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FIXED-BED GASIFICATION RESEARCH USING U.S. COALS, VOLUME 16 GASIFICATION OF 2-INCH MINNESOTA PEAT SODS

Contract H0222001

Black, Sivalls, and Bryson, Incorporated

**BUREAU OF MINES
UNITED STATES DEPARTMENT OF THE INTERIOR**

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FOREWORD

This report was prepared by Black, Sivalls & Bryson, Incorporated, Houston, Texas under USBM Contract Number HO222001. The contract was administered under the technical direction of the Twin Cities Research Center with Mr. Robert Zahl acting as Technical Project Officer. Mr. Frank Pavlich was the contract administrator for the Bureau of Mines. This report is a partial summary of the work recently completed as a part of this contract during the period June 1985 to September 1985. This report was submitted by the authors on September 23, 1985.

Funding for this contract was through USBM/USDOE Interagency Agreement DE-A121-7ET10205. Funding for this gasification test of two-inch peat sods was provided by the State of Minnesota, Department of Natural Resources under contract number 40347.

The University of Minnesota, Particle Technology Laboratory, Minneapolis, Minnesota, a subcontractor to Black, Sivalls & Bryson, Incorporated participated in preparation of this report. The peat gasified during the tests described here was donated by the State of Minnesota Department of Natural Resources as part of the MNDNR peat development program.

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INTRODUCTION

The United States Department of Interior, Bureau of Mines, Twin Cities Research Center, Minneapolis, Minnesota is the site of a 6.5 foot diameter Wellman-Galusha gasifier, installed in 1977-78. This gasifier, combustor/incinerator, and flue gas scrubber system in the past had been operated jointly by Bureau of Mines personnel, personnel from member companies of the Mining and Industrial Fuel Gas Group (MIFGa), and United States Department of Energy (DOE) personnel/consultants. Numerous tests using a variety of coals have to date been performed.

In May of 1982, Black, Sivalls & Bryson, Incorporated was awarded the contract to plan, execute, and report gasification test performance data from this small industrial fixed-bed gasification test facility. BS&B is responsible for program administration, test planning, test execution, and all documentation of program activities and test reports. The University of Minnesota, Particle Technology Laboratory is subcontractor to BS&B to monitor process parameters, and provide analysis for material inputs and outputs.

This report is the sixteenth volume in a series of final contract reports describing the fixed-bed gasification of U.S. coals at the Bureau of Mines, Twin Cities Research Center. This report documents test BOM/FGT-017, gasification of peat sods, which began on June 24, 1985, and was completed on June 27, 1985. The total funding for this test, plus the peat sods gasified during this test were supplied by the State of Minnesota, Department of Natural Resources under the Peat Development Program.

Section 1 gives a brief summary of the tests. Section 2 identifies test objectives. Section 3 contains a description of the fuels. Sections 4 and 5 describe the facility and monitoring systems. Sections 6 and 7 describe the conduct and results of the tests. Section 8 presents conclusions. Test data is included in the Appendices.

SECTION 1

TEST SUMMARY

Peat harvested in Northern Minnesota is available in several forms, among them are low-pressure extrusions referred to as sods and high pressure extruded pellets. Both of these physical forms for peat were evaluated in the gasification test program during the 1984 test season (BOM/FGT-010, BOM/FGT-011, and BOM/FGT-013).

Gasification of the 2 inch diameter peat sods was conducted in a Wellman-Galusha gas producer. The raw gas was sampled/cleaned for analysis and burned in a combustion chamber. The products of combustion were water-quenched, cleaned of sulfur oxides and particles, and then exhausted. Output stream characterization included ash, gas, tar, water, and unconverted dust.

These 2 inch peat sods gasified reasonably well and substantially better than the 3 inch sods gasified during BOM/FGT-013. Gas quality was steady (150 to 160 Btu/scf) and reasonably high throughputs were achieved (2.5 to 2.7 tons/hour). Table 1-1 gives design point data for gasification of this fuel at 2.6 tons/hour and a blast saturation temperature of 152 F (67 C). Maximum throughput was limited by the inability to feed the 2 inch pellets into the retort through the lock hopper and 10 inch ID fuel feed pipes.

Table 1-1

Design Point Characteristics for Gasification
of 2-Inch Peat Sods

Throughput - 2.6 tons/hour (155 lb/hr/sq ft grate)

Air/Peat	1.03	lb/lb
Steam/Peat	0.24	lb/lb
Blast Saturation Temperature	152	deg. F
Gas Offtake Temperature	171	deg. F
Wet Gas/Peat	39.1	scf/lb
Gas Dewpoint	167	deg. F
Tar Yield	5.0	lb/100 lb peat
Tar Analysis		
HHV (dry)	15659	Btu/lb
Pourpoint	110	deg. F
Viscosity (210 F)	158.8	SUS
Specific Gravity (60/60 F)	1.0369	
Dry Gas Composition (mol %)		
Hydrogen	18.8	
Carbon Monoxide	21.6	
Methane	1.61	
Ethane	0.220	
Ethylene	0.001	
Propane	0.095	
Propylene	0.039	
Carbon Dioxide	12.65	
Nitrogen + Argon	44.82	
Water	29.39	lb/1000 dscf
Dry Gas HHV	154	Btu/dscf
Dry Gas LHV	142	Btu/dscf
Thermal Efficiencies		
Hot, Raw	93.2	%
Cold, with Tar	78.6	%
Cold, without Tar	64.8	%

SECTION 2

TEST OBJECTIVES

2.1 Selection of Fuel for Testing

Peat pellets and peat sods had been gasified previously as part of this program (Thimsen, Maurer, et al 1985, Volume 11). Generally, the peat pellets performed well as fixed-bed gasifier fuels during BOM/FGT-010 and BOM/FGT-013. The peat sods gasified during BOM/FGT-011 performed poorly due to limited throughputs, gas channeling and low gas quality. During the 1984 peat harvesting season, a different peat harvesting technology was employed (by contractors to the Minnesota Department of Natural Resources) to produce slightly smaller peat sods with higher density and greater physical strength. It was deemed useful to evaluate these smaller and presumably stronger sods as a fixed-bed gasifier fuel.

2.2 Test Objectives

- A. Determine gasifier performance (including throughput and conversion efficiency) gasifying peat sods.
- B. Identify the operational requirements for gasifying peat sods.

2.3 Test Plan

Figure 2-1 shows the projected load levels for this short 5-day test. Three to four load levels were anticipated while establishing maximum throughput, and the limitations to throughput.

Use of the agitator and establishment of optimum blast saturation temperature (steam/air ratio) were left to the facility manager's judgement based on observed performance during the test. The grate spacings were 6 inches and 6.5 inches between the top and middle and the middle and bottom grate levels respectively.

Figure 2-1
Proposed Test Plan, BOM/FGT-017

SECTION 3

Description of Fuel Tested

The peat sods gasified during BOM/FGT-017 were produced from peatlands west of Cotton, Minnesota by Great Lakes Peat Company. Figure 3-1 shows the location of the production fields. The sods are produced by extruding a relatively thin layer of peat through 2 inch dies under mild pressure. The extruded sods are allowed to air dry in the field and are removed from the field at 30-50% moisture.

The sods gasified during BOM/FGT-017 were produced during July-August 1984. They were crushed and screened in January 1985 and stored in the open until June 1985. Nominally 300 tons of screened sods were transported to the test site in live bottom trailers during the week of June 23, 1985.

Table 3-1 gives the average analysis of the peat sods gasified during BOM/FGT-017. Table 3-2 shows how this sod peat fits in the coal test objective matrix. This sod peat is a high moisture, low ash fusion temperature fuel.

The primary differences between the peat sods gasified during BOM/FGT-017 and those gasified during BOM/FGT-011 (Thimsen, Maurer et al, 1985) are three:

1. The -017 sods were extruded through a 2 inch die rather than the 3 inch die used for the -011 sods. Somewhat different harvesting equipment was also used.
2. The -011 sods were crushed and screened at a gravel pit and may have picked up contaminants. The -017 sods were crushed and screened near the production site. The -017 sods are lower in ash than the -011 sods.
3. The -017 sods were harvested using a harvesting system that cleared the field of trash. This resulted in a sod product that contained less woody material than the -011 sods.

Figure 3-1

Location of the Peat Production Fields BOM/FGT-017

Table 3-1

Average Analysis of 2 Inch Peat Sods

Proximate Analysis (%)

Volatile Matter	41.89
Fixed Carbon	15.43
Ash	6.23
Moisture	36.45

Sulfur	0.20
--------	------

Heating Value (Btu/lb)	5573
------------------------	------

Ultimate Analysis (%)

Carbon	32.71
Hydrogen	3.47
Nitrogen	1.58
Sulfur	0.20
Oxygen	19.36
Ash	6.23
Moisture	36.45

Ash Fusion Temperatures (deg. F):

	Oxidizing	Reducing
Initial Deformation	2140	2070
Softening	2165	2100
Hemispherical	2205	2125
Fluid	2390	2195

Free Swelling Index:	0
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Table 3-2

Characteristics of Peat Sods with Regard to the
Coal Test Objective Matrix.

COAL TEST OBJECTIVE MATRIX									
PHYSICAL CHARACTERISTICS		COAL RANK							
TYPE	RANGE	BITUMINOUS	SUB-BITUMINOUS			LIGNITE	PEAT/BIOMASS	PETROLEUM COKE	BRIQUETTES
			A	B	C				
ASH CONTENT	H + 20%								
	M 10 - 20%								
	L - 10%						017		
ASH FUSION	H + 2700 F								
	M 2300-2700 F								
	L - 2300 F						017		
FREE SWELLING INDEX	H 3 +								
	M 1 - 3								
	L 0 - 1						017		
MOISTURE CONTENT	H + 15%						017		
	M 5 - 15%								
	L - 5 %								
FRIABILITY (GRINDABILITY)	H								
	M						017		
	L								

SECTION 4

FACILITY DESCRIPTION

The USBM/TCRC gasification facility is described in detail in Volume 1 of this series (Thimsen, Maurer et al, 1984). A brief description of the equipment and monitoring systems is given here.

4.1 Test Facility

The gasification test facility includes a 6.5 foot diameter Wellman-Galusha gas producer, a combustion test chamber and a wet caustic scrubber. The site also includes an iron ore pelletizing kiln which was not used during this test. The entire stream of producer gas was consumed in the combustion chamber. A process flow schematic is shown in Figure 4-1. A bottom size screen removes fine material prior to transport to the overhead storage bin by bucket elevator.

The facility is equipped with standard industrial monitoring equipment for measurement of temperatures, pressures, flows, and process conditions. These are recorded by an automatic data acquisition system for subsequent process analysis.

4.1.1 Gas Producer

The gas producer is a 6.5 foot ID Wellman-Galusha, single-staged, fixed-bed, atmospheric-pressure gasifier. The gasifier has a gravity fuel feed system, a water-cooled agitator, and an eccentric-step type grate for ash removal. The retort is water jacketed and has no refractory lining. Steam generated in the water jacket is mixed with blast air. Steam/air ratio in the blast is controlled with the temperature of the saturated steam/air mixture. Steam is imported if that generated in the water jacket is not adequate.

4.1.2 Gas Combustor

The gas combustor includes a baffle burner and a refractory-lined combustion chamber, and is designed to burn the full gas output of the gasifier at a rated capacity of 30 MMBTU/hour. The combustion products exhaust through an impingement tray-type wet caustic scrubber for sulfur dioxide and particulate removal. An induced draft fan is used to exhaust the scrubbed products of combustion through a flue stack.

4.2 Gas Sampling and Conditioning System

Figure 4-2 is a schematic of the gas sampling and conditioning system. The sampling port is thermally insulated to prevent

Figure 4-1

Coal Gasifier Process Flow Schematic,
Bureau of Mines, Twin Cities Research Center.

Figure 4-2

Schematic Diagram of the Gas Sampling and Conditioning System

condensation. The hot producer gas is quenched rapidly upon entering the surface condenser which is cooled by cold water or cold, compressed air. The rapid quenching causes tar, oil, and water to condense on the inner surface of the condenser tube. The tar fog generated during cooling is removed in the electrostatic precipitator. The detarred gas is refrigerated and dessicated to remove water remaining in the gas stream. The dry, detarred gas is metered and transported to the instruments. Condensate samples are collected from traps in the condenser, electrostatic precipitator, and refrigerator.

4.3 Gas Analysis Equipment

Carbon dioxide and carbon monoxide concentrations are continuously measured with individual Beckman 864 non-dispersive infrared (NDIR) analyzers. Oxygen is monitored continuously with a Beckman 755 paramagnetic oxygen analyzer. Higher heating value of the sample gas is measured with a SIGMA continuous flow calorimeter. These signals are all recorded by the automatic data acquisition system.

Detailed gas composition is determined every 23 minutes with a Hewlett-Packard model 5880A gas chromatograph. The principal features of this chromatograph are listed in Table 4-1.

Sulfur species concentrations in the gas are determined with a HP 5793 gas chromatograph by manual injection of grab samples. The principal features of the HP 5793 are given in Table 4-2.

Table 4-1

Operating Configuration and Conditions,
Hewlett-Packard Model 5880A Gas Chromatograph

1. Columns used:
 - a. 1-10 ft x 1/8 inch SS Porapak Q
 - b. 1-10 ft x 1/8 inch SS Molecular Sieve 5A
 - c. 2-18 ft x 1/8 inch SS 2% OV-101 on WHP
2. Dual detectors - flame ionization detector in series with thermal conductivity detector
3. Set up for analysis of the following species:
Hydrogen, Carbon dioxide, Ethylene, Ethane, Propane,
Propylene, Oxygen, Nitrogen, Methane, and Carbon monoxide
4. Argon Carrier Gas - flow rate of 28 ml/min
5. Programmed Temperature from 75 C to 165 C to 135 C
6. 1.0 ml sample
7. 18 minute analysis time

Table 4-2

Operating Configuration and Conditions,
Hewlett-Packard Model 5793 Gas Chromatograph

1. Flame photometric detector
2. Single column - 18" x 1/8" Teflon Supelpak-S (Porapak QS)
3. Ten port valve for sample injection and column backflush
4. Integrator with limited control capabilities
5. Nitrogen carrier gas: Carrier Flowrate = 32 ml/min
6. Sample loop size = 125 ul
7. Temperature program:
Initial temperature 30 C
Initial time 1.5 min
Program rate 35 C/min
Final temperature 170 C
Final time 5.0 min
8. Analysis cycle time 25 min.

SECTION 5

TEST PROCEDURES

Test procedures are described in detail in Volume 1 of this series (Thimsen, Maurer et al, 1984). The following is a summary of the procedures including specific procedures used in this test only.

5.1 Test Teams

5.1.1 Gasifier Operation and Overall Coordination

The gasifier operations team was organized by Black, Sivals & Bryson, Incorporated (BS&B) and consisted of the facility manager, facility engineers, three shift lead operators and additional helpers as required. The gasifier was staffed with a lead operator and two helpers, three shifts each day.

The gasifier operations team was responsible for overall operation of the gasifier and associated process equipment and coordination of the three test teams. This includes: gasifier start up, coal gas handling and incineration, exhaust gas cleanup, coal addition and sample collection, fire bed monitoring, process equipment maintenance and repair, operation of the boiler, changes in process conditions, sampling of waste water streams, and measurement of retort temperature and pressure profiles.

5.1.2 Gasifier Monitoring

The gas sampling and data retrieval/monitoring team was organized by the University of Minnesota Particle Technology Laboratory, and consisted of persons with individual responsibility for:

- 1) sample gas cleanup
- 2) gas chromatograph
- 3) continuous gas analysis and SIGMA continuous calorimeter
- 4) data acquisition system
- 5) safety evaluation personnel

and such equipment operators as were necessary. The monitoring systems were staffed 24 hours per day.

The monitoring team was responsible for recording continuous process signals, operation of the gas chromatographs and continuous gas analysis equipment, operation of the gas sampling and conditioning system, collection of tar and oil samples, analysis of coal, ash, and cyclone dust samples, retort exhaust particle sampling and evaluation of health and safety measures.

5.1.3 Stack Gas Sampling

Interpoll, Incorporated, a subcontractor to the Black, Sivalis and Bryson, Incorporated, had a two man team on site on June 22, 1984. They sampled for exhaust emissions from the gas combustor.

5.2 Gasifier Sampling and Data Acquisition Procedures

5.2.1 Continuous Data

An Analog Devices, Incorporated MACSYM 350 data acquisition system was used for this test. Process signals are sampled once a minute. Ten-minute signal averages are recorded on floppy disc. Thirty-minute signal averages are printed by line printer. The operations team also logs these signals hourly along with some twenty other parameters not sampled by the data acquisition system. During observation of transients the sample time is reduced to 6 seconds with one minute averages written to disc.

5.2.2 Gas Analysis Data

The continuous gas analyzers are calibrated daily, according to the manufacturer's recommendations. Output signals are recorded by the data acquisition system.

The HP 5880A gas chromatograph is calibrated using a mixture of oxygen, carbon monoxide, carbon dioxide, hydrogen, methane, ethane, ethylene, propane, propylene, and nitrogen at concentrations which nearly duplicate the gasifier offgas. Another calibration mixture with the concentrations of all the species except nitrogen increased by about 50%, and the nitrogen correspondingly reduced, is used to check the linearity of the detectors.

The HP 5793 gas chromatograph is calibrated before and after the test. Calibrations with varying levels of hydrogen sulfide in nitrogen have confirmed the square root response of the flame photometric detector to gas sulfur concentrations. The hydrogen sulfide FPD calibration factor is used for determination of carbonyl sulfide and mercaptan concentrations.

5.2.3 Tar and Oil Data

The condensed tar, oil, and water are removed from the accumulation reservoirs daily. Water collected in the surface condenser and sample electrostatic precipitator is decanted from the tar and combined with the water from the refrigerator. Tar from the surface condenser is combined with tar and oil collected in the sample electrostatic precipitator. Condensate loadings are measured by weighing both the tar/oil sample and the water sample. Moisture content of each daily tar sample is

determined by distillation.

5.2.4 Fuel Data

Fuel samples are taken by the operations team during fuel addition to the lock hopper four times each shift. These four samples are stored in one bucket and submitted as a composite shift sample. Detailed chemical analysis of the peat is performed on a single composite of the shift samples.

5.2.5 Ash Data

An ash sample is taken by the operations team each time ash is discharged, and stored in a sealed container. For each ash sample the bulk density, particle size distributions, and carbon, sulfur, and moisture content of the ash are tabulated by the monitoring team. The carbon and sulfur content of each sample is determined from milled samples submitted by the monitoring team. Detailed chemical analysis of the peat ash is performed on a single composite of the shift samples.

5.2.6 Dust Data

Samples of cyclone dust are grabbed daily from the dust accumulation bin. A single composite of all daily samples is submitted for analysis.

5.2.7 Exhaust Gas Sampling

The gas phase combustion exhaust is analysed by EPA methods 5 and 6 for sulfur dioxide, nitrogen oxides, and particulates once during the test.

5.2.8 Retort Particle Sampling

Sampling of the gasifier offtake for particles is performed periodically as operating conditions permit.

5.2.9 Retort Temperature and Pressure Data

Vertical temperature and pressure profiles are taken at a single location periodically. The measurements are made at the end of relatively stable periods of operation just before operational changes are made.

SECTION 6

CONDUCT OF TEST

6.1 Gasification of Peat Sods

BOM/FGT-017 gasification of 2 inch sod peat began at 0640 on June 24, 1985. The start of this test was an uninterrupted continuation of testing from BOM/FGT-016 (Western Energy Rosebud) separated by a purge of 2.25 tons of metallurgical coke.

The major difficulty with the gasification of three peat sods was not the gasification process, but rather the feeding of the fuel through the weigh bin, lock hopper, and two 10-inch diameter feed pipes. The frequency of "coalups" had to be increased to every 1/2 hour rather than an hourly basis. Hammering on the pipes, running the vibrators, and rodding the pipes became routine to promote flow of the fuel into the retort.

The fire bed and gas quality reflected relatively stable conditions through the following load progression.

	SATURATION AIR FLOW	HOURLY AVERAGE PEAT THROUGHOUT
6 HRS	600 CFM	.2 TONS
13 HRS	800 CFM	1.1 TONS
29 HRS	1000 CFM	2.2 TONS
33 HRS	1200 CFM	2.7 TONS

BOM/FGT-017 resulted in better gas quality and a more manageable ash bed than BOM/FGT-011 gasification of peat sods. This may be the results of a better quality, uncontaminated feedstock, and a smaller (i.e. 2") and more uniform size sods. During this test the sods were screened over a 1/2" square mesh screen, while the previous peat sod gasification test used a 1/4" square mesh screen.

Figure 6-1 summarizes the conduct of test BOM/FGT-017.

Figure 6-1
Test History, BOM/FGT-017

SECTION 7

TEST RESULTS

7.1 Data Summary

7.1.1 Continuous Output Transducer Data

The data acquisition system operated well throughout the test period. Figure 7-1 shows the major physical operating characteristics of the gasifier with the 2 inch peat sods.

Offtake temperatures were low (80-150 C) during periods of comparatively stable operation. This is consistent with the high-moisture content of the peat fuel.

The dry gas heating value for the 2 inch peat sods ranged from 150 to 160 Btu/dscf during the majority of the test.

Fire loss pressure was relatively low throughout the test, similar to the previous peat tests and generally followed the blast air flow.

7.1.2 Peat, Ash, and Dust Data

7.1.2.1 Peat

A complete list of the tests performed on the bulk peat, ash, and cyclone dust samples collected during the 2 inch peat sod test together with the number of samples analyzed, is given in Table 7-1.

The peat sod feed size distribution for BOM/FGT-017 is given in Figure 7-2. More than 75% of this material was above 3/4 inch and less than 3% smaller than 1/4 inch. The geometric mean of the feed peat was nominally 1.0 inches as shown in Figure 7-3.

The physical and chemical analysis of the peat feedstock is given in Table 7-2. These sods exhibited a lower ash fraction than any of the previously gasified samples of Minnesota peat. All other physical and chemical properties compare well with the peat gasified in tests BOM/FGT-010, 011 and 013.

7.1.2.2 Ash

The ash size distribution analysis results and geometric mean ash particle size are shown in Figure 7-4.

The geometric mean ash particle size, dry ash bulk density are shown in Figure 7-5, along with the gasifier operating conditions. In general, ash sulfur content tracks ash carbon content. Ash carbon content was generally low (<5%). Ash sulfur content observed when gasifying the peat sods was around

HIGHER HEATING VALUE (BTU / SCF)

FIRE LOSS PRESSURE (IN WC)

OFFTAKE TEMPERATURE (DEG C)

SATURATION TEMPERATURE (DEG C)

BLAST AIR FLOW (SCFM)

TEST DATE (JULY 1985)

Physical Characteristics of the Gasifier Operation

Figure 7-1

Table 7-1

Summary of Peat, Ash and Cyclone Dust Analysis

Material	Type of Analysis	Number of Samples Collected and Analyzed	Number of composite Samples Analyzed

Peat	Particle size distribution	11	---
	Proximate analysis	---	1
	Ultimate analysis	---	1
	Ash fusion temperature	---	1
	Free swelling index	---	1

Ash	Particle size distribution	31	---
	Bulk density	31	---
	Moisture content	31	---
	Carbon content	31	---
	Sulfur content	31	---
	Chemical analysis	---	1

Cyclone	Proximate analysis	---	1(**)
Dust	Ultimate analysis	---	1(**)

(**) Composite of 9 cyclone dust samples.

Figure 7-2

Feed Peat Size Distribution Analysis and
Geometric Mean Peat Particle Size

Figure 7-3

Average Particle Size Distribution of Feed Peat

Table 7-2

Physical and Chemical Properties of Peat and Cyclone Dust

<u>Material</u>	<u>Peat</u>	<u>Cyclone Dust</u>
<u>Type of Analysis(*):</u>		
Proximate Analysis, wt %:		
Moisture	36.45	---
Volatile Matter	41.89	35.35
Ash	6.23	21.30
Fixed Carbon (**)	15.43	43.36
Sulfur	0.20	1.21
Ultimate Analysis, wt %:		
Hydrogen	3.47	3.65
Carbon	32.71	67.30
Nitrogen	1.58	2.51
Sulfur	0.20	1.21
Oxygen (**)	19.36	4.03
Ash	6.23	21.30
Moisture	36.45	---
Heating Value, Btu/lb:		
As received	5573	---
Moisture free	8770	11522
Ash Fusion Temp. Deg. F:		
(Oxidizing Atmosphere)		
Initial Def., IT	2140	---
Softening, ST	2165	---
Softening, HT	2205	---
Fluid, FT	2390	---
(Reducing Atmosphere)		
Initial Def., IT	2070	---
Softening, ST	2100	---
Softening, HT	2125	---
Fluid, FT	2195	---
Free Swelling Index	0	---

(*) Peat analysis is as received, cyclone dust analysis is dry basis.

(**) By difference.

Figure 7-4

Ash Size Distribution Analysis and Geometric
Mean Ash Particle Size

Ash Characteristics and Operating Conditions

Figure 7-5

0.2%.

The elemental analysis of the peat ashes collected throughout the test is given in Table 7-3. This ash is comparable to the peat ash generated during tests BOM/FGT-010, 011, and 013.

7.1.2.3 Cyclone Dust

The chemical analysis of cyclone dust collected during BOM/FGT-017 is tabulated in Table 7-2. A comparison of the dust analysis with the 2 inch sod analysis, on a dry basis, shows that the dust has a 117% greater ash content, and on a moisture and ash free basis, the dust has a 31% greater ultimate carbon content and a 31% greater heating value. This suggests that the dust is partially carbonized peat, consistent with previous gasification results.

7.1.3 Gas Analysis Data

The HP 5880A gas chromatograph measuring the major gas species and hydrocarbons operated continuously during the test with the exception of calibration periods. The HP5793 gas chromatograph measuring gas sulfur species was operated with hand injections.

The major gas species measured are shown in Figure 7-6. Figure 7-7 compares the dry gas HHV and major gas species with the gasifier operating conditions. The hydrocarbons are shown in Figure 7-8. The gasification of the 2 inch peat sods was steady throughout the test, with the exception of periods when the fuel feed allowed the gasifier freeboard to increase (i.e. fuel level in the retort drops). Hydrogen was steady throughout the test at nominally 18 percent. Carbon monoxide varied from 20 to 28 percent, with carbon dioxide varying between 10 to 14 percent.

The product gas higher heating value was steady at nominally 150 Btu/dscf and showed virtually no variation with either the blast air flow or saturation temperature (Figure 7-7). Likewise, the higher order hydrocarbons exhibited steady concentrations throughout the test (Figure 7-8).

The gas sulfur species are shown in Figures 7-9 and 7-10. The measured total sulfur varied between 200 and 600 ppm. The major sulfur species identified in the product gas were (1) hydrogen sulfide, (2) carbonyl sulfide, (3) methyl mercaptan, (4) ethyl mercaptan, (5) dimethyl sulfide, and (6) thiophene. Figure 7-9 presents the total sulfur along with the normalized concentrations of hydrogen sulfide and carbonyl sulfide. Hydrogen sulfide contributed nominally 50 to 70 percent of the total sulfur, with carbonyl sulfide contributing from 10 to 35 percent of the total sulfur. Combined, hydrogen sulfide and carbonyl sulfide contained nominally 85 to 90 percent of the total sulfur. The remaining 10 to 15 percent of the sulfur was either in mercaptans or higher order sulfur species as shown in Figure 7-10. These sulfur data are generally consistent with the

Table 7-3

Elemental Analysis of Moisture-Free Ash

Element	Mass Fraction % for Composite Sample (*)
Fe	13.10
Fe (2+)	4.80
Si	23.20
Al	6.50
C	3.80
Ca	10.00
Mg	1.80
K	1.20
P	0.12
Na	0.53
S	0.16
Ti	0.37

(*) Unaccounted for mass is presumed to be oxygen bound onto metals as oxides.

Major Gas Species Measured by the Gas Chromatograph

Figure 7-6

Dry Gas HHV, Major Gas Species and Gasifier
Operational Parameters

Figure 7-7

Figure 7-8
Minor Gas Species Measured by the Gas Chromatograph

Figure 7-9
Total Gas Sulfur and Normalized H_2S and
COS Species Concentrations

FGT-017

Figure 7-10
Total Gas Sulfur and Normalized Mercaptans
and Higher Order Sulfur Species Concentrations

results from the previous peat gasification tests, although the previous data exhibited lower COS concentrations and slightly higher mercaptan concentrations.

7.1.4 Tar and Water Yield Data

The tar and water yields observed during BOM/FGT-017, are shown with operating conditions in Figure 7-11. The water yield was generally between 25 to 30 lb/1000 scf with the tar yield at nominally 2 lb/1000 scf. Physical and chemical analyses of these materials are shown in Table 7-4. On a moisture-free basis, the chemical analyses of these tars exhibit excellent agreement with the pyrolysis products derived from the previous peat gasification tests. The pour point of the tar collected during this gasification test was similar to that of the peat pellets gasified during BOM/FGT-013.

7.2 Material and Energy Balance Calculations

The procedure for calculating material and energy balances is fully explained in Volume 1 of this series (Thimsen, Maurer et al, 1984). Briefly, the material compositions presented in Section 7.1, the peat feed rate, the blast saturation temperature, the dust yield data (presented in Section 7.5), and the tar and water yields are used to calculate a material balance. The blast air flow and gas flow rates are calculated assuming atomic nitrogen and carbon conservation around the gasifier. The energy balance is calculated by assigning appropriate enthalpies to the material flows, and using measured heat losses.

Tables 7-5 to 7-8 show calculations for specified time periods during BOM/FGT-017. Each evaluation corresponds to a period of relatively stable gasifier operation. The overall average mass and energy balances close to within 4.3 percent and 5.5 percent respectively (Table 7-9). Although this is generally within the overall expected accuracy, the closure with these balances for peat is substantially worse than for the coals gasified.

Examination of the elemental balances for hydrogen and oxygen indicate a systematic imbalance of 10-25% excess recovery of these elements. The oxygen/hydrogen mole ratio of the excess of these elements falls in the range of 0.5 to 1.0, indicating that some part of the imbalance could be accounted for by inaccurately measured water leaving or entering the retort, or fuel moisture content above the analysis used, or some combination of these causes. This problem has been noted before (Volume 10, Thimsen, Maurer et al, 1985) when large amounts of import steam are used to prepare the desired blast steam/air ratio. This suggests that the quality of the import steam is substantially less than 100%, and that unmetered liquid mist is entering with the blast. This liquid mist would not affect the steam-air ratio as measured by the blast saturation temperature.

Figure 7-11
Tar/oil yield and Water yield with Operating Conditions

Table 7-4

Condensed Material Analysis

Tar	As recieved	Dry Basis
Heating Valve, btu/lb	13725	15659
Flash point, deg. F	185	
Water by distillation, %	12.35	
Specific gravity, 60/60 deg. F	1.0369	
Sediment (solids), % W/W	0.55	
Pour point, deg. F	110	
Cold (solid) point, deg. F	105	
Viscosity at:		
122 deg. F Saybolt Universal, Sec.	73.6	
122 deg. F Kinematic, centistokes	154.6	
210 deg. F Saybolt Universal, Sec.	158.8	
210 deg. F Kinematic, centistokes	33.6	
Ultimate Analysis, WT%		
Hydrogen	7.87	8.98
Carbon	68.90	78.61
Nitrogen	2.82	3.22
Oxygen (by difference)	7.77	8.86
Sulfur	0.20	.23
Moisture (total)	12.35	---
Ash	0.09	.10
Water		
Total organics, % W/W	1.523	

Table 7-5

Material Balance and Thermal Efficiency Calculation
1.03 tn/hr, 148 F

Input Data

Time period: 6/24/85 14:00 - 6/25/85 03:00 (13.0 hours)

Gasifier Operation:	Coal Data:
Coal feed, Ton/hour = 1.03	Type = Peat Sods
Blast air flow (dry) , Scfm = 623.	Mass Fraction Carbon % = 32.7
Saturated air temperature, F= 148.	Mass Fraction Fixed Carbon = 15.43
Steam/Air Ratio (lb./lb.) = 0.20	Mass Fraction Moisture % = 36.45
Ambient air temperature, F = 74.	Mass Fraction nitrogen % = 1.58
Off-take temperature, F = 283.	Mass Percent sulfur = 0.20
	Heating value, Btu/lb = 5573

Tar and Water Yield (dry basis):	Ash and Dust Data:(dry basis)
Water yield, lb./1000 SCF = 19.77	Ash discharge ,lb/hour = 229.
Tar yield, lb/1000 SCF = 1.37	Ash carbon ,percent = 22.8
Carbon in Tar (percent) = 78.6	Ash sulfur ,percent = 1.26
Sulfur in Tar (percent) = 0.23	Ash moisture (wet),percent = 6.6
Tar HHV, thou. Btu/lb = 15.66	Cyclone dust,lb/hour(est.) = 21.

Gas Composition (Dry): (normalized to 100.00)

H2 % = 17.7	CH4 % = 1.28	H2S (calc ppm)= 299
CO % = 23.5	C2H4 % = 0.102	COS (calc ppm)= 100
CO2 % = 11.12	C2H6 % = 0.080	
N2 % = 45.5	C3H6 % = 0.054	
O2 % = 0.00	C3H8 % = 0.028	HHV, Btu/SCF = 151
Molec. Weight= 24.91	Argon(est. %) = 0.535	LHV, Btu/SCF = 141

Calculation Results (based on nitrogen and carbon balance)

Material Balance (Percent unaccounted for: 4.12)

Input,	lb/hr	% Total	Output,	lb/hr	% Total
Coal	= 2055.	44.3	Dry gas	= 3227.	72.5
Steam (total)	= 434.	9.4	Water in gas	= 972.	21.8
Air(calc,dry)	= 2151.	46.4	Oil and tar	= 67.	1.5
			Ash(calc,dry)	= 163.	3.7
			Dust	= 21.	0.5
Total	= 4640.		Total	= 4449.	

Energy Balance (Percent unaccounted for: 9.91)

Input,	MM BTU/hr	Output,	MM Btu/hr	% Total
Coal	= 11.5	Dry coal gas	= 7.4	69.8
Air	= 0.007	Oil and tar	= 1.05	9.9
Steam(import)	= 0.324	Sensible	= 0.30	2.8
Cooling water	= 0.001	Latent	= 1.035	9.7
		Ash	= 0.527	5.0
		Dust	= 0.237	2.2
		Cooling water	= 0.049	0.5
Total	= 11.8	Total	= 10.6	

Performance Data

Cold gas efficiency,	percent = 62.9
Cold gas with tar efficiency,	percent = 71.9
Hot gas without tar efficiency	percent = 74.1
Hot gas with tar efficiency,	percent = 83.1
Air/Coal	(lb./lb.) = 1.047
Steam/Coal	(lb./lb.) = 0.211
Air/Fixed Carbon	(lb./lb.) = 6.784
Coal/Gasifier Area	(lb./hr./sqft) = 61.9
Fixed Carbon/Area	(lb./hr./sqft) = 9.6
Producer Gas/Coal	(SCF/lb.) = 33.9
Producer Gas/Fixed Carbon	(SCF/lb.) = 219.8
Tar Yield	(lb./lb. coal) = 0.033

Table 7-6

Material Balance and Thermal Efficiency Calculation
1.95 tn/hr, 151 F

Input Data

Time period: 6/25/85 04:00 - 6/26/85 08:00 (28.0 hours)

Gasifier Operation:

Coal feed, Ton/hour = 1.95
Blast air flow (dry) , Scfm = 852.
Saturated air temperature, F = 151.
Steam/Air Ratio (lb./lb.) = 0.23
Ambient air temperature, F = 81.
Off-take temperature, F = 190.

Coal Data:

Type = Peat Sods
Mass Fraction Carbon % = 32.7
Mass Fraction Fixed Carbon = 15.43
Mass Fraction Moisture % = 36.45
Mass Fraction nitrogen % = 1.58
Mass Percent sulfur = 0.20
Heating value, Btu/lb = 5573

Tar and Water Yield (dry basis):

Water yield, lb./1000 SCF = 28.87
Tar yield, lb/1000 SCF = 2.10
Carbon in Tar (percent) = 78.6
Sulfur in Tar (percent) = 0.23
Tar HHV, thou. Btu/lb = 15.66

Ash and Dust Data:(dry basis)

Ash discharge ,lb/hour = 239.
Ash carbon ,percent = 2.5
Ash sulfur ,percent = 0.27
Ash moisture (wet),percent = 3.2
Cyclone dust,lb/hour(est.) = 39.

Gas Composition (Dry): (normalized to 100.00)

H2 % = 18.6	CH4 % = 1.56	H2S (calc ppm) = 688
CO % = 21.6	C2H4 % = 0.204	COS (calc ppm) = 99
CO2 % = 12.65	C2H6 % = 0.104	
N2 % = 44.6	C3H6 % = 0.090	
O2 % = 0.00	C3H8 % = 0.037	HHV, Btu/SCF = 154
Molec. Weight = 24.91	Argon(est. %) = 0.525	LHV, Btu/SCF = 142

Calculation Results (based on nitrogen and carbon balance)

Material Balance (Percent unaccounted for: -5.71)

Input,	lb/hr	% Total	Output,	lb/hr	% Total
Coal	= 3909.	44.2	Dry gas	= 6157.	65.9
Steam (total)	= 906.	10.3	Water in gas	= 2708.	29.0
Air(calc,dry)	= 4024.	45.5	Oil and tar	= 197.	2.1
			Ash(calc,dry)	= 242.	2.6
			Dust	= 39.	0.4
Total	= 8838.		Total	= 9343.	

Energy Balance (Percent unaccounted for: 4.96)

Input,	MM BTU/hr	Output,	MM Btu/hr	% Total
Coal	= 21.8	Dry coal gas	= 14.4	67.5
Air	= 0.027	Oil and tar	= 3.08	14.4
Steam(import)	= 0.620	Sensible	= 0.39	1.8
Cooling water	= 0.002	Latent	= 2.886	13.5
		Ash	= 0.092	0.4
		Dust	= 0.450	2.1
		Cooling water	= 0.030	0.1
Total	= 22.5	Total	= 21.3	

Performance Data

Cold gas efficiency, percent = 64.2
Cold gas with tar efficiency, percent = 77.9
Hot gas without tar efficiency percent = 78.6
Hot gas with tar efficiency, percent = 92.4
Air/Coal (lb./lb.) = 1.029
Steam/Coal (lb./lb.) = 0.232
Air/Fixed Carbon (lb./lb.) = 6.672
Coal/Gasifier Area (lb./hr./sqft) = 117.8
Fixed Carbon/Area (lb./hr./sqft) = 18.2
Producer Gas/Coal (SCF/lb.) = 38.7
Producer Gas/Fixed Carbon (SCF/lb.) = 250.5
Tar Yield (lb./lb. coal) = 0.050

Table 7-7

Material Balance and Thermal Efficiency Calculation
2.57 tn/hr, 152 F

Input Data

Time period: 6/26/85 09:00 - 6/27/85 08:00 (23.0 hours)

Gasifier Operation:

Coal feed, Ton/hour = 2.57
Blast air flow (dry) , Scfm =1076.
Saturated air temperature, F= 152.
Steam/Air Ratio (lb./lb.) = 0.23
Ambient air temperature, F = 69.
Off-take temperature, F = 171.

Coal Data:

Type = Peat Sods
Mass Fraction Carbon % = 32.7
Mass Fraction Fixed Carbon = 15.43
Mass Fraction Moisture % = 36.45
Mass Fraction nitrogen % = 1.58
Mass Percent sulfur = 0.20
Heating value, Btu/lb = 5573

Tar and Water Yield (dry basis):

Water yield, lb./1000 SCF = 29.39
Tar yield, lb/1000 SCF = 2.09
Carbon in Tar (percent) = 78.6
Sulfur in Tar (percent) = 0.23
Tar HHV, thou. Btu/lb = 15.66

Ash and Dust Data:(dry basis)

Ash discharge ,lb/hour = 0.
Ash carbon ,percent = 0.4
Ash sulfur ,percent = 0.07
Ash moisture (wet),percent = 8.2
Cyclone dust,lb/hour(est.) = 51.

Gas Composition (Dry): (normalized to 100.00)

H2 % = 18.8	CH4 % = 1.61	H2S (calc ppm)= 726
CO % = 21.6	C2H4 % = 0.220	COS (calc ppm)= 120
CO2 % = 12.65	C2H6 % = 0.001	
N2 % = 44.3	C3H6 % = 0.095	
O2 % = 0.00	C3H8 % = 0.039	HHV, Btu/SCF = 154
Molec. Weight= 24.83	Argon(est. %)= 0.521	LHV, Btu/SCF = 142

Calculation Results (based on nitrogen and carbon balance)

Material Balance (Percent unaccounted for: -6.32)

Input,	lb/hr	% Total	Output,	lb/hr	% Total
Coal	= 5141.	44.1	Dry gas	= 8116.	65.6
Steam (total)	= 1223.	10.5	Water in gas	= 3644.	29.4
Air(calc,dry)	= 5281.	45.4	Oil and tar	= 259.	2.1
			Ash(calc,dry)	= 310.	2.5
			Dust	= 51.	0.4
Total	= 11645.		Total	= 12381.	

Energy Balance (Percent unaccounted for: 4.58)

Input,	MM BTU/hr	Output,	MM Btu/hr	% Total
Coal	= 28.7	Dry coal gas	= 19.1	67.9
Air	= 0.011	Oil and tar	= 4.06	14.4
Steam(import)	= 0.778	Sensible	= 0.44	1.6
Cooling water	= 0.003	Latent	= 3.883	13.8
		Ash	= 0.026	0.1
		Dust	= 0.592	2.1
		Cooling water	= 0.021	0.1
Total	= 29.5	Total	= 28.1	

Performance Data

Cold gas efficiency, percent = 64.8
Cold gas with tar efficiency, percent = 78.6
Hot gas without tar efficiency percent = 79.3
Hot gas with tar efficiency, percent = 93.2
Air/Coal (lb./lb.) = 1.027
Steam/Coal (lb./lb.) = 0.238
Air/Fixed Carbon (lb./lb.) = 6.658
Coal/Gasifier Area (lb./hr./sqft) = 154.9
Fixed Carbon/Area (lb./hr./sqft) = 23.9
Producer Gas/Coal (SCF/lb.) = 39.1
Producer Gas/Fixed Carbon (SCF/lb.) = 253.5
Tar Yield (lb./lb. coal) = 0.050

Table 7-8

Material Balance and Thermal Efficiency Calculation
2.76 tn/hr, 141 F

Input Data

Time period: 6/27/85 08:00 - 6/27/85 16:00 (8.0 hours)

Gasifier Operation:

Coal feed, Ton/hour = 2.76
Blast air flow (dry) , Scfm = 1072.
Saturated air temperature, F = 141.
Steam/Air Ratio (lb./lb.) = 0.16
Ambient air temperature, F = 65.
Off-take temperature, F = 166.

Coal Data:

Type = Peat Sods
Mass Fraction Carbon % = 32.7
Mass Fraction Fixed Carbon = 15.43
Mass Fraction Moisture % = 36.45
Mass Fraction nitrogen % = 1.58
Mass Percent sulfur = 0.20
Heating value, Btu/lb = 5573

Tar and Water Yield (dry basis):

Water yield, lb./1000 SCF = 24.88
Tar yield, lb/1000 SCF = 2.82
Carbon in Tar (percent) = 78.6
Sulfur in Tar (percent) = 0.23
Tar HHV, thou. Btu/lb = 15.66

Ash and Dust Data: (dry basis)

Ash discharge ,lb/hour = 156.
Ash carbon ,percent = 0.5
Ash sulfur ,percent = 0.08
Ash moisture (wet), percent = 7.0
Cyclone dust, lb/hour (est.) = 55.

Gas Composition (Dry): (normalized to 100.00)

H2 % = 18.8	CH4 % = 1.61	H2S (calc ppm) = 712
CO % = 21.6	C2H4 % = 0.220	COS (calc ppm) = 152
CO2 % = 12.64	C2H6 % = 0.110	
N2 % = 44.3	C3H6 % = 0.095	
O2 % = 0.00	C3H8 % = 0.039	HHV, Btu/SCF = 156
Molec. Weight = 24.84	Argon (est. %) = 0.520	LHV, Btu/SCF = 144

Calculation Results (based on nitrogen and carbon balance)

Material Balance (Percent unaccounted for: -3.65)

Input,	lb/hr	% Total	Output,	lb/hr	% Total
Coal	= 5512.	46.8	Dry gas	= 8310.	68.0
Steam (total)	= 871.	7.4	Water in gas	= 3157.	25.9
Air (calc, dry)	= 5399.	45.8	Oil and tar	= 358.	2.9
			Ash (calc, dry)	= 333.	2.7
			Dust	= 55.	0.5
Total	= 11782.		Total	= 12213.	

Energy Balance (Percent unaccounted for: 4.47)

Input,	MM BTU/hr	Output,	MM Btu/hr	% Total
Coal	= 30.7	Dry coal gas	= 19.8	66.2
Air	= 0.006	Oil and tar	= 5.60	18.8
Steam (import)	= 0.492	Sensible	= 0.41	1.4
Cooling water	= 0.005	Latent	= 3.376	11.3
		Ash	= 0.031	0.1
		Dust	= 0.635	2.1
		Cooling water	= 0.021	0.1
Total	= 31.2	Total	= 29.8	

Performance Data

Cold gas efficiency, percent = 63.3
Cold gas with tar efficiency, percent = 81.2
Hot gas without tar efficiency percent = 75.2
Hot gas with tar efficiency, percent = 93.2
Air/Coal (lb./lb.) = 0.979
Steam/Coal (lb./lb.) = 0.158
Air/Fixed Carbon (lb./lb.) = 6.347
Coal/Gasifier Area (lb./hr./sqft) = 166.1
Fixed Carbon/Area (lb./hr./sqft) = 25.6
Producer Gas/Coal (SCF/lb.) = 35.2
Producer Gas/Fixed Carbon (SCF/lb.) = 228.0
Tar Yield (lb./lb. coal) = 0.065

Table 7-9

Material Balance and Thermal Efficiency Calculation
Peat Sods Overall Average

Input Data

Time period: Overall Average (72.0 hours)

Gasifier Operation:

Coal feed, Ton/hour = 2.07
Blast air flow (dry) , Scfm = 907.
Saturated air temperature, F = 149.
Steam/Air Ratio (lb./lb.) = 0.21
Ambient air temperature, F = 73.
Off-take temperature, F = 191.

Coal Data:

Type = Peat Sods
Mass Fraction Carbon % = 32.7
Mass Fraction Fixed Carbon = 15.43
Mass Fraction Moisture % = 36.45
Mass Fraction nitrogen % = 1.58
Mass Percent sulfur = 0.20
Heating value, Btu/lb = 5573

Tar and Water Yield (dry basis):

Water yield, lb./1000 SCF = 27.41
Tar yield, lb/1000 SCF = 2.10
Carbon in Tar (percent) = 78.6
Sulfur in Tar (percent) = 0.23
Tar HHV, thou. Btu/lb = 15.66

Ash and Dust Data:(dry basis)

Ash discharge ,lb/hour = 152.
Ash carbon ,percent = 7.9
Ash sulfur ,percent = 0.52
Ash moisture (wet),percent = 4.6
Cyclone dust,lb/hour (est.) = 41.

Gas Composition (Dry): (normalized to 100.00)

H2 % = 18.6	CH4 % = 1.55	H2S (calc ppm) = 589
CO % = 21.8	C2H4 % = 0.199	CO2 (calc ppm) = 120
CO2 % = 12.46	C2H6 % = 0.063	CH3SH (calc ppm) = 0
N2 % = 44.6	C3H6 % = 0.088	C2H5SH (calc ppm) = 0
O2 % = 0.00	C3H8 % = 0.037	HHV, Btu/SCF = 154
Molec. Weight = 24.87	Argon (est. %) = 0.524	LHV, Btu/SCF = 142

Calculation Results (based on nitrogen and carbon balance)

Material Balance (Percent unaccounted for: -4.32)

Input,	lb/hr	% Total	Output,	lb/hr	% Total
Coal	= 4146.	44.7	Dry gas	= 6448.	66.7
Steam (total)	= 905.	9.8	Water in gas	= 2697.	27.9
Air (calc,dry)	= 4214.	45.5	Oil and tar	= 207.	2.1
			Ash (calc,dry)	= 272.	2.8
			Dust	= 41.	0.4
Total	= 9265.		Total	= 9665.	

Energy Balance (Percent unaccounted for: 5.45)

Input,	MM BTU/hr	Output,	MM Btu/hr	% Total
Coal	= 23.1	Dry coal gas	= 15.1	67.4
Air	= 0.013	Oil and tar	= 3.23	14.4
Steam(import)	= 0.603	Sensible	= 0.40	1.8
Cooling water	= 0.002	Latent	= 2.875	12.8
		Ash	= 0.311	1.4
		Dust	= 0.478	2.1
		Cooling water	= 0.028	0.1
Total	= 23.7	Total	= 22.4	

Performance Data

Cold gas efficiency, percent = 63.7
Cold gas with tar efficiency, percent = 77.3
Hot gas without tar efficiency percent = 77.3
Hot gas with tar efficiency, percent = 91.0
Air/Coal (lb./lb.) = 1.017
Steam/Coal (lb./lb.) = 0.218
Air/Fixed Carbon (lb./lb.) = 6.588
Coal/Gasifier Area (lb./hr./sqft) = 124.9
Fixed Carbon/Area (lb./hr./sqft) = 19.3
Producer Gas/Coal (SCF/lb.) = 37.5
Producer Gas/Fixed Carbon (SCF/lb.) = 243.0
Tar Yield (lb./lb. coal) = 0.050

There is also some concern that the moisture content of the peat samples analyzed is less than that of the peat fed to the gasifier. While care was taken to keep the sample containers sealed, some drying may have occurred during handling.

Energy losses in dust and ash, and thermal losses amount to less than 6% in all three cases, indicating a high overall fuel conversion efficiency during these analyses periods. Tar amounted to 14 - 19% of the energy output. In general, the dry gas contained about 67% of the output energy.

7.3 Grate Performance Model

The details of the grate performance model are presented in Volume 1 of this series (Thimsen, Maurer et al, 1984). Generally speaking, the model calculates the volume swept by the voids in the bottom two levels of the eccentric grate. This volume is a function of the grate spacings, eccentricity and rotational speed. This calculated volume is then compared to the volume of dry ash, determined by the dry ash weight and dry bulk density.

Figure 7-12 shows the results of these calculations for the gasification of 2" peat sods. The ash removal rate data in Figure 7-12 exhibits significant scatter. Although the data scatter is very large, the simplified correlation model splits the data suggesting that the model correlates the "average" ash removal data reasonably well.

7.4 Combustion Emissions Monitoring

On June 24, 1985, emissions measurements were performed on the exhaust gases within the exhaust stack, downstream of the scrubber and ID fan. The full report on these measurements is contained in Appendix K.

The particulate concentration varied little between 3 measurements and averaged 0.0063 gr/acf. The corresponding mass rate averaged 0.63 lb/hour and the particulate emission factor averaged 0.055 lb/million Btu. If this particulate is assumed to be ash, the particulate measured corresponds to about 0.5% of the ash generated during this period, and would imply less than 0.1% of the wet peat feed penetrating the scrubber.

The sulfur dioxide concentrations were measured to be 61 ppm, actual. This corresponds to a sulfur dioxide rate of 4.3 lb/hour and an emission factor of 0.51 lb/million Btu. The sulfur dioxide emission factor calculated from the fuel analysis is 0.716 lb/million Btu, indicating that most of the sulfur in the feed peat goes to the overhead product. This is consistent with the relatively low sulfur flow out the ash pit during this period

Figure 7-12

Comparison of the Geometrical Grate Performance
Model with Ash Removal Rates

(approximately 0.79 lb/hour).

Nitric oxide emissions averaged 0.77 lb/MM Btu (F-Factor Method).

7.5 Retort Particle Sampling

A total of 10 particle samplings were made during this test. The particle sampling test run on June 25 at 06:42 resulted in no usable data. All filter samples included tar droplets. The total mass of particulate is taken to be the toluene insoluble portion of the samples collected.

Figure 7-13 shows the dust/coal percent variation with face velocity during this test. No curve fitting is reasonable for this data set. The relatively low particulate loss measured during this peat gasification test is thought to result from the three phenomena listed below:

- (1) The relatively low face velocity with high throughput resulting from the low gas offtake temperature.
- (2) The fibrous nature of the peat, which does not produce fine particulate.
- (3) The wetting of the fuel in the top of the retort due to tar condensation.

All of these phenomena will act to reduce the particulate loss with the product gas.

Two single samples of particles collected during peat sod gasification was analyzed for its size distribution. The results are included in Appendix F (Figure F-3 and F-4). The mass median diameters ranged from 70 to 80 um. A bimodal size distribution function was found to fit the data well. The larger volume (mass) mode was 300 um. The smaller volume mode was 44 um. These data are tabulated but not plotted in Appendix F.

Figure 7-13

Dust Carryover vs. Gas Face Velocity

SECTION 8

CONCLUSIONS

1. The demonstrated maximum gasification throughput of 2-inch peat sods was 2.6 ton/hour corresponding to a thermal input of 29 million Btu/hr. This was achieved for 30+ hours. This throughput was limited by the ability to continuously feed the sods into the retort.

2. Material and energy flows that can be expected:

Material In (lb/lb Peat)		Energy In (million Btu/hr)	
Air	1.03	Peat	28.7
Steam	0.238	Steam	0.78
Unaccounted	0.142		
Material Out (lb/lb Peat)		Energy Out (million Btu/hr)	
Dry Gas	1.58	Dry Coal Gas	19.1
Tar/Oil	0.050	Tar/Oil	4.06
Water	0.71	Sensible/Latent Heat	4.32
Dust	0.010	Dust	0.59
Ash	0.060	Ash	0.03
		Cooling Water	0.02
		Unaccounted	1.36

3. Blast saturation temperatures between 64 C and 66 C (147 F and 151 F) were used while gasifying peat sods. Fusion of ash did not occur during this test. This is in direct contrast with the peat gasification tests run in 1984 which were at lower blast saturation temperatures and consistently exhibited ash fusion problems.
4. Particle emissions from the combustion chamber were 0.055 lb/million Btu input which is a factor of 5.8 less than the particulate emission loadings measured in 1984. Sulfur dioxide emissions were 0.51 lb/million Btu input. This amounts to 72 percent of the sulfur entering the gasifier via the peat feed.
5. Offtake temperatures during periods of relatively stable operation were low (176 F, 80 C). Tar generated during gasification of the peat is condensed as a fog at these temperatures.
6. Based on these tests, the 2-inch diameter peat sod is recommended as a fixed-bed gasifier feedstock due to high throughputs achievable and good gas quality.

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APPENDIX A

Gasifier Operator's Log

These are the comments recorded by the gasifier operators during the course of the test.

Note: Grate speeds are referred to as:

"gear teeth engaged per stroke/Grate RPD per gear tooth engaged"

Grate speed is the multiple of these two numbers.

BOM/FGT 017

MINNESOTA PEAT SOD

START DATE: JUNE 24, 1985

TIME START: 0640

0700 Condition of bed as follows:

Freeboard - 32 1/2" avg
Ash Height - 27.42" avg
Offtake temperature 570 C

0725 Ran agitator 1 complete revolution.

0730 Cyclone dump. 30 seconds water on.
1/2 Rake fine ash.

0750 Freeboard 36" avg.

0800 Firetest 12" avg. Multizones on #1, 5, 6 with high zone at 72".

0805 Ran agitator 1 complete revolution.

0809 Reduced saturation temperature to 62 C.

0810 Coal leg alarm went off and temp hit 50 C.

0820 Coal leg temp dropped to 30 C.

0825 Cyclone dump/rake fine ash.

0830 Ash dump, very hot, 8" chunks.

0835 Coal Leg temp dropped to 37 C.

0840 Offtake temp continues to drop 554 C at this time.

0850 Started to put up peat - 1.45 tons on dial; 12 buckets.

0900 Freeboard 35 1/2" average dark holes.

0905 Coal leg temperature 34 C.

0921 Coal leg temperature 32 C.

0925 Completed peat fill to weigh bin - 4.17 tons.

0927 Cyclone Dump - very little ash.

0930 Kept coal discharge bins open; only used valve to fill storage bin. Also turned on the vibrator while coal valve was open.

0940 Inspected weigh bin. The peat was evenly distributed above discharge gates. Very little room left in bin because of density of peat. Cannot put more than 4-5 tons in weigh bin.

0942 Changed caustic barrel

1000 Freeboard 40 1/2" average.

1005 Ash dump - very hot. 4" chunks.

1015 Offtake temp. continues to drop 474 C at this time.

1020 Change grate speed to 3.0

1021 Drop saturation temperature to 60 C.

1030 Grate stopped and we reset to 1. tooth and 5.3 speed.

1030 Peat from weigh bin working fine.

1040 Increased Sat. temp to 64 C as CO2% was 16.

1045 Offtake temp continues to come down: 427C at this time.

1050 CO2% coming down - 14% now. CO% going up 20% now.

1100 Freeboard 42 1/2" average.

1125 CO2% - down again.

1130 Cyclone Dump - very little.

1150 CO2% down to 12.5%; offtake temp stable at 416 C.

1151 Ash pit pressure has been dropping steady all morning; current reading 1.8 - 2.3 range.

1200 Freeboard 44" average.

1215 Changed grate speed to 3 teeth and 3.0.

1225 Grate stopped, reset to 2 teeth and 5.0.

1230 Cyclone dump. Water on 30 sec.

1235 2 loads of peat came in and were dumped.

1235 Turned on agitator for 1 complete revolution.

1245 Turned on agitator for 1 complete revolution.

1300 Freeboard 37" average. Taking test feels different than with coal. The peat feels powdery and soft on end of test rod.

1303 Offtake temp continues to decline 230 C at this time.
1310 Offtake started to increase. 250x C now.
1317 Started agitator for complete revolution.
1324 Cyclone Dump. Water on 30 sec. Some yellow dust starting to show up.
1340 Offtake stabilized at 235 C.
1350 CO2% running around 12.
1400 Firetest 12.42" Avg.
Multizone on #1
Multizone on #4
Multizone on #7
Low ash on #2
Low ash on #7
Sticky on #5
Sticky on #1
1435 Started to put peat in weigh bin. 2.10 on dial.
1500 Completed Peat in weigh bin. 4.62 on dial

3rd SHIFT - BEAUTIFUL AFTERNOON!

1510 Dump ash at 600 lbs. Some Rosebud clinker still working it's way out.
1530 Dumped 0.8 tons from weigh bins. Must use vibrators.
1600 Have 17" on average. Pounded in #4, 5, and 6 rods. #4 came out hot with 10" ash. #3, 5, 6, & 7 had 20" plus ash. No dirty bars. Zones are narrowing. Increase grate speed to 3/5.0 in order to keep up with increasing ash average.
1620 Dump ash again at +600 lbs. Combination of 6-8" clinkers, and sized down to dust. Hot and dry!
1630 South leg quits filling 10 secs ahead of north leg. We are on the lookout for larger sticks which might hang up in coal pipes.
Offtake finally down under 200 C, but CO2 remains over 13%.
1740 Dump ash again at 740 lbs. more softball sized clinkers.
1800 Firetest shows a loss of 7" on ash average. Have highs and lows all around: 22" vs 6", 17" vs 0", and 26" vs 0".

- Three low holes, dirty with #2 and #4 red on bottom 4-5". #3 was highest firezone. Slow grate to 2 teeth/3.5.
- 1820 Start loading weigh bin at 1.89 tons.
- 1830 Another load of peat sods arrives. Finally reach 1.01 tons/hr this drop. T-705 down to 125 C. Gas quality is gradually improving.
- 1855 Stop coaling up weigh bin at 4.35 tons.
- 1930 Cyclone has no carry over.
Dump ash again at 580 lbs.
- * Only dropped 0.79 tons of coal. Both sides of coal bin dropped as usual.
- 2000 Firetest believable for a change. Left rods in for 7 mins., and all came out hot and visible. Overall average 6.0" even. Two low hole #3 and #5 with only 2" ash. #1, 2, 6, & 7 between 5" and 8". High hole #4 with 13" but dirty. #5 hole hottest with 3 foot fire zone. Slow grate speed to 1/3.5 in order to build ash. Offtake at 132 C.
- 2100 Gas quality much improved. Now is about 153 BTU/FT3 lower heating value. Offtake near 120C.
- 2130 Drop 1 ton peat again.
- 2210 Start putting peat into weigh bin at 1.68 tons.
- 2230 Dropped 1.07 tons from weigh bin.
- 2245 Resume grate speed 1/2.0. "Peating" up continues.

TUESDAY JUNE 25th 1985

1st SHIFT

- 2300 Reviewed previous shift with lead operator. Saturation air flow 800 cfm
- 2330 Cyclone flush - very little dust carry-over.
- 0000 Firetest - Ash average 10.71. All rods red after 7 minutes. High - 26" on hole 3. Multizone - 12.28 on hole 4. All rods down easy with exception to #3 crust layer.
- 0010 Increased grated speed from 2.0 to 3.5 at 1 - tooth.
- 0130 .50 ton peat left in bin started coal-up

- 0140 Ash Dump at 595#. Still getting softball-size clinker, for larger size, golfball size and smaller. Grayish white in color.
- 0230 Peat hanging-up in upper bin. Poked slide valves until flowing. Increased grate speed from 1/5.0 to 2/3.50
- 0300 Increased air flow to 1000 CFM. Increased furnace pressure to 130. Opened back pressure valve to 75% open. Increased primary blower to 2500 (30% open). Increased secondary blower to 11,000 (40% open).
- 0330 Cyclone flush - about a rake full.
- 0340 Changed out caustic barrel.
- 0345 Coal alarm - pounded on coal legs.
- 0400 Firetest - ash average 11.71". All rods down easy. 16" from grate there is heavy layer crust on all holes. All rods red after 7 min. #1 hole needed 10 min. Slowed grate from 3.5 to 3.0 with 2-teeth.
- 0430 Cyclone Flush - 1 1/2 rakes of small gravel type carry over; dropped 1.53 tons peat.
- 0450 Coal leg alarm - both coal legs empties. Roded out. Dropped peat again.
- 0500 1.65 Ton at 1/2" hour mark. Will start dropping peat every half hour.
- 0530 Cyclone flush - small amount of carry-over continuing coal-up.
- 0600 Firetest - ash average 17.42". Increased grate speed from 2/3.0 - 2/4.0. Bed seems in good shape. All rods down good. Still have crust layer about 16" from grate.
- 0630 Dropped 1.19 tons. Both sides fed evenly. Starting outside clean-up.
- * Truck arrived with larger peat sod.

2nd SHIFT Everything is running GOOD!!!

- 0715 Increased primary and secondary airflow to 3,500 + 10,000.
- 0715 Cyclone dump - dark chunks. Little ash. Shut grate off for motor replacement on drive.

0740 Ran agitator for 1 complete run. Coal leg alarm went off.

0745 Boiler off - repairman was here blowing it down. The peat was from piles down in the dirt pit on the lower level.

0750 Started to put peat-up - 1.59 on dial. Seemed to have higher H2O level.

0800 Stopped peat-up at 2.30.

0815 Restarted grate at 2 teeth. Firetest shows small fire zones all around. Good ash level on bottom 22.42" avg. Freeboard 45 1/2" avg.

0820 Adjusted grate speed 2-teeth and 10.0.

0827 Cyclone dump little or no ash.

0845 Ash dump - cool - 410 lbs.

0850 Changed grate teeth to 4 and adjusted speed to 6.0.

0900 Freeboard 44" avg.

0915 Lube gasifier.

0925 Cyclone Dump O.K. Very little ash.

0945 Peat in weigh bin. Reached 4.31 tons so stopped. Did an Ash Dump. Cool - 422 lbs. Big chunks.

1000 Freeboard 43 1/2" average.

1012 Increased grate speed to 4 teeth and 8.0.

1025 Cyclone dump. Water on 30 sec.

1030 Poked down #3 hole as it had a high fire at test.

1040 Started agitator for 1 complete rev. CO2% high and CO dropping.

1047 Started agitator for 1 complete rev.

1100 Turned on agitator on slow setting 1.6.

1105 Ash dump - cool small chunks. 2-4 inches.

1107 Reset agitator control to 3.0.

1115 Increased saturation temperature to 65 C.

1125 Cyclone dump - little chunks ash. Water on 30 sec.

1200 Freeboard 43" average
Firetest 10.75" average

1216 Reduced grate speed to 6.0.

1220 Ash dump - small clinkers cool.

1225 Raised saturation temperature to 66 C.

1230 Cyclone dump - very little ash.

1305 Freeboard 44 1/2" average. Poked down #3 hole because it was multizone and dirty on last test.

1327 Cyclone dump. Water on 30 seconds.

1400 Freeboard 49" Average.

1405 Firetest. 12.14" Average.

1420 Ash dump

1422 Coal leg temp started to rise. Turned on vibrators and pounded pipe.

1430 pH 8.5 on water from scrubber turned down to 20-20 on caustic.

3rd SHIFT HOT, WINDY, AND HUUUUMID!!!

1500 "Peating" up every half hour. Using one ton every half hour. Vibrators being used. Covered peat on pad with plastic and will use up peat outside of pad first.

1530 Dump ash. Some 3" to 4" chunks. Mostly smaller. Ash glassy. Not nearly as hot as yesterday. pH is 7.0. Offtake of 82C with 150 BTU gas. CO2 still 11%+, CO at 22%.

1610 Flush cyclone for one minute, and got some brown bubbles on top with 3 brillo-pad sized chunks and 1/2 cup of dust of the bottom.

1630 Will begin filling weigh bin.

1700 Drop 1.10 tons. Being very careful to not scoop up rocks from dirty areas. Freeboard running 42" just after agitator.

1800 Firetest much better. Rods in for 7 mins. No dirty bars, no cold bars. All Firezone from 2" to 8" thick. #3 continues high at 28" ash increase grate speed to

- 4/6.5 to reduce ash avg.
- 1810 Must replace top of #1 poke hole as leaking gas badly in closed position. Cap packing is loose.
- 1820 Dump and sample ash again at 803 lbs. Ash dry. Observed one large clinker about 8" diameter.
- 1830 Continue to load peat, trying to keep ahead of half hour drop. Now averaging 2 plus TPH.
- 1900 Another truck load of the smaller sized sods arrives. Dumped on SE corner of pad.
- * Nothing but trouble with flow from weigh bin. See log!! Had to clean out weigh bin completely. Dropped 2.05 tons over 1 hour and 7 dumps.
- 2000 Firetest average 13.3" ash.
- #6 Dirty, 2 zones at 6" and 14".
#1 Bar cold, also at 14".
#3 Remains high and hot at 27".
All rods in easily.
Keep grate at 4/6.5 speed.
- 2030 Peat hangs up again. This time the coal legs were blocked. See log between 2030 hrs and 2105 hrs. Coal legs alarm sounds. Temp up to 45C. North leg too hot to touch.
- 2105 Finally got north coal leg to run out. Dropped 1.80 tons from 2030 to 2105 hrs. Offtake temp went up to 86 C. Ran agitator around twice to level peat in retort.
- 2200 Firetest shows 11.1" ash avg. Reduce grate speed to 4/6.0. No dirty bars. All in with ease. #3 low at 4", #4 hole high at 27". Firezone very narrow, 4" to 6".
- 2213 Coal leg temp alarm sound again. Will do some more pounding on north coal leg.
- 2215 Dropped an additional 1.14 tons.
- 2230 Dropped another 0.59 tons. "Peating" up continues.

WEDNESDAY JUNE 26th 1985

1st SHIFT

- 2300 Ash dump at 617 lbs. Coaling-up with peat continuous operation.

0000 Firetest - Ash avg 8.5". All rods down easy. Good Firezone on all rods. Reduced grate speed to 4/4.5 from 4.6/0.

0130 Cyclone flush - very little carry-over.
Started loading peat from pad.

0135 Ash dump at 652 lbs.

0200 Firetest - 8.8" ash average. All rods down easy. #1, 2, 3 red after 7 min. 4, 5, 6, 7 down for 10 min. Increased grate speed to 4/5.0 from 4/4.50.

0230 Cyclone flush - small amount of carry-over, couple chunks.

0300 Peat flowing down. Coal legs real good tonight - knock-knock!

0330 Cyclone flush - very little carry-over.

0400 Firetest-Ash average 9.5". Bed still soft-no problem putting rods down. Seems to be getting colder. Rod taking longer to heat up.

0430 Ash Dump 603#. Still filling weigh bin.

0600 Firetest - Ash Avg. 14.1". High - #4 hole with 24#. Low - #3 hole with 5". All rods down easy - red zone after 10 min. down.

0620 Cyclone flush. Increased grate speed from 4/5.0 to 4/6.0.

0630 Started outside clean-up.

2nd SHIFT Everything runing good!

Dump every 1/2 hr.

700 Freeboard 42 1/2" average.

715 Ash Dump 1-3" chunks. Cool and dry.

720 Started to clean-up left over peat in lower area before it rains. Lots of fines.

730 Cyclone dump - very little ash. Water on 30 seconds.

0737 Started to increase CFM to 1200 on SAF.

0745 Increase grate speed to 7.0.

0750 SAF CFM hit 1200.

0800 Freeboard 46" avg.
Firetest 12.42" avg ash. All holes cold with narrow fire zones.

0825 Changed grate speed to 5 teeth and 5.0.

0830 Cyclone dump. Very little ash comes out. Water on 30 seconds.

0900 Freeboard 40 1/2" average. Peat has a lot of fines in it. 1.33 ton/1/2 hour - biggest load yet.

0915 Changed combustor primary air flow to 70%. 3,300 - 4,000 cfm. Changed secondary air flow to 60%, 12,000 CFM. Started using peat from concrete pad area.

0930 Cyclone dump. Very little dust. Water on 30 sec.

0935 Lube gasifier and motors on fans.

0940 Another load of peat in - looks wet.

0950 Ash dump - damp - cool.

1000 Freeboard 43# avg. Firetest 13.57" avg. Ash. #1 and 2 seemed cooler than others. Narrow fire zones.

1010 Coal leg alarm went off. Pounded pipe with hammer and turned on pipe vibrators.

1027 Cyclone dump water on 30 seconds.

1035 Started to mix course peat with other before dumping in the hopper.

1040 Increased grate speed to 6.0.

1053 Increased SAF to 1400 cfm.

1055 Hit 1400 cfm. Increased primary air flow to 85% on combustor. Increased secondary air flow to 75% on combustor.

1150 Decreased to 1200 CFM on the SAF as the coal feed system would not keep up at 1400 CFM. South leg ran out. Decreased grate to 6.0.

1155 Ash dump. Warm and damp.

1157 Discontinued using large peat.

1200 Freeboard 45 1/2" average.
Firetest 11.43" average ash.

1215 Coal leg alarm went off. South leg empty.

1235 Cyclone dump O.K. Water on 30 sec. Enough ash for sample this time.

1250 Coal leg alarm went off. Turned on vibrator and pounded pipe. Seemed plugged up in storage area.

1310 Another load of peat arrived.

1315 Ash dump warm. Dump small chunks.

1330 Coal leg alarm off again. South side plugged.

1400 Freeboard 41 1/2" average. Firetest 11" average ash. Rods in for 10 minutes, but not real hot. However, we could see that the zones are narrow 6"-12" area.

1430 Coal leg alarm off again.

1455 Ash dump - warm, wet.

1500 Freeboard 47 1/2" average.

3rd SHIFT

1530 Drop 1.59 tons on the 1/2 hour at current load of 1200 CFM.

1535 Start crew filling weigh bin.

Freeboard at 47.5".

1600 Firetest shows 9.7" ash average. Low of 7" on #1, high of 12" on #6. Left rods in 8-14 minutes and still had cold zones on #1, #3, 4, 5, & 6. Slow grate to 5/5.5 in order to build ash. All rods in with ease.

Dropped 1.39 tons this half-hour.

Had trouble with south coal leg up at valve. T-714 hit 50 C. Rodded out area at valve, then dropped 1.68 tons. Weigh bin emptying fine.

1645 Dump ash at 550 lbs. An occasional 4" diameter chunk. Ash warm and damp.

1730 Last two "peat"-ups went smoothly. Dropping only 2.31 tons/hour.

1800 Firetest indicates only 8.1" Ash avg. No dirty bars. Slow grate speed to 5/3.0. Hauled out the old rail and straightened the bent rods.

Freeboard now 38" on #1 and #4 vs. 47 1/2" at 1500 hrs on the same two holes.

1830 Another heavy Cyclone Dump. Flushed for one minute and got 25 rakefulls.

Peat truck arrives.

1900 Tried to feed retort. This time the north coal leg clogged above lower disc valve. Rodded pipe.

1906 Finally dropped a total of 1.71 tons. North leg too hot to touch, but T-714 thermocouples read 30 C.

1930 Coal leg south side now the culprit. Finally drop 1.05 tons after rodding valve area, using both sets of vibrators and pounding the south leg.

1950 Peat trucker finally gets his load dumped. Had hydraulic trouble.

Offtake up some to 85 C.

2000 Firetest shows we've climbed back to 9.7" ash avg. All rods in easily. Nice clear 6" Firezones on all rods. Keep grate speed at 5/3.0.

Offtake up some more to 87 C.

Dropped 1.67 tons of peat after rodding north leg.

2030 More peat feed hang-ups. This time south side of weigh bin clogged. Only dropped 1.09 tons total after pounding, rodding, etc.

2035 Dump ash at 780 lbs. Very dry, with dust sized to 4" chunks.

Continue filling weigh bin.

2100 South side weigh bin hangs up once more. Drop only 1.18 tons.

2200 North coal leg rodded out. finally drop 1 1/2 tons.

Firetest shows 10.9" ash. Rods in easy; no double zones. Bed in good shape.

2300 Cyclone dump a little lighter.

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1st SHIFT

2300 Reviewed operation with lead operator.

2330 Replaced caustic barrel. Started outside coal-up.
Cyclone flush - about 4 rakes of mud.

0000 Firetest - ash average - 11.4". All rods down easy -
produces nice orange firezone. No dirty rods.
Increase grate to 5/35.

0030 North coal leg plugged at lower disc - rodded out O.K.

0130 South coal leg plugged at lower disc. Rodded out-O.K.

0200 Firetest - because U of M not finished with sample, we
will be slightly delayed.

0210 Ash dump at 505 lbs. - softball size and smaller.

0215 Firetest - ash average - 13.4. All rods down easy.
Grate at 5/3.5.

0230 Cyclone flush - about 5 rakes of mud. pH-steady at 7.0.

0300 South coal leg plugged at lower disc. Valve turned on
coal leg vibrator and hammered - O.K.

0330 Cyclone Flush - About 5 rakes of mud.

0400 Firetest - ash average 18.0". All rods down easy, bed
even around with 12" low/24" high. Increased grate to
5/5.0.

0500 Ash dump at 724 lbs - softball size and smaller golden
brown in color.

0530 North coal leg plugged - hammered leg - O. K.

0600 Firetest - 14.2" Ash average. All rods down easy; low
8"/high 22". Remaining 5/5.0 grate speed.

0630 Gas quality at 27 CO - 12 CO2. Started outside clean-
up.

2nd SHIFT

Coal legs plug on a regular basis. Must cycle valve
"2" times on a load-up.

0700 Ash dump. Warm-dry 363# net.

0705 Raining outside and heavy mist.

TABLE G-2
FIRE TEST LOG

DATE	TIME	INSERT TIME	POKE HOLE NUMBER												AVERAGE (IN)		
			RD	#1	RD	#2	RD	#3	RD	#4	RD	#5	RD	#6		RD	#7
6-24	0800	3	D	12	C	10	C	7	H	9	D	10	D	26	C	10	12.00
6-24	1000	3	D	11	D	8	C	8	D	3	D	12	D	25	C	7	10.57
6-24	1200	4	H	23		12		7		42	H	9	D	21	D	23	19.57
6-24	1400	4	D	7	H	4	C	7	D	10	H	19	H	35	D	5	12.43
6-24	1600	4	C	3		9		26	H	10		22		22		21	16.14
6-24	1800	5		26	D	0	H	17	D	0		22	D	6	H	4	10.71
6-24	2000	7	D	6		6	D	2	D	13	H	2		8	H	5	6.00
6-24	2200	7	H	3		3	H	0	H	5	H	5		8	D	1	3.57
6-25	0000	7		3		9		26	D	12		8		9		8	10.71
6-25	0200	7		10		18		35	D	8		8		3		16	14.00
6-25	0400	7		13	D	4		31		8		7		13		6	11.71
6-25	0600	7		18		31		33		16		7		11		2	16.86
6-25	0800	7	H	26	H	26	H	40	H	15	H	11	H	22	H	17	22.43
6-25	1000	6	C	23	C	19	H	36	H	14	H	21	C	16	H	9	19.71
6-25	1200	6	H	6	H	4	D	15	H	11	C	8	H	20	H	11	10.71
6-25	1400	6	H	7	H	27	H	14	H	13	C	8	C	6	H	10	12.14
6-25	1600	6	C	9		28	D	8		23		9		11	C	12	14.29
6-25	1800	7		22		6		9		28		14		16		13	15.43
6-25	2000	7	C	14		7	H	27		14		16	D	6		9	13.29
6-25	2200	7	C	9	C	12		4		27	C	10		7		9	11.14
6-26	0000	7		11		5		11		8		8		8		9	8.57
6-26	0200	7-10		10		7		12		13		14		6		0	8.86
6-26	0400	7-10		5		14		8	C	15		12		13		0	9.57
6-26	0600	10		17		13		5		24		12		10		18	14.14
6-26	0800	10	C	13	C	9	C	14	C	8	C	12	C	15	C	16	12.43
6-26	1000	10	C	14	C	11	H	15	H	8	H	16	C	13	H	18	13.57
6-26	1200	10	H	14	H	10	H	5	H	12	H	14	H	11	H	14	11.43
6-26	1400	10	C	8	C	14	C	16	C	10	C	11	C	10	C	8	11.00
6-26	1600	8-14	C	7		8	C	9	C	10	C	10	C	12		12	9.71
6-26	1800	10-12		6	C	10		8		15		5		4		9	8.14
6-26	2000	10-14		12		10		13		8		11		9		5	9.71
6-26	2200	8-10	C	14		12		11		9		10	C	9		11	10.86
6-27	0000	8-10		9		10		10		10		15		17		9	11.43
6-27	0200	8-10		14		10		15		9		9		14		23	13.43
6-27	0400	8-10		12		18		16		17		24		21		18	18.00
6-27	0600	8-10		13		8		22		22		15		10		10	14.29
6-27	0800	10		10		16		12	C	12		11		13		13	12.43
6-27	1000	5		25		10		14	H	17		8		8		17	14.14
6-27	1200	5-6		9		17		14		17		16		10		12	13.57
6-27	1400	5		9		9		17		10		13		10		11	11.29
6-27	1600	7		10		9		17		9		6		12		9	10.29

END OF BOM/EGT 017 PEAT SDS

DATE	TIME	#1	#2	#3	#4	#5	#6	#7	AVERAGE	AGITATOR DEPTH
6-26	0400		42			42			42	35 INCHES
6-26	0500			40			42		41	35 INCHES
6-26	0600	39			38				38.5	35 INCHES
6-26	0700		43			42			42.5	35 INCHES
6-26	0800			45			47		46	35 INCHES
6-26	0900	40			41				40.5	35 INCHES
6-26	1000		42			44			43	35 INCHES
6-26	1100			43			42		42.5	35 INCHES
6-26	1200	45			46				45.5	35 INCHES
6-26	1300		42			43			42.5	35 INCHES
6-26	1400			41			42		41.5	35 INCHES
6-26	1500	47			48				47.5	35 INCHES
6-26	1600			40			40		40	35 INCHES
6-26	1700		41			41			41	35 INCHES
6-26	1800	37			39				38	35 INCHES
6-26	1900			40			39		39.5	35 INCHES
6-26	2000		42			44			43	35 INCHES
6-26	2100	38			39				38.5	35 INCHES
6-26	2200			40			41		40.5	35 INCHES
6-26	2300		41			40			40.5	35 INCHES
6-27	0000	38			41				39.5	35 INCHES
6-27	0100		42			41			41.5	35 INCHES
6-27	0200			43			42		42.5	35 INCHES
6-27	0300	38			46				42	35 INCHES
6-27	0400		44			42			43	35 INCHES
6-27	0500			43			41		42	35 INCHES
6-27	0600	40			40				40	35 INCHES
6-27	0700		43			46			44.5	35 INCHES
6-27	0800			44			42		43	35 INCHES
6-27	0900	44			42				43	35 INCHES
6-27	1000		42			44			43	35 INCHES
6-27	1100			42			43		42.5	35 INCHES
6-27	1200	41			40				40.5	35 INCHES
6-27	1300		42			43			42.5	35 INCHES
6-27	1400			42			43		42.5	35 INCHES
6-27	1500	42			41				41.5	35 INCHES
6-27	1600	38			38				38	35 INCHES
6-27	1700		42			41			41.5	35 INCHES

END OF BOM/FGT 017 PEAT SODS

TABLE G-1
FREEBOARD HEIGHT LOG

DATE	TIME	#1	#2	#3	#4	#5	#6	#7	AVERAGE	AGITATOR DEPTH
6-24	0800	35			35				35	35 INCHES
6-24	0900		35			36			35.5	35 INCHES
6-24	1000			39			42		40.5	35 INCHES
6-24	1100	43			42				42.5	35 INCHES
6-24	1200		44			44			44	35 INCHES
6-24	1300			37			37		37	35 INCHES
6-24	1400	39			39				39	35 INCHES
6-24	1500		41			43			42	35 INCHES
6-24	1600			39			38		38.5	35 INCHES
6-24	1700		42			41			41.5	35 INCHES
6-24	1800		43			42			42.5	35 INCHES
6-24	1900	37			38				37.5	35 INCHES
6-24	2000	38			38				38	35 INCHES
6-24	2100			41			40		40.5	35 INCHES
6-24	2200			40			40		40	35 INCHES
6-24	2300	38			39				38.5	35 INCHES
6-25	0000	38			40				39	35 INCHES
6-25	0100		44			42			43	35 INCHES
6-25	0200			42			40		41	35 INCHES
6-25	0300	38			39				38.5	35 INCHES
6-25	0400		42			44			43	35 INCHES
6-25	0500			42			46		44	35 INCHES
6-25	0600	40			41				40.5	35 INCHES
6-25	0700		44			46			45	35 INCHES
6-25	0800			46			45		45.5	35 INCHES
6-25	0900	43			45				44	35 INCHES
6-25	1000		44			43			43.5	35 INCHES
6-25	1100	38		35	38		34		36.25	35 INCHES
6-25	1200	44			42				43	35 INCHES
6-25	1300		45			44			44.5	35 INCHES
6-25	1400			50			48		49	35 INCHES
6-25	1500	38			39				38.5	35 INCHES
6-25	1600		40			38			39	35 INCHES
6-25	1700		43			41			42	35 INCHES
6-25	1800			41			38		39.5	35 INCHES
6-25	1900	38			38				38	35 INCHES
6-25	2000	42			38				40	35 INCHES
6-25	2100			41			40		40.5	35 INCHES
6-25	2200		42			40			41	35 INCHES
6-25	2300			40			41		40.5	35 INCHES
6-26	0000	36			38				37	35 INCHES
6-26	0100		42			42			42	35 INCHES
6-26	0200			42			41		41.5	35 INCHES
6-26	0300	36			39				37.5	35 INCHES

APPENDIX G

Gasifier Operator Logged Data

Included are three tables of data:

G-1. Freeboard Data

G-2. Firetest Data

D - Multiple incandescent zones

H - Relatively hot incandescent zone

C - Relatively cold incandescent zone

G-3. Operator Logged Data I

Water flows in gpm.

Water totals in gallons.

Steam flows in lb/min.

G-4. Operator Logged Data II

Agitator counter in (total revolutions * 2)

Grate Gear counter in (total grate revolutions * 116)

Further description of these data are given in Volume 1 of this series (Thimsen, Maurer et al, 1984).

Figure F-4

Figure F-3

Cumulative Dust Data for BOM/FGT-017

Particle Size (micron)		Cumulative Percent Less Than Run Number	
Sieved	Shifted Sieved	017-03	017-04
1400	1892	---	98.98
840	1135	---	98.50
595	804	---	98.42
420	568	---	97.88
250	338	99.40	96.20
149	201	98.84	94.73
74	100	76.76	79.36
Microscopy (micron)			
	100	76.76	79.36
	56	47.03	50.11
	32	28.76	23.65
	17.8	13.10	7.93
	10	3.96	1.98
	5.6	0.40	0.15
	3.2	---	---

DUST DATA for BOM/FGT-017

Grand Average Gas/Air Ratio
2.0Estimated Offtake Elbow Area/ Sampler Inlet Area
4310 .Retort Area Less Draft Shroud Area
28.75 square feet

RUN #	DATE	TEST LENGTH (min)	MASS PARTICLES (milligram)	COAL FEED RATE (lb/hr)	T- 705 (deg. K)	P-705 ("hg abs)	F-701 (scfm)	GAS FLOW RATE (acfm)	DUST RT/ COAL RT (%)	PROBE DEPTH (inch)	AGITATOR ANGLE (deg)	AGITATOR RATE (sw/hr)	FREE-BOARD (inch)
1	25-JUN-85 01:17	3.0	40.20	2453	380	29.42	620	1431	0.31	34	-	0	42.0
2	25-JUN-85 01:36	3.0	30.00	2440	382	29.38	619	1438	0.23	34	-	0	42.0
3	25-JUN-85 01:51	3.0	33.90	2440	381	29.39	620	1440	0.26	34	-	0	39.8
4	25-JUN-85 06:22	3.0	63.70	2870	385	29.35	1016	2387	0.42	34	-	0	42.8
5	25-JUN-85 06:58	3.0	73.20	2870	377	29.32	1011	2319	0.48	34	-	0	45.2
6	25-JUN-85 06:42	3.0	SAMPLING FAILURE			SAMPLING FAILURE			SAMPLING FAILURE				
7	27-JUN-85 00:43	3.0	18.50	5427	351	29.44	1074	2314	0.06	34	-	0	40.5
8	27-JUN-85 01:25	3.0	17.10	5360	353	29.45	1199	2596	0.06	34	-	0	42.0
9	27-JUN-85 01:45	3.0	37.50	4853	350	29.45	1199	2579	0.15	34	-	0	42.0
10	27-JUN-85 02:05	3.0	31.00	4853	349	29.42	1199	2572	0.12	34	-	0	42.0

APPENDIX F

Retort Particle Sampling Data

Reference: Volume 1, Thimsen, Maurer et al, 1984

F-1. Dust Loading Data

F-2. Cumulative Dust Data

F-3. Cumulative Dust Size Distribution

F-4. Cumulative Dust Size Distribution

DATE	TIME	SAMPLE #	INITIAL DRY WT.	FINAL DRY WT.	NET DRY WT	INITIAL WET WT.	FINAL WET WT.	NET WET WT	NET DRY + NET WET
6-24	0830	A1	330	60	270	75	62	13	283
6-24	1000	A2	408	55	353	73	64	9	362
6-24	1230	A3	371	62	309	83	53	30	339
6-24	1500	A4	576	75	501	86	62	24	525
6-24	1630	A5	630	60	570	69	58	11	581
6-24	1740	A6	749	84	665	95	58	37	702
6-24	1930	A7	541	54	487	180	31	149	636
6-25	0140	A8	595	14	581	250	6	244	825
6-25	0435	A9	555	26	529	284	14	270	799
6-25	0845	A10	409	50	359	140	89	51	410
6-25	1050	A11	441	77	364	145	87	58	422
6-25	1112	A12	436	73	363	175	88	87	450
6-25	1230	A13	393	96	297	158	96	62	359
6-25	1430	A14	484	98	386	173	99	74	460
6-25	1542	A15	375	58	317	139	123	16	333
6-25	1820	A16	694	98	596	225	83	142	738
6-25	2035	A17	602	95	507	188	80	108	615
6-25	2235	A18	617	44	573	334	35	299	872
6-26	0135	A19	652	14	638	335	41	294	932
6-26	0430	A20	603	51	552	358	41	317	869
6-26	0730	A21	507	114	393	149	85	64	457
6-26	1000	A22	394	130	264	167	106	61	325
6-26	1150	A23	370	124	246	198	117	81	327
6-26	1315	A24	455	128	327	173	75	98	425
6-26	1504	A25	436	109	327	173	75	98	425
6-26	1650	A26	479	220	259	214	168	46	305
6-26	2230	A27	471	170	301	146	122	24	325
6-26	2350	A28	569	96	473	400	84	316	789
6-27	0215	A29	505	88	417	408	75	333	750
6-27	0500	A30	724	79	645	431	79	352	997
6-27	0700	A31	446	136	310	173	120	530	840
6-27	0930	A32	533	90	443	182	150	32	475
6-27	1106	A33	366	145	221	162	110	52	273
6-27	1300	A34	482	80	402	175	137	38	440
6-27	1445	A35	320	110	210	137	107	30	240
6-27	1616	A36	394	180	214	168	141	27	241

END OF BOM/EGT 017 PEAT SODS

APPENDIX E

Ash Removal Log

Ash weights are given in pounds.

Flush water is given in gallons.

ASH ANALYSIS FOR BOM/FGT-016

Sample Number	Date	Time	Cumulative Mass Fraction, % less than stated size, inch					Bulk Density gm/cc	Moisture content %	Carbon content %	Sulfur content %
			1/4	1/2	3/4	1	2				
1	6/24/84	8:30	36.2	53.6	63.1	72.5	92.1	0.79	1	20.7	0.68
2	6/24/84	10:00	31.5	44.3	53.5	57.3	78.6	0.82	0	11.3	0.65
3	6/24/84	12:30	92.5	98.1	100.0	100.0	100.0	0.60	38	34.5	2.80
4	6/24/84	15:00	27.7	35.0	39.1	41.5	49.3	0.91	0	32.3	1.20
5	6/24/84	16:29	20.1	25.1	29.1	31.8	39.3	0.98	0	0.0	1.50
6	6/24/84	17:39	37.1	44.9	51.1	56.4	69.9	1.01	—	31.8	1.50
7	6/24/84	19:29	22.1	30.2	37.0	45.6	56.5	0.98	0	17.9	0.56
8	6/25/84	1:39	20.6	33.9	42.5	51.8	77.6	0.85	4	4.4	0.44
9	6/25/84	4:34	15.2	23.9	33.4	40.3	54.4	0.79	3	4.4	0.80
10	6/25/84	8:44	37.0	55.6	70.4	82.0	92.6	0.84	8	4.8	0.65
11	6/25/84	10:50	4.1	14.7	31.6	75.7	100.0	0.57	2	2.3	0.43
12	6/25/84	11:11	14.6	27.2	35.8	48.9	89.0	0.72	3	2.6	0.19
13	6/25/84	12:30	9.7	19.4	32.0	43.1	77.1	0.70	4	4.7	0.33
14	6/25/84	14:30	11.3	24.3	43.7	64.6	100.0	0.74	3	2.8	0.17
15	6/25/84	15:42	4.1	11.5	21.8	33.0	70.2	0.76	2	2.8	0.05
16	6/25/84	18:20	3.8	12.0	22.3	31.1	47.7	—	1	0.1	0.05
17	6/25/84	20:35	4.4	12.1	18.8	23.4	48.0	0.68	1	1.3	0.04
18	6/25/84	22:35	12.0	29.5	42.2	52.1	71.5	0.69	3	0.1	0.09
19	6/25/84	1:35									
20	6/26/84	4:30	15.7	39.5	57.7	68.6	89.5	0.68	5	1.2	0.62
21	6/26/84	7:30									
22	6/26/84	10:00	22.2	44.8	58.8	69.3	85.2	0.88	5	1.1	0.09
24	6/26/84	11:50									
25	6/26/84	15:03	15.8	38.6	57.2	69.8	91.3	0.80	5	0.8	0.08
26	6/26/84	16:50									
27	6/26/84	22:29	5.4	13.2	22.0	28.3	40.8	0.67	4	0.1	0.05
28	6/27/84	23:50	23.2	39.4	54.2	66.3	94.3	0.63	18	0.2	0.05
29	6/27/84	2:15	22.3	39.1	54.7	65.8	89.4	0.66	10	0.3	0.05
30	6/27/84	5:00	15.5	39.6	53.9	73.3	91.9	0.61	6	0.1	0.04
31	6/27/84	7:00	14.3	29.1	41.2	55.2	90.9	0.66	8	0.1	0.07
32	6/27/84	9:30	55.0	75.1	82.7	88.3	100.0	0.72	10	0.1	0.06
33	6/27/84	11:06	12.1	25.2	32.4	38.1	54.5	0.60	5	0.4	0.15
34	6/27/84	13:00	19.0	42.7	59.3	73.8	100.0	0.67	7	0.5	0.10
35	6/27/84	14:44	10.7	24.3	35.5	45.1	64.4	0.68	5	0.3	0.05
36	6/27/84	16:15	13.3	30.6	49.2	60.0	80.7	0.72	6	1.5	0.07

AVERAGES

5 - 33	17.4	31.2	42.8	54.3	75.9	0.750	4.6	4.9	0.32
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APPENDIX D
Ash Analysis Data

DATE	TIME	SAMPLE #	START WT. (TONS)	STOP WT. (TONS)	NET WT. (TONS)	SCREEN (IN)	WASH
6-27	1500	S11	5.40	3.94	1.46	0.5	NO
6-27	1530	S11	4.43	3.07	1.36	0.5	NO
6-27	1600	S11	3.07	1.79	1.28	0.5	NO
6-27	1630	S11	1.79	0.54	1.25	0.5	NO
6-27	1700	S11	0.54	0.05	0.49	0.5	NO

DATE	TIME	SAMPLE #	START WT. (TONS)	STOP WT. (TONS)	NET WT. (TONS)	SCREEN (IN)	WASH
6-26	1638	S8	3.07	2.01	1.06	0.5	NO
6-26	1700	S8	3.01	1.90	1.11	0.5	NO
6-26	1730	S8	4.41	3.19	1.22	0.5	NO
6-26	1800	S8	3.19	1.98	1.21	0.5	NO
6-26	1830	S8	1.98	1.16	0.82	0.5	NO
NORTH LEG IS BLOCKED							
6-26	1900	S8	2.96	2.00	0.96	0.5	NO
6-26	1906	S8	2.00	1.25	0.75	0.5	NO
6-26	1930	S8	3.63	2.58	1.05	0.5	NO
6-26	2000	S8	4.30	2.63	1.67	0.5	NO
SOUTH SIDE WEIGH BIN IS NOT DROPPING							
6-26	2030	S8	2.63	2.03	0.60	0.5	NO
6-26	2043	S8	2.03	1.54	0.49	0.5	NO
6-26	2100	S8	2.53	1.35	1.18	0.5	NO
6-26	2130	S8	3.58	2.35	1.23	0.5	NO
6-26	2200	S8	3.63	2.13	1.50	0.5	NO
6-26	2230	S8	2.13	0.79	1.34	0.5	NO
6-26	2300	S9	3.39	2.21	1.18	0.5	NO
6-26	2330	S9	4.32	3.07	1.25	0.5	NO
6-27	0000	S9	3.07	2.04	1.03	0.5	NO
6-27	0030	S9	2.04	0.77	1.27	0.5	NO
6-27	0100	S9	2.86	1.46	1.40	0.5	NO
6-27	0130	S9	3.88	2.48	1.40	0.5	NO
6-27	0200	S9	4.33	3.11	1.22	0.5	NO
6-27	0230	S9	4.51	3.49	1.02	0.5	NO
6-27	0300	S9	4.43	3.20	1.23	0.5	NO
6-27	0330	S9	3.20	1.74	1.46	0.5	NO
6-27	0400	S9	2.56	1.22	1.34	0.5	NO
6-27	0430	S9	2.68	0.97	1.71	0.5	NO
6-27	0500	S9	2.66	1.27	1.39	0.5	NO
6-27	0530	S9	3.41	1.86	1.55	0.5	NO
6-27	0600	S9	3.34	2.25	1.09	0.5	NO
6-27	0630	S9	3.87	2.38	1.49	0.5	NO
6-27	0700	S10	3.61	2.26	1.35	0.5	NO
6-27	0730	S10	4.36	3.26	1.10	0.5	NO
6-27	0800	S10	5.67	4.17	1.50	0.5	NO
6-27	0830	S10	4.17	2.45	1.72	0.5	NO
6-27	0900	S10	4.92	3.52	1.40	0.5	NO
6-27	0930	S10	5.68	4.35	1.33	0.5	NO
6-27	1000	S10	5.35	4.13	1.22	0.5	NO
6-27	1030	S10	5.58	4.10	1.48	0.5	NO
6-27	1100	S10	5.42	4.18	1.24	0.5	NO
6-27	1130	S10	4.18	2.79	1.39	0.5	NO
6-27	1200	S10	5.48	4.22	1.26	0.5	NO
6-27	1230	S10	5.50	4.13	1.37	0.5	NO
6-27	1300	S10	5.43	3.90	1.53	0.5	NO
6-27	1330	S10	5.43	4.06	1.37	0.5	NO
6-27	1400	S10	5.45	4.13	1.32	0.5	NO
6-27	1430	S10	5.51	4.19	1.32	0.5	NO

DATE	TIME	SAMPLE #	START WT. (TONS)	STOP WT. (TONS)	NET WT. (TONS)	SCREEN (IN)	WASH
6-25	1930	S5	2.08	0.03	2.05	0.5	NO
			UPPER BIN BLOCKAGE CLEANED OUT				
6-25	2030	S5	2.30	1.39	0.91	0.5	NO
			COAL LEGS ARE HANGING UP AGAIN				
6-25	2100	S5	3.24	2.57	0.67	0.5	NO
6-25	2105	S5	2.57	1.44	1.13	0.5	NO
6-25	2130	S5	3.17	2.18	0.99	0.5	NO
			MORE HANG-UPS IN THE COAL LEGS				
6-25	2200	S5	3.49	2.87	0.62	0.5	NO
6-25	2215	S5	2.87	1.73	1.14	0.5	NO
6-25	2230	S5	1.73	1.14	0.59	0.5	NO
6-25	2300	S6	3.60	2.27	1.33	0.5	NO
6-25	2330	S6	2.88	2.00	0.88	0.5	NO
6-26	0000	S6	3.11	2.15	0.96	0.5	NO
6-26	0030	S6	2.32	1.31	1.01	0.5	NO
6-26	0100	S6	3.55	2.46	1.09	0.5	NO
6-26	0130	S6	4.15	3.16	0.99	0.5	NO
6-26	0200	S6	4.06	3.06	1.00	0.5	NO
6-26	0230	S6	3.06	1.82	1.24	0.5	NO
6-26	0300	S6	3.45	2.57	0.88	0.5	NO
6-26	0330	S6	4.24	3.36	0.88	0.5	NO
6-26	0400	S6	3.35	2.31	1.04	0.5	NO
6-26	0430	S6	2.31	1.16	1.15	0.5	NO
6-26	0500	S6	2.85	2.05	0.80	0.5	NO
6-26	0530	S6	4.13	3.28	0.85	0.5	NO
6-26	0600	S6	4.47	3.62	0.85	0.5	NO
6-26	0630	S6	3.62	2.60	1.02	0.5	NO
6-26	0700	S7	2.60	1.39	1.21	0.5	NO
6-26	0730	S7	2.73	1.76	0.97	0.5	NO
6-26	0800	S7	2.62	1.65	0.97	0.5	NO
6-26	0830	S7	2.54	1.32	1.22	0.5	NO
6-26	0900	S7	3.24	1.91	1.33	0.5	NO
6-26	0930	S7	3.76	2.53	1.23	0.5	NO
6-26	1000	S7	4.33	3.21	1.12	0.5	NO
6-26	1030	S7	3.21	1.93	1.28	0.5	NO
6-26	1100	S7	3.47	2.22	1.25	0.5	NO
6-26	1130	S7	4.15	2.31	1.84	0.5	NO
6-26	1200	S7	2.82	1.86	0.96	0.5	NO
6-26	1220	S7	2.91	2.13	0.78	0.5	NO
6-26	1230	S7	2.62	1.92	0.70	0.5	NO
6-26	1300	S7	4.58	3.42	1.16	0.5	NO
6-26	1330	S7	5.06	3.80	1.26	0.5	NO
6-26	1355	S7	5.61	4.89	0.72	0.5	NO
6-26	1430	S7	5.09	3.48	1.61	0.5	NO
6-26	1500	S8	4.71	3.38	1.33	0.5	NO
6-26	1530	S8	3.38	1.79	1.59	0.5	NO
6-26	1600	S8	4.26	2.87	1.39	0.5	NO
6-26	1630	S8	3.69	3.07	0.62	0.5	NO
			SOUTH LEG IS BLOCKED				

DATE	TIME	SAMPLE #	START WT. (TONS)	STOP WT. (TONS)	NET WT. (TONS)	SCREEN (IN)	WASH
6-24	0700	S1	4.17	1.69	2.48	0.5	NO
6-24	0730	S1	1.69	1.61	0.80	0.5	NO
6-24	0830	S1	1.61	1.46	0.15	0.5	NO
6-24	0930	S1	4.17	4.05	0.12	0.5	NO
6-24	1030	S1	4.05	3.85	0.20	0.5	NO
6-24	1130	S1	3.85	3.72	0.13	0.5	NO
6-24	1230	S1	3.72	3.49	0.23	0.5	NO
6-24	1330	S1	3.49	2.95	0.54	0.5	NO
6-24	1430	S1	2.95	2.10	0.85	0.5	NO
6-24	1530	S2	4.62	3.75	0.87	0.5	NO
6-24	1630	S2	3.75	2.86	0.89	0.5	NO
6-24	1730	S2	2.86	1.89	0.97	0.5	NO
6-24	1830	S2	3.43	2.42	1.01	0.5	NO
6-24	1930	S2	4.35	3.56	0.79	0.5	NO
6-24	2030	S2	3.56	2.69	0.87	0.5	NO
6-24	2130	S2	2.69	1.68	1.01	0.5	NO
6-24	2230	S2	3.16	2.09	1.07	0.5	NO
6-24	2330	S3	4.36	3.18	1.18	0.5	NO
6-25	0030	S3	3.18	1.98	1.20	0.5	NO
6-25	0130	S3	1.98	0.50	1.48	0.5	NO
6-25	0230	S3	4.18	3.18	1.00	0.5	NO
6-25	0330	S3	4.33	3.15	1.18	0.5	NO
6-25	0430	S3	3.15	1.62	1.53	0.5	NO
6-25	0500	S3	2.67	1.05	1.62	0.5	NO
6-25	0530	S3	2.96	2.13	0.83	0.5	NO
6-25	0600	S3	3.72	2.95	0.77	0.5	NO
6-25	0730	S4	3.09	1.59	1.50	0.5	NO
6-25	0800	S4	2.30	1.14	1.16	0.5	NO
6-25	0830	S4	2.73	1.76	0.97	0.5	NO
6-25	0900	S4	3.52	2.25	1.27	0.5	NO
6-25	0930	S4	4.06	2.88	1.18	0.5	NO
6-25	1000	S4	4.31	3.11	1.20	0.5	NO
6-25	1030	S4	3.11	2.04	1.07	0.5	NO
6-25	1100	S4	4.13	3.03	1.10	0.5	NO
6-25	1130	S4	4.37	3.45	0.92	0.5	NO
6-25	1200	S4	3.45	2.38	1.07	0.5	NO
6-25	1230	S4	3.47	2.38	1.09	0.5	NO
6-25	1300	S4	4.08	3.19	0.89	0.5	NO
6-25	1330	S4	4.16	3.20	0.96	0.5	NO
6-25	1400	S4	3.20	2.13	1.07	0.5	NO
6-25	1430	S4	3.01	2.05	0.96	0.5	NO
6-25	1500	S5	4.07	3.04	1.03	0.5	NO
6-25	1530	S5	3.93	2.94	0.99	0.5	NO
6-25	1600	S5	2.94	1.89	1.05	0.5	NO
6-25	1630	S5	1.89	0.87	1.02	0.5	NO
6-25	1700	S5	2.54	1.44	1.10	0.5	NO
6-25	1730	S5	2.70	1.68	1.02	0.5	NO
6-25	1800	S5	1.68	0.88	0.80	0.5	NO
6-25	1830	S5	1.75	0.58	1.17	0.5	NO

APPENDIX C

Peat Addition Log

Peat weights are given in short tons.

Feed Peat Size Distribution for BOM/FGT-017

Sample Number	Date	Time	Screen Mesh Size inch	Cumulative Mass Fraction, % less than stated mesh size, inch				
				1/4	1/2	3/4	1	1 1/2
1	6/24/84	12:00	1/2	2.3	5.2	21.9	43.2	81.0
2	6/24/84	20:00	1/2	1.8	5.5	24.4	50.1	83.7
3	6/25/84	4:00	1/2	0.7	2.9	16.2	38.1	79.4
4	6/25/84	12:00	1/2	1.5	5.0	23.9	45.1	73.3
5	6/25/84	20:00	1/2	3.3	6.9	22.5	45.8	89.5
6	6/26/84	4:00	1/2	7.2	14.1	39.0	59.8	90.2
7	6/26/84	12:00	1/2	2.5	7.8	35.0	59.4	89.3
8	6/26/84	20:00	1/2	1.7	5.9	19.8	35.3	75.7
9	6/27/84	4:00	1/2	2.4	6.3	27.8	48.8	86.5
10	6/27/84	12:00	1/2	2.1	6.7	24.6	44.1	88.9
11	6/27/84	16:00	1/2	3.1	8.6	29.3	50.5	82.9

APPENDIX B
Peat Sizing Data

1630 0.54 tons remaining up top.
Rod out cyclone overflow pipe to make sure is clear for flooding cyclone.

1700 Emptied out weigh bin. (-00.06 tons) Will now wait for coal legs to run empty, then flood cyclone.

1717 Start flooding cyclone. Load down to 800 CFM. Saturation to 70C. Close down furnace pressure and primary and secondary blowers to 20% open. Interlocks off. Will only turn off saturation blower. Cut back to only city water on scrubber so as not to flood combustor. Waiting for cyclone outlet pressure to go negative.

1724 Sat. blower off.

1726 Had to light vent stack with torch.

1729 Cyclone reaches overflow. Water off..

1800 Caustic lines being flushed. Boiler on low fire. Headers off. Scrubber pumps off. Top ring on full to keep T-823 cool (47 C). Horizontal duct burning at elbow near combustor.

1830 Open downcomer tee. Drained about 75 gallons of precipitate. It is actually raining inside the horizontal duct, as moisture condenses out.
Begin hauling peat out back.

2000 Turn off ID fan and combustor burners. Start up grate to churn out ash.

END .017

1100 Freeboard 42 1/2" average.
1105 Ash dump, warm-moist.
1125 Cyclone dump - 1 rake only.
1130 Rain and mist are subsiding.
1200 Freeboard 40 1/2" average. Firetest 13.57" average ash.
Good bed. Rods down easy.
1210 Load of peat came in.
1215 CO2% down to 10%. CO% up to 30%.
1225 Cyclone dump. Water on 30 seconds. 1 rake only.
1245 Primary combustion air flow gauge started to work
properly again. 4,000 cfm.
1300 Freeboard 42 1/2" average.
1315 Ash dump, warm-moist. Small chunks avg. 1 1/2" size.
1320 Primary air flow on combustion went way off gauge
over 5,000.
1330 Cyclone Dump. Water on 30 secs.
1345 Primary air flow back to 4,000 CFM on gauge.
1400 Freeboard 42 1/2" avg. Firetest 11.28" Avg. Good bed.
All rods went down nice - 6" - 12" Firezones.
1430 Cyclone dump - 6 rakes full. Water on 30 seconds.
1440 Ash dump - warm and moist. Clinkers small to -6" size.
1500 Freeboard 42" average.

3rd SHIFT

1515 Preparing for shut down.
1530 Will continue operations as normal until weigh bin
empty. Readings, Firetest etc.
Temp. and pressure probes finished.
1600 Still show 1.79 tons in weigh bins. Firetest indicates
10.3" ash avg. found crust on bottom 6" above grate
Firezones 4"-6" all around. Grate remains at 5/5.0.
1615 Dump ash at 568 lbs. Last ash sample #017. Few large
chunks, mostly finer ash.

- 0710 Started to put peat-up in weigh bin. Have to watch shaker screen close for plugging.
- 0725 Coal leg alarm went off. Cycle valve 4 times to get coal down.
- 0755 Cleaning out screen on shaker. Used water pressure on it. Worked O.K.
- 0805 Coal leg alarm went off. Firetest 12.42" Avg. Very good bed. All Firezones looked good. Showed nice on rods. Freeboard 43" Avg. #3 seemed lower than normal.
- 0820 Dropped saturation temp to 60 C. This is for a short term basis to determine if a lower sat. temp will affect CO₂ and CO quality. Temperature was at 66 C. CO=11%.
- 0825 Cyclone dump 15 rakes. CO=28%.
- 0830 Had to cycle valve 4 times to get peat to completely fill coal leg.
- 0840 Actually drizzling outside.
- 0845 Seems like the CO₂ and CO responded positively to the lower saturation temp. CO₂% is 10%. CO is 30%.
- 0900 Seems like the coal leg temp. always goes up when dropping from the weigh bin. If I cycle the valve 4-6 times per drop, it doesn't get high enough to sound alarm.
- 0910 CO₂ going back up - 11 1/2%
CO going down slightly 28%.
- 0920 Ash dump 475 lbs. net.
- 0925 Primary air flow on combustor quit reading.
- 0930 Cyclone dump 10 rakes full. Yellowish gas bubbles on top. Water on 30 sec.
- 1000 Freeboard 43" average. Firetest 11.71" average ash. #1 seemed to have a high fire. Will poke down later. Overall, not as nice a test as the last one. Left rods in 4 minutes.
- 1020 Poked down #1 hole.
- 1025 Cyclone dump water on 30 seconds. 2 rakes.
- 1050 CO₂% going down - 10 1/2%. CO% going up gradually - 28%.

HOURLY PRECIPITATION (WATER EQUIVALENT IN INCHES)

JUN 1985

14922

MINNEAPOLIS-ST. PAUL, MINNESOTA

DATE	A.M. HOUR ENDING AT												P.M. HOUR ENDING AT												DATE
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
01									T	0.08	0.05	0.02	T	T	0.02										01
02																									02
03																									03
04																									04
05																									05
06																									06
07																									07
08								T	T	T	T														08
09																									09
10										T	T	T	T	T	T	T		T	T	T	T	T	0.02		10
11	0.03	0.03	0.08	0.01	0.02	0.09	0.06	0.04	0.02	T	T			T	T	0.03	T	0.01	T	0.08	0.18	0.19	0.01	0.04	11
12																									12
13																									13
14																									14
15							T	T					0.02	0.02	0.08	0.02	T		0.16	0.02					15
16																									16
17							T											0.11							17
18																	0.06	0.08	T						18
19																									19
20																									20
21										T	0.02	T					0.04	0.01					T	T	21
22	T	T																			0.05	0.13	0.07		22
23																									23
24																									24
25																									25
26																									26
27	0.01	T				0.06	T	0.02	0.04	T	T	T								T	0.02	T	0.01	0.02	27
28																									28
29																									29
30																									30

MAXIMUM SHORT DURATION PRECIPITATION

TIME PERIOD (MINUTES)	5	10	15	20	30	45	60	80	100	120	150	180
PRECIPITATION (INCHES)	0.11	0.14	0.15	0.15	0.20	0.20	0.24	0.28	0.33	0.38	0.44	0.45
ENDED: DATE	22	22	22	22	22	22	11	11	11	11	11	11
ENDED: TIME	2154	2155	2200	2200	2215	2215	2133	2156	2200	2138	2200	2230

THE PRECIPITATION AMOUNTS FOR THE INDICATED TIME INTERVALS MAY OCCUR AT ANY TIME DURING THE MONTH. THE TIME INDICATED IS THE ENDING TIME OF THE INTERVAL. DATE AND TIME ARE NOT ENTERED FOR TRACE AMOUNTS.

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FIRST CLASS

JUN 1985 14922
MINNEAPOLIS-ST. PAUL, MINNESOTA

SUMMARY BY HOURS

L-3

OBSERVATIONS AT 3-HOUR INTERVALS

JUN 1985 14922
MINNEAPOLIS-ST. PAUL, MINNESOTA

HOUR LST	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI- BILITY	WEATHER	TEMPERATURE				WIND DIRECTION	SPEED (KNOTS)	REL HUMIDITY %	SKY COVER (TENTHS)	CEILING IN HUNDREDS OF FEET	VISI- BILITY	WEATHER	TEMPERATURE				WIND DIRECTION	SPEED (KNOTS)	REL HUMIDITY %
					AIR OF	WET BULB OF	DEW POINT OF									AIR OF	WET BULB OF	DEW POINT OF				
JUN 1st																						
03	0	UNL	20	RW	52	50	48	86	20	6		0	UNL	20		42	39	34	73	36	7	
06	1	UNL	20		55	52	50	83	22	6		7	150	20		44	41	37	77	36	5	
09	10	75	12		62	56	52	70	24	12		10	90	15		48	43	36	63	02	5	
12	10	70	12		62	59	57	84	20	11		10	75	15		51	45	37	59	34	8	
15	10	28	10		62	60	58	87	29	9		6	120	15		56	47	38	51	33	7	
18	3	UNL	25		63	54	47	56	33	20		5	UNL	20		58	48	38	48	02	10	
21	0	UNL	25		53	46	38	57	35	15		0	UNL	20		51	44	35	55	01	5	
24	0	UNL	20		47	42	35	63	36	12		0	UNL	20		47	43	39	74	33	6	
JUN 2nd																						
JUN 3rd																						
03	0	UNL	20		42	40	38	86	31	3		0	UNL	20		42	40	38	86	31	3	
06	1	UNL	12		47	46	44	89	00	0		9	UNL	12		47	46	44	89	00	0	
09	10	15	15		55	50	40	57	16	5		10	UNL	15		55	48	40	57	16	5	
12	10	70	12		59	50	40	50	17	3		9	250	15		59	50	40	50	17	3	
15	10	28	10		61	51	41	48	16	7		10	220	15		61	51	41	48	16	7	
18	3	UNL	25		59	50	42	48	00	0		10	150	15		59	50	42	48	00	0	
21	0	UNL	25		55	49	43	64	17	8		9	110	15		59	50	42	54	00	0	
24	0	UNL	20		55	49	43	64	17	8		10	75	15		55	49	43	64	17	8	
JUN 4th																						
JUN 5th																						
JUN 6th																						
03	10	100	15		55	50	45	69	00	0		0	UNL	20		47	44	41	80	33	6	
06	10	60	15		55	51	47	75	03	4		0	UNL	20		48	46	43	83	00	0	
09	10	100	15		60	52	45	58	17	7		0	UNL	20		61	50	39	44	34	10	
12	10	50	15		61	53	46	58	18	8		0	UNL	20		65	52	40	40	28	7	
15	8	50	15		63	55	48	58	23	10		0	UNL	20		68	54	40	36	15	4	
18	6	UNL	15		64	56	49	58	21	9		0	UNL	20		69	54	40	35	22	4	
21	7	90	15		56	52	49	78	20	9		2	UNL	20		64	52	41	43	00	0	
24	6	49	20		56	50	43	62	35	10		1	UNL	15		57	50	44	62	10	6	
JUN 7th																						
JUN 8th																						
JUN 9th																						
03	10	UNL	15	H	67	59	52	59	22	10		8	100	15		66	64	62	87	10	5	
06	10	UNL	15		66	60	55	68	22	8		8	UNL	15		69	66	64	84	13	6	
09	10	100	6		70	64	60	71	24	3		9	110	20		76	70	67	74	11	5	
12	8	UNL	6		78	70	65	64	21	12		4	UNL	20		89	78	73	59	18	15	
15	8	UNL	10		85	70	62	46	32	14		1	UNL	12		92	73	58	23	24	24	
18	8	UNL	20		84	68	58	41	29	13		2	UNL	20		85	70	62	46	31	24	
21	6	UNL	20		75	67	63	66	05	8		2	UNL	15		76	59	46	35	29	14	
24	0	UNL	15		69	64	61	76	19	5		0	UNL	12		73	57	43	34	30	15	
JUN 10th																						
JUN 11th																						
JUN 12th																						
03	5	UNL	15	R	55	50	45	69	23	2		10	55	7		55	53	52	90	36	8	
06	9	250	15		58	54	50	75	06	3		10	7	6		56	54	53	90	06	7	
09	10	150	15		63	54	45	52	12	9		10	60	12		57	54	51	81	10	11	
12	10	150	15		66	55	46	49	07	8		10	50	15		58	53	49	72	07	7	
15	10	150	15		64	56	49	58	12	6		10	31	12		59	55	52	78	09	8	
18	10	75	20		64	55	47	54	07	7		10	50	10		58	53	48	70	05	7	
21	10	70	15		59	55	52	78	01	7		10	36	4		53	51	49	86	04	13	
24	10	60	10		57	55	53	87	28	5		10	55	20		52	49	47	83	36	9	
JUN 13th																						
JUN 14th																						
JUN 15th																						
03	3	UNL	15	R	51	48	44	77	00	0		2	UNL	20		56	50	45	67	13	5	
06	1	UNL	15		50	48	46	86	21	5		7	120	20		59	53	48	67	11	5	
09	2	UNL	15		66	55	46	49	29	8		10	100	15		64	57	51	63	15	10	
12	10	UNL	15		66	53	40	39	26	7		10	90	9		64	59	55	73	16	9	
15	7	250	20		72	57	44	37	25	9		10	65	8		63	60	57	81	16	13	
18	10	120	25		71	56	42	35	24	4		10	13	1		61	59	57	87	13	17	
21	8	110	25		64	54	46	52	12	8		10	6	6		60	58	57	90	10	9	
24	9	120	20		61	53	45	56	13	9		10	7	5		60	59	58	93	14	3	
JUN 16th																						
JUN 17th																						
JUN 18th																						
03	2	UNL	10	F	56	54	53	90	15	3		9	UNL	20		55	50	46	72	24	9	
06	4	UNL	7		58	57	56	93	13	4		0	UNL	20		58	51	44	60	26	11	
09	9	UNL	20		67	62	59	76	15	8		1	UNL	20		66	53	41	40	29	20	
12	10	70	20		74	64	58	58	16	13		10	55	20		64	54	46	52	27	22	
15	9	UNL	20		78	67	60	54	17	19		10	44	15		64	55	47	54	28	24	
18	5	250	20		73	69	66	79	23	20		8	20	25		58	54	50	75	30	15	
21	4	UNL	20		68	59	53	59	32	8		1	UNL	25		55	52	49	80	29	8	
24	1	UNL	20		59	52	45	60	24	5		7	110	20		55	52	49	80	29	11	

JUN 1985
MINNEAPOLIS-ST. PAUL, MINNESOTA
NAT'L WEA SER FCST OFC
FEDERAL AVIATION BUILDING

ISSN 0198-2745

LOCAL CLIMATOLOGICAL DATA

Monthly Summary

INTERNATIONAL AIRPORT

LATITUDE 44°53'

LONGITUDE 93°13'

ELEVATION (GROUND)

834 FEET

TIME ZONE CENTRAL

14922

DATE	TEMPERATURE °F					DEGREE DAYS BASE 65°F		WEATHER TYPES 1 FOG 2 HEAVY FOG 3 THUNDERSTORM 4 ICE PELLETS 5 HAIL 6 GLAZE 7 DUSTSTORM 8 SMOKE, HAZE 9 BLOWING SNOW	SNOW ICE PELLETS OR ICE ON GROUND AT 0600 INCHES	PRECIPITATION		AVERAGE STATION PRESSURE IN INCHES ELEV. 838 FEET ABOVE M.S.L.	WIND (M.P.H.)			SUNSHINE		SKY COVER (TENTHS)		DATE			
	MAXIMUM	MINIMUM	AVERAGE	DEPARTURE FROM NORMAL	AVERAGE DEW POINT	HEATING ISEASON BEGINS WITH JUL	COOLING ISEASON BEGINS WITH JAN			WATER EQUIVALENT (INCHES)	SNOW, ICE PELLETS (INCHES)		RESULTANT DIR.	RESULTANT SPEED	AVERAGE SPEED	FASTEST MILE		MINUTES	PERCENT OF TOTAL POSSIBLE		SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT	
																SPEED	DIRECTION						
01	65	47	56	-8	48	9	0		0	0.17	0.0	28.910	29	5.9	12.5	23	33	828	90	7	4	01	
02	59	39*	49*	-15	36	16	0		0	0.00	0.0	29.140	35	7.3	7.9	14	36	874	95	7	5	02	
03	62	40	51	-14	41	14	0		0	0.00	0.0	29.240	18	1.6	4.1	9	17	855	92	10	8	03	
04	65	53	59	-6	46	6	0		0	0.00	0.0	29.190	21	4.7	8.4	13	20	744	80	8	8	04	
05	70	45	58	-7	41	7	0		0	0.00	0.0	29.210	32	2.7	5.8	12	32	883	95	0	1	05	
06	83	51	67	1	47	0	2		0	0.00	0.0	29.110	18	13.0	13.8	22	19	874	94	5	5	06	
07	87	63	75	9	59	0	10	8	0	0.00	0.0	28.960	25	7.4	10.7	18	29	798	86	9	7	07	
08	102*	64	83*	17	60	0	18		0	0.00	0.0	28.760	25	6.8	15.9	30	30	845	91	4	4	08	
09	75	58	67	0	44	0	2		0	0.00	0.0	29.025	31	17.9	18.4	23	32	896	96	2	2	09	
10	66	52	59	-8	48	6	0		0	0.02	0.0	29.180	09	2.4	6.0	10	12	713	76	10	9	10	
11	59	51	55	-12	51	10	0	1	0	0.92	0.0	29.140	06	7.0	9.2	16	07	538	58	10	10	11	
12	68	44	56	-11	42	9	0		0	0.00	0.0	29.180	33	10.6	11.9	24	33	878	94	4	3	12	
13	72	46	59	-9	44	6	0		0	0.00	0.0	29.060	22	4.0	7.2	12	26	854	91	6	6	13	
14	65	54	60	-8	53	5	0	1 3	0	0.32	0.0	28.935	14	9.2	9.6	20	13	585	63	9	9	14	
15	73	57	65	-3	58	0	0	1	0	0.00	0.0	28.870	33	6.6	8.4	18	32	801	86	8	7	15	
16	80	55	68	0	57	0	3	3	0	0.11	0.0	28.870	17	5.3	10.5	23	23	819	88	9	6	16	
17	68	54	61	-8	47	4	0	1	0	0.14	0.0	28.850	28	15.9	16.9	29	28	823	88	6	5	17	
18	70	55	63	-6	50	2	0		0	0.00	0.0	28.970	34	12.3	13.6	21	36	717	77	9	8	18	
19	71	50	61	-8	46	4	0		0	0.00	0.0	29.080	31	8.0	8.7	16	33	937	100	4	3	19	
20	82	51	67	-2	51	0	2		0	0.00	0.0	28.870	16	11.6	12.2	24	15	895	96	4	3	20	
21	81	59	70	0	59	0	5	3	0	0.07	0.0	28.590	20	11.3	19.1	30	30	554	59	9	8	21	
22	81	58	70	0	50	0	5	1 3 5	0	0.25	0.0	28.820	28	15.3	17.3	30	30	867	93	0	2	22	
23	71	56	64	-6	49	1	0		0	0.00	0.0	29.060	34	8.5	10.3	17	32	922	98	0	0	23	
24	80	51	66	-4	53	0	1		0	0.00	0.0	29.180	12	11.1	11.9	17	11	935	100	1	1	24	
25	93	67	80	9	64	0	15		0	0.00	0.0	28.980	16	15.7	18.4	31	18	758	81	8	9	25	
26	81	66	74	3	67	0	9		0	0.05	0.0	28.950	26	3.4	10.1	20	23	725	77	10	10	26	
27	69	57	63	-8	58	2	0	1	0	0.13	0.0	29.060	30	8.4	11.6	21	29	644	69	9	7	27	
28	70	54	62	-9	51	3	0		0	0.00	0.0	29.260	32	6.4	7.2	12	31	898	96	6	6	28	
29	76	53	65	-6	54	0	0		0	0.00	0.0	29.300	36	7.3	8.4	14	01	812	87	7	8	29	
30	82	58	70	-1	57	0	5		0	0.00	0.0	29.330	06	4.9	6.2	10	07	827	89	7	6	30	
SUM		SUM		SUM		TOTAL		TOTAL		TOTAL		TOTAL		FOR THE MONTH:		TOTAL		%		SUM		SUM	
2226		1608				104		77		2.18		0.0		29.040		28		2.4		11.1		31	
AVG		AVG		AVG		DEP.		DEP.		PRECIPITATION		DEP.				DATE: 25		POSSIBLE		MONTH		AVG.	
74.2		53.6		63.9		-4.2		50.9		63		-57						27995		86		6.2	
NUMBER OF DAYS										SEASON TO DATE		SNOW, ICE PELLETS		GREATEST IN 24 HOURS AND DATES					GREATEST DEPTH ON GROUND OF				
										TOTAL		TOTAL											
MAXIMUM TEMP										76.82		142		THUNDERSTORMS 4					PRECIPITATION				
5 90°										2 32°		2 0°		DEP. DEP. HEAVY FOG 0					0.92 11				
2										0		0		-325 -28					CLEAR 5 PARTLY CLOUDY 12 CLOUDY 13				

* EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.
† TRACE AMOUNT.

* ALSO ON EARLIER DATE(S).

HEAVY FOG: VISIBILITY 1/4 MILE OR LESS.

BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

FUNNEL CLOUD OBSERVED DAY 16 AND DAY 22.

DATA IN COLS 6 AND 12-15 ARE BASED ON 21 OR MORE OBSERVATIONS AT HOURLY INTERVALS. RESULTANT WIND IS THE VECTOR SUM OF WIND SPEEDS AND DIRECTIONS DIVIDED BY THE NUMBER OF OBSERVATIONS. ONE OF THREE WIND SPEEDS IS GIVEN UNDER FASTEST MILE: FASTEST MILE - HIGHEST RECORDED SPEED FOR WHICH A MILE OF WIND PASSES STATION (DIRECTION IN COMPASS POINTS). FASTEST OBSERVED ONE MINUTE WIND - HIGHEST ONE MINUTE SPEED (DIRECTION IN TENS OF DEGREES). PEAK GUST - HIGHEST INSTANTANEOUS WIND SPEED (A / APPEARS IN THE DIRECTION COLUMN). ERRORS WILL BE CORRECTED AND NOTED IN SUBSEQUENT PUBLICATIONS.

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

noaa

NATIONAL
OCEANIC AND
ATMOSPHERIC ADMINISTRATION

NATIONAL
ENVIRONMENTAL SATELLITE, DATA
AND INFORMATION SERVICE

NATIONAL
CLIMATIC DATA CENTER
ASHEVILLE NORTH CAROLINA

Kenneth D. Haden
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

Test No. 1
Gasifier Quench Stack

3.5 Results of Opacity Observations - EPA Method 9

Percent Opacity	Optical Density	Relative Frequency (%)
0	.0000	100
5	.0223	0
10	.0458	0
15	.0706	0
20	.0969	0
25	.1249	0
30	.1549	0
35	.1871	0
40	.2219	0
45	.2596	0
50	.3010	0
55	.3468	0
60	.3979	0
65	.4559	0
70	.5229	0
75	.6021	0
80	.6990	0
85	.8239	0
90	1.0000	0
95	1.3010	0
99	2.0000	0
0	0	Time Average

Observer: E. Trowbridge
Cert Date: 5-1-85
Date of Observation: 6-24-85
Time of Observation: 1520-1620

INTERPOLL REPORT NO. 5-2028
BS & B ENERGY SYSTEMS
MINNEAPOLIS, MINNESOTA

TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 8A	RUN 8B
DATE OF RUN	6-24-85	6-24-85
TIME OF RUN (HRS)	1613	1615
FLASK NUMBER	41	42
VOLUME OF FLASK (ML)	2076	2094
DATA TIME OF SAMPLING		
FLASK TEMPERATURE (DEG-F)	75.0	75.0
BAR. PRESS (IN.HG)	29.27	29.27
FLASK VACUUM (IN.HG)	27.30	27.10
FLASK ABS. PRESS. (IN.HG)	1.97	2.17
DATA TIME OF FLASK OPENING		
FLASK TEMPERATURE (DEG-F)	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-3.40	-1.00
FLASK ABS. PRESS (IN.HG)	25.39	27.79
VOLUME GAS SAMPLED (DSML)	1595	1760
MOISTURE CONTENT (% V/V)	26.54	26.54
OXYGEN CONTENT (% V/V, DRY)	15.60	15.60
NO2 IN GAS SAMPLE (UG)	415.5	404.4
NOX CONCENTRATION		
(GR/DSCF)	.1139	.1004
(MG/DSCM)	261	230
(PPM-DRY)	136	120
(PPM-WET)	100	88
DRY STANDARD FLOW (DSCFM)	7200.	7200.
NOX MASS RATE (LB/HR)	7.03	6.20
NOX EMISSION FACTOR (LB/MMBTU)		
F-FACTOR METHOD*	.759	.670

* F=11837.0 DSCF/MMBTU

INTERPOLL REPORT NO. 5-2028
BS & B ENERGY SYSTEMS
MINNEAPOLIS, MINNESOTA

TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 7A	RUN 7B	RUN 7C	RUN 7D
DATE OF RUN	6-24-85	6-24-85	6-24-85	6-24-85
TIME OF RUN (HRS)	1605	1607	1609	1611
FLASK NUMBER	37	38	39	40
VOLUME OF FLASK (ML)	2054	2075	2080	2093
DATA TIME OF SAMPLING				
FLASK TEMPERATURE (DEG-F)	75.0	75.0	75.0	75.0
BAR. PRESS (IN.HG)	29.27	29.27	29.27	29.27
FLASK VACUUM (IN.HG)	27.00	27.10	27.00	27.10
FLASK ABS. PRESS. (IN.HG)	2.27	2.17	2.27	2.17
DATA TIME OF FLASK OPENING				
FLASK TEMPERATURE (DEG-F)	71.6	71.6	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-.90	-1.00	-.45	-3.20
FLASK ABS. PRESS (IN.HG)	27.89	27.79	28.34	25.59
VOLUME GAS SAMPLED (DSML)	1726	1744	1779	1608
MOISTURE CONTENT (% V/V)	26.54	26.54	26.54	26.54
OXYGEN CONTENT (% V/V, DRY)	15.60	15.60	15.60	15.60
NO2 IN GAS SAMPLE (UG)	445.2	378.4	393.3	419.2
NOX CONCENTRATION				
(GR/DSCF)	.1127	.0948	.0966	.1139
(MG/DSCM)	258	217	221	261
(PPM-DRY)	135	113	116	136
(PPM-WET)	99	83	85	100
DRY STANDARD FLOW (DSCFM)	7200.	7200.	7200.	7200.
NOX MASS RATE (LB/HR)	6.96	5.85	5.96	7.03
NOX EMISSION FACTOR (LB/MMBTU)				
F-FACTOR METHOD*	.752	.632	.644	.760

INTERPOLL REPORT NO. 5-2028
BS & B ENERGY SYSTEMS
MINNEAPOLIS, MINNESOTA

TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 6A	RUN 6B	RUN 6C	RUN 6D
DATE OF RUN	6-24-85	6-24-85	6-24-85	6-24-85
TIME OF RUN (HRS)	1456	1557	1600	1603
FLASK NUMBER	33	34	35	36
VOLUME OF FLASK (ML)	2088	2071	2089	2127
DATA TIME OF SAMPLING				
FLASK TEMPERATURE (DEG-F)	74.0	76.0	76.0	76.0
BAR. PRESS (IN.HG)	29.27	29.27	29.27	29.27
FLASK VACUUM (IN.HG)	27.40	27.10	27.10	27.10
FLASK ABS. PRESS. (IN.HG)	1.87	2.17	2.17	2.17
DATA TIME OF FLASK OPENING				
FLASK TEMPERATURE (DEG-F)	71.6	71.6	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-2.20	-2.50	-3.00	-2.50
FLASK ABS. PRESS (IN.HG)	26.59	26.29	25.79	26.29
VOLUME GAS SAMPLED (DSML)	1693	1639	1619	1684
MOISTURE CONTENT (% V/V)	25.50	26.54	26.54	26.54
OXYGEN CONTENT (% V/V, DRY)	15.80	15.60	15.60	15.60
NO2 IN GAS SAMPLE (UG)	415.5	378.4	419.2	441.5
NOX CONCENTRATION				
(GR/DSCF)	.1073	.1009	.1132	.1146
(MG/DSCM)	245	231	259	262
(PPM-DRY)	128	121	135	137
(PPM-WET)	96	89	99	101
DRY STANDARD FLOW (DSCFM)	7120.	7200.	7200.	7200.
NOX MASS RATE (LB/HR)	6.55	6.23	6.98	7.07
NOX EMISSION FACTOR (LB/MMBTU)				
F-FACTOR METHOD*	.743	.673	.755	.764

* F=11837.0 DSCF/MMBTU

INTERPOLL REPORT NO. 5-2028
BS & B ENERGY SYSTEMS
MINNEAPOLIS, MINNESOTA

TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 5A	RUN 5B	RUN 5C	RUN 5D
DATE OF RUN	6-24-85	6-24-85	6-24-85	6-24-85
TIME OF RUN (HRS)	1447	1450	1453	1455
FLASK NUMBER	29	30	31	32
VOLUME OF FLASK (ML)	2068	2071	2044	2090
DATA TIME OF SAMPLING				
FLASK TEMPERATURE (DEG-F)	74.0	74.0	74.0	74.0
BAR. PRESS (IN.HG)	29.27	29.27	29.27	29.27
FLASK VACUUM (IN.HG)	27.30	27.10	27.20	27.20
FLASK ABS. PRESS. (IN.HG)	1.97	2.17	2.07	2.07
DATA TIME OF FLASK OPENING				
FLASK TEMPERATURE (DEG-F)	71.6	71.6	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-1.70	-1.45	-1.30	-1.35
FLASK ABS. PRESS (IN.HG)	27.09	27.34	27.49	27.44
VOLUME GAS SAMPLED (DSML)	1704	1710	1704	1739
MOISTURE CONTENT (% V/V)	25.50	25.50	25.50	25.50
OXYGEN CONTENT (% V/V, DRY)	15.80	15.80	15.80	15.80
NO2 IN GAS SAMPLE (UG)	1127.8	437.8	411.8	430.4
NOX CONCENTRATION				
(GR/DSCF)	.2893	.1119	.1056	.1081
(MG/DSCM)	662	256	242	247
(PPM-DRY)	346	134	126	129
(PPM-WET)	258	100	94	96
DRY STANDARD FLOW (DSCFM)	7120.	7120.	7120.	7120.
NOX MASS RATE (LB/HR)	17.66	6.83	6.45	6.60
NOX EMISSION FACTOR (LB/MMBTU)				
F-FACTOR METHOD*	2.005	.776	.732	.749

* F=11837.0 DSCF/MMBTU

INTERPOLL REPORT NO. 5-2028
BS & B ENERGY SYSTEMS
MINNEAPOLIS, MINNESOTA

TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 4A	RUN 4B	RUN 4C	RUN 4D
DATE OF RUN	6-24-85	6-24-85	6-24-85	6-24-85
TIME OF RUN (HRS)	1434	1437	1440	1443
FLASK NUMBER	25	26	27	28
VOLUME OF FLASK (ML)	2100	2035	2054	2031
DATA TIME OF SAMPLING				
FLASK TEMPERATURE (DEG-F)	74.0	74.0	74.0	74.0
BAR. PRESS (IN.HG)	29.27	29.27	29.27	29.27
FLASK VACUUM (IN.HG)	27.20	27.20	27.10	27.30
FLASK ABS. PRESS. (IN.HG)	2.07	2.07	2.17	1.97
DATA TIME OF FLASK OPENING				
FLASK TEMPERATURE (DEG-F)	71.6	71.6	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-2.00	-.95	-.75	-1.30
FLASK ABS. PRESS (IN.HG)	26.79	27.84	28.04	27.49
VOLUME GAS SAMPLED (DSML)	1703	1719	1742	1699
MOISTURE CONTENT (% V/V)	25.50	25.50	25.50	25.50
OXYGEN CONTENT (% V/V, DRY)	15.80	15.80	15.80	15.80
NO2 IN GAS SAMPLE (UG)	445.2	426.6	411.8	456.3
NOX CONCENTRATION				
(GR/DSCF)	.1143	.1084	.1033	.1174
(MG/DSCM)	261	248	236	269
(PPM-DRY)	137	130	124	140
(PPM-WET)	102	97	92	105
DRY STANDARD FLOW (DSCFM)	7120.	7120.	7120.	7120.
NOX MASS RATE (LB/HR)	6.97	6.62	6.30	7.16
NOX EMISSION FACTOR (LB/MMBTU)				
F-FACTOR METHOD*	.792	.751	.716	.813

* F=11837.0 DSCF/MMBTU

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TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 3A	RUN 3B	RUN 3C	RUN 3D
DATE OF RUN	6-24-85	6-24-85	6-24-85	6-24-85
TIME OF RUN (HRS)	1326	1328	1330	1332
FLASK NUMBER	21	22	23	24
VOLUME OF FLASK (ML)	2068	2031	2056	2031
DATA TIME OF SAMPLING				
FLASK TEMPERATURE (DEG-F)	70.0	70.0	70.0	70.0
BAR. PRESS (IN.HG)	29.30	29.30	29.30	29.30
FLASK VACUUM (IN.HG)	27.30	27.10	27.30	27.20
FLASK ABS. PRESS. (IN.HG)	2.00	2.20	2.00	2.10
DATA TIME OF FLASK OPENING				
FLASK TEMPERATURE (DEG-F)	71.6	71.6	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-1.60	-.85	-1.60	-1.30
FLASK ABS. PRESS (IN.HG)	27.19	27.94	27.19	27.49
VOLUME GAS SAMPLED (DSML)	1707	1713	1697	1690
MOISTURE CONTENT (% V/V)	16.88	16.88	16.88	16.88
OXYGEN CONTENT (% V/V, DRY)	16.40	16.40	16.40	16.40
NO2 IN GAS SAMPLE (UG)	430.4	445.2	482.3	467.5
NOX CONCENTRATION				
(GR/DSCF)	.1102	.1136	.1242	.1209
(MG/DSCM)	252	260	284	277
(PPM-DRY)	132	136	149	145
(PPM-WET)	110	113	124	120
DRY STANDARD FLOW (DSCFM)	7370.	7370.	7370.	7370.
NOX MASS RATE (LB/HR)	6.96	7.18	7.84	7.64
NOX EMISSION FACTOR (LB/MMBTU)				
F-FACTOR METHOD*	.865	.892	.975	.950

* F=11837.0 DSCF/MMBTU

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BS & B ENERGY SYSTEMS

MINNEAPOLIS, MINNESOTA

TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 2A	RUN 2B	RUN 2C	RUN 2D
DATE OF RUN	6-24-85	6-24-85	6-24-85	6-24-85
TIME OF RUN (HRS)	1318	1320	1322	1324
FLASK NUMBER	17	18	19	20
VOLUME OF FLASK (ML)	2054	2045	2009	2060
DATA TIME OF SAMPLING				
FLASK TEMPERATURE (DEG-F)	70.0	70.0	70.0	70.0
BAR. PRESS (IN.HG)	29.32	29.32	29.32	29.32
FLASK VACUUM (IN.HG)	27.00	27.20	27.30	27.30
FLASK ABS. PRESS. (IN.HG)	2.32	2.12	2.02	2.02
DATA TIME OF FLASK OPENING				
FLASK TEMPERATURE (DEG-F)	71.6	71.6	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-1.30	-1.80	-1.40	-1.40
FLASK ABS. PRESS (IN.HG)	27.49	26.99	27.39	27.39
VOLUME GAS SAMPLED (DSML)	1694	1667	1670	1713
MOISTURE CONTENT (% V/V)	16.88	16.88	16.88	16.88
OXYGEN CONTENT (% V/V, DRY)	16.40	16.40	16.40	16.40
NO2 IN GAS SAMPLE (UG)	374.7	389.5	354.3	371.0
NOX CONCENTRATION				
(GR/DSCF)	.0967	.1021	.0927	.0947
(MG/DSCM)	221	234	212	217
(PPM-DRY)	116	122	111	113
(PPM-WET)	96	102	92	94
DRY STANDARD FLOW (DSCFM)	7370.	7370.	7370.	7370.
NOX MASS RATE (LB/HR)	6.11	6.45	5.86	5.98
NOX EMISSION FACTOR (LB/MMBTU)				
F-FACTOR METHOD*	.759	.802	.728	.743

* F=11837.0 DSCF/MMBTU

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BS & B ENERGY SYSTEMS
MINNEAPOLIS, MINNESOTA

TEST NO. 1
GASIFIER QUENCH STACK

RESULTS OF OXIDES OF NITROGEN (NOX) DETERMINATIONS -- METHOD 7

	RUN 1A	RUN 1B	RUN 1C	RUN 1D
DATE OF RUN	6-24-85	6-24-85	6-24-85	6-24-85
TIME OF RUN (HRS)	1308	1310	1312	1314
FLASK NUMBER	13	14	15	16
VOLUME OF FLASK (ML)	2060	2048	2045	2067
DATA TIME OF SAMPLING				
FLASK TEMPERATURE (DEG-F)	70.0	70.0	70.0	70.0
BAR. PRESS (IN.HG)	29.34	29.34	29.34	29.34
FLASK VACUUM (IN.HG)	27.10	27.20	27.20	27.40
FLASK ABS. PRESS. (IN.HG)	2.24	2.14	2.14	1.94
DATA TIME OF FLASK OPENING				
FLASK TEMPERATURE (DEG-F)	71.6	71.6	71.6	71.6
LAB. BAR. PRESS (IN.HG)	28.79	28.79	28.79	28.79
FLASK STATIC PRESS (IN.HG)	-1.40	-2.05	-1.55	-1.60
FLASK ABS. PRESS (IN.HG)	27.39	26.74	27.24	27.19
VOLUME GAS SAMPLED (DSML)	1698	1651	1682	1711
MOISTURE CONTENT (% V/V)	16.88	16.88	16.88	16.88
OXYGEN CONTENT (% V/V, DRY)	16.40	16.40	16.40	16.40
NO2 IN GAS SAMPLE (UG)	374.7	358.0	382.1	408.1
NOX CONCENTRATION				
(GR/DSCF)	.0964	.0948	.0993	.1043
(MG/DSCM)	221	217	227	239
(PPM-DRY)	115	113	119	125
(PPM-WET)	96	94	99	104
DRY STANDARD FLOW (DSCFM)	7370.	7370.	7370.	7370.
NOX MASS RATE (LB/HR)	6.09	5.99	6.27	6.59
NOX EMISSION FACTOR (LB/MMBTU)				
F-FACTOR METHOD*	.757	.744	.780	.819

* F=11837.0 DSCF/MMBTU

3.4 Results of Oxides of Nitrogen Determinations

TEST NO. 1
GASIFIER QUENCH STACK

3.3 RESULTS OF SULFUR DIOXIDE DETERMINATIONS -- METHOD 6

	RUN 1	RUN 2	RUN 3
DATE OF RUN	6/24/85	6/24/85	6/24/85
TIME RUN START/END (HRS)	1230/1333	1356/1500	1518/1621
BAROMETRIC PRESSURE (IN.HG.)	29.34	29.34	29.34
METER TEMPERATURE (DEG-F)	86.10	82.00	83.30
METER CORRECTION COEFFICIENT	.9974	.9974	.9974
VOLUME THROUGH GAS METER			
AT METER CONDITIONS...(CF)	52.690	54.510	51.270
STANDARD CONDITIONS...(SCF)	50.106	52.255	48.993
TOTAL SAMPLING TIME (MIN)	60.0	60.0	60.0
MOISTURE CONTENT (%V/V)	16.88	25.50	26.54
OXYGEN CONTENT (%V/V DRY)	16.40	15.80	15.60
MILLIEQUIVALENTS OF SO4 IN GAS SAMPLE	6.7954	7.4960	7.3959
SULFUR DIOXIDE CONCENTRATION			
(GR/DSCF)	.0670	.0709	.0746
(MG/DSCM)	153	162	171
(PPM-DRY)	58	61	64
(PPM-WET)	48	45	47
DRY STANDARD VOLUMETRIC FLOW (DSCFM)	7370	7120	7200
SULFUR DIOXIDE MASS RATE (LB/HR)	4.23	4.33	4.60
HEAT INPUT (MMBTU/HR)	19.0	7.0	10.0
SULFUR DIOXIDE EMISSION FACTOR (LB/MMBTU)			
CLASSICAL METHOD	.223	.618	.460
F-FACTOR METHOD*	.526	.491	.497

TEST NO. 1
GASIFICATION QUENCH STACK

3.2 RESULTS OF PARTICULATE LOADING DETERMINATIONS -- METHOD 5

	RUN 1	RUN 2	RUN 3
DATE OF RUN	6-24-85	6-24-85	6-24-85
TIME RUN START/END(HRS)	1230/1333	1356/1500	1518/1621
PITOT TUBE COEFFICIENT	.840	.840	.840
WATER IN SAMPLE			
CONDENSATE (ML)	150.1	333.0	337.0
SILICA GEL (GRAMS)	66.0	47.0	39.0
TOTAL PARTICULATE MATER- IAL COLLECTED (GRAMS)	.0269	.0447	.0267
VM (MCF)	52.69	54.51	51.27
Y	.9974	.9974	.9974
PBAR (IN.HG)	29.34	29.34	29.34
DELTA-H (IN.WC)	2.40	2.60	2.29
TM (DEG-F)	86.10	82.00	83.30
VMSTD (DSCF)	50.13	52.28	49.02
TOTAL SAMPLING TIME (MIN)	60.0	60.0	60.0
NOZZLE DIAMETER (IN)	.370	.370	.370
AVG STACK GAS TEMP (DEG=F)	147	159	159
VOLUMETRIC FLOW			
ACTUAL (ACFM)	10390	11424	11713
DRY STANDARD ... (DSCFM)	7368	7120	7197
ISOKINETIC VARIATION (%)	101.4	109.4	101.5
PARTICLE CONCENTRATION*			
ACTUAL (GR/ACF)	.0059	.0082	.0052
DRY STANDARD . (GR/DSCF)	.0083	.0132	.0084
PARTICLE MASS FLOW (LB/HR)	.52	.81	.52
EMISSION FACTOR (LB/MMBTU)			
BY F FACTOR (320-F)	.0550	.0860	.0500
BY F FACTOR (ORSAT)	.0650	.0914	.0560

* DRY CATCH ONLY
F-FACTOR=11837.0

TEST NO. 1
GASIFICATION QUENCH STACK

3.1 RESULTS OF ORSAT & MOISTURE ANALYSES -- METHOD 3 & 4 (% V/V)

	RUN 1	RUN 2	RUN 3
DATE OF RUN	6-24-85	6-24-85	6-24-85
DRY BASIS (ORSAT)			
CARBON DIOXIDE	4.00	4.80	5.00
OXYGEN	16.40	15.80	15.60
CARBON MONOXIDE	0	0	0
NITROGEN	79.60	79.40	79.40
WET BASIS (ORSAT)			
CARBON DIOXIDE	3.33	3.58	3.67
OXYGEN	13.63	11.77	11.46
CARBON MONOXIDE	0	0	0
NITROGEN	66.17	59.16	58.34
MOISTURE CONTENT	16.87	25.49	26.53
DRY MOLECULAR WEIGHT	29.30	29.40	29.42
WET MOLECULAR WEIGHT	27.39	26.49	26.39
SPECIFIC GRAVITY (RELATIVE TO AIR)	.9461	.9152	.9117
VELOCITY WEIGHTED AND TIME-AVERAGED OXYGEN DURING METHOD 5 RUNS	15.58	15.48	14.96
FO	1.13	1.06	1.06

3 RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition results (Orsat and moisture) are presented first followed by the computer printout of the particulate, sulfur dioxide, oxides of nitrogen, and visible emission data. Preliminary measurements including traverse point description are given in the appendices.

The results have been calculated on a DEC PDP-11 Computer using standard Fortran programs. EPA-published equations have been used as the basis of the calculation techniques in these programs. It should be noted in interpreting these results that the particulate emission rates have been calculated by both the "concentration x flow" and the "ratio of areas" methods and the average reported. The average is the best estimate of the true value, since the bias introduced by anisokinetic sampling is approximately equal but of opposite sign in the two calculation techniques and thus cancels in the average.

Table 3. Summary of the Results of the June 24, 1985, Oxides of Nitrogen Emission Test on the Gasifier Quench Stack at the Bureau of Mines Gasifier Plant Located in Minneapolis, Minnesota.

ITEM	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6	RUN 7	RUN 8**
Time of test (HRS)	1308-1314	1318-1324	1326-1332	1434-1443	1447-1455	1456-1603	1605-1611	1613-1615
NO _x concentration (PPM/DRY)	118	116	141	133	184	130	125	128
(PPM/WET)	98	96	117	99	137	96	92	94
NO _x mass rate (LB/HR)	6.2	6.1	7.4	6.7	9.4	6.7	6.5	6.6
NO _x emission factor (LB/MMBTU) F-Factor Method	.78	.76	.92	.77	1.07	.73	.70	.71

Note: Each result reported is the average of four separate determinations. See Section 3.4 for results of individual samplings.

**Only two samples in this run.

TABLE 2. SUMMARY OF THE RESULTS OF THE JUNE 24, 1985 SULFUR DIOXIDE
EMISSION TEST ON THE GASIFIER QUENCH STACK AT THE BUREAU
OF MINES GASIFIER PLANT LOCATED IN MINNEAPOLIS, MINNESOTA

ITEM	RUN 1	RUN 2	RUN 3
TIME OF TEST (HRS)	1230-1333	1356-1500	1518-1621
SO2 CONCENTRATION (PPM/DRY)	58	61	64
(PPM/WET)	48	45	47
SO2 MASS RATE (LB/HR)	4	4	5
SO2 EMISSION FACTOR (LB/MMBTU) F-FACTOR METHOD	.53	.49	.50

TABLE 1. SUMMARY OF THE RESULTS OF THE 6-24-85 PARTICULATE EMISSION
TEST ON THE GASIFIER QUENCH STACK AT THE BUREAU OF MINES
GASIFIER PLANT LOCATED IN MINNEAPOLIS, MINNESOTA

ITEM	RUN 1	RUN 2	RUN 3
DATE OF TEST	6-24-85	6-24-85	6-24-85
TIME OF TEST (HRS)	1230/1333	1356/1500	1518/1621
ESTIMATED HEAT INPUT (MMBTU/HR)*	8.0	8.9	9.3
ESTIMATED BURNING RATE (DSCFM)*	959	1067	1115
VOLUMETRIC FLOW			
ACTUAL (ACFM)	10400	11400	11700
STANDARD (DSCFM)	7370	7120	7200
GAS TEMPERATURE (DEG-F)	147	159	159
GAS MOISTURE CONTENT (% V/V)	16.88	25.50	26.54
GAS COMPOSITION (% V/V, DRY)			
CARBON DIOXIDE	4.00	4.80	5.00
OXYGEN	16.40	15.80	15.60
NITROGEN	79.60	79.40	79.40
ISOKINETIC VARIATION (%)	101.3	109.4	101.4
PARTICULATE CONCENTRATION			
ACTUAL (GR/ACF)	.006	.008	.005
STANDARD (GR/DSCF)	.008	.013	.008
PARTICULATE EMISSION RATE (LB/HR)	.53	.84	.52

* CALCULATED FROM FLUE GAS DATA USING PLANT ESTIMATED HEATING VALUE OF THE PRODUCER GAS

the pollutant concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

The important results of the various flue gas tests performed on the gasifier combustor stack, which is downstream of the wet quench system, are presented in the following tables. Table 1 summarizes the results of the particulate emission test. As will be noted, the particulate emission factor was quite low for the first run and then increased substantially for the second run and then fell off for Run 3. This variation in the particulate emission factor is most likely attributable to the fact that pet-coke was being gasified during the first part of the first run. When the Minnesota peat sod reached the gasifier, operational parameters of the gasifier had to be changed rapidly. These changes were made during Run 2. By the time Run 3 was performed, the gasifier had settled down and was close to operating at steady state.

The results of the sulfur dioxide test are summarized in Table 2. These results are characterized primarily by their constancy and averaged approximately .53 LB/10⁶BTU.

The results of the oxides of nitrogen determinations are summarized in Table 3. As will be noted, the oxides of nitrogen emission factor was quite constant except for Runs 3 and 5. Run 5 included one very high NO_x concentration. It could not be determined whether this high concentration was due to a short term excursion in the flue gas or a sampling artifact.

Visible emissions were read throughout the testing period. At no time were any visible emissions observed after the moisture plume had dissipated.

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of this fact and a complete review of the entire data and results, it is our opinion that

Testing was performed in the stack for the combustor system. This is downstream of the water quench tower which removes some of the larger particulate material.

The back half of the EPA Method 5 particulate sampling train was used to collect sulfur dioxide samples. This is the large impinger version specified in EPA Method 6 and provides for a complete stack traverse during sample collection. Collected sulfur dioxide samples were returned to the laboratory for sulfate analysis by the standard barium/Thorin I titration technique.

Oxides of nitrogen samples were collected exactly in accordance with EPA Method 7. The collected samples were returned to the laboratory, aged for 16 hours at ≥ 72 °F, shook for two minutes and analyzed by ion chromatography (Method 7A).

An integrated flue gas sample was extracted simultaneously with each particulate and sulfur dioxide sample using a specially designed gas sampling system. Integrated flue gas samples were collected in 44-liter Tedlar bags. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis.

The important results of the tests are summarized in Section 2. Detailed results are presented in Section 3. Results of preliminary measurements, field data and all other supporting information are presented in the appendices.

INTRODUCTION

On June 24, 1985, Interpoll Inc. personnel conducted a series of emission tests on the pilot low BTU Gasifier at the Bureau of Mines (BOM) Twin Cities Research Center, Minneapolis, Minnesota. On-site testing was performed by Dr. P. Lonnes and E. Trowbridge. Coordination between testing activities and gasifier operation was provided by Dick Pooler of Black, Sivalls and Bryson (BSB).

Plant operational difficulties were encountered over the weekend which delayed testing. A different feed was still in the bunker and peat did not reach the gasifier until afternoon, at which point, operational parameters had to be adjusted and flue gas characteristics changed.

The unit tested is a six-foot, six-inch Wellman-Galusha, single stage, fixed-bed gasifier with an agitator. This gasifier has a nominal operating capacity of 30 10⁶BTU/HR (bituminous coal). A combustion test chamber is attached to the gasifier and it also has a nominal capacity of 30 10⁶BTU/HR. The combustion test chamber is a horizontal, cylindrical chamber, seven feet I.D. by 21 feet long, and exhausts through an impingement tray-type scrubber and an induced draft fan to a three-foot diameter stack. Minnesota peat sod was gasified during this set of tests.

Particulate, SO₂, NO_x and visible emission determinations were performed in accordance with EPA Methods 1-7 and 9, CFR Title 40, Part 60, Appendix A (Revised July 1, 1984). A preliminary determination of the gas velocity profile was made before the first and only particulate run to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. An Interpoll sampling train which meets or exceeds specifications in the above-cited reference was used to collect particulate samples by means of a heated glass-lined probe.

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	diameter
FT/SEC	feet per second
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g	gram
HP	horsepower
HRS	hours
IN.	inches
IN. HG.	inches of mercury
IN. WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10 ⁶ BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/DSCM	milligrams per dry standard cubic meter
microns (μm)	micrometer
MIN.	minutes
ohm-cm	ohm-centimeter
PPH	pounds per hour
PPM	parts per million
PSI	pounds per square inch
SQ. FT.	square feet
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure.

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APPENDICES:

- A - Results of Preliminary Measurements
- B - Location of Test Ports and Traverse Points
- C - Methods 2-5 Field Data Sheets
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- G - Calculation of the Low BTU Gas Dry F-Factor
- H - Plant Operational Data
- I - Procedures
- J - Calculation Equations
- K - Sampling Train Calibration Data

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**RESULTS OF THE JUNE 24, 1985,
FLUE GAS TESTS FOR MINNESOTA
PEAT GASIFICATION TEST BURN
IN THE WELLMAN-GALUSHA GASIFIER
AT THE BOM TWIN CITIES RESEARCH
CENTER IN MINNEAPOLIS, MINNESOTA**

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Approved by:

Perry Lonnes, Ph.D.
President

Report Number 5-2028
July 19, 1985

APPENDIX K

Stack Sampling Report

This is the report submitted by Interpoll, Inc., Circle Pines, Minnesota. The appendices to the stack sampling report have not been included here. The appendices include raw data and calculations.

1

RETORT TEMPERATURE AND PRESSURE PROBE DATA

TEST: BOM/FGT-017
DATE: 06/27/85
RETORT ACCESS PORT NUMBER:

COAL: PEAT SODS

5

DATA: INCHES ABOVE GRATE PRESSURE (inwc) TEMPERATURE (deg C)

INCHES ABOVE GRATE	PRESSURE (inwc)	TEMPERATURE (deg C)
0	1.2	88
6	1.2	127
12	1.2	1116
18	1.5	1232
24	2.0	682
30	2.3	593
36	2.3	382
42	2.5	282
48	2.5	193
54	2.8	132
60	3.1	99
66	3.5	93
72	3.7	---
78	3.8	---

TIME (hrs)	1520	1530
Blast Air (scfm)	1200	1200
Saturation Temperature (deg C)	59.5	59.5
Ashpit Pressure (inwc)	9.1	9.0
Offtake Temperature (deg C)	90	90

RETORT TEMPERATURE AND PRESSURE PROBE DATA

TEST: BOM/FGT-017
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 RETORT ACCESS PORT NUMBER:

COAL: PEAT SODS

5

DATA: INCHES ABOVE GRATE PRESSURE (inwc) TEMPERATURE (deg C)

			TIME (hrs)	1509	1539
0	1.4	---	Blast Air	1200	1200
6	1.6	---	(scfm)		
12	1.9	1021			
18	2.1	693	Saturation	65.5	65.5
24	2.4	599	Temperature		
30	2.6	---	(deg C)		
36	3.2	543			
42	4.1	416	Ashpit	11.8	11.5
48	4.4	---	Pressure		
54	4.8	288	(inwc)		
60	5.0	127			
66	5.1	104	Offtake	82	82
72	5.3	---	Temperature		
			(deg C)		

APPENDIX J

Retort Pressure and Temperature Probe Data

Reference: Volume 1, Thimsen, Maurer et al (1984)

AVERAGE FROM PERIOD: 6/27/85 8: 0 TO 6/27/85 16: 0

SIGNAL	AVERAGE	UNITS	STD.DEV.
CO	28.553	%	1.255
CO2	10.252	%	0.668
O2	-0.166	%	0.126
SIGMA	166.669	BTU/SCF	4.623
AG VEL	-0.988	SPH	0.133
GR VEL	0.049	RPD/T	0.000
T - 3	--OFF--	DEG C	
T - 8	--OFF--	DEG C	
T - 9	--OFF--	DEG C	
T-701	18.428	DEG C	1.800
T-702	28.679	DEG C	1.663
T-703	58.159	DEG C	0.951
T-703A	39.923	DEG C	1.459
TT1-703	60.416	DEG C	0.995
TT2-703	60.639	DEG C	0.965
T-705	74.626	DEG C	1.212
T-706	65.381	DEG C	0.478
T-707	72.510	DEG C	0.749
T-710	17.153	DEG C	0.458
T-711	74.654	DEG C	2.981
T-712	17.064	DEG C	0.410
T-713	24.512	DEG C	0.554
T-715	-45.026	DEG C	2.697
T-806	73.108	DEG C	0.954
T-811	--OFF--	DEG C	
T-812	--OFF--	DEG C	
T-813	--OFF--	DEG C	
T-814	--OFF--	DEG C	
T-815	--OFF--	DEG C	
T-816	--OFF--	DEG C	
T-817	--OFF--	DEG C	
T-818	--OFF--	DEG C	
T-819	260.543	DEG C	11.278
T-820	184.183	DEG C	7.067
T-821	56.552	DEG C	2.944
T-822	68.214	DEG C	0.674
T-823	69.910	DEG C	0.818
F-701	1071.929	SCFM	3.685
F-715	1036.663	LBS/HR	160.990
F-802	1442.277	SCFM	1221.249
F-803	7486.964	SCFM	453.363
P-703	9.644	IN WC	0.779
P-705	3.317	IN WC	0.235
P-704	6.327	IN WC	0.632
P-706	1.835	IN WC	0.148
P-707	--OFF--	IN WC	
P-810	-1.573	IN WC	0.021

AVERAGE BASE TEMPERATURE 19.590

AVERAGE FROM PERIOD: 6/26/85 9: 0 TO 6/27/85 8: 0

SIGNAL	AVERAGE	UNITS	STD.DEV.
CO	24.026	%	2.047
CO2	13.232	%	1.007
O2	-0.178	%	0.094
SIGMA	158.121	BTU/SCF	6.768
AG VEL	-0.871	SPH	0.342
GR VEL	0.045	RPD/T	0.012
T - 3	--OFF--	DEG C	
T - 8	--OFF--	DEG C	
T - 9	--OFF--	DEG C	
T-701	20.681	DEG C	3.190
T-702	30.993	DEG C	3.169
T-703	63.785	DEG C	1.920
T-703A	41.582	DEG C	4.394
TT1-703	66.218	DEG C	0.839
TT2-703	66.493	DEG C	0.843
T-705	77.306	DEG C	3.086
T-706	69.187	DEG C	2.726
T-707	74.861	DEG C	2.582
T-710	16.495	DEG C	0.737
T-711	75.974	DEG C	6.340
T-712	16.493	DEG C	0.713
T-713	24.839	DEG C	1.199
T-715	-41.015	DEG C	8.173
T-806	74.273	DEG C	2.483
T-811	--OFF--	DEG C	
T-812	--OFF--	DEG C	
T-813	--OFF--	DEG C	
T-814	--OFF--	DEG C	
T-815	--OFF--	DEG C	
T-816	--OFF--	DEG C	
T-817	--OFF--	DEG C	
T-818	--OFF--	DEG C	
T-819	228.341	DEG C	18.686
T-820	145.297	DEG C	16.044
T-821	53.526	DEG C	4.679
T-822	67.343	DEG C	2.468
T-823	68.503	DEG C	2.449
F-701	1076.184	SCFM	41.696
F-715	1626.698	LBS/HR	241.783
F-802	2023.629	SCFM	77.414
F-803	7063.315	SCFM	421.660
P-703	11.981	IN WC	1.492
P-705	3.969	IN WC	0.603
P-704	8.013	IN WC	1.067
P-706	2.058	IN WC	0.436
P-707	--OFF--	IN WC	
P-810	-1.563	IN WC	0.102

AVERAGE BASE TEMPERATURE 21.042

AVERAGE FROM PERIOD: 6/25/85 4: 0 TO 6/26/85 8: 0

SIGNAL	AVERAGE	UNITS	STD.DEV.
CO	24.778	%	3.714
CO2	12.771	%	1.653
O2	-0.129	%	0.182
SIGMA	153.141	BTU/SCF	7.923
AG VEL	41.599	SPH	211.034
GR VEL	0.054	RPD/T	0.016
T - 3	--OFF--	DEG C	
T - 8	--OFF--	DEG C	
T - 9	--OFF--	DEG C	
T-701	26.959	DEG C	3.853
T-702	37.486	DEG C	3.758
T-703	63.669	DEG C	0.905
T-703A	43.956	DEG C	2.843
TT1-703	65.731	DEG C	0.880
TT2-703	66.008	DEG C	0.883
T-705	87.645	DEG C	21.870
T-706	82.711	DEG C	8.165
T-707	84.590	DEG C	15.614
T-710	15.976	DEG C	0.305
T-711	67.469	DEG C	3.247
T-712	16.339	DEG C	0.436
T-713	24.073	DEG C	0.836
T-715	-32.532	DEG C	6.294
T-806	81.818	DEG C	12.796
T-811	--OFF--	DEG C	
T-812	--OFF--	DEG C	
T-813	--OFF--	DEG C	
T-814	--OFF--	DEG C	
T-815	--OFF--	DEG C	
T-816	--OFF--	DEG C	
T-817	--OFF--	DEG C	
T-818	--OFF--	DEG C	
T-819	202.991	DEG C	27.431
T-820	90.882	DEG C	16.035
T-821	45.935	DEG C	2.658
T-822	64.610	DEG C	2.028
T-823	65.320	DEG C	2.152
F-701	851.619	SCFM	26.648
F-715	1271.662	LBS/HR	54.888
F-802	1723.465	SCFM	276.806
F-803	5563.144	SCFM	758.500
P-703	5.496	IN WC	1.140
P-705	1.765	IN WC	0.274
P-704	3.731	IN WC	1.048
P-706	0.707	IN WC	0.211
P-707	--OFF--	IN WC	
P-810	-1.571	IN WC	0.015

AVERAGE BASE TEMPERATURE 21.786

AVERAGE FROM PERIOD: 6/24/85 14: 0 TO 6/25/85 3: 0

SIGNAL	AVERAGE	UNITS	STD.DEV.
CO	27.237	%	4.117
CO2	11.241	%	1.553
O2	0.029	%	0.718
SIGMA	151.174	BTU/SCF	17.726
AG VEL	-1.096	SPH	0.308
GR VEL	0.037	RPD/T	0.013
T - 3	--OFF--	DEG C	
T - 8	--OFF--	DEG C	
T - 9	--OFF--	DEG C	
T-701	23.488	DEG C	2.268
T-702	34.482	DEG C	2.807
T-703	61.779	DEG C	4.236
T-703A	44.309	DEG C	3.971
TT1-703	64.070	DEG C	1.809
TT2-703	64.330	DEG C	1.821
T-705	139.398	DEG C	48.136
T-706	124.774	DEG C	24.310
T-707	135.443	DEG C	39.352
T-710	15.540	DEG C	1.133
T-711	78.516	DEG C	8.216
T-712	15.835	DEG C	1.167
T-713	22.483	DEG C	1.694
T-715	-26.656	DEG C	3.503
T-806	119.680	DEG C	33.411
T-811	--OFF--	DEG C	
T-812	--OFF--	DEG C	
T-813	--OFF--	DEG C	
T-814	--OFF--	DEG C	
T-815	--OFF--	DEG C	
T-816	--OFF--	DEG C	
T-817	--OFF--	DEG C	
T-818	--OFF--	DEG C	
T-819	504.810	DEG C	84.441
T-820	83.800	DEG C	18.037
T-821	103.168	DEG C	18.770
T-822	69.713	DEG C	5.210
T-823	66.111	DEG C	5.065
F-701	623.017	SCFM	28.302
F-715	656.946	LBS/HR	131.711
F-802	885.294	SCFM	109.463
F-803	3403.217	SCFM	455.127
P-703	3.523	IN WC	0.944
P-705	1.735	IN WC	0.677
P-704	1.788	IN WC	0.574
P-706	1.293	IN WC	0.639
P-707	--OFF--	IN WC	
P-810	0.013	IN WC	0.199

AVERAGE BASE TEMPERATURE 21.709

APPENDIX I

Continuous Output Transducer Data

These are averages of the continuous output transducer data averaged for the time periods over which material and energy balance calculations were made.

SULFUR GAS CHROMATOGRAPH DATA

DATE TIME	H2S PPM	COS PPM	TOTAL PPM
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6/24/1985

6:31	2047	0	2047
7:33	1246	593	1838
8:45	1448	856	2303
9:48	526	544	1070
11:57	698	1070	1768
19:17	775	164	939
21:32	1009	214	1223
22:45	850	196	1046
23:10	542	538	1080

6/25/1985

0:47	890	249	1139
4:36	344	80	424
7:35	181	0	181
9:02	214	0	214
10:25	247	0	247
12:14	233	0	233
16:37	549	117	666
16:58	516	187	703
17:27	479	110	589
18:13	1496	555	2051
21:28	324	0	324
22:25	355	0	355

6/26/1985

11:43	49	0	49
18:58	377	0	377
21:12	392	74	466
22:14	379	56	435
23:37	386	44	430

6/27/1985

0:29	357	0	357
1:28	388	63	451
2:29	384	0	384
3:33	405	0	405
4:32	356	77	432
5:30	324	77	401
6:30	400	75	475
7:32	431	131	562
8:36	414	143	558
10:09	394	84	478
11:07	379	0	379
11:34	400	87	487
11:56	351	100	451

GAS CHROMATOGRAPH DATA

DATE TIME	H2 %	CO2 %	C2H4 %	C2H6 %	O2 %	N2 %	CH4 %	CO %	C3H6 %	C3H8 %	C3H4 %	HHV BTU/SCF	LHV BTU/SCF	TMP %	MW	S.G. WRT AIR

6/27/1985																
12:58	17.773	8.341	0.165	0.124	0.000	42.31	1.572	28.12	0.084	0.036	0.015	171.4	160.4	98.53	24.14	0.833
12:58	17.773	8.341	0.165	0.124	0.000	42.31	1.572	28.12	0.084	0.036	0.015	171.4	160.4	98.53	24.14	0.833
13:33	17.459	8.496	0.182	0.117	0.000	42.85	1.597	27.57	0.091	0.036	0.017	169.2	158.3	98.42	24.22	0.836
13:33	17.459	8.496	0.182	0.117	0.000	42.85	1.597	27.57	0.091	0.036	0.017	169.2	158.3	98.42	24.22	0.836
14: 9	17.099	8.891	0.191	0.111	0.000	43.47	1.547	26.63	0.090	0.037	0.020	164.6	153.9	98.09	24.29	0.838
14: 9	17.099	8.891	0.191	0.111	0.000	43.47	1.547	26.63	0.090	0.037	0.020	164.6	153.9	98.09	24.29	0.838
14:44	17.127	8.999	0.195	0.108	0.000	43.81	1.519	26.37	0.083	0.033	0.019	163.3	152.7	98.27	24.35	0.840
14:44	17.127	8.999	0.195	0.108	0.000	43.81	1.519	26.37	0.083	0.033	0.019	163.3	152.7	98.27	24.35	0.840
15:19	17.287	9.690	0.214	0.115	0.000	43.76	1.649	25.34	0.084	0.035	0.020	162.3	151.4	98.19	24.38	0.842
15:19	17.287	9.690	0.214	0.115	0.000	43.76	1.649	25.34	0.084	0.035	0.020	162.3	151.4	98.19	24.38	0.842
15:55	17.262	9.298	0.183	0.112	0.000	43.92	1.557	26.01	0.080	0.035	0.019	162.8	152.1	98.48	24.42	0.843
15:55	17.262	9.298	0.183	0.112	0.000	43.92	1.557	26.01	0.080	0.035	0.019	162.8	152.1	98.48	24.42	0.843
16:30	16.970	9.910	0.216	0.113	0.000	44.61	1.603	25.16	0.087	0.031	0.010	160.2	149.6	98.71	24.65	0.851
16:30	16.970	9.910	0.216	0.113	0.000	44.61	1.603	25.16	0.087	0.031	0.010	160.2	149.6	98.71	24.65	0.851
17: 5	17.095	10.092	0.210	0.114	0.000	44.44	1.627	24.63	0.086	0.036	0.022	159.1	148.4	98.35	24.54	0.847
17: 5	17.095	10.092	0.210	0.114	0.000	44.44	1.627	24.63	0.086	0.036	0.022	159.1	148.4	98.35	24.54	0.847

GAS CHROMATOGRAPH DATA

DATE TIME	H2 %	CO2 %	C2H4 %	C2H6 %	O2 %	N2 %	CH4 %	CO %	C3H6 %	C3H8 %	C3H4 %	HHV BTU/SCF	LHV BTU/SCF	TMP %	MW	S.G. WRT AIR

6/26/1985																
23:22	17.874	13.456	0.287	0.101	0.000	45.48	1.531	18.97	0.096	0.033	0.035	143.7	132.6	97.86	24.75	0.854
23:58	18.634	12.961	0.262	0.106	0.000	44.26	1.602	20.23	0.098	0.035	0.025	150.7	139.2	98.21	24.56	0.848
23:58	18.634	12.961	0.262	0.106	0.000	44.26	1.602	20.23	0.098	0.035	0.025	150.7	139.2	98.21	24.56	0.848

6/27/1985

0:33	18.460	12.633	0.254	0.105	0.000	44.39	1.558	20.59	0.094	0.034	0.023	150.6	139.2	98.13	24.54	0.847
0:33	18.460	12.633	0.254	0.105	0.000	44.39	1.558	20.59	0.094	0.034	0.023	150.6	139.2	98.13	24.54	0.847
1: 9	18.366	12.670	0.261	0.104	0.000	44.17	1.546	20.39	0.095	0.032	0.023	149.6	138.3	97.66	24.44	0.844
1: 9	18.366	12.670	0.261	0.104	0.000	44.17	1.546	20.39	0.095	0.032	0.023	149.6	138.3	97.66	24.44	0.844
1:45	18.808	12.462	0.249	0.107	0.000	43.24	1.604	20.96	0.096	0.035	0.023	153.4	141.8	97.59	24.27	0.838
1:45	18.808	12.462	0.249	0.107	0.000	43.24	1.604	20.96	0.096	0.035	0.023	153.4	141.8	97.59	24.27	0.838
2:20	18.643	10.447	0.219	0.114	0.000	42.26	1.641	24.13	0.093	0.038	0.021	163.1	151.5	97.60	23.99	0.828
2:20	18.643	10.447	0.219	0.114	0.000	42.26	1.641	24.13	0.093	0.038	0.021	163.1	151.5	97.60	23.99	0.828
2:56	19.115	11.199	0.217	0.115	0.000	41.85	1.637	23.51	0.096	0.034	0.010	162.5	150.8	97.78	24.04	0.830
2:56	19.115	11.199	0.217	0.115	0.000	41.85	1.637	23.51	0.096	0.034	0.010	162.5	150.8	97.78	24.04	0.830
3:32	19.152	11.439	0.223	0.116	0.000	41.91	1.655	22.83	0.099	0.044	0.038	161.1	149.2	97.51	23.98	0.828
3:32	19.152	11.439	0.223	0.116	0.000	41.91	1.655	22.83	0.099	0.044	0.038	161.1	149.2	97.51	23.98	0.828
4: 8	19.026	11.384	0.210	0.108	0.000	42.42	1.549	23.04	0.092	0.038	0.024	159.6	147.9	97.89	24.13	0.833
4: 8	19.026	11.384	0.210	0.108	0.000	42.42	1.549	23.04	0.092	0.038	0.024	159.6	147.9	97.89	24.13	0.833
4:44	18.661	12.241	0.233	0.104	0.000	43.69	1.535	21.51	0.095	0.037	0.025	153.7	142.3	98.12	24.43	0.843
4:44	18.661	12.241	0.233	0.104	0.000	43.69	1.535	21.51	0.095	0.037	0.025	153.7	142.3	98.12	24.43	0.843
5:20	18.472	12.315	0.246	0.108	0.000	43.86	1.563	21.33	0.096	0.036	0.023	153.1	141.7	98.05	24.46	0.844
5:20	18.472	12.315	0.246	0.108	0.000	43.86	1.563	21.33	0.096	0.036	0.023	153.1	141.7	98.05	24.46	0.844
5:56	19.182	11.922	0.217	0.115	0.000	42.30	1.642	22.53	0.094	0.038	0.021	159.7	147.9	98.07	24.21	0.836
5:56	19.182	11.922	0.217	0.115	0.000	42.30	1.642	22.53	0.094	0.038	0.021	159.7	147.9	98.07	24.21	0.836
6:32	19.559	10.560	0.174	0.118	0.000	41.42	1.673	24.81	0.087	0.036	0.008	167.7	155.7	98.44	24.00	0.828
6:32	19.559	10.560	0.174	0.118	0.000	41.42	1.673	24.81	0.087	0.036	0.008	167.7	155.7	98.44	24.00	0.828
7: 8	19.800	9.901	0.144	0.116	0.000	40.55	1.622	25.68	0.082	0.044	0.024	170.3	158.3	97.96	23.70	0.818
7: 8	19.800	9.901	0.144	0.116	0.000	40.55	1.622	25.68	0.082	0.044	0.024	170.3	158.3	97.96	23.70	0.818
7:44	19.484	10.258	0.148	0.114	0.000	40.86	1.592	25.24	0.085	0.043	0.021	167.6	155.8	97.84	23.81	0.822
7:44	19.484	10.258	0.148	0.114	0.000	40.86	1.592	25.24	0.085	0.043	0.021	167.6	155.8	97.84	23.81	0.822
8:20	19.389	10.303	0.158	0.114	0.000	40.88	1.608	25.06	0.083	0.041	0.020	167.0	155.2	97.66	23.79	0.821
8:20	19.389	10.303	0.158	0.114	0.000	40.88	1.608	25.06	0.083	0.041	0.020	167.0	155.2	97.66	23.79	0.821
8:56	17.337	9.005	0.193	0.105	0.000	43.47	1.488	25.97	0.085	0.034	0.020	162.4	151.7	97.71	24.14	0.833
8:56	17.337	9.005	0.193	0.105	0.000	43.47	1.488	25.97	0.085	0.034	0.020	162.4	151.7	97.71	24.14	0.833
9:32	16.978	9.673	0.218	0.110	0.000	44.34	1.565	24.84	0.089	0.037	0.020	159.0	148.3	97.87	24.38	0.841
9:32	16.978	9.673	0.218	0.110	0.000	44.34	1.565	24.84	0.089	0.037	0.020	159.0	148.3	97.87	24.38	0.841
10: 8	17.396	10.520	0.229	0.113	0.000	44.10	1.600	24.30	0.092	0.038	0.019	159.3	148.4	98.40	24.55	0.847
10: 8	17.396	10.520	0.229	0.113	0.000	44.10	1.600	24.30	0.092	0.038	0.019	159.3	148.4	98.40	24.55	0.847
10:44	17.362	9.771	0.216	0.115	0.000	43.70	1.622	25.28	0.094	0.033	0.009	162.3	151.4	98.21	24.39	0.842
10:44	17.362	9.771	0.216	0.115	0.000	43.70	1.622	25.28	0.094	0.033	0.009	162.3	151.4	98.21	24.39	0.842
11:20	17.134	9.342	0.214	0.117	0.000	43.62	1.631	26.22	0.095	0.047	0.030	165.0	154.2	98.45	24.44	0.844
11:20	17.134	9.342	0.214	0.117	0.000	43.62	1.631	26.22	0.095	0.047	0.030	165.0	154.2	98.45	24.44	0.844
11:56	17.529	9.226	0.210	0.124	0.000	42.69	1.717	26.43	0.094	0.041	0.018	167.7	156.7	98.08	24.21	0.836
11:56	17.529	9.226	0.210	0.124	0.000	42.69	1.717	26.43	0.094	0.041	0.018	167.7	156.7	98.08	24.21	0.836

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GAS CHROMATOGRAPH DATA

DATE TIME	H2 %	CO2 %	C2H4 %	C2H6 %	O2 %	N2 %	CH4 %	CO %	C3H6 %	C3H8 %	C3H4 %	HHV BTU/SCF	LHV BTU/SCF	TMP %	MW	S.G. WRT AIR

6/26/1985																
8:14	17.404	13.920	0.234	0.103	0.000	45.29	1.490	18.87	0.097	0.038	0.026	140.8	130.0	97.47	24.84	0.858
8:50	18.065	13.969	0.216	0.109	0.000	44.43	1.576	18.80	0.092	0.033	0.010	143.2	132.0	97.30	24.63	0.850
8:50	18.065	13.969	0.216	0.109	0.000	44.43	1.576	18.80	0.092	0.033	0.010	143.2	132.0	97.30	24.63	0.850
9:26	18.796	12.257	0.202	0.114	0.000	42.38	1.642	21.78	0.097	0.049	0.029	156.1	144.5	97.35	24.16	0.834
9:26	18.796	12.257	0.202	0.114	0.000	42.38	1.642	21.78	0.097	0.049	0.029	156.1	144.5	97.35	24.16	0.834
10: 2	18.577	12.018	0.188	0.114	0.000	42.65	1.614	22.05	0.090	0.041	0.019	155.4	143.9	97.36	24.19	0.835
10: 2	18.577	12.018	0.188	0.114	0.000	42.65	1.614	22.05	0.090	0.041	0.019	155.4	143.9	97.36	24.19	0.835
10:38	18.649	12.434	0.189	0.117	0.000	42.52	1.652	21.71	0.091	0.044	0.019	155.1	143.6	97.42	24.25	0.837
10:38	18.649	12.434	0.189	0.117	0.000	42.52	1.652	21.71	0.091	0.044	0.019	155.1	143.6	97.42	24.25	0.837
11:15	18.899	11.354	0.182	0.113	0.000	41.93	1.611	23.27	0.091	0.043	0.020	160.3	148.7	97.51	24.04	0.830
11:15	18.899	11.354	0.182	0.113	0.000	41.93	1.611	23.27	0.091	0.043	0.020	160.3	148.7	97.51	24.04	0.830
12: 2	18.703	12.050	0.195	0.116	0.000	42.03	1.645	22.28	0.110	0.040	0.019	157.5	145.9	97.19	24.11	0.832
12: 2	18.703	12.050	0.195	0.116	0.000	42.03	1.645	22.28	0.110	0.040	0.019	157.5	145.9	97.19	24.11	0.832
12:37	19.229	11.116	0.145	0.111	0.000	41.51	1.598	23.73	0.091	0.045	0.020	162.1	150.4	97.59	23.94	0.826
12:37	19.229	11.116	0.145	0.111	0.000	41.51	1.598	23.73	0.091	0.045	0.020	162.1	150.4	97.59	23.94	0.826
13:13	19.239	11.303	0.164	0.112	0.000	41.53	1.633	23.31	0.089	0.040	0.020	161.3	149.6	97.44	23.92	0.826
13:13	19.239	11.303	0.164	0.112	0.000	41.53	1.633	23.31	0.089	0.040	0.020	161.3	149.6	97.44	23.92	0.826
13:48	18.754	12.151	0.200	0.111	0.000	42.25	1.660	21.73	0.093	0.037	0.021	155.5	143.9	97.00	24.06	0.830
13:48	18.754	12.151	0.200	0.111	0.000	42.25	1.660	21.73	0.093	0.037	0.021	155.5	143.9	97.00	24.06	0.830
14:24	18.250	12.379	0.202	0.108	0.000	43.13	1.560	21.22	0.092	0.038	0.020	151.2	140.0	97.00	24.24	0.837
14:24	18.250	12.379	0.202	0.108	0.000	43.13	1.560	21.22	0.092	0.038	0.020	151.2	140.0	97.00	24.24	0.837
15:16	18.632	12.936	0.231	0.111	0.000	44.05	1.636	20.95	0.101	0.031	0.007	152.9	141.4	98.68	24.69	0.852
15:16	18.632	12.936	0.231	0.111	0.000	44.05	1.636	20.95	0.101	0.031	0.007	152.9	141.4	98.68	24.69	0.852
15:51	18.219	13.118	0.227	0.103	0.000	44.40	1.517	20.35	0.095	0.036	0.024	148.3	137.0	98.09	24.67	0.852
15:51	18.219	13.118	0.227	0.103	0.000	44.40	1.517	20.35	0.095	0.036	0.024	148.3	137.0	98.09	24.67	0.852
16:27	18.365	12.803	0.232	0.108	0.000	43.87	1.589	20.62	0.111	0.041	0.023	151.0	139.6	97.76	24.49	0.845
16:27	18.365	12.803	0.232	0.108	0.000	43.87	1.589	20.62	0.111	0.041	0.023	151.0	139.6	97.76	24.49	0.845
17: 2	18.205	13.194	0.250	0.113	0.000	43.94	1.656	20.16	0.099	0.036	0.022	149.6	138.3	97.68	24.56	0.848
17: 2	18.205	13.194	0.250	0.113	0.000	43.94	1.656	20.16	0.099	0.036	0.022	149.6	138.3	97.68	24.56	0.848
17:38	18.124	13.582	0.256	0.106	0.000	44.54	1.567	19.60	0.098	0.031	0.012	146.5	135.2	97.91	24.72	0.853
17:38	18.124	13.582	0.256	0.106	0.000	44.54	1.567	19.60	0.098	0.031	0.012	146.5	135.2	97.91	24.72	0.853
18:13	18.476	12.678	0.240	0.111	0.000	43.31	1.638	21.03	0.097	0.040	0.031	153.0	141.5	97.65	24.40	0.842
18:13	18.476	12.678	0.240	0.111	0.000	43.31	1.638	21.03	0.097	0.040	0.031	153.0	141.5	97.65	24.40	0.842
18:49	18.209	12.940	0.242	0.109	0.000	43.96	1.609	20.42	0.099	0.038	0.026	149.9	138.5	97.66	24.52	0.846
18:49	18.209	12.940	0.242	0.109	0.000	43.96	1.609	20.42	0.099	0.038	0.026	149.9	138.5	97.66	24.52	0.846
19:24	17.940	13.052	0.242	0.105	0.000	44.42	1.542	20.15	0.095	0.037	0.024	147.3	136.1	97.60	24.60	0.849
19:24	17.940	13.052	0.242	0.105	0.000	44.42	1.542	20.15	0.095	0.037	0.024	147.3	136.1	97.60	24.60	0.849
20: 1	17.995	13.159	0.258	0.100	0.000	44.82	1.521	19.87	0.098	0.034	0.024	146.5	135.4	97.88	24.68	0.852
20: 1	17.995	13.159	0.258	0.100	0.000	44.82	1.521	19.87	0.098	0.034	0.024	146.5	135.4	97.88	24.68	0.852
21:33	18.849	6.554	0.201	0.202	0.000	40.37	2.018	30.24	0.110	0.097	0.000	190.3	178.0	98.64	23.58	0.814
21:33	18.849	6.554	0.201	0.202	0.000	40.37	2.018	30.24	0.110	0.097	0.000	190.3	178.0	98.64	23.58	0.814
22:11	18.479	13.003	0.253	0.103	0.000	44.88	1.520	20.16	0.095	0.027	0.010	148.7	137.3	98.52	24.71	0.853
22:11	18.479	13.003	0.253	0.103	0.000	44.88	1.520	20.16	0.095	0.027	0.010	148.7	137.3	98.52	24.71	0.853
22:46	18.231	12.923	0.258	0.100	0.000	44.98	1.500	19.93	0.090	0.024	0.009	146.8	135.6	98.05	24.63	0.850
22:46	18.231	12.923	0.258	0.100	0.000	44.98	1.500	19.93	0.090	0.024	0.009	146.8	135.6	98.05	24.63	0.850
23:22	17.874	13.456	0.287	0.101	0.000	45.48	1.531	18.97	0.096	0.033	0.035	143.7	132.6	97.86	24.75	0.854

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GAS CHROMATOGRAPH DATA

DATE TIME	H2 %	CO2 %	C2H4 %	C2H6 %	O2 %	N2 %	CH4 %	CO %	C3H6 %	C3H8 %	C3H4 %	HHV BTU/SCF	LHV BTU/SCF	TMP %	MW	S.G. WRT AIR

6/25/1985

13: 9	18.248	13.626	0.209	0.102	0.000	44.41	1.534	19.35	0.092	0.036	0.023	144.9	133.7	97.63	24.62	0.850
13:44	18.684	12.909	0.206	0.104	0.000	43.49	1.567	20.67	0.091	0.036	0.021	150.9	139.4	97.78	24.43	0.843
14:20	18.968	12.059	0.183	0.106	0.000	42.48	1.570	21.98	0.085	0.035	0.020	155.5	144.0	97.49	24.14	0.833
14:55	18.588	12.620	0.202	0.108	0.000	43.02	1.592	21.09	0.090	0.036	0.020	152.2	140.7	97.37	24.29	0.838
15:30	19.252	11.727	0.198	0.110	0.000	41.57	1.635	23.36	0.091	0.038	0.018	162.0	150.2	98.00	24.14	0.833
16: 6	19.175	11.514	0.181	0.111	0.000	41.27	1.610	23.33	0.089	0.034	0.008	161.0	149.3	97.32	23.94	0.827
16:42	19.101	11.308	0.176	0.113	0.000	41.63	1.627	23.47	0.088	0.044	0.032	161.6	149.9	97.59	24.00	0.828
17:17	18.701	11.598	0.169	0.110	0.000	42.17	1.600	22.60	0.081	0.035	0.017	156.7	145.3	97.08	24.01	0.829
17:53	18.654	11.105	0.165	0.102	0.000	42.26	1.510	23.07	0.078	0.036	0.019	156.9	145.6	97.00	23.93	0.826
18:28	18.467	11.805	0.183	0.105	0.000	42.81	1.548	22.14	0.083	0.036	0.019	154.2	142.9	97.20	24.15	0.833
19: 4	18.469	12.488	0.182	0.107	0.000	43.10	1.586	21.09	0.082	0.036	0.019	151.2	139.8	97.16	24.24	0.837
19:39	18.777	12.400	0.186	0.109	0.000	42.47	1.610	21.31	0.088	0.038	0.020	153.4	141.9	97.00	24.10	0.832
20:16	18.636	12.535	0.194	0.112	0.000	42.70	1.614	21.30	0.090	0.035	0.009	153.1	141.6	97.22	24.22	0.836
20:52	17.850	10.499	0.176	0.109	0.000	43.25	1.583	23.70	0.081	0.047	0.037	157.7	146.7	97.34	24.13	0.833
21:27	19.239	11.342	0.166	0.103	0.000	41.70	1.557	23.19	0.083	0.038	0.021	159.8	148.2	97.43	23.93	0.826
22: 3	18.738	12.347	0.182	0.106	0.000	42.66	1.569	21.61	0.086	0.038	0.021	153.7	142.2	97.36	24.21	0.836
22:39	18.882	12.436	0.195	0.109	0.000	42.59	1.622	21.17	0.089	0.036	0.020	153.5	141.9	97.14	24.11	0.832
23:14	18.208	12.035	0.200	0.098	0.000	44.79	1.489	20.30	0.086	0.035	0.016	147.0	135.9	97.26	24.28	0.838
23:50	17.832	13.251	0.214	0.098	0.000	44.83	1.475	19.47	0.089	0.030	0.011	143.2	132.2	97.30	24.58	0.849

6/26/1985

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0:26	17.615	14.011	0.227	0.099	0.000	45.55	1.461	18.05	0.091	0.041	0.033	138.3	127.5	97.18	24.72	0.853
1: 2	17.962	14.310	0.235	0.102	0.000	45.26	1.525	17.86	0.093	0.035	0.020	139.5	128.4	97.40	24.74	0.854
1:37	18.135	13.609	0.231	0.100	0.000	44.73	1.525	18.91	0.092	0.036	0.022	143.4	132.2	97.39	24.58	0.848
2:13	18.073	13.771	0.218	0.099	0.000	44.83	1.496	19.03	0.089	0.036	0.022	143.0	131.9	97.67	24.70	0.853
2:13	18.073	13.771	0.218	0.099	0.000	44.83	1.496	19.03	0.089	0.036	0.022	143.0	131.9	97.67	24.70	0.853
2:49	17.995	13.720	0.220	0.100	0.000	44.99	1.490	18.79	0.087	0.030	0.010	141.8	130.7	97.44	24.65	0.851
2:49	17.995	13.720	0.220	0.100	0.000	44.99	1.490	18.79	0.087	0.030	0.010	141.8	130.7	97.44	24.65	0.851
3:25	17.923	14.040	0.229	0.100	0.000	45.33	1.507	18.15	0.093	0.042	0.032	140.2	129.2	97.44	24.72	0.853
3:25	17.923	14.040	0.229	0.100	0.000	45.33	1.507	18.15	0.093	0.042	0.032	140.2	129.2	97.44	24.72	0.853
4: 2	17.342	14.222	0.234	0.100	0.000	46.14	1.479	17.67	0.093	0.034	0.020	136.4	125.7	97.34	24.87	0.859
4: 2	17.342	14.222	0.234	0.100	0.000	46.14	1.479	17.67	0.093	0.034	0.020	136.4	125.7	97.34	24.87	0.859
4:38	17.702	13.762	0.231	0.100	0.000	45.36	1.493	18.65	0.095	0.032	0.012	140.8	129.9	97.44	24.74	0.854
4:38	17.702	13.762	0.231	0.100	0.000	45.36	1.493	18.65	0.095	0.032	0.012	140.8	129.9	97.44	24.74	0.854
5:14	18.358	13.483	0.216	0.104	0.000	44.15	1.533	19.37	0.094	0.044	0.033	145.7	134.4	97.38	24.49	0.846
5:14	18.358	13.483	0.216	0.104	0.000	44.15	1.533	19.37	0.094	0.044	0.033	145.7	134.4	97.38	24.49	0.846
5:50	18.314	13.500	0.212	0.102	0.000	44.46	1.528	19.16	0.090	0.038	0.023	144.5	133.3	97.42	24.52	0.846
5:50	18.314	13.500	0.212	0.102	0.000	44.46	1.528	19.16	0.090	0.038	0.023	144.5	133.3	97.42	24.52	0.846
6:26	18.109	13.591	0.221	0.103	0.000	44.61	1.535	19.05	0.094	0.038	0.022	143.8	132.7	97.38	24.58	0.848
6:26	18.109	13.591	0.221	0.103	0.000	44.61	1.535	19.05	0.094	0.038	0.022	143.8	132.7	97.38	24.58	0.848
7: 2	18.642	13.105	0.206	0.107	0.000	43.69	1.588	20.15	0.090	0.032	0.010	149.2	137.8	97.62	24.42	0.843
7: 2	18.642	13.105	0.206	0.107	0.000	43.69	1.588	20.15	0.090	0.032	0.010	149.2	137.8	97.62	24.42	0.843
7:38	18.251	12.868	0.203	0.105	0.000	43.89	1.542	20.34	0.090	0.047	0.031	148.4	137.2	97.38	24.42	0.843
7:38	18.251	12.868	0.203	0.105	0.000	43.89	1.542	20.34	0.090	0.047	0.031	148.4	137.2	97.38	24.42	0.843
8:14	17.404	13.920	0.234	0.103	0.000	45.29	1.490	18.87	0.097	0.038	0.026	140.8	130.0	97.47	24.84	0.858

GAS CHROMATOGRAPH DATA

DATE TIME	H2 %	CO2 %	C2H4 %	C2H6 %	O2 %	N2 %	CH4 %	CO %	C3H6 %	C3H8 %	C3H4 %	HHV BTU/SCF	LHV BTU/SCF	TMP %	MW	S.G. WRT AR

6/24/1985

10:38	10.426	15.421	0.023	0.025	0.000	60.09	0.496	12.65	0.015	0.006	0.000	80.7	74.9	99.15	27.48	0.948
11:13	13.211	13.997	0.025	0.026	0.000	54.60	0.530	15.11	0.016	0.007	0.001	98.1	90.9	97.52	26.07	0.900
11:49	15.016	11.543	0.049	0.030	0.000	50.48	0.657	19.94	0.020	0.007	0.001	121.2	113.0	97.74	25.25	0.872
12:25	14.443	13.487	0.045	0.037	0.000	51.90	0.728	16.72	0.023	0.013	0.005	110.1	102.0	97.41	25.61	0.884
13: 1	15.824	12.273	0.081	0.052	0.000	49.24	0.861	19.81	0.037	0.019	0.011	127.1	118.1	98.20	25.26	0.872
13:37	16.994	10.827	0.102	0.060	0.000	46.38	1.014	22.88	0.044	0.017	0.004	142.9	133.1	98.33	24.75	0.854
14:13	15.443	12.678	0.092	0.056	0.000	49.67	0.924	19.01	0.039	0.016	0.003	124.2	115.3	97.94	25.35	0.875
14:48	16.859	11.507	0.126	0.059	0.000	47.25	1.061	21.13	0.047	0.021	0.018	137.9	128.1	98.08	24.81	0.857
15:24	16.707	11.825	0.112	0.055	0.000	47.69	0.962	20.70	0.043	0.020	0.015	134.6	125.0	98.13	24.93	0.861
16: 0	16.643	12.871	0.128	0.061	0.000	48.35	1.012	19.34	0.051	0.020	0.013	131.1	121.4	98.50	25.21	0.870
16:35	16.593	12.664	0.143	0.068	0.000	47.66	1.137	20.13	0.056	0.021	0.008	135.2	125.4	98.47	25.17	0.869
17:12	17.204	12.543	0.078	0.075	0.000	46.92	1.089	20.64	0.050	0.025	0.005	137.4	127.4	98.63	25.04	0.864
17:48	17.794	11.625	0.077	0.074	0.000	45.15	1.181	22.61	0.048	0.027	0.014	146.5	136.1	98.60	24.72	0.853
18:23	17.294	11.433	0.080	0.080	0.000	45.45	1.249	22.67	0.049	0.028	0.012	145.9	135.7	98.35	24.74	0.854
18:59	16.537	12.077	0.062	0.075	0.000	47.16	1.065	21.59	0.042	0.026	0.011	137.6	128.0	98.65	25.15	0.868
19:35	16.800	12.301	0.048	0.065	0.000	47.11	1.079	21.28	0.035	0.025	0.009	137.0	127.3	98.74	25.14	0.868
20:10	17.618	11.613	0.071	0.075	0.000	45.37	1.146	22.56	0.040	0.025	0.011	145.1	134.9	98.52	24.75	0.854
20:46	18.211	9.645	0.074	0.079	0.000	43.51	1.311	25.59	0.043	0.026	0.010	158.6	147.9	98.50	24.25	0.837
21:22	18.457	9.749	0.076	0.086	0.000	42.92	1.388	25.91	0.047	0.029	0.011	161.6	150.6	98.67	24.25	0.837
21:57	18.280	9.013	0.069	0.086	0.000	42.66	1.373	26.40	0.050	0.030	0.010	162.4	151.5	97.97	23.98	0.828
22:33	18.007	9.128	0.074	0.088	0.000	42.04	1.375	26.27	0.051	0.027	0.004	161.2	150.5	97.06	23.82	0.822
23:14	18.292	9.556	0.097	0.095	0.000	42.24	1.457	26.01	0.072	0.044	0.022	163.5	152.5	97.89	24.03	0.830
23:50	17.854	10.330	0.142	0.097	0.000	42.87	1.501	24.78	0.068	0.033	0.015	158.9	148.1	97.69	24.21	0.836

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0:26	17.920	10.077	0.114	0.095	0.000	43.04	1.509	25.05	0.065	0.036	0.014	159.6	148.8	97.92	24.22	0.836
1: 3	18.054	9.821	0.119	0.096	0.000	42.78	1.493	25.53	0.067	0.042	0.000	161.7	150.8	98.01	24.17	0.834
1:39	17.809	10.517	0.162	0.099	0.000	43.28	1.566	24.39	0.076	0.036	0.015	158.8	147.8	97.95	24.32	0.839
2:15	17.767	10.511	0.124	0.089	0.000	43.57	1.394	24.56	0.066	0.034	0.015	156.4	145.7	98.12	24.40	0.842
2:51	18.219	10.158	0.143	0.091	0.000	43.00	1.454	25.03	0.067	0.027	0.007	160.2	149.2	98.20	24.24	0.837
3:27	17.863	10.175	0.162	0.093	0.000	43.22	1.449	24.73	0.077	0.040	0.029	158.9	148.1	97.84	24.23	0.836
4: 3	18.197	10.220	0.172	0.101	0.000	42.44	1.543	25.11	0.080	0.035	0.008	162.4	151.3	97.91	24.16	0.834
4:39	17.449	10.453	0.159	0.087	0.000	44.24	1.400	24.12	0.075	0.033	0.016	154.7	144.2	98.03	24.44	0.844
5:15	17.660	10.200	0.146	0.094	0.000	43.05	1.410	25.19	0.075	0.035	0.014	158.9	148.2	97.87	24.30	0.839
5:51	17.980	9.755	0.145	0.099	0.000	42.42	1.497	25.97	0.076	0.037	0.015	163.5	152.5	97.98	24.17	0.834
6:27	18.052	9.347	0.133	0.095	0.000	42.22	1.471	26.40	0.072	0.038	0.013	164.5	153.6	97.84	24.05	0.830
7: 3	18.509	9.187	0.133	0.103	0.000	41.31	1.559	26.97	0.074	0.037	0.014	168.9	157.6	97.90	23.91	0.825
7:40	17.852	8.523	0.133	0.094	0.000	42.33	1.472	27.25	0.073	0.037	0.014	166.6	155.8	97.78	23.95	0.827
8:16	18.221	9.285	0.150	0.098	0.000	42.11	1.500	26.69	0.079	0.036	0.014	166.7	155.7	98.18	24.09	0.831
9:12	18.057	11.098	0.212	0.095	0.000	44.28	1.505	23.97	0.090	0.026	0.008	158.5	147.4	99.34	24.75	0.854
9:49	17.659	11.481	0.205	0.089	0.000	44.59	1.399	22.52	0.079	0.031	0.015	151.1	140.4	98.07	24.57	0.848
10:25	17.209	12.588	0.249	0.088	0.000	45.89	1.395	20.63	0.089	0.030	0.019	144.4	133.9	98.19	24.89	0.859
11: 2	17.730	13.028	0.250	0.096	0.000	45.10	1.500	20.32	0.096	0.036	0.019	146.6	135.7	98.17	24.81	0.857
11:38	18.017	13.408	0.227	0.097	0.000	45.07	1.464	19.82	0.094	0.037	0.019	145.2	134.2	98.25	24.83	0.857
12:34	18.201	13.010	0.247	0.102	0.000	44.01	1.583	20.44	0.101	0.040	0.034	149.7	138.4	97.77	24.56	0.848

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APPENDIX H

Gas Chromatograph Data

The results of each successful gas chromatograph analysis are included here. Results from both the HP5880A (analysis for permanent gasses and hydrocarbons) and the HP5793 (analysis for gaseous sulfur species) are included in separate tables.

DATE	TIME	AGITATOR			GRATE		
		COUNTER TOTAL	SWEEPS PER HR	DRIVE SETTING	GEAR COUNTER	GEAR REVOLUTIONS RPH	DRIVE SETTING TEETH/RPD
6-26	0230	630			3638	49	4/5.0
6-26	0330	630			3689	51	4/5.0
6-26	0430	630			3738	49	4/5.0
6-26	0530	630			3783	45	4/5.0
6-26	0630	630			3833	50	4/6.0
6-26	0730	630			3904	71	4/6.1
6-26	0830	630			3966	62	5/5.0
6-26	0930	630			4024	58	5/5.0
6-26	1030	630			4084	60	5/5.0
6-26	1130	630			4193	109	5/7.0
6-26	1230	630			4246	53	5/6.0
6-26	1330	630			4318	72	5/6.0
6-26	1430	630			4387	69	5/6.0
6-26	1530	630			4459	72	5/6.0
6-26	1630	630			4542	83	5/5.5
6-26	1730	630			4597	55	5/5.5
6-24	1830	630			4645	48	5/3.0
6-24	1930	630			4688	43	5/3.0
6-26	2030	630			4724	36	5/3.0
6-26	2130	630			4764	40	5/3.0
6-26	2230	630			4797	33	5/3.0
6-26	2330	630			4832	35	5/3.0
6-27	0030	630			4871	39	5/3.5
6-27	0130	630			4918	47	5/3.5
6-27	0230	630			4956	38	5/3.5
6-27	0330	630			5003	47	5/3.5
6-27	0430	630			5042	39	5/5.0
6-27	0530	630			5110	68	5/5.0
6-27	0630	630			5158	48	5/5.0
6-27	0730	630			5236	78	5/5.0
6-27	0830	630			5292	56	5/5.0
6-27	0930	630			5354	62	5/5.0
6-27	1030	630			5415	61	5/5.0
6-27	1130	630			5475	60	5/5.0
6-27	1230	630			5533	58	5/5.0
6-27	1330	630			5597	64	5/5.0
6-27	1430	630			5658	61	5/5.0
6-27	1530	630			5717	59	5/5.0
6-27	1630	630			5780	63	5/5.0

TABLE G-4
OPERATOR DATA LOG 1B

DATE	TIME	AGITATOR			GRATE		
		COUNTER TOTAL	SWEEPS PER HR	DRIVE SETTING	GEAR COUNTER	GEAR REVOLUTIONS RPH	DRIVE SETTING TEETH/RPD
6-24	0730	611	5		1747	28	1/5.1
6-24	0830	613	2		1782	35	2/4.0
6-24	0930	613			1835	53	2/4.0
6-24	1030	613			1878	43	1/5.3
6-24	1130	613			1901	23	1/5.3
6-24	1230	614	1		1931	30	2/5.0
6-24	1330	618	4		1972	41	2/5.0
6-24	1430	618			2010	38	2/5.0
6-24	1530	618			2054	44	2/5.0
6-24	1630	618			2106	52	3/5.0
6-24	1730	618			2180	74	3/5.0
6-24	1830	618			2233	53	2/3.5
6-24	1930	618			2268	35	2/3.5
6-24	2030	618			2296	28	1/3.5
6-24	2130	618			2315	19	1/3.5
6-24	2230	618			2327	12	OFF
6-24	2330	618			2336	9	1/2.0
6-25	0030	618			2349	13	1/2.0
6-25	0130	618			2372	23	1/5.0
6-25	0230	618			2398	26	2/3.5
6-25	0330	618			2429	31	2/3.5
6-25	0430	618			2463	34	2/3.0
6-25	0530	618			2495	32	2/3.0
6-25	0630	618			2522	27	2/3.0
6-25	0730	620	2		2556	34	OFF
6-25	0830	620			2576	20	2/10.0
6-25	0930	620			2622	46	4/6.0
6-25	1030	620			2691	69	4/8.0
6-25	1130	626	6	3	2773	82	4/8.0
6-25	1230	628	2		2843	70	4/6.0
6-25	1330	628			2900	57	4/6.0
6-25	1430	628			2961	61	4/6.0
6-25	1530	628			3018	57	4/6.0
6-25	1630	628			3076	58	4/6.0
6-25	1730	628			3134	58	4/6.0
6-25	1830	628			3185	51	4/6.0
6-25	1930	628			3246	61	4/6.5
6-25	2030	628			3312	66	4/6.5
6-25	2130	630	2		3373	61	4/6.5
6-25	2230	630			3434	61	4/6.0
6-25	2330	630			3487	53	4/6.0
6-26	0030	630			3550	63	4/4.5
6-26	0130	630			3589	39	4/4.5

DATE	TIME	AGITATOR WATER FLOW	JACKET WATER IN			JACKET WATER OUT		STEAM				
			FLOW	METER TOTAL	HOURLY USAGE	METER TOTAL	HOURLY USAGE	REG. INLET PRESSURE	REGULATED PRESSURE	TEMP	ORIFICE DELTA P	VALVE POSIT
6-26	0330	2.5	10.0	34239	60	14019	51	90	39.5	295	7.5	30
6-26	0430	2.5	10.0	34244	50	14071	52	90	39.5	290	5	32
6-26	0530	2.5	10.0	34249	50	14121	50	90	39.5	290	5	32
6-26	0630	2.5	10.0	34255	60	14172	51	90	39.5	290	7	34
6-26	0730	2.5	10.0	34261	60	14236	64	82	39.5	300	7	34
6-26	0830	2.5	10.0	34266	50	14288	52	84	40	300	7	35
6-26	0930	2.5	10.0	34271	50	14333	45	84	40	300	5	34
6-26	1030	2.5	10.0	34277	60	14382	49	86	40	300	6	31
6-26	1130	2.5	10.0	34284	70	14451	69	86	40	300	6	28
6-26	1230	2.5	10.0	34288	40	14489	38	84	39.5	300	4.5	32
6-26	1330	2.5	10.0	34293	50	14539	50	84	39.5	295	5	32
6-26	1430	2.5	10.0	34299	60	14580	41	84	40	285	6	30
6-26	1530	2.5	10.0	34304	50	14631	51	84	39	295	6	32
6-26	1630	2.5	10.0	34310	60	14691	60	82	39.5	290	5	34
6-26	1730	2.5	10.0	34315	50	14733	42	82	39	295	7	36
6-26	1830	2.5	10.0	34319	40	14775	42	84	39.5	295	6	30
6-26	1930	2.5	10.0	34325	60	14833	58	82	39	295	7	36
6-26	2030	2.5	10.0	34331	60	14884	51	84	39	295	7	34
6-26	2130	2.5	10.0	34336	50	14939	55	84	39	290	6	34
6-26	2230	2.5	10.0	34341	50	14986	47	82	39.5	295	7	36
6-26	2330	2.5	10.0	34346	50	15034	48	85	39.5	295	8	38
6-27	0030	2.5	10.0	34352	60	15088	54	85	39.5	295	6	36
6-27	0130	2.5	10.0	34358	60	15144	56	85	39.5	295	10	38
6-27	0230	2.5	10.0	34363	50	15190	46	85	39.5	295	10	36
6-27	0330	2.5	10.0	34368	50	15239	49	85	39.5	295	10	36
6-27	0430	2.5	10.0	34373	50	15292	53	85	39.5	295	10	36
6-27	0530	2.5	10.0	34379	60	15351	59	85	39.5	295	10	36
6-27	0630	2.5	10.0	34384	50	15393	42	85	39.5	295	10	34
6-27	0730	2.5	10.0	34391	70	15460	67	85	39.5	295	10	35
6-27	0830	2.5	10.0	34396	50	15503	43	78	39.5	295	5	27
6-27	0930	2.5	10.0	34401	50	15559	56	89	40	295	5.5	25
6-27	1030	2.5	10.0	34407	60	15611	52	80	39.5	295	4	27
6-27	1130	2.5	10.0	34412	50	15661	50	80	39.5	300	4.5	29
6-27	1230	2.5	10.0	34417	50	15709	48	86	40	295	5	28
6-27	1330	2.5	10.0	34423	60	15763	54	78	39	295	4	25
6-27	1430	2.5	10.0	34428	50	15812	49	85	39.5	295	4.5	27
6-27	1530	2.5	10.0	34433	50	15862	50	88	39	290	4	38
6-27	1630	2.5	10.0	34440	70	15911	49	92	39.5	285	3	32

END OF BOM/FGT 017 PEAT SIDS

TABLE G-3

OPERATOR DATA LOG #1

DATE	TIME	AGITATOR WATER FLOW	JACKET WATER IN			JACKET WATER OUT		STEAM				
			FLOW	METER TOTAL	HOURLY USAGE	METER TOTAL	HOURLY USAGE	REG. INLET PRESSURE	REGULATED PRESSURE	TEMP	ORIFICE DELTA P	VALVE POSIT
6-24	0730	2.5	10.0	34002	60	11702	61	86	39.5	290	2	20
6-24	0830	2.5	10.0	34007	50	11753	51	80	39.5	290	1.5	17
6-24	0930	2.5	10.0	34012	50	11808	55	80	39.5	290	4	18
6-24	1030	2.5	10.0	34018	60	11864	56	78	39.5	290	4	12
6-24	1130	2.5	10.0	34023	50	11912	48	8	39.5	285	3	16
6-24	1230	2.5	10.0	34028	50	11967	55	88	39.5	290	3	14
6-24	1330	2.5	10.0	34034	60	12019	52	78	39.5	290	6	23
6-24	1430	2.5	10.0	34039	50	12068	47	78	39.5	290	4.5	22
6-24	1530	2.5	10.0	34045	60	12127	59	85	39	285	4	22
6-24	1630	2.5	10.0	34050	50	12178	51	88	39.5	285	2.5	22
6-24	1730	2.5	10.0	34055	50	12229	51	92	39.5	285	4	25
6-24	1830	2.5	10.0	34061	60	12279	50	92	39.5	290	3	21
6-24	1930	2.5	10.0	34066	60	12329	50	88	39	285	6	22
6-24	2030	2.5	10.0	34071	50	12380	51	92	39.5	292	6	23
6-24	2130	2.5	10.0	34077	60	12437	57	86	39.5	285	6	22
6-24	2230	2.5	10.0	34082	50	12480	43	88	39.5	285	5	26
6-24	2330	2.5	10.0	34088	60	12538	58	90	39.5	290	5	25
6-25	0030	2.5	10.0	34093	50	12589	51	85	39	290	2.5	26
6-25	0130	2.5	10.0	34099	60	12649	60	90	39.5	290	6	26
6-25	0230	2.5	10.0	34104	50	12700	51	80	39.5	295	4.5	18
6-25	0330	2.5	10.0	34109	50	12751	51	90	39.5	290	7.5	28
6-25	0430	2.5	10.0	34115	60	12802	51	90	39.5	290	5	32
6-25	0530	2.5	10.0	34120	50	12861	59	90	39.5	290	5	32
6-25	0630	2.5	10.0	34125	50	12905	44	90	39.5	290	4	32
6-25	0730	2.5	10.0	34132	70	12970	65	82	39.5	295	5	32
6-25	0830	2.5	10.0	34137	50	13023	53	84	40	285	7	30
6-25	0930	2.5	10.0	34142	50	13065	42	86	39.5	300	5	28
6-25	1030	2.5	10.0	34147	50	13122	57	86	39.5	295	4	32
6-25	1130	2.5	10.0	34153	60	13175	53	86	39.5	295	5	30
6-25	1230	2.5	10.0	34158	50	13226	51	84	39.5	295	6	34
6-25	1330	2.5	10.0	34163	50	13277	51	82	40	295	6	32
6-25	1430	2.5	10.0	34169	60	13336	59	86	39.5	295	5	32
6-25	1530	2.5	10.0	34174	50	13387	51	84	39.5	295	4	33
6-25	1630	2.5	10.0	34180	60	13439	52	86	39	285	5	28
6-25	1730	2.5	10.0	34185	50	13490	51	84	39	292	6	29
6-25	1830	2.5	10.0	34191	60	13542	52	85	39	292	5	29
6-25	1930	2.5	10.0	34195	40	13592	50	88	39	290	5	34
6-25	2030	2.5	10.0	34201	60	13652	60	86	39.5	295	4	30
6-25	2130	2.5	10.0	34206	50	13703	51	86	39	295	5	32
6-25	2230	2.5	10.0	34211	50	13754	51	86	39.5	295	6	31
6-25	2330	2.5	10.0	34216	50	13802	48	90	39.5	295	4	30
6-26	0030	2.5	10.0	34223	70	13864	62	90	39.5	290	7	30
6-26	0130	2.5	10.0	34227	40	13908	44	90	39.5	290	4	30
6-26	0230	2.5	10.0	34233	60	13968	60	90	39.5	295	5	32