Title V
CRIST ELECTRIC GENERATING PLANT PERMIT APPLICATION

Volume IV

EUS-5

SANDERS ENGINEERING & ANALYTICAL SERVICES, INC.

PARTICULATE EMISSIONS TEST REPORT
STEADY STATE OPERATIONS

FOR

GULF POWER COMPANY
Plant Crist, Unit 4
Pensacola, Florida

April 26, 1995

1568 LEROY STEVENS ROAD

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SEAS

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ENVIRONMENTAL ENGINEERING
AIR & WATER QUALITY MODELING
ENVIRONMENTAL ASSESSMENTS
PSD ANALYSIS
EMERGENCY RESPONSE MONITORING

AMBIENT AIR MONITORING
CONTINUOUS IN-STACK MONITORING
SOURCE TESTING
VISIBLE EMISSIONS TESTING
CONSULTING SERVICES

TEST REPORT CERTIFICATION

In regard to this test, we certify that to the best of our knowledge, all of the data regarding the testing performed by our agents is true and correct.

Sanders Engineering & Analytical Services, Inc.

Dated: 5/5/95

By: Edward R. Harris

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1. INTRODUCTION

Sanders Engineering & Analytical Services, Inc. (SEAS) performed a particulate emissions test during steady state operations at Gulf Power Company, Plant Crist, Unit 4, located in Pensacola, Florida. The testing was conducted on April 26, 1995. The testing was performed in accordance with the applicable U.S. EPA procedures specified at **40 CFR, Part 60, Appendix A, Methods 1, 2, 3, 4, and 17**.

The purpose of the test was to demonstrate compliance with the rules and regulations of the Florida Department of Environmental Protection, and to meet the necessary requirements contained in the permit to operate issued by the Florida Department of Environmental Protection.

The test was conducted by Mr. Edward Harris, Mr. John Wilson, and Mr. Dean Holmes of Sanders Engineering & Analytical Services, Inc., and was coordinated with Mr. John McPherson of Gulf Power Company. The Florida Department of Environmental Protection was notified so their representative could be present to observe the testing.

The test was conducted in accordance with the guidelines of the Florida Department of Environmental Protection. Further discussion of the test methods are included later in the report.

2. SUMMARY AND DISCUSSION OF RESULTS

The results of the particulate emissions test for the steady state runs, along with the results of the computations, are summarized in Table I. The equations used in the calculations of the results, along with the completed field data sheets for the testing, are presented in Appendix A. The sample calculations of the first run are presented in Appendix B. The quality control checks of the equipment used in the sampling program are included in Appendix C.

The results of the testing indicate the particulate emission rate during steady state for Plant Crist, Unit 4, is 0.012 LBS/MMBTU. The applicable Florida Department of Environmental Protection rules and regulations require an emission rate of no greater than 0.10 LBS/MMBTU. The results of the testing indicate that the unit is in compliance with the particulate emission condition of the permit to operate issued by the Florida Department of Environmental Protection.

TABLE I. PARTICULATE EMISSIONS TEST RESULTS
GULF POWER COMPANY
PLANT CRIST, UNIT 4, STEADY STATE
4/26/95

Title of Run		RUN 1	RUN 2	RUN 3
Sampling Time -Start	Military	0752	0918	1045
Sampling Time -Stop	Military	0858	1023	1151
F Factor	SDCF/BTU	9820	9820	9820
Plant Load	Megawatts	82.0	82.0	82.0
Static Pressure	In. H2O	-1.20	-1.20	-1.20
Barometric Pressure	In. Hg	30.21	30.21	30.21
Average dH	In. H20	1.1	1.0	1.1
Meter correction		0.999	0.999	0.999
Avg. Meter Temp.	Deg. F	61.5	69.8	73.4
% O2	%	6.4	6.4	6.6
%CO2	%	12.0	11.5	11.5
Volume Metered	ACF	40.409	38.913	40.766
Volume Water	Ml	68.0	77.0	69.0
Sampling Time	Minutes	64	64	64
Nozzle Diameter	Inches	0.222	0.222	0.222
Avg. Stack Temp.	Deg. F	298.2	302.0	305.2
Area of Stack	Sq. Feet	92.1350	92.1350	92.1350
Wt. of Part.	Mg.	24.0	12.0	9.4
Number of Points		32	32	32
Avg. Sqrt dP	In. H20	0.9029	0.8488	0.8926

RESULTS OF COMPUTATIONS

		RUN 1	RUN 2	RUN 3	Average
Volume of Gas Sampled	SDCF	41.362	39.193	40.794	40.450
H2O vapor in Gas Stream	PERCENT	7.2	8.5	7.4	7.7
Avg. Stack Gas Velocity	FT/SEC	60.1	56.9	59.8	58.9
Volumetric Flow Rate	SDCF/M	216193	200709	212613	209838
Volumetric Flow Rate	ACF/M	332214	314339	330439	325664
Particulate Conc.	Grs/SDCF	0.009	0.005	0.004	0.006
Particulate Conc.	Grs/ACF	0.006	0.003	0.002	0.004
Particulate Mass Rate	Lb/Hr	16.6	8.1	6.5	10.4
Particulate Mass Rate	Lb/MMBtu F Factor	0.018	0.010	0.007	0.012
Heat Input	MMBTU/Hr	916.44	850.80	888.83	885.36
Percent of Isokinetic	%	102.5	104.6	102.8	

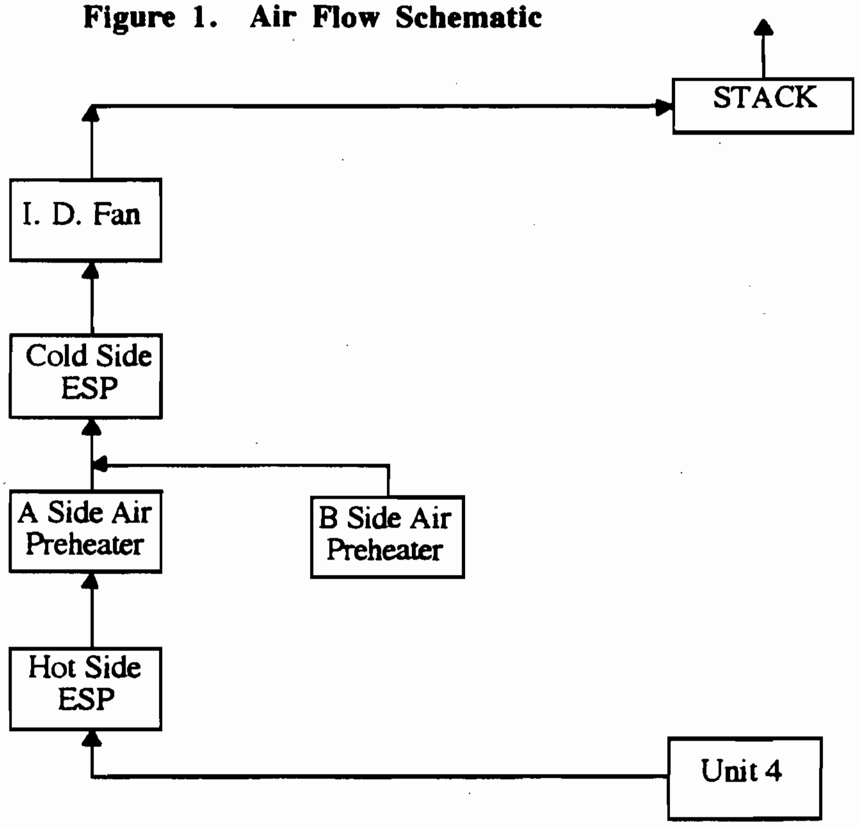
3. PROCESS DESCRIPTION

The process consists of a steam electric generating unit firing bituminous coal for the production of electric energy. The coal is received by barge, and loaded directly onto the conveyor feeding the plant, or onto the stockpile and later loaded onto the conveyor belt transporting the coal to the plant. The coal from the conveyor is loaded into bunkers capable of holding between 36 to 48 hours supply of coal. The coal is then fed to pulverizing mills before being fired in the unit through the burners. Upon combustion of the coal in the fire box, approximately 20 percent of the ash falls to the bottom of the boiler and is removed by the ash removal system. The remaining 80 percent exits with the flue gases through the heat exchange and economizer sections of the furnace, and is collected by electrostatic precipitators.

3.1. Source Air Flow

As shown in Figure I, the flue gases exit the boiler and flow through a hot side precipitator. The exhaust gases are separated into ducts A and B before entering air preheaters. The exhaust gases are combined before entering a cold side ESP. The flue gases exiting the cold side ESP are exhausted through a stack into the atmosphere.

Figure 1. Air Flow Schematic



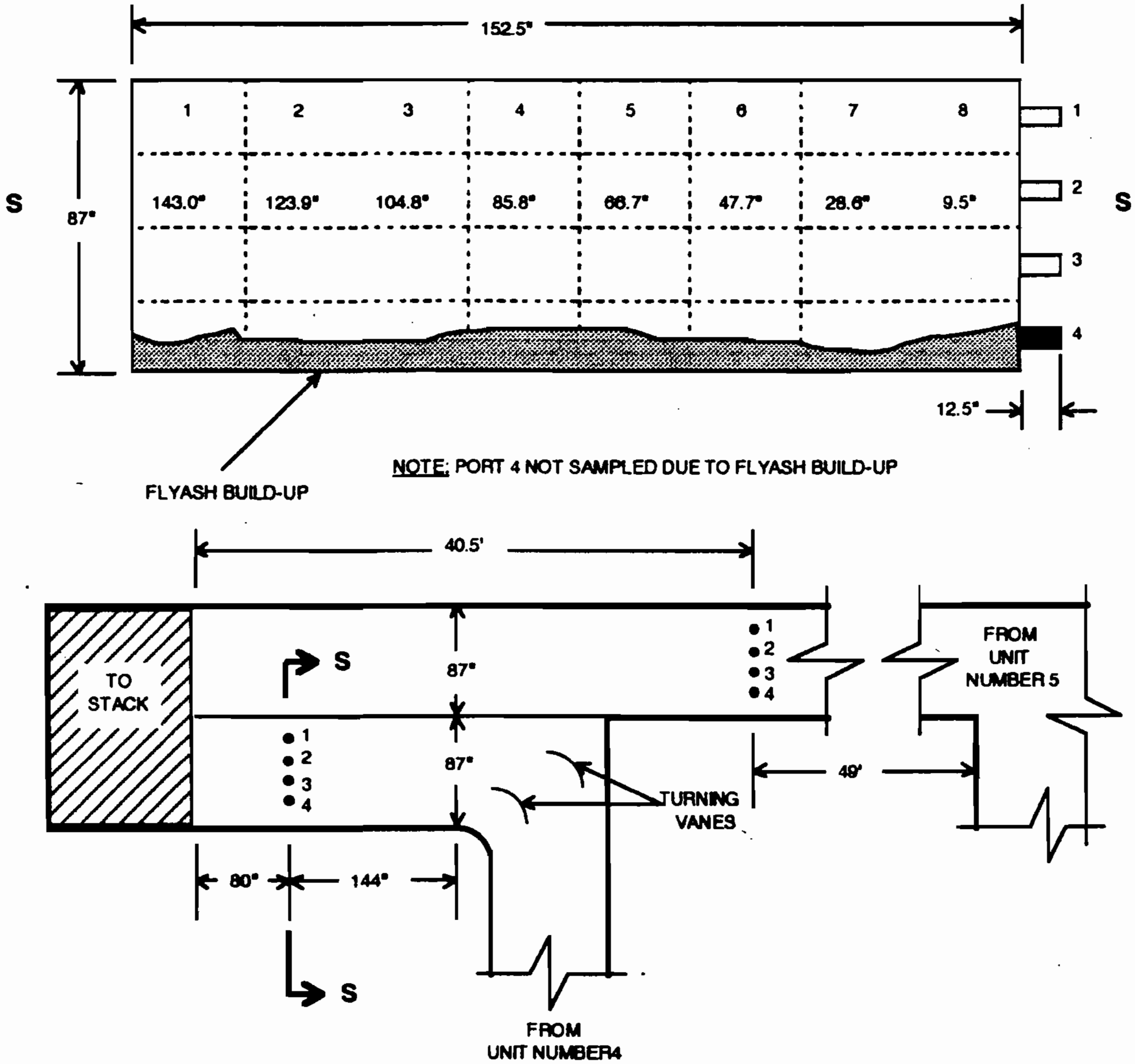
3.2. Operation During Testing

The average heat input during steady state operation, as based on F-factor calculations, was 885.36 million BTU per hour resulting in the production of approximately 82 megawatts of electricity. Precipitator data supplied by Gulf Power personnel is given in Appendix D.

4. SAMPLE POINT LOCATION

The sample point locations and outlet duct schematic are presented in Figure 2. Method 1 was used for determination of the number and location of sampling points. The minimum number of points (25) required for rectangular stacks was met by sampling a total of 32 points.

Figure 2. Sample Point Locations

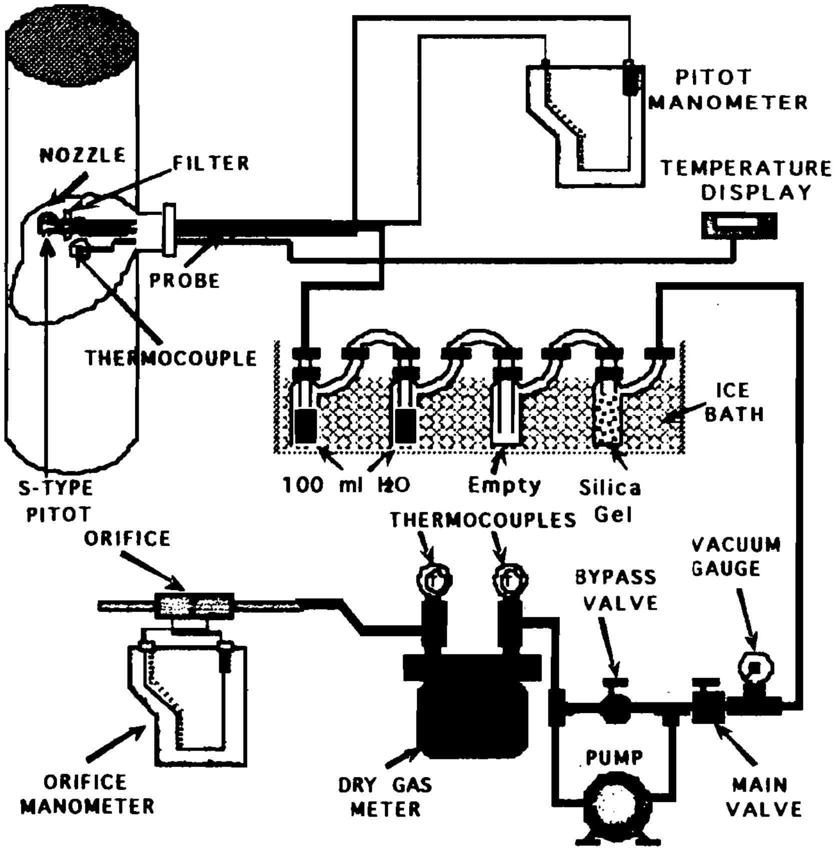


NOTE: PORT 4 NOT SAMPLED DUE TO FLYASH BUILD-UP

5. PARTICULATE SAMPLING PROCEDURE (EPA Method 17)

The sampling procedure utilized is that specified in **40 CFR, Part 60, Appendix A, Method 17,** as modified by the governing regulatory agency. A brief description of this procedure is as follows:

Figure 3. Particulate Sampling Train



The first impingers were partially filled with 100 milliliters of deionized water. The next impinger was left empty to act as a moisture trap. Preweighed 6 to 16 mesh indication silica gel was added to the last impinger. The sampling equipment manufactured by Lear Siegler (Model 100) or Sanders Engineering (Model 200) was assembled as shown in the attached drawing. The system was leak checked by plugging the inlet to the nozzle and pulling a 15 inch mercury vacuum. A leakage rate not in excess of 0.02 cubic feet per minute was considered acceptable.

The inside dimensions of the stack liner were measured and recorded. The required number of sampling points were marked on the probe for easy visibility. The range of velocity pressure, the percent moisture, and the temperature of the effluent gases were determined. From this data, the correct nozzle size and the nomograph multiplication factor were determined.

Crushed ice was placed around the impingers. The nozzle was placed on the first traverse point with the tip pointing directly into the gas stream. The pump was started immediately and the flow was adjusted to isokinetic sampling conditions. After the required time interval had elapsed, the probe was repositioned to the next traverse point and isokinetic sampling was re-established. This was performed for each point until the run was completed. Readings were taken at each point and recorded on the field data sheet. At the conclusion of each run, the pump was turned off and the final readings were recorded.

5.1. Particulate Sample Recovery

Care was exercised in moving the collection train to the sample recovery area to minimize the loss of collected sample, or the gain of extraneous particulate matter. The volume of water in the impingers was measured, the silica gel impinger was weighed and recorded on the field data sheet. The nozzle, and all sample-exposed surfaces were washed with reagent grade acetone into a clean sample container. A brush was used to loosen any adhering particulate matter and subsequent washings were placed into the container. The filter was carefully removed from the fritted support and placed in a clean separate sample container. A sample of the acetone used in the washing was saved for a blank laboratory analysis.

5.2. Particulate Analytical Procedures

The filter and any loose particulate matter were transferred from the sample container to a clean, tared weighing dish. The filter was placed in a desiccator for at least 24 hours and then weighed to the nearest 0.1 milligram until a constant weight was obtained. The original weight of the filter was deducted, and the weight gain was recorded to the nearest 0.1 milligram.

The wash solution was transferred to a clean, tared beaker. The solution was evaporated to dryness, desiccated to a constant weight, and the weight gain was recorded to the nearest 0.1 milligram.

APPENDIX A EQUATIONS AND FIELD DATA SHEETS

EQUATIONS

1. $$P_s = P_{bar} + \frac{P_g}{13.6}$$

2. $$P_m = P_{bar} + \frac{\overline{\Delta H}}{13.6}$$

3. $$V_s = K_p C_p \overline{\sqrt{\Delta P}} \sqrt{\frac{\overline{T_s}}{M_s P_s}}$$

4. $$V_{m(Std)} = K_1 V_m Y \left[\frac{P_{bar} + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right]$$

5. $$V_{w(Std)} = 0.04707 \, V_{lc}$$

6. $$B_{ws} = \frac{V_{w(Std)}}{V_{m(Std)} + V_{w(Std)}}$$

7. $$M_d = 0.44 (\%CO_2) + 0.32 (\%O_2) + 0.28 (\%N_2 + \%CO)$$

8. $$M_s = M_d(1 - B_{ws}) + 18 (B_{ws})$$

9. $$EA = \left[\frac{(\%O_2 - 0.5 (\%CO))}{0.264 (\%N_2) - ((\%O_2) - 0.5 (\%CO))} \right] 100$$

10. $Q_a = (V_s)(A_s)(60)$

11. $Q_s = Q_a (1 - B_{ws}) \frac{(528)}{\overline{T}_s} \frac{(P_s)}{29.92}$

12. $E_H = \left(\frac{PMR}{H_I} \right)$

13. $E = C_d F_{O_2} \left(\frac{20.9}{20.9 - \%O_2} \right)$

14. $C_s = 0.0154 \frac{M_n}{V_{m(Std)}}$

15. $C_{50} = \frac{21 C_s}{21 - [(1.5)(\%O_2) - 0.133 (N_2) - 0.75 (\%CO)]}$

16. $C_{12} = \frac{C_s (12)}{\%CO_2}$

17. $PMR = (C_s)(Q_s) \frac{(60)}{7000}$

18. $V_n = \left[(0.002669)(V_{1c}) + \frac{V_m Y}{\overline{T}_m} \left(P_{bar} + \frac{\overline{\Delta H}}{13.6} \right) \right] \frac{\overline{T}_s}{P_s}$

19. $I = \frac{100 V_n}{(60) \O V_s A_n}$

NOMENCLATURE

A_n = Cross-sectional area of nozzel, ft ^{2}

A_s = Cross sectional area of stack, ft ^{2}

B_{ws} = Wator vapor in the gas stream, proportion by volume (dimensionless)

C_p = Pitot tube coefficient (dimensionless) (0.84)

C_s = Particulate concentration, grains/SDCF

C_d = Particulate concentration, lbs/SDCF

C_{12} = Particulate concentration (C_s adjusted to 12% CO) grains/SDCF

C_{50} = Particulate concentration (C_s adjusted to 50% excess air) grains/SDCF

EA = Excess air, %

E = Emission in lb/mmBTU

E_H = Emission in lb/mmBTU, based on heat input

H_I = Total Heat Input, Million BTU per Hour (MMBTU/hr)

I = Percent of isokinetic sampling

K_1 = 17.64 °R/ inches Hg

K_p = Pitot tube constant,

$$85.49 \text{ ft/sec} \left[\frac{\text{(lb/lb-mole) (in. Hg)}}{\text{(°R) (inc. } H_2O)} \right]^{\frac{1}{2}}$$

M_n = Total amount of particulate collected, mg

M_d = Molecular weight of stack gas; dry basis, lb/lb mole

M_s = Molecular weight of stack gas; wet basis, lb/lb mole

P_{bar} = Barometric pressure at the sampling site, in. Hg

NOMENCLATURE (continued)

P_m = Meter pressure, in. Hg

P_s = Absolute stack pressure, in. Hg

P_g = Stack static pressure, in. H_2O
PMR = Particulate mass rate, lb/Hr

Q_a = Volumetric flow rate ACFM

Q_s = Volumetric flow rate SDCFM

V_s = Average stack gas velocity, ft/sec

V_{lc} = Total volume of liquid collected in impingers & silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, ACF

$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, corrected to standard conditions, SDCF

$V_{w(std)}$ = Volume of water vapor in gas sample, corrected to standard conditions, SCF

V_n = Volume collected at stack conditions through nozzle, ACF

Y = Dry gas meter calibration factor (dimensionless)

ΔH = Average pressure difference of orifice, in. H_2O

ΔP = Velocity head of stack gas, in. H_2O

$\overline{\sqrt{\Delta P}}$ = Average of square roots of the velocity pressure, in. H_2O

Ø = Total sampling time, minutes

$\%CO_2$, $\%O_2$, N_2, $\%CO$ - Number % by volume, dry basis, from gas analysis

F_{O_2} = Oxygen based F factor (9820 SDCF/mmBTU for bituminous coal)

T_s = Temperature of the stack, °R (° F + 460)

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FIELD DATA SHEET

COMPANY GPCO DATE 4/26/95 DGM# S-101

PLANT Crist OPERATOR EWH ΔH@ 0.75 cu. ft./min.

UNIT #4 S.S. METHOD 17 PROBE N/A liner 14' length

RUN 1

NOZZLE CALIBRATION

PRE	POST
.222	.222
.222	.222
.222	.222
.222	.222
AVERAGE	AVERAGE

FILTER NUMBER 612

METER READING

964.509 FINAL
924.100 INITIAL
40.409 NET

LEAK CHECK

SYSTEM Pre	SYSTEM Post	PITOT Pre	PITOT Post
15 in. Hg	10 in. Hg	☑ impact	☑ impact
0.000 cfm	0.000 cfm	☑ static	☑ static

VOLUME OF LIQUID WATER COLLECTED

	IMP. 1	IMP. 2	IMP. 3	IMP. 4
FINAL	158	100	0	1475.0
INITIAL	100	100	0	1465.0
NET	58	0	0	10.0

TOTAL 68.0

GAS ANALYSIS

O_2 6.4 %
CO_2 12.0 %
CO –

STATIC -1.20 in. H_2O

BAROMETRIC 30.21 in. Hg

RUN 2

NOZZLE CALIBRATION

PRE	POST
.222	.222
.222	.222
.222	.222
.222	.222
AVERAGE	AVERAGE

FILTER NUMBER 613

METER READING

1008.313 FINAL
969.400 INITIAL
38.913 NET

LEAK CHECK

SYSTEM Pre	SYSTEM Post	PITOT Pre	PITOT Post
15 in. Hg	10 in. Hg	☑ impact	☑ impact
0.000 cfm	0.000 cfm	☑ static	☑ static

VOLUME OF LIQUID WATER COLLECTED

	IMP. 1	IMP. 2	IMP. 3	IMP. 4
FINAL	168	100	0	1385.0
INITIAL	100	100	0	1376.0
NET	68	100	0	9.0

TOTAL 77.0

GAS ANALYSIS

O_2 6.4 %
CO_2 11.5 %
CO –

STATIC -1.20 in. H_2O

BAROMETRIC 30.21 in. Hg

RUN 3

NOZZLE CALIBRATION

PRE	POST
.222	.222
.222	.222
.222	.221
.222	.222
AVERAGE	AVERAGE

FILTER NUMBER 614

METER READING

49.366 FINAL
8.600 INITIAL
40.766 NET

LEAK CHECK

SYSTEM Pre	SYSTEM Post	PITOT Pre	PITOT Post
15 in. Hg	10 in. Hg	☑ impact	☑ impact
0.000 cfm	0.000 cfm	☑ static	☑ static

VOLUME OF LIQUID WATER COLLECTED

	IMP. 1	IMP. 2	IMP. 3	IMP. 4
FINAL	164	100	0	1480.0
INITIAL	100	100	0	1475.0
NET	64	0	0	5.0

TOTAL 69.0

GAS ANALYSIS

O_2 6.6 %
CO_2 11.5 %
CO –

STATIC -1.20 in. H_2O

BAROMETRIC 30.21 in. Hg

PORT #	TIME	GAS METER VOL. (cu.ft.)	VEL. HEAD ΔP in.H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #					STACK	PROBE	HOT BOX	IMP.	GAS METER		
									IN	OUT	
1 - 1	7:52	924.100	1.20	1.58	299	N/A	N/A	50	58	58	5
2	:54	925.500	1.20	1.58	299			✓	58	58	4.5
3	:56	926.900	1.06	1.39	298			✓	59	59	4
4	:58	928.300	1.0	1.31	298			✓	59	59	4
5	8:00	929.600	1.0	1.31	298			✓	59	59	4
6	:02	931.100	0.78	1.02	297			47	60	59	3
7	:04	932.350	0.75	0.98	298			✓	60	59	3
8	:06	933.600	0.76	1.00	297			✓	60	59	3
1 - 1	:08	934.850	1.35	1.77	298			✓	60	59	5
2	:10	936.200	0.99	1.30	298			✓	60	59	4
3	:12	937.800	1.05	1.38	298	N/A	N/A	✓	60	60	4
4	:14	939.100	1.09	1.43	298			✓	61	61	4.5
5	:16	940.500	0.86	1.13	297			✓	61	61	4
6	:18	941.900	0.75	0.98	298			✓	61	61	3
7	:20	943.000	0.75	0.98	298			50	61	61	3
8-	:22	944.100	0.72	0.94	297			✓	61	61	3
2 - 1	8:25	945.492	0.96	1.26	298			✓	62	62	4
2	:27	946.700	0.87	1.14	298			✓	62	62	4
3	:29	948.000	1.09	1.43	299			✓	62	62	5
4	:31	949.400	0.92	1.21	299			✓	62	62	4
5	:33	950.750	0.75	0.98	299			✓	63	62	3.5
6	:35	952.000	0.70	0.92	299			✓	63	62	3.5
7	:37	953.250	0.60	0.79	299			50	64	63	3.0
8	:39	954.350	0.69	0.91	298			✓	64	63	3.5

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/26/95

SITE Ciist #4 S.S. RUN # 1 PAGE 2 OF 7

PORT #		GAS METER VOL. (cu. ft.)	VEL. HEAD ΔP in. H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #	TIME				STACK	PROBE	HOT BOX	IMP.	GAS METER IN	GAS METER OUT	
3 - 1	8:42	955.610	0.65	0.85	297	N/A	N/A	50	64	64	3.5
2	:44	957.000	0.65	0.85	298			✓	64	64	4
3	:46	957.950	0.45	0.59	298			✓	64	64	3
4	:48	958.950	0.42	0.55	299			✓	64	64	3
5	:50	960.050	0.55	0.72	300			✓	64	64	3
6	:52	960.950	0.59	0.78	299			✓	64	64	3.5
7	:54	962.000	0.63	0.83	299			✓	64	64	4
8	:56	963.300	0.74	0.97	296			✓	64	64	4
Final	8:56	964.509									
			0.903	1.089	298.2						

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/26/95

SITE Crist #4 S.S. RUN # 1 PAGE 3 OF 7

PORT #	TIME	GAS METER VOL. (cu. ft.)	VEL. HEAD ΔP in. H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #					STACK	PROBE	HOT BOX	IMP.	GAS METER IN	GAS METER OUT	
3 - 1	9:18	969.400	0.69	0.91	300	N/A	N/A	50	67	67	2
2	:20	970.500	0.70	0.93	300			✓	67	67	2
3	:22	971.750	0.45	0.59	301			✓	67	67	2
4	:24	972.800	0.43	0.57	301			✓	67	67	2
5	:26	973.800	0.55	0.73	301			✓	68	68	2
6	:28	974.950	0.60	0.79	302			✓	68	68	2
7	:30	976.000	0.60	0.79	301			✓	68	68	2
8	:32	977.100	0.73	0.97	299			49	68	68	3
3 - 1	:34	978.250	0.71	0.94	299			✓	69	69	3
2	:36	979.400	0.60	0.79	301			✓	69	69	3
3	:38	980.600	0.49	0.65	301			✓	69	69	2
4	:40	981.600	0.45	0.59	301			✓	69	69	2
5	:42	982.600	0.61	0.81	302			✓	70	69	2.5
6	:44	983.800	0.58	0.77	302			✓	70	70	2.5
7	:46	984.800	0.55	0.73	301			✓	70	70	2.5
8	9:48	985.900	0.63	0.83	300			✓	70	70	3
2 - 1	9:51	987.088	0.83	1.10	303			✓	70	70	3.5
2	:53	988.300	0.95	1.26	303			52	70	70	4
3	:55	989.600	1.0	1.33	304			✓	70	70	4
4	:57	991.100	0.78	1.03	303			✓	70	70	4
5	:59	992.500	0.74	0.98	303			✓	71	70	4
6	10:01	993.700	0.65	0.86	303			✓	71	70	3
7	:03	994.800	0.65	0.86	302			✓	71	71	3
8	10:05	996.000	0.71	0.94	302			✓	71	71	3.5

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/26/95

SITE Crist #4 S.S. RUN # 2 PAGE 4 OF 7

PORT #		GAS METER VOL. (cu.ft.)	VEL. HEAD ΔP in.H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #	TIME				STACK	PROBE	HOT BOX	IMP.	GAS METER IN	GAS METER OUT	
1- 1	10:07	997.195	1.40	1.86	304	N/A	N/A	54	72	71	5.5
2	:09	998.800	1.10	1.46	304			✓	72	71	5
3	:11	1000.200	1.18	1.57	305			✓	72	72	5
4	:13	1.750	1.12	1.50	304			✓	72	72	5
5	:15	3.200	1.0	1.34	304			✓	72	72	5
6	:17	4.600	0.76	1.02	303			✓	72	72	4
7	:19	5.900	0.66	0.88	303			✓	72	72	3
8	:21	7.000	0.66	0.88	303			✓	72	72	3
Final	10:23	1008.313									
			0.8488		302.0				69.8		

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/26/95

SITE Crist # 4 S.S. RUN # 2 PAGE 5 OF 7

PORT #	TIME	GAS METER VOL. (cu. ft.)	VEL. HEAD ΔP in. H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #					STACK	PROBE	HOT BOX	IMP.	GAS METER		
									IN	OUT	
1- 1	10 :45	8.600	1.55	2.04	306	N/A	N/A	50	72	72	7
2	:47	10.300	1.14	1.50	305			✓	72	72	5
3	:49	11.900	1.15	1.51	306			✓	72	72	5
4	:51	13.300	1.03	1.34	306			✓	73	72	5
5	:53	14.800	1.08	1.48	306			✓	73	72	5
6	:55	16.400	0.71	0.92	306			✓	73	72	4
7	:57	17.500	0.67	0.87	305			✓	73	73	3.5
8	:59	18.800	0.64	0.83	305			✓	73	73	3
2- 1	11 :02	19.810	1.25	1.63	305			✓	73	73	5
2	:04	21.400	1.0	1.30	306			47	73	72	5
3	:06	22.700	1.04	1.36	306			✓	73	72	5
4	:08	24.300	0.80	1.04	306			✓	74	73	4
5	:10	25.500	0.75	0.98	305			✓	74	73	4
6	:12	26.600	0.61	0.79	305			✓	74	74	3
7	:14	27.800	0.55	0.72	305			✓	74	74	3
8	:16	28.960	0.72	0.94	303			✓	74	74	4
2- 1	11 :18	30.100	1.28	1.68	305			✓	74	74	6
2	:20	31.600	0.85	1.11	305			✓	74	74	5
3	:22	33.000	1.05	1.38	306			49	74	73	5
4	:24	34.300	0.79	1.03	306			✓	74	73	4
5	:26	35.500	0.74	0.97	306			✓	74	74	4
6	:28	36.700	0.63	0.82	306			✓	74	73	4
7	:30	37.850	0.60	0.78	305			✓	74	73	3
8	:32	39.100	0.70	0.92	304			✓	74	74	4

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/26/95

SITE Crist #4 S.S. RUN # 3 PAGE 6 OF 7

PORT #		GAS METER VOL. (cu. ft.)	VEL. HEAD ΔP in. H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #	TIME				STACK	PROBE	HOT BOX	IMP.	GAS METER		
									IN	OUT	
3 - 1	11 :35	40.375	0.60	0.78	305	n/a	n/a	50	74	74	4
2	:37	41.500	0.65	0.85	304			✓	74	74	4
3	:39	42.700	0.76	0.99	304			✓	74	74	4
4	:41	44.000	0.45	0.59	305			✓	74	74	3
5	:43	44.900	0.55	0.72	306			✓	74	74	3.5
6	:45	46.100	0.59	0.77	305			✓	74	74	3.5
7	:47	47.150	0.52	0.68	305			✓	74	74	3
8	:49	48.150	0.65	0.85	305			✓	74	74	4
Final	11:51	49.366									
									73.4		

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/26/95

SITE Crist #4 S.S. RUN # 3 PAGE 1 OF 2

LABORATORY ANALYSIS & CHAIN OF CUSTODY

COMPANY/PLANT: Gulf Power /Crist

UNIT #: 4 DATE OF TEST: 4/25 - 4/26/95 TYPE OF TEST: ☐ M-5 ☒ M-17 ☐ OTHER ______

SAMPLE #	RELINQUISHED BY	RECEIVED BY	TIME	DATE	REASON FOR CHANGE
609 & Wash					
610 & Wash					
611 & Wash		EKH	1000 am	4/28/95	
612 & Wash	EKH				no change
613 & Wash					
614 & Wash					

UNIT # 4 Soot Blow

RUN # 1	FILTER # 609	BEAKER # 3 WASH (ML) 45
FINAL WEIGHT	134.40mg	64480.8 mg
INITIAL WEIGHT	122.3 mg	64477.5 mg
DIFFERENCE	12.1	3.3
CORRECTED TOTAL WEIGHT		15.4
RUN # 2	FILTER # 610	BEAKER # 6 WASH (ML) 40
FINAL WEIGHT	132.30mg	68390.9mg
INITIAL WEIGHT	123.6 mg	68389.2 mg
DIFFERENCE	8.7	1.7
CORRECTED TOTAL WEIGHT		10.4
RUN # 3	FILTER # 611	BEAKER # 21 WASH (ML) 50
FINAL WEIGHT	131.0 mg	70058.8mg
INITIAL WEIGHT	123.2 mg	70056.6mg
DIFFERENCE	7.8	2.2
CORRECTED TOTAL WEIGHT		10.0
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		

UNIT # 4 Steady State

RUN # 1	FILTER # 612	BEAKER # 32 WASH (ML) 60
FINAL WEIGHT	142.20 mg	64728.3 mg
INITIAL WEIGHT	121.7mg	64724.8 mg
DIFFERENCE	20.5	3.5
CORRECTED TOTAL WEIGHT		24.0
RUN # 2	FILTER # 613	BEAKER # 35 WASH (ML) 60
FINAL WEIGHT	131.4mg	68566.2mg
INITIAL WEIGHT	122.1mg	68563.5mg
DIFFERENCE	9.3	2.7
CORRECTED TOTAL WEIGHT		12.0
RUN # 3	FILTER # 614	BEAKER # 36 WASH (ML) 65
FINAL WEIGHT	129.4mg	67936.9
INITIAL WEIGHT	122.1 mg	67934.8 mg
DIFFERENCE	7.3	2.1
CORRECTED TOTAL WEIGHT		9.4
WASH SOLVENT BLANK (ML)	____	BEAKER # 47 WASH (ML) 100
FINAL WEIGHT		68998.9mg
INITIAL WEIGHT		68998.9mg
DIFFERENCE		0.0
CORRECTION FACTOR (MG/ML)		

ALL WEIGHTS ARE IN MILLIGRAMS (MG)

APPENDIX B SAMPLE CALCULATIONS

Input and Constants

$$f := \frac{9820\ ft^{3}}{mm\ btu}$$

$pg := -(1.2\ in.\ H2O)$

$pbar := 30.21\ in.\ Hg.$

$\Delta havg := 1.1\ in.\ H2O$

$y := 0.999$

$tm := 61.5\ °F$

$o2 := 6.4$

$co2 := 12.$

$vm := 40.409\ ft^{3}$

$vlc := 68.\ ml$

$theta := 64\ min$

$nozdia := 0.222\ in.$

$ts := 298.2\ °F$

$as := 92.135\ ft^{2}$

$mn := 24.\ mg$

$numberofpoints := 32$

$sqrt\Delta p := 0.9029\ in.\ H2O^{0.5}$

$$kp := \frac{85.49\ 1\ ft\ 1\ \left(\frac{lb\ in.\ Hg.}{lb\text{-}mole\ °R\ in.\ H2O}\right)^{0.5}}{1\ sec}$$

$cp := 0.84$

$$k1 := \frac{17.64\ °R}{in.\ Hg.}$$

$$ts = \frac{(ts + 460\ °F)\ °R}{°F}$$

758.2 °R

$$tm = \frac{(tm + 460\ °F)\ °R}{°F}$$

521.5 °R

$$n2 = 100 - o2 - co2$$

81.6

$$an = \frac{nozdia^2\ 3.1416}{4\ (\frac{12\ in.}{ft})^2}$$

$0.000268803\ ft^2$

Calculations

Equation 1

$$ps = pbar + \frac{pg}{\frac{13.6\ in.\ H2O}{1\ in.\ Hg.}}$$

30.1218 in. Hg.

Equation 2

$$pm = pbar + \frac{\Delta havg}{\frac{13.6\ in.\ H2O}{in.\ Hg.}}$$

30.2909 in. Hg.

Equation 3

$$vmstd = \frac{k1\ vm\ y\ (pbar + \frac{\Delta havg}{\frac{13.6\ in.\ H2O}{in.\ Hg.}})}{tm}$$

$41.3618\ ft^{3}$

Equation 4

$$vwstd = \frac{0.04707\ ft^{3}\ vlc}{ml}$$

$3.20076\ ft^{3}$

Equation 5

$$bws = \frac{vwstd}{vmstd + vwstd}$$

0.0718262

Equation 6

$$md = \frac{(0.44\ co2 + 0.32\ o2 + 0.28\ n2)\ lb}{lb\text{-}mole}$$

$$\frac{30.176\ lb}{lb\text{-}mole}$$

Equation 7

$$ms = md\ (1 - bws) + \frac{bws\ 18\ lb}{lb\text{-}mole}$$

$$\frac{29.3014\ lb}{lb\text{-}mole}$$

Equation 8

$$vs = kp\ cp\ sqrt\Delta p\ \left(\frac{ts}{ms\ ps}\right)^{0.5}$$

$$\frac{60.0954\ ft}{sec}$$

Equation 9

$$qa = \frac{vs\ as\ 60\ sec}{min}$$

$$\frac{332214.\ ft^{3}}{min}$$

Equation 10

$$qs = \frac{qa\ (1 - bws)\ 528\ {}^{\circ}R\ ps}{ts\ 29.92\ in.\ Hg.}$$

$$\frac{216180.\ ft^{3}}{min}$$

Equation 11

```
     0.0154 gr mn
cs = ------------
       mg vmstd

0.00893577 gr
-------------
       3
     ft
```

Equation 12

```
      cs qs 60 min
pmr = ------------
           7000 gr
      hour -------
             lb

16.5577 lb
----------
   hour
```

Equation 13

```
      cs f 20.9 1 lb
e = -------------------
    (20.9 - o2) 7000 gr

0.0180686 lb
------------
   mm btu
```

Equation 14

```
                            3
         0.002669 in. Hg. ft   vlc   vm y pm
     ts (------------------------ + -------)
                   ml °R              tm
vn = -----------------------------------------
                       ps

          3
63.5891 ft
```

Equation 15

$$i = \frac{100\ \%\ vn}{\frac{60\ sec\ theta\ vs\ an}{min}}$$

102.512 %

Equation 16

$$hi = \frac{pmr}{e}$$

$$916.383\ \frac{mm\ btu}{hour}$$

APPENDIX C QUALITY CONTROL

INITIAL
METER CALIBRATION FORM - DGM

DATE: 12-27-94 Box No. S-101

Ref. DGM Ser. # 1044456 Calibrated By EDWARD HARRIS

RUN #	1	2	3	4	5
DELTA H (DGM)	0.50	1.00	1.50	2.00	2.50
Y (Ref. DGM)	0.985	0.985	0.985	0.985	0.985
Reference DGM					
Gas Vol. Initial	973.200	979.920	985.000	990.895	996.540
Gas Vol. Final	979.920	985.000	990.895	996.540	1003.024
Meter Box DGM					
Gas Vol. Initial	878.100	884.800	889.855	895.700	901.300
Gas Vol. Final	884.800	889.855	895.700	901.300	907.700
Reference DGM					
Temp.	Avg.	Avg.	Avg.	Avg.	Avg.
Deg F Initial	44	49	54	57	57
Deg F Final	49	49	57	57	57
Meter Box DGM					
Temp. Initial In	43	47	50	54	54
Temp. Initial Out	43	47	50	54	54
Temp. Final In	47	47	54	54	54
Temp. Final Out	47	47	54	54	54
P Bar IN: Hg	30.20	30.20	30.20	30.20	30.20
Time (sec.)	959	527	502	416	432
Meter Calibration Factor (Y)	0.999	0.999	0.998	0.997	1.001
Qm (C.F.M.)	0.442	0.606	0.729	0.839	0.928
Km (Std Pressure)	0.825	0.797	0.779	0.777	0.769
DELTA Ha	1.51	1.60	1.65	1.65	1.68
Average Y (Meter Calibration Factor				0.999	
Average Km (Standard Pressure)				0.789	
Average DELTA Ha of Orifice				1.617	

Y= ≤ .03
Max & Min ≤ .02 from Avg
Final Avg within 5% of Initial Avg
ΔHa = Max & Min ≤ .2 from Avg

FINAL
METER CALIBRATION FORM - DGM

DATE:	05-05-95	Box No.	S-101
Ref. DGM Ser. #	1044453	Calibrated By	Edward Harris

RUN #	1	2	3
DELTA H (DGM)	1.5	1.5	1.5
Y (Ref. DGM)	0.995	0.995	0.995
Reference DGM			
Gas Vol. Initial	716.400	722.300	728.395
Gas Vol. Final	722.300	728.395	735.398
Meter Box DGM			
Gas Vol. Initial	778.600	784.484	790.565
Gas Vol. Final	784.484	790.565	797.520
Reference DGM			
Temp.	Avg.	Avg.	Avg.
Deg F Initial	79	79	80
Deg F Final	79	79	80
Meter Box DGM			
Temp. Initial In	80	80	80
Temp. Initial Out	80	80	80
Temp. Final In	80	80	80
Temp. Final Out	80	80	80
P Bar IN. Hg	30.10	30.10	30.10
Time (sec.)	488	506	580
Meter Calibration Factor (Y)	0.996	0.995	0.998
Qm (C.F.M.)	0.711	0.709	0.709
Km (Std Pressure)	0.740	0.737	0.738
DELTA Ha	1.63	1.64	1.64

Average Y (Meter Calibration Factor)	0.997
Initial Y (Meter Calibration Factor)	0.999
Percent Error	0.20%
Average Km (Standard Pressure)	0.738
Average DELTA Ha of Orifice	1.64

MAGEHELIC CALIBRATION

BOX	175	S101	173	S-318	C-133
SER. NO.	R01126 YC2	R-22D	R20208 A617	R74D	91126A M91
RANGE	0-2	0-2	0-2	0-5	0-2
REFERENCE READING	FIELD DEVICE READING				
0.000	0.00	0.00	0.00		0.00
0.050					
0.150					
0.200					
0.250					
0.450					
0.50	0.49	0.50			0.500
1.00	1.00	0.97			1.000
1.30					
1.80	1.77	1.77			1.83
2.50					
4.50					
5.0					
9.0					
13.0					
22.0					

SIGNATURE: Edward L. Harris

DATE: 12/23/94

MAGEHELIC CALIBRATION

BOX	460	S-100	2879		
SER. NO.	91127W W137		R-33D		
RANGE	0-2	0-2	0-2		
REFERENCE READING	FIELD DEVICE READING				
0.000	0.00	0.00	0.00		
0.050					
0.150					
0.200					
0.250					
0.450					
0.50	0.50	0.52	0.51		
1.00	1.00	1.02	1.00		
1.30					
1.80	1.83	1.83	1.77		
2.50					
4.50					
5.0					
9.0					
13.0					
22.0					

SIGNATURE: Edward L. [illegible]

DATE: 12/23/94

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MAGEHELIC CALIBRATION

BOX #1

SER. NO.	10720-AB68	R1061-6AG48	R5031-SE376	R1062-9JA82	R1051-3MR42	R90124 RI119
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING			FIELD DEVICE READING			
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.050	0.050					
0.150	0.150	0.150				
0.200	0.200					
0.250		0.250				
0.450		0.450				
0.50			0.50			
1.00			1.00			
1.30				1.30		
1.80			1.80			
2.50				2.50	2.5	
4.50				4.50		
5.0					5.0	5.0
9.0					9.0	
13.0						14.0
22.0						21.0

SIGNATURE: [illegible] L. Harris

DATE: [illegible]

MAGEHELIC CALIBRATION
BOX #2

SER. NO.	10819-DR2	R1090-2AG18	R50315-EB93	R1062-9TA87	30830-AM79	R1072-2MC5
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING			FIELD DEVICE READING			
0.000	0.0001	0.0001	0.00	0.00	0.0	0.0
0.050	0.058					
0.150	0.161	0.151				
0.200	0.210					
0.250		0.255				
0.450		0.450				
0.50			0.51			
1.00			1.02			
1.30				1.32		
1.80			1.82			
2.50				2.61	2.6	
4.50				4.52		
5.0					5.0	5.2
9.0					8.9	
13.0						13.0
22.0						21.7

SIGNATURE: [illegible] L. Harris

DATE: [illegible]

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MAGEHELIC CALIBRATION

BOX #3

SER. NO.	R900723 MRR1	R0112642	R10608 CF20	
RANGE	0-0.50	0-2.0	0-10	
REFERENCE READING	FIELD DEVICE READING			
0.000	0.001	0.00	0.0	
0.050				
0.150	0.15			
0.200				
0.250	0.240			
0.450	0.450			
0.50		0.52		
1.00		1.00		
1.50				
1.80		1.85		
2.50			2.5	
4.50				
5.0			5.0	
9.0			9.2	
13.0				
22.0				

SIGNATURE: [illegible] L. Harris

DATE: [illegible]

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MAGEHELIC CALIBRATION

BCX #4

SER. NO.	R22D	R90051 6GT21	R90101 SCD102
RANGE	0-0.50	0-3	0-25
REFERENCE READING	FIELD DEVICE READING		
0.000	0.000	0.00	0.0
0.050			
0.150	0.154		
0.200			
0.250	0.256		
0.450	0.455		
0.50			
1.00			
1.30		1.32	
1.80			
2.50		2.55	
4.50		4.59	
5.0			5.0
9.0			
13.0			13.0
22.0			22.0

SIGNATURE: Harris

DATE: 12/02/94

TEMPERATURE CALIBRATIONS - DEGREES FAHRENHEIT

REFERENCE DEVICE READING*	0 DEG. F	210 DEG.	420 DEG.	630 DEG.	840 DEG.	1050 DEG.	1260 DEG.	1470 DEG.	1680 DEG.	1900 DEG.
2879	-2	209	420	629	838	1049	1259	1469	1679	1899
METER BOX #1 C-133 11580	0	209	416	624	833	1044	1255	1462	1674	1900
METER BOX #3 C-173 S11-24										
METER BOX #2 C-175 15962	0	208	417	628	839	1052	1265	1474	1678	1905
METER BOX #4 D-460 15751	0	206	417	624	839	1057	1273	1486	1690	1903
METER BOX #5 S-100 15751	-2	203	412	622	837	1055	1272	1484	1690	1900
METER BOX #6 S-101 15751	0	209	416	624	833	1045	1255	1463	1679	1904
PORTABLE THERMOCOUPLE # 1 (Yellow)	0	210	419	632	840	1050	1260	1470	1680	1900
PORTABLE THERMOCOUPLE # 2 (Blue)	0	209	416	625	839	1055	1270	1480	1684	1891
PORTABLE THERMOCOUPLE # 2 (Green)										
PINK T83658	0	209	417	629	843	1060	1275	1490	1693	1903

DATE: 12-27-94 **SIGNATURE:** Edward L Harris

* Reference Device is an Omega Engineering CL505-A calibrated reference thermocouple-potentiometer system.

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SANDERS ENGINEERING &
ANALYTICAL SERVICES, Inc.

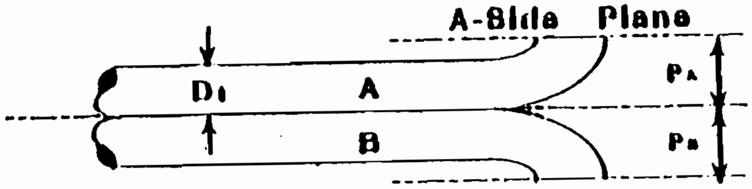
1568 Leroy Stevens Rd.
Mobile, Al. 36695

Office: (205) 633-4120
FAX#: (205) 633 2285

The Pitot used was within the following geometric specifications:

D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.)

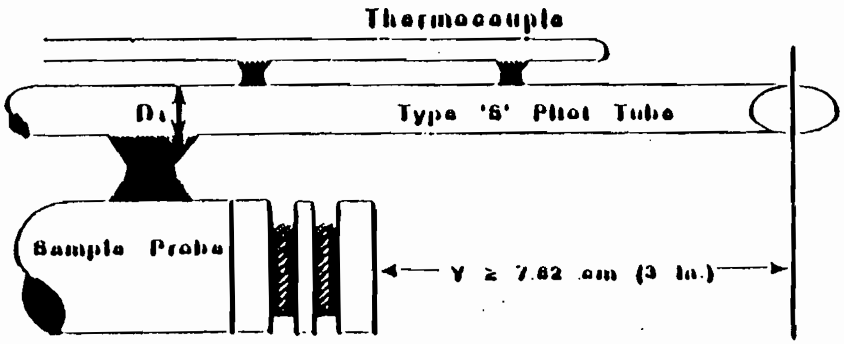
C_p = 0.84



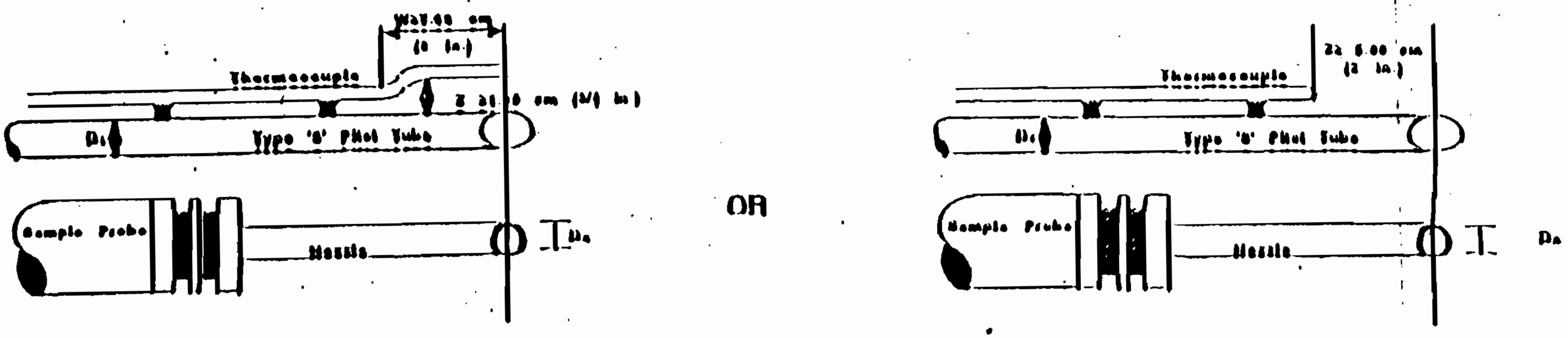
Note:

1.05 $D_t \leq$ 1.50 D_t

$P_A = P_B$



Minimum pitot-sample probe separation needed to prevent interference



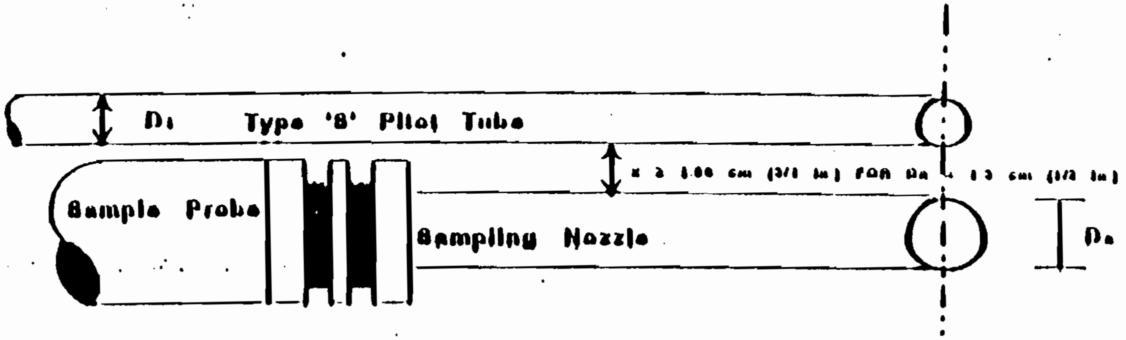
Proper thermocouple placement to prevent interference.

SANDERS ENGINEERING &
ANALYTICAL SERVICES, Inc.

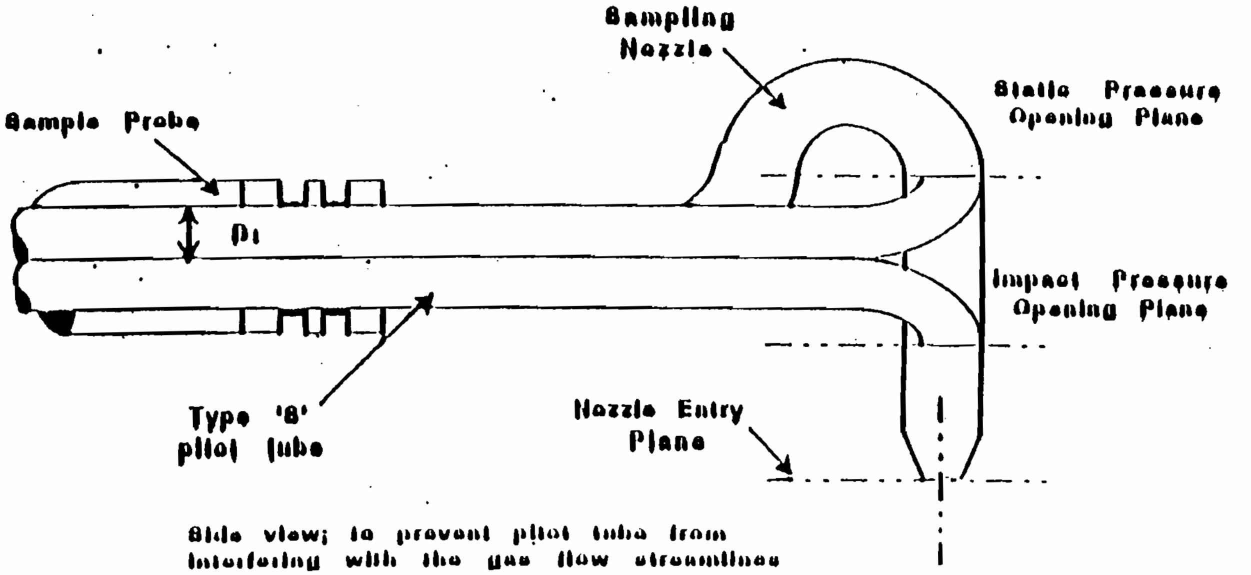
1568 Leroy Stevens Rd.
Mobile, AL 36605

Office: (205) 633-4120
FAX#: (205) 633-2285

Proper pitot tube-sampling nozzel configuration to prevent aero-dynamic interference; buttonhook type nozzle; centers of nozzle and pitot opening aligned; Dt between 0.48 and 0.95 cm (3/16 and 3/8 in.)



Bottom view showing minimum pitot/nozzle separation



Side view; to prevent pitot tube from interfering with the gas flow streamlines approaching the nozzle, the impact pressure opening plane of the pitot tube shall be even with or above the nozzle entry plane.

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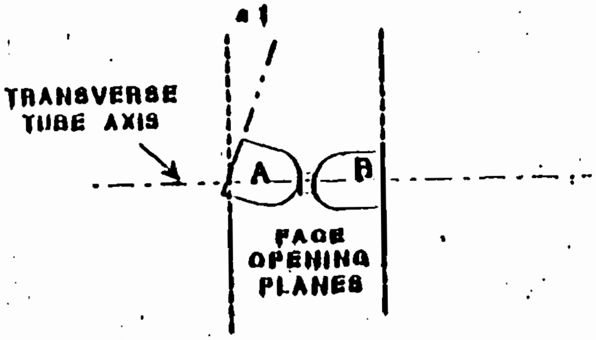
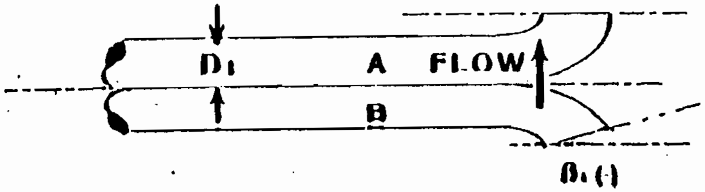
ANALYTICAL SERVICES, Inc.

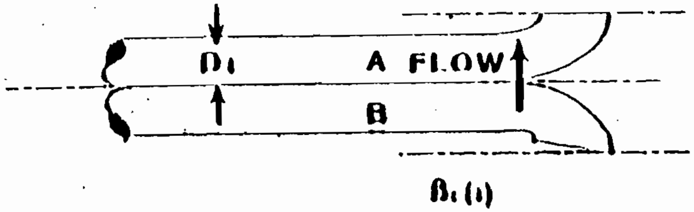
1568 Leroy Stevens Rd.
Mobile, AL 36695

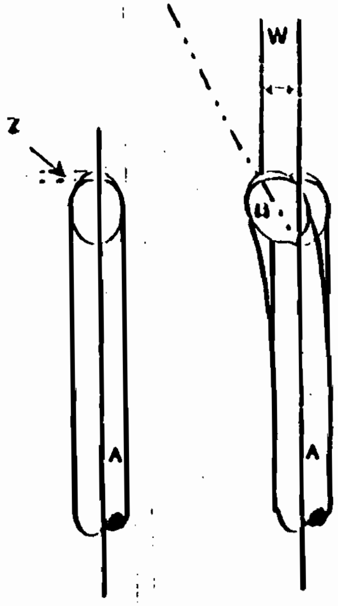
Office: (205) 633-4120
FAX#: (205) 633-2285

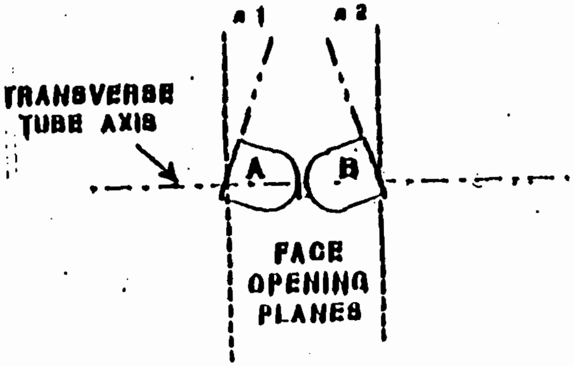
Types of face-opening misalignment that can result from field use or improper construction of type 'S' pitot tubes. These will not affect the baseline value of Cp(s) so long as α_1 and $\alpha_2 < 10°$, β_1 and $\beta_2 < 5°$, $z \leq$ 0.32 cm (1/8 in.)

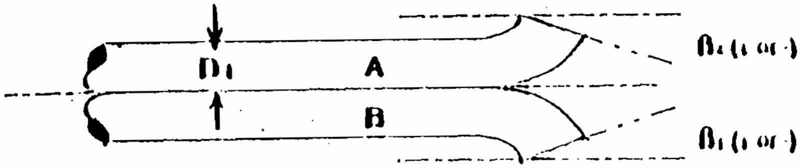












APPENDIX D OPERATIONAL DATA

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST CHRONOLOGY
UNIT # 4
SOOTBLOWING CONDITIONS
April 25, 1995

RUN # 1	START	9:06 a.m.	No problems noted at beginning of run.
	STOP	10:12 a.m.	No problems noted at end of run.
RUN # 2	START	10:55 a.m.	No problems noted at beginning of run.
	STOP	11:56 a.m.	No problems noted at end of run.
RUN # 3	START	12:36 p.m.	No problems noted at beginning of run.
	STOP	1:42 p.m.	No problems noted at end of run.

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST CHRONOLOGY
UNIT # 4
STEADY STATE CONDITIONS
April 26,1995

RUN # 1	START	7:52 a.m.	No problems noted at beginning of run.
	STOP	8:58 a.m.	No problems noted at end of run.
RUN # 2	START	9:18 a.m.	No problems noted at beginning of run.
	STOP	10:23 a.m.	No problems noted at end of run.
RUN # 3	START	10:45 a.m.	No problems noted at beginning of run.
	STOP	11:51 p.m.	No problems noted at end of run.

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT #4
SOOT BLOWING CONDITIONS
April 25, 1995

TIME OF 6 MIN. AVERAGE	OPACITY (%)
(RUN # 1)	(RUN # 1)
8:01 - 8:06	4.0
8:07 - 8:12	4.1
8:13 - 8:18	4.5
8:19 - 9:24	4.3
9:25 - 9:30	4.3
9:31 - 9:36	4.2
(RUN # 2)	(RUN # 2)
10:55 - 11:00	3.7
11:01 - 11:06	3.6
11:07 - 11:12	3.6
11:13 - 11:18	3.5
11:19 - 11:24	3.4
11:25 - 11:30	4.0
11:31 - 11:36	3.7
11:37 - 11:42	3.3
11:43 - 11:48	3.5
11:49 - 11:54	3.6
11:55 - 12:00	3.4

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT # 4
SOOT BLOWING CONDITIONS
April 25, 1995

(RUN # 3)	(RUN # 3)
12:31.- 12:36	3.5
12:37.- 12:42	3.7
12:43 - 12:48	4.0
12:49 - 12:54	3.9
12:55 - 13:00	3.7
13:01 - 13:06	3.4
13:07 - 13:12	3.6
13:13 - 13:18	3.4
13:19 - 13:24	3.8
13:25 - 13:30	3.6
13:31 -.13:36	3.5
13:37 - 13:42	4.0

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT # 4
STEADY STATE CONDITIONS
April 26, 1995

TIME OF 6 MIN. AVERAGE	OPACITY (%)
(RUN # 1)	(RUN # 1)
7:49 - 7:54	4.2
7:55 - 8:00	4.0
8:01 - 8:06	3.8
8:07 - 8:12	3.6
8:13 - 8:18	3.4
8:19 - 8:24	3.4
8:25 - 8:30	3.2
8:31 - 8:36	3.3
8:37 - 8:42	3.2
8:43 - 8:48	3.4
8:49 - 8:54	3.3
8:55 - 9:00	3.7
(RUN # 2)	(RUN # 2)
9:13 - 9:18	3.3
9:19 - 9:24	3.3
9:25 - 9:30	3.3
9:31- 9:36	3.2
9:37 - 9:42	4.5
9:43 - 9:48	3.4
9:49 - 9:54	3.4
6:55 - 10:00	3.3
10:01 - 10:06	3.5
10:07 - 10:12	3.2
10:13 - 10:18	3.3
10:19 - 10:24	3.3

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT # 4
STEADY STATE CONDITIONS
April 26, 1995

(RUN # 3)	(RUN # 3)
10:43 - 10:48	3.3
10:49 - 10:54	3.1
10:55 - 11:00	3.2
11:01 - 11:06	3.1
11:07 - 11:12	3.2
11:13 - 11:18	3.1
11:19- 11:24	3.2
11:25 - 11:30	3.0
11:31 - 11:36	3.1
11:37 - 11:42	3.0
11:43 - 11:48	3.0
11:49 - 11:54	3.4

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State

DATE: 05/26/95

RUN # : 1

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State

DATE: 05/26/95

RUN # : 1

Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Steady State

DATE: 5/26/95

RUN # : 1

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	25	270	210	NO READING
4B	25	250	200	36
4C	80	340	480	52
4D	80	300	660	58
4E	60	320	440	50
4F	70	300	500	50

RUN # : 1

Start or End End

4A	25	270	210	NO READING
4B	40	260	250	36
4C	80	340	480	52
4D	80	300	660	58
4E	60	320	440	50
4F	70	300	500	55

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State

DATE: 05/26/95

RUN # : 2

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State

DATE: 05/26/95

RUN # : 2

Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Steady State DATE: 5/26/95

RUN # : 2 Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	25	270	210	NO READING
4B	40	260	250	36
4C	80	340	480	52
4D	80	300	660	58
4E	60	320	440	50
4F	70	300	500	52

RUN # : 2 Start or End End

4A	40	260	280	NO READING
4B	30	250	210	40
4C	80	340	480	52
4D	80	300	650	58
4E	74	375	580	52
4F	70	310	500	52

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State

DATE: 05/26/95

RUN # : 3

Start or End Start

Transformer Box A

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State

DATE: 05/26/95

RUN # : 3

Start or End End

Transformer Box B

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State DATE: 05/26/95

RUN # : 3 Start or End Start

Transformer Box A

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State DATE: 05/26/95

RUN # : 3 Start or End End

Transformer Box B

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Steady State

DATE: 5/26/95

Transformer Box A

RUN # : 3

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	40	270	280	NO READING
4B	30	250	210	40
4C	80	340	480	52
4D	80	300	650	58
4E	74	375	500	52
4F	70	310	740	52

Transformer Box B

RUN # : 3

Start or End End

4A	35	270	200	NO READING
4B	30	250	480	40
4C	85	350	660	52
4D	80	300	570	58
4E	74	350	520	52
4F	70	300	500	52

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Soot Blowing DATE: 05/25/95

RUN # : 1 Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	30	400	360	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Soot Blowing DATE: 05/25/95

RUN # : 1 Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Soot Blowing DATE: 05/25/95

RUN # : 1 Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	50	230	200	NO READING
4B	35	240	160	38
4C	85	340	700	55
4D	80	310	640	58
4E	78	375	580	54
4F	68	300	500	54

RUN # : 1 Start or End End

4A	30	250	200	NO READING
4B	40	270	300	38
4C	75	340	480	50
4D	80	300	630	58
4E	74	350	580	54
4F	68	300	500	54

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 2

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State

DATE: 05/26/95

RUN # : 2

Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	360	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 2

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	30	250	200	NO READING
4B	40	270	300	38
4C	75	340	480	50
4D	80	300	630	58
4E	74	350	580	54
4F	68	300	500	54

RUN # : 2

Start or End End

4A	35	260	240	NO READING
4B	30	260	300	42
4C	80	340	400	52
4D	80	310	660	58
4E	70	330	560	52
4F	68	300	500	54

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 3

Start or End Start

Transformer Box A

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	360	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 3

Start or End End

Transformer Box B

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	365	18
4-B	28	335	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Soot Blowing DATE: 05/25/95

Transformer Box A

RUN # : 3 Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	35	260	240	NO READING
4B	30	260	300	42
4C	80	340	400	52
4D	80	310	660	58
4E	70	330	560	52
4F	68	300	500	54

Transformer Box B

RUN # : 3 Start or End End

4A	30	240	240	NO READING
4B	30	240	260	42
4C	75	340	360	48
4D	80	300	680	52
4E	72	350	550	52
4F	68	300	520	52

SANDERS ENGINEERING & ANALYTICAL SERVICES, INC.

PARTICULATE EMISSIONS TEST REPORT
SOOT BLOWING OPERATIONS

FOR

GULF POWER COMPANY
Plant Crist, Unit 4
Pensacola, Florida

April 25, 1995

1568 LEROY STEVENS ROAD
MOBILE, ALABAMA 36695 • 205/633-4120

SEAS

SANDERS ENGINEERING & ANALYTICAL SERVICES, INC.

1568 LEROY STEVENS ROAD MOBILE, ALABAMA 36695 • OFFICE 334 / 633-4120
FAX 334 / 633-2285

ENVIRONMENTAL ENGINEERING
AIR & WATER QUALITY MODELING
ENVIRONMENTAL ASSESSMENTS
PSD ANALYSIS
EMERGENCY RESPONSE MONITORING

AMBIENT AIR MONITORING
CONTINUOUS IN-STACK MONITORING
SOURCE TESTING
VISIBLE EMISSIONS TESTING
CONSULTING SERVICES

TEST REPORT CERTIFICATION

In regard to this test, we certify that to the best of our knowledge, all of the data regarding the testing performed by our agents is true and correct.

Sanders Engineering & Analytical Services, Inc.

Dated: 5/5/95

By: Edward K.

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LIST OF TABLES

ILLUSTRATIONS

1. INTRODUCTION

Sanders Engineering & Analytical Services, Inc. (SEAS) performed a particulate emissions test during soot blowing operations at Gulf Power Company, Plant Crist, Unit 4, located in Pensacola, Florida. The testing was conducted on April 25, 1995. The testing was performed in accordance with the applicable U.S. EPA procedures specified at **40 CFR, Part 60, Appendix A, Methods 1, 2, 3, 4, and 17**.

The purpose of the test was to demonstrate compliance with the rules and regulations of the Florida Department of Environmental Protection, and to meet the necessary requirements contained in the permit to operate issued by the Florida Department of Environmental Protection.

The test was conducted by Mr. Edward Harris, Mr. John Wilson, and Mr. Dean Holmes of Sanders Engineering & Analytical Services, Inc., and was coordinated with Mr. John McPherson of Gulf Power Company. The Florida Department of Environmental Protection was notified so their representative could be present to observe the testing.

The test was conducted in accordance with the guidelines of the Florida Department of Environmental Protection. Further discussion of the test methods are included later in the report.

2. SUMMARY AND DISCUSSION OF RESULTS

The results of the particulate emissions test for the soot blowing runs, along with the results of the computations, are summarized in Table I. The equations used in the calculations of the results, along with the completed field data sheets for the testing, are presented in Appendix A. The sample calculations of the first run are presented in Appendix B. The quality control checks of the equipment used in the sampling program are included in Appendix C.

The results of the testing indicate the particulate emission rate during soot blowing for Plant Crist, Unit 4, is 0.009 LBS/MMBTU. The applicable Florida Department of Environmental Protection rules and regulations require an emission rate of no greater than 0.30 LBS/MMBTU. The results of the testing indicate that the unit is in compliance with the particulate emission condition of the permit to operate issued by the Florida Department of Environmental Protection.

TABLE I. PARTICULATE EMISSIONS TEST RESULTS
GULF POWER COMPANY
PLANT CRIST, UNIT 4, SOOT BLOWING
4/25/95

Title of Run		RUN 1	RUN 2	RUN 3
Sampling Time -Start	Military	0906	1050	1236
Sampling Time -Stop	Military	1012	1156	1342
F Factor	SDCF/BTU	9820	9820	9820
Plant Load	Megawatts	82.0	82.0	82.0
Static Pressure	In. H2O	-1.20	-1.20	-1.20
Barometric Pressure	In. Hg	30.25	30.25	30.25
Average dH	In. H20	0.9	1.0	1.0
Meter correction		0.999	0.999	0.999
Avg. Meter Temp.	Deg. F	62.9	67.6	71.4
% O2	%	5.9	5.8	5.9
%CO2	%	11.5	12.0	12.0
Volume Metered	ACF	37.557	39.044	39.825
Volume Water	Ml	52.0	75.0	58.0
Sampling Time	Minutes	64	64	64
Nozzle Diameter	Inches	0.222	0.222	0.219
Avg. Stack Temp.	Deg. F	296.8	296.8	298.6
Area of Stack	Sq. Feet	92.1350	92.1350	92.1350
Wt. of Part.	Mg.	15.4	10.4	10.0
Number of Points		32	32	32
Avg. Sqrt dP	In. H20	0.8670	0.8681	0.9031

RESULTS OF COMPUTATIONS

		RUN 1	RUN 2	RUN 3	Average
Volume of Gas Sampled	SDCF	38.370	39.544	40.049	39.321
H2O vapor in Gas Stream	PERCENT	6.0	8.2	6.4	6.9
Avg. Stack Gas Velocity	FT/SEC	57.6	57.8	60.0	58.5
Volumetric Flow Rate	SDCF/M	210390	206419	217884	211565
Volumetric Flow Rate	ACF/M	318203	319716	331687	323202
Particulate Conc.	Grs/SDCF	0.006	0.004	0.004	0.005
Particulate Conc.	Grs/ACF	0.004	0.003	0.003	0.003
Particulate Mass Rate	Lb/Hr	11.1	7.2	7.2	8.5
Particulate Mass Rate	Lb/MMBtu F Factor	0.012	0.008	0.008	0.009
Heat Input	MMBTU/Hr	922.59	911.21	955.46	929.75
Percent of Isokinetic	%	97.7	102.6	101.2	

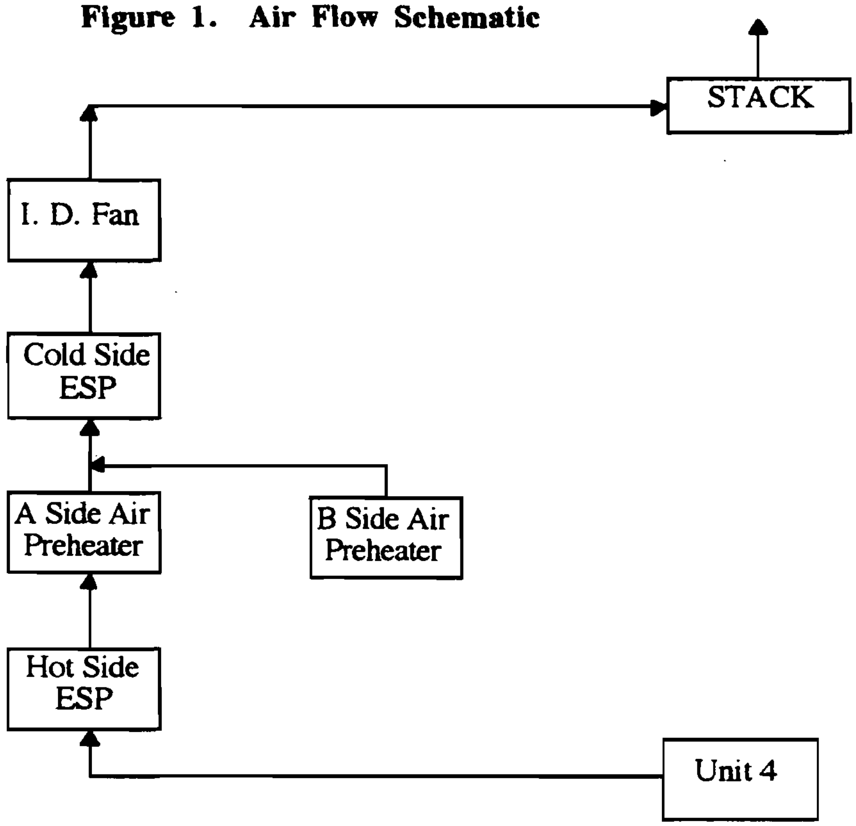
3. PROCESS DESCRIPTION

The process consists of a steam electric generating unit firing bituminous coal for the production of electric energy. The coal is received by barge, and loaded directly onto the conveyor feeding the plant, or onto the stockpile and later loaded onto the conveyor belt transporting the coal to the plant. The coal from the conveyor is loaded into bunkers capable of holding between 36 to 48 hours supply of coal. The coal is then fed to pulverizing mills before being fired in the unit through the burners. Upon combustion of the coal in the fire box, approximately 20 percent of the ash falls to the bottom of the boiler and is removed by the ash removal system. The remaining 80 percent exits with the flue gases through the heat exchange and economizer sections of the furnace, and is collected by electrostatic precipitators.

3.1. Source Air Flow

As shown in Figure I, the flue gases exit the boiler and flow through a hot side precipitator. The exhaust gases are separated into ducts A and B before entering air preheaters. The exhaust gases are combined before entering a cold side ESP. The flue gases exiting the cold side ESP are exhausted through a stack into the atmosphere.

Figure 1. Air Flow Schematic



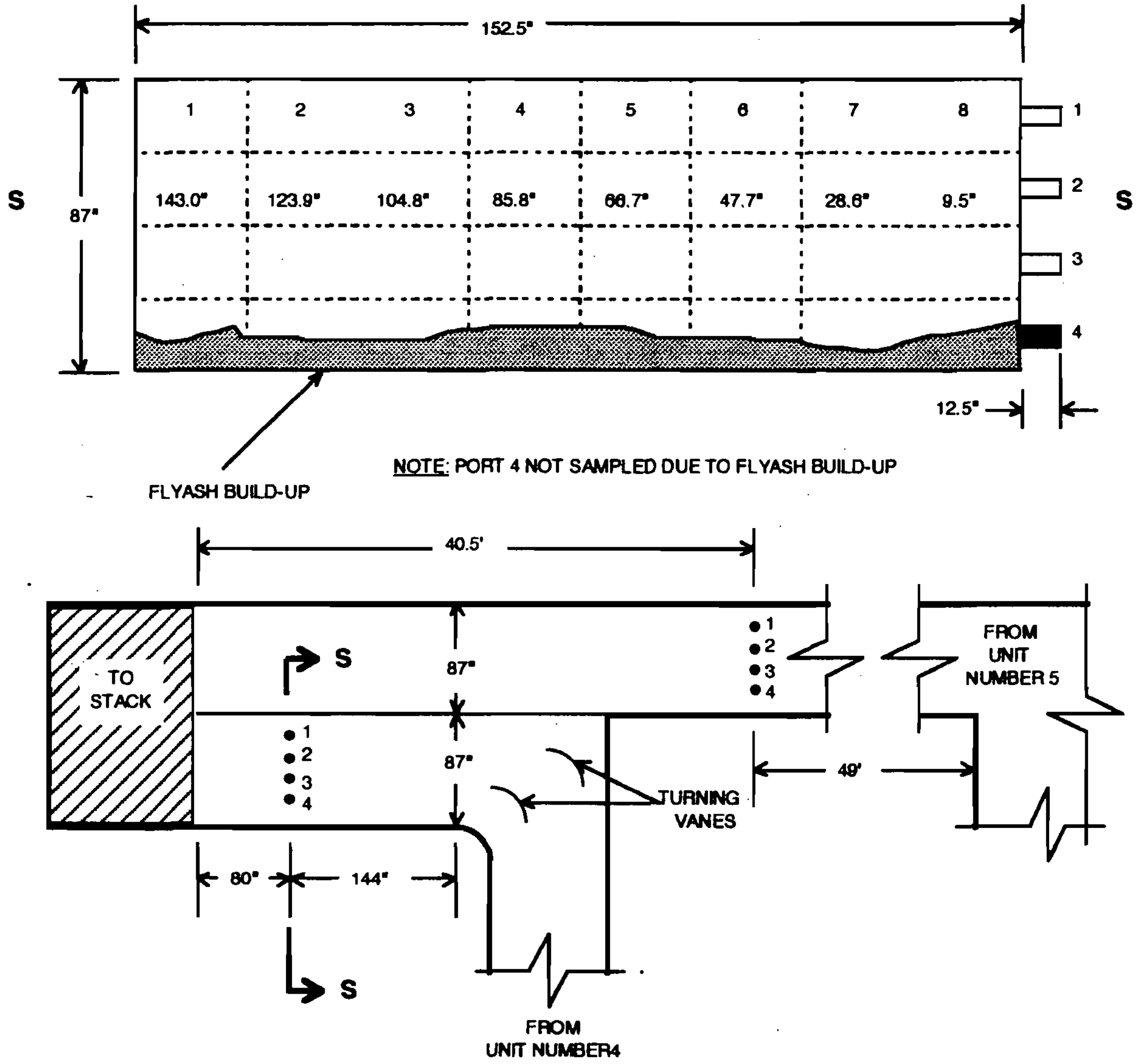
3.2. Operation During Testing

The average heat input during soot blowing operation, as based on F-factor calculations, was 929.75 million BTU per hour resulting in the production of approximately 82 megawatts of electricity. Precipitator data supplied by Gulf Power personnel is given in Appendix D.

4. SAMPLE POINT LOCATION

The sample point locations and outlet duct schematic are presented in Figure 2. Method 1 was used for determination of the number and location of sampling points. The minimum number of points (25) required for rectangular stacks was met by sampling a total of 32 points.

Figure 2. Sample Point Locations



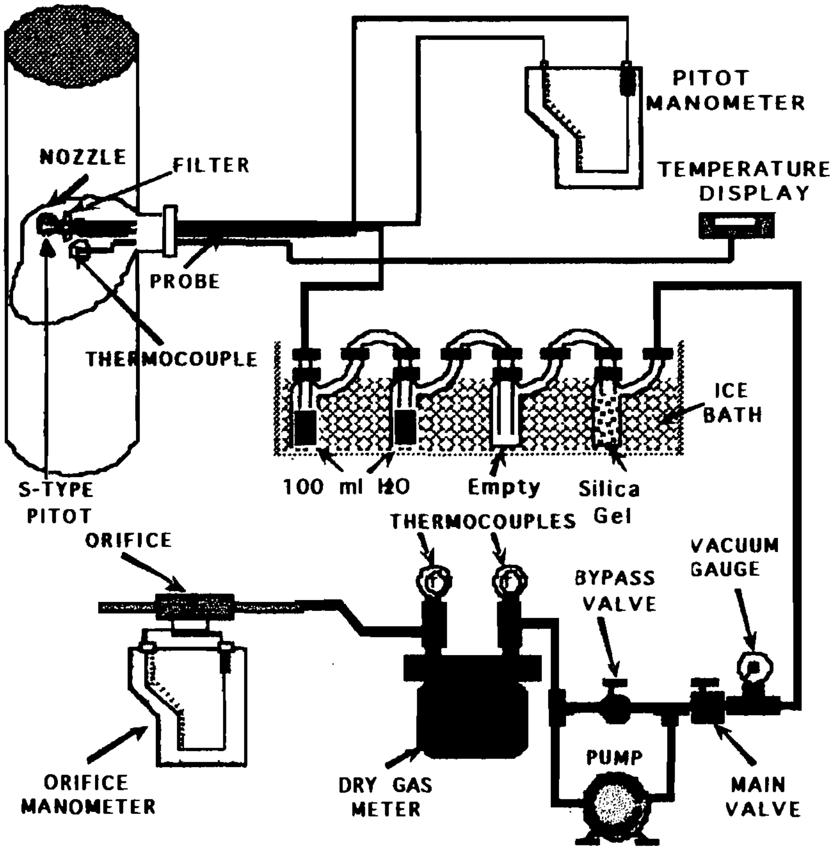
NOTE: PORT 4 NOT SAMPLED DUE TO FLYASH BUILD-UP

5. PARTICULATE SAMPLING PROCEDURE (EPA Method 17)

The sampling procedure utilized is that specified in **40 CFR, Part 60, Appendix A, Method 17,** as modified by the governing regulatory agency. A brief description of this procedure is as follows:

The first impingers were partially filled with 100 milliliters of deionized water. The next impinger was left empty to act as a moisture trap. Preweighed 6 to 16 mesh indication silica gel was added to the last impinger. The sampling equipment manufactured by Lear Siegler (Model 100) or Sanders Engineering (Model 200) was assembled as shown in the attached drawing. The system was leak checked by plugging the inlet to the nozzle and pulling a 15 inch mercury vacuum. A leakage rate not in excess of 0.02 cubic feet per minute was considered acceptable.

Figure 3. Particulate Sampling Train



The inside dimensions of the stack liner were measured and recorded. The required number of sampling points were marked on the probe for easy visibility. The range of velocity pressure, the percent moisture, and the temperature of the effluent gases were determined. From this data, the correct nozzle size and the nomograph multiplication factor were determined.

Crushed ice was placed around the impingers. The nozzle was placed on the first traverse point with the tip pointing directly into the gas stream. The pump was started immediately and the flow was adjusted to isokinetic sampling conditions. After the required time interval had elapsed, the probe was repositioned to the next traverse point and isokinetic sampling was re-established. This was performed for each point until the run was completed. Readings were taken at each point and recorded on the field data sheet. At the conclusion of each run, the pump was turned off and the final readings were recorded.

5.1. Particulate Sample Recovery

Care was exercised in moving the collection train to the sample recovery area to minimize the loss of collected sample, or the gain of extraneous particulate matter. The volume of water in the impingers was measured, the silica gel impinger was weighed and recorded on the field data sheet. The nozzle, and all sample-exposed surfaces were washed with reagent grade acetone into a clean sample container. A brush was used to loosen any adhering particulate matter and subsequent washings were placed into the container. The filter was carefully removed from the fritted support and placed in a clean separate sample container. A sample of the acetone used in the washing was saved for a blank laboratory analysis.

5.2. Particulate Analytical Procedures

The filter and any loose particulate matter were transferred from the sample container to a clean, tared weighing dish. The filter was placed in a desiccator for at least 24 hours and then weighed to the nearest 0.1 milligram until a constant weight was obtained. The original weight of the filter was deducted, and the weight gain was recorded to the nearest 0.1 milligram.

The wash solution was transferred to a clean, tared beaker. The solution was evaporated to dryness, desiccated to a constant weight, and the weight gain was recorded to the nearest 0.1 milligram.

APPENDIX A EQUATIONS AND FIELD DATA SHEETS

EQUATIONS

1. $$P_s = P_{bar} + \frac{P_g}{13.6}$$

2. $$P_m = P_{bar} + \frac{\overline{\Delta H}}{13.6}$$

3. $$V_s = K_p C_p \overline{\sqrt{\Delta P}} \sqrt{\frac{\overline{T}_s}{M_s P_s}}$$

4. $$V_{m(Std)} = K_1 V_m Y \left[\frac{P_{bar} + \frac{\overline{\Delta H}}{13.6}}{\overline{T}_m} \right]$$

5. $$V_{w(Std)} = 0.04707 \, V_{lc}$$

6. $$B_{ws} = \frac{V_{w(Std)}}{V_{m(Std)} + V_{w(Std)}}$$

7. $$M_d = 0.44 (\%CO_2) + 0.32 (\%O_2) + 0.28 (\%N_2 + \%CO)$$

8. $$M_s = M_d(1 - B_{ws}) + 18 (B_{ws})$$

9. $$EA = \left[\frac{(\%O_2 - 0.5 (\%CO))}{0.264 (\%N_2) - ((\%O_2) - 0.5 (\%CO))} \right] 100$$

10. $Q_a = (V_s)\,(A_s)\,(60)$

11. $Q_s = Q_a\,(1\text{-}B_{ws})\,\dfrac{(528)}{\overline{T}_s}\,\dfrac{(P_s)}{29.92}$

12. $E_H = \left(\dfrac{PMR}{H_I}\right)$

13. $E = C_d\,F_{O_2}\left(\dfrac{20.9}{20.9 - \%O_2}\right)$

14. $C_s = 0.0154\,\dfrac{M_n}{V_{m(Std)}}$

15. $C_{50} = \dfrac{21\ C_s}{21 - [(1.5)\,(\%O_2) - 0.133\,(N_2) - 0.75\,(\%CO)]}$

16. $C_{12} = \dfrac{C_s\ (12)}{\%CO_2}$

17. $PMR = (C_s)\,(Q_s)\,\dfrac{(60)}{7000}$

18. $V_n = \left[(0.002669)\,(V_{1c}) + \dfrac{V_m Y}{\overline{T}_m}\left(p_{bar} + \dfrac{\overline{\Delta H}}{13.6}\right)\right]\dfrac{\overline{T}_s}{P_s}$

19. $I = \dfrac{100\ V_n}{(60)\ \theta\ V_s\ A_n}$

NOMENCLATURE

A_n = Cross-sectional area of nozzel, ft ^{2}

A_s = Cross sectional area of stack, ft ^{2}

B_{ws} = Wator vapor in the gas stream, proportion by volume (dimensionless)

C_p = Pitot tube coefficient (dimensionless) (0.84)

C_s = Particulate concentration, grains/SDCF

C_d = Particulate concentration, lbs/SDCF

C_{12} = Particulate concentration (C_s adjusted to 12% CO) grains/SDCF

C_{50} = Particulate concentration (C_s adjusted to 50% excess air) grains/SDCF

EA = Excess air, %

E = Emission in lb/mmBTU

E_H = Emission in lb/mmBTU, based on heat input

H_I = Total Heat Input, Million BTU per Hour (MMBTU/hr)

I = Percent of isokinetic sampling

K_1 = 17.64 °R/ inches Hg

K_p = Pitot tube constant,

$$85.49 \text{ ft/sec} \left[\frac{(\text{lb/lb-mole})\ (\text{in. Hg})}{(\text{°R})\ (\text{Inc. } H_2O)}\right]^{\frac{1}{2}}$$

M_n = Total amount of particulate collected, mg

M_d = Molecular weight of stack gas; dry basis, lb/lb mole

M_s = Molecular weight of stack gas; wet basis, lb/lb mole

P_{bar} = Barometric pressure at the sampling site, in. Hg

NOMENCLATURE (continued)

P_m = Meter pressure, in. Hg

P_s = Absolute stack pressure, in. Hg

P_g = Stack static pressure, in. H_2O

PMR = Particulate mass rate, lb/Hr

Q_a = Volumetric flow rate ACFM

Q_s = Volumetric flow rate SDCFM

V_s = Average stack gas velocity, ft/sec

V_{lc} = Total volume of liquid collected in impingers & silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, ACF

$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, corrected to standard conditions, SDCF

$V_{w(std)}$ = Volume of water vapor in gas sample, corrected to standard conditions, SCF

V_n = Volume collected at stack conditions through nozzle, ACF

Y = Dry gas meter calibration factor (dimensionless)

ΔH = Average pressure difference of orifice, in. H_2O

ΔP = Velocity head of stack gas, in. H_2O

$\overline{\sqrt{\Delta P}}$ = Average of square roots of the velocity pressure, in. H_2O

Ø = Total sampling time, minutes

$\% CO_2$, $\% O_2$, N_2, %CO - Number % by volume, dry basis, from gas analysis

F_{O_2} = Oxygen based F factor (9820 SDCF/mmBTU for bituminous coal)

T_s = Temperature of the stack, °R (° F + 460)

SEAS

SANDERS ENGINEERING & ANALYTICAL SERVICES, Inc.

1568 Leroy Stevens Rd.
Mobile, AL 36695

Office: (205) 633-4120
FAX#: (205) 633-2285

FIELD DATA SHEET

COMPANY GPCO DATE 4-25-95 DGM# S-101

PLANT Crist OPERATOR ELH ΔHa 0.75 cu. ft. /min.

UNIT 4 S.B. METHOD 17 PROBE N/A liner 14' length

	RUN 1	RUN 2	RUN 3
NOZZLE CALIBRATION PRE	.222 .222 .221 .222 AVERAGE	.221 .222 .222 .222 AVERAGE	.219 .219 .220 .219 AVERAGE
POST	.222 .222 .222 .222 AVERAGE	.221 .222 .222 .222 AVERAGE	.219 .219 .220 .219 AVERAGE
FILTER NUMBER	609	610	611
METER READING FINAL	819.257	859.444	900.425
INITIAL	781.700	820.400	860.600
NET	37.557	39.044	39.825
FINAL			
INITIAL			
NET			
LEAK CHECK SYSTEM Pre	15 in. hg 0.000 cfm	15 in. hg 0.000 cfm	15 in. hg 0.000 cfm
SYSTEM Post	7 in. hg 0.000 cfm	10 in. hg 0.000 cfm	10 in. hg 0.000 cfm
PITOT Pre	☑ impact ☑ static	☑ impact ☑ static	☑ impact ☑ static
PITOT Post	☑ impact ☑ static	☑ impact ☑ static	☑ impact ☑ static

VOLUME OF LIQUID WATER COLLECTED

	RUN 1 IMP. 1	IMP. 2	IMP. 3	IMP. 4	RUN 2 IMP. 1	IMP. 2	IMP. 3	IMP. 4	RUN 3 IMP. 1	IMP. 2	IMP. 3	IMP. 4
FINAL	144	100	0	1457.0	164	100	0	1376.0	150	100	0	1465.0
INITIAL	100	100	0	1449.0	100	100	0	1365.0	100	100	0	1457.0
NET	44	0	0	8.0	64	0	0	11.0	50	0	0	8.0
TOTAL				52.0				75.0				58.0

	RUN 1	RUN 2	RUN 3
GAS ANALYSIS O_2	5.9 %	5.8 %	5.9 %
CO_2	11.5 %	12.0 %	12.0 %
CO	–	–	–
STATIC	-1.20 in. H_2O	-1.20 in. H_2O	-1.20 in. H_2O
BAROMETRIC	30.25 in. hg	30.25 in. hg	30.25 in. hg

1.289

PORT # / POINT #	TIME	GAS METER VOL. (cu.ft.)	VEL. HEAD ΔP in.H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
					STACK	PROBE	HOT BOX	IMP.	GAS METER IN	GAS METER OUT	
3 – 1	9:06	781.700	0.60	0.77	295	N/A	N/A	60	61	61	1
2	:08	782.800	0.69	0.88	296			✓	61	61	1
3	:10	783.950	0.61	0.78	297			✓	61	61	1
4	:12	785.000	0.45	0.58	298			✓	61	61	1
5	:14	785.900	0.56	0.72	298			✓	61	61	1
6	:16	787.000	0.69	0.88	298			53	61	61	2
7	:18	788.000	0.60	0.77	297			✓	61	61	2
8	:20	789.100	0.75	0.96	296			✓	61	61	2
3 - 1	9:22	790.200	0.60	0.77	297			✓	61	61	2
2	:24	791.100	0.60	0.77	297			✓	63	62	2
3	:26	792.300	0.58	0.74	297			✓	63	62	2
4	:28	793.400	0.45	0.57	298			✓	63	62	2
5	:30	794.300	0.60	0.77	298			52	63	62	2
6	:32	795.300	0.65	0.83	298			✓	63	63	2
7	:34	796.400	0.60	0.77	298			✓	63	63	2
8	:36	797.500	0.75	0.96	294			✓	64	63	2.5
2 - 1	9:40	798.629	0.95	1.22	297			✓	64	63	3.5
2	:42	800.000	1.30	1.67	298			51	64	63	4
3	:44	801.600	1.0	1.29	298			✓	64	63	3.5
4	:46	802.900	0.80	1.03	298			✓	64	63	3
5	:48	804.100	0.75	0.96	297			✓	64	63	2
6	:50	805.300	0.68	0.87	297			✓	64	63	2
7	:52	806.300	0.68	0.87	296			✓	64	63	2
8	:54	807.400	0.80	1.03	295			✓	64	63	2.5

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/25/95

SITE Crist 4 S.B. RUN # 1 PAGE 2 OF 7

Bottom Port not Sampled due to Ash buildup
(Port #4)

PORT # POINT #	TIME	GAS METER VOL. (cu. ft.)	VEL. HEAD ΔP in.H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
					STACK	PROBE	HOT BOX	IMP.	GAS METER		
									IN	OUT	
$- 1	9:56	808.729	1.40	1.80	296	N/A	N/A	55	65	64	5
2	:58	810.250	1.12	1.44	297			✓	65	64	4.5
3	10:00	811.700	1.24	1.60	297			✓	65	64	4.5
4	:02	813.300	0.95	1.22	296			✓	65	64	4
5	:04	814.550	0.84	1.08	296			✓	65	64	4
6	:06	815.750	0.71	0.91	295			✓	65	65	3
7	:08	816.900	0.80	1.03	296			✓	65	65	3
8	:10	818.200	0.71	0.91	295			✓	65	65	3
Final	10:12	819.257									
			0.866	0.983	296.8						

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/25/95

SITE Crist #4 SB RUN # 1 PAGE 3 OF 7

1.29

1.32

PORT # / POINT #	TIME	GAS METER VOL. (cu.ft.)	VEL. HEAD ΔP in.H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
					STACK	PROBE	HOT BOX	IMP.	GAS METER		
									IN	OUT	
1 - 1	10:50	820.400	0.70	0.90	297	N/A	N/A	50	66	66	2.5
2	:52	821.600	1.05	1.35	298			✓	66	66	2.5
3	:54	823.100	1.10	1.42	298			✓	66	66	4
4	:56	824.400	0.99	1.30	298			✓	66	66	4
5	:58	825.700	0.93	1.22	297			✓	66	66	4
6	11:00	827.100	0.74	0.97	297			52	67	66	3
7	:02	828.350	0.75	0.99	297			✓	67	66	3
8	:04	829.400	0.66	0.87	297			✓	67	66	3
2 - 1	11:07	830.655	0.91	1.20	296			✓	67	67	2.5
2	:09	831.900	0.98	1.29	297			✓	67	67	3.5
3	:11	833.200	1.05	1.38	297			✓	67	67	4
4	:13	834.700	0.76	1.00	297			51	67	67	3
5	:15	836.100	0.76	1.0	297			✓	67	67	3
6	:17	837.100	0.66	0.87	297			✓	68	67	3
7	:19	838.300	0.63	0.83	296			✓	68	67	3
8	:21	839.400	0.70	0.92	295			✓	68	67	3
2 - 1	11:23	840.650	0.93	1.22	297			✓	68	67	3.5
2	:25	841.900	0.96	1.27	297			✓	68	67	4
3	:27	843.300	0.87	1.15	297			50	68	68	3
4	:29	844.500	0.80	1.06	297			✓	68	68	3.5
5	:31	845.700	0.70	0.93	297			✓	68	68	3
6	:33	846.900	0.66	0.87	297			✓	69	68	2.5
7	:35	848.200	0.61	0.81	297			✓	69	68	3
8	:37	849.200	0.77	1.02	297			✓	69	68	3

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/25/95

SITE Crist #4 S.B. RUN # 2 PAGE 4 OF 7

PORT # / POINT #	TIME	GAS METER VOL. (cu.ft.)	VEL. HEAD ΔP in. H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F STACK	PROBE	HOT BOX	IMP.	GAS METER IN	OUT	VAC. in. H_g
3 -1	11:40	850.600	0.75	0.999	293	N/A	N/A	50	69	68	4
2	:42	851.700	0.63	0.83	297			✓	69	68	3.5
3	:44	852.900	0.57	0.75	297			✓	69	69	3
4	:46	854.100	0.41	0.54	298			✓	69	69	2
5	:48	854.900	0.55	0.73	298			✓	69	69	3
6	:50	856.000	0.62	0.82	298			✓	70	69	3
7	:52	857.100	0.55	0.73	297			✓	70	69	3
8	:54	858.200	0.66	0.87	294			✓	70	69	3
Final	11:56	859.444									
			0.868								

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/25/95

SITE Crist #4 S.B. RUN # 2 PAGE 5 OF 7

PORT #	TIME	GAS METER VOL. (cu.ft.)	VEL. HEAD ΔP in.H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #					STACK	PROBE	HOT BOX	IMP.	GAS METER		
									IN	OUT	
3 - 1	12:36	860.600	0.70	0.87	296	NA	N/A	50	70	70	2.5
2	:38	861.800	0.62	0.77	297			✓	70	70	2.5
3	:40	862.950	0.47	0.59	297			✓	70	70	2
4	:42	863.800	0.45	0.56	298			✓	70	70	2
5	:44	864.800	0.58	0.72	299			✓	70	70	2
6	:46	865.700	0.58	0.72	299			✓	70	70	2
7	:48	866.800	0.60	0.75	298			✓	70	70	2
8	:50	868.000	0.75	0.94	295			49	71	70	3.5
2 - 1	12:53	869.500	1.07	1.34	298			✓	71	70	5
2	:55	870.800	0.95	1.19	299			✓	71	70	4
3	:57	872.100	1.03	1.29	299			✓	71	70	4
4	:59	873.500	0.80	1.00	300			✓	71	71	4
5	13:01	874.700	0.70	0.87	299			✓	71	71	3.5
6	:03	875.900	0.71	0.89	299			✓	71	71	3.5
7	:05	877.000	0.71	0.89	298			47	71	71	3.5
8	:07	878.200	0.75	0.94	299			✓	71	71	3.5
1 - 1	13:10	879.378	1.25	1.57	299			✓	72	71	5.5
2	:12	880.800	1.16	1.45	299			✓	72	71	5
3	:14	882.350	1.10	1.38	299			✓	72	71	5
4	:16	883.700	1.0	1.25	300			✓	72	71	5
5	:18	885.100	0.77	0.96	299			✓	73	72	4
6	:20	886.200	0.86	1.08	299			✓	73	72	4
7	:22	887.500	0.80	1.01	297			✓	73	72	4
8	:24	888.700	0.74	0.93	297			✓	73	72	4

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/25/95

SITE Crist #4 S.B. RUN # 3 PAGE 6 OF 7

PORT #	TIME	GAS METER VOL. (cu.ft.)	VEL. HEAD ΔP in.H_2O	ORIFICE HEAD ΔH in. H_2O	TEMPERATURE °F						VAC. in. H_g
POINT #					STACK	PROBE	HOT BOX	IMP.	GAS METER		
									IN	OUT	
1 - 1	:26	890.000	1.20	1.51	299	N/A	N/A	54	73	72	5
2	:28	891.300	1.05	1.32	300			✓	73	72	5
3	:30	892.700	0.96	1.21	300			✓	73	73	5
4	:32	894.100	0.98	1.23	300			✓	73	73	5
5	:34	895.500	0.85	1.07	299			✓	73	73	5
6	:36	896.900	0.76	0.96	299			✓	73	73	4
7	:38	898.000	0.80	1.01	299			✓	73	73	4.5
8	:40	899.200	0.75	0.94	299			✓	73	73	4.5
Final	13:42	900.425									

CHECK INDICATES TEMPERATURES MEET REQUIRED LIMITS.

COMPANY GPCO DATE 4/25/95

SITE Crist #4 S.B. RUN # 3 PAGE 7 OF 7

LABORATORY ANALYSIS & CHAIN OF CUSTODY

COMPANY/PLANT: Gulf Power / Crist

UNIT #: 4 DATE OF TEST: 4/25 - 4/26/95 TYPE OF TEST: ☐ M-5 ☒ M-17 ☐ OTHER ______

SAMPLE #	RELINQUISHED BY	RECEIVED BY	TIME	DATE	REASON FOR CHANGE
609 & Wash	EAH	EAH	10:00 am	4/28/95	No Change
610 & Wash					
611 & Wash					
612 & Wash					
613 & Wash					
614 & Wash					

UNIT # 4 SootBlow

RUN # 1	FILTER # 609	BEAKER # 3 WASH (ML) 45
FINAL WEIGHT	134.40mg	64480.8 mg
INITIAL WEIGHT	122.3 mg	64477.5 mg
DIFFERENCE	12.1	3.3
CORRECTED TOTAL WEIGHT		15.4
RUN # 2	FILTER # 610	BEAKER # 6 WASH (ML) 40
FINAL WEIGHT	132.30mg	68390.9 mg
INITIAL WEIGHT	123.6 mg	68389.2 mg
DIFFERENCE	8.7	1.7
CORRECTED TOTAL WEIGHT		10.4
RUN # 3	FILTER # 611	BEAKER # 21 WASH (ML) 50
FINAL WEIGHT	131.0 mg	70058.8 mg
INITIAL WEIGHT	123.2 mg	70056.6 mg
DIFFERENCE	7.8	2.2
CORRECTED TOTAL WEIGHT		10.0
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		

UNIT # 4 Steady State

RUN # 1	FILTER # 612	BEAKER # 32 WASH (ML) 60
FINAL WEIGHT	142.20 mg	64728.3 mg
INITIAL WEIGHT	121.7mg	64724.8 mg
DIFFERENCE	20.5	3.5
CORRECTED TOTAL WEIGHT		24.0
RUN # 2	FILTER # 613	BEAKER # 35 WASH (ML) 60
FINAL WEIGHT	131.4mg	68566.2mg
INITIAL WEIGHT	122.1mg	68563.5 mg
DIFFERENCE	9.3	2.7
CORRECTED TOTAL WEIGHT		12.0
RUN # 3	FILTER # 614	BEAKER # 36 WASH (ML) 65
FINAL WEIGHT	129.4mg	67936.9
INITIAL WEIGHT	122.1 mg	67934.8 mg
DIFFERENCE	7.3	2.1
CORRECTED TOTAL WEIGHT		9.4
WASH SOLVENT BLANK (ML)	____	BEAKER # 47 WASH (ML) 100
FINAL WEIGHT		68998.9mg
INITIAL WEIGHT		68998.9 mg
DIFFERENCE		0.0
CORRECTION FACTOR (MG/ML)		

ALL WEIGHTS ARE IN MILLIGRAMS (MG)

APPENDIX B SAMPLE CALCULATIONS

Input and Constants

$$f := \frac{9820\ \mathrm{ft}^{3}}{\mathrm{mm\ btu}}$$

$pg := -(1.2\ \mathrm{in.\ H2O})$

$pbar := 30.25\ \mathrm{in.\ Hg.}$

$\Delta havg := 0.9\ \mathrm{in.\ H2O}$

$y := 0.999$

$tm := 62.9\ {}^{\circ}\mathrm{F}$

$o2 := 5.9$

$co2 := 11.5$

$vm := 37.557\ \mathrm{ft}^{3}$

$vlc := 52.\ \mathrm{ml}$

$theta := 64\ \mathrm{min}$

$nozdia := 0.222\ \mathrm{in.}$

$ts := 296.8\ {}^{\circ}\mathrm{F}$

$as := 92.135\ \mathrm{ft}^{2}$

$mn := 15.4\ \mathrm{mg}$

$numberofpoints := 32$

$sqrt\Delta p := 0.867\ \mathrm{in.\ H2O}^{0.5}$

$$kp := \frac{85.49\ 1\ \mathrm{ft}\ 1\ \left(\frac{\mathrm{lb\ in.\ Hg.}}{\mathrm{lb\text{-}mole}\ {}^{\circ}\mathrm{R\ in.\ H2O}}\right)^{0.5}}{1\ \mathrm{sec}}$$

$cp := 0.84$

$$k1 := \frac{17.64\ {}^{\circ}\mathrm{R}}{\mathrm{in.\ Hg.}}$$

$$ts = \frac{(ts + 460\ {}^{\circ}F)\ {}^{\circ}R}{{}^{\circ}F}$$

$756.8\ {}^{\circ}R$

$$tm = \frac{(tm + 460\ {}^{\circ}F)\ {}^{\circ}R}{{}^{\circ}F}$$

$522.9\ {}^{\circ}R$

$$n2 = 100 - o2 - co2$$

82.6

$$an = \frac{nozdia^{2}\ 3.1416}{4\left(\frac{12\ in.}{ft}\right)^{2}}$$

$0.000268803\ ft^{2}$

Calculations

Equation 1

$$ps = pbar + \frac{pg}{\frac{13.6\ \text{in. } H2O}{1\ \text{in. Hg.}}}$$

30.1618 in. Hg.

Equation 2

$$pm = pbar + \frac{\Delta havg}{\frac{13.6\ \text{in. } H2O}{\text{in. Hg.}}}$$

30.3162 in. Hg.

Equation 3

$$vmstd = \frac{k1\ vm\ y\ \left(pbar + \frac{\Delta havg}{\frac{13.6\ \text{in. } H2O}{\text{in. Hg.}}}\right)}{tm}$$

$38.3717\ ft^3$

Equation 4

$$vwstd = \frac{0.04707\ ft^3\ vlc}{ml}$$

$2.44764\ ft^3$

Equation 5

$$bws = \frac{vwstd}{vmstd + vwstd}$$

0.0599628

Equation 6

$$md = \frac{(0.44\ co2 + 0.32\ o2 + 0.28\ n2)\ lb}{lb\text{-}mole}$$

$$\frac{30.076\ lb}{lb\text{-}mole}$$

Equation 7

$$ms = md\ (1 - bws) + \frac{bws\ 18\ lb}{lb\text{-}mole}$$

$$\frac{29.3519\ lb}{lb\text{-}mole}$$

Equation 8

$$vs = kp\ cp\ sqrt\Delta p\ \left(\frac{ts}{ms\ ps}\right)^{0.5}$$

$$\frac{57.5649\ ft}{sec}$$

Equation 9

$$qa = \frac{vs\ as\ 60\ sec}{min}$$

$$\frac{318225.\ ft^{3}}{min}$$

Equation 10

$$qs = \frac{qa\ (1 - bws)\ 528\ {}^{\circ}R\ ps}{ts\ 29.92\ in.\ Hg.}$$

$$\frac{210391.\ ft^{3}}{min}$$

Equation 11

$$cs = \frac{0.0154\ gr\ mn}{mg\ vmstd}$$

$$\frac{0.0061806\ gr}{ft^{3}}$$

Equation 12

$$pmr = \frac{cs\ qs\ 60\ min}{hour\ \frac{7000\ gr}{lb}}$$

$$\frac{11.1458\ lb}{hour}$$

Equation 13

$$e = \frac{cs\ f\ 20.9\ 1\ lb}{(20.9 - o2)\ 7000\ gr}$$

$$\frac{0.0120809\ lb}{mm\ btu}$$

Equation 14

$$vn = \frac{ts\ \left(\frac{0.002669\ in.\ Hg.\ ft^{3}\ vlc}{ml\ °R} + \frac{vm\ y\ pm}{tm}\right)}{ps}$$

$$58.0628\ ft^{3}$$

Equation 15

$$i = \frac{100\ \%\ vn}{\frac{60\ sec\ theta\ vs\ an}{min}}$$

97.7179 %

Equation 16

$$hi = \frac{pmr}{e}$$

$$\frac{922.596\ mm\ btu}{hour}$$

APPENDIX C QUALITY CONTROL

INITIAL
METER CALIBRATION FORM - DGM

DATE: 12-27-94 Box No. S-101

Ref. DGM Ser. # 1044456 Calibrated By EDWARD HARRIS

RUN #	1	2	3	4	5
DELTA H (DGM)	0.50	1.00	1.50	2.00	2.50
Y (Ref. DGM)	0.985	0.985	0.985	0.985	0.985
Reference DGM					
Gas Vol. Initial	973.200	979.920	985.000	990.895	996.540
Gas Vol. Final	979.920	985.000	990.895	996.540	1003.024
Meter Box DGM					
Gas Vol. Initial	878.100	884.800	889.855	895.700	901.300
Gas Vol. Final	884.800	889.855	895.700	901.300	907.700
Reference DGM					
Temp.	Avg.	Avg.	Avg.	Avg.	Avg.
Deg F Initial	44	49	54	57	57
Deg F Final	49	49	57	57	57
Meter Box DGM					
Temp. Initial In	43	47	50	54	54
Temp. Initial Out	43	47	50	54	54
Temp. Final In	47	47	54	54	54
Temp. Final Out	47	47	54	54	54
P Bar IN.-Hg	30.20	30.20	30.20	30.20	30.20
Time (sec.)	959	527	502	416	432
Meter Calibration Factor (Y)	0.999	0.999	0.998	0.997	1.001
Qm (C.F.M.)	0.442	0.606	0.729	0.839	0.928
Km (Std Pressure)	0.825	0.797	0.779	0.777	0.769
DELTA Ha	1.51	1.60	1.65	1.65	1.68

Average Y (Meter Calibration Factor	0.999
Average Km (Standard Pressure)	0.789
Average DELTA Ha of Orifice	1.617

Y= ≤ .03
Max & Min ≤ .02 from Avg
Final Avg within 5% of Initial Avg
ΔHa = Max & Min ≤ .2 from Avg

FINAL
METER CALIBRATION FORM - DGM

DATE: 05-05-95 Box No. S-101

Ref. DGM Ser. # 1044453 Calibrated By Edward Harris

RUN #	1	2	3
DELTA H (DGM)	1.5	1.5	1.5
Y (Ref. DGM)	0.995	0.995	0.995
Reference DGM			
Gas Vol. Initial	716.400	722.300	728.395
Gas Vol. Final	722.300	728.395	735.398
Meter Box DGM			
Gas Vol. Initial	778.600	784.484	790.565
Gas Vol. Final	784.484	790.565	797.520
Reference DGM			
Temp.	Avg.	Avg.	Avg.
Deg F Initial	79	79	80
Deg F Final	79	79	80
Meter Box DGM			
Temp. Initial In	80	80	80
Temp. Initial Out	80	80	80
Temp. Final In	80	80	80
Temp. Final Out	80	80	80
P Bar IN. Hg	30.10	30.10	30.10
Time (sec.)	488	506	580
Meter Calibration Factor (Y)	0.996	0.995	0.998
Qm (C.F.M.)	0.711	0.709	0.709
Km (Std Pressure)	0.740	0.737	0.738
DELTA Ha	1.63	1.64	1.64

Average Y (Meter Calibration Factor)	0.997
Initial Y (Meter Calibration Factor)	0.999
Percent Error	0.20%
Average Km (Standard Pressure)	0.738
Average DELTA Ha of Orifice	1.64

MAGEHELIC CALIBRATION

BOX	175	S101	173	S-318	C-133	
SER. NO.	R01126 YC2	R-22D	R20208 A617	R74D	91126A M91	
RANGE	0-2	0-2	0-2	0-5	0-2	
REFERENCE READING	FIELD DEVICE READING					
0.000	0.00	0.00	0.00		0.00	
0.050						
0.150						
0.200						
0.250						
0.450						
0.50	0.49	0.50			0.500	
1.00	1.00	0.97			1.000	
1.30						
1.80	1.77	1.77			1.83	
2.50						
4.50						
5.0						
9.0						
13.0						
22.0						

SIGNATURE: Edward L. Harris

DATE: 12/27/94

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MAGEHELIC CALIBRATION

BOX	460	S-100	2879		
SER. NO.	91127W W137		R-33D		
RANGE	0-2	0-2	0-2		
REFERENCE READING		FIELD DEVICE READING			
0.000	0.00	0.00	0.00		
0.050					
0.150					
0.200					
0.250					
0.450					
0.50	0.50	0.52	0.51		
1.00	1.00	1.02	1.00		
1.30					
1.80	1.83	1.83	1.77		
2.50					
4.50					
5.0					
9.0					
13.0					
22.0					

SIGNATURE: Edward L. [illegible]

DATE: 12/22/94

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MAGEHELIC CALIBRATION

BOX #1

SER. NO.	10720-AB68	R1061-6AG48	R5031-SEB76	R1062-9JA82	R1051-3MR42	R90124 RI119
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING	FIELD DEVICE READING					
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.050	0.050					
0.150	0.150	0.150				
0.200	0.200					
0.250		0.250				
0.450		0.450				
0.50			0.50			
1.00			1.00			
1.30				1.30		
1.80			1.80			
2.50				2.50	2.5	
4.50				4.50		
5.0					5.0	5.0
9.0					9.0	
13.0						14.0
22.0						21.0

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DATE: 12/23/94

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MAGEHELIC CALIBRATION
BOX #2

SER. NO.	10819-DR2	R1090-2AG18	R50315-EB93	R1062-9TA87	30830-AM79	R1072-2MC5
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING			FIELD DEVICE READING			
0.000	0.000	0.000	0.00	0.00	0.0	0.0
0.050	0.058					
0.150	0.161	0.151				
0.200	0.210					
0.250		0.255				
0.450		0.450				
0.50			0.51			
1.00			1.02			
1.30				1.32		
1.80			1.82			
2.50				2.61	2.6	
4.50				4.52		
5.0					5.0	5.2
9.0					8.9	
13.0						13.0
22.0						21.7

SIGNATURE: Edward L. Harris

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MAGEHELIC CALIBRATION

BOX #3

SER. NO.	R900723 MRR1	R0112642	R10608 CF20	
RANGE	0-0.50	0-2.0	0-10	
REFERENCE READING	FIELD DEVICE READING			
0.000	0.00	0.00	0.0	
0.050				
0.150	0.15			
0.200				
0.250	0.240			
0.450	0.450			
0.50		0.52		
1.00		1.00		
1.50				
1.80		1.85		
2.50			2.5	
4.50				
5.0			5.0	
9.0			9.2	
13.0				
22.0				

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DATE: 3/27/94

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MAGEHELIC CALIBRATION

BCX #4

SER. NO.	R22D	R90051 6GT21	R90101 SCD102
RANGE	0-0.50	0-5	0-25
REFERENCE READING	FIELD DEVICE READING		
0.000	0.000	0.00	0.0
0.050			
0.150	0.154		
0.200			
0.250	0.256		
0.450	0.455		
0.50			
1.00			
1.30		1.32	
1.80			
2.50		2.55	
4.50		4.59	
5.0			5.0
9.0			
13.0			13.0
22.0			22.0

SIGNATURE: [illegible] Harris

DATE: 12/[illegible]/94

TEMPERATURE CALIBRATIONS - DEGREES FAHRENHEIT

REFERENCE DEVICE READING*	0 DEG. F	210 DEG.	420 DEG.	630 DEG.	840 DEG.	1050 DEG.	1260 DEG.	1470 DEG.	1680 DEG.	1900 DEG.
2879	-2	209	420	629	838	1049	1259	1469	1679	1899
METER BOX #1 C-133 11580	0	209	416	624	833	1044	1255	1462	1674	1900
METER BOX #3 C-173 S11-24										
METER BOX #2 C-175 15962	0	208	417	628	839	1052	1265	1474	1678	1905
METER BOX #4 D-460 15751	0	206	417	624	839	1057	1273	1486	1690	1903
METER BOX #5 S-100 15751	-2	203	412	622	837	1055	1272	1484	1690	1900
METER BOX #6 S-101 15751	0	209	416	624	833	1045	1255	1463	1679	1904
PORTABLE THERMOCOUPLE # 1 (Yellow)	0	210	419	632	840	1050	1260	1470	1680	1900
PORTABLE THERMOCOUPLE # 2 (Blue)	0	209	416	625	839	1055	1270	1480	1684	1891
PORTABLE THERMOCOUPLE # 2 (Green)										
PINK T83658	0	209	417	629	843	1060	1275	1490	1693	1903

DATE: 12-27-94

SIGNATURE: Edward L Harris

* Reference Device is an Omega Engineering CL505-A calibrated reference thermocouple-potentiometer system.

SANDERS ENGINEERING & ANALYTICAL SERVICES, Inc.

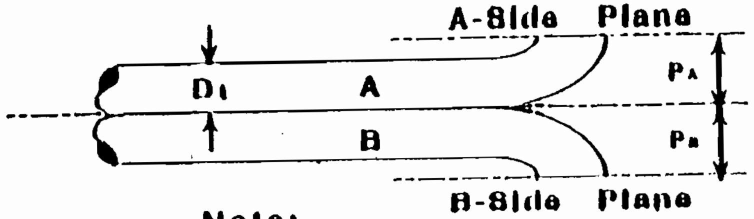
1688 Leroy Stevens Rd.
Mobile, AL 36695

Office: (205) 633-4120
FAX#: (205) 633-2285

The Pitot used was within the following geometric specifications:

D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.)

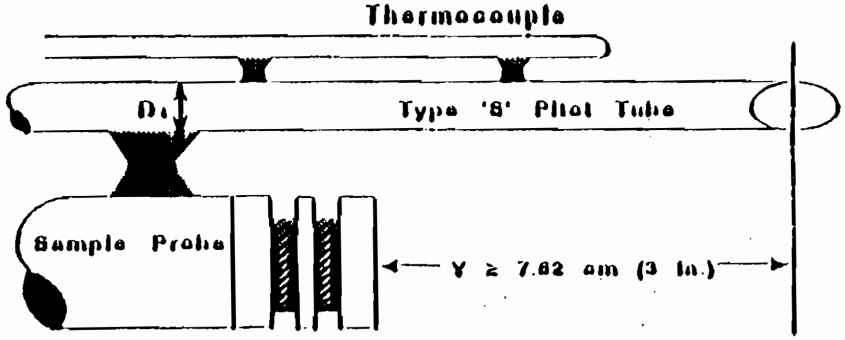
C_p = 0.84



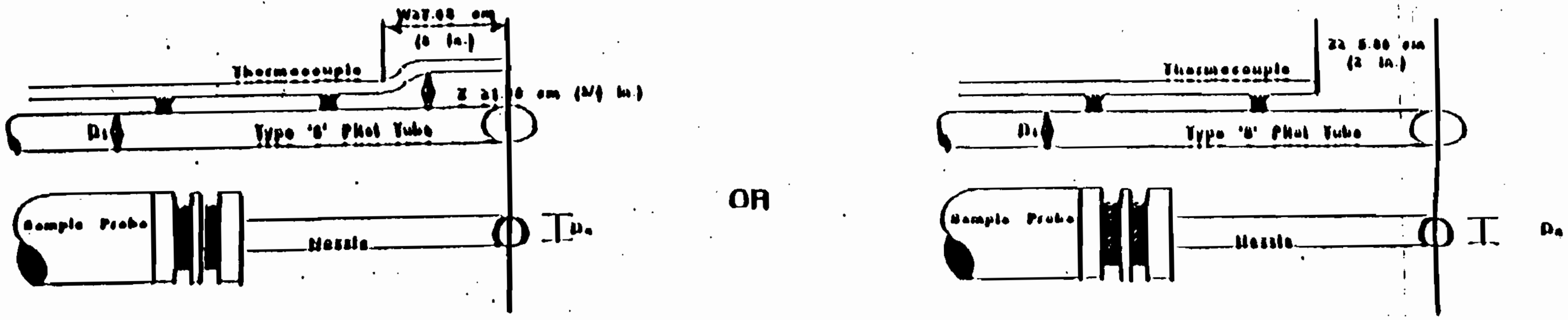
Note:

$1.05\ D_t \leq 1.50\ D_t$

$P_A = P_B$



Minimum pitot-sample probe separation needed to prevent interference



Proper thermocouple placement to prevent interference.

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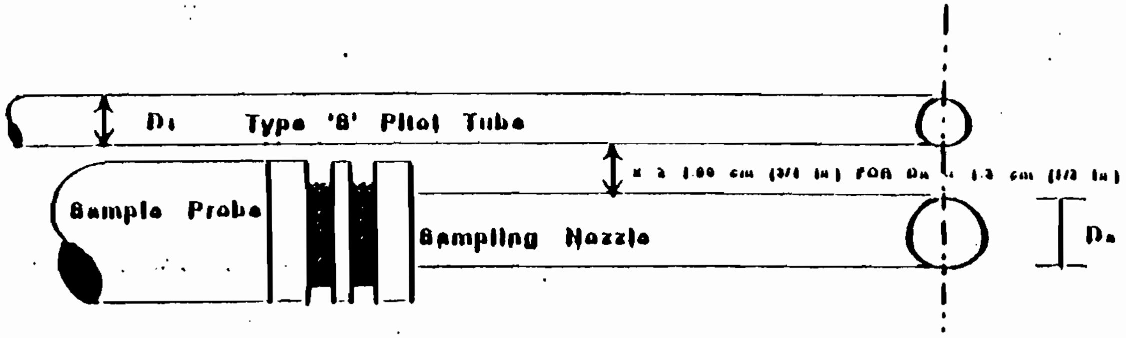
ANALYTICAL SERVICES, Inc.

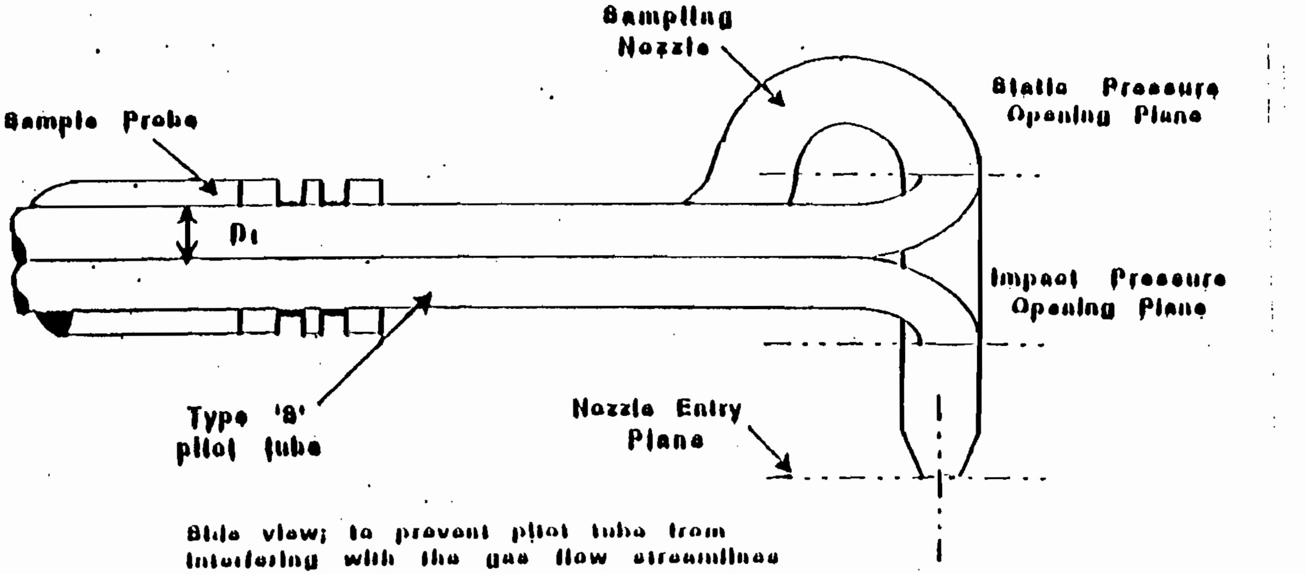
1568 Leroy Stevens Rd.
Mobile, AL 36695

Office: (205) 633-4120
FAX#: (205) 633-2265

Proper pitot tube-sampling nozzel configuration to prevent aero-dynamic interference; buttonhook type nozzle; centers of nozzle and pitot opening aligned; Dt between 0.48 and 0.95 cm (3/16 and 3/8 in.)



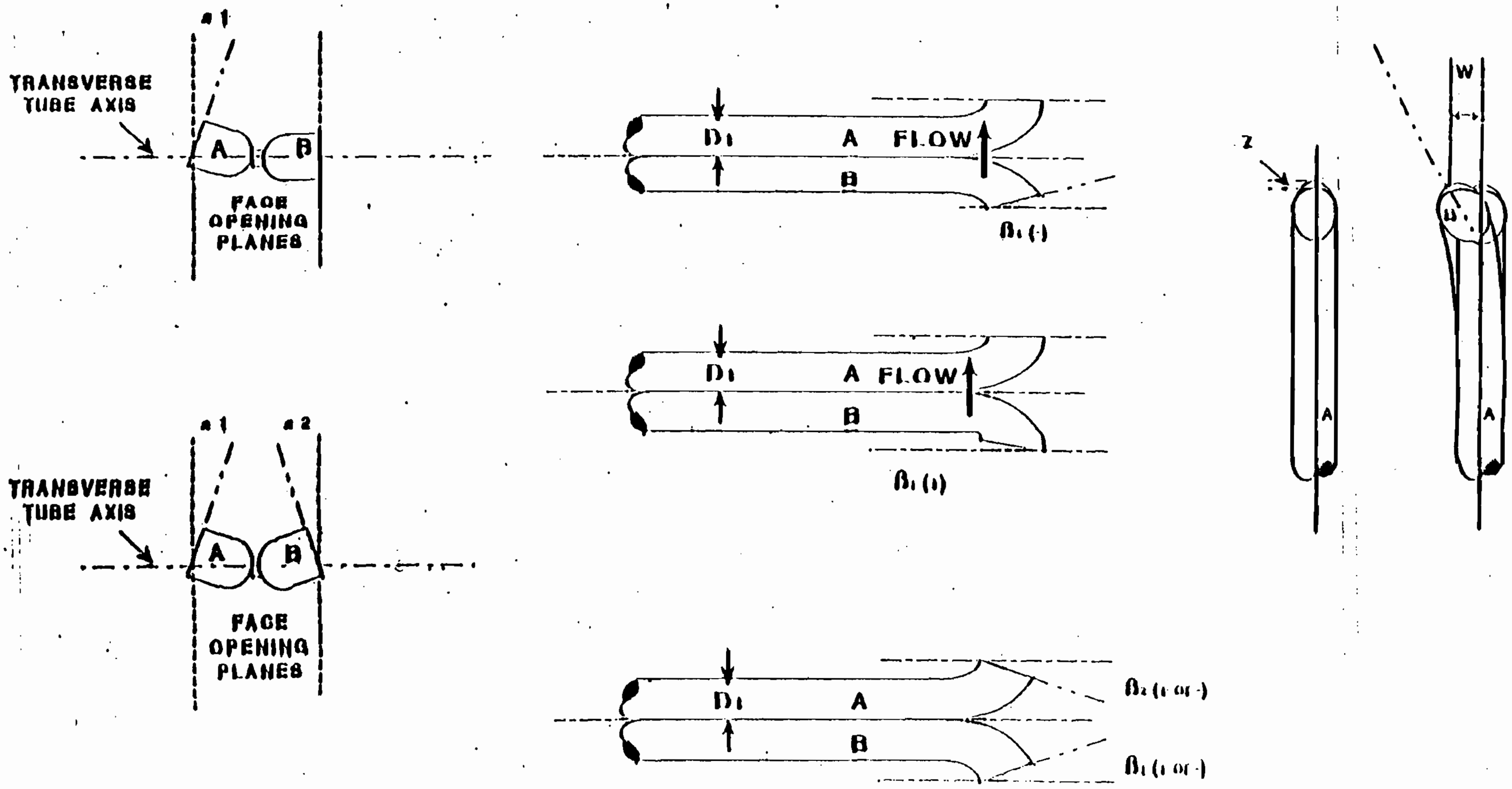
Bottom view showing minimum pitot/nozzle separation



Side view; to prevent pitot tube from interfering with the gas flow streamlines approaching the nozzle, the impact pressure opening plane of the pitot tube shall be even with or above the nozzle entry plane.

SANDERS ENGINEERING &
ANALYTICAL SERVICES, Inc.
1568 Leroy Stevens Rd.
Mobile, AL 36695
Office: (205) 633-4120
FAX#: (205) 633-2286

Types of face-opening misalignment that can result from field use or improper construction of type 'S' pitot tubes. These will not affect the baseline value of Cp(s) so long as α_1 and $\alpha_2 < 10°$, β_1 and $\beta_2 < 5°$, $z \leq 0.32$ cm (1/8 in.)



APPENDIX D OPERATIONAL DATA

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST CHRONOLOGY
UNIT # 4
SOOTBLOWING CONDITIONS
April 25, 1995

RUN # 1	START	9:06 a.m.	No problems noted at beginning of run.
	STOP	10:12 a.m.	No problems noted at end of run.
RUN # 2	START	10:55 a.m.	No problems noted at beginning of run.
	STOP	11:56 a.m.	No problems noted at end of run.
RUN # 3	START	12:36 p.m.	No problems noted at beginning of run.
	STOP	1:42 p.m.	No problems noted at end of run.

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST CHRONOLOGY
UNIT # 4
STEADY STATE CONDITIONS
April 26,1995

RUN # 1	START	7:52 a.m.	No problems noted at beginning of run.
	STOP	8:58 a.m.	No problems noted at end of run.
RUN # 2	START	.9:18 a.m.	No problems noted at beginning of run.
	STOP	10:23 a.m.	No problems noted at end of run.
RUN # 3	START	10:45 a.m.	No problems noted at beginning of run.
	STOP	11:51 p.m.	No problems noted at end of run.

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT #4
SOOT BLOWING CONDITIONS
April 25, 1995

TIME OF 6 MIN. AVERAGE	OPACITY (%)
(RUN # 1)	(RUN # 1)
8:01 - 8:06	4.0
8:07 - 8:12	4.1
8:13 - 8:18	4.5
8:19 - 9:24	4.3
9:25 - 9:30	4.3
9:31 - 9:36	4.2
(RUN # 2)	(RUN # 2)
10:55 - 11:00	3.7
11:01 - 11:06	3.6
11:07 - 11:12	3.6
11:13 - 11:18	3.5
11:19 - 11:24	3.4
11:25 - 11:30	4.0
11:31 - 11:36	3.7
11:37 - 11:42	3.3
11:43 - 11:48	3.5
11:49 - 11:54	3.6
11:55 - 12:00	3.4

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT # 4
SOOT BLOWING CONDITIONS
April 25, 1995

(RUN # 3)	(RUN # 3)
12:31.- 12:36	3.5
12:37.- 12:42	3.7
12:43 - 12:48	4.0
12:49 - 12:54	3.9
12:55 - 13:00	3.7
13:01 - 13:06	3.4
13:07 - 13:12	3.6
13:13 - 13:18	3.4
13:19 - 13:24	3.8
13:25 - 13:30	3.6
13:31 -.13:36	3.5
13:37 - 13:42	4.0

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT # 4
STEADY STATE CONDITIONS
April 26, 1995

TIME OF 6 MIN. AVERAGE	OPACITY (%)
(RUN # 1)	(RUN # 1)
7:49 - 7:54	4.2
7:55 - 8:00	4.0
8:01 - 8:06	3.8
8:07 - 8:12	3.6
8:13 - 8:18	3.4
8:19 - 8:24	3.4
8:25 - 8:30	3.2
8:31 - 8:36	3.3
8:37 - 8:42	3.2
8:43 - 8:48	3.4
8:49 - 8:54	3.3
8:55 - 9:00	3.7
(RUN # 2)	(RUN # 2)
9:13 - 9:18	3.3
9:19 - 9:24	3.3
9:25 - 9:30	3.3
9:31- 9:36	3.2
9:37 - 9:42	4.5
9:43 - 9:48	3.4
9:49 - 9:54	3.4
6:55 - 10:00	3.3
10:01 - 10:06	3.5
10:07 - 10:12	3.2
10:13 - 10:18	3.3
10:19 - 10:24	3.3

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST
SIX - MINUTE OPACITY AVERAGES
UNIT # 4
STEADY STATE CONDITIONS
April 26, 1995

(RUN # 3)	(RUN # 3)
10:43 - 10:48	3.3
10:49 - 10:54	3.1
10:55 - 11:00	3.2
11:01 - 11:06	3.1
11:07 - 11:12	3.2
11:13 - 11:18	3.1
11:19- 11:24	3.2
11:25 - 11:30	3.0
11:31 - 11:36	3.1
11:37 - 11:42	3.0
11:43 - 11:48	3.0
11:49 - 11:54	3.4

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State
DATE: 05/26/95

RUN # : 1
Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State
DATE: 05/26/95

RUN # : 1
Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Steady State

DATE: 5/26/95

RUN # : 1

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	25	270	210	NO READING
4B	25	250	200	36
4C	80	340	480	52
4D	80	300	660	58
4E	60	320	440	50
4F	70	300	500	50

RUN # : 1

Start or End End

4A	25	270	210	NO READING
4B	40	260	250	36
4C	80	340	480	52
4D	80	300	660	58
4E	60	320	440	50
4F	70	300	500	55

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State

DATE: 05/26/95

RUN # : 2

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State

DATE: 05/26/95

RUN # : 2

Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Steady State

DATE: 5/26/95

RUN # : 2

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	25	270	210	NO READING
4B	40	260	250	36
4C	80	340	480	52
4D	80	300	660	58
4E	60	320	440	50
4F	70	300	500	52

RUN # : 2

Start or End End

4A	40	260	280	NO READING
4B	30	250	210	40
4C	80	340	480	52
4D	80	300	650	58
4E	74	375	580	52
4F	70	310	500	52

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State

DATE: 05/26/95

RUN # : 3

Start or End Start

Transformer Box A

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State

DATE: 05/26/95

RUN # : 3

Start or End End

Transformer Box B

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Steady State DATE: 05/26/95

RUN # : 3 Start or End Start

Transformer Box A

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State DATE: 05/26/95

RUN # : 3 Start or End End

Transformer Box B

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Steady State

DATE: 5/26/95

Transformer Box A

RUN # : 3

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	40	270	280	NO READING
4B	30	250	210	40
4C	80	340	480	52
4D	80	300	650	58
4E	74	375	500	52
4F	70	310	740	52

Transformer Box B

RUN # : 3

Start or End End

4A	35	270	200	NO READING
4B	30	250	480	40
4C	85	350	660	52
4D	80	300	570	58
4E	74	350	520	52
4F	70	300	500	52

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 1

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	30	400	360	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 1

Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Soot Blowing DATE: 05/25/95

RUN # : 1 Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	50	230	200	NO READING
4B	35	240	160	38
4C	85	340	700	55
4D	80	310	640	58
4E	78	375	580	54
4F	68	300	500	54

RUN # : 1 Start or End End

4A	30	250	200	NO READING
4B	40	270	300	38
4C	75	340	480	50
4D	80	300	630	58
4E	74	350	580	54
4F	68	300	500	54

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 2

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	370	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Steady State

DATE: 05/26/95

RUN # : 2

Start or End End

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	360	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Soot Blowing DATE: 05/25/95

RUN # : 2 Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	30	250	200	NO READING
4B	40	270	300	38
4C	75	340	480	50
4D	80	300	630	58
4E	74	350	580	54
4F	68	300	500	54

RUN # : 2 Start or End End

4A	35	260	240	NO READING
4B	30	260	300	42
4C	80	340	400	52
4D	80	310	660	58
4E	70	330	560	52
4F	68	300	500	54

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

COLD PRECIPITATOR

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 3

Start or End Start

Transformer Box A

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	360	18
4-B	28	340	300	NO READING
4-C	34	NO READING	190	19

TEST: Soot Blowing

DATE: 05/25/95

RUN # : 3

Start or End End

Transformer Box B

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4-A	31	420	365	18
4-B	28	335	300	NO READING
4-C	34	NO READING	190	19

CRIST ELECTRIC GENERATING PLANT
PARTICULATE COMPLIANCE TEST: UNIT # 4
PRECIPITATOR READINGS

HOT PRECIPITATOR

TEST: Soot Blowing

DATE: 05/25/95

Transformer Box A

RUN # : 3

Start or End Start

	Primary Amps (AC AMPS)	Primary Volts (AC Volts)	Secondary Amps (DC mAmps)	Secondary Volts (DC KVolts)
4A	35	260	240	NO READING
4B	30	260	300	42
4C	80	340	400	52
4D	80	310	660	58
4E	70	330	560	52
4F	68	300	500	54

Transformer Box B

RUN # : 3

Start or End End

4A	30	240	240	NO READING
4B	30	240	260	42
4C	75	340	360	48
4D	80	300	680	52
4E	72	350	550	52
4F	68	300	520	52

SANDERS ENGINEERING & ANALYTICAL SERVICES, INC.

PARTICULATE EMISSIONS TEST REPORT
STEADY STATE OPERATIONS

FOR

GULF POWER COMPANY
Plant Crist, Unit 5
Pensacola, Florida

April 18, 1996

1568 LEROY STEVENS ROAD
MOBILE, ALABAMA 36695 • 205/633-4120

SANDERS ENGINEERING & ANALYTICAL SERVICES, INC.

1568 LEROY STEVENS ROAD MOBILE, ALABAMA 36695 • OFFICE 334 / 633-4120
FAX 334 / 633-2285

ENVIRONMENTAL ENGINEERING
AIR & WATER QUALITY MODELING
ENVIRONMENTAL ASSESSMENTS
PSD ANALYSIS
EMERGENCY RESPONSE MONITORING

AMBIENT AIR MONITORING
CONTINUOUS IN-STACK MONITORING
SOURCE TESTING
VISIBLE EMISSIONS TESTING
CONSULTING SERVICES

REPORT CERTIFICATION

The sampling and analysis for this report was carried out under my direction and supervision.

Date: 4-30-96

Signature: Edward L. Harris
Edward L. Harris
Environmental Specialist

I have reveiwed the testing details and results in this report and hereby certify that the test report is authentic and accurate to the best of my knowledge.

Date: 4-30-96

Signature: Joseph C. Sanders
Joseph C. Sanders
Manager

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ILLUSTRATIONS

1. INTRODUCTION

Sanders Engineering & Analytical Services, Inc. (SEAS) performed particulate emissions testing during steady state operations at Gulf Power Company, Plant Crist, Unit 5, located in Pensacola, Florida. The testing was conducted on April 18, 1996. The testing was performed in accordance with the applicable U.S. EPA procedures specified at **40 CFR, Part 60, Appendix A, Methods 1, 2, 3, 4, and 17**.

The purpose of the test was to demonstrate compliance with the rules and regulations of the Florida Department of Environmental Protection, and to meet the necessary requirements contained in the permit to operate issued by the Florida Department of Environmental Protection.

The test was conducted by Mr. Edward Harris and Mr. Dean Holmes of Sanders Engineering & Analytical Services, Inc., and was coordinated with Mr. John McPherson of Gulf Power Company. The Florida Department of Environmental Protection was notified so their representative could be present to observe the testing.

The test was conducted in accordance with the guidelines of the Florida Department of Environmental Protection. Further discussion of the test methods are included later in the report.

2. SUMMARY AND DISCUSSION OF RESULTS

The results of the particulate emissions test for the steady state runs, along with the results of the computations, are summarized in Table I. The equations used in the calculations of the results, along with the completed field data sheets for the testing, are presented in Appendix A. The sample calculations of the first run are presented in Appendix B. The quality control checks of the equipment used in the sampling program are included in Appendix C.

There were no problems encountered during the performance of the test. The bottom port of the duct was not sampled due to ash build-up. One of the other ports was alternately sampled twice on each run to compensate for the port not sampled. At the completion of each run, the filter and probe were removed to a relatively clean, draft-free area for clean-up.

The results of the testing indicate the particulate emission rate during steady state for Plant Crist, Unit 5, is 0.029 LBS/MMBTU. The applicable Florida Department of Environmental Protection rules and regulations require an emission rate of no greater than 0.10 LBS/MMBTU. The results of the testing indicate that the unit is in compliance with the particulate emission condition of the permit to operate issued by the Florida Department of Environmental Protection.

TABLE I. PARTICULATE EMISSIONS TEST RESULTS

GULF POWER COMPANY

PLANT CRIST, UNIT 5, STEADY STATE

4/18/96

Title of Run		RUN 1	RUN 2	RUN 3
Sampling Time -Start	Military	0914	1258	1526
Sampling Time -Stop	Military	1020	1403	1631
F Factor	SDCF/MMBTU	9820	9820	9820
Plant Load	Megawatts	88.0	88.0	88.0
Static Pressure	In. H2O	-0.35	-0.35	-0.35
Barometric Pressure	In. Hg	30.05	30.05	30.05
Average dH	In. H20	0.966	1.141	1.098
Meter correction		1.024	1.024	1.024
Avg. Meter Temp.	Deg. F	62.1	65.7	68.4
% O2	%	5.3	5.1	5.3
%CO2	%	12.5	12.5	12.5
Volume Metered	ACF	35.676	38.566	37.930
Volume Water	Ml	78.0	82.0	82.0
Sampling Time	Minutes	64	64	64
Nozzle Diameter	Inches	0.222	0.221	0.221
Avg. Stack Temp.	Deg. F	301.4	304.4	306.6
Area of Stack	Sq. Feet	92.1350	92.1350	92.1350
Wt. of Part.	Mg.	41.7	41.3	33.5
Number of Points		32	32	32
Avg. Sqrt dP	In. H20	0.8161	0.8906	0.8712

RESULTS OF COMPUTATIONS

		RUN 1	RUN 2	RUN 3	Average
Volume of Gas Sampled	SDCF	37.177	39.929	39.068	
H2O vapor in Gas Stream	PERCENT	9.0	8.8	9.0	8.9
Avg. Stack Gas Velocity	FT/SEC	54.7	59.8	58.6	57.7
Volumetric Flow Rate	SDCFM	191,484	208,924	203,728	201,379
Volumetric Flow Rate	ACF/M	302,348	330,553	323,870	318,923
Particulate Conc.	Grs/SDCF	0.017	0.016	0.013	0.015
Particulate Conc.	Grs/ACF	0.011	0.010	0.008	0.010
Particulate Mass Rate	Lb/Hr	28.4	28.5	23.1	26.6
Particulate Mass Rate	Lb/MMBtu	0.032	0.030	0.025	0.029
Heat Input	MMBTU/Hr	873.28	965.02	929.11	922.47
Percent of Isokinetic	%	104.0	103.3	103.7	

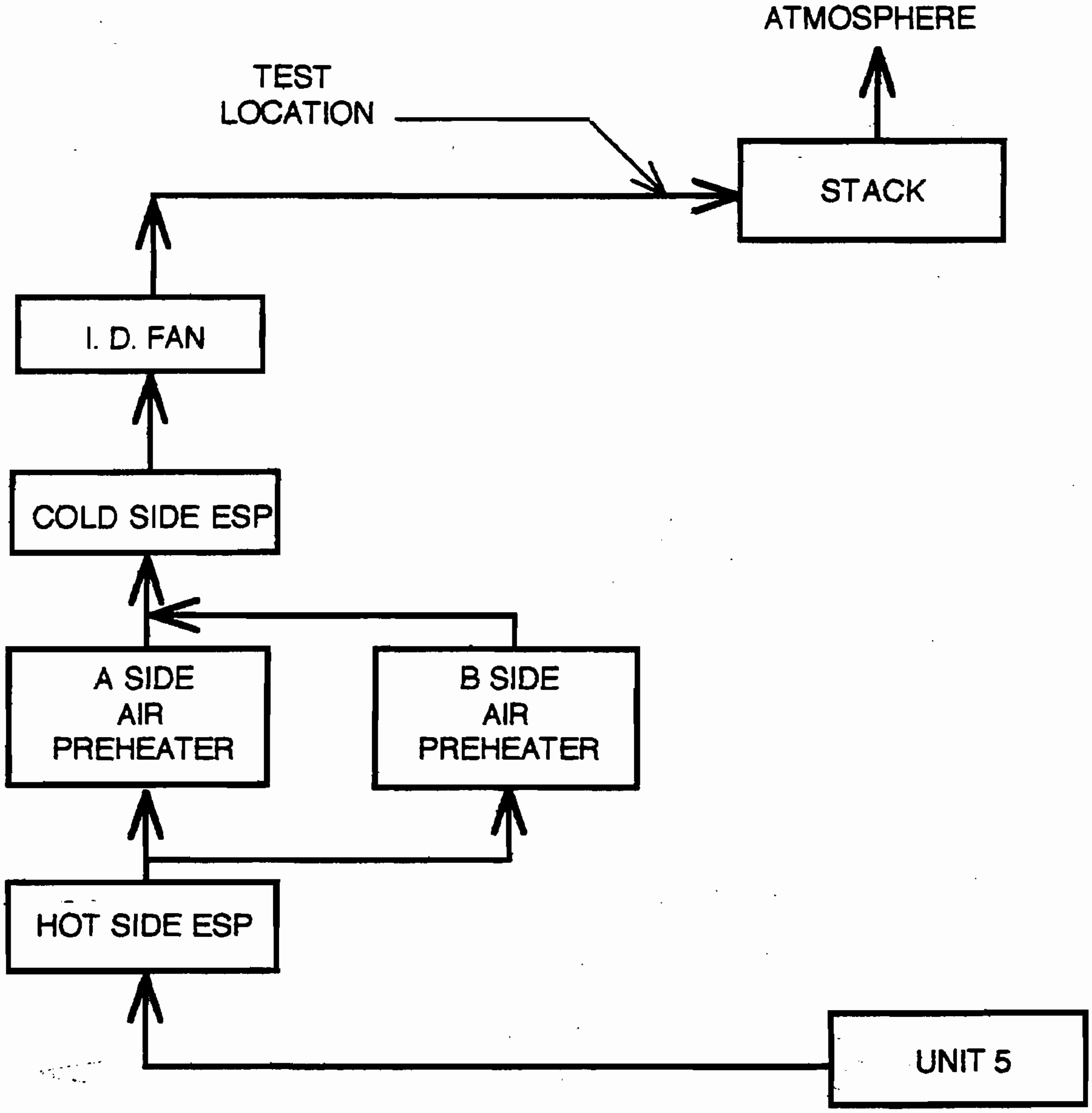
3. PROCESS DESCRIPTION

The process consists of a steam electric generating unit firing bituminous coal for the production of electric energy. The coal is received by barge, and loaded directly onto the conveyor feeding the plant, or onto the stockpile and later loaded onto the conveyor belt transporting the coal to the plant. The coal from the conveyor is loaded into bunkers capable of holding between 36 to 48 hours supply of coal. The coal is then fed to pulverizing mills before being fired in the unit through the burners. Upon combustion of the coal in the fire box, approximately 20 percent of the ash falls to the bottom of the boiler and is removed by the ash removal system. The remaining 80 percent exits with the flue gases through the heat exchange and economizer sections of the furnace, and is collected by electrostatic precipitators.

3.1. Source Air Flow

As shown in Figure 1, the flue gases exit the boiler and flow through a hot side precipitator. The exhaust gases are separated into ducts A and B before entering air preheaters. The exhaust gases are combined before entering a cold side ESP. The flue gases exiting the cold side ESP are exhausted through a stack into the atmosphere.

Figure 1. Air Flow Schematic



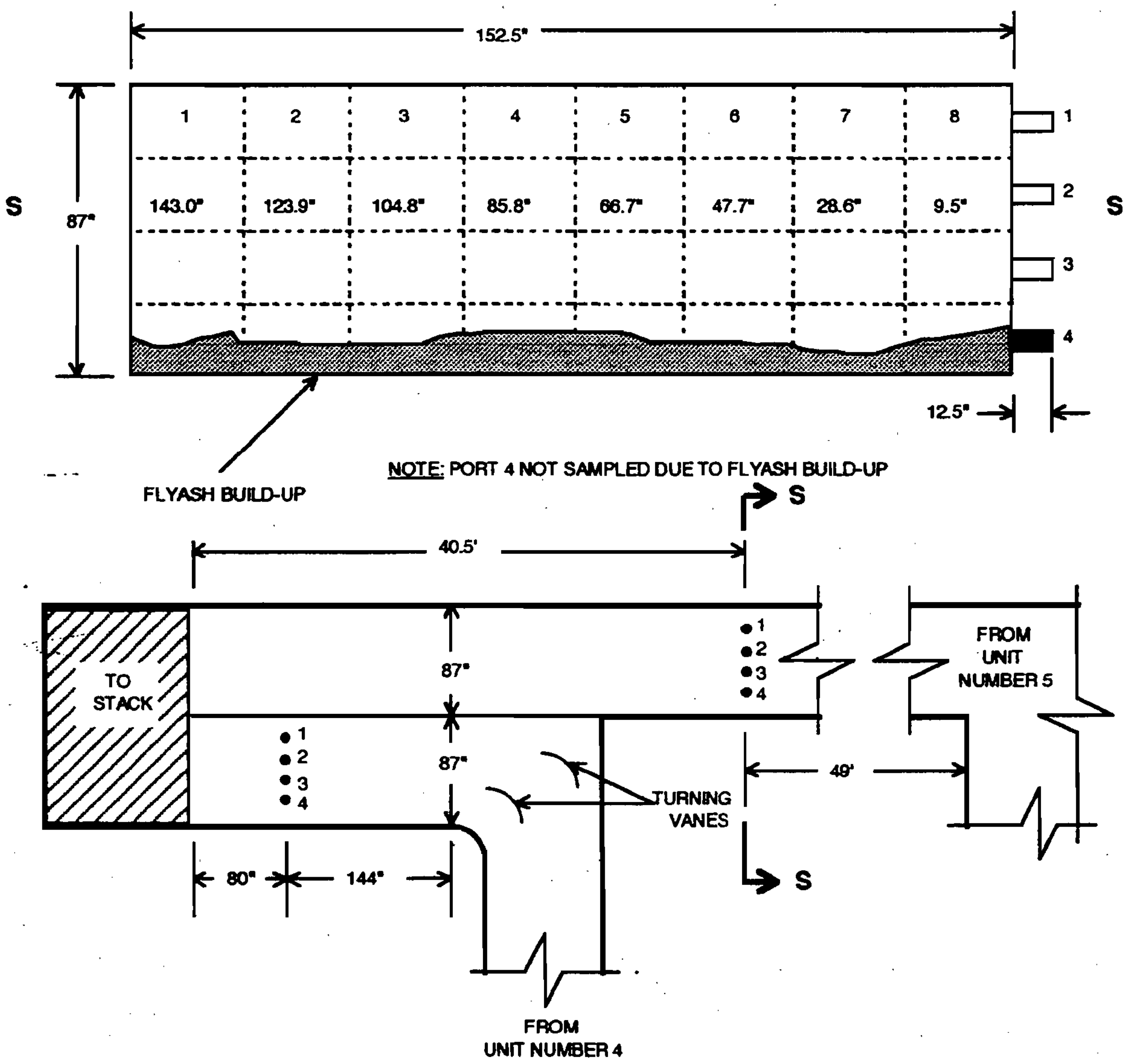
3.2. Operation During Testing

The average heat input during steady state operation, as based on F-factor calculations, was 922.47 million BTU per hour resulting in the production of approximately 88 megawatts of electricity. Precipitator data supplied by Gulf Power personnel is given in Appendix D.

4. SAMPLE POINT LOCATION

The sample point locations and outlet duct schematic are presented in Figure 2. Method 1 was used for determination of the number and location of sampling points. The minimum number of points (25) required for rectangular stacks was met by sampling a total of 32 points.

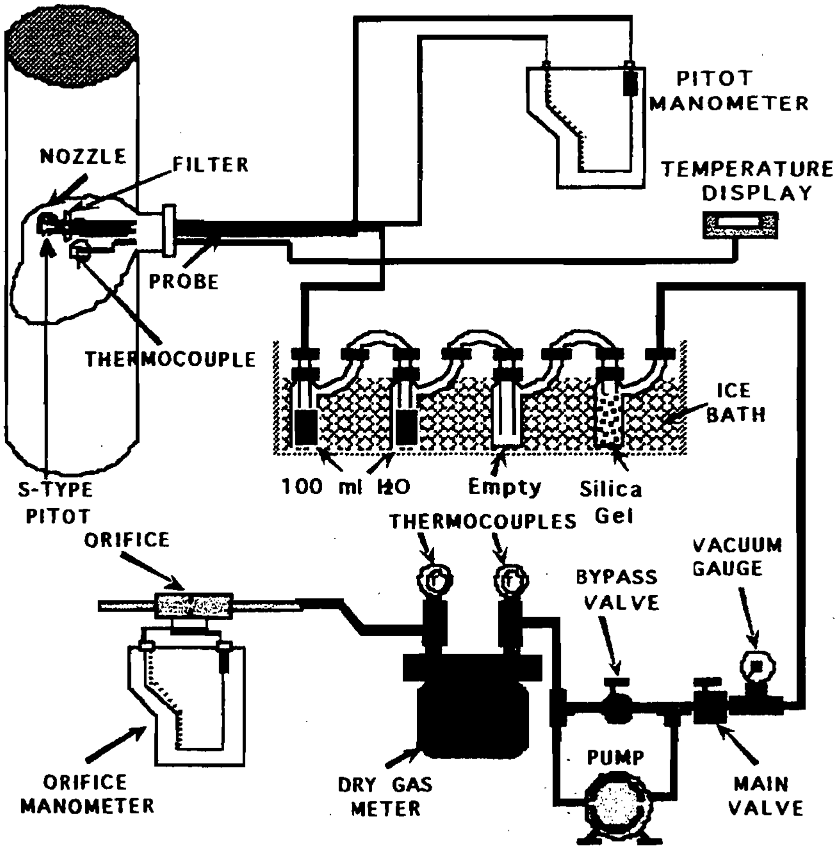
Figure 2. Sample Point Locations



5. PARTICULATE SAMPLING PROCEDURE (EPA Method 17)

The sampling procedure utilized is that specified in **40 CFR, Part 60, Appendix A, Method 17,** as modified by the governing regulatory agency. A brief description of this procedure is as follows:

Figure 3. Particulate Sampling Train



The first impingers were partially filled with 100 milliliters of deionized water. The next impinger was left empty to act as a moisture trap. Preweighed 6 to 16 mesh indication silica gel was added to the last impinger. The sampling equipment manufactured by Lear Siegler (Model 100) or Sanders Engineering (Model 200) was assembled as shown in the attached drawing. The system was leak checked by plugging the inlet to the nozzle and pulling a 15 inch mercury vacuum. A leakage rate not in excess of 0.02 cubic feet per minute was considered acceptable.

The inside dimensions of the stack liner were measured and recorded. The required number of sampling points were marked on the probe for easy visibility. The range of velocity pressure, the percent moisture, and the temperature of the effluent gases were determined. From this data, the correct nozzle size and the nomograph multiplication factor were determined.

Crushed ice was placed around the impingers. The nozzle was placed on the first traverse point with the tip pointing directly into the gas stream. The pump was started immediately and the flow was adjusted to isokinetic sampling conditions. After the required time interval had elapsed, the probe was repositioned to the next traverse point and isokinetic sampling was re-established. This was performed for each point until the run was completed. Readings were taken at each point and recorded on the field data sheet. At the conclusion of each run, the pump was turned off and the final readings were recorded.

5.1. Particulate Sample Recovery

Care was exercised in moving the collection train to the sample recovery area to minimize the loss of collected sample, or the gain of extraneous particulate matter. The volume of water in the impingers was measured, the silica gel impinger was weighed and recorded on the field data sheet. The nozzle, and all sample-exposed surfaces were washed with reagent grade acetone into a clean sample container. A brush was used to loosen any adhering particulate matter and subsequent washings were placed into the container. The filter was carefully removed from the fritted support and placed in a clean separate sample container. A sample of the acetone used in the washing was saved for a blank laboratory analysis.

5.2. Particulate Analytical Procedures

The filter and any loose particulate matter were transferred from the sample container to a clean, tared weighing dish. The filter was placed in a desiccator for at least 24 hours and then weighed to the nearest 0.1 milligram until a constant weight was obtained. The original weight of the filter was deducted, and the weight gain was recorded to the nearest 0.1 milligram.

The wash solution was transferred to a clean, tared beaker. The solution was evaporated to dryness, desiccated to a constant weight, and the weight gain was recorded to the nearest 0.1 milligram.

APPENDIX A EQUATIONS AND FIELD DATA SHEETS

EQUATIONS

1. $P_s = P_{bar} + \dfrac{P_g}{13.6}$

2. $P_m = P_{bar} + \dfrac{\overline{\Delta H}}{13.6}$

3. $V_s = K_p C_p \overline{\sqrt{\Delta P}} \sqrt{\dfrac{\overline{T_s}}{M_s P_s}}$

4. $V_{m(Std)} = K_1 V_m Y \left[\dfrac{P_{bar} + \dfrac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right]$

5. $V_{w(Std)} = 0.04707 V_{1c}$

6. $B_{ws} = \dfrac{V_{w(Std)}}{V_{m(Std)} + V_{w(Std)}}$

7. $M_d = 0.44 (\%CO_2) + 0.32 (\%O_2) + 0.28 (\%N_2 + \%CO)$

8. $M_s = M_d(1 - B_{ws}) + 18 (B_{ws})$

9. $EA = \left[\dfrac{(\%O_2 - 0.5 (\%CO))}{0.264 (\%N_2) - ((\%O_2) - 0.5 (\%CO))} \right] 100$

10. $Q_a = (V_s)(A_s)(60)$

11. $Q_s = Q_a (1 - B_{ws}) \frac{(528)}{\overline{T}_s} \frac{(P_s)}{29.92}$

12. $E_H = \left(\frac{PMR}{H_I} \right)$

13. $E = C_d F_{O_2} \left(\frac{20.9}{20.9 - \%O_2} \right)$

14. $C_s = 0.0154 \frac{M_n}{V_{m(Std)}}$

15. $C_{50} = \frac{21 \ C_s}{21 - [(1.5)(\%O_2) - 0.133 (N_2) - 0.75 (\%CO)]}$

16. $C_{12} = \frac{C_s (12)}{\%CO_2}$

17. $PMR = (C_s)(Q_s) \frac{(60)}{7000}$

18. $V_n = \left[(0.002669)(V_{1c}) + \frac{V_m Y}{\overline{T}_m} \left(P_{bar} + \frac{\overline{\Delta H}}{13.6} \right) \right] \frac{\overline{T}_s}{P_s}$

19. $I = \frac{100 \ V_n}{(60) \ \emptyset \ V_s \ A_n}$

NOMENCLATURE

A_n = Cross-sectional area of nozzel, ft ^{2}

A_s = Cross sectional area of stack, ft ^{2}

B_{ws} = Water vapor in the gas stream, proportion by volume (dimensionless)

C_p = Pitot tube coefficient (dimensionless) (0.84)

C_s = Particulate concentration, grains/SDCF

C_d = Particulate concentration, lbs/SDCF

C_{12} = Particulate concentration (C_s adjusted to 12% CO) grains/SDCF

C_{50} = Particulate concentration (C_s adjusted to 50% excess air) grains/SDCF

EA = Excess air, %

E = Emission in lb/mmBTU

E_H = Emission in lb/mmBTU, based on heat input

H_I = Total Heat Input, Million BTU per Hour (MMBTU/hr)

I = Percent of isokinetic sampling

K_1 = 17.64 °R/ inches Hg

K_p = Pitot tube constant,

$$85.49 \text{ ft/sec} \left[\frac{(\text{lb/lb-mole})\ (\text{in. Hg})}{(°\text{R})\ (\text{inc. } H_2O)}\right]^{\frac{1}{2}}$$

M_n = Total amount of particulate collected, mg

M_d = Molecular weight of stack gas; dry basis, lb/lb mole

M_s = Molecular weight of stack gas; wet basis, lb/lb mole

P_{bar} = Barometric pressure at the sampling site, in. Hg

NOMENCLATURE (continued)

P_m = Meter pressure, in. Hg

P_s = Absolute stack pressure, in. Hg

P_g = Stack static pressure, in. H_2O
PMR = Particulate mass rate, lb/Hr

Q_a = Volumetric flow rate ACFM

Q_s = Volumetric flow rate SDCFM

V_s = Average stack gas velocity, ft/sec

V_{lc} = Total volume of liquid collected in impingers & silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, ACF

$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, corrected to standard conditions, SDCF

$V_{w(std)}$ = Volume of water vapor in gas sample, corrected to standard conditions, SCF

V_n = Volume collected at stack conditions through nozzle, ACF

Y = Dry gas meter calibration factor (dimensionless)

ΔH = Average pressure difference of orifice, in. H_2O

ΔP = Velocity head of stack gas, in. H_2O

$\overline{\sqrt{\Delta P}}$ = Average of square roots of the velocity pressure, in. H_2O

Ø = Total sampling time, minutes

$\%CO_2$, $\%O_2$, N_2, $\%CO$ - Number % by volume, dry basis, from gas analysis

F_{O_2} = Oxygen based F factor (9820 SDCF/mmBTU for bituminous coal)

T_s = Temperature of the stack, °R (° F + 460)

SEAS

SANDERS ENGINEERING & ANALYTICAL SERVICES, Inc.

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Mobile, AL 36695

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FAX#: (205) 633-2285

FIELD DATA SHEET

COMPANY GPCO DATE 4-18-96 DGM# S-101

PLANT Crist OPERATOR ELH ΔHa 0.74 cu. ft./min.

UNIT #5 ~~Soot Blow~~ Steady State METHOD 17 PROBE N/A liner 12' length

RUN 1

RATA Run 8

NOZZLE CALIBRATION

PRE	POST
.222	.222
.222	.222
.222	.222
.222 AVERAGE	.222 AVERAGE

FILTER NUMBER 1365

METER READING

403.576 FINAL
367.900 INITIAL
35.676 NET

LEAK CHECK

SYSTEM Pre	SYSTEM Post	PITOT Pre	PITOT Post
15 in. Hg	10 in. Hg	~~impact~~	~~impact~~
0.000 cfm	0.000 cfm	~~static~~	~~static~~

VOLUME OF LIQUID WATER COLLECTED

	IMP. 1	IMP. 2	IMP. 3	IMP. 4
FINAL	166	100	0	1579.0
INITIAL	100	100	0	1567.0
NET	66	0	0	12.0

TOTAL 78.0

GAS ANALYSIS

O_2 5.3 %
CO_2 12.5 %
CO —

STATIC -0.35 in. H_2O

BAROMETRIC 30.05 in. Hg

RUN 2

RATA Run 10

NOZZLE CALIBRATION

PRE	POST
.221	.221
.221	.221
.221	.221
.221 AVERAGE	.221 AVERAGE

FILTER NUMBER 1366

METER READING

443.966 FINAL
405.400 INITIAL
38.566 NET

LEAK CHECK

SYSTEM Pre	SYSTEM Post	PITOT Pre	PITOT Post
15 in. Hg	12 in. Hg	~~impact~~	~~impact~~
0.000 cfm	0.000 cfm	~~static~~	~~static~~

VOLUME OF LIQUID WATER COLLECTED

	IMP. 1	IMP. 2	IMP. 3	IMP. 4
FINAL	174	100	0	1587.0
INITIAL	100	100	0	1579.0
NET	74	0	0	8.0

TOTAL 82.0

GAS ANALYSIS

O_2 5.1 %
CO_2 12.5 %
CO —

STATIC -0.35 in. H_2O

BAROMETRIC 30.05 in. Hg

RUN 3

RATA Run 11

NOZZLE CALIBRATION

PRE	POST
.221	.221
.221	.221
.221	.221
.221 AVERAGE	.221 AVERAGE

FILTER NUMBER 1367

METER READING

483.230 FINAL
445.300 INITIAL
37.930 NET

LEAK CHECK

SYSTEM Pre	SYSTEM Post	PITOT Pre	PITOT Post
15 in. Hg	10 in. Hg	~~impact~~	~~impact~~
0.000 cfm	0.000 cfm	~~static~~	~~static~~

VOLUME OF LIQUID WATER COLLECTED

	IMP. 1	IMP. 2	IMP. 3	IMP. 4
FINAL	172	100	0	1431.0
INITIAL	100	100	0	1421.0
NET	72	0	0	10.0

TOTAL 82.0

GAS ANALYSIS

O_2 5.3 %
CO_2 12.5 %
CO —

STATIC -0.35 in. H_2O

BAROMETRIC 30.05 in. Hg

K= 1.44

DONOT USE FOR RATA CALCS

Port # / Point #	Time	Gas Meter Vol. (cu. ft.)	Vel. Head ΔP in. H_2O	Orifice Head ΔH in. H_2O	Temperature (F) Stack	Probe	Hot Box	Imp.	Gas Meter In	Gas Meter Out	Vac. in. H_g	9:08 Port4	
3- 1	9 :14	367.900	.65	.94	297	N/A	N/A	53	60	60	2	.72	29
2	:16	369.100	.64	.92	301			✓	60	60	2	.70	30
3	:18	370.100	.52	.75	303			✓	60	60	2	.62	30
4	:20	371.100	.53	.76	303			✓	60	60	2	.32	30
5	:22	372.100	.64	.92	302			✓	61	60	2	.43	30
6	:24	373.200	.60	.86	302			✓	60	60	2	.59	30
7	:26	374.250	.65	.94	301			✓	61	60	2	.50	30
8	:28	375.350	.71	1.02	297			✓	61	61	2	.35	29
3- 1	:30	376.500	.70	1.01	296			✓	61	61	2		
2	:32	377.700	.68	.98	303			✓	62	61	2		
3	:34	378.800	.52	.75	303			✓	62	61	2		
4	:36	379.800	.50	.72	303			✓	62	62	2	.6	
5	:38	380.800	.65	.94	303			55	62	62	2		
6	:40	381.900	.60	.86	302			✓	62	62	2		
7	:42	382.900	.65	.94	301			✓	62	62	2		
8	:44	383.950	.75	1.08	297			✓	62	62	2		
2- 1	9 :47	385.120	.70	1.01	297			54	63	62	3		
2	:49	386.300	.59	.85	302			✓	63	62	3		
3	:51	387.500	.75	1.08	304			✓	63	62	3		
4	:53	388.600	.62	.89	303			✓	63	63	3		
5	:55	389.600	.69	1.0	303			✓	63	62	3		
6	:57	390.750	.57	.82	303			✓	64	63	3		
7	:59	391.800	.67	.97	302			✓	64	63	3		
8	10 :01	392.900	.70	1.01	299			✓	64	63	3		
1- 1	:04	394.010	.90	1.30	299			✓	64	63	4		
2	:06	394.300	.73	1.06	304			56	64	63	4		
3	:08	396.500	.89	1.29	304			✓	64	63	4		
4	:16	397.800	.85	1.23	304			✓	64	63	4		
5	:12	399.050	.70	1.01	303			✓	64	63	4		
6	:14	400.100	.85	1.23	303			✓	64	63	4		
7	:16	401.400	.68	.98	302			✓	64	63	4		
8	:18	402.400	.55	.79	299			✓	64	64	3		

Final 10 :20 403.576

Check Indicates Temperatures Meet Required Limits.

Company GPCO

Date 4-18-96

Site Crist #5 Steady State

Run # 1

Page 2 Of

RATA RUN #8

K=1.430

Do NOT USE FOR RATA CALCS.

Port # Point #	Time	Gas Meter Vol. (cu. ft.)	Vel. Head ΔP in. H_2O	Orifice Head ΔH in. H_2O	Temperature (F)						Vac. in. H_g	12:52 Port 4	
					Stack	Probe	Hot Box	Imp.	Gas Meter In	Gas Meter Out			
1- 1	12:58	405.480	1.02	1.45	296	N/A	N/A	50	64	64	4	.75	29
2	13:06	406.700	.85	1.21	302			✓	64	64	4	.74	30
3	:02	408.000	1.13	1.61	306			✓	64	64	4	.52	30
4	:04	409.450	.90	1.28	306			✓	64	64	3	.40	30
5	:06	410.600	.75	1.07	305			✓	64	64	3	.50	30
6	:08	411.800	.97	1.38	305			✓	64	64	3	.40	30
7	:10	413.200	.80	1.14	305			✓	65	65	3	.36	30
8	:12	414.400	.60	.85	304			52	65	65	3	.35	30
1- 1	:14	415.450	1.01	1.44	305			✓	65	65	4		
2	:16	416.700	.88	1.25	307			✓	65	65	4		
3	:18	418.000	1.25	1.78	306			✓	65	65	5		
4	:20	419.600	.94	1.34	306			✓	66	65	4		
5	:22	420.800	.75	1.07	305			✓	66	65	4		
6	:24	422.000	.96	1.37	305			✓	66	66	5		
7	:26	423.300	.83	1.18	305			✓	66	65	4		
8	:28	424.650	.60	.86	303			✓	66	65	4		
2- 1	13:31	425.630	.78	1.11	301			✓	66	66	4		
2	:33	426.800	.68	.97	306			54	66	66	4		
3	:35	427.950	.83	1.18	306			✓	66	66	4		
4	:37	429.200	.63	.90	306			✓	67	66	4		
5	:39	430.300	.72	1.03	306			✓	66	66	4		
6	:41	431.450	.65	.93	305			✓	67	66	4		
7	:43	432.500	.78	1.11	305			✓	67	66	4		
8	:45	433.750	.70	1.00	299			✓	67	66	4		
3- 1	:47	434.928	.77	1.10	301			✓	67	66	4		
2	:49	436.100	.74	1.06	304			✓	67	66	4		
3	:51	437.250	.60	.86	306			✓	67	66	4		
4	:53	438.300	.55	.78	307			56	68	67	4		
5	:55	439.350	.75	1.07	306			✓	67	67	4		
6	:57	440.550	.69	.98	306			✓	68	67	4		
7	:59	441.600	.71	1.01	305			✓	68	67	4		
8	:01	442.750	.80	1.14	301			✓	68	67	5		

final 14:03 443.966

Check Indicates Temperatures Meet Required Limits.

Company GPCO

Date 4-18-96

Site Crist #5 ~~Steady State~~

Run # 2

Page 3 Of

* Run 10 For RATA

Port # Point #	Time	Gas Meter Vol. (cu. ft.)	Vel. Head ΔP in. H_2O	Orifice Head ΔH in. H_2O	Temperature (F) Stack	Probe	Hot Box	Imp.	Gas Meter In	Gas Meter Out	Vac. in. H_g	15:21 Port4	
1- 1	15:26	445.300	1.10	1.57	300	N/A	N/A	50	67	67	5	.85	30
2	:28	446.600	.85	1.21	304			✓	67	67	4	.73	30
3	:30	447.900	1.23	1.76	308			✓	67	67	5	.60	30
4	:32	449.350	1.02	1.46	309			✓	67	67	4	.40	30
5	:34	450.800	.80	1.15	308			✓	67	67	4	.30	30
6	:36	452.000	.95	1.36	308			✓	67	67	4	.53	30
7	:38	453.300	.74	1.06	307			✓	68	67	4	.30	30
8	:40	454.500	.60	.86	306			✓	68	67	3	.30	30
2- 1	:43	455.564	.75	1.07	300			52	68	67	3		
2	:45	456.800	.67	.96	308			✓	68	68	3		
3	:47	457.800	.80	1.15	309			✓	68	68	4		
4	:49	459.050	.60	.86	309			✓	68	68	3		
5	:51	460.100	.70	1.00	309			✓	69	68	3		
6	:53	461.200	.64	.92	309			✓	69	68	3		
7	:55	462.350	.74	1.06	307			✓	69	68	3		
8	:57	463.500	.78	1.12	303			✓	69	68	4		
2- 1	:59	464.750	.76	1.09	301			✓	69	68	4		
2	16:01	465.900	.66	.95	308			✓	69	68	4		
3	:03	467.000	.82	1.18	309			✓	69	68	4.5		
4	:05	468.300	.65	.93	309			✓	70	69	4		
5	:07	469.350	.73	1.05	309			✓	70	69	4		
6	:09	470.500	.65	.93	308			✓	70	69	4		
7	:11	471.600	.75	1.08	307			✓	70	69	4		
8	:13	472.750	.79	1.14	302			✓	70	69	5		
3 - 1	16:15	474.000	.80	1.15	302			57	70	69	5		
2	:17	475.250	.74	1.06	308			✓	70	69	4.5		
3	:19	476.500	.57	.82	309			✓	70	69	4		
4	:21	477.400	.57	.82	309			✓	70	69	4		
5	:23	478.500	.78	1.12	308			✓	69	68	5		
6	:25	479.600	.70	1.01	308			✓	69	69	5		
7	:27	481.050	.75	1.08	307			✓	69	69	5		
8	:29	482.000	.79	1.14	302			✓	69	69	5		

K=1.441

DO NOT USE FOR RATA CALCS.

Final 16:31 483.230

Check Indicates Temperatures Meet Required Limits.

Company GPCO

Date 4-18-94

Site Crist #5 Steady State

Run # 3

Page 4 Of

Run 11

LABORATORY ANALYSIS & CHAIN OF CUSTODY

COMPANY/PLANT: Gulf Power Co.

UNIT #: 5 DATE OF TEST: 4/18/96 TYPE OF TEST: ☐ M-5 ☒ M-17 ☐ OTHER ______

SAMPLE #	RELINQUISHED BY	RECEIVED BY	TIME	DATE	REASON FOR CHANGE
1365	EKH	JCA	8:30	4-19-96	Analysis
1366					
1367					

UNIT # 5- ~~Soot Blowing~~ Steady State

RUN # 1	FILTER # 1365	BEAKER # 36 WASH (ML) 29
FINAL WEIGHT	144.1	67954.2
INITIAL WEIGHT	123.8	67932.8
DIFFERENCE	20.3	21.4
CORRECTED TOTAL WEIGHT		41.7
RUN # 2	FILTER # 1366	BEAKER # 47 WASH (ML) 34
FINAL WEIGHT	152.0	~~689~~ 69008.4
INITIAL WEIGHT	122.3	68996.8
DIFFERENCE	29.7	11.6
CORRECTED TOTAL WEIGHT		41.3
RUN # 3	FILTER # 1367	BEAKER # 49 WASH (ML) 27
FINAL WEIGHT	151.8	65922.1
INITIAL WEIGHT	121.0	65919.4
DIFFERENCE	30.8	2.7
CORRECTED TOTAL WEIGHT		33.5
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		

UNIT # ______

RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		
WASH SOLVENT BLANK (ML)	100	BEAKER # 18 WASH (ML) 100
FINAL WEIGHT		67341.7
INITIAL WEIGHT		67341.6
DIFFERENCE		0.1
CORRECTION FACTOR (MG/ML)		0.001

ALL WEIGHTS ARE IN MILLIGRAMS (MG)

APPENDIX B SAMPLE CALCULATIONS

Input and Constants

$$f := \frac{9820\ \text{ft}^{3}}{\text{mm btu}}$$

$pg := -(0.35\ \text{in. H2O})$

$pbar := 30.05\ \text{in. Hg.}$

$\Delta havg := 0.966\ \text{in. H2O}$

$y := 1.024$

$tm := 62.1\ °\text{F}$

$o2 := 5.3$

$co2 := 12.5$

$vm := 35.676\ \text{ft}^{3}$

$vlc := 78.\ \text{ml}$

$theta := 64\ \text{min}$

$nozdia := 0.222\ \text{in.}$

$ts := 301.4\ °\text{F}$

$as := 92.135\ \text{ft}^{2}$

$mn := 41.7\ \text{mg}$

$numberofpoints := 32$

$sqrt\Delta p := 0.8161\ \text{in. H2O}^{0.5}$

$$kp := \frac{85.49\ 1\ \text{ft}\ 1 \left(\dfrac{\text{lb in. Hg.}}{\text{lb–mole}\ °\text{R in. H2O}}\right)^{0.5}}{1\ \text{sec}}$$

$cp := 0.84$

$$k1 := \frac{17.64\ °\text{R}}{\text{in. Hg.}}$$

$$ts = \frac{(ts + 460\ {}^{\circ}F)\ {}^{\circ}R}{{}^{\circ}F}$$

761.4 °R

$$tm = \frac{(tm + 460\ {}^{\circ}F)\ {}^{\circ}R}{{}^{\circ}F}$$

522.1 °R

$$n2 = 100 - o2 - co2$$

82.2

$$an = \frac{nozdia^{2}\ \ 3.1416}{4\left(\frac{12\ in.}{ft}\right)^{2}}$$

$0.000268803\ ft^{2}$

Calculations

Equation 1

$$ps = pbar + \frac{pg}{\frac{13.6\ \text{in. H2O}}{1\ \text{in. Hg.}}}$$

30.0243 in. Hg.

Equation 2

$$pm = pbar + \frac{Ahavg}{\frac{13.6\ \text{in. H2O}}{\text{in. Hg.}}}$$

30.121 in. Hg.

Equation 3

$$vmstd = \frac{k1\ vm\ y\ \left(pbar + \frac{Ahavg}{\frac{13.6\ \text{in. H2O}}{\text{in. Hg.}}}\right)}{tm}$$

$37.1784\ ft^3$

Equation 4

$$vwstd = \frac{0.04707\ ft^3\ vlc}{ml}$$

$3.67146\ ft^3$

Equation 5

$$bws = \frac{vwstd}{vmstd + vwstd}$$

0.0898769

Equation 6

$$md = \frac{(0.44\ co2 + 0.32\ o2 + 0.28\ n2)\ lb}{lb\text{-}mole}$$

$$\frac{30.212\ lb}{lb\text{-}mole}$$

Equation 7

$$ms = md\ (1 - bws) + \frac{bws\ 18\ lb}{lb\text{-}mole}$$

$$\frac{29.1144\ lb}{lb\text{-}mole}$$

Equation 8

$$vs = kp\ cp\ sqrt\Delta p\ \left(\frac{ts}{ms\ ps}\right)^{0.5}$$

$$\frac{54.6958\ ft}{sec}$$

Equation 9

$$qa = \frac{vs\ as\ 60\ sec}{min}$$

$$\frac{302364.\ ft^{3}}{min}$$

Equation 10

$$qs = \frac{qa\ (1 - bws)\ 528\ ^{\circ}R\ ps}{ts\ 29.92\ in.\ Hg.}$$

$$\frac{191497.\ ft^{3}}{min}$$

Equation 11

$$cs = \frac{0.0154 \text{ gr mn}}{\text{mg vmstd}}$$

$$\frac{0.0172729 \text{ gr}}{\text{ft}^3}$$

Equation 12

$$pmr = \frac{\text{cs qs 60 min}}{\text{hour } \frac{7000 \text{ gr}}{\text{lb}}}$$

$$\frac{28.3518 \text{ lb}}{\text{hour}}$$

Equation 13

$$e = \frac{\text{cs f 20.9 1 lb}}{(20.9 - \text{o2}) \text{ 7000 gr}}$$

$$\frac{0.0324639 \text{ lb}}{\text{mm btu}}$$

Equation 14

$$vn = \frac{\text{ts} \left(\frac{0.002669 \text{ in. Hg. ft}^3 \text{ vlc}}{\text{ml } {}^\circ\text{R}} + \frac{\text{vm y pm}}{\text{tm}}\right)}{\text{ps}}$$

$$58.7275 \text{ ft}^3$$

Equation 15

$$i = \frac{100\ \%\ vn}{\dfrac{60\ sec\ theta\ vs\ an}{min}}$$

104.021 %

Equation 16

$$hi = \frac{pmr}{e}$$

$$\frac{873.333\ mm\ btu}{hour}$$

APPENDIX C QUALITY CONTROL

INITIAL
METER CALIBRATION FORM - DGM

DATE: 12-05-95 Box No. S-101

Ref. DGM Ser. # 1044453 Calibrated By EDWARD HARRIS

RUN #	1	2	3	4	5
DELTA H (DGM)	0.50	1.00	1.50	2.00	3.00
Y (Ref. DGM)	1.014	1.014	1.014	1.014	1.014
Reference DGM					
Gas Vol. Initial	19.500	25.177	31.500	38.100	45.000
Gas Vol. Final	25.177	31.500	38.100	45.000	51.466
Meter Box DGM					
Gas Vol. Initial	24.400	30.000	36.261	42.805	49.615
Gas Vol. Final	30.000	36.261	42.805	49.615	56.004
Reference DGM					
Temp.	Avg.	Avg.	Avg.	Avg.	Avg.
Deg F Initial	66	67	67	67	67
Deg F Final	67	67	67	67	67
Meter Box DGM					
Temp. Initial In	66	67	68	69	69
Temp. Initial Out	66	67	68	69	69
Temp. Final In	66	67	69	69	69
Temp. Final Out	66	67	69	69	69
P Bar IN. Hg	30.08	30.08	30.08	30.08	30.08
Time (sec.)	873	688	582	525	404
Meter Calibration Factor (Y)	1.026	1.022	1.022	1.026	1.023
Qm (C.F.M.)	0.399	0.563	0.695	0.806	0.981
Km (Std Pressure)	0.727	0.726	0.730	0.733	0.730
DELTA Ha	1.77	1.78	1.75	1.73	1.75

Average Y (Meter Calibration Factor	1.024
Average Km (Standard Pressure)	0.729
Average DELTA Ha of Orifice	1.755

Y= ≤ .03
Max & Min ≤ .02 from Avg
Final Avg within 5% of Initial Avg
ΔHa = Max & Min ≤ .2 from Avg

POST TEST QUALITY ASSURANCE

Date: 4/30/96
BOX #: **S-101**
Ref. Meter: 1044453
Calibrated By: **Edward Harris**

DRY GAS METER

	Unit	Run 1	Run 2	Run 3
FIELD METER ΔH	In. H_2O	1.50	1.50	1.50
Initial Gas Volume	Ft.^{3}	52.300	57.450	62.660
Final Gas Volume	Ft.^{3}	57.450	62.660	68.750
Initial Temp. In	°F	70	71	72
Initial Temp. Out	°F	71	71	72
Final Temp. In	°F	71	72	73
Final Temp. Out	°F	70	72	73
REF. METER Y	*Dimensionless*	1.014	1.014	1.014
Initial Gas Volume	Ft.^{3}	31.300	36.500	41.750
Final Gas Volume	Ft.^{3}	36.500	41.750	48.000
Initial Temp.	°F	70	71	71
Final Temp.	°F	70	71	71
Barometric Pressure	In. Hg	29.95	29.95	29.95
Time	sec	460	465	535
Meter Calibration Factor	*Dimensionless*	1.021	1.019	1.040
ΔH_a	In. H_2O	1.777	1.785	1.664
Average Y	*Dimensionless*	1.027		
Initial Y	*Dimensionless*	1.024		
Percent Error	%	0.3	*(Allowed 5.0%)*	

DIFFERENTIAL PRESSURE GAUGE

Ref. Pressure In H_2O	Magnehelic Pressure In H_2O	Percent Error (+/- 5%)
0.00	0.00	0
0.50	0.51	2
1.50	1.50	0

TEMPERATURE SENSOR

Ref. Temp. (°F)	Thermocouple Temp. (°F)	Percent Error (Allowed 1.5% of Absolute)
280	281	0.14

ARENOID BAROMETER

Reference Barometer	Test Barometer	0.1 Diff. Allowed
29.70	29.68	-0.02

MAGEHELIC CALIBRATION

BOX	2879	S-100	C-133	C-175	S-102	S-101	S-103
SER. NO.		91126AM 91	9126A M91	R90125 MR6	R74D	R22D	R20208 A617
RANGE	0-2	0-2	0-2	0-2	0-5	0-2	0-2
REFERENCE READING		FIELD DEVICE READING					
0.000		0.00	0.00	0.00	0.00	0.00	0.00
0.050							
0.150							
0.200							
0.250							
0.450							
0.50	0.50	0.51	0.50	0.51	0.51	0.50	0.50
1.00	0.99	1.01	0.98	1.01	1.01	0.98	1.01
1.30							
1.80	1.80	1.82	1.79	1.82	1.81	1.79	1.82
2.50							
4.50							
5.0							
9.0							
13.0							
22.0							

SIGNATURE: Edward L. Harris

DATE: 12-5-95

MAGEHELIC CALIBRATION

BOX #1

SER. NO.	10720-AB68	R1061-6AG48	R5031-SEB76	R1062-9JA82	R1051-3MR42	R90124 RI119
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING	FIELD DEVICE READING					
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.050	0.050					
0.150	0.150	0.140				
0.200	0.190					
0.250		0.250				
0.450		0.450				
0.50			0.50			
1.00			1.00			
1.30				1.30		
1.80			1.80			
2.50				2.50	2.48	
4.50				4.50		
5.0					5.0	5.0
9.0					9.02	
13.0						13.0
22.0						22.0

SIGNATURE: Edward L. Harris

DATE: 12/22/95

MAGEHELIC CALIBRATION

BOX #2

SER. NO.	10819-DR2	R1090-2AG18	RS0315-EB93	R1062-9TA87	30830-AM79	R1072-2MC5
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING			FIELD DEVICE READING			
0.000	0.000	0.000	0.00	0.00	0.0	0.0
0.050	0.050					
0.150	0.155	0.152				
0.200	0.205					
0.250		0.256				
0.450		0.456				
0.50			0.52			
1.00			1.04			
1.30				1.32		
1.80			1.83			
2.50				2.55	2.49	
4.50				4.50		
5.0					4.9	5.2
9.0					8.8	
13.0						12.9
22.0						22.0

SIGNATURE: Edward L. Harris

DATE: 12/22/95

MAGEHELIC CALIBRATION

BOX #3

SER. NO.	R10908AG71 MRR1	R0112642	R10608CF20 CF20
RANGE	0-0.50	0-2.0	0-10
REFERENCE READING	FIELD DEVICE READING		
0.000	0.00	0.00	0.0
0.050			
0.150	0.149		
0.200			
0.250	0.240		
0.450	0.450		
0.50		0.50	
1.00		0.98	
1.50			
1.80		1.78	
2.50			2.5
4.50			
5.0			5.0
9.0			9.0
13.0			
22.0			

SIGNATURE: Edward L. Harris

DATE: 12/22/95

MAGEHELIC CALIBRATION
BOX #4

SER. NO.	R22D	R90051 6GT21	R90101 5CD102
RANGE	0-0.50	0-5	0-25
REFERENCE READING	FIELD DEVICE READING		
0.000	0.000	0.00	0.0
0.050			
0.150	0.151		
0.200			
0.250	0.251		
0.450	0.455		
0.50			
1.00			
1.30		1.27	
1.80			
2.50		2.52	
4.50		4.55	
5.0			5.0
9.0			
13.0			13.0
22.0			21.6

SIGNATURE: Edward F. Harris

DATE: 12/22/95

TEMPERATURE CALIBRATIONS - DEGREES FAHRENHEIT

REFERENCE DEVICE READING*	0 DEG. F	210 DEG.	420 DEG.	630 DEG.	840 DEG.	1050 DEG.	1260 DEG.	1470 DEG.	1680 DEG.	1900 DEG.
2679	0	217	421	630	839	1050	1260	1471	1681	1900
METER BOX #1 C-133 11580	0	212	423	635	842	1053	1264	1475	1679	1910
METER BOX #2 C-175 15962	0	211	423	627	839	1052	1265	1475	1687	1903
METER BOX #5 S-100 15751	2	211	417	628	844	1062	1279	1491	1698	1907
METER BOX #6 S-101 15751	0	210	419	628	839	1058	1255	1473	1691	1900
PORTABLE THERMOCOUPLE # 2 (Blue)	2	209	415	628	837	1053	1260	1468	1679	1908
PORTABLE THERMOCOUPLE # 2 (Green)	2	211	417	627	842	1058	1273	1484	1688	1896
PINK T140293	-1	208	415	624	840	1056	1272	1482	1687	1894
PORTABLE THERMOCOUPLE (Yellow)	0	210	419	632	840	1050	1259	1470	1680	1901
PORTABLE THERMOCOUPLE T-105998 (Black)	1	209	416	625	839	1055	1270	1481	1684	1891
METER BOX S-102	-2	209	417	625	837	1049	1259	1462	1658	1890
METER BOX S-103	4	215	423	632	844	1057	1266	1471	1667	1895

DATE: 12-05-95 **SIGNATURE:** Edward L. Harris

* Reference Device is an Omega Engineering CL505-A calibrated reference thermocouple-potentiometer system.

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ANALYTICAL SERVICES, Inc.
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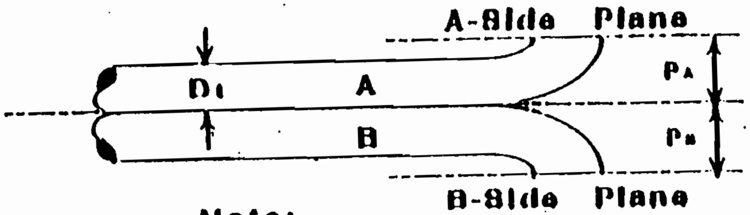
FAX#: (205) 633-2285

The Pitot used was within the following geometric specifications:

Dt between 0.48 and 0.95 cm (3/16 and 3/8 in.)

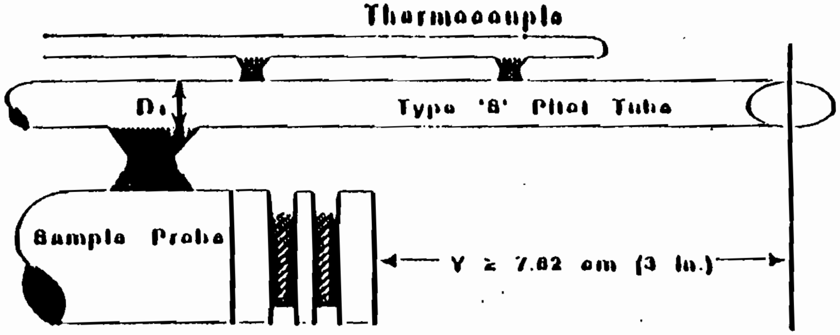
C_p = 0.84



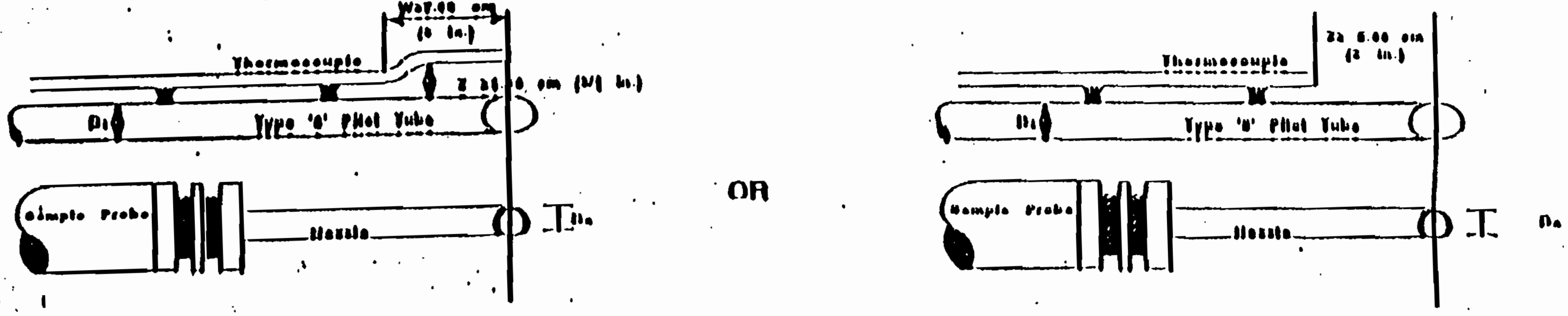
Note:

1.05 Dt ≤ 1.50 Dt

$P_A = P_B$

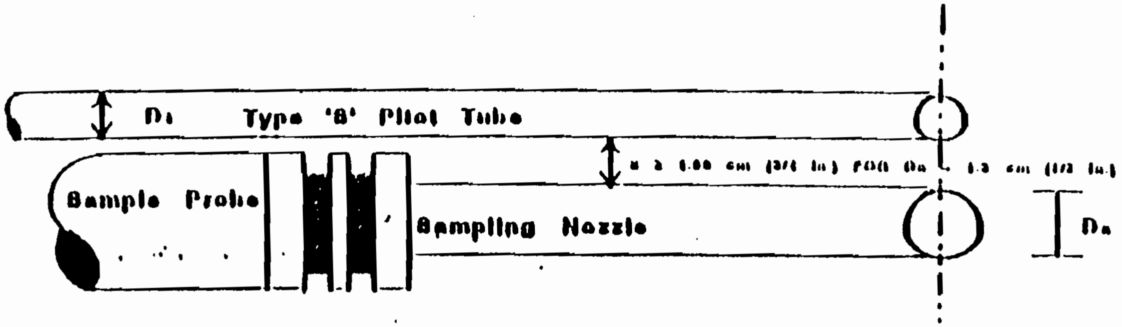


Minimum pitot-sample probe separation needed to prevent interference

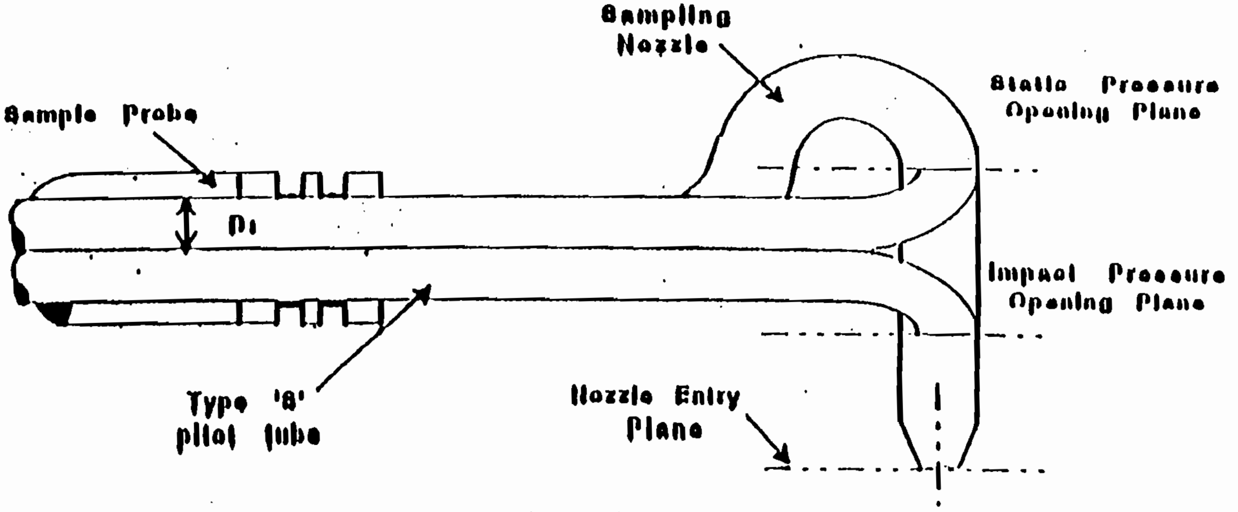


Proper thermocouple placement to prevent interference.

Proper pitot tube-sampling nozzel configuration to prevent aero-dynamic interference; buttonhook type nozzle; centers of nozzle and pitot opening aligned; Dt between 0.48 and 0.95 cm (3/16 and 3/8 in.)



Bottom view showing minimum pitot/nozzle separation



Side view; to prevent pitot tube from interfering with the gas flow streamlines approaching the nozzle, the impact pressure opening plane of the pitot tube shall be even with or above the nozzle entry plane.

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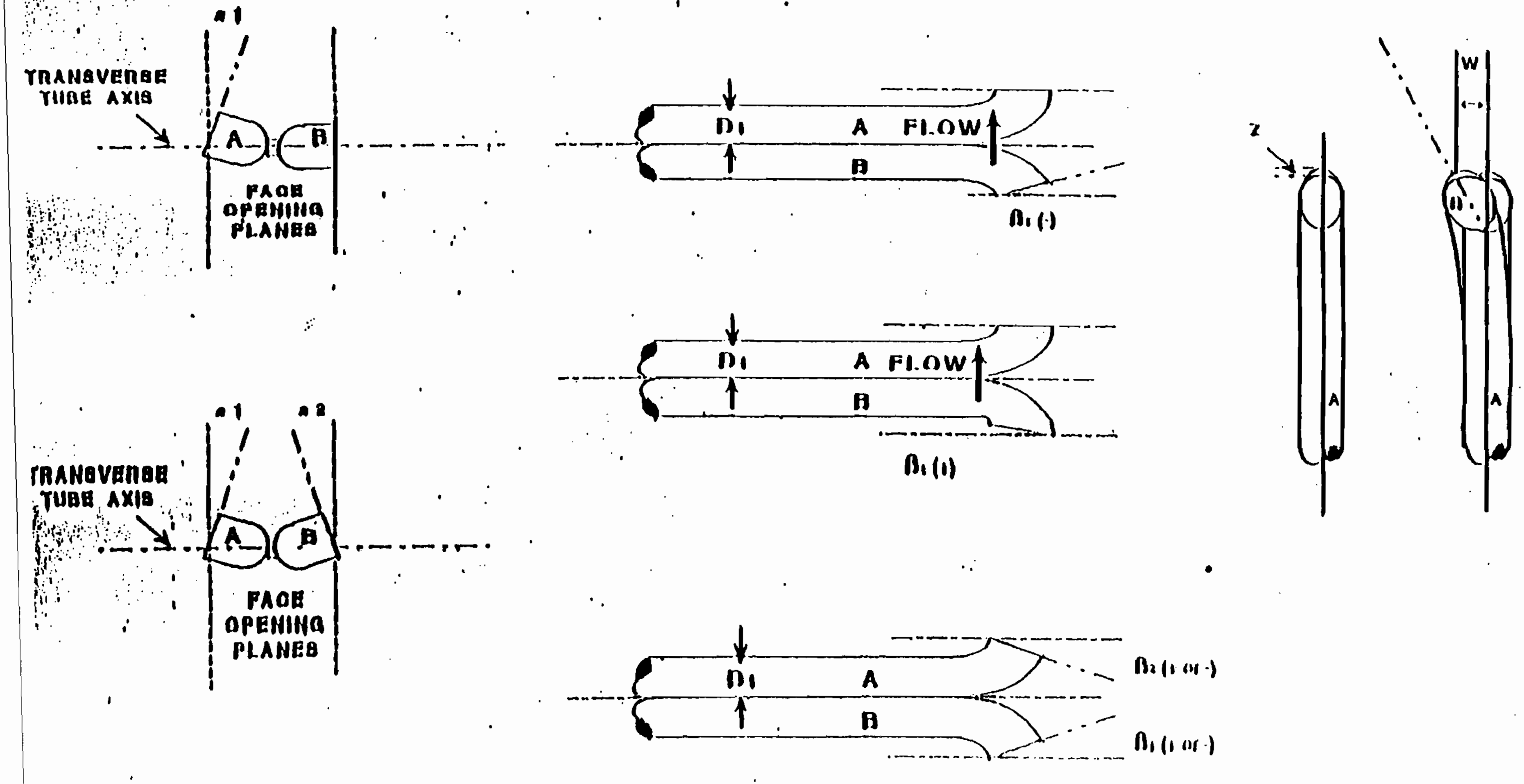
Types of face-opening misalignment that can result from field use or improper construction of type 'S' pitot tubes. These will not affect the baseline value of Cp(s) so long as α_1 and $\alpha_2 < 10°$, β_1 and $\beta_2 < 5°$, $\leq$ 0.32 cm (1/8 in.)



APPENDIX D OPERATIONAL DATA

Best Available Copy

CRIST ELECTRIC GENERATING PLANT

STEADY STATE

UNIT 5
DATE 4-18

start of flow
908 end
252
521

TIME	RUN NUMBER	MAIN STEAM FLOW (LBS/HR)	MW LOAD	BOILER AIR FLOW	PULVERIZER MILLS COAL FLOW 10^3 LB/HR						% O_2			% OPACITY	[redacted] FAN AMPS				GAS TEMP (F°) AIR PREHEATER				PULVERIZER MILLS TEMPERATURES °F					
									GEN	SS	↙	FD	EMS		I.D.	F.D.			A	B			A	B	C	D		
914	1	723	88	687	53640	532830	25871	616680	248880	20824	3.8	6.5		6.9	245	100			296	296			150	136	150	140		
1020	END	723	88	696	53830	533124	26048	616912	248983	20830	4.1	6.6		7.9	247	100			297	298			150	136	150	140		
1258	2	723	88	685	54226	533728	26425	617398	249212	20842	3.7	6.4		9.5	248	100			298	296			150	136	150	140		
1403	END	723	88	687	54443	534063	26632	617667	249330	20847	3.8	6.4		9.9	248	150			299	299			150	136	150	140		
1526	3	722	88	686	54609	534317	26784	617868	249430	20853	4.2	6.4		13.2	249	180			300	300			150	136	150	140		
1631	END	721	88	688	54811	534625	26967	618120	249545	20859	3.8	6.4		12.2	245	150			300	301			150	136	150	140		

CRIST ELECTRIC GENERATING PLANT

Precipitator Readings

Unit 5
Date 4-18-96
Load 88

Run # THREE
Start Time
Finish Time

Precipitator Cabinet		Primary AMPS	Primary Volts	Secondary AMPS	Secondary Voltage
Start	A	111	370	1.42	
	B	113	0	.85	
	C	40	270	.25	
	D	54	340	.30	
	E	52	335	.36	
	F	73	360	.60	
Finish	A	111	370	1.42	
	B	124	0	.84	
	C	40	280	.3	
	D	55	330	.32	
	E	46	320	.3	
	F	80	370	.58	

SANDERS ENGINEERING & ANALYTICAL SERVICES, INC.

PARTICULATE EMISSIONS TEST REPORT
SOOT BLOWING OPERATIONS

FOR

GULF POWER COMPANY
Plant Crist, Unit 5
Pensacola, Florida

April 17, 1996

1568 LEROY STEVENS ROAD

MOBILE, ALABAMA 36695 • 205/633-4120

SEAS

SANDERS ENGINEERING & ANALYTICAL SERVICES, INC.

1568 LEROY STEVENS ROAD MOBILE, ALABAMA 36695 • OFFICE 334 / 633-4120
FAX 334 / 633-2285

ENVIRONMENTAL ENGINEERING
AIR & WATER QUALITY MODELING
ENVIRONMENTAL ASSESSMENTS
PSD ANALYSIS
EMERGENCY RESPONSE MONITORING

AMBIENT AIR MONITORING
CONTINUOUS IN-STACK MONITORING
SOURCE TESTING
VISIBLE EMISSIONS TESTING
CONSULTING SERVICES

REPORT CERTIFICATION

The sampling and analysis for this report was carried out under my direction and supervision.

Date: 4-30-96

Signature: Edward L. Harris
Edward L. Harris
Environmental Specialist

I have reveiwed the testing details and results in this report and hereby certify that the test report is authentic and accurate to the best of my knowledge.

Date: 4-30-96

Signature: Joseph C. Sanders
Joseph C. Sanders
Manager

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ILLUSTRATIONS

1. INTRODUCTION

Sanders Engineering & Analytical Services, Inc. (SEAS) performed particulate emissions testing during soot blowing operations at Gulf Power Company, Plant Crist, Unit 5, located in Pensacola, Florida. The testing was conducted on April 17, 1996. The testing was performed in accordance with the applicable U.S. EPA procedures specified at **40 CFR, Part 60, Appendix A, Methods 1, 2, 3, 4, and 17**.

The purpose of the test was to demonstrate compliance with the rules and regulations of the Florida Department of Environmental Protection, and to meet the necessary requirements contained in the permit to operate issued by the Florida Department of Environmental Protection.

The test was conducted by Mr. Edward Harris and Mr. Dean Holmes of Sanders Engineering & Analytical Services, Inc., and was coordinated with Mr. John McPherson of Gulf Power Company. The Florida Department of Environmental Protection was notified so their representative could be present to observe the testing.

The test was conducted in accordance with the guidelines of the Florida Department of Environmental Protection. Further discussion of the test methods are included later in the report.

2. SUMMARY AND DISCUSSION OF RESULTS

The results of the particulate emissions test for the soot blowing runs, along with the results of the computations, are summarized in Table I. The equations used in the calculations of the results, along with the completed field data sheets for the testing, are presented in Appendix A. The sample calculations of the first run are presented in Appendix B. The quality control checks of the equipment used in the sampling program are included in Appendix C.

There were no problems encountered during the performance of the test. The bottom port of the duct was not sampled due to ash build-up. One of the other ports was alternately sampled twice on each run to compensate for the port not sampled. At the completion of each run, the filter and probe were removed to a relatively clean, draft-free area for clean-up.

The results of the testing indicate the particulate emission rate during soot blowing for Plant Crist, Unit 5, is 0.015 LBS/MMBTU. The applicable Florida Department of Environmental Protection rules and regulations require an emission rate of no greater than 0.30 LBS/MMBTU. The results of the testing indicate that the unit is in compliance with the particulate emission condition of the permit to operate issued by the Florida Department of Environmental Protection.

TABLE I. PARTICULATE EMISSIONS TEST RESULTS

GULF POWER COMPANY
PLANT CRIST, UNIT 5, SOOT BLOWING
4/17/96

Title of Run		RUN 1	RUN 2	RUN 3
Sampling Time -Start	Military	0817	1008	1426
Sampling Time -Stop	Military	0923	1113	1531
F Factor	SDCF/MMBTU	9820	9820	9820
Plant Load	Megawatts	88.0	88.0	88.0
Static Pressure	In. H2O	-0.35	-0.35	-0.35
Barometric Pressure	In. Hg	30.31	30.31	30.31
Average dH	In. H20	1.017	0.999	0.992
Meter correction		1.024	1.024	1.024
Avg. Meter Temp.	Deg. F	58.6	66.3	71.3
% O2	%	5.2	5.3	5.5
%CO2	%	13.5	13.0	13.5
Volume Metered	ACF	36.665	36.310	36.400
Volume Water	Ml	70.0	79.0	79.0
Sampling Time	Minutes	64	64	64
Nozzle Diameter	Inches	0.225	0.221	0.221
Avg. Stack Temp.	Deg. F	292.9	299.4	303.9
Area of Stack	Sq. Feet	92.1350	92.1350	92.1350
Wt. of Part.	Mg.	18.4	19.4	21.4
Number of Points		32	32	32
Avg. Sqrt dP	In. H20	0.8449	0.8252	0.8286

RESULTS OF COMPUTATIONS

		RUN 1	RUN 2	RUN 3	Average
Volume of Gas Sampled	SDCF	38.802	37.862	37.603	
H2O vapor in Gas Stream	PERCENT	7.8	8.9	9.0	8.6
Avg. Stack Gas Velocity	FT/SEC	55.8	54.9	55.2	55.3
Volumetric Flow Rate	SDCFM	201,813	194,554	194,413	196,927
Volumetric Flow Rate	ACF/M	308,446	303,607	305,385	305,813
Particulate Conc.	Grs/SDCF	0.007	0.008	0.009	0.008
Particulate Conc.	Grs/ACF	0.005	0.005	0.006	0.005
Particulate Mass Rate	Lb/Hr	12.6	13.2	14.6	13.5
Particulate Mass Rate	Lb/MMBtu	0.014	0.015	0.017	0.015
Heat Input	MMBTU/Hr	926.28	887.28	875.26	896.27
Percent of Isokinetic	%	100.3	105.2	104.6	

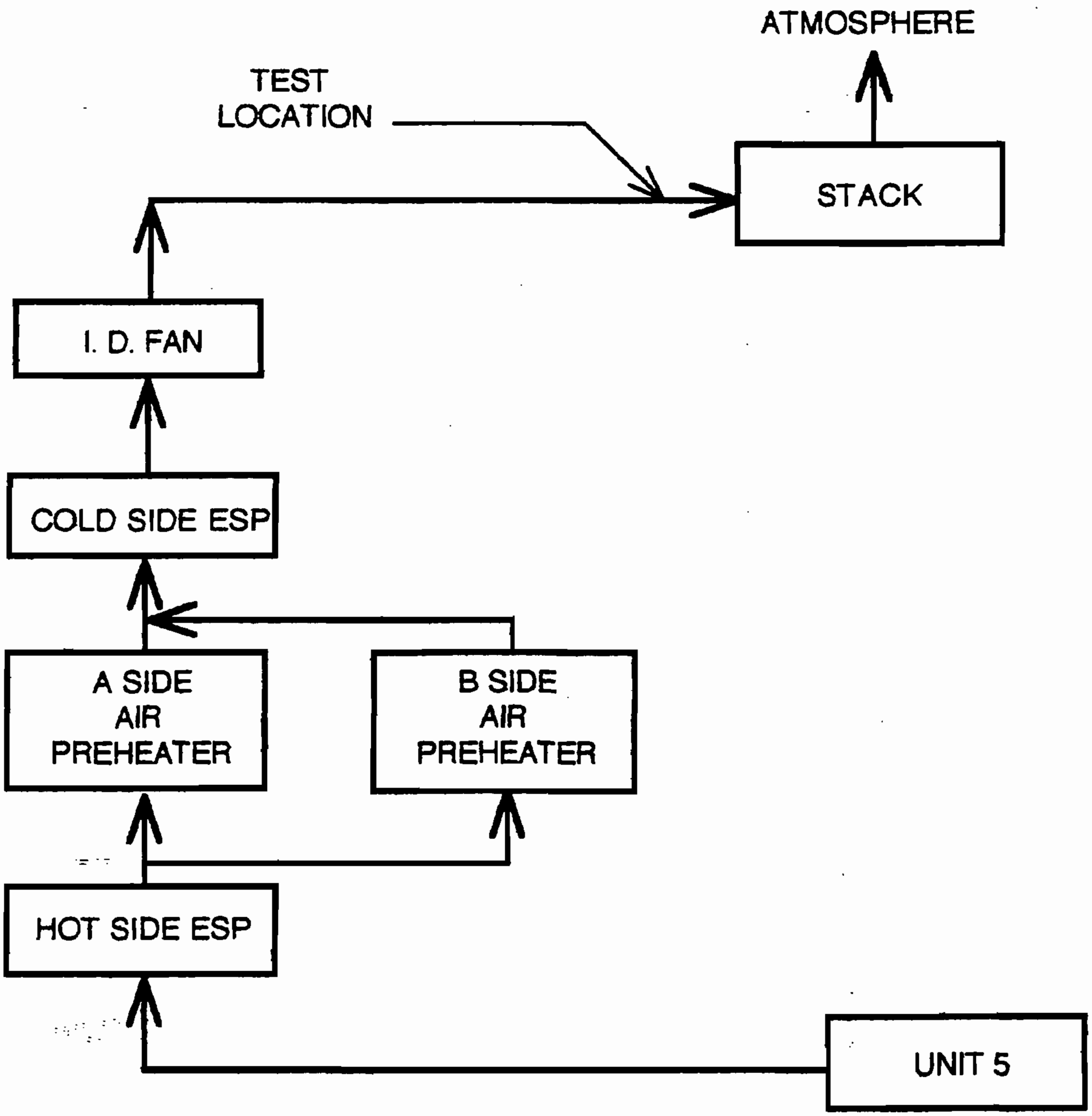
3. PROCESS DESCRIPTION

The process consists of a steam electric generating unit firing bituminous coal for the production of electric energy. The coal is received by barge, and loaded directly onto the conveyor feeding the plant, or onto the stockpile and later loaded onto the conveyor belt transporting the coal to the plant. The coal from the conveyor is loaded into bunkers capable of holding between 36 to 48 hours supply of coal. The coal is then fed to pulverizing mills before being fired in the unit through the burners. Upon combustion of the coal in the fire box, approximately 20 percent of the ash falls to the bottom of the boiler and is removed by the ash removal system. The remaining 80 percent exits with the flue gases through the heat exchange and economizer sections of the furnace, and is collected by electrostatic precipitators.

3.1. Source Air Flow

As shown in Figure 1, the flue gases exit the boiler and flow through a hot side precipitator. The exhaust gases are separated into ducts A and B before entering air preheaters. The exhaust gases are combined before entering a cold side ESP. The flue gases exiting the cold side ESP are exhausted through a stack into the atmosphere.

Figure 1. Air Flow Schematic



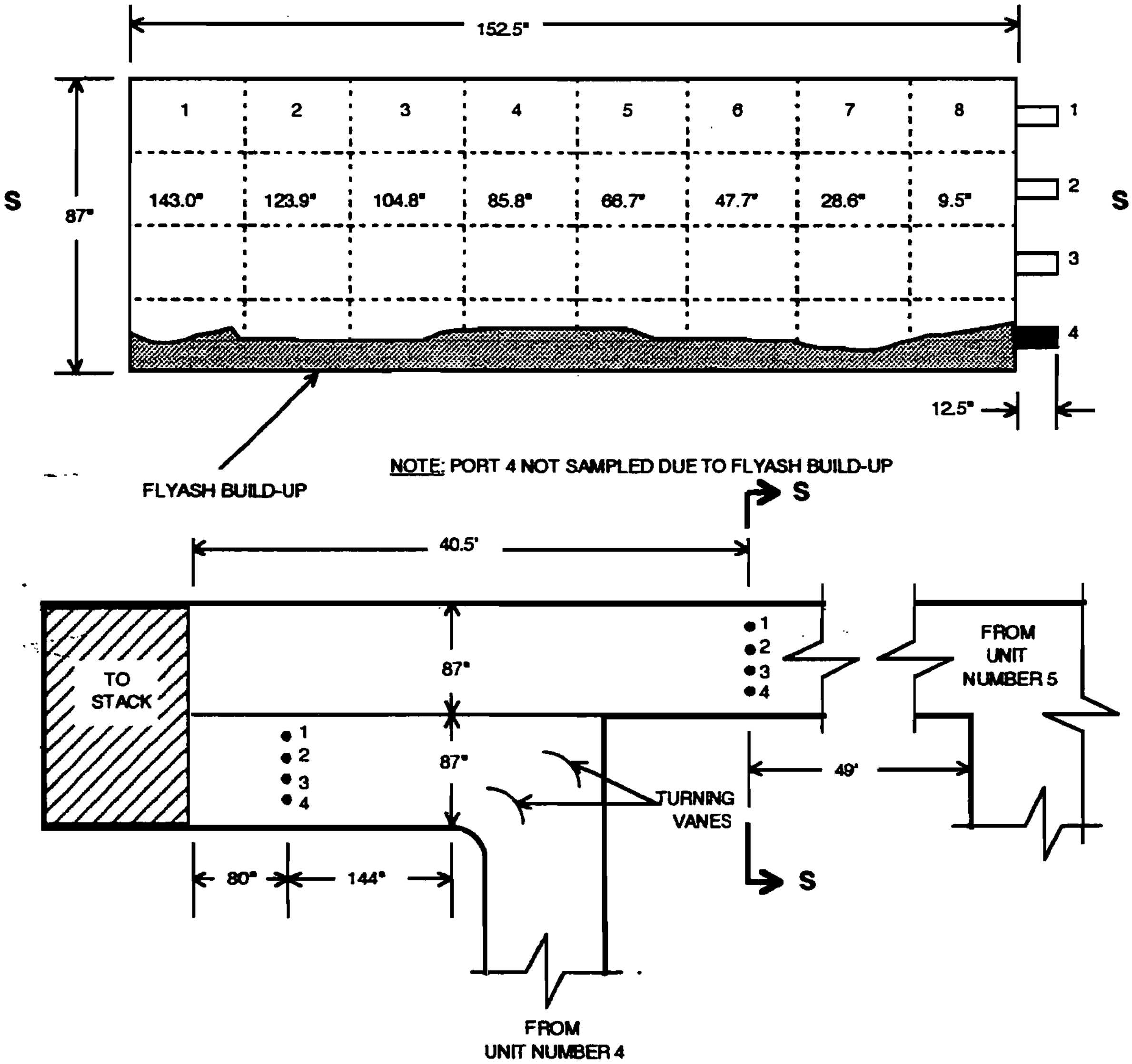
3.2. Operation During Testing

The average heat input during soot blowing operation, as based on F-factor calculations, was 896.27 million BTU per hour resulting in the production of approximately 88 megawatts of electricity. Precipitator data supplied by Gulf Power personnel is given in Appendix D.

4. SAMPLE POINT LOCATION

The sample point locations and outlet duct schematic are presented in Figure 2. Method 1 was used for determination of the number and location of sampling points. The minimum number of points (25) required for rectangular stacks was met by sampling a total of 32 points.

Figure 2. Sample Point Locations



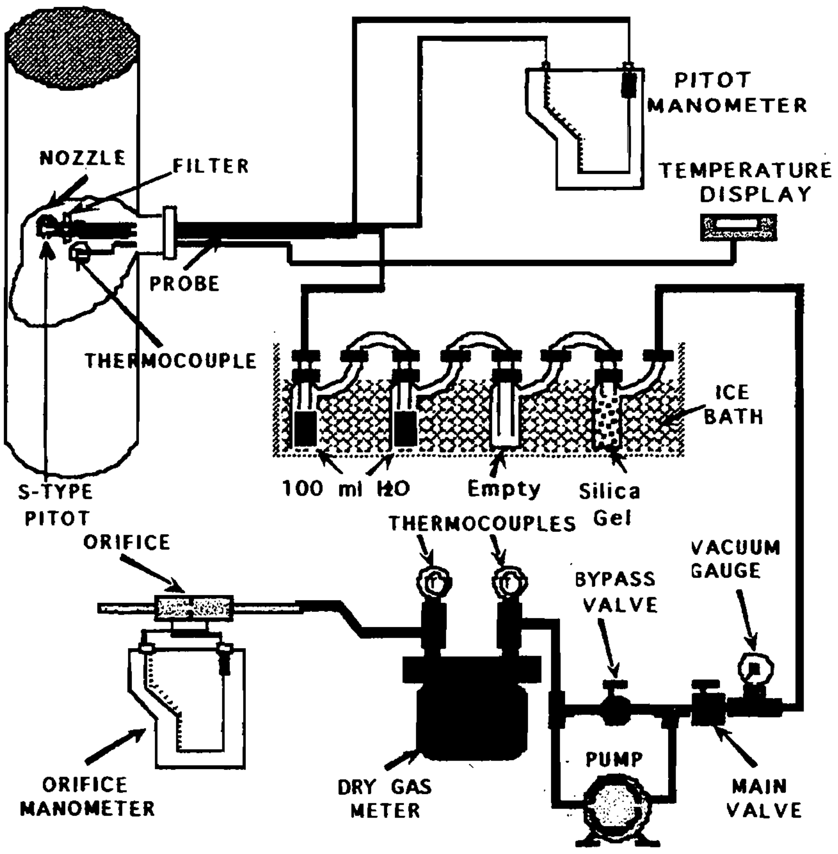
NOTE: PORT 4 NOT SAMPLED DUE TO FLYASH BUILD-UP

5. PARTICULATE SAMPLING PROCEDURE (EPA Method 17)

The sampling procedure utilized is that specified in **40 CFR, Part 60, Appendix A, Method 17**, as modified by the governing regulatory agency. A brief description of this procedure is as follows:

The first impingers were partially filled with 100 milliliters of deionized water. The next impinger was left empty to act as a moisture trap. Preweighed 6 to 16 mesh indication silica gel was added to the last impinger. The sampling equipment manufactured by Lear Siegler (Model 100) or Sanders Engineering (Model 200) was assembled as shown in the attached drawing. The system was leak checked by plugging the inlet to the nozzle and pulling a 15 inch mercury vacuum. A leakage rate not in excess of 0.02 cubic feet per minute was considered acceptable.

Figure 3. Particulate Sampling Train



The inside dimensions of the stack liner were measured and recorded. The required number of sampling points were marked on the probe for easy visibility. The range of velocity pressure, the percent moisture, and the temperature of the effluent gases were determined. From this data, the correct nozzle size and the nomograph multiplication factor were determined.

Crushed ice was placed around the impingers. The nozzle was placed on the first traverse point with the tip pointing directly into the gas stream. The pump was started immediately and the flow was adjusted to isokinetic sampling conditions. After the required time interval had elapsed, the probe was repositioned to the next traverse point and isokinetic sampling was re-established. This was performed for each point until the run was completed. Readings were taken at each point and recorded on the field data sheet. At the conclusion of each run, the pump was turned off and the final readings were recorded.

5.1. Particulate Sample Recovery

Care was exercised in moving the collection train to the sample recovery area to minimize the loss of collected sample, or the gain of extraneous particulate matter. The volume of water in the impingers was measured, the silica gel impinger was weighed and recorded on the field data sheet. The nozzle, and all sample-exposed surfaces were washed with reagent grade acetone into a clean sample container. A brush was used to loosen any adhering particulate matter and subsequent washings were placed into the container. The filter was carefully removed from the fritted support and placed in a clean separate sample container. A sample of the acetone used in the washing was saved for a blank laboratory analysis.

5.2. Particulate Analytical Procedures

The filter and any loose particulate matter were transferred from the sample container to a clean, tared weighing dish. The filter was placed in a desiccator for at least 24 hours and then weighed to the nearest 0.1 milligram until a constant weight was obtained. The original weight of the filter was deducted, and the weight gain was recorded to the nearest 0.1 milligram.

The wash solution was transferred to a clean, tared beaker. The solution was evaporated to dryness, desiccated to a constant weight, and the weight gain was recorded to the nearest 0.1 milligram.

APPENDIX A EQUATIONS AND FIELD DATA SHEETS

EQUATIONS

1. $$P_s = P_{bar} + \frac{P_g}{13.6}$$

2. $$P_m = P_{bar} + \frac{\overline{\Delta H}}{13.6}$$

3. $$V_s = K_p C_p \overline{\sqrt{\Delta P}} \sqrt{\frac{\overline{T_s}}{M_s P_s}}$$

4. $$V_{m(Std)} = K_1 V_m Y \left[\frac{P_{bar} + \frac{\overline{\Delta H}}{13.6}}{\overline{T_m}} \right]$$

5. $$V_{w(Std)} = 0.04707 \, V_{lc}$$

6. $$B_{ws} = \frac{V_{w(Std)}}{V_{m(Std)} + V_{w(Std)}}$$

7. $$M_d = 0.44 (\%CO_2) + 0.32 (\%O_2) + 0.28 (\%N_2 + \%CO)$$

8. $$M_s = M_d (1 - B_{ws}) + 18 (B_{ws})$$

9. $$EA = \left[\frac{(\%O_2 - 0.5 (\%CO))}{0.264 (\%N_2) - ((\%O_2) - 0.5 (\%CO))} \right] 100$$

10. $$Q_a = (V_s)(A_s)(60)$$

11. $$Q_s = Q_a\,(1-B_{ws})\,\frac{(528)}{\overline{T}_s}\,\frac{(P_s)}{29.92}$$

12. $$E_H = \left(\frac{PMR}{H_I}\right)$$

13. $$E = C_d\,F_{O_2}\left(\frac{20.9}{20.9 - \%O_2}\right)$$

14. $$C_s = 0.0154\,\frac{M_n}{V_{m(Std)}}$$

15. $$C_{50} = \frac{21\ C_s}{21 - [(1.5)(\%O_2) - 0.133\,(N_2) - 0.75\,(\%CO)]}$$

16. $$C_{12} = \frac{C_s\,(12)}{\%CO_2}$$

17. $$PMR = (C_s)(Q_s)\,\frac{(60)}{7000}$$

18. $$V_n = \left[(0.002669)(V_{1c}) + \frac{V_m Y}{\overline{T}_m}\left(P_{bar} + \frac{\overline{\Delta H}}{13.6}\right)\right]\frac{\overline{T}_s}{P_s}$$

19. $$I = \frac{100\ V_n}{(60)\,\theta\,V_s\,A_n}$$

NOMENCLATURE

A_n = Cross-sectional area of nozzel, ft ^{2}

A_s = Cross sectional area of stack, ft ^{2}

B_{ws} = Water vapor in the gas stream,
proportion by volume (dimensionless)

C_p = Pitot tube coefficient (dimensionless) (0.84)

C_s = Particulate concentration, grains/SDCF

C_d = Particulate concentration, lbs/SDCF

C_{12} = Particulate concentration (C_s adjusted to 12% CO)
grains/SDCF

C_{50} = Particulate concentration (C_s adjusted to 50% excess air)
grains/SDCF

EA = Excess air, %

E = Emission in lb/mmBTU

E_H = Emission in lb/mmBTU, based on heat input

H_I = Total Heat Input, Million BTU per Hour (MMBTU/hr)

I = Percent of isokinetic sampling

K_1 = 17.64 °R/ inches Hg

K_p = Pitot tube constant,

$$85.49 \text{ ft/sec} \left[\frac{(\text{lb/lb-mole})\ (\text{in. Hg})}{(^\circ\text{R})\ (\text{inc. } H_2O)} \right]^{\frac{1}{2}}$$

M_n = Total amount of particulate collected, mg

M_d = Molecular weight of stack gas; dry basis, lb/lb mole

M_s = Molecular weight of stack gas; wet basis, lb/lb mole

P_{bar} = Barometric pressure at the sampling site, in. Hg

NOMENCLATURE (continued)

P_m = Meter pressure, in. Hg

P_s = Absolute stack pressure, in. Hg

P_g = Stack static pressure, in. H_2O

PMR = Particulate mass rate, lb/Hr

Q_a = Volumetric flow rate ACFM

Q_s = Volumetric flow rate SDCFM

V_s = Average stack gas velocity, ft/sec

V_{lc} = Total volume of liquid collected in impingers & silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, ACF

$V_{m(std)}$ = Volume of gas sample measured by dry gas meter, corrected to standard conditions, SDCF

$V_{w(std)}$ = Volume of water vapor in gas sample, corrected to standard conditions, SCF

V_n = Volume collected at stack conditions through nozzle, ACF

Y = Dry gas meter calibration factor (dimensionless)

ΔH = Average pressure difference of orifice, in. H_2O

ΔP = Velocity head of stack gas, in. H_2O

$\overline{\sqrt{\Delta P}}$ = Average of square roots of the velocity pressure, in. H_2O

Ø = Total sampling time, minutes

$\%CO_2$, $\%O_2$, N_2, %CO - Number % by volume, dry basis, from gas analysis

F_{O_2} = Oxygen based F factor (9820 SDCF/mmBTU for bituminous coal)

T_s = Temperature of the stack, °R (° F + 460)

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FIELD DATA SHEET

COMPANY GPCO DATE 4-17-96 DGM# S-101

PLANT Crist OPERATOR E&H ΔH@ 0.74

UNIT #5 ~~Steady State~~ Soot Blow METHOD 17 PROBE N/A liner 12' length

	RUN 1	RUN 2	RUN 3
	RATA Run 1	RATA Run 2	RATA Run 5

NOZZLE CALIBRATION

	RUN 1 PRE	RUN 1 POST	RUN 2 PRE	RUN 2 POST	RUN 3 PRE	RUN 3 POST
	.225	.225	.221	.221	.221	.221
	.225	.225	.221	.221	.221	.221
	.225	.224	.221	.221	.221	221
AVERAGE	.225	.225	.221	.221	.221	.221

	RUN 1	RUN 2	RUN 3
FILTER NUMBER	1636	1637	1638

METER READING

	RUN 1	RUN 2	RUN 3
FINAL	220.965	258.810	322.300
INITIAL	184.300	222.500	285.900
NET	36.665	36.310	36.400

LEAK CHECK

	RUN 1	RUN 2	RUN 3
SYSTEM Pre in. Hg	15	15	15
SYSTEM Post in. Hg	10	10	10
SYSTEM Pre cfm	0.000	0.000	0.000
SYSTEM Post cfm	0.000	0.000	0.000
PITOT Pre impact	✓	✓	✓
PITOT Pre static	✓	✓	✓
PITOT Post impact	✓	✓	✓
PITOT Post static	✓	✓	✓

VOLUME OF LIQUID WATER COLLECTED

	IMP. 1	IMP. 2	IMP. 3	IMP. 4
RUN 1 FINAL	164	100	0	1468.0
RUN 1 INITIAL	100	100	0	1462.0
RUN 1 NET	64	0	0	6.0
RUN 1 TOTAL				70.0
RUN 2 FINAL	174	100	6	1473.0
RUN 2 INITIAL	100	100	0	1468.0
RUN 2 NET	74	0	0	5.0
RUN 2 TOTAL				79.0
RUN 3 FINAL	168	100	0	1567.0
RUN 3 INITIAL	100	100	0	1556.0
RUN 3 NET	68	0	0	11.0
RUN 3 TOTAL				79.0

GAS ANALYSIS

	RUN 1	RUN 2	RUN 3
O_2	5.2%	5.3 %	5.5 %
CO_2	13.5%	13.0%	13.5%
CO	–	–	–
STATIC in. H_2O	-0.35	-0.35	-0.35
BAROMETRIC in. Hg	30.31	30.31	30.31

K= ..2

Port # Point #	Time	Gas Meter Vol. (cu. ft.)	Vel. Head ΔP in. H_2O	Orifice Head ΔH in. H_2O	Temperature (F)				Gas Meter		Vac. in. H_g	8:12 Port 4	
					Stack	Probe	Hot Box	Imp.	In	Out			
1 - 1	8 :17	184.300	.84	1.19 '	293	N/A	N/A	55	57	57	3	.70	29
2	:19	185.400	.72	1.02	295			✓	57	57	2	.76	2
3	:21	186.600	.91	1.29	295			✓	57	57	3	.60	2
4	:23	187.900	.78	1.11	294			✓	57	57	3	.40	2
5	:25	189.100	.73	1.04	293			✓	57	57	3	.30	2
6	:27	190.300	.87	1.24	294			✓	57	57	3	.44	28
7	:29	191.500	.76	1.08	292			✓	58	58	3	.29	28
8	:31	192.750	.60	0.85	292			✓	58	58	3	.40	28
2 - 1	:33	193.800	.84	1.19	294			✓	58	58	3		
2	:35	195.100	.74	1.05 '	295			✓	58	58	3		
3	:37	196.200	.92	1.31	294			59	58	58	3		
4	:39	197.500	.80	1.14	294			✓	58	58	3		
5	:41	198.800	.73	1.04	293			✓	59	58	3		
6	:43	199.900	.85	1.21	293			✓	59	58	3		
7	:45	201.200	.76	1.08	292			✓	59	58	3		
8	:47	202.300	.62	.88	287			✓	59	58	3		
2 - 1	:50	203.000	.68	.97	291			59	59	58	2		
2	:52	204.400	.64	.90	292			✓	59	58	2.5		
3	:54	205.500	.75	1.06	292			✓	59	58	3		
4	:56	206.700	.65	.92	292			✓	59	59	3		
5	:58	207.000	.64	.90	293			✓	59	59	3		
6	9 :00	208.900	.65	.92	293			✓	60	59	3		
7	:02	210.000	.58	.82	292			✓	60	59	3		
8	:04	211.000	.55	.78	290			✓	60	59	3		
3 - 1	9:07	212.064	.75	1.06	291			✓	60	59	3		
2	:09	213.200	.73	1.03	294			✓	60	59	3		
3	:11	214.400	.60	.85	295			✓	60	59	3		
4	:13	215.500	.58	.82	294			✓	60	59	3		
5	:15	216.600	.66	.93	294			✓	61	60	3		
6	:17	217.600	.66	.93	294			✓	61	60	3		
7	:19	218.900	.66	.93	293			✓	61	60	3		
8	:21	219.900	.70	.99	292			✓	61	60	3		

Didn't use For Flow Calcs.

Final 9:23 220.965

Check Indicates Temperatures Meet Required Limits.

Company GPCO

Date 4-17-96

Site Crist #5 Soot Blow

Run # 1

Page 2 Of ___

~~DONT~~ USE FOR RATA RUN 1

Best Available Copy

K=1.458

Port # Point #	Time	Gas Meter Vol. (cu. ft.)	Vel. Head ΔP in. H_2O	Orifice Head ΔH in. H_2O	Temperature (F) Stack	Probe	Hot Box	Imp.	Gas Meter In	Gas Meter Out	Vac. in. H_g	10:01 Port 4	
1- 1	10 :08	222.500	.85	1.24	298	N/A	N/A	53	63	63	4	.82	29
2	:10	223.900	.74	1.07	298			✓	63	63	4	.84	29
3	:12	225.050	.90	1.31	301			✓	63	63	4	.77	29
4	:14	226.200	.70	1.02	300			✓	63	63	4	.45	29
5	:16	227.400	.73	1.06	300			✓	63	63	4	.30	29
6	:18	228.500	.87	1.26	300			✓	63	63	4	.45	29
7	:20	229.800	.79	1.15	299			✓	64	63	4	.30	29
8	:22	231.100	.60	.87	296			✓	64	63	4	.36	29
2- 1	10 :24	232.185	.67	.97	295			55	65	65	3		
2	:26	233.250	.63	.91	300			✓	65	65	3		
3	:28	234.400	.75	1.09	301			✓	65	65	3		
4	:30	235.500	.62	.90	301			✓	65	65	3		
5	:32	236.650	.68	.99	301			✓	66	66	3		
6	:34	237.700	.65	.95	300			✓	66	66	3		
7	:36	238.800	.58	.85	300			✓	66	66	3		
8	:38	239.900	.60	.88	295			✓	67	67	3		
2- 1	:40	240.950	.68	1.00	293			✓	67	67	3		
2	:42	242.000	.64	.94	301			✓	68	67	4		
3	:44	243.350	.70	1.03	302			✓	68	67	4		
4	:46	244.200	.58	.85	302			✓	68	67	4		
5	:48	245.400	.67	.98	302			✓	68	68	4		
6	:50	246.480	.70	1.03	301			✓	68	68	4		
7	:52	247.600	.56	.82	300			✓	69	68	4		
8	:54	248.700	.65	.96	298			✓	69	68	4		
3- 1	:57	249.800	.77	1.13	295			59	69	68	5		
2	:59	250.975	.73	1.07	302			✓	69	68	5		
3	11 :01	252.200	.60	.88	303			✓	69	68	4		
4	:03	253.300	.57	.84	302			✓	69	68	4		
5	:05	254.300	.65	.96	301			✓	69	69	4		
6	:07	255.450	.64	.94	301			✓	69	69	4		
7	:09	256.500	.65	.96	301			✓	69	69	4		
8	:11	257.650	.72	1.06	292			✓	69	69	4		
Final	11:13	258.810											

U PART. NOT FOR ↓ Didn't USE FOR RHOO CARDS

Check Indicates Temperatures Meet Required Limits.

Company GPCO Date 4-17-96

Site Crist #5 Soot Blow Run # 2 Page 3 Of

~~START RATA RUN HERE~~

R-2

Best Available Copy

Port # / Point #	Time	Gas Meter Vol. (cu. ft.)	Vel. Head ΔP in. H_2O	Orifice Head ΔH in. H_2O	Temperature (F) Stack	Probe	Hot Box	Imp.	Gas Meter In	Gas Meter Out	Vac. in. H_g	14:20 Port 4	
1 - 1	14:26	285.900	.84	1.22	294	N/A	N/A	52	70	70	3	.70	29
2	:28	287.200	.77	1.12	303			✓	70	70	3	.75	29
3	:30	288.400	.98	1.42	307			✓	70	70	3	.62	29
4	:32	289.750	.78	1.13	307			✓	70	70	3	.41	29
5	:34	290.900	.70	1.01	306			✓	71	70	3	.30	29
6	:36	292.100	.84	1.22	305			✓	71	70	3	.45	29
7	:38	293.500	.79	1.15	305			✓	71	70	3	.25	29
8	:40	294.800	.63	.91	303			✓	71	70	3	.35	29
2- 1	14:42	295.740	.65	.94	300			✓	71	70	3		
2	:44	296.850	.63	.91	305			✓	71	70	2		
3	:46	297.900	.74	1.07	306			✓	71	70	2		
4	:48	299.100	.59	.84	306			✓	71	70	3		
5	:50	300.150	.68	.97	305			56	72	71	3		
6	:52	301.300	.73	1.04	305			✓	72	71	3		
7	:54	302.400	.60	.86	304			✓	72	71	3		
8	:56	303.475	.62	0.89	303			✓	72	71	3		
3- 1	14:59	304.555	.74	1.06	302			✓	72	71	3		
2	:01	305.650	.70	1.00	306			✓	72	71	3		
3	:03	306.800	.62	.89	306			✓	72	71	3		
4	:05	306.950	.54	.77	305			✓	72	72	3		
5	:07	308.950	.65	.93	304			✓	72	72	3		
6	:09	309.900	.65	.93	304			✓	72	72	3		
7	:11	311.100	.66	.95	304			58	72	72	3		
8	:13	312.350	.68	.98	299			✓	72	72	3		
3- 1	:15	313.450	.75	1.08	302			✓	72	72	3		
2	:17	314.500	.70	1.00	305			✓	72	72	3		
3	:19	315.600	.64	.92	306			✓	72	72	3		
4	:21	316.800	.53	.76	305			✓	72	72	3		
5	:23	317.800	.64	.92	305			✓	72	72	3		
6	:25	318.900	.65	.93	304			✓	72	72	3		
7	:27	320.100	.66	.95	303			✓	72	72	3		
8	:29	321.300	.68	.98	302			✓	72	72			

Didn't use for RATA CALCS.

Final 15:31 322.300

RATA RUN #5

Check Indicates Temperatures Meet Required Limits.

Company CPCO

Date 4-17-96

Site Crist #5 Soot Blow

Particulate Run # 3

Page 4 Of 4

RATA RUN # 5

LABORATORY ANALYSIS & CHAIN OF CUSTODY

COMPANY/PLANT: Gulf Power Co.

UNIT #: 5 DATE OF TEST: 4-17-96 TYPE OF TEST: ☐ M-5 ☒ M-17 ☐ OTHER ____

SAMPLE #	RELINQUISHED BY	RECEIVED BY	TIME	DATE	REASON FOR CHANGE
1636	ESA	JCG	8:30 AM	4-19-96	Analysis
1637					
1638					

UNIT # Crist 5 - ~~Steady State~~ Soot Blow

RUN # 1	FILTER # 1636	BEAKER # 16 WASH (ML) ____
FINAL WEIGHT	141.4	70158.0
INITIAL WEIGHT	127.8	70153.2
DIFFERENCE	13.6	4.8
CORRECTED TOTAL WEIGHT		18.4
RUN # 2	FILTER # 1637	BEAKER # 23 WASH (ML) ____
FINAL WEIGHT	141.5	63355.1
INITIAL WEIGHT	127.3	63349.9
DIFFERENCE	14.2	5.2
CORRECTED TOTAL WEIGHT		19.4
RUN # 3	FILTER # 1638	BEAKER # 45 WASH (ML) ____
FINAL WEIGHT	141.5	67596.2
INITIAL WEIGHT	127.8	67588.5
DIFFERENCE	13.7	7.7
CORRECTED TOTAL WEIGHT		21.4
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		

UNIT # ____

RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		
RUN # ____	FILTER # ____	BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		
INITIAL WEIGHT		
DIFFERENCE		
CORRECTED TOTAL WEIGHT		
WASH SOLVENT BLANK (ML) 100		BEAKER # ____ WASH (ML) ____
FINAL WEIGHT		67341.7
INITIAL WEIGHT		67341.6
DIFFERENCE		0.1
CORRECTION FACTOR (MG/ML)		0.001

ALL WEIGHTS ARE IN MILLIGRAMS (MG)

APPENDIX B SAMPLE CALCULATIONS

Input and Constants

$$f := \frac{9820\ ft^{3}}{mm\ btu}$$

$$pg := -(0.35\ in.\ H2O)$$

$$pbar := 30.31\ in.\ Hg.$$

$$\Delta havg := 1.017\ in.\ H2O$$

$$y := 1.024$$

$$tm := 58.6\ °F$$

$$o2 := 5.2$$

$$co2 := 13.5$$

$$vm := 36.665\ ft^{3}$$

$$vlc := 70.\ ml$$

$$theta := 64\ min$$

$$nozdia := 0.225\ in.$$

$$ts := 292.9\ °F$$

$$as := 92.135\ ft^{2}$$

$$mn := 18.4\ mg$$

$$numberofpoints := 32$$

$$sqrt\Delta p := 0.8449\ in.\ H2O^{0.5}$$

$$kp := \frac{85.49\ 1\ ft\ 1\ \left(\frac{lb\ in.\ Hg.}{lb\text{-}mole\ °R\ in.\ H2O}\right)^{0.5}}{1\ sec}$$

$$cp := 0.84$$

$$k1 := \frac{17.64\ °R}{in.\ Hg.}$$

$$ts = \frac{(ts + 460\ °F)\ °R}{°F}$$

752.9 °R

$$tm = \frac{(tm + 460\ °F)\ °R}{°F}$$

518.6 °R

$$n2 = 100 - o2 - co2$$

81.3

$$an = \frac{nozdia^{2}\ 3.1416}{4\ \left(\frac{12\ in.}{ft}\right)^{2}}$$

$0.000276117\ ft^{2}$

Calculations

Equation 1

$$ps = pbar + \frac{pg}{\frac{13.6 \text{ in. H2O}}{1 \text{ in. Hg.}}}$$

30.2843 in. Hg.

Equation 2

$$pm = pbar + \frac{\Delta havg}{\frac{13.6 \text{ in. H2O}}{\text{in. Hg.}}}$$

30.3848 in. Hg.

Equation 3

$$vmstd = \frac{k1 \; vm \; y \left(pbar + \frac{\Delta havg}{\frac{13.6 \text{ in. H2O}}{\text{in. Hg.}}}\right)}{tm}$$

38.8038 ft^3

Equation 4

$$vwstd = \frac{0.04707 \text{ ft}^3 \; vlc}{ml}$$

3.2949 ft^3

Equation 5

$$bws = \frac{vwstd}{vmstd + vwstd}$$

0.0782662

Equation 6

$$md = \frac{(0.44\ co2 + 0.32\ o2 + 0.28\ n2)\ lb}{lb\text{-}mole}$$

$$\frac{30.368\ lb}{lb\text{-}mole}$$

Equation 7

$$ms = md\ (1 - bws) + \frac{bws\ 18\ lb}{lb\text{-}mole}$$

$$\frac{29.4\ lb}{lb\text{-}mole}$$

Equation 8

$$vs = kp\ cp\ \mathrm{sqrt}\Delta p \left(\frac{ts}{ms\ ps}\right)^{0.5}$$

$$\frac{55.7939\ ft}{sec}$$

Equation 9

$$qa = \frac{vs\ as\ 60\ sec}{min}$$

$$\frac{308434.\ ft^{3}}{min}$$

Equation 10

$$qs = \frac{qa\ (1 - bws)\ 528\ {}^{\circ}R\ ps}{ts\ 29.92\ in.\ Hg.}$$

$$\frac{201799.\ ft^{3}}{min}$$

Equation 11

$$cs = \frac{0.0154\ gr\ mn}{mg\ vmstd}$$

$$\frac{0.00730239\ gr}{ft^{3}}$$

Equation 12

$$pmr = \frac{cs\ qs\ 60\ min}{hour\ \frac{7000\ gr}{lb}}$$

$$\frac{12.631\ lb}{hour}$$

Equation 13

$$e = \frac{cs\ f\ 20.9\ 1\ lb}{(20.9 - o2)\ 7000\ gr}$$

$$\frac{0.0136372\ lb}{mm\ btu}$$

Equation 14

$$vn = \frac{ts\ \left(\frac{0.002669\ in.\ Hg.\ ft^{3}\ vlc}{ml\ {}^{\circ}R} + \frac{vm\ y\ pm}{tm}\right)}{ps}$$

$$59.3332\ ft^{3}$$

Equation 15

$$i = \frac{100\ \%\ vn}{\frac{60\ sec\ theta\ vs\ an}{min}}$$

100.297 %

Equation 16

$$hi = \frac{pmr}{e}$$

$$\frac{926.217\ mm\ btu}{hour}$$

APPENDIX C QUALITY CONTROL

INITIAL
METER CALIBRATION FORM - DGM

DATE: 12-05-95 Box No. S-101

Ref. DGM Ser. # 1044453 Calibrated By EDWARD HARRIS

RUN #	1	2	3	4	5
DELTA H (DGM)	0.50	1.00	1.50	2.00	3.00
Y (Ref. DGM)	1.014	1.014	1.014	1.014	1.014
Reference DGM					
Gas Vol. Initial	19.500	25.177	31.500	38.100	45.000
Gas Vol. Final	25.177	31.500	38.100	45.000	51.466
Meter Box DGM					
Gas Vol. Initial	24.400	30.000	36.261	42.805	49.615
Gas Vol. Final	30.000	36.261	42.805	49.615	56.004
Reference DGM					
Temp.	Avg.	Avg.	Avg.	Avg.	Avg.
Deg F Initial	66	67	67	67	67
Deg F Final	67	67	67	67	67
Meter Box DGM					
Temp. Initial In	66	67	68	69	69
Temp. Initial Out	66	67	68	69	69
Temp. Final In	66	67	69	69	69
Temp. Final Out	66	67	69	69	69
P Bar IN. Hg	30.08	30.08	30.08	30.08	30.08
Time (sec.)	873	688	582	525	404
Meter Calibration Factor (Y)	1.026	1.022	1.022	1.026	1.023
Qm (C.F.M.)	0.399	0.563	0.695	0.806	0.981
Km (Std Pressure)	0.727	0.726	0.730	0.733	0.730
DELTA Ha	1.77	1.78	1.75	1.73	1.75

Average Y (Meter Calibration Factor	1.024
Average Km (Standard Pressure)	0.729
Average DELTA Ha of Orifice	1.755

Y= ≤ .03
Max & Min ≤ .02 from Avg
Final Avg within 5% of Initial Avg
ΔHa = Max & Min ≤ .2 from Avg

POST TEST QUALITY ASSURANCE

Date: 4/30/96 BOX #: **S-101**

Ref. Meter: 1044453 Calibrated By: **Edward Harris**

DRY GAS METER

	Unit	Run 1	Run 2	Run 3
FIELD METER ΔH	In. H_2O	1.50	1.50	1.50
Initial Gas Volume	Ft.^{3}	52.300	57.450	62.660
Final Gas Volume	Ft.^{3}	57.450	62.660	68.750
Initial Temp. In	°F	70	71	72
Initial Temp. Out	°F	71	71	72
Final Temp. In	°F	71	72	73
Final Temp. Out	°F	70	72	73
REF. METER Y	*Dimensionless*	1.014	1.014	1.014
Initial Gas Volume	Ft.^{3}	31.300	36.500	41.750
Final Gas Volume	Ft.^{3}	36.500	41.750	48.000
Initial Temp.	°F	70	71	71
Final Temp.	°F	70	71	71
Barometric Pressure	In. Hg	29.95	29.95	29.95
Time	sec	460	465	535
Meter Calibration Factor	*Dimensionless*	1.021	1.019	1.040
$\Delta H_@$	In. H_2O	1.777	1.785	1.664
Average Y	*Dimensionless*	1.027		
Initial Y	*Dimensionless*	1.024		
Percent Error	%	0.3	*(Allowed 5.0%)*	

DIFFERENTIAL PRESSURE GAUGE

Ref. Pressure in H_2O	Magnehelic Pressure in H_2O	Percent Error (+/- 5%)
0.00	0.00	0
0.50	0.51	2
1.50	1.50	0

TEMPERATURE SENSOR

Ref. Temp. (°F)	Thermocouple Temp. (°F)	Percent Error (Allowed 1.5% of Absolute)
280	281	0.14

ARENOID BAROMETER

Reference Barometer	Test Barometer	0.1 Diff. Allowed
29.70	29.68	-0.02

MAGEHELIC CALIBRATION

BOX	2879	S-100	C-133	C-175	S-102	S-101	S-103
SER. NO.		91126AM 91	9126A M91	R90125 MR6	R74D	R22D	R20208 A617
RANGE	0-2	0-2	0-2	0-2	0-5	0-2	0-2
REFERENCE READING	FIELD DEVICE READING						
0.000		0.00	0.00	0.00	0.00	0.00	0.00
0.050							
0.150							
0.200							
0.250							
0.450							
0.50	0.50	0.51	0.50	0.51	0.51	0.50	0.50
1.00	0.99	1.01	0.98	1.01	1.01	0.98	1.01
1.30							
1.80	1.80	1.82	1.79	1.82	1.81	1.79	1.82
2.50							
4.50							
5.0							
9.0							
13.0							
22.0							

SIGNATURE: Edward L. Harris

DATE: 12-5-95

MAGEHELIC CALIBRATION
BOX #1

SER. NO.	10720- AB68	R1061- 6AG48	R5031- SEB76	R1062- 9JA82	R1051- 3MR42	R90124 RI119
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING	FIELD DEVICE READING					
0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.050	0.050					
0.150	0.150	0.140				
0.200	0.190					
0.250		0.250				
0.450		0.450				
0.50			0.50			
1.00			1.00			
1.30				1.30		
1.80			1.80			
2.50				2.50	2.48	
4.50				4.50		
5.0					5.0	5.0
9.0					9.02	
13.0						13.0
22.0						22.0

SIGNATURE: Edward R. Harris

DATE: 12/22/95

MAGEHELIC CALIBRATION

BOX #2

SER. NO.	10819-DR2	R1090-2AG18	R50315-EB93	R1062-9TA87	30830-AM79	R1072-2MC5
RANGE	0-0.25	0-0.50	0-2	0-5	0-10	0-25
REFERENCE READING	FIELD DEVICE READING					
0.000	0.000	0.000	0.00	0.00	0.0	0.0
0.050	0.050					
0.150	0.155	0.152				
0.200	0.205					
0.250		0.256				
0.450		0.456				
0.50			0.52			
1.00			1.04			
1.30				1.32		
1.80			1.83			
2.50				2.55	2.49	
4.50				4.50		
5.0					4.9	5.2
9.0					8.8	
13.0						12.9
22.0						22.0

SIGNATURE: Edward L Harris

DATE: 12/22/95

MAGEHELIC CALIBRATION

BOX #3

SER. NO.	R10908AG71 MRR1	R0112642	R10608CF20 CF20
RANGE	0-0.50	0-2.0	0-10
REFERENCE READING	FIELD DEVICE READING		
0.000	0.00	0.00	0.0
0.050			
0.150	0.149		
0.200			
0.250	0.240		
0.450	0.450		
0.50		0.50	
1.00		0.98	
1.50			
1.80		1.78	
2.50			2.5
4.50			
5.0			5.0
9.0			9.0
13.0			
22.0			

SIGNATURE: Edward L. Harris

DATE: 12/22/95

MAGEHELIC CALIBRATION
BOX #4

SER. NO.	R22D	R90051 6GT21	R90101 5CD102
RANGE	0-0.50	0-5	0-25
REFERENCE READING	FIELD DEVICE READING		
0.000	0.000	0.00	0.0
0.050			
0.150	0.151		
0.200			
0.250	0.251		
0.450	0.455		
0.50			
1.00			
1.30		1.27	
1.80			
2.50		2.52	
4.50		4.55	
5.0			5.0
9.0			
13.0			13.0
22.0			21.6

SIGNATURE: Edward L Harris

DATE: 12/22/95

TEMPERATURE CALIBRATIONS - DEGREES FAHRENHEIT

REFERENCE DEVICE READING*	0 DEG. F	210 DEG.	420 DEG.	630 DEG.	840 DEG.	1050 DEG.	1260 DEG.	1470 DEG.	1680 DEG.	1900 DEG.
2879	0	217	421	630	839	1050	1260	1471	1681	1900
METER BOX #1 C-133 11580	0	212	423	635	842	1053	1264	1475	1679	1910
METER BOX #2 C-175 15962	0	211	423	627	839	1052	1265	1475	1687	1903
METER BOX #5 S-100 15751	2	211	417	628	844	1062	1279	1491	1698	1907
METER BOX #6 S-101 15751	0	210	419	628	839	1058	1255	1473	1691	1900
PORTABLE THERMOCOUPLE # 2 (Blue)	2	209	415	628	837	1053	1260	1468	1679	1908
PORTABLE THERMOCOUPLE # 2 (Green)	2	211	417	627	842	1058	1273	1484	1688	1896
PINK T140293	-1	208	415	624	840	1056	1272	1482	1687	1894
PORTABLE THERMOCOUPLE (Yellow)	0	210	419	632	840	1050	1259	1470	1680	1901
PORTABLE THERMOCOUPLE T-105998 (Black)	1	209	416	625	839	1055	1270	1481	1684	1891
METER BOX S-102	-2	209	417	625	837	1049	1259	1462	1658	1890
METER BOX S-103	4	215	423	632	844	1057	1266	1471	1667	1895

DATE: 12-05-95 **SIGNATURE:** Edward L. Harris

* Reference Device is an Omega Engineering CL505-A calibrated reference thermocouple-potentiometer system.

Best Available Copy

SEAS

SANDERS ENGINEERING & ANALYTICAL SERVICES, Inc.

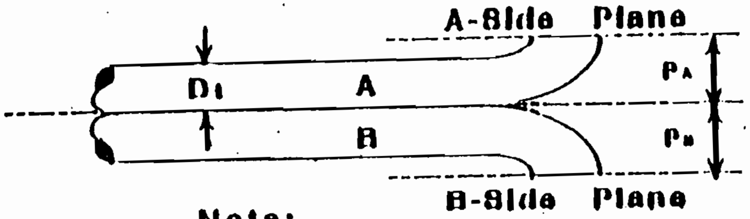
1568 Leroy Stevens Rd.
Mobile, AL 36695

Office: (205) 633-4120
FAX#: (205) 633-2285

The Pitot used was within the following geometric specifications:

Di between 0.48 and 0.95 cm (3/16 and 3/8 in.)

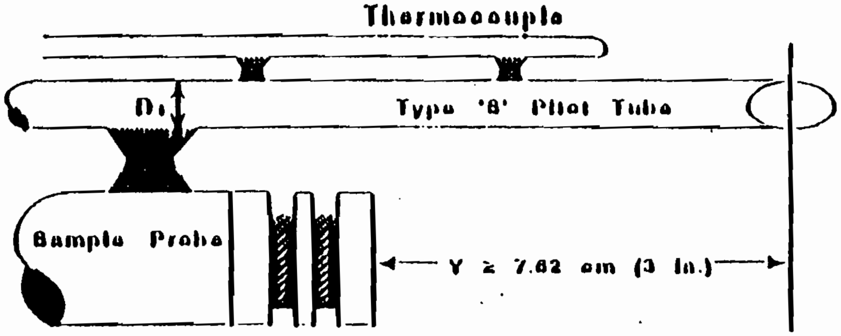
C_p = 0.84



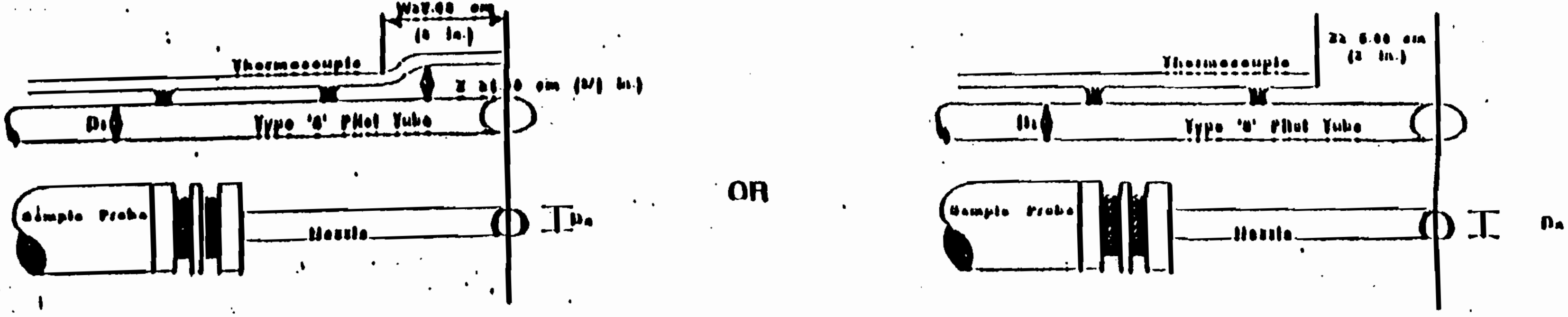
Note:

1.05 Di ≤ 1.50 Di

$P_A = P_B$



Minimum pitot-sample probe separation needed to prevent interference



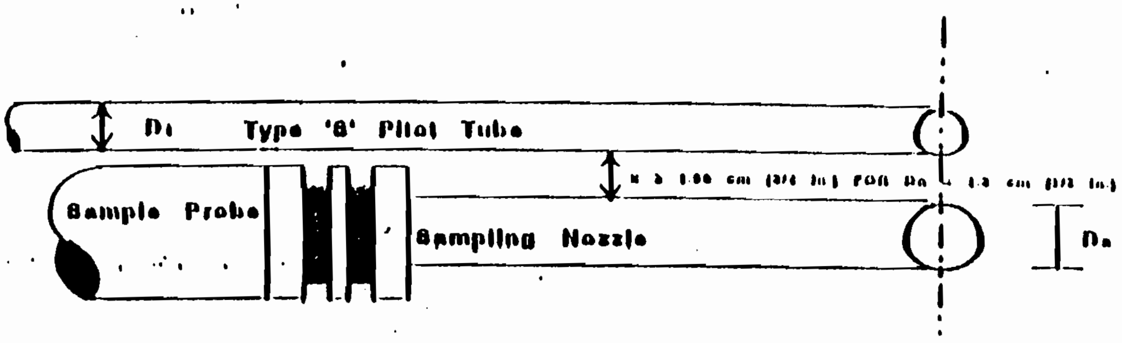
Proper thermocouple placement to prevent interference.

SANDERS ENGINEERING &
ANALYTICAL SERVICES, Inc.

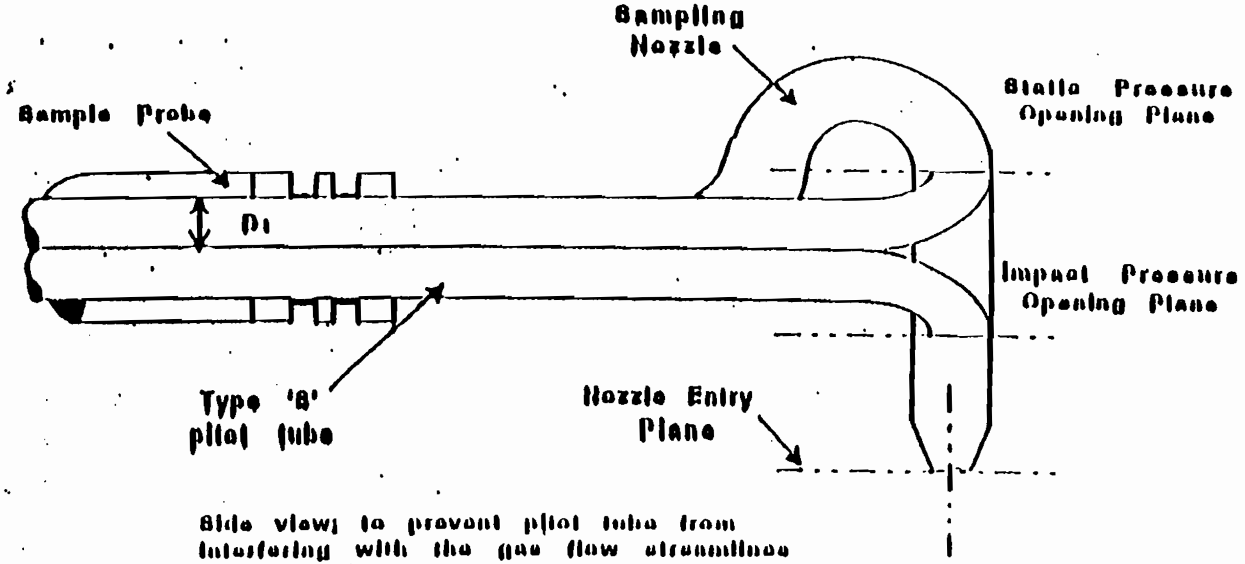
1566 Leroy Stevens Rd.
Mobile, AL 36606

Office: (205) 633-4120
FAX#: (205) 633-2206

Proper pitot tube-sampling nozzel configuration to prevent aero-dynamic interference; buttonhook type nozzle; centers of nozzle and pitot opening aligned; Dt between 0.48 and 0.95 cm (3/16 and 3/8 in.)



Bottom view showing minimum pitot/nozzle separation



Side view; to prevent pitot tube from interfering with the gas flow streamlines approaching the nozzle, the impact pressure opening plane of the pitot tube shall be even with or above the nozzle entry plane.

Best Available Copy

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ANALYTICAL SERVICES, Inc.

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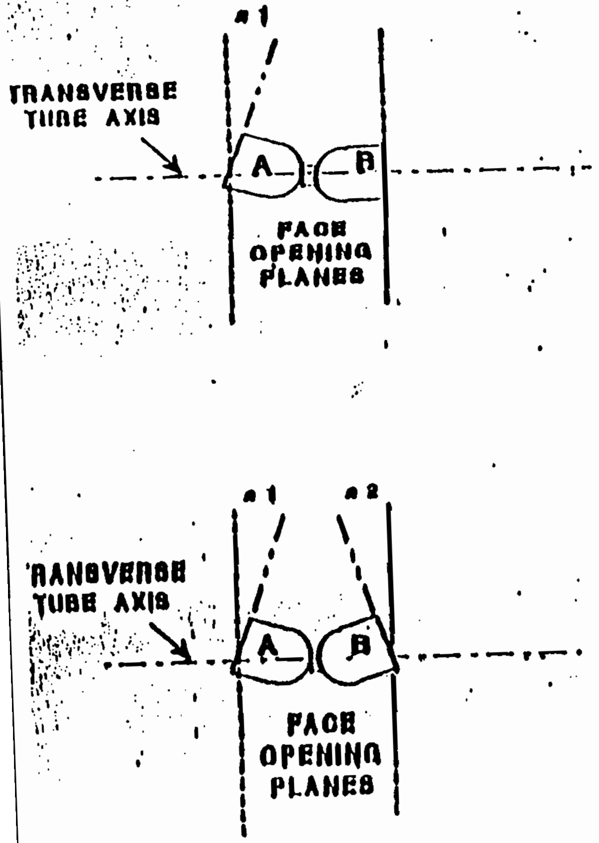
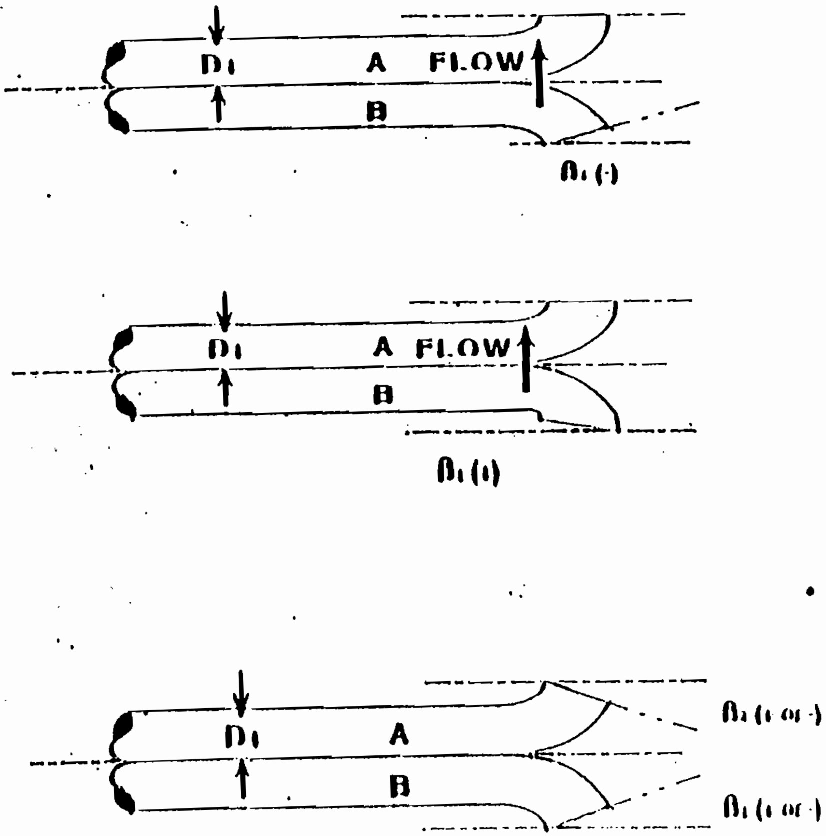
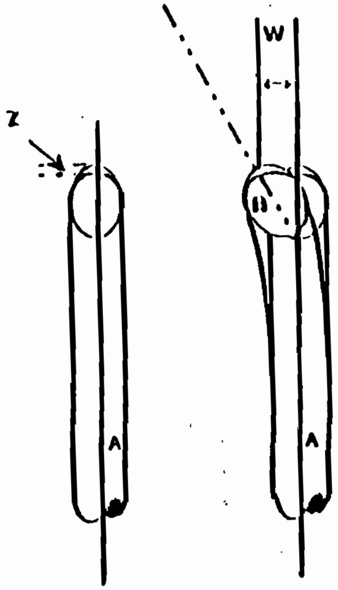
Mobile, AL 36695

Office: (205) 633-4120
FAX#: (205) 633-2285

Types of face-opening misalignment that can result from field use or improper construction of type 'S' pitot tubes. These will not affect the baseline value of Cp(s) so long as $\alpha 1$ and $\alpha 2 < 10°$, $\beta 1$ and $\beta 2 < 5°$, $z \leq$ 0.32 cm (1/8 in.)







Crist ELECTRIC GENERATING PLANT

SOOTBLOWING

UNIT 5

DATE 4-17-96

	TIME	RUN NUMBER	MAIN STEAM FLOW (LBS/HR)	MW LOAD	BOILER AIR FLOW	PULVERIZER MILLS COAL FLOW 10^3 LB/HR						% O_2			% OPACITY	I.D. FAN AMPS				GAS TEMP (F°) AIR PREHEATER				PULVERIZER MILLS TEMPERATURES °F					
						A	B	C	D			F.D.		EMS		A								A	B	C	D		
Start	8.17	1	719	88	703	51281	527669	22657	612887			6.5	4.3		5.0	250				292	275			162	135	160	162		
Finish	9.23					51470	527953	22846	613111																				
Start	1008	2	721	88	702	51570	528103	22950	613224			6.5	4.1		4.7	250				295	292			162	135	159	162		
Finish	113					51760	528387	23137	613441																				
Start	1420	3				52263	529140	23645	614011			6.5	4.0		4.7	250				299	299			162	135	159	162		
Finish	1531					52428	529399	23816	614207																				

3800705

```
Opacity Percent               01-06   5.1       31-36   5.4
                              07-12   5.2       37-42   5.6
                              13-18   5.0       43-48   5.1
                              19-24   4.8       49-54   4.8
                              25-30   5.1       55-60   5.2

Hourly Averages               SO2               NOX              CO2
Measured                    616.7 ppm         293.4 ppm         13.0 %
Bias Adjusted               624.7 ppm         300.7 ppm         13.0 %
Rate                          1.4 lb/mmbtu      0.4 lb/mmbtu
Bias Adjusted                 1.4 lb/mmbtu      0.4 lb/mmbtu
3 Hr Avg
Mass Emissions             1401.1 lb/mmbtu                     101.4 ton/hr
Bias Adjusted              1419.2 lb/hr                        101.4 ton/hr
Bias Factor                   1.012             1.024            0.999
Source                        1                 1                1
Heat Input                  988.4
Load Range                    2.6
Zero Calibration              0.9 ppm           1.1 ppm          0.0 %
Expected Value                0.0 ppm           0.0 ppm          0.0 %
Span Calibration           2647.8 ppm         877.5 ppm         17.3 %
Expected Value             2620.0 ppm         876.0 ppm         16.9 %

Hourly Averages               Flow          Gross Generation     Opacity
Measured               13686000   scfh        89.5 MWge
Bias Adjusted          13685589   scfh
Bias Factor                   0.999
Source                        1
Zero Calibration             -0.8 scfh                           0.1 %
Expected Value                0.0 scfh                           0.0 %
Span Calibration            261.2 scfh                          42.1 %
Expected Value              262.5 scfh                          42.7 %

Instrument Status          Opacity Monitor    Normal
                           SO2 Analyzer       Normal
                           NOX Analyzer       Normal
                           CO2 Analyzer       Normal
                           Flow Monitor       Normal

Legend                     ** Excess Emissions    ## Insufficient Data
                           !! Fans Off            $$ Boiler Off

===========================================================================
```

```
                              Crist Unit 5
                           Pensacola, Florida
=======================================================================
 Today's Date: 04/18/96                          Report Date: 04/17/96
 Today's Time: 17:14:01                          Report Hour: 08 - 09

 Opacity Percent             01-06    5.1       31-36    5.5
                             07-12    5.0       37-42    5.1
                             13-18    5.1       43-48    5.1
                             19-24    5.0       49-54    5.2
                             25-30    5.2       55-60    4.7

 Hourly Averages             SO2                NOX                CO2
 Measured                  618.2 ppm          306.5 ppm          12.9 %
 Bias Adjusted             626.2 ppm          314.2 ppm          12.9 %
 Rate                        1.4 lb/mmbtu       0.5 lb/mmbtu
 Bias Adjusted               1.4 lb/mmbtu       0.5 lb/mmbtu
 3 Hr Avg
 Mass Emissions           1368.8 lb/mmbtu                        98.0 ton/hr
 Bias Adjusted            1386.4 lb/hr                           98.0 ton/hr
 Bias Factor                 1.012              1.024             0.999
 Source                      1                  1                 1
 Heat Input                955.8
 Load Range                  2.6
 Zero Calibration            1.2 ppm            1.1 ppm           0.0 %
 Expected Value              0.0 ppm            0.0 ppm           0.0 %
 Span Calibration         2629.9 ppm          875.0 ppm          17.2 %
 Expected Value           2620.0 ppm          876.0 ppm          16.9 %

 Hourly Averages             Flow          Gross Generation      Opacity
 Measured             13338000    scfh       89.8 MWge
 Bias Adjusted        13337599    scfh
 Bias Factor                 0.999
 Source                      1
 Zero Calibration           -0.8 scfh                             0.1 %
 Expected Value              0.0 scfh                             0.0 %
 Span Calibration          258.3 scfh                            42.1 %
 Expected Value            262.5 scfh                            42.7 %

 Instrument Status         Opacity Monitor    Normal
                           SO2 Analyzer       Normal Calibration
                           NOX Analyzer       Normal Calibration
                           CO2 Analyzer       Normal Calibration
                           Flow Monitor       Normal Calibration

 Legend                    ** Excess Emissions    ## Insufficient Data
                           !! Fans Off            $$ Boiler Off

=======================================================================
```

```
                              Crist Unit 5
                           Pensacola, Florida
============================================================================
 Today's Date: 04/18/96                            Report Date: 04/17/96
 Today's Time: 17:16:21                            Report Hour: 09 - 10

 Opacity Percent            01-06   5.0     31-36   5.8
                            07-12   5.1     37-42   5.0
                            13-18   4.9     43-48   4.8
                            19-24   5.3     49-54   5.8
                            25-30   4.8     55-60   4.9

 Hourly Averages              SO2              NOX                CO2
 Measured                   609.5 ppm        291.7 ppm          13.1 %
 Bias Adjusted              617.4 ppm        299.0 ppm          13.1 %
 Rate                         1.3 lb/mmbtu     0.4 lb/mmbtu
 Bias Adjusted                1.4 lb/mmbtu     0.4 lb/mmbtu
 3 Hr Avg
 Mass Emissions            1347.1 lb/mmbtu                      99.4 ton/hr
 Bias Adjusted             1364.5 lb/hr                         99.4 ton/hr
 Bias Factor                  1.012            1.024             0.999
 Source                       1                1                 1
 Heat Input                 968.9
 Load Range                   2.6
 Zero Calibration             1.2 ppm          1.1 ppm           0.0 %
 Expected Value               0.0 ppm          0.0 ppm           0.0 %
 Span Calibration          2629.9 ppm        875.0 ppm          17.2 %
 Expected Value            2620.0 ppm        876.0 ppm          16.9 %

 Hourly Averages              Flow          Gross Generation     Opacity
 Measured               13314000    scfh      89.8 MWge
 Bias Adjusted          13313600    scfh
 Bias Factor                  0.999
 Source                       1
 Zero Calibration            -0.8 scfh                           0.1 %
 Expected Value               0.0 scfh                           0.0 %
 Span Calibration           258.3 scfh                          42.1 %
 Expected Value             262.5 scfh                          42.7 %

 Instrument Status          Opacity Monitor    Normal
                            SO2 Analyzer       Normal
                            NOX Analyzer       Normal
                            CO2 Analyzer       Normal
                            Flow Monitor       Normal

 Legend                     ** Excess Emissions     ## Insufficient Data
                            !! Fans Off             $$ Boiler Off

============================================================================
```

```
                               Crist Unit 5
                            Pensacola, Florida
==========================================================================
Today's Date: 04/18/96                             Report Date: 04/17/96
Today's Time: 17:18:18                             Report Hour: 10 - 11

Opacity Percent            01-06   4.8      31-36   5.2
                           07-12   5.2      37-42   5.7
                           13-18   5.0      43-48   5.8
                           19-24   5.6      49-54   5.7
                           25-30   6.5      55-60   5.7

Hourly Averages            SO2              NOX               CO2
Measured                 605.9 ppm        291.5 ppm          13.1 %
Bias Adjusted            613.8 ppm        298.8 ppm          13.1 %
Rate                       1.3 lb/mmbtu     0.4 lb/mmbtu
Bias Adjusted              1.4 lb/mmbtu     0.4 lb/mmbtu
3 Hr Avg
Mass Emissions          1340.9 lb/mmbtu                      99.5 ton/hr
Bias Adjusted           1358.4 lb/hr                         99.5 ton/hr
Bias Factor                1.012            1.024             0.999
Source                     1                1                 1
Heat Input               970.2
Load Range                 2.6
Zero Calibration           1.2 ppm          1.1 ppm           0.0 %
Expected Value             0.0 ppm          0.0 ppm           0.0 %
Span Calibration        2629.9 ppm        875.0 ppm          17.2 %
Expected Value          2620.0 ppm        876.0 ppm          16.9 %

Hourly Averages            Flow          Gross Generation     Opacity
Measured            13332000   scfh        89.8 MWge
Bias Adjusted       13331600   scfh
Bias Factor                0.999
Source                     1
Zero Calibration          -0.8 scfh                           0.1 %
Expected Value             0.0 scfh                           0.0 %
Span Calibration         258.3 scfh                          42.1 %
Expected Value           262.5 scfh                          42.7 %

Instrument Status        Opacity Monitor    Normal
                         SO2 Analyzer       Normal
                         NOX Analyzer       Normal
                         CO2 Analyzer       Normal
                         Flow Monitor       Normal

Legend                   ** Excess Emissions    ## Insufficient Data
                         !! Fans Off            $$ Boiler Off



==========================================================================
```

```
                              Crist Unit 5
                           Pensacola, Florida
==========================================================================
 Today's Date: 04/18/96                            Report Date: 04/17/96
 Today's Time: 17:22:13                            Report Hour: 13 - 14

 Opacity Percent               01-06   5.5       31-36   6.3
                               07-12   5.7       37-42   6.4
                               13-18   5.7       43-48   5.4
                               19-24   6.4       49-54   5.3
                               25-30   6.3       55-60   5.3

 Hourly Averages               SO2               NOX               CO2
 Measured                    596.2 ppm         296.0 ppm         13.0 %
 Bias Adjusted               603.9 ppm         303.4 ppm         13.0 %
 Rate                          1.3 lb/mmbtu      0.4 lb/mmbtu
 Bias Adjusted                 1.3 lb/mmbtu      0.5 lb/mmbtu
 3 Hr Avg
 Mass Emissions             1312.3 lb/mmbtu                      98.2 ton/hr
 Bias Adjusted              1329.2 lb/hr                         98.2 ton/hr
 Bias Factor                   1.012             1.024            0.999
 Source                        1                 1                1
 Heat Input                  957.6
 Load Range                    2.6
 Zero Calibration              1.2 ppm           1.1 ppm          0.0 %
 Expected Value                0.0 ppm           0.0 ppm          0.0 %
 Span Calibration           2629.9 ppm         875.0 ppm         17.2 %
 Expected Value             2620.0 ppm         876.0 ppm         16.9 %

 Hourly Averages               Flow         Gross Generation      Opacity
 Measured                13260000   scfh      89.6 MWge
 Bias Adjusted           13259602   scfh
 Bias Factor                   0.999
 Source                        1
 Zero Calibration             -0.8 scfh                           0.1 %
 Expected Value                0.0 scfh                           0.0 %
 Span Calibration            258.3 scfh                          42.1 %
 Expected Value              262.5 scfh                          42.7 %

 Instrument Status           Opacity Monitor   Normal
                             SO2 Analyzer      Normal
                             NOX Analyzer      Normal
                             CO2 Analyzer      Normal
                             Flow Monitor      Normal

 Legend                      ** Excess Emissions    ## Insufficient Data
                             !! Fans Off            $$ Boiler Off

==========================================================================
```

```
                              Crist Unit 5
                           Pensacola, Florida
========================================================================
 Today's Date: 04/18/96                          Report Date: 04/17/96
 Today's Time: 17:24:28                          Report Hour: 14 - 15

  pacity Percent              01-06    5.5       31-36    5.6
                              07-12    5.1       37-42    8.4
                              13-18    5.9       43-48    5.9
                              19-24    5.6       49-54    6.5
                              25-30    5.9       55-60    5.8

Hourly Averages               SO2                NOX                CO2
Measured                    596.8 ppm          295.1 ppm          13.1 %
Bias Adjusted               604.5 ppm          302.5 ppm          13.1 %
Rate                          1.3 lb/mmbtu       0.4 lb/mmbtu
Bias Adjusted                 1.3 lb/mmbtu       0.4 lb/mmbtu
3 Hr Avg
Mass Emissions             1310.7 lb/mmbtu                        98.7 ton/hr
Bias Adjusted              1327.6 lb/hr                           98.7 ton/hr
Bias Factor                   1.012              1.024             0.999
Source                        1                  1                 1
Heat Input                  962.8
Load Range                    2.6
Zero Calibration              1.2 ppm            1.1 ppm           0.0 %
Expected Value                0.0 ppm            0.0 ppm           0.0 %
Span Calibration           2629.9 ppm          875.0 ppm          17.2 %
Expected Value             2620.0 ppm          876.0 ppm          16.9 %

Hourly Averages               Flow           Gross Generation     Opacity
Measured               13230000    scfh        89.6 MWge
 ias Adjusted          13229603    scfh
 ias Factor                   0.999
Source                        1
Zero Calibration             -0.8 scfh                             0.1 %
Expected Value                0.0 scfh                             0.0 %
Span Calibration            258.3 scfh                            42.1 %
Expected Value              262.5 scfh                            42.7 %

Instrument Status           Opacity Monitor     Normal
                            SO2 Analyzer        Normal
                            NOX Analyzer        Normal
                            CO2 Analyzer        Normal
                            Flow Monitor        Normal

Legend                      ** Excess Emissions     ## Insufficient Data
                            !! Fans Off             $$ Boiler Off

========================================================================
```

CRIST ELECTRIC GENERATING PLANT

Precipitator Readings

Unit 5

Date 4-17-96

Load 88 MW

Run # 1

Start Time 0812

Finish Time 0923

Precipitator Cabinet		Primary AMPS	Primary Volts	Secondary AMPS	Secondary Voltage
Start	A	54	360	340	
	B	58	390	550	
	C	58	330	280	
Finish	A	52	360	.34	
	B	59	385	.54	
	C	58	330	.28	

CRIST ELECTRIC GENERATING PLANT

Precipitator Readings

Unit 5

Date 4-17-96

Load 88MW

Run # 1

Start Time 0812

Finish Time 0923

Precipitator Cabinet		Primary AMPS	Primary Volts	Secondary AMPS	Secondary Voltage
Start	A	112	370	1420	
	B	123	0	860	
	C	50	280	340	
	D	90	380	550	
	E	80	360	640	
	F	94	370	740	
Finish	A	100	370	1.420	
	B	123	0	.84	
	C	50	280	.28	
	D	90	360	.46	
	E	80	360	.64	
	F	94	370	.74	

CRIST ELECTRIC GENERATING PLANT

Precipitator Readings

Unit 5
Date 4-17-96
Load 88 MW

Run # 2
Start Time 10:08
Finish Time 11:13

Precipitator Cabinet		Primary AMPS	Primary Volts	Secondary AMPS	Secondary Voltage
Start	A	52	360	.34	
	B	59	385	.54	
	C	58	330	.28	
Finish	A	52	360	34	
	B	58	385	.54	
	C	58	330	.28	

CRIST ELECTRIC GENERATING PLANT

Precipitator Readings

Unit 5

Date 4-17-96

Load 88 MW

Run # 2

Start Time 10:08

Finish Time 11:13

Precipitator Cabinet		Primary AMPS	Primary Volts	Secondary AMPS	Secondary Voltage
Start	A	100	370	1,420	
	B	123	0	.84	
	C	50	280	,28	
	D	70	360	.46	
	E	80	360	.64	
	F	94	370	.74	
Finish	A	110	370	1,420	
	B	125	0	.84	
	C	50	340	.28	
	D	50	320	.26	
	E	80	360	.64	
	F	94	320	.74	

CRIST ELECTRIC GENERATING PLANT

Precipitator Readings

Unit 5
Date 4-17-96
Load 88MW

Run # 3
Start Time 1420
Finish Time

Precipitator Cabinet		Primary AMPS	Primary Volts	Secondary AMPS	Secondary Voltage
Start	A	52	360	.34	
	B	58	380	.54	
	C	58	330	.28	
Finish	A	52	360	.34	
	B	58	380	.54	
	C	58	330	.28	

CRIST ELECTRIC GENERATING PLANT

Precipitator Readings

Unit 5

Date 4-17-96

Load 88MW

Run # 3

Start Time 1426

Finish Time 1531

Precipitator Cabinet		Primary AMPS	Primary Volts	Secondary AMPS	Secondary Voltage
Start	A	110	370	1.42	
	B	123	0	.84	
	C	45	260	.26	
	D	80	370	.56	
	E	80	360	.64	
	F	94	370	.74	
Finish	A	110	370	1.420	
	B	123	0	.84	
	C	45	26.0	.28	
	D	45	300	.24	
	E	78	360	.62	
	F	94	370	.74	

APPENDIX D OPERATIONAL DATA