Appendix 2

Unit 2 Electrostatic Precipitator Performance Upgrade Performance Testing

ACKNOWLEDGMENTS

The authors wish to acknowledge Mr. Dave Stafford and Mr. Dan Hill of New York State Electric & Gas Corporation for their assistance in the logistics of the field sampling effort and in assuring steady state plant operating conditions.

The authors also thank the following CONSOL on-site test personnel: Mr. L. A. Anthony, Mr. O. C. Bedillion, Jr., Mr. F. L. Lobodinsky, Mr. R. J. Morris, and Dr. J. A. Withum.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ABS	Absolute
acfm	Actual Cubic Feet per Minute
ASTM	American Society for Testing and Materials
Amps	Amperes
An	Area of Sampling Nozzle, ft^2
Avg	Average
$BaCl_2$	Barium Chloride
C-Factor	Pitot Tube Calibrations
CCT-4	Clean Coal Technology Round 4
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CONSOL R&D	CONSOL Inc., Research & Development
D_{16}	Particle Diameter (µm) at 16% Level
D_{50}	Particle Diameter (µm) at 50% Level
D_{84}	Particle Diameter (µm) at 84% Level
°F	Degrees Fahrenheit
ΔH	Dry Test Meter Orifice Calibration
dM/d log dp	Change in Mass Loading/Change in the Log of the Particle Diameter
dscf	Dry Standard Cubic Feet
dscfm	Dry Standard Cubic Feet per Minute
EPA	Environmental Protection Agency
ESP	Electrostatic Precipitator
F-Factor	Fuel Factor Relating Gas Volume to Coal Quality
fpm	Foot per Minute
ft	Foot
ft^3	Cubic foot
gr	Grains
gr/dscf	Grains per Dry Standard Cubic Foot
GMD	Geometric Mean Diameter
GSD	Geometric Standard Deviation
H_2O	Water
Hg	Mercury
hr	Hour
%ISO	Percent Isokinetic Sampling Rate
KACFM	Actual cubic feet per minute x 1000
kV	Kilovolts, Direct Current
lb/lb-Mole	Pound per Pound-Mole
lb/hr	Pound per Hour
lb/MM Btu	Pound per Million Btu Heat Input
"Hg	Inches Mercury
MACS	Miniature Acid Condensation System
µm	Micrometers
min	Minutes
MM Btu	Million British Thermal Units
MMD	Mass Median Diameter
MWe	Station Rating, Megawatts-Electric
N_2	Nitrogen

LIST OF ABBREVIATIONS (cont.)

O_2	Oxygen
0% O_2	Emissions Corrected Oxygen Free Basis
PC	Pulverized Coal
PM	Particulate Matter
PM_{10}	Particulate Matter Smaller than 10 Micrometers in Diameter
ppmv	Parts per Million, Volumetric
PRSD	Percent Relative Standard Deviation
PSD	Particle Size Distribution
QA/QC	Quality Assurance/Quality Control
"S" Pitot	Stausscheibe or Reverse Type Pitot Tube
Ft^2	Square Foot
SDEV	Standard Deviation
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
SOx	Total of SO_2 and SO_3
Std ft^3	Standard Cubic Foot
Temp	Temperature
TC	Thermocouple
tph	Tons per hour
V-I Curves	Voltage-to-Current Ratio
Vol	Volume
wt	Weight
Y-Factor	Dry Test Meter Volume Calibration

EPA METHODS

Method 1	Sample Point Selection
Method 2	Determination of Volumetric Gas Flow
Method 3	Determination of Gas Composition (ORSAT)
Method 4	Determination of Flue Gas Moisture
Method 6	Determination of SO_2 Emissions
Method 17	Determination of Particulate Matter (In-Stack Filter Method)

ABSTRACT

ESP performance parameters were measured at the NYSEG Milliken Unit 2 during the week of October 16, 1995. ESP inlet and outlet measurements included particulate, SO_2/SO_3 concentrations, and particle size distributions. Fly ash resistivity was measured at the ESP inlet. As-fired coal samples were obtained for each test day.

The measured ESP particulate removal efficiency ranged from 99.80% to 99.88% for the North ESP and from 99.91% to 99.94% for the South ESP. ESP inlet SO_3 concentrations averaged 8 ppmv (duct conditions). The average mass mean particle diameter at the ESP inlet was 11.4 μm; the mass mean diameter at the ESP outlet was 2.4 μm. Approximately 92% of the ESP outlet particulate consisted of particles smaller than 10 μm.

All the sampling data were obtained using EPA reference methods or EPA- endorsed methodology. All the sampling data, sampling methods, and coal analyses are contained in this report.

INTRODUCTION

The Unit 2 ESP Upgrade performance evaluation was conducted as part of the Milliken Clean Coal Technology Demonstration Program. The test program involved simultaneous sampling at the ESP inlet and ESP outlet for a number of species including particulate mass loading, SO_3, fly ash resistivity, and particle size. The sampling was conducted during the week of October 16, 1995. The Unit 2 boiler is equipped with a four chambered precipitator that has two separate gas passages (North and South sides). Because of this, separate sampling programs were conducted on both the North side and South side ducts. Corresponding as-fired coal samples were taken during each test period. The ESP performance data is being used in the evaluation of the EPRI ESPERT® predictive model. All of the sampling was coordinated with the control room operators to ensure that the testing was conducted under full load and normal operating conditions.

TESTING STRATEGY

Unit 2 flue gas is exhausted through two separate gas handling ducts, each equipped with an ESP. Because of this, a decision was made to test each ESP individually . The North side precipitator was evaluated on October 17-18, and the South side unit was tested on October 19-20. Triplicate particulate testing was conducted at the inlet and outlet of each precipitator. Duplicate inlet and outlet particle size distributions were determined. Four inlet and outlet SO_2/SO_3 measurements were obtained on each ESP. In addition to these parameters, fly ash resistivity measurements were conducted at both ESP inlet ducts.

MEASUREMENT PARAMETERS

ESP Inlet and outlet data were obtained for the following parameters:

Particulate Matter (PM)
Sulfur Dioxide (SO_2)
Sulfuric Trioxide (SO_3)
Particle Size Distribution
Flue Gas Composition (O_2, CO_2, N_2)
Flue Gas Moisture
Volumetric Flue Gas Flowrate
Flue Gas Temperature
Fly Ash Resistivity (Inlet Only)

A coal sample was obtained for each test day.

SAMPLING LOCATIONS

ESP Inlet - The ESP inlet sampling locations on the North and South ducts are shown in Figure 1. This sampling point is located immediately upstream of the ESP. Each duct is fitted with twelve 6" sampling ports. A sampling scheme using every other sampling port was used for the PM sampling. Sampling was conducted at port depths of 7", 21", and 35". This plan resulted in a total of six ports and 18 sampling points for each duct. PM sampling was conducted for 6 min at each point which resulted in a total sampling time of 108 min.

Particle size measurements were conducted at the mid-point in three ports for each duct. The ports were selected based on the velocity profile obtained during the PM sampling.
SO_3 sampling was conducted through ports C and I. Resistivity measurements were taken at every other port.

ESP Outlet - The two ESP outlet sampling locations are shown in Figure 1. These ducts are a mirror image of the inlet locations. Sampling was conducted in the two outlet ducts located immediately downstream of the ESP. Each duct is fitted with twelve 6" sampling ports and the sampling scheme was identical to the ESP inlet sampling previously described. PM sampling was conducted for 8 min at each point which resulted in a total sampling time of 144 min. Longer sampling times were used at this location due to the low particulate loadings.

Particle size sampling was conducted at the mid-point in two different ports for each duct. These ports were selected based on the velocity profile obtained from the PM sampling data.

SO_3 sampling was conducted through ports C and I. Resistivity measurements were taken at every other port.

As-Fired Coal Samples - Coal samples were taken from the individual gravimetric feeders located above the coal mills. This sample was obtained using the automatic samplers that were installed on each feeder. These samples were coordinated with the emission measurements. Sample size and increments were taken in accordance with ASTM procedures. At the completion of the test program, the gross coal sample was riffled down to fit into a 5 gallon bucket. These samples were then transported back to the CONSOL lab for final sample preparation and subsequent analysis.

EXPERIMENTAL

The emissions sampling was conducted using EPA reference techniques, where applicable. In cases where no suitable reference method existed, sampling was conducted using EPA endorsed methodologies or other published, well-documented procedures. A summary of the sampling procedures used in this test program is provided below.

Selection of Sampling Points - The sampling points at both locations were selected as described in EPA Method 1. Neither location met the standard EPA requirement for the minimum number of sampling points and additional sampling points were used to help offset any potential location biases.

Volumetric Flow Rate - Individual point velocities and duct volumetric flow rates were determined in conjunction with the PM sampling using the procedure outlined in EPA Method 2. The particulate sampling probes were equipped with type "S" pitot assemblies complete with thermocouples which were calibrated prior to the test program.

Gas Composition (O_2, CO_2, and N_2) - Flue gas compositions at both locations were determined using a Teledyne Model Max 5 combustion gas analyzer. This instrument uses an electrochemical sensor to determine oxygen and calculates the CO_2 concentration based on fuel chemistry. Nitrogen is determined by difference. The O_2 and CO_2 concentrations determined by this instrument were confirmed by Orsat analysis. The dry molecular weights of the flue gas samples were calculated from these data as outlined in EPA Method 3.

Flue Gas Moisture Content - Flue gas moisture was determined by measuring the condensate collected in the impinger assemblies for each of the PM samples. The impinger recovery procedure and calculations are outlined in EPA Method 4, Method 5, and Method 17.

Particulate Matter Concentrations - PM sampling was conducted at both the ESP inlet and outlet as outlined in EPA Method 17. This method specifies the use of an in-stack filter at the front end of the sampling probe. Particulate matter is defined as any material that is collected on the filter at the duct temperature and pressure. Both the ESP inlet and outlet locations had a nominal average temperature of ~290 °F and an absolute pressure of ~28.5" Hg.

A stainless steel filter canister fitted with a high efficiency ceramic filter was used at the inlet locations. This assembly can hold up to 50 g of particulate and is particularly well-suited for high particulate loading applications.

Obstructive support beams near the port locations at the ESP outlet location made Method 5 sampling difficult. Because of this, an in-stack filter system was used. Originally, a flat-pack filter was tried. However, due to filter recovery problems, this was replaced with a 63 mm in-stack stainless steel filter holder. This sampling component allowed for the use of 63 mm quartz-fiber filters. These filters have greater weight stability and are more easily recovered from the filter holder after sampling. These attributes result in more accurate mass measurements. As with the inlet sampling, the filter temperature is maintained at the flue gas temperature. Particulate matter is defined as any material that is collected on the sampling media at duct conditions of ~290 °F and an absolute pressure of ~28.5" Hg. Schematic drawings of the two particulate trains are shown in Figure 2.

SO_2 Emissions - SO_2 concentrations were measured by replacing the water solution in the PM sampling impingers with a 3% hydrogen peroxide solution. After sampling, the impinger contents were analyzed for SO_2 as described in EPA Method 6. This technique is a $BaCl_2$ titration to a thorin end point. Additional SO_2 measurements were obtained with the acid condensation sampling trains using a similar recovery and analytical procedure.

Particle Size Sampling ESP Inlet - Particle size sampling was conducted at the ESP inlet using an Andersen 5-stage cyclone sampler. This sampler is designed to operate inside of the duct (in-situ) and provides aerodynamic particle size data. The sampling protocol was conducted as outlined in the instruction manual and followed published procedures prepared by Southern Research Institute for the California Air Resource Board.

Particle Size Sampling ESP Outlet - Particle size sampling was conducted at the ESP outlet using an Andersen 7-stage impactor sampler. This sampler is designed to operate in-situ and provides aerodynamic particle size data. The sampling protocol was conducted as outlined in the instruction manual and also following published procedures prepared by Southern Research Institute for the California Air Resource Board. The impactor was fitted with a right-angle flow adapter which eliminated the need for the goose-neck inlet nozzle. The right-angle flow adapter produces a more valid size distribution.

SO_3 Measurements - SO_3 measurements were made using a CONSOL R&D modified EPA "Miniature Acid Condensation System" (MACS). In this sampling train (Figure 3), the flue gas is pulled through a heated quartz probe (500 °F) fitted with a quartz wool filter plug into a condenser packed with glass wool. The condenser temperature is maintained at ~140 °F which allows for the selective condensation of SO_3 (as sulfuric acid mist). The gas then exits the condenser and is pulled through hydrogen peroxide-filled impingers which oxidize the SO_2 to sulfate. After sampling, the quartz plug, sampling probe, condenser, and impingers are separately recovered and analyzed for sulfate using the $BaCl_2$ titration discussed in EPA Method 6. Additional SO_2 measurements are also obtained with this sampling method.

Ash Resistivity Measurements - Resistivity measurements were made using a point-to-plane fly ash resistivity probe designed and fabricated by engineers from Southern Companies. With this probe, the voltage drop across an ash layer is determined by taking the difference between the "clean plate" and "dirty plate" V-I curves and using the corresponding measured current. Measurements were also calculated using the "spark method". These methods are documented in the instructions supplied with the sampling probe.

RESULTS AND DISCUSSION

Unit 2 Operating Conditions

A variety of plant operating variables were monitored to assure steady-state, base load operations for all test periods. These data were recorded by the existing plant data system and transferred to CONSOL personnel. A summary of the major indicators of plant operations showing steady-state, base load conditions are shown in Table 1.

These data show very low daily variation. Station load, coal feed rate, gas flow rate, and $\%O_2$ at the economizer outlet showed daily variabilities of less than 1% (10/20/95 O_2 showed a PRSD of ~3%), verifying uniform daily test conditions. The weekly variation for these parameters were also very low which verify steady-state conditions for each test day. Additional process parameters indicative of uniform operation are included in Appendix A.

As-Fired Coal Analysis

Coal samples were obtained for each test day and coincided with the daily sampling activities. The proximate, ultimate and major elemental analyses completed on these samples are shown in Table 2. Key coal quality parameters are summarized in Table 3:

These data show a very consistent coal feed for the four test days, making day-to-day comparisons meaningful.

Flue Gas Flow Distribution

The flue gas flow distribution between the North and South precipitators and a comparison of flows at the inlet and outlet sampling locations, along with flue gas temperatures and velocities, are shown in Table 4.

The flue gas volumetric flow rates to each precipitator show an even split between the North and South precipitators. The percent difference between the inlet and outlet volumetric flow rates (dscfm) was ~1% for both the North and South sides. These differences are well within the uncertainty of the pitot tubes used in the measurements and are not a cause for concern. The reproducibility of the flow measurements indicates steady-state boiler operation for each of the test periods.

Particulate Sampling Results and ESP Operating Efficiency

North Side

The detailed particulate sampling data for each test on the North ESP are presented in Table 5 and are summarized in Table 6.

The average inlet loading was 3574 lb/hr, 2.487 gr/dscf, or 4.818 lb/MM Btu. These data show 24% variability (PRSD). This variability is due to the unusually high inlet loading measured for the second test and may be due to soot blowing during the test. The Unit 2 soot-blowers operate as required and are triggered by pressure differentials. There was no attempt made during this program to coordinate the sampling and soot-blowing schedules. Disregarding the second inlet PM sample, the average particulate loadings is 3158 lb/hr, 2.20 gr/dscf, and 4.24 lb/MM Btu (variability of ~5%).

The ESP outlet particulate loadings measured with the EPA Method 17 train ranged from 4 lb/hr to 6 lb/hr. The particulate removal efficiency ranged from 99.80% to 99.88% and averaged 99.85%.

South Side

The detailed particulate sampling data for each test on the South ESP are presented in Table 7 and are summarized in Table 8.

The average South side inlet particulate loading was 3349 lb/hr, 2.327 gr/dscf, or 4.51 lb/MM Btu. These data show 6% variability (PRSD).

The ESP outlet emissions measured with the EPA Method 17 train ranged from 2 lb/hr to 3 lb/hr. Particulate removal efficiencies ranged from 99.90% to 99.94% and averaged 99.91%.

The data indicate the South ESP is performing slightly better than the North ESP.

ESP Inlet Fly Ash Analysis

A summary of the analyses (including major ash elements) of the ESP inlet Method 17 samples is shown in Table 2. The carbon content for the four inlet fly ash samples collected on the North side were 2.49%, 2.95%, 3.18%, and 2.60% for an average of 2.81%. The carbon content for the three inlet fly ash samples collected on the South side were 1.61%, 2.11%, and 1.88% for an average of 1.87%.

Particle Size Distributions and PM_{10} Emissions

The particle sizing devices used in this test program separate the particulate matter entrained in the flue gas stream according to their aerodynamic properties. Aerodynamic particle size relates to how a particle behaves when subjected to centrigugal and gravitational forces and is defined as the diameter of a unit density sphere which has the same settling velocity of the particle in question. Aerodynamic particle size data for the ESP inlet and outlet are presented in Tables 9 through 12. Graphical presentations of these data showing the cumulative and differential particle size distributions are given in Appendix B. The particle size data are summarized in Table 13.

The mass median diameter is defined as the mid point of the cumulative particle size distribution. The geometric standard deviation is given by the following equation:

$$GSD = D_{84}/D_{50} = D_{50}/D_{16} = (D_{84}/D_{16})^{1/2}$$

By knowing the MMD and the GSD, the complete particle size distribution can be reconstructed providing the distribution is log-normal.

The data presented in the table above are typical of data for coal-fired PC boilers. The average particle size entering the control device is ~11.5 μm while the particles exiting the ESP show an average particle size of ~2.5 μm. These data show that approximately 90% of the ESP particulate is classified as PM_{10} (particles smaller than 10 μm - aerodynamic basis).

Particulate Removal by Particle Size

The particle size distribution data, in conjunction with the PM measurements, can be used to calculate the particulate removal by the ESP as a function of particle size. Fractional size efficiency data are summarized in Table 14 and are shown graphically in Figure 4.

As expected, the ESP collection efficiency for the larger particles (>5 μm) is higher than the collection efficiency for the smaller particles. The net operating efficiencies of the precipitators are a result of the significant fraction of large particles (>5 μm) entering the device. The South side ESP appears to be doing a better job of fine particle (<2 μm) collection than the North side ESP.

ESP Inlet and Outlet SO_2 and SO_3 Measurements

SO_2 Measurements

A series of SO_2 measurements were obtained at the ESP inlet and outlet. SO_2 concentrations were measured at the same time as the PM testing at each location. These data are shown in Tables 5 and 7 and are summarized in Table 15.

The four inlet SO_2 measurements taken over a two-day period averaged 2.42 lb/MM Btu with a PRSD of 3%. The four outlet SO_2 measurements averaged 2.46 lb/MM Btu with a PRSD of 7%. On a lb/hr basis, the inlet averaged 1794 lb/hr (PRSD = 4%) and the outlet averaged 1771 lb/hr (PRSD = 8%). The percent difference between the inlet and outlet SO_2 measurements on a lb/hr basis was 1.3%. These values show excellent agreement between the ESP inlet and outlet measurements and also excellent repeatability of the replicate measurements.

The three inlet SO_2 measurements taken over a two-day period averaged 2.52 lb/MM Btu with a PRSD of 4%. The three outlet SO_2 measurements averaged 2.61 lb/MM Btu with a PRSD of 3%. On a lb/hr basis, the inlet averaged 1871 lb/hr (PRSD = 6%) and the outlet averaged 1846 lb/hr (PRSD = 4%). The percent difference between the inlet and outlet SO_2 measurements on a lb/hr basis was 1.3%. As with the North side, these values show excellent agreement between the ESP inlet and outlet measurements and also excellent repeatability of the replicate measurements.

SO_3 Measurements

Duplicate inlet and outlet SO_3 measurements were conducted on each test day for a total of four samples for each sampling location. The SO_3 sampling technique also provides an SO_2 value. These data are shown in Tables 16 and 17 and are summarized in Table 18.

These data show very consistent ESP inlet and outlet gas phase SO_3 levels. The inlet showed an average value of 8.4 ppmv (duct conditions) with a standard deviation of 1.4 ppmv. This calculates to a PRSD of 17%. The average outlet concentration was 8.0 ppmv with a standard deviation of 1.0 ppmv (PRSD = 13%). A fourth outlet sample conducted on 10/17/95 was significantly lower than the other measurements and was not included in the statistics.

The south side results are very similar to the values obtained on the north side. The inlet showed an average value of 8.4 ppmv (duct conditions) with a standard deviation of 1.6 ppmv. This

calculates to a PRSD of 18%. The average outlet concentration was 7.7 ppmv with a standard deviation of 0.6 ppmv (PRSD = 8%).

The flue gas SO_3 concentrations at the ESP inlet and outlet are comparable for each ESP. These data, along with the volumetric gas flows and particulate loadings, verify a homogeneous boiler flue gas composition with no evidence of stratification prior to entry into the precipitators.

There is no statistical difference between the inlet and outlet SO_3 values for either precipitator.

Data in this table show a slightly higher outlet gas temperature as compared to the inlet (291°F vs. 289°F). These measurements are within the uncertainty of the measurement procedure and instrumentation and are not considered statistically different.

Fly Ash Resistivity Measurements

Fly ash resistivity measurements were conducted at the ESP inlet location. Duplicate measurements were made in six of the twelve ports (even ports) for each inlet. The field sampling sheets are included in Appendix C. Summaries of the ash resistivity results are presented in Table 19.

Run 7 on the North inlet and Run 23 on the South inlet show resistivities about an order of magnitude higher than the other runs. The field data and calculations for these runs were verified and no explanation for these readings was found.

QA/QC PROCEDURES

All of the testing and analysis was completed by trained individuals with experience specific to emission measurements and analysis. The sampling and associated QA/QC procedures were followed as prescribed in the sampling methods. All sampling was conducted under normal, base-load conditions.

Pretest calibrations were performed on the major sampling equipment, and included the pitot tubes, sampling nozzles, dry test meters, meter orifices, barometer, and temperature readouts. The analytical balance used for the gravimetric filter analyses is inspected and certified twice a year by an outside vendor. The accuracy of this balance was checked daily with class "S" standard weights. The calibration data are on file at CONSOL R&D, Library, PA.

All field data were recorded on standard forms and are contained in a file binder at CONSOL R&D. The field data sheets and calculations were checked by two senior test professionals.

The coal samples were analyzed in duplicate following standard ASTM methodology. All of the coal analyses fell well within the ASTM criteria for data quality. The analysis of standard reference material used as QC checks is available upon request.

The sampling team was in daily communication with the Unit 2 operators to assure that the unit was operating at the required test conditions. The emission data were reduced in the field to ensure data quality and accuracy.

TABLE 1

PLANT OPERATING PARAMETERS
(hourly averages for each day of testing)

Parameter	10/17/95	10/18/95	10/19/95	10/20/95	Avg
Gas Flow, kACFM PRSD	493 0.5%	500 0.7%	498 0.8%	501 0.5%	498 0.7%
Inlet Temp, °F PRSD	292 1.6%	301 1.4%	298 1.2%	302 0.8%	298 1.5%
Coal Feed, tph PRSD	54.60 0.0%	53.99 0.0%	53.99 0.0%	54.00 0.0%	54.15 0.6%
Net MW PRSD	148.5 0.3%	148.4 0.2%	147.7 0.5%	147.7 0.2%	148.1 0.3%
Economizer $\%O_2$ PRSD	4.00 0.8%	4.10 0.2%	4.10 0.2%	4.01 3.4%	4.05 1.4%
% Opacity PRSD	2.80 36%	2.37 23%	3.37 23%	1.50 22%	2.51 31%

TABLE 2

Analysis of Milliken Boiler Feed Coal Samples

As–Fired Basis

Coal ID	1	2	3	4	AVG	SDEV	PRSD
Volatile Matter	36.24	36.69	36.04	36.11	36.27	0.29	0.8%
Ash	6.56	6.61	6.77	6.79	6.69	0.11	1.7%
Carbon	73.53	73.71	73.83	73.67	73.68	0.12	0.2%
Hydrogen	4.79	4.84	4.72	4.75	4.77	0.05	1.1%
Nitrogen	1.46	1.49	1.48	1.47	1.47	0.01	0.8%
Sulfur	1.72	1.76	1.74	1.76	1.75	0.02	1.1%
Oxygen	4.99	5.32	5.08	5.33	5.18	0.17	3.3%
Total Moisture	6.96	6.27	6.39	6.23	6.46	0.34	0.05
Btu/lb	13035	13141	13096	13112	13096	45	0.3%
F_d Factor, O_2[1]	9993	9928	9952	9918	9948	34	0.3%
F Factor, CO_2[2]	1811	1800	1810	1803	1806	5	0.3%

Dry Basis

Coal ID	1	2	3	4	AVG	SDEV	PRSD
Volatile Matter	38.95	39.15	38.50	38.51	38.78	0.32	0.8%
Ash	7.05	7.06	7.23	7.25	7.15	0.11	1.5%
Carbon	79.02	78.64	78.87	78.56	78.77	0.21	0.3%
Hydrogen	5.14	5.16	5.04	5.06	5.10	0.06	1.2%
Nitrogen	1.57	1.59	1.58	1.57	1.57	0.01	0.6%
Sulfur	1.85	1.88	1.86	1.88	1.87	0.01	0.8%
Oxygen	5.36	5.68	5.43	5.68	5.54	0.17	3.0%
Btu/lb	14010	14020	13990	13984	14001	17	0.1%
F_d Factor, O_2[1]	9881	9827	9849	9819	9844	28	0.3%
F Factor, CO_2[2]	1811	1800	1810	1803	1806	5	0.3%

Analysis of Major Ash Elements, % of Dry Ash

SiO_2	48.63	47.23	46.42	47.47	47.44	0.91	1.9%
Al_2O_3	24.05	23.37	23.20	23.26	23.47	0.39	1.7%
TiO_2	0.98	0.98	0.94	0.95	0.96	0.02	2.1%
Fe_2O_3	17.83	19.21	18.72	17.26	18.26	0.87	4.8%
CaO	2.72	2.78	2.85	2.98	2.83	0.11	3.9%
MgO	0.78	0.75	0.77	0.82	0.78	0.03	3.8%
Na_2O	0.65	0.61	0.64	0.69	0.65	0.03	5.1%
K_2O	1.77	1.67	1.69	1.79	1.73	0.06	3.4%
P_2O_5	0.50	0.50	0.50	0.49	0.50	0.00	1.0%
LiO_2	0.02	0.02	0.02	0.02	0.02	0.00	0.0%
SO_3	2.28	2.27	2.55	2.82	2.48	0.26	10.5%
Undetermined	−0.21	0.61	1.70	1.45	0.89	0.87	97.7%

1 & 2 – F Factor is in units of dscf of flue gas produced per MM Btu Heat input using O_2 or CO_2 as the dilution gas.

TABLE 2 (Cont'd)

North Side ESP Inlet Ash Analysis, % Dry Basis

	10/17 am	10/17 pm	10/18 am	10/18 pm	AVG	SDEV	PRSD
Moisture	0.55	0.43	0.49	0.40	0.47	0.07	14.2%
Ash	96.69	96.30	95.97	96.76	96.43	0.37	0.4%
Carbon	2.49	2.95	3.18	2.60	2.81	0.32	11.3%
Sulfur	0.47	0.47	0.46	0.42	0.46	0.02	5.2%
SiO_2	47.67	47.34	46.54	47.05	47.15	0.48	1.0%
Al_2O_3	23.13	22.99	22.79	23.07	23.00	0.15	0.6%
TiO_2	1.06	1.08	1.07	1.10	1.08	0.02	1.6%
Fe_2O_3	16.79	17.07	17.60	17.76	17.31	0.45	2.6%
CaO	2.73	2.57	2.51	2.66	2.62	0.10	3.7%
MgO	0.75	0.75	0.73	0.75	0.75	0.01	1.3%
Na_2O	0.67	0.67	0.64	0.66	0.66	0.01	2.1%
K_2O	1.71	1.71	1.65	1.69	1.69	0.03	1.7%
P_2O_5	0.47	0.50	0.49	0.48	0.49	0.01	2.7%
LiO_2	0.02	0.02	0.02	0.02	0.02	0.00	0.0%
SO_3	1.18	1.18	1.14	1.04	1.14	0.07	5.8%
Undetermined	3.82	4.12	4.82	3.72	4.12	0.50	12.1%

South Side ESP Inlet Ash Analysis, % Dry Basis

	10/19 am	10/19 pm	10/20		AVG	SDEV	PRSD
Moisture	0.51	0.43	0.40		0.45	0.05	12.0%
Ash	97.55	97.29	97.54		97.46	0.14	0.1%
Carbon	1.61	2.11	1.88		1.87	0.24	12.6%
Sulfur	0.49	0.42	0.43		0.45	0.04	8.0%
SiO_2	48.55	48.12	48.14		48.27	0.23	0.5%
Al_2O_3	23.38	23.36	23.61		23.45	0.13	0.6%
TiO_2	1.05	1.11	1.05		1.07	0.03	3.1%
Fe_2O_3	17.09	17.32	17.94		17.45	0.41	2.4%
CaO	2.69	2.70	2.78		2.72	0.05	1.7%
MgO	0.75	0.77	0.77		0.76	0.01	1.4%
Na_2O	0.66	0.66	0.66		0.66	0.00	0.0%
K_2O	1.71	1.74	1.72		1.72	0.01	0.8%
P_2O_5	0.50	0.49	0.51		0.50	0.01	1.9%
LiO_2	0.02	0.02	0.02		0.02	0.00	0.0%
SO_3	1.23	1.05	1.08		1.12	0.09	8.1%
Undetermined	2.37	2.66	1.72		2.25	0.45	20.2%

TABLE 3

SUMMARY OF DAILY COAL SAMPLE ANALYSES
(Results on Dry Basis)

Parameter	Average	SDEV	PRSD
Total Moisture, %	6.5	0.3	5.2
Carbon, %	78.77	0.21	0.3
Sulfur, %	1.87	0.01	0.8
Ash, %	7.15	0.11	1.5
Volatile Matter, %	38.78	0.32	0.8
Heating Value, Btu/lb	14001	17	0.1
F-Factor, dscf flue gas per MM Btu heat input	9844	28	0.3

TABLE 4

FLUE GAS FLOW DISTRIBUTION

Avg Measurements for All Test Periods	North Inlet	North Outlet	South Inlet	South Outlet
Flue Gas Temp, °F	292	294	296	289
Flue Gas Velocity, fpm	37.8	37.2	38.5	37.5
Volumetric Flow, acfm (PRSD)	270,000 3.7%	265,500 2.9%	275,000 3.1%	267,700 2.1%
Volumetric Flow, dscfm (PRSD)	167,500 2.4%	165,700 1.2%	167,800 2.3%	166,700 1.3%

TABLE 5
MILLIKEN UNIT 2 ESP PERFORMANCE TESTING

North Side ESP

Location			ESP IN	ESP IN	ESP OUT	ESP IN	ESP OUT	ESP IN	ESP OUT	ESP OUT
Test #			#1	#2	#1	#3	#2	#4	#3	#4
Date			10-17-95	10-17-95	10-17-95	10-18-95	10-18-95	10-18-95	10-18-95	10-18-95
Start Time			0935	1430	0935	0839	0835	1250	1220	1520
Stop Time			1150	1640	1225	1030	1142	1440	1520	1720
Sample Type			M-17	M-17	M-17	M-17	M-17	M-17	M-17	M-17
SAMPLING DATA:										
Y factor of dry gas meter	–		0.973	0.973	0.996	0.973	0.996	0.973	0.996	0.996
Gas Volume	–	ft^3	54.81	57.46	85.09	59.56	112.85	60.19	91.13	92.70
Delta H of dry gas meter	–	" H_2O	0.70	0.74	1.19	0.79	1.31	0.80	1.31	1.35
Meter Temperature	–	°F	105.5	116.8	102.1	128.7	121.7	130.1	117.7	117.4
C Factor of pitot tube	–		0.761	0.761	0.774	0.761	0.774	0.761	0.774	0.774
Nozzle Diameter	–	in	0.246	0.246	0.274	0.246	0.274	0.246	0.274	0.274
An (area of nozzle)	–	ft^2	0.00033	0.00033	0.00041	0.00033	0.00041	0.00033	0.00041	0.00041
Area of Stack	–	ft^2	119	119	119	119	119	119	119	119
H_2O Weight	–	grams	71.9	70.9	106.6	83.9	139.6	91.5	132.1	125.7
Sample Time	–	min	108	108	144	108	180	108	144	144
Barometric Pressure	–	" Hg	29.70	29.75	29.70	29.54	29.54	29.51	29.51	29.48
Static Pressure	–	" H_2O	-17.0	-16.3	-17.7	-17.3	-17.0	-17.3	-17.0	-17.0
% Oxygen	–		5.6	5.9	6.0	5.6	6.0	6.0	6.2	6.0
% Carbon Dioxide	–		13.4	13.1	13.0	13.4	13.0	13.0	12.8	13.0
% N_2 + CO	–		81.0	81.0	81.0	81.0	81.0	81.0	81.0	81.0
Stack Temp (Dry Bulb)	–	°F	287	291	273	292	291	296	294	296
"S" sample (avg vel pressure)	–	" H_2O	0.347	0.369	0.335	0.395	0.353	0.399	0.355	0.370
Dust Wt.	–	grams	6.8036	11.0943	0.0200	7.4694	0.0214	7.4687	0.0135	0.0158
CALCULATED DATA:										
DSCF SAMPLED	–	ft^3	49.49	50.96	79.22	51.41	101.01	51.77	82.05	83.43
ABS ST PRES	–	" Hg	28.45	28.55	28.40	28.27	28.29	28.24	28.26	28.23
ABS ST TEMP	–	°R	747	751	733	752	751	756	754	756
H_2O	–	% by Vol	6.40	6.15	5.96	7.14	6.11	7.69	7.05	6.63
Water Volume	–	ft^3	3.39	3.34	5.02	3.95	6.58	4.31	6.22	5.92
Dry Molecular Weight	–	lb/lb-Mole	30.37	30.33	30.32	30.37	30.32	30.32	30.30	30.32
Wet Molecular Weight	–	lb/lb-Mole	29.58	29.57	29.59	29.49	29.57	29.37	29.43	29.50
% Excess Air	–		35.5	38.1	39.0	35.5	39.0	39.0	40.8	39.0
Dry Mole Frac.	–		0.936	0.939	0.940	0.929	0.939	0.923	0.930	0.934
Wet Mole Frac.	–		0.064	0.061	0.060	0.071	0.061	0.077	0.070	0.066
GAS FLOW DATA:										
Gas Velocity	–	fps	36.11	37.27	35.77	38.84	37.25	39.23	37.54	38.35
acfm	–		257818	266112	255411	277284	265975	280126	268027	273793
dscfm	–		162182	167556	164217	170823	166004	170454	164782	168466
Excess Air Free dscfm	–		118727	120256	117073	125052	118348	121520	115899	120102
PARTICULATE LOADING:										
Grains/dscf	–		2.121	3.359	0.0039	2.242	0.0033	2.226	0.0025	0.0029
lb/hr	–		2950	4826	5.5	3283	4.7	3254	3.6	4.2
lb/MM Btu	–		4.09	6.61	0.008	4.30	0.006	4.39	0.005	0.006
ESP Collection Efficiency					99.82%		99.85%		99.89%	99.87%
% ISOKINETIC	–		101.99	101.64	97.47	100.59	98.35	101.49	100.61	100.06
SO2 CALCULATIONS:										
lb/dscf	–		1.74E-04	1.77E-04	1.60E-04	1.79E-04	1.79E-04	1.84E-04	1.84E-01	1.89E-04
lb/hr	–		1692	1784	1579	1831	1783	1880	1819	1913
ppmv @ Duct Conditions	–		1100	1121	1012	1131	1131	1161	1161	1196
ppmv @ 0% O_2	–		1503	1562	1420	1544	1586	1629	1651	1677
lb/MM Btu (O_2 Based)	–		2.35	2.44	2.22	2.40	2.47	2.53	2.57	2.61
COAL ANALYSIS:										
% Carbon			79.02	79.02	79.02	78.64	78.64	78.64	78.64	78.64
% Hydrogen			5.14	5.14	5.14	5.16	5.16	5.16	5.16	5.16
% Nitrogen			1.57	1.57	1.57	1.59	1.59	1.59	1.59	1.59
% Sulfur			1.85	1.85	1.85	1.88	1.88	1.88	1.88	1.88
% Oxygen			5.37	5.37	5.37	5.67	5.67	5.67	5.67	5.67
% Ash			7.05	7.05	7.05	7.06	7.06	7.06	7.06	7.06
% Volatile Matter			38.95	38.95	38.95	39.15	39.15	39.15	39.15	39.15
Btu/lb			14010	14010	14010	14020	14020	14020	14020	14020
Carbon Conversion			99.90%	99.90%	99.90%	99.90%	99.90%	99.90%	99.90%	99.90%
Calculated Feed Rate, lb/hr (dry)			50055	50555	49169	52976	49945	51284	48814	50685
F-Factor			9880	9880	9880	9828	9828	9828	9828	9828
Moisture			7.0%	7.0%	7.0%	6.3%	6.3%	6.3%	6.3%	6.3%
Calculated F-Factor Finng Rate, lb/hr-dry			102932	104257	101498	108909	103070	105832	100937	104598
Calculated F-Factor Finng Rate, lb/hr-wet			110679	112104	109138	116231	110000	112948	107724	111630
ASH ANALYSIS:										
% Ash			96.69	96.31	----	95.97	----	96.76	----	----
% Carbon			2.49	2.95	----	3.18	----	2.60	----	----
% Sulfur			0.47	0.47	----	0.46	----	0.42	----	----
Calculated MWe Rating			146	148	144	154	146	150	143	148

02-Dec-95

O:\APPRES\STACK\NYSEG95\M17-1

TABLE 6

NORTH SIDE ESP INLET AND OUTLET PARTICULATE SUMMARY

	Test 1	Test 2	Test 3	Test 4	Test 5*	Avg	PRSD
Date	10/17	10/17	10/18	10/18	10/18	---	---
Inlet, lb/hr	2946	4820	3279	3250	---	3574	24%
Inlet, gr/dscf	2.121	3.359	2.242	2.226	---	2.487	24%
Inlet, lb/MM Btu	4.06	6.55	4.29	4.37	---	4.818	24%
Outlet, lb/hr	6	---	5	4	4	5	18%
Outlet, gr/dscf	0.004	---	0.003	0.003	0.003	0.003	17%
Outlet, lb/MM Btu	0.008	---	0.006	0.005	0.006	0.006	21%
ESP Efficiency, mass	99.80	---	99.85	99.88	99.88	99.85	---
ESP Efficiency, conc.	99.81	---	99.87	99.87	99.87	99.88	---

* - ESP efficiency for Test 5 was calculated from the average inlet loading from Tests 3 and 4.

TABLE 7
MILLIKEN UNIT 2 ESP PERFORMANCE TESTING

South Side ESP

Location			ESP IN	ESP OUT	ESP IN	ESP OUT	ESP IN	ESP OUT
Test #			#1	#1	#2	#2	#3	#3
Date			10-19-95	10-19-95	10-19-95	10-19-95	10-20-95	10-20-95
Start Time			0835	0839	1350	1150	0825	0815
Stop Time			1025	1150	1550	1500	1025	1030
Sample Type			M-17	M-17	M-17	M-17	M-17	M-17
SAMPLING DATA:								
Y factor of dry gas meter	–		0.973	0.996	0.973	0.996	0.973	0.996
Gas Volume	–	ft^3	54.41	87.56	57.59	88.44	61.14	93.38
Delta H of dry gas meter	–	" H_2O	0.74	1.24	0.79	1.27	0.82	1.37
Meter Temperature	–	°F	97.7	103.2	97.9	103.4	123.9	125.1
C Factor of pitot tube	–		0.761	0.774	0.761	0.774	0.761	0.774
Nozzle Diameter	–	in	0.246	0.274	0.246	0.274	0.246	0.274
A n (area of nozzle)	–	ft^2	0.00033	0.00041	0.00033	0.00041	0.00033	0.00041
Area of Stack	–	ft^2	119	119	119	119	119	119
H_2O Weight	–	grams	86.6	121.8	95.9	129.7	93.0	134.4
Sample Time	–	min	108	144	108	144	108	144
Barometric Pressure	–	" Hg	29.65	29.65	29.65	29.60	29.46	29.46
Static Pressure	–	" H_2O	-17.5	-16.3	-17.0	-16.3	-17.0	-16.5
% Oxygen	–		5.7	6.5	5.9	6.3	5.8	6.5
% Carbon Dioxide	–		13.3	12.5	13.1	12.7	13.2	12.5
% N_2 + CO	–		81.0	81.0	81.0	81.0	81.0	81.0
Stack Temp (Dry Bulb)	–	°F	290	286	298	289	300	290
"S" sample (avg vel pressure)	–	" H_2O	0.370	0.349	0.381	0.355	0.410	0.373
Dust Wt.	–	grams	7.8308	0.0099	7.4413	0.0099	8.1563	0.0092
CALCULATED DATA:								
DSCF SAMPLED	–	ft^3	49.74	81.24	52.64	81.89	53.05	82.89
ABS ST PRES	–	" Hg	28.36	28.45	28.40	28.40	28.21	28.25
ABS ST TEMP	–	°R	750	746	758	749	760	750
H_2O	–	% by Vol	7.58	6.60	7.90	6.94	7.63	7.10
Water Volume	–	ft^3	4.08	5.74	4.52	6.11	4.38	6.33
Dry Molecular Weight	–	lb/lb-Mole	30.36	30.26	30.33	30.28	30.34	30.26
Wet Molecular Weight	–	lb/lb-Mole	29.42	29.45	29.36	29.43	29.40	29.39
% Excess Air	–		36.3	43.7	38.1	41.8	37.2	43.7
Dry Mole Frac.	–		0.924	0.934	0.921	0.931	0.924	0.929
Wet Mole Frac.	–		0.076	0.066	0.079	0.069	0.076	0.071
GAS FLOW DATA:								
Gas Velocity	–	fps	37.52	36.88	38.29	37.32	39.88	38.41
acfm	–		267876	263349	273387	266462	284710	274255
dscfm	–		165224	165553	166473	165929	172271	169345
Excess Air Free dscfm	–		120163	114065	119478	115912	124464	116678
PARTICULATE LOADING:								
Grains/dscf	–		2.429	0.002	2.181	0.002	2.372	0.002
lb/hr	–		3441	3	3114	3	3504	2
lb/MM Btu	–		4.70	0.004	4.28	0.004	4.61	0.003
ESP Collection Efficiency				99.92%		99.91%		99.93%
% ISOKINETIC	–		100.61	99.14	105.67	99.72	102.92	98.89
SO2 CALCULATIONS:								
lb/dscf	–		1.87E-04	1.83E-04	1.77E-04	1.80E-04	1.94E-04	1.91E-04
lb/hr	–		1855	1814	1763	1793	2003	1938
ppmv @ Duct Conditions	–		1183	1151	1115	1136	1225	1202
ppmv @ 0% O_2	–		1627	1671	1554	1627	1695	1745
lb/MM.Btu (O_2 Based)	–		2.53	2.61	2.42	2.54	2.63	2.72
COAL ANALYSIS:								
% Carbon			78.87	78.87	78.87	79.37	78.56	78.56
% Hydrogen			5.04	5.04	5.04	5.04	5.06	5.06
% Nitrogen			1.58	1.58	1.58	1.58	1.57	1.57
% Sulfur			1.86	1.86	1.86	1.86	1.88	1.88
% Oxygen			5.42	5.42	5.42	5.42	5.68	5.68
% Ash			7.23	7.23	7.23	7.23	7.25	7.25
% Volatile Matter			38.50	38.50	38.50	38.50	38.51	38.51
Btu/lb			13990	13990	13990	13990	13984	13984
Carbon Conversion			99.90%	99.90%	99.90%	99.90%	99.90%	99.90%
Calculated Feed Rate, lb/hr (dry)			50709	47754	50324	48628	52681	49040
F-Factor			9850	9850	9850	9850	9818	9818
Moisture			6.40%	6.40%	6.40%	6.40%	6.20%	6.20%
Calculated F-Factor Firing Rate, lb/hr-dry			104637	99327	104041	100936	108786	101981
Calculated F-Factor Firing Rate, lb/hr-wet			111792	106119	111155	107837	115976	108722
ASH ANALYSIS:								
% Ash			97.55	----	97.29	----	97.55	----
% Carbon			1.61	----	2.11	----	1.88	----
% Sulfur			0.49	----	0.42	----	0.42	----
Calculated MWe Rating			148	140	147	143	154	144

TABLE 8

SOUTH SIDE ESP INLET AND OUTLET PARTICULATE SUMMARY

	Test 1	Test 2	Test 3	Avg	PRSD
Date	10/19	10/19	10/20	---	---
Inlet, lb/hr	3437	3110	3500	3349	6%
Inlet, gr/dscf	2.429	2.181	2.372	2.327	6%
Inlet, lb/MM Btu	4.68	4.26	4.60	4.51	5%
Outlet, lb/hr	3	3	2	3	5%
Outlet, gr/dscf	0.002	0.002	0.002	0.002	<5%
Outlet, lb/MM Btu	0.004	0.004	0.003	0.004	<5%
ESP Efficiency, mass	99.91	99.90	99.94	99.91	---
ESP Efficiency, conc.	99.92	99.91	99.92	99.91	---

TABLE 9

NYSEG MILLIKEN STATION ESP INLET & OUTLET PARTICLE SIZE DATA

SOUTHERN RESEARCH FIVE STAGE CYCLONE SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 17, 1995
LOCATION – ESP INLET UNIT 2 – NORTH TIME – 1240–1400

TABULAR PRESENTATION OF CYCLONE DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
1	7.5	5.4770	75.39	24.61	2.11E+00	1.88E+00	27.5	3165.5
2	3.5	1.3619	18.75	5.86	5.25E–01	1.58E+00	5.1	787.1
3	2.5	0.2514	3.46	2.40	9.69E–02	6.40E–01	3.0	145.3
4	1.1	0.0944	1.30	1.10	3.64E–02	1.04E–01	1.7	54.6
5	0.64	0.0329	0.45	0.65	1.27E–02	5.24E–02	0.8	19.0
Filter	0.32	0.0472	0.65	---	1.82E–02	6.05E–02	0.45	27.3
TOTALS		7.2647	100.00		2.80			4199

acfm = 0.837 MMD = 11.0 μm
% ISO = 98.1 GSD = 2.3 μm
% H_2O = 5.6 % < 10μm = 47%

ANDERSEN SEVEN STAGE IMPACTOR SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 17, 1995
LOCATION – ESP OUTLET UNIT 2 – NORTH TIME – 1336–1655

TABULAR PRESENTATION OF IMPACTOR DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
PRE	7.6	0.0060	20.69	79.31	6.52E–04	5.82E–04	27.52	0.903
1	4.5	0.0051	17.59	61.72	5.54E–04	2.41E–03	5.81	0.767
2	2.8	0.0051	17.59	44.14	5.54E–04	2.82E–03	3.55	0.767
3	1.8	0.0060	20.69	23.45	6.52E–04	3.40E–03	2.27	0.903
4	1.1	0.0012	4.14	19.31	1.30E–04	6.07E–04	1.42	0.181
5	0.73	0.0017	5.86	13.45	1.85E–04	1.01E–03	0.90	0.256
6	0.44	0.0010	3.45	10.00	1.09E–04	4.86E–04	0.56	0.150
7	0.19	0.0008	2.76	7.24	8.69E–05	2.35E–04	0.28	0.120
Filter	0.09	0.0021	7.24	---	2.28E–04	7.58E–04	0.13	0.316
TOTALS		0.0290	100.00		0.0031			4.4

acfm = 1.135 MMD = 3.4 μm
% ISO = 6.3 GSD = 3.3 μm
% H_2O = 98.0 % < 10μm = 88%

O:\APPRES\STACK\NYSEG95\PS-1

11/01/95

TABLE 10

NYSEG MILLIKEN STATION ESP INLET & OUTLET PARTICLE SIZE DATA

SOUTHERN RESEARCH FIVE STAGE CYCLONE SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 18, 1995
LOCATION – ESP INLET UNIT 2 – NORTH TIME – 1018–1140

TABULAR PRESENTATION OF CYCLONE DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
1	7.5	5.0734	79.26	20.74	1.90E+00	1.69E+00	27.3	2855.4
2	3.5	1.0465	16.35	4.40	3.92E–01	1.18E+00	5.1	589.0
3	2.5	0.1800	2.81	1.58	6.74E–02	4.48E–01	2.9	101.3
4	1.1	0.0435	0.68	0.90	1.63E–02	4.63E–02	1.6	24.5
5	0.62	0.0205	0.32	0.58	7.66E–03	3.15E–02	0.8	11.5
Filter	0.31	0.0374	0.58	---	1.40E–02	4.65E–02	0.44	21.0
TOTALS		6.4013	100.00		2.40			3603

acfm = 0.859 MMD = 11.5 μm
% ISO = 100.8 GSD = 2.4 μm
% H_2O = 5.1 % < 10μm= 47%

ANDERSEN SEVEN STAGE IMPACTOR SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 18, 1995
LOCATION – ESP OUTLET UNIT 2 – NORTH TIME – 1345–1724

TABULAR PRESENTATION OF IMPACTOR DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
PRE	7.3	0.0036	14.57	85.43	4.30E–04	3.79E–04	27.08	0.604
1	4.3	0.0024	9.72	75.71	2.87E–04	1.23E–03	5.60	0.403
2	2.7	0.0034	13.77	61.94	4.07E–04	2.07E–03	3.41	0.571
3	1.8	0.0055	22.27	39.68	6.58E–04	3.46E–03	2.19	0.923
4	1.1	0.0016	6.48	33.20	1.91E–04	8.86E–04	1.37	0.268
5	0.69	0.0018	7.29	25.91	2.15E–04	1.14E–03	0.86	0.302
6	0.42	0.0013	5.26	20.65	1.55E–04	7.09E–04	0.54	0.218
7	0.17	0.0014	5.67	14.98	1.67E–04	4.28E–04	0.27	0.235
Filter	0.08	0.0037	14.98	---	4.42E–04	1.47E–03	0.12	0.621
TOTALS		0.0247	100.00		0.0030			4.1

acfm = 1.171 MMD = 2.0 μm
% ISO = 6.6 GSD = 3.2 μm
% H_2O = 97.7 % < 10μm= 92%

TABLE 11

NYSEG MILLIKEN STATION ESP INLET & OUTLET PARTICLE SIZE DATA

SOUTHERN RESEARCH FIVE STAGE CYCLONE SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 19, 1995
LOCATION – ESP INLET UNIT 2 – SOUTH TIME – 1120–1250

TABULAR PRESENTATION OF CYCLONE DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
1	7.2	5.4758	85.19	14.81	2.04E+00	1.79E+00	26.9	2899.6
2	3.3	0.6664	10.37	4.44	2.48E–01	7.34E–01	4.9	352.9
3	2.3	0.1634	2.54	1.90	6.09E–02	3.97E–01	2.8	86.5
4	1.0	0.0652	1.01	0.89	2.43E–02	6.88E–02	1.6	34.5
5	0.59	0.0201	0.31	0.58	7.48E–03	3.09E–02	0.8	10.6
Filter	0.30	0.0370	0.58	– – –	1.38E–02	4.58E–02	0.42	19.6
TOTALS		6.4279	100.00		2.40			3404

acfm = 0.890 MMD = 11.5 μm
% ISO = 107.1 GSD = 2.3 μm
% H_2O = 7.3 % < 10μm= 47%

ANDERSEN SEVEN STAGE IMPACTOR SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 19, 1995
LOCATION – ESP OUTLET UNIT 2 – SOUTH TIME – 1235–1540

TABULAR PRESENTATION OF IMPACTOR DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
PRE	7.3	0.0035	15.42	84.58	4.15E–04	3.66E–04	27.08	0.582
1	4.3	0.0018	7.93	76.65	2.14E–04	9.14E–04	5.60	0.299
2	2.7	0.0033	14.54	62.11	3.91E–04	1.99E–03	3.41	0.549
3	1.8	0.0037	16.30	45.81	4.39E–04	2.31E–03	2.19	0.616
4	1.1	0.0028	12.33	33.48	3.32E–04	1.54E–03	1.37	0.466
5	0.69	0.0015	6.61	26.87	1.78E–04	9.44E–04	0.86	0.250
6	0.42	0.0007	3.08	23.79	8.30E–05	3.78E–04	0.54	0.116
7	0.17	0.0016	7.05	16.74	1.90E–04	4.88E–04	0.27	0.266
Filter	0.09	0.0038	16.74	– – –	4.51E–04	1.50E–03	0.12	0.632
TOTALS		0.0227	100.00		0.0027			3.8

acfm = 1.168 MMD = 2.0 μm
% ISO = 6.8 GSD = 3.0 μm
% H_2O = 98.5 % < 10μm= 92%

O:\APPRES\STACK\NYSEG\PS-3 11/01/95

TABLE 12

NYSEG MILLIKEN STATION ESP INLET & OUTLET PARTICLE SIZE DATA

SOUTHERN RESEARCH FIVE STAGE CYCLONE SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 20, 1995
LOCATION – ESP INLET UNIT 2 – SOUTH TIME – 1300–1430

TABULAR PRESENTATION OF CYCLONE DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
1	7.3	5.3029	81.43	18.57	2.04E+00	1.80E+00	27.1	2966.0
2	3.4	1.0007	15.37	3.20	3.85E−01	1.14E+00	5.0	559.7
3	2.4	0.1397	2.14	1.06	5.37E−02	3.56E−01	2.8	78.1
4	1.1	0.0298	0.46	0.60	1.15E−02	3.23E−02	1.6	16.7
5	0.60	0.0107	0.16	0.43	4.10E−03	1.68E−02	0.8	6.0
Filter	0.30	0.0283	0.43	---	1.09E−02	3.62E−02	0.43	15.8
TOTALS		6.5121	100.00		2.50			3642

acfm = 0.887 MMD = 11.5 μm
% ISO = 101.4 GSD = 2.4 μm
% H_2O = 8.1 % < 10μm= 47%

ANDERSEN SEVEN STAGE IMPACTOR SAMPLING SUMMARY

PLANT – Milliken Station DATE – October 20, 1995
LOCATION – ESP OUTLET UNIT 2 – SOUTH TIME – 1121–1425

TABULAR PRESENTATION OF IMPACTOR DATA

STAGE	D_{50}	MASS	MASS %	CUM %	GR/DSCF	dM/dLOG dp	GMD	LBS/HR
PRE	6.9	0.0035	14.29	85.71	4.04E−04	3.49E−04	26.36	0.580
1	4.0	0.0023	9.39	76.33	2.65E−04	1.11E−03	5.27	0.381
2	2.5	0.0032	13.06	63.27	3.69E−04	1.88E−03	3.19	0.530
3	1.7	0.0059	24.08	39.18	6.81E−04	3.64E−03	2.05	0.978
4	1.0	0.0044	17.96	21.22	5.08E−04	2.33E−03	1.29	0.729
5	0.63	0.0025	10.20	11.02	2.88E−04	1.45E−03	0.80	0.414
6	0.39	0.0016	6.53	4.49	1.85E−04	8.70E−04	0.50	0.265
7	0.15	0.0006	2.45	2.04	6.92E−05	1.62E−04	0.24	0.099
Filter	0.07	0.0005	2.04	---	5.77E−05	1.92E−04	0.10	0.083
TOTALS		0.0245	100.00		0.0028			4.1

acfm = 1.222 MMD = 2.2 μm
% ISO = 7.1 GSD = 2.7 μm
% H_2O = 98.9 % < 10μm= 95%

O:\APPRES\STACK\NYSEG\PS-4 11/01/95

TABLE 13

SUMMARY OF PARTICLE SIZE SAMPLING DATA

	North Inlet		South Inlet		Avg
ESP Inlet Data:					
Test Date	10/17	10/18	10/19	10/20	---
Mass Median Diameter, µm	11.0	11.5	11.5	11.5	11.4
GSD, µm	2.3	2.4	2.3	2.4	2.4
$\%PM_{10}$	47%	47%	47%	47%	47%
ESP Outlet Data:					
Test Date	10/17	10/18	10/19	10/20	---
Mass Median Diameter, µm	3.4	2.0	2.0	2.2	2.4
GSD, µm	3.3	3.2	3.0	2.7	3.1
$\%PM_{10}$	88%	92%	92%	95%	92%

TABLE 14

ESP REMOVAL BY PARTICLE SIZE

Size Interval	ESP Inlet gr/dscf	ESP Outlet gr/dscf	Particulate Removal Efficiency
North Side			
< 1 µm	0.0229	0.0008	96.51%
1 µm to 2 µm	0.0259	0.0006	97.68%
2 µm to 5 µm	0.3884	0.0011	99.72%
5 µm to 10 µm	0.7434	0.0007	99.91%
> 10 µm	1.3310	0.0003	99.98%
Net Particulate	2.51	0.0035	99.86%
South Side			
< 1 µm	0.0163	0.0005	96.93%
1 µm to 2 µm	0.0305	0.0004	98.69%
2 µm to 5 µm	0.3508	0.0005	99.86%
5 µm to 10 µm	0.7015	0.0003	99.96%
> 10 µm	1.2395	0.0002	99.98%
Net Particulate	2.34	0.0019	99.92%

TABLE 15

ESP INLET AND OUTLET SO_2 CONCENTRATIONS

	10/17/95			10/18/95				
	Inlet (am)	Outlet (am/pm)	Inlet (pm)	Inlet (am)	Outlet (am)	Inlet (pm)	Outlet (pm, 1)	Outlet (pm, 2)
North								
ppmv, (duct)	1103	1015	1124	1134	1134	1164	1165	1199
ppmv, (0% O_2)	1507	1424	1566	1548	1590	1633	1656	1681
lb/hr	1690	1577	1781	1829	1781	1877	1817	1911
lb/MM Btu	2.33	2.20	2.42	2.39	2.46	2.53	2.56	2.60

	10/19/95				10/20/95	
	Inlet (am)	Outlet (am)	Inlet (pm)	Outlet (pm)	Inlet (am)	Outlet (pm)
South						
ppmv, (duct)	1187	1154	1118	1139	1228	1205
ppmv, (0% O_2)	1632	1675	1558	1631	1700	1750
lb/hr	1853	1812	1761	1791	2000	1935
lb/MM Btu	2.52	2.60	2.41	2.53	2.63	2.71

TABLE 16

Milliken Unit #2 North Duct SO_3 Sampling

TEST	#1	#2	#3	#4	#1	#2	#3	#4
DATE	10/17/95	10/17/95	10/18/95	10/18/95	10/17/95	10/17/95	10/18/95	10/18/95
START TIME	1110	1545	0936	1305	1110	1420	0930	1420
END TIME	1210	1645	1036	1405	1210	1520	1030	1520
LOCATION	ESP Inlet Samples				ESP Outlet Samples			
METER VARIABLES								
SAMPLE TIME [min]	60	60	60	60	60	60	60	60
BAROMETRIC PRESSURE [" Hg]	29.70	29.75	29.53	29.51	29.70	29.75	29.53	29.49
SAMPLE VOLUME [ft ^{3}]	5.60	5.77	6.05	5.66	5.27	5.43	5.30	5.36
METER TEMPERATURE [° F]	93.5	100.0	112.0	110.0	93.4	95.0	111.3	109.4
ORIFICE PRESSURE [" H_2O]	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Y FACTOR	1.022	1.022	1.022	1.022	0.990	0.990	0.990	0.990
DSCF SAMPLED	5.417	5.526	5.631	5.283	4.940	5.083	4.784	4.848
CONDENSER TEMP [° F]	135	138	140	142	145	145	138	138
CC/MIN @ COND	2881	2954	3020	2842	2671	2749	2557	2591
DUCT OXYGEN [%]	5.90	6.30	5.10	8.10	6.20	6.20	6.40	5.95
DUCT TEMP DURING TEST [° F]	292	293	305	282	294	281	283	298
SO_2								
SO_2 in IMPINGERS								
lb/dscf	1.76E-04	1.72E-04	1.95E-04	1.64E-04	1.64E-04	1.76E-04	1.80E-04	1.93E-04
ppmv, As Sampled	1061	1040	1180	988	990	1062	1087	1167
ppmv, @ 0% Oxygen	1478	1489	1561	1614	1533	1530	1566	1632
ppmv, @ Duct Conditions	1061	1040	1180	988	1078	1076	1087	1167
SO_3					(1)			
SO_3 in PROBE								
lb/dscf	2.72E-07	1.64E-07	3.02E-07	2.79E-07	2.07E-07	2.90E-07	2.61E-07	4.92E-07
ppmv, As Sampled	1.3	0.8	1.5	1.4	1.0	1.4	1.3	2.4
ppmv, @ 0% Oxygen	1.8	1.1	1.9	2.2	1.5	2.0	1.8	3.3
ppmv, @ Duct Conditions	1.3	0.8	1.5	1.4	1.1	1.4	1.3	2.4
SO_3 in CONDENSER								
lb/dscf	1.28E-06	1.46E-06	1.88E-06	1.35E-06	6.21E-07	1.14E-06	1.40E-06	1.38E-06
ppmv, As Sampled	6.2	7.1	9.1	6.5	3.0	5.5	6.8	6.7
ppmv, @ 0% Oxygen	8.6	10.1	12.0	10.7	4.6	7.9	9.8	9.3
ppmv, @ Duct Conditions	6.2	7.1	9.1	6.5	3.3	5.6	6.8	6.7
GAS PHASE SO_3 [lb/dscf]	1.55E-06	1.62E-06	2.18E-06	1.63E-06	8.28E-07	1.43E-06	1.66E-06	1.87E-06
GAS PHASE SO_3 [Duct ppmv]	**7.5**	**7.8**	**10.5**	**7.9**	**4.4**	**7.0**	**8.0**	**9.1**
GAS PHASE SO_3, 0% OXYGEN	**10.4**	**11.2**	**13.9**	**12.9**	**6.2**	**10.0**	**11.6**	**12.7**
% SO_3 in TOTAL SO_x	*0.70%*	*0.75%*	*0.88%*	*0.79%*	*0.40%*	*0.65%*	*0.73%*	*0.77%*

(1) – This sample not included in statistical analysis.

Data Summary	Inlet	Outlet
Avg Gas Phase SO_3 [Duct ppmv]	8.4	8.0
Standard Deviation	1.4	1.0
PRSD	17%	13%
Avg Gas Phase SO_3 [0% O_2 ppmv]	12.1	11.4
Standard Deviation	1.6	1.4
PRSD	12.9%	11.9%
% SO_3 in Total SO_x	0.78%	0.72%

TABLE 17

Milliken Unit #2 South Duct SO_3 Sampling

TEST	#1	#2	#3	#4	#1	#2	#3	#4
DATE	10/19/95	10/19/95	10/20/95	10/20/95	10/19/95	10/19/95	10/20/95	10/20/95
START TIME	0930	1232	0945	1145	0910	1050	0825	1025
END TIME	1030	1332	1045	1245	1010	1150	0925	1125
LOCATION	ESP Inlet Samples				ESP Outlet Samples			
METER VARIABLES								
SAMPLE TIME [min]	60	60	60	60	60	60	60	60
BAROMETRIC PRESSURE [" Hg]	29.65	29.60	29.46	29.46	29.65	29.64	29.47	29.46
SAMPLE VOLUME [ft ^{3}]	4.90	5.52	5.65	6.03	6.58	6.07	6.23	6.11
METER TEMPERATURE [° F]	82.3	78.6	113.9	104.8	88.6	90.0	115.2	115.9
ORIFICE PRESSURE [" H_2O]	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Y FACTOR	1.022	1.022	1.022	1.022	0.990	0.990	0.990	0.990
DSCF SAMPLED	4.830	5.469	5.229	5.671	6.211	5.713	5.574	5.459
CONDENSER TEMP [° F]	138	138	140	140	138	137	138	140
CC/MIN @ COND	2581	2923	2804	3041	3319	3048	2979	2927
DUCT OXYGEN [%]	5.80	8.20	6.90	8.00	6.40	6.70	6.90	7.20
DUCT TEMP DURING TEST [° F]	299	276	297	284	289	287	296	292
SO_2								
SO_2 in IMPINGERS								
lb/dscf	1.90E-04	1.63E-04	1.77E-04	1.68E-04	1.73E-04	1.79E-04	1.78E-04	1.83E-04
ppmv, As Sampled	1151	985	1070	1018	1046	1081	1077	1108
ppmv, @ 0% Oxygen	1593	1621	1598	1649	1507	1591	1608	1690
ppmv, @ Duct Conditions	1151	985	1070	1018	1046	1081	1077	1108
SO_3								
SO_3 in PROBE								
lb/dscf	6.16E-07	2.62E-07	3.16E-07	3.69E-07	3.55E-07	2.89E-07	3.36E-07	3.64E-07
ppmv, As Sampled	3.0	1.3	1.5	1.8	1.7	1.4	1.6	1.8
ppmv, @ 0% Oxygen	4.1	2.1	2.3	2.9	2.5	2.1	2.4	2.7
ppmv, @ Duct Conditions	3.0	1.3	1.5	1.8	1.7	1.4	1.6	1.8
SO_3 in CONDENSER								
lb/dscf	1.48E-06	1.09E-06	1.56E-06	1.26E-06	1.21E-06	1.18E-06	1.44E-06	1.23E-06
ppmv, As Sampled	7.2	5.3	7.5	6.1	5.8	5.7	7.0	6.0
ppmv, @ 0% Oxygen	9.9	8.7	11.3	9.9	8.4	8.4	10.4	9.1
ppmv, @ Duct Conditions	7.2	5.3	7.5	6.1	5.8	5.7	7.0	6.0
GAS PHASE SO_3 [lb/dscf]	2.10E-06	1.35E-06	1.88E-06	1.63E-06	1.56E-06	1.47E-06	1.78E-06	1.60E-06
GAS PHASE SO_3 [Duct ppmv]	10.1	6.5	9.1	7.9	7.6	7.1	8.6	7.7
GAS PHASE SO_3, 0% OXYGEN	14.0	10.7	13.5	12.8	10.9	10.4	12.8	11.8
% SO_3 in TOTAL SO_x	*0.87%*	*0.66%*	*0.84%*	*0.77%*	*0.72%*	*0.65%*	*0.79%*	*0.69%*

Data Summary	Inlet	Outlet
Avg Gas Phase SO_3 [Duct ppmv]	8.4	7.7
Standard Deviation	1.6	0.6
PRSD	18%	8%
Avg Gas Phase SO_3 [0% O_2 ppmv]	12.8	11.5
Standard Deviation	1.4	1.1
PRSD	11.3%	9.2%
% SO_3 in Total SO_x	0.79%	0.71%

TABLE 18

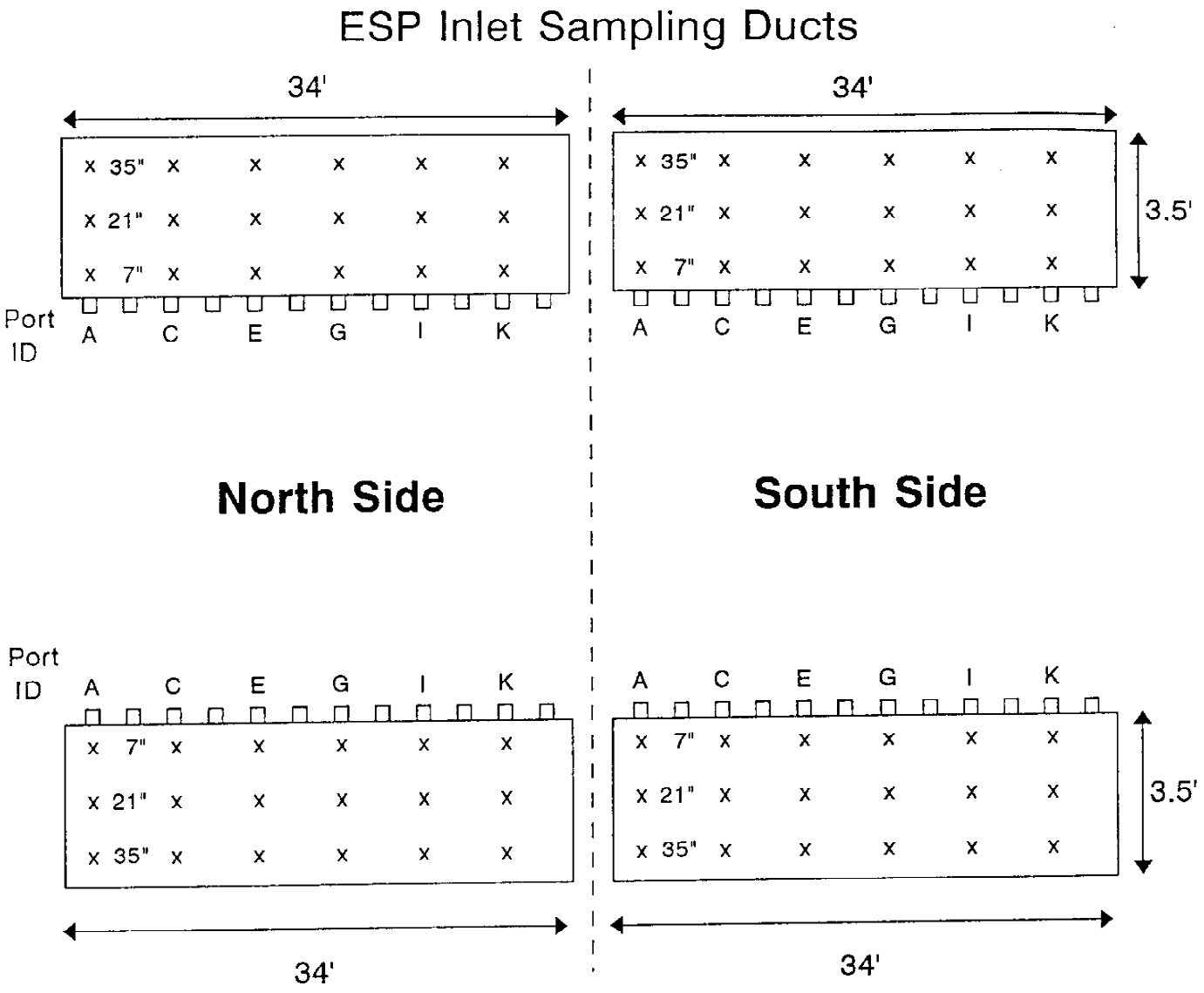
ESP INLET AND OUTLET SO_3 MEASUREMENTS

	Inlet (4 Samples)		Outlet (3 Samples)	
	Average	SDEV	Average	SDEV
North				
Flue Gas Temp, °F	293	9	287	9
Flue Gas O_2, %	6.3	1.2	6.2	0.2
Gas Phase SO_3, ppmv (duct)	8.4	1.4	8.0	1.0
Gas Phase SO_3, ppmv (0% O_2)	12.1	1.6	11.4	1.4
SO_2, ppmv (duct)	1070	81	1105	55
SO_2, ppmv (0% O_2)	1535	64	1576	52
% SO_3 in total SOx	0.78	0.08	0.72	0.06
	Inlet (4 Samples)		**Outlet (4 Samples)**	
	Average	**SDEV**	**Average**	**SDEV**
South				
Flue Gas Temp, °F	289	11	291	4
Flue Gas O_2, %	7.2	1.1	6.8	0.4
Gas Phase SO_3, ppmv (duct)	8.4	1.6	7.7	0.6
Gas Phase SO_3, ppmv (0% O_2)	12.8	1.4	11.5	1.1
SO_2, ppmv (duct)	1056	72	1078	25
SO_2, ppmv (0% O_2)	1615	26	1599	75
% SO_3 in total SOx	0.79	0.09	0.71	0.06

TABLE 19

ASH RESISTIVITY SUMMARY

	Date	Port	Temp, °F	Resistivity, ohms
North				
Run 1	10/17	B	297	4.49×10^{10}
Run 2	10/17	D	291	3.90×10^{10}
Run 3	10/17	F	288	2.09×10^{10}
Run 4	10/17	H	299	2.68×10^{10}
Run 5	10/17	J	289	3.02×10^{10}
Run 6	10/17	L	278	1.72×10^{10}
Run 7	10/18	B	302	1.39×10^{11}
Run 8	10/18	D	293	4.74×10^{10}
Run 9	10/18	F	297	4.23×10^{10}
Run 10	10/18	H	305	3.86×10^{10}
Run 11	10/18	J	297	3.30×10^{10}
Run 12	10/18	L	278	1.37×10^{10}
	Date	**Port**	**Temp, °F**	**Resistivity, ohms**
South				
Run 13	10/19	B	289	2.02×10^{10}
Run 14	10/19	D	299	2.93×10^{10}
Run 15	10/19	F	293	3.87×10^{10}
Run 16	10/19	H	277	2.07×10^{10}
Run 17	10/19	J	295	3.43×10^{10}
Run 18	10/19	L	304	3.69×10^{10}
Run 19	10/20	B	295	2.20×10^{10}
Run 20	10/20	D	302	4.67×10^{10}
Run 21	10/20	F	292	1.98×10^{10}
Run 22	10/20	H	280	2.29×10^{10}
Run 23	10/20	J	300	2.25×10^{11}
Run 24	10/20	L	300	2.58×10^{10}



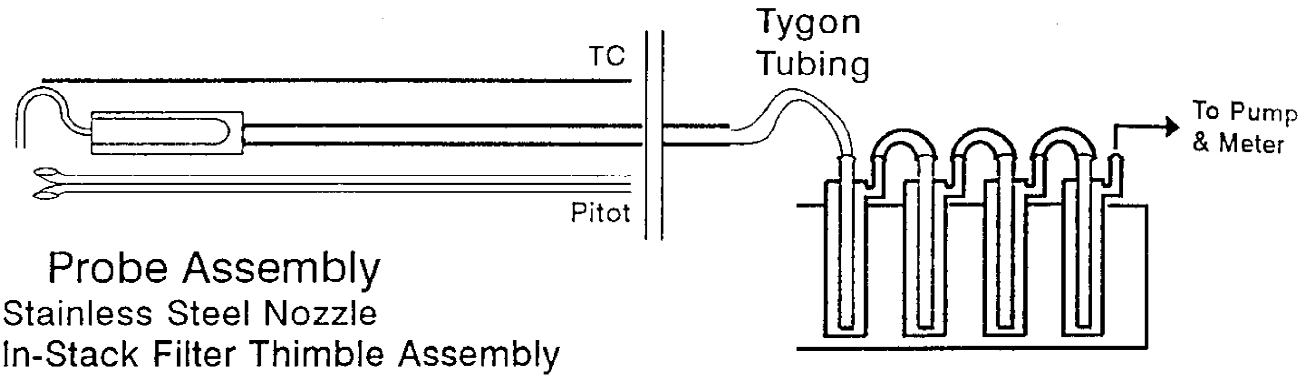
Total Ports Sampled per Duct- 6
Total Points Sampled per Duct- 18
Cross-Sectional Areas - 119 sq ft

Figure 1 - Milliken Unit #2 ESP Sampling Locations

O:\APPRES\STACK\NYSEG95\PORTS

EPA Method 17 Particulate Sampling Trains

(ESP Inlet Sampling with Ceramic Thimble)



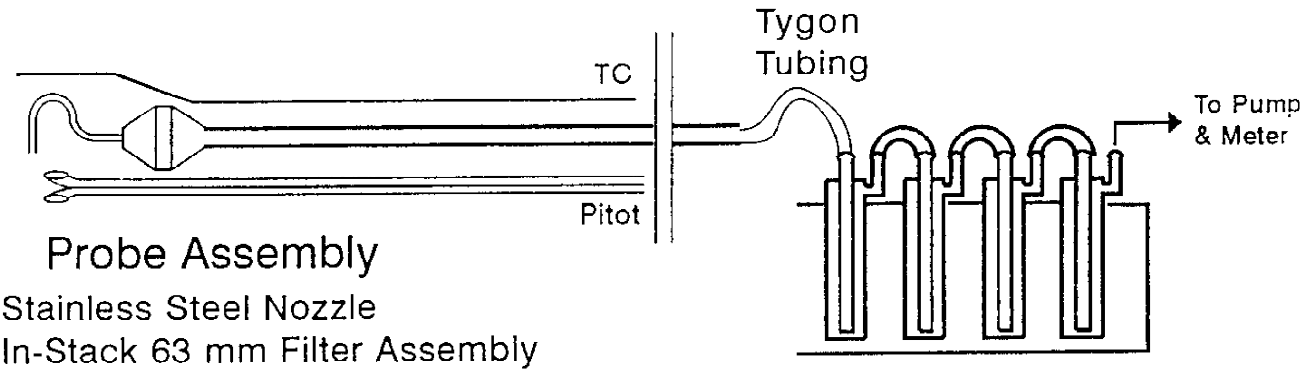
Probe Assembly

Stainless Steel Nozzle
In-Stack Filter Thimble Assembly
Ceramic Filter Thimble
Pitot Tube
Stack Thermocouple

Impinger Assembly

#1 & 2 - 3% H_2O_2
#3 - Blank
#4 - Silica Gel

(ESP Outlet Sampling with Quartz-Fiber Filter Disk)



Probe Assembly

Stainless Steel Nozzle
In-Stack 63 mm Filter Assembly
63 mm Quartz-Fiber Filter
Pitot Tube
Stack Thermocouple

Impinger Assembly

#1 & 2 - 3% H_2O_2
#3 - Blank
#4 - Silica Gel

Figure 2 - Schematics of Particulate Sampling Trains

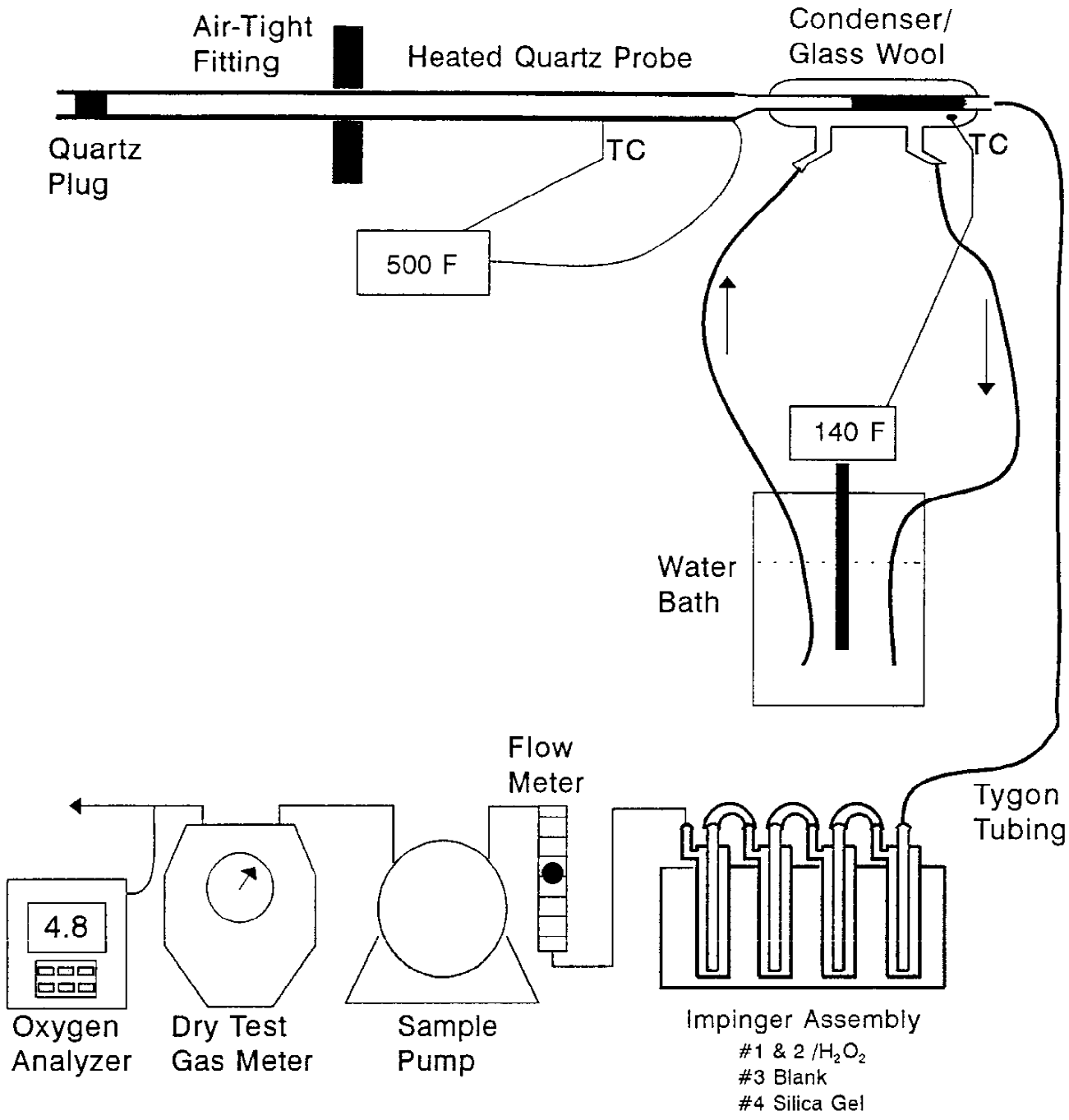


Figure 3 - CONSOL R&D SO_3 Sampling Train

Milliken Unit #2 - ESP Data

ESP Particulate Removal by Size - October, 1995

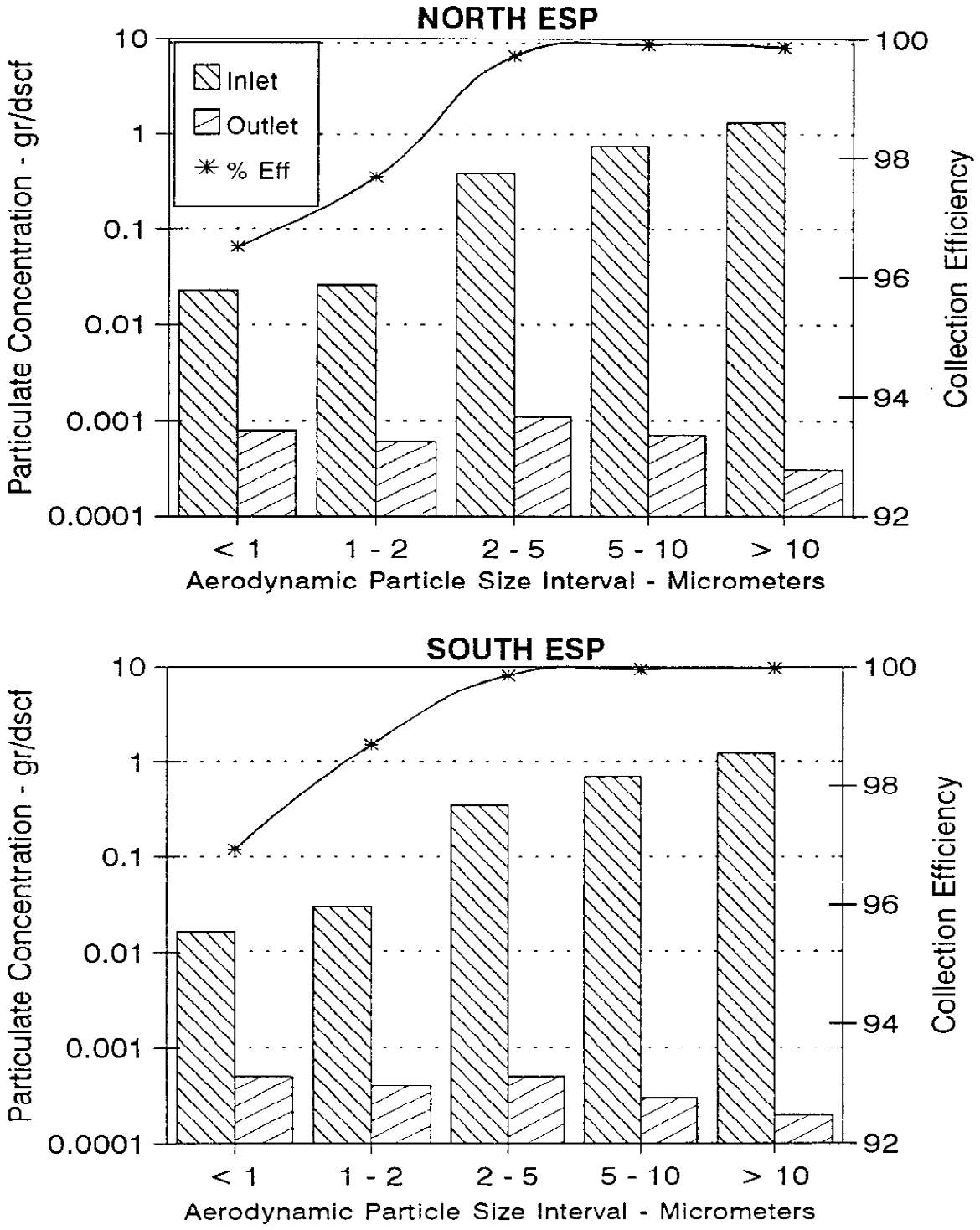


Figure 4 - Particulate Removal by Particle Size

APPENDIX A

Milliken Unit #2 Operating Conditions

10/17/95
10/18/95
10/19/95
10/20/95

NYSEG – Milliken Unit #2 Operating Data

October 17, 1995

Time	ESP Inlet Gas			Avg Coal Flow, tph	Station Net MW	$\%O_2$ at Econ. Exit	Avg Opacity
	Gas Flow kACFM	Temp, °F	ppmv, SO_2				
0800	491	285	1006	54.60	148.7	3.98	2.54
0900	490	286	1004	54.61	148.2	4.00	3.62
1000	490	288	991	54.60	148.2	3.98	3.77
1100	493	290	1004	54.60	147.8	3.98	4.07
1200	492	290	1008	54.60	148.6	3.98	3.89
1300	490	291	1038	54.60	148.2	3.98	3.38
1400	498	293	991	54.60	148.1	3.98	1.97
1500	495	295	1002	54.60	148.7	4.00	1.77
1600	492	297	1009	54.60	148.7	4.00	2.65
1700	495	298	1021	54.60	149.0	4.02	1.81
1800	493	297	1021	54.59	148.9	4.08	1.28
Avg	493	292	1009	54.60	148.5	4.00	2.80
SDEV	3	5	14	0.00	0.4	0.03	0.99
PRSD	0.5%	1.6%	1.4%	0.0%	0.3%	0.8%	35.6%

October 18, 1995

Time	ESP Inlet Gas			Avg Coal Flow, tph	Station Net MW	$\%O_2$ at Econ. Exit	Avg Opacity
	Gas Flow kACFM	Temp, °F	ppmv, SO_2				
0800	492	294	1044	53.99	148.1	4.10	2.62
0900	499	294	1020	53.99	148.1	4.08	2.23
1000	500	297	1024	53.99	148.6	4.11	2.77
1100	502	300	1028	54.00	148.2	4.11	2.94
1200	496	300	1036	54.00	148.3	4.09	2.70
1300	500	302	1014	53.99	148.2	4.09	2.67
1400	503	303	1012	53.99	148.3	4.11	2.37
1500	505	304	1008	53.99	148.3	4.09	1.72
1600	502	304	1025	54.00	148.9	4.09	1.55
1700	502	306	1035	53.99	149.0	4.10	1.48
1800	504	306	1013	54.01	148.9	4.10	3.03
Avg	500	301	1024	53.99	148.4	4.10	2.37
SDEV	4	4	11	0.01	0.3	0.01	0.56
PRSD	0.7%	1.4%	1.1%	0.0%	0.2%	0.2%	23.4%

NYSEG – Milliken Unit #2 Operating Data

October 19, 1995

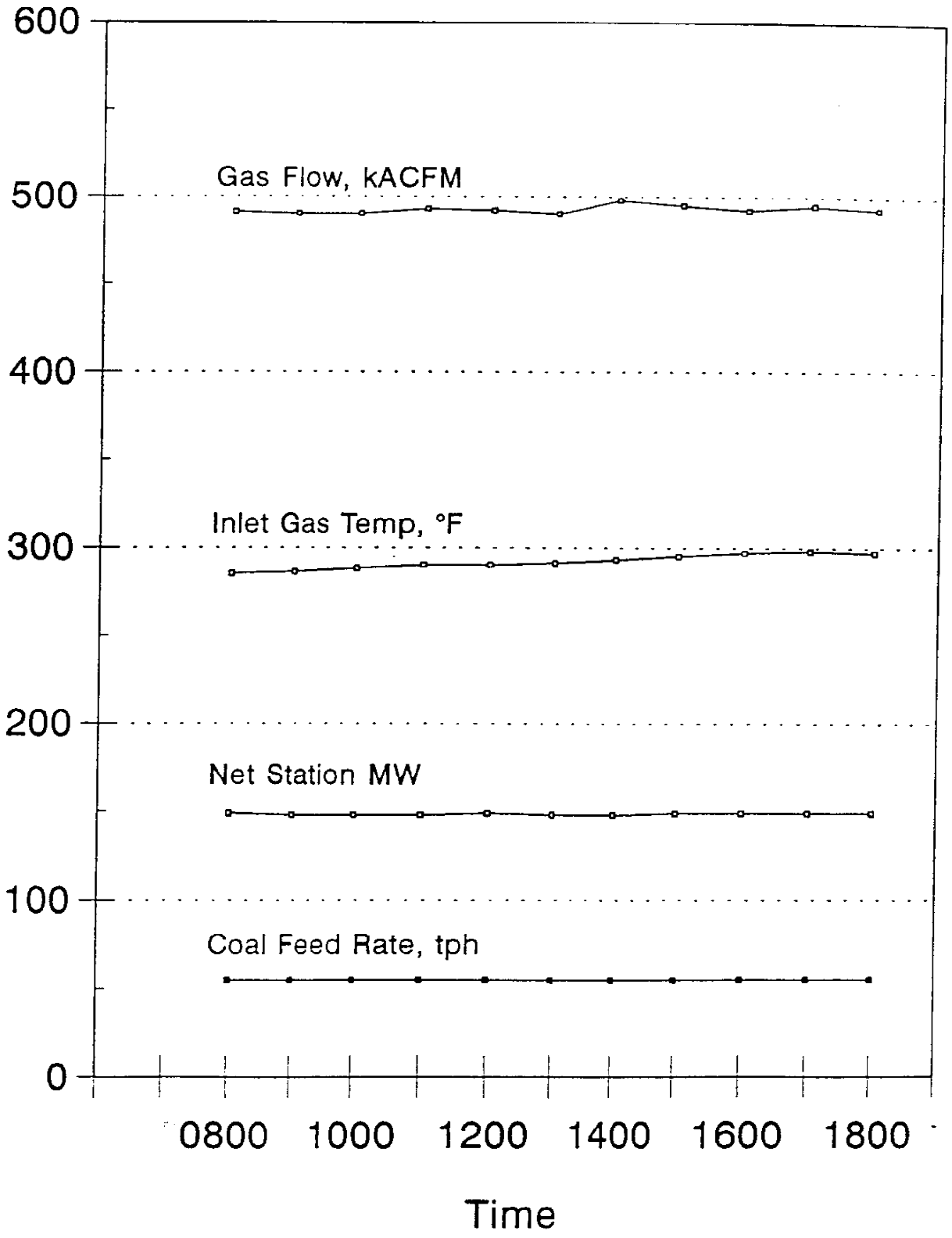
Time	ESP Inlet Gas			Avg Coal Flow, tph	Station Net MW	$\%O_2$ at Econ. Exit	Avg Opacity
	Gas Flow kACFM	Temp, °F	ppmv, SO_2				
0800	495	293	1006	53.99	146.6	4.11	4.62
0900	491	294	996	53.99	146.6	4.09	4.35
1000	492	295	985	53.99	147.0	4.10	4.33
1100	497	296	997	54.00	147.1	4.08	3.77
1200	499	296	980	54.01	148.1	4.10	3.13
1300	502	298	989	53.98	148.2	4.10	3.07
1400	498	300	967	53.98	148.3	4.10	3.10
1500	503	301	973	53.98	148.3	4.10	2.45
1600	502	302	978	54.00	148.3	4.11	2.55
1700	502	303	991	53.98	148.2	4.09	2.65
1800	499	303	971	54.01	148.0	4.10	3.08
Avg	498	298	985	53.99	147.7	4.10	3.37
SDEV	4	4	12	0.01	0.7	0.01	0.77
PRSD	0.8%	1.2%	1.2%	0.0%	0.5%	0.2%	22.9%

October 20, 1995

Time	ESP Inlet Gas			Avg Coal Flow, tph	Station Net MW	$\%O_2$ at Econ. Exit	Avg Opacity
	Gas Flow kACFM	Temp, °F	ppmv, SO_2				
0800	502	300	1012	54.00	147.9	4.10	1.67
0900	499	299	1016	53.99	147.9	4.09	1.19
1000	498	299	1040	54.01	147.8	4.10	1.31
1100	505	301	1044	54.00	148.1	4.10	1.32
1200	503	302	1034	53.99	148.1	4.09	1.14
1300	501	303	1024	53.99	147.5	4.11	1.37
1400	502	304	1022	53.99	147.4	4.10	1.48
1500	501	305	1021	54.00	147.4	4.06	1.20
1600	504	305	1018	54.00	147.7	3.80	1.99
1700	502	305	1008	53.99	147.4	3.80	2.08
1800	497	304	1003	54.00	147.8	3.80	1.73
Avg	501	302	1022	54.00	147.7	4.01	1.50
SDEV	2	2	13	0.01	0.3	0.14	0.33
PRSD	0.5%	0.8%	1.3%	0.0%	0.2%	3.4%	21.7%

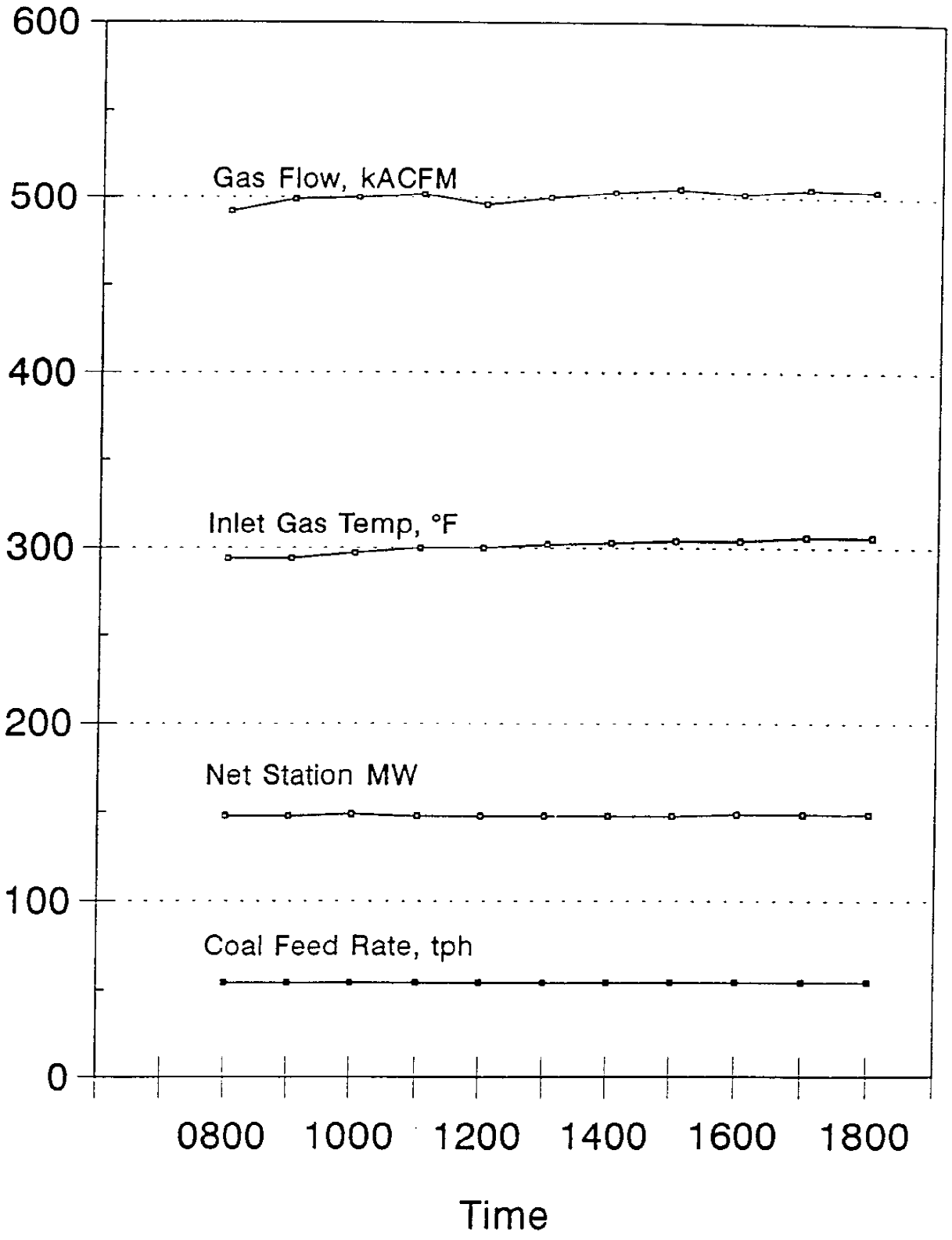
Milliken Unit #2 Operating Data

October 17, 1995



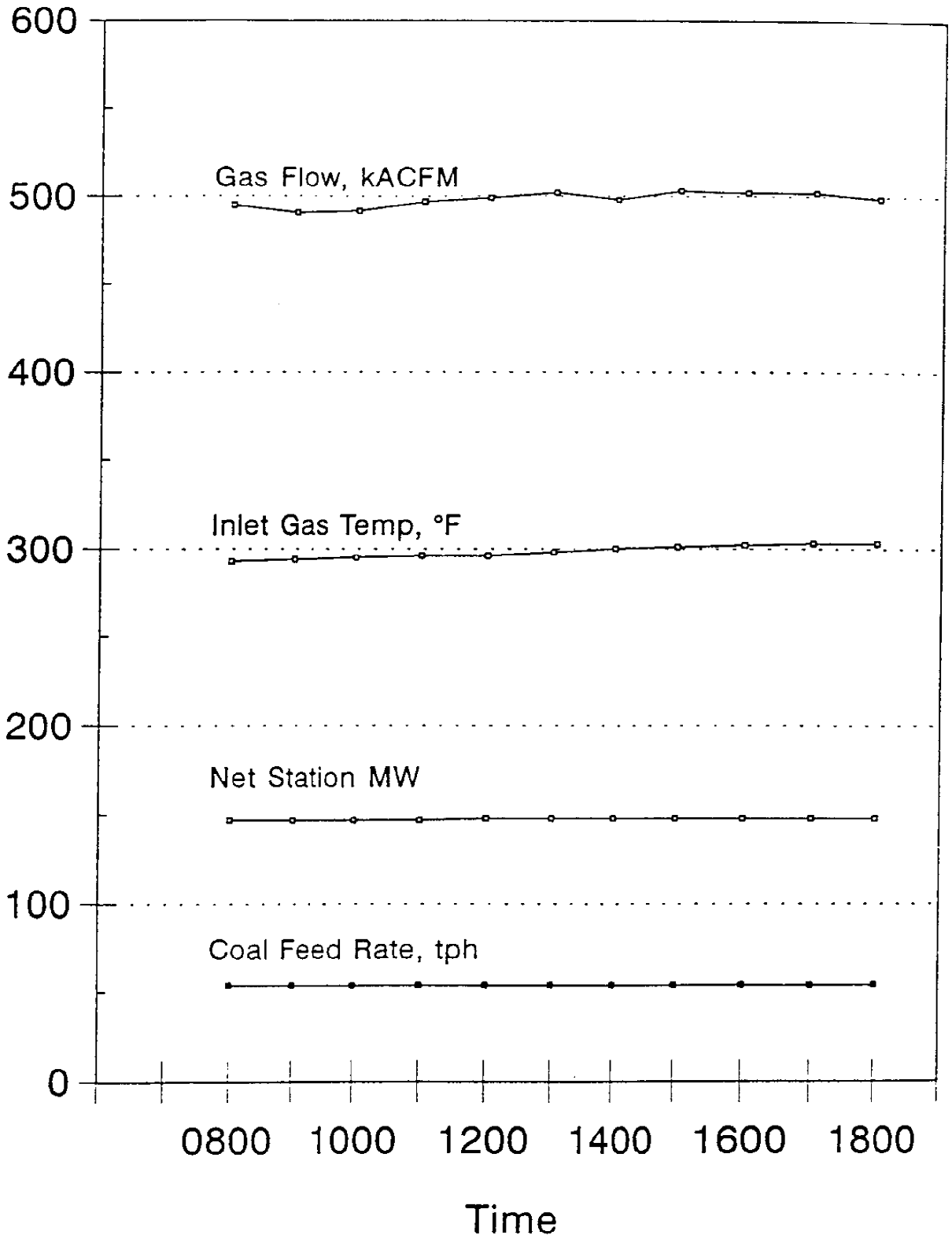
Milliken Unit #2 Operating Data

October 18, 1995



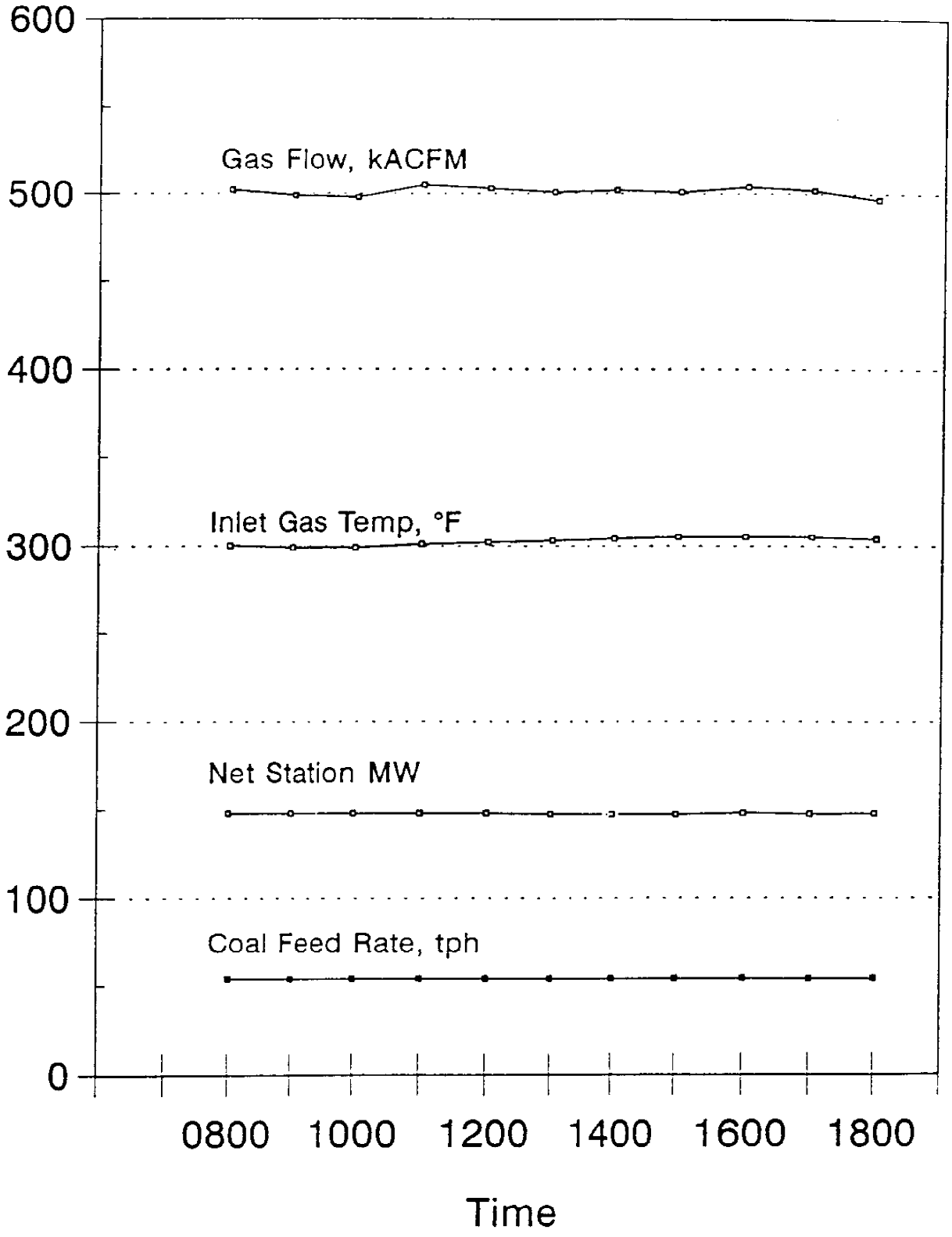
Milliken Unit #2 Operating Data

October 19, 1995



Milliken Unit #2 Operating Data

October 20, 1995



APPENDIX B

Cumulative and Differential Particle Size Graphs

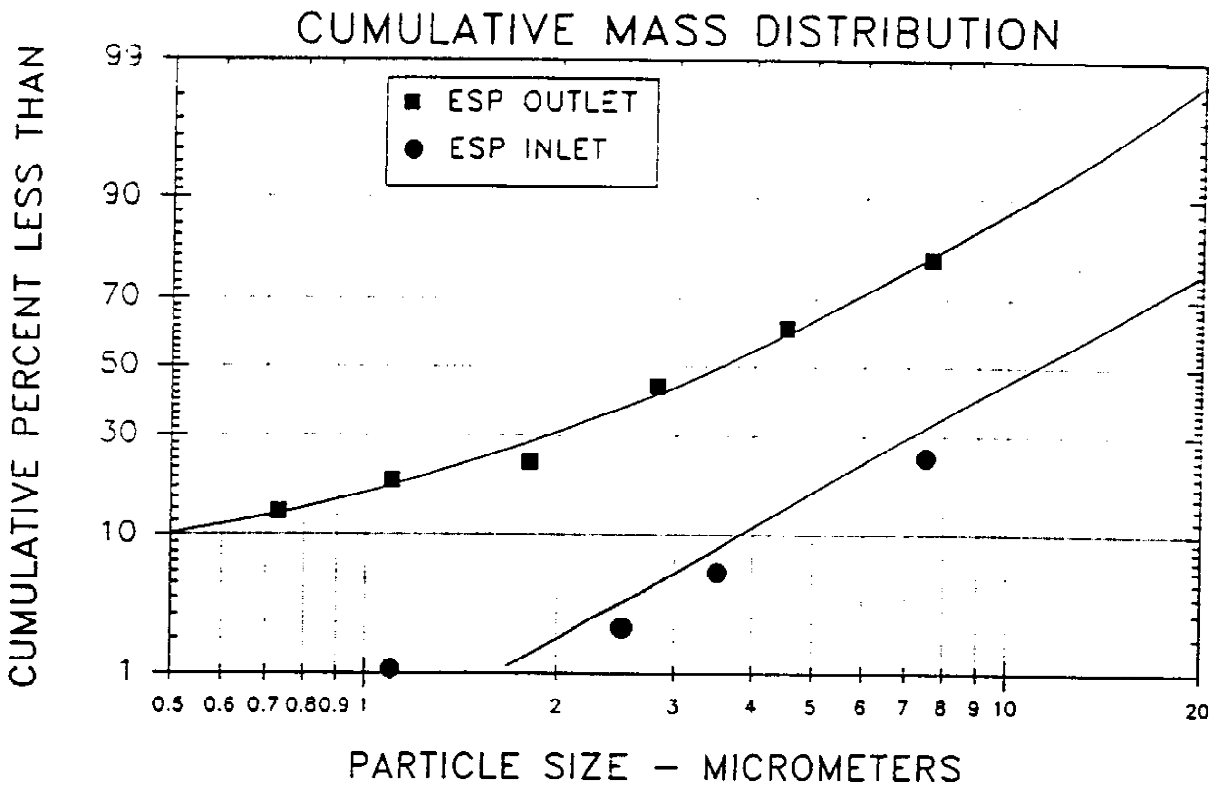
10/17/95 Inlet & Outlet Data

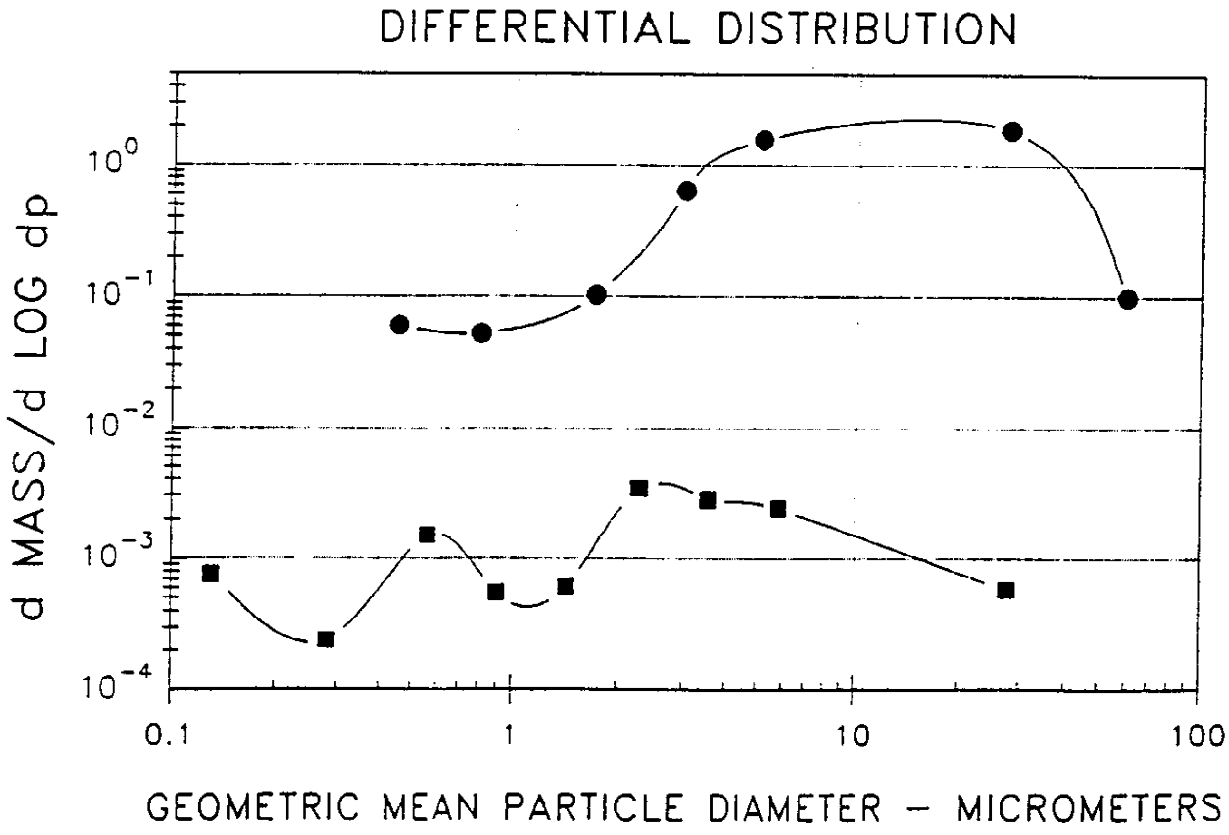
10/18/95 Inlet & Outlet Data

10/19/95 Inlet & Outlet Data

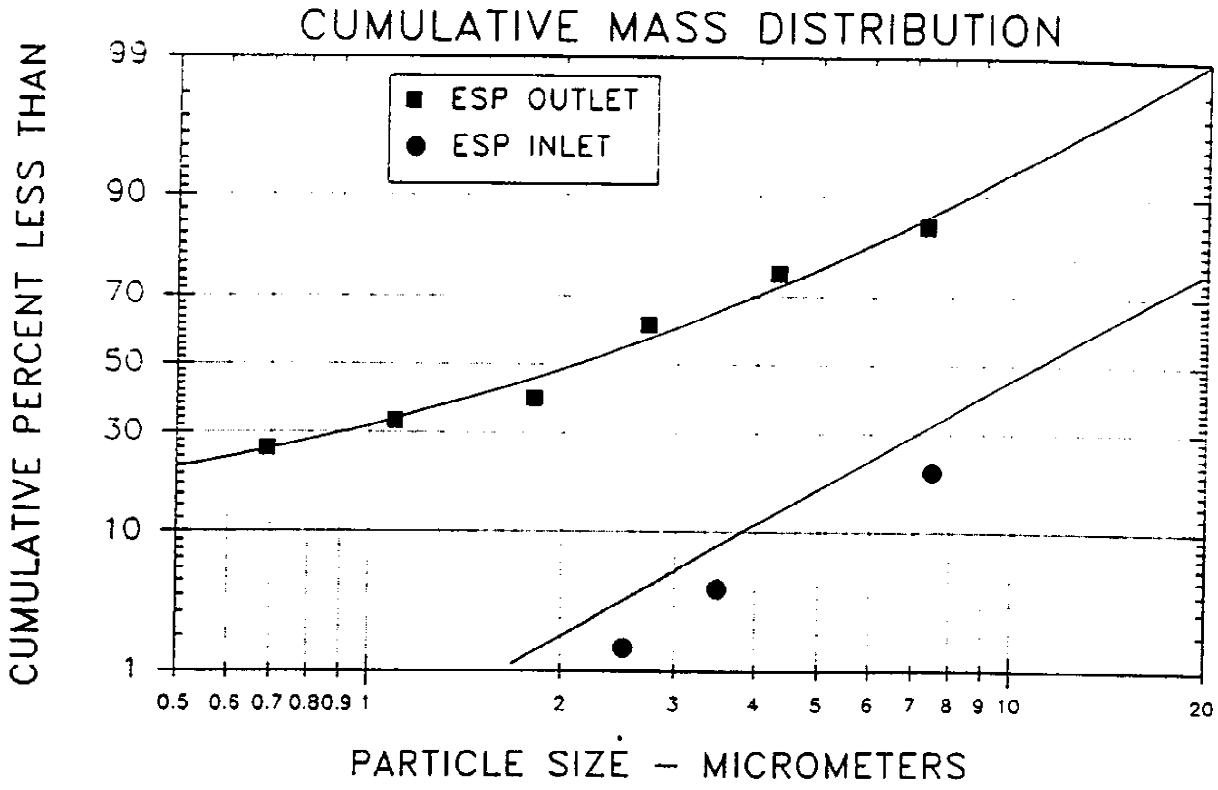
10/20/95 Inlet & Outlet Data

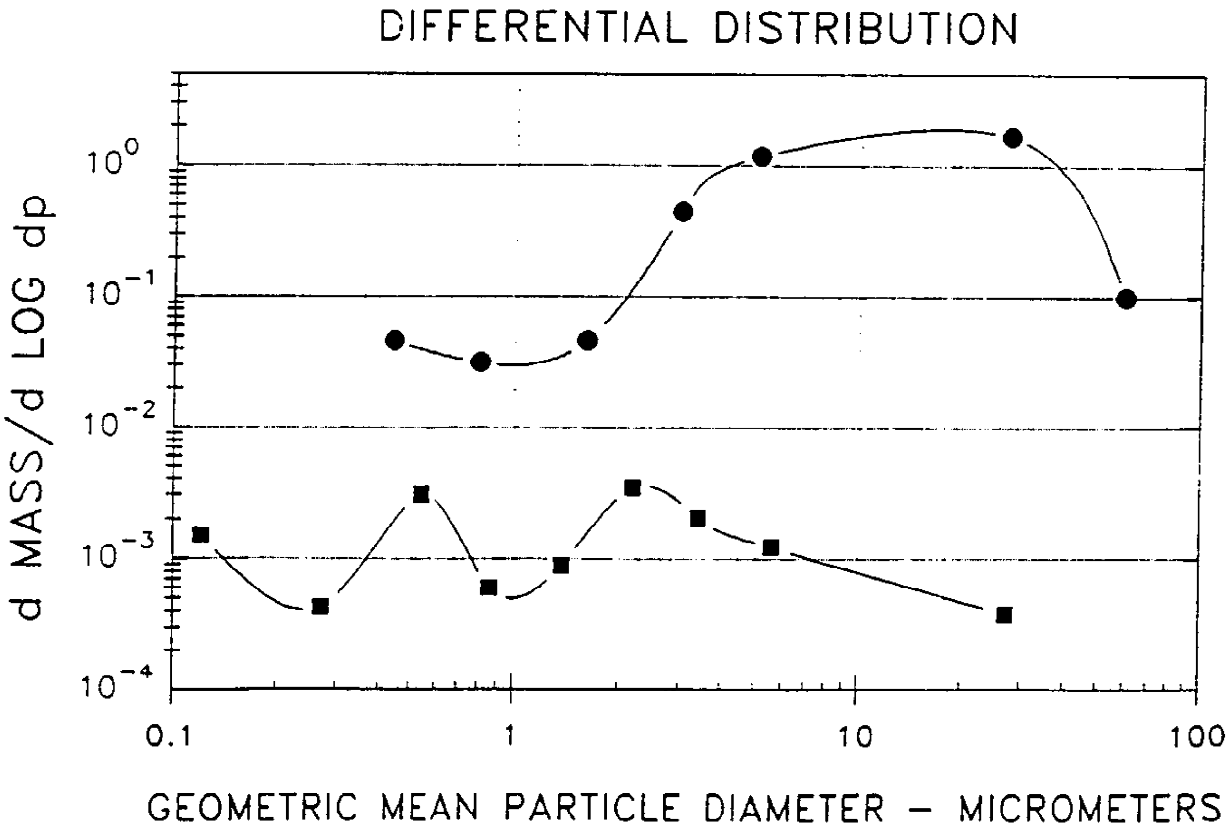
PARTICLE SIZE DISTRIBUTIONS – OCTOBER 17, 199



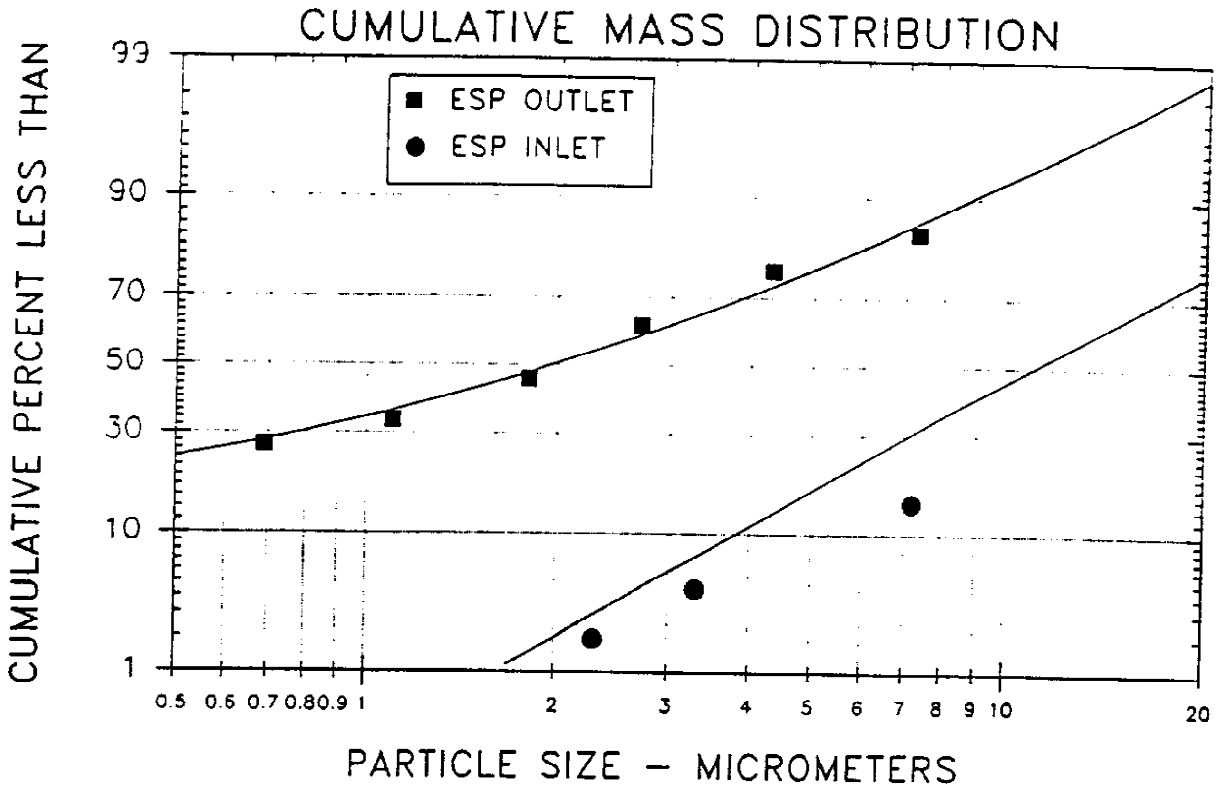


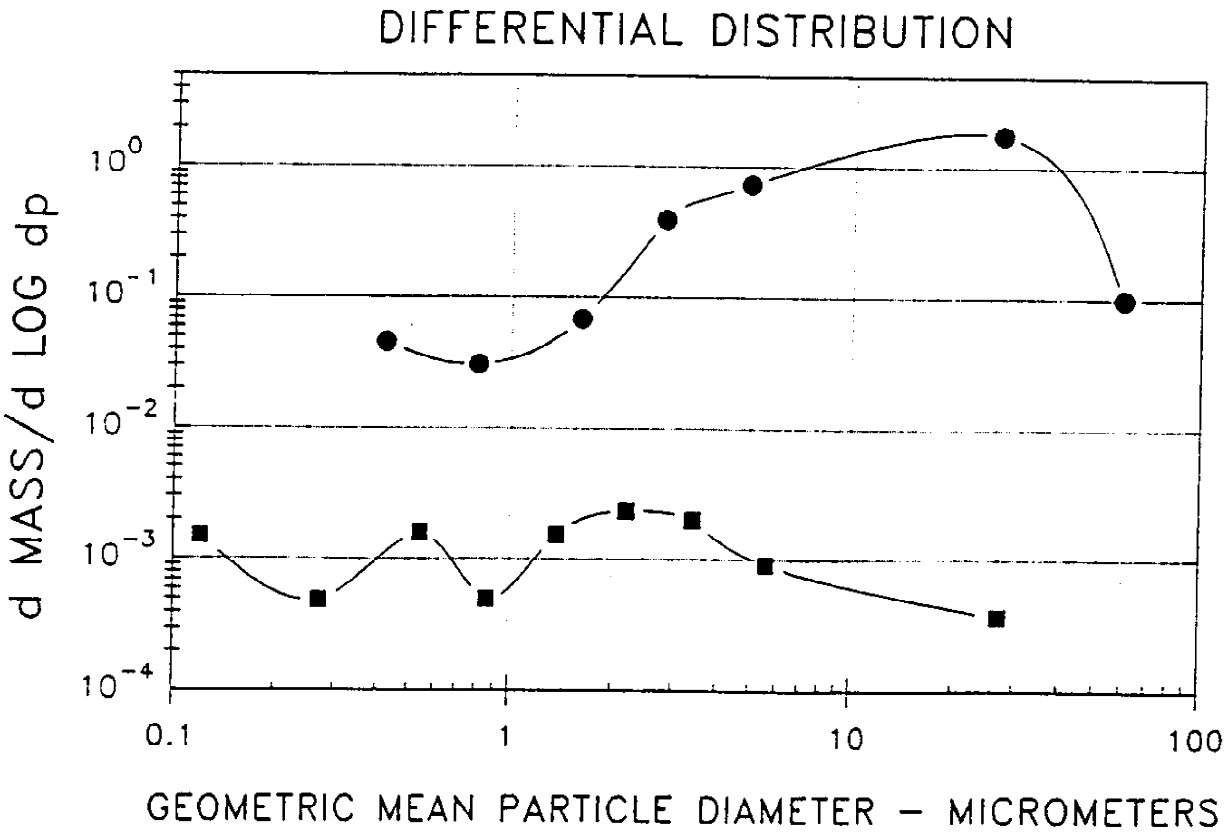
PARTICLE SIZE DISTRIBUTIONS – OCTOBER 18, 199



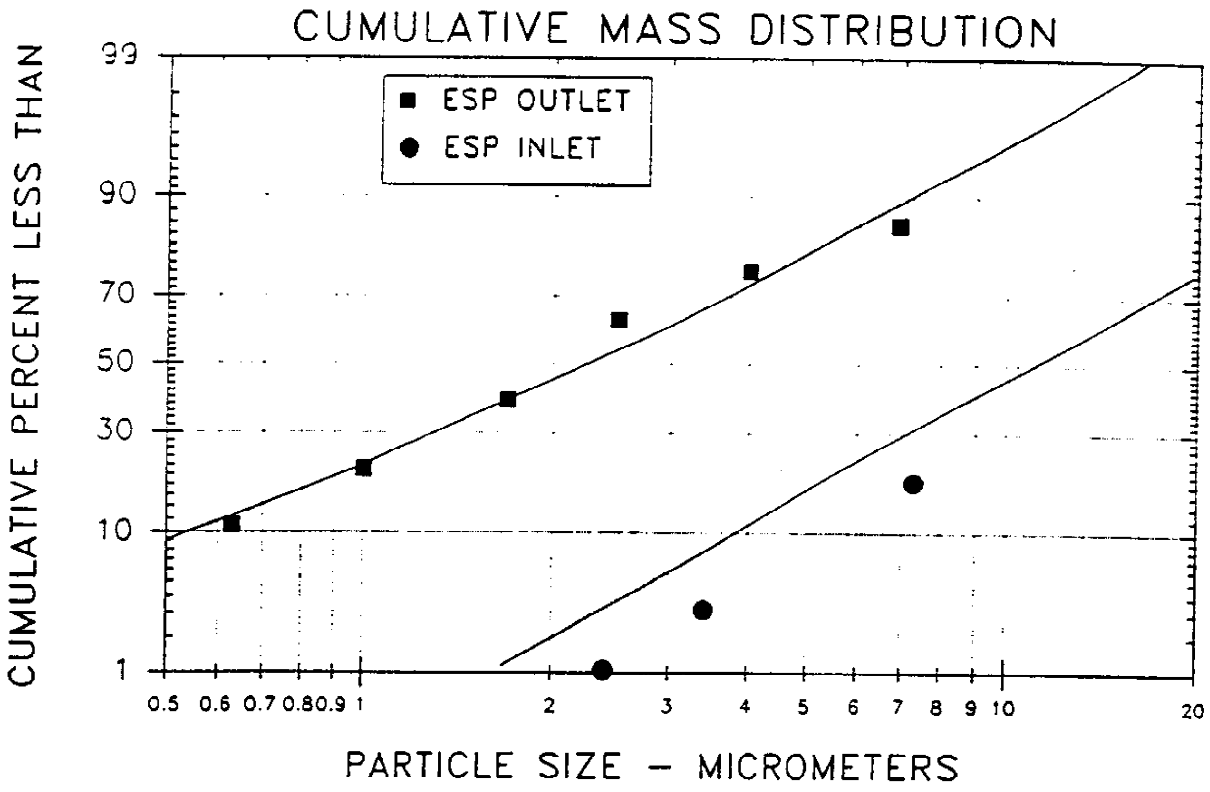


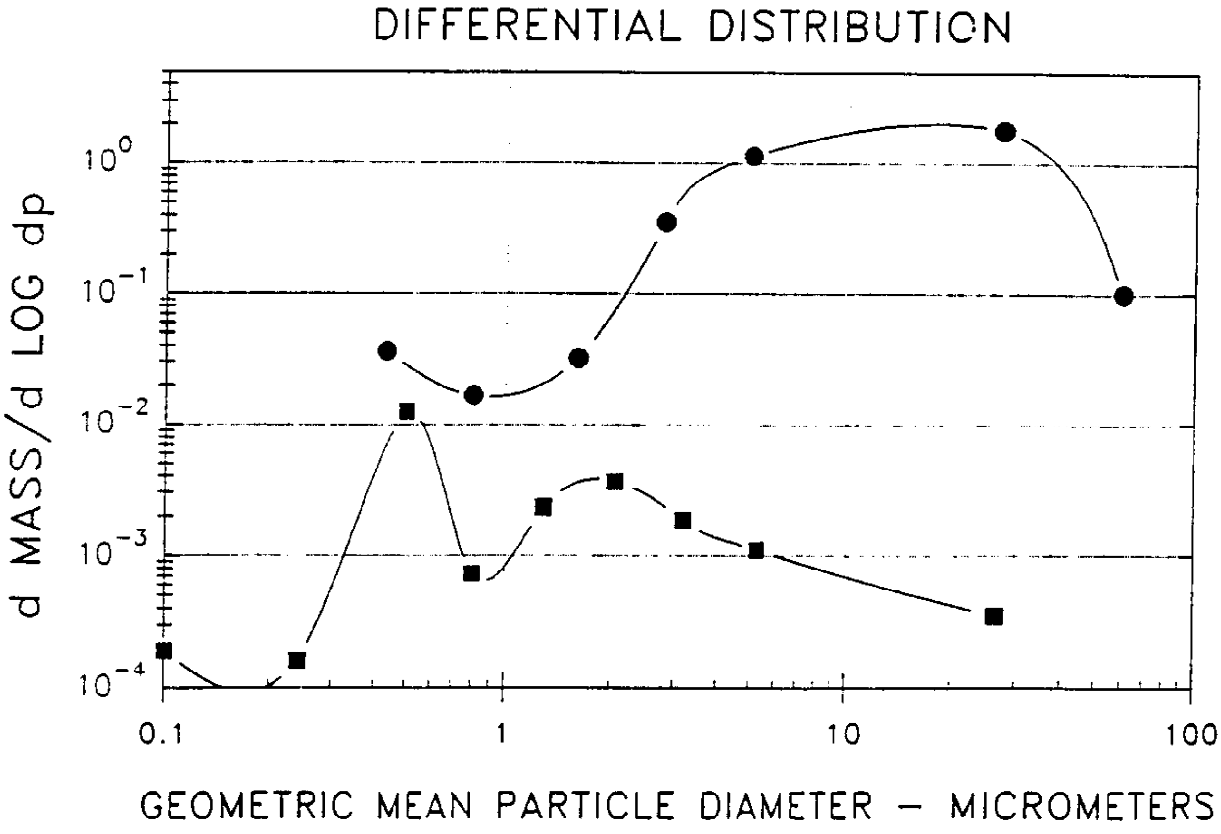
PARTICLE SIZE DISTRIBUTIONS – OCTOBER 19, 199





PARTICLE SIZE DISTRIBUTIONS – OCTOBER 20, 199





APPENDIX C

Ash Resistivity Field Data Sheets

North ESP Inlet	South Esp Inlet
Port B	Port B
Port D	Port D
Port F	Port F
Port H	Port H
Port J	Port J
Port L	Port L

old probe

TYPICAL POINT PLANE PROBE DATA

LOCATION Inlet to ESP- Unit 2 LAYER THICKNES 12.45 mm

TIME 0900 DATE 10-17-95 TEST NO. 1

CONDITIONS _____ NOTE Port B North Duc

STARTING READING 651,646 644 (647) Unit #2 P=4.49x10'

ENDING READING 4.02 Power Breaker Kicked

Run for Longer 40 min

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°C)	GAS TEMP.
0	13.96	2.00	144	
20	13.83	1.78	145	
40	13.72	1.63	145	
60	13.80	1.54	146	
120	13.53	1.28	147	
140	13.91	1.24	147	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty	
500	8.94	10.93	
600	9.41	11.42	
700	9.91	11.96	
800	10.39	12.53	
900	10.72	12.90	
1000	11.03	13.23	2.2
1100	11.30	13.65	
1200	11.58	14.12	
1500	12.54	15.09	
2000	13.76	16.51	
3000	15.42	19.05	
4000	17.01	20.64	

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (

TYPICAL POINT PLANE PROBE DATA

-1d Probe

LOCATION Inlet to ESP LAYER THICKNES 1.46

TIME _____ DATE 10-17-95 TEST NO. #1 Port-D North D.

CONDITIONS _____ NOTE Unit #2

STARTING READING 6.32 6.28 6.29 (6.30) $\rho = 3.90 \times 10^{0}$ s/cm

ENDING READING 4.84

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	14.02	2.00	144	
20	13.82	1.81	144	
40	13.75	1.67	144	
60	13.72	1.57	145	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	9.18	9.52
600	9.51	10.21
700	9.96	10.67
800	10.41	11.22
900	10.63	11.72
1000	11.08	12.22
1100	11.50	12.61
1200	11.82	13.04
1500	12.57	13.86
2000	14.01	15.26
3000	15.93	17.61
4000	17.01	19.24

1.14

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (

Old Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION Inlet to ESP LAYER THICKNES 1.84

TIME _____ DATE 10-17-95 TEST NO. #1 Part-F nort

CONDITIONS _____ NOTE Unit #2

STARTING READING 6.34 6.31 6.30 (6.32) $\rho = 2.09 \times 10^{0}$ g/cm³

ENDING READING 4.48

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	14.19	2.00	141	
20	13.75	1.82	142	
40	14.07	1.78	142	
60	14.05	1.68	143	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	8.83	9.32
600	9.41	9.95
700	9.89	10.40
800	10.34	10.94
900	10.76	11.53
1000	11.13	11.90 .77
1100	11.44	12.36
1200	11.97	12.61
1500	12.83	13.73
2000	13.84	15.33
3000	16.13	17.53
4000	17.18	19.21

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

New Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION Inlet to ESP LAYER THICKNES 1.57

TIME _____ DATE 10-17-95 TEST NO. #1 Port-H north

CONDITIONS _____ NOTE Unit #2

STARTING READING 9.32 9.34 9.28 (9.31) $\rho = 2.68 \times 10^{10}$ Ω/cm²

ENDING READING 7.74

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	10.44	2.00	294	296
20	10.46	1.93	298	298
40	10.45 [illegible]	[illegible] 1.84	299	299
60	[illegible] 10.47	[illegible] 1.70	300	300

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.56	7.14
600	6.90	7.53
700	7.27	7.97
800	7.62	8.31
900	7.90	8.60
1000	8.18	9.02 .84
1100	8.49	9.28
1200	8.71	9.59
1500	9.38	10.33
2000	10.32	11.45
3000	11.99	13.19
4000	13.31	SPARK

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

New Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION Inlet to ESP LAYER THICKNES 1.49

TIME _____ DATE 10-17-95 TEST NO. #1 Port J north

CONDITIONS _____ NOTE Unit #2

STARTING READING 8.97 8.94 8.95 (8.95) $\rho = 3.02 \times 10^{10}$ Ω/cm

ENDING READING 7.46

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	10.37	2.00	286	287
20	~~13.33~~ 10.39	~~1.88~~ 1.87	289	290
40	10.37	1.81	288	289
60	1035	1.78	290	290

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty	
500	6.40	7.05	
600	6.76	7.53	
700	7.11	7.86	
800	7.39	8.23	
900	7.69	8.59	0.90
1000	8.04	8.94	
1100	8.26	9.24	
1200	8.57	9.52	
1500	9.22	10.28	
2000	10.22	11.71	
3000	11.81	13.10	
4000	13.06	14.55	

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run 16

new Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION Inlt to ESR LAYER THICKNES 1.98

TIME _____ DATE 10-17-95 TEST NO. #1

CONDITIONS _____ NOTE Port [redacted] L north C

STARTING READING 9.22 9.25 9.17 (9.21) Unit #2 P=1.72x10'

ENDING READING 7.23 Power Breaker Kicked Run Pr [redacted] Longer 40min

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	10.33	2.00	275	275
20	10.37	1.92	276	276
40	10.38	1.90	276	279
60	10.37	1.85	278	372
120	10.39	1.76	277	278
140	10.39	1.72	277	278

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.68	7.13
600	7.04	7.53
700	7.35	7.88
800	7.66	8.23
900	7.93	8.54
1000	8.20	8.88
1100	8.50	9.14
1200	8.69	9.46
1500	9.34	10.17
2000	10.36	11.28
3000	11.91	13.03
4000	12.89	14.53

0.68

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (1

TYPICAL POINT PLANE PROBE DATA

2nd Probe

LOCATION Inlet to ESP LAYER THICKNES .80

TIME _____ DATE 10-18-95 TEST NO. #2 Port B north

CONDITIONS _____ NOTE Unit #2

STARTING READING 6.51 6.50 6.53 6.51 $P = 1.39 \times 10^{6}$ p/cm²

ENDING READING 5.71

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	14.44	2.00	148	
20	14.16	1.73	149	
40	14.15	1.53	150	
60	14.17	1.38	151	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	9.05	10.88
600	9.32	11.49
700	10.03	12.04
800	10.40	12.52
900	10.74	12.92
1000	11.14	13.37
1100	11.49	13.827
1200	11.86	14.21
1500	12.77	15.10
2000	14.18	16.64
3000	16.29	18.41
4000	16.84	20.31

2.23

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (7)

TYPICAL POINT PLANE PROBE DATA

LOCATION Inlet to ESP LAYER THICKNES 1.74

TIME _____ DATE 10-18-95 TEST NO. #2 Port-D North

CONDITIONS _____ NOTE Q=; T=2

STARTING READING 642 641 639 (641) P= 4.74 x 10⁰ N/cm²

ENDING READING 4.67

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	14.15	2.00	144	
20	14.02	1.82	145	
40	13.94	1.58	145	
60	13.88	1.42	146	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	9.10	10.19
600	9.55	10.71
700	9.80	11.20
800	10.15	11.68
900	10.61	12.17
1000	11.01	12.66
1100	11.30	13.19
1200	11.68	13.48
1500	12.79	14.31
2000	14.02	15.95
3000	16.14	17.52
4000	17.98	19.73

1.65

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (8)

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.49

TIME _____ DATE 10-18-95 TEST NO. 2 Port - F North

CONDITIONS _____ NOTE Unit #2

STARTING READING 639 637 6.38 (6.38) $P = 4.23 \times 10^{0}$ J/cm²

ENDING READING 4.89

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°C)	GAS TEMP.
0	14.15	2.00	145	
20	14.08	1.97	146	
40	14.09	1.93	147	
60	14.05	1.80	147	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	8.99	9.58
600	9.48	10.20
700	9.88	10.70
800	10.36	10.27
900	10.63	11.56
1000	10.87	12.13
1100	11.33	12.44
1200	11.53	12.81
1500	12.62	13.87
2000	13.90	15.31
3000	16.16	17.57
4000	17.68	19.34

1.26

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (

TYPICAL POINT PLANE PROBE DATA

New probe

LOCATION ESP Inlet LAYER THICKNES 1.14

TIME _____ DATE 10-18-95 TEST NO. 2 Port-H North

CONDITIONS _____ NOTE Unit #2

STARTING READING 8.57 8.54 8.59 (8.57) $\rho = 3.86 \times 10^{0}$ Ωcm

ENDING READING 7.43

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	9.69	2.00	305	305
20	9.72	1.84	305	305
40	9.71	1.60	305	305
60	9.71	1.56	305	305

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.11	6.79
600	6.46	7.23
700	6.81	7.58
800	7.17	8.02
900	7.49	8.27
1000	7.70	8.58 .88
1100	8.02	8.82
1200	8.19	9.12
1500	8.90	9.81
2000	9.84	10.75
3000	11.08	12.32
4000	12.09	13.64

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (

TYPICAL POINT PLANE PROBE DATA

new probe

LOCATION Inlet to ESP LAYER THICKNES 1.03

TIME _____ DATE 10-18-95 TEST NO. #2 Port J

CONDITIONS _____ NOTE North Duct Unit #2

STARTING READING 8.65 867 862 (865) $S^o = 3.30 \times 10^{-5}$ J/cm²

ENDING READING 7.62

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	9.84	2.00	298	297
20	9.83	1.78	296	296
40	9.77	1.72	296	296
60	9.78	1.65	297	297

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.26	6.78
600	6.65	7.19
700	6.95	7.46
800	7.31	7.81
900	7.60	8.11
1000	7.84	8.52
1100	8.08	8.67
1200	8.35	8.95
1500	8.97	9.61
2000	9.75	10.70
3000	11.28	12.23
4000	12.46	13.45

0.68

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (

New Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION Inlet to ESP LAYER THICKNES 2.01

TIME _____ DATE 10-18-95 TEST NO. # 2 Part-L Duct

CONDITIONS _____ NOTE Unit # 2

STARTING READING 9.23 9.20 9.18 (920) $\rho = 1.37 \times 10^{0}$ g/cm³

ENDING READING 7.19

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	10.03	2.00	283	283
20	10.07	1.99	284	284
40	10.02	1.93	284	284
60		1.81	284	285

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.32	6.57
600	6.61	7.08
700	6.93	7.38
800	7.41	7.68
900	7.67	8.05
1000	7.82	8.37
1100	8.04	8.64
1200	8.38	8.90
1500	8.95	9.65
2000	9.94	10.68
3000	11.47	12.40
4000	12.68	13.69

055

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (1

New Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.56

TIME _____ DATE 10-19-95 TEST NO. #1 Port B South

CONDITIONS _____ NOTE Unit #2

STARTING READING 9.03 9.00 9.02 (9.02) ρ: 2.02 x 10^{10} Ω/cm²

ENDING READING 7.46

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	10.03	2.00	288	288
20	10.12	1.84	288	288
40	10.12	1.75	289	289
60	10.10	1.60	289	289

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.55	6.69
600	6.85	7.09
700	7.17	7.68
800	7.50	7.96
900	7.79	8.34
1000	8.15	8.78
1100	8.34	8.98
1200	8.50	9.17
1500	9.20	9.94
2000	10.17	11.06
3000	11.80	12.74
4000	12.70	14.08

0.63

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (1?

TYPICAL POINT PLANE PROBE DATA

new probe

LOCATION ESP Inlet LAYER THICKNES 0.94

TIME _____ DATE 10-19-95 TEST NO. #1 Port D South

CONDITIONS _____ NOTE Unit #2

STARTING READING 8.77 8.76 8.76 (8.76) $P = 2.93 \times 10^{10}$ a/cm

ENDING READING 7.82

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	10.37	2.00	298	298
20	10.38	1.81	298	298
40	10.37	1.71	299	299
60	10.34	1.64	299	299

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.61	7.05
600	6.93	7.42
700	7.33	7.77
800	7.64	8.10
900	7.91	8.44
1000	8.18	8.73
1100	8.45	9.01
1200	8.71	9.24
1500	9.36	9.97
2000	10.38	11.09
3000	11.80	12.79
4000	13.04	14.22

0.55

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (14)

old Probe new Box

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.06

TIME _____ DATE 10-19-95 TEST NO. #1 Port-F South

CONDITIONS _____ NOTE Unit #2

STARTING READING 6.016 6.18 6.15 (6.16) $\rho = 3.87 \times 10^{0}$ g/cm²

ENDING READING 5.10

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F	GAS TEMP.
0	12.66	2.00	291	
20	12.61	3.00	292	
40	12.60	1.97	293	
60	12.63	1.90	293	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	8.06	8.36
600	8.48	8.69
700	8.81	9.22
800	9.23	9.61
900	9.63	10.05
1000	9.71	10.53 .82
1100	10.19	10.75
1200	10.50	11.09
1500	11.35	11.95
2000	12.57	13.26
3000	14.43	15.31
4000	15.81	16.88

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (15

old Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.28

TIME _____ DATE 10-19-95 TEST NO. #1 Port H South I

CONDITIONS _____ NOTE Unit #2

STARTING READING 6.34 6.32 6.30 (6.32) $\rho = 2.07 \times 10^{0}$ Ω/cm²

ENDING READING 5.04

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°C)	GAS TEMP.
0	14.04	[redacted] 2.00	135	
20	14.15	2.00	136	
40	13.99	1.90	136	
60	14.01	1.83	136	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	9.06	9.88
600	9.49	9.64
700	9.95	10.09
800	10.31	10.63
900	10.75	11.10
1000	11.12	11.65 0.53
1100	11.44	12.05
1200	11.73	12.22
1500	12.79	13.42
2000	14.05	14.73
3000	15.98	17.07
4000	17.58	18.91

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (

3rd Probe

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.43

TIME _____ DATE 10-19-95 TEST NO. #1 Port-J South

CONDITIONS _____ NOTE Unit #2

STARTING READING 6.38 6.39 6.41 (6.39) $\rho = 3.43 \times 10^{10}$ Ω/cm²

ENDING READING 4.96

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°C)	GAS TEMP.
0	14.16	2.00	145	
20	14.06	1.86	145	
40	14.04	1.79	146	
60	14.12	1.64	146	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	8.85	9.52
600	9.18	10.07
700	10.04	10.69
800	10.54	11.09
900	10.81	11.63
1000	11.23	12.21
1100	11.55	12.57
1200	11.91	12.86
1500	12.96	13.84
2000	14.35	15.36
3000	16.83	17.76
4000	18.34	19.69

0.98

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (1

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.11

TIME _____ DATE 10-19-95 TEST NO. #1 Port L south

CONDITIONS _____ NOTE Unit #2

STARTING READING 8.74 8.75 8.71 (8.73) $r = 3.69 \times 10^{10}$ Ω/cm²

ENDING READING 7.62

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°C)	GAS TEMP.
0	11.40	2.00	150	
20	11.16	1.72	151	
40	11.23	1.71	151	
60	11.23	1.666	151	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	7.37	755
600	7.88	809
700	8.26	8.46
800	8.35	8.95
900	8.58	9.30
1000	8.92	9.74 .82
1100	9.19	10.06
1200	9.50	10.24
1500	10.24	11.07
2000	11.32	12.25
3000	13.03	14.16
4000	14.42	15.54

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (1

TYPICAL POINT PLANE PROBE DATA

3id Probe & box

LOCATION ESP Inlet LAYER THICKNES 1.48

TIME _____ DATE 10-20-95 TEST NO. 2 Port B

CONDITIONS _____ NOTE South duct Unit 2

STARTING READING 6,32 629632 2.196 $\times 10^{10}\ \Omega$

ENDING READING 4.83

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	11.85	2.00	293	
20	11.84	1.90	294	
40	11.80	1.84	295	
60	11.81	1.73	295	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	7.61	7.93
600	8.03	8.46
700	8.44	8.96
800	8.76	9.35
900	9.03	9.67
1000	9.38	10.03 - 0.65
1100	9.69	10.45
1200	9.98	10.73
1500	10.85	11.65
2000	11.95	13.00
3000	13.74	14.93
4000	15.06	16.42

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (1

New 20X 0.1 probe

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 0.77

TIME _____ DATE 10-20-95 TEST NO. 2 Port D

CONDITIONS _____ NOTE South Duct Unit #2

STARTING READING 8.62 8.56 8.59 $4.67 \times 10^{10}\ \Omega$

ENDING READING 7.82

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	9.84	2.00	302	302
20	9.79	1.28	301	301
40	9.80	1.67	302	302
60	9.75	1.59	302	302

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	6.25	6.96
600	6.61	7.39
700	7.00	7.71
800	7.20	8.04
900	7.55	8.25
1000	7.84	8.56 ÷ 0.72
1100	8.05	8.80
1200	8.22	9.05
1500	8.86	9.63
2000	9.74	10.55
3000	11.14	12.04
4000	12.16	13.25

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run 2

TYPICAL POINT PLANE PROBE DATA

new

LOCATION ESP INLET LAYER THICKNES 1.01

TIME _____ DATE 10-20-95 TEST NO. 2 Port F

CONDITIONS _____ NOTE _____

STARTING READING 8.52 8.55 8.56

ENDING READING 7.53 1.98 × 10^10 Ω

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP. (
0	9.79	2.00	291	291
20	9.78	1.85	292	292
40	9.77	1.72	292	292
60	9.74	1.74	292	292

V-I DATA

Current NA	Voltage (Volts) Clean	Dirty
500	6.25	6.62
600	6.64	6.91
700	6.95	7.28
800	7.25	7.60
900	7.52	7.90
1000	7.79	8.19 = 0.40
1100	7.99	8.46
1200	8.28	8.70
1500	8.87	9.30
2000	9.83	10.35
3000	11.23	11.87
4000	12.39	13.19

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run 21

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.31

TIME _____ DATE 10-20-95 TEST NO. *2 Port-H

CONDITIONS _____ NOTE _____

STARTING READING 5.59 6.00 6.02

ENDING READING 4.576 $2.29 \times 10^{10}\ \Omega$

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)	GAS TEMP.
0	13.93	200	138	
20	13.97	1.95	138	
40	13.97	1.93	138	
60	14.19	1.86	138	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	8.86	8.92
600	9.40	9.57
700	9.81	10.07
800	10.16	10.56
900	10.59	11.04
1000	10.82	11.42
1100	11.15	11.76
1200	11.52	12.09
1500	12.49	13.08
2000	14.01	14.59
3000	16.08	16.97
4000	17.72	18.67

=0.60

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (2

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 0.36

TIME _____ DATE 10-20-95 TEST NO. 2 Port J

CONDITIONS _____ NOTE South Duct Unit #2

STARTING READING 6.20 6.16 6.19

ENDING READING 5.82 2.25 x 10 Ω

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°C)	GAS TEMP.
0	14.10	2.00	148	
20	14.23	1.88	149	
40	14.28	1.74	149	
60	14.39	1.65	149	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	9.07	10.13
600	9.38	10.71
700	9.95	11.27
800	10.32	11.73
900	10.59	12.16
1000	11.05	12.67 = 1.62
1100	11.41	12.98
1200	11.72	13.22
1500	12.74	14.34
2000	14.05	15.73
3000	15.58	17.99
4000	17.15	19.81

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (2

New Probe old Box

TYPICAL POINT PLANE PROBE DATA

LOCATION ESP Inlet LAYER THICKNES 1.78

TIME _____ DATE 10-20-95 TEST NO. 2 Port-L

CONDITIONS _____ NOTE South Duct Unit #2

STARTING READING 9.61 9.57 9.62

ENDING READING 7.82 2.58 x 10^10 Ω

SAMPLE COLLECTION

TIME	VOLTAGE (KV)	CURRENT (AMPS)	PROBE TEMP (°F)C	GAS TEMP.
0	11.02	2.00	148	
20	10.85	1.68	149	
40	10.71	1.51	149	
60	10.90	1.49	149	

V-I DATA

Current NA	Voltage Clean	(Volts) Dirty
500	7.01	7.69
600	7.39	8.11
700	7.78	8.47
800	8.13	8.83
900	8.41	9.18
1000	8.74	9.66
1100	9.02	9.92
1200	9.27	10.16
1500	9.96	10.96
2000	11.00	12.19
3000	12.65	13.85
4000	13.97	15.35

0.92

SPARK DATA

V	I	E
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
GAS TEMP (C)		

Run (2)