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AP-42 Section 11.10  
Reference 12  
Report Sect. \_\_\_\_\_  
Reference \_\_\_\_\_

existing section

# COAL PREPARATION PLANT EMISSION TESTS

EPA TEST NO. 72-CI-19A

FINAL

TEST NO. 1281-25

CONSOLIDATION COAL COMPANY

Bishop, West Virginia

PREPARED FOR

ENVIRONMENTAL PROTECTION AGENCY

Research Triangle Park  
North Carolina 27711

Contract No 68-02-0233



SCOTT RESEARCH LABORATORIES, INC.

PLUMSTEADVILLE, PENNSYLVANIA 18949

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## 1.0 INTRODUCTION

Scott Research Laboratories, Inc. performed source sampling tests at the Bishop, West Virginia plant of Consolidation Coal Company during the week of February 28, 1972. The plant uses a Research Cottrell venturi scrubber to control the exhaust gas emissions from a coal cleaning and preparation operation.

The outlet exhaust gases, as they were being emitted to the atmosphere, were sampled and analyzed for the determination of total particulate loading, oxides of nitrogen, sulfur dioxide, carbon dioxide, carbon monoxide, carbon dioxide, and oxygen concentrations. Since there was an easily accessible location for sampling the exhaust gases before they entered the venturi scrubber, samples were also collected in the inlet to the scrubber and the same analyses performed as on the outlet samples. The particulate samples were collected simultaneously at the inlet and outlet of the scrubber; and the gaseous samples were taken at both locations during the particulate traverses.

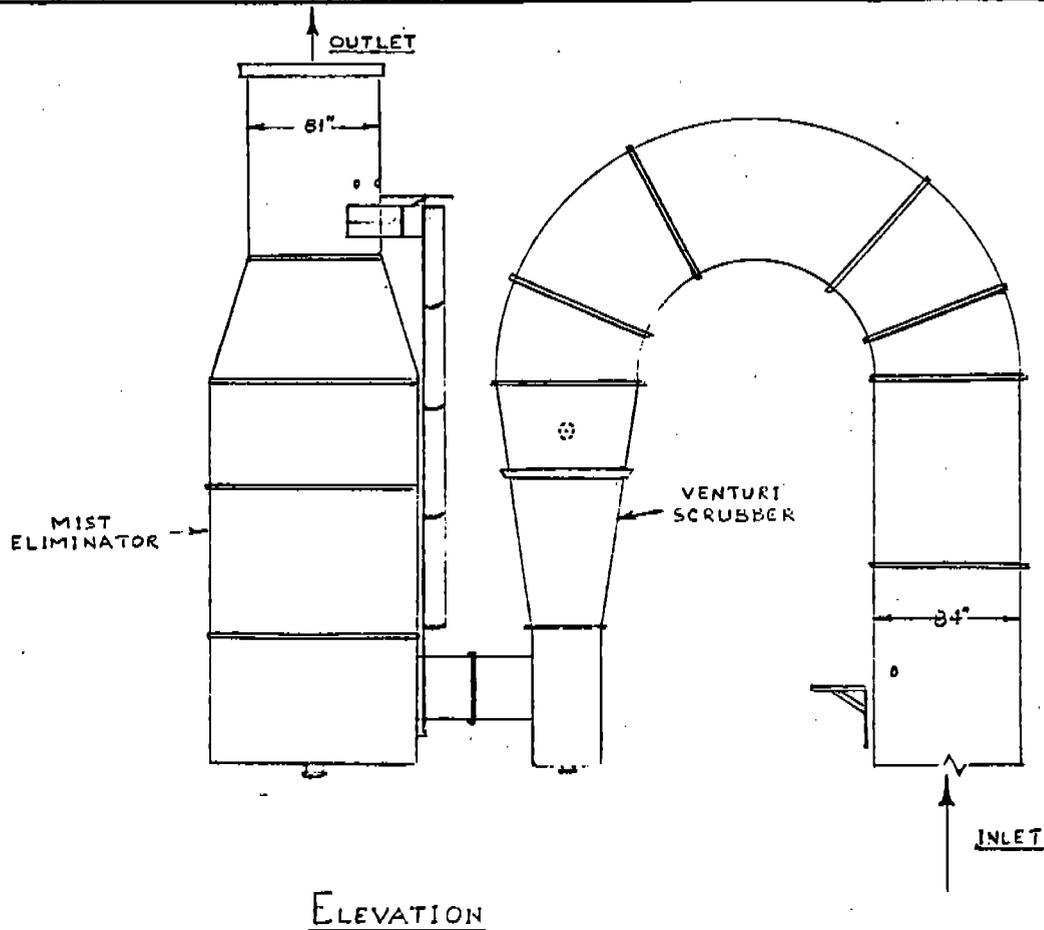
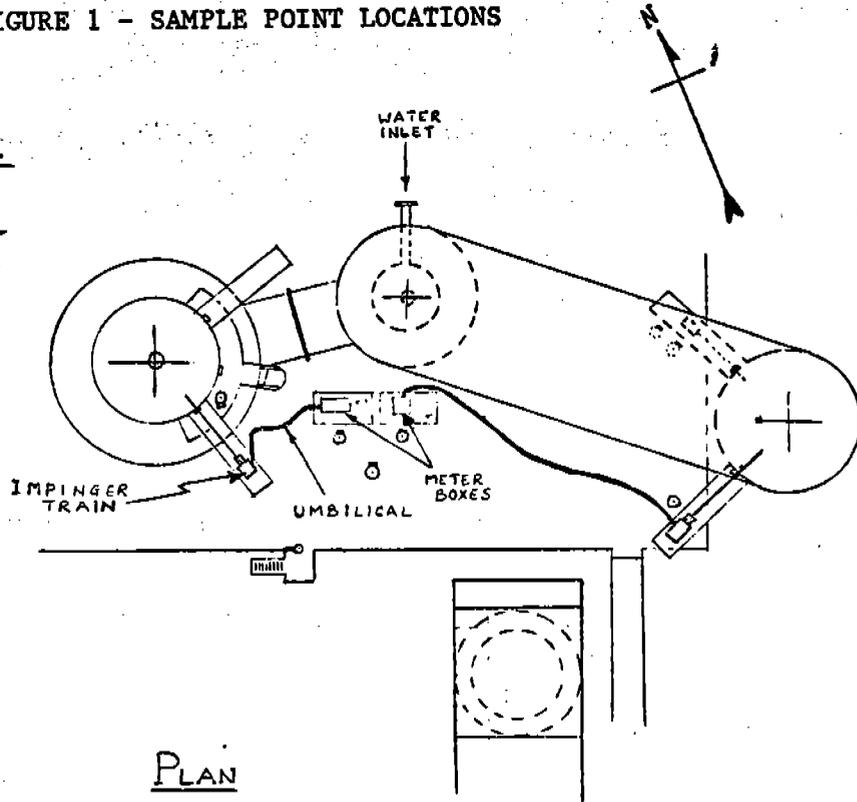
Three complete runs were performed at the plant. One run was conducted each day on February 29, March 1, and 2, 1972. Figure 1 shows the location of the sampling points at the plant.



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FIGURE 1 - SAMPLE POINT LOCATIONS

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## 2.0 SUMMARY OF RESULTS

A summary of test results is presented in Table 1. The particulate weights are summarized and shown in Table 2, with all of the particulate results included as Appendix A. Appendix B presents all of the gaseous results, and the raw data sheets are included as Appendix C.

From Table 2 it is observed that the particulate matter collected from the outlet during Run 1 is somewhat higher than what was collected during the other two runs. The higher weight was due to an increase both in the front half and back half of the train. The amount of particulate matter collected at the inlet varied considerably from run to run. The first day a total of 55,612.5 mg. were collected, while the next day 83,626.0 mg. were collected, and then only 37,437.0 mg. were collected during the third run.

The average value for the outlet concentration of the second and third run was only 0.013 gr/scf, considering only the front half. This amounts to an emission rate of only 12.5 lbs/hr.

From Table 1 it is observed that the sulfur dioxide concentrations vary all the way from 0.8 ppm up to 3155.6 ppm. The values do not appear to be questionable since the outlet and inlet values both show the same variation from one run to another.

The  $\text{NO}_x$  values were fairly consistent for both the inlet and outlet. The outlet  $\text{NO}_x$  concentration averaged 57.1 ppm and the average inlet concentration was 73.1 ppm.

On the basis of the front half of the particulate train values (gr/scf) the collection efficiency of the scrubber varied from 99.79%



TABLE 1 - SUMMARY OF TEST RESULTS

Run Number	1-0		2-0		3-0		1-1		2-1		3-1	
	Outlet	2/29/72	Outlet	3/1/72	Outlet	3/2/72	Inlet	2/29/72	Inlet	3/1/72	Inlet	3/2/72
Sample Point Location	90.78	87.48	88.78	95.44	89.84	94.76	15.32	145	3935	4055	114,860	
Sample Date	14.37	12.98	12.74	13.26	15.32	15.32	149	3906	112,030	114,860		
Sample Gas Vol., scf.	125	125	125	149	145	145	3906	113,630	112,030	114,860		
Moisture, %	4054	4060	4232	3906	3935	4055	113,630	112,030	112,030	114,860		
Stack Gas Temp., °F	106,330	107,530	111,560	113,630	112,030	114,860	113,630	112,030	112,030	114,860		
Stack Gas Vel., fpm	98.1	76.3	77.4	55,612.5	83,626.0	37,437.0	55,612.5	83,626.0	83,626.0	37,437.0		
Stack Gas Vol., SCFM	121.3	89.7	89.3	55,743.5	83,702.5	37,474.0	55,743.5	83,702.5	83,702.5	37,474.0		
Particulate Collected												
Probe, cyclone, filter, mg.	0.017	0.013	0.013	8.974	14.336	6.084	8.974	14.336	14.336	6.084		
Total, mg.	0.021	0.016	0.015	8.995	14.349	6.090	8.995	14.349	14.349	6.090		
Particulate Concentration												
Probe, cyclone, filter, gr/scf	15.16	12.39	12.83	8739.00	13764.00	5988.80	8739.00	13764.00	13764.00	5988.80		
Total, gr/scf	18.77	14.55	14.81	8759.40	13776.40	5994.70	8759.40	13776.40	13776.40	5994.70		
Particulate Emissions	96.95	92.39	90.37	102.58	97.93	100.75	102.58	97.93	97.93	100.75		
Probe, cyclone, filter, lb/hr.												
Total, lb/hr.												
Percent Isokinetic												
Carbon Monoxide, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Carbon Dioxide, %	1.0	0.7	0.1	0.9	0.9	1.0	0.9	0.9	0.9	1.0		
Oxygen, %	19.2	19.7	20.6	19.7	18.6	19.0	19.7	18.6	18.6	19.0		
Sulfur Dioxide, ppm	0.8	3155.6	214.1	17.1	2904.2	300.0	17.1	2904.2	2904.2	300.0		
NO <sub>x</sub> , ppm	57.7	51.1	62.5	64.8	69.4	85.1	64.8	69.4	69.4	85.1		



TABLE 2 - PARTICULATE WEIGHTS SUMMARY

Run Number: Sample Location	1-0	2-0	3-0	1-1	2-1	3-1
	Outlet	Outlet	Outlet	Inlet	Inlet	Inlet
Container 1, mg.	39.8	51.5	30.0	273.5	253.0	202.0
Container 2, mg.	58.3	24.8	47.4	55,339.0	83,373.0	37,235.0
Container 3a, mg.	3.0	2.9	0*	3.0	32.0	6.0
Container 3b, mg.	8.1	1.7	3.1	21.0	32.5	22.0
Container 5, mg.	12.1	8.7	8.8	107.0	12.0	9.0
Probe, cyclone filter, mg.	98.1	76.3	77.4	55,612.5	83,626.0	37,437.0
Total, mg.	121.3	89.7	89.3	55,743.5	83,702.5	37,474.0

\* Blank was higher than sample value.



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to 99.91%. For Run 1 the efficiency was 99.81%, Run 2 it was 99.91%,  
and for Run 3 it was 99.79%.



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### 3.0 PROCESS DESCRIPTION AND OPERATION

The Bishop preparation plant was built in the mid 1950's and has been upgraded to process coal through froth flotation cells. An old Link-Belt multilouvre thermal dryer was replaced by a Link-Belt Fluid Bed dryer in March 1970. At that time, a Research Cottrell Flooded Disc scrubber was installed to clean the exhaust gases before being emitted to the atmosphere. The dryer exhaust fans are rated at 183,000 cfm at 170<sup>o</sup>F and the scrubber design calls for a 26" ΔP according to Research Cottrell.

The Bishop preparation plant has the capability to process all stored coal in 5 hours of continuous operation. Thus, only one test could be made per day. During the tests, 50 percent of the filter cake from flotation cells was being dried in the thermal dryer. This is the maximum amount of cake allowed by design specifications.

Loadout of rail cars during the tests indicated the plant production rate was 400 TPH of cleaned coal. Of this it was calculated 300 tons were being fed to the dryer. Design capacity of the dryer was 368 TPH cleaned, dried coal and 40 TPH exhaust moisture. Plant blueprints gave an operating load of 293 TPH to the dryer.

The control panel in the plant was monitored and the following data taken during the tests:



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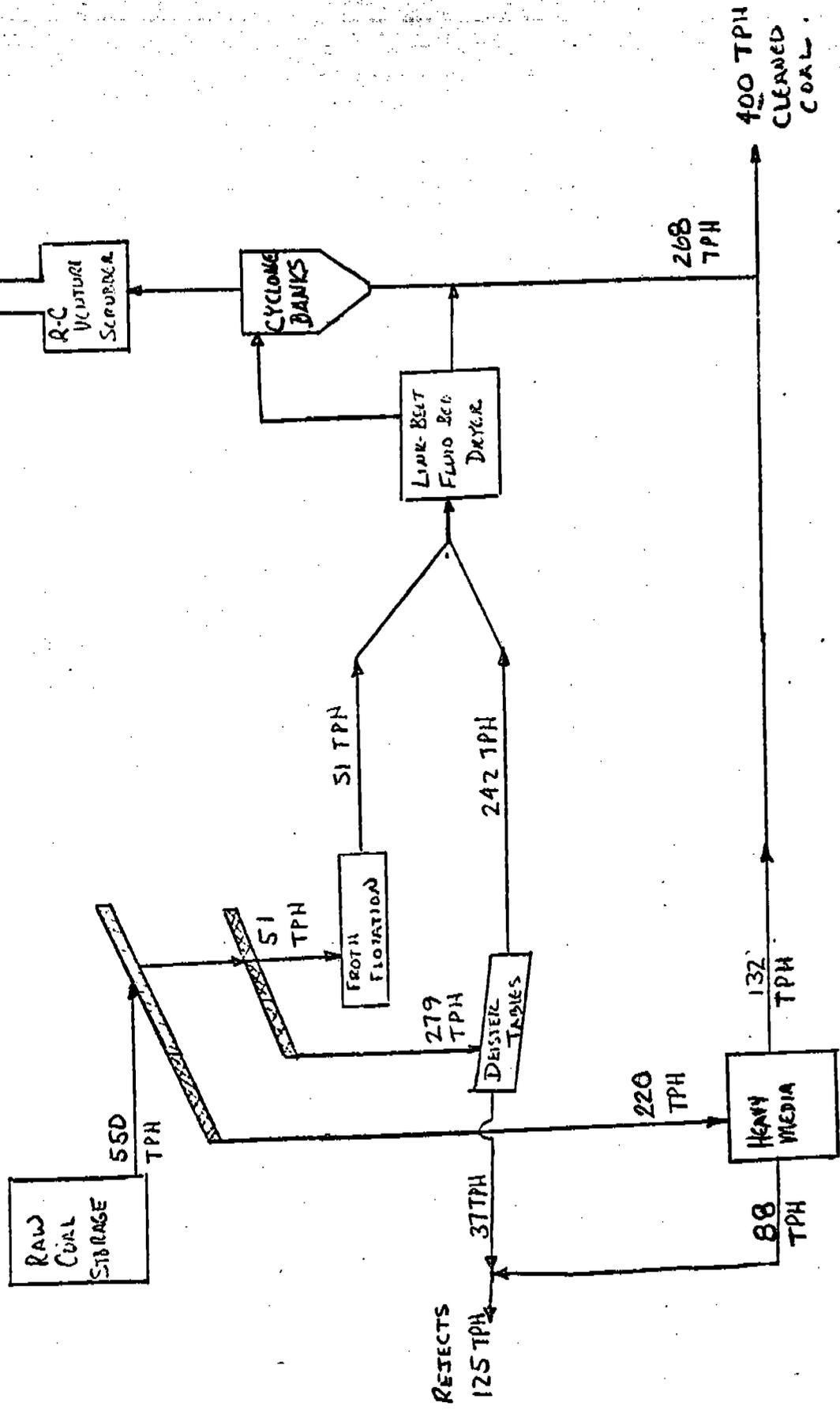
	<u>1st Run</u>	<u>2nd Run</u>	<u>3rd Run</u>
Exhaust fan, amp.	300	300	300
Roll feeder temp., °F	780-800	800	800
Furnace air temp., °F	1020-1240	1000-1210	960-1190
Dryer-inlet temp., °F	910-1030	940-1060	880-1020
Pulverizer temp., °F	180-185	180-185	175-185
Dryer Exhaust, °F	130-140	130-140	130-140
Exhaust fan inlet, °F	170	170	165-170

Taps were installed across the venturi throat so that the pressure drop could be measured during the tests. Readings showed that the scrubber was not operating as designed. The pressure drop measured was in the range of 16-17 in. water gauge.



PLANT: CONSOLIDATION BISHOP  
SEAM: POKANANTAS #3 & #5  
TEST DATE: 29 FEB - 2 MAR 1972

A 160,000 cfm



PROCESS DIAGRAM



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#### 4.0 LOCATION OF SAMPLING POINTS

The exhaust gases from the coal cleaning operation pass through an 84 inch diameter duct into a Research Cottrell venturi scrubber. From the venturi scrubber, the gases flow through a mist eliminator and are then emitted to the atmosphere through an 81 inch diameter stack.

The location (inlet) for sampling the gases before they enter the venturi scrubber was chosen in a straight vertical section of the 84 inch diameter duct. The two ports were installed at  $90^{\circ}$  apart and were located approximately 40 feet downstream from a bend and approximately 15 feet upstream from a bend. Special sampling platforms were required to support the sampling train at both ports. An angle iron support extending ten feet out from the stack supported a plywood platform.

The location (outlet) for sampling the gases prior to the discharge to the atmosphere was in a straight section of the 81 inch diameter stack atop the mist eliminator. The sampling ports were located approximately 7 feet upstream from the top of the stack and approximately 10 feet downstream from the outlet of the mist eliminator.

There were three sample ports spaced  $45^{\circ}$  apart at the outlet location. The two ports at  $90^{\circ}$  apart, were used for the particulate sampling. The center port was used for gaseous sampling. The outlet ports were approximately 30 feet above the platform area where the particulate sample control units were located. Again, special support systems were required to hold the particulate sampling train. Figure 1 shows the physical layout of the system and the location of the sample ports.



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Figure 2 shows the traverse points used at each sample point location. At the inlet, 36 traverse points were sampled four minutes each. At the outlet, 48 traverse points were sampled 3 minutes each. At the outlet location, in order to stay at least two inches away from the wall, the first two and last two points on the traverse were combined. Thus, the first and last points (each containing two traverse points) were sampled for six minutes each. The traverse points were chosen in accordance with Method 1 published in the Federal Register, Volume 36, No. 24.

The two ports at each location were designated as A and B. A was the port on the left and B was the port  $90^{\circ}$  to the right of A.



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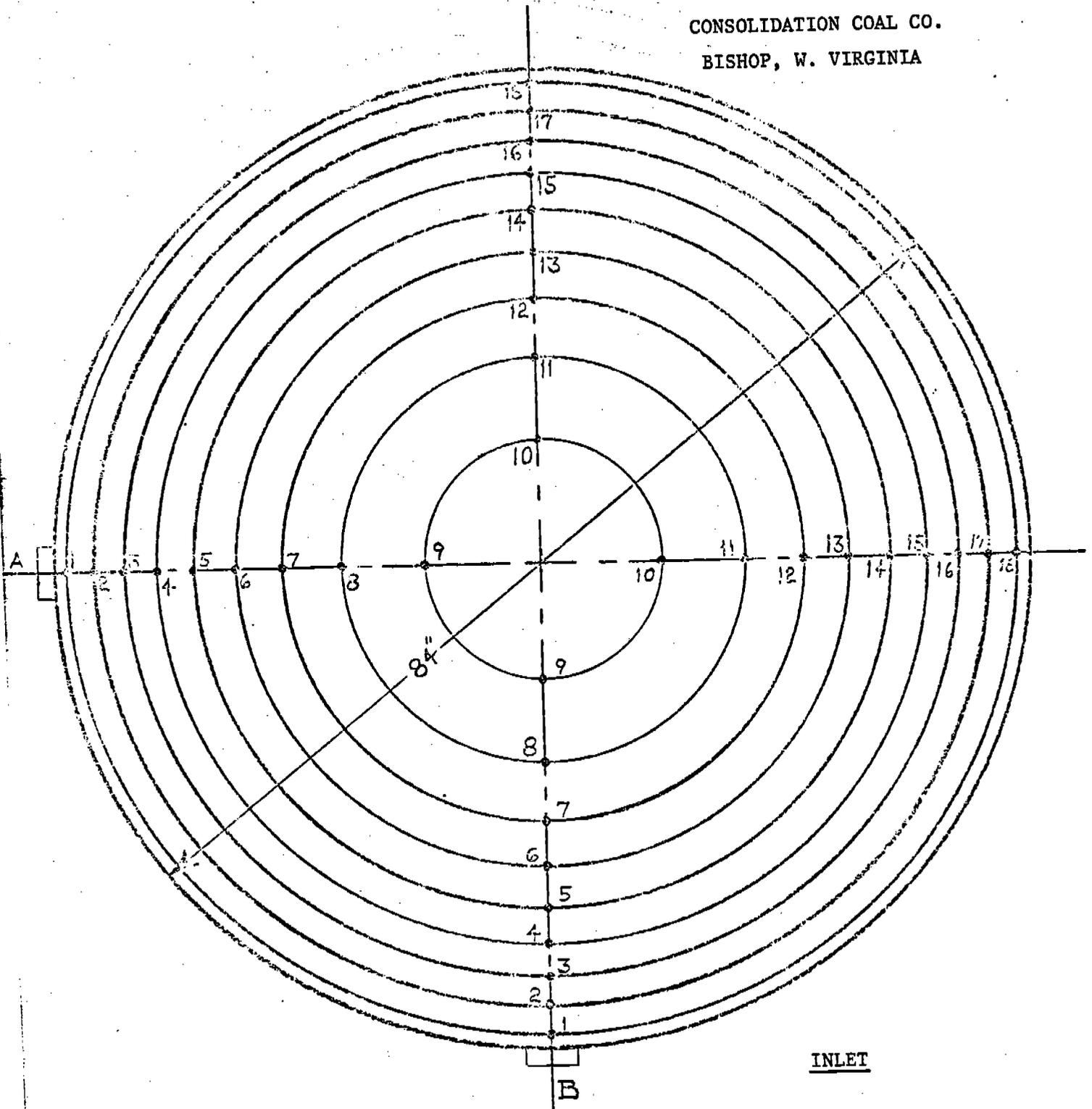


FIGURE 2 - TRAVERSE POINT LOCATIONS



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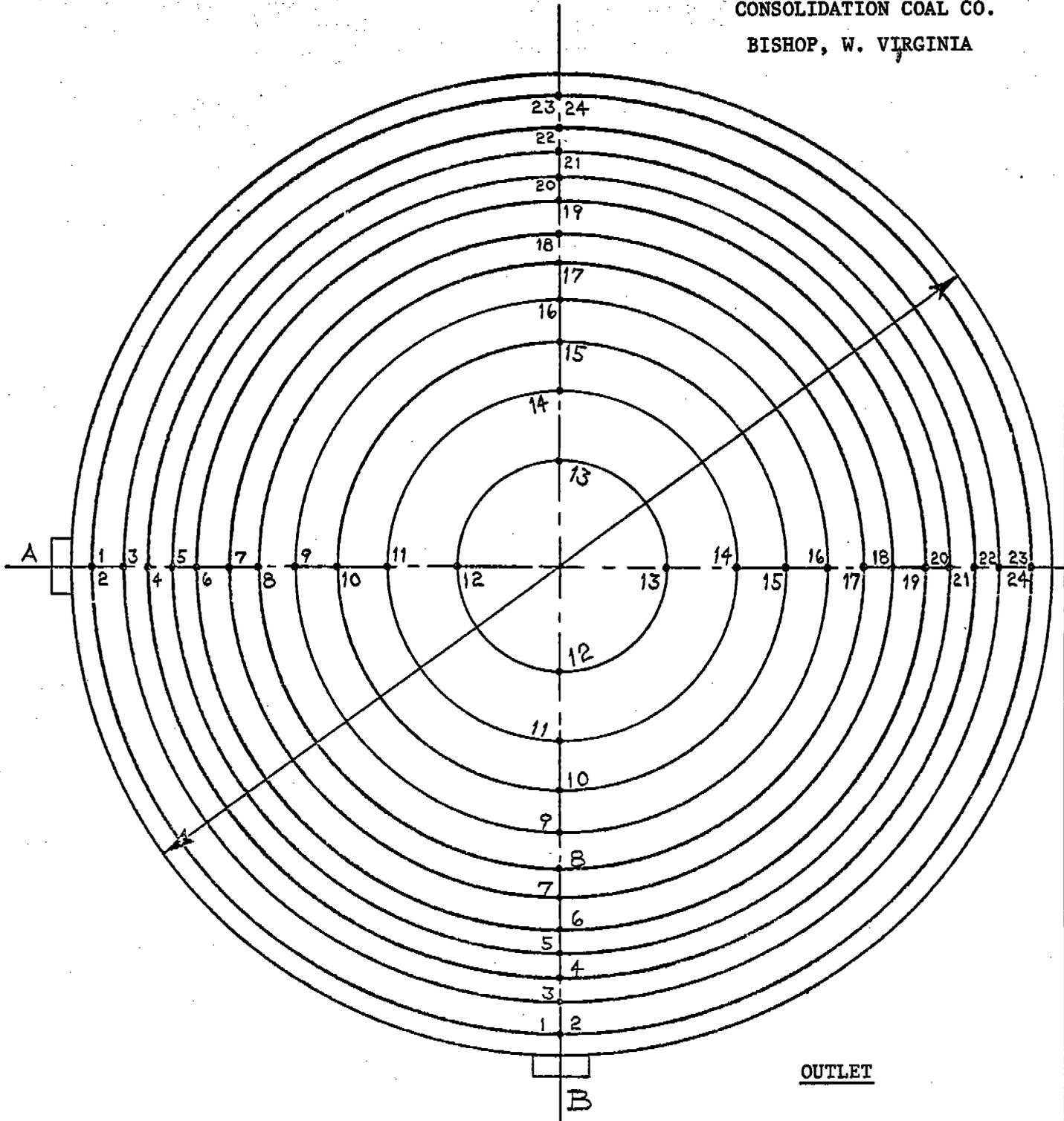


FIGURE 2 TRAVERSE POINT LOCATIONS  
(continued)



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## 5.0 SAMPLING AND ANALYTICAL PROCEDURES

### 5.1 PARTICULATE SAMPLING AND ANALYTICAL PROCEDURES

Samples were collected for the determination of particulate matter simultaneously from the inlet and outlet of the venturi scrubber. The sampling and analytical procedures used were the same as those specified by Method 5, "Determination of Particulate Emissions from Stationary Sources", and published in the Federal Register, Volume 36, No. 247, Thursday, December 23, 1971. This method is attached as Appendix D. In addition, the impinger catch was analyzed.

Briefly, the method consists of withdrawing a sample isokinetically from the stack through a heated glass probe into a cyclone, filter, and impinger train. The cyclone and filter are contained in a heated box. The sample volume is measured with a dry gas meter, and isokinetic conditions are maintained by monitoring the stack gas velocity with an "S" type pitot tube. After testing is completed, the train is thoroughly washed including the probe. The washings are evaporated, dried, and weighed along with the filter in order to obtain a total weight of particulate matter collected.

The stack gas velocity and flow rate were measured using Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)", and published in the Federal Register. Using both the weight of sample collected and the flow rate determined, a total particulate emission rate was calculated.

### 5.2 GASEOUS SAMPLING PROCEDURES

Stack gas samples were taken at regular intervals during each particulate sampling traverse to determine the concentration of



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O<sub>2</sub>, CO, CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub> present in the stack effluent. The sampling locations were the same with respect to the venturi scrubber as those used for the particulate samples. The sampling and analytical procedures used were in accordance with Federal Register, Volume 36, No. 247, December 23, 1972, "Standards of Performance for New Stationary Sources".

### 5.3 SO<sub>2</sub> SAMPLING AND ANALYTICAL PROCEDURES

All SO<sub>2</sub> samples were taken through a ½ inch O.D. glass probe heated to approximately 250°F. This was connected to a glass sample train consisting of one bubbler and three impingers connected in series. The bubbler contained 15 ml. of 80% isopropanol and was used to remove any SO<sub>3</sub> present in the sample stream. The SO<sub>2</sub> was collected in the next two impingers, each containing 15 ml. of 3% H<sub>2</sub>O<sub>2</sub>. The third impinger was used to trap any overflow from the two SO<sub>2</sub> impingers.

Each sampling period was 30 minutes in duration, and the sampling rate was maintained at approximately 1 liter per minute with an in-line flowmeter. A temperature compensated dry gas meter was used to measure the total volume of gas sampled.

Following each test, the SO<sub>2</sub> samples were transferred to polyethylene bottles with distilled water washes. All samples were then returned to the laboratory where they were diluted to volume in a 50 or 100 ml. volumetric flask. A suitable aliquot of each sample was then titrated with a 0.01 N barium perchlorate solution in the presence of thorin indicator. The results were reported as parts per million SO<sub>2</sub>.



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#### 5.4 NO<sub>x</sub> SAMPLING AND ANALYTICAL PROCEDURES

The NO<sub>x</sub> samples were taken using the same heated glass probe described in Section 6.3. Each sample was drawn through this probe into a previously evacuated 2 liter flask containing 25 ml. of NO<sub>x</sub> absorbing solution. The flasks were shaken for 5 minutes following each sampling period and then allowed to stand for at least 16 hours. Following this, the samples were shaken again for 2 minutes just prior to measuring the final flask pressure. The samples were then transferred to glass shipping bottles with distilled water washes and neutralized with 1.0 N sodium hydroxide. At the end of the test period, all samples were returned to the laboratory for analysis.

The samples were analyzed via the phenoldisulfonic acid procedure described in the aforementioned Federal Register. The absorbances were measured with a Bausch and Lomb Spectronic 20 Colorimeter. The results were reported as parts per million NO<sub>2</sub>.

#### 5.5 ORSAT SAMPLING AND ANALYTICAL PROCEDURE

Integrated gas samples were taken for Orsat analysis (CO, CO<sub>2</sub> and O<sub>2</sub>) during each particulate sampling period. The sampling apparatus consisted of a ½ inch O.D. stainless steel probe, a stainless steel coiled tube condenser, a glass water trap, a carbon vane pump, a flow-meter and needle valve assembly, a 3 inch #21 stainless steel hypodermic needle, and a 5 liter Tedlar sample bag fitted with a syringe cap.

The sampling procedure was initiated by purging the probe and condenser system with stack air, adjusting the sample flow rates to approximately 80 cc per minute, and inserting the hypodermic needle



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into the syringe cap on the sample bag. The integrated sample was taken over a 1 hour period yielding approximately 4.8 liters of sample for analysis.

At the end of each test day, the sample bags were analyzed by Orsat for CO, CO<sub>2</sub> and O<sub>2</sub>. Repetitive analyses were performed on each bag to insure satisfactory duplication. The results were reported in percentages.

