Big Ben 3 Test Results

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1.0 INTRODUCTION

Tampa Electric Company's (TEC) Corporate Environmental Services(CES) performed a series of emission tests on Unit No. 3 at the Big Bend Generating Station located in Hillsborough County on Big Bend Road, near Ruskin, Florida. The tests performed were used to determine the effects on emissions of supplementing the normal fuel for the facility (bituminous coal) with petroleum coke. Two conditions were tested:

1. Baseline firing with no petroleum coke
2. 20% petroleum coke with 80% normal fuels

The tests were authorized by Florida Department of Environmental Protection (FDEP) relating to Big Bend Unit No. 3, operating permit No. AO29-179911. The Baseline period began on February 17, 1996 and was completed February 23, 1996. The Petroleum Coke test burn began February 24, 1996 and ran through March 3, 1996.

Unit No. 3 is a steam-generating boiler which is normally fired with coal. Three tests runs for particulate matter, carbon monoxide and sulfuric acid mist were performed on the boiler during sootblowing conditions for both baseline and petroleum coke blend tests. Sulfur dioxide, nitrogen oxides and opacity data was recorded using continuous emission monitors (CEMS) during the baseline and trial burn tests.

All testing was performed following the procedures and quality control guidelines given in 40 CFR 60 Appendix A - Test Methods.

Section 2.0 presents a brief source description and diagram of the sample point locations.

Section 3.0 outlines the procedures and test methods used along with diagrams of sampling trains used.

Section 4.0 presents the test results and comparison tables.

All supporting documentation, field data sheets, laboratory data, sample calculations, calibration data, quality assurance/quality control measures are included in the Appendices to this report.

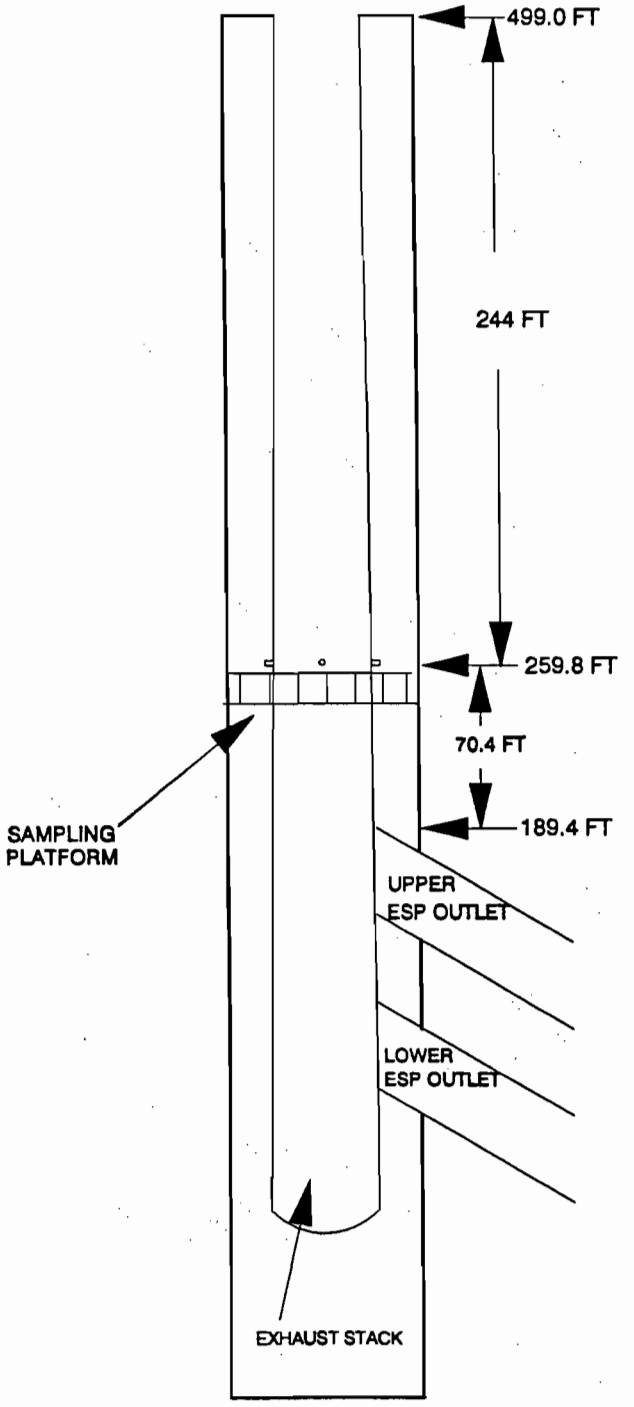
All baseline emission tests for Unit No. 3 in the non-scrubbed mode were performed in common stack 2 (CS002). Because of the common stack configuration of stack 2 and stack 3, petroleum coke blend testing was performed during a Unit No. 4 outage. During the petroleum coke blend test, all emissions were directed through common stack 3 (CS003). All petroleum coke blend emissions test were performed at this location.

2.0 SOURCE DESCRIPTION

Big Bend Generating Station is a coal-fired steam electric generating facility located in Hillsborough County on Big Bend Road, near Ruskin, Florida at UTM coordinates East 361.9 North 3075.0. The Unit No. 3 source sampling location (CS002) consists of four sample ports located 90° apart on the circumference of the 24 ft. diameter circular stack, which is 499 ft in height. Upstream and downstream gas flow disturbances were determined to be 9.97 and 2.9 stack diameters away from the test ports, respectively. Using these criteria, a total of 24 sampling points were chosen for particulate sampling and sulfuric acid mist sampling, as stipulated in the U.S. EPA Method 1 test procedure. A diagram of the stack sampling location is included in Figure 1 along with other pertinent information on the test site.

Unit No. 3 is equipped with an electrostatic precipitator for the control of flyash emissions. Appendix C details the operational parameters of the electrostatic precipitator during the test period.

The Unit No. 4 source sampling location (CS003) was used in conjunction with unit 3, which consists of four sample ports located 90° apart on the circumference of the 28.75 ft. diameter circular stack, at 499 ft in height. Upstream and downstream gas flow disturbances were determined to be 8.51 and 2.99 stack diameters away from the test ports, respectively. Using these criteria, a total of 24 sampling points were chosen for particulate sampling and sulfuric acid mist sampling, as stipulated in the U.S. EPA Method 1 test procedure. A diagram of the stack sampling location is included in Figure 2 along with other pertinent information on the test site.



BIG BEND GENERATING STATION
BASELINE TEST LOCATION
CS 002

TRAVERSE POINT	PERCENTAGE OF DIAMETER	DISTANCE ,INCHES FROM STACK WALL
1	2.1	6.05
2	6.7	19.30
3	11.8	33.98
4	17.7	50.98
5	25.0	72.00
6	35.6	102.53

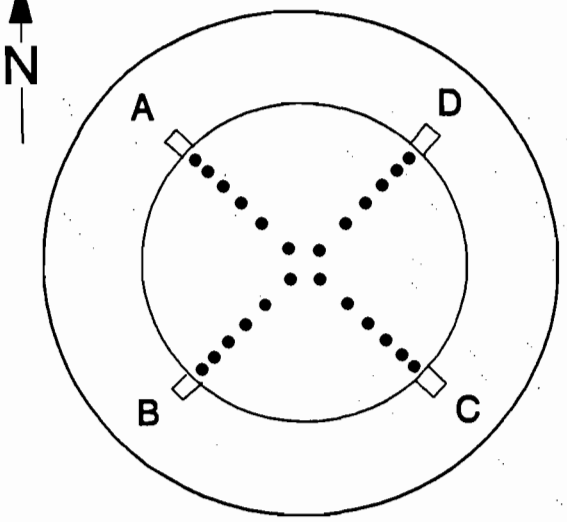
UPSTREAM DISTURBANCE=
9.97 STACK DIAMETERS

DOWNSTREAM DISTURBANCES=
2.9 STACK DIAMETERS

STACK DIAMETER 24 FT. ID

STACK AREA = 452.3894

PORT LENGTH'S = 17 IN.

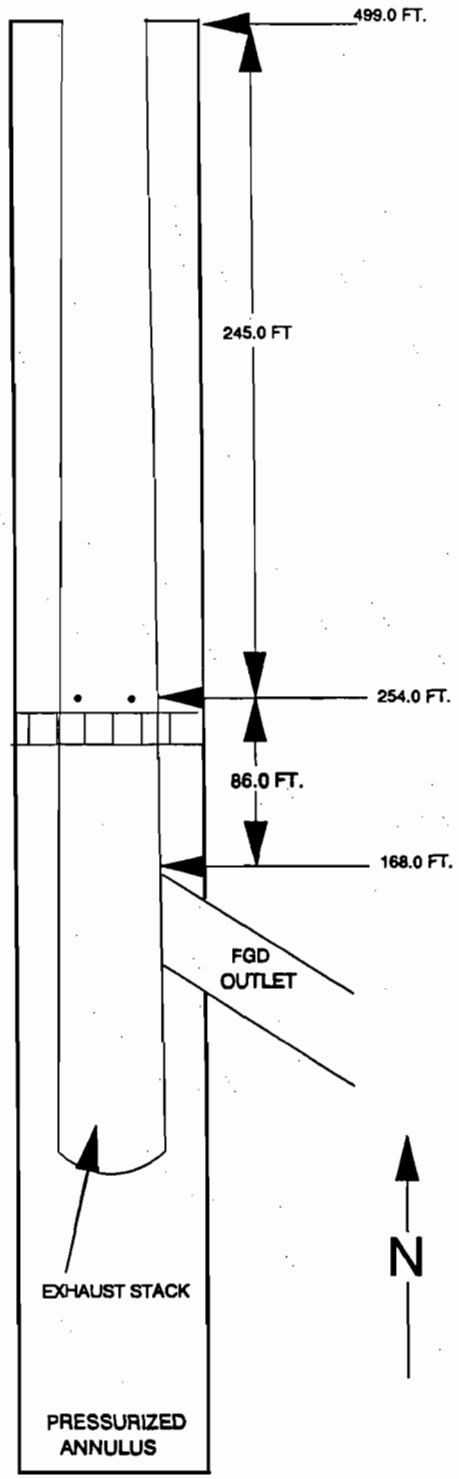


PORT LOCATION PLAN

FIGURE 1

TAMPA ELECTRIC
A TECO ENERGY COMPANY

REVISED 4-17-96



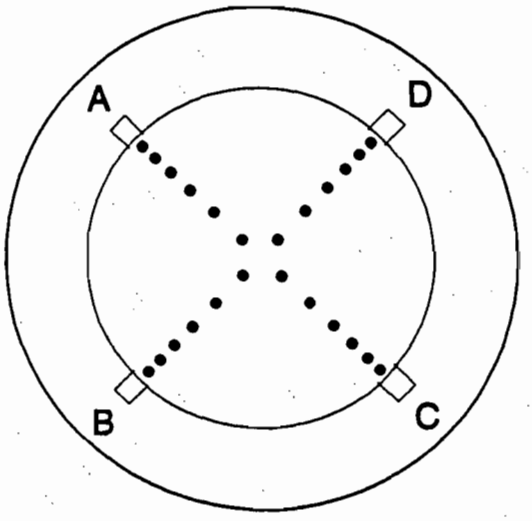
BIG BEND GENERATING STATION
FUEL BLEND TEST LOCATION
CS 003

TRAVERSE POINT	PERCENTAGE OF DIAMETER	DISTANCE ,INCHES FROM STACK WALL
1	2.1%	7.26 IN.
2	6.7%	23.16 IN.
3	11.8%	40.78 IN.
4	17.7%	61.17 IN.
5	25.0%	86.40 IN.
6	35.6%	123.03 IN.

UPSTREAM DISTURBANCE=
8.51 STACK DIAMETERS

DOWNSTREAM DISTURBANCES=
2.99 STACK DIAMETERS

STACK DIAMETER = 28.8 FT. ID.
STACK AREA = 652.9480 SQ. FT.
PORT LENGTH'S = 14.0 IN.



PORT LOCATION PLAN

FIGURE 2

TAMPA ELECTRIC
A TECO ENERGY COMPANY

REVISED 4-17-96

3.0 TEST PROCEDURES/SAMPLING TRAIN DIAGRAMS

All particulate, sulfuric acid mist, carbon monoxide, oxygen, and visible emission testing followed the procedures and quality assurance/quality control guidelines given in 40 CFR 60 Appendix A.

Fuel sampling and analysis was performed following ASTM procedures and EPA methods. Fuel analysis for concentration of chromium, lead, nickel, beryllium, vanadium and zinc was prepared using ASTM 3683-78 (Reapproved 1989), "Standard Test Method for Trace Elements in Coal and Coke Ash by Atomic Absorption" and performed by EPA Method 200.7 "Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry". Fuel analysis for concentration of mercury was prepared and analyzed using ASTM 3684-94 "Total Mercury in Coal by Oxygen Bomb Combustion/Atomic Absorption Method".

Particulate matter sampling was performed according to U.S. EPA Method 17, "Determination of Particulate Matter from Stationary Sources" and U.S. EPA Method 5-B "Determination of Non-sulfuric Acid Particulate Matter from Stationary Sources". Sampling was performed using the equipment depicted in Figure 3 and Figure 4 respectively. Particulate matter was collected on a high purity glass micro fiber thimble measuring 19 X 90 mm for method 17 and a filter measuring 8.26 cm in diameter for method 5-B. Sulfuric acid mist sampling was performed according to U.S. EPA Method 8 "Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources." Sampling was performed using the equipment depicted in Figure 5.

Diluent sampling and analysis was performed according to U.S. EPA Method 3 "Gas Analysis for Determination of Emission Rate Correction Factor, or Excess Air". Sampling was performed using the equipment depicted in Figure 6.Diluent analysis was performed using the equipment depicted in Figure 7.

Carbon monoxide sampling was performed in accordance with U.S..EPA Reference Method 10 (40 CFR Part 60, Appendix A) "Determination of Carbon Monoxide Emissions from Stationary Sources". Testing was performed using a Thermo Environmental Model 48H gas filter correlation CO analyzer. Associated diluent sampling was performed in accordance with USEPA Reference Method 3-A (40 CFR Part 60, Appendix A), "Determination of Oxygen and Carbon Dioxide concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)". Testing was performed using a Servomex Model 1400-B Oxygen Analyzer.

TCEMS Description

The following discussion briefly outlines the operation principles of Corporate Environmental Services transportable Continuous Emissions Monitoring System (TCEMS) shown schematically in Figure 8. Additional information on instrument operation may be found in the individual instrument manuals provided by the manufacturers.

Data Acquisition System

The data acquisition system (DAS), uses a personal computer with an internal 16 bit analog-to-digital converter with an external 16 channel multiplexer. In addition to providing an instantaneous display of analyzer responses, the DAS can average data, calculate emission rates, and document analyzer calibrations. The test results and calibrations are stored on the hard disk and printed on a dot matrix printer.

TCEMS Sample Handling System

The extractive monitors utilized in the TCEMS require that the effluent stream be conditioned to eliminate any possible interference (i.e., water vapor and particulate matter), before being transported and injected into each analyzer. Figure 8 depicts a schematic of the entire sample handling system. The major components of this system are listed below:

- Gas transport tubing
- Moisture removal system
- Sampling pump

Gas Transport Tubing

Two separate 1/4 inch O.D. Teflon tubes were used for the sample gas transport.

Moisture Removal System

The moisture removal system was comprised of an ice bath condenser, constructed of a 30-foot section of 3/8 inch O.D. Teflon tubing, wrapped in a 12-inch coil. Effluent travels through this coil and then passes, in series, through two stainless steel moisture traps where the condensate drops out and is removed via a condensate discharge pump. With the exception of the discharge pump, the entire assembly is chilled in a ice bath.

Sampling Pump

The Thomas Model 2107CE20-TFE pump is used to transport the effluent sample through the conditioning system to the analyzers. All internal parts of the pump that come into contact with the gas sample are constructed of 316 stainless steel or Teflon.

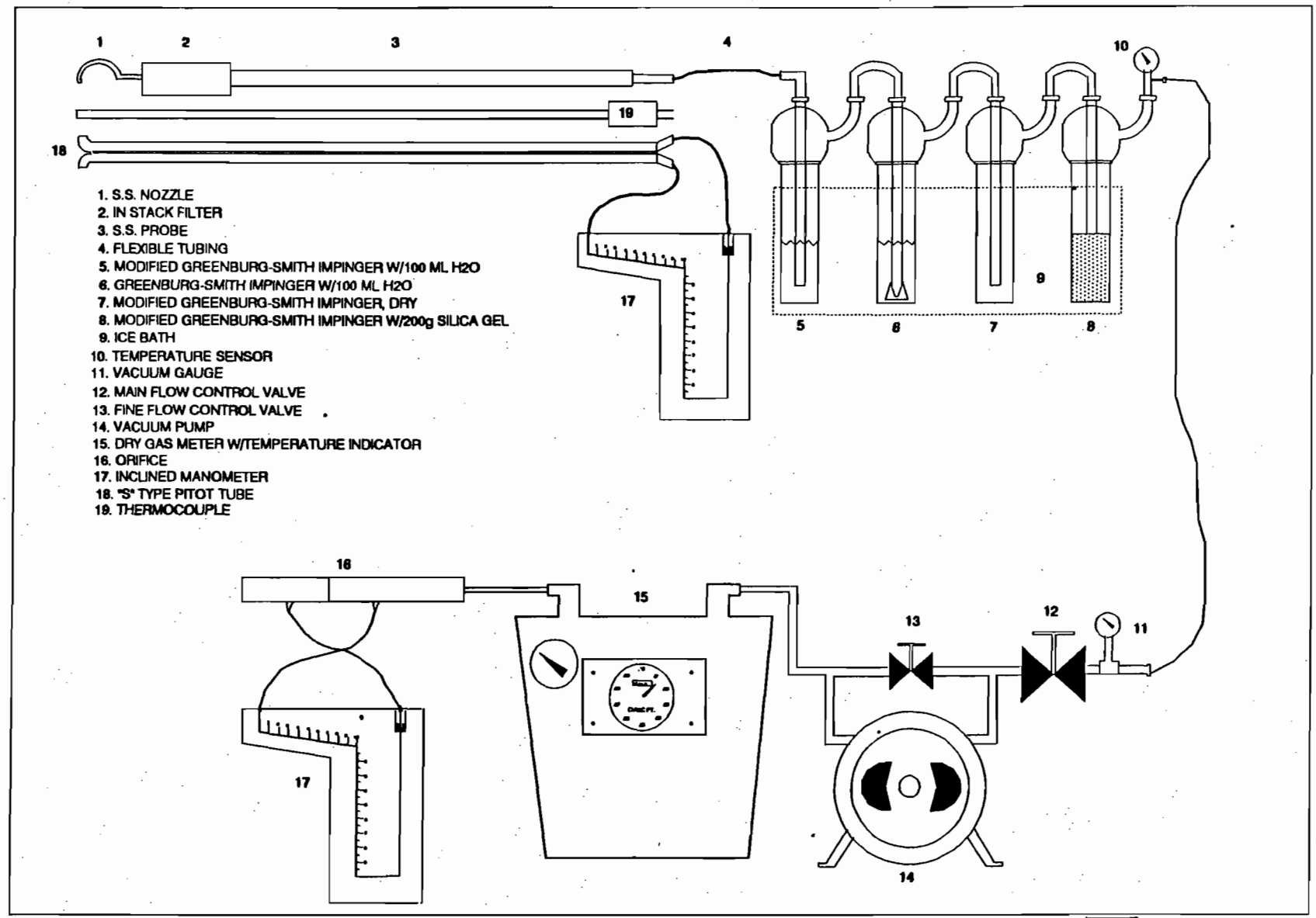


FIGURE 3
PARTICULATE SAMPLING TRAIN
USEPA METHOD 17

TAMPA ELECTRIC
A TECO ENERGY COMPANY

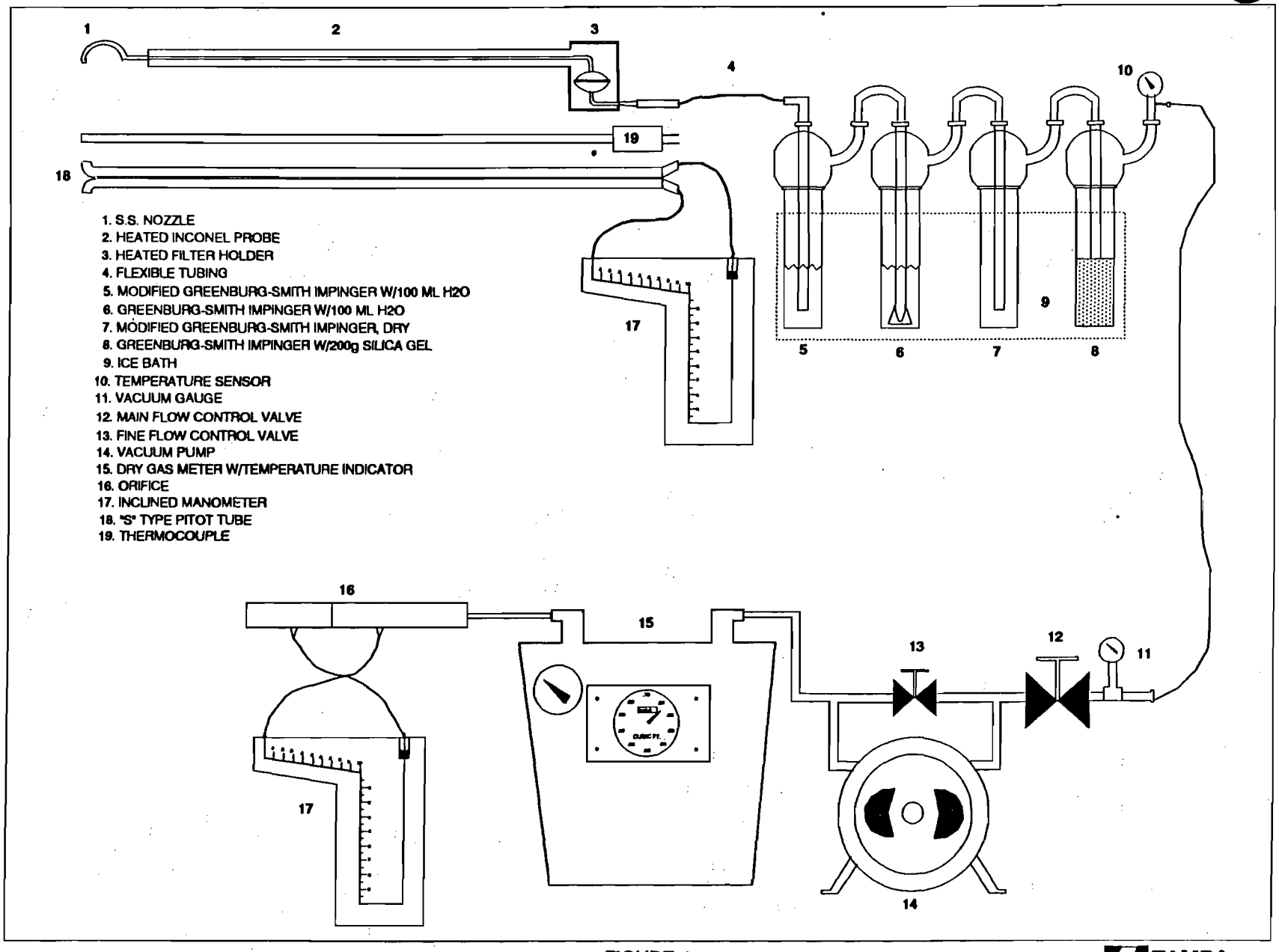


FIGURE 4
PARTICULATE SAMPLING TRAIN
USEPA METHOD 5-B

TAMPA ELECTRIC
A TECO ENERGY COMPANY

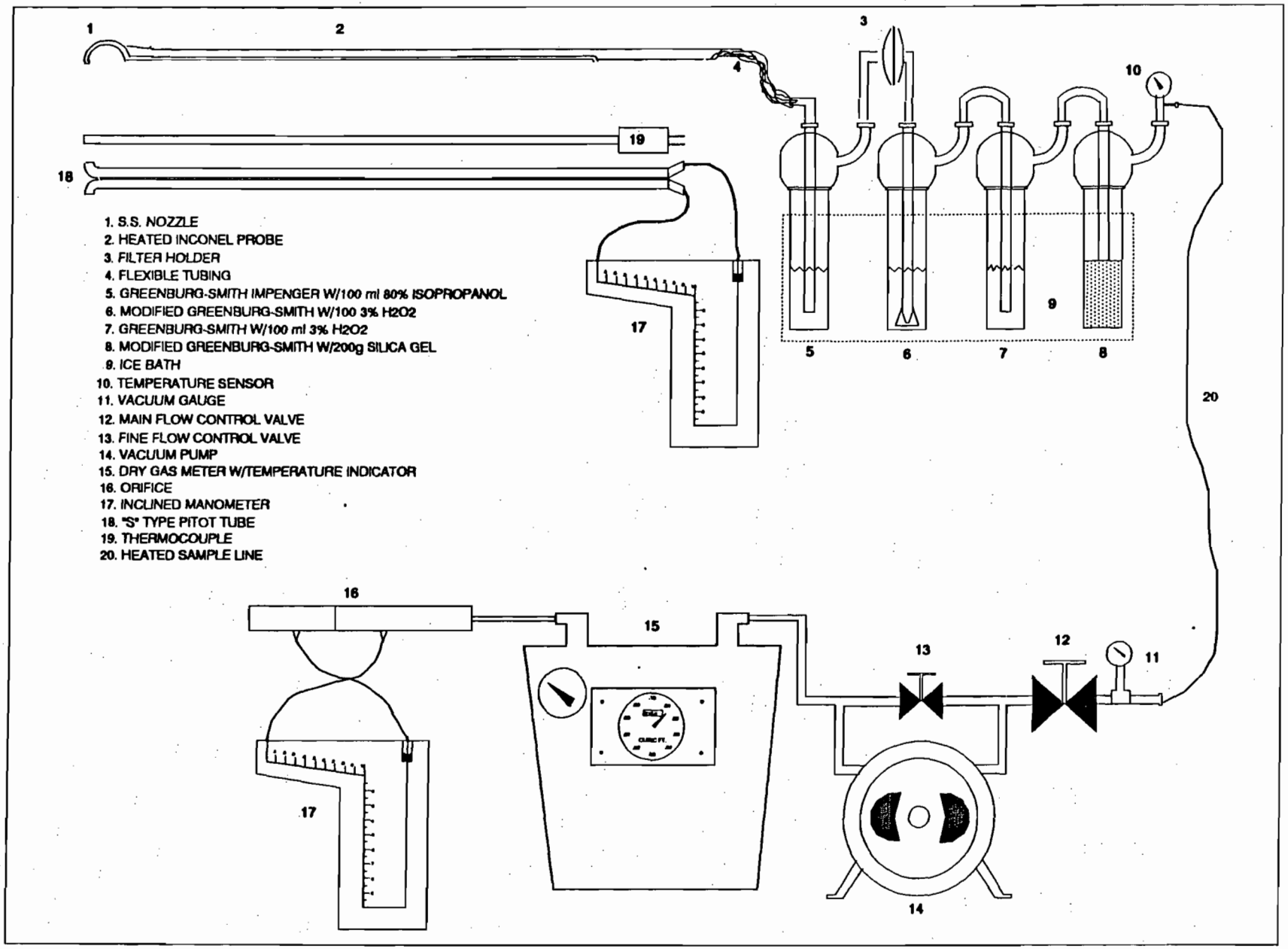


FIGURE 5
SULFURIC ACID MIST SAMPLING TRAIN
USEPA METHOD 8

TAMPA ELECTRIC
A TECO ENERGY COMPANY

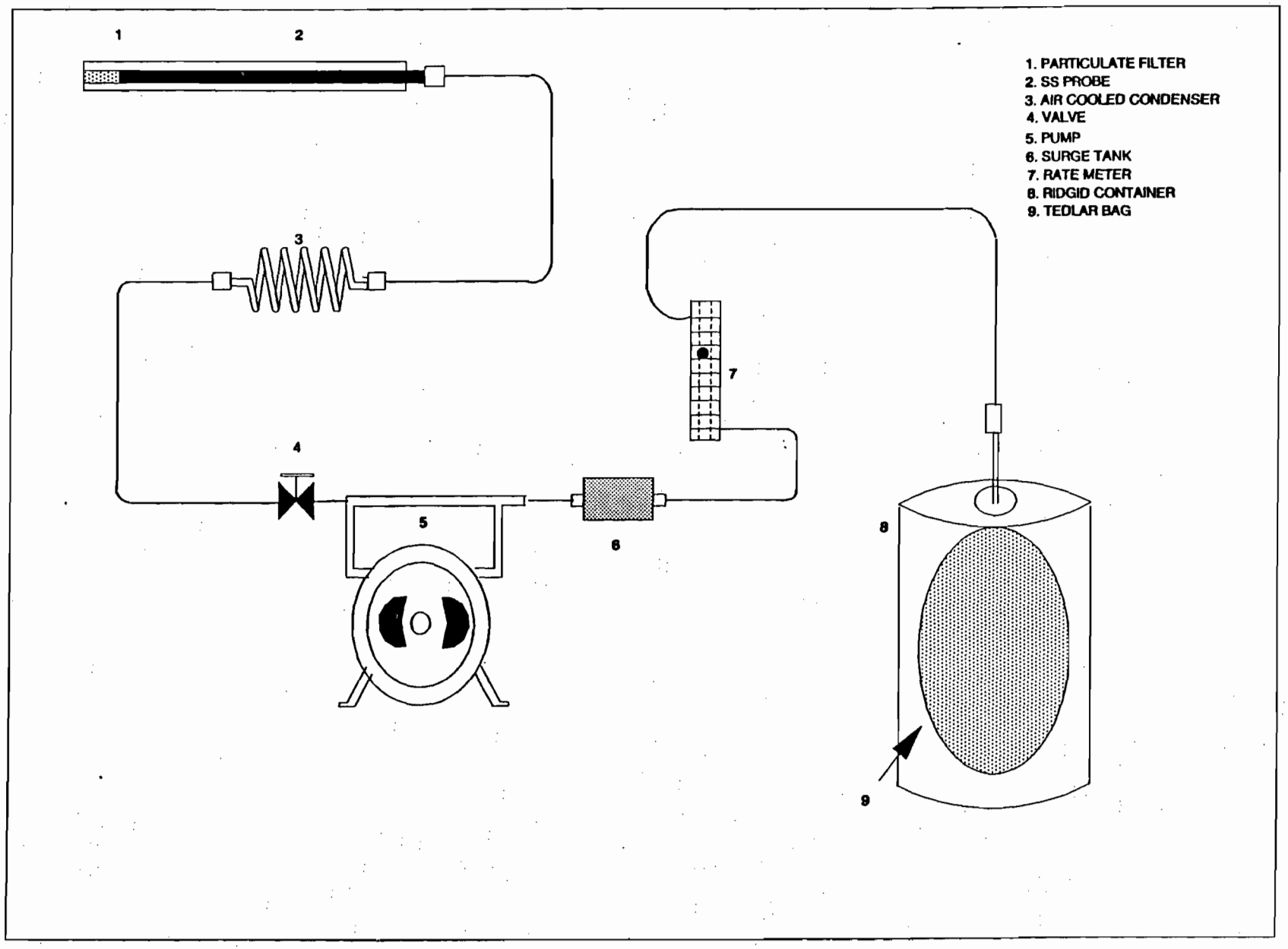


FIGURE 6
INTEGRATED GAS SAMPLING TRAIN
USEPA METHOD 3-B

TAMPA ELECTRIC
A TECO ENERGY COMPANY

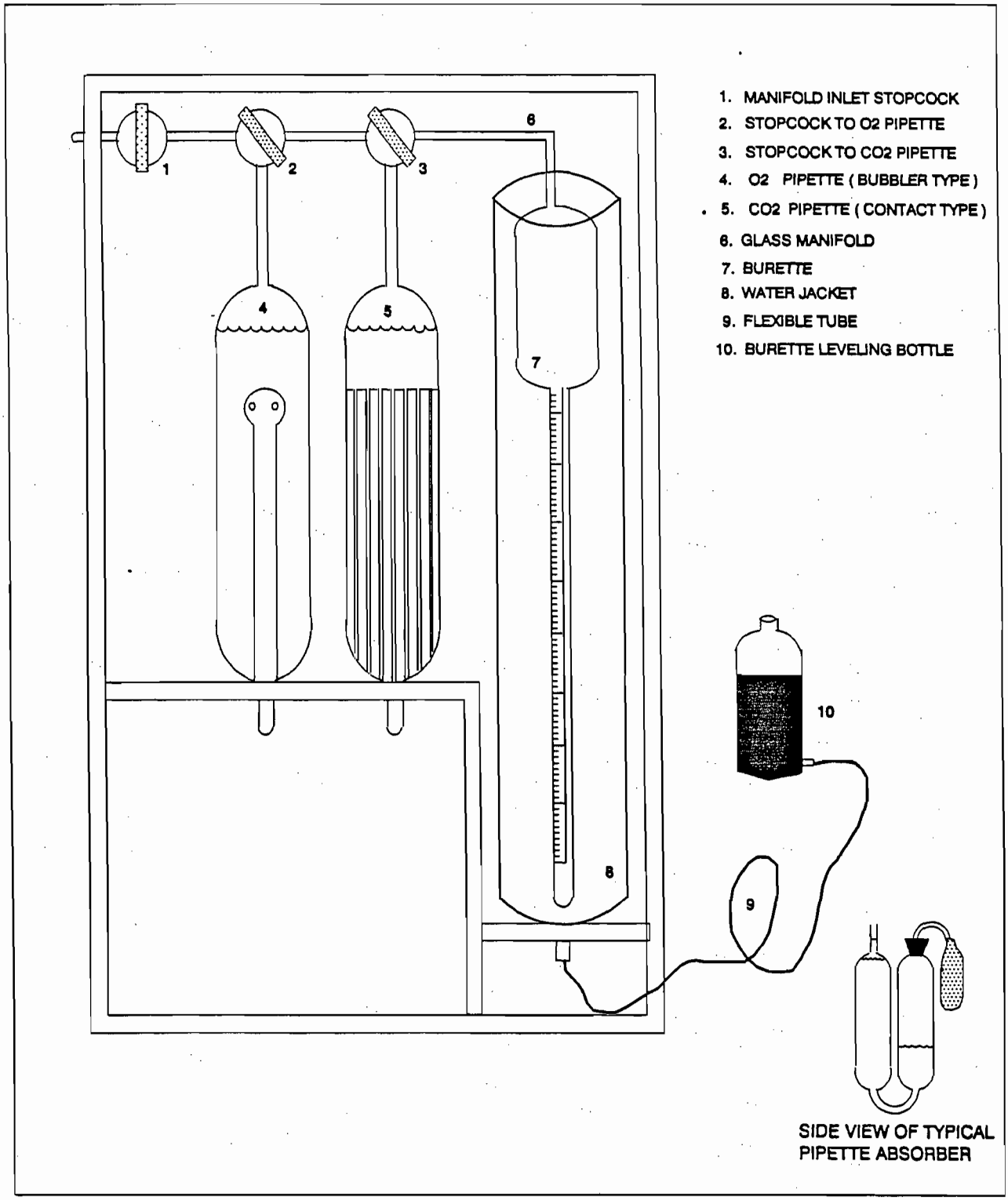
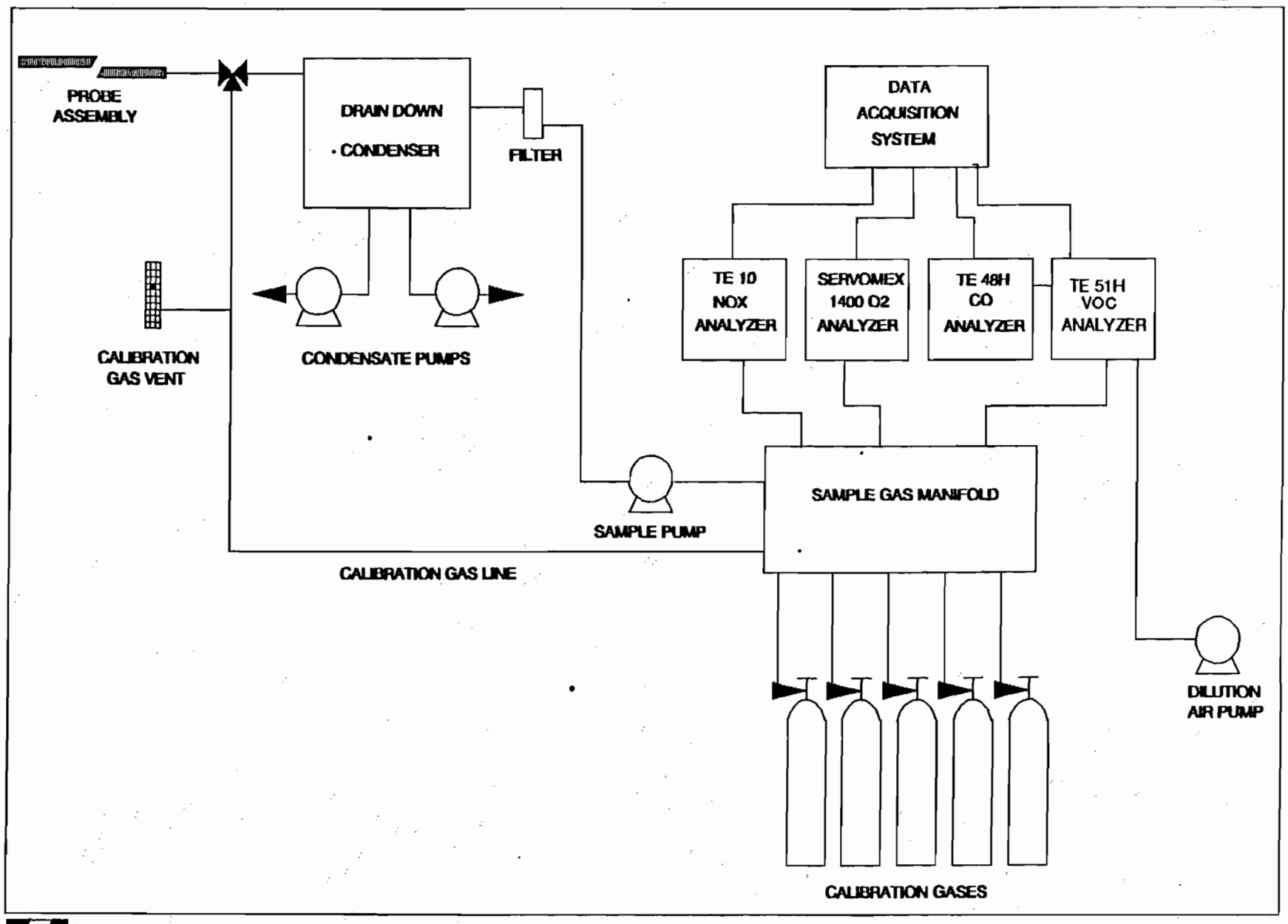


FIGURE 7
ORSAT ANALYZER
USEPA METHOD 3B

TAMPA ELECTRIC
A TECO ENERGY COMPANY



TAMPA ELECTRIC
A TECO ENERGY COMPANY

FIGURE 8
USEPA METHODS 3A, 10, 20, 25-A

4.0 SUMMARY OF RESULTS

Section 4.1 presents the comparison tables of Continuous Emission Monitor Data from the baseline period and the full fuel blend test period. Data is presented for opacity, SO_2 and NO_x.

BIG BEND STATION UNIT NO. 3 AVERAGE CEM DATA OVER FULL TEST PERIOD			
BASELINE		PETROLEUM COKE	ALLOWABLE EMISSION RATE
Opacity	13	12	20(%)*
SO_2	4.3	0.2	6.5 (LB/MMBTU)
NO_x	0.65	0.63	0.70 (LB/MMBTU)**
*SIX MINUTE AVERAGE **30 DAY ROLLING AVERAGE			

Section 4.2 presents the stack test results for the trial burn performed at Big Bend Station Unit No. 3. Results are shown comparing all parameters tested during baseline and test burn stack tests. These comparisons show stack test data for particulate, carbon monoxide, and sulfuric acid mist sampled during a series of three day tests. Continuous Emission Data was extracted from daily reports to correspond with stack test times. The stack test data is summarized below. The results are within the allowable levels.

BIG BEND STATION UNIT NO. 3 STACK TEST DATA			
	BASELINE	PETROLEUM COKE	ALLOWABLE EMISSION RATE
Particulate (LB/MMBTU)	0.04	0.01	0.3*
SO_2 (LB/MMBTU)	4.6	0.2	6.5
NO_x (LB/MMBTU)	0.70	0.68	0.70**
CO (LB/MMBTU)	0.11	0.10	N/A
H_2SO_4 (g/DSCM)	0.021	0.018	N/A
**30 DAY ROLLING AVERAGE			
*SOOTBLOWING LIMIT			

Section 4.3 presents the fuel sampling and analysis of weekly composites taken of over the baseline and the fuel blend burn.

4.1 CEM DATA

BIG BEND STATION UNIT NO 3
CEM DATA COMPARISON
BASELINE TEST BURN
FEBRUARY 17, 1996 THRU FEBRUARY 23, 1996
PETROLEUM TEST BURN
FEBRUARY 24,1996 THRU MARCH 3, 1996

	SO2 OUTLET (LB/MMBTU)	CO2-INLET (%)	NOx INLET (LB/MMBTU)	OPACITY (%)
BASELINE TEST BURN AVERAGE				
02-17-96 THRU 02-23-96	4.3	14.0	0.65	13
PETROLEUM TEST BURN AVERAGE				
02-24-96 THRU 03-03-96	0.2	14.4	0.63	12

TABLE4.1.1

BIG BEND STATION UNIT NO 3
CEM DATA
DAILY AVERAGES
BASELINE TEST BURN
FEBRUARY 17, 1996 THRU FEBRUARY 23, 1996

DATE	SO2 OUTLET (LB/MMBTU)	CO2-INILET (%)	NOX INLET (LB/MMBTU)	OPACITY (%)
02-17-96	3.0	14.4	0.65	13
02-18-96	4.6	14.3	0.68	14
02-19-96	4.6	14.3	0.71	14
02-20-96	4.4	13.8	0.70	13
02-21-96	4.4	13.7	0.62	12
02-22-96	4.6	13.6	0.61	13
02-23-96	4.4	13.6	0.60	12
BASELINE AVERAGE	4.3	14.0	0.65	13

TABLE4.1.2

BIG BEND STATION BOILER NO 3
CEM DATA
DAILY AVAERAGES
PETROLEUM COKE TEST BURN
FEBRUARY 24,1996 THRU MARCH 3, 1996

DATE	SO2 OUTLET (LB/MMBTU)	CO2-INLET (%)	NOx INLET (LB/MMBTU)	OPACITY (%)
02-24-96	0.3	13.5	0.58	12
02-25-96	0.2	14.5	0.64	12
02-26-96	0.1	14.7	0.64	12
02-27-96	0.2	14.8	0.64	12
02-28-96	0.1	14.7	0.59	12
02-29-96	0.1	14.1	0.64	12
03-01-96	0.1	14.6	0.67	13
03-02-96	0.2	14.7	0.68	13
03-03-96	0.1	14.9	0.66	13
PETROLEUM COKE TESTBURN AVERAGE	0.2	14.4	0.63	12

TABLE4.1.3

4.2 STACK TEST DATA

BIG BEND STATION UNIT NO. 3
STACK TEST DATA
BASELINE TEST BURN
FEBRUARY 18, FEBRUARY 19, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 29, MARCH 1, 1996

PARTICULATE (Lb/MMBtu)
U.S. EPA METHOD 5-B

RUN	1	2	3	AVG.
BASELINE TESTS	0.044	0.042	0.055	0.047
20% PETROLEUM COKE TESTS	0.009	0.011	0.003	0.008

SULFURIC ACID MIST (g/dscm)
U.S. EPA METHOD 8

RUN	1	2	3	AVG.
BASELINE TESTS	0.0208	0.0221	0.0190	0.0206
20% PETROLEUM COKE TESTS	0.0175	0.0171	0.0186	0.0177

CARBON MONOXIDE (Lb/MMBtu)
U.S.EPA METHOD 10

RUN	1	2	3	AVG.
BASELINE TESTS	0.009	0.159	0.160	0.11
20% PETROLEUM COKE TESTS	0.106	0.106	0.099	0.10

TABLE 4.2.1

BIG BEND STATION UNIT NO. 3
CONTINUOUS EMISSION MONITOR DATA DURING STACK TESTS*
BASELINE TEST BURN
FEBRUARY 18, FEBRUARY 19, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 29, MARCH 1, 1996

NOx (lb/MMBtu)

	DATE	02-18-96	02-19-96	AVG.
	TIME	0900-1400	0800-1200	
BASELINE TESTS		0.68	0.71	0.70

	DATE	02-29-96	03-01-96	AVG.
	TIME	1000-1600	1100-1700	
20% PETROLEUM COKE TESTS		0.67	0.69	0.68

* CONTINUOUS EMISSION MONITOR DATA CORRESPONDS TO STACK TEST DAYS AND TIME

TABLE 4.2.2

BIG BEND STATION UNIT NO. 3
CONTINUOUS EMISSION MONITOR DATA DURING STACK TESTS*
BASELINE TEST BURN
FEBRUARY 18, FEBRUARY 19, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 29, MARCH 1, 1996

SO2 (lb/MMBtu) OUTLET

	DATE	02-18-96	02-19-96	AVG.
	TIME	0900-1400	0800-1200	
BASELINE TESTS		4.6	4.7	4.6

	DATE	02-29-96	03-01-96	AVG.
	TIME	1000-1600	1100-1700	
20% PETROLEUM COKE TESTS		0.2	0.2	0.2

* CONTINUOUS EMISSION MONITOR DATA CORRESPONDS TO STACK TEST DAYS AND TIME

TABLE 4.2.3

BIG BEND STATION UNIT NO. 3
CONTINUOUS EMISSION MONITOR DATA DURING STACK TESTS*
BASELINE TEST BURN
FEBRUARY 18,19, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 29, MARCH 1, 1996

OPACITY (%)

	DATE	02-18-96	02-19-96	AVG.
	TIME	0900-1400	0800-1200	
BASELINE TESTS		14	14	14

	DATE	02-29-96	03-01-96	AVG.
	TIME	1000-1600	1100-1700	
20% PETROLEUM COKE TESTS		12	13	13

* CONTINUOUS EMISSION MONITOR DATA CORRESPONDS TO STACK TEST DAYS AND TIME

TABLE 4.2.4

4.3 FUEL ANALYSIS DATA

BIG BEND STATION UNIT NO. 3
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
FEBRUARY 17,1996 THRU FEBRUARY 23, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 24,1996 THRU MARCH 3, 1996

ZINC (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)
EPA 200.7

BASELINE TESTS	02-17-96 THRU 02-23-96	27.34 ug/g
20% PETROLEUM COKE TESTS	02-24-96 THRU 03-01-96	27.34 ug/g
20% PETROLEUM COKE TESTS	03-02-96 THRU 03-03-96	33.96 ug/g

NICKEL (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)
EPA 200.7

BASELINE TESTS	02-17-96 THRU 02-23-96	10.53 ug/g
20% PETROLEUM COKE TESTS	02-24-96 THRU 03-01-96	35.93 ug/g
20% PETROLEUM COKE TESTS	03-02-96 THRU 03-03-96	35.23 ug/g

TABLE 4.3.1

BIG BEND STATION UNIT NO. 3
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
FEBRUARY 17,1996 THRU FEBRUARY 23, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 24,1996 THRU MARCH 3, 1996

BERYLLIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)
EPA 200.7

BASELINE TESTS	02-17-96 THRU 02-23-96	1.05 ug/g
20% PETROLEUM COKE TESTS	02-24-96 THRU 03-01-96	1.01 ug/g
20% PETROLEUM COKE TESTS	03-02-96 THRU 03-03-96	0.97 ug/g

LEAD (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)
EPA 200.7

BASELINE TESTS	02-17-96 THRU 02-23-96	4.54 ug/g
20% PETROLEUM COKE TESTS	02-24-96 THRU 03-01-96	6.63 ug/g
20% PETROLEUM COKE TESTS	03-02-96 THRU 03-03-96	6.03 ug/g

TABLE 4.3.2

BIG BEND STATION UNIT NO. 3
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
FEBRUARY 17,1996 THRU FEBRUARY 23, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 24,1996 THRU MARCH 3, 1996

CHROMIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)
EPA 200.7

BASELINE TESTS	02-17-96 THRU 02-23-96	12.86 ug/g
20% PETROLEUM COKE TESTS	02-24-96 THRU 03-01-96	10.67 ug/g
20% PETROLEUM COKE TESTS	03-02-96 THRU 03-03-96	10.15 ug/g

VANADIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)
EPA 200.7

BASELINE TESTS	02-17-96 THRU 02-23-96	30.40 ug/g
20% PETROLEUM COKE TESTS	02-24-96 THRU 03-01-96	94.84 ug/g
20% PETROLEUM COKE TESTS	03-02-96 THRU 03-03-96	92.58 ug/g

TABLE 4.3.3

BIG BEND STATION UNIT NO. 3
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
FEBRUARY 17,1996 THRU FEBRUARY 23, 1996
PETROLEUM COKE FUEL BLEND
FEBRUARY 24,1996 THRU MARCH 3, 1996

MERCURY (ug/g)
ASTM D 3684-94 (REAPPROVED 1994)

BASELINE TESTS	02-17-96 THRU 02-23-96	0.108 ug/g
20% PETROLEUM COKE TESTS	02-24-96 THRU 03-01-96	0.092 ug/g
20% PETROLEUM COKE TESTS	03-02-96 THRU 03-03-96	0.113 ug/g

TABLE 4.3.4

4.4 UNIT OPERATIONS SUMMARY

Boiler performance was not noticeably affected by the petroleum coke blend. No significant differences were observed in overall boiler operation. Extensive daily computerized records exist for the baseline and petroleum test burn. The records are available for inspection at the station but are not included because of the quantity of the material.

Similarly, the performance of the pollution control equipment did not experience any significant changes. Appendix C - Boiler Precipitator Operation data shows records from all stack tests performed during the test burn.

A table summarizing boiler operation and fuel input is included in this section.

Big Ben 4 Test Results

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1.0 INTRODUCTION

Tampa Electric Company's (TEC) Central Testing Laboratory (CTL) performed a series of emission tests on Unit No. 4 at the Big Bend Generating Station located in Hillsborough County on Big Bend Road, near Ruskin, Florida. The tests performed were used to determine the effects on emissions of supplementing the normal fuel for the facility (bituminous coal) with petroleum coke. Two conditions were tested:

1. Baseline firing with no petroleum coke
2. 20% petroleum coke with normal fuels

The tests were authorized by letters dated December 14, 1994 from the Florida Department of environmental Protection (FDEP) relating to Big Bend Unit No. 4, Site Certification No. PA-79; and PSD-FL-040. The Baseline period began on October 30, 1994 and was completed November 5, 1994. The Petroleum Coke test burn began November 8, 1994 and ran through November 29, 1994. Additional Carbon Monoxide testing was required and was performed during a three day burn December 19 - 21, 1994.

Unit No. 4 is a steam-generating boiler which is normally fired with coal. Emissions tests are required at this facility for particulate matter and sulfur dioxide (SO_2) to satisfy the FDEP permit compliance requirements. Sulfuric acid mist and carbon monoxide sampling were added for this test. Six tests for particulate matter, carbon monoxide and sulfuric acid mist were performed on the boiler during each condition. Sulfur dioxide, nitrogen oxides and opacity data was recorded using continuous emission monitors (CEMS) during the baseline and trial burn tests.

All testing was performed following the procedures and quality control guidelines given in 40 CFR 60 Appendix A - Test Methods.

Section 2.0 presents a brief source description and diagram of the sample point locations.

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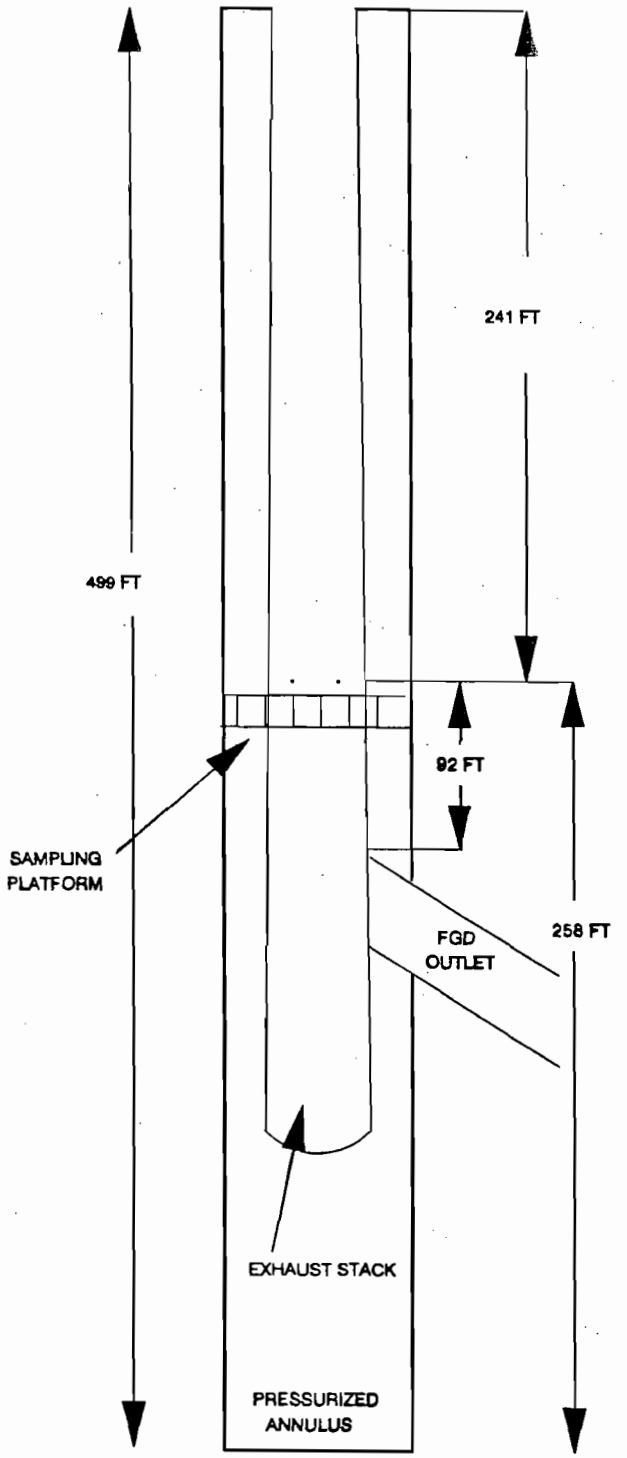
All supporting documentation, field data sheets, laboratory data, sample calculations, calibration data, quality assurance/quality control measures are included in the Appendices to this report.

2.0 SOURCE DESCRIPTION

Big Bend Generating Station is a coal-fired steam electric generating facility located in Hillsborough County on Big Bend Road, near Ruskin, Florida at UTM coordinates East 361.9 North 3075.0. The Unit No. 4 source sampling location consists of four sample ports located 90° apart on the circumference of the 28.75 ft. diameter circular stack, which is 499 ft in height. Upstream and downstream gas flow disturbances were determined to be 3.25 and 8.43 stack diameters away from the test ports, respectively. Using these criteria, a total of 24 sampling points were chosen for particulate sampling and sulfuric acid mist sampling, as stipulated in the U.S. EPA Method 1 test procedure. A diagram of the stack sampling location is included in Figure 1 along with other pertinent information on the test site.

Unit No. 4 is equipped with an electrostatic precipitator for the control of flyash emissions and a flue gas desulfurization (FGD) system for control of sulfur dioxide emissions.

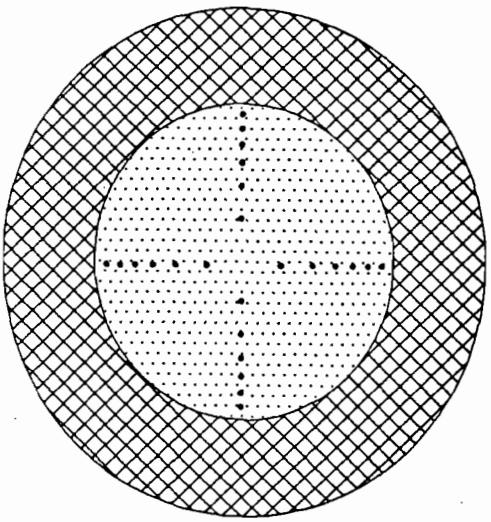


TRAVERSE POINT	PERCENTAGE OF DIAMETER	DISTANCE ,INCHES FROM STACK WALL
1	2.1	7.16
2	6.7	22.83
3	11.8	40.21
4	17.7	60.31
5	25.0	85.19
6	35.6	121.31

UPSTREAM DISTURBANCE=
6.5 STACK DIAMETERS

DOWNSTREAM DISTURBANCES=
3.2 STACK DIAMETERS

PORT NIPPLE = 12 INCHES
PROBE LENGTH = 13 FT
STACK DIAMETER = 28.75'



AERIAL VIEW

BIG BEND GENERATING STATION
BOILER NO. 4 TEST LOCATION
TRAVERSE POINTS

FIGURE 1

TAMPA ELECTRIC
A TECO ENERGY COMPANY

3.0 TEST PROCEDURES/SAMPLING TRAIN DIAGRAMS

All particulate, sulfuric acid mist, carbon monoxide, oxygen, and visible emission testing followed the procedures and quality assurance/quality control guidelines given in 40 CFR 60 Appendix A.

Fuel sampling and analysis was performed following ASTM procedures. Fuel analysis for concentration of chromium, lead, nickel, beryllium, vanadium and zinc was performed using ASTM 3683-98 (Reapproved 1989), "Standard Test Method for Trace Elements in Coal and Coke Ash by Atomic Absorption." Fuel analysis for concentration of mercury was performed using ASTM 3684-94 "Total Mercury in Coal by Oxygen Bomb Combustion/Atomic Absorption Method."

Particulate matter sampling was performed according to U.S. EPA Method 5-B, "Determination of Nonsulfuric Acid Particulate Matter from Stationary Sources." Sampling was performed using the equipment depicted in Figure 2. Particulate matter was collected on a high purity glass microfiber filter measuring 8.26 cm in diameter. Sulfuric acid mist sampling was performed according to U.S. EPA Method 8 "Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources." Sampling was performed using the equipment depicted in Figure 3. Diluent sampling and analysis was performed according to U.S. EPA Method 3 "Gas Analysis for Determination of Emission Rate Correction Factor, or Excess Air". Sampling was performed using the equipment depicted in Figure 4. Diluent analysis was performed using the equipment depicted in Figure 5.

Carbon monoxide sampling was performed in accordance with U.S..EPA Reference Method 10 (40 CFR Part 60, Appendix A) "Determination of Carbon Monoxide Emissions from Stationary Sources". Testing was performed using a Thermo Environmental Model 48H gas filter correlation CO analyzer. Associated diluent sampling was performed in accordance with USEPA Reference Method 3-A (40 CFR Part 60, Appendix A), "Determination of Oxygen and Carbon Dioxide concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)". Testing was performed using a Servomex Model 1400-B Oxygen Analyzer.

TCEMS Description

The following discussion briefly outlines the operation principles of Central Testing Laboratory's Transportable Continuous Emissions Monitoring System (TCEMS). Additional information on instrument operation may be found in the individual instrument manuals provided by the manufacturers.

Data Acquisition System

The data acquisition system (DAS) developed by Entropy Environmentalists Inc., uses a portable personal computer with a 20 megabyte hard disk and an internal 12 bit analog-to-digital converter with an external 16 channel multiplexer. In addition to providing an instantaneous display of analyzer responses, the DAS can average data, calculate emission rates, and document analyzer calibrations. The test results and calibrations are stored on the hard disk and printed on a dot matrix printer.

TCEMS Sample Handling System

The extractive monitors utilized in the TCEMS require that the effluent stream be conditioned to eliminate any possible interference (i.e., water vapor and particulate matter), before being transported and injected into each analyzer. Figure 7 depicts a schematic of the entire sample handling system. The major components of this system are listed below:

- Gas transport tubing
- Moisture removal system
- Sampling pump

Gas Transport Tubing

Two separate 1/4 inch O.D. Teflon tubes were used for the sample gas transport.

Moisture Removal System

The moisture removal system was comprised of an ice bath condenser, constructed of a 30-foot section of 3/8 inch O.D. Teflon tubing, wrapped in a 12-inch coil. Effluent travels through this coil and then passes, in series, through two stainless steel moisture traps where the condensate drops out and is removed via a condensate discharge pump. With the exception of the discharge pump, the entire assembly is chilled in a ice bath.

Sampling Pump

The Thomas Model 2107CE20-TFE pump is used to transport the effluent sample through the conditioning system to the analyzers. All internal parts of the pump that come into contact with the gas sample are constructed of 316 stainless steel or Teflon.

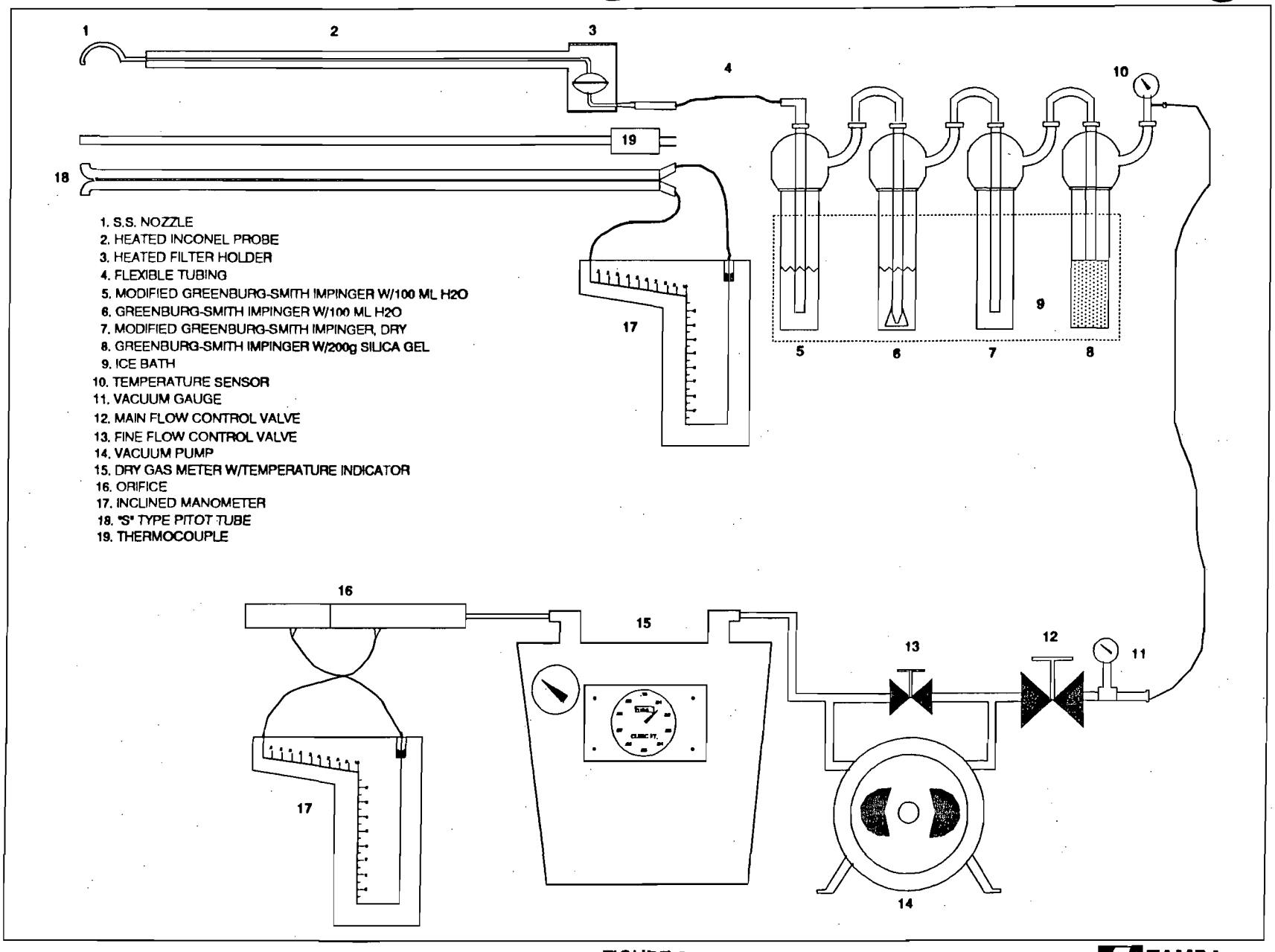


FIGURE 2

PARTICULATE SAMPLING TRAIN

USEPA METHOD 5-B

TAMPA ELECTRIC
A TECO ENERGY COMPANY

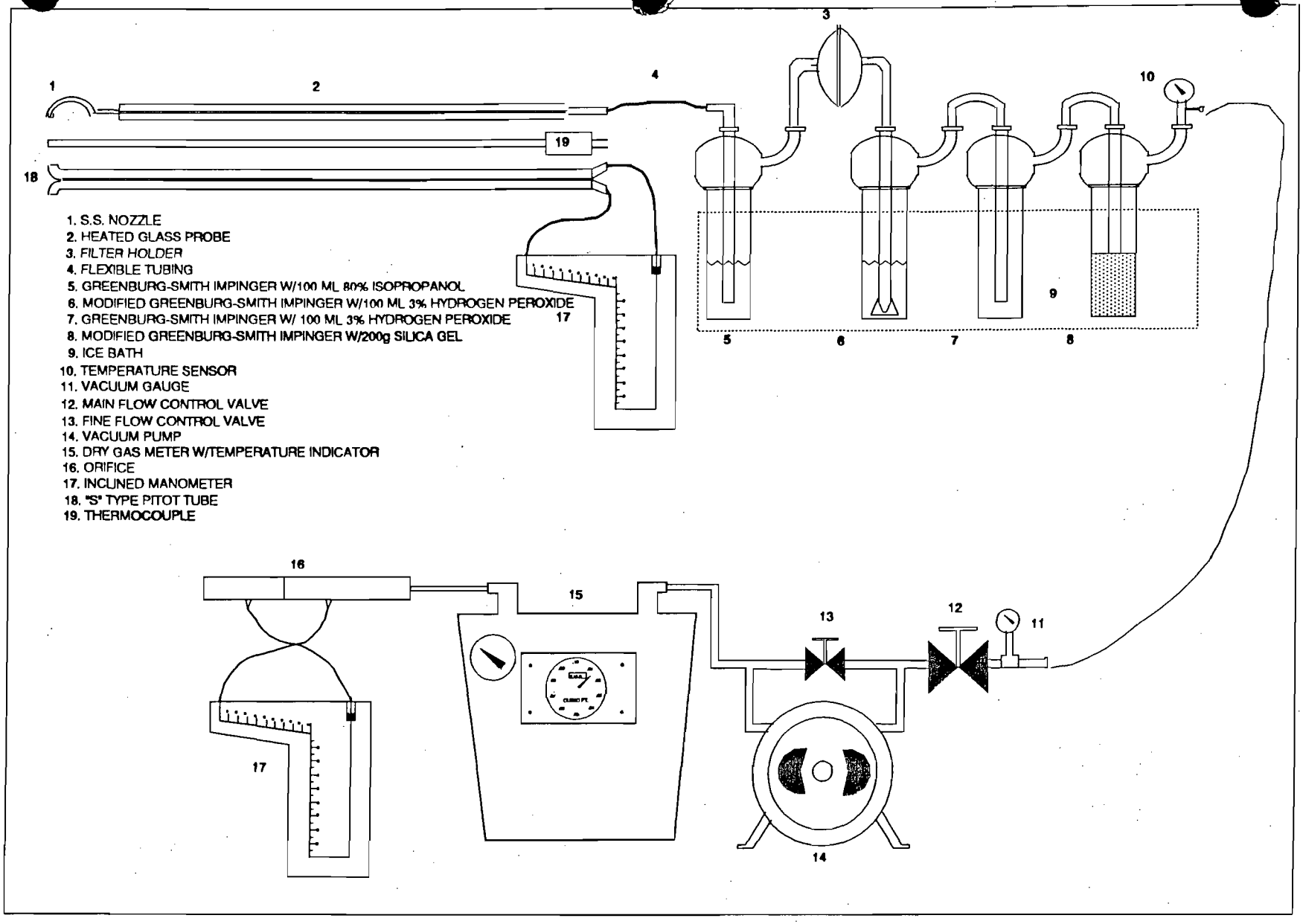
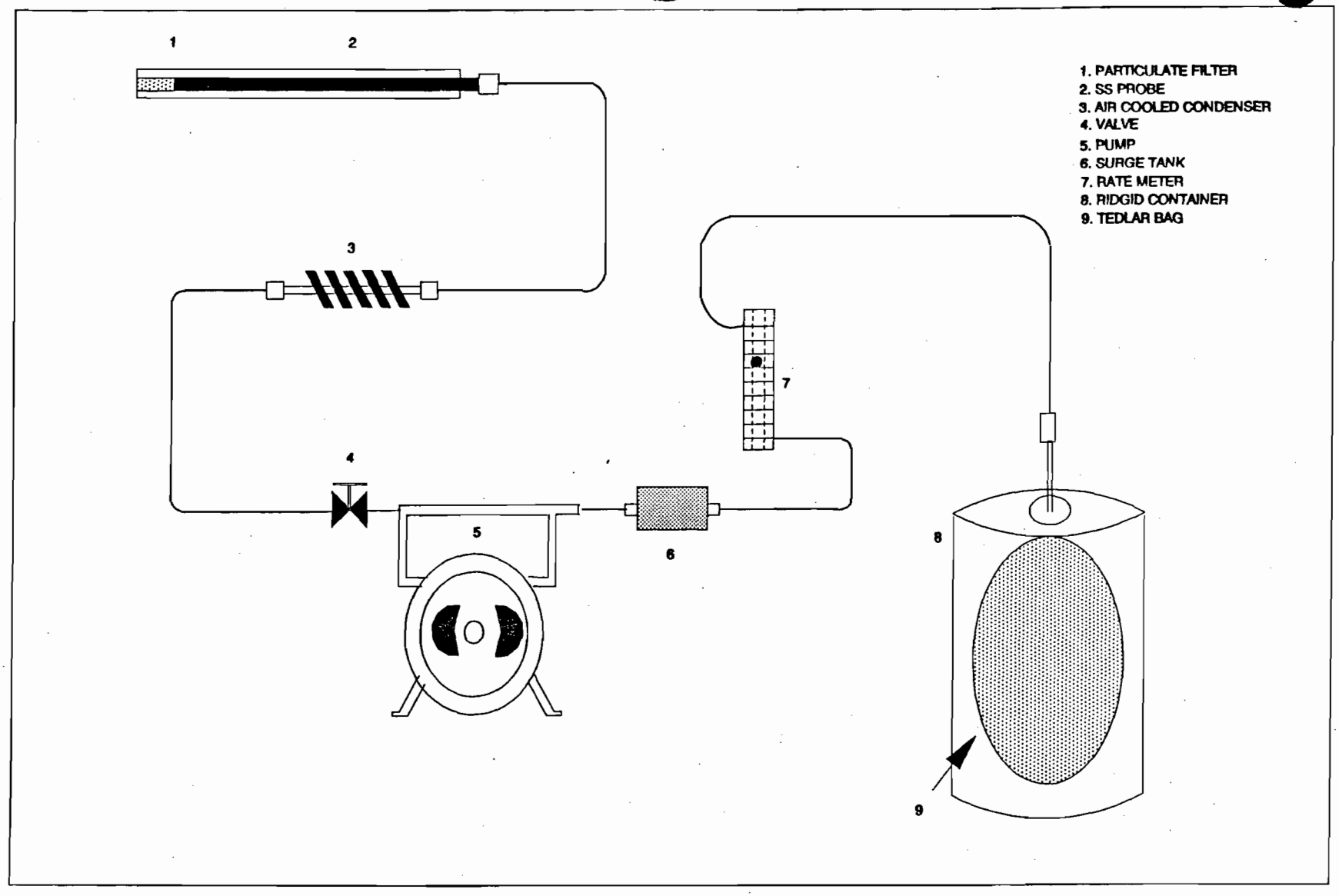


FIGURE 3
SULFURIC ACID MIST SAMPLING TRAIN
USEPA METHOD 8

TAMPA ELECTRIC
A TECO ENERGY COMPANY

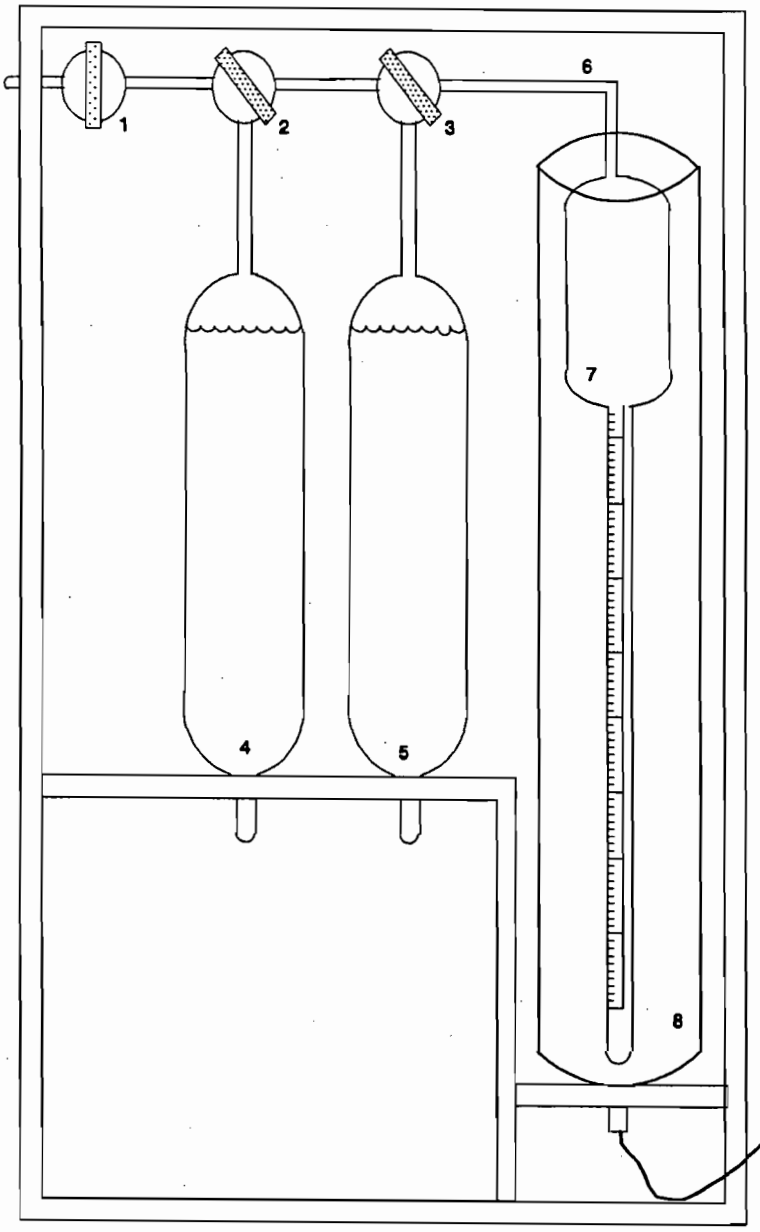


TAMPA ELECTRIC
A TECO ENERGY COMPANY

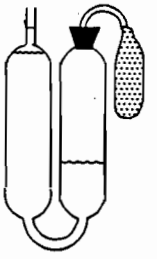
FIGURE 4

INTEGRATED GAS SAMPLING TRAIN

USEPA METHOD 3



1. MANIFOLD INLET STOPCOCK
2. STOPCOCK TO O2 PIPETTE
3. STOPCOCK TO CO2 PIPETTE
4. O2 PIPETTE
5. CO2 PIPETTE
6. GLASS MANIFOLD
7. BURETTE
8. WATER JACKET
9. FLEXIBLE TUBE
10. BURETTE LEVELING BOTTLE

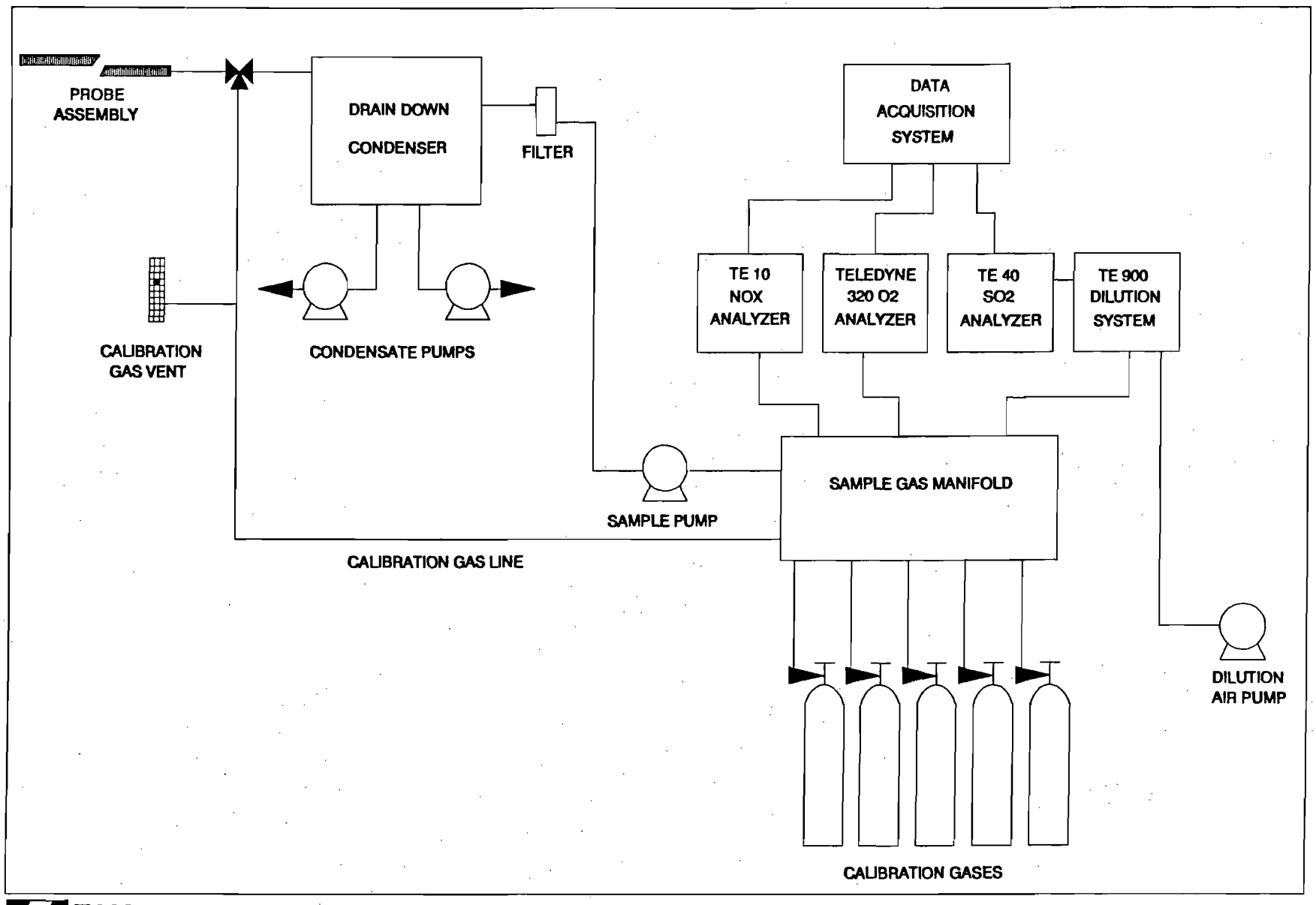


SIDE VIEW OF TYPICAL PIPETTE ABSORBER

FIGURE 5

ORSAT ANALYZER

TAMPA ELECTRIC
A TECO ENERGY COMPANY



TAMPA ELECTRIC
A TECO ENERGY COMPANY

FIGURE 6

USEPA METHODS 3A, 6C, 7E CEM SYSTEM LAYOUT

4.0 SUMMARY OF RESULTS

Section 4.1 presents the comparison tables of Continuous Emission Monitor Data from the baseline period and the full test burn period. Data is presented for opacity, SO_2 and NO_x. The data in these tables show no appreciable difference, and is well below the permitted levels. Overall average CEM data is shown below.

BIG BEND STATION UNIT NO. 4

AVERAGE CEM DATA OVER FULL TEST PERIOD

	BASELINE	PETROLEUM COKE	ALLOWABLE EMISSION RATE
OPACITY	7	8	20 (%)*
SO_2	0.25	0.29	0.82 (LB/MMBTU)**
NO_x	0.43	0.42	0.60 (LB/MMBTU)**

*SIX MINUTE AVERAGE
**30 DAY ROLLING AVG

Section 4.2 presents the stack test results for the trial burn performed at Big Bend Station Unit No. 4. Results are shown comparing all parameters tested during baseline and test burn stack tests. These comparisons show stack test data for particulate, carbon monoxide, and sulfuric acid mist sampled during a series of three day tests. Fuel samples were also taken to correspond with stack tests, and Continuous Emission Data was extracted from daily reports to corresond with stack test times. The stack test data is summarized below. The results are well within the allowable levels.

BIG BEND STATION UNIT NO. 4

STACK TEST DATA

	BASELINE	PETROLEUM COKE	ALLOWABLE EMISSION RATE
PARTICULATE	0.0025	0.0035	0.03 (LB/MMBTU)
SO_2	0.28	0.53	0.82 (LB/MMBTU)**
NO_X	0.44	0.52	0.60 (LB/MMBTU)**
CO	0.010	0.002	0.029
H_2SO_4	0.007	0.002	N/A (g/DSCM)

**30 DAY ROLLING AVG

Section 4.3 Presents the fuel sampling and analysis of weekly composites taken of over seven day baseline and the twenty one day test burn.

4.1 CEM DATA

BIG BEND STATION UNIT NO 4
CEM DATA COMPARISON
BASELINE TEST BURN
OCTOBER 30, 1994 THRU NOVEMBER 5, 1994
PETROLEUM TEST BURN
NOVEMBER 7, 1994 THRU DECEMBER 1, 1994
DECEMBER 19, 1994 THRU DECEMBER 21, 1994

	SO2 OUTLET (LB/MMBTU)	SO2 INLET (LB/MMBTU)	REDUCTION (%)	NOx INLET (LB/MMBTU)	OPACITY (%)
BASELINE TEST BURN AVERAGE 10-30-94 THRU 11-5-94	0.25	5.33	95	0.43	7
PETROLEUM TEST BURN AVERAGE 11-07-94 THRU 12-01-94 12-19-94 THRU 12-21-94	0.29	5.19	92	0.42	8

TABLE4.1.1

BIG BEND STATION UNIT NO 4
CEM DATA
DAILY AVERAGES
BASELINE TEST BURN
OCTOBER 30, 1994 THRU NOVEMBER 5, 1994

DATE	SO2 OUTLET (LB/MMBTU)	SO2 INLET (LB/MMBTU)	REDUCTION (%)	NOX INLET (LB/MMBTU)	OPACITY (%)
10-30-94	0.31	5.17	94	0.39	6
10-31-94	0.23	5.08	95	0.34	6
11-01-94	0.20	5.65	96	0.39	6
11-02-94	0.22	5.43	96	0.38	6
11-03-94	0.28	5.32	95	0.44	7
11-04-94	0.24	5.32	95	0.56	8
11-05-94	0.25	5.33	*	0.54	8
BASELINE AVERAGE	0.25	5.33	95	0.43	7

* CEM SO2 REDUCTION NOT AVAILABILE 11-05-94

TABLE4.1.2

BIG BEND STATION BOILER NO 4
CEM DATA
DAILY AVAERAGES
PETROLEUM COKE TEST BURN
NOVEMBER 7, 1994 THRU DECEMBER 1, 1994
DECEMBER 19 THRU DECEMBER 21, 1994

DATE	SO2 OUTLET (LB/MMBTU)	SO2 INLET (LB/MMBTU)	REDUCTION (%)	NOx INLET (LB/MMBTU)	OPACITY (%)
11-07-94	0.29	5.17	94	0.39	6
11-08-94	0.34	5.08	94	0.34	9
11-09-94	*	*	*	*	*
11-10-94	*	*	*	*	*
11-11-94	*	*	*	*	*
11-12-94	*	*	*	*	*
11-13-94	0.25	5.33	89	0.54	7
11-14-94	0.46	5.16	91	0.49	5
11-15-94	0.52	5.23	90	0.46	4
11-16-94	0.63	5.13	88	0.52	3
11-17-94	0.50	5.14	90	0.50	10
11-18-94	0.39	5.18	94	0.51	12
11-19-94	0.32	5.16	94	0.59	13
11-20-94	0.31	5.14	94	0.58	13
11-21-94	0.32	5.21	94	0.54	12
11-22-94	0.20	5.28	98	0.46	13
11-23-94	0.29	5.27	96	0.45	10
11-24-94	0.29	5.39	95	0.48	5
11-25-94	0.29	5.39	95	0.48	5
11-26-94	**	**	**	**	4
11-27-94	**	**	**	**	4
11-28-94	0.33	5.17	94	0.58	4
11-29-94	0.29	5.08	94	0.55	4
11-30-94	0.22	5.12	96	0.47	3
12-01-94	0.25	5.13	95	0.55	6
12-19-94	0.26	5.43	95	0.56	4
12-20-94	0.28	5.57	95	0.53	4
12-21-94	0.27	5.44	95	0.54	5
PETROLEUM COKE TESTBURN AVERAGES	0.29	5.19	92	0.42	8

* BOILER NO 4 OUTAGE NOVEMBER 9,10,11,12, 1994
** NOx AND SO2 CEMS OUT OF SEVIVCE NOVEMBER 26,27, 1994

TABLE4.1.3

4.2 STACK TEST DATA

BIG BEND STATION UNIT NO. 4
STACK TEST DATA
BASELINE TEST BURN
NOVEMBER 1,2,3, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 16, 17, 18 AND DECEMBER 20, 1994

PARTICULATE (Lb/MMBtu)
U.S. EPA METHOD 5-B

RUN	1	2	3	4	5	6	AVG.
BASELINE TESTS	0.0020	0.0020	0.0030	0.0010	0.0030	0.0040	0.0025
20% PETROLEUM COKE TESTS	0.0040	0.0030	0.0030	0.0040	0.0030	0.0040	0.0035

SULFURIC ACID MIST (g/dscm)
U.S. EPA METHOD 8

RUN	1	2	3	4	5	6	AVG.
BASELINE TESTS	0.0023	0.0021	0.0024	0.0040	0.0142	0.0172	0.0070
20% PETROLEUM COKE TESTS	0.0011	0.0019	0.0021	0.0023	0.0025	0.0023	0.0020

CARBON MONOXIDE (Lb/MMBtu)
U.S.EPA METHOD 10

RUN	1	2	3	4	5	6	AVG.
BASELINE TESTS	0.021	0.022	0.013	0.001	0.002	0.002	0.0102
20% PETROLEUM COKE TESTS	0.002	0.002	0.001	0.002	0.002	0.003	0.0020

TABLE 4.2.1

BIG BEND STATION UNIT NO. 4
TRACE METALS FUEL ANALYSIS
STACK TEST FUEL SAMPLES
BASELINE TEST BURN
NOVEMBER 1,2,3, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 16, 17, 18 AND DECEMBER 20, 1994

ZINC (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

SAMPLE RUN	1	2	3	AVG.
BASELINE TESTS	154.0	72.2	60.6	95.6
20% PETROLEUM COKE TESTS	41.6	41.6	52.4	45.2

AVG 122 113.10

NICKEL (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

RUN	1	2	3	AVG.
BASELINE TESTS	13.6	14.3	13.3	13.7
20% PETROLEUM COKE TESTS	76.0	78.8	68.8	74.5

AVG 14.0

BERYLLIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

RUN	1	2	3	AVG.
BASELINE TESTS	0.84	0.92	0.93	0.90
20% PETROLEUM COKE TESTS	0.76	0.75	0.80	0.77

.88

TABLE 4.2.2

BIG BEND STATION UNIT NO. 4
TRACE METALS FUEL ANALYSIS
STACK TEST FUEL SAMPLES
BASELINE TEST BURN
NOVEMBER 1,2,3, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 16, 17, 18 AND DECEMBER 20, 1994

LEAD (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

RUN	1	2	3	AVG.
BASELINE TESTS	8.64	7.58	7.76	7.99
20% PETROLEUM COKE TESTS	6.91	6.51	6.42	6.61

8.11

CHROMIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

RUN	1	2	3	AVG.
BASELINE TESTS	28.9	21.4	21.8	24.0
20% PETROLEUM COKE TESTS	20.4	25.5	19.4	21.8

AVG
1/2
25.1

VANADIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

RUN	1	2	3	AVG.
BASELINE TESTS	41.9	40.7	41.9	41.5
20% PETROLEUM COKE TESTS	405.0	407.0	350.0	387.3

41.3

TABLE 4.2.3

BIG BEND STATION UNIT NO. 4
TRACE METALS FUEL ANALYSIS
STACK TEST FUEL SAMPLES
BASELINE TEST BURN
NOVEMBER 1,2,3, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 16, 17, 18 AND DECEMBER 20, 1994

MERCURY (ug/g)
ASTM D 3684–94

RUN	1	2	3	AVG.
BASELINE TESTS	0.075	0.069	0.142	0.095
20% PETROLEUM COKE TESTS	0.100	0.113	0.064	0.092

.078

N. Hogan

Baseline

TABLE 4.2.4

BIG BEND STATION UNIT NO. 4
CONTINUOUS EMISSION MONITOR DATA DURING STACK TESTS*
BASELINE TEST BURN
NOVEMBER 1,2,3, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 16,17,18, 1994

NOx (lb/MMBtu)

	DATE	11/01/94	11/2/94	11/3/94	AVG.
	TIME	10:00–18:00	09:00–19:00	10:00–19:00	
BASELINE TESTS		0.45	0.41	0.45	0.44

	DATE	11/16/94	11/17/94	11/18/94	AVG.
	TIME	08:00–17:00	08:00–11:00	08:00–12:00	
20% PETROLEUM COKE TESTS		0.50	0.52	0.55	0.52

* CONTINUOUS EMISSION MONITOR DATA CORRESPONDS TO STACK TEST DAYS AND TIME

TABLE 4.2.5

BIG BEND STATION UNIT NO. 4
CONTINUOUS EMISSION MONITOR DATA DURING STACK TESTS*
BASELINE TEST BURN
NOVEMBER 1,2,3, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 16,17,18, 1994

SO2 (lb/MMBtu) INLET
SO2 (lb/MMBtu) OUTLET
SO2 REMOVAL EFFICIENCY (%)

BASELINE TESTS	DATE	11/01/94	11/2/94	11/3/94	AVG.
	TIME	10:00–18:00	09:00–19:00	10:00–19:00	
	OUTLET	0.27	0.27	0.29	0.28
	INLET	4.92	5.07	5.06	5.02
	SO2 REMOVAL (%)	95	95	94	95

20% PETROLEUM COKE TESTS	DATE	11/16/94	11/17/94	11/18/94	AVG.
	TIME	08:00–17:00	08:00–11:00	08:00–12:00	
	OUTLET	0.62	0.57	0.40	0.53
	INLET	5.1	5.2	5.27	5.19
	SO2 REMOVAL (%)	88	89	92	90

* CONTINUOUS EMISSION MONITOR DATA CORRESPONDS TO STACK TEST DAYS AND TIME

TABLE 4.2.6

BIG BEND STATION UNIT NO. 4
CONTINUOUS EMISSION MONITOR DATA DURING STACK TESTS*
BASELINE TEST BURN
NOVEMBER 1,2,3, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 16,17,18, 1994

OPACITY (%)

	DATE	11/01/94	11/2/94	11/3/94	AVG.
	TIME	10:00–18:00	09:00–19:00	10:00–19:00	
BASELINE TESTS		6	6	7	6

	DATE	11/16/94	11/17/94	11/18/94	AVG.
	TIME	08:00–17:00	08:00–11:00	08:00–12:00	
20% PETROLEUM COKE TESTS		2 **	12	13	9

* CONTINUOUS EMISSION MONITOR DATA CORRESPONDS TO STACK TEST DAYS AND TIME

TABLE 4.2.7

4.3 FUEL ANALYSIS DATA

BIG BEND STATION UNIT NO. 4
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
OCTOBER 30, 1994 THRU NOVEMBER 5, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 10, 1994 THRU DECEMBER 1, 1994

ZINC (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

BASELINE TESTS	10-30-94 THRU 11-05-94	67.1 ug/g
20% PETROLEUM COKE TESTS	11-10-94 THRU 11-16-94	58.4 ug/g
	11-17-94 THRU 11-23-94	65.0 ug/g
	11-24-94 THRU 12-01-94	91.2 ug/g

NICKEL (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

BASELINE TESTS	10-30-94 THRU 11-05-94	12.6 ug/g
20% PETROLEUM COKE TESTS	11-10-94 THRU 11-16-94	79.2 ug/g
	11-17-94 THRU 11-23-94	71.6 ug/g
	11-24-94 THRU 12-01-94	73.8 ug/g

TABLE 4.3.1

BIG BEND STATION UNIT NO. 4
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
OCTOBER 30, 1994 THRU NOVEMBER 5, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 10, 1994 THRU DECEMBER 1, 1994

BERYLLIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

BASELINE TESTS	10-30-94 THRU 11-05-94	0.91 ug/g
20% PETROLEUM COKE TESTS	11-10-94 THRU 11-16-94	0.75 ug/g
	11-17-94 THRU 11-23-94	0.75 ug/g
	11-24-94 THRU 12-01-94	0.75 ug/g

LEAD (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

BASELINE TESTS	10-30-94 THRU 11-05-94	6.70 ug/g
20% PETROLEUM COKE TESTS	11-10-94 THRU 11-16-94	7.53 ug/g
	11-17-94 THRU 11-23-94	6.78 ug/g
	11-24-94 THRU 12-01-94	7.64 ug/g

TABLE 4.3.2

BIG BEND STATION UNIT NO. 4
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
OCTOBER 30, 1994 THRU NOVEMBER 5, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 10, 1994 THRU DECEMBER 1, 1994

CHROMIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

BASELINE TESTS	10-30-94 THRU 11-05-94	27.6 ug/g
20% PETROLEUM COKE TESTS	11-10-94 THRU 11-16-94	14.5 ug/g
	11-17-94 THRU 11-23-94	21.2 ug/g
	11-24-94 THRU 12-01-94	24.8 ug/g

VANADIUM (ug/g)
ASTM D 3683-78 (REAPPROVED 1989)

BASELINE TESTS	10-30-94 THRU 11-05-94	37.9 ug/g
20% PETROLEUM COKE TESTS	11-10-94 THRU 11-16-94	440.0 ug/g
	11-17-94 THRU 11-23-94	418.0 ug/g
	11-24-94 THRU 12-01-94	410.0 ug/g

TABLE 4.3.3

BIG BEND STATION UNIT NO. 4
TRACE METALS FUEL ANALYSIS
WEEKLY COMPOSITES
BASELINE TEST BURN
OCTOBER 30, 1994 THRU NOVEMBER 5, 1994
PETROLEUM COKE TEST BURN
NOVEMBER 10, 1994 THRU DECEMBER 1, 1994

MERCURY (ug/g)
ASTM D 3684-94

BASELINE TESTS	10-30-94 THRU 11-05-94	0.078 ug/g
20% PETROLEUM COKE TESTS	11-10-94 THRU 11-16-94	0.079 ug/g
	11-17-94 THRU 11-23-94	0.063 ug/g
	11-24-94 THRU 12-01-94	0.077 ug/g

TABLE 4.3.4

4.4 UNIT OPERATIONS SUMMARY

Boiler performance was not noticeably affected by the petroleum coke blend. No measurable differences were observed in overall boiler operation. Extensive daily computerized records exist for the baseline and petroleum test burn. The records are available for inspecton at the station but are not included because of the quantity of the material, estimated at over 400 pages. Appendix C - Boiler Precipitator Operation data shows records from all stack tests performed during test burn.

Similarly, the FGD system did not require any operational parameters changes due to the introduction of the petroleum coke. All parameters were within normal operating ranges. The emissions testing data indicates a slight degradation of the SO_2 removal efficiency. However, due to the variable nature of the process, these deviations are not unusual and should not be considered related to the petroleum.