Stack test site reflects the sum of the sulfur in the flyash as well as the sulfur in the SO_2 emissions.

Silicon was not analyzed in the ESP Outlet flyash samples since the EPA methodology requires dissolution of the filter which is pure SiO_2.

Table 2b. Results of the November 5, 1991 Trace Metal Determinations Performed at the ESP Inlets to the No. 1, 3 & 4 Boilers and Common Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

	Emission Factor ($LB/10^6 BTU$)					
	Run 1		Run 2		Run 3	
Element	Inlet	Stack	Inlet	Stack	Inlet	Stack
Aluminum	1.97×10^{-1}	1.72×10^{-3}	3.32×10^{-1}	1.88×10^{-3}	2.07×10^{-1}	2.16×10^{-3}
Antimony	$<3.70 \times 10^{-6}$	$<3.70 \times 10^{-6}$	$<3.70 \times 10^{-6}$	$<3.70 \times 10^{-6}$	$<3.70 \times 10^{-6}$	$<3.70 \times 10^{-6}$
Arsenic	2.62×10^{-5}	4.27×10^{-7}	4.28×10^{-5}	4.27×10^{-7}	2.49×10^{-5}	4.27×10^{-7}
Barium	1.09×10^{-2}	1.31×10^{-4}	1.82×10^{-2}	9.95×10^{-5}	1.15×10^{-2}	4.38×10^{-5}
Beryllium	4.19×10^{-6}	6.11×10^{-8}	6.74×10^{-6}	6.11×10^{-8}	3.36×10^{-6}	1.22×10^{-7}
Boron	8.11×10^{-4}	2.11×10^{-5}	1.27×10^{-3}	1.91×10^{-5}	7.46×10^{-4}	2.34×10^{-5}
Calcium	2.80×10^{-1}	2.45×10^{-3}	4.67×10^{-1}	2.95×10^{-3}	2.73×10^{-1}	2.61×10^{-3}
Cadmium	8.03×10^{-6}	3.05×10^{-7}	4.74×10^{-5}	2.56×10^{-6}	3.87×10^{-5}	3.05×10^{-7}
Chromium	1.31×10^{-4}	1.40×10^{-6}	2.22×10^{-4}	2.44×10^{-6}	1.06×10^{-4}	1.77×10^{-6}
Copper	3.50×10^{-4}	7.27×10^{-6}	5.33×10^{-4}	2.75×10^{-5}	3.26×10^{-4}	6.72×10^{-6}
Iron	7.53×10^{-2}	6.05×10^{-4}	1.26×10^{-1}	7.34×10^{-4}	7.75×10^{-2}	8.08×10^{-4}
Potassium	7.45×10^{-3}	1.02×10^{-4}	1.10×10^{-2}	1.80×10^{-4}	6.48×10^{-3}	1.29×10^{-4}
Magnesium	5.94×10^{-2}	5.19×10^{-4}	9.92×10^{-2}	6.28×10^{-4}	5.91×10^{-2}	7.13×10^{-4}
Manganese	1.92×10^{-4}	3.60×10^{-6}	3.11×10^{-4}	4.09×10^{-6}	1.67×10^{-4}	4.34×10^{-6}
Molybdenum	2.39×10^{-5}	$<1.22 \times 10^{-6}$	3.78×10^{-5}	$<1.22 \times 10^{-6}$	1.75×10^{-5}	$<1.22 \times 10^{-6}$
Sodium	3.25×10^{-2}	3.00×10^{-4}	5.13×10^{-2}	4.85×10^{-4}	3.10×10^{-2}	3.77×10^{-4}
Nickel	1.18×10^{-4}	2.26×10^{-6}	1.82×10^{-4}	1.01×10^{-5}	9.58×10^{-5}	1.83×10^{-6}
Lead	1.30×10^{-4}	3.24×10^{-6}	4.71×10^{-4}	3.72×10^{-5}	3.56×10^{-4}	1.65×10^{-6}
Selenium	3.03×10^{-5}	7.94×10^{-7}	4.14×10^{-5}	7.94×10^{-7}	2.64×10^{-5}	8.55×10^{-7}
Strontium	3.95×10^{-3}	4.48×10^{-5}	6.58×10^{-3}	4.54×10^{-5}	3.91×10^{-3}	3.70×10^{-5}
Vanadium	3.35×10^{-4}	4.46×10^{-6}	5.05×10^{-4}	4.88×10^{-6}	2.96×10^{-4}	5.13×10^{-6}
Zinc	2.84×10^{-4}	1.15×10^{-5}	4.43×10^{-4}	8.85×10^{-5}	2.37×10^{-4}	7.69×10^{-5}
Mercury	4.22×10^{-6}	3.24×10^{-6}	5.95×10^{-6}	1.65×10^{-6}	1.04×10^{-6}	4.40×10^{-6}
Silver	3.06×10^{-6}	7.33×10^{-7}	$<2.77 \times 10^{-6}$	6.11×10^{-7}	$<1.72 \times 10^{-6}$	1.53×10^{-6}
Sulfur	1.16×10^{-2}		1.99×10^{-2}		1.18×10^{-2}	
Silicon	2.77×10^{-1}		4.71×10^{-1}		2.80×10^{-1}	
SO_2		4.41×10^{-1}		4.67×10^{-1}		4.22×10^{-1}

Note:

Sulfur could not be analyzed in the ESP Outlet flyash samples since the first two impingers in the 4M5 sampling train contain 10% H_2O_2 which retains SO_2. Thus the sulfur results reported for the Stack test site reflects the sum of the sulfur in the flyash as well as the sulfur in the SO_2 emissions.

Silicon was not analyzed in the ESP Outlet flyash samples since the EPA methodology requires dissolution of the filter which is pure SiO_2.

Table 3. Results of the November 5, 1991 Trace Metal Determinations performed at the ESP Inlets to the No. 1, 3 & 4 Boilers and Common Stack at the NSP Black Dog Plant in Burnsville, Minnesota.

	Mass Flow (LB/HR)						
	Run 1		Run 2		Run 3		Avg. Removal
Element	Inlet	Stack	Inlet	Stack	Inlet	Stack	Eff. (%w/w)
Aluminum	1010	8.8	1162	9.7	1050	10.9	99.085
Antimony	<.019	<.019	<.019	<.019	<.019	<.019	
Arsenic	.13	.0021	.15	.0021	.13	.0021	98.45
Barium	56	.67	64	.51	58	.22	99.209
Beryllium	.021	.00036	.024	.00047	.017	.00055	97.70
Boron	4.2	.11	4.4	.099	3.8	.12	97.32
Cadmium	.041	.0017	.17	.013	.20	.017	93.23
Calcium	1435	12.6	1635	15.2	1383	13.2	99.079
Chromium	.67	.0071	.78	.013	.54	.0090	98.54
Copper	1.8	.037	1.9	.14	1.7	.034	96.19
Iron	386	3.1	440	3.8	393	4.1	99.101
Potassium	38	.52	39	.93	33	.65	98.09
Magnesium	305	2.7	347	3.2	300	3.6	99.00
Manganese	.98	.019	1.1	.021	.85	.022	97.85
Molybdenum	.12	<.0063	.13	<.0063	.089	<.0063	>94.27
Sodium	167	1.5	179	2.5	157	1.9	98.83
Nickel	.61	.012	.64	.052	.49	.0092	96.01
Lead	.66	.017	1.6	.19	1.8	.0084	95.03
Selenium	.16	.0042	.15	.0042	.14	.0042	97.19
Strontium	20	.23	23	.23	20	.19	98.97
Vanadium	1.7	.023	1.8	.025	1.5	.026	98.51
Zinc	1.5	.059	1.5	.46	1.2	.091	85.94
Mercury	.022	.017	.021	.0087	.0053	.022	(77.9)
Silver	.009	.0038	<.010	.0032	<.0087	.0078	<52.94
Sulfur	60	-	70	-	60	-	
Silicon	1420	-	1650	-	1420	-	
SO_2	-	1490	-	1630	-	1460	

Note:
Sulfur could not be analyzed in the ESP Outlet flyash samples since the first two impingers in the 4M5 sampling train contain 10% H_2O_2 which retains SO_2. Thus the sulfur results reported for the Stack test site reflects the sum of the sulfur in the flyash as well as the sulfur in the SO_2 emissions.

Silicon was not analyzed in the ESP Outlet flyash samples since the EPA methodology requires dissolution of the filter which is pure SiO_2.

B 13

2.3 PM-10

The results of the PM-10 Constant Sampling Rate (CSP) determinations are summarized in Table 4. The total particulate emission rate averaged 89.9 LB/HR using the CSR PM-10 sampling train. The size distribution results obtained from the in situ aerodynamic size classifications (See Section 3.4) indicate that about 86.2% by weight of the flyash particles have diameters less than 10 microns. The PM-10 emission rate averaged 77.7 LB/HR.

Table 4. Summary of the **PM-10 Measurements** Performed on the No. 1, 3 & 4 Boilers at the NSP Black Dog Plant in Burnsville, Minnesota.

	Run 1	Run 2	Run 3	Avg.
Total mass rate (LB/HR)	93.4	91.3	85.1	89.9
% ≤ 10 um	88.8	90.9	78.8	86.2
PM-10 mass rate (LB/HR)	82.9	83.0	67.1	77.7

2.4 Conclusions

No difficulties incurred in the field or in the laboratory analysis of the flue gas samples which could not be solved. Based on these facts plus a complete review of all of the data, it is our opinion that the results reported herein are accurate and closely reflect the actual values which existed at the time the test was performed.

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition (Orsat and moisture) are presented first followed by the computer printout of the particulate and PM-10 results and the trace metals sampling data. Preliminary measurements including test port locations are given in the appendices.

The results have been calculated on a personal computer using programs written in Extended BASIC specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs. Emission rates have been calculated using the product of the concentration times flow method.

3.1 Results of Orsat and Moisture Analyses

Test No. 1
No. 1 Boiler Inlet

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Dry basis (orsat)			
carbon dioxide............	10.90	11.10	11.60
oxygen....................	8.50	8.20	7.70
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	80.60	80.70	80.70
Wet basis (orsat)			
carbon dioxide............	9.88	9.80	10.20
oxygen....................	7.70	7.24	6.77
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	73.04	71.23	70.94
water vapor...............	9.37	11.74	12.10
Dry molecular weight........	30.08	30.10	30.16
Wet molecular weight........	28.95	28.68	28.69
Specific gravity............	1.000	0.991	0.991
Water mass flow......(LB/HR)	68400	79180	90050
FO	1.138	1.144	1.138

Test No. 1
No. 3 Boiler Inlet

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Dry basis (orsat)			
carbon dioxide............	11.60	12.30	12.20
oxygen....................	8.00	7.30	7.40
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	80.40	80.40	80.40
Wet basis (orsat)			
carbon dioxide............	10.44	10.95	10.95
oxygen....................	7.20	6.50	6.64
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	72.33	71.59	72.14
water vapor...............	10.04	10.96	10.27
Dry molecular weight........	30.18	30.26	30.25
Wet molecular weight........	28.95	28.92	28.99
Specific gravity............	1.000	0.999	1.001
Water mass flow......(LB/HR)	75127	81562	76675
FO	1.112	1.106	1.107

Test No. 1
No. 4 Boiler Inlet

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Dry basis (orsat)			
carbon dioxide............	13.40	13.60	13.80
oxygen....................	6.00	5.80	5.60
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	80.60	80.60	80.60
Wet basis (orsat)			
carbon dioxide............	11.95	12.16	12.34
oxygen....................	5.35	5.18	5.01
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	71.87	72.04	72.08
water vapor...............	10.83	10.62	10.57
Dry molecular weight........	30.38	30.41	30.43
Wet molecular weight........	29.04	29.09	29.12
Specific gravity............	1.003	1.005	1.006
Water mass flow......(LB/HR)	154997	146005	145447
FO	1.112	1.110	1.109

Test No. 1
Unit 1-3-4 Stack

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Dry basis (orsat)			
carbon dioxide...........	12.40	12.80	13.00
oxygen...................	7.10	6.80	6.60
carbon monoxide..........	0.00	0.00	0.00
nitrogen.................	80.50	80.40	80.40
Wet basis (orsat)			
carbon dioxide...........	11.10	11.47	11.66
oxygen...................	6.35	6.09	5.92
carbon monoxide..........	0.00	0.00	0.00
nitrogen.................	72.04	72.03	72.08
water vapor..............	10.51	10.41	10.35
Dry molecular weight........	30.27	30.32	30.34
Wet molecular weight........	28.98	29.04	29.07
Specific gravity...........	1.001	1.003	1.004
Water mass flow......(LB/HR)	275574	274697	266935
FO	1.113	1.102	1.100

Test No. 2 (Cascade Impactor)
Units 1-3-4 Stack

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Control	Run 1	Run 2
Date of run	11-05-91	11-05-91	11-05-91
Dry basis (orsat)			
carbon dioxide............	12.30	12.40	11.50
oxygen....................	7.30	7.10	8.20
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	80.40	80.50	80.30
Wet basis (orsat)			
carbon dioxide............	11.22	11.19	10.14
oxygen....................	6.66	6.41	7.23
carbon monoxide...........	0.00	0.00	0.00
nitrogen..................	73.33	72.64	70.84
water vapor...............	8.80	9.77	11.78
Dry molecular weight........	30.26	30.27	30.17
Wet molecular weight........	29.18	29.07	28.73
Specific gravity............	1.008	1.004	0.993
Water mass flow......(LB/HR)	0.00	263478	%322396.
FO	1.106	1.113	1.104

Test No. 2 (Cascade Impactor)
Units 1-3-4 Stack

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

	Run 3
Date of run	11-05-91
Dry basis (orsat)	
carbon dioxide............	10.50
oxygen....................	9.40
carbon monoxide...........	0.00
nitrogen..................	80.10
Wet basis (orsat)	
carbon dioxide............	9.44
oxygen....................	8.45
carbon monoxide...........	0.00
nitrogen..................	71.99
water vapor...............	10.12
Dry molecular weight........	30.06
Wet molecular weight........	28.84
Specific gravity...........	0.996
Water mass flow......(LB/HR)	255657
FO	1.095

3.2 Results of Particulate Determinations

Test No. 1
No. 1 Boiler Inlet

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040/1240	1350/1605	1710/1920
Static pressure......(IN.WC)	-7.00	-7.00	-7.00
Cross sectional area (SQ.FT)	233.33	233.33	233.33
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	123.0	145.0	158.0
desiccant..........(GRAMS)	19.0	21.0	27.0
total..............(GRAMS)	142.0	166.0	185.0
Total particulate material.. ....collected(grams)	3.7387	3.8698	8.2187
Gas meter coefficient.......	1.0056	1.0056	1.0056
Barometric pressure..(IN.HG)	29.13	29.13	29.13
Avg. orif.pres.drop..(IN.WC)	1.12	0.90	1.07
Avg. gas meter temp..(DEF-F)	110.2	113.5	114.7
Volume through gas meter....			
at meter conditions...(CF)	71.23	65.19	70.31
standard conditions.(DSCF)	64.73	58.87	63.39
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.312	.312	.312
Avg.stack gas temp ..(DEG-F)	377	376	390
Volumetric flow rate........			
actual..............(ACFM)	430922	398014	446950
dry standard.......(DSCFM)	235753	212303	233292
Isokinetic variation.....(%)	100.6	101.6	99.6
Particulate concentration...			
actual............(GR/ACF)	0.48738	0.54085	1.04383
dry standard.....(GR/DSCF)	0.89121	1.01436	2.00062
Particle mass rate...(LB/HR)	1800.893	1845.854	4000.516
F-factor ....(DSCF/MMBTU)	9780	9780	9780
Emission factor...(LB/MMBTU)	2.099	2.332	4.426

Test No. 1
No. 3 Boiler Inlet

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040/1304	1350/1510	1710/1927
Static pressure......(IN.WC)	-8.16	-8.16	-8.16
Cross sectional area (SQ.FT)	222.63	222.63	222.63
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	117.0	138.0	122.0
desiccant..........(GRAMS)	27.0	20.0	23.0
total..............(GRAMS)	144.0	158.0	145.0
Total particulate material.. ....collected(grams)	7.0157	8.7489	4.5739
Gas meter coefficient.......	0.9992	0.9992	0.9992
Barometric pressure..(IN.HG)	29.07	29.07	29.07
Avg. orif.pres.drop..(IN.WC)	1.04	1.01	0.99
Avg. gas meter temp..(DEF-F)	88.5	87.4	92.1
Volume through gas meter....			
at meter conditions...(CF)	64.98	64.47	64.17
standard conditions.(DSCF)	60.86	60.50	59.70
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.294	.294	.294
Avg.stack gas temp ..(DEG-F)	327	331	332
Volumetric flow rate........			
actual..............(ACFM)	418179	417756	419319
dry standard.......(DSCFM)	240079	236139	238706
Isokinetic variation.....(%)	99.8	100.9	98.5
Particulate concentration...			
actual...........(GR/ACF)	1.02074	1.26077	0.67267
dry standard.....(GR/DSCF)	1.77868	2.23132	1.18211
Particle mass rate...(LB/HR)	3660.177	4516.295	2418.636
F-factor ....(DSCF/MMBTU)	9780	9780	9780
Emission factor...(LB/MMBTU)	4.026	4.791	2.557

Test No. 1
No. 4 Boiler Inlet

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040/1255	1350/1602	1710/1922
Static pressure......(IN.WC)	-9.10	-9.10	-9.10
Cross sectional area (SQ.FT)	357.00	357.00	357.00
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	179.0	172.0	170.0
desiccant..........(GRAMS)	28.0	21.0	23.0
total..............(GRAMS)	207.0	193.0	193.0
Total particulate material..			
..........collected(grams)	5.3014	4.7899	2.9425
Gas meter coefficient.......	0.9939	0.9939	0.9939
Barometric pressure..(IN.HG)	29.17	29.17	29.17
Avg. orif.pres.drop..(IN.WC)	1.61	1.48	1.49
Avg. gas meter temp..(DEF-F)	82.6	86.1	85.0
Volume through gas meter....			
at meter conditions...(CF)	84.90	81.50	81.70
standard conditions.(DSCF)	80.35	76.61	76.95
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.310	.310	.310
Avg.stack gas temp ..(DEG-F)	316	308	314
Volumetric flow rate........			
actual..............(ACFM)	786850	748354	754245
dry standard.......(DSCFM)	454883	438199	438492
Isokinetic variation.....(%)	100.3	99.3	99.7
Particulate concentration...			
actual...........(GR/ACF)	0.58834	0.56468	0.34287
dry standard.....(GR/DSCF)	1.01810	0.96474	0.59000
Particle mass rate...(LB/HR)	3969.568	3623.561	2217.504
F-factor ....(DSCF/MMBTU)	9780	9780	9780
Emission factor...(LB/MMBTU)	1.995	1.866	1.126

Test No. 1
Unit 1-3-4 Stack

Results of Particulate Loading Determinations-------Method 5

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040/1254	1350/1612	1710/1915
Static pressure......(IN.WC)	-1.85	-1.85	-1.85
Cross sectional area (SQ.FT)	397.61	397.61	397.61
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	116.0	120.0	116.0
desiccant..........(GRAMS)	16.0	10.0	11.0
total..............(GRAMS)	132.0	130.0	127.0
Total particulate material..			
..........collected(grams)	0.0325	0.0307	0.0383
Gas meter coefficient.......	1.0003	1.0003	1.0003
Barometric pressure..(IN.HG)	28.94	28.94	28.94
Avg. orif.pres.drop..(IN.WC)	0.64	0.64	0.62
Avg. gas meter temp..(DEF-F)	48.2	52.0	55.9
Volume through gas meter....			
at meter conditions...(CF)	52.64	52.81	52.34
standard conditions.(DSCF)	52.98	52.76	51.89
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.195	.195	.195
Avg.stack gas temp ..(DEG-F)	314	313	316
Volumetric flow rate........			
actual..............(ACFM)	1423339	1431439	1405036
dry standard.......(DSCFM)	836298	842891	824638
Isokinetic variation.....(%)	101.3	100.1	100.6
Particulate concentration...			
actual............(GR/ACF)	0.00556	0.00529	0.00668
dry standard.....(GR/DSCF)	0.00947	0.00898	0.01139
Particle mass rate...(LB/HR)	67.850	64.871	80.501
F-factor ....(DSCF/MMBTU)	9780	9780	9780
Emission factor...(LB/MMBTU)	0.020	0.019	0.023

3.3 Sampling Data for the Metals Tests

Test No. 1
No. 1 Boiler Inlet

Results of Multi-Metal Modified Method 5 (4M5) Sampling.....

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040-1240	1350-1605	1710-1920
Static pressure......(IN.WC)	-7.00	-7.00	-7.00
Cross sectional area (SQ.FT)	233.33	233.33	233.33
Pitot tube coefficient......	0.840	0.840	0.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	123.0	145.0	158.0
desiccant..........(GRAMS)	19.0	21.0	27.0
total..............(GRAMS)	142.0	172.0	185.0
Gas meter coefficient.......	1.0056	1.0056	1.0056
Barometric pressure..(IN.HG)	29.13	29.13	29.13
Avg. orif.pres.drop..(IN.WC)	1.12	0.90	1.07
Avg. gas meter temp..(DEF-F)	110.2	113.5	114.7
Volume through gas meter....			
at meter conditions...(CF)	71.23	65.19	70.31
standard conditions.(DSCF)	64.73	58.87	63.39
standard conditions..(NM^3)	1.833	1.667	1.795
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.312	.312	.312
Avg.stack gas temp ..(DEG-F)	377	376	390
Volumetric flow rate........			
actual..............(ACFM)	430922	398014	446950
dry standard.......(DSCFM)	235753	212303	233292
Isokinetic variation.....(%)	100.6	101.6	99.6

Test No. 1
No. 3 Boiler Inlet

Results of Multi-Metal Modified Method 5 (4M5) Sampling.....

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040-1304	1350-1510	1710-1927
Static pressure......(IN.WC)	-8.16	-8.16	-8.16
Cross sectional area (SQ.FT)	222.63	222.63	222.63
Pitot tube coefficient......	0.840	0.840	0.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	117.0	138.0	122.0
desiccant..........(GRAMS)	27.0	20.0	23.0
total..............(GRAMS)	144.0	161.0	145.0
Gas meter coefficient.......	0.9992	0.9992	0.9992
Barometric pressure..(IN.HG)	29.07	29.07	29.07
Avg. orif.pres.drop..(IN.WC)	1.04	1.01	0.99
Avg. gas meter temp..(DEF-F)	88.5	87.4	92.1
Volume through gas meter....			
at meter conditions...(CF)	64.98	64.47	64.17
standard conditions.(DSCF)	60.86	60.50	59.70
standard conditions..(NM^3)	1.723	1.713	1.691
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.294	.294	.294
Avg.stack gas temp ..(DEG-F)	327	331	332
Volumetric flow rate........			
actual..............(ACFM)	418179	417756	419319
dry standard.......(DSCFM)	240079	236139	238706
Isokinetic variation.....(%)	99.8	100.9	98.5

Test No. 1
No. 4 Boiler Inlet

Results of Multi-Metal Modified Method 5 (4M5) Sampling.....

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040-1255	1350-1602	1710-1922
Static pressure......(IN.WC)	-9.10	-9.10	-9.10
Cross sectional area (SQ.FT)	357.00	357.00	357.00
Pitot tube coefficient......	0.840	0.840	0.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	179.0	172.0	170.0
desiccant..........(GRAMS)	28.0	21.0	23.0
total..............(GRAMS)	207.0	195.0	193.0
Gas meter coefficient.......	0.9939	0.9939	0.9939
Barometric pressure..(IN.HG)	29.17	29.17	29.17
Avg. orif.pres.drop..(IN.WC)	1.61	1.48	1.49
Avg. gas meter temp..(DEF-F)	82.6	86.1	85.0
Volume through gas meter....			
at meter conditions...(CF)	84.90	81.50	81.70
standard conditions.(DSCF)	80.35	76.61	76.95
standard conditions..(NM^3)	2.275	2.169	2.179
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.310	.310	.310
Avg.stack gas temp ..(DEG-F)	316	308	314
Volumetric flow rate........			
actual..............(ACFM)	786850	748354	754245
dry standard.......(DSCFM)	454883	438199	438492
Isokinetic variation.....(%)	100.3	99.3	99.7

Test No. 1
Unit 1-3-4 Stack

Results of Multi-Metal Modified Method 5 (4M5) Sampling.....

	Run 1	Run 2	Run 3
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1040-1254	1350-1612	1710-1915
Static pressure......(IN.WC)	-1.85	-1.85	-1.85
Cross sectional area (SQ.FT)	397.61	397.61	397.61
Pitot tube coefficient......	0.840	0.840	0.840
Water in sample gas			
condenser.............(ML)	0.0	0.0	0.0
impingers..........(GRAMS)	116.0	120.0	116.0
desiccant..........(GRAMS)	16.0	10.0	11.0
total..............(GRAMS)	132.0	131.0	127.0
Gas meter coefficient.......	1.0003	1.0003	1.0003
Barometric pressure..(IN.HG)	28.94	28.94	28.94
Avg. orif.pres.drop..(IN.WC)	0.64	0.64	0.62
Avg. gas meter temp..(DEF-F)	48.2	52.0	55.[illegible]
Volume through gas meter....			
at meter conditions...(CF)	52.64	52.81	52.34
standard conditions.(DSCF)	52.98	52.76	51.89
standard conditions..(NM^3)	1.500	1.494	1.469
Total sampling time....(MIN)	120.00	120.00	120.00
Nozzle diameter.........(IN)	.195	.195	.195
Avg.stack gas temp ..(DEG-F)	314	313	316
Volumetric flow rate........			
actual..............(ACFM)	1423339	1431439	1405036
dry standard.......(DSCFM)	836298	842891	824638
Isokinetic variation.....(%)	101.3	100.1	100.6

3.4 Results of PM-10 Determinations

Results of the Particle Size Distribution Determination

Sample Identification: No. 1, 3 & 4 Boilers Stack - November 5, 1991
Cascade Impactor Sampling

Assigned Density: 1.00 g/cc

	Run 1		Run 2		Run 3	
Stage	um	% ≥	um	% ≥	um	% ≥
Preimpactor	10.2	11.23	10.2	9.08	10.2	21.17
1	6.4	18.85	6.4	14.45	6.4	26.99
2	4.2	21.84	4.2	17.71	4.2	29.85
3	2.5	39.84	2.5	33.81	2.5	43.83
4	1.5	51.41	1.5	47.43	1.5	56.14
5	1.0	66.37	1.0	64.50	1.0	71.09
6	0.64	79.12	0.64	76.19	0.64	84.37
7	0.36	80.70	0.36	81.42	0.36	89.99

um — Aerodynamic equivalent diameter in microns
% ≥ — Relative cumulative frequency - percent by mass of aerosol with diameters greater than stated size

Test No. 2 (Cascade Impactor)
Units 1-3-4 Stack

Results of Particulate Loading Determinations-------Method 5

	Control	Run 1	Run 2
Date of run	11-05-91	11-05-91	11-05-91
Time run start/end.....(HRS)	1018/1123	1206/1300	1428/1538
Static pressure......(IN.WC)	-1.85	-1.85	-1.85
Cross sectional area (SQ.FT)	397.61	397.61	397.61
Pitot tube coefficient......	.840	.840	.840
Water in sample gas			
condenser.............(ML)	48.0	31.0	57.0
impingers..........(GRAMS)	0.0	0.0	0.0
desiccant..........(GRAMS)	9.0	19.0	20.0
total..............(GRAMS)	57.0	50.0	77.0
Total particulate material.. ....collected(grams)	0.0000	0.0177	0.0218
Gas meter coefficient.......	1.0070	1.0070	1.0070
Barometric pressure..(IN.HG)	28.94	28.94	28.94
Avg. orif.pres.drop..(IN.WC)	0.75	0.71	0.71
Avg. gas meter temp..(DEF-F)	49.8	48.9	55.8
Volume through gas meter....			
at meter conditions...(CF)	27.54	21.50	27.19
standard conditions.(DSCF)	27.82	21.76	27.15
Total sampling time....(MIN)	60.00	48.00	60.00
Nozzle diameter.........(IN)	.195	.195	.195
Avg.stack gas temp ..(DEG-F)	313	315	312
Volumetric flow rate........			
actual..............(ACFM)	1460239	1465050	1480124
dry standard.......(DSCFM)	875747	866907	859446
Isokinetic variation.....(%)	101.6	100.3	101.0
Particulate concentration...			
actual...........(GR/ACF)	0.00000	0.00743	0.00719
dry standard.....(GR/DSCF)	0.00000	0.01257	0.01239
Particle mass rate...(LB/HR)	0.00	93.38	91.28

Test No. 2 (Cascade Impactor)
Units 1-3-4 Stack

Results of Particulate Loading Determinations-------Method 5

	Run 3
Date of run	11-05-91
Time run start/end.....(HRS)	1636/1816
Static pressure......(IN.WC)	-1.85
Cross sectional area (SQ.FT)	397.61
Pitot tube coefficient......	.840
Water in sample gas	
condenser.............(ML)	74.0
impingers..........(GRAMS)	0.0
desiccant..........(GRAMS)	28.0
total..............(GRAMS)	102.0
Total particulate material..	
..........collected(grams)	0.0340
Gas meter coefficient.......	1.0070
Barometric pressure..(IN.HG)	28.94
Avg. orif.pres.drop..(IN.WC)	0.68
Avg. gas meter temp..(DEF-F)	53.9
Volume through gas meter....	
at meter conditions...(CF)	42.55
standard conditions.(DSCF)	42.64
Total sampling time....(MIN)	96.00
Nozzle diameter.........(IN)	.195
Avg.stack gas temp ..(DEG-F)	314
Volumetric flow rate........	
actual..............(ACFM)	1369583
dry standard.......(DSCFM)	808046
Isokinetic variation.....(%)	105.4
Particulate concentration...	
actual...........(GR/ACF)	0.00725
dry standard.....(GR/DSCF)	0.01229
Particle mass rate...(LB/HR)	85.14
F-factor ....(DSCF/MMBTU)	0
Emission factor...(LB/MMBTU)	0.000

4 RESULTS OF FUEL ANALYSES

INTERPOLL LABORATORIES INC.

Fuel Laboratory
(612) 786-6020

11-26-1991

Client: NSP/BLACK DOG

Laboratory Log Number: 4677-101-0681

Sample Identification: COAL COMPOSITE UNITS 1-3-4 11/5/91

Ultimate Analysis WT %

Parameter	Moisture & Ash Free	Moisture Free	As Received
Moisture, Total			27.22
Ash		6.68	4.86
Carbon	74.40	69.44	50.54
Hydrogen	5.32	4.96	3.61
Nitrogen	0.09	0.09	0.06
Oxygen (calculated)	19.84	18.52	13.47
Sulfur	0.35	0.32	0.24
Heating Value, BTU/LB.	12819	11963	8707

Respectfully submitted,

Jeannie F. O'Neil

Jeannie F. O'Neil,
Manager
Inorganic Chemistry Group

INTERPOLL LABORATORIES, INC.
(612)786-6020

NSP/Black Dog
Laboratory Log No. 4677

Results of Trace Metal Analyses

Source: Units 1, 3 & 4
Sample Type: Coal

Trace Metal	Method	Concentration in Sample (ug/g)[a] 11/5/91
(Log No.)		(4677-101)
Silver	SW-846, 6010	< 0.06
Aluminum	SW-846, 6010	3730
Arsenic	SW-846, 7060	0.4
Boron	SW-846, 6010	23.3
Barium	SW-846, 6010	188
Beryllium	SW-846, 6010	0.1
Calcium	SW-846, 6010	6480
Cadmium	SW-846, 6010	0.1
Chromium	SW-846, 6010	2.3
Copper	SW-846, 6010	18.8
Iron	SW-846, 6010	1670
Mercury	SW-846, 7470	< 0.006
Potassium	SW-846, 6010	188
Magnesium	SW-846, 6010	1380
Manganese	SW-846, 6010	5.2
Molybdenum	SW-846, 6010	0.8
Sodium	SW-846, 6010	534
Nickel	SW-846, 6010	2.5
Lead	SW-846, 6010	5.7
Antimony	SW-846, 7041	0.4
Selenium	SW-846, 7740	0.3
Strontium	Std. Meth. 326A	566
Vanadium	SW-846, 6010	8.9
Zinc	SW-846, 6010	9.6

[a]Results are reported on an as received basis, with a moisture content of 27.2% and an ash content of 4.86%.

APPENDIX A

VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 1
No. 1 Boiler Inlet

Results of Volumetric Flow Rate Determination-------Method 2

Date of Determination............	11-05-91
Time of Determination.......(HRS)	910
Barometric pressure.......(IN.HG)	29.13
Pitot tube coefficient...........	.84
Number of sampling ports.........	10
Total number of points...........	40
Shape of duct....................	Rectangular
Duct width..................(IN)	60
Duct length.................(IN)	560
Duct area................(SQ.FT)	233.33
Direction of flow...............	UP
Static pressure...........(IN.WC)	-7
Avg. gas temp.............(DEG-F)	375
Moisture content..........(% V/V)	9.37
Avg. linear velocity.....(FT/SEC)	32.2
Gas density..............(LB/ACF)	.04546
Molecular weight......(LB/LBMOLE)	30.08
Mass flow of gas..........(LB/HR)	1229480
Volumetric flow rate.............	
actual...................(ACFM)	450758
dry standard............(DSCFM)	247004

Test No. 1
No. 4 Boiler Inlet

Results of Volumetric Flow Rate Determination-------Method 2

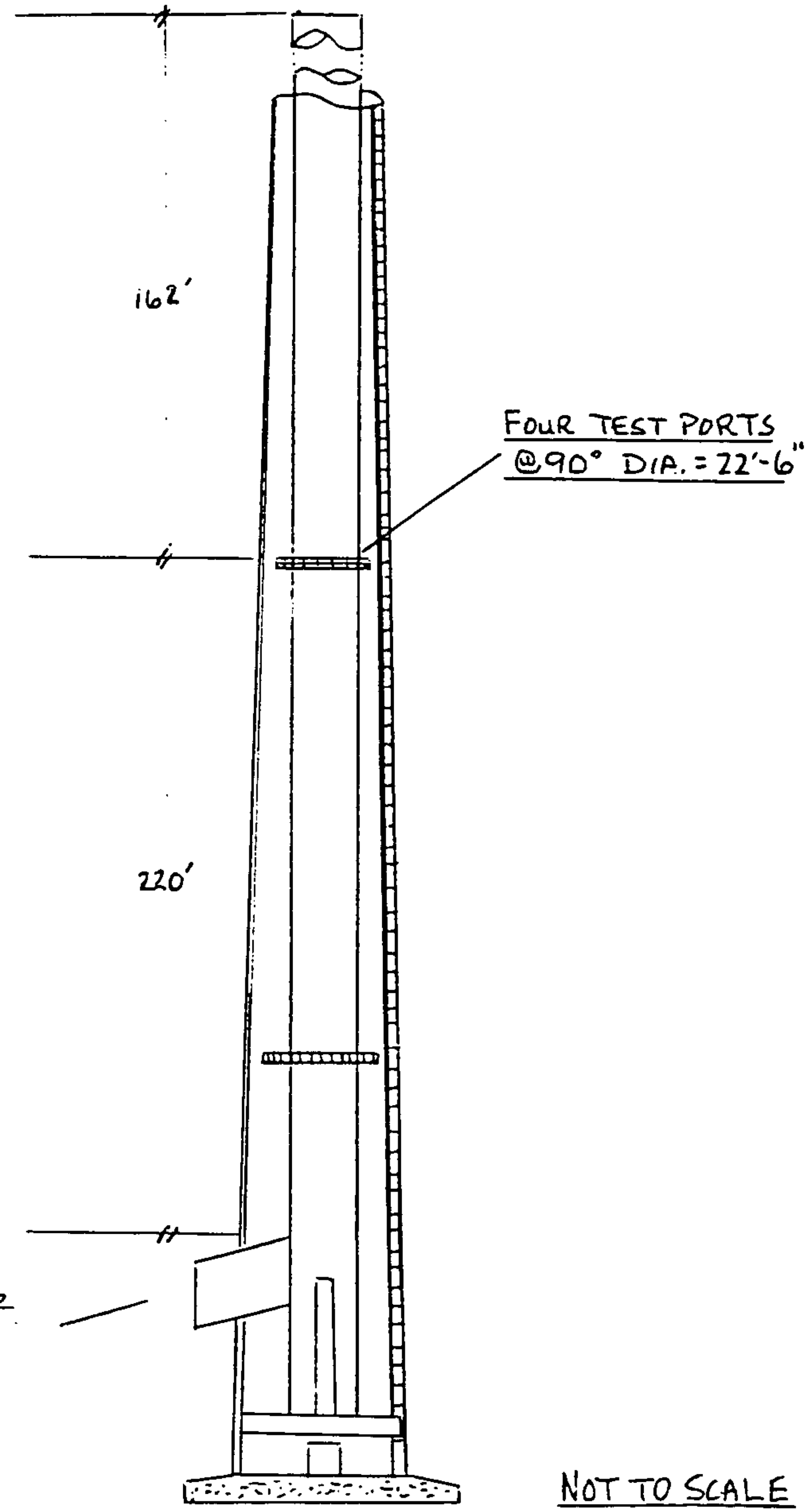
Date of Determination............	11-05-91
Time of Determination.......(HRS)	840
Barometric pressure.......(IN.HG)	29.17
Pitot tube coefficient...........	.84
Number of sampling ports.........	6
Total number of points...........	48
Shape of duct....................	Rectangular
Duct width..................(IN)	76.5
Duct length.................(IN)	672
Duct area................(SQ.FT)	357.00
Direction of flow................	UP
Static pressure..........(IN.WC)	-9.100001
Avg. gas temp............(DEG-F)	312
Moisture content..........(% V/V)	10.83
Avg. linear velocity.....(FT/SEC)	36.2
Gas density..............(LB/ACF)	.04916
Molecular weight......(LB/LBMOLE)	30.38
Mass flow of gas..........(LB/HR)	2285381
Volumetric flow rate.............	
actual..................(ACFM)	774850
dry standard...........(DSCFM)	450328

APPENDIX B

LOCATION OF TEST PORTS

NORTHERN STATES POWER

BLACK DOG STATION - UNITS 1-4



NOT TO SCALE

1/91 DHD

APPENDIX C

FIELD DATA SHEETS

TABLE OF CONTENTS

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Total 60" x 560"

Job N.S.P. Black Dog Station

Source Inlet - Boiler #1

Test 1 Runs (1-3) Date 11/5/91

Stack dimen. 60" x 280" (½) IN.

Dry bulb _____ °F Wet bulb _____ °F

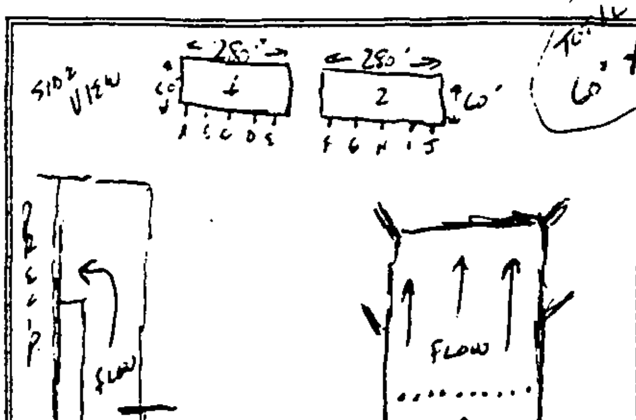
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 29.13 in Hg

Static pressure -7.0 in WC

Operators D. Brennan & G. Hovs

Pitot No. 24-6 Cp .84



Schematic of Cross Section

Page 1

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length: 9 in.		Time start: 910 hrs	
A	1		7.5	16.5	.13	362
	2		22.5	31.5	.12	
	3		37.5	46.5	.10	364
	4		52.5	61.5	.08	
B	1				.31	364
	2				.17	
	3				.16	366
	4				.10	
C	1				.24	366
	2				.16	
	3				.10	367
	4				.07	
D	1				.28	364
	2				.17	
	3				.15	365
	4				.16	
E	1				.23	366
	2				.22	
	3				.25	390
	4				.25	
F	1				.56	406
	2				.34	
	3				.28	407
	4				.15	
Temp. meas. tool & S/N: #2					Time end: hrs	

R or nothing= reg. manometer; S= expanded; E = electronic S-392.1

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job NSP Black Dog

Source No. 1 Boiler Inlet

Test 1 Run ____ Date ________

Stack dimen. ________ IN.

Dry bulb ____ °F Wet bulb ____ °F

Manometer: ☐ Reg. ☐ Exp. ☐ Elec.

Barometric pressure ______ in Hg

Static pressure ______ in WC

Operators ________

Pitot No. ______ Cp ______

See page 1

Schematic of Cross Section

Page 2

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length: in.		Time start: hrs	
G	1				.16	388
	2				.19	
	3				.14	390
	4				.12	
H	1				.47	393
	2				.28	
	3				.20	392
	4				.17	
I	1				24	364
	2				.18	
	3				.16	362
	4				.12	
J	1				.54	364
	2				.33	
	3				.25	363
	4				.14	
~~K~~	~~1~~					
	~~2~~					
	~~3~~					
	~~4~~					
~~L~~	~~1~~					
	~~2~~					
	~~3~~					
	~~4~~					
Temp. meas. tool & S/N:					Time end: 940 hrs	

R or nothing= reg. manometer; S= expanded; E = electronic S-392.1

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job N.S.P. BLACK DOG Date 11/5/91 Test 1 Run 1

Source INLET - BOILER #1 No. of traverse points 40

Method ~~5~~ M5 SS Filter holder: ~~SS THIMBLE~~ HOLDER Filter type: SS. THIMBLE

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac)

Posttest: .00 cfm at 16 in. Hg. (vac)

Particulate Catch Data:

No.s of ~~filters~~ SS. THIMBLE s used: 1 THIMBLE (27)

Recovery solvent(s): MeCl2 ~~acetone~~ FRONT HALF; other(s)

No. of probe wash bottles: 1

Sample recovered by: D.B.

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1	600	477	123.0
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1439	1420	19
Total			142

Integrated Gas Sampling Data:

Bag Pump No. B-2 Box No. 1 Bag No. 1

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: .00 cc/min at 15 in. Hg.

Time start: 1040 (HRS) Time end: 1300 (HRS)

Sampling rate: 200 cc/min Operator: D.B.

S/N of O_2 Analyzer used to monitor train outlet: #11

CF-023

S-0046RR

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: N.S.P. - Black Dog
Source: Exist - Boiler #1
Date: 1/15/91 Test: 1 Run: 1

Operators: D.B. & G.H.
Meter Box No.: 7 ΔH@: 1.83 IN WC
Gasmeter coeff.: 1.0052

Pitot No.: 24-6 Cp: .84
Bar. Press.: 29.13 inHg H2O x
Nozzle No.: 1-5 Nozzle Dia: .312 IN.

PAGE 1

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	1040	768.00											
A- 1	3	769.43	.11	.65	769.41	3.5	362	253	251	42	101	100	7.9
2	6	769.97	.02	.11	769.99	1.0	375	255	250	43	101	101	7.0
3	9	771.29	.10	.57	771.30	3.0	373	254	250	43	103	101	6.3
4	12	772.828	.14	.80	772.84	4.0	371	256	248	43	105	102	6.6
B- 1	15	775.16	.32	1.84	775.19	8.0	363	259	245	45	108	104	7.2
2	18	776.61	.12	.69	776.63	4.5	371	260	246	45	108	104	7.1
3	21	777.79	.08	.46	777.81	3.5	372	260	247	45	109	104	7.0
4	24	778.536	.03	.17	778.53	2.0	368	261	248	46	108	105	7.3
C- 1	27	780.55	.23	1.34	780.54	6.5	360	258	248	46	110	105	7.5
2	30	781.82	.09	.52	781.79	4.0	371	257	249	46	110	105	7.8
3	33	783.31	.13	.75	783.29	4.5	370	258	248	46	111	106	7.8
4	36	784.503	.08	.46	784.48	3.5	368	256	250	47	111	106	7.5
D- 1	39	786.86	.32	1.86	786.85	8.0	364	257	250	47	113	107	6.3
2	42	788.34	.13	.73	788.34	4.5	393	256	251	47	112	107	6.4
3	45	790.26	.21	1.20	790.25	6.5	378	254	253	47	111	107	7.0
4	48	792.264	.24	1.35	792.27	7.0	389	255	251	48	112	107	6.5
E- 1	51	795.16	.50	2.85	795.20	14.0	379	254	251	48	113	108	6.0
2	54	797.80	.41	2.28	797.82	11.0	405	256	252	48	114	108	6.0
3	57	800.12	.32	1.79	800.15	8.5	401	256	252	50	114	108	5.9
4	60	802.164	.23	1.32	802.15	7.5	375	257	252	50	114	108	6.3
F- 1	63	804.15	.22	1.29	804.13	7.5	361	256	251	50	113	108	6.8
2	66	806.14	.23	1.31	806.12	8.0	382	256	250	52	115	109	7.2
3	69	808.07	.21	1.21	808.04	7.0	378	258	246	52	114	109	7.3
4	72	810.053	.23	1.34	810.06	8.0	365	257	247	52	115	109	8.2
	θ =	Vm =		ΔH =							Avg. =		

PAGE 1 OF 2

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Black Dog
Source No. 1 Boiler Inlet
Date 11-5-91 Test 1 Run 1

Operators DB + Git
Meter Box No. ____ ^H@ ____ IN WC
Gasmeter coeff. ____
Pitot No. ____ Cp ____
Bar. Press. ____ inHg H2O ____ x
Nozzle No. ____ Nozzle Dia ____ IN.

Page 2

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (x v/v)
			810.053											
G-	1	75	812.69	.24	1.38	812.11	8.0	376	258	249	53	115	109	6.7
	2	78	813.73	.16	.90	813.76	5.5	398	255	253	54	115	109	6.1
	3	81	815.16	.12	.67	815.20	5.0	400	254	252	54	115	110	6.5
	4	84	816.858	.15	.88	816.84	6.0	358	255	249	54	115	110	6.9
H-	1	87	818.85	.24	1.39	818.89	8.0	363	254	250	54	116	110	6.2
	2	90	820.88	.23	1.30	820.89	7.5	400	254	251	55	116	111	6.0
	3	93	822.47	.14	.79	822.44	5.0	399	253	253	55	116	111	6.1
	4	96	823.922	.125	.71	823.91	5.0	394	251	255	55	116	111	6.4
I-	1	99	826.33	.33	1.92	826.32	9.0	370	254	251	56	117	112	7.9
	2	102	828.31	.22	1.27	828.30	7.5	375	252	253	56	117	112	7.3
	3	105	830.05	.17	.98	830.03	6.0	377	252	254	56	117	112	7.2
	4	108	831.573	.13	.75	831.55	5.0	372	253	255	56	116	111	7.0
J-	1	111	833.91	.31	1.82	833.90	8.5	363	251	253	57	117	112	8.2
	2	114	835.77	.19	1.10	835.74	7.0	375	252	254	57	117	112	7.9
	3	117	837.54	.18	1.04	837.52	6.5	377	250	256	58	118	112	7.4
	4	120	839.227	.16	.93	839.21	6.0	369	248	251	58	118	112	8.2
		θ = 120	Vm = 71.227		^H = 1.12							Avg. = 110.2		

PAGE 2 of 2

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job N.S.P. Black Dog
Source Boiler #1 Inlet
Method 4.MSSS Filter holder: SS. Thimble
Date 11/5/91 Test 1 Run 2
No. of traverse points
Filter type: SS. Thimble

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac)
Postest: .00 cfm at 15 in. Hg. (vac)

Particulate Catch Data:

No.s of ~~filters~~ thimbles used: SS Thimble (8)

Recovery solvent(s): ~~acetone~~ MeCl₂ Front Half; other(s)

No. of probe wash bottles: 1
Sample recovered by: D.B.

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	625	480	145.0
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1355	1334	21.0
Total			166.0

Integrated Gas Sampling Data:

Bag Pump No. B-2 Box No. 1 Bag No. 2

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: .00 cc/min at 15 in. Hg.

Time start: 1350 (HRS) Time end: 1605 (HRS)

Sampling rate: 200 cc/min Operator: DB

S/N of O_2 Analyzer used to monitor train outlet: 11

CF-023

S-0046RR

CF-D11

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP BLACKDOG
Source BOILER #1 INLET
Date ~~11-9-91~~ 11/5/91 Filter 1 Run 2

Operators D.B. & GH
Meter Box No. 7 ^H@ 1.83 IN WC
Gasmeter coeff. 1.0056
PAGE 1

Pitot No. 24-6 Cp
Bar. Press. 29.13 inHg H2O x
Nozzle No. 1-5 Nozzle Dia .313 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Gas/In (°F)	Gas/Out (°F)	Oxygen (%v/v)
	1350	839.50											
A-1	3	841.12	.15	.85	841.11	5.0	362	243	263	48	108	108	8.3
2	6	842.31	.08	.45	842.28	3.5	357	244	261	48	109	108	7.6
3	9	843.88	.15	.84	843.88	5.0	360	245	260	48	110	109	7.5
4	12	845.546	.16	.91	845.54	5.5	354	245	261	46	112	109	8.2
B 1	15	847.63	.25	1.41	847.61	7.0	364	246	262	46	113	110	8.0
2	18	849.30	.16	.90	849.26	6.0	367	245	262	46	114	110	7.8
3	21	850.51	.095	.53	850.53	4.0	375	247	263	46	114	110	7.2
4	24	851.122	.02	.11	851.12	2.0	372	246	264	46	113	110	6.3
C-1	27	852.49	.11	.62	852.49	4.5	366	248	261	46	113	110	7.5
2	30	854.40	.22	1.24	854.43	7.0	367	249	262	46	116	111	7.4
3	33	855.67	.09	.51	855.68	4.5	361	247	262	45	116	110	7.8
4	36	856.887	.08	.45	856.86	4.0	360	248	264	45	115	111	8.2
D-1	39	858.83	.21	1.24	858.80	7.5	368	250	264	45	116	111	6.2
2	42	859.91	.07	.38	859.88	3.5	393	252	265	45	116	111	6.3
3	45	861.40	.13	.71	861.36	4.5	388	251	266	46	116	111	6.4
4	48	862.861	.13	.73	862.85	5.0	373	252	265	46	117	111	6.4
E 1	51	865.01	.27	1.49	864.99	8.0	384	250	265	46	117	111	5.9
2	54	867.05	.25	1.36	867.02	8.0	398	252	264	47	117	112	6.0
3	57	868.95	.22	1.20	868.93	7.0	399	251	261	47	117	112	6.1
4	60	871.016	.25	1.37	870.98	8.0	394	250	262	47	118	112	6.5
F 1	63	872.64	.16	.89	872.63	6.0	376	250	262	47	116	112	6.9
2	66	874.50	.20	1.12	874.48	7.0	375	253	262	48	117	112	7.2
3	69	876.16	.16	.90	876.14	6.5	372	252	261	48	117	112	7.3
4	72	877.813	.16	.90	877.80	6.5	370	253	259	48	117	112	7.5
	θ =	Vm =		^H =							Avg. =		

PAGE 1 OF 2

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job ______ Source ______ Date 11/13/91 Test 1 Run 2

Operators ______ Meter Box No. ______ *H ______ IN WC Gasmeter coeff. ______

Pitot No. ______ Cp ______ Bar. Press. ______ inHg H2O ______ x Nozzle No. ______ Nozzle Dia ______ IN.

PAGE 2

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Gas Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Cas/In	Cas/Out	Oxygen (xv/v)
G-	1	75	879.29	.13	.71	879.28	5.5	389	254	260	48	116	112	6.2
	2	78	881.04	.19	1.04	881.06	6.5	394	253	261	50	116	112	6.0
	3	81	882.53	.125	.68	882.50	5.5	395	253	259	51	117	112	6.2
	4	84	883.963	.13	.71	883.98	5.5	389	251	260	51	117	112	7.2
H	1	87	885.39	.12	.67	885.42	5.5	375	251	261	51	117	112	6.0
	2	90	886.75	.11	.60	886.77	5.0	398	253	261	51	117	112	6.2
	3	93	888.22	.12	.65	888.19	5.5	396	255	260	53	117	112	6.5
	4	96	889.625	.12	.66	889.61	5.5	391	256	258	54	117	112	6.8
I	1	99	891.21	.15	.83	891.20	6.5	384	255	259	54	117	112	7.9
	2	102	893.16	.22	1.23	893.14	8.0	378	254	260	54	118	113	8.1
	3	105	894.75	.15	.85	894.75	7.0	369	251	259	54	118	113	7.7
	4	108	896.233	.13	.74	896.25	6.0	361	250	261	54	118	113	7.6
J	1	111	898.34	.24	1.38	898.31	8.0	353	250	260	55	118	113	8.0
	2	114	900.06	.17	.97	900.04	6.5	357	248	259	55	118	113	7.8
	3	117	902.01	.23	1.29	902.02	8.0	372	246	256	56	118	113	7.6
	4	120	904.685	.31	1.75	904.34	9.5	368	245	253	56	118	113	7.3
		(1605)												
		θ 120	65.105		H .90							Avg. = 113.5		

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job N.S.P. Black Dog Date 11/5/91 Test 1 Run 3
Source Boiler #1 Inlet No. of traverse points
Method YMS SS Filter holder: SS Thimble Holder Filter type: SS Thimble

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac)
Postest: .00 cfm at 14 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: (1) Thimble # 32

Recovery solvent(s): ~~acetone~~ $MeCl_2$ Front Half
other(s)

No. of probe wash bottles: (1)
Sample recovered by: D.B.

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	640	482	158
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant		~~1357~~	
	1359	1332	27.0
Total			185

Integrated Gas Sampling Data:

Bag Pump No. B-2 Box No. 1 Bag No. 3

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: .00 cc/min at 16 in. Hg.

Time start: 1710 (HRS) Time end: 1920 (HRS)

Sampling rate: 200 cc/min Operator: D.B.

S/N of O_2 Analyzer used to monitor train outlet: 11

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job N.S.P. Buck Dog
Source Boiler #1 Inlet
Date 11/3/91 Test 1 Run 3

Operators D.B. & G.H.
Meter Box No. 7 ΔH@ 1.83 IN WC
Gasmeter coeff. 1.005C

PAGE 1

Pitot No. 24-6 Cp .84
Bar. Press. 29.13 inHg H2O x
Nozzle No. 1-5 Nozzle Dia .312 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Cas/In (°F)	Cas/Out (°F)	Oxygen (xv/v)
	(1710)	905.00											
A- 1	3	906.43	.12	.65	906.41	4.0	376	240	259	56	109	109	8.2
2	6	908.20	.20	1.06	908.20	4.5	379	241	261	56	110	109	8.0
3	9	910.49	.33	1.75	910.50	6.5	380	245	263	52	112	110	7.6
4	12	912.118	.16	.85	912.11	4.0	378	244	262	52	112	110	7.4
B- 1	15	914.38	.32	1.70	914.39	7.0	381	243	264	52	114	110	7.8
2	18	916.50	.27	1.43	916.47	6.0	386	245	265	50	115	110	7.3
3	21	917.62	.08	.42	917.60	3.0	395	249	264	50	114	110	7.3
4	24	919.542	.23	1.22	919.53	6.0	383	250	264	50	116	111	7.3
C- 1	27	921.46	.22	1.18	921.43	6.0	375	252	262	50	116	111	7.6
2	30	923.64	.30	1.60	923.64	7.0	384	253	263	49	117	112	8.0
3	33	924.93	.10	.53	924.91	4.0	391	254	265	49	116	111	8.1
4	36	926.130	.09	.47	926.12	3.5	390	251	264	48	116	111	7.7
D- 1	39	928.29	.30	1.59	928.32	7.0	388	252	265	48	117	112	6.6
2	42	929.67	.12	.61	929.69	4.0	418	254	264	48	117	112	6.6
3	45	931.05	.12	.62	931.07	4.0	415	253	264	45	117	112	6.7
4	48	932.328	.10	.52	932.33	3.5	409	253	261	45	117	112	6.7
E- 1	51	934.72	.37	1.95	934.76	8.0	395	255	263	45	118	113	6.2
2	54	936.75	.26	1.33	936.78	7.0	425	255	264	45	118	113	6.3
3	57	938.87	.28	1.42	938.86	7.5	427	254	263	46	118	113	6.3
4	60	940.563	.18	.93	940.55	5.0	416	252	263	46	118	113	6.6
F- 1	63	943.54	* .57	3.02	943.55	11.5	390	251	264	46	119	113	6.9
2	66	945.11	.14	.73	945.08	4.5	402	250	265	46	117	113	7.1
3	69	946.86	.20	1.05	946.87	5.0	396	252	266	46	117	113	7.3
4	72	948.448	.15	.79	948.44	4.5	390	252	265	48	118	113	7.3
	Θ =	Vm =		ΔH =							Avg. =		

CF-D11

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job ____ Source ____ Date ____ Test 1 Run 3

Operators ____ Meter Box No. ____ ^H@ ____ IN WC Computer coeff. ____

PAGE 2

Pitot No. ____ Cp ____ Bar. Press. ____ inHg H2O ____ x Nozzle No. ____ Nozzle Dia ____ IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Cos/In	Cos/Out	Oxygen (%v/v)
		948.448											
G- 1	75	950.11	.17	.92	950.12	5.5	372	252	264	49	117	113	7.0
2	78	951.40	.10	.52	951.38	4.0	410	250	263	49	118	113	6.3
3	81	952.91	.15	.78	952.93	5.0	406	251	263	50	118	113	6.1
4	84	954.522	.16	.84	954.53	5.5	398	250	262	50	119	114	6.3
H- 1	87	955.85	.10	.54	955.82	4.5	379	248	261	50	118	114	6.2
2	90	957.50	.17	.89	957.47	5.5	404	246	260	52	119	114	5.8
3	93	959.04	.15	.78	959.02	5.0	403	246	260	52	119	114	5.9
4	96	960.592	.15	.79	960.58	5.0	396	245	260	53	119	114	6.1
I- 1	99	963.06	.38	2.03	963.07	9.5	385	245	259	53	120	115	7.5
2	102	965.31	.30	1.62	965.30	8.0	379	246	255	53	120	114	7.4
3	105	967.05	.18	.97	967.03	6.0	377	244	254	53	119	114	7.2
4	108	968.629	.15	.81	968.61	5.0	372	243	253	54	119	114	7.1
J- 1	111	969.98	.11	.60	969.97	4.5	365	242	250	54	118	114	7.3
2	114	971.93	.22	1.21	971.90	7.0	361	240	246	54	119	114	7.5
3	117	973.65	.18	.98	973.63	6.0	369	239	245	55	119	114	7.3
4	120	975.309	.17	.92	975.32	5.5	372	238	243	55	119	114	7.3
	(1920)												
	θ = 120	Vm = 70.309		^H = 1.07							Avg. = 114.7		

S-0037R

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INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job NSP Blackdog / Mpls, MN

Source No. 3 Boiler / Inlet

Test 1 Run 0 Date 11-5-91

Stack dimen. 48.5 X 661 IN.

Dry bulb 325 °F Wet bulb -- °F

Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

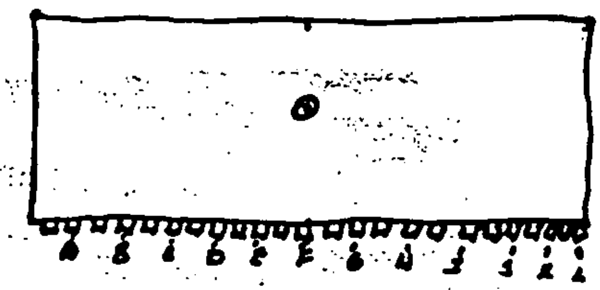
Barometric pressure 29.07 in Hg

.6 Hg Static pressure -8.16 in WC

Operators M. Kuehler + P. O'Neill

Pitot No. 21V-6 Cp .84

Should use a 5 ft. probe



Schematic of Cross Section

	Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length: 9 in.		Time start: 0930 hrs	
S- .210	A - 1		6.06	15.06	.185	
.260	2		18.19	27.19	.187	
.325	3		30.31	39.31	.159	
.400	4		42.44	51.44	.245	
1- .320	B - 1				.068	
.360	2				.050	
.390	3				.030	
.410	4				.015	325
8- .045	C - 1				.46	
.035	2				.53	
.080	3				.57	
.275	4				.57	
3- .400	D - 1				.100	
.310	2				.095	
.280	3				.110	
.310	4				.160	
1- .350	E - 1				.060	
.370	2				.040	
.395	3				.075	
.410	4				.180	
8- .040	F - 1				.140	
.055	2				.170	
.040	3				.212	
.035	4				.255	
	Temp. meas. tool & S/N:		PDT-19 / TC		Time end:	hrs

R or nothing= reg. manometer; S= expanded; E = electronic S-392.1

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Blackdog / Mpls, MN
Source No. 3 Boiler / Inlet
Method 5 + 4 Mass Filter holder: S.S.

Date 11-5-91 Test 1 Run 1
No. of traverse points 48
Filter type: S.S. Thimbel

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: <0.01 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 17

Recovery solvent(s)
☐ acetone
☒ other(s) $MeCl_2$

No. of probe wash bottles: 1
Sample recovered by: M. Koehler + P. O'Neill

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	606	489	117
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1406	1379	27
Total			144

Integrated Gas Sampling Data:

Bag Pump No. 13 B Box No. 10 Bag No. 1

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1040 (HRS) Time end: 1304 (HRS)

Sampling rate: 200 cc/min Operator: M. Koehler

S/N of O_2 Analyzer used to monitor train outlet: 3

CF-023

S-0046RR

Pg. 1 of 2

CF-D11

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP / Black Dog
Source No. 3 Boiler / Inlet
Date 11-5-91 Test 1 Run 1

Operators M. Kaehler + P O'Neill
Meter Box No. 6 ^H@ 1.82 IN WC
Gasmeter coeff. .9992

Pitot No. 21V-6 Cp .84
Bar. Press. 29.07 inHg H2O 10 %
Nozzle No. 2-3 Nozzle Dia .294 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	(1040)	144.25											
A - 4	2.5	145.46	.16	.73	5.46	3	285	237	245	43	78	77	9.6
3	5	146.62	.14	.61	6.58	3	320				79	77	8.9
2	7.5	147.84	.17	.74	7.81	3.5	325	234	243	41	80	77	9.0
1	10	149.09	.19	.84	9.12	4	318				82	78	9.2
B - 4	12.5	149.43	.01	.04	9.42	2	275	235	246	40	79	77	9.2
3	15	149.79	.015	.06	9.79	2	325				79	77	8.8
2	17.5	150.62	.09	.39	0.69	3	325	233	244	40	81	78	9.4
1	20	151.37	.06	.26	1.42	2.5	328				82	78	10.9
C - 4	22.5	153.79	.66	2.90	3.84	10	321	239	244	40	80	79	8.4
3	25	156.17	.62	2.74	6.20	9.5	322				87	81	8.3
2	27.5	158.35	.57	2.44	8.43	9	347	240	246	41	89	81	8.2
1	30	160.30	.35	1.68	0.28	7	347				90	81	8.2
D - 4	32.5	161.68	.22	.95	1.68	5	345	240	249	41	87	81	8.2
3	35	162.79	.13	.56	2.75	4	345				89	81	7.3
2	37.5	163.68	.09	.38	3.65	3	348	238	247	40	89	82	7.2
1	40	164.63	.10	.42	4.59	3.5	350				89	82	7.9
E - 4	42.5	165.93	.19	.81	5.88	4.5	356	235	245	40	89	83	7.5
3	45	166.90	.11	.46	6.86	3	362				91	83	7.3
2	47.5	167.39	.03	.12	7.37	2	359	235	243	41	89	83	7.3
1	50	167.79	.01	.04	7.67	2	355				88	83	7.3
F - 4	52.5	169.12	.21	.90	9.03	4.5	349	237	244	42	90	84	7.8
3	55	170.48	.21	.90	0.40	4.5	352				93	85	7.1
2	57.5	171.62	.16	.69	1.59	4	354	239	246	42	93	85	7.1
1	60	172.95	.14	.60	2.71	4	354				93	85	7.3
	θ =	Vm =		^H =							Avg. =		

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Blackdog / Mpls, MN
Source No. 3 Boiler / Inlet
Date 11-5-91 Test 1 Run 1

Operators Mulacker & P O'Neill
Meter Box No. 6 ^H@ 1.86 IN WC
Gasmeter coeff. .9992

Pitot No. 21V-8 Cp .84
Bar. Press. 29.07 inHg H2O 10 x
Nozzle No. 2-5 Nozzle Dia .294 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Cas/In (°F)	Cas/Out (°F)	Oxygen (xv/v)
G-4	62.5	174.62	.38	1.64	4.55	7	349	239	245	42	94	86	7.7
3	65	176.30	.30	1.32	6.21	6.5	338				96	87	7.8
2	67.5	177.78	.24	1.08	7.71	5	319	241	245	43	96	87	7.9
1	70	178.99	.16	.72	8.93	4	322				96	88	8.1
H-4	72.5	180.85	.41	1.84	0.89	8	325	240	247	43	95	88	7.3
3	75	182.79	.43	1.93	2.88	8	325				98	89	7.3
2	77.5	184.68	.37	1.65	4.74	7.5	330	242	246	42	99	89	7.7
1	80	186.41	.31	1.40	6.45	7	325				99	90	7.7
I-4	82.5	187.90	.24	1.09	7.95	6	321	239	249	42	96	89	7.5
3	85	189.55	.26	1.17	9.51	6	315				98	90	7.8
2	87.5	190.43	.08	.36	0.38	3	318	238	251	42	97	90	8.1
1	90	191.27	.05	.22	1.07	2.5	318				96	90	8.0
J-4	92.5	192.99	.37	1.68	2.95	7	315	235	250	42	96	90	8.4
3	95	194.81	.35	1.58	4.76	7	319				99	91	7.9
2	97.5	196.77	.39	1.80	6.70	7.5	305	237	252	42	99	91	7.9
1	100	198.02	.45	2.07	8.78	8.5	308				100	92	8.1
K-4	102.5	200.72	.35	1.61	0.61	7.5	311	237	250	43	100	92	7.8
3	105	202.60	.37	1.71	2.50	7.5	308				101	92	7.7
2	107.5	204.58	.40	1.84	4.46	8	312	240	247	43	101	92	8.0
1	110	206.46	.39	1.79	6.40	7.5	312				101	92	8.0
L-4	112.5	207.27	.06	.28	7.13	3	305	238	245	43	96	91	8.1
3	115	207.95	.05	.23	7.87	2.5	294				96	91	8.8
2	117.5	208.60	.05	.23	8.57	2.5	295	235	246	43	95	91	8.7
1	120	209.23	.04	.18	9.19	2.5	294				95	91	8.8
	(1304)												
	θ = 120	Vm = 64.98		^H 1.04							Avg. = 88.5		

C-15

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Blackdog / Mpls, MN
Source No. 3 Boiler / Inlet
Method 5 / 17 / 5 Filter holder: S.S.

Date 11-5-91 Test 1 Run 2
No. of traverse points 48
Filter type: S.S. Thimbel

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: < 0.01 cfm at 12 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: 35

Recovery solvent(s)
☐ acetone
☒ other(s) MeCl2

No. of probe wash bottles: 1
Sample recovered by: M. Koehler + P. O'Neill

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	627	489	138
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1440	1420	20
Total			158

Integrated Gas Sampling Data:

Bag Pump No. 138 Box No. 10 Bag No. 2

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1350 (HRS) Time end: 1510 (HRS)

Sampling rate: 200 cc/min Operator: M. Koehler

S/N of O_2 Analyzer used to monitor train outlet: 3

CF-023

S-0046RR

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Blackdog / Mpls, MN
Source No. 3 Boiler / Inlet
Date 11-5-91 Test 1 Run 2

Operators M. Kaehler + P. O'Neill
Meter Box No. 6 ^H@ 1.82 IN WC
Gasmeter coeff. .9992

Pitot No. 21V-6 Cp .84
Bar. Press. 29.07 inHg H2O 10 x
Nozzle No. 2-3 Nozzle Dia. .249 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	(1350)	209.80											
A - 4	2.5	211.24	.21	.94	1.19	3.5	322	234	243	45	81	82	9.7
3	5	212.37	.13	.57	2.27	3	321				82	82	9.4
2	7.5	213.39	.11	.48	3.27	2.5	321	237	241	44	83	82	9.2
1	10	214.60	.17	.74	4.51	3	330				85	82	9.1
B - 4	12.5	214.99	.02	.08	4.93	2	330	237	242	43	83	81	9.1
3	15	215.52	.03	.13	5.45	2	328				83	81	8.6
2	17.5	216.20	.05	.22	6.13	2	328	238	244	43	84	81	8.3
1	20	216.92	.06	.26	6.86	2	328				85	82	8.3
C - 4	22.5	219.29	.63	2.78	9.24	9	325	241	248	42	88	83	7.7
3	25	221.70	.67	2.97	1.70	9	324				89	83	7.7
2	27.5	223.99	.58	2.52	3.97	9	335	241	250	42	89	83	7.7
1	30	225.99	.43	1.86	5.92	7	346				90	83	8.0
D - 4	32.5	227.22	.18	.78	7.19	4	344	242	248	42	88	83	8.0
3	35	228.43	.15	.64	8.34	3.5	359				90	83	6.9
2	37.5	229.45	.12	.51	9.37	3	358	240	245	43	90	84	7.2
1	40	230.33	.09	.38	0.26	2.5	362				90	83	7.2
E - 4	42.5	231.66	.20	.85	1.58	4	356	238	246	43	90	83	7.6
3	45	232.72	.12	.51	2.61	3	352				91	84	7.1
2	47.5	233.48	.07	.29	3.40	2	361	240	245	42	91	84	7.1
1	50	233.97	.03	.12	3.92	2	359				89	84	7.2
F - 4	52.5	235.34	.21	.91	5.28	4	348	237	247	41	90	84	8.6
3	55	236.70	.20	.85	6.61	4	360				92	85	7.1
2	57.5	237.89	.17	.72	7.83	3.5	361	237	246	41	92	85	7.2
1	60	238.89	.12	.51	8.87	3	355				92	85	7.2
	θ =	Vm =		^H =							Avg. =		

S-0037R

pg 242

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Blackdog / Mpls, MN
Source No. 3 Boiler / Inlet
Date 11-5-91 Test 1 Run 2

Operators Millgehler + P. O'Neill
Meter Box No. 6 ΔH@ 1.82 IN WC
Gasmeter coeff. .9992

Pitot No. 21V-6 Cp .84
Bar. Press. 29.07 inHg H2O 10 x
Nozzle No. 2-5 Nozzle Dia. .249 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
G-4	62.5	240.72	.37	1.60	0.68	6.5	348	237	245	41	91	84	7.5
3	65	242.48	.32	1.43	2.40	6	324				91	84	7.7
2	67.5	243.99	.25	1.12	3.92	5	320	235	243	42	91	84	8.0
1	70	245.18	.15	.66	5.09	4	331				91	84	8.2
H-4	72.5	247.12	.42	1.84	7.04	7	335	238	246	42	91	84	7.8
3	75	248.99	.39	1.71	8.92	7	335				93	85	7.8
2	77.5	250.82	.36	1.58	0.72	7	340	240	245	42	94	85	7.5
1	80	252.49	.30	1.33	2.38	6	329				94	85	7.9
I-4	91.5	253.99	.25	1.12	3.90	5	325	243	247	42	91	84	7.9
3	95	255.21	.15	.67	5.08	4	321				93	85	8.0
2	87.5	255.94	.07	.31	5.89	2	320	242	250	43	91	84	8.4
1	90	256.34	.02	.09	6.32	2	317				89	84	9.2
J-4	92.5	257.96	.28	1.25	7.93	5.5	318	238	252	44	91	85	9.7
3	95	259.61	.31	1.39	9.62	6	318				94	86	7.8
2	97.5	261.48	.38	1.72	1.51	7	314	238	251	44	96	87	7.8
1	100	263.46	.42	1.91	3.50	8	314				97	87	7.8
K-4	102.5	265.38	.39	1.76	5.41	7.5	320	240	250	43	97	88	7.9
3	105	267.33	.40	1.81	7.35	8	317				98	88	7.7
2	107.5	269.32	.42	1.89	9.33	8	325	238	247	43	98	88	7.9
1	110	271.22	.42	1.89	1.31	8	325				98	89	7.9
L-4	112.5	272.05	.06	.27	2.07	3	310	241	245	45	93	88	8.1
3	115	272.05	.06	.28	2.83	3	295				93	88	8.5
2	117.5	273.66	.05	.23	3.53	3	295	242	248	45	92	88	8.6
1	120	274.27	.04	.18	4.15	2	295				92	87	9.3
	(1510)												
[redacted]	Θ [redacted] 0	[redacted] = [redacted] 17	[redacted]	^H [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Avg.	= 87.4	

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Blackdog / Mpls, MN Date 11-5-91 Test 1 Run 3
Source No. 3 Boiler / Inlet No. of traverse points 48
Method 5+4M-Filter holder: S.S. Filter type: S.S. Thimbel

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Postest: ____ cfm at ____ in. Hg. (vac) ☐

Particulate Catch Data:

No.s of filters used: 40

Recovery solvent(s): ☐ acetone ☑ other(s) $MeCl_2$

No. of probe wash bottles: 1
Sample recovered by: M. Kaehler + P O'Neill

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1	613	491	122
Impinger No. 2			
Impinger No. 3			
Condenser			
Desiccant	1458	1435	23
Total			145

Integrated Gas Sampling Data:

Bag Pump No. B8 Box No. 10 Bag No. 3

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1710 (HRS) Time end: 1927 (HRS)

Sampling rate: 200 cc/min Operator: M. Kaehler

S/N of O_2 Analyzer used to monitor train outlet: 3

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Blackdog / Mpls, MN
Source No. 3 Boiler / Inlet
Date 11-5-91 Test 1 Run 1

Operators M. Koehler P. O'Neill
Meter Box No. 6 ΔH@ 1.82 IN WC
Gasmeter coeff. .9992

Pitot No. 21V-6 Cp .84
Bar. Press. 29.07 inHg H2O 11 x
Nozzle No. 2-5 Nozzle Dia .294 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	(1710)	275.00											
A-4	2.5	276.34	.18	.78	6.26	3.5	335	232	241	46	82	82	9.0
3	5	277.46	.14	.59	7.37	3	338				84	83	9.0
2	7.5	278.48	.13	.56	8.44	3	326	235	242	44	85	83	9.1
1	10	279.67	.16	.69	9.63	3.5	332				97	84	9.0
B-4	12.5	280.19	.03	.12	0.15	2	335	238	244	44	85	83	9.0
3	15	280.77	.05	.21	0.81	2	332				87	84	9.1
2	17.5	281.47	.05	.21	1.48	2	332	237	245	43	87	84	8.3
1	20	282.23	.06	.25	2.21	2	339				88	85	9.0
C-4	22.5	284.66	.68	2.90	4.64	10	342	240	244	43	92	86	8.1
3	25	287.02	.64	2.72	7.01	10	347				96	87	7.7
2	27.5	289.30	.58	2.48	9.28	9.5	347	240	247	43	97	88	7.7
1	30	291.23	.39	1.67	1.14	7	348				97	88	7.6
D-4	32.5	292.58	.21	.90	2.51	4.5	345	239	251	43	94	88	7.7
3	35	293.83	.15	.64	3.67	4	345				96	88	7.0
2	37.5	294.70	.10	.42	4.61	3	353	242	246	44	96	88	7.1
1	40	295.59	.08	.33	5.45	3	363				95	88	7.1
w=12" E-4	42.5	296.86	.18	.76	6.71	4	355	240	245	44	94	88	7.4
3	45	297.71	.12	.50	7.73	3.5	348				95	89	7.3
2	47.5	298.55	.07	.29	8.51	3	362	239	248	43	95	89	7.2
1	50	299.18	.05	.20	9.17	2.5	360				94	89	8.3
F-4	52.5	300.60	.23	.96	0.58	5	356	238	251	42	94	89	8.5
3	55	301.93	.20	.83	1.89	4.5	355				97	90	7.4
2	57.5	303.16	.17	.71	3.12	4	349	241	249	42	98	90	7.0
1	60	304.29	.14	.58	4.23	4	354				98	90	7.5
[redacted]	θ [redacted]	[redacted] = [redacted]	[redacted]	^H [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Avg. [redacted]	[redacted]	

S-00270

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Blackdog / Mpls, MN
Source No. 3 Boiler / Inlet
Date 11-5-91 Test 1 Run 3

Operators M. Kaehler + P. O'Neill
Meter Box No. 6 ^H@ 1.92 IN WC
Gasmeter coeff. .9992

Pitot No. 21V-6 Cp .84
Bar. Press. 29.07 inHg H2O 12 x
Nozzle No. 2-5 Nozzle Dia .394 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
88888888888			88888888	8888888	88888	8888	8888888	8888888	888888	888888	888888	8888888	8888888
G-4	62.5	306.17	.41	1.72	6.12	7.5	350	240	247	42	98	90	7.9
3	65	307.99	.36	1.56	7.92	7	328				100	91	7.9
2	67.5	309.66	.28	1.20	9.51	6	337	242	250	42	100	91	8.2
1	70	310.87	.19	.81	0.81	4.5	337				99	91	8.3
H-4	72.5	312.77	.40	1.72	2.71	7.5	333	242	251	43	98	91	7.4
3	75	314.62	.38	1.65	4.56	7.5	327				100	92	7.5
2	77.5	316.38	.33	1.43	6.29	7	327	241	253	43	100	92	7.8
1	80	318.10	.32	1.39	8.00	6.5	326				100	92	7.5
I-4	82.5	319.59	.25	1.09	9.51	6	324	237	251	43	98	91	7.7
3	85	320.20	.11	.48	0.52	3.5	315				98	91	7.7
2	87.5	321.42	.06	.26	1.26	2.5	321	237	248	43	97	91	8.1
1	90	321.95	.04	.17	1.87	2	305				95	90	8.2
J-4	92.5	323.72	.33	1.46	3.62	7	310	239	248	43	97	91	8.2
3	95	325.40	.29	1.28	5.25	6.5	311				99	92	7.7
2	97.5	327.17	.37	1.63	7.10	7	313	236	245	44	100	92	7.7
1	100	328.95	.34	1.50	8.87	7	313				100	92	8.2
K-4	102.5	330.80	.39	1.72	0.72	7.5	314	235	249	44	100	92	8.0
3	105	332.64	.34	1.50	2.54	7	313				100	92	7.2
2	107.5	334.43	.37	1.64	4.39	7.5	313	232	247	43	100	92	7.8
1	110	336.35	.43	1.90	6.39	8	314				101	93	8.0
L-4	112.5	337.21	.07	.31	7.20	3	300	237	250	42	96	91	8.0
3	115	337.93	.05	.22	7.89	2.5	299				95	91	8.7
2	117.5	338.54	.04	.17	8.50	2.5	301	240	250	42	94	90	8.6
1	120	339.17	.04	.17	9.11	2.5	301				94	90	8.5
	(1927)												
88888888888	θ = 120	Vm = 64.17	88888888	^H =	88888	8888	8888888	8888888	888888	888888	Avg. =		8888888

S-0037R

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job N.P-BLACK DOG

Source NO 4 BOILER - INLET

Test 1 Run 1 Date 11-5-91

Stack dimen. 76 1/2 X 336 IN.

Dry bulb ______ °F Wet bulb ______ °F

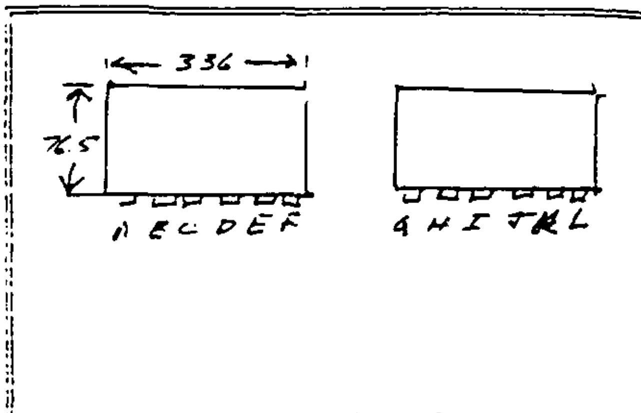
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 29.17 in Hg

Static pressure -9.1 in WC

Operators E.TROWBRIDGE - C.MOSSER

Pitot No. 23V-6 Cp .840



Schematic of Cross Section

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length:	7½ in.	Time start: 0840 hrs	
A	1		9.56	17.06	.45	240
	2		28.68	36.18	.41	292
	3		47.80	55.30	.26	292
	4		66.92	74.42	.21	292
B	1				.22	285
	2				.29	287
	3				.27	287
	4				.25	289
C	1				.27	345
	2				.28	320
	3				.26	318
	4				.26	310
D	1				.20	315
	2				.26	316
	3				.24	316
	4				.14	316
E	1				.30	310
	2				.28	312
	3				.15	315
	4				.10	318
F	1				.34	306
	2				.20	307
	3				.15	310
	4				.10	310
			(CONTINUED)			
Temp. meas. tool & S/N:			PDT-12		Time end:	hrs

R or nothing= reg. manometer; S= expanded; E = electronic S-392.1

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job NSP / BLACKDOG

Source NO 4 BOILER INLET

Test 1 Run 1 Date 11-5-91

Stack dimen. ______ IN.

Dry bulb ____ °F Wet bulb ____ °F

Manometer: ☐ Reg. ☐ Exp. ☐ Elec.

Barometric pressure ______ in Hg

Static pressure ______ in WC

Operators ______

Pitot No. ______ Cp ______

PAGE 2

Schematic of Cross Section

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length:	in.	Time start:	hrs
G	1				.42	298
	2				.30	299
	3				.18	302
	4				.12	312
H	1				.43	315
	2				.52	312
	3				.36	310
	4				.26	305
I	1				.48	306
	2				.45	310
	3				.28	315
	4				.20	318
J	1				.28	322
	2				.30	324
	3				.32	326
	4				.30	328
K	1				.35	322
	2				.30	324
	3				.16	325
	4				.30	325
L	1				.50	324
	2				.40	326
	3				.30	326
	4				.14	328
Temp. meas. tool & S/N:					Time end: 0900	hrs

R or nothing= reg. manometer; S= expanded; E = electronic S-392.

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP/BLACKDOG Date 11-5-91 Test 1 Run 1
Source No4 BOILER No. of traverse points 48
Method 4M5-SS Filter holder: SS-INSTACK Filter type: SS

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac)
Posttest: 0 cfm at 12 in. Hg. (vac)

Particulate Catch Data:

No.s of filters used: SS#9

Recovery solvent(s)
- ☐ acetone
- ☒ other(s) MC

No. of probe wash bottles: 1
Sample recovered by: ET

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		100	
Impinger No. 2	379	100	179
Impinger No. 3		0	
Condenser			
Desiccant	1357	1329	28
Total			207

Integrated Gas Sampling Data:

Bag Pump No. B10 Box No. 5 Bag No. 1

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1141 (HRS) Time end: 1254 (HRS)

Sampling rate: 200 cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 6

CF-023

S-0046RR

CF-D11

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP/BLACK DOG
Source NAV BOILER - INLET
Date 11-5-91 Test 1 Run 1

Operators E.TROWBRIDGE-C.MOSSNC
Meter Box No. 2 ^H@ 1.85 IN WC
Gasmeter coeff. .9959

Pitot No. 23V-6 Cp .840
Bar. Press. 29.17 inHg H2O ____ %
Nozzle No. 8-5 Nozzle Dia .376 IN.

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
		1040	110.50											
L	4	2.5	111.90	.24	1.34	1.94	4.2	320	263	252	40	74	75	2.4
	3	5	114.00	.35	1.90	3.83	7.0	324				76	75	4.0
	2	7.5	116.25	.50	2.69	6.24	8.2	329	265	250	41	76	75	3.9
	1	10	118.50	.55	2.96	8.62	6.3	329				76	75	4.1
K	4	12.5	120.40	.29	1.57	0.39	6.0	325	262	257	41	76	75	4.6
	3	15	121.84	.18	.97	1.78	4.4	329				77	75	4.2
	2	17.5	123.95	.45	2.41	3.97	8.1	334	260	260	42	79	75	4.8
	1	20	125.85	.32	1.72	5.83	6.9	335				80	76	6.3
J	4	22.5	127.80	.37	1.99	7.82	7.0	334	263	262	42	81	76	6.9
	3	25	129.85	.39	2.10	9.87	7.4	335				81	76	4.8
	2	27.5	131.80	.36	1.95	1.85	7.3	330	265	260	41	82	76	5.0
	1	30	133.77	.35	1.91	3.80	7.3	324				82	76	6.2
I	4	32.5	135.40	.24	1.31	5.43	5.8	325	262	263	42	82	77	7.2
	3	35	137.32	.33	1.84	7.35	7.2	307				82	77	4.0
	2	37.5	139.65	.50	2.78	9.71	10.0	310	260	264	44	84	77	8.3
	1	40	142.00	.48	2.66	2.02	10.0	312				84	77	8.5
H	4	42.5	143.81	.28	1.55	3.79	6.8	315	264	267	43	85	78	9.0
	3	45	145.61	.30	1.67	5.62	4.8	314				85	78	8.8
	2	47.5	147.55	.34	1.90	7.57	7.2	310	261	266	44	85	78	6.8
	1	50	149.92	.51	2.85	9.97	10.0	307				85	78	7.5
G	4	52.5	151.20	.12	.67	1.14	3.9	305	263	262	42	85	78	9.4
	3	55	152.53	.16	.91	2.50	4.5	295				85	79	9.8
	2	57.5	154.41	.32	1.82	4.41	7.2	298	263	265	43	85	79	9.6
	1	60	156.65	.42	2.41	6.61	9.0	290				85	79	10.2
F	4	62.5	157.90	.14	.79	7.88		300	264	266	43	85	79	9.8
		θ =	Vm =		^H =							Avg. =		

(CONTINUED)

S-0037R

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP/BLACKDOG
Source No 4 BOILER INLET
Date 11-5-91 Test 1 Run 1

Operators PAGE 2
Meter Box No. "HP" IN WC
Gasmeter coeff.

Pitot No. Cp
Bar. Press. inHg H2O x
Nozzle No. Nozzle Dia IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dec. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
888888888		157.90	8888888	8888888	88888	8888	8888888	8888888	888888	888888	888888	8888888	888888
F — 3	65	159.12	.13	.72	9.09	4.1	317	264	262	44	85	79	8.6
2	67.5	160.78	.27	1.49	0.82	6.0	318				87	80	9.5
1	70	162.80	.38	2.09	2.88	8.0	325	261	264	45	89	80	8.8
E 4	72.5	163.94	.10	.55	3.94	3.8	322				89	80	8.0
3	75	164.95	.08	.45	4.90	3.0	310	260	263	45	89	81	7.6
2	77.5	166.31	.18	1.00	6.32	5.0	322				90	81	7.8
1	80	168.02	.25	1.37	7.99		330	264	262	44	90	81	8.7
D 4	82.5	169.30	.15	.82	9.29	4.2	327				90	81	8.5
3	85	170.90	.22	1.22	0.86	5.5	322	266	263	45	92	82	7.9
2	87.5	172.50	.25	1.38	2.54	6.0	326				93	82	8.6
1	90	174.07	.20	1.11	4.05	5.7	325	265	265	46	93	82	8.6
C 4	92.5	175.75	.24	1.33	5.70	6.0	323				93	82	9.3
3	95	177.41	.26	1.44	7.41	6.1	325	262	267	46	93	82	7.6
2	97.5	179.18	.28	1.56	9.20	6.6	320				93	82	7.5
1	100	180.98	.28	1.57	0.99	6.6	314	260	264	45	93	82	8.1
B 4	102.5	182.65	.25	1.41	2.68	6.4	312				93	82	10.3
3	105	184.40	.24	1.35	4.38	6.3	306	261	262	45	92	83	8.9
2	107.5	185.89	.18	1.03	5.83	5.7	302				92	83	9.5
1	110	187.78	.30	1.71	7.70	7.2	300	260	264	44	92	83	9.2
A 4	112.5	189.54	.28	1.60	9.50	7.0	301				92	83	10.7
3	115	191.07	.20	1.15	1.04	5.9	295	263	265	45	92	83	9.8
2	117.5	193.10	.36	2.07	5.09	9.2	297				92	84	10.5
1	120	195.20	.38	2.20	5.21	9.0	290	262	263	45	92	84	11.0
	1255												
888888888	Θ = [illegible]	Vm = 8[illegible]40	8888888	ΔH = [illegible]	88888	8888	8888888	8888888	888888	888888	Avg. = [illegible]	82.6	888888

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INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP/Black Dog
Source No 4 Boiler
Method 4ms-5s Filter holder: SS
Date 11-5-91 Test 1 Run 2
No. of traverse points 48
Filter type: S.S.

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Posttest: 0 cfm at 15 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: SS #20

Recovery solvent(s)
☐ acetone
☒ other(s) MC

No. of probe wash bottles: 1
Sample recovered by: ET

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1		100	
Impinger No. 2	372	100	172
Impinger No. 3		0	
Condenser			
Desiccant	1445	1424	21
Total			193

Integrated Gas Sampling Data:

Bag Pump No. 810 Box No. 5 Bag No. 2

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1351 (HRS) Time end: 1601 (HRS)

Sampling rate: 200 cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 6

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP/BLACKDOG
Source NO4 BOILER INLET
Date 11-5-91 Test 1 Run 2

Operators ET-CM
Meter Box No. 2 ΔH@ 1.85 IN WC
Gasmeter coeff. .9954

Pitot No. R3V-b Cp .840
Bar. Press. 29.10 inHg H_2O x
Nozzle No. 8-5 Nozzle Dia .300 IN.

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (x v/v)
		1350	195.70											
A	4	2.5	197.48	.25	1.44	7.41	6.2	280	258	262	40	81	80	9.9
	3	5	199.18	.26	1.49	9.14	6.3	277				81	80	8.5
	2	7.5	201.14	.36	2.08	1.19		270	262	263	40	83	80	8.3
	1	10	203.22	.37	2.14	3.26	9.0	268				83	80	10.0
B	4	12.5	205.00	.28	1.55	5.03	7.0	302	265	261	41	84	80	9.6
	3	15	206.74	.26	1.46	6.75	7.0	292				84	80	7.9
	2	17.5	208.38	.22	1.24	8.34	6.5	288	263	262	42	85	80	8.3
	1	20	210.20	.30	1.69	0.19	7.8	289				85	80	8.6
C	4	22.5	211.95	.25	1.39	1.87	7.0	300	264	265	42	86	80	5.7
	3	25	213.60	.27	1.50	3.61	7.1	302				86	81	5.3
	2	27.5	215.43	.27	1.49	5.35	7.2	306	265	264	43	87	81	5.1
	1	30	217.10	.26	1.44	7.06	8.2	303				87	82	5.9
D	4	32.5	218.42	.15	.82	8.55	5.0	320	263	261	43	88	82	6.4
	3	35	219.98	.23	1.26	9.95	6.8	313				89	82	5.6
	2	37.5	221.68	.27	1.48	1.69	7.1	315	261	261	44	90	82	6.2
	1	40	223.22	.20	1.10	3.19	6.4	312				90	82	6.4
E	4	42.5	224.30	.10	.55	4.25	4.0	316	266	260	42	90	82	7.7
	3	45	225.46	.12	.66	5.41	4.9	310				91	83	5.9
	2	47.5	226.90	.18	.98	6.83	6.0	321	265	263	43	92	83	6.0
	1	50	228.53	.25	1.36	8.50	7.5	324				93	83	6.9
F	4	52.5	229.65	.10	.55	9.56	4.6	318	261	260	44	93	83	7.2
	3	55	230.84	.12	.67	0.73	4.7	306				93	83	7.0
	2	57.5	232.41	.22	1.22	2.31	6.7	311	264	263	44	93	83	7.0
	1	60	234.35	.34	1.87	4.27	9.0	315				94	84	7.5
G	4	62.5	235.35	.08	.45	5.25	4.0	295	261	260	43	94	84	8.9
		Θ =	Vm =		ΔH =							Avg. =		

(CONTINUED)

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP / BLACK DOG
Source NO 4 BOILER INLET
Date 11-5-91 Test 1 Run 2

Operators PAGE 2
Meter Box No. ____ ^Hf ____ IN WC
Gasmeter coeff. ____

Pitot No. ____ Cp ____
Bar. Press. ____ inHg H2O ____ x
Nozzle No. ____ Nozzle Dia ____ IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
		235.35											
G - 3	65	236.56	.13	.73	6.46	5.1	297	262	264	44	94	84	8.0
2	67.5	238.25	.26	1.47	8.20	7.5	295				94	84	8.2
1	70	240.38	.38	2.17	0.30	10.0	288	265	264	45	94	85	9.1
H 4	72.5	242.28	.32	1.78	2.22	9.0	308				94	85	9.3
3	75	244.04	.27	1.52	3.98	7.2	299	266	262	44	94	85	6.9
2	77.5	245.88	.30	1.69	5.84	8.7	300				94	85	7.0
1	80	248.21	.50	2.81	8.24	13.0	300	264	260	45	95	85	7.0
I 4	82.5	249.76	.20	1.12	9.75	7.0	306				94	85	5.6
3	85	251.50	.28	1.56	1.54	8.8	309	262	264	45	93	85	5.0
2	87.5	253.75	.45	2.50	3.80	12.0	308				92	85	4.8
1	90	256.01	.45	2.51	6.06	12.0	306	262	265	46	92	85	9.0
J 4	92.5	257.90	.30	1.69	7.92	9.0	300				90	85	5.9
3	95	259.76	.32	1.75	9.81	10.0	320	264	263	46	90	85	4.6
2	97.5	261.67	.32	1.72	1.68	10.0	332				88	85	5.2
1	100	263.46	.28	1.51	3.44	9.0	329	260	262	46	88	84	5.3
K 4	102.5	265.05	.20	1.08	4.93	7.3	325				88	84	5.5
3	105	266.28	.14	.76	6.17	5.9	327	265	260	45	87	84	5.0
2	107.5	267.70	.20	1.07	7.65	7.3	336				88	83	5.1
1	110	269.68	.35	1.87	9.60	10.0	334	264	263	44	89	83	6.2
L 4	112.5	270.96	.15	.81	0.89	6.0	324				89	83	7.1
3	115	272.70	.30	1.62	2.70	8.5	326	263	261	44	89	83	6.2
2	117.5	274.90	.45	2.45	4.94	11.0	320				89	83	5.9
1	120	277.20	.50	2.69	7.21	14.0	330	260	262	44	89	83	7.3
	(16.02)												
	θ = 120	Vm = 81.50		^H = 1.[illegible]							Avg. = 86.1		

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INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP/BLACK DOG
Source NO 4 BOILER
Method 4A/5S Filter holder: SS

Date 11-5-91 Test 1 Run 3
No. of traverse points 48
Filter type: SS

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Posttest: 0 cfm at 14 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: SS # 31

Recovery solvent(s)
☐ acetone
☒ other(s) MC

No. of probe wash bottles: 1
Sample recovered by: ET

Condensate Data:

Item	Weight (g) Final	Tare	Difference
Impinger No. 1		100	
Impinger No. 2	370	100	170
Impinger No. 3		0	
Condenser			
Desiccant	1462	1439	23
Total			193

Integrated Gas Sampling Data:

Bag Pump No. B-10 Box No. 5 Bag No. 3

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1711 (HRS) Time end: 1921 (HRS)

Sampling rate: 200 cc/min Operator: ET

S/N of O_2 Analyzer used to monitor train outlet: 6

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP/BLACK DOG
Source NO 4 BOILER INLET
Date 11-3-91 Test 1 Run 3

Operators ET-CML
Meter Box No. 2 ^H@ 1.83 IN WC
Counter coeff. .9939

Pitot No. 23V-6 Cp .840
Bar. Press. 28.17 inHg H2O x
Nozzle No. 8-5 Nozzle Dia .310 IN.

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Gas/In (°F)	Gas/Out (°F)	Oxygen (xv/v)
		1710	277.70											
L	4	2.5	279.30	.22	1.21	9.27	4.0	320	259	264	39	77	76	7.6
	3	5	281.04	.28	1.52	1.01	4.9	318				78	76	6.3
	2	7.5	283.25	.46	2.45	3.22	7.0	332	263	265	40	80	76	6.8
	1	10	285.60	.50	2.67	5.52	7.8	330				83	76	7.7
K	4	12.5	287.30	.26	1.39	7.20	5.0	319	264	262	40	84	76	7.1
	3	15	288.42	.12	.64	8.34	3.5	330				84	77	4.4
	2	17.5	289.90	.22	1.17	9.88	4.0	338	261	263	41	85	77	4.6
	1	20	291.91	.38	2.03	1.90	6.5	336				85	77	6.0
J	4	22.5	293.70	.30	1.64	3.72	5.8	311	260	262	40	88	77	6.1
	3	25	295.54	.32	1.74	5.59	6.0	324				89	78	4.8
	2	27.5	297.40	.32	1.72	7.46	6.0	334	262	260	41	90	78	5.0
	1	30	299.26	.33	1.79	9.36	6.1	327				91	79	5.4
I	4	32.5	300.88	.20	1.11	0.87	4.5	308	260	263	42	91	79	8.0
	3	35	302.55	.26	1.45	2.58	5.5	308				91	79	6.0
	2	37.5	304.68	.43	2.39	4.78	7.4	310	258	264	42	92	79	7.5
	1	40	306.98	.44	2.49	7.03	8.0	295				92	79	8.5
H	4	42.5	308.80	.26	1.46	8.76	6.0	301	261	263	41	92	79	10.0
	3	45	310.57	.28	1.57	0.54	6.1	302				92	79	9.8
	2	47.5	312.45	.30	1.68	2.59	6.5	305	265	264	42	92	80	8.8
	1	50	314.81	.52	2.91	4.82	10.0	304				92	80	9.3
G	4	52.5	315.82	.08	.45	5.78	3.0	297	261	262	42	90	80	10.9
	3	55	317.58	.30	1.70	7.64	6.0	293				90	81	10.5
	2	57.5	319.10	.40	2.25	9.78	7.8	300	264	261	42	91	81	10.6
	1	60	322.22	.52	2.95	2.22	10.0	295				92	81	11.7
F	4	62.5	323.34	.10	.56	3.30	3.0	305	263	260	43	92	81	10.6
		θ =	Vm =		^H =							Avg. =		

(CONTINUED)

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP/BLACKDOG
Source No4 Boiler Inlet
Date 11-5-81 Test 1 Run 3

Operators Pdl 2
Meter Box No. ____ ^H@ ____ IN WC
Gasmeter coeff. ____

Pitot No. ____ Cp ____
Bar. Press. ____ inHg H2O ____ x
Nozzle No. ____ Nozzle Dia ____ IN.

Traverse Point No.		Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dev. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
			323.34											
F	3	65	324.40	.12	.67	4.47		305	260	262	42	92	81	9.1
	2	67.5	326.00	.22	1.20	6.03	5.0	329				90	81	8.8
	1	70	327.70	.26	1.41	7.73	5.4	329	264	265	43	91	81	9.2
E	4	72.5	328.76	.10	.55	8.79	3.0	312				90	81	8.2
	3	75	329.80	.08	.44	9.74	2.9	322	265	262	44	90	81	7.9
	2	77.5	331.18	.18	.97	1.14	4.1	336				90	81	7.8
	1	80	332.85	.27	1.45	2.86	5.5	337	266	260	44	91	81	8.9
D	4	82.5	334.10	.12	.66	4.03	3.1	317				91	81	8.8
	3	85	335.50	.20	1.09	5.52	4.5	325	265	263	45	91	81	8.0
	2	87.5	337.18	.25	1.35	7.18	5.2	333				92	82	8.7
	1	90	338.68	.20	1.09	8.67	4.8	321	260	258	45	93	82	8.8
C	4	92.5	340.41	.25	1.41	0.37	5.5	301				93	82	9.4
	3	95	342.10	.25	1.38	2.05	5.5	316	263	261	45	93	82	8.2
	2	97.5	343.85	.27	1.48	5.79	5.7	323				93	82	7.7
	1	100	345.51	.24	1.33	5.44	5.5	318	263	264	46	93	82	8.3
B	4	102.5	347.20	.25	1.42	7.14	6.0	295				93	82	10.8
	3	105	348.97	.27	1.54	8.92	6.2	292	260	265	46	93	82	8.2
	2	107.5	350.54	.22	1.23	0.50	5.8	310				93	82	9.2
	1	110	352.40	.28	1.58	2.30	6.2	303	260	261	47	93	83	9.4
A	4	112.5	354.16	.25	1.46	4.02	6.0	279				93	83	9.9
	3	115	355.75	.25	1.42	5.72	6.0	298	262	260	47	93	83	10.2
	2	117.5	357.60	.28	1.59	7.53	6.2	299				93	83	10.5
	1	120	359.40	.30	1.70	9.39	6.5	301	264	263	47	93	83	11.2
		1122												
		θ = 120	Vm = 81.72		^H = 1.49							Avg. = 35.[illegible]		

3-005[illegible]

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job NSP Black Dog

Source Units 1, 3, 4 Stack

Test 1 Run 0 Date 11/5/91

Stack dimen. 270 IN.

Dry bulb ____ °F Wet bulb ____ °F

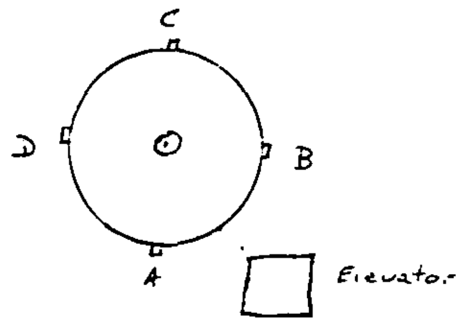
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 28.94 in Hg

Static pressure -1.85 in WC

Operators D. Van Hoever & J. Bergstrom

Pitot No. MM5-8 Cp .84



Schematic of Cross Section

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: 6 in.		Time start: hrs	
A 1	.044	11.88	17.88		
2	.146	39.42	45.42		
3	.296	79.92	85.92		
B 1					
2					
3					
C 1					
2					
3					
D 1					
2					
3					
Temp. meas. tool & S/N:				Time end: hrs	

R or nothing= reg. manometer; S= expanded; E = electronic S-392.1

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job N.S.P. Black Dog
Source Unit 1,3,4 Stack
Method 4MS Filter holder: teflon

Date 11/5/91 Test 1 Run-1
No. of traverse points 12
Filter type: glass fiber (pallflex)

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Posttest: ≤ 0 cfm at 7 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used:

Recovery solvent(s)

☒ ~~acetone~~
☒ other(s) MeCl2 + .1NHNO3

No. of probe wash bottles: 2
Sample recovered by: Dutt

Condensate Data:

Item	Weight(g) Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	516	400	116
Impinger No. 3			
Condenser			
Desiccant	1456	1440	16
Total			132

Integrated Gas Sampling Data:

Bag Pump No. B13 Box No. 25 Bag No. 1

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1045 (HRS) Time end: 1254 (HRS)

Sampling rate: 200 cc/min Operator: Dutt

S/N of O_2 Analyzer used to monitor train outlet: 9

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INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Black Dog
Source Unit 1, 3, 4 / Stack
Date 1/15/91 Test 1 Run 1

Operators DuH & J.B, & T.M
Meter Box No. 8 ^H@ 1.86 IN WC
Gasmeter coeff. 1.0003

Pitot No. VMM5-8 Cp .84
Bar. Press. 28.94 inHg H2O 4 %
Nozzle No. glass Nozzle Dia .175 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Gas Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	1040	497.20											
D 3	5	499.61	.86	.72	9.49	3	314	253	254	40	39	37	7.5
3	10	501.82	.78	.66	1.70	3	314				45	40	7.2
2	15	503.97	.78	.66	3.93	3	314				48	41	7.2
2	20	506.19	.76	.65	6.14	3	314	257	260	41	50	42	7.3
1	25	508.26	.67	.57	8.21	3	314				50	42	7.4
1	30	510.24	.65	.55	0.27	3	311				51	43	7.3
C 3	35	512.62	.80	.69	2.55	3	311	260	258	41	52	43	7.2
3	40	514.79	.72	.66	4.79	3	311				52	44	7.2
2	45	517.03	.79	.68	7.05	3	314				53	45	7.3
2	50	519.25	.77	.66	9.29	3	314	260	262	42	53	45	7.1
1	55	521.24	.62	.53	1.30	3	316				54	46	7.2
1	60	523.39	.62	.53	3.32	3	316				54	46	7.2
B 3	65	525.50	.78	.67	5.58	2	315	262	260	43	50	45	7.3
3	70	527.84	.84	.72	7.91	3	314				50	45	7.3
2	75	530.07	.75	.65	0.11	2	314				51	45	7.3
2	80	532.29	.75	.65	2.32	2	314	260	259	44	53	46	7.2
1	85	534.40	.66	.57	4.40	2	315				53	46	7.2
1	90	536.43	.63	.54	6.43	2	315				54	47	7.2
A 3	95	538.67	.83	.72	8.70	2	315	262	257	45	53	47	7.3
3	100	541.12	.84	.73	1.10	2	315				54	47	7.2
2	105	543.40	.81	.70	3.41	2	315				55	48	7.2
2	110	545.67	.81	.70	5.72	2	315	260	260	45	55	48	7.2
1	115	547.62	.66	.57	7.80	2	315				56	48	7.0
1	120	549.84	.65	.56	9.87	2	315				56	48	7.4
	1254												
	θ = 120	Vm = 52.64		^H = .64							Avg. = 48		

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INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Black Dog
Source Unit #1,3,4 Stack
Method 4ms Filter holder: teflon

Date 11/5/91 Test 1 Run 2
No. of traverse points 12
Filter type: glass fiber

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Posttest: 0 cfm at 8 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: ______

Recovery solvent(s)
☐ acetone
☒ other(s) MeCl2

No. of probe wash bottles: ______
Sample recovered by: ______

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	520	400	120
Impinger No. 3			
Condenser			
Desiccant	1418	1408	10
Total			130

Integrated Gas Sampling Data:

Bag Pump No. B13 Box No. 25 Bag No. 3
Bag Material: 5-layer Aluminized Tedlar Size: 44 L
Pretest leak check: 0 cc/min at 14 in. Hg.
Time start: 1350 (HRS) Time end: 1612 (HRS)
Sampling rate: 500 cc/min Operator: DoH
S/N of O_2 Analyzer used to monitor train outlet: 9

CF-023

S-0046RR

CF-D11

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP/Black Dog
Source Units 1,3,4 Stack
Date 11-5-91 Test 1 Run 2

Operators Dan JB & T.111
Meter Box No. 8 ^H@ 1.86 IN WC
Cocometer coeff. 1.0003

Pitot No. MN58 Cp .84
Bar. Press. 28.94 inHg H2O 10 X
Nozzle No. 91432 Nozzle Dia .192 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Obs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1350	550.56											
A-	5	552.83	.81	.68	2.82	2	314	252	248	42	43	43	7.3
	10	555.14	.82	.68	5.08	2	314				48	44	7.4
	15	557.39	.77	.64	7.27	2	314				49	45	7.3
	20	559.53	.79	.66	9.50	2	314	257	255	42	51	45	7.1
	25	561.68	.77	.65	1.71	2	313				53	46	7.2
	30	563.92	.81	.68	3.99	2	313				55	46	7.2
B-	35	566.24	.79	.67	6.23	2	313	256	259	43	55	47	7.2
	40	568.44	.81	.68	8.51	2	313				56	47	7.1
	45	570.75	.80	.68	0.78	2	312				56	48	7.2
	50	573.97	.76	.64	2.99	2	312	257	259	43	56	48	7.2
	55	575.46	.78	.66	5.23	2	313				56	48	7.2
	60	577.41	.70	.59	7.36	2	313				57	49	7.3
C-	65	579.66	.79	.67	9.62	2	313	260	258	43	56	49	7.2
	70	581.80	.79	.67	1.87	3	313				57	50	7.1
	75	584.16	.81	.69	4.16	3	313				57	50	7.3
	80	586.29	.76	.64	6.35	3	314	261	257	44	59	50	7.2
	85	588.40	.60	.51	8.35	2.5	314				59	50	7.1
	90	590.35	.58	.49	0.29	2.5	314				59	51	7.0
D-	95	592.79	.82	.70	2.60	2	314	264	260	44	58	50	7.1
	100	594.97	.80	.68	4.88	2	314				59	51	7.1
	105	597.04	.75	.64	7.09	2	314				59	51	7.1
	110	599.23	.75	.64	9.30	2	314	262	258	45	59	51	7.2
	115	601.27	.65	.55	1.35	2	313				59	52	7.2
	120	603.37	.65	.55	3.41	2	313	260	260	46	60	52	7.2
	(1612)												
	θ = 120	Vm = 52.81		^H = .64							Avg. = 52		

S-0037R

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP / Black Dog
Source Units 1, 2, 3 Stack
Method NMS Filter holder: Teflon

Date 11-5-91 Test 2 Run 3
No. of traverse points 12
Filter type: Glass Fiber (Gall Flex)

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☑
Posttest: 0 cfm at 7 in. Hg. (vac) ☑

Particulate Catch Data:

No.s of filters used:

Recovery solvent(s)

☐ acetone
☑ other(s) MeCl2 + 1N HNO3

No. of probe wash bottles: 2
Sample recovered by: DVH

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2	602	486	116
Impinger No. 3			
Condenser			
Desiccant	1367	1356	11
Total			127

Integrated Gas Sampling Data:

Bag Pump No. B-13 Box No. 25 Bag No. 3

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: ______ (HRS) Time end: ______ (HRS)

Sampling rate: ______ cc/min Operator: DVH

S/N of O_2 Analyzer used to monitor train outlet: 9

CF-023

S-0046RR

CF-011

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Black Dog
Source Unit #1,3/4 Stack
Date 11/5/91 Test 2 Run 3

Operators DJ / 4?J.B / ?T.M
Meter Box No. 8 ^H@ 1.86 IN WC
Gasmeter coeff. 1.0003

Pitot No. MM5-8 Cp .84
Bar. Press. 28.94 inHg H2O 10 %
Nozzle No. 9E55 Nozzle Dia. .195 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgm. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1710	603.66											
3	5	605.96	.81	.69	5.95	3	314	263	259	46	50	48	7.2
3	10	608.30	.81	.69	8.23	3	314				55	49	7.2
2	15	610.44	.75	.64	0.43	3	317				57	49	7.3
2	20	612.60	.73	.62	2.60	3	317	264	258	47	57	49	7.3
1	25	614.66	.63	.54	4.63	3	316				58	50	7.3
1	30	616.72	.65	.55	6.69	3	316				59	51	7.3
3	35	618.96	.78	.67	8.94	3	316	263	257	48	59	51	7.2
3	40	621.24	.77	.66	1.20	3	312				59	57	7.3
2	45	623.54	.71	.61	3.35	3	315				60	52	7.2
2	50	625.54	.71	.61	5.57	3	315	261	258	48	60	52	7.3
1	55	627.57	.62	.53	7.53	3	315				61	52	7.2
1	60	629.71	.65	.56	9.60	3	315				60	52	7.4
3	65	632.10	.85	.73	1.97	3	315	266	259	46	60	52	7.7
3	70	634.29	.82	.70	4.29	3	317				60	53	7.4
2	75	636.46	.79	.67	6.56	2	320				61	53	7.5
2	80	638.76	.78	.67	8.82	2	320	257	260	45	61	53	7.5
1	85	640.75	.62	.53	0.84	2	319				62	54	7.4
1	90	643.	.80	.69	3.14	2	318				61	54	7.4
3	95	645.42	.83	.71	5.48	2	319	256	258	45	61	54	7.3
3	100	647.70	.77	.66	7.73	2	320				62	54	7.3
2	105	649.91	.74	.63	9.94	2	317				62	55	7.3
2	110	651.98	.62	.53	1.96	2	316	254	260	46	63	55	7.4
1	115	653.94	.59	.51	3.95	2	316				62	55	7.4
1	120	656.00	.63	.54	5.99	2	316				62	55	7.5
	(1915)												
	θ = 120	Vm = 52.34		^H = .62							Avg. = 55.9		

S-0037R

INTERPOLL LABORATORIES EPA METHOD 2 FIELD DATA SHEET

Job NSP / Black Dog

Source Units 1,3,4 Stack

Test 2 Run 0 Date 11-5-91

Stack dimen. 270 IN.

Dry bulb _____ °F Wet bulb _____ °F

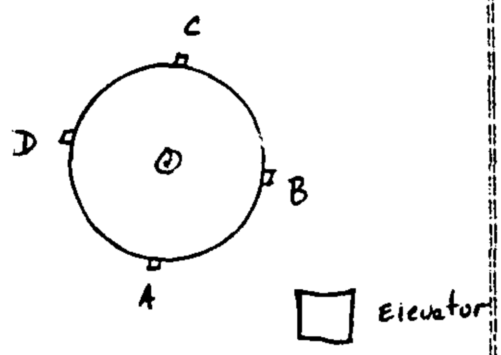
Manometer: ☒ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 28.94 in Hg

Static pressure -1.85 in WC

Operators JB. DUH T.M.

Pitot No. V23-5 Cp ______



Schematic of Cross Section

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length: in.		Time start: hrs	
Temp. meas. tool & S/N:					Time end: hrs	

R or nothing= reg. manometer; S= expanded; E = electronic S-392.1

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job N.S.P. Black Dog
Source Units #1,3,4 Stack
Test 2 Run C
Date 11/4/91
Operator D. Van Hoever

Pitot Tube No. N23-5
Barometric pres. 28.94 in.Hg.
Duct shape: ☒ Round ☐ Rectang.
Duct dimensions 270" in.
Length of port 6 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ΔP (in. WC)	$\sqrt{\Delta P}$	$\dfrac{100\sqrt{\Delta P}}{(\sqrt{\Delta P})_{avg}}$
A 1	311	.74	.86	
B 1	312	.82	.90	
C 1	312	.81	.90	
D 1	312	.80	.89	
Averages	312		.89	

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$\Delta P = (\sqrt{\Delta P}_{avg})^2 =$ .79 in. WC

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: 40.5 ______ in.
Distance from the end of port: 46.5 ______ in.

CF-016

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP / Black Dog
Source Units 1,3,4 Stack
Method 201 Filter holder: NA

Date 11-5-91 Test 2 Run 0
No. of traverse points 1
Filter type: Glass fiber

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0 cfm at 7 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: Recovery solvent(s)

☐ acetone
☒ other(s) MeCl2

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser	48	0	48
Desiccant	1469	1460	9
Total			57

Integrated Gas Sampling Data:

Bag Pump No. B7 Box No. 28 Bag No. 1

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 14 in. Hg.

Time start: 1023 (HRS) Time end: 1123 (HRS)

Sampling rate: 400 cc/min Operator: JB

S/N of O_2 Analyzer used to monitor train outlet:

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Black Dog
Source Unit #1, 3, 4 Stack
Date 11/5/91 Test 2 Run 0

Operators JB & DCH & T.M.
Meter Box No. 5 ^H@ 1.95 IN WC
Gasmeter coeff. 1.0070

Pitot No. V23-5 Cp .84
Bar. Press. 28.54 inHg H2O 7 %
Nozzle No. ___ Nozzle Dia .195 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgm Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	(1018)	526.76											
D 1	5	529.0	.79	.70	8.97	4	310	248	256	43	42	40	7.3
1	10	531.25	.79	.70	1.36	4	313				50	42	7.3
1	15	533.55	.79	.70	3.82	4	313				51	43	7.3
C 1	20	536.20	.79	.70	6.26	4	313	252	259	44	53	45	7.3
1	25	538.25	.79	.70	8.52	5	312				54	47	7.3
1	30	540.65	.79	.70	0.78	5	314				55	46	7.3
B 1	35	543.0	.79	.70	3.03	5	314	255	257	45	54	47	7.3
1	40	545.35	.79	.70	5.29	5	314				55	48	7.3
1	45	547.53	.79	.70	7.55	5	314				56	50	7.3
A 1	50	549.78	.79	.70	9.82	5	314	252	260	44	57	49	7.3
1	55	552.00	.79	.70	2.09	5	311				57	50	7.3
1	60	554.30	.79	.70	4.36	5	314	255	259	45	56	50	7.3
	(1123)												
	θ = 60	Vm = 27.54		^H = .75							Avg. = 49.8		

S-0037R

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job NSP / Black Dog
Source Units 1,3,4, Stack
Test 2 Run 1
Date 11-5-91
Operator SG, DVH, TM

Pitot Tube No. V23-5
Barometric pres. 28.94 in.Hg.
Duct shape: ☑ Round ☐ Rectang.
Duct dimensions 270 in.
Length of port 6 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ΔP (in. WC)	$\sqrt{\Delta P}$	$\frac{100 \sqrt{\Delta P}}{(\sqrt{\Delta P})_{avg}}$
A 1	314	.80	.89	89.97
B 1	315	.76	.87	87.48
C 1	315	.78	.88	87.72
D 1	315	.84	.92	94.47
Averages	315		.8891	

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$$\Delta P = (\sqrt{\Delta P}_{avg})^2 = \underline{.79} \text{ in. WC}$$

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: 40.5 ______ in.
Distance from the end of port: 46.5 ______ in.

CF-018

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP / Black Dog Date 11-5-91 Test 2 Run 1
Source Units 1,3,4, stack No. of traverse points 1
Method 201 Filter holder: N/A Filter type:

Sample Train Leak Check:

Pretest: ≤ 0.02 cfm at 15 in. Hg. (vac) ☒
Posttest: 0 cfm at 8 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used: Recovery solvent(s)

☐ acetone
☐ other(s)

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser			31
Desiccant	1488	1469	19
Total			50

Integrated Gas Sampling Data:

Bag Pump No. B7 Box No. 28 Bag No. 2

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1210 (HRS) Time end: 1300 (HRS)

Sampling rate: 400 cc/min Operator: JB

S/N of O_2 Analyzer used to monitor train outlet:

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job NSP Black Dog
Source Units 1,3,4 Stack
Date 11/5/91 Test 2 Run 1

Operators Dutt & JB & TM
Meter Box No. 5 ^H@ 1.95 IN WC
Gasmeter coeff. 1.0070

Pitot No. U23-5 Cp .84
Bar. Press. 28.94 inHg H2O 9 %
Nozzle No. ____ Nozzle Dia .195 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Des. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (%v/v)
	1206	554.50									43	43	7.3
D 1	6	557.16	.79	.69	7.15	4	315	258	261	45	47	44	7.2
1	12	559.80	.79	.69	9.81	4	315				50	46	7.3
C 1	18	562.40	.79	.69	2.49	4	315				52	46	7.3
1	24	565.10	.79	.69	5.19	4	315	261	259	46	54	47	7.2
B 1	30	567.82	.79	.71	7.89	4	315				55	48	7.3
1	36	570.64	.79	.71	0.60	4	315				55	49	7.3
A 1	42	573.28	.79	.71	3.31	4	315						
1	48	576.00	.79	.71	6.02	4	316						
	(1300)												
	θ = 48	Vm = 21.5		^H = .71							Avg. = 48.9		

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job NSP / Black Dog
Source Unit #1,3,4 Stack
Test 2 Run 2
Date 11/5/91
Operator DWH & J.B

Pitot Tube No. V23-5
Barometric pres. 28.94 in.Hg.
Duct shape: [X] Round [ ] Rectang.
Duct dimensions 270 in.
Length of port 6 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ΔP (in. WC)	$\sqrt{\Delta P}$	$\frac{100\sqrt{\Delta P}}{(\sqrt{\Delta P})_{avg}}$
D 1	316	.79	.889	88.34
C 1	313	.78	.883	87.22
B 1	316	.80	.894	89.46
A 1	315	.83	.911	92.8
Averages	315		.894	

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$$\Delta P = (\sqrt{\Delta P}_{avg})^2 = .80 \text{ in. WC}$$

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: 40.5 ____ in.
Distance from the end of port: 46.5 ____ in.

CF-016

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job NSP Black Dog
Source Unit #1,3,4 Stack
Method 201 Filter holder: NA

Date 11/5/91 Test 2 Run 2
No. of traverse points 4
Filter type: glass fiber

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac) ☒
Postest: 0 cfm at 8 in. Hg. (vac) ☒

Particulate Catch Data:

No.s of filters used:

Recovery solvent(s)

☐ acetone
☒ other(s) MeCl2

No. of probe wash bottles:
Sample recovered by:

Condensate Data:

Item	Weight(g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser	57	0	57
Desiccant	1508	1488	20
Total			77

Integrated Gas Sampling Data: –

Bag Pump No. B7 Box No. 28 Bag No. 3

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 14 in. Hg.

Time start: 1428 (HRS) Time end: 1538 (HRS)

Sampling rate: 400 cc/min Operator: DAH

S/N of O_2 Analyzer used to monitor train outlet:

CF-023

S-0046RR

CF-01

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job: VSP / Black Dog
Source: Units 1,3,4 Stack
Date: 11-5-91 Test: 2 Run: 2

Operators: SB, DVH, T.M.
Meter Box No.: 5 ^H@: 1.95 IN WC
Gasmeter coeff.: 1.0070

Pitot No.: V23.5 Cp: .84
Bar. Press.: 28.94 inHg H2O: 10 x
Nozzle No.: [illegible] Nozzle Dia: .195 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Stack (°F)	Probe (°F)	Oven (°F)	Impg. (°F)	Gas/In (°F)	Gas/Out (°F)	Oxygen (%v/v)
	1428	576.10											
A 1	5	578.27	.80	.69	8.29	4	314	257	260	43	55	50	7.2
1	10	580.44	.80	.71	0.55	4	312				57	50	7.2
1	15	582.70	.80	.71	2.81	4	312				58	51	7.2
C 1	20	585.00	.80	.71	5.07	4	312	255	261	44	59	52	7.2
1	25	587.18	.80	.71	7.33	4	312				59	53	7.2
1	30	589.40	.80	.71	9.60	4	312				60	54	7.3
B 1	35	591.87	.80	.72	1.88	5	312	254	258	45	60	53	7.2
1	40	594.11	.80	.72	4.15	4	312				60	53	7.2
1	45	596.38	.80	.72	6.42	4	312				60	53	7.2
D 1	50	598.64	.80	.72	8.70	4	312	257	260	44	61	54	7.1
1	55	600.10	.80	.72	0.97	4	312				61	54	7.1
1	60	603.29	.80	.72	3.25	5	313				61	54	7.2
	(1538)												
	θ = 60	Vm = 27.19		^H = .71							Avg. = 55.8		

2

S-0037R

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PM-10 TRAVERSE POINT SELECTION DATA SHEET

Job N.S.P. Black Dog
Source Unit 1,3,4 Stack
Test 2 Run 3
Date 11/5/91
Operator D. Van Hoever & T.M

Pitot Tube No. V23-5
Barometric pres. 28.94 in.Hg.
Duct shape: [X] Round [ ] Rectang.
Duct dimensions 270 in.
Length of port 6 in.

PM-10 Guidelines require that the velocity at each of the four selected traverse points be within +/- 20%. Record the velocity pressure of the traverse points and perform the indicated calculations. The values in the last column must fall within range of 80 - 120.

Traverse Point	Gas Temp. (deg-F)	Velocity Pressure ^P (in. WC)	$\sqrt{\text{^P}}$	$\frac{100\sqrt{\text{^P}}}{(\sqrt{\text{^P}})_{avg}}$
A 1	313	.78	.883	88.46
B 1	313	.79	.889	89.59
C 1	313	.79	.889	89.59
D 1	313	.75	.866	85.06
Averages	313	XXXX	.8817	XXXX

The average velocity pressure to be used for the sizing run may now be calculated from the following expression:

$$\text{^P} = (\sqrt{\text{^P}}_{avg})^2 = .78 \text{ in. WC}$$

Traverse points on round ducts: .15 D and .85 D
Distance from the duct wall: 40.5 ______ in.
Distance from the end of port: 46.5 ______ in.

CF-019

INTERPOLL LABORATORIES EPA METHOD 5/17 SAMPLE LOG SHEET

Job N.S.P. Black Dog
Source Unit #1,3,4 Stack
Method 201 Filter holder: N/A

Date 11/5/91 Test 2 Run 3
No. of traverse points 4
Filter type: glass fiber

Sample Train Leak Check:

Pretest: < 0.02 cfm at 15 in. Hg. (vac)
Postest: 0 cfm at 8 in. Hg. (vac)

Particulate Catch Data:

No.'s of filters used: Recovery solvent(s)

☐ acetone
☒ other(s) $MeCl_2$

No. of probe wash bottles: 1
Sample recovered by: Duff

Condensate Data:

Item	Weight (g)		
	Final	Tare	Difference
Impinger No. 1			
Impinger No. 2			
Impinger No. 3			
Condenser	74	0	74
Desiccant	1536	1508	28
Total			102

Integrated Gas Sampling Data:

Bag Pump No. B-7 Box No. ~~30~~ 31 Bag No. 7

Bag Material: 5-layer Aluminized Tedlar Size: 44 L

Pretest leak check: 0 cc/min at 15 in. Hg.

Time start: 1636 (HRS) Time end: 1816 (HRS)

Sampling rate: 400 cc/min Operator: Duff

S/N of O_2 Analyzer used to monitor train outlet: ___

CF-023

S-0046RR

INTERPOLL LABORATORIES EPA METHOD 5 FIELD DATA SHEET

Job N.S.P. Black Dog
Source Units 1,3,4 Stack
Date 11/5/91 Test 2 Run 3

Operators J.B & D.V.H & T.M
Meter Box No. 5 ΔH@ 1.95 IN WC
Gasmeter coeff. 1.0070

Pitot No. 123-5 Cp .84
Bar. Press. 28.54 inHg H2O 11 x
Nozzle No. ____ Nozzle Dia .175 IN.

Traverse Point No.	Sampling Time (min)	Sample Volume (cf)	Velocity Head (inWC)	Orifice Meter (inWC)	Dgs. Vol. (cf)	VAC. inHg	Temperatures (°F) Stack	Probe	Oven	Impg.	Gas/In	Gas/Out	Oxygen (xv/v)
	1636	605.32											
1	6	608.10	.78	.68	7.87	4	313	250	251	43	46	46	7.1
1	12	610.66	.78	.67	0.56	4	314				51	47	7.2
1	18	613.21	.78	.68	3.19	4	314				53	49	7.2
1	24	615.86	.78	.68	5.84	4	314	252	257	44	55	50	7.2
1	30	618.46	.78	.68	8.50	4	314				56	51	7.2
1	36	621.14	.78	.68	1.15	4	314				56	51	7.2
1	42	623.89	.78	.68	3.81	4	314	255	260	45	58	52	7.2
1	48	626.30	.78	.69	6.48	4	314				58	52	7.1
1	54	629.20	.78	.69	4.15	4	314				58	52	7.2
1	60	631.91	.78	.69	1.82	4	313	254	258	46	58	53	7.2
1	66	634.46	.78	.69	4.49	4	313				59	53	7.2
1	72	637.10	.78	.69	7.16	4	312				59	53	7.2
1	78	639.75	.78	.69	9.84	4	315	256	255	43	59	53	7.2
1	84	642.42	.78	.69	2.51	4	315				54	53	7.2
1	90	645.14	.78	.69	5.17	4	316				59	53	7.1
1	96	647.87	.78	.68	7.84	4	320	257	260	44	59	54	7.2
	(1816)												
	θ = 96	Vm = 42.55		ΔH = .68							Avg. = 53.9		

S-0037

APPENDIX D

INTERPOLL LABS ANALYTICAL DATA

TABLE OF CONTENTS

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job N.S.P. Blackdog
Team Leader SP
Date Submitted 11-5-91
Test No.
Date of Analysis 11-6-91

Source BOILER #1
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician R. [illegible]

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
1/1	4677-05	1	0.00	10.90	19.40	10.90	8.50	1.14
		2	0.00	10.90	19.40	10.40	8.50	1.14
	☒ B ☐ F	Avg				10.90	8.50	
1/2	-08	1	0.00	11.10	19.30	11.10	8.20	1.14
		2	0.00	11.10	19.30	11.10	8.20	1.14
	☒ B ☐ F	Avg				11.10	8.20	
1/3	-12	1	0.00	11.60	19.30	11.60	7.70	1.14
		2	0.00	11.60	19.30	11.60	7.70	1.14
	☒ B ☐ F	Avg				11.60	7.70	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☐ Ambient Air QA Check
☐ Orsat Analyzer System Leak Check
☐ F_o Within EPA M-3 Guidelines for fuel type.

Where $F_o = \frac{20.9 - O_2}{CO_2}$

F=Flask (250 cc all glass)
B=Tedlar Bag (5-layer)

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

LSC-04-BP

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job NSP Blackdog
Team Leader MK
Date Submitted 11-5-91
Test No. 1
Date of Analysis 11-6-91

Source NO.3 BOILER
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician R. Gilman

Test/Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
1/1	4677-19	1	0.00	11.60	19.60	11.60	8.00	1.11
		2	0.00	11.60	19.60	11.60	8.00	1.11
	☑ B ☐ F	Avg				11.60	8.00	
1/2	-23	1	0.00	12.30	19.60	12.30	7.30	1.11
		2	0.00	12.30	19.60	12.30	7.30	1.11
	☑ B ☐ F	Avg				12.30	7.30	
1/3	-27	1	0.00	12.20	19.60	12.20	7.40	1.11
		2	0.00	12.20	19.60	12.20	7.40	1.11
	☑ B ☐ F	Avg				12.20	7.40	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☑ Ambient Air QA Check
☑ Orsat Analyzer System Leak Check
☐ F_o Within EPA M-3 Guidelines for fuel type.

Where $F_o = \frac{20.9 - O_2}{CO_2}$

F=Flask (250 cc all glass)
B=Tedlar Bag (5-layer)

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

LSC-04-BR

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job NSP Blackdog
Team Leader ET
Date Submitted 11-5-91
Test No. 1
Date of Analysis 11-6-91

Source NO 4 BOILER
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician R Gillman

Test/ Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
1/1	4677-33	1	0.00	13.40	19.40	13.40	6.00	1.11
		2	0.00	13.40	19.40	13.40	6.00	1.11
	☒ B ☐ F	Avg				13.40	6.00	
1/2	-37	1	0.00	13.60	19.40	13.60	5.80	1.11
		2	0.00	13.60	19.40	13.60	5.80	1.11
	☒ B ☐ F	Avg				13.60	5.80	
1/3	-41	1	0.00	13.80	19.40	13.80	5.60	1.11
		2	0.00	13.80	19.40	13.80	5.60	1.11
	☒ B ☐ F	Avg				13.80	5.60	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☒ Ambient Air QA Check
☒ Orsat Analyzer System Leak Check
☐ F_o Within EPA M-3 Guidelines for fuel type.

Where $F_o = \frac{20.9 - O_2}{CO_2}$

F=Flask (250 cc all glass)
B=Tedlar Bag (5-layer)

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

LSC-04-RD

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job: NSP/Black Dog
Team Leader: DRH
Date Submitted: 11-5-91
Test No.: 1
Date of Analysis: 11-6-91

Source: Units 1,3&4
Test Site: Stack
Date of Test: 11-5-91
No. of Runs Completed: 3
Technician: R Eielson

Test/Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
1/1	4677-72	1	0.00	12.40	19.50	12.40	7.10	1.113
		2	0.00	12.40	19.50	12.40	7.10	1.113
	☒ B ☐ F	Avg				12.40	7.10	
1/2	-73	1	0.00	12.80	19.60	12.80	6.80	1.104
		2	0.00	12.80	19.60	12.80	6.80	1.104
	☒ B ☐ F	Avg				12.80	6.80	
1/3	-74	1	0.00	13.00	19.60	13.00	6.60	1.095
		2	0.00	13.00	19.60	13.00	6.60	1.095
	☒ B ☐ F	Avg				13.00	6.60	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☒ Ambient Air QA Check
☒ Orsat Analyzer System Leak Check
☒ F_o Within EPA M-3 Guidelines for fuel type.

Where $F_o = \frac{20.9 - O_2}{CO_2}$

F=Flask (250 cc all glass)
B=Tedlar Bag (5-layer)

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

LSC-04-BR

Interpoll Laboratories
(612) 786-6020

EPA Method 3 Data Reporting Sheet
Orsat Analysis

Job NSP Black Dog
Team Leader DVH
Date Submitted 11-5-91
Test No. 2
Date of Analysis 11-6-91

Source Units 1,3,4
Test Site Stack
Date of Test 11-5-91
No. of Runs Completed
Technician R Gulm

Test/Run	Sample Log Number and Type	No. of An.	Buret Readings (ml) Zero Pt.	After CO_2	After O_2	Conc. CO_2 %v/v Dry	Conc. O_2 %v/v Dry	F_o
2/0	4677-02	1	0.00	12.30	19.60	12.30	7.30	1.11
		2	0.00	12.30	19.60	12.30	7.30	1.11
	☑ B ☐ F	Avg				12.30	7.30	
2/1	-72	1	0.00	12.40	19.50	12.40	7.10	1.11
		2	0.00	12.40	19.50	12.40	7.10	1.11
	☑ B ☐ F	Avg				12.40	7.10	
2/2	-73	1	0.00	11.50	19.70	11.50	8.20	1.10
		2	0.00	11.50	19.70	11.50	8.20	1.10
	☑ B ☐ F	Avg				11.50	8.20	
2/3	-74	1	0.00	10.50	19.90	10.50	9.40	1.10
		2	0.00	10.50	19.90	10.50	9.40	1.10
	☑ B ☐ F	Avg				10.50	9.40	
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						
		1						
		2						
	☐ B ☐ F	Avg						

☑ Ambient Air QA Check
☑ Orsat Analyzer System Leak Check
☐ F_o Within EPA M-3 Guidelines for fuel type.

Where $F_o = \frac{20.9 - O_2}{CO_2}$

F=Flask (250 cc all glass)
B=Tedlar Bag (5-layer)

EPA Method 3 Guidelines

Fuel Type	F0 Range
Coal:	
Anthracite/Lignite	1.016-1.130
Bituminous	1.083-1.230
Oil:	
Distillate	1.260-1.413
Residual	1.210-1.370
Gas:	
Natural	1.600-1.836
Propane	1.434-1.586
Butane	1.405-1.553
Wood/Wood Bark	1.000-1.130

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP /Black Dog
Team Leader D.R.
Date Submitted 11-6-91
Test No. 1
Date of Analysis 11-
Transport Leakage [X] None [ ] ______ ml

Source No.1 Boiler
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician B. Dyke
Solvent Methylene Chloride

0	Test ____ Run 0 Field Blank Log Number ______ Vol. of Solvent ____ ml *Solvent Residue ____ ug/ml	Dish No. ______ Dish Tare Wt. ______ g Dish+Sample Wt. ______ g Sample Wt. ______ g
1	Test 1 Run 1 Vol. of Solvent 100 ml Log Number 4677-02 Comments ______	Dish No. 27 Dish Tare Wt. 52.4457 g Dish+Sample Wt. 53.4544 g Sample Wt. 1.0092 g
2	Test 1 Run 2 Vol. of Solvent 80 ml Log Number -06 Comments ______	Dish No. 30 Dish Tare Wt. 47.2611 g Dish+Sample Wt. 48.2629 g Sample Wt. 1.0018 g
3	Test 1 Run 3 Vol. of Solvent 100 ml Log Number -10 Comments ______	Dish No. 68 Dish Tare Wt. 48.0377 g Dish+Sample Wt. 50.7326 g Sample Wt. 2.6949 g
4	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ______ Comments ______	Dish No. ______ Dish Tare Wt. ______ g Dish+Sample Wt. ______ g Sample Wt. ______ g
5	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ______ Comments ______	Dish No. ______ Dish Tare Wt. ______ g Dish+Sample Wt. ______ g Sample Wt. ______ g

*Solvent Residue ___ ug/ml=[(Sample Wt. ____ g)(10^6)]/Vol. of Sol. ____ ml
EPA-M5 Acetone Residue Blank Spec. ≤7.3 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	1.0088	1.0015 D-6	2.6945		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job NSP Blackdog
Team Leader DB
Date Submitted 11-6-91
Test No. 1
Date of Analysis 11-7-91

Source Boiler NO. 1
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician R. C[illegible]

0	Test ____ Run 0 Field Blank Log Number ____ Comments ____	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g
1	Test 1 Run 1 Log Number 4677-03 Comments ____	Filter No. 27 Filter Type S. Steel Filter Tare Wt. 40.8269 g Filter+Sample Wt. 43.5568 g Sample Wt. 2.7299 g
2	Test 1 Run 2 Log Number -07 Comments ____	Filter No. 8 Filter Type S. Steel Filter Tare Wt. 40.8266 g Filter+Sample Wt. 43.6949 g Sample Wt. 2.8683 g
3	Test 1 Run 3 Log Number -11 Comments ____	Filter No. 32 Filter Type S. Steel Filter Tare Wt. 43.3745 g Filter+Sample Wt. 48.8987 g Sample Wt. 5.5242 g
4	Test ____ Run ____ Log Number ____ Comments ____	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Log Number ____ Comments ____	Filter No. ____ Filter Type ____ Filter Tare Wt. ____ g Filter+Sample Wt. ____ g Sample Wt. ____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	2.7299	2.8683	5.5242		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP/Black Dog
Team Leader MK
Date Submitted 11-
Test No. 1
Date of Analysis 11
Transport Leakage ☒ None ☐ ____ ml

Source No. 3 Boiler
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician B. Onke
Solvent Methylene chloride

0	Test 1 Run 0 Field Blank Log Number 4677-14 Vol. of Solvent 200 ml *Solvent Residue 4.0 ug/ml	Dish No. 26 Dish Tare Wt. 48.3870 g Dish+Sample Wt. 48.3878 g Sample Wt. 0.0008 g
1	Test 1 Run 1 Vol. of Solvent 160 ml Log Number -16 Comments	Dish No. 43 Dish Tare Wt. 46.5920 g Dish+Sample Wt. 49.1312 g Sample Wt. 2.5392 g
2	Test 1 Run 2 Vol. of Solvent 160 ml Log Number -20 Comments	Dish No. 57A Dish Tare Wt. 47.9152 g Dish+Sample Wt. 51.2481 g Sample Wt. 3.3329 g
3	Test 1 Run 3 Vol. of Solvent 170 ml Log Number -24 Comments	Dish No. 60 Dish Tare Wt. 49.6280 g Dish+Sample Wt. 51.4556 g Sample Wt. 1.8276 g
4	Test Run Vol. of Solvent ml Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g
5	Test Run Vol. of Solvent ml Log Number Comments	Dish No. Dish Tare Wt. g Dish+Sample Wt. g Sample Wt. g

*Solvent Residue 4.0 ug/ml=[(Sample Wt. 0.0008 g)(10^6)]/Vol. of Sol. 200 ml
EPA-M5 Acetone Residue Blank Spec. ≤7.3 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	2.5386	3.3323	1.8267		

D-8

LSC-01YP

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job NSP Blackdog
Team Leader mk
Date Submitted 11-6-91
Test No. 1
Date of Analysis 11-7-91

Source NO. 3 Boiler
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician R Gilhm

0
Test ____ Run 0
Field Blank
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

1
Test 1 Run 1
Log Number 4677-17
Comments ____

Filter No. 17
Filter Type S.Steel
Filter Tare Wt. 40.4348 g
Filter+Sample Wt. 44.9119 g
Sample Wt. 4.4771 g

2
Test 1 Run 2
Log Number - 21
Comments ____

Filter No. 35
Filter Type S.Steel
Filter Tare Wt. 42.0128 g
Filter+Sample Wt. 47.4294 g
Sample Wt. 5.4166 g

3
Test 1 Run 3
Log Number - 25
Comments ____

Filter No. 40
Filter Type S.Steel
Filter Tare Wt. 43.1203 g
Filter+Sample Wt. 45.8675 g
Sample Wt. 2.7472 g

4
Test ____ Run ____
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

5
Test ____ Run ____
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	4.4771	5.4166	2.7472		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	7.0157	8.7469	4.5739		

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP / Black Dog
Team Leader ET
Date Submitted 11-6-91
Test No. 1
Date of Analysis 11
Transport Leakage ☒ None ☐ ______ ml

Source No. 4 Boiler
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician B. Duke
Solvent Methylene chloride

0	Test 1 Run 0 Field Blank Log Number 4677-28 Vol. of Solvent 200 ml *Solvent Residue 4.0 ug/ml	Dish No. 34 Dish Tare Wt. 57.8084 g Dish+Sample Wt. 57.8092 g Sample Wt. 0.0008 g
1	Test 1 Run 1 Vol. of Solvent 100 ml Log Number -30 Comments	Dish No. 61 Dish Tare Wt. 44.5904 g Dish+Sample Wt. 45.0485 g Sample Wt. 0.4581 g
2	Test 1 Run 2 Vol. of Solvent 80 ml Log Number -34 Comments	Dish No. 62 Dish Tare Wt. 50.8910 g Dish+Sample Wt. 51.2862 g Sample Wt. 0.3952 g
3	Test 1 Run 3 Vol. of Solvent 80 ml Log Number -38 Comments	Dish No. 109 Dish Tare Wt. 44.7964 g Dish+Sample Wt. 45.1543 g Sample Wt. 0.3579 g
4	Test ____ Run ____ Vol. of Solvent ____ ml Log Number Comments	Dish No. Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Vol. of Solvent ____ ml Log Number Comments	Dish No. Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g

*Solvent Residue 40 ug/ml=[(Sample Wt. 0.0008 g)(10⁶)]/Vol. of Sol. 200 ml
EPA-M5 Acetone Residue Blank Spec. ≤ 7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.4577	0.3949 D-1	0.3576		

LSC-01YR

Interpoll Laboratories
(612) 786-6020

EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job NSP Blackdog
Team Leader ET
Date Submitted 11-6-91
Test No. 1
Date of Analysis 11-7-91

Source NO. 4 Boiler
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3
Technician R. Glenn

0
Test ____ Run 0
Field Blank
Log Number ______
Comments ______
Filter No. ______
Filter Type ______
Filter Tare Wt. ______ g
Filter+Sample Wt. ______ g
Sample Wt. ______ g

1
Test 1 Run 1
Log Number 4677-31
Comments ______
Filter No. 9
Filter Type S.Steel
Filter Tare Wt. 39.7576 g
Filter+Sample Wt. 44.6013 g
Sample Wt. 4.8437 g

2
Test 1 Run 2
Log Number -35
Comments ______
Filter No. 20
Filter Type S.Steel
Filter Tare Wt. 39.9409 g
Filter+Sample Wt. 44.3359 g
Sample Wt. 4.3950 g

3
Test 1 Run 3
Log Number -39
Comments ______
Filter No. 31
Filter Type S.Steel
Filter Tare Wt. 41.7709 g
Filter+Sample Wt. 44.3558 g
Sample Wt. 2.5849 g

4
Test ____ Run ____
Log Number ______
Comments ______
Filter No. ______
Filter Type ______
Filter Tare Wt. ______ g
Filter+Sample Wt. ______ g
Sample Wt. ______ g

5
Test ____ Run ____
Log Number ______
Comments ______
Filter No. ______
Filter Type ______
Filter Tare Wt. ______ g
Filter+Sample Wt. ______ g
Sample Wt. ______ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	4.8437	4.3950	2.5849		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	5.3014	4.7899	2.9425		

Interpoll Laboratories
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EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP / Black Dog — Source unit 1, 2, 3
Team Leader DJH — Test Site Stack
Date Submitted 11-5-91 — Date of Test 11-4-91
Test No. 1 — No. of Runs Completed 3
Date of Analysis 11-15-91 — Technician B. [illegible]
Transport Leakage ☒ None ☐ ____ ml — Solvent Methylene Chloride

0	Test 1 Run 0-1 Field Blank Log Number 4677-42 Vol. of Solvent 100 ml *Solvent Residue ____ ug/ml	Dish No. 19 Dish Tare Wt. 50.7360 g Dish+Sample Wt. 50.7399 g Sample Wt. 0.0039 g
1	Test 1 Run 1 Vol. of Solvent 100 ml Log Number -52 Comments ____	Dish No. 21 Dish Tare Wt. 50.3770 g Dish+Sample Wt. 50.3934 g Sample Wt. 0.0164 g
2	Test 1 Run 2 Vol. of Solvent 80 ml Log Number -57 Comments ____	Dish No. 23 Dish Tare Wt. 50.4445 g Dish+Sample Wt. 50.4535 g Sample Wt. 0.0090 g
3	Test 1 Run 3 Vol. of Solvent 100 ml Log Number -62 Comments ____	Dish No. 25 Dish Tare Wt. 50.6904 g Dish+Sample Wt. 50.6987 g Sample Wt. 0.0083 g
4	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g
5	Test ____ Run ____ Vol. of Solvent ____ ml Log Number ____ Comments ____	Dish No. ____ Dish Tare Wt. ____ g Dish+Sample Wt. ____ g Sample Wt. ____ g

*Solvent Residue ____ ug/ml = [(Sample Wt. ____ g)(10^6)]/Vol. of Sol. ____ ml
EPA-M5 Acetone Residue Blank Spec. ≤7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0164	0.0090	0.0083		

D-12

LSC-01Y!

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EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job NSP/ Black Dog
Team Leader Duit
Date Submitted 11-5-91
Test No. 1
Date of Analysis 11-16-91

Source Units #1,3,4
Test Site Stack
Date of Test 11-4-91
No. of Runs Completed 3
Technician M. Hamer

0	Test 1 Run 0-1 Field Blank Log Number 4677-44 Comments	Filter No. 6051 Filter Type 4MS 3.52" Filter Tare Wt. .4470 g Filter+Sample Wt. .4470 g Sample Wt. 0.0000 g
1	Test 1 Run 1 Log Number -54 Comments	Filter No. 6053 Filter Type 4MS 3.52" Filter Tare Wt. .4166 g Filter+Sample Wt. .4327 g Sample Wt. 0.0161 g
2	Test 1 Run 2 Log Number -59 Comments	Filter No. 6054 Filter Type 4MS 3.52" Filter Tare Wt. .4297 g Filter+Sample Wt. .4514 g Sample Wt. 0.0217 g
3	Test 1 Run 3 Log Number -64 Comments	Filter No. 6055 Filter Type 4MS 3.52 Filter Tare Wt. .4122 g Filter+Sample Wt. .4422 g Sample Wt. 0.0300 g
4	Test Run Log Number Comments	Filter No. Filter Type Filter Tare Wt. g Filter+Sample Wt. g Sample Wt. g
5	Test Run Log Number Comments	Filter No. Filter Type Filter Tare Wt. g Filter+Sample Wt. g Sample Wt. g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0161	0.0217	0.0300		

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5
	0.0325	0.0307	0.0383		

LSC-0200

Interpoll Laboratories
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EPA Method 5 Data Reporting Sheet
Probe/Cyclone Wash

Job NSP/Black Dog
Team Leader DVH
Date Submitted 11-5-91
Test No. 1
Date of Analysis 11-15-91
Transport Leakage ☒ None ☐ ______ ml

Source unit 1,2,3
Test Site Stack
Date of Test 11-4-91
No. of Runs Completed 3
Technician B. Drake
Solvent Methylene Chloride

0	Test 1 Run 0-2 Field Blank Log Number 4677-47 Vol. of Solvent 100 ml *Solvent Residue _____ ug/ml	Dish No. 22 Dish Tare Wt. 50.4660 g Dish+Sample Wt. 50.4678 g Sample Wt. 0.0018 g
1	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
2	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
3	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
4	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g
5	Test _____ Run _____ Vol. of Solvent _____ ml Log Number _____ Comments _____	Dish No. _____ Dish Tare Wt. _____ g Dish+Sample Wt. _____ g Sample Wt. _____ g

*Solvent Residue ___ ug/ml=[(Sample Wt. _____ g)(10^6)]/Vol. of Sol. _____ ml
EPA-M5 Acetone Residue Blank Spec. ≤7.8 ug/ml

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5

LSC-01YF

Testing Laboratory Internal Correspondence

NSP

		DATE	March 20, 1992
FROM	T M Leverentz	LOCATION	CSC-2
TO	Roger Clarke Patricia Boyce	LOCATION	GO-2 GO-2

SUBJECT ANALYSIS OF COAL ASH

1.0 Purpose of Testing

The Testing Lab analyzed samples of coal ash from various plants to provide current information on coal ash generated from NSP's steam plants.

2.0 Test Methods

The samples were leached according to EPA's Methods 1311 and 1312. For Total Composition analyses, the samples were digested with a mixture of acids in a closed microwave vessel that resulted in a nearly complete dissolution of the sample.

3.0 Test Results

The results of the Lab's analyses are attached. Also attached are the results of Interpoll Lab's analyses of Riverside ash. All Total Composition results are reported on a dry weight basis. A floppy disk containing the Lab's results will also be sent to Roger Clarke.

T. M. LEVERENTZ, SUPERVISING CHEMIST, ENVIRONMENTAL LAB

BY T M Leverentz

T.M Leverentz
Supervising Chemist

Attachments

Coal Ash Total Comp.

Lab No.		170.34	171.01	171.02	171.03	171.04	171.05
Plant		Black Dog	Black Dog	Black Dog	Black Dog	High Bridge	High Bridge
Unit No(s).		#2	#2	#1,3,4	#1,3,4	#3,4,5,6	#3,4,5,6
Ash Type		Fly	Bed Material	Fly	Bottom	Fly	Bottom
Aluminum	% Al2O3	13.4	38.1	19.7	17.8	19.8	16.4
Calcium	% CaO	29.6	6.1	25.8	20.1	26.1	16.4
Iron	% Fe2O3	6.4	2.1	7.0	7.9	5.7	5.0
Magnesium	% MgO	5.9	1.3	6.1	5.1	6.4	4.3
Phosphorus	% P2O5	1.9	0.5	1.7	0.8	1.4	0.9
Potassium	% K2O	0.5	0.9	0.7	0.5	0.5	0.4
Silicon	% Si02	24.4	49.4	39.9	53.5	39.0	49.9
Sodium	% Na2O	1.4	1.3	1.8	0.9	2.1	1.2
Sulfur	%SO3	13.2	1.3	2.5	0.7	2.3	1.7
Titanium	% TiO2	1.2	1.7	1.4	1.4	1.5	1.3
Loss on Ignition	%	2.87	0.22	0.56	0.15	0.32	4.79
Carbon	% C	2.07	0.33	0.29	0.85	0.10	3.16
Antimony	mg/Kg Sb	3	2	4	2	3	2
Arsenic	mg/Kg As	15	10	19	7	13	2
Barium	mg/Kg Ba	4800	1500	7900	4200	6550	4000
Beryllium	mg/Kg Be	4	4	6	5	6	5
Boron	mg/Kg B	660	110	620	230	585	250
Bromine	% Br	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	mg/Kg Cd	<10	<10	<10	<10	<10	<10
Chlorine	% Cl	0.016	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	mg/Kg Cr	70	300	100	70	75	40
Cobalt	mg/Kg Co	70	240	120	360	95	220
Copper	mg/Kg Cu	200	320	270	160	245	220
Fluorine	% F	0.034	0.003	0.036	<0.002	0.013	0.002
Lead	mg/Kg Pb	44	39	56	14	48	24
Lithium	mg/Kg Li	400	200	300	300	400	300
Manganese	mg/Kg Mn	220	80	310	290	215	150
Mercury	mg/Kg Hg	0.5	<0.2	<0.2	<0.2	0.2	<0.2
Molybdenum	mg/Kg Mo	80	60	110	110	105	90
Nickel	mg/Kg Ni	90	130	90	70	60	30
Nitrogen	% N	0.10	0.02	0.04	0.04	0.03	0.07
Selenium	mg/Kg Se	17	3	14	7	12	2
Silver	mg/Kg Ag	<5	<5	5	5	7	5
Strontium	mg/Kg Sr	4160	960	3390	2380	3120	2080
Thallium	mg/Kg Tl	20	30	70	50	50	30
Tin	mg/Kg Sn	<100	<100	<100	<100	<100	<100
Uranium	mg/Kg U	<500	<500	<500	<500	<500	<500
Vanadium	mg/Kg V	260	440	400	290	315	190
Zinc	mg/Kg Zn	140	230	240	70	70	30

Coal Ash 1312 Leach

Lab No.		171.06	171.07	171.08	171.09	171.10	171.11
Plant		Black Dog	Black Dog	Black Dog	Black Dog	High Bridge	High Bridge
Unit No(s).		#2	#2	#1,3,4	#1,3,4	#3,4,5,6	#3,4,5,6
Ash Type		Fly	Bed Material	Fly	Bottom	Fly	Bottom
Alkalinity	mg/L CaCO3	611	651	737	128	759	96
Aluminum	mg/L Al	46	175	169	20	55	13
Ammonia	mg/L N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Antimony	mg/L Sb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L As	0.004	0.002	0.001	0.001	<0.001	0.001
Barium	mg/L Ba	8.8	2.2	2.9	0.5	12.0	0.8
Beryllium	mg/L Be	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Boron	mg/L B	<0.05	<0.05	<0.05	0.41	<0.05	0.46
Cadmium	mg/L Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium	mg/L Ca	143	148	150	72	224	200
Chloride	mg/L Cl	1	1	3	1	1	<1
Chromium	mg/L Cr	0.15	0.03	0.03	0.02	0.02	0.09
Cobalt	mg/L Co	<0.05	<0.05	<0.05	<0.05	0.05	0.05
Copper	mg/L Cu	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide	mg/L CN	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride	mg/L F	<0.1	<0.1	<0.1	<0.1	2.1	0.1
Iron	mg/L Fe	0.03	<0.03	<0.03	<0.03	0.10	0.05
Lead	mg/L Pb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	mg/L Mg	<1	<1	<1	<1	<1	<1
Manganese	mg/L Mn	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	mg/L Hg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	mg/L Mo	0.23	0.14	0.14	0.06	0.11	0.09
Nickel	mg/L Ni	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrite	mg/L N	0.3	<0.2	<0.2	<0.2	0.4	<0.2
Nitrite + Nitrate	mg/L N	3.9	2.1	2.1	1.9	3.5	1.9
pH		11.7	11.2	11.6	11.0	11.9	10.6
Phosphorus	mg/L P	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Potassium	mg/L K	6.0	3.9	4.2	0.2	2.7	0.8
Selenium	mg/L Se	0.058	<0.005	<0.005	<0.005	0.012	<0.005
Silver	mg/L Ag	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/L Na	53	16	29	<1	56	3
Strontium	mg/L Sr	13.4	10.1	10.6	1.6	21.5	4.4
Sulfate	mg/L SO4	20	60	20	100	5	460
TDS	mg/L	660	890	940	330	830	760
Thallium	mg/L Tl	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tin	mg/L Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vanadium	mg/L V	<0.05	<0.05	<0.05	0.06	<0.05	<0.05
Zinc	mg/L Zn	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Coal Ash TCLP Leach

Lab No.		171.16	171.17	171.18	171.19	171.20	171.21
Plant		Black Dog	Black Dog	Black Dog	Black Dog	High Bridge	High Bridge
Unit No(s).		#2	#2	#1,3,4	#1,3,4	#3,4,5,6	#3,4,5,6
Ash Type		Fly	Bed Material	Fly	Bottom	Fly	Bottom
Arsenic	mg/L As	<0.005	0.007	<0.005	0.009	<0.005	0.006
Barium	mg/L Ba	0.39	0.26	0.36	0.88	2.25	0.32
Beryllium	mg/L Be	<0.005	<0.005	<0.005	0.009	<0.005	0.007
Boron	mg/L B	1.2	4.6	9.7	3.5	3.3	5.3
Cadmium	mg/L Cd	<0.001	0.002	<0.001	0.003	<0.001	0.006
Chromium	mg/L Cr	0.17	0.07	0.73	0.08	0.12	0.13
Copper	mg/L Cu	0.01	0.52	<0.01	0.14	0.01	0.05
Iron	mg/L Fe	0.17	1.89	0.21	15.0	0.24	6.57
Lead	mg/L Pb	<0.005	0.014	<0.005	0.008	<0.005	<0.005
Manganese	mg/L Mn	<0.01	0.22	<0.01	0.25	<0.01	0.29
Mercury	mg/L Hg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Molybdenum	mg/L Mo	0.53	0.22	0.51	0.20	0.42	0.27
Nickel	mg/L Ni	0.02	1.29	0.02	0.19	0.01	0.16
Nitrite + Nitrate	mg/L N	2.6	0.8	2.7	0.8	2.3	0.8
pH		10.1	5.0	8.8	4.7	10.3	5.1
Selenium	mg/L Se	0.031	<0.005	0.240	<0.005	0.031	<0.005
Silver	mg/L Ag	0.01	0.01	0.02	0.01	0.01	0.01
Sulfate	mg/L SO4	770	520	1170	190	120	820
Tin	mg/L Sn	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	mg/L Zn	<0.01	1.32	<0.01	0.27	0.01	0.10

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EPA Method 5 Data Reporting Sheet
Filter Gravimetrics

Job NSP/ Black Dog
Team Leader DVH
Date Submitted 11-5-91
Test No. 1
Date of Analysis 11-16-91

Source Units # 1, 3, 4
Test Site Stack
Date of Test 11-4-91
No. of Runs Completed 3
Technician M. Hamer

0
Test 1 Run 0 0
Field Blank
Log Number 4677-49
Comments second blank

Filter No. 6052
Filter Type 4MS 3.52"
Filter Tare Wt. .4018 g
Filter+Sample Wt. .4019 g
Sample Wt. 0.0001 g

1
Test ____ Run ____
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

2
Test ____ Run ____
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

3
Test ____ Run ____
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

4
Test ____ Run ____
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

5
Test ____ Run ____
Log Number ____
Comments ____

Filter No. ____
Filter Type ____
Filter Tare Wt. ____ g
Filter+Sample Wt. ____ g
Sample Wt. ____ g

Results:

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5

Field Blk.	Run 1	Run 2	Run 3	Run 4	Run 5

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Cascade Impactor Laboratory Data Sheet

Job NSP/ Black Dog

Date of test 11/5/91

Source Unit 1,3 : 4

Test 2 Run 0

Analyst TTM Impactor No. 0

Substrate used Gold Plated a-H Coated/port

Stage No.	Weight (g) Tare	Final	Uncorr. Mass	Control	Corr. Mass	Cum. Weight (g)	% W/W	Part Dia. (um)
Preimpact.	42.25580	43.25681	+.00101	NA	NA	NA	NA	NA
1	2.16915	2.16880	-0.00035					
2	2.05699	2.05689	-0.00010					
3	1.94259	1.94238	-0.00021					
4	1.36554	1.36529	-0.00025					
5	2.01706	2.01696	-0.00010					
6	2.09949	2.09927	-0.00022					
7	2.07401	2.07397	-0.00004					
Filter	0.32701	0.32361	-0.00340					

Sampling rate data:

V_{std} = 27.82 DSCF

t_m = 313 °F

θ = 60 min.

P_b = 28.94 in. Hg

P_s = -1.85 in. WC

MC = 9.80 % v/v

$$q_a = \frac{5.67\ V_{std}\ (t_s + 460)}{\theta\ (P_b + P_s/13.6)(100 - MC)}$$

$$q_a = \frac{5.67 \times (27.82) \times (313 + 460)}{(60) \times (28.94 + -1.85 / 13.6) \times (100 - 8.80)} = 0.774 \text{ acfm}$$

Rev. 1 CF-028

Interpoll Laboratories
(612)786-6020

Cascade Impactor Laboratory Data Sheet

Job NSP/Black Dog

Date of test 11/5/91

Source Unit 1, 3:4

Test 2 Run 1

Analyst TLM Impactor No. 1

Substrate used Gold Plated a-H Coated foil

Stage No.	Weight (g) Tare	Final	Uncorr. Mass	Control	Corr. Mass	Cum. Weight (g)	% W/W	Part Dia. (um)
Preimpact.	47.62531	47.62831	0.00300	-.00101	0.00199	0.00199	11.23	10.2
1	202519	2.02619	0.00100	+.00035	0.00135	0.00334	18.85	6.4
2	1.99312	1.99355	0.00043	+.00010	0.00053	0.00387	21.84	4.2
3	2.10138	2.10436	0.00299	+.00021	0.00319	0.00706	39.84	2.5
4	1.99313	1.99493	0.00180	+.00025	0.00205	0.00911	51.41	1.5
5	1.99789	2.00054	0.00265	+.00010	0.00265	0.01176	66.37	1.0
6	2.07238	2.07442	0.00204	+.00022	0.00226	0.01402	79.12	0.64
7	2.34900	2.34924	0.00024	+.00004	0.00028	0.01430	80.70	0.36
Filter	0.23802	0.23804	0.00002	+.00340	0.00342	0.01772		

Sampling rate data:

V_{std} = 21.76 DSCF

t_m = 315 °F

θ = 48 min.

P_b = 28.94 in. Hg

P_m = -1.85 in. WC

MC = 9.77 % v/v

$$q_m = \frac{5.67\ V_{std}\ (t_m + 460)}{\theta\ (P_b + P_m/13.6)\ (100 - MC)}$$

$$q_a = \frac{5.67 \times (\ 21.76\ ) \times (\ 315 + 460)}{(\ 48\ ) \times (\ 28.94 + -1.85\ /\ 13.6) \times (\ 100 - 9.77\ )} = 0.766 \text{ acfm}$$

Rev. 1 CF-028

Interpoll Laboratories
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Cascade Impactor Laboratory Data Sheet

Job NSP/Black Dog Date of test 11/5/91

Source Unit 1,3:4 Test 2 Run 2

Analyst TLm Impactor No. 2 Substrate used Gold plated A-Coated fords

Stage No.	Weight (g) Tare	Final	Uncorr. Mass	Control	Corr. Mass	Cum. Weight (g)	% W/W)	Part Dia. (um)
Preimpact.	45.71493	48.71492	0.00299	0.0001	0.00198	0.00198	9.08	10.2
1	2.17109	2.17191	0.00082	+.00035	0.00117	0.00315	14.45	6.4
2	2.12755	2.12816	0.00061	+.00010	0.00071	0.00386	17.71	4.2
3	2.08270	2.08600	0.00330	+.00021	0.00351	0.00737	33.81	2.5
4	1.92580	1.92852	0.00272	+.00025	0.00297	0.01034	47.43	1.5
5	1.98789	1.99151	0.00362	+.00010	0.00372	0.01406	64.50	1.0
6	2.02814	2.03047	0.00233	+.00022	0.00255	0.01661	76.19	0.64
7	2.03684	2.03794	0.0010	+.00004	0.00114	0.01775	81.42	0.36
Filter	0.32060	0.32125	0.00065	+.00340	0.00405	0.0218		

Sampling rate data:

V_{std} = 27.15 DSCF P_b = 28.94 in. Hg

t_s = 312 °F P_s = -1.85 in. WC

θ = 60 min. MC = 11.78 % v/v

$$q_s = \frac{5.67\ V_{std}\ (t_s + 460)}{\theta\ (P_b + P_s/13.6)(100 - MC)}$$

$$q_s = \frac{5.67 \times (27.15) \times (312 + 460)}{(60) \times (28.95 + -1.85\ /\ 13.6) \times (100 - 11.78)} = 0.779 \text{ acfm}$$

Rev. 1 CF-028

Interpoll Laboratories
(612)786-6020

Cascade Impactor Laboratory Data Sheet

Job NSP/Black Dog Date of test 11/5/91

Source Unit # 1,3,4 Test 2 Run 3

Analyst TM Impactor No. 3 Substrate used Gold Plated A-H Coated foils

Stage No.	Weight (g) Tare	Final	Uncorr. Mass	Control	Corr. Mass	Cum. Weight (g)	% W/W	Part Dia. (um)
Preimpact.	50.59691	50.60491	0.00820	-0.00101	0.00719	0.00719	21.17	10.2
1	1.91391	1.91554	0.00163	+.00035	0.00198	0.00917	26.99	6.4
2	1.96268	1.96355	0.00087	+.00010	0.00097	0.01014	29.85	4.2
3	2.01358	2.01812	0.00454	+.0004	0.00475	0.01489	43.83	2.5
4	1.93487	1.93880	0.00393	+.00025	0.00418	0.01907	56.14	1.5
5	1.99527	2.00025	0.00498	+.00010	0.00508	0.02415	71.09	1.0
6	2.02609	2.03038	0.00429	+.00022	0.00451	0.02866	84.37	0.64
7	2.05919	2.06106	0.00187	+.00004	0.00191	0.03057	89.99	0.36
Filter	0.32660	0.32664	0.00004	+.00340	0.00340	0.03397		

Sampling rate data:

V_{std} = 42.64 DSCF P_b = 28.94 in. Hg

t_m = 314 °F P_s = -1.85 in. WC

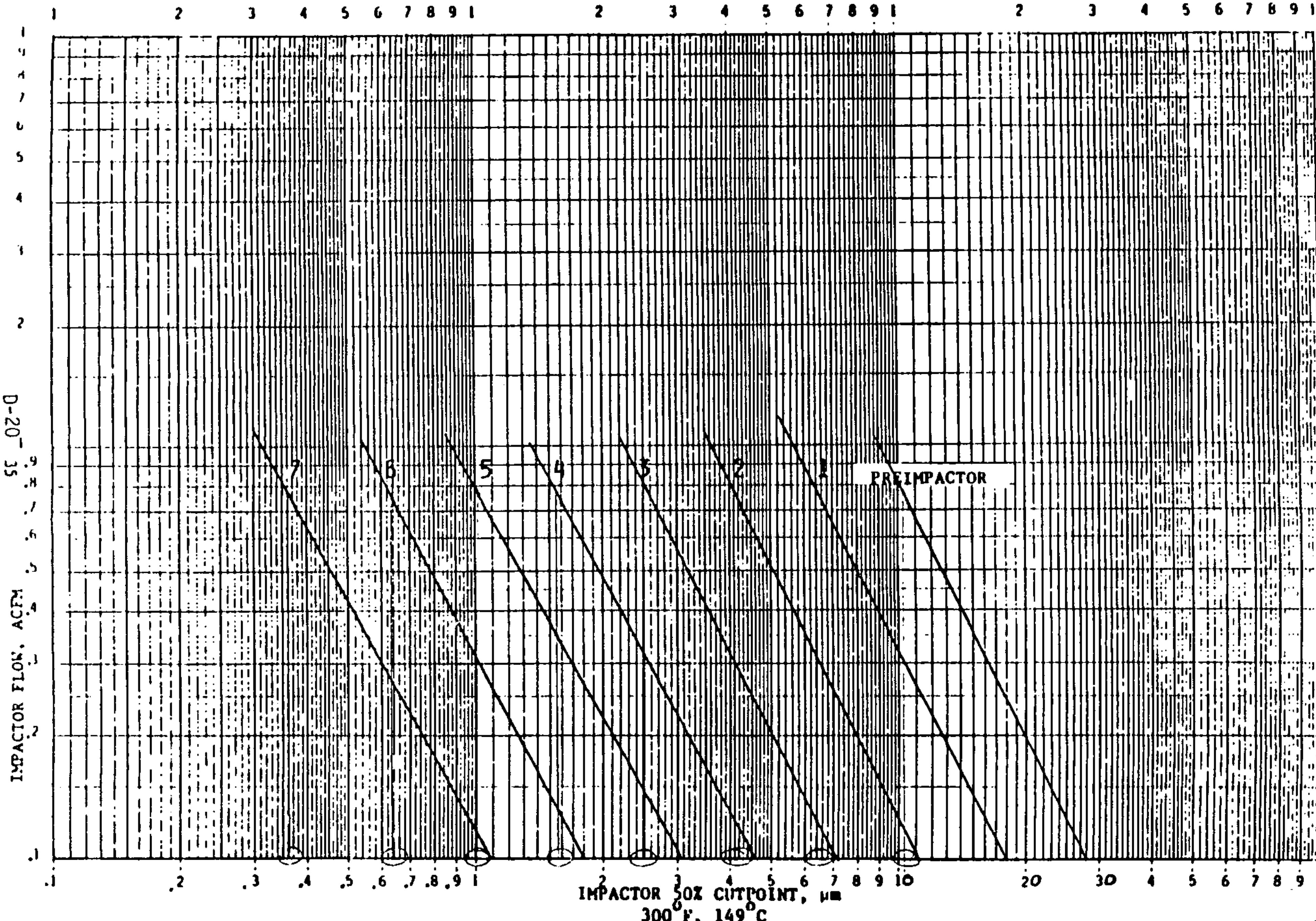
θ = 96 min. MC = 10.12 % v/v

$$q_a = \frac{5.67\ V_{std}\ (t_m + 460)}{\theta\ (P_b + P_s/13.6)(100 - MC)}$$

$$q_a = \frac{5.67 \times (42.64) \times (314 + 460)}{(96) \times (28.94 + -1.85 / 13.6) \times (100 - 10.12)} = 0.753 \text{ acfm}$$

Rev. 1 CF-028

FIGURE 20



Preimpactor 0.80 ACFM for
@ [illegible]°F 10µm 50% cut

INTERPOLL LABORATORIES, INC.
(612)786-6020

NSP/Black Dog
Laboratory Log No. 4677

Results of Trace Metal Analyses

Test: 1
Source: Units 1, 3 & 4 Inlet
Sample Type: Total Train Catch

		Total Mass of Trace Metal in Sample (ug)		
Trace Metal	Method	Run 1	Run 2	Run 3
(Log No.)		(4677-94)	(4677-95)	(4677-96)
Silver	SW-846, 6010	16	< 17	< 16
Aluminum	SW-846, 6010	1880000	2040000	1920000
Arsenic	SW-846, 7060	250	263	231
Boron	SW-846, 6010	7740	7780	6920
Barium	SW-846, 6010	104000	112000	107000
Beryllium	SW-846, 6010	40.0	41.4	31.2
Calcium	SW-846, 6010	2670000	2870000	2530000
Cadmium	SW-846, 6010	76.7	291	359
Chromium	SW-846, 6010	1250	1360	988
Copper	SW-846, 6010	3340	3270	3020
Iron	SW-846, 6010	719000	773000	719000
Potassium	SW-846, 6010	71100	67700	60100
Magnesium	SW-846, 6010	567000	609000	548000
Manganese	SW-846, 6010	1830	1910	1550
Molybdenum	SW-846, 6010	228	232	162
Sodium	SW-846, 6010	310000	315000	288000
Nickel	SW-846, 6010	1130	1120	889
Lead	SW-846, 6010	1240	2890	3300
Antimony	SW-846, 7041	32	15.7	< 7.9
Selenium	SW-846, 7740	289	254	245
Strontium	Std. Meth. 326A	37700	40400	36300
Vanadium	SW-846, 6010	3200	3100	2750
Zinc	SW-846, 6010	2710	2720	2200

INTERPOLL LABORATORIES, INC.
(612)786-6020

NSP/Black Dog
Laboratory Log No. 4677

Results of Trace Metal Analysis

Test: 1
Source: Units 1, 3 & 4 Inlet

		Total Mass of Trace Metal in Sample (ug)			
Trace Metal	Method	Field Blank	Run 1	Run 2	Run 3
(Front Half + HNO_3/H_2O_2 Impinger Catch)					
(Log No.)			(4677-94)	(4677-95)	(4677-96)
Mercury	SW-846, 7470		18.3	10.9	9.06
(Permanganate Impinger Catch)					
(Log No.)		(4677-97)	(4677-98)	(4677-99)	(4677-100)
Mercury	SW-846, 7470	5.77	9.47	31.4	6.39
Total		5.77	27.77	42.3	15.45
Blank corrected			22.0	36.53	9.68

INTERPOLL LABORATORIES, INC.
(612)786-6020

NSP/Black Dog
Laboratory Log No. 4677

Results of Trace Metal Analyses

Test: 1
Source: Units 1, 3 & 4 Stack
Sample Type: Total Train Catch

		Total Mass of Trace Metal in Sample (ug)				
Trace Metal	Method	Field Blank 1	Field Blank 2	Run 1	Run 2	Run 3
(Log No.)		(4677-67)	(4677-68)	(4677-69)	(4677-70)	(4677-71)
Silver	SW-846, 6010	< 1	< 1	1.8	1.5	3.7
Aluminum	SW-846, 6010	177	130	4370	4750	5340
Arsenic	SW-846, 7060	0.897	0.08	1.0	1.0	1.0
Boron	SW-846, 6010	4.7	6.9	57.6	52.6	62.1
Barium	SW-846, 6010	5.4	4.4	326	248	110
Beryllium	SW-846, 7091	< 0.005	< 0.005	0.17	0.22	0.26
Calcium	SW-846, 6010	230	190	6200	7390	6470
Cadmium	SW-846, 6010	< 0.5	< 0.5	0.8	6.2	0.8
Chromium	SW-846, 6010	2.9	1.4	4.8	7.4	5.7
Copper	SW-846, 6010	4.2	5.9	23	72.4	21.2
Iron	SW-846, 6010	70	45	1530	1840	1990
Potassium	SW-846, 6010	< 40	< 40	250	440	310
Magnesium	SW-846, 6010	40	31	1300	1560	1740
Manganese	SW-846, 6010	1.9	1.5	10.4	11.5	12
Molybdenum	SW-846, 6010	15.0	12.3	14.7	14.7	13.9
Sodium	SW-846, 6010	680	668	1410	1860	1580
Nickel	SW-846, 6010	2.0	2.0	7.6	26.7	6.4
Lead	SW-846, 6010	6.0	3.0	11	94	7
Antimony	SW-846, 7041	0.2	0.4	< 0.5	7.81	< 0.5
Selenium	SW-846, 7740	0.05	< 0.05	2.0	2.0	2.0
Strontium	Std. Meth. 326A	< 5	< 5	110	111	89
Vanadium	SW-846, 6010	1	< 1	11	12	12.4
Zinc	SW-846, 6010	13.5	11.7	37.3	225	52.5

INTERPOLL LABORATORIES, INC.
(612)786-6020

NSP/Black Dog
Laboratory Log No. 4677

Results of Trace Metal Analysis

Test: 1

Source: Units 1, 3 & 4 Stack

		Total Mass of Trace Metal in Sample (ug)				
Trace Metal	Method	Field Blank 1	Field Blank 2	Run 1	Run 2	Run 3
(Front Half + HNO_3/H_2O_2 Impinger Catch)						
(Log No.)		(4677-67)	(4677-68)	(4677-69)	(4677-70)	(4677-71)
Mercury	SW-846, 7470	0.08	0.06	4.89	3.55	6.66
(Permanganate Impinger Catch)						
(Log No.)		(4677-46)	(4677-51)	(4677-56)	(4677-61)	(4677-66)
Mercury	SW-846, 7470	0.30	0.12	3.07	0.54	3.92

Job NSP-Black Dog Source Units 1,3 & 4 Stack Date of Test 11-5-91

Element		GF/AA	ICP	Field Blanks (MICROGRAMS) H	Field Blanks 1	Field Blanks 2	Analytical Detection Limit	Minimum Detectable Mass	Best Estimate of of Field Blank	Total Mass in Sample (µg) (Not corrected for blank) Run 1	Run 2	Run 3	Total Mass in Sample (µg) (Corrected for blank) Run 1	Run 2	Run 3
Silver					<1	<1			0	1.8	1.5	3.7	1.8	1.5	3.7
Aluminum					177.	130.			154	4370.	4750.	5340	4216.	4596.	5186
Arsenic					.897	.08			0	1.0	1.0	1.0	1.0	1.0	1.0
Boron					4.7	6.9			5.8	57.6	52.6	62.1	51.8	46.8	56.3
Barium					5.4	4.4			4.7	326.	248.	110.	321.3	243.3	105.3
Beryllium					<.005	<.005			0	0.17	0.22	0.26	.17	.22	.26
Calcium					230.	190.			181	6200.	7390.	6470.	6019	7209	6289
Cadmium					<.5	<.5			0	0.8	6.2	0.8	.8	6.2	.8
Chromium					2.9	1.4			1.4	4.8	7.4	5.7	3.4	6.0	4.3
Copper					4.2	5.9			5.1	23.	72.4	21.2	17.9	67.3	16.1
Iron					70.	45.			45	1530.	1840.	1990.	1485.	1795.	1945.
Potassium					<40.	<40.			0	250.	440.	310.	250.	440.	310.
Magnesium					40.	31.			25	1300.	1560.	1740.	1275.	1535.	1715.
Maganese					1.9	1.5			1.5	10.4	11.5	12.	8.9	10.0	10.5
Molybdenum					15.	12.3			13	14.7	14.7	13.9	< 3	< 3	< 3
Sodium					680.	668.			674	1410	1860	1580	736.	1186.	906.
Nickel					2.0	2.0			2	7.6	26.7	6.4	5.6	24.7	4.4
Lead					6.0	3.0			3	11.	94.	7.	8.	91.	4.
Antimony					0.2	0.4			<.5	<.5	7.81	<.5	<.5	7.31	<.5
Selenium					.05	<.05			0	2.0	2.0	2.0	2.0	2.0	2.0
Strontium					<5.	<5.			0	110.	111.	89.	110.	111.	89.
Vanadium					1.	<1.			0	11.	12.	12.4	11.	12.	12.4
Mercury	Front	CV/AA			.08	.06				4.89	3.55	6.66			
	KMnO4				.30	.12				3.07	0.54	3.92			
	Total				.38	.18			0	7.96	4.09	10.58	7.96	4.09	10.58

H - historical average mass of the trace element in a Pallflex quartz filter (12-19-91)

Job NSP- Black Dog Source Unit 5 1,3&4 Stack Date of Test 11-5-91

Element		GF/AA	ICP	MICROGRAMS: Field Blanks H	1	2	Analytical Detection Limit	Minimum Detectable Mass	Best Estimate of Field Blank	Total Mass in Sample (µg) (Not corrected for blank) Run 1	Run 2	Run 3	Total Mass in Sample (µg) (Corrected for blank) Run 1	Run 2	Run 3
Zinc					13.5	11.7			9.1	37.3	225.	52.5	28.2	215.9	43.4
Mercury	Front	CV/AA													
	$KMnO_4$														
	Total														

H[illegible]histo[illegible]l a[illegible]ug[illegible]ss [illegible] the[illegible]e [illegible]ont[illegible] a Pallflex quartz filter

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job NSP Black Dog Station   Source Boiler # 1
Team Leader DVH   Test Site Inlet
Date Submitted 11/6/91   Date of Test 11/5/91
Test No. 1   No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3	Probe Wash: ☐Acetone ☐D.I. Water	■As per EPA M-5 ☐Other	MeCl2
3	Filter: ☐4" G.F. ■S.S. Thimble ☐2.5" G.F. ☐47 mm G.F.	■As per EPA M-5 ☐As per EPA M-17 ☐Other	
4	Impinger Catch: ☐D.I. Water ☐3% H_2O_2 ☐4M5 Hg Only ■4M5 Metals SS ☐1.0 N NaOH ☐Other	☐MN Protocol ☐WI Protocol ☐EPA M-6 or 8 ☐Acid Gases ☐Formaldehyde ☐Metals ☐Other	
3	Integrated Gas sample	■As per EPA M-3 ☐As per EPA M-10 ☐Other	
—	Oxides of Nitrogen (NO_x)	☐As per EPA M-7A ☐Other	Date Time(HRS)
—	☐ Fuel Sample ☐ Aggregate	☐Attached fuel Form #S-0163RRR	
—	Particle Size	☐X-Ray Sedigraph ☐Bahco Method ☐Other	
—	Audit Samples ☐Sulfur Dioxide ☐Oxides of Nit. ☐Other	☐As per EPA M-6 ☐As per EPA M-7A ☐Other	

Source Information

1) Type of Source: ■ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Dryer ☐ Other
2) Fuel: ■ Coal ☐ Wood ☐ Gas ☐ Oil ☐ RDF ☐ Other
3) Is sample combustible? ■ No ☐ Yes
4) Does sample need special handling? ■ No ☐ Yes If yes, explain

S-279RRRR

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job NSP Blackdog / Minneapolis, MN
Team Leader M. Koehler
Date Submitted 11-5-91
Test No. 1

Source No. 3 Boiler
Test Site Inlet
Date of Test 11-5-91
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
3+1	Probe Wash: ☐ Acetone ☐ D.I. Water ☒ $MeCl_2$	☒ As per EPA M-5 ☐ Other ____	
3+1	Filter: ☐ 4" G.F. ☒ S.S. Thimble ☐ 2.5" G.F. ☐ 47 mm G.F.	☒ As per EPA M-5 ☐ As per EPA M-17 ☒ Other Mercury	
3+1	Impinger Catch: ☐ D.I. Water ☐ 3% H_2O_2 ☒ 4M5 Hg Only ☐ 4M5 Metals ☐ 1.0 N NaOH ☐ Other ____	☒ MN Protocol ☐ WI Protocol ☐ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☐ Metals ☐ Other ____	
3	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other ____	
–	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other ____	Date ____ Time (HRS) ____
–	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
–	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other ____	
–	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other ____	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other ____	

Source Information

1) Type of Source: ☒ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Dryer ☐ Other ____
2) Fuel: ☒ Coal ☐ Wood ☐ Gas ☐ Oil ☐ RDF ☐ Other ____
3) Is sample combustible? ☒ No ☐ Yes
4) Does sample need special handling? ☒ No ☐ Yes If yes, explain ____

S-278RRRR

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job NSP /BLACKDOG
Team Leader E TROWBRIDGE
Date Submitted 11-5-91
Test No. 1

Source NO 4 BOILER
Test Site INLET
Date of Test 11-5-91
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
4	Probe Wash: ☒ ~~Acetone~~ MC ☐ D.I. Water	☒ As per EPA M-5 ☐ Other	
4	Filter: ☐ 4" G.F. ☒ S.S. Thimble ☐ 2.5" G.F. ☐ 47 mm G.F.	☒ As per EPA M-5 ☐ As per EPA M-17 ☒ Other METALS	
4	Impinger Catch: ☐ D.I. Water ☐ 3% H_2O_2 ☐ 4M5 Hg Only ☒ 4M5 Metals ☐ 1.0 N NaOH ☐ Other	☐ MN Protocol ☐ WI Protocol ☐ EPA M-6 or 8 ☐ Acid Gases ☐ Formaldehyde ☒ Metals ☐ Other	
3	Integrated Gas sample	☒ As per EPA M-3 ☐ As per EPA M-10 ☐ Other	
	Oxides of Nitrogen (NO_x)	☐ As per EPA M-7A ☐ Other	Date Time(HRS)
	☐ Fuel Sample ☐ Aggregate	☐ Attached fuel Form #S-0163RRR	
	Particle Size	☐ X-Ray Sedigraph ☐ Bahco Method ☐ Other	
	Audit Samples ☐ Sulfur Dioxide ☐ Oxides of Nit. ☐ Other	☐ As per EPA M-6 ☐ As per EPA M-7A ☐ Other	

Source Information

1) Type of Source: ☒ Boiler ☐ Asphalt Plant ☐ Incinerator ☐ Dryer ☐ Other
2) Fuel: ☒ Coal ☐ Wood ☐ Gas ☐ Oil ☐ RDF ☐ Other
3) Is sample combustible? ☐ No ☐ Yes
4) Does sample need special handling? ☐ No ☐ Yes If yes, explain

Interpoll Laboratories
(612) 786-6020

Chain of Custody
Sample Deposition Sheet

Job NSP / Black Dog
Team Leader D.V.H
Date Submitted 11/5/91
Test No. 1

Source Unit #1, 3, 4
Test Site Stack
Date of Test 11/5/91
No. of Runs Completed 3

No. of Samples	Type of Sample	Analysis Required	Comments
5	Probe Wash: [X] ~~Acetone~~ MeCl2 [X] ~~D.I. Water~~, 1N HNO3	[X] As per EPA M-5 [X] Other METALS	
5	Filter: [ ] 4" G.F. [ ] S.S. Thimble [ ] 2.5" G.F. [ ] 47 mm G.F. [X] 3.5" Pallflex	[X] As per EPA M-5 [ ] As per EPA M-17 [X] Other METALS	
5 pairs	Impinger Catch: [ ] D.I. Water [ ] 3% H_2O_2 [X] 4M5 Hg Only [X] 4M5 Metals [ ] 1.0 N NaOH [ ] Other	[ ] MN Protocol [ ] WI Protocol [ ] EPA M-6 or 8 [ ] Acid Gases [ ] Formaldehyde [ ] Metals [ ] Other	
3	Integrated Gas sample	[X] As per EPA M-3 [ ] As per EPA M-10 [ ] Other	
	Oxides of Nitrogen (NO_x)	[ ] As per EPA M-7A [ ] Other	Date Time (HRS)
3	[X] Fuel Sample [ ] Aggregate	[ ] Attached fuel Form #S-0163RRR	see proposal
	Particle Size	[ ] X-Ray Sedigraph [ ] Bahco Method [ ] Other	
	Audit Samples [ ] Sulfur Dioxide [ ] Oxides of Nit. [ ] Other	[ ] As per EPA M-6 [ ] As per EPA M-7A [ ] Other	

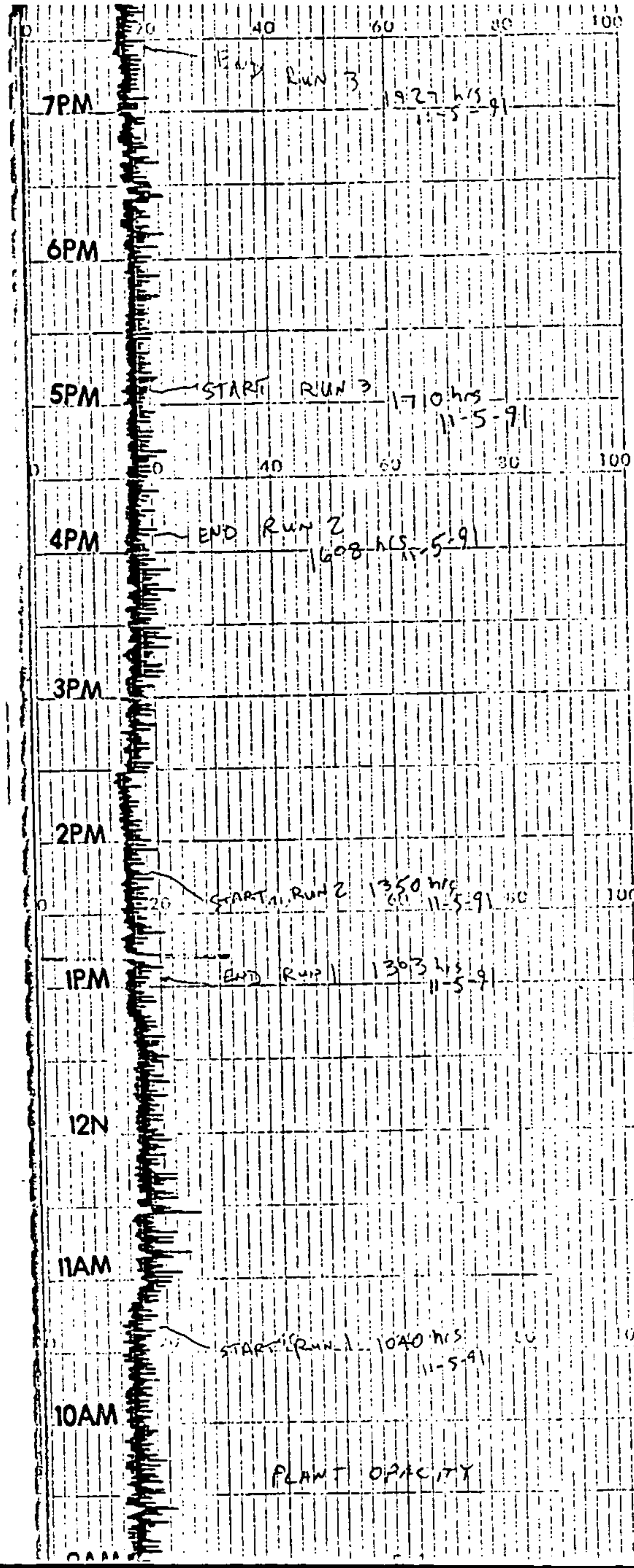
Source Information

1) Type of Source: [X] Boiler [ ] Asphalt Plant [ ] Incinerator [ ] Dryer [ ] Other
2) Fuel: [X] Coal [ ] Wood [ ] Gas [ ] Oil [ ] RDF [ ] Other
3) Is sample combustible? [X] No [ ] Yes
4) Does sample need special handling? [X] No [ ] Yes If yes, explain

S-278RRRR

APPENDIX E

BOILER OPERATIONAL DATA



No. 560104

GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

AIR TOXICS TEST UNITS 1, 3, + 4

11-5-91

ulative sad coal. (wet)

0900	Blew soot #1 & #4 unit #4 0900 – #1 0900 – 1030
1030	Blew soot #3 unit. 1030 –
1040	~~Start test~~ (1er) Test
1050	#11 F.D. Speed Swinging a little ±20 rpm
1120	#21 IK.s stuck in Boiler –
1200	# IK is out of Boiler
1220	Blowing Soot (wall.s) on #4 Boiler
1240	Blowing Soot on #1 unit
1303	done with the Firstle (1er) Test.
1350	START (2do) Test
1430	#3 Blew Soot 7 IR's All IK's + AH's
1608	TEST "2" IS FINISHED
1630	TAKING BOTTOM ASH SAMPLES
1710	START 3rd Test
1800	#1 Boiler BLEW ALL SOOT BLOWERS
1920	#4 Boiler BLEW ALL SOOT " " "
1927	TEST #3 IS DONE

FORM IT 2503

11/73 12/85 - 13/73 14/162

BLACKDOG STEAM PLANT
GENERATED LOAD RECORD
UNIT #1

ON LINE @ 0000

OFF LINE @ 2047

DATE NOV 05 1991

#1 "MAIN GENERATOR"				HOUSE	TOTAL VARS	
TIME	MEGA-WATTS	MEGAVARS REC	MEGAVARS DEL	MEGAVARS DEL	VARS REC	VARS DEL
0100	58		14	3		17
0200	57		14	3		17
0300	56		14	2		16
0400	57		7.5	2.5		10.0
0500	57		8.3	2.5		10.8
0600	57		9.2	2.5		11.7
0700	57		9.1	2.5		11.6
0800	58		10	2.7		12
0900	57		13	2		15
1000	60		13	2		15
1100	59		11	3		14
1200	62		10	4		14
1300	60		10	4		14
1400	59		9.8	2.7		12
1500	60		10	3.8		13.8
1600	62		10	2.5		12.5
1700	62		11	2.5		
1800	62		12	2.5		
1900	62		12	2.5		
2000	60		10	2.5		12.5
2100						
2200						
2300						
2400						

EQUIPTMENT "RUN TIME"		
EQUIPTMENT	IN	OUT
AIR HEATER	00	
11 ID FAN	00	
12 ID FAN	00	
11 FD FAN	00	
12 FD FAN	00	

TIME	"SOOT BLOWERS"
0220	All elements
0500	all elements
0903	All elements
1300	All Available elements
1800	ACC

```
1 HOURLY                          UNIT 1 HOURLY LOG                                11:05:17      11/05/91

1FWP 1294.4 PSIG      1 AVG.  FEEDWATER PRESSURE              63.8 MEG W   1 INT.  GROSS MEGAWATTS (+HOUSE)
                                                              12.2 M-VARS  1 AVG.  MAIN GENERATOR VARS
1MWH   59.9 MEG W     1 INT.  NET MEGAWATTS (GEN GROSS)        4.0 MEG W   1 INT.  HOUSE GENERATOR MEG-W
                                                               2.8 M-VARS  1 AVG.  HOUSE GENERATOR VARS
1FFH  495.2 K #/HR    1 INT.  FEEDWATER FLOW                   0.0 MEG W   1 RSA SUPPLY TO ONE MEGAWATTS

1FWT  410.7 DEG F     1 AVG.  FEEDWTR TO ECON TEMP             3.9 MEG W   1 TOTAL STATION USE INT. HOUSE+1RSA
                                                               0.0 KVOLTS  1 AVG.  GENERATOR AB PHASE
1MSP  899.1 PSIG      1 AVG.  FINAL STEAM PRESSURE            2495 AMPS    1 AVG.  GENERATOR B PHASE
                                                             216.8 DCVOLT  1 AVG.  MAIN EXCITER
1MST  955.6 DEG F     1 AVG.  FINAL STEAM TEMP               414.5 AMPS    1 AVG.  MAIN FIELD

1ATT  285.6 DEG F     1 AVG.  ATTEMP INLET FW TEMP

1AFH   35.2 K #/HR    1 INT.  TOTAL ATTEMP FLOW                0.0 M-BTU   TOTAL FUEL BTU INPUT
                                                             521.7 M-BTU   BOILER NET BTU OUTPUT
1BPH  29.18 INCHES    AVG. PLANT BAROMETRIC PRESS
                                                            !!!!!! PERCNT  BOILER EFFICIENCY
1CVP  28.07 INCHES    1 AVG.  CONDENSER VACUUM                41.7 PERCNT  TURBINE EFFICIENCY
                                                            !!!!!! PERCNT  COMBINED CYCLE EFF
1CWP
                                                              8169 PERCNT  TURBINE GROSS HEAT RATE
1CIT                                                             0 PERCNT  COMBINED CYCLE HEAT RATE

                                                                 0 BTU'S   COAL BTUS/POUND (@1070)
1COT                                                             0 BTU'S   OIL BTUS/GALLON (@1071)
                                                                 0 BTU'S   GAS BTUS/SCF    (@1072)

1HWT   79.2 DEG F    11 AVG.  HOTWELL PUMP DSCH TEMP
  OR   78.8 DEG F    12 AVG.  HOTWELL PUMP DSCH TEMP           0.0 GPM     1 INT.  TORCH OIL FLOW
                                                              71.9 KSCFH   1 INT.  TORCH GAS FLOW
       1.00 HOURS     1 INT.  GEN ON LINE % HOUR               0.0 KSCFH   1 INT.  MAIN GAS FLOW
                                                              72.1 KSCFH   1 INT.  TOTAL GAS FLOW

                                                               8.1 TPH     11 MILL COAL FLOW
      515.7 K #/HR    1 INT.  FINAL STEAM FLOW                 9.2 TPH     12 MILL COAL FLOW
      18943 #/HR     11 INT.  ATTEMP SPRAY FLOW                6.7 TPH     13 MILL COAL FLOW
      16396 #/HR     12 INT.  ATTEMP SPRAY FLOW                2.9 TPH     14 MILL COAL FLOW
      950.8 PSIG      1 AVG.  DRUM PRESSURE                   34.4 TPH     TOTAL COAL FLOW
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1 HOURLY                          UNIT 1 HOURLY LOG                                  12:05:18      11/05/91

1FWP 1297.7 PSIG     1 AVG. FEEDWATER PRESSURE                 65.2 MEG W   1 INT. GROSS MEGAWATTS (+HOUSE)
                                                               10.9 M-VARS  1 AVG. MAIN GENERATOR VARS
1MWH   61.4 MEG W    1 INT. NET MEGAWATTS (GEN GROSS)           3.9 MEG W   1 INT. HOUSE GENERATOR MEG-W
                                                                2.7 M-VARS  1 AVG. HOUSE GENERATOR VARS
1FFH  489.5 K #/HR   1 INT. FEEDWATER FLOW                      0.0 MEG W   1 RSA SUPPLY TO ONE MEGAWATTS

1FWT  413.7 DEG F    1 AVG. FEEDWTR TO ECON TEMP                3.9 MEG W   1 TOTAL STATION USE INT. HOUSE+1RSA
                                                                0.0 KVOLTS  1 AVG. GENERATOR AB PHASE
1MSP  899.6 PSIG     1 AVG. FINAL STEAM PRESSURE               2549 AMPS    1 AVG. GENERATOR B PHASE
                                                              217.0 DCVOLT  1 AVG. MAIN EXCITER
1MST  950.3 DEG F    1 AVG. FINAL STEAM TEMP                  414.4 AMPS    1 AVG. MAIN FIELD

1ATT  267.3 DEG F    1 AVG. ATTEMP INLET FW TEMP

1AFH   37.6 K #/HR   1 INT. TOTAL ATTEMP FLOW                   0.0 M-BTU   TOTAL FUEL BTU INPUT
                                                              536.4 M-BTU   BOILER NET BTU OUTPUT
1BPH  29.17 INCHES   AVG. PLANT BAROMETRIC PRESS
                                                             !!!!!! PERCNT  BOILER EFFICIENCY
1CVP  28.02 INCHES   1 AVG. CONDENSER VACUUM                   41.5 PERCNT  TURBINE EFFICIENCY
                                                             !!!!!! PERCNT  COMBINED CYCLE EFF
1CWP
                                                               8211 PERCNT  TURBINE GROSS HEAT RATE
1CIT                                                              0 PERCNT  COMBINED CYCLE HEAT RATE

1CCT                                                              0 BTU'S   COAL BTUS/POUND (@1070)
                                                                  0 BTU'S   OIL BTUS/GALLON (@1071)
                                                                  0 BTU'S   GAS BTUS/SCF    (@1072)

1HWT   80.6 DEG F   11 AVG. HOTWELL PUMP DSCH TEMP
  OR   73.1 DEG F   12 AVG. HOTWELL PUMP DSCH TEMP              0.0 GPM     1 INT. TORCH OIL FLOW
                                                               72.0 KSCFH   1 INT. TORCH GAS FLOW
       1.00 HOURS    1 INT. GEN ON LINE % HOUR                  0.0 KSCFH   1 INT. MAIN GAS FLOW
                                                               72.3 KSCFH   1 INT. TOTAL GAS FLOW

                                                                8.1 TPH     11 MILL COAL FLOW
      530.1 K #/HR   1 INT. FINAL STEAM FLOW                    9.1 TPH     12 MILL COAL FLOW
      19663 #/HR    11 INT. ATTEMP SPRAY FLOW                   6.7 TPH     13 MILL COAL FLOW
      17997 #/HR    12 INT. ATTEMP SPRAY FLOW                   2.9 TPH     14 MILL COAL FLOW
      953.4 PSIG     1 AVG. DRUM PRESSURE                      34.4 TPH     TOTAL COAL FLOW
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UNIT 1 HOURLY LOG

13:05:17   11/05/81

1 HOURLY

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1FWP 1298.5 PSIG     1 AVG. FEEDWATER PRESSURE
1MWH   60.9 MEG W    1 INT. NET MEGAWATTS (GEN GROSS)
1FFH  487.4 K #/HR   1 INT. FEEDWATER FLOW
1FWT  412.9 DEG F    1 AVG. FEEDWTR TO ECON TEMP
1MSP  891.9 PSIG     1 AVG. FINAL STEAM PRESSURE
1MST  948.7 DEG F    1 AVG. FINAL STEAM TEMP
1ATT  287.6 DEG F    1 AVG. ATTEMP INLET FW TEMP
1AFH   37.3 K #/HR   1 INT. TOTAL ATTEMP FLOW
1BPH  29.15 INCHES   AVG. PLANT BAROMETRIC PRESS
1CVP  28.00 INCHES   1 AVG. CONDENSER VACUUM
1CWF
1CIT
1COT

1HWT   79.2 DEG F   11 AVG. HOTWELL PUMP DSCH TEMP
  OR   79.7 DEG F   12 AVG. HOTWELL PUMP DSCH TEMP

       1.00 HOURS    1 INT. GEN ON LINE % HOUR

      524.6 K #/HR   1 INT. FINAL STEAM FLOW
      17613 #/HR    11 INT. ATTEMP SPRAY FLOW
      17607 #/HR    12 INT. ATTEMP SPRAY FLOW
      945.2 PSIG     1 AVG. DRUM PRESSURE
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  64.7 MEG W    1 INT. GROSS MEGAWATTS (+HOUSE)
  10.4 M-VARS   1 AVG. MAIN GENERATOR VARS
   3.8 MEG W    1 INT. HOUSE GENERATOR MEG-W
   2.6 M-VARS   1 AVG. HOUSE GENERATOR VARS
   0.0 MEG W    1 RSA SUPPLY TO ONE MEGAWATTS

   3.7 MEG W    1 TOTAL STATION USE INT. HOUSE+1RSA
   0.0 KVOLTS   1 AVG. GENERATOR AB PHASE
  2522 AMPS     1 AVG. GENERATOR B PHASE
 215.5 DCVOLT   1 AVG. MAIN EXCITER
 411.4 AMPS     1 AVG. MAIN FIELD

   0.0 M-BTU      TOTAL FUEL BTU INPUT
 531.4 M-BTU      BOILER NET BTU OUTPUT

!!!!!! PERCNT     BOILER EFFICIENCY
  41.5 PERCNT     TURBINE EFFICIENCY
!!!!!! PERCNT     COMBINED CYCLE EFF

  8224 PERCNT     TURBINE GROSS HEAT RATE
     0 PERCNT     COMBINED CYCLE HEAT RATE

     0 BTU'S      COAL BTUS/POUND  (81070)
     0 BTU'S      OIL BTUS/GALLON  (81071)
     0 BTU'S      GAS BTUS/SCF     (81072)

   0.0 GPM      1 INT. TORCH OIL FLOW
  73.4 KSCFH    1 INT. TORCH GAS FLOW
   0.0 KSCFH    1 INT. MAIN GAS FLOW
  73.0 KSCFH    1 INT. TOTAL GAS FLOW

   9.1 TPH       11 MILL COAL FLOW
   9.1 TPH       12 MILL COAL FLOW
   4.7 TPH       13 MILL COAL FLOW
   1.9 TPH       14 MILL COAL FLOW
  24.4 TPH       TOTAL COAL FLOW
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1 HOURLY                    UNIT 1 HOURLY LOG                          14:05:17      11/05/91

1FWP 1297.4 PSIG     1 AVG. FEEDWATER PRESSURE
1MWH   59.1 MEG W    1 INT. NET MEGAWATTS (GEN GROSS)
1FFH  494.4 K #/HR   1 INT. FEEDWATER FLOW
1FWT  409.2 DEG F    1 AVG. FEEDWTR TO ECON TEMP
1MSP  857.0 PSIG     1 AVG. FINAL STEAM PRESSURE
1MST  750.7 DEG F    1 AVG. FINAL STEAM TEMP
1ATT  284.9 DEG F    1 AVG. ATTEMP INLET FW TEMP
1AFH   30.9 K #/HR   1 INT. TOTAL ATTEMP FLOW
1BPR  29.14 INCHES   AVG. PLANT BAROMETRIC PRESS
1CVF  28.03 INCHES   1 AVG. CONDENSER VACUUM
1CWP
1CIT
1COT

1HWT   79.0 DEG F   11 AVG. HOTWELL PUMP DSCH TEMP
  UR   79.6 DEG F   12 AVG. HOTWELL PUMP DSCH TEMP

       1.00 HOURS    1 INT. GEN ON LINE % HOUR

      509.0 K #/HR   1 INT. FINAL STEAM FLOW
      17734 #/HR    11 INT. ATTEMP SPRAY FLOW
      13165 #/HR    12 INT. ATTEMP SPRAY FLOW
      947.7 PSIG     1 AVG. DRUM PRESSURE

  62.9 MEG W   1 INT. GROSS MEGAWATTS (+HOUSE)
  10.2 M-VARS 1 AVG. MAIN GENERATOR VARS
   2.8 MEG W   1 INT. HOUSE GENERATOR MEG-W
   2.4 M-VARS 1 AVG. HOUSE GENERATOR VARS
   0.0 MEG W   1 PSA SUPPLY TO ONE MEGAWATTS

   3.7 MEG W   1 TOTAL STATION USE INT. HOUSE+1PSA
   0.0 KVOLTS 1 AVG. GENERATOR AB PHASE
  2447 AMPS    1 AVG. GENERATOR B PHASE
 211.3 DCVOLT 1 AVG. MAIN EXCITER
 405.4 AMPS    1 AVG. MAIN FIELD

   0.0 M-BTU   TOTAL FUEL BTU INPUT
 514.9 M-BTU   BOILER NET BTU OUTPUT

!!!!!! PERCNT BOILER EFFICIENCY
  41.7 PERCNT TURBINE EFFICIENCY
!!!!!! PERCNT COMBINED CYCLE EFF

  3192 PERCNT TURBINE GROSS HEAT RATE
     0 PERCNT COMBINED CYCLE HEAT RATE

     0 BTU'S   COAL BTUS/POUND (81072)
     0 BTU'S   OIL BTUS/GALLON (81072)
     0 BTU'S   GAS BTUS/SCF     (81072)

   0.0 GPM     1 INT. TORCH OIL FLOW
  75.2 KSCFH   1 INT. TORCH GAS FLOW
   0.0 KSCFH   1 INT. MAIN GAS FLOW
  75.3 KSCFH   1 INT. TOTAL GAS FLOW

   8.1 TPH     11 MILL COAL FLOW
   9.1 TPH     12 MILL COAL FLOW
   6.7 TPH     13 MILL COAL FLOW
   2.9 TPH     14 MILL COAL FLOW
  34.4 TPH     TOTAL COAL FLOW
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1 HOURLY   UNIT 1 HOURLY LOG   15:05:19   11/05/81

1FWP	1307.8 PSIG	1 AVG.	FEEDWATER PRESSURE
1NWH	53.0 MEG W	1 INT.	NET MEGAWATTS (GEN GROSS)
1FFH	475.7 K #/HR	1 INT.	FEEDWATER FLOW
1FWT	410.1 DEG F	1 AVG.	FEEDWTR TO ECON TEMP
1MSP	833.0 PSIG	1 AVG.	FINAL STEAM PRESSURE
1NST	952.4 DEG F	1 AVG.	FINAL STEAM TEMP
1ATT	284.7 DEG F	1 AVG.	ATTEMP INLET FW TEMP
1AFH	85.6 K #/HR	1 INT.	TOTAL ATTEMP FLOW
1BPM	27.15 INCHES	AVG.	PLANT BAROMETRIC PRESS
1CVP	20.04 INCHES	1 AVG.	CONDENSER VACUUM
1CWF			
1CIT			
1COT			
1HWT	75.2 DEG F	11 AVG.	HOTWELL PUMP DSCH TEMP
OR	75.2 DEG F	12 AVG.	HOTWELL PUMP DSCH TEMP
	1.00 HOURS	1 INT.	GEN ON LINE X HOUR
	510.0 K #/HR	1 INT.	FINAL STEAM FLOW
	17181 #/HR	11 INT.	ATTEMP SPRAY FLOW
	11507 #/HR	12 INT.	ATTEMP SPRAY FLOW
	846.8 PSIG	1 AVG.	DRUM PRESSURE

63.1	MEG W	1 INT.	GROSS MEGAWATTS (+HOUSE)
10.0	M-VARS	1 AVG.	MAIN GENERATOR VARS
0.0	MEG W	1 INT.	HOUSE GENERATOR MEG-W
0.7	M-VARS	1 AVG.	HOUSE GENERATOR VARS
0.0	MEG W	1	RSA SUPPLY TO ONE MEGAWATTS
3.0	MEG W	1	TOTAL STATION USE INT. HOUSE+1RSA
0.0	KVOLTS	1 AVG.	GENERATOR AB PHASE
2459	AMPS	1 AVG.	GENERATOR B PHASE
211.5	DCVOLT	1 AVG.	MAIN EXCITER
406.0	AMPS	1 AVG.	MAIN FIELD
0.0	M-BTU		TOTAL FUEL BTU INPUT
516.0	M-BTU		BOILER NET BTU OUTPUT
??????	PERCENT		BOILER EFFICIENCY
41.8	PERCENT		TURBINE EFFICIENCY
??????	PERCENT		COMBINED CYCLE EFF
8178	PERCENT		TURBINE GROSS HEAT RATE
1	PERCENT		COMBINED CYCLE HEAT RATE
0	BTU/S		COAL BTUS/POUND (@1072)
0	BTU/S		OIL BTUS/GALLON (@1072)
0	BTU/S		GAS BTUS/SCF (@1072)
0.0	GPM	1 INT.	TORCH OIL FLOW
72.1	KSCFH	1 INT.	TORCH GAS FLOW
0.0	KSCFH	1 INT.	MAIN GAS FLOW
72.0	KSCFH	1 INT.	TOTAL GAS FLOW
8.1	TPH	11	MILL COAL FLOW
8.1	TPH	12	MILL COAL FLOW
1.0	TPH	13	MILL COAL FLOW
8.8	TPH	14	MILL COAL FLOW
26.1	TPH		TOTAL COAL FLOW

HOURLY UNIT 1 HOURLY LOG [illegible] 11/05/91

FWP	1296.2 PSIG	1	AVG.	FEEDWATER PRESSURE
MWH	61.5 MEG W	1	INT.	NET MEGAWATTS (GEN GROSS)
FFH	437.2 K #/HR	1	INT.	FEEDWATER FLOW
FWT	4[illegible].8 DEG F	1	AVG.	FEEDWTR TO ECON TEMP
MSP	[illegible]01.[illegible] PSIG	1	AVG.	FINAL STEAM PRESSURE
MST	[illegible]4[illegible].6 DEG F	1	AVG.	FINAL STEAM TEMP
ATT	267.4 DEG F	1	AVG.	ATTEMP INLET FW TEMP
AFH	37.6 K #/HR	1	INT.	TOTAL ATTEMP FLOW
BPH	2[illegible].1[illegible] INCHES		AVG.	PLANT BAROMETRIC PRESS
[illegible]	2[illegible].01 INCHES	1	AVG.	CONDENSER VACUUM
CWF				
[illegible]				
[illegible]				
HWT	[illegible].[illegible] DEG F	11	AVG.	HOTWELL PUMP DISCH TEMP
[illegible]JR	7[illegible].[illegible] DEG F	12	AVG.	HOTWELL PUMP DISCH TEMP
	1.00 HOURS	1	INT.	GEN ON LINE % HOUR
	[illegible] K #/HR	1	INT.	FINAL STEAM FLOW
	[illegible] #/HR	11	INT.	ATTEMP SPRAY FLOW
	[illegible] #/HR	12	INT.	ATTEMP SPRAY FLOW
	[illegible] PSIG	1	AVG.	DRUM PRESSURE

65.2	MEG W	1 INT.	GROSS MEGAWATTS (+HOUSE)
10.0	M-VARS	1 AVG.	MAIN GENERATOR VARS
2.8	MEG W	1 INT.	HOUSE GENERATOR MEG-W
2.5	M-VARS	1 AVG.	HOUSE GENERATOR VARS
0.0	MEG W	1 RSA	SUPPLY TO ONE MEGAWATTS
3.7	MEG W	1 TOTAL	STATION USE INT. HOUSE+RSA
0.0	KVOLTS	1 AVG.	GENERATOR AB PHASE
2541	AMPS	1 AVG.	GENERATOR B PHASE
215.6	DCVOLT	1 AVG.	MAIN EXCITER
412.1	AMPS	1 AVG.	MAIN FIELD
0.0	M-BTU		TOTAL FUEL BTU INPUT
536.3	M-BTU		BOILER NET BTU OUTPUT
!!!!!!	PERCNT		BOILER EFFICIENCY
41.4	PERCNT		TURBINE EFFICIENCY
!!!!!!	PERCNT		COMBINED CYCLE EFF
8226	PERCNT		TURBINE GROSS HEAT RATE
0	PERCNT		COMBINED CYCLE HEAT RATE
0	BTU'S		COAL BTUS/POUND (81070)
0	BTU'S		OIL BTUS/GALLON (81071)
0	BTU'S		GAS BTUS/SCF (81072)
[illegible]	GPM	1 INT.	TORCH OIL FLOW
71.[illegible]	KSCFH	1 INT.	TORCH GAS FLOW
0.0	KSCFH	1 INT.	MAIN GAS FLOW
72.0	KSCFH	1 INT.	TOTAL GAS FLOW
[illegible].1	TPH	11	MILL COAL FLOW
[illegible].[illegible]	TPH	12	MILL COAL FLOW
7.[illegible]	TPH	13	MILL COAL FLOW
[illegible]	TPH	14	MILL COAL FLOW
[illegible]	TPH		TOTAL COAL FLOW

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1 HOURLY                                   UNIT 1 HOURLY LOG                                          17:05:17       11/05/81

1FWP 1292.3 PSIG    1 AVG. FEEDWATER PRESSURE                      64.1 MEG W   1 INT. GROSS MEGAWATTS (+HOUSE)
                                                                  10.4 M-VARS  1 AVG. MAIN GENERATOR VARS
1NMW   62.3 MEG W   1 INT. NET MEGAWATTS (GEN GROSS)                3.9 MEG W   1 INT. HOUSE GENERATOR MEG-W
                                                                    2.1 M-VARS  1 AVG. HOUSE GENERATOR VARS
1FFH  493.1 K #/HR  1 INT. FEEDWATER FLOW                           0.0 MEG W   1 RSA SUPPLY TO ONE MEGAWATTS

1FWT  414.7 DEG F   1 AVG. FEEDWTR TO ECON TEMF                     3.7 MEG W   1 TOTAL STATION USE INT. HOUSE+1RSA
                                                                    0.0 KVOLTS  1 AVG. GENERATOR AB PHASE
1MSP  878.3 PSIG    1 AVG. FINAL STEAM PRESSURE                    2593 AMPS    1 AVG. GENERATOR B PHASE
                                                                  219.3 DCVOLT  1 AVG. MAIN EXCITER
1MST  949.3 DEG F   1 AVG. FINAL STEAM TEMP                       414.7 AMPS    1 AVG. MAIN FIELD

1ATT  288.7 DEG F   1 AVG. ATTEMP INLET FW TEMP

1AFH   37.7 K #/HR  1 INT. TOTAL ATTEMP FLOW                        0.0 M-BTU   TOTAL FUEL BTU INPUT
                                                                  542.6 M-BTU   BOILER NET BTU OUTPUT
1BPH  29.20 INCHES  AVG. PLANT BAROMETRIC PRESS
                                                                 !!!!!! PERCNT BOILER EFFICIENCY
1CVP  28.01 INCHES  1 AVG. CONDENSER VACUUM                        41.6 PERCNT TURBINE EFFICIENCY
                                                                 !!!!!! PERCNT COMBINED CYCLE EFF
1CWP
                                                                   8205 PERCNT TURBINE GROSS HEAT RATE
1CIT                                                                  0 PERCNT COMBINED CYCLE HEAT RATE

                                                                      1 BTU'S   COAL BTUS/POUND (@1070)
1COT                                                                  0 BTU'S   OIL BTUS/GALLON (@1071)
                                                                      0 BTU'S   GAS BTUS/SCF     (@1072)

1HWT   81.4 DEG F   11 AVG. HOTWELL PUMP DSCH TEMP                  0.0 GPH     1 INT. TORCH OIL FLOW
  JA   80.2 DEG F   12 AVG. HOTWELL PUMP DSCH TEMP                 71.7 KSCFH   1 INT. TORCH GAS FLOW
                                                                    0.0 KSCFH   1 INT. MAIN GAS FLOW
       1.00 HOURS   1 INT. GEN ON LINE % HOUR                      71.7 KSCFH   1 INT. TOTAL GAS FLOW

                                                                    9.1 TPH     11 MILL COAL FLOW
     536.4 K #/HR   1 INT. FINAL STEAM FLOW                         9.2 TPH     12 MILL COAL FLOW
     20670 #/HR     11 INT. ATTEMP SPRAY FLOW                       7.1 TPH     13 MILL COAL FLOW
     17034 #/HR     12 INT. ATTEMP SPRAY FLOW                       0.0 TPH     14 MILL COAL FLOW
     903.9 PSIG     1 AVG. DRUM PRESSURE                           25.4 TPH     TOTAL COAL FLOW
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1 HOURLY                          UNIT 1 HOURLY LOG                                     18:05:17      11/05/91

1FWP 1289.? PSIG    1 AVG. FEEDWATER PRESSURE                64.? MEG W    1 INT. GROSS MEGAWATTS (+HOUSE)
                                                             12.5 M-VARS   1 AVG. MAIN GENERATOR VARS
1MWH   62.5 MEG W   1 INT. NET MEGAWATTS (GEN GROSS)          3.9 MEG W    1 INT. HOUSE GENERATOR MEG-W
                                                              2.5 M-VARS   1 AVG. HOUSE GENERATOR VARS
1FFH  495.5 K #/HR  1 INT. FEEDWATER FLOW                     0.0 MEG W    1 RSA SUPPLY TO ONE MEGAWATTS

1FWT  415.2 DEG F   1 AVG. FEEDWTR TO ECON TEMP               3.8 MEG W    1 TOTAL STATION USE INT. HOUSE+1RSA
                                                              0.0 KVOLTS   1 AVG. GENERATOR AB PHASE
1MSP  895.? PSIG    1 AVG. FINAL STEAM PRESSURE             2602 AMPS      1 AVG. GENERATOR B PHASE
                                                            223.3 DCVOLT   1 AVG. MAIN EXCITER
1MST  743.6 DEG F   1 AVG. FINAL STEAM TEMP                 423.0 AMPS     1 AVG. MAIN FIELD

1ATT  28?.1 DEG F   1 AVG. ATTEMP INLET FW TEMP

1AFH   35.8 K #/HR  1 INT. TOTAL ATTEMP FLOW                  0.0 M-BTU      TOTAL FUEL BTU INPUT
                                                            545.2 M-BTU      BOILER NET BTU OUTPUT
1BFH  29.23 INCHES  AVG. PLANT BAROMETRIC PRESS
                                                           !!!!!! PERCNT     BOILER EFFICIENCY
1CVP  28.04 INCHES  1 AVG. CONDENSER VACUUM                  41.5 PERCNT     TURBINE EFFICIENCY
                                                           !!!!!! PERCNT     COMBINED CYCLE EFF
1CWP
                                                             8217 PERCNT     TURBINE GROSS HEAT RATE
1CIT                                                            0 PERCNT     COMBINED CYCLE HEAT RATE

                                                                0 BTU'S      COAL BTUS/POUND (@1070)
1COT                                                            0 BTU'S      OIL BTUS/GALLON (@1071)
                                                                0 BTU'S      GAS BTUS/SCF    (@1072)

1HWT   81.? DEG F   11 AVG. HOTWELL PUMP DSCH TEMP
  OR   80.8 DEG F   12 AVG. HOTWELL PUMP DSCH TEMP            0.0 GPM      1 INT. TORCH OIL FLOW
                                                             70.8 KSCFH    1 INT. TORCH GAS FLOW
       1.00 HOURS   1 INT. GEN ON LINE % HOUR                 0.0 KSCFH    1 INT. MAIN GAS FLOW
                                                             71.0 KSCFH    1 INT. TOTAL GAS FLOW

     538.5 K #/HR   1 INT. FINAL STEAM FLOW                   8.1 TPH        11 MILL COAL FLOW
     20287 #/HR     11 INT. ATTEMP SPRAY FLOW                 9.2 TPH        12 MILL COAL FLOW
     15507 #/HR     12 INT. ATTEMP SPRAY FLOW                 7.? TPH        13 MILL COAL FLOW
     952.0 PSIG     1 AVG. DRUM PRESSURE                      ?.1 TPH        14 MILL COAL FLOW
                                                             ??.1 TPH        TOTAL COAL FLOW
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1 HOURLY                      UNIT 1 HOURLY LOG                         19:05:18      11/05/91

1FWP 1279.4 PSIG    1 AVG. FEEDWATER PRESSURE          65.1 MEG W   1 INT. GROSS MEGAWATTS (+HOUSE)
                                                       12.5 M-VARS  1 AVG. MAIN GENERATOR VARS
1MWH   61.3 MEG W   1 INT. NET MEGAWATTS (GEN GROSS)    3.8 MEG W   1 INT. HOUSE GENERATOR MEG-W
                                                        2.6 M-VARS  1 AVG. HOUSE GENERATOR VARS
1FFH  514.6 K #/HR  1 INT. FEEDWATER FLOW               0.0 MEG W   1 RSA SUPPLY TO ONE MEGAWATTS

1FWT  412.7 DEG F   1 AVG. FEEDWTR TO ECON TEMP         3.8 MEG W   1 TOTAL STATION USE INT. HOUSE+1RSA
                                                        0.0 KVOLTS  1 AVG. GENERATOR AB PHASE
1MSP  899.9 PSIG    1 AVG. FINAL STEAM PRESSURE        2547 AMPS    1 AVG. GENERATOR B PHASE
                                                      220.6 DCVOLT  1 AVG. MAIN EXCITER
1MST  949.5 DEG F   1 AVG. FINAL STEAM TEMP           419.4 AMPS    1 AVG. MAIN FIELD

1ATT  287.5 DEG F   1 AVG. ATTEMP INLET FW TEMP

1AFH   34.2 K #/HR  1 INT. TOTAL ATTEMP FLOW            0.0 M-BTU   TOTAL FUEL BTU INPUT
                                                      535.6 M-BTU   BOILER NET BTU OUTPUT
1BPH  29.26 INCHES  AVG. PLANT BAROMETRIC PRESS
                                                     !!!!!! PERCNT  BOILER EFFICIENCY
1CVP  28.10 INCHES  1 AVG. CONDENSER VACUUM            41.4 PERCNT  TURBINE EFFICIENCY
                                                     !!!!!! PERCNT  COMBINED CYCLE EFF
1CWP
                                                       8249 PERCNT  TURBINE GROSS HEAT RATE
1CIT                                                      0 PERCNT  COMBINED CYCLE HEAT RATE

                                                          0 BTU'S   COAL BTUS/POUND (@1070)
1COT                                                      0 BTU'S   OIL BTUS/GALLON (@1071)
                                                          0 BTU'S   GAS BTUS/SCF    (@1072)

1HWT   80.7 DEG F   11 AVG. HOTWELL PUMP DSCH TEMP      0.0 GPM     1 INT. TORCH OIL FLOW
  OR   80.5 DEG F   12 AVG. HOTWELL PUMP DSCH TEMP     70.9 KSCFH   1 INT. TORCH GAS FLOW
                                                        0.0 KSCFH   1 INT. MAIN GAS FLOW
       1.00 HOURS   1 INT. GEN ON LINE % HOUR          70.8 KSCFH   1 INT. TOTAL GAS FLOW

                                                        8.2 TPH     11 MILL COAL FLOW
      530.1 K #/HR  1 INT. FINAL STEAM FLOW             9.2 TPH     12 MILL COAL FLOW
      18539 #/HR    11 INT. ATTEMP SPRAY FLOW           6.9 TPH     13 MILL COAL FLOW
      15633 #/HR    12 INT. ATTEMP SPRAY FLOW           3.1 TPH     14 MILL COAL FLOW
      955.4 PSIG    1 AVG. DRUM PRESSURE               35.1 TPH     TOTAL COAL FLOW
```

1 HOURLY UNIT 1 HOURLY LOG 20:05:19 11/05/91

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1FWP 1281.5 PSIG    1 AVG. FEEDWATER PRESSURE
1MWH   61.9 MEG W   1 INT. NET MEGAWATTS (GEN GROSS)
1FFH  506.5 K #/HR  1 INT. FEEDWATER FLOW
1FWT  414.0 DEG F   1 AVG. FEEDWTR TO ECON TEMP
1MSP  898.7 PSIG    1 AVG. FINAL STEAM PRESSURE
1MST  953.6 DEG F   1 AVG. FINAL STEAM TEMP
1ATT  287.7 DEG F   1 AVG. ATTEMP INLET FW TEMP
1AFH   40.6 K #/HR  1 INT. TOTAL ATTEMP FLOW
1BPH  29.29 INCHES  AVG. PLANT BAROMETRIC PRESS
1CVP  28.12 INCHES  1 AVG. CONDENSER VACUUM
1CWP
1IIT
1OOT
1HWT   90.7 DEG F   11 AVG. HOTWELL PUMP DSCH TEMP
  OR   90.2 DEG F   12 AVG. HOTWELL PUMP DSCH TEMP
       1.00 HOURS   1 INT. GEN ON LINE % HOUR

     534.2 K #/HR   1 INT. FINAL STEAM FLOW
     21657 #/HR     11 INT. ATTEMP SPRAY FLOW
     20275 #/HR     12 INT. ATTEMP SPRAY FLOW
     934.5 PSIG     1 AVG. DRUM PRESSURE
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  65.7 MEG W   1 INT. GROSS MEGAWATTS (+HOUSE)
  11.9 M-VARS  1 AVG. MAIN GENERATOR VARS
   3.9 MEG W   1 INT. HOUSE GENERATOR MEG-W
   2.6 M-VARS  1 AVG. HOUSE GENERATOR VARS
   0.0 MEG W   1 RSA SUPPLY TO ONE MEGAWATTS

   3.7 MEG W   1 TOTAL STATION USE INT. HOUSE+1RSA
   0.0 KVOLTS  1 AVG. GENERATOR AB PHASE
  2574 AMPS    1 AVG. GENERATOR B PHASE
 220.7 DCVOLT  1 AVG. MAIN EXCITER
 419.7 AMPS    1 AVG. MAIN FIELD

   0.0 M-BTU   TOTAL FUEL BTU INPUT
 541.4 M-BTU   BOILER NET BTU OUTPUT

!!!!!! PERCNT  BOILER EFFICIENCY
  41.5 PERCNT  TURBINE EFFICIENCY
!!!!!! PERCNT  COMBINED CYCLE EFF

  8226 PERCNT  TURBINE GROSS HEAT RATE
     0 PERCNT  COMBINED CYCLE HEAT RATE

     0 BTU'S   COAL BTUS/POUND (@1070)
     0 BTU'S   OIL BTUS/GALLON (@1071)
     0 BTU'S   GAS BTUS/SCF    (@1072)

   0.0 GPM     1 INT. TORCH OIL FLOW
  70.9 KSCFH   1 INT. TORCH GAS FLOW
   0.0 KSCFH   1 INT. MAIN GAS FLOW
  71.0 KSCFH   1 INT. TOTAL GAS FLOW

   7.9 TPH     11 MILL COAL FLOW
   9.2 TPH     12 MILL COAL FLOW
   1.3 TPH     13 MILL COAL FLOW
   3.0 TPH     14 MILL COAL FLOW
  34.5 TPH     TOTAL COAL FLOW
```

1991

BLACKDOG STEAM PLANT
GENERATED LOAD RECORD
UNIT #3

DATE ________

ON LINE @ ________

OFF LINE @ ________

	MAIN GENERATOR		
TIME	MEGAWATTS	MEGAVARS REC	DEL
0100	79	1	
0200	80	1	
0300	80	1	
0400	80	6	
0500	81	5	
~~0600~~	~~80~~	~~4~~	
0700	79	11	
~~0800~~	~~78~~		~~13~~
0900	80		12
1000	80		11
1100	79		9
1200	79		7
1300	79		9
1400	79		8
1500	79		5
1600	79		7
1700	79		9
1800	79		31
1900	79		31
2000	79		20
2100	79		20
2200	79		14
2300	79		12
2400	79		11

"SOOT BLOWING"			
TIME	IR'S	IK'S	AH
0245	1	all	2
~~0500~~	~~2~~	~~ALL~~	~~2~~
1030	4	8	2
~~1430~~	~~6~~	~~All~~	~~2~~
2030	All	All	2

BOILER ROOM LOG

NORTHERN STATES POWER COMPANY - BLACK DOG STATION

NOV 0 5 1991

FORM 17-5139

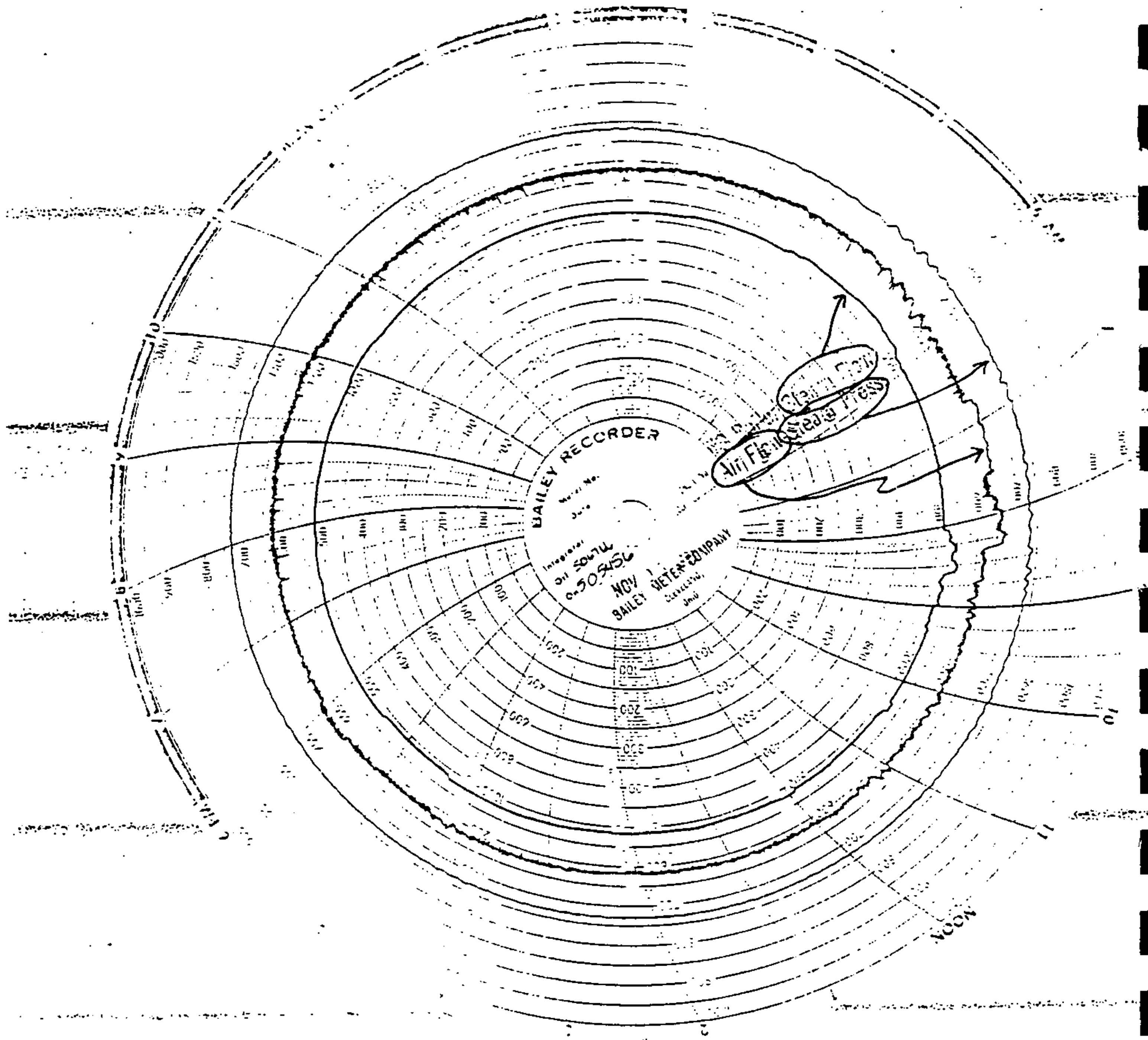
UNIT NO. 3

DATE

LOAD MW	PRESSURE DR.	ST. HDR.	F.W.	MULTI-POINTER GAUGE READINGS FURN DR.	SEC S.H. DIFF	PRI S.H. DIFF	R.H. DIFF	EC. DIFF. 31	EC. DIFF. 32	REC DAMP DIFF	A.H. 31	A.H. 32	COTT. 31	COTT. 32	I.D. 31	I.D. 32	AIR TO A.H.	AIR FR. A.H.	MILL CL. DIFF. 31	33	32	34
9	1495	1456	2180	.4		2.5	3.1	.4	.1		2.4	2.7	.24		7	7.5	8.5	6.2	5.4	5.4	5.3	5.3
9	1496	1456	2166	.5		2.6	3.1	.3	.1		2.5	2.8	.24		7	7.5	8.6	6.2	5.3	5.4	5.4	5.2
0	1497	1456	2177	.5		2.7	3.2	.5	.2		2.4	2.9	.23		7.2	7.5	8.6	6.3	5.3	5.3	5.4	5.2
0	1502	1461	2172	.4		2.8	3.3	.4	.2		2.5	3	.25		7.5	7.8	9	6.5	5.2	5.3	5.2	5
~~79~~	~~1497~~	~~1457~~	~~2163~~	~~.4~~		~~2.7~~	~~3.2~~	~~.4~~	~~.2~~		~~2.4~~	~~2.8~~	~~.25~~		~~7~~	~~7.5~~	~~5.5~~	~~6~~	~~5.5~~	~~5.5~~	~~5.5~~	~~5.3~~
81	1504	1462	2166	.4		2.6	3	.2	.2		2.4	2.8	.25		7	7.5	8.9	6.2	5.8	5.8	5.8	5.4
0	1510	1465	2166	.4		2.6	3	.2	.2		2.4	2.8	.25		7	7.5	8.9	6.2	5.8	5.8	5.8	5.4
79	1496	1456	2178	.4		2.6	4	.2	.2		2.6	2.8	.25		7.8	7.5	8.9	6.2	5.8	5.9	5.8	5.4
~~78~~	~~1495~~	~~1459~~	~~2176~~	~~.4~~		~~2.6~~	~~4~~	~~.2~~	~~.2~~		~~2.4~~	~~2.8~~	~~.25~~		~~7.8~~	~~7.5~~	~~8.9~~	~~6.2~~	~~5.8~~	~~5.8~~	~~5.8~~	~~5.4~~
80	1506	1468	2179	.45		2.5	3.3	.5	.2		2.4	2.7	.25		7	7.6	7.5	5	5.4	5.5	5.5	5.5
0	1501	1462	2175	.3		2.5	3.3	.5	.2		2.4	2.7	.25		7	7.7	7.5	5	5.3	5.4	5.5	5.6
79	1501	1461	2171	.4		2.4	3.4	.5	.1		2.5	2.8	.25		7.5	7.8	7	4.2	5.2	5.4	5.5	5.5
9	1497	1458	2170	.4		2.4	3.4	.4	.2		2.4	2.9	.25		7.2	7.6	7	4.6	5.2	5.4	5.5	5.5
9	1497	1459	2170	.4		2.4	3.4	.4	.2		2.3	2.9	.22		7.2	7.6	7.4	5	5.4	5.4	5.5	5.5
9	1500	1461	2170	.4		2.4	3.4	.4	.2		2.3	2.8	.22		7.1	7.6	7.4	5	5.4	5.4	5.4	5.5
79	1497	1457	2171	.4		2.4	3.4	.4	.2		2.3	2.8	.22		7.1	7.5	7.3	5	5.3	5.3	5.4	5.5
9	1500	1460	2172	.4		2.3	3.4	.4	.2		2.3	2.8	.22		7.1	7.7	7.2	5	5.4	5.4	5.5	5.5
9	1497	1458	2174	.4		2.4	3.4	.4	.2		2.4	2.9	.22		7.2	7.8	7.1	5	5.5	5.5	5.5	5.6
9	1497	1458	2177	.4		2.4	3.5	.4	.2		2.4	2.7	.22		7.2	7.8	7.2	5	5.6	5.6	5.6	5.7
9	1499	1459	2174	.4		2.4	3.4	.5	.2		2.4	2.8	.22		7.2	7.8	7.3	5	5.5	5.5	5.5	5.7
9	1499	1459	2169	.3		2.4	3.3	.4	.2		2.4	2.8	.23		7.1	7.8	8	5	5.6	5.7	5.6	5.9
79	1501	1461	2170	.4		2.6	3.4	.5	.2		[illegible]	[illegible]	.23		7.1	7.8	8	5	5.5	5.5	5.5	5.9
9	1502	1463	2173	.4		2.5	3.4	.5	.2		2.4	2.9	.23		7.2	7.9	8	5	5.5	5.5	5.5	5.8
9	1497	1458	2175	.4		2.4	3.4	.4	.2		2.3	2.8	.23		7	7.7	8	5	5.5	5.5	5.5	5.8
79	1497	1458	2168	.3		2.4	3.2	.4	.2		2.4	2.8	.25		7	7.8	8	5	5.6	5.6	5.5	5.7

SOOT BLOWING

BANKED HOURS	
HOURS OUT OF SERVICE	
SIGNATURES	
0-8	Gertz Fischer
8-16	Tom B. - Ehlers
16-24	Ehlers - Poochin


BAILEY RECORDER
BAILEY METER COMPANY
NOV
NOON
Air Flow
Steam Flow
Steam Press

3 HOURLY   UNIT 3 HOURLY LOG   11:05:04   11/05/91

3FWP	2173.5	PSIG	3 AVG.	FEEDWATER PRESS
3MWH.	79.3	MEG W	3 INT.	GROSS MEGAWATTS
3FFH	557.6	K #/HR	3 INT.	FEEDWATER FLOW
3CRT	705.3	DEG F	3 AVG.	COLD REHEAT TEMP
3CRP	545.6	PSIG	3 AVG.	COLD REHEAT PRESS
3RHF	480.4	K #/HR	3 INT.	REHEAT FLOW
3HRP	325.5	PSIG	3 AVG.	HOT REHEAT PRESS
3HRT	996.7	DEG F	3 AVG.	HOT REHEAT TEMP
3AFH	55.8	K #/HR	3 INT.	TOTAL ATTEMP FLOW
3ATT	297.2	DEG F	3 AVG.	FW TO ATTEMP TEMP
3FWT	356.4	DEG F	3 AVG.	FW TO ECON TEMP
3MSP	1458.5	PSIG	3 AVG.	FINAL STEAM PRESS
3MST	989.1	DEG F	3 AVG.	FINAL STEAM TEMP
3BPH	(USE UNIT-1'S)			PLANT BAROMETRIC PRESS
3CVP				
3CWP				
3CIT				
3COT				
3HWT				

73.8	MEG W	3 INT.	NET MEGAWATTS
13.9	KVOLTS	3 AVG.	GENERATOR AB PHASE
10.2	M-VARS	3 AVG.	GENERATOR VARS
3286.9	AMPS	3 AVG.	GENERATOR B PHASE
762.1	AMPS	3 AVG.	EXCITER CURRENT
5.4	MEG W	31 INT.	STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA	SUPPLY TO THREE INT. WATTS
5.2	MEG W	3 TOTAL	STATION USE AUX + RSA INT.
1585.1	AMPS	31 BUS AVG.	A PHASE CURRENT
0.0	AMPS	1 RSA	TO 3 A PHASE CURRENT
0.0	AMPS	2 RSA	TO 3 A PHASE CURRENT
518.8	K #/HR	3 INT.	FINAL STEAM FLOW
1498.3	PSIG	3 AVG.	DRUM PRESS.
422.4	DEG F	3 AVG.	ECON FEEDWATER OUTLET TEMP
996.4	DEG F	31 AVG.	HOT REHEAT OUT TEMP
997.3	DEG F	32 AVG.	HOT REHEAT OUT TEMP
25.1	K #/HR	31 INT.	ATTEMP SPRAY FLOW
690.1	DEG F	31 AVG.	ATTEMP OUT STEAM TEMP
0.0	DEG F	31 AVG.	SEC SUPERHEAT OUT TEMP
30.3	K #/HR	32 INT.	ATTEMP SPRAY FLOW
670.7	DEG F	32 AVG.	ATTEMP OUT STEAM TEMP
0.0	DEG F	32 AVG.	SEC SUPERHEAT OUT TEMP
50.8	DEG C	3 GEN	STATOR TEMP 1
51.6	DEG C	3 GEN	STATOR TEMP 2
51.6	DEG C	3 GEN	STATOR TEMP 3
56.6	DEG C	3 GEN	ROTOR TEMP
49.9	DEG C	3 GEN	H2 INLET TEMP 3
45.4	DEG C	3 GEN	H2 OUTLET TEMP 1

3 HOURLY   UNIT 3 HOURLY LOG   12:05:05   11/05/91

3FWP	2173.5 PSIG	3 AVG.	FEEDWATER PRESS
3MWH	78.5 MEG W	3 INT.	GROSS MEGAWATTS
3FFH	562.0 K #/HR	3 INT.	FEEDWATER FLOW
3CRT	702.7 DEG F	3 AVG.	COLD REHEAT TEMP
3CRP	342.5 PSIG	3 AVG.	COLD REHEAT PRESS
3RHF	477.2 K #/HR	3 INT.	REHEAT FLOW
3HRP	322.9 PSIG	3 AVG.	HOT REHEAT PRESS
3HRT	991.2 DEG F	3 AVG.	HOT REHEAT TEMP
3AFH	54.4 K #/HR	3 INT.	TOTAL ATTEMP FLOW
3ATT	296.4 DEG F	3 AVG.	FW TO ATTEMP TEMP
3FWT	355.5 DEG F	3 AVG.	FW TO ECON TEMP
3MSP	1458.1 PSIG	3 AVG.	FINAL STEAM PRESS
3MST	987.7 DEG F	3 AVG.	FINAL STEAM TEMP
3BPH	(USE UNIT-1'S)	PLANT	BAROMETRIC PRESS
3CVP			
3CWP			
3CIT			
3COT			
3HWT			

73.1	MEG W	3 INT. NET MEGAWATTS
13.9	KVOLTS	3 AVG. GENERATOR AB PHASE
8.9	M-VARS	3 AVG. GENERATOR VARS
3250.2	AMPS	3 AVG. GENERATOR B PHASE
753.0	AMPS	3 AVG. EXCITER CURRENT
5.5	MEG W	31 INT. STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA SUPPLY TO THREE INT. WATTS
5.3	MEG W	3 TOTAL STATION USE AUX + RSA INT.
1597.1	AMPS	31 BUS AVG. A PHASE CURRENT
0.0	AMPS	1 RSA TO 3 A PHASE CURRENT
0.0	AMPS	2 RSA TO 3 A PHASE CURRENT
515.4	K #/HR	3 INT. FINAL STEAM FLOW
1497.6	PSIG	3 AVG. DRUM PRESS.
419.8	DEG F	3 AVG. ECON FEEDWATER OUTLET TEMP
990.7	DEG F	31 AVG. HOT REHEAT OUT TEMP
991.6	DEG F	32 AVG. HOT REHEAT OUT TEMP
25.2	K #/HR	31 INT. ATTEMP SPRAY FLOW
671.7	DEG F	31 AVG. ATTEMP OUT STEAM TEMP
0.0	DEG F	31 AVG. SEC SUPERHEAT OUT TEMP
29.1	K #/HR	32 INT. ATTEMP SPRAY FLOW
664.2	DEG F	32 AVG. ATTEMP OUT STEAM TEMP
0.0	DEG F	32 AVG. SEC SUPERHEAT OUT TEMP
50.6	DEG C	3 GEN STATOR TEMP 1
51.4	DEG C	3 GEN STATOR TEMP 2
51.4	DEG C	3 GEN STATOR TEMP 3
56.2	DEG C	3 GEN ROTOR TEMP
49.8	DEG C	3 GEN H2 INLET TEMP 3
45.3	DEG C	3 GEN H2 OUTLET TEMP 1

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3 HOURLY                       UNIT 3 HOURLY LOG                                  13:05:05          11/05/91

3FWP  2174.0 PSIG   3 AVG. FEEDWATER PRESS              73.6 MEG W    3 INT. NET MEGAWATTS
                                                        13.9 KVOLTS   3 AVG. GENERATOR AB PHASE
3MWH    79.1 MEG W  3 INT. GROSS MEGAWATTS               8.1 M-VARS   3 AVG. GENERATOR VARS
                                                      3275.7 AMPS     3 AVG. GENERATOR B PHASE
3FFH   559.4 K #/HR 3 INT. FEEDWATER FLOW
                                                       751.1 AMPS     3 AVG. EXCITER CURRENT
3CRT   707.5 DEG F  3 AVG. COLD REHEAT TEMP
                                                         5.5 MEG W    31 INT. STATION AUX MEGAWATTS
3CRP   344.9 PSIG   3 AVG. COLD REHEAT PRESS            -0.2 MEG W    1+2 RSA SUPPLY TO THREE INT. WATTS
                                                         5.3 MEG W    3 TOTAL STATION USE AUX + RSA INT.
3RHF   479.4 K #/HR 3 INT. REHEAT FLOW                1597.0 AMPS     31 BUS AVG. A PHASE CURRENT
                                                         0.0 AMPS     1 RSA TO 3 A PHASE CURRENT
3HRP   325.0 PSIG   3 AVG. HOT REHEAT PRESS              0.0 AMPS     2 RSA TO 3 A PHASE CURRENT

3HRT   999.1 DEG F  3 AVG. HOT REHEAT TEMP

3AFH    52.4 K #/HR 3 INT. TOTAL ATTEMP FLOW
                                                       517.4 K #/HR   3 INT. FINAL STEAM FLOW
3ATT   296.8 DEG F  3 AVG. FW TO ATTEMP TEMP          1498.0 PSIG     3 AVG. DRUM PRESS.

3FWT   356.1 DEG F  3 AVG. FW TO ECON TEMP             420.9 DEG F    3 AVG. ECON FEEDWATER OUTLET TEMP

3MSP  1458.3 PSIG   3 AVG. FINAL STEAM PRESS           998.6 DEG F    31 AVG. HOT REHEAT OUT TEMP
                                                       999.4 DEG F    32 AVG. HOT REHEAT OUT TEMP
3MST   991.8 DEG F  3 AVG. FINAL STEAM TEMP
                                                        24.8 K #/HR   31 INT. ATTEMP SPRAY FLOW
3BPH (USE UNIT-1'S) PLANT BAROMETRIC PRESS             677.8 DEG F    31 AVG. ATTEMP OUT STEAM TEMP
                                                         0.0 DEG F    31 AVG. SEC SUPERHEAT OUT TEMP
3CVP
                                                        27.7 K #/HR   32 INT. ATTEMP SPRAY FLOW
3CWP                                                   675.3 DEG F    32 AVG. ATTEMP OUT STEAM TEMP
                                                         0.0 DEG F    32 AVG. SEC SUPERHEAT OUT TEMP
3CIT
                                                       50.7   DEG C   3 GEN STATOR TEMP 1
3COT                                                   51.5   DEG C   3 GEN STATOR TEMP 2
                                                       51.5   DEG C   3 GEN STATOR TEMP 3
3HWT                                                   55.9   DEG C   3 GEN ROTOR TEMP
                                                       49.9   DEG C   3 GEN H2 INLET TEMP 3
                                                       45.4   DEG C   3 GEN H2 OUTLET TEMP 1
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3 HOURLY　　UNIT 3 HOURLY LOG　　14:05:05　　11/05/91

3FWP	2174.3 PSIG	3 AVG.	FEEDWATER PRESS	
3MWH	79.0 MEG W	3 INT.	GROSS MEGAWATTS	
3FFH	562.0 K #/HR	3 INT.	FEEDWATER FLOW	
3CRT	708.0 DEG F	3 AVG.	COLD REHEAT TEMP	
3CRP	343.7 PSIG	3 AVG.	COLD REHEAT PRESS	
3RHF	477.3 K #/HR	3 INT.	REHEAT FLOW	
3HRP	323.8 PSIG	3 AVG.	HOT REHEAT PRESS	
3HRT	1001.2 DEG F	3 AVG.	HOT REHEAT TEMP	
3AFH	52.5 K #/HR	3 INT.	TOTAL ATTEMP FLOW	
3ATT	296.6 DEG F	3 AVG.	FW TO ATTEMP TEMP	
3FWT	355.9 DEG F	3 AVG.	FW TO ECON TEMP	
3MSP	1458.4 PSIG	3 AVG.	FINAL STEAM PRESS	
3MST	992.8 DEG F	3 AVG.	FINAL STEAM TEMP	
3BPH	(USE UNIT-1'S)		PLANT BAROMETRIC PRESS	
3CVP				
3CWP				
3CIT				
3COT				
3HWT				

73.5	MEG W	3 INT. NET MEGAWATTS
13.9	KVOLTS	3 AVG. GENERATOR AB PHASE
7.8	M-VARS	3 AVG. GENERATOR VARS
3263.1	AMPS	3 AVG. GENERATOR B PHASE
748.2	AMPS	3 AVG. EXCITER CURRENT
5.5	MEG W	31 INT. STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA SUPPLY TO THREE INT. WATTS
5.3	MEG W	3 TOTAL STATION USE AUX + RSA INT.
1592.8	AMPS	31 BUS AVG. A PHASE CURRENT
0.0	AMPS	1 RSA TO 3 A PHASE CURRENT
0.0	AMPS	2 RSA TO 3 A PHASE CURRENT
514.9	K #/HR	3 INT. FINAL STEAM FLOW
1497.8	PSIG	3 AVG. DRUM PRESS.
420.7	DEG F	3 AVG. ECON FEEDWATER OUTLET TEMP
1000.8	DEG F	31 AVG. HOT REHEAT OUT TEMP
1001.7	DEG F	32 AVG. HOT REHEAT OUT TEMP
25.0	K #/HR	31 INT. ATTEMP SPRAY FLOW
681.2	DEG F	31 AVG. ATTEMP OUT STEAM TEMP
0.0	DEG F	31 AVG. SEC SUPERHEAT OUT TEMP
27.5	K #/HR	32 INT. ATTEMP SPRAY FLOW
678.0	DEG F	32 AVG. ATTEMP OUT STEAM TEMP
0.0	DEG F	32 AVG. SEC SUPERHEAT OUT TEMP
50.6	DEG C	3 GEN STATOR TEMP 1
51.4	DEG C	3 GEN STATOR TEMP 2
51.4	DEG C	3 GEN STATOR TEMP 3
55.5	DEG C	3 GEN ROTOR TEMP
49.8	DEG C	3 GEN H2 INLET TEMP 3
45.3	DEG C	3 GEN H2 OUTLET TEMP 1

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3 HOURLY                    UNIT 3 HOURLY LOG                    15:05:05        11/05/91

3FWP  2173.5 PSIG   3 AVG. FEEDWATER PRESS
3MWH    79.1 MEG W  3 INT. GROSS MEGAWATTS
3FFH   556.7 K #/HR 3 INT. FEEDWATER FLOW
3CRT   707.1 DEG F  3 AVG. COLD REHEAT TEMP
3CRP   343.6 PSIG   3 AVG. COLD REHEAT PRESS
3RHF   477.7 K #/HR 3 INT. REHEAT FLOW
3HRP   323.9 PSIG   3 AVG. HOT REHEAT PRESS
3HRT   996.5 DEG F  3 AVG. HOT REHEAT TEMP
3AFH    48.7 K #/HR 3 INT. TOTAL ATTEMP FLOW
3ATT   297.0 DEG F  3 AVG. FW TO ATTEMP TEMP
3FWT   355.9 DEG F  3 AVG. FW TO ECON TEMP
3MSP  1458.6 PSIG   3 AVG. FINAL STEAM PRESS
3MST   991.8 DEG F  3 AVG. FINAL STEAM TEMP
3BPH (USE UNIT-1'S) PLANT BAROMETRIC PRESS
3CVP
3CWP
3CIT
3COT
3HWT

  73.7 MEG W    3 INT.  NET MEGAWATTS
  13.9 KVOLTS   3 AVG.  GENERATOR AB PHASE
   7.0 M-VARS   3 AVG.  GENERATOR VARS
3269.6 AMPS     3 AVG.  GENERATOR B PHASE

 744.6 AMPS     3 AVG.  EXCITER CURRENT

   5.4 MEG W    31 INT. STATION AUX MEGAWATTS
  -0.2 MEG W    1+2 RSA SUPPLY TO THREE INT. WATTS
   5.2 MEG W    3 TOTAL STATION USE AUX + RSA INT.
1584.0 AMPS     31 BUS AVG. A PHASE CURRENT
   0.0 AMPS     1 RSA TO 3 A PHASE CURRENT
   0.0 AMPS     2 RSA TO 3 A PHASE CURRENT

 515.4 K #/HR   3 INT.  FINAL STEAM FLOW
1498.1 PSIG     3 AVG.  DRUM PRESS.

 420.0 DEG F    3 AVG.  ECON FEEDWATER OUTLET TEMP

 996.1 DEG F    31 AVG. HOT REHEAT OUT TEMP
 997.1 DEG F    32 AVG. HOT REHEAT OUT TEMP

  22.6 K #/HR   31 INT. ATTEMP SPRAY FLOW
 688.6 DEG F    31 AVG. ATTEMP OUT STEAM TEMP
   0.0 DEG F    31 AVG. SEC SUPERHEAT OUT TEMP

  25.7 K #/HR   32 INT. ATTEMP SPRAY FLOW
 684.6 DEG F    32 AVG. ATTEMP OUT STEAM TEMP
   0.0 DEG F    32 AVG. SEC SUPERHEAT OUT TEMP

 50.7  DEG C    3 GEN STATOR TEMP 1
 51.5  DEG C    3 GEN STATOR TEMP 2
 51.5  DEG C    3 GEN STATOR TEMP 3
 55.6  DEG C    3 GEN ROTOR TEMP
 49.9  DEG C    3 GEN H2 INLET TEMP 3
 45.5  DEG C    3 GEN H2 OUTLET TEMP 1
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3 HOURLY UNIT 3 HOURLY LOG 16:05:05 11/05/91

3FWP	2170.5	PSIG	3 AVG.	FEEDWATER PRESS
3MWH	79.3	MEG W	3 INT.	GROSS MEGAWATTS
3FFH	567.7	K #/HR	3 INT.	FEEDWATER FLOW
3CRT	707.7	DEG F	3 AVG.	COLD REHEAT TEMP
3CRP	346.7	PSIG	3 AVG.	COLD REHEAT PRESS
3RHF	482.9	K #/HR	3 INT.	REHEAT FLOW
3HRP	326.7	PSIG	3 AVG.	HOT REHEAT PRESS
3HRT	990.6	DEG F	3 AVG.	HOT REHEAT TEMP
3AFH	47.8	K #/HR	3 INT.	TOTAL ATTEMP FLOW
3ATT	297.0	DEG F	3 AVG.	FW TO ATTEMP TEMP
3FWT	356.0	DEG F	3 AVG.	FW TO ECON TEMP
3MSP	1458.4	PSIG	3 AVG.	FINAL STEAM PRESS
3MST	990.7	DEG F	3 AVG.	FINAL STEAM TEMP
3BPH	(USE UNIT-1'S)			PLANT BAROMETRIC PRESS
3CVP				
3CWP				
3CIT				
3COT				
3HWT				

73.9	MEG W	3 INT.	NET MEGAWATTS
13.9	KVOLTS	3 AVG.	GENERATOR AB PHASE
6.1	M-VARS	3 AVG.	GENERATOR VARS
3277.6	AMPS	3 AVG.	GENERATOR B PHASE
742.7	AMPS	3 AVG.	EXCITER CURRENT
5.5	MEG W	31 INT.	STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA	SUPPLY TO THREE INT. WATTS
5.3	MEG W	3 TOTAL	STATION USE AUX + RSA INT.
1596.7	AMPS	31 BUS AVG.	A PHASE CURRENT
0.0	AMPS	1 RSA	TO 3 A PHASE CURRENT
0.0	AMPS	2 RSA	TO 3 A PHASE CURRENT
520.7	K #/HR	3 INT.	FINAL STEAM FLOW
1498.9	PSIG	3 AVG.	DRUM PRESS.
417.7	DEG F	3 AVG.	ECON FEEDWATER OUTLET TEMP
990.0	DEG F	31 AVG.	HOT REHEAT OUT TEMP
990.9	DEG F	32 AVG.	HOT REHEAT OUT TEMP
22.7	K #/HR	31 INT.	ATTEMP SPRAY FLOW
677.0	DEG F	31 AVG.	ATTEMP OUT STEAM TEMP
0.0	DEG F	31 AVG.	SEC SUPERHEAT OUT TEMP
25.0	K #/HR	32 INT.	ATTEMP SPRAY FLOW
680.4	DEG F	32 AVG.	ATTEMP OUT STEAM TEMP
0.0	DEG F	32 AVG.	SEC SUPERHEAT OUT TEMP
50.6	DEG C	3 GEN	STATOR TEMP 1
51.4	DEG C	3 GEN	STATOR TEMP 2
51.4	DEG C	3 GEN	STATOR TEMP 3
55.5	DEG C	3 GEN	ROTOR TEMP
49.8	DEG C	3 GEN	H2 INLET TEMP 3
45.2	DEG C	3 GEN	H2 OUTLET TEMP 1

3 HOURLY   UNIT 3 HOURLY LOG   17:05:05   11/05/91

3FWP	2172.1 PSIG	3 AVG.	FEEDWATER PRESS
3MWH	79.1 MEG W	3 INT.	GROSS MEGAWATTS
3FFH	563.9 K #/HR	3 INT.	FEEDWATER FLOW
3CRT	708.1 DEG F	3 AVG.	COLD REHEAT TEMP
3CRP	345.3 PSIG	3 AVG.	COLD REHEAT PRESS
3RHF	480.1 K #/HR	3 INT.	REHEAT FLOW
3HRP	325.0 PSIG	3 AVG.	HOT REHEAT PRESS
3HRT	997.4 DEG F	3 AVG.	HOT REHEAT TEMP
3AFH	48.7 K #/HR	3 INT.	TOTAL ATTEMP FLOW
3ATT	296.8 DEG F	3 AVG.	FW TO ATTEMP TEMP
3FWT	356.0 DEG F	3 AVG.	FW TO ECON TEMP
3MSP	1458.4 PSIG	3 AVG.	FINAL STEAM PRESS
3MST	991.9 DEG F	3 AVG.	FINAL STEAM TEMP
3BPH	(USE UNIT-1'S)		PLANT BAROMETRIC PRESS
3CVP			
3CWP			
3CIT			
3COT			
3HWT			

73.6	MEG W	3 INT. NET MEGAWATTS
13.9	KVOLTS	3 AVG. GENERATOR AB PHASE
9.7	M-VARS	3 AVG. GENERATOR VARS
3279.9	AMPS	3 AVG. GENERATOR B PHASE
760.6	AMPS	3 AVG. EXCITER CURRENT
5.5	MEG W	31 INT. STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA SUPPLY TO THREE INT. WATTS
5.3	MEG W	3 TOTAL STATION USE AUX + RSA INT.
1595.3	AMPS	31 BUS AVG. A PHASE CURRENT
0.0	AMPS	1 RSA TO 3 A PHASE CURRENT
0.0	AMPS	2 RSA TO 3 A PHASE CURRENT
517.3	K #/HR	3 INT. FINAL STEAM FLOW
1498.5	PSIG	3 AVG. DRUM PRESS.
419.4	DEG F	3 AVG. ECON FEEDWATER OUTLET TEMP
996.9	DEG F	31 AVG. HOT REHEAT OUT TEMP
997.8	DEG F	32 AVG. HOT REHEAT OUT TEMP
23.1	K #/HR	31 INT. ATTEMP SPRAY FLOW
680.3	DEG F	31 AVG. ATTEMP OUT STEAM TEMP
0.0	DEG F	31 AVG. SEC SUPERHEAT OUT TEMP
25.9	K #/HR	32 INT. ATTEMP SPRAY FLOW
680.8	DEG F	32 AVG. ATTEMP OUT STEAM TEMP
0.0	DEG F	32 AVG. SEC SUPERHEAT OUT TEMP
50.7	DEG C	3 GEN STATOR TEMP 1
51.5	DEG C	3 GEN STATOR TEMP 2
51.4	DEG C	3 GEN STATOR TEMP 3
55.9	DEG C	3 GEN ROTOR TEMP
49.9	DEG C	3 GEN H2 INLET TEMP 3
45.4	DEG C	3 GEN H2 OUTLET TEMP 1

3 HOURLY UNIT 3 HOURLY LOG 18:05:05 11/05/91

3FWP	2172.7 PSIG	3 AVG.	FEEDWATER PRESS
3MWL	78.9 MEG W	3 INT.	GROSS MEGAWATTS
3FFH	555.3 K #/HR	3 INT.	FEEDWATER FLOW
3CRT	708.1 DEG F	3 AVG.	COLD REHEAT TEMP
3CRP	344.0 PSIG	3 AVG.	COLD REHEAT PRESS
3RHF	478.1 K #/HR	3 INT.	REHEAT FLOW
3HRP	324.3 PSIG	3 AVG.	HOT REHEAT PRESS
3HRT	999.9 DEG F	3 AVG.	HOT REHEAT TEMP
3AFH	49.0 K #/HR	3 INT.	TOTAL ATTEMP FLOW
3ATT	296.8 DEG F	3 AVG.	FW TO ATTEMP TEMP
3FWT	356.0 DEG F	3 AVG.	FW TO ECON TEMP
3MSP	1450.4 PSIG	3 AVG.	FINAL STEAM PRESS
3MST	993.0 DEG F	3 AVG.	FINAL STEAM TEMP
3BPH	(USE UNIT-1'S)		PLANT BAROMETRIC PRESS
3CVP			
3CWP			
3GST			
3C01			
3HU7			

75.5 MEG W	3 INT.	NET MEGAWATTS
14.0 KVOLTS	3 AVG.	GENERATOR AB PHASE
2.1 M-VARS	3 AVG.	GENERATOR VARS
3400.6 AMPS	3 AVG.	GENERATOR B PHASE
884.5 AMPS	3 AVG.	EXCITER CURRENT
5.5 MEG W	31 INT.	STATION AUX MEGAWATTS
-0.2 MEG W	1+2 RSA	SUPPLY TO THREE INT. WATTS
5.3 MEG W	3	TOTAL STATION USE AUX + RSA INT.
1527.3 AMPS	31	BUS AVG. A PHASE CURRENT
0.0 AMPS	1	RSA TO 3 A PHASE CURRENT
0.0 AMPS	2	RSA TO 3 A PHASE CURRENT
515.6 K #/HR	3 INT.	FINAL STEAM FLOW
1497.9 PSIG	3 AVG.	DRUM PRESS.
420.2 DEG F	3 AVG.	ECON FEEDWATER OUTLET TEMP
999.4 DEG F	31 AVG.	HOT REHEAT OUT TEMP
1000.4 DEG F	32 AVG.	HOT REHEAT OUT TEMP
23.6 K #/HR	31 INT.	ATTEMP SPRAY FLOW
682.8 DEG F	31 AVG.	ATTEMP OUT STEAM TEMP
0.0 DEG F	31 AVG.	SEC SUPERHEAT OUT TEMP
26.0 K #/HR	32 INT.	ATTEMP SPRAY FLOW
683.1 DEG F	32 AVG.	ATTEMP OUT STEAM TEMP
0.0 DEG F	32 AVG.	SEC SUPERHEAT OUT TEMP
51.0 DEG C	3	GEN STATOR TEMP 1
51.7 DEG C	3	GEN STATOR TEMP 2
51.7 DEG C	3	GEN STATOR TEMP 3
58.1 DEG C	3	GEN ROTOR TEMP
49.9 DEG C	3	GEN H2 INLET TEMP 3
45.1 DEG C	3	GEN H2 OUTLET TEMP 1

3 HOURLY UNIT 3 HOURLY LOG 19:05:05 11/05/91

3FWP	2173.2	PSIG	3 AVG. FEEDWATER PRESS	74.0	MEG W	3 INT. NET MEGAWATTS
				14.1	KVOLTS	3 AVG. GENERATOR AB PHASE
3MWH	79.5	MEG W	3 INT. GROSS MEGAWATTS	29.9	M-VARS	3 AVG. GENERATOR VARS
				3437.1	AMPS	3 AVG. GENERATOR B PHASE
3FFH	561.1	K #/HR	3 INT. FEEDWATER FLOW			
				879.0	AMPS	3 AVG. EXCITER CURRENT
3CRT	709.4	DEG F	3 AVG. COLD REHEAT TEMP			
				5.5	MEG W	31 INT. STATION AUX MEGAWATTS
3CRP	346.6	PSIG	3 AVG. COLD REHEAT PRESS	-0.2	MEG W	1+2 RSA SUPPLY TO THREE INT. WATTS
				5.3	MEG W	3 TOTAL STATION USE AUX + RSA INT.
3RHF	481.1	K #/HR	3 INT. REHEAT FLOW	1585.9	AMPS	31 BUS AVG. A PHASE CURRENT
				0.0	AMPS	1 RSA TO 3 A PHASE CURRENT
3HRP	326.5	PSIG	3 AVG. HOT REHEAT PRESS	0.0	AMPS	2 RSA TO 3 A PHASE CURRENT
3HRT	1002.0	DEG F	3 AVG. HOT REHEAT TEMP			
3AFH	49.8	K #/HR	3 INT. TOTAL ATTEMP FLOW			
				518.6	K #/HR	3 INT. FINAL STEAM FLOW
3ATT	297.3	DEG F	3 AVG. FW TO ATTEMP TEMP	1498.3	PSIG	3 AVG. DRUM PRESS.
3FWT	356.6	DEG F	3 AVG. FW TO ECON TEMP	421.3	DEG F	3 AVG. ECON FEEDWATER OUTLET TEMP
3MSP	1458.3	PSIG	3 AVG. FINAL STEAM PRESS	1001.6	DEG F	31 AVG. HOT REHEAT OUT TEMP
				1002.4	DEG F	32 AVG. HOT REHEAT OUT TEMP
3MST	992.7	DEG F	3 AVG. FINAL STEAM TEMP			
				23.7	K #/HR	31 INT. ATTEMP SPRAY FLOW
3BPH	(USE UNIT-1'S)		PLANT BAROMETRIC PRESS	685.4	DEG F	31 AVG. ATTEMP OUT STEAM TEMP
				0.0	DEG F	31 AVG. SEC SUPERHEAT OUT TEMP
3CVP						
				26.0	K #/HR	32 INT. ATTEMP SPRAY FLOW
3CWP				686.5	DEG F	32 AVG. ATTEMP OUT STEAM TEMP
				0.0	DEG F	32 AVG. SEC SUPERHEAT OUT TEMP
3CIT						
				51.2	DEG C	3 GEN STATOR TEMP 1
3COT				51.8	DEG C	3 GEN STATOR TEMP 2
				51.9	DEG C	3 GEN STATOR TEMP 3
3HWT				59.1	DEG C	3 GEN ROTOR TEMP
				49.9	DEG C	3 GEN H2 INLET TEMP 3
				45.1	DEG C	3 GEN H2 OUTLET TEMP 1

3 HOURLY　　UNIT 3 HOURLY LOG　　20:05:05　　11/05/91

3FWP	2173.4 PSIG	3 AVG.	FEEDWATER PRESS
3MWH	79.2 MEG W	3 INT.	GROSS MEGAWATTS
3FFH	557.8 K #/HR	3 INT.	FEEDWATER FLOW
3CRT	709.1 DEG F	3 AVG.	COLD REHEAT TEMP
3CRP	345.5 PSIG	3 AVG.	COLD REHEAT PRESS
3RHF	479.9 K #/HR	3 INT.	REHEAT FLOW
3HRP	325.5 PSIG	3 AVG.	HOT REHEAT PRESS
3HRT	1000.1 DEG F	3 AVG.	HOT REHEAT TEMP
3AFH	49.1 K #/HR	3 INT.	TOTAL ATTEMP FLOW
3ATT	297.2 DEG F	3 AVG.	FW TO ATTEMP TEMP
3FWT	356.4 DEG F	3 AVG.	FW TO ECON TEMP
3MSP	1458.6 PSIG	3 AVG.	FINAL STEAM PRESS
3MST	992.8 DEG F	3 AVG.	FINAL STEAM TEMP
3BPH	(USE UNIT-1'S)	PLANT	BAROMETRIC PRESS
3CVP			
3CWP			
3CIT			
3COT			
3HWT			

73.8	MEG W	3 INT.	NET MEGAWATTS
14.1	KVOLTS	3 AVG.	GENERATOR AB PHASE
27.4	M-VARS	3 AVG.	GENERATOR VARS
3394.1	AMPS	3 AVG.	GENERATOR B PHASE
861.8	AMPS	3 AVG.	EXCITER CURRENT
5.4	MEG W	31 INT.	STATION AUX MEGAWATTS
-0.2	MEG W	1+2 RSA	SUPPLY TO THREE INT. WATTS
5.2	MEG W	3 TOTAL	STATION USE AUX + RSA INT.
1578.4	AMPS	31 BUS AVG.	A PHASE CURRENT
0.0	AMPS	1 RSA	TO 3 A PHASE CURRENT
0.0	AMPS	2 RSA	TO 3 A PHASE CURRENT
517.3	K #/HR	3 INT.	FINAL STEAM FLOW
1498.4	PSIG	3 AVG.	DRUM PRESS.
420.7	DEG F	3 AVG.	ECON FEEDWATER OUTLET TEMP
999.7	DEG F	31 AVG.	HOT REHEAT OUT TEMP
1000.6	DEG F	32 AVG.	HOT REHEAT OUT TEMP
23.1	K #/HR	31 INT.	ATTEMP SPRAY FLOW
689.6	DEG F	31 AVG.	ATTEMP OUT STEAM TEMP
0.0	DEG F	31 AVG.	SEC SUPERHEAT OUT TEMP
26.2	K #/HR	32 INT.	ATTEMP SPRAY FLOW
687.4	DEG F	32 AVG.	ATTEMP OUT STEAM TEMP
0.0	DEG F	32 AVG.	SEC SUPERHEAT OUT TEMP
51.2	DEG C	3 GEN	STATOR TEMP 1
51.9	DEG C	3 GEN	STATOR TEMP 2
51.9	DEG C	3 GEN	STATOR TEMP 3
59.1	DEG C	3 GEN	ROTOR TEMP
50.0	DEG C	3 GEN	H2 INLET TEMP 3
45.2	DEG C	3 GEN	H2 OUTLET TEMP 1

BLACKDOG STEAM PLANT
GENERATED LOAD RECORD
UNIT #4

DATE 0 5 1991

ON LINE @ ________

OFF LINE @ ________

	MAIN GENERATOR		
TIME	MEGAWATTS	MEGAVARS REC	DEL
0100	148		3
0200	149		3
0300	150		3
0400	151		3
0500	151		3
0600	150		2
0700	150		3
0800	152		2
0900	152		2
1000	160		2
1100	160		1
1200	162		1
1300	160		1
1400	157	0	
1500	158		1
1600	158		1
1700	158		1
1800	158		2
1900	158		3
2000	138		4
2100	137		4
2200	137		2
2300	137		2
2400	137		2

"SOOT BLOWING"

TIME	IR'S	IK'S	AIR Heaters
0000	15	6	2
0405	all	6	2
0900	15	6	2
1230	All	4	2
0730	All	All	2

BOILER ROOM LOG

NORTHERN STATES POWER COMPANY - BLACK DOG STATION

BOILER NO. 4

NOV 0 5 1991

FORM 17-5145

DATE

	LOAD MW	PRESSURE F.W.	PRESSURE Drum	Sec. S.H. Diff	Pri S.H. Diff	R.H. S.H. Diff	Econ. Diff. 41	Econ. Diff. 42	Rec. Damp Diff	A.H. 41	A.H. 42	Coil 41	Coil 42	I.D. 41	I.D. 42	Air To A.H.	Air F.R. A.H.	Pul 41	Pri Air 41	Pul 42	Pri Air 42	Pul 43	Pri Air 43	Pul 44	Pri Air 44	Furn. Dr. −
A	150	2573	1759	.4	3.0	3.0				2.8	2.8		.28	8.0	8.0	6.2	2.8	12	2.7	13	2.6	16	2.2	16	2.9	.5
A	148	2531	1762	.48	2.9	3.1				2.6	2.7		.28	8.3	8.3	6.2	2.6	12	2.7	13	2.6	16	2.3	16	2.8	.5
	149	[illegible]	[illegible]	.4	3.0	3.0				2.6	2.6		.3	8.5	8.5	6.2	2.6	12	2.7	13	2.6	16	2.2	16	2.9	.4
	150	2526	1766	.4	2.9	3.0				2.6	2.6		.28	8.3	8.3	6.2	2.6	12	2.7	13	2.6	16	2.2	16	2.9	.4
	151	2528	1763	.45	2.8	3				2.6	2.7		.26	8	8.2	6.4	3	12	2.7	13	2.6	16	2.3	16	2.9	.5
	151	2539	1768	.38	3	3				2.5	2.5		.27	8.5	8.2	6.2	2.5	12	2.7	13	2.6	16	22	16	2.9	.5
	152	[illegible]	1766	.48	3.1	3				2.5	2.5		.30	8.3	8	6.5	2.2	12	2.7	13	2.6	16	2.2	16	2.9	.5
	150	2509	1893	.48	2.9	3				2.5	2.4		.28	8.5	8.3	6.3	2.5	12	2.7	13	2.7	16	23	16	2.9	.5
	152	2550	1887	.45	2.9	3				2.6	2.6		.28	8.2	8.2	6.3	3	12	2.7	13	2.6	16	2.3	16	2.9	.5
	152	2519	1861	.50	3.2	3.4				3.2	3.4		.32	9	9	7	3	13	2.6	13	2.6	17	2.3	17	2.8	.4
	160	2440	1876	.50	3.2	3.5				3	3		.3	9.6	9.4	7.4	3.5	13	2.6	14	2.6	17	2.4	17	3	.4
	160	2416	1888	.50	3.3	3.4				3	3		.3	9.4	9.4	7.3	3	13	2.6	14	2.6	17	2.4	17	3	.4
	162	2449	1893	.50	3.3	3.4				3.4	3.4		.3	9.2	9.2	7	3	13	2.6	14	2.6	17	2.4	17	3	.4
P	160	2461	1897	.50	3.2	3.3				3.6	3.6		.3	9.2	9	7	3	13	2.6	14	2.6	17	2.6	17	2.9	.5
	156	2479	1902	.40	2.5	3.2				3.2	3.2		.3	9.3	9.4	6.5	3	13	2.8	14	2.6	17	2.4	16	2.8	.4
	157	2507	1904	.46	2.6	3.4				3.2	3.2		.3	9.5	9.5	6.5	3	13	2.7	14	2.6	17	2.4	16	2.8	.4
	158	2468	1900	.44	2.5	3.4				2.8	2.8		.3	9.3	9.3	6.5	3	13	2.7	14	.26	17	2.4	16	2.7	.4
	157	2478	1903	4.5	2.6	3.3				2.8	2.8		.3	9	9	6	3	13	2.6	14	2.4	17	2.4	16	2.8	.9
	159	2484	1905	4.5	3	3				3	3		.3	9	9	7	3	13	2.7	14	2.5	16	2.3	16	3	.4
	158	2476	1903	4.5	3	3				3	3		.3	9	9	7	3	13	2.7	14	2.5	16	2.3	16	2.9	.4
	138	2597	1720	.3	2.2	2.8	—	—	—	2.4	2.4		.25	7.5	7.5	5	2.1	11	2.4	13	2.4	15	2.2	13	2.4	.3
	137	2617	1700	.35	2.2	2.7	—	—	—	2.2	2.2		.25	7.5	7.5	5	2	11	2.4	13	2.4	16	2.2	14	2.4	.5
D	138	2570	1700	.35	2.3	2.5				1.9	1.9		.22	6.8	6.8	4.8	1.8	11	2.3	13	2.4	16	2.2	14	2.5	.4
L	137	2598	1702	.31	2.2	2.2				1.9	1.9		.22	6.8	6.8	4.6	1.7	11	2.4	13	2.4	16	2.2	13	2.6	.3
M	137	2570	1703	.32	2.3	2.0				2.3	2.2		.22	6.6	6.7	4.8	1.8	11	2.3	13	2.3	16	2.2	14	2.5	.4
X																										

BANKED HOURS

HOURS OUT OF SERVICE

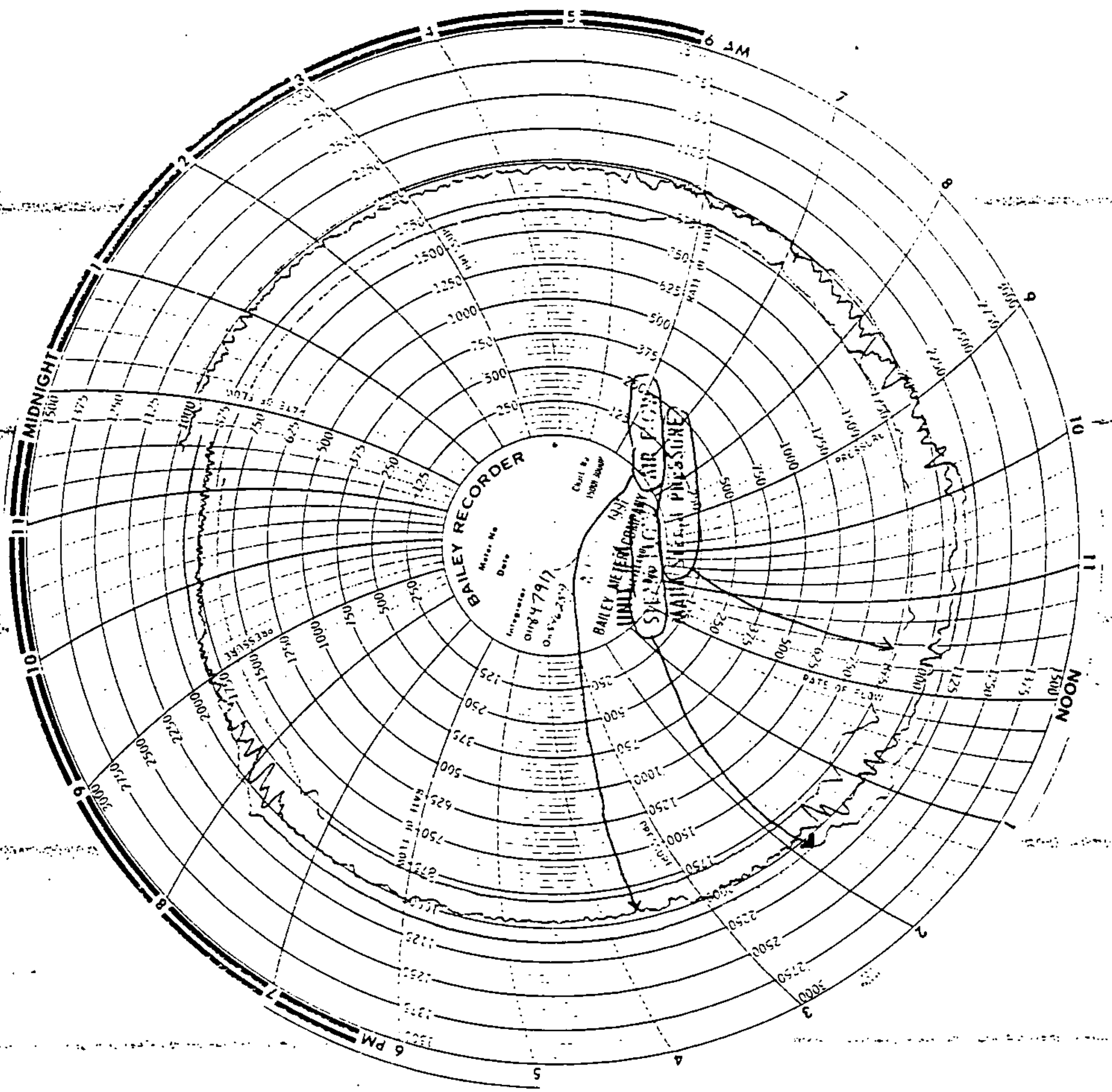
SIGNATURE

Shift	Instr. Air 31	Instr. Air 41	House Air 41	Vent Fans 41	Vent Fans 42
2-6		1			
8a					
4-12					

[illegible] - [illegible]

[illegible]

[illegible] - Ehlers



BAILEY RECORDER
BAILEY METER COMPANY
MIDNIGHT
NOON
6 AM
6 PM
RATE OF FLOW
PRESSURE
AIR FLOW
STEAM PRESSURE

4 HOURLY UNIT 4 HOURLY LOG 11:05:05 11/05/91

```
4FWP 2446.6 PSIG    4 AVG. FEEDWATER PRESS
4MWH  161.4 MEG W   4 INT. GROSS MEGAWATTS
4FFH 1182.8 K #/HR  4 INT. FEEDWATER FLOW
4CRT  968.7 DEG F   4 AVG. COLD REHEAT TEMP
4CRP  440.0 PSIG    4 AVG. COLD REHEAT PRESS
4RHF  974.7 K #/HR  4 INT. REHEAT FLOW
4HRP  401.6 PSIG    4 AVG. HOT REHEAT PRESS
4HRT 1000.9 DEG F   4 AVG. HOT REHEAT TEMP
4AFH  151.9 K #/HR  4 INT. ATTEMP FLOW
4ATT  333.9 DEG F   4 AVG. FW TO ATTEMP TEMP
4FWT  449.5 DEG F   4 AVG. FW TO ECON TEMP
4MSP 1779.1 PSIG    4 AVG. FINAL STEAM PRESS
4MST  999.1 DEG F   4 AVG. FINAL STEAM TEMP
4BPH(USE UNIT-1"S) PLANT BAROMETRIC PRESS
4CVP
4CWP
4CIT
4COT
4HWT
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 155.1 MEG W   4 INT. NET MEGAWATTS
  17.5 KVOLTS  4 AVG. GENERATOR AB PHASE
   1.9 M-VARS  4 AVG. GENERATOR VARS
5266.4 AMPS    4 AVG. GENERATOR B PHASE

1545.0 AMPS    4 AVG. EXCITER CURRENT

   6.2 MEG W  41 INT. STATION AUX MEGAWATTS
  -0.2 MEG W   2 RSA TOTAL SUPPLY TO FOUR INT. MEGAWATTS
   6.1 MEG W   4 TOTAL STATION USE AUX + RSA INT.
1123.5 AMPS   41 BUS AVG. A PHASE CURRENT
1356.7 AMPS   42 BUS AVG. A PHASE CURRENT
   0.0 AMPS    2 RSA TO 41 A PHASE CURRENT
   0.0 AMPS    2 RSA TO 42 A PHASE CURRENT

1060.1 K #/HR  4 INT. FINAL STEAM HOURLY FLOW
1890.5 PSIG    4 AVG. DRUM PRESSURE

 497.5 DEG F   4 AVG. ECON FEEDWATER OUTLET TEMP

1011.4 DEG F  41 AVG. HOT REHEAT OUT TEMP
 990.4 DEG F  42 AVG. HOT REHEAT OUT TEMP

  76.5 K #/HR 41 AVG. ATTEMP SPRAY FLOW
 720.7 DEG F  41 AVG. ATTEMP OUT STEAM TEMP
 996.4 DEG F  41 AVG. SEC SUPERHEAT OUT TEMP

  75.7 K #/HR 42 AVG. ATTEMP SPRAY FLOW
 715.8 DEG F  42 AVG. ATTEMP OUT STEAM TEMP
1003.2 DEG F  42 AVG  SEC SUPERHEAT OUT TEMP

  66.0 DEG C   4 GEN STATOR TEMP 1
  69.5 DEG C   4 GEN STATOR TEMP 2
  68.7 DEG C   4 GEN STATOR TEMP 3
  45.5 DEG C   4 GEN ROTOR TEMP
  43.4 DEG C   4 GEN H2 INLET TEMP 3
  60.4 DEG C   4 GEN H2 OUTLET TEMP 1
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4 HOURLY UNIT 4 HOURLY LOG 12:05:05 11/05/91

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4FWP 2459.0 PSIG   4 AVG. FEEDWATER PRESS
4MWH  161.0 MEG W  4 INT. GROSS MEGAWATTS
4FFH 1171.1 K #/HR 4 INT. FEEDWATER FLOW
4CRT  968.7 DEG F  4 AVG. COLD REHEAT TEMP
4CRP  437.9 PSIG   4 AVG. COLD REHEAT PRESS
4RHF  967.0 K #/HR 4 INT. REHEAT FLOW
4HRP  399.9 PSIG   4 AVG. HOT REHEAT PRESS
4HRT 1002.0 DEG F  4 AVG. HOT REHEAT TEMP
4AFH  153.0 K #/HR 4 INT. ATTEMP FLOW
4ATT  334.0 DEG F  4 AVG. FW TO ATTEMP TEMP
4FWT  449.4 DEG F  4 AVG. FW TO ECON TEMP
4MSP 1790.8 PSIG   4 AVG. FINAL STEAM PRESS
4MST 1004.7 DEG F  4 AVG. FINAL STEAM TEMP
4BPH(USE UNIT-1"S) PLANT BAROMETRIC PRESS
4CVP
4CWP
4CIT
4COT
4HWT
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```
 154.9 MEG W  4 INT. NET MEGAWATTS
  17.5 KVOLTS 4 AVG. GENERATOR AB PHASE
   1.5 M-VARS 4 AVG. GENERATOR VARS
5246.5 AMPS   4 AVG. GENERATOR B PHASE

1540.1 AMPS   4 AVG. EXCITER CURRENT

   6.1 MEG W  41 INT. STATION AUX MEGAWATTS
  -0.2 MEG W  2 RSA TOTAL SUPPLY TO FOUR INT. MEGAWATTS
   5.9 MEG W  4 TOTAL STATION USE AUX + RSA INT.
1112.4 AMPS   41 BUS AVG. A PHASE CURRENT
1318.8 AMPS   42 BUS AVG. A PHASE CURRENT
   0.0 AMPS   2 RSA TO 41 A PHASE CURRENT
   0.0 AMPS   2 RSA TO 42 A PHASE CURRENT

1048.5 K #/HR 4 INT. FINAL STEAM HOURLY FLOW
1899.7 PSIG   4 AVG. DRUM PRESSURE

 498.2 DEG F  4 AVG. ECON FEEDWATER OUTLET TEMP

1012.5 DEG F  41 AVG. HOT REHEAT OUT TEMP
 991.6 DEG F  42 AVG. HOT REHEAT OUT TEMP

  77.2 K #/HR 41 AVG. ATTEMP SPRAY FLOW
 726.6 DEG F  41 AVG. ATTEMP OUT STEAM TEMP
 999.9 DEG F  41 AVG. SEC SUPERHEAT OUT TEMP

  76.0 K #/HR 42 AVG. ATTEMP SPRAY FLOW
 722.6 DEG F  42 AVG. ATTEMP OUT STEAM TEMP
1009.1 DEG F  42 AVG  SEC SUPERHEAT OUT TEMP

  66.0 DEG C  4 GEN STATOR TEMP 1
  69.5 DEG C  4 GEN STATOR TEMP 2
  68.8 DEG C  4 GEN STATOR TEMP 3
  45.0 DEG C  4 GEN ROTOR TEMP
  43.3 DEG C  4 GEN H2 INLET TEMP 3
  60.4 DEG C  4 GEN H2 OUTLET TEMP 1
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4FWP 2454.1 PSIG   4 AVG. FEEDWATER PRESS
4MWH  160.8 MEG W  4 INT. GROSS MEGAWATTS
4FFH 1169.9 K #/HR 4 INT. FEEDWATER FLOW
4CRT  968.7 DEG F  4 AVG. COLD REHEAT TEMP
4CRP  441.0 PSIG   4 AVG. COLD REHEAT PRESS
4RHF  972.0 K #/HR 4 INT. REHEAT FLOW
4HRP  402.7 PSIG   4 AVG. HOT REHEAT PRESS
4HRT  990.3 DEG F  4 AVG. HOT REHEAT TEMP
4AFH  150.3 K #/HR 4 INT. ATTEMP FLOW
4ATT  334.3 DEG F  4 AVG. FW TO ATTEMP TEMP
4FWT  449.9 DEG F  4 AVG. FW TO ECON TEMP
4MSP 1768.4 PSIG   4 AVG. FINAL STEAM PRESS
4MST  990.8 DEG F  4 AVG. FINAL STEAM TEMP
4BPH(USE UNIT-1"S) PLANT BAROMETRIC PRESS
4CVP
4CWP
4CIT
4COT
4HWT
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```
 154.7 MEG W   4 INT. NET MEGAWATTS
  17.5 KVOLTS  4 AVG. GENERATOR AB PHASE
   1.0 M-VARS  4 AVG. GENERATOR VARS
5235.3 AMPS    4 AVG. GENERATOR B PHASE

1536.6 AMPS    4 AVG. EXCITER CURRENT

   6.0 MEG W   41 INT. STATION AUX MEGAWATTS
  -0.2 MEG W   2 RSA TOTAL SUPPLY TO FOUR INT. MEGAWATTS
   5.8 MEG W   4 TOTAL STATION USE AUX + RSA INT.
1108.6 AMPS    41 BUS AVG. A PHASE CURRENT
1301.5 AMPS    42 BUS AVG. A PHASE CURRENT
   0.0 AMPS    2 RSA TO 41 A PHASE CURRENT
   0.0 AMPS    2 RSA TO 42 A PHASE CURRENT

1059.3 K #/HR  4 INT. FINAL STEAM HOURLY FLOW
1879.2 PSIG    4 AVG. DRUM PRESSURE

 497.9 DEG F   4 AVG. ECON FEEDWATER OUTLET TEMP

 998.1 DEG F   41 AVG. HOT REHEAT OUT TEMP
 982.6 DEG F   42 AVG. HOT REHEAT OUT TEMP

  75.4 K #/HR  41 AVG. ATTEMP SPRAY FLOW
 725.3 DEG F   41 AVG. ATTEMP OUT STEAM TEMP
 989.4 DEG F   41 AVG. SEC SUPERHEAT OUT TEMP

  75.9 K #/HR  42 AVG. ATTEMP SPRAY FLOW
 718.1 DEG F   42 AVG. ATTEMP OUT STEAM TEMP
 996.8 DEG F   42 AVG  SEC SUPERHEAT OUT TEMP

  66.2 DEG C   4 GEN STATOR TEMP 1
  69.7 DEG C   4 GEN STATOR TEMP 2
  69.0 DEG C   4 GEN STATOR TEMP 3
  45.1 DEG C   4 GEN ROTOR TEMP
  43.4 DEG C   4 GEN H2 INLET TEMP 3
  60.5 DEG C   4 GEN H2 OUTLET TEMP 1
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4 HOURLY　　UNIT 4 HOURLY LOG　　14:05:05　　11/05/91

Tag	Value	Units	Unit	Type	Description
4FWP	2467.8	PSIG	4	AVG.	FEEDWATER PRESS
4MWH	157.3	MEG W	4	INT.	GROSS MEGAWATTS
4FFH	1152.0	K #/HR	4	INT.	FEEDWATER FLOW
4CRT	968.7	DEG F	4	AVG.	COLD REHEAT TEMP
4CRP	428.4	PSIG	4	AVG.	COLD REHEAT PRESS
4RHF	948.1	K #/HR	4	INT.	REHEAT FLOW
4HRP	391.1	PSIG	4	AVG.	HOT REHEAT PRESS
4HRT	991.3	DEG F	4	AVG.	HOT REHEAT TEMP
4AFH	122.2	K #/HR	4	INT.	ATTEMP FLOW
4ATT	332.9	DEG F	4	AVG.	FW TO ATTEMP TEMP
4FWT	446.6	DEG F	4	AVG.	FW TO ECON TEMP
4MSP	1768.4	PSIG	4	AVG.	FINAL STEAM PRESS
4MST	996.0	DEG F	4	AVG.	FINAL STEAM TEMP
4BPH(USE UNIT-1"S) PLANT BAROMETRIC PRESS					
4CVP					
4CWP					
4CIT					
4COT					
4HWT					

Value	Units	Unit	Type	Description
151.3	MEG W	4	INT.	NET MEGAWATTS
17.5	KVOLTS	4	AVG.	GENERATOR AB PHASE
0.8	M-VARS	4	AVG.	GENERATOR VARS
5119.0	AMPS	4	AVG.	GENERATOR B PHASE
1512.3	AMPS	4	AVG.	EXCITER CURRENT
5.9	MEG W	41	INT.	STATION AUX MEGAWATTS
-0.2	MEG W	2	RSA	TOTAL SUPPLY TO FOUR INT. MEGAWATTS
5.8	MEG W	4	TOTAL	STATION USE AUX + RSA INT.
1084.3	AMPS	41	BUS AVG.	A PHASE CURRENT
1290.0	AMPS	42	BUS AVG.	A PHASE CURRENT
0.0	AMPS	2	RSA TO 41	A PHASE CURRENT
0.0	AMPS	2	RSA TO 42	A PHASE CURRENT
1035.7	K #/HR	4	INT.	FINAL STEAM HOURLY FLOW
1877.9	PSIG	4	AVG.	DRUM PRESSURE
493.5	DEG F	4	AVG.	ECON FEEDWATER OUTLET TEMP
997.7	DEG F	41	AVG.	HOT REHEAT OUT TEMP
985.0	DEG F	42	AVG.	HOT REHEAT OUT TEMP
55.8	K #/HR	41	AVG.	ATTEMP SPRAY FLOW
731.3	DEG F	41	AVG.	ATTEMP OUT STEAM TEMP
1001.2	DEG F	41	AVG.	SEC SUPERHEAT OUT TEMP
65.8	K #/HR	42	AVG.	ATTEMP SPRAY FLOW
711.1	DEG F	42	AVG.	ATTEMP OUT STEAM TEMP
986.0	DEG F	42	AVG	SEC SUPERHEAT OUT TEMP
65.5	DEG C	4	GEN	STATOR TEMP 1
68.9	DEG C	4	GEN	STATOR TEMP 2
68.4	DEG C	4	GEN	STATOR TEMP 3
44.4	DEG C	4	GEN	ROTOR TEMP
42.9	DEG C	4	GEN	H2 INLET TEMP 3
59.9	DEG C	4	GEN	H2 OUTLET TEMP 1

4FWP	2491.0	PSIG	4 AVG.	FEEDWATER PRESS
4MWH	157.3	MEG W	4 INT.	GROSS MEGAWATTS
4FFH	1124.3	K #/HR	4 INT.	FEEDWATER FLOW
4CRT	968.7	DEG F	4 AVG.	COLD REHEAT TEMP
4CRP	424.6	PSIG	4 AVG.	COLD REHEAT PRESS
4RHF	934.8	K #/HR	4 INT.	REHEAT FLOW
4HRP	387.9	PSIG	4 AVG.	HOT REHEAT PRESS
4HRT	999.7	DEG F	4 AVG.	HOT REHEAT TEMP
4AFH	133.1	K #/HR	4 INT.	ATTEMP FLOW
4ATT	332.4	DEG F	4 AVG.	FW TO ATTEMP TEMP
4FWT	446.0	DEG F	4 AVG.	FW TO ECON TEMP
4MSP	1799.5	PSIG	4 AVG.	FINAL STEAM PRESS
4MST	996.9	DEG F	4 AVG.	FINAL STEAM TEMP
4BPH(USE UNIT-1"S)				PLANT BAROMETRIC PRESS
4CVP				
4CWP				
4CIT				
4COT				
4HWT				

151.5	MEG W	4 INT.	NET MEGAWATTS
17.6	KVOLTS	4 AVG.	GENERATOR AB PHASE
0.9	M-VARS	4 AVG.	GENERATOR VARS
5119.1	AMPS	4 AVG.	GENERATOR B PHASE
1515.0	AMPS	4 AVG.	EXCITER CURRENT
5.9	MEG W	41 INT.	STATION AUX MEGAWATTS
-0.2	MEG W	2 RSA	TOTAL SUPPLY TO FOUR INT. MEGAWATTS
5.7	MEG W	4	TOTAL STATION USE AUX + RSA INT.
1072.6	AMPS	41 BUS AVG.	A PHASE CURRENT
1281.6	AMPS	42 BUS AVG.	A PHASE CURRENT
0.0	AMPS	2 RSA	TO 41 A PHASE CURRENT
0.0	AMPS	2 RSA	TO 42 A PHASE CURRENT
1020.2	K #/HR	4 INT.	FINAL STEAM HOURLY FLOW
1902.1	PSIG	4 AVG.	DRUM PRESSURE
493.5	DEG F	4 AVG.	ECON FEEDWATER OUTLET TEMP
1009.4	DEG F	41 AVG.	HOT REHEAT OUT TEMP
990.0	DEG F	42 AVG.	HOT REHEAT OUT TEMP
64.3	K #/HR	41 AVG.	ATTEMP SPRAY FLOW
722.8	DEG F	41 AVG.	ATTEMP OUT STEAM TEMP
994.1	DEG F	41 AVG.	SEC SUPERHEAT OUT TEMP
68.7	K #/HR	42 AVG.	ATTEMP SPRAY FLOW
715.0	DEG F	42 AVG.	ATTEMP OUT STEAM TEMP
996.7	DEG F	42 AVG	SEC SUPERHEAT OUT TEMP
65.1	DEG C	4 GEN	STATOR TEMP 1
68.5	DEG C	4 GEN	STATOR TEMP 2
68.0	DEG C	4 GEN	STATOR TEMP 3
44.4	DEG C	4 GEN	ROTOR TEMP
42.9	DEG C	4 GEN	H2 INLET TEMP 3
59.8	DEG C	4 GEN	H2 OUTLET TEMP 1

4 HOURLY | UNIT 4 HOURLY LOG | 16:05:05 | 11/05/91

4FWP	2485.5	PSIG	4 AVG.	FEEDWATER PRESS
4MWH	157.9	MEG W	4 INT.	GROSS MEGAWATTS
4FFH	1131.3	K #/HR	4 INT.	FEEDWATER FLOW
4CRT	968.7	DEG F	4 AVG.	COLD REHEAT TEMP
4CRP	426.7	PSIG	4 AVG.	COLD REHEAT PRESS
4RHF	939.4	K #/HR	4 INT.	REHEAT FLOW
4HRP	390.1	PSIG	4 AVG.	HOT REHEAT PRESS
4HRT	997.2	DEG F	4 AVG.	HOT REHEAT TEMP
4AFH	135.3	K #/HR	4 INT.	ATTEMP FLOW
4ATT	332.8	DEG F	4 AVG.	FW TO ATTEMP TEMP
4FWT	446.6	DEG F	4 AVG.	FW TO ECON TEMP
4MSP	1800.5	PSIG	4 AVG.	FINAL STEAM PRESS
4MST	996.6	DEG F	4 AVG.	FINAL STEAM TEMP
4BPH(USE UNIT-1"S)				PLANT BAROMETRIC PRESS
4CVP				
4CWP				
4CIT				
4COT				
4HWT				

152.1	MEG W	4 INT.	NET MEGAWATTS
17.6	KVOLTS	4 AVG.	GENERATOR AB PHASE
0.4	M-VARS	4 AVG.	GENERATOR VARS
5131.5	AMPS	4 AVG.	GENERATOR B PHASE
1516.4	AMPS	4 AVG.	EXCITER CURRENT
5.9	MEG W	41 INT.	STATION AUX MEGAWATTS
-0.2	MEG W	2 RSA	TOTAL SUPPLY TO FOUR INT. MEGAWATTS
5.7	MEG W	4 TOTAL	STATION USE AUX + RSA INT.
1053.1	AMPS	41 BUS	AVG. A PHASE CURRENT
1274.5	AMPS	42 BUS	AVG. A PHASE CURRENT
0.0	AMPS	2 RSA	TO 41 A PHASE CURRENT
0.0	AMPS	2 RSA	TO 42 A PHASE CURRENT
1026.4	K #/HR	4 INT.	FINAL STEAM HOURLY FLOW
1904.1	PSIG	4 AVG.	DRUM PRESSURE
493.4	DEG F	4 AVG.	ECON FEEDWATER OUTLET TEMP
1003.0	DEG F	41 AVG.	HOT REHEAT OUT TEMP
991.3	DEG F	42 AVG.	HOT REHEAT OUT TEMP
64.2	K #/HR	41 AVG.	ATTEMP SPRAY FLOW
728.6	DEG F	41 AVG.	ATTEMP OUT STEAM TEMP
995.4	DEG F	41 AVG.	SEC SUPERHEAT OUT TEMP
70.9	K #/HR	42 AVG.	ATTEMP SPRAY FLOW
716.7	DEG F	42 AVG.	ATTEMP OUT STEAM TEMP
996.3	DEG F	42 AVG	SEC SUPERHEAT OUT TEMP
65.5	DEG C	4 GEN	STATOR TEMP 1
68.9	DEG C	4 GEN	STATOR TEMP 2
68.4	DEG C	4 GEN	STATOR TEMP 3
44.7	DEG C	4 GEN	ROTOR TEMP
43.2	DEG C	4 GEN	H2 INLET TEMP 3
60.1	DEG C	4 GEN	H2 OUTLET TEMP 1

4 HOURLY UNIT 4 HOURLY LOG 17:05:05 11/05/91

4FWP	2486.7	PSIG	4	AVG.	FEEDWATER PRESS
4MWH	157.9	MEG W	4	INT.	GROSS MEGAWATTS
4FFH	1133.5	K #/HR	4	INT.	FEEDWATER FLOW
4CRT	968.7	DEG F	4	AVG.	COLD REHEAT TEMP
4CRP	426.6	PSIG	4	AVG.	COLD REHEAT PRESS
4RHF	939.6	K #/HR	4	INT.	REHEAT FLOW
4HRP	389.9	PSIG	4	AVG.	HOT REHEAT PRESS
4HRT	999.3	DEG F	4	AVG.	HOT REHEAT TEMP
4AFH	141.3	K #/HR	4	INT.	ATTEMP FLOW
4ATT	332.7	DEG F	4	AVG.	FW TO ATTEMP TEMP
4FWT	446.8	DEG F	4	AVG.	FW TO ECON TEMP
4MSP	1800.6	PSIG	4	AVG.	FINAL STEAM PRESS
4MST	997.2	DEG F	4	AVG.	FINAL STEAM TEMP
4BPH(USE UNIT-1"S)					PLANT BAROMETRIC PRESS
4CVP					
4CWP					
4CIT					
4COT					
4HWT					

152.0	MEG W	4	INT.	NET MEGAWATTS
17.5	KVOLTS	4	AVG.	GENERATOR AB PHASE
0.9	M-VARS	4	AVG.	GENERATOR VARS
5141.6	AMPS	4	AVG.	GENERATOR B PHASE
1518.8	AMPS	4	AVG.	EXCITER CURRENT
5.8	MEG W	41	INT.	STATION AUX MEGAWATTS
-0.2	MEG W	2		RSA TOTAL SUPPLY TO FOUR INT. MEGAWATTS
5.7	MEG W	4		TOTAL STATION USE AUX + RSA INT.
1070.8	AMPS	41		BUS AVG. A PHASE CURRENT
1282.7	AMPS	42		BUS AVG. A PHASE CURRENT
0.0	AMPS	2		RSA TO 41 A PHASE CURRENT
0.0	AMPS	2		RSA TO 42 A PHASE CURRENT
1025.1	K #/HR	4	INT.	FINAL STEAM HOURLY FLOW
1903.6	PSIG	4	AVG.	DRUM PRESSURE
493.6	DEG F	4	AVG.	ECON FEEDWATER OUTLET TEMP
1003.9	DEG F	41	AVG.	HOT REHEAT OUT TEMP
994.6	DEG F	42	AVG.	HOT REHEAT OUT TEMP
67.0	K #/HR	41	AVG.	ATTEMP SPRAY FLOW
731.1	DEG F	41	AVG.	ATTEMP OUT STEAM TEMP
996.5	DEG F	41	AVG.	SEC SUPERHEAT OUT TEMP
74.2	K #/HR	42	AVG.	ATTEMP SPRAY FLOW
716.8	DEG F	42	AVG.	ATTEMP OUT STEAM TEMP
996.6	DEG F	42	AVG	SEC SUPERHEAT OUT TEMP
65.6	DEG C	4		GEN STATOR TEMP 1
69.0	DEG C	4		GEN STATOR TEMP 2
68.5	DEG C	4		GEN STATOR TEMP 3
44.8	DEG C	4		GEN ROTOR TEMP
43.2	DEG C	4		GEN H2 INLET TEMP 3
60.1	DEG C	4		GEN H2 OUTLET TEMP 1

4 HOURLY UNIT 4 HOURLY LOG 18:05:06 11/05/91

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4FWP 2485.6 PSIG    4 AVG. FEEDWATER PRESS
4MWH  157.9 MEG W   4 INT. GROSS MEGAWATTS
4FFH 1126.2 K #/HR  4 INT. FEEDWATER FLOW
4CRT  968.7 DEG F   4 AVG. COLD REHEAT TEMP
4CRP  426.8 PSIG    4 AVG. COLD REHEAT PRESS
4RHF  941.2 K #/HR  4 INT. REHEAT FLOW
4HRP  390.2 PSIG    4 AVG. HOT REHEAT PRESS
4HRT  999.6 DEG F   4 AVG. HOT REHEAT TEMP
4AFH  146.0 K #/HR  4 INT. ATTEMP FLOW
4ATT  332.6 DEG F   4 AVG. FW TO ATTEMP TEMP
4FWT  446.8 DEG F   4 AVG. FW TO ECON TEMP
4MSP 1800.6 PSIG    4 AVG. FINAL STEAM PRESS
4MST  997.2 DEG F   4 AVG. FINAL STEAM TEMP
4BPH(USE UNIT-1"S) PLANT BAROMETRIC PRESS
4CVP
4CWP
4CIT
4COT
4HWT
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 152.0 MEG W    4 INT. NET MEGAWATTS
  17.5 KVOLTS   4 AVG. GENERATOR AB PHASE
   2.0 M-VARS   4 AVG. GENERATOR VARS
5153.7 AMPS     4 AVG. GENERATOR B PHASE

1523.4 AMPS     4 AVG. EXCITER CURRENT

   5.9 MEG W    41 INT. STATION AUX MEGAWATTS
  -0.2 MEG W    2 RSA TOTAL SUPPLY TO FOUR INT. MEGAWATTS
   5.7 MEG W    4 TOTAL STATION USE AUX + RSA INT.
1068.8 AMPS     41 BUS AVG. A PHASE CURRENT
1268.6 AMPS     42 BUS AVG. A PHASE CURRENT
   0.0 AMPS     2 RSA TO 41 A PHASE CURRENT
   0.0 AMPS     2 RSA TO 42 A PHASE CURRENT

1025.4 K #/HR   4 INT. FINAL STEAM HOURLY FLOW
1903.1 PSIG     4 AVG. DRUM PRESSURE

 493.9 DEG F    4 AVG. ECON FEEDWATER OUTLET TEMP

1004.0 DEG F    41 AVG. HOT REHEAT OUT TEMP
 995.2 DEG F    42 AVG. HOT REHEAT OUT TEMP

  69.7 K #/HR   41 AVG. ATTEMP SPRAY FLOW
 734.3 DEG F    41 AVG. ATTEMP OUT STEAM TEMP
 996.0 DEG F    41 AVG. SEC SUPERHEAT OUT TEMP

  76.4 K #/HR   42 AVG. ATTEMP SPRAY FLOW
 717.4 DEG F    42 AVG. ATTEMP OUT STEAM TEMP
 996.1 DEG F    42 AVG  SEC SUPERHEAT OUT TEMP

  65.5 DEG C    4 GEN STATOR TEMP 1
  68.9 DEG C    4 GEN STATOR TEMP 2
  68.4 DEG C    4 GEN STATOR TEMP 3
  44.8 DEG C    4 GEN ROTOR TEMP
  43.1 DEG C    4 GEN H2 INLET TEMP 3
  60.0 DEG C    4 GEN H2 OUTLET TEMP 1
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4FWP 2492.0 PSIG   4 AVG. FEEDWATER PRESS
4MWH  158.1 MEG W  4 INT. GROSS MEGAWATTS
4FFH 1122.1 K #/HR 4 INT. FEEDWATER FLOW
4CRT  968.7 DEG F  4 AVG. COLD REHEAT TEMP
4CRP  426.2 PSIG   4 AVG. COLD REHEAT PRESS
4RHF  937.7 K #/HR 4 INT. REHEAT FLOW
4HRP  389.5 PSIG   4 AVG. HOT REHEAT PRESS
4HRT 1006.5 DEG F  4 AVG. HOT REHEAT TEMP
4AFH  153.2 K #/HR 4 INT. ATTEMP FLOW
4ATT  332.8 DEG F  4 AVG. FW TO ATTEMP TEMP
4FWT  447.2 DEG F  4 AVG. FW TO ECON TEMP
4MSP 1801.3 PSIG   4 AVG. FINAL STEAM PRESS
4MST  999.7 DEG F  4 AVG. FINAL STEAM TEMP
4BPH(USE UNIT-1"S) PLANT BAROMETRIC PRESS
4CVP
4CWP
4CIT
4COT
4HWT

 152.2 MEG W   4 INT. NET MEGAWATTS
  17.5 KVOLTS  4 AVG. GENERATOR AB PHASE
   2.2 M-VARS  4 AVG. GENERATOR VARS
5148.8 AMPS    4 AVG. GENERATOR B PHASE

1526.6 AMPS    4 AVG. EXCITER CURRENT

   5.8 MEG W  41 INT. STATION AUX MEGAWATTS
  -0.2 MEG W   2 RSA TOTAL SUPPLY TO FOUR INT. MEGAWATTS
   5.7 MEG W   4 TOTAL STATION USE AUX + RSA INT.
1069.7 AMPS   41 BUS AVG. A PHASE CURRENT
1279.4 AMPS   42 BUS AVG. A PHASE CURRENT
   0.0 AMPS    2 RSA TO 41 A PHASE CURRENT
   0.0 AMPS    2 RSA TO 42 A PHASE CURRENT

1020.6 K #/HR  4 INT. FINAL STEAM HOURLY FLOW
1902.3 PSIG    4 AVG. DRUM PRESSURE

 495.1 DEG F   4 AVG. ECON FEEDWATER OUTLET TEMP

1013.4 DEG F  41 AVG. HOT REHEAT OUT TEMP
 999.6 DEG F  42 AVG. HOT REHEAT OUT TEMP

  76.5 K #/HR 41 AVG. ATTEMP SPRAY FLOW
 732.5 DEG F  41 AVG. ATTEMP OUT STEAM TEMP
 995.9 DEG F  41 AVG. SEC SUPERHEAT OUT TEMP

  76.0 K #/HR 42 AVG. ATTEMP SPRAY FLOW
 723.1 DEG F  42 AVG. ATTEMP OUT STEAM TEMP
1002.6 DEG F  42 AVG  SEC SUPERHEAT OUT TEMP

  65.5 DEG C   4 GEN STATOR TEMP 1
  69.0 DEG C   4 GEN STATOR TEMP 2
  68.4 DEG C   4 GEN STATOR TEMP 3
  45.0 DEG C   4 GEN ROTOR TEMP
  43.2 DEG C   4 GEN H2 INLET TEMP 3
  60.2 DEG C   4 GEN H2 OUTLET TEMP 1
```

```
4 HOURLY                          UNIT 4 HOURLY LOG                                   20:05:05              11/05/91

4FWP 2492.2 PSIG    4 AVG. FEEDWATER PRESS           150.0 MEG W   4 INT. NET MEGAWATTS
                                                      17.5 KVOLTS 4 AVG. GENERATOR AB PHASE
4MWH  155.8 MEG W   4 INT. GROSS MEGAWATTS             3.0 M-VARS 4 AVG. GENERATOR VARS
                                                    5055.9 AMPS   4 AVG. GENERATOR B PHASE
4FFH 1119.2 K #/HR 4 INT. FEEDWATER FLOW
                                                    1516.8 AMPS   4 AVG. EXCITER CURRENT
4CRT  968.7 DEG F   4 AVG. COLD REHEAT TEMP
                                                       5.8 MEG W  41 INT. STATION AUX MEGAWATTS
4CRP  420.6 PSIG    4 AVG. COLD REHEAT PRESS          -0.2 MEG W  2 RSA TOTAL SUPPLY TO FOUR INT. MEGAWATTS
                                                       5.7 MEG W  4 TOTAL STATION USE AUX + RSA INT.
4RHF  928.5 K #/HR 4 INT. REHEAT FLOW               1063.3 AMPS   41 BUS AVG. A PHASE CURRENT
                                                    1270.3 AMPS   42 BUS AVG. A PHASE CURRENT
4HRP  384.2 PSIG    4 AVG. HOT REHEAT PRESS            0.0 AMPS   2 RSA TO 41 A PHASE CURRENT
                                                       0.0 AMPS   2 RSA TO 42 A PHASE CURRENT
4HRT 1000.2 DEG F   4 AVG. HOT REHEAT TEMP

4AFH  148.0 K #/HR 4 INT. ATTEMP FLOW
                                                    1012.4 K #/HR 4 INT. FINAL STEAM HOURLY FLOW
4ATT  332.3 DEG F   4 AVG. FW TO ATTEMP TEMP        1867.1 PSIG   4 AVG. DRUM PRESSURE

4FWT  445.7 DEG F   4 AVG. FW TO ECON TEMP           493.2 DEG F  4 AVG. ECON FEEDWATER OUTLET TEMP

4MSP 1767.0 PSIG    4 AVG. FINAL STEAM PRESS        1004.6 DEG F  41 AVG. HOT REHEAT OUT TEMP
                                                     996.0 DEG F  42 AVG. HOT REHEAT OUT TEMP
4MST  994.5 DEG F   4 AVG. FINAL STEAM TEMP
                                                      72.0 K #/HR 41 AVG. ATTEMP SPRAY FLOW
4BPH(USE UNIT-1"S) PLANT BAROMETRIC PRESS            737.7 DEG F  41 AVG. ATTEMP OUT STEAM TEMP
                                                     992.9 DEG F  41 AVG. SEC SUPERHEAT OUT TEMP
4CVP
                                                      76.2 K #/HR 42 AVG. ATTEMP SPRAY FLOW
4CWP                                                 720.7 DEG F  42 AVG. ATTEMP OUT STEAM TEMP
                                                     996.1 DEG F  42 AVG  SEC SUPERHEAT OUT TEMP
4CIT
                                                      65.4 DEG C  4 GEN STATOR TEMP 1
4COT                                                  68.8 DEG C  4 GEN STATOR TEMP 2
                                                      68.3 DEG C  4 GEN STATOR TEMP 3
4HWT                                                  44.5 DEG C  4 GEN ROTOR TEMP
                                                      43.1 DEG C  4 GEN H2 INLET TEMP 3
                                                      60.0 DEG C  4 GEN H2 OUTLET TEMP 1
```

APPENDIX F

PROCEDURES

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INTERPOLL LABORATORIES
4500 BALL ROAD N.E.
CIRCLE PINES, MN 55014-1819
(612) 786-6020

11/7/88

APPENDIX A

[redacted] METHODOLOGY FOR THE DETERMINATION OF METALS EMISSIONS IN EXHAUST GASES FROM STATIONARY SOURCE COMBUSTION PROCESSES

1. Applicability and Principle

1.1 Applicability. This method is applicable for the determination of total chromium (Cr), cadmium (Cd), arsenic (As), nickel (Ni), manganese (Mn), beryllium (Be), copper (Cu), zinc (Zn), lead (Pb), selenium (Se), phosphorus (P), thallium (Tl), silver (Ag), antimony (Sb), barium (Ba), and mercury (Hg) emissions from municipal waste incinerators, sewage sludge incinerators, and hazardous waste incinerators. This method may also be used for the determination of particulate emissions following the additional procedures described. Modifications to the sample recovery and analysis procedures described in this protocol for the purpose of determining particulate emissions may potentially impact the front half mercury determination.*

1.2 Principle. Particulate and gaseous metal emissions are withdrawn isokinetically from the source and collected on a heated filter, and in a series of chilled impingers containing a solution of dilute nitric acid in hydrogen peroxide in two impingers, and acidic potassium permanganate solution in two (or one) impingers. Sampling train components are recovered and digested in separate front and back half fractions. Materials collected in the sampling train are digested with acid solutions to dissolve inorganics and to remove organic constituents that may create analytical interferences. Acid digestion is performed using conventional Parr® Bomb or microwave digestion techniques. The nitric acid and hydrogen peroxide impinger solution, the acidic potassium permanganate impinger solution, and the probe rinse and digested filter solutions are analyzed for mercury by cold vapor atomic absorption spectroscopy (CVAAS). Except for the permanganate solution, the

*Field tests to date have shown that of the total amount of mercury measured by the method, only 0 to <2% was measured in the front half. Therefore, it is tentatively concluded, based on the above data, that particulate emissions may be measured by this train, without significantly altering the mercury results.

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remainder of the sampling train catches are analyzed for Cr, Cd, Ni, Mn, Be, Cu, Zn, Pb, Se, P, Tl, Ag, Sb, Ba, and As by inductively coupled argon plasma emission spectroscopy (ICAP) or atomic absorption spectroscopy (AAS). Graphite furnace atomic absorption spectroscopy (GFAAS) is used for analysis of antimony, arsenic, cadmium, lead, selenium, and thallium, if these elements require greater analytical sensitivity than can be obtained by ICAP. Additionally, if desired, the tester may use AAS for analyses of all metals if the detection limits meet the goal of the testing program. For convenience, aliquots of each digested sample fraction can be combined proportionally for a single analytical determination. The efficiency of the analytical procedure is quantified by the analysis of spiked quality control samples containing each of the target metals including actual sample matrix effects checks.

2. Range, Sensitivity, Precision, and Interferences

2.1 Range. For the analyses described in this methodology and for similar analyses, the ICAP response is linear over several orders of magnitude. Samples containing metal concentrations in the nanograms per milliliter (ng/ml) to micrograms per milliliter (ug/ml) range in the analytical finish solution can be analyzed using this technique. Samples containing greater than approximately 50 ug/ml of chromium, lead, or arsenic should be diluted before analysis. Samples containing greater than approximately 20 ug/ml of cadmium should be diluted before analysis.

2.2 Analytical Sensitivity. ICAP detection limits in the analytical solution (based on SW-846, Method 6010) are approximately as follows: Sb (32 ng/ml), As (53 ng/ml), Ba (2 ng/ml), Be (0.3 ng/ml), Cd (4 ng/ml), Cr (7 ng/ml), Cu (6 ng/ml), Pb (42 ng/ml), Mn (2 ng/ml), Ni (15 ng/ml), P (75 ng/ml), Se (75 ng/ml), Ag (7 ng/ml), Ti (40 ng/ml), and Zn (2 ng/ml). The actual method detection limits are sample dependent and may vary as the sample matrix may affect the limits. The detection limits for analysis by direct aspiration AAS (based on SW-846, Method 7000) are approximately as follows: Sb (200 ng/ml), As (2 ng/ml), Ba (100 ng/ml), Be (5 ng/ml), Cd (5 ng/ml), Cr (50 ng/ml), Cu (20 ng/ml), Pb (100 ng/ml), Mn (10 ng/ml), Ni (40 ng/ml), Se (2 ng/ml), Ag (10 ng/ml), Tl (100 ng/ml), and Zn (5 ng/ml). The detection limit for mercury by CVAAS is approximately 0.2 ng/ml. The use of GFAAS can give added sensitivity compared to the use of direct aspiration AAS for the following metals: Sb (3 ng/ml), As (1 ng/ml), Be (0.2 ng/ml), Cd (0.1 ng/ml), Cr (1 ng/ml), Pb (1 ng/ml), Se (2 ng/ml), and Tl (1 ng/ml). To ensure the possibility of optimum ease in obtaining accurate measurements, the concentration of target metals in samples should be at least ten times the detection limit. Under certain conditions, and with greater care in the analytical procedure, this concentration can be as low as approximately three times the detection limit. However, the scatter of such data may render them unacceptable or may require many analyses before the desired reliability of analytical data is obtained.

Using the procedures described in this method, the theoretical analytical detection limits shown above, a volume of 300 ml for the front half and 150 ml for the back half samples, and a stack gas sample volume of 1.25 m^3, the corresponding in-stack detection limits are presented in Table A-1 and calculated as shown:

$$\frac{A \times B}{C} = D$$

where: A = analytical detection limit, ug/ml.
B = volume of sample prior to aliquot for analysis, ml.
C = stack sample volume, dscm, m^3.
D = in-stack detection limit, ug/m^3.

Values in Table A-1 are calculated for the front and back half and/or the total train.

Actual method in-stack detection limits are based on actual test values. If required, this method's in-stack detection limits listed can be improved for a specific test by using one or more of the following options:

- A normal 1-hour sampling run collects a stack gas sampling volume of about 1.25 m^3. If the sampling time is increased and 5 m^3 is collected, the in-stack method detection limits would be one fourth of the values shown above (this means that with this change, the method is four times more sensitive than normal).
- The in-stack detection limits assume that all of the sample is digested (with exception of the aliquot for mercury) and the final liquid volume for analysis is 300 ml for the front half and 150 ml for the back half sample. If the front half volume is reduced from 300 ml to 30 ml, the front half in-stack detection limits would be one tenth of the values shown above (ten times more sensitive). If the back half volume is reduced from 150 ml to 25 ml the in-stack detection limits would be one sixth of the above values. Matrix effects checks are necessary on

TABLE A-1. IN-STACK METHOD DETECTION LIMITS (ug/m^3) FOR TRAIN FRACTIONS USING ICAP AND AAS

Metal	Front Half Fraction 1 Probe and Filter	Back Half$_1$ Fraction 2 Impingers 1-3	Back Half$_2$ Fraction 3 Impingers 4-5	Total Train
Antimony	7.7 (0.7)*	3.8 (0.4)*		11.5 (1.1)*
Arsenic	12.7 (0.3)*	6.4 (0.1)*		19.1 (0.4)*
Barium	0.5	0.3		0.8
Beryllium	0.07 (0.05)*	0.04 (0.03)*		0.11 (0.08)*
Cadmium	1.0 (0.02)*	0.5 (0.01)*		1.5 (0.3)*
Chromium	1.7 (0.2)*	0.8 (0.1)*		2.5 (0.3)*
Copper	1.4	0.7		2.1
Lead	10.1 (0.2)*	5.0 (0.1)*		15.1 (0.3)*
Manganese	0.5 (0.2)*	0.2 (0.1)*		0.7 (0.3)*
Mercury	0.05**	0.03**	0.03**	0.11**
Nickel	3.6	1.8		5.4
Phosphorus	18	9		27
Selenium	18 (0.5)*	9 (0.3)*		27 (0.8)*
Silver	1.7	0.9		2.6
Thallium	9.6 (0.2)*	4.8 (0.1)*		14.4 (0.3)*
Zinc	0.5	0.3		0.8

( )* Detection limit when analyzed by GFAAS.
** Detection limit when analyzed by CVAAS.
Actual method in-stack detection limits are based on actual test values.

analyses of samples and typically are of greater significance for samples that have been concentrated below the normal sample volume. A volume less than 25 ml may not allow resolubilization of the residue and may increase interference by other compounds.

- o When both of the above two improvements are used on one sample at the same time, the resultant improvements are multiplicative. For example, where stack gas volume is increased by a factor of five and the total liquid sample digested volume of both the front and back halves is reduced by factor of six, the in-stack method detection limit is reduced by a factor of thirty (the method is thirty times more sensitive).
- o Conversely, reducing stack gas sample volume and increasing sample liquid volume will increase limits. The front half and back half$_1$ samples (Fractions 1 and 2) can be combined prior to analysis. The resultant liquid volume (excluding Fraction 3 which must be analyzed separately) is recorded. Combining the sample as described does not allow determination (whether front or back half$_1$) of where in the train

the sample was captured. The in-stack method detection limit then becomes a single value for all metals, except mercury for which the contribution of Fraction 3 must be considered.

- The above discussion assumes no blank correction. Blank corrections are discussed later in this method.

2.3 Precision. The precisions (relative standard deviation) for each metal detected in a method development test at a sewage sludge incinerator, are as follows: Sb (13.9%), As (13.5%), Ba (13.1%), Cd (11.5%), Cr (12.5%), Cu (11.9%), Pb (11.6%), Ni (7.7%), P (13.5%), Se (15.3%), Tl (12.3%), and Zn (11.8%). Beryllium, manganese and silver were not detected in the tests; however, based on the analytical sensitivity of the ICAP for these metals, it is assumed that their precisions should be similiar to those for the other metals.

2.4 Interferences. Iron can be a spectral interference during the analysis of arsenic, chromium, and cadmium by ICAP. Aluminum can be a spectral interference during the analysis of arsenic and lead by ICAP. Generally, these interferences can be reduced by diluting the sample, but this increases the method detection limit. Refer to EPA Method 6010 (SW-846) for details on potential interferences for this method. For all GFAAS analyses, matrix modifiers should be used to limit interferences, and standards should be matrix matched.

3. Apparatus

3.1 Sampling Train. A schematic of the sampling train is shown in Figure A-1. It is similar to the Method 5 train. The sampling train consists of the following components.

3.1.1 Probe Nozzle (Probe Tip) and Borosilicate or Quartz Glass Probe Liner. Same as Method 5, Sections 2.1.1 and 2.1.2. Glass nozzles are required unless an alternate probe tip prevents the possibility of contamination or interference of the sample with its materials of construction. If a probe tip other than glass is used, no correction of the stack sample test results can be made because of the effect on the results by the probe tip.

3.1.2 Pitot Tube and Differential Pressure Gauge. Same as Method 2, Sections 2.1 and 2.2, respectively.

3.1.3 Filter Holder. Glass, same as Method 5, Section 2.1.5, except that a Teflon filter support may be used, if desired, to replace the glass frit.

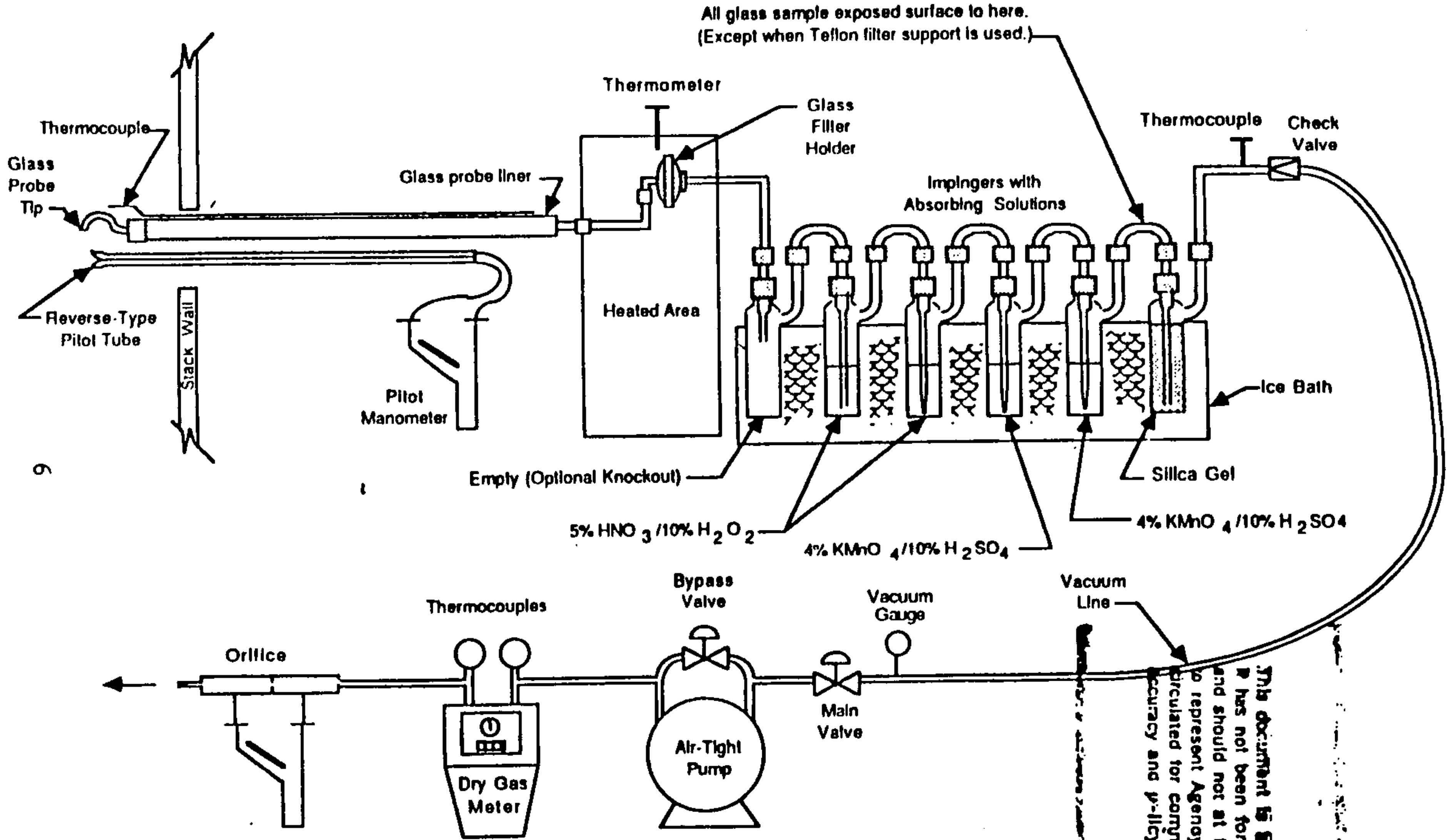

Figure A-1. Schematic of multiple metals sampling train.

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3.1.4 Filter Heating System. Same as Method 5, Section 2.1.6.

3.1.5 Condenser. The following system shall be used for the condensation and collection of gaseous metals and for determining the moisture content of the stack gas. The condensing system should consist of four to six impingers connected in series with leak-free ground glass fittings or other leak-free, non-contaminating fittings. The first impinger is optional and is recommended as a water knockout trap for use during test conditions which require such a trap. The impingers to be used in the metals train are now described. When the first impinger is used as a water knockout, it shall have a short stem. The second impinger (or the first HNO_3/H_2O_2 impinger) shall be as described for the first impinger in Method 5, Paragraph 2.1.7. The third impinger (or the impinger used as the second HNO_3/H_2O_2 impinger in any case) is the same as the Greenburg Smith impinger with the standard tip described as the second impinger in Method 5, Paragraph 2.1.7. All other impingers used in the metals train are the same as the second impinger previously described. The first impinger should be empty, the second and third shall contain known quantities of a nitric acid/hydrogen peroxide solution (Section 4.2.1), the fourth (and fifth, if required) shall contain a known quantity of acidic potassium permanganate solution (Section 4.2.2), and the last impinger shall contain a known quantity of silica gel or equivalent desiccant. A thermometer capable of measuring to within 1°C (2°F) shall be placed at the outlet of the last impinger. When the water knockout impinger is not needed, it is removed from the train and the other impingers remain the same. If mercury analysis is not needed, the potassium permanganate impingers are removed.

3.1.6 Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.8 through 2.1.10, respectively.

3.2 Sample Recovery. The following items are needed for sample recovery:

3.2.1 Nonmetallic Probe Liner and Probe Nozzle Brushes, Wash Bottles, Sample Storage Containers, Petri Dishes, Graduated Cylinders, Plastic Storage Containers, Funnel and Rubber Policeman, and Glass Funnel. Same as Method 5, Sections 2.2.1 through 2.2.8, respectively.

3.2.2 Labels. For identification of samples.

3.2.3 Polypropylene Tweezers and/or Plastic Gloves. For recovery of the filter from the sampling train filter holder.

3.2.4 Nonmetallic Bristle Brush. For quantitative recovery of materials collected in the front half of the sampling train.

3.3 Sample Preparation and Analysis. For the analysis, the following equipment is needed:

3.3.1 Volumetric Flasks, 100 ml, 250 ml, and 1000 ml. For preparation of standards and sample dilution.

3.3.2 Graduated Cylinders. For preparation of reagents.

3.3.3 Parr[R] Bombs or Microwave Pressure Relief Vessels with Capping Station (CEM Corporation model or equivalent).

3.3.4 Beakers and Watchglasses. 250 ml beakers for sample digestion with watchglasses to cover the tops.

3.3.5 Ring Stands and Clamps. For securing equipment such as filtration apparatus.

3.3.6 Filter Funnels. For holding filter paper.

3.3.7 Whatman 541 Filter Paper (or equivalent).For filtration of digested samples.

3.3.8 Disposable Pasteur Pipets and Bulbs.

3.3.9 Volumetric Pipets.

3.3.10 Analytical Balance. Accurate to within 0.1 mg.

3.3.11 Microwave or Conventional Oven. For heating samples at fixed power levels or temperatures.

3.3.12 Hot Plates.

3.3.13 Atomic Absorption Spectrometer (AAS). Equipped with a background corrector.

3.3.13.1 Graphite Furnace Attachment. With antimony, arsenic, cadmium, lead, selenium, thalium, and hollow cathode lamps (HCLs) or electrodeless discharge lamps (EDLs). Same as EPA Methods 7041 (antimony), 7060 (arsenic), 7131 (cadmium), 7421 (lead), 7740 (selenium), and 7841 (thallium).

3.3.13.2 Cold Vapor Mercury Attachment. With a mercury HCL or EDL. The equipment needed for the cold vapor mercury attachment includes an air recirculation pump, a quartz cell, an aerator apparatus, and a heat lamp or desiccator tube. The heat lamp should be capable of raising the ambient temperature at the quartz cell by 10°C such that no condensation forms on the wall of the quartz cell. Same as EPA Method 7470.

3.3.14 Inductively Coupled Argon Plasma Spectrometer. With either a direct or sequential reader and an alumina torch. Same as EPA Method 6010.

4. Reagents

Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available; otherwise, use the best available grade.

4.1 Sampling. The reagents used in sampling are as follows:

4.1.1 Filters. The filters shall contain less than 1.25 ug of each of the metals to be measured. Analytical results provided by filter manufacturers are acceptable. However, if no such results are available, filter blanks must be analyzed for each target metal prior to emission testing. Quartz fiber or glass fiber filters without organic binders shall be used. The filters should exhibit at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Standard Method D2986-71 (incorporated by reference). For particulate determination, the filter should have a surface alkalinity less than 7.5 pH. Again, analytical results provided by filter manufacturers are acceptable. Pallflex^R type 2500 QAT-UP Ultra Pure Filters have been found to meet these limits.

4.1.2 Water. To conform to ASTM Specification D1193.77, Type II (incorporated by reference). Analyze the water for all target metals prior to field use. All target metals should be less than 1 ng/ml.

4.1.3 Nitric Acid. Concentrated. Baker Instra-analyzed or equivalent.

4.1.4 Hydrochloric Acid. Concentrated. Baker Instra-analyzed or equivalent.

4.1.5 Hydrogen Peroxide, 30 Percent (V/V).

4.1.6 Potassium Permanganate.

4.1.7 Sulfuric Acid. Concentrated.

4.1.8 Silica Gel and Crushed Ice. Same as Method 5, Sections 3.1.2 and 3.1.3, respectively.

4.2 Pretest Preparation for Sampling Reagents.

4.2.1 Nitric Acid/Hydrogen Peroxide Absorbing Solution. Add 50 ml of concentrated nitric acid and 333 ml of 30 percent hydrogen peroxide to a 1000 ml volumetric flask or graduated cylinder containing approximately 500 ml of water. Dilute to volume with water. The reagent shall contain less than 2 ng/ml of each target metal.

4.2.2 Acidic Potassium Permanganate Solution. Fill a 1 liter volumetric flask or graduated cylinder with approximately 800 ml of water. Weigh out 40.0 g of potassium permanganate and dissolve it in the water. Add 100 ml of concentrated sulfuric acid and mix well. Let the solution cool and dilute to volume with water. The reagent shall contain less than 2 ng/ml of each target metal.

Precaution: To prevent autocatalytic decomposition of the permanganate solution, filter the solution through Whatman 541 filter paper. Also due to reaction of the potassium permanganate with the acid, there may be pressure buildup in the sample storage bottle. These bottles should not be filled full and should be vented both to relieve excess pressure and to prevent explosion due to pressure buildup. Venting is highly recommended, but should not allow contamination of the sample; a No. 70-72 hole drilled in the container cap and Teflon liner has been used.

4.2.3 Nitric Acid, 0.1 N. Add 6.3 ml of concentrated nitric acid (70 percent) to a graduated cylinder containing approximately 900 ml of water. Dilute to 1000 ml with water. Mix well. The reagent shall contain less than 2 ng/ml of each target metal.

4.2.4 Hydrochloric Acid, 8 N. Add 690 ml of concentrated hydrochloric acid to a graduated cylinder containing 250 ml of water. Dilute to 100 ml with water. Mix well. The reagent shall contain less than 2 ng/ml of each the target metals.

4.3 Glassware Cleaning Reagents.

4.3.1 Nitric Acid, Concentrated. Fisher ACS grade or equivalent.

4.3.2 Water. To conform to ASTM Specifications D1193-77, Type II.

4.3.3 Nitric Acid, 10 Percent (V/V). Add 500 ml of concentrated nitric acid to a graduated cylinder containing approximately 4000 ml of water. Dilute to 5000 ml with water.

4.4 Sample Digestion and Analysis Reagents.

4.4.1 Hydrochloric Acid, Concentrated.

4.4.2 Hydrofluoric Acid, Concentrated.

4.4.3 Nitric Acid, Concentrated. Baker Instra-analyzed or equivalent.

4.4.4 Nitric Acid, 10 Percent (V/V). Add 100 ml of concentrated nitric acid to 800 ml of water. Dilute to 1000 ml with water. Mix well. Reagent shall contain less than 2 ng/ml of each target metal.

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4.4.5 Nitric Acid, 5 Percent (V/V). Add 50 ml of concentrated nitric acid to 800 ml of water. Dilute to 1000 ml with water. Reagent shall contain less than 2 ng/ml of each target metal.

4.4.6 Water. To conform to ASTM Specifications D1193-77, Type II.

4.4.7 Hydroxylamine Hydrochloride and Sodium Chloride Solution. See EPA Method 7470 for preparation.

4.4.8 Stannous Chloride.

4.4.9 Potassium Permanganate, 5 Percent (W/V).

4.4.10 Sulfuric Acid, Concentrated.

4.4.11 Nitric Acid, 50 Percent (V/V).

4.4.12 Potassium Persulfate, 5 Percent (W/V).

4.4.13 Nickel Nitrate, $Ni(NO_3)_2 \cdot 6H_2O$.

4.4.14 Lanthanum Oxide, La_2O_3.

4.4.15 AAS Grade Hg Standard, 1000 ug/ml.

4.4.16 AAS Grade Pb Standard, 1000 ug/ml.

4.4.17 AAS Grade As Standard, 1000 ug/ml.

4.4.18 AAS Grade Cd Standard, 1000 ug/ml.

4.4.19 AAS Grade Cr Standard, 1000 ug/ml.

4.4.20 AAS Grade Sb Standard, 1000 ug/ml.

4.4.21 AAS Grade Ba Standard, 1000 ug/ml.

4.4.22 AAS Grade Be Standard, 1000 ug/ml.

4.4.23 AAS Grade Cu Standard, 1000 ug/ml.

4.4.24 AAS Grade Mn Standard, 1000 ug/ml.

4.4.25 AAS Grade Ni Standard, 1000 ug/ml.

4.4.26 AAS Grade P Standard, 1000 ug/ml.

4.4.27 AAS Grade Se Standard, 1000 ug/ml.

4.4.28 AAS Grade Ag Standard, 1000 ug/ml.

4.4.29 AAS Grade Tl Standard, 1000 ug/ml.

4.4.30 AAS Grade Zn Standard, 1000 ug/ml.

4.4.31 AAS Grade Al Standard, 1000 ug/ml.

4.4.32 AAS Grade Fe Standard, 1000 ug/ml.

4.4.33 The metals standards may also be made from solid chemicals as described in EPA Method 200.7. EPA Method 7470 or Standard Methods for the Analysis of Water and Wastewater, 15th Edition, Method 303F should be referred to for additional information on mercury standards.

4.4.34 Mercury Standards and Quality Control Samples. Prepare a 10 ug/ml mercury standard by adding 5 ml of 1000 ug/ml mercury standard to a 500 ml volumetric flask. Dilute to 500 ml with 20 ml of 15 percent nitric acid and then water. Prepare a 200 ng/ml standard by adding 5 ml of the 10 ug/ml standard to a 250 ml volumetric flask and dilute to 250 ml with 5 ml of 4% $KMnO_4$, 5 ml 15 percent nitric acid, and then water. Other standards should be prepared by dilution of the 200 ng/ml mercury standard. At least four standards should be used to prepare the standard curve. Standards containing 0.25, 0.50, 1.00, and 2.00 total ng are suggested. Quality control samples should be prepared by making a separate 10 ng/ml standard and diluting until it is in the range of the samples.

4.4.35 ICAP Standards and Quality Control Samples. Calibration standards for ICAP analysis can be combined into four different mixed standard solutions as shown below.

MIXED STANDARD SOLUTIONS FOR ICAP ANALYSIS

Solution	Elements
I	As, Be, Cd, Mn, Pb, Se, Zn
II	Ba, Cu, Fe
III	Al, Cr, Ni
IV	Ag, P, Sb, Tl

Prepare these standards by combining and diluting the appropriate volumes of the 1000 ug/ml solutions with 5 percent nitric acid. A minimum of one standard and a blank can be used to form each calibration curve. However, a separate quality control sample spiked with known amounts of the target metals in quantities expected to be in the midrange of the calibration curve should be prepared. Suggested standard levels are 50 ug/ml for Al, 25 ug/ml for Cr and Pb, 15 ug/ml for Fe, and 10 ug/ml for the remaining elements. Standards containing less than 1 ug/ml of metal should be prepared daily. Standards containing greater than 1 ug/ml of metal should be stable for a minimum of 1 to 2 weeks.

4.4.36 Graphite Furnace AAS Standards for Antimony, Arsenic, Cadmium, Lead, Selenium, and Thallium. Prepare a 10 ug/ml standard by adding 1 ml of 1000 ug/ml standard to a 100 ml volumetric flask. Dilute to 100 ml with 10 percent nitric acid. For graphite furnace AAS, the standards must be matrix matched; e.g., if the samples contain 6 percent nitric acid and 4 percent hydrofluoric acid, the standards should also be made up with 6 percent nitric acid and 4 percent hydrofluoric acid. Prepare a 100 ng/ml standard by adding 1 ml of the 10 ug/ml standard to a 100 ml volumetric flask and dilute to 100 ml with the appropriate matrix solution. Other standards should be prepared by dilution of the 100 ng/ml standards. At least four standards should be used to make up the standard curve. Suggested levels are 10, 50, 75, and 100 ng/ml. Quality control samples should be prepared by making a separate 10 ug/ml standard and diluting until it is in the range of the samples. Standards containing less than 1 ug/ml of metal should be prepared daily. Standards containing greater than 1 ug/ml of metal should be stable for a minimum of 1 to 2 weeks.

4.4.37 Matrix Modifiers.

4.4.37.1 Nickel Nitrate, 1 Percent (V/V). Dissolve 4.956 g of $Ni(NO_3)_2 \cdot 6H2O$ in approximately 50 ml of water in a 100 ml volumetric flask. Dilute to 100 ml with water.

4.4.37.2 Nickel Nitrate, One-tenth Percent (V/V). Dilute 10 ml of 1 percent nickel nitrate solution to 100 ml with water. Inject an equal amount of sample and this modifier into the graphite furnace during AAS analysis for As.

4.4.37.3 Lanthanum. Dissolve 0.5864 g of La_2O_3 in 10 ml of concentrated HNO_3 and dilute to 100 ml with water. Inject an equal amount of sample and this modifier into the graphite furnace during AAS analysis for Pb.

5. Procedure

5.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

5.1.1 Pretest Preparation. Follow the same general procedure given in Method 5, Section 4.1.1, except that, unless particulate emissions are to be determined, the filter need not be desiccated or weighed. All sampling train glassware should first be rinsed with hot tap water and then washed in hot soapy water. Next, glassware should be rinsed three times with tap water, followed by three additional rinses with water. All glassware should then be soaked in a 10 percent (V/V) nitric acid solution for a minimum of 4 hours, rinsed three times with water, rinsed a final time with acetone, and allowed to air dry. All glassware openings where contamination can occur should be covered until the sampling train is assembled, prior to sampling.

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5.1.2 Preliminary Determinations. Same as Method 5, Section 4.1.2.

5.1.3 Preparation of Sampling Train. Follow the same general procedures given in Method 5, Section 4.1.3, except place 100 ml of the nitric acid/hydrogen peroxide solution (Section 4.2.1) in the two HNO_3/H_2O_2 impingers (normally the second and third impingers), place 100 ml of the acidic potassium permanganate solution (Section 4.2.2) in the fourth and fifth impinger, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the last impinger. Alternatively, the silica gel may be weighed directly in the impinger just prior to train assembly.

Several options are available to the tester based on the sampling conditions. The use of an empty first impinger can be eliminated if the moisture to be collected in the impingers is calculated or determined to be less than 150 ml. The tester shall include two impingers containing the acidic potassium permanganate solution for the first test run, unless past testing experience at the same or similar sources has shown that only one is necessary. The last permanganate impinger may be discarded if both permanganate impingers have retained their original deep purple permanganate color. A maximum of 200 ml in each permanganate impinger (or a maximum of three permanganate impingers) may be used, if necessary, to maintain the desired color in the last permanganate impinger.

Retain for reagent blanks, 100 ml of the nitric acid/hydrogen peroxide solution and 100 ml of the acidic potassium permanganate solution. These solutions should be labeled and treated as described in Section 7. Set up the sampling train as shown in Figure A-1.

<u>Precaution:</u> Extreme care should be taken to prevent contamination within the train. Prevent the mercury collection reagent (acidic potassium permanganate) from contacting any glassware of the train which is washed and analyzed for Mn. Prevent hydrogen peroxide from mixing with the acidic potassium permanganate.

5.1.4 Leak-Check Procedures. Follow the leak-check procedures given in Method 5, Section 4.1.4.1 (Pretest Leak-Check), Section 4.1.4.2 (Leak-Checks During the Sample Run), and Section 4.1.4.3 (Post-Test Leak-Checks).

5.1.5 Sampling Train Operation. Follow the procedures given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in Figure 5-2 of Method 5.

5.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

5.2 Sample Recovery. Begin cleanup procedures as soon as the probe is removed from the stack at the end of a sampling period.

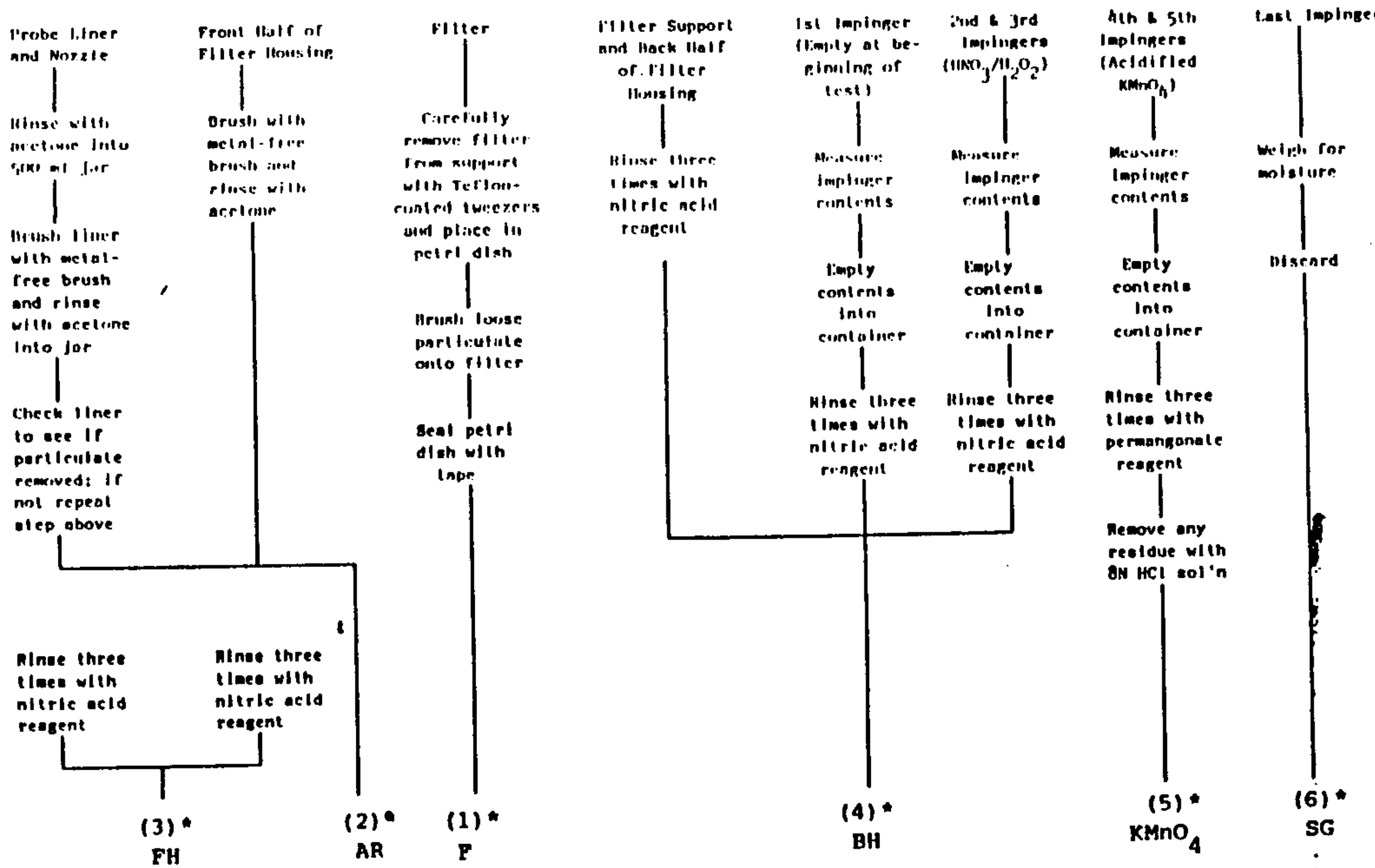
The probe should be allowed to cool prior to sample recovery. When it can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a rinsed, non-comtaminating cap over the probe nozzle to prevent losing or gaining particulate matter. Do not cap the probe tip tightly while the sampling train is cooling. This normally causes a vacuum to form in the filter holder, thus causing the undesired result of drawing liquid from the impingers into the filter.

Before moving the sampling train to the cleanup site, remove the probe from the sampling train and cap the open outlet. Be careful not to lose any condensate that might be present. Cap the filter inlet where the probe was fastened. Remove the umbilical cord from the last impinger and cap the impinger. Cap off the filter holder outlet and impinger inlet. Use non-contaminating caps, whether ground-glass stoppers, plastic caps, or serum caps, to close these openings.

Transfer the probe and filter-impinger assembly to a cleanup area that is clean and protected from the wind and other potential causes of contamination or loss of sample. Inspect the train before and during disassembly and note any abnormal conditions. The sample is recovered and treated as follows (see schematic in Figure A-2). Assure that all items necessary for recovery of the sample do not contaminate it.

5.2.1 Container No. 1 (Filter). Carefully remove the filter from the filter holder and place it in its identified petri dish container. Acid-washed polypropylene or Teflon coated tweezers or clean, disposable surgical gloves rinsed with water should be used to handle the filters. If it is necessary to fold the filter, make certain the particulate cake is inside the fold. Carefully transfer the filter and any particulate matter or filter fibers that adhere to the filter holder gasket to the petri dish by using a dry (acid-cleaned) nylon bristle brush. Do not use any metal-containing materials when recovering this train. Seal the labeled petri dish.

5.2.2 Container No. 2 (Probe). <u>Note</u>: Container No. 2 can be omitted if the testing does not include the determination of particulate concentration. Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate



* Indicates container numbers.

Figure A-2. Sample recovery scheme.

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matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with acetone and placing the wash in a glass container. Distilled water may be used instead of acetone when approved by the Administrator and shall be used when specified by the Administrator; in these cases, save a water blank and follow the Administrator's directions on analysis. Perform the acetone rinses as follows: Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a metal-free Nylon bristle brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

Brush and rinse the inside parts of the Swagelok fitting with acetone in a similar way until no visible particles remain.

Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces will be wetted with acetone. Let the acetone drain from the lower end into the sample container. A funnel (glass or polyethylene) may be used to aid on transferring liquid washings to the container. Follow the acetone rinse with a metal-free probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe; hold a sample container underneath the lower end of the probe, and catch any acetone and particulate matter which is brushed through the probe three times or more until no visible particulate matter is carried out with the acetone or until none remains in the probe liner on visual inspection. Rinse the brush with acetone, and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe as described above.

It is recommended that two people be used to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contaminations.

After ensuring that all joints have been wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a metal-free nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. After all acetone washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that acetone will not leak out when it is shipped to

... is a preliminary draft ... formally released by ... at this stage be construed ... Agency policy. It is being ... comment on its ... accuracy and policy implications

the laboratory. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Label the container clearly to identify its contents.

5.2.3 Container No. 3 (Probe Rinse). Rinse the probe liner, probe nozzle, and front half of the filter holder by rinsing these components thoroughly with 0.1 N nitric acid and placing the wash into a sample storage container. Perform the rinses as described in Method 12, Section 5.2.2. Measure and record the volume of the combined rinses, and place the sample into a storage container. Mark the height of the fluid level on the outside of the container and use this mark to determine if leakage occurs during transport. Seal the container and clearly label the contents.

5.2.4 Container No. 4 (Impingers 1 through 3, Contents and Rinses). Due to the large quantity of liquid involved, the tester may place the impinger solutions in more than one container. Measure the liquid in the first three impingers volumetrically to within 0.5 ml using a graduated cylinder. Record the volume of liquid present. This information is required to calculate the moisture content of the sampled flue gas. Clean each of the first three impingers and connecting glassware by thoroughly rinsing with 0.1 N nitric acid as described in Method 12, Section 5.2.4. Combine the rinses and impinger solutions, measure and record the volume. Mark the height of the fluid level on the outside of the container to determine if leakage occurs during transport. Seal the container and clearly label the contents.

5.2.5 Container No. 5 (Acidified Potassium Permanganate Solution and Rinses, Impingers No. 4 & 5). Pour all the liquid from the permanganate impingers (fourth and fifth, if two permanganate impingers are used) into a graduated cylinder and measure the volume to within 0.5 ml. This information is required to calculate the moisture content of the sampled flue gas. Rinse the permanganate impinger(s) and connecting glass pieces a minimum of three times with acidified potassium permanganate solution. Combine the rinses with the permanganate impinger solution in a graduated cylinder and measure the total volume within 0.5 ml. Place the combined rinses and impinger contents in a labeled container. Mark the height of the fluid level on the outside of the container to determine if leakage occurs during transport. See the following note and the Precaution in Paragraph 4.2.2 and properly seal the container and clearly label the contents.

Note: Due to the potential reaction of the potassium permanganate with the acid, there may be pressure buildup in the sample storage bottles. These bottles should not be filled full and should be vented to relieve excess pressure. Venting is highly recommended. A No. 70-72 hole drilled in the container cap and Teflon liner has been found to allow adequate venting without loss of sample.

5.2.6 Container No. 6 (Silica Gel). Note the color of the indicating silica gel to determine whether it has been completely spent and make a notation of its condition. Transfer the silica gel from its impinger to its original container and seal. The tester may use a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. The small amount of particles that may adhere to the impinger wall need not be removed. Do not use water or other liquids to transfer the silica gel since weight gained in the silica gel impinger is used for moisture calculations. Alternatively, if a balance is available in the field, record the weight of the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

5.2.7 Container No. 7 (Acetone Blank). Once during each field test, place 100 ml of the acetone used in the sample recovery process into a labeled container for use as a recovery solvent blank. Seal the container.

5.2.8 Container No. 8 (0.1 N Nitric Acid Blank). Once during each field test, place 100 ml of the 0.1 N nitric acid solution used in the sample recovery process into a labeled container for use as a recovery solvent blank. Seal the container.

5.2.9 Container No. 9 (5% Nitric Acid/10% Hydrogen Peroxide Blank). Once during each field test, place 100 ml of the 5% nitric acid/10% hydrogen peroxide solution used as the nitric acid impinger reagent into a labeled container for use as a blank. Seal the container.

5.2.10 Container No. 10 (Acidified Potassium Permanganate Blank). Once during each field test, place 100 ml of the acidified potassium permanganate solution used as the impinger solution and in the sample recovery process into a labeled container for use as a blank. Seal the container.

Note: This container should be vented, as described in Section 5.2.4, to relieve excess pressure.

5.2.11 Container No. 11 (Filter Blank). Once during each field test, place an unused filter from the same lot as the sampling filters in a labeled petri dish. Seal the petri dish.

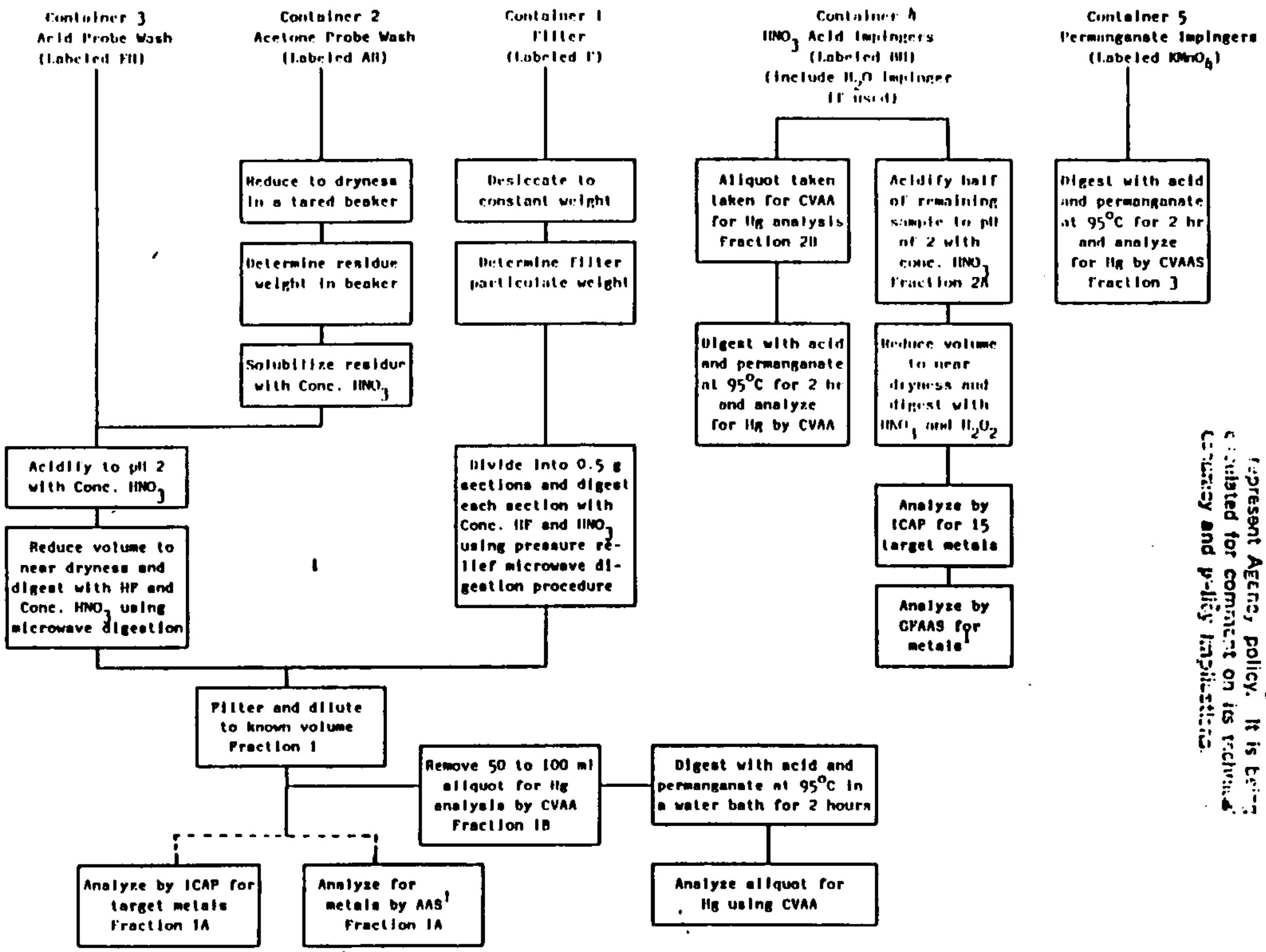
5.3 Sample Preparation. Note the level of the liquid in each of the containers and determine if any sample was lost during shipment. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. A diagram illustrating sample preparation and analysis procedures for each of the sample train components is shown in Figure A-3.

5.3.1 Container No. 1 (Filter). The filter with its filter catch should be divided into portions containing approximately 0.5 g each and placed into the analyst's choice of either individual microwave pressure relief vessels or Parr[R] Bombs. Six ml of concentrated nitric acid and 4 ml of concentrated hydrofluoric acid should be added to each vessel. For microwave heating, microwave the sample vessels for approximately 12-15 minutes in intervals of 1 to 2 minutes at 600 Watts. For conventional heating, heat the Parr Bombs at 140°C (285°F) for 6 hours. Then cool the samples to room temperature and combine with the acid digested probe rinse as required in Section 5.3.3, below.

<u>Notes</u>: 1. Suggested microwave heating times are approximate and are dependent upon the number of samples being digested. Twelve to 15 minute heating times have been found to be acceptable for simultaneous digestion of up to 12 individual samples. Sufficient heating is evidenced by sorbent reflux within the vessel.

2. If the sampling train uses an optional cyclone, the cyclone catch should be prepared and digested using the same procedures described for the filters and combined with the digested filter samples.

5.3.2 Container No. 2 (Probe). Note the level of liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Measure the liquid in this container either volumetrically to ± 1 ml or gravimetrically to ± 0.5 g. Transfer the contents to an acid-cleaned tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight according to the procedures described in Section 4.3 of Method 5. Report the results to the nearest 0.1 mg. Resolubilize the residue with concentrated nitric acid and combine the resultant sample including all liquid and any particulate matter with Container No. 3 prior to beginning the following step 5.3.3.



[1]Analysis by AAS for metals found at less than 2 ug/ml in digestate solution, if desired. Or analyze for each metal by AAS, if desired.

Figure A-3. Sample preparation and analysis scheme.

5.3.3 Container No. 3 (Probe Rinse). The pH of this sample shall be 2 or lower. If the pH is higher, the sample should be acidified with concentrated nitric acid to pH 2. The sample should be rinsed into a beaker with water and the beaker should be covered with a ribbed watchglass. The sample volume should be reduced to approximately 50 ml by heating on a hot plate at a temperature just below boiling. Inspect the sample for visible particulate matter, and depending on the results of the inspection, perform one of the following. If no particulate matter is observed, combine the sample directly with the acid digested portions of the filter prepared previously in Section 5.3.1. If particulate matter is observed, digest the sample in microwave vessels or Parr[R] Bombs following the procedures described in Section 5.3.1; then combine the resultant sample directly with the acid digested portions of the filter prepared previously in Section 5.3.1. The resultant combined sample is referred to as Fraction 1. Filter the combined solution of the acid digested filter and probe rinse samples using Whatman 541 filter paper. Dilute to 300 ml (or the appropriate volume for the expected metals concentration) with water. Measure and record the combined volume of the Fraction 1 solution to within 0.1 ml. Quantitatively remove a 50 ml aliquot and label as Fraction 1B. Label the remaining 250 ml portion as Fraction 1A. Fraction 1A is used for ICAP or AAS analysis. Fraction 1B is used for the determination of front half mercury.

5.3.4 Container No. 4 (Impingers 1-3). Measure and record the total volume of this sample to within 0.5 ml. Remove a 50 ml aliquot for mercury analysis and label as Fraction 2B. The Fraction 2B aliquot should be prepared and analyzed as described in Section 5.4.3. The remaining portion of Container No. 3 should be labeled Fraction 2A and shall be pH 2 or lower. If necessary, use concentrated nitric acid to lower this fraction to pH 2. The sample should be rinsed into a beaker with water and the beaker should be covered with a ribbed watchglass. The sample volume should be reduced to approximately 20 ml by heating on a hot plate at a temperature just below boiling. Then follow either of the digestion procedures described in Sections 5.3.4.1 and 5.3.4.2, below.

5.3.4.1 Conventional Digestion Procedure. Add 30 ml of 50 percent nitric acid and heat for 30 minutes on a hot plate to just below boiling. Add 10 ml of 3 percent hydrogen peroxide and heat for 10 more minutes. Add 50 ml of hot water and heat the sample for an additional 20 minutes. Cool, filter the sample, and dilute to 150 ml (or the appropriate volume for the expected metals concentrations) with water.

5.3.4.2 Microwave Digestion Procedure. Add 10 ml of 50 percent nitric acid and heat for 6 minutes in intervals of 1 to 2 minutes at 600 Watts. Allow the sample to cool. Add 10 ml of 3 percent hydrogen peroxide and heat for 2 more minutes. Add 50 ml of hot water and heat for an additional 5 minutes. Cool, filter the sample, and dilute to 150 ml (or the appropriate volume for the expected metals concentrations) with water.

Note: All microwave heating times given are approximate and are dependent upon the number of samples being digested at a time. Heating times as given above have been found acceptable for simultaneous digestion of up to 12 individual samples. Sufficient heating is evidenced by solvent reflux within the vessel.

5.3.5 Container No. 5 (Impingers 4 & 5). Measure and record the total volume of this sample to within 0.5 ml. This sample is referred to as Fraction 3. Follow the analysis procedures described in Section 5.4.3.

5.3.6 Container No. 6 (Silica Gel). Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. (This step may be conducted in the field.)

5.4 Sample Analysis. For each sampling train, five individual samples are generated for analysis. A schematic identifying each sample and the prescribed sample preparation and analysis scheme is shown in Figure A-3. The first two samples, labeled Fractions 1A and 1B, consist of the digested samples from the front half of the train. Fraction 1A is for ICAP or AAS analysis as described in Sections 5.4.1 and/or 5.4.2. Fraction 1B is for determination of front half mercury as described in Section 5.4.3.

The back half of the train was used to prepare the third through fifth samples. The third and fourth samples, labeled Fractions 2A and 2B, contain the digested samples from the H_2O and NHO_3/H_2O_2 Impingers 1 through 3. Fraction 2A is for ICAP or AAS analysis. Fraction 2B will be analyzed for mercury.

The fifth sample, labeled Fraction 3, consists of the impinger contents and rinses from the permanganate Impingers 4 and 5. This sample is analyzed for mercury as described in Section 5.4.3. The total back half mercury catch is determined from the sum of Fraction 2B and Fraction 3.

5.4.1 ICAP Analysis. Fraction 1A and Fraction 2A are analyzed by ICAP using EPA Method 200.7 (40 CFR 136, Appendix C). Calibrate the ICAP and set up an analysis program as described in Method 200.7. The quality control procedures described in Section 7.3.1 of this method shall be followed.

Recommended wavelengths for use in the analysis are listed below.

Element	Wavelength
Aluminum	308.215
Antimony	206.833
Arsenic	193.696
Barium	455.403
Beryllium	313.042
Cadmium	226.502
Chromium	267.716
Copper	324.754
Iron	259.940
Lead	220.353
Manganese	257.610
Nickel	231.604
Selenium	196.026
Silver	328.068
Thallium	190.864
Zinc	213.856

The wavelengths listed are recommended because of their sensitivity and overall acceptance. Other wavelengths may be substituted if they can provide the needed sensitivity and are treated with the same corrective techniques for spectral interference.

Initially, analyze all samples for the target metals plus iron and aluminum. If iron and aluminum are present in the sample, the sample may have to be diluted so that each of these elements is at a concentration of less than 50 ppm to reduce their spectral interferences on arsenic and lead.

Note: When analyzing samples in a hydrofluoric acid matrix, an alumina torch should be used; since all front half samples will contain hydrofluoric acid, use an alumina torch.

5.4.2 AAS by Direct Aspiration and/or Graphite Furnace. If analysis of metals in Fraction 1A and Fraction 2A using graphite furnace or direct aspiration AAS is desired, Table A-2 should be used to determine which techniques and methods should be applied for each target metal. Table A-2 should also be consulted to determine possible interferences and techniques to be followed for their minimization. Calibrate the instrument according to Section 6.3 and follow the quality control procedures specified in Section 7.3.2.

5.4.3 Cold Vapor AAS Mercury Analysis. Fraction 1B, Fraction 3, and Fraction 2B should be analyzed for mercury using cold vapor atomic absorption spectroscopy following the method outlined in EPA Method 7470 or in Standard

TABLE A-2. APPLICABLE TECHNIQUES, METHODS, AND MINIMIZATION OF INTERFERENCE FOR AAS ANALYSIS

Metal	Technique	Method No.	Wavelength (nm)	Interference: Cause	Interference: Minimization
Sb	Aspiration	7040	217.6	1000 mg/ml Pb Ni, Cu, or acid	Use secondary wavelenght of 231.1 nm. Match sample & standards acid concentration or use nitrous oxide/acetylene flame
Sb	Furnace	7041	217.6	High Pb	Secondary wavelength or Zeeman correction
As	Furnace	7060	193.7	Arsenic volati - zation Aluminium	Spiked samples & add nickel nitrate solution to digestates prior to analyses Use Zeeman background correction
Ba	Aspiration	7080	553.6	Calcium Barium ionization	High hollow cathode current & narrow band set 2 mL of KCl per 100 mL of sample
Be	Aspiration	7090	234.9	500 ppm Al High Mg & Si	Add 0.1% flouride Use method of standard additions
Be	Furnace	7091	234.9	Be in optical path	Optimize parameters to miminize effects
Cd	Aspiration	7130	228.8	Absorption & light scattering	Background correction is required
Cd	Furnace	7131	228.8	As above Excess chloride Pipet tips	As above Ammonium phosphate used as a matrix modifier Use cadmium-free tips
Cr	Aspiration	7190	357.9	Alkali metal Absorption & scatt	KCl ionization suppressant in sample & stand Consult manufacturer's literature
Cr	Furnace	7191	357.9	200 mg/L calcium & phosphate	All calcium nitrate for a know constant effect and to eliminate effect of phosphate

(continued)

TABLE A-2 (CONTINUED)

Metal	Technique	Method No.	Wavelength (nm)	Interference: Cause	Interference: Minimization
Cu	Aspiration	7210	324.7	Absorpt & scatter	Consult manufacturer's manual
Fe	Aspiration	7380	248.3	Contamination	Great care taken to aviod contamination
Pb	Aspiration	7420	283.3	217.0 nm alternat	Background correction required
Pb	Furnace	7421	283.3	Poor recoveries	Matrix modifier, add 10 uL of phosphorus acid to 1-mL of prepared sample in sampler cup
Mn	Aspiration	7460	279.5	403.1 nm alternat	Background correction required
Ni	Aspiration	7520	232.0	352.4 nm alternat Fe, Co, & Cr Nonlinear respons	Background correction required Matrix matching or a nitrous-oxide/acety flame Sample dilution or use 352.4 nm line
Se	Furnace	7740	196.0	Volitality Adsorpt & scatter	Spike samples & reference materials & add nick nitrate to minimize volatilization Background correction is required & Zeeman background correction can be useful
Ag	Aspiration	7760	328.1	Absorpt & scatter AgCl insoluble Viscosity	Background correction is required Avoid hydrochloric acid unless silver is in solution as a chloride complex Sample & standards monitored for apiration rat
Tl	Aspiration	7840	276.8		Background correction is required Hydrochloric acid should not be used
Tl	Furnace	7841	276.8	Hydrochloric acid or chloride	Background correction is required Verify that losses are not occuring for volitization by spiked samples or standad add Palladium is a suitable matrix modifier
Zn	Aspiration	7950	213.9	High Si, Cu & P Contamination	Strontium removes Cu and phosphate Care should be taken to avid contamination

Methods for Water and Wastewater Analysis, 15th Edition, Method 303F. Set up the calibration curve as described in Section 7.3 of Method 303F. Add approximately 5 ml of each sample to BOD bottles. Record the amount of sample added. The amount used is dependent upon the expected levels of mercury. Dilute to approximately 120 ml with mercury-free water. Add approximately 15 ml of 5 percent potassium permanganate solution to the Fraction 2B and Fraction 3 samples. Add 5 percent potassium permanganate solution to the Fraction 1B sample as needed to produce a purple solution lasting at least 15 minutes. A minimum of 25 ml is suggested. Add 5 ml of 50 percent nitric acid, 5 ml of concentrated sulfuric acid, and 9 ml of 5 percent potassium persulfate to each sample and each standard. Digest the solution in the capped BOD bottle at 95°C (205°F) in a convection oven or water bath for 2 hours. Cool. Add 5 ml of hydroxylamine hydrochloride solution and mix the sample. Then add 7 ml of stannous chloride to each sample and analyze immediately.

6. Calibration

Maintain a laboratory log of all calibrations.

6.1 Sampling Train Calibration. Calibrate the sampling train components according to the indicated sections of Method 5: Probe Nozzle (Section 5.1); Pitot Tube (Section 5.2); Metering System (Section 5.3); Probe Heater (Section 5.4); Temperature Gauges (Section 5.5); Leak-Check of the Metering System (Section 5.6); and Barometer (Section 5.7).

6.2 Inductively Coupled Argon Plasma Spectrometer Calibration. Prepare standards as outlined in Section 4.6.4. Profile and calibrate the instrument according to the instrument manufacturer's recommended procedures using the above standards. The instrument calibration should be checked once per hour. If the instrument does not reproduce the concentrations of the standard within 10 percent, the complete calibration procedures should be performed.

6.3 Atomic Absorption Spectrometer - Direct Aspiration, Graphite Furnace and Cold Vapor Mercury Analyses. Prepare the standards as outlined in Section 4.6.5. Calibrate the spectrometer using these prepared standards. Calibration procedures are also outlined in the EPA methods referred to in Table A-2 and in Standard Methods for Water and Wastewater, 15th Edition, Method 303F (for mercury). Each standard curve should be run in duplicate and the mean values used to calculate the calibration line. The instrument should be recalibrated approximately once every 10 to 12 samples.

7. Quality Control

7.1 Sampling. Field Reagent Blanks. The blank samples in Container Numbers 7 through 11 produced previously in Sections 5.2.7 through 5.2.11, respectively, shall be processed, digested, and analyzed as follows. Digest and process Container No. 11 contents per Section 5.3.1, Container No. 7 per Section 5.3.2, and Container No. 8 per Section 5.3.3. This produces Fraction Blank 1A and Fraction Blank 1B. Digest and process Container No. 9 contents per Section 5.3.4. This produces Fraction Blank 2A and Fraction Blank 2B. Container No. 11 contents are Fraction Blank 3. Analyze Fraction Blank 1A and Fraction Blank 2A per Section 5.4.1 and/or 5.4.2. Analyze Fraction Blank 1B, Fraction Blank 2B, and Fraction Blank 3 per Section 5.4.3. The maximum correction allowed to the field source sample value is the lesser of the following: (1) the actual blank value, or (2) the maximum blank correction allowed per the Note in Section 8.4.3 and the Note in Section 8.5.2.

7.2 With prior approval by the Administrator, an attempt may be made to determine if the reagents used in Section 5.3 caused contamination. They should be analyzed by the procedures in Section 5.4. Then the Administrator will determine whether or not the laboratory blank values can be used in the calculation of the stationary source test results.

7.3 Quality Control Samples. The following quality control samples should be analyzed.

7.3.1 ICAP Analysis. Follow the quality control shown in Section 8 of Method 6010. For the purposes of a three run test series, these requirements have been modified to include the following: two instrument check standard runs, two calibration blank runs, one interference check sample at the beginning of the analysis (must be within 25% or analyze by standard addition), one quality control sample to check the accuracy of the calibration standards (must be within 25% of calibration), and one duplicate analysis (must be within 5% of average or repeat all analysis).

7.3.2 Direct Aspiration and/or Graphite Furnace AAS Analysis for Antimony, Arsenic, Barium, Beryllium, Cadmium, Copper, Chromium, Lead, Nickel, Manganese, Mercury, Phosphorus, Selenium, Silver, Thallium, and Zinc. All samples should be analyzed in duplicate. Perform a matrix spike on one front half sample and one back half sample or one combined sample. If recoveries of less than 75 percent or greater than 125 percent are obtained for the matrix spike, analyze each sample by the method of additions. A quality control sample should be analyzed to check the accuracy of the calibration standards. The results must be within 10% or the calibration repeated.

7.3.3 Cold Vapor AAS Analysis for Mercury. All samples should be analyzed in duplicate. A quality control sample should be analyzed to check the accuracy of the calibration standards (within 10% or repeat calibration). Perform a matrix spike on one sample from the nitric impinger portion (must be within 25% or samples must be analyzed by the method of standard additions). Additional information on quality control can be obtained from EPA Method 7470 or in Standard Methods for Water and Wastewater, 15th Edition, Method 303F.

8. Calculations

8.1 Dry Gas Volume. Using the data from this test, calculate $V_{m(std)}$, the dry gas sample volume at standard conditions as outlined in Section 6.3 of Method 5.

8.2 Volume of Water Vapor and Moisture Content. Using the data obtained from this test, calculate the volume of water vapor $V_{w(std)}$ and the moisture content B_{ws} of the stack gas. Use Equations 5-2 and 5-3 of Method 5.

8.3 Stack Gas Velocity. Using the data from this test and Equation 2-9 of Method 2, calculate the average stack gas velocity.

8.4 Metals (Except Mercury) in Source Sample.

8.4.1 Fraction 1A, Front Half, Metals (except Hg). Calculate the amount of each metal collected in Fraction 1 of the sampling train using the following equation:

$$M_{fh} = C_a F_{dm} V_{soln} \qquad \text{Eq. 1}$$

where:

M_{fh} = total mass of each metal (except Hg) collected in the front half of the sampling train (Fraction 1), ug.

C_a = concentration of metal in sample Fraction 1A as read from the standard curve (ug/ml).

F_{dm} = dilution factor (F_{dm} = the inverse of the fractional portion V_{conc-p} in V_{conc}. V_{conc} is the solution actually used in the instrument to produce the reading which is C_a. V_{conc} is either a pure or a diluted solution of Fraction 1A. When V_{conc} has been diluted to bring it into the analytical range based on the calibration of the instrument, V_{conc} will have the following two portions: V_{conc-d}, which is the diluent solution, and V_{conc-p}, which is the original Fraction 1A solution. For example, when the dilution of Fraction 1A is from 2 to 10 ml, the fractional portion V_{conc-p} (2 ml) in V_{conc} (10 ml) is 1/5, and F_{dm} = 5).

V_{soln} = total volume of digested sample solution (Fraction 1), ml.

8.4.2 Fraction 2A, Back Half, Metals (except Hg). Calculate the amount of each metal collected in Fraction 2 of the sampling train using the following equation.

$$M_{bh} = C_a \, F_a \, V_a \qquad \text{Eq. 2}$$

where:

M_{bh} = total mass of metal (except Hg) collected in the back half of the sampling train (Fraction 2), ug.
C_a = concentration of metal in sample Fraction 2A, as read from the standard curve (ug/ml).
F_a = aliquot factor, volume of Fraction 2 divided by volume of aliquot Fraction 2A.
V_a = volume of sample aliquot analyzed (concentrated Fraction 2A), ml.

8.4.3 Total Train, Metals (except Hg). Calculate the total amount of each of the quantified metals collected in the sampling train as follows:

$$M_t = (M_{fh} - M_{fb}) + (M_{bh} - M_{bb}) \qquad \text{Eq. 3}$$

where:

M_t = total mass of each metal (separately stated for each metal) collected in the sampling train, ug.
M_{fb} = blank correction value of mass of metal detected in front half of field reagent blank, ug.
M_{bb} = blank correction value of mass of metal detected in back half of field reagent blank, ug.

Note: The maximum value of field reagent blank that may be subtracted is 2 ug for the front half and 1 ug for the back half, or 3 ug for an analysis of the solution resulting from combining Fraction 1A and Fraction 2A;* or 5% of the average mass for the correponding fraction of the sampling train, whichever is greater.

8.5 Mercury in Source Sample.

8.5.1 Fraction 1B, Front Half, Hg. Calculate the amount of mercury collected in the front half, Fraction 1, of the sampling train using the following equation:

$$Hg_{fh} = \left(\frac{C}{V_{bf}}\right) \times V_{soln} \qquad \text{Eq. 4}$$

*In combining Fractions 1A and 2A, proportional aliquots must be used. Appropriate changes must be made in Equations 1-3 to reflect this approach.

where:

Hg_{fh} = total mass of mercury collected in the front half of the sampling train (Fraction 1), ug.
C = quantity of mercury in analyzed sample, ug.
V_{soln} = total volume of digested sample solution (Fraction 1), ml.
V_{bf} = volume of Fraction 1B analyzed, ml. See the following Note.

Note: V_{bf} is the actual amount of Fraction 1B analyzed. For example, if 1 ml of Fraction 1B were diluted to 100 ml to bring it into the proper analytical range, V_{bf} would be 0.01, etc.

8.5.2 Fraction 2B and Fraction 3, Back Half, Hg. Calculate the amount of mercury collected in Fractions 2B and 3 using Equations 5 and 6, respectively. Calculate the total amount of mercury collected in the back half of the sampling train using Equation 7.

$$Hg_{(F2B)} = \left(\frac{C}{V_{bb2}}\right) \times V_{soln} \qquad \text{Eq. 5}$$

where:

$Hg_{(F2B)}$ = total mass of mercury collected in Fraction 2, ug.
C = quantity of mercury in analyzed sample, ug.
V_{bb2} = volume of Fraction 2B analyzed, ml (see Note in Section 8.5.1).
V_{soln} = total volume of Fraction 2, ml.

$$Hg_{(F3)} = \left(\frac{C}{V_{bb3}}\right) \times V_{soln} \qquad \text{Eq. 6}$$

where:

$Hg_{(F3)}$ = total mass of mercury collected in Fraction 3, ug.
C = quantity of mercury in analyzed sample, ug.
V_{bb3} = volume of Fraction 3 analyzed, ml (see Note in Section 8.5.1).
V_{soln} = total volume of Fraction 3, ml.

$$Hg_{bh} = Hg_{(F2B)} + Hg_{(F3)} \qquad \text{Eq. 7}$$

where:

Hg_{bh} = total mass of mercury collected in the back half of the sampling train, ug.

and should not at this stage be construed to represent Agency policy. It is being circulated for comment on its technical accuracy and policy implications.

8.5.3 Total Train Mercury Catch. Calculate the total amount of mercury collected in the sampling train using Equation 8.

$$M_t = (Hg_{fh} - Hg_{fb}) + (Hg_{bh} - Hg_{bb}) \qquad \text{Eq. 8}$$

where:

M_t = total mass of mercury collected in the sampling train, ug.
Hg_{fb} = blank correction value of mass of mercury detected in the front half of the field reagent blank, ug.
Hg_{bb} = blank correction value of mass of mercury detected in the back half of the field reagent blank, ug.

Note: The maximum value of field reagent blank that may be subtracted is 1 ug for the front half and 2 ug for the back half, or 3 ug for a combined front half/back half analysis; or 5% of the average mass of mercury for the correponding fraction of the sampling train; whichever is greater.

8.6 Metal Concentration of Stack Gas. Calculate the cadmium, total chromium, arsenic, nickel, manganese, beryllium, copper, lead, phosphorus, thallium, silver, barium, zinc, selenium, antimony, and mercury concentrations in the stack gas (dry basis, adjusted to standard conditions) as follows:

$$C_s = K_4 \ (M_t/V_{m(std)}) \qquad \text{Eq. 9}$$

where:

C_s = concentration of each metal in the stack gas, mg/dscm.
K_4 = 10^{-3} mg/ug.
M_t = total mass of each metal collected in the sampling train, ug.
$V_{m(std)}$ = volume of gas sample as measured by the dry gas meter, corrected to dry standard conditions, dscm.

8.7 Isokinetic Variation and Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively. To calculate the average stack gas velocity, use Equation 2-9 of Method 2 and the data from this field test.

9. Bibliography

9.1 Ward, T.E., S.C. Steinsberger, W.G. DeWees, R.R. Segall, W.S. Smith, K.M. Luk, and P.M. Grohse. "Laboratory and Field Evaluation of Methodology for Measuring Emissions of Trace Metals for Stationary Sources," Draft report prepared for U.S. Environmental Protection Agency, Environmental Monitoring

PM-10 Emissions and Particle Size Testing

The PM-10 concentration and the size distribution will be determined in accordance with EPA's interim "Guidelines for Source Testing for Size Specific Particulate Emissions," (1) using an inertial cascade impactor currently manufactured by Anderson 2000 Inc., the exact model of which is known as "Flow Sensor."

The Flow Sensor impactor is a high flow rate (10-30 LPM) eight-stage cascade impactor which is equipped with a special high capacity preimpactor to collect particles approximately 10 microns and larger (50% cut point at 0.6 ACFM). This preimpactor has an inlet which is at 90 degrees to the exit.

Since the complete size distribution is required as well as the PM-10 concentration, the entire cascade impactor with the preimpactor is used in conjunction with an EPA Method 5 sampling train except that the final filter and its support are removed from the impactor.

The preimpactor and cascade impactor is attached to the in-stack end of the probe. The classifier is equipped with the appropriate "straight" type nozzle and nozzle plug and inserted into the stack gas to preheat for a 20-minute period to prevent condensation prior to initiating sampling. The exact nozzle diameter is selected based on a pretest velocity traverse.

A simple four point sampling grid is used. If the velocities at the four traverse points are ± 20% of one another, one sampler is used to sample each of the four grid points. Otherwise a separate sample is required for each traverse point which does not fall in the ± 20% velocity range. Experience has shown that this requirement is not as stringent as it appears and one sampler can usually be used for all four points.

(1) PM-10 SIP Development Guideline USEPA EPA-450/2-86-001, June 1987: Appendix C.

The velocity pressure, stack gas temperature, moisture content and static pressure for each traverse point from a preliminary test is used together with the impactor 50% cut point curves to select the appropriate nozzle required to give isokinetic sampling with the desired 50% cut points. If the site meets the ± 20% velocity requirements, sampling is initiated after a 20 minute warm up period by uncapping the nozzle and positioning the in-situ impactor nozzle at the first traverse point. The pump is activated and the flow is rapidly adjusted using the calibrated orifice to the desired rate. The data recording by the operator during the test is identical to that for Method 5 sampling except that the flow rate is held constant. Sampling is continued until all four points are sampled.

After sampling is complete, the coarse valve is closed, the pump turned off and the probe withdrawn from the stack. The preimpactor sample is recovered in the field and the impactor catch is returned in tact to the laboratory for gravimetric analysis. The Method 5 Sampling train is also processed up and through the glass fiber filter since the in-stack filter in the impactor is not being used. The EPA Method 5 probe rinse and filter catch are then substituted for the impactor filter catch in the calculations.

The impactor may be operated with bare collection plates or with a coating. The PM-10 Guidelines recommends that a coating be used. A very light film of high temperature silicone grease is applied to each stage before conditioning and weighing. Chemical reactions can occur with this coating which could alter the apparent weight collected by each stage. A control sampling of the same duration is run with an instack filter assembly in place of the preimpactor. The instack filter is discarded at the end of the run. The control sample is collected and processed in an identical manner as the other impactor samplings. The change in weight in the stages in the control run is then used to correct the subsequent determinations.

Impactors are not designed in a manner such that they will meet a Method 5 leak check, nor need they be. The maximum pressure drop across the housing is only a few hundredths IN.WC. since the flow has free access to the inside of the impactor through the open nozzle. For this reason, the pre- and post test leak checks are conducted prior to and after removing the impactor assembly from the end of the probe. The standard EPA Method 5 leak specifications are then used for this portion of the sampling train.

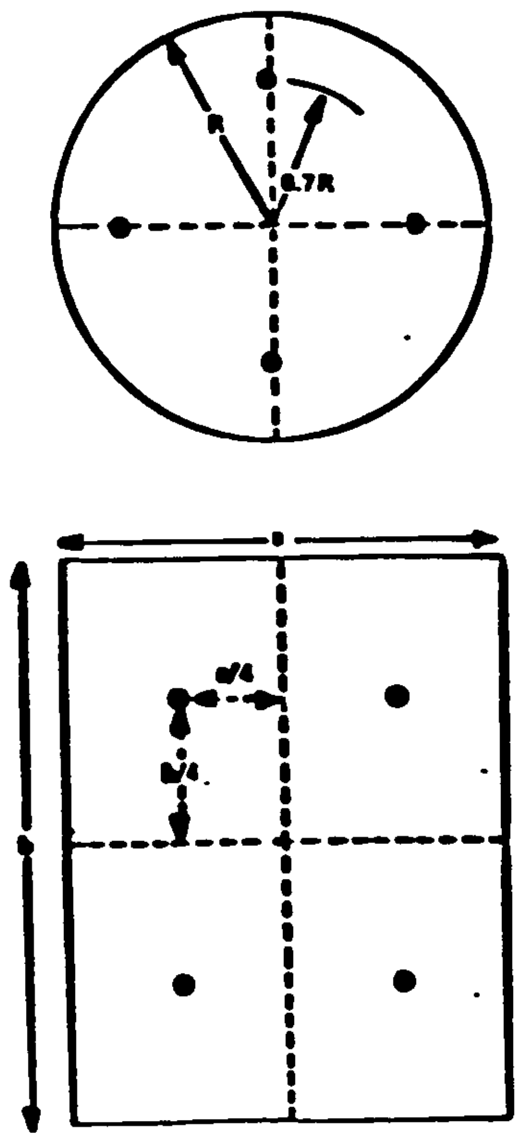


FIGURE 1. RECOMMENDED SAMPLING POINTS FOR CIRCULAR AND SQUARE OR RECTANGULAR DUCTS.

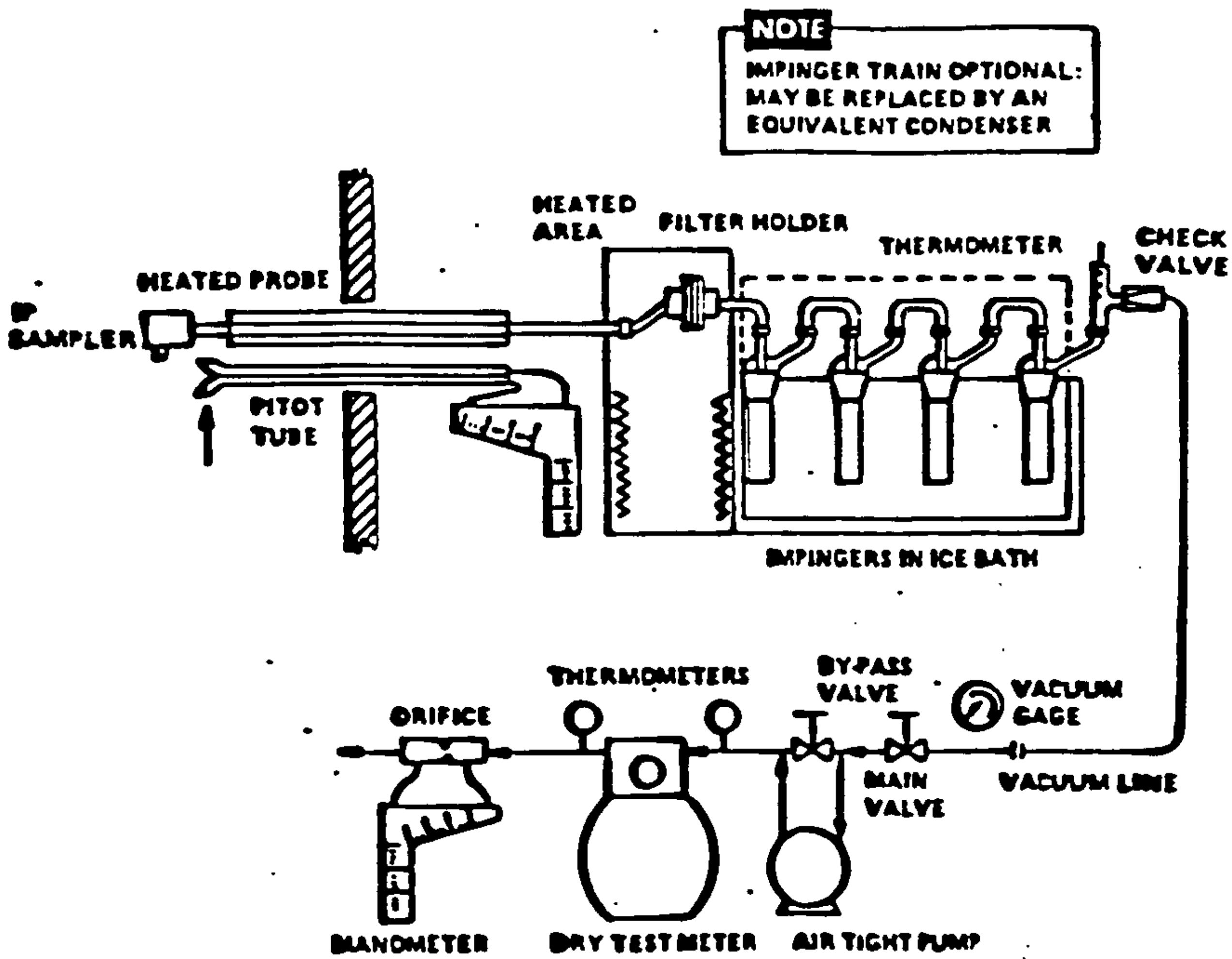


FIGURE 2. PM 10 PARTICULATE SAMPLING TRAIN FOR CONDENSIBLE AND NONCONDENSIBLE PARTICULATE (MODIFIED EPA METHOD 5 TRAIN).

TABLE II

50% EFFECTIVE CUT DIAMETER,
PARTICLE DENSITY - 1.0 gm/cm^3

FLOW ACFM	PREIMPACTOR	STAGE NO. 1	STAGE NO. 2	STAGE NO. 3	STAGE NO. 4	STAGE NO. 5	STAGE NO. 6	STAGE NO. 7
				AIR TEMP = 70.0°F				
0.1	24.3	15.6	9.8	6.3	3.8	2.5	1.7	0.95
0.2	17.2	11.0	7.0	4.5	2.7	1.8	1.1	0.66
0.3	14.0	9.0	5.6	3.6	2.2	1.4	0.92	0.53
0.4	12.2	7.8	4.9	3.1	1.9	1.2	0.78	0.45
0.5	11.0	7.0	4.4	2.8	1.7	1.1	0.70	0.40
0.6	10.0	6.4	4.0	2.6	1.6	1.0	0.64	0.36
0.7	9.2	6.0	3.7	2.4	1.4	0.92	0.58	0.33
0.75	9.0	5.7	3.6	2.3	1.4	0.89	0.56	0.32
				AIR TEMP = 150°F				
0.1	25.6	17.0	10.6	6.8	4.2	2.8	1.7	1.0
0.2	18.2	11.8	7.5	4.8	2.9	2.0	1.2	0.70
0.3	15.0	9.6	6.1	3.9	2.4	1.6	0.96	0.55
0.4	13.0	8.2	5.2	3.4	2.0	1.4	0.84	0.47
0.5	11.7	7.4	4.7	3.0	1.8	1.2	0.74	0.42
0.6	10.6	6.7	4.3	2.7	1.6	1.1	0.66	0.38
0.7	9.8	6.2	4.0	2.5	1.5	1.0	0.62	0.35
0.75	9.5	6.0	3.8	2.4	1.4	0.96	0.59	0.33
				AIR TEMP = [redacted]				
0.1	28.1	18.0	11.3	7.2	4.7	3.1	1.8	1.1
0.2	20.0	13.0	8.1	5.2	3.2	2.3	1.3	0.76
0.3	16.2	10.5	6.6	4.2	2.6	1.7	1.0	0.60
0.4	14.2	9.0	5.7	3.6	2.3	1.5	0.90	0.52
0.5	12.8	8.1	5.1	3.2	2.0	1.3	0.80	0.46
0.6	11.6	7.4	4.7	2.9	1.8	1.2	0.73	0.44
0.7	10.8	6.8	4.3	2.7	1.7	1.1	0.67	0.39
0.75	10.5	6.6	4.2	2.6	1.6	1.0	0.65	0.37

(TABLE continued...)

TABLE II (continued)

AIR TEMP = 500°F								
0.1	31.0	20.0	11.9	8.0	4.8	3.3	2.1	1.2
0.2	22.0	14.0	8.7	5.6	3.4	2.3	1.5	0.83
0.3	17.8	11.4	7.1	4.5	2.7	1.8	1.2	0.66
0.4	15.3	9.8	6.1	3.9	2.4	1.6	1.0	0.56
0.5	13.9	8.8	5.5	3.5	2.1	1.4	0.89	0.50
0.6	12.5	8.0	5.0	3.2	1.9	1.3	0.80	0.45
0.7	11.5	7.4	4.6	2.9	1.8	1.2	0.74	0.42
0.75	11.2	7.2	4.4	2.8	1.7	1.1	0.71	0.40
AIR TEMP = 1000°F								
0.1	34.6	22.2	14.0	9.0	5.4	3.6	2.3	1.4
0.2	24.6	15.7	9.8	6.3	3.8	2.6	1.6	0.94
0.3	20.0	12.8	8.0	5.2	3.2	2.1	1.3	0.75
0.4	17.2	11.0	6.9	4.5	2.7	1.8	1.1	0.64
0.5	15.6	9.9	6.2	4.0	2.4	1.6	1.0	0.57
0.6	10.4	9.0	5.6	3.6	2.2	1.5	0.91	0.52
0.7	10.3	8.3	5.2	3.4	2.0	1.4	0.84	0.47
0.75	10.3	8.0	5.0	3.3	2.0	1.3	0.80	0.46

APPENDIX G

CALCULATION EQUATIONS

CALCULATION EQUATIONS

METHOD 2

$$\overline{V}_s = 85.48\, C_p\, (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s\, M_s}}$$

$$Q_{s,d} = 60(1 - B_{ws})\, \overline{V}_s\, A\, \left(\frac{528}{T_{s(avg)}}\right) \left(\frac{P_s}{29.92}\right)$$

$$Q_a = 60\, \overline{V}_s\, A$$

$$\dot{m}_g = \frac{4.995\, Q_{s,d}\, G_d}{1 - B_{ws}}$$

$$RH^* = 100\, (vp_{twb}\ 0.0003641\, P_s\, (T_{db} - T_{wb}))/vp_{tdb}$$

$$B^*_{ws} = RH(vp_{tdb})/P_s$$

$$= \frac{4.585 \times 10^{-2}\, P_s M_s}{T_s\ (avg)}$$

*Alternate equations for calculating moisture content from wet bulb and dry buld data.

SYMBOLS

A	=	Cross sectional area of stack, SQ. FT.
A_n	=	Cross sectional area of nozzle, SQ. FT.
B_{ws}	=	Water vapor in gas stream, proportion by volume
C_p	=	Pitot tube coefficient, dimensionless
C_a	=	Concentration of particulate matter in stack gas, wet basis, GR/ACF
C_s	=	Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, GR/DSCF
EA	=	Excess air, percent by volume
Y	=	Dry test meter correction factor, dimensionless
G_d	=	Specific gravity (relative to air), dimensionless
I	=	Isokinetic variation, percent by volume
M_d	=	Molecular weight of stack gas, dry basis, g/g - mole.
$\dot{m}_g$	=	Mass flow of wet flue gas, LB/HR
$\dot{m}_p$	=	Particulate mass flow, LB/HR
M_s	=	Molecular weight of stack gas, wet basis, g/g, mole.
M_p	=	Total amount of particulate matter collected, g
P_{bar}	=	Atmospheric pressure, IN. HG. (uncompensated)
P_g	=	Stack static gas pressure, IN. WC.

P_s = Absolute pressure of stack gas, IN.HG.

P_{std} = Standard absolute pressure, 29.92 IN. HG.

A_a = Actual volumetric stack gas flow rate, ACFM

$Q_{s,d}$ = Dry volumetric stack gas flow rate corrected to standard conditions, DSCFM

RH = Relative humidity, %

T_{db} = Dry bulb temperature of stack gas, ^oF

T_{wb} = Wet bulb temperature of stack gas, ^oF

$T_{m(avg)}$ = Absolute average dry gas meter temperature, ^oR

$T_s(avg)$ = Absolute average stack temperature, ^oF

T_{std} = Standard absolute temperature, 528 ^oF (68 ^oF)

θ = Total sampling time, min.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, CF

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, DSCF

$V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, SCF

$\overline{V}_s$ = Average actual stack gas velocity, FT/SEC

vp_{tdb} = Vapor pressure at T_{db}, IN. HG.

VP_{twb}	=	Vapor pressure at T_{wb}, IN. HG
$\overline{\Delta H}$	=	Average pressure differential across the orifice meter, IN. WC.
ΔP	=	Velocity pressure of stack gas, IN. WC.
Y	=	Dry test meter correction coefficient, dimensionless
ρ	=	Actual gas density, LB/ACF

CALCULATION EQUATIONS

METHOD 3

$$\%EA = \frac{100(\%O_2 -).5\%\ CO)}{0.264\%\ N_2 - \%O_2 + 0.5\%\ CO}$$

$$M_d = 0.44(\%CO_2) + 0.32\ (\%O_2) + 0.28\ (\%N_2 + \%CO)$$

$$M_s = M_d\ (I - B_{ws}) + 0.18\ B_{ws}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

CALCULATION EQUATIONS

METHOD 5

$$V_{m(std)} = 17.65\ V_m\ \gamma\ \left(\frac{P_{bar} + \overline{\Delta H}/13.6}{T_{m(avg)}}\right)$$

$$V_{w(std)} = 0.0472\ V_{Is}$$

$$B_{ws} = \frac{V_{w(std)}}{V_{w(std)} + V_{m(std)}}$$

$$I = 0.0944\ \left(\frac{T_{s(avg)}\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1 - B_{ws})}\right)$$

$$C_s = \frac{15.43\ M_p}{V_{m(std)}}$$

$$C_a = \frac{272.3\ M_p\ P_s}{T_{s(avg)}\ (V_{w(std)} + V_{m(std)})}$$

$$(\dot{m}_p)_1 = 8.5714 \times 10^{-3}\ C_s\ Q_{s,d}$$

$$(\dot{m}_p)_2 = \frac{1.3228 \times 10^{-1}\ M_p\ A}{\theta\ A_n}$$

$$\dot{m}_p = \frac{(\dot{m}_p)_1 + (\dot{m}_p)_2}{2}$$

SYMBOLS

A = Cross sectional area of stack, SQ. FT.

A_n = Cross sectional area of nozzle, SQ. FT.

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

C_p = Pitot tube coefficient, dimensionless

C_a = Concentration of particulate matter in stack gas, wet basis, GR/ACF

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, GR/DSCF

EA = Excess air, percent by volume

Y = Dry test meter correction factor, dimensionless

G_d = Specific gravity (relative to air), dimensionless

I = Isokinetic variation, percent by volume

M_d = Molecular weight of stack gas, dry basis, g/g - mole.

$\dot{m}_g$ = Mass flow of wet flue gas, LB/HR

$\dot{m}_p$ = Particulate mass flow, LB/HR

M_s = Molecular weight of stack gas, wet basis, g/g, mole.

M_p = Total amount of particulate matter collected, g

P_{bar} = Atmospheric pressure, IN. HG. (uncompensated)

P_g = Stack static gas pressure, IN. WC.

P_s = Absolute pressure of stack gas, IN.HG.

P_{std} = Standard absolute pressure, 29.92 IN. HG.

A_a = Actual volumetric stack gas flow rate, ACFM

$Q_{s,d}$ = Dry volumetric stack gas flow rate corrected to standard conditions, DSCFM

RH = Relative humidity, %

T_{db} = Dry bulb temperature of stack gas, ^{o}F

T_{wb} = Wet bulb temperature of stack gas, ^{o}F

$T_{m(avg)}$ = Absolute average dry gas meter temperature, ^{o}R

$T_s(avg)$ = Absolute average stack temperature, ^{o}F

T_{std} = Standard absolute temperature, 528 ^{o}F (68 ^{o}F)

θ = Total sampling time, min.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, CF

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, DSCF

$V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, SCF

$\bar{V}_s$ = Average actual stack gas velocity, FT/SEC

vP_{tdb} = Vapor pressure at T_{db}, IN. HG.

VP_{twb}	=	Vapor pressure at T_{wb}, IN. HG
$\overline{\Delta H}$	=	Average pressure differential across the orifice meter, IN. WC.
ΔP	=	Velocity pressure of stack gas, IN. WC.
Υ	=	Dry test meter correction coefficient, dimensionless
ρ	=	Actual gas density, LB/ACF

CALCULATIONS FOR METALS

1. CONCENTRATION (ug/Nm^3)

$$ug/Nm^3 = \frac{35.31\ ft^3}{m^3} \times \frac{ug\ in\ sample}{V_m\ (DSCF)}$$

where V_m = Exhaust gas volume through meter (DSCF)

2. EMISSION RATE (lb/hr)

$$(lb/hr) = \frac{ug}{Nm^3} \times \frac{lb}{454g} \times \frac{g}{1000mg} \times \frac{mg}{1000ug} \times \frac{DSCF}{min} \times \frac{60\ min}{hr} \times \frac{0.0283\ Nm^3}{DSCF}$$

$$(lb/hr) = (3.74 \times 10^{-9}) \times DSCFM \times \frac{ug}{Nm^3}$$

where DSCFM = Volumetric flow rate in the source

Calculation of Elemental
Emission Factors

$$E_i = \frac{1.2762 \times 10^{-5}\ C_i}{20.9 - O_2}$$

where E = emission factor of element i in $LB/10^6BTU$

C_i = concentratior of element i in ug/Nm^3

O_2 = oxygen content in flue gas at point of sample collection in %v/v,d

APPENDIX H

SAMPLING TRAIN CALIBRATION DATA

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job NSP Black Dog   Date 11/4/91

Operator DVH   Module No. 8

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 29.30 in. Hg. τ = 1.0003   ^H@ 1.86 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F) Inlet	Meter Temp. (°F) Outlet
[redacted]	(489)	[redacted]	
2.5	490.85	35	30
5.0	492.70	36	30
7.5	494.55	38	30
10	496.401	39	31
[redacted]	V_m= 7.401	Avg(t_m)= 33.625°F	

Calculate Y_{cn} as follows:

$$Y_{cn} = \frac{1.786}{\tau \; V_m} \left[\frac{(t_m + 460)}{P_b} \right]^{0.5}$$

$$Y_{cn} = \frac{1.786}{(1.0003)(7.401)} \left[\frac{(33.625 + 460)}{(29.3)} \right]^{0.5}$$

Y_{cn} = .99

If Y_{cn} is not within the range of 0.97 to 1.03, "the volume metering system should be investigated before beginning."

CFR Title 40, Part 60, Appendix A, Method 5, Section 4.4.1

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job N.S.P Black Dog Date 11/5/91

Operator DKH Module No. 5

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 29.30 in. Hg. τ = 1.0070 ^H@ 1.95 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(519.5)		
2.5	521.28	31	28
5.0	523.05	34	29
7.5		36	30
10	526.575	36	30
	V_m= 7.075	Avg (t_m)= 31.75 °F	

Calculate Y_{cn} as follows:

$$Y_{cn} = \frac{1.786}{\tau\ V_m}\left[\frac{(t_m + 460)}{P_b}\right]^{0.5}$$

$$Y_{cn} = \frac{1.786}{(1.0070)(7.075)}\left[\frac{(31.75 + 460)}{(29.30)}\right]^{0.5}$$

Y_{cn} = 1.02

If Y_{cn} is not within the range of 0.97 to 1.03, "the volume metering system should be investigated before beginning."

CFR Title 40, Part 60, Appendix A, Method 5, Section 4.4.1

Interpoll Laboratories, Inc.
(612) 786-6060

EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job N.S.P. BLACK DOG STATION Date 11/4/91

Operator D. BRENNAN Module No. 7

Instructions: Operate the control module at a flow rate equal to ^H@ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 29.54 in. Hg. τ = 1.0056 ^H@ 1.83 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F) Inlet	Meter Temp. (°F) Outlet
[redacted]	(760.00)	[redacted]	
2.5	761.90	84	75
5.0		86	76
7.5	765.75	87	78
10	767.65	88	79
[redacted]	V_m = 7.65	Avg (t_m) = 81.625 °F	

Calculate Y_{cn} as follows:

$$Y_{cn} = \frac{1.786}{\tau\, V_m}\left[\frac{(t_m + 460)}{P_b}\right]^{0.5}$$

$$Y_{cn} = \frac{1.786}{(1.0056)(7.65)}\left[\frac{\overset{541.625}{(81.625) + 460}}{(29.54)}\right]^{0.5}$$

Y_{cn} = .9941

If Y_{cn} is not within the range of 0.97 to 1.03, "the volume metering system should be investigated before beginning."

CFR Title 40, Part 60, Appendix A, Method 5, Section 4.4.1

Interpoll Laboratories, Inc.
(612) 786-6020

EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job NSP Black dog Date 11-4-91

Operator P. O'Neill Module No. 6

Instructions: Operate the control module at a flow rate equal to $\Delta H@$ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 29.45 in. Hg. γ = 0.9992 $\Delta H@$ 1.82 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F)	
		Inlet	Outlet
	(136.10)		
2.5	137.98	60	56
5.0	139.86	62	58
7.5	141.75	63	59
10	143.62	64	60
	V_m=7.52	Avg(t_m)=60.25 °F	

Calculate Y_{cn} as follows:

$$Y_{cn} = \frac{1.786}{\gamma \; V_m}\left[\frac{(t_m + 460)}{P_b}\right]^{0.5}$$

$$Y_{cn} = \frac{1.786}{(.9992)(7.52)}\left[\frac{(60.25) + 460}{(29.45)}\right]^{0.5}$$

Y_{cn} = .999

If Y_{cn} is not within the range of 0.97 to 1.03, "the volume metering system should be investigated before beginning."

CFR Title 40, Part 60, Appendix A, Method 5, Section 4.4.1

Interpoll Laboratories, Inc.
(612) 786-6020

EPA Method 5 Gas Metering System
Quality Control Check Data Sheet

Job NSP/BLACKDOG Date 11-4-91

Operator E. TROWBRIDGE Module No. 2

Instructions: Operate the control module at a flow rate equal to $\Delta H@$ for 10 minutes before attaching the umbilical. Record the following data:

Bar press 29.46 in. Hg. γ = .9939 $\Delta H@$ 1.85 in. W.C.

Time (min)	Volume (CF)	Meter Temp. (°F) Inlet	Meter Temp. (°F) Outlet
	(102.50)		
2.5	104.40	67	63
5.0	106.30	68	63
7.5	108.21	70	64
10	110.13	72	64
	V_m = 7.63	Avg (t_m) = 66.4 °F	

Calculate Y_{cn} as follows:

$$Y_{cn} = \frac{1.786}{\gamma\, V_m}\left[\frac{(t_m + 460)}{P_b}\right]^{0.5}$$

$$Y_{cn} = \frac{1.786}{(.9939)(7.63)}\left[\frac{(66.4) + 460}{(29.46)}\right]^{0.5} \quad 4.227$$

Y_{cn} = .9955

If Y_{cn} is not within the range of 0.97 to 1.03, "the volume metering system should be investigated before beginning."

CFR Title 40, Part 60, Appendix A, Method 5, Section 4.4.1

Interpoll Laboratories, Inc.
(612) 786-5020

Meter Box Calibration and Usage Status

Date of Report: November 7, 1991

Meter Box No. : 2 (Rockwell Dry Test Meter Serial No. 964549)

Date of Last Calibration: October 28, 1991
Calibration Technician: E. Trowbridge
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
October 29, 1991	1-3447	838.20	1099.45	261.25	261.25
November 5, 1991	1-3451	1102.50	1359.40	256.90	518.15

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: November 7, 1991

Meter Box No.: 5 (Rockwell Dry Test Meter Serial No. 676477)

Date of Last Calibration: October 24, 1991
Calibration Technician: E. Trowbridge
Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
November 5, 1991	1-3451	519.50	647.87	128.37	128.37

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: November 7, 1991

Meter Box No. : 6 (Rockwell Dry Test Meter Serial No. 64710)

Date of Last Calibration: October 12, 1991
Calibration Technician: D. Van Hoever
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
November 5, 1991	1-3451	136.10	339.17	203.07	203.07

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6020

Meter Box Calibration and Usage Status

Date of Report: November 7, 1991

Meter Box No. : 7 (Rockwell Dry Test Meter Serial No. 964551)

Date of Last Calibration: October 25, 1991
Calibration Technician: E. Trowbridge
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
October 30, 1991	1-3448	601.00	727.77	126.77	126.77
November 5, 1991	1-3451	760.00	975.31	215.31	342.08

* Total volume through meter since last calibration.

Interpoll Laboratories, Inc.
(612) 786-6[illegible]20

Meter Box Calibration and Usage Status

Date of Report: November 7, 1991

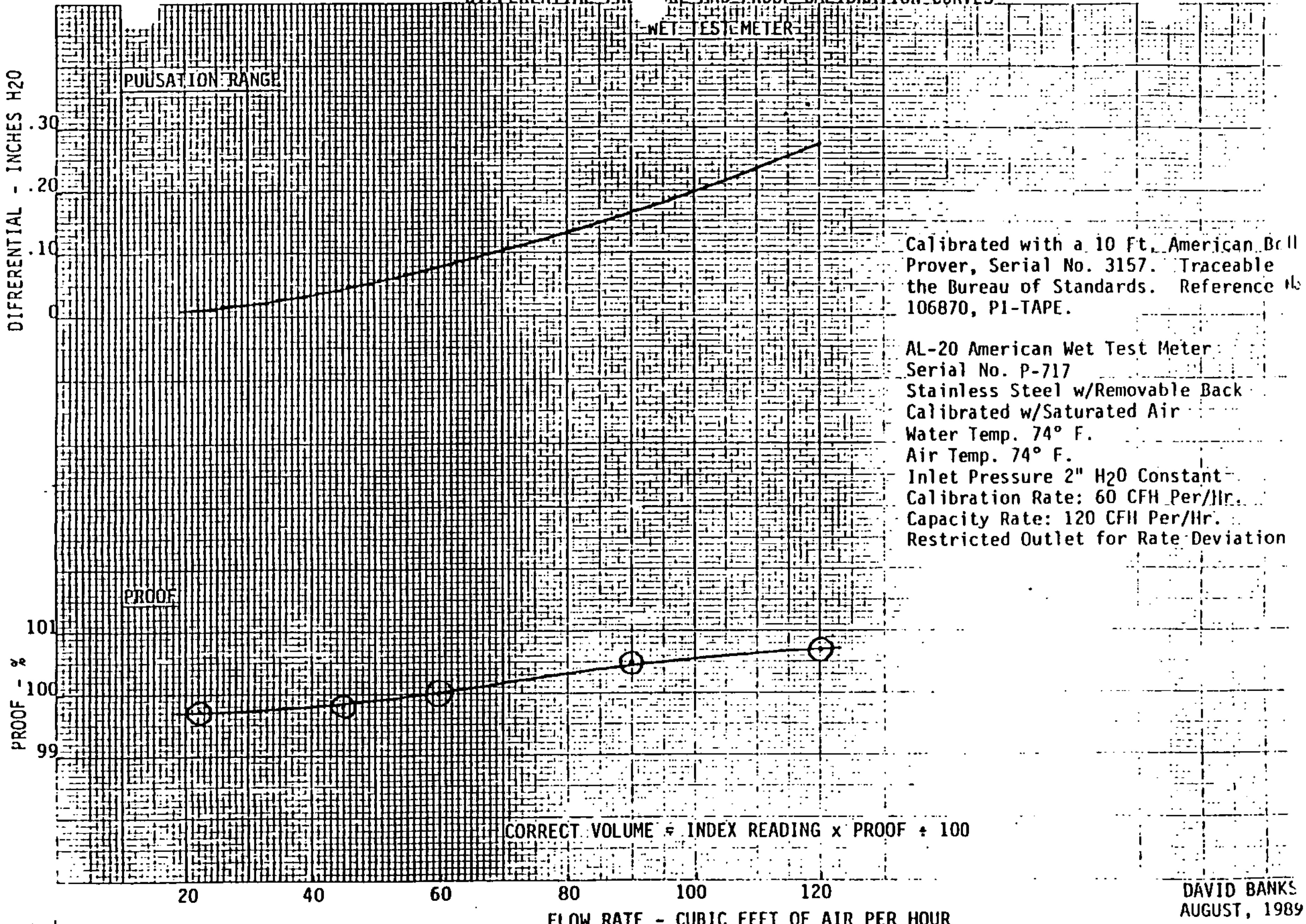
Meter Box No. : 8 (Rockwell Dry Test Meter Serial No. 964553)

Date of Last Calibration: October 12, 1991
Calibration Technician: D. Van Hoever
Wet Test Meter No.: American Meter AL-20

Date of Use	Report No.	Initial Meter Reading	Final Meter Reading	Volume/Job (cu. ft.)	Total Volume* (cu. ft.)
November 5, 1991	1-3451	489.00	656.00	167.00	167.00

* Total volume through meter since last calibration.

DIFFERENTIAL PRE' 'RE AND PROOF CALIBRATION CURVES



Interpoll Laboratories, Inc.

(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 11-5-91 Nozzle: Glass

Technician: Duane Van Hoever

The nozzle is rotated in 60 degree increments and the diameter at each point is measured to the nearest 0.001 inch. The observed readings and average are shown below.

Position	Diameter (inches)
1	.195
2	.195
3	.194
Average:	.195

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 11-5-91 Nozzle Number 1-5
Technician: Duke Brennan

The nozzle is rotated in 60 degree increments and the diameter at each point is measured to the nearest 0.001 inch. The observed readings and average are shown below.

Position	Diameter (inches)
1	.312
2	.312
3	.312
Average:	.312

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 11-5-91 Nozzle Number 2-5
Technician: Mark Kaehler

The nozzle is rotated in 60 degree increments and the diameter at each point is measured to the nearest 0.001 inch. The observed readings and average are shown below.

Position	Diameter (inches)
1	.294
2	.296
3	.293
Average:	.294

Interpoll Laboratories, Inc.
(612) 786-6020

Nozzle Calibration
Data Sheet

Date of Calibration: 11-5-91 Nozzle Number 8-5

Technician: Ed Trowbridge

The nozzle is rotated in 60 degree increments and the diameter at each point is measured to the nearest 0.001 inch. The observed readings and average are shown below.

Position	Diameter (inches)
1	.311
2	.309
3	.310
Average:	.310

Interpoll Laboratories, Inc.

Temperature Measurement Device Calibration Sheet

Unit under test:

Vendor: Atkins

Model: 3965B-K

Serial Number: 2

Range: 0-2000 °F

Thermocouple Type: K

Date of Calibration: 8-6-91

Technician: Mark Koehler

Method of Calibration:

☐ Comparison against ASTM mercury in glass thermometer using a thermostatted and insulated aluminum block designed to provide uniform temperature. The temperature is adjusted by adjusting the voltage on the block heater cartridge.

☒ Omega Model CL-300 Type K Thermocouple Simulator which provides 22 precise temperature equivalent millivolt signals. The CL-300 is cold junction compensated. Calibration accuracy is ± 0.1% of span (2100 °F) ± 1 degree (for negative temperatures add ± 2 degrees. The CL-300 simulates exactly the millivoltage of a Type K thermocouple at the indicated temperature.

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	2.0	2.0	.43
100	100	100.1	.1	.02
200	200	202	2	.30
300	300	301	1	.13
400	400	397	3	.35
500	500	497	3	.31
600	600	599	1	.09
700	700	699	1	.09
800	800	802	2	.16
900	900	904	4	.29
1000	1000	1008	8	.55
1100	1100	1100	11	.71
1200	1200	1217	17	1.02
1300	1300	1316	16	.91
1400	1400	1419	19	1.02
1500	1500	1516	16	.82
1600	1600	1617	17	.83
1700	1700	1711	11	.51
1800	1800	1807	7	.31
1900	1900	1899	1	.04
2000	2000	1993	7	.28
2100				
		Averages:	7.10	.44

OF = off scale response by unit under test (°F)

% dev = 100 Δt / (460 + t)

☒ Unit in tolerance

☐ Unit was not in tolerance; recalibrated - See new calibration sheet.

S-433

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:

Vendor: Fluke
Model: 51 — Serial Number: #12
Range: 0 - 2100 °F — Thermocouple Type: K
Date of Calibration: 10-18-91 — Technician: [illegible signature]

Method of Calibration:

☐ Comparison against ASTM mercury in glass thermometer using a thermostatted and insulated aluminum block designed to provide uniform temperature. The temperature is adjusted by adjusting the voltage on the block heater cartridge.

☒ Omega Model CL-300 Type K Thermocouple Simulator which provides 22 precise temperature equivalent millivolt signals. The CL-300 is cold junction compensated. Calibration accuracy is ± 0.1% of span (2100 °F) ± 1 degree (for negative temperatures add ± 2 degrees. The CL-300 simulates exactly the millivoltage of a Type K thermocouple at the indicated temperature.

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	1.0	1.0	.21
100	100	101.0	1.0	.17
200	200	202.6	2.6	.39
300	300	302.0	2.0	.26
400	400	399.8	.2	.02
500	500	501.0	1.0	.10
600	600	602.4	2.4	.22
700	700	700.6	.6	.05
800	800	802.2	2.2	.17
900	900	900.8	.8	.05
1000	1000	1002.0	2.0	.13
1100	1100	1101.8	1.8	.11
1200	1200	1203.8	3.8	.22
1300	1300	1300.4	.4	.02
1400	1400	1403.4	3.4	.18
1500	1500	1501.0	1.0	.05
1600	1600	1602.0	2.0	.09
1700	1700	1700.6	.6	.02
1800	1800	1802.0	2.0	.08
1900	1900	1900.2	.2	.008
2000	2000	2001.8	1.8	.07
2100	2100	2099.2	.8	.03
------		Averages:	1.52	.12

OF = off scale response by unit under test (°F)
% dev = 100 Δt / (460 + t)

☒ Unit in tolerance
☐ Unit was not in tolerance; recalibrated - See new calibration sheet.

S-433

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:

Vendor Beckman Industrial

Model HD110 T — Serial Number 10507095 (PDT #18)

Range -4 to 1999 °F °F — Thermocouple Type K

Date of Calibration 9/12/91 — Technician D.V.H

Method of Calibration:

☐ Comparison against ASTM mercury in glass thermometer using a thermostatted and insulated aluminum block designed to provide uniform temperature. The temperature is adjusted by adjusting the voltage on the block heater cartridge.

☒ Omega Model CL-300 Type K Thermocouple Simulator which provides 22 precise temperature equivalent millivolt signals. The CL-300 is cold junction compensated. Calibration accuracy is ± 0.1% of span (2100 °F) ± 1 degree (for negative temperatures add ± 2 degrees. The CL-300 simulates exactly the millivoltage of a Type K thermocouple at the indicated temperature.

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	0	0	0
100	100	96	4	.71
200	200	200	0	0
300	300	298	2	.39
400	400	395	5	.58
500	500	495	5	.52
600	600	598	2	.18
700	700	699	1	.08
800	800	804	4	.32
900	900	906	6	.44
1000	1000	1011	11	.75
1100	1100	1115	15	.96
1200	1200	1221	21	1.26
1300	1300	1322	22	1.25
1400	1400	1426	26	1.39
1500	1500	1524	24	1.22
1600	1600	1626	26	1.26
1700	1700	1721	21	.97
1800	1800	1819	19	.84
1900	1900	1912	12	.51
2000	—	—	—	—
2100	—	—	—	—
		Averages:		.68

OF = off scale response by unit under test (°F)

% dev = $100 \Delta t / (460 + t)$

☒ Unit in tolerance

☐ Unit was not in tolerance; recalibrated - See new calibration sheet.

S-433

Interpoll Laboratories, Inc.

Temperature Measurement Device
Calibration Sheet

Unit under test:

Vendor Beckman

Model HD 110T — Serial Number PDT-19

Range 0-1900 °F — Thermocouple Type K

Date of Calibration 10-21-91 — Technician M. Kaehler

Method of Calibration:

☐ Comparison against ASTM mercury in glass thermometer using a thermostatted and insulated aluminum block designed to provide uniform temperature. The temperature is adjusted by adjusting the voltage on the block heater cartridge.

☐ Omega Model CL-300 Type K Thermocouple Simulator which provides 22 precise temperature equivalent millivolt signals. The CL-300 is cold junction compensated. Calibration accuracy is ± 0.1% of span (2100 °F) ± 1 degree (for negative temperatures add ± 2 degrees. The CL-300 simulates exactly the millivoltage of a Type K thermocouple at the indicated temperature.

Desired Temp (°F) Nominal	Temperature of Standard or Simulated Temp (°F)	Response of Unit Under Test (°F)	Deviation Δt (°F)	Deviation (%)
0	0	-3	3	.65
100	100	94	6	1.07
200	200	197	3	.45
300	300	295	5	.66
400	400	392	8	.93
500	500	492	8	.83
600	600	594	5	.47
700	700	696	4	.34
800	800	801	1	.08
900	900	903	3	.22
1000	1000	1008	8	.55
1100	1100	1112	12	.77
1200	1200	1218	18	1.08
1300	1300	1319	19	1.08
1400	1400	1423	23	1.24
1500	1500	1521	21	1.07
1600	1600	1622	22	1.07
1700	1700	1718	18	.83
1800	1800	1816	16	.71
1900	1900	1909	9	.38
2000				
2100				
		Averages:	10.60	.72

OF = off scale response by unit under test (°F)

% dev = 100 Δt / (460 + t)

☑ Unit in tolerance

☐ Unit was not in tolerance; recalibrated - See new calibration sheet.

S-433

Interpoll Laboratories
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 8-MM5

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .462 IN.
3. Base to Side B opening plane (P_B) .462 IN.

Alignment:

4. $\alpha_1 < 10^0$ 0
5. $\alpha_2 < 10^0$ 0
6. $B_1 < 5^0$ 1
7. $B_2 < 5^0$ 1

8. Z <.125" .03
9. W <.0625" .02

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .762 IN.

Date of Inspection: 2-1-91

Inspected by: [signature]

S-348(1)

(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 23-5

Pitot tube dimensions:

1. External tubing diameter (D_t) .313 IN.
2. Base to Side A opening plane (P_A) .457 IN.
3. Base to Side B opening plane (P_B) .458 IN.

Alignment:

4. $\alpha_1 < 10^0$ 0
5. $\alpha_2 < 10^0$ 0
6. $B_1 < 5^0$ 1
7. $B_2 < 5^0$ 2
8. Z <.125" .04
9. W <.0625" .03

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .760 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .762 IN.

☒ Meets all EPA design criteria thus C_p = 0.84

☐ Does not meet EPA design criteria - thus calibrate in wind tunnel
C_p = ________

Date of Inspection: 2-10-91

Inspected by: [signature]

CFR Title 40 Part 60 Appendix A Method 2

Interpoll Inc.
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 24-6

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .460 IN.
3. Base to Side B opening plane (P_B) .458 IN.

Alignment:

4. $\alpha_1 < 10^0$ 0
5. $\alpha_2 < 10^0$ 0

6. $B_1 < 5^0$ .01
7. $B_2 < 5^0$ .02

8. Z <.125" .01
9. W <.0625" .01

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .758 IN.
11. Pitot to probe sheath 3.0 IN.
12. Pitot to thermocouple (parallel to probe) ______ IN.
13. Pitot to thermocouple (perpendicular to probe) ______ IN.

Date of Inspection: 6-26-90

Inspected by: [signature]

S-348(1)

Interpoll Laboratories
(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 6-21

Pitot tube dimensions:

1. External tubing diameter (D_t) .316 IN.
2. Base to Side A opening plane (P_A) .464 IN.
3. Base to Side B opening plane (P_B) .462 IN.

Alignment:

4. $\alpha_1 < 10^0$ 0
5. $\alpha_2 < 10^0$ 0
6. $B_1 < 5^0$ 2
7. $B_2 < 5^0$ 1
8. Z <.125" 0.02
9. W <.0625" 0.02

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .762 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .762 IN.

Date of Inspection: 2-1-91

Inspected by: [signature]

S-348(1)

(612)786-6020

S-Type Pitot Tube Inspection Sheet

Pitobe No. 23-6

Pitot tube dimensions:

1. External tubing diameter (D_t) .313 IN.
2. Base to Side A opening plane (P_A) .164 IN.
3. Base to Side B opening plane (P_B) .165 IN.

Alignment:

4. $\alpha_1 < 10^o$ 1
5. $\alpha_2 < 10^o$ 1
6. $B_1 < 5^o$ 2
7. $B_2 < 5^o$ 2
8. Z <.125" .03
9. W <.0625" .03

Distance from Pitot to Probe Components:

10. Pitot to 0.500 IN. nozzle .758 IN.
11. Pitot to probe sheath 3.00 IN.
12. Pitot to thermocouple (parallel to probe) 3.00 IN.
13. Pitot to thermocouple (perpendicular to probe) .762 IN.

☑ Meets all EPA design criteria thus C_p = 0.84

☐ Does not meet EPA design criteria - thus calibrate in wind tunnel C_p = ______

Date of Inspection: 2-11-94

Inspected by: [signature]

CFR Title 40 Part 60 Appendix A Method 2

S-348(R-11)

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 7-17-71
Technician STEVE LONNES
Mercury Column Barometer No. NOVA-1
Aneroid Barometer No. S/N 560209

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference (P_{ba}-P_{bm})
29.13	86	0.150	28.98	29.08	0.10
LATITUDE		-0.001	28.98	29.08	0.10

Has this barometer shown any consistent problems with calibration? Yes/No. If yes, explain. NO

Has problem been alleviated? Yes/No. How? N/A

*Note

Aneroid barometers will be calibrated periodically against a mercury column barometer. The aneroid barometer to be calibrated should be placed in close proximity to the mercury barometer and left to equilibrate for 20-30 minutes before calibrating. Aneriod barometer will be calibrated to the adjusted mercury barometer readings.

S-312

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 7/8/15.

Technician Duane Van Hoever

Mercury Column Barometer No. 1

Aneroid Barometer No. Ultimeter Serial # 8C1216

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference (P_{ba}-P_{bm})
29.27	70	.11	29.16	29.17	+.01

Has this barometer shown any consistent problems with calibration? Yes/No. If yes, explain. No

Has problem been alleviated? Yes/No. How?

*Note

Aneroid barometers will be calibrated periodically against a mercury column barometer. The aneroid barometer to be calibrated should be placed in close proximity to the mercury barometer and left to equilibrate for 20-30 minutes before calibrating. Aneriod barometer will be calibrated to the adjusted mercury barometer readings.

S-312

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 7-22-91

Technician [illegible]

Mercury Column Barometer No. ULTIMETER MODEL 12

Aneroid Barometer No. SN-01002008

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference (P_{ba}-P_{bm})
28.95	74	(.119)		29.00	.05
Laditude		(.001	28.950		

Has this barometer shown any consistent problems with calibration? Yes/No. If yes, explain. No

Has problem been alleviated? Yes/No. How?

*Note

Aneroid barometers will be calibrated periodically against a mercury column barometer. The aneroid barometer to be calibrated should be placed in close proximity to the mercury barometer and left to equilibrate for 20-30 minutes before calibrating. Aneriod barometer will be calibrated to the adjusted mercury barometer readings.

S-312

INTERPOLL LABORATORIES
(612)786-6020

Stack Sampling Department - QA
Aneroid Barometer Calibration Sheet

Date 4-29-91

Technician Mark Kaehler

Mercury Column Barometer No. 1-Lab

Aneroid Barometer No. 636235

Actual Mercury Barometer Read	Ambient Temp.	Temperature Correction Factor	Adjsted Mercury Barometer Read	Initial Aneriod Barometer Read	Difference ($P_{ba}-P_{bm}$)
28.60	70	.107	28.493	28.350	.140

Has this barometer shown any consistent problems with calibration? Yes/No If yes, explain.

Has problem been alleviated? Yes/No. How?

*Note

Aneroid barometers will be calibrated periodically against a mercury column barometer. The aneroid barometer to be calibrated should be placed in close proximity to the mercury barometer and left to equilibrate for 20-30 minutes before calibrating. Aneriod barometer will be calibrated to the adjusted mercury barometer readings.

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APPENDIX I

MASS RATE CONVERSION FACTOR FOR G/SEC

Mass Rate Conversion

Factor for g/sec

$$g/sec = \frac{LB}{HR} \times \left[\frac{HR}{3600\,sec} \times \frac{453.6\,g}{LB}\right]$$

$$g/s = 0.126\ (LB/HR)$$

APPENDIX J

RESULTS OF FLYASH COMPOSITION CALCULATION

INTERPOLL LABORATORIES, INC.
(612)786-6020

Metals Results for NSP/Black Dog: Boilers #1, 3 and 4 ESP Inlet Composite Samples

	Test 1 Run 1 (4677-94)		Test 1 Run 2 (4677-95)		Test 1 Run 3 (4677-96)	
ELEMENT	TOTAL UG	% of Total Weight as the Oxide	TOTAL UG	% of Total Weight as the Oxide	TOTAL UG	% of Total Weight as the Oxide
Ag	0.00	0.00000	0.00	0.00000	0.00	0.00000
Al	1880000.00	22.12503	2040000.00	22.14238	1920000.00	23.05630
As	250.00	0.00206	263.00	0.00199	231.00	0.00194
B	7740.00	0.15523	7780.00	0.14391	6920.00	0.14162
Ba	104000.00	0.72316	112000.00	0.71826	107000.00	0.75918
Be	40.00	0.00069	41.40	0.00066	31.20	0.00055
C	61000.00	0.37993	52200.00	0.29985	55100.00	0.35017
Ca	2670000.00	23.26803	2870000.00	23.06738	2530000.00	22.49735
Cd	76.70	0.00055	291.00	0.00191	359.00	0.00261
Cr	1250.00	0.01138	1360.00	0.01142	988.00	0.00918
Cu	3340.00	0.02604	3270.00	0.02351	3020.00	0.02402
Fe	719000.00	6.40209	773000.00	6.34805	719000.00	6.53257
Hg	22.00	0.00015	36.50	0.00023	9.68	0.00007
K	71100.00	0.53346	67700.00	0.46848	60100.00	0.46012
Mg	567000.00	5.85666	609000.00	5.80166	548000.00	5.77577
Mn	1830.00	0.01582	1910.00	0.01523	1550.00	0.01367
Mo	228.00	0.00213	232.00	0.00200	162.00	0.00154
Na	310000.00	2.60263	315000.00	2.43910	288000.00	2.46721
Ni	1130.00	0.00896	1120.00	0.00819	889.00	0.00719
Pb	1240.00	0.00832	2890.00	0.01788	3300.00	0.02259
S	112000.00	1.74196	122000.00	1.75004	110000.00	1.74572
Sb	32.00	0.00024	15.70	0.00011	0.00	0.00000
Se	289.00	0.00253	254.00	0.00205	245.00	0.00219
Si	2670000.00	35.56784	2890000.00	35.50685	2600000.00	35.34126
Sr	37700.00	0.27768	40400.00	0.27445	36300.00	0.27282
V	3200.00	0.03558	3100.00	0.03179	2750.00	0.03120
Zn	2710.00	0.02101	2720.00	0.01945	2200.00	0.01740
Totals	9225177.70	99.76913	9916583.60	99.09683	8996154.88	99.53424

INTERPOLL LABORATORIES, INC.
(612)786-6020

Metals Results for NSP/Black Dog: Boilers #1, 3 and 4 ESP Outlet Samples

	Test 1 Run 1 (4677-69)		Test 1 Run 2 (4677-70)		Test 1 Run 3 (4677-71)	
ELEMENT	TOTAL UG	% of Total Weight as the Oxide	TOTAL UG	% of Total Weight as the Oxide	TOTAL UG	% of Total Weight as the Oxide
Ag	1.80	0.00595	1.50	0.00525	3.70	0.01038
Al	4220.00	24.53505	4600.00	28.31244	5190.00	25.60510
As	1.00	0.00406	1.00	0.00430	1.00	0.00345
B	57.60	0.57071	46.80	0.49089	56.30	0.47336
Ba	326.00	1.11986	243.00	0.88369	105.00	0.30607
Be	0.17	0.00145	0.22	0.00199	0.26	0.00188
C	0.00	0.00000	0.00	0.00000	0.00	0.00000
Ca	6020.00	25.91752	7210.00	32.86073	6290.00	22.97905
Cd	0.80	0.00281	6.20	0.02307	0.80	0.00239
Cr	3.40	0.01529	6.00	0.02857	4.30	0.01641
Cu	17.90	0.06894	67.30	0.27441	16.10	0.05262
Fe	1480.00	6.51033	1800.00	8.38221	1940.00	7.24148
Hg	7.96	0.02645	4.09	0.01439	10.58	0.02983
K	250.00	0.92666	440.00	1.72654	310.00	0.97505
Mg	1280.00	6.53169	1540.00	8.31919	1720.00	7.44781
Mn	8.90	0.03802	10.00	0.04522	10.50	0.03806
Mo	0.00	0.00000	0.00	0.00000	0.00	0.00000
Na	736.00	3.05265	1190.00	5.22506	906.00	3.18869
Ni	5.60	0.02193	24.90	0.10321	4.40	0.01462
Pb	8.00	0.02652	91.00	0.31931	4.00	0.01125
S	358000.00	0.00000	386000.00	0.00000	348000.00	0.00000
Sb	0.00	0.00000	7.81	0.03045	0.00	0.00000
Se	2.00	0.00865	2.00	0.00915	2.00	0.00734
Si						
Sr	110.00	0.40027	111.00	0.42759	89.00	0.27481
V	11.00	0.06042	12.00	0.06978	12.00	0.05593
Zn	28.20	0.10800	216.00	0.87577	43.40	0.14105
Totals	372576.33	69.95323	403630.82	88.43321	364719.34	68.87662

APPENDIX K

SULFUR DIOXIDE DISPOSITION

QA/QC SO_2 Disposition Calculations

A. Maximum Potential SO_2 Emission Factor From Fuel Analysis

Based on the fuel analysis of the coal samples collected on the day of testing, the fuel contained 0.24% sulfur and had a heating value of 8707 BTU/LB. The potential sulfur dioxide emission rate can be caluclated directly from these values:

$$E = \frac{20000 B_s \phi}{HHV}$$

$$E = \frac{20000\,(0.24)\,(1)}{8707} = 0.55\ LB/10^6 BTU$$

$$E = \frac{20000\,(0.24)\,(0.8)}{8707} = 0.44\ LB/10^6 BTU$$

where ϕ = 1 is equivalent to assuming that all the sulfur in the fuel is emitted as SO_2 and ϕ = 0.8 assumes that 0.2 (20%) is retained in the ash (system).

B. From Emission Testing

Since the trace metal train impingers contain peroxide, the SO_2 emission factor can also be calculated from the emission data using the following expression:

$$E = \frac{29.2\, C_s}{20.9 - O_2}$$

Run	Mass (ug) S	Mass (ug) SO_2	V_{std} (Nm^3)	C (ug/Nm^3)	O_2 (%v/v)	E ($LB/10^6$ BTU)
1	358000	715263	1.500	477000	7.10	0.44
2	386000	771205	1.494	516000	6.80	0.47
3	695269	695269	1.469	473000	6.60	0.42

C. Comparison of Emission Factors

The results of the exhaust gas sampling are seen to be in relatively good agreement with the results of the fuel sampling and analysis.