Commonwealth of Pennsylvania
Environmental Resources
October 10, 1991

Subject: Source Test Review

To: Data File
Philadelphia Electric Company
Croyden Generating Station
Croyden, Montgomery County

From: William Schneider WS
Air Pollution Control Engineer
Division of Technical Services and Monitoring
Bureau of Air Quality Control

Through: Chief, Source Testing and Monitoring Section MP

Philadelphia Electric Company (PECO) operates Combustion Turbine Units 11, 21, and 22 at its Croyden generating facility. Gilbert/Commonwealth, Inc. conducted three NO_x Method 7D tests and three CO Method 10B tests simultaneously at each unit on July 16-18, 1991. Sampling was conducted at the transition between the diffuser and regenerator at each turbine unit. This location was necessary because leakage of the generator would likely reduce the NO_x and CO concentrations if sampling was performed in the exhaust stack. An attempt was made to conduct sampling at near maximum load for the combustion turbine. A pretest protocol was approved by the Department.

All tests are acceptable to the Department.

NO_x Emissions (lbs/mmbtu)

Unit	Run No. 1	Run No. 2	Run No. 3
11	1.12	1.21	1.11
21	1.12	1.08	1.09
22	0.54	0.54	0.56

CO Emissions (lbs/mmbtu)

Unit	Run No. 1	Run No. 2	Run No. 3
11	0.00372	0.00418	0.00507
21	0.00280	0.00284	0.00308
22	0.00226	0.00270	0.00376

Unit 11 Operating Conditions

	Run No. 1	Run No. 2	Run No. 3
Flue Gas Flow (DSCFM)	323,186	334,679	336,084
Turbine Load (MW)	29	29	27

Unit 21 Operating Conditions

	Run No. 1	Run No. 2	Run No. 3
Flue Gas Flow (DSCFM)	373,508	367,106	388,583
Turbine Load (MW)	45	43	42

Unit 22 Operating Conditions

	Run No. 1	Run No. 2	Run No. 3
Flue Gas Flow (DSCFM)	382,376	367,946	366,803
Turbine Load (MW)	47	47	45

cc: A.P File
Edward Brown, Southeast Regional Office
Krishnan Ramamurthy, A&C
EPA/RSL
Reading File - Source Testing

WS:lk

SOURCE SAMPLING REPORT FOR MEASUREMENT OF NO_x AND CO EMISSIONS

COMBUSTION TURBINE UNITS 11, 21, AND 22

PHILADELPHIA ELECTRIC COMPANY
CROYDON GENERATING STATION
CROYDON, PA

G/C, INC., REPORT R-04-6314-000
AUGUST, 1991

SOURCE SAMPLING REPORT FOR MEASUREMENT OF NO_x AND CO EMISSIONS

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CROYDON, PA.

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AUGUST, 1991

PREPARED BY

GILBERT/COMMONWEALTH, INC.
P.O. BOX 1498
READING, PENNSYLVANIA 19603

ERIC ROLAND
ENVIRONMENTAL SPECIALIST
TESTING SERVICES GROUP

FOREWORD

The source sampling program as defined by this report was confined to the measurement of NO_x and CO emissions and pertinent exhaust gas characteristics at referenced operating conditions for the combustion turbine units No. 11, 21, and 22 at your Croydon Generating Station.

The sampling program was performed according to procedures specified by the Federal Environmental Protection Agency and by the Pennsylvania Department of Environmental Resources.

TABLE OF CONTENTS

6. Laboratory Results
   - 6.1 NO_x Analysis
   - 6.2 CO Analysis
   - 6.3 Fuel Analysis

7. Computer Printouts
   - 7.1 NO_x, Moisture, CO - Unit 11
   - 7.2 NO_x, Moisture, CO - Unit 21
   - 7.3 NO_x, Moisture, CO - Unit 22

8. Calibration Data

9. Sample Calculations

SECTION I

SUMMARY OF TEST RESULTS

SECTION I - SUMMARY OF TEST RESULTS

Unit 11 running at an average load of 28.3 MW had average flue gas characteristics of 16.43% O_2, 2.95% CO_2, and 3.4% moisture. The NO_x emissions were an average of 1.146 LBS/MMBTU. CO emissions were an average of 0.00432 LBS/MMBTU.

Unit 21 running at an average load of 43 MW had average flue gas characteristics of 16.49% O_2, 2.74% CO_2, and 3.0% moisture. The NO_x emissions were an average of 1.099 LBS/MMBTU. CO emissions were an average of 0.00291 LBS/MMBTU.

Unit 22 running at an average load of 46.3 MW had average flue gas characteristics of 15.19% O_2, 3.73% CO_2, and 4.1% moisture. The NO_x emissions were an average of 0.547 LBS/MMBTU. CO emissions were an average of 0.00291 LBS/MMBTU.

These results are detailed in Tables 1-4.

O_2 traverses completed on each unit showed no signs of stratification.

TABLE 1

SUMMARY OF TEST RESULTS
PHILADELPHIA ELECTRIC COMPANY
CROYDON STATION
G/C, INC. REPORT R-04-6314-000

DATE	7/16/91	7/17/91	7/18/91
UNIT	11	21	22
RUN NO.	1-3	1-3	1-3
TIME	1014-1355	0844-1212	0934-1247
LOAD (MW)	28.3	43	46.3
FLUE GAS CHARACTERISTICS			
DSCFM	331,316	376,399	372,375
O_2, %	16.43	16.49	15.19
CO_2, %	2.95	2.74	3.73
MOISTURE, %	3.4	3.0	4.1
NO_x EMISSIONS			
PPM	210.7	202.6	128.5
LBS/HR	500.02	545.77	342.77
LBS/MMBTU	1.146	1.099	0.547
MMBTU/HR	436.0	496.7	630.7
CO EMISSIONS			
PPM	1.33	0.90	1.17
LBS/HR	1.88	1.44	1.83
LBS/MMBTU	0.00432	0.00291	0.00291

TABLE 2

SUMMARY OF TEST RESULTS
PHILADELPHIA ELECTRIC COMPANY
CROYDON STATION
G/C, INC. REPORT R-04-6314-000

DATE		7/16/91	
UNIT		11	
RUN NO.	1	2	3
TIME	1014-1114	1137-1237	1255-1355
LOAD (MW)	29	29	27
FLUE GAS CHARACTERISTICS			
DSCFM	323,186	334,679	336,084
O_2, %	16.25	16.40	16.63
CO_2, %	3.03	3.03	2.80
MOISTURE, %	3.4	3.4	3.4
NO_x EMISSIONS			
PPM	214.7	223.3	194.2
LBS/HR	497.20	535.34	467.51
LBS/MMBTU	1.12	1.21	1.11
MMBTU/HR	443.0	442.0	423.0
CO EMISSIONS			
PPM	1.20	1.30	1.50
LBS/HR	1.65	1.85	2.15
LBS/MMBTU	0.00372	0.00418	0.00507

TABLE 3

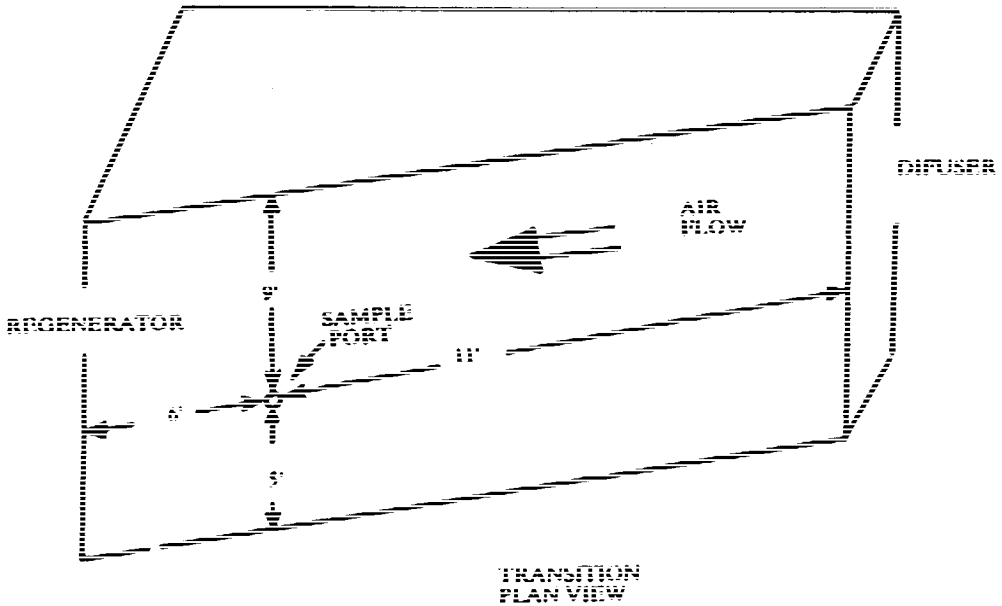
SUMMARY OF TEST RESULTS
PHILADELPHIA ELECTRIC COMPANY
CROYDON STATION
G/C, INC. REPORT R-04-6314-000

DATE		7/17/91	
UNIT		21	
RUN NO.	1	2	3
TIME	0844-0944	0958-1058	1112-1212
LOAD (MW)	45	43	42
FLUE GAS CHARACTERISTICS			
DSCFM	373,508	367,106	388,583
O_2, %	16.33	16.40	16.73
CO_2, %	2.85	2.73	2.65
MOISTURE, %	3.0	3.0	3.0
NO_x EMISSIONS			
PPM	214.3	203.9	189.5
LBS/HR	573.54	536.15	527.63
LBS/MMBTU	1.12	1.08	1.09
MMBTU/HR	510.0	495.0	485.0
CO EMISSIONS			
PPM	0.90	0.90	0.90
LBS/HR	1.43	1.41	1.49
LBS/MMBTU	0.00280	0.00284	0.00308

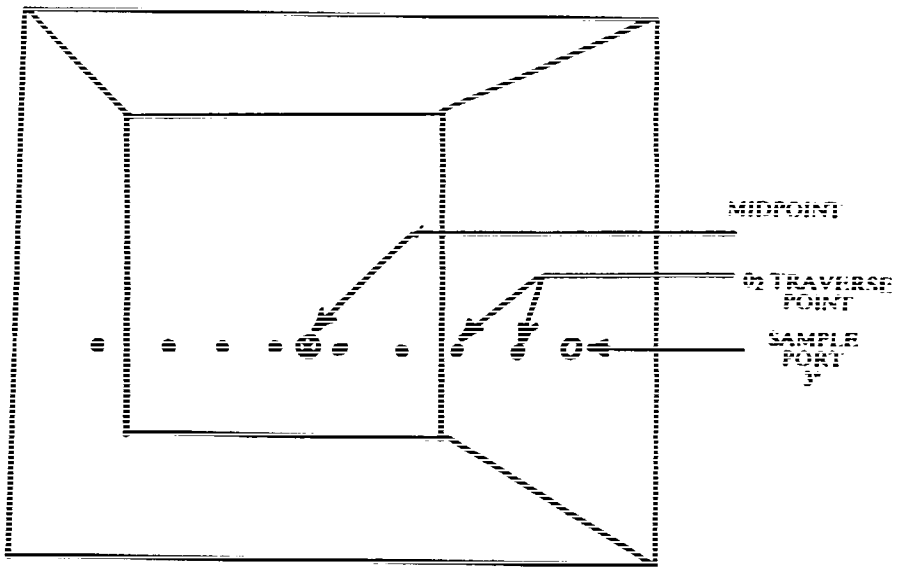
TABLE 4

SUMMARY OF TEST RESULTS
PHILADELPHIA ELECTRIC COMPANY
CROYDON STATION
G/C, INC. REPORT R-04-6314-000

DATE		7/18/91	
UNIT		22	
RUN NO.	1	2	3
TIME	0934-1034	1041-1141	1147-1247
LOAD (MW)	47	47	45
FLUE GAS CHARACTERISTICS			
DSCFM	382,376	367,946	366,803
O_2, %	15.23	15.10	15.25
CO_2, %	3.80	3.85	3.83
MOISTURE, %	4.1	4.1	4.1
NO_x EMISSIONS			
PPM	125.8	129.1	130.7
LBS/HR	344.71	340.25	343.34
LBS/MMBTU	0.54	0.54	0.56
MMBTU/HR	642.0	632.0	618.0
CO EMISSIONS			
PPM	0.90	1.10	1.50
LBS/HR	1.45	1.71	2.33
LBS/MMBTU	0.00226	0.00270	0.00376



TRANSITION
PLAN VIEW



TRANSITION
CROSS SECTION VIEW
LOOKING INTO DIFUSER

@2 TRAVERSE

POINT NO.	DISTANCE FROM PORT
1	1.5"
2	3.5"
3	5.5"
4	7.5"
5	9.5"
6	11.5"
7	13.5"
8	15.5"

FIGURE 1 - PHILADELPHIA ELECTRIC COMPANY
CROYDON GENERATING STATION
COMBUSTION TURBINE UNITS 11, 21, AND 22
SAMPLING LOCATION

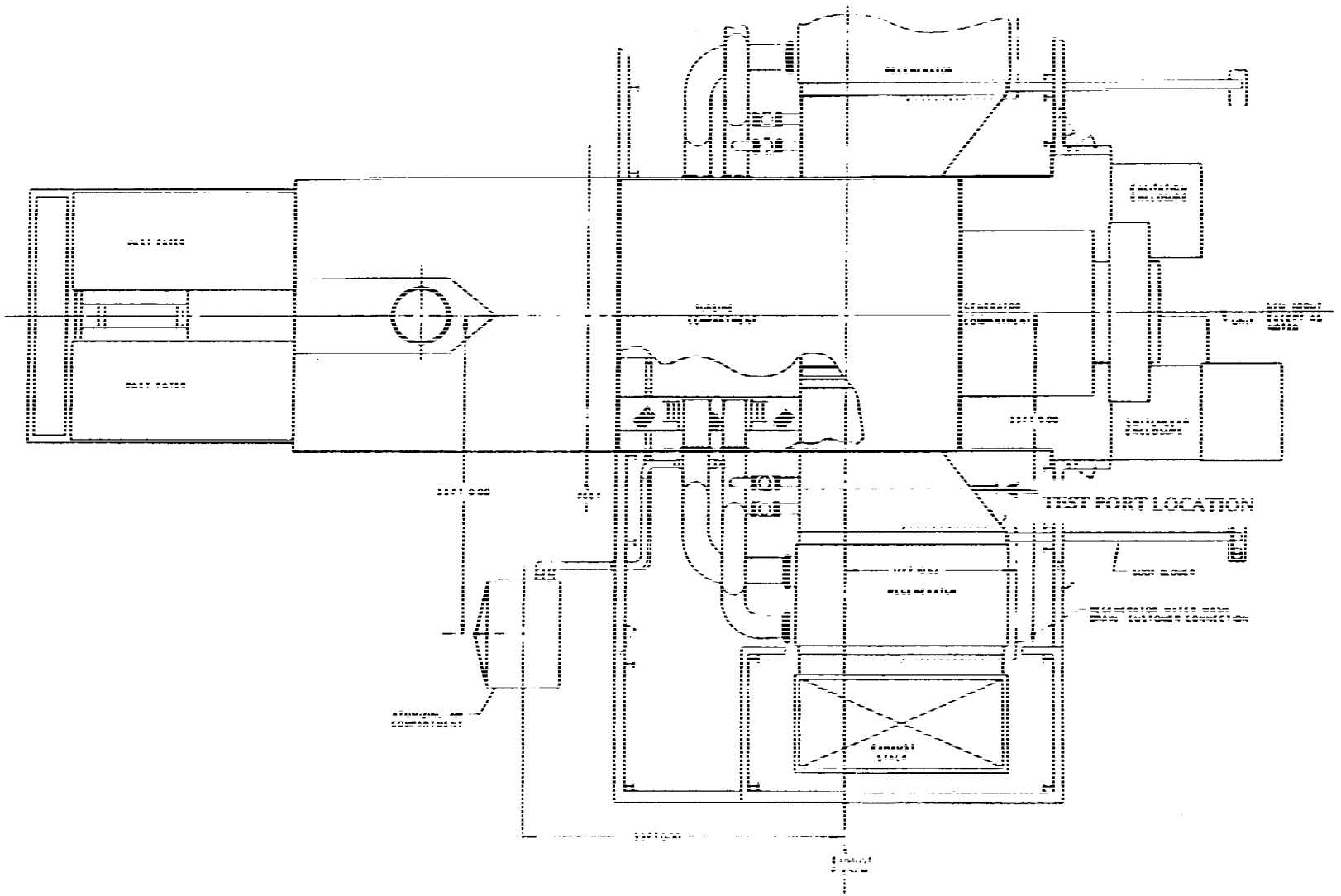


FIGURE 2 - PHILADELPHIA ELECTRIC COMPANY
CROYDON GENERATING STATION
COMBUSTION TURBINE UNITS 11, 21, AND 22

SECTION II

ANALYSES

SECTION II - ANALYSIS

1. Introduction

The data presented in this report represents the results of source sampling exhaust emissions located in the transition between the diffuser and regenerator for Combustion Turbine Units 11, 21, and 22 (Figure 1). Sampling was performed while the units were maintained at normal operating conditions.

Specific requirements of this source sampling program are as follows:

a. Identification of NO_x and CO emissions from the transition between the diffuser and regenerator for compliance with existing pollution control regulations.

b. O_2 traverse to determine the extent of O_2 stratification across the duct.

c. Percent moisture of the exhaust gas.

d. Orsat analysis of exhaust gas conditions.

e. Fuel analysis of fuel burned during the test period.

f. Combustion calculations to determine flue gas flow.

Field work for the sampling program was completed on July 16, 17, and 18, 1991. The sampling program was completed by the Gilbert field test crew with the assistance of PECo personnel.

2. Sampling Program Procedures

To satisfy the objectives for this project, the sampling program was set up on the basis of running one O_2 traverse to determine if any O_2 stratifications existed, followed by three (3) NO_x tests (Method 7D) and three (3) CO tests (Method 10B) simultaneously. A moisture train was then run to determine percent moisture in the exhaust gas. Each unit (11, 21, and 22) was tested independently on separate days. All procedures for the determination of molecular weight, moisture content, NO_x, CO, O_2, and CO_2 concentrations of the exhaust gas were made according to standard test methods as referenced in Appendix 2.

3. Operating Conditions

In the execution of this sampling program an attempt was made to achieve near maximum load for the Combustion Turbine. Details of the operating parameters can be found in the operating data included in Appendix 3.

4. Results

Test data developed by each test run are reproduced in the Appendices included with this report. Information on basic gas characteristics developed by each test run is contained in the printout of the computer program included as Appendix 7.

A summary of pertinent test results and essential information to evaluate test results developed for each test run is included with this report as Tables 1 thru 4.

5. Discussion

Sampling Conditions

All field sampling work was completed at the transition between the diffuser and regenerator and subject to prevailing weather conditions; however, there were no interruptions in the operation of individual test trains due to equipment or weather problems.

During the completion of this test program, the Units were maintained near the normal load condition.

NO_x emissions (ppm) measured by the analyzer were generally steady during the 1 hour test runs and consistent for all three tests.

NO_x emissions in lbs/hour are documented in Tables 1 thru 4.

NO_x emissions in lbs/MMBtu of heat input are documented in Tables 1 thru 4. NOx lbs/MMBtu were calculated using both CO_2 and O_2 based "F" Factors from the Orsat analysis of the integrated bag samples. The resulting close agreement between the lbs/MMBtu values calculated using the two different "F" Factors indicates that the bag samples and Orsat analysis of the samples were representative of theoretically correct CO_2/O_2 relationships.

CO emissions in PPM and LBS/HR are documented in Tables 1 thru 4.

APPENDIX 1

PROJECT PARTICIPANTS

APPENDIX 1

PROJECT PARTICIPANTS

The following members of Gilbert/Commonwealth staff participated in the planning and execution of this project and preparation of this report.

Field Sampling Crew:

George Albright	Project Coordinator
Gary Helm	Engineering Technician
Eric Roland	Environmental Specialist

Laboratory Participants:

Vaughn O'Neill	Chemist
Josie King	Chemist

All field tests were completed with the assistance of technical personnel from Philadelphia Electric Company.

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.1 NO_X TESTING PROCEDURES

2.2 CO TESTING PROCEDURES

2.3 O_2 TESTING PROCEDURES

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.1 NO_X TESTING PROCEDURES

NO_X emissions were sampled according to EPA Method 7D as it appears in 40 CFR, Part 60, Appendix A. Exhaust gas was withdrawn from the sampling point at a rate of approximately 0.4-0.5 liters per minute and passed through three NO_X impingers containing Potassium Permanganate absorbing solution. Each sample run was one-hour in duration. A single moisture run was performed to determine percent moisture in the exhaust gas. Ion chromatography was used to determine micro grams of NO_2 in the sample. The calculations used to determine ppm and lbs/MMBtu of NO_X are shown in Appendix 9.

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.2 CO TESTING PROCEDURES

CO emissions were sampled in accordance with EPA Method 10B as it appears in 40 CFR, Part 60, Appendix A. Exhaust gas was withdrawn from the sampling point at a rate of approximately 0.3 liters/minute and passed through three impingers containing Potassium Permanganate solution prior to being collected in a Tedlar bag. Each sample run was one-hour in length. CO concentration in the sample bags was determined by gas chromatography. The calculations used to determine ppm (CO) are shown in Appendix 9.

APPENDIX 2

TESTING AND ANALYTICAL PROCEDURES

2.3 O_2 TESTING PROCEDURES

O_2 emissions were sampled according to EPA Method 3 as it appears in 40 CFR, Part 60, Appendix A. The single point, integrated sampling form of Method 3 was used to collect approximately 30 liters of exhaust gas in a Tedlar bag for each one-hour test run. A series of Orsat analyses were performed on the bag sample after the collection period. The average CO_2 and O_2 values of the integrated sample were considered to represent the one-hour average CO_2 and O_2 values. These values are expressed as a dry basis percentage.

A series of single point grab samples were also analyzed during the test period.

APPENDIX 3

UNIT OPERATING DATA

APPENDIX 3

UNIT OPERATING DATA

3.1 OPERATING DATA - UNIT 11

Operating Data - Unit 11

M-25249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 2-26-91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

2030 2-26-91

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)	35							
AMBIENT TEMP.	24							
EXHAUST TEMP. (A) (900-1090)	1020							
EXHAUST TEMP. (B) (900-1080)	1026							
COMP. DISCH. TEMP (@ 600°F)	535							
COMB. MONITOR TEMP. SPREAD (@50°F)	107							
IGV POSITION (deg) (82°)	79							
BRG. AREA TEMP.	649							

8-30-91

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

M-25249 10/66

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 2-16-81

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
	0425 2-16-81							
OAD (MW)	29							
AMBIENT TEMP.	82							
EXHAUST TEMP. (A) (900-1090)	960							
EXHAUST TEMP. (B) 900-1080)	960							
COMP. DISCH. TEMP. (≯ 600°F)	550							
COMB. MONITOR TEMP. SPREAD (≯50°F)	43							
GV POSITION (deg) 825)	29							
#8 BRG. AREA TEMP.	682							
	1025							

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

M-25249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 7-16-91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.I.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
	RAS 7-16-91							
LOAD (MW)	29							
AMBIENT TEMP.	82							
EXHAUST TEMP (A) (900-1090)	965							
EXHAUST TEMP (B) (900-1080)	960							
COMP. DISCH. TEMP. (@ 600°F)	595							
COMB. MONITOR TEMP. SPREAD (≤50°F)	103							
IGV POSITION (deg) (82°)	29							
#BRG. AREA TEMP.	682							
	M-29							

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

M-25249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 2-26-91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)	27							
AMBIENT TEMP.	94							
EXHAUST TEMP. (A) (900-1090)	948							
EXHAUST TEMP. (B) (900-1080)	928							
COMP. DISCH. TEMP. (@ 600PF)	560							
COMB. MONITOR TEMP. SPREAD (@60PF)	51							
IGV POSITION (deg) (82°)	79							
#BRG. AREA TEMP.	479							

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

APPENDIX 3

UNIT OPERATING DATA

3.2 OPERATING DATA - UNIT 21

Operating Data - Unit 21

2 249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 7-17-91

E RUCTIONS:

Readings shall be recorded each day the unit is operated.

Report all abnormalities to supervision immediately.

Submit readings to Shift Supervisor for review.

After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

	11	12	21	22	31	32	41	42
N I NO.								
OAD (MW)			46					
N. IENT TEMP.			74					
CHAUST TEMP. (A) C 1090)			962					
CHAUST TEMP. (B) 900-1080)			1020					
C IP DISCH. TEMP. F 00F)			622					
COMB. MONITOR TEMP SPREAD C 5°F)			47					
IGV POSITION (deg) (82°)			81					
IG. AREA TEMP.			614					

By: .....

Reviewed By: .....
Sh. Supervisor

Reviewed By: .....
Engr. Supv./STA

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 7-17-91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

0125 hrs CORRECTED LOAD

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)			45	43				
A AMBIENT TEMP.			76	75				
EXHAUST TEMP. (A) (900-1080)			970	966				
E HAUST TEMP. (B) (900-1080)			1020	962				
C TMP. DISCH. TEMP. 600°F)			625	625				
COMB. MONITOR TEMP. SPREAD (*50°F)			47	45				
V POSITION (deg) (82°)			80	80				
ERG. AREA TEMP.			626	682				

TST

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./SRA

+252-49 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 1 - 17 - 91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (P.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
GAS (MW)			43					
AMBIENT TEMP.			80					
EXHAUST TEMP. (A) 900-1080)			952					
EXHAUST TEMP. (B) 900-1080)			952					
COMP. DISCH. TEMP. (@ 600F)			602					
COMB. MONITOR TEMP. SPREAD (@50F)			38					
IGV POSITION (deg) 32°)			82					
*BRG. AREA TEMP.			693					

Test

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

V 05249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 7-17-91

STRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)			42					
BIENT TEMP			84					
EXHAUST TEMP. (A) (1010-1090)			945					
EXHAUST TEMP (B) (900-1080)			980					
MP. DISCH. TEMP. (600°F)			642					
COMB. MONITOR TEMP. SPREAD (150°F)			43					
V POSITION (deg) (92°)			92					
RG. AREA TEMP.			857					

FST 3

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

APPENDIX 3

UNIT OPERATING DATA

3.3 OPERATING DATA - UNIT 22

Operating Data - Unit 22

V-25249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 7-18-91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)				48				
AMBIENT TEMP.				74				
EXHAUST TEMP (A) (900-1090)				1004				
EXHAUST TEMP (B) (900-1080)				995				
COMP. DISCH. TEMP. (@ 800°F)				825				
COMB. MONITOR TEMP SPREAD (@ 50°F)				45				
IGV POSITION (deg) (82°)				81				
*BRG. AREA TEMP.				235				

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

M-25249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 1-18-91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)				47				
AMBIENT TEMP.				81				
EXHAUST TEMP. (A) (900-1090)				1225				
EXHAUST TEMP. (B) (900-1080)				1223				
COMP. DISCH. TEMP. (≯600°F)				620				
COMB. MONITOR TEMP. SPREAD (≯50°F)				39				
GV POSITION (deg) (82°)				81				
BRG. AREA TEMP.				151				

TEST-1

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

1-252249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 7-12-91

INSTRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)				47				
AMBIENT TEMP.				85				
EXHAUST TEMP. (A) (1000-1090)				1062				
EXHAUST TEMP. (B) (900-1080)				982				
COMP. DISCH. TEMP. (600°F)				633				
COMB. MONITOR TEMP. SPREAD (250°F)				43				
IGV POSITION (deg) (82°)				81				
BRG. AREA TEMP.				227				

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./SITA

T&T-2

M-25249 10/86

CROYDON STATION
CONTROL ROOM
DAILY OPERATING READINGS

DATE: 7-18-91

STRUCTIONS:

1. Readings shall be recorded each day the unit is operated.
2. Report all abnormalities to supervision immediately.
3. Submit readings to Shift Supervisor for review.
4. After review Shift Supervisor shall forward readings to Engineer, Supervisory (R.E.) or his designated representative.

UNIT NO.	11	12	21	22	31	32	41	42
LOAD (MW)				45				
MBIENT TEMP.				89				
EXHAUST TEMP. (A) (900-1090)				982				
XHAUST TEMP. (B) (900-1080)				979				
OMP DISCH. TEMP. ≥ 600°F)				615				
COMB. MONITOR TEMP SPREAD (≤50°F)				38				
GV POSITION (deg) (82°)				81				
BRG. AREA TEMP.				964				

Test-3

By: _____

Reviewed By: _____
Sh. Supervisor

Reviewed By: _____
Engr. Supv./STA

APPENDIX 4

RAW DATA

APPENDIX 4

RAW DATA

4.1 NO_x, MOISTURE, O_2 TRAVERSE - UNIT 11

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

SUBJECT RCO

NOx - 4 - 2

Unit 4

P.O. | PAGE OF

9-6-82
DATE

DATE

	TIME	METER	TEMP IN	TEMP OUT	ORIFICE	VAC.
START	1004	0	390.380	79	81	0
1		5	390.393	86	85	6
2		10	390.4	92	87	2
3		15	390.493	85	89	0
4		20	390.588	89	88	0
5		25	390.680	91	89	0
6		30	390.785	92	90	0
7		35	390.784	93	91	0
8		40	———	94	92	0
9		45	390.890	95	93	0
10		50	390.900	94	93	6
11		55	390.952	94	93	0
END		60	391.018			0

	START	FINISH	NET
IMP A			
B			
C			

	START	FINISH	NET
GEL			

	Stop	Finish	NET
D			
E			

Type 02 Grabs
Lot 28362
28526

BAROMETER 30.12

STACK TEMP. 92

CONTROL BOX NO. 1385

Y = 1.03

STD
+1.38" H2O

ORSAT %

CO2		NET
3.0	19.0	16.0
3.3	19.9	16.5
3.5	19.0	16.1
3.9	19.3	16.4

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

CLIENT Peco

Croydon Stack

Unit 11 Nov-Dec

J.O. | PAGE OF

DATE 11-6-79

DATE

	TIME	METER	TEMP IN	TEMP OUT	ORIFICE	VAC.
START	1132	0 39,042	95	93	6	
1		5 39,140	95	94	01	
2		10 39,239	95	95	0	
3		15 39,343	95	94	0	
4		20 39,453	98	96	0	
5		25 39,561	96	96	0	
6		30 39,663	96	96	0	
7		35 39,764	96	97	0	
8		40 39,856	99	97	0	
9		45 39,957	99	99	0	
10		50 40,054	97	99	0	
11		55 40,148	99	99	0	
END		60 40,242				

	START	FINISH	NET
IMP A			
B			
C			

	STOP	Finish	NET
D			
E			

	START	FINISH	NET
GEL			

Pmr 1135

1230

BAROMETER 30.28

STACK TEMP. 928

CONTROL BOX NO. 185

Y=1.03

ORSAT

CO_2		$NET O_2$
2.8	19.3	16.5
3.9	19.3	15.4
3.4	19.5	16.0
3.3	19.4	16.3

Oil Gallons
78969
79459

STK +13.9"Wg

GAI 150 REV. 10-78

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

CLIENT PEC

Cromby STG

NOx - L3

JOB NO. | PAGE OF

DATE 2/26/91

DATE

TIME | METER | LOAD | SET | ADJUST | VAC.

	TIME	METER	LOAD	SET	ADJUST	VAC.
START	1355	0 39424	99	98	0	
1		5 39422	99	98	0	
2		10 39843	108	99	0	
3		15 39900	101	100	0	
4		20 39965	101	100	0	
5		25 40028	101	100	0	
6		30 40096	102	101	0	
7		35 40161	102	101	0	
8		40 40225	102	101	0	
9		45 40285	101	100	0	
10		50 40339	101	100	0	
11		55 40405	101	100	0	
END		60 40462				

	START	FINISH	NET
IMP A			
B			
C			

	STOP	FINISH	NET
D			
E			

	START	FINISH	NET
GEL			

BAROMETER 30.1

STACK TEMP. 350

CONTROL BOX NO. 1355

Y = 1.03

ORSAT

CO_2		NO_x
2.9	19.5	16.6
2.7	19.0	16.3
2.8	19.6	16.8
2.8	19.6	16.8

Oil Gauge

1357 79185

1359 79265

STG + 129

Date: 7-16-91 Moisture Determination Run #: GW2 #2

Point	Clock Actual	Time Run	Dry Gas Meter ft.	Orifice Pressure in. H2O	Dry Gas Temp (F) Inlet	Dry Gas Temp (F) Outlet
1		0.0	391.539	1.45	103	104
		3.5	—	1.95	104	103
2		7.0	398.1	1.95	112	104
		10.5	—	1.95	114	103
3		14.0	404.3	1.95	115	103
		17.5	—	1.95	115	103
		21.0	407.913			

Y= Meter Factor = 1.01

Barometric Pressure: 30.18 in. Hg ; BP
Net Volume: 16.374 Cubic ft. ; VM
Avg. Orifice: 1.95 in. H2O ; PM
Avg. Meter Temp. 102.8 F ; TM 562.8

Moisture Collected

Impingers: 151, 151

Silica Gel: 241, 232, 9

	Impingers	Silica Gel
Final vol.	302	
Initial vol.	298	
Net vol.	4	
Final wt.		241
Initial wt.		232
Net wt.		9

Silica Gel	9	gm
Impingers	7	ml
Total Moisture	11	gm , VW

$$VM\ (std.) = \frac{17.65 \times VM \times Y \times [\ BP + (\ PM / 13.6\ )\ ]}{(\ TM + 460\ )}$$

$$VW\ (gas) = 0.0471 \times VW = std.\ FT.$$

$$\% Moist. = \frac{100 \times VW\ (gas)}{VM\ (std.) + VW\ (gas)}$$

$$VM\ (std.) = 17.65 \times \frac{16.374 \times 1.01}{(562.8 + 460)} \times [30.18 + (1.95 / 13.6)] = 14.830$$

$$VW\ (gas) = 0.0471 \times 11 = 0.518$$

$$\% Moist. = \frac{100 \times 0.518}{14.830 + 0.518} = \frac{51.8}{15.348} = 3.4\%$$

Sheet 1 of 1

PARTICULATE FIELD DATA

Client PECO

W. O. No. _____

Plant Cromby

Run No. UNIT 11 O_2-TRAVERSE

Location UNIT 11

Date 9/16/91

Operator ALBRIGHT

Sample Box No. _____

Meter Box No. _____

Meter ΔH _____

C Factor _____

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point

SKETCH

OASAT

% CO_2	% O_2
2.8	16.4

Pitot Calibration _____

Thimble No. _____

Filter No. _____

Ambient Temp. °F _____

Bar. Press. "Hg _____

Assumed Moisture % _____

Heater Box Setting, °F _____

Probe Tip Dia., In. _____

Probe Length _____

Probe Heater Setting _____

Avg. ΔP _____ Avg. ΔH _____

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	% O_2 DRY GAS METER, °F	PITOT IN. H_2O ΔP	ORIFICE ΔH IN. H_2O DESIRED	ORIFICE ΔH IN. H_2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP. °F	IMPINGER TEMP. °F		STACK TEMP. °F
1			0.0	16.6										
2				16.9										
3				16.6										
4				16.6										
5				16.5										
6				16.5										
7				16.6										
8														

APPENDIX 4

RAW DATA

4.2 NO_x, MOISTURE, O_2 TRAVERSE - UNIT 21

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

SUBJECT PEC

Oyster Creek

UNIT 2 RUN 2

W.O. | PAGE 37

7/29/92
DATE

DATE

	TIME	METER	IN	OUT	DELTA	VAC
START	0849	0	402,818	77	77	0
1		5	402,825	79	79	0
2		10	———	80	79	0
3		15	402,897	180	79	0
4		20	402,958	79	80	0
5		25	———	82	82	0
6		30	403,042	83	83	0
7		35	403,084	85	84	0
8		40	403,087	84	85	0
9		45	403,134	85	82	0
10		50	403,188	85	82	0
11		55	403,244	88	82	0
END		60	403,301			

	START	FINISH	NET
IMP A			
" B			
" C			

	START	FINISH	NET
D			
E			

	START	FINISH	NET
GEL			

0845

0946

BAROMETER 29.98

STACK TEMP. 920

CONTROL BOX NO. 185

Y= 1.03

ORSAT

CO_2		NO_x
2.9	19.3	76.4
2.8	19.3	76.5
2.9	19.1	76.2
2.8	19.0	76.2

STATIC +14.2"H_2O

Pec
2062429
2062421

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

SUBJECT PCO
Clayton

W.O. | PAGE 99

NOx-24-3

DATE 7/29/97

UNIT 2 Run 3

DATE

	TIME	METER	TEMP IN	TEMP OUT	ORIFICE	VAC.
START	0832	409.254	96	95	6	
1	5	409.330	95	95	6	
2	10	409.390	96	95	0	
3	15	409.450	99	96	0	
4	20	409.510	99	97	0	
5	25	409.552	99	97	0	
6	30	409.580	99	97	0	
7	35	409.627	100	98	0	
8	40	409.660	100	99	0	
9	45	409.741	100	99	0	
10	50	409.800	100	100	0	
11	55	409.872	100	100	0	
END	60	409.931				

	START	FINISH	NET
IMP A			
B			
C			

	Stop	Finish	NET
D			
E			

	START	FINISH	NET
GEL			

FUEL 29130

113

113

BAROMETER 29.99

STACK TEMP. 954

CONTROL BOX NO. 185

Y= 1.03

ORSAT

CO2		NET
2.5	19.2	16.7
2.7	19.5	16.8
2.4	19.3	16.9
2.8	19.5	16.7

20948.2

Sheet 1 of 1

PARTICULATE FIELD DATA

Client PEco

W. O. No. _____

Plant Cheyney

Run No. UNIT 2 / O2 TRAVERSE

Location UNIT 2

Date _____

Operator _____

Sample Box No. _____

Meter Box No. _____

MeterΔH _____

C Factor _____

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point

SKETCH

Pitot Calibration _____

Thimble No. _____

Filter No. _____

Ambient Temp. °F _____

Bar. Press. "Hg _____

Assumed Moisture % _____

Heater Box Setting, °F _____

Probe Tip Dia., In. _____

Probe Length _____

Probe Heater Setting _____

Avg. ΔP _____ Avg. ΔH _____

POINT	DISTANCE IN INCHES	CLOCK TIME ACTUAL	CLOCK TIME RUN	O2 DRY GAS METER, CF	PITOT IN. H2O ΔP	ORIFICE ΔH IN. H2O DESIRED	ORIFICE ΔH IN. H2O ACTUAL	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP. °F	IMPINGER TEMP. °F		STACK TEMP. °F
1		0810	0.0	17.0										
2				16.7										
3				16.9										
4				16.9										
5				16.9										
6				16.9										
7				16.9										
8														

APPENDIX 4

RAW DATA

4.3 NO_x, MOISTURE, O_2 TRAVERSE - UNIT 22

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

CLIENT PECO

NOx-22-1

UNIT 22 Run 2

Croydon STATION

W.O. | PAGE OF

2/18/97
DATE

DATE

	TIME	METER	IN	OUT	DELTA	GAS
START	0930	0 926,946	82	88	6	
1		5 926,980	85	84	5	
2		10 927,025	85	85	0	
3		15 927,086	82	89	6	
4		20 927,192	89	88	0	
5		25 927,268	91	88	6	
6		30 927,338	92	89	10	
7		35 927,410	93	90	6	
8		40 927,480	94	94	6	
9		45 927,543	94	93	5	
10		50 927,610	95	94	6	
11		55 927,675	96	94	6	
END		60 927,744				

	START	FINISH	NET
LMB A			
B			
C			

	START	FINISH	NET
GEL			

	Stop	Finish	NET
D			
E			

0937
1037

BAROMETER 29.88

STACK TEMP. 999

CONTROL BOX NO. 385

Y= 1.03

O2SAT		
CO2		NOx
3.9	8.2	45.3
3.8	8.0	45.2
3.8	8.0	45.2
3.7	7.9	45.3

FUEL
439,179
439,833

STATIC 65" H2O

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

CLIENT peco

NOx-RA-2

W.O. | PAGE

Unit 2A 2w 2

9/29/97
DATE

Cryden Station

DATE

	TIME	METER	TEMP IN	TEMP OUT	ORIFICE	VAC.
START	1054	0 428,220	96	85	6	
1		5 428,840	97	96	01	
2		10 429,392	99	96	0	
3		15 429,964	99	96	0	
4		20 430,029	98	97	0	
5		25 430,095	99	99	0	
6		30 430,166	100	99	0	
7		35 430,238	100	99	0	
8		40 430,288	100	99	0	
9		45 430,353	101	100	0	
10		50 430,420	102	101	0	
11		55 430,492	102	101	0	
END		60 430,563				

	START	FINISH	NET	STOP	FINISH	NET
LINE A				D		
B				E		
C						

	START	FINISH	NET
GEL			

1043 439310

1143 440389

BAROMETER 29.88

STACK TEMP. 99?

CONTROL BOX NO. 1385

Y = 1.03

ORSAT

CO_2		NO_x
3.8	18.8	15.0
3.8	19.0	15.2
3.9	19.1	15.2
3.9	18.9	15.0

Stack 1467'6"

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

SUBJECT: PEO
Condon Station

C.O. | PAGE OF

UNIT #2 Run 3

NOx-23-3

DATE: 2/28/97

DATE

	TIME	METER	TBAR	SAT	ORIFICE	VAC.
START	1122	0 428.581	103	103	0	
1		5 428.640	104	104	0	
2		10 428.709	104	103	0	
3		15 428.770	104	104	0	
4		20 428.835	104	104	0	
5		25 428.905	105	105	0	
6		30 428.976	104	105	0	
7		35 429.035	105	105	0	
8		40 429.105	106	105	0	
9		45 429.182	106	106	0	
10		50 429.239	106	106	0	
11		55 429.300	106	106	0	
END		60 429.368				

	START	FINISH	NET
LEAK A			
" B			
" C			

	Stop	Finish	NET
D			
E			

	START	FINISH	NET
GEL			

BAROMETER 29.88

STACK TEMP. 325

CONTROL BOX NO. 1385

Y = 1.03

ORSAT

SO_2		NO_x
3.5	13.5	15.3
3.6	13.8	15.2
3.5	13.9	15.3
3.5	13.9	15.2

Static +16.3 "H2O

REL 94.0%
449.263
478.240

Date: 2/8/89 Moisture Determination Run #: OW-2 P2

Point	Clock Actual	Time Run	Dry Gas Meter ft.	Orifice Pressure in. HO	Dry Gas Temp (F) Inlet	Outlet
1	1452	0.0	483.438	2.0	106	105
		3.5	487.2	2.0	114	104
2		7.0	———	2.0	118	102
		10.5	496.910	2.0	120	102
3		14.0	504.1	2.0	123	105
		17.5	508.0	1.5	121	104
		21.0	495.487			

Y= Meter Factor = 1.03

Barometric Pressure: 29.88 in. Hg , BP
Net Volume: ——— Cubic ft. , VM
Avg. Orifice: ——— in. HO , PM
Avg. Meter Temp. ——— F , TM

Moisture Collected

Impingers: 150 ml
40 ml
——— ml

Silica Gel

Final vol. 310 ml Final wt. 245 gm
Initial vol. 300 ml Initial wt. 239 gm
Net vol. 10 ml Net wt. 6 gm

Silica Gel 6 gm
Impingers 10 ml
Total Moisture 16 gm , VW

$$VM\ (std.) = \frac{17.65 \times VM \times Y \times [\ BP + (\ PM / 13.6\ )\ ]}{(\ TM + 460\ )}$$

VW (gas) = 0.0471 x VW = std FT.

$$\% Moist. = \frac{100 \times VW\ (gas)}{VM\ (std.) + VW\ (gas)}$$

VM (std.) = 17.65x ——— x 1.03 x[——— + (——— /13.6)]= ———
(——— + 460)

VW (gas) = 0.0471 x ——— = ———

% Moist. = 100 x ——— = ———
——— + ———

Client PECO

PARTICULATE FIELD DATA
(continued)

Sheet _____ of _____

W.O. No. _____

Plant Choptank

Location Unit 22

Run No. O2 - Traverse

Date 7/18/91

POINT	DISTANCE IN INCHES	O_2 CLOCK TIME ACTUAL	RUN	DRY GAS METER, CF	PITOT IN. H_2O ΔP	ORIFICE ΔH IN. H_2O DESIRED	ACTUAL	DRY GAS TEMP. °F INLET	OUTLET	PUMP VACUUM IN. Hg GAUGE	BOX TEMP °F	IMPINGER TEMP °F		STACK TEMP. °F
1		16.0												
2		15.9												
3		15.9												
4		15.9												
5		15.8												
6		15.8												
7		15.8												
8														

APPENDIX 5

COMBUSTION CALCULATIONS FOR FLUE GAS FLOW

5.1 COMBUSTION CALCULATIONS - UNIT 11

5.2 COMBUSTION CALCULATIONS - UNIT 21

5.3 COMBUSTION CALCULATIONS - UNIT 22

APPENDIX 5

COMBUSTION CALCULATIONS FOR FLUE GAS FLOW

5.1 COMBUSTION CALCULATIONS - UNIT 11

UNIT 11 FUEL ANALYSIS
RUN 1

BTU/LB =	19370
% ASH =	0.01
% SULFUR =	0.14
% CARBON =	86.90
% H2 =	12.80
%O2 =	0.14
DENSITY(LBS/GAL)=	7.11
GAL/HR =	3214

ORSAT INFORMATION

% O2 =	16.25
% CO2 =	3.03
% N2 =	80.73
% CO =	0.00

%M = 3.4

FUEL CONSUMED(LBS/HR) =	228854.75
EXCESS AIR =	321
COMBUSTIBLES % =	0
TEMP. =	971
MOLECULAR WEIGHT OF GAS =	28.76
MOLE FRACTION OF GAS =	0.966
STACK PRESSURE =	31.18
NOx Lbs/SCF =	2.56E-05
MMBTU/HR =	443
THEORETICAL AIR =	7.45
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	31.38
H2O IN AIR =	0.41
WET GAS TOTAL =	32.30
TOTAL FLUE GAS =	62.57
DENSITY OF GAS =	0.0276
TOTAL FLUE GAS FLOW =	865,768
Qs (dscfm) =	323,186
LBS/HR NOx =	497.20
LBS NOx/MMBTU =	1.12

UNIT 11 FUEL ANALYSIS
RUN 2

BTU/LB =	19370
% ASH =	0.01
% SULFUR =	0.14
% CARBON =	86.90
% H2 =	12.80
%O2 =	0.14
DENSITY(LBS/GAL)=	7.11
GAL/HR =	3210

ORSAT INFORMATION

% O2 =	16.40
% CO2 =	3.03
% N2 =	80.58
% CO =	0.00

%M = 3.4

FUEL CONSUMED(LBS/HR) =	228826.31
EXCESS AIR =	337
COMBUSTIBLES % =	0
TEMP. =	978
MOLECULAR WEIGHT OF GAS =	28.76
MOLE FRACTION OF GAS =	0.966
STACK PRESSURE =	31.20
NOx Lbs/SCF =	2.67E-05
MMBTU/HR =	442
THEORETICAL AIR =	7.45
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	32.54
H2O IN AIR =	0.42
WET GAS TOTAL =	33.48
TOTAL FLUE GAS =	64.85
DENSITY OF GAS =	0.0274
TOTAL FLUE GAS FLOW =	901,405
Qs (dscfm) =	334,679
LBS/HR NOx =	535.34
LBS NOx/MMBTU =	1.21

UNIT 11 FUEL ANALYSIS
RUN 3

BTU/LB =	19370
% ASH =	0.01
% SULFUR =	0.14
% CARBON =	86.90
% H2 =	12.80
%O2 =	0.14
DENSITY(LBS/GAL)=	7.11
GAL/HR =	3074

ORSAT INFORMATION

% O2 =	16.63
% CO2 =	2.80
% N2 =	80.58
% CO =	0.00

%M = 3.4

FUEL CONSUMED(LBS/HR) =	21859.21
EXCESS AIR =	358
COMBUSTIBLES % =	0
TEMP. =	950
MOLECULAR WEIGHT OF GAS =	28.74
MOLE FRACTION OF GAS =	0.966
STACK PRESSURE =	31.20
NOx Lbs/SCF =	2.32E-05
MMBTU/HR =	423
THEORETICAL AIR =	7.45
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	34.11
H2O IN AIR =	0.44
WET GAS TOTAL =	35.07
TOTAL FLUE GAS =	67.94
DENSITY OF GAS =	0.0279
TOTAL FLUE GAS FLOW =	887,562
Qs (dscfm) =	336,084
LBS/HR NOx =	467.51
LBS NOx/MMBTU =	1.11

APPENDIX 5

COMBUSTION CALCULATIONS FOR FLUE GAS FLOW

5.2 COMBUSTION CALCULATIONS - UNIT 21

UNIT 21 FUEL ANALYSIS
RUN 1

BTU/LB =	19410
% ASH =	0.01
% SULFUR =	0.13
% CARBON =	87.00
% H2 =	12.60
%O2 =	0.25
DENSITY(LBS/GAL)=	7.11
GAL/HR =	3697

ORSAT INFORMATION

% O2 =	15.33
% CO2 =	2.85
% N2 =	80.83
% CO =	0.00

%M = 3.0

FUEL CONSUMED(LBS/HR) =	26289.37
EXCESS AIR =	326
COMBUSTIBLES % =	0
TEMP. =	970
MOLECULAR WEIGHT OF GAS =	28.78
MOLE FRACTION OF GAS =	0.970
STACK PRESSURE =	31.02
NOx Lbs/SCF =	2.56E-05
MMBTU/HR =	510
THEORETICAL AIR =	7.40
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	31.52
H2O IN AIR =	0.41
WET GAS TOTAL =	32.44
TOTAL FLUE GAS =	62.97
DENSITY OF GAS =	0.028
TOTAL FLUE GAS FLOW =	1.00E+06
Qs (cfsc fm) =	373,508
LBS/HR NOx =	573.54
LBS NOx/MMBTU =	1.12

UNIT 21 FUEL ANALYSIS
RUN 2

BTU/LB =	19410
% ASH =	0.01
% SULFUR =	0.13
% CARBON =	87.00
% H2 =	12.60
%O2 =	0.25
DENSITY(LBS/GAL)=	7.11
GAL/HR =	3588

ORSAT INFORMATION

% O2 =	16.40
% CO2 =	2.73
% N2 =	80.88
% CO =	0.00

%M = 3.0

FUEL CONSUMED(LBS/HR) =	25514.27
EXCESS AIR =	331
COMBUSTIBLES % =	0
TEMP. =	960
MOLECULAR WEIGHT OF GAS =	28.76
MOLE FRACTION OF GAS =	0.970
STACK PRESSURE =	31.01
NOx Lbs/SCF =	2.43E-05
MMBTU/HR =	495
THEORETICAL AIR =	7.40
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	31.92
H2O IN AIR =	0.41
WET GAS TOTAL =	32.85
TOTAL FLUE GAS =	63.76
DENSITY OF GAS =	0.028
TOTAL FLUE GAS FLOW =	9.78E+05
Qs (dscfm) =	367,106
LBS/HR NOx =	536.15
LBS NOx/MMBTU =	1.08

UNIT 21 FUEL ANALYSIS
RUN 3

BTU/LB =	19410
% ASH =	0.01
% SULFUR =	0.13
% CARBON =	87.00
% H2 =	12.60
%O2 =	0.25
DENSITY(LBS/GAL)=	7.11
GAL/HR =	3512

ORSAT INFORMATION

% O2 =	16.73
% CO2 =	2.65
% N2 =	80.63
% CO =	0.00

%M = 3.0

FUEL CONSUMED(LBS/HR) =	24973.83
EXCESS AIR =	367
COMBUSTIBLES % =	0
TEMP. =	954
MOLECULAR WEIGHT OF GAS =	28.76
MOLE FRACTION OF GAS =	0.970
STACK PRESSURE =	31.02
NOx Lbs/SCF =	2.26E-05
MMBTU/HR =	485
THEORETICAL AIR =	7.40
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	34.55
H2O IN AIR =	0.45
WET GAS TOTAL =	35.51
TOTAL FLUE GAS =	68.93
DENSITY OF GAS =	0.028
TOTAL FLUE GAS FLOW =	1.03E+06
Gs (dscfm) =	388,583
LBS/HR NOx =	527.63
LBS NOx/MMBTU =	1.09

APPENDIX 5

COMBUSTION CALCULATIONS FOR FLUE GAS FLOW

5.3 COMBUSTION CALCULATIONS - UNIT 22

UNIT 22 FUEL ANALYSIS
RUN 1

BTU/LB =	19360
% ASH =	0.01
% SULFUR =	0.12
% CARBON =	86.90
% H2 =	12.60
%O2 =	0.38
DENSITY(LBS/GAL)=	7.13
GAL/HR =	4654

ORSAT INFORMATION

% O2 =	15.23
% CO2 =	3.80
% N2 =	80.98
% CO =	0.00

XM = 4.1

FUEL CONSUMED(LBS/HR) =	331173.71
EXCESS AIR =	247
COMBUSTIBLES % =	0
TEMP. =	979
MOLECULAR WEIGHT OF GAS =	28.76
MOLE FRACTION OF GAS =	0.959
STACK PRESSURE =	31.09
NOx Lbs/SCF =	1.50E-05
MMBTU/HR =	642
THEORETICAL AIR =	7.41
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	25.76
H2O IN AIR =	0.33
WET GAS TOTAL =	26.61
TOTAL FLUE GAS =	51.52
DENSITY OF GAS =	0.027
TOTAL FLUE GAS FLOW =	1.04E+06
Qs (dscfm) =	382,375
LBS/HR NOx =	344.71
LBS NOx/MMBTU =	0.54

UNIT 22 FUEL ANALYSIS
RUN 2

BTU/LB =	19360
% ASH =	0.01
% SULFUR =	0.12
% CARBON =	86.90
% H2 =	12.60
%O2 =	0.38
DENSITY(LBS/GAL)=	7.13
GAL/HR =	4577

ORSAT INFORMATION

% O2 =	15.10
% CO2 =	3.85
% N2 =	81.05
% CO =	0.00

XM = 4.1

FUEL CONSUMED(LBS/HR) =	325624.86
EXCESS AIR =	240
COMBUSTIBLES % =	0
TEMP. =	987
MOLECULAR WEIGHT OF GAS =	28.76
MOLE FRACTION OF GAS =	0.959
STACK PRESSURE =	31.11
NOx Lbs/SCF =	1.54E-05
MMBTU/HR =	632
THEORETICAL AIR =	7.41
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	25.18
H2O IN AIR =	0.33
WET GAS TOTAL =	25.03
TOTAL FLUE GAS =	50.39
DENSITY OF GAS =	0.027
TOTAL FLUE GAS FLOW =	1.01E+06
Qs (dscfm) =	367,946
LBS/HR NOx =	340.25
LBS NOx/MMBTU =	0.54

UNIT 22 FUEL ANALYSIS
RUN 3

BTU/LB =	19360
% ASH =	0.01
% SULFUR =	0.12
% CARBON =	86.90
% H2 =	12.60
%O2 =	0.38
DENSITY(LBS/GAL)=	7.13
GAL/HR =	4477

ORSAT INFORMATION

% O2 =	15.25
% CO2 =	3.53
% N2 =	81.23
% CO =	0.00

XM = 4.1

FUEL CONSUMED(LBS/HR) =	319112.06
EXCESS AIR =	246
COMBUSTIBLES % =	0
TEMP. =	975
MOLECULAR WEIGHT OF GAS =	28.72
MOLE FRACTION OF GAS =	0.959
STACK PRESSURE =	31.08
NOx Lbs/SCF =	1.56E-05
MMBTU/HR =	618
THEORETICAL AIR =	7.41
UNBURNED FUEL LOSS =	0.00
FUEL BURNED =	0.52
DRY AIR =	25.66
H2O IN AIR =	0.33
WET GAS TOTAL =	26.51
TOTAL FLUE GAS =	51.32
DENSITY OF GAS =	0.027
TOTAL FLUE GAS FLOW =	9.97E+06
Qs (cfs=fm) =	366,803
LBS/HR NOx =	343.34
LBS NOx/MMBTU =	0.56

APPENDIX 6

LABORATORY RESULTS

6.1 NO_x ANALYSIS

6.2 CO ANALYSIS

6.3 FUEL ANALYSIS

APPENDIX 6

LABORATORY RESULTS

6.1 NO_x ANALYSIS

ROY F. WESTON, INC.
Lionville Laboratory

CLIENT: GILBERT ASSOCIATES, INC SAMPLES RECEIVED: 07-18-91
RFW #: 9107L202
W.O. #: 3494-02-01

INORGANIC NARRATIVE

The following is a summary of the quality control results and a description of any problems encountered during the analysis of this batch of samples:

1. All preparation blank results were below the required detection limit.

2. All laboratory control standards (blank spikes) were within the control limits of 80-120%.

3. All calibration verification checks are within the required control limits of 90-110%. Calibration verification is performed using independent standards.

4. The analytical methods applied by the laboratory, unless otherwise requested, for all inorganic analyses are derived from the USEPA Method for Chemical Analysis of Water and Wastes (USEPA 600/4-79-020), and Standard Methods for the Examination of Water and Wastewater 16 ed. Methods for the analysis of solid samples are derived from Test Methods for Evaluating Solid Waste (USEPA SW846).

Jack R. Tuschall, Ph.D.
Laboratory Manager
Lionville Analytical Laboratory

8.23.91
Date

pas.21\j7-202

ROY F. WESTON INC.

INORGANICS DATA SUMMARY REPORT 08/20/91

CLIENT: GILBERT ASSOCIATES, INC
WORK ORDER: 3494-02-01-0000

WESTON BATCH #: 9107L202

SAMPLE	SITE ID	ANALYTE	RESULT		UNITS	REPORTING LIMIT
-001	NOX11-1	NOX	8220		ug NOX	464
-002	NOX21-1	NOX	8190		ug NOX	464
-003	NOX22-1	NOX	5580		ug NOX	464
-004	BLANK	NOX	464	u	ug NOX	464
-005	SPIKE (DBR)	NOX	2560		ug NOX	232
-006	NOX11-2	NOX	7800		ug NOX	464
-007	NOX11-3	NOX	7920		ug NOX	464
-008	NOX21-2	NOX	8130		ug NOX	464
-009	NOX21-3	NOX	6930		ug NOX	464
-010	NOX22-2	NOX	5600		ug NOX	464
-011	NOX22-3	NOX	5550		ug NOX	464

ROY F. WESTON INC.

INORGANICS METHOD BLANK DATA SUMMARY PAGE 08/20/91

CLIENT: GILBERT ASSOCIATES, INC
WORK ORDER: 3494-02-01-0000

WESTON BATCH #: 910712G2

SAMPLE	SITE ID	ANALYTE	RESULT		UNITS	REPORTING LIMIT
BLANK10	911IC125-MB1	NOX	464	U	ug NOX	464
BLANK10	911IC129-MB1	NOX	464	U	ug NOX	464

ROY F. WESTON INC.

INORGANICS ACCURACY REPORT 08/20/91

CLIENT: GILBERT ASSOCIATES, INC
WORK ORDER: 3494-02-01-0000

WESTON BATCH #: 9107L202

SAMPLE	SITE ID	ANALYTE	SPIKED SAMPLE	INITIAL RESULT		SPIKED AMOUNT	%REC/QV
BLANK10	91LIC125-MB1	NOX	18900	464	u	18500	102
BLANK10	91LIC129-MB1	NOX	19800	464	u	18500	107

WESTON Analytics Use Only: 9107L002

Custody Transfer Record/Lab Work Request

WESTON

Page 1 of 1

Client: Gilbert Commonwealth
Est. Final Proj. Sampling Date: 7/16, 7/16
Work Order #: 000-00-00
Project Contact/Phone #: 775-2600 Ext 3776
AD Project Manager: Eric Reichard / Dale King
QC: SM Del. SM TAT 21
Date Rec'd: 7/16/91 Date Due: 8/6/91 STD
Account #:

Refrigerator #										
#/Type Container	Liquid	10								
	Solid									
Volume	Liquid									
	Solid									
Preservatives										
ANALYSES REQUESTED →		ORGANIC: VOA	BNA	Pest/PCB	Herb		INORG: Metal	CN	NOx	

Lab ID	Client ID/Description	Matrix QC Chosen (✓)	Matrix	Date Collected	NOx
001	Alux II-1, 2-3 ...		A	7/16/91	X
002	Alux II-1, 2-3 ...		↓	7/16/91	↓
003	Alux III-1, 2, 3 ...		↓	7/16/91	↓
004	BLANK		↓	7/16/91	↓
005	Spike (Dec)		↓	7/16/91 — Xenosmoke Rack at (Gilbert)	↓

MATRIX CODES:
S - Soil
SE - Sediment
SO - Solid
SL - Sludge
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
L - EP/TCLP Leachate
WI - Wipe
X - Other
F - Fish

Special Instructions:
EPA METHOD 7D - NOx Analysis
* Analyze Spike Sample also

DATE/REVISIONS: (See Pg 2)
1. 006-011 added
2. client ID's changed
3.
4.
5.
6.

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[signature]	[signature]	7/16/91	1520		7/16/91		

WESTON Analytics Use Only

Samples were:
1) Shipped __ or Hand Delivered X
Airbill # ____
2) Ambient or Chilled
3) Received in Good Condition (Y) or N
4) Properly Preserved (Y) or N
5) Received Within Holding Times (Y) or N

COC Tape was:
1) Present on Outer Package Y or (N)
2) Unbroken on Outer Package Y or (N)
3) Present on Sample Y or (N)
4) Unbroken on Sample Y or (N)
COC Record Present Upon Sample Rec't (Y) or N

Discrepancies Between Samples Labels and COC Record? Y or (N)
NOTES:

L372 ____ L373 ____ L375 ____ L377 ____ L378 Ref# ____ Cooler# ____ 381-5964

RFW 21-21-001/A-8/90

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

9107L202

Client Roltair Commercial Div

Work Order 000020

Date Rec'd 8/8/91 Date Due 8/29/91

RFW Contact

Client Contact/Phone

WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected	Refrigerator#	#/Type Container	Volume	Preservative	ANALYSES REQUESTED
001	MW-11-2	W	8/7/91	12	VOA	40	HCl	X
2	11-3		1					
3	21-2		8/7/91					
4	21-3		1					
5	22-2		8/7/91					
6	22-3	↓	1	↓	↓	↓	↓	↓

Matrix: W - Water, DS - Drum Solids, X - Other
S - Soil, O - Oil, DL - Drum Liquids
SE - Sediment, A - Air, F - Fish
SO - Solid, Wi - Wipe, L - EP/TCLP Leachate

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed) Y N
NOTES:

4 Properly Preserved Y N
NOTES:

5 Received Within Holding Times Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

7-116

RFW 21-21-001/A-12/88

APPENDIX 6

LABORATORY RESULTS

6.2 CO ANALYSIS

WESTON WAY
WEST CHESTER, PA 19380
PHONE: 215-692-3030
TELEX: 83-5348

MANAGERS DESIGNERS/CONSULTANTS

12 August 1991

Gilbert Commonwealth
P.O. Box 1498
Reading, PA 19603

Attention: Mr. Steve Foulk

Subject: Carbon Monoxide Analysis

Dear Mr. Foulk:

The results of the carbon monoxide analysis performed on the set of nine Tedlar® gas sample bags delivered in lots of 3 to WESTON on July 16, 17 and 18, 1991 are outlined below and support data is attached.

The analysis was performed according to EPA Method 10B. No problems were encountered with the samples delivered and analyzed on July 16. Background noise levels increased during analysis of the July 17 and 18 samples. The lowest detectable limit was 0.5 ppm CO. Multiple injections were conducted for each bag and the average of three runs was calculated.

Very truly yours,

ROY F. WESTON, INC.

Jeffrey D. O'Neill
Senior Section Manager

JDO/mb

gil006t.ltr

DATA SUMMARY

SAMPLE NO.	DATE	CONCENTRATION PPMV
CO-11-1	7/16	1.2
CO-11-2	7/16	1.3
CO-11-3	7/16	1.5
CO-21-1	7/17	0.9
CO-21-2	7/17	0.9
CO-21-3	7/17	0.9
CO-22-1	7/18	0.9
CO-22-2	7/18	1.1
CO-22-3	7/18	1.5

EPA METHOD 10B
CARBON MONOXIDE ANALYSIS
7/16/91

SAMPLE	PEAK AREA	AUG. PEAK AREA	CONCENTRATION PPMV RESPONSE FACTOR[1]
24.9 ppm CO	13,731 13,941 14,392	14,021	1.776×10^{-3}
252 ppm CO	155,398 151,663 155,047	154,036	1.636×10^{-3}
CO-11-1	576 653 742	657	1.2
CO-11-2	670 783	727	1.3
CO-11-3	619 960 971	850	1.5
24.9 ppm CO	14,187		1.755×10^{-6}

[1] Used 1.765×10^{-3} average response factor.

EPA METHOD 10B
CARBON MONOXIDE ANALYSIS
7/17-18/91

SAMPLE	PEAK AREA	AUG. PEAK AREA	CONCENTRATION PPMV RESPONSE FACTOR[1]
24.9 ppm CO	14,735 15,389 14,641 16,282	15,262	1.632×10^{-3}
49.4 ppm CO	29,397 30,148 31,762	30,436	1.623×10^{-3}
CO-21-3	657 508 687	617	0.9
CO-21-2	700 407 755 538	600	0.9
CO-21-1	397 575 858	610	0.9
24.9 ppm CO	17,229	17,229	1.445×10^{-3}
CO-22-1	444 824 613	627	0.9
CO-22-3	1,781 657 717	1,052	1.5
CO-22-2	976 809 605	797	1.1
24.9 ppm. CO	19,549 17,557	18,553	1.342×10^{-3}
49.4 ppm. CO	33,671 34,433 35,272	34,458	1.434×10^{-3}

[1] Used 1.536×10^{-3} for CO-21.
1.407×10^{-3} for CO-22

APPENDIX 6

LABORATORY RESULTS

6.3 FUEL ANALYSIS

SPORTS, STEVENS and McCOY, INC.
ENGINEERS • PLANNERS • SURVEYORS

REQUEST FOR LABORATORY ANALYTICAL SERVICES

10672.1

Client Name: G/C

Address:

Sports, Stevens & McCoy Report to: Steve Foth

P.O. No:

W.O. No:

Phone Report Requested:

FAXReport:

Requested Reporting Date:

Lab Approval

Priority charges authorized by client:

Project Description: G-E-Prep Sampled By: Client Date/Time: 7/11/91

CLIENT SAMPLE ID	# OF CONTAINERS	SAMPLE DESCRIPTION	ANALYSIS REQUESTED
Dock #1			BTU/lb - gold
" #21	1	19360	API Gravity & Ash - Single
" #22			Carbon, Hydrogen
			Oxygen
		19361	
		19362	
		19363	
		19364	
		19365	
		19366	
		19367	

CHAIN OF CUSTODY

Delivery to laboratory

Custody relinquished by:

To: Woodgate Van Dam Date: 7/14/91 Time: 2:05

Intralaboratory Transfer

Custody relinquished by: 1992000

To: Date: Time:

Custody relinquished by:

To: Date: Time:

Custody relinquished by:

To: Date: Time:

Custody relinquished by:

To: Date: Time:

Comments/Special Requests

Distribution: white - original pink - report
yellow - laboratory gold - sample receipt

Form No: L05A. REV. 12/90

SSM/Laboratories

ANALYTICAL REPORT

CLIENT: Steve Folk
Gilbert/Commonwealth, Inc.
P. O. Box 1498
Reading PA 19603

PROJECT: 106721
PO NO: 52850
REPORTED: 29-JUL-91
RECEIVED: 19-JUL-91
WORK ORDER:

PROJECT DESCRIPTION: Oil Peco

SAMPLING DATE: 17-JUL-91 BY: Client

	UNITS	RESULT
SAMPLE: 1025780		
UNIT #11		
Heating Value	BTU/lb	19370
Gravity, API		34.2
Ultimate Analysis		
CHN Analysis		
Carbon	%	86.9
Hydrogen	%	12.8
Nitrogen	%	< 0.02
Oxygen	%	0.14
Ash	%	< 0.01
Sulfur	%	0.14

< Indicates less than value.
Density (lbs/gal) = 7.111
Heating Value (Btu/gal) = 137710

SAMPLE: 1025781		
UNIT #21		
Heating Value	BTU/lb	19410
Gravity, API		34.2
Ultimate Analysis		
CHN Analysis		
Carbon	%	87.0
Hydrogen	%	12.6
Nitrogen	%	< 0.02
Oxygen	%	0.25
Ash	%	< 0.01
Sulfur	%	0.13

< Indicates less than value.
Density (lbs/gal) = 7.111
Heating Value (Btu/gal) = 138010

GSM /Laboratories

CLIENT: Gilbert/Commonwealth, Inc.
PROJECT: 106721

SAMPLE: 1025782
UNIT #22

Heating Value	BTU/lb	19360
Gravity, API		33.8

Ultimate Analysis
CHN Analysis

Carbon	%	86.9
Hydrogen	%	12.6
Nitrogen	%	< 0.02
Oxygen	%	0.38
Ash	%	< 0.01
Sulfur	%	0.12

< Indicates less than value.
Density (lbs/gal) = 7.128
Heating Value (Btu/gal) = 137970

Respectfully submitted,

Vaughan J. O'Neill,
Group Leader, Physical Testing

30 Noble Street ■ P.O. Box 6527 ■ Reading, PA 19611-0527 ■ 215/376-4595 or 215/376-6581 ■ Fax: 215/376-8522
Engineering Offices in Baltimore, Lehigh Valley, Reading and Trenton.

APPENDIX 7

COMPUTER PRINTOUTS

7.1 NO_x, MOISTURE, CO - UNIT 11

7.2 NO_x, MOISTURE, CO - UNIT 21

7.3 NO_x, MOISTURE, CO - UNIT 22

APPENDIX 7

COMPUTER PRINTOUTS

7.1 NO_x, MOISTURE, CO - UNIT 11

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.:C04-6314-000

TEST: NO-11-1 DATE: 7/16/91 START TIME: 1014 END TIME: 1114

OPERATOR:ALBRIGHT

VM = 0.688 TM = 90 PPM = 214.7 VMSTD = 0.686 NO2(ug) = 8220.0

NOx, lbs/SCF = 2.56E-05 %M = 3.4 BP = 30.17 CONC(mg/DSCM) = 410.595

DSCFM = 323,186 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	390.330	79	81	0		
5		86	85	0	16.0	3.0
5		87	86	0		
5		88	87	0		
5		89	88	0	16.5	3.3
5		91	89	0		
5		92	90	0		
5		93	91	0	16.1	2.9
5		94	92	0		
5		95	93	0		
5		96	93	0		
5	391.018	94	93	0	16.4	2.9

TIME	VM	TM	OR	O2	CO2
60	0.688	90	0	16.3	3.0

EMISSIONS

DRY:

PPM,NOX =	214.7	MMBTU/HR =	443.0
LBS/HR =	497.20		
LBS/MMBTU =	1.122		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.: 04-5314-000

TEST: NO-11-2 DATE: 7/16/91 START TIME: 1137 END TIME: 1237

OPERATOR: ALBRIGHT

VM = 0.635 TM = 97 PPM = 223.3 VMSTD = 0.626 NO2(ug) = 7800.0

NOx, Lbs/SCF = 2.67E-05 %M = 3.4 BP = 30.18 CONC(mg/DSCM) = 426.909

DSCFM = 334,679 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	391.047	95	93	0		
5		95	94	0	16.5	2.8
5		95	95	0		
5		97	96	0		
5		98	96	0	16.4	2.9
5		98	96	0		
5		98	96	0		
5		98	97	0	16.4	3.1
5		99	97	0		
5		97	97	0		
5		98	97	0		
5	391.682	99	98	0	16.3	3.3

TIME	VM	TM	OR	O2	CO2
60	0.635	97	0	16.4	3.0

EMISSIONS

DRY:

PPM,NOX =	223.3	MMBTU/HR =	462.0
LBS/HR =	535.34		
LBS/MMBTU =	1.211		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.: 04-6814-000

TEST: NOX-11-3 DATE: 7/16/91 START TIME: 1255 END TIME: 1355

OPERATOR: ALBRIGHT

VM =	0.748	TM =	101	PPM =	194.2	VMSTD =	0.732	NO2(ug) =	7920.0
NOx, Lbs/SCF =	2.32E-05	%M =	3.4			BP =	30.18	CONC(mg/DSCM) =	371.254
DSCFM =	336,084							Y(METER) =	1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	391.714	99	98	0	16.6	2.9
5		99	98	0		
5		100	99	0		
5		101	100	0		
5		101	100	0	16.3	2.7
5		101	100	0		
5		102	101	0		
5		102	101	0		
5		102	101	0	16.8	2.8
5		101	100	0		
5		101	100	0		
5	392.462	101	100	0	16.8	2.8

TIME	VM	TM	OR	O2	CO2
60	0.748	101	0	16.6	2.8

EMISSIONS

DRY:

PPM,NOX =	194.2	MMBTU/HR =	423.0
LBS/HR =	467.51		
LBS/MMBTU =	1.105		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

FIELD MOISTURE DETERMINATION

CLIENT: PECO

W.O. NO.: 6314-000

TEST: M-11-1 DATE: 7/16/91 TIME: 1400

OPERATOR: ALBRIGHT

BAROMETRIC PRESSURE: 30.18

GAS METER
START: 392.538 FINAL: 407.813 NET: 15.275

Y FACTOR= 1.03

FLOW METER
AVE. ORIFICE DROP 1.95 AVE. TEMPERATURE: 108

MOISTURE

IMP 1	START:	150	FINAL:	151	NET: 1
IMP 2	START:	150	FINAL:	151	NET: 1
IMP 3	START:	0	FINAL:	0	NET: 0
GEL	START:	232	FINAL:	241	NET: 9

TOTAL COLLECTED MOISTURE: 11.0

TOTAL MOISTURE BY WEIGHT: 3.4 %

SAMPLE VOLUME(VMSTD): 14.3825

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

CO EMISSIONS

CLIENT: PHILADELPHIA ELECTRIC COMPANY

LOCATION: CROYDON STATION

UNIT 11

	LAB RESULTS CO, PPM BAG SAMPLE	% CO2 IN STACK	CO, PPM, DRY BASIS CORRECTED FOR CO2	CO LBS/SCF	FLOW DSCFM	CO LBS/HR	MMBTU/HR	CO LBS/MMBTU
RUN 1	1.20	3.03	1.16	8.49E-08	323,186	1.65	443	0.00372
RUN 2	1.30	3.03	1.26	9.20E-08	334,679	1.85	442	0.00418
RUN 3	1.50	2.80	1.46	1.06E-07	336,084	2.15	423	0.00507

APPENDIX 7

COMPUTER PRINTOUTS

7.2 NO_x, MOISTURE, CO - UNIT 21

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.: 04-6314-000

TEST: NOX-21-1 DATE: 7/17/91 START TIME: 844 END TIME: 944

OPERATOR: ALBRIGHT

VM = 0.6883 TM = 83 PPM = 214.3 VMSTD = 0.6886 NO2(ug) = 81990.0

NOX, Lbs/SCF = 2.56E-05 %M = 3.0 BP = 29.98 CONC(mg/DSCM) = 409.826

DSCFM = 373,508 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	407.818	77	77	0	16.4	2.9
5		79	79	0		
5		80	79	0		
5		80	79	0		
5		79	80	0	16.5	2.8
5		82	82	0		
5		85	83	0		
5		85	84	0		
5		86	85	0	16.2	2.9
5		85	87	0		
5		85	87	0		
5	408.501	88	87	0	16.2	2.8

TIME	VM	TM	OR	O2	CO2
60	0.6883	83	0	16.3	2.9

EMISSIONS

DRY:

PPM, NOX =	214.3	MMBTU/HR. =	510.0
LBS/HR =	573.54		
LBS/MMBTU =	1.125		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.:04-6314-000

TEST: NOX-21-2 DATE: 7/17/91 START TIME: 958 END TIME: 1058

OPERATOR:ALBRIGHT

VM = 0.725 TM = 92 PPM = 203.9 VMSTD = 0.716 NO2(ug) = 8130.0

NOx, Lbs/SCF = 2.43E-05 %M = 3.1 BP = 30.00 CONC(mg/DSCM) = 389.7785

DSCFM = 367.106 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	408.536	90	89	0	16.3	2.9
5		90	89	0		
5		90	89	0		
5		90	89	0		
5		91	89	0	16.5	2.7
5		92	91	0		
5		93	91	0		
5		93	92	0		
5		94	93	0	16.5	2.6
5		94	93	0		
5		95	95	0		
5	409.251	95	94	0	16.3	2.7

TIME	VM	TM	OR	O2	CO2
60	0.725	92	0	16.4	2.7

EMISSIONS

DRY:
PPM,NOX = 203.9 MMBTU/HR = 495.0
LBS/HR = 536.15
LBS/MMBTU = 1.0833

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.:04-6314-000

TEST: NOX-21-3 DATE: 7/17/91 START TIME: 1112 END TIME: 1212

OPERATOR:ALBRIGHT

YH = 0.673 TM = 98 PPM = 189.5 VMSTD = 0.667 NO2(ug) = 6930.0

NOX, Lbs/SCF = 2.26E-05 %M = 3.1 BP = 29.99 CONC(mg/DSCM) = 362.392

DSCFM = 388,583 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	409.258	96	95	0	16.7	2.5
5		95	95	0		
5		96	95	0		
5		99	96	0		
5		99	97	0	16.8	2.7
5		99	97	0		
5		99	97	0		
5		100	98	0		
5		100	99	0	16.7	2.6
5		100	99	0		
5		100	100	0		
5	409.951	100	100	0	16.7	2.8

TIME	YH	TM	OR	O2	CO2
60	0.673	98	0	16.7	2.7

EMISSIONS

DRY:

PPM,NOX =	189.5	MMBTU/HR =	485.0
LBS/HR =	527.63		
LBS/MMBTU =	1.088		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

FIELD MOISTURE DETERMINATION

CLIENT: PECO

W.O. NO.: 6314-000

TEST: M21-1 DATE: 7/17/91 TIME: 1235

OPERATOR: ALBRIGHT

BAROMETRIC PRESSURE: 29.97

GAS METER
START: 410.066 FINAL: 426.933 NET: 16.867

Y FACTOR= 1.03

FLOW METER
AVE. ORIFICE DROP 2.00 AVE. TEMPERATURE: 96

MOISTURE

IMP 1	START:	150	FINAL:	152	NET: 2
IMP 2	START:	150	FINAL:	152	NET: 2
IMP 3	START:	0	FINAL:	0	NET: 0
GEL	START:	232	FINAL:	239	NET: 7

TOTAL COLLECTED MOISTURE: 11.0

TOTAL MOISTURE BY WEIGHT: 3.0 %

SAMPLE VOLUME(VMSTD): 16.601

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

CO EMISSIONS

CLIENT: PHILADELPHIA ELECTRIC COMPANY

LOCATION: CROYDON STATION

UNIT 21

	LAB RESULTS CO, PPM BAG SAMPLE	% CO2 IN STACK	CO, PPM, DRY BASIS CORRECTED FOR CO2	CO LBS/SCF	FLOW DSCFM	CO LBS/HR	MMBTU/HR	CO LBS/MMBTU
RUN 1	0.90	2.85	0.87	6.38E-08	373,508	1.43	510	0.00280
RUN 2	0.90	2.73	0.88	6.39E-08	367,264	1.41	495	0.00284
RUN 3	0.90	2.65	0.88	6.40E-08	388,751	1.49	485	0.00308

APPENDIX 7

COMPUTER PRINTOUTS

7.3 NO_x, MOISTURE, CO - UNIT 22

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.:04-6314-000

TEST: NOX-22-1 DATE: 7/18/91 START TIME: 934 END TIME: 1034

OPERATOR:ALBRIGHT

VM = 0.798 TM = 90 PPM = 135.8 VMSTD = 0.788 NO2(ug) = 5580.0

NOx, Lbs/SCF = 1.50E-05 %M = 4.1 BP = 29.88 CONC(mg/DSCM) = 240.598

DSCFM = 382,376 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	426.946	85	84	0	15.3	3.9
5		86	84	0		
5		86	85	0		
5		87	87	0		
5		89	88	0	15.2	3.8
5		91	88	0		
5		92	89	0		
5		93	90	0		
5		94	92	0	15.2	3.8
5		94	93	0		
5		95	94	0		
5	427.744	96	96	0	15.2	3.7

TIME	VM	TM	OR	O2	CO2
60	0.798	90	0	15.2	3.8

EMISSIONS

DRY:

PPM,NOX =	135.8	MMBTU/HR =	642.0
LBS/HR =	344.71		
LBS/MMBTU =	0.537		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.: 04-6314-000

TEST: NOX-22-2 DATE: 7/18/91 START TIME: 1041 END TIME: 1141

OPERATOR: ALBRIGHT

VM = 0.793 TM = 99 PPM = 129.1 VMSTD = 0.771 NO2(ug) = 5600.0

NOx, Lbs/SCF = 1.54E-05 %M = 4.3 BP = 29.88 CONC(mg/DSCM) = 246.797

DSCFM = 367,946 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	427.770	96	95	0	15.0	3.8
5		97	96	0		
5		97	96	0		
5		97	96	0		
5		98	97	0	15.2	3.8
5		99	98	0		
5		100	99	0		
5		100	99	0		
5		100	99	0	15.2	3.9
5		101	100	0		
5		102	101	0		
5	428.563	102	101	0	15.0	3.7

TIME	VM	TM	OR	O2	CO2
60	0.793	99	0	15.1	3.8

EMISSIONS

DRY:

PPM,NOX =	129.1	MMBTU/HR =	632.0
LBS/HR =	340.25		
LBS/MMBTU =	0.538		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

NOX EMISSIONS

CLIENT: PECO

W.O. NO.: 04-6314-000

TEST: NOX-22-3 DATE: 7/18/91 START TIME: 1147 END TIME: 1247

OPERATOR: ALBRIGHT

VM = 0.787 TM = 105 PPM = 130.7 VMSTD = 0.757 NO2(ug) = 5550.0

NOx, Lbs/SCF = 1.568E-05 %M = 4.3 BP = 29.88 CONC(mg/DSCM) = 249.8816

DSCFM = 366,803 Y(METER) = 1.03

TIME PER READING	METER	TEMPERATURE INLET	TEMPERATURE OUTLET	ORIFICE	O2	CO2
5	428.581	103	103	0	15.3	3.5
5		104	104	0		
5		104	103	0		
5		104	104	0		
5		104	104	0	15.2	3.6
5		105	105	0		
5		104	105	0		
5		105	105	0		
5		106	105	0	15.3	3.5
5		106	106	0		
5		106	106	0		
5	439.368	106	106	0	15.2	3.6

TIME	VM	TM	OR	O2	CO2
60	0.787	105	0	15.3	3.5

EMISSIONS

DRY:

PPM, NOX =	130.7	MMBTU/HR =	618.0
LBS/HR =	343.34		
LBS/MMBTU =	0.556		

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

FIELD MOISTURE DETERMINATION

CLIENT: PECO

W.O. NO.: 6314-000

TEST: M-22-1 DATE: 7/18/91 TIME: 1252

OPERATOR: ALBRIGHT

BAROMETRIC PRESSURE: 29.88

GAS METER
START: 429.438 FINAL: 445.487 NET: 16.049

Y FACTOR= 1.03

FLOW METER
AVE.ORIFICE DROP 1.92 AVE. TEMPERATURE: 113

MOISTURE

IMP 1	START:	150	FINAL:	150	NET:	0
IMP 2	START:	150	FINAL:	160	NET:	10
IMP 3	START:	0	FINAL:	0	NET:	0
GEL	START:	239	FINAL:	243	NET:	4

TOTAL COLLECTED MOISTURE: 14.0

TOTAL MOISTURE BY WEIGHT: 4.1 %

SAMPLE VOLUME(VMSTD): 15.286

GILBERT/COMMONWEALTH, INC.
TESTING SERVICES GROUP

CO EMISSIONS

CLIENT: PHILADELPHIA ELECTRIC COMPANY

LOCATION: CROYDON STATION

UNIT 22

	LAB RESULTS CO, PPM BAG SAMPLE	% CO2 IN STACK	CO, PPM, DRY BASIS CORRECTED FOR CO2	CO LBS/SCF	FLOW DSCFM	CO LBS/HR	MMBTU/HR	CO LBS/MMBTU
RUN 1	0.90	3.80	0.87	6.32E-08	382,376	1.45	642	0.00226
RUN 2	1.10	3.85	1.06	7.72E-08	368,184	1.71	632	0.00270
RUN 3	1.50	3.53	1.45	1.06E-07	366,960	2.33	618	0.00376

APPENDIX 8

CALIBRATION DATA

Gilbert/Commonwealth Inc.
Testing Services Group
METER BOX CALIBRATION

DATE: 7/19/91 METER BOX NUMBER: 1385

BAROMETRIC PRESS. (Pb) = 29.49 in. Hg CALIBRATED BY: ROLAND

Orifice Manometer Setting (delta H) In. H2O	GAS VOLUME: Wet Test Meter (Vw) cu. ft.	GAS VOLUME: Dry Gas Meter (Vd) cu. ft.	TEMPERATURES: Wet Test Meter (Tw) deg. F	TEMPERATURES: Dry Gas Meter Inlet (Tdi) deg. F	TEMPERATURES: Dry Gas Meter Outlet (Tdo) deg. F	TEMPERATURES: Dry Gas Meter Average (Td) deg. F	Time min.	Yi	delta H@i
0.5	5.000	5.060	77.5	91.5	85.5	88.5	11.85	1.01	1.63
1.0	5.000	5.113	77.5	99	87.5	93.3	8.17	1.00	1.94
1.5	10.000	10.260	77.5	104	89.5	96.8	15.53	1.01	2.09
2.0	10.000	10.323	77.5	108.5	92.5	100.5	13.48	1.01	2.43
3.0	10.000	10.401	77.5	111	94	102.5	11.17	1.00	2.15
4.0	10.000	10.520	77.5	113.5	95.5	104.5	9.88	0.99	2.15
							AVERAGE Yi	1.00	2.01

FORMULAS

$$Yi = \frac{(Vw)(Pb)(Td+460)}{(Vd)(Pb+(dH/13.6))(Tw+460)}$$

$$delta\ dH@ = \frac{0.321}{(Qn)(Qn)}$$

$$Kp = Qn \sqrt{\frac{(Pb)(29)}{(Tdo+460)(delta\ H)}}$$

$$Qn = \frac{(Vd)(Tdo+460)}{(Time)(Td+460)}$$

Gilbert/Commonwealth Inc.
Testing Services Group
METER BOX CALIBRATION

DATE: 7/8/91 METER BOX NUMBER: 1385

BAROMETRIC PRESS. (Pb) = 29.39 in. Hg CALIBRATED BY: ROLAND

Orifice Manometer Setting (delta H) In. H20	GAS VOLUME: Wet Test Meter (Vw) cu. ft.	GAS VOLUME: Dry Gas Meter (Vd) cu. ft.	TEMPERATURES: Wet Test Meter (Tw) deg. F	TEMPERATURES: Dry Gas Meter Inlet (Tdi) deg. F	TEMPERATURES: Dry Gas Meter Outlet (Tdo) deg. F	TEMPERATURES: Dry Gas Meter Average (Td) deg. F	Time min.	Yi	delta H@i
0.5	5.000	4.313	74.5	83.5	77.5	83.5	12.18	1.03	1.82
1.0	5.000	5.005	74.5	90	80.5	93.3	8.59	1.02	1.78
1.5	10.000	10.094	74.5	107	84.5	95.8	14.58	1.03	1.82
2.0	10.000	10.160	74.5	115.5	89	102.3	13.13	1.03	2.00
3.0	12.500	12.735	74.5	120.5	93.5	107.0	13.41	1.03	2.09
4.0	10.000	10.401	74.5	120	96.5	108.3	9.38	1.01	2.04
							AVERAGE Yi	1.03	1.95

FORMULAS

$$Yi = \frac{(Vw)(Pb)(Td+460)}{(Vd)(Pb+(\Delta H/13.6))(Tw+460)}$$

$$\Delta H@i = \frac{0.822}{(\theta m)(Qm)}$$

$$\theta m = 3\theta \left(\frac{(Pb)(29)}{(Tdc+460)(delta\ H)} \right)^{1}$$

$$Qm = \frac{(Vd)(Tdc+460)}{(\theta time)(Pb+460)}$$

GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS
READING, PA.

CLIENT

PROJECT

FILING CODE

W.O. | PAGE OF

SYSTEM

ENGINEER RCAND

DATE 10/30/96

CALCULATION FOR

REVIEWED BY

DATE

Pot Meter-Thermocouple Calibration

Pot Meter #	1
Thermocouple Type	K
Ice Bath Temperature °F	29
Certified Mercury Bulb °F	32
Ambient Temperature °F	67
Certified Mercury Bulb °F	67
Boiling H_2O °F	206
Certified Mercury Bulb °F	209
Hot Synthetic Oil °F	350
Certified Mercury Bulb °F	352

Remarks:

FILING CODE

APPENDIX 9

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

Particulate Isokinetic Sampling

I. Calculations for stack volume and Isokinetic Rate

Time	Dry Gas Meter Ft^3	Pitot ΔP, In. H_2O	Orifice ΔH, In. H_2O	Dry Gas Temp °F In	Out	Stack Static Pressure In. H_2O	Stack Temp °F
T	VM	ΔP	PM	TMX	TMO	PST	TS

1. DN = Nozzle Diameter, inches

2. PB = Barometric Pressure, inches Hg

3. TT = Net Sampling Time, minutes

4. VM = VM final - VM initial = Sample Gas Volume, ft^3

5. TM = Average Dry Gas Temperature at Meter, °F

$$TM = \frac{\text{Avg. TMX} + \text{Avg. TMO}}{2}$$

6. PM = Average Orifice Pressure Drop, inches H_2O

PM = Avg. ΔH

7. Volume of dry gas sampled at standard conditions[a], DSCF

$$VMSTD = \frac{17.65 \times VM \times Y \left(BP + \frac{PM}{13.6}\right)}{(TM + 460)}$$

8. VW = Total Water Collected = gm H_2O Silica gel + ml Imp. H_2O = ml

9. Volume of water vapor at standard conditions[b], SCF

VW gas = 0.0471 x VW = SCF

10. Percent moisture in stack gas

$$\%\ M = \frac{100 \times VW\ gas}{VM\ STD + VW\ gas}$$

11. Mole fraction of dry gas

$$MD = \frac{100 - \%M}{100}$$

12. Molecular weight of dry stack gas

$$MWD = (\%CO_2 \times \frac{44}{100}) + (\%O_2 \times \frac{32}{100}) + \left[(\%CO + \%N_2) \times \frac{28}{100} \right]$$

12A. $\%EA = \%$ Excess Air $= \frac{[(\% O_2) - 0.5 (\%CO)]}{0.264 (\%N_2) - [(\%O_2) + 0.5\% (CO)]} \times 100$

13. Molecular weight of wet stack gas

$$MW = MWD \times MD + 18 (1 - MD)$$

14. AS = Stack Area, square inches

15. PS = Stack Pressure, inches Hg

$$PS = PB \pm \text{Avg. PST}$$

NOTE: PST in. Hg. $= \frac{\text{PST in. } H_2O}{13.6}$

16. TS = Average Stack Temperature, °F

TS = Average TS

17. SDE = Average $\sqrt{\text{Velocity Head } (\Delta P) \times (\text{Stack Temperature} + 460)}$

(Calculated each time)

$$SDE = \text{Avg } \sqrt{\Delta P \times (TS + 460)}$$

18. Stack gas velocity at stack conditions, fpm

$$VS = 5130 \times Cp \times \text{Avg}(SDE) \times \left[\frac{1}{PS \times MW} \right]^{1/2} = FPM$$

Cp = pitot tube coefficient

19. Stack gas volumetric flow rate at standard conditions[c], DSCFM

$$Q_s = \frac{0.123 \times VS \times AS \times MD \times PS}{(TS + 460)} = DSCFM$$

20. Stack gas volumetric flow rate at stack conditions, ACFM

$$Q_a = \frac{.05667 \times QS \ (TS + 460)}{PS \times MD} = ACFM$$

21. Percent Isokinetic

$$\%I = \frac{1.032 \times (TS + 460) \times VMSTD}{VS \times TT \times PS \times MD \times (DN)^2}$$

NOTES: [a]Dry standard cubic feet at 69°F, 29.92 in. Hg.

[b]Standard conditions at 68°F, 29.92 in. Hg.

[c]Dry standard cubic feet per minute at 68°F, 29.92 in. Hg.

II. Calculations for grain loading and emission rates

22. Particulate, gr/DSCF

$$\text{gr/DSCF} = 0.0154 \times \frac{\text{mg}}{\text{VMSTD}}$$

23. Particulate at stack conditions, gr/ACF

$$\text{gr/ACF} = \frac{17.65 \text{ gr/DSCF} \times \text{PS} \times \text{MD}}{(\text{TS} + 460)}$$

24. Particulate, lb/hr conc. method

$$\text{lb/hr} = 0.00857 \times \text{gr/DSCF} \times \text{QS}$$

25. Particulate lb/hr area method = $0.132 \times \frac{\text{mg Particulate} \times \text{AS}}{\left(\frac{\text{DN}^2}{2}\right) \times \text{TT}}$

26. Particulate, combustion

$$\frac{\text{lb/hr}}{10^6 \text{ BTU/hr}}$$

27. Particulate, process lb/ton

$$\text{lb/ton} = \frac{\text{lb/hr}}{\text{tons/hr}}$$

28. Particulate, lb/MMBTU, F-Factor Method =

Using O_2 =

$$\frac{0.0154 \times \text{mg} \times \text{F-Factor} \times 20.9}{7000 \times \text{VMSTD} \times (20.9 - \%O_2)}$$

Using CO_2:

$$\frac{0.0154 \times \text{mg} \times \text{F-Factor} \times 100}{7000 \times \text{VMSTD} \times \%\ CO_2}$$

29. F-Factor, dscf/mmBtu

O_2 Formula:

$$\text{F-Factor} = \frac{10^6(3.64(\%H) + 1.53(\%C) + 0.57(\%S) + 0.14(\%N) - 0.46(\%O_2))}{\text{GCV}}$$

CO_2 Formula:

$$\frac{10^6(0.321)(\%C)}{\text{GCV}}$$

CALCULATION FOR NO_x, LBS/MMBTU - EPA METHOD 7D

Lab results in $\mu gm\ NO_2$

$$\text{Concentration mg/DSCM} = \frac{10^{-3}\ \text{mg}\ [\mu gm\ NO_2]}{\dfrac{(100)}{100-\%CO_2}\ V_{\text{Titrated}}\ (Fe^{3}) \times 2.832 \times 10^{-2}\ \dfrac{m^3}{Ft^3}} = \frac{mg}{m^3}$$

$$NO_x\ (ppm) = \frac{\dfrac{mg}{m^3}}{1.912\ \dfrac{mg/m^3}{ppm}}$$

NO_x, Lbs/SCF = PPM x 1.194×10^{-7}

NO_x, Lbs/Hr = Lbs/SCF x Stack Gas Volume (DSCFM) x 60

$$NO_x,\ \text{Lbs/MMBtu} = \frac{\text{Lbs/Hr}}{\text{MMBtu/Hr}}$$

CALCULATIONS FOR CO LBS/MMBTU

Lab results reported in PPM(CO)

CO concentration corrected for CO_2 absorption by KM_nO_4 scrubbing solution

$$C = C_b\,(1\text{-}F)$$

C = CO Conc. Dry Basis, ppm

C_b = CO Conc. Lab Results, ppm

F = % CO_2 In Stack

CO, Lbs/scf = ppm X 7.3 X 10^{-8}

CO, Lbs/hr = Lbs/scf X Stack Gas Volume (DSCFM) X 60

CO, Lbs/MMBtu = Lbs/hr $\frac{}{}$ MMBtu/hr

SAMPLE CALCULATIONS

COMBUSTION CALCULATION FOR FLUE GAS FLOW AND LBS/MMBTU
Run No.

Fuel Analysis _____BTU/lb _____Lbs/gal

_____%C _____%H

_____%O_2 _____%s

_____%Ash

Fuel Consumption_____gallons/hr

_____ gallons/hr x _____ lbs/gallons = _____lbs/hr

1. Theoretical Air (T.A.) = $144 \times \frac{8c + 24(H_2 - O_2/8) + 3(s)}{\text{Btu/lb}}$ = _____ $\frac{\text{lb air}}{10{,}000\ \text{Btu}}$

2. Unburned Fuel Loss (UFL) = $\frac{\%\ \text{Ash} \times \%\ \text{combustibles}}{100\%\ \text{combustibles}}$ = _____ %

As the % ash is only a trace amount, the % combustibles in the ash and the UFL are assumed to be zero.

3. Fuel Burned = [100(100 %-Ash | BTU/lb fuel] - .007 x UFL = _____lb/fuel/10,000 BTU

Flue Gas Characteristics

_____^{0}F Stack Temperature, Barometer_____ in Hg

_____% CO_2 _____% CO

_____% O_2 _____% N_2

_____Static Pressure (inches H_20)

_____% Moisture

% Excess Air = $\frac{(\%\ O_2 - 0.5(\%\ CO)}{0.264\ (\%N) - [(\%02) + 0.5\ (\%\ CO)]}$ = x 100 = _____

4. Dry air (D.A.) = $\frac{[100 + \%\ E.A.]}{100}$ (T.A. - 0.8 (UFL) = _____lb dry air/10,000 BTU

5. H_20 in Air = D.A. x 0.013 lb H_20/lb dry air = _____ lb/H_20/10,000 BTU

6. Wet Gas Total = Eq.3 - Eq.4 - Eq.5 = _____ lb/10,000 BTU

7. Total Flue Gas = Eq.6 x $\frac{\text{BTU/lb fuel}}{10{,}000}$ = _____ lb gas/lb fuel

8. Density of Gas @ _____ ^{0}F = $\frac{\text{Molecular Wt of Wet Gas}}{385.1}$ x $\frac{528}{\text{Ts} + 460}$ = _____ $\frac{\text{lb}}{\text{Cu. Ft.}}$

Molecular weight of wet stack gas

MW = MWD x MD + 18 (1-MD)

Mole fraction of dry gas

MD = $\frac{100 - \%M}{100}$

Molecular weight of dry stack gas

MWD = $\frac{(\%CO_2 \times 44)}{100}$ + $\frac{(\%O_2 \times 32)}{100}$ + $\frac{(\%CO + \%N_2) \times 28}{100}$

9. Total Flue Gas Flow = Eq.7 x lbs fuel/hr x $\frac{\text{hour}}{60 \text{ minutes}}$ x $\frac{1}{\text{Eq. 8}}$ = _____ ACFM

10. Qs(dscfm) = $\frac{\text{Qa(acfm)} \times \text{Md} \times \text{Ps}}{0.05645 \times (T_s + 460)}$ = _____ dscfm

PS = Barometric Pressure + $\frac{\text{Static Pressure}}{13.6}$

11. NO_x (lbs/hr) = NO_x (ppm) x 1.194 x 10^{-7} x DSCFM x 60 = lbs/hr NO_x

12. NO_x(lbs.) = $\frac{\text{lbs./hour}}{\text{MMBtu}}$

MMBtu/hr = Fuel Consumption lbs/hr x Btu/lb

MMBtu/hr = _____ x _____ = _____