Commonwealth of Pennsylvania
Environmental Resources
December 20, 1988

Subject: Source Test Review

To: Data File
Crozer-Chester Medical Center
Upland, Delaware County

From: Richard St. Louis, Chief
Source Testing Unit
Division of Technical Services and Monitoring
Bureau of Air Quality Control

Through: Chief, Source Testing and Monitoring Section

The Crozer-Chester Medical Center operates two Superior Model 40 GDX-16 reciprocating engines designated as Unit Nos. 1 and 2. The engines have a two fuel capacity of natural gas, No. 2 fuel oil, or a mixture of both fuels. There are no emission control systems.

Clean Air Engineering conducted six EPA Method 20 test runs on each of the two engines. Runs 1-3 were conducted while the engines were being fired with 92% natural gas and 8% fuel oil while Runs 4-6 were conducted with the engines fired solely on No. 2 fuel oil. The tests were conducted in accordance with a preapproved protocol and are acceptable to the Department.

The following table was extracted from the test report:

Unit No. 1

Run No.	1	2	3	4	5	6
CO_2 (%)	5.4	5.5	5.4	6.6	6.3	6.4
NO_x-Actual (ppm)	537	535	534	842	809	838
NO_x-15% O_2 (ppm)	342	337	341	556	562	570

Unit No. 2

Run No.	1	2	3	4	5	6
CO_2 (%)	6.2	5.9	6.2	7.1	6.8	6.7
NO_x-Actual (ppm)	440	417	404	779	747	739
NO_x-15% O_2 (ppm)	245	242	225	476	480	479

NOV 23 1988

Clean Air Engineering

207 N. Woodwork Ln. • Palatine, IL 60067 • 312/991-3300

November 21, 1988

Ms. Nancy Holmes
Environmental Manager
Cogeneration Partners of America
Metroview Corporate Center
333 Thornall Street
Edison, New Jersey 08837

Dear Ms. Holmes:

Enclosed are three copies of the report prepared by Clean Air Engineering for Cogeneration Partners of America on nitrogen oxides testing performed at Crozer-Chester Medical Center on October 25, 1988.

You can reach me at 312/991-3300 if you have any questions about the data or comments about the report.

Thank you for this opportunity to do business with you.

Respectfully submitted,

CLEAN AIR ENGINEERING

Elizabeth Williams
Manager Technical Communications

NOV 23 1988

COGENERATION PARTNERS OF AMERICA
379 Thornall Street
Edison, New Jersey 08837
(201) 549-5118 FAX (201) 549-5288

November 22, 1988

Mr. N. Rao Kona
Regional Air Pollution Control Engineer
PADER
1875 New Hope Street
Norristown, PA 19401

Reference: Application Number 23-399-017A
Two (2) Dual Fuel Reciprocating Engines
Crozer Chester Medical Center.

Dear Mr. Kona:

Please find enclosed three (3) copies of the compliance stack tests done by Clean Air Engineering for nitrogen oxides emissions for the project listed above.

If you have any questions, please feel free to call me.

Thank you.

Very truly yours,

Cogeneration Partners of America

Nancy Holmes
Senior Environmental Manager

NH:emm
Enclosures

cc: B. Meacher

11/19/98

Blaine:

Please review the attached "Report on Nitrogen Oxides Emissions" conducted on the Frazier-Chester Medical Center on their Units 1 & 2 reciprocating engines.

Your comments, as soon as possible, will be appreciated.

Thanks,

Jim Donnelly

NOV 23

CLEAN AIR ENGINEERING, INC
November 18, 1988

REPORT ON
NITROGEN OXIDES EMISSIONS

Performed at:
CROZER-CHESTER MEDICAL CENTER
RECIPROCATING ENGINES
UNITS 1 AND 2

Conducted for:
COGENERATION PARTNERS OF AMERICA

CAE Project No: 4492

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SUMMARY

INTRODUCTION

Cogeneration Partners of America contracted Clean Air Engineering to determine the levels of nitrogen oxides emissions at the Crozer-Chester Medical Center in Upland, Pennsylvania for diagnostic and compliance purposes.

The testing took place at the stacks of Units 1 and 2 on October 25, 1988. Coordinating the field testing were:

N. Holmes - Cogeneration Partners of America
J. Balabuszko - Clean Air Engineering

SUMMARY OF TEST RESULTS

Nitrogen Oxides

Unit 1

1) The nitrogen oxides concentration at the stack averaged 340 ppm corrected to 15 percent carbon dioxide for runs 1 through 3 on October 25, 1988 with 8% fuel oil and 92% natural gas burning.

2) The nitrogen oxides concentration at the stack averaged 563 ppm corrected to 15 percent carbon dioxide for runs 4 through 6 on October 25, 1988 with 100% fuel oil burning.

Unit 2

1) The nitrogen oxides concentration at the stack averaged 237 ppm corrected to 15 percent carbon dioxide for runs 1 through 3 on October 25, 1988 with 8% fuel oil and 92% natural gas burning.

2) The nitrogen oxides concentration at the stack averaged 478 ppm corrected to 15 percent carbon dioxide for runs 4 through 6 on October 25, 1988 with 100% fuel oil burning.

To the best of our knowledge, the data presented in this report is accurate and complete.

Respectfully submitted,

CLEAN AIR ENGINEERING

Jack Demkovich
Manager Central Region

Elizabeth Williams
Manager Technical Communications

DESCRIPTION OF INSTALLATION

Cogeneration Partners of America contains two Superior Model 40 GDX-16 Reciprocating Engines. The engines have a two fuel capacity of natural gas, number 2 fuel oil, or a mixture of both fuels.

There are no emission control devices.

During runs 1 through 3, both units burned 8 percent fuel oil and 92 percent natural gas. During runs 4 through 6, both units burned 100 percent fuel oil.

The testing reported in this document was conducted at the stacks of Units 1 and 2.

SUMMARY OF PROCEDURES

SAMPLING PROCEDURES

The sampling followed procedures detailed in U.S. Environmental Protection Agency (EPA) Methods 3A and 20. These methods are titled:

- Method 3A-"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure);"
- Method 20-"Determination of Nitrogen Oxides, Sulfur Dioxide, and Diluent Emissions from Stationary Gas Turbines."

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR), Part 60, Appendix A.

The sampling apparatus is shown in Fig 1 on page 6-1. The sampling equipment was designed and manufactured by the Research Appliance Co. and Clean Air Engineering to meet U.S. EPA standards. All equipment was calibrated at the Clean Air Engineering laboratory prior to shipment to the job site.

Sampling Locations

The stacks of Units 1 and 2 each have two ports. A twenty four point traverse was performed during the first of each set of three runs at each condition to determine the points with the highest carbon dioxide concentration.

The eight points with highest carbon dioxide concentrations were used to determine nitrogen oxides emissions for the first run at each condition. The same eight points were sampled to determine the nitrogen oxides emissions for the second and third runs at each condition. The sampling time per point was 1.5 minutes for a total sampling time of 12 minutes. The stack sampling point locations are shown in Fig 2 on page 6-2.

ANALYTICAL PROCEDURES

Carbon Dioxide

The carbon dioxide content was measured following the procedures detailed in EPA Method 3A. A sample was extracted continuously from each flue gas stream, and a portion was conveyed to a Horiba PIR 2000 carbon dioxide analyzer.

Nitrogen Oxides

The nitrogen oxides emission rate was determined using procedures detailed in EPA Method 20. A sample was extracted continuously from each flue gas stream, and a portion was conveyed to a TECO chemiluminescent nitrogen oxides analyzer.

QUALITY CONTROL PROCEDURES

Quality control procedures for all aspects of field sampling; sample preservation and holding time; reagent quality; analytical method; analyst training and safety; and instrument cleaning, calibration and safety were followed. These procedures are generally consistent with EPA guidelines documented in "Quality Assurance Manuals for Air Pollution Measurement Systems," Vol 3, "Stationary Source Specific Methods" (EPA-600/4-77-027b).

RESULTS

Nitrogen Oxides

The results of analysis for nitrogen oxides are presented in Tables 1 and 2 on pages 4-2 and 4-3, respectively.

Table 1

Nitrogen Oxides Results
EPA Method 20
October 25, 1988
Unit 1

Run No.	1	2	3
Start Time (approx.)	9:45 am	10:35 am	10:55 am
Stop Time (approx.)	10:11 am	10:47 am	11:07 am
OPERATING CONDITION	8% Fuel Oil 92% Nat Gas	8% Fuel Oil 92% Nat Gas	8% Fuel Oil 92% Nat Gas
Carbon Dioxide (percent)	5.4	5.5	5.4
Nitrogen Oxides (ppm) (actual)	537	535	534
(corrected to 15% carbon dioxide)	342	337	341

Run No.	4	5	6
Start Time (approx.)	12:25 pm	1:08 pm	1:28 pm
Stop Time (approx.)	1:01 pm	1:20 pm	1:40 pm
OPERATING CONDITION	100% Fuel Oil	100% Fuel Oil	100% Fuel Oil
Carbon Dioxide (percent)	6.6	6.3	6.4
Nitrogen Oxides (ppm) (actual)	842	809	838
(corrected to 15% carbon dioxide)	556	562	570

Table 2

Nitrogen Oxides Results
EPA Method 20
October 25, 1988
Unit 2

Run No.	1	2	3
Start Time (approx.)	2:00 pm	2:41 pm	3:05 pm
Stop Time (approx.)	2:36 pm	2:53 pm	3:17 pm
OPERATING CONDITION	8% Fuel Oil 92% Nat Gas	8% Fuel Oil 92% Nat Gas	8% Fuel Oil 92% Nat Gas
Carbon Dioxide (percent)	6.2	5.9	6.2
Nitrogen Oxides (ppm) (actual)	440	417	404
(corrected to 15% carbon dioxide)	245	242	225

Run No.	4	5	6
Start Time (approx.)	3:53 pm	4:33 pm	4:50 pm
Stop Time (approx.)	4:21 pm	4:45 pm	5:02 pm
OPERATING CONDITION	100% Fuel Oil	100% Fuel Oil	100% Fuel Oil
Carbon Dioxide (percent)	7.1	6.8	6.7
Nitrogen Oxides (ppm) (actual)	779	747	739
(corrected to 15% carbon dioxide)	476	480	479

DISCUSSION

No deviations from standard U.S. EPA testing procedures were noted.

FIGURES

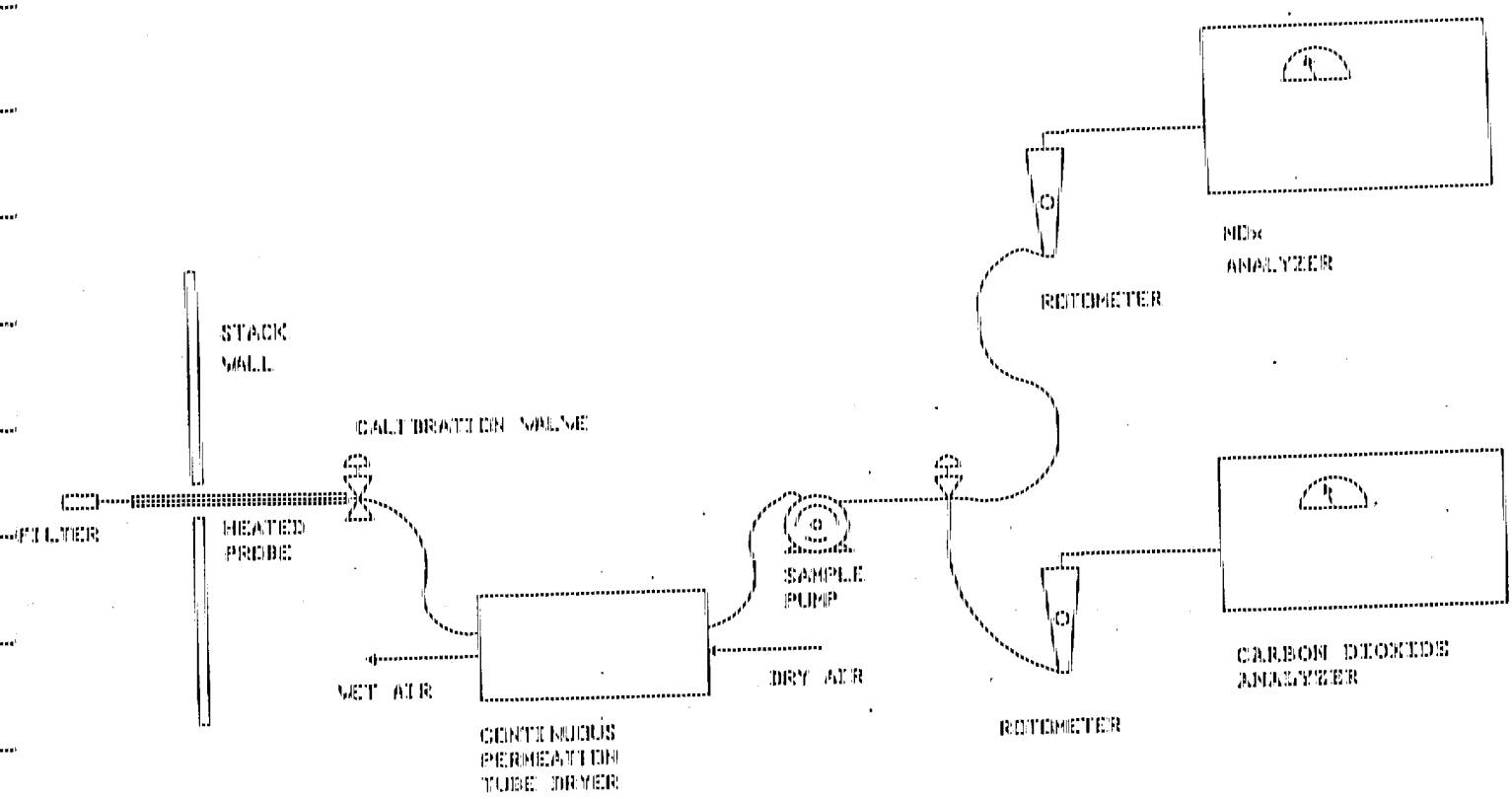
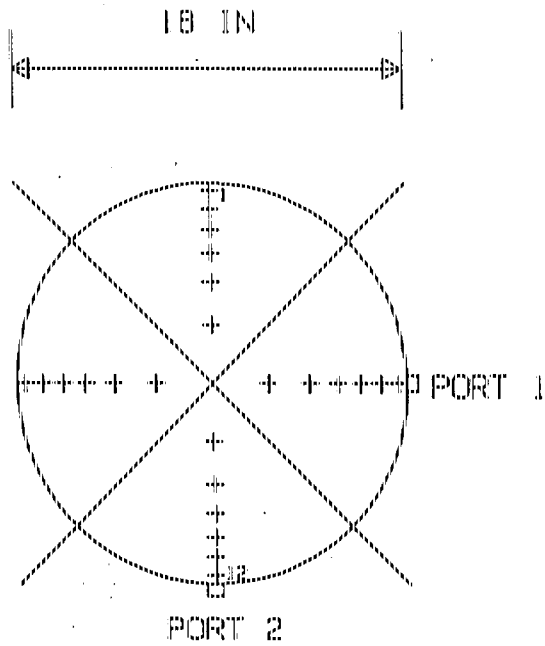


Fig 1. The EPA Method 20 sampling apparatus is shown.



TRAVERSE POINT	PORT TO POINT DISTANCE (IN)
1	17.6
2	16.8
3	15.9
4	14.8
5	13.5
6	11.6
7	6.4
8	4.5
9	3.2
10	2.1
11	1.2
12	0.4

One of Two Identical Locations

Fig 2. The cross section of the stack shows sampling point locations.

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NOMENCLATURE

COGENERATION PARTNERS OF AMERICA
CAE Project No: 4492

Nomenclature

A	--	absorbance
An	--	cross sectional area of nozzle (ft^2)
As	--	cross sectional area of stack (ft^2)
Bwo	--	proportion of water vapor in the gas stream by volume (%)
Bws	--	proportion of water vapor in the gas stream by volume (%) at saturated conditions
Cp	--	pitot tube coefficient (dimensionless)
Df	--	dilution factor
Fd	--	ratio of dry gas generated to gross calories (dcfm/MBtu)
Fc	--	ratio of gas generated to gross calories (dscf/MBtu)
GCV	--	gross calorific value of fuel (Btu/lb)
DH	--	average pressure drop across the meter box orifice (in. H_2O)
(DP)$^{1/2}$	--	average of square roots of velocity heads of stack gas (in. H_2O)$^{1/2}$
DH@	--	meter orifice calibration coefficient (dimensionless)
%I	--	percent of isokinetic sampling (acceptable: $90\% \leq \%I \leq 110\%$)
Kp	--	$\frac{[(lb/lb\text{-}mole)(in.\ Hg)]^{1/2}}{[(^\circ R)(in.\ H_2O)]^{1/2}}$
Kc	--	spectrophotometer calibration factor
Md	--	dry molecular weight of stack gas (lb/lb-mole)
Ms	--	molecular weight of stack gas, wet basis (lb/lb-mole)
Mn	--	total amount of particulate matter collected (gm)
N	--	normality of titrant (meq/ml)
Pb	--	barometric pressure (in. Hg)
Pf	--	final absolute pressure of flask (in. Hg)
Pi	--	initial absolute pressure of flask (in. Hg)
Ps	--	absolute stack gas pressure (in. Hg)
Qa	--	volumetric flow rate, actual conditions
Qstd	--	volumetric flow rate, standard conditions, dry basis
std	--	standard conditions, 29.92 in. Hg 68°F
Tf	--	final absolute temperature of flask (°R)
Ti	--	initial absolute temperature of flask (°R)
Tm	--	average dry gas meter temperature (°F)
Ts	--	average stack temperature (°F)
Tstd	--	absolute temperature, standard conditions (528°R)
θ	--	total sampling time (min)
Va	--	volume of aliquot (ml)
Vf	--	volume of flask (ml)
Vlc	--	total volume of liquid collected in impingers and silica gel (ml)
Vm	--	volume of gas sample through the dry gas meter at meter conditions (ft^3)
Vmstd	--	volume of gas sample through the dry gas meter, standard conditions (ft^3)
Vsc	--	volume of flask sample, standard conditions (ml)
Vsoln	--	total volume of solution (ml)
Vt	--	volume of titrant used to titrate aliquot (ml)
Vtb	--	volume of titrant used to titrate blank (ml)
Vwstd	--	volume of water collected, standard conditions (ft^3)
Vs	--	stack gas velocity (ft/sec)
Yd	--	gas meter correction factor (dimensionless)

SAMPLE CALCULATIONS

COGENERATION PARTNERS OF AMERICA
CAE Project No: 4492

SAMPLE CALCULATIONS

1. Nitrogen oxides emissions

$$\text{ppm}_{\text{drift calibrated}} = \text{ppm (strip)} - \frac{(\text{zero I} + \text{zero F})}{2} \quad \frac{\text{ppm (cal gas)}}{\left(\frac{(\text{cal I} + \text{cal F})}{2} - \frac{(\text{zero I} + \text{zero F})}{2}\right)}$$

$$= \left(840 - \frac{(3 + 5)}{2}\right) \quad \frac{550}{\left(\frac{(550 + 550)}{2} - \frac{(3 + 5)}{2}\right)}$$

$$= 842$$

Where:

ppm (cal gas)	=	actual concentration of the upscale calibration gas
Cal I	=	initial system calibration bias check response for upscale calibration gas, ppm
Cal F	=	final system calibration bias check response for the upscale calibration gas, ppm
Zero I	=	initial system calibration bias check response for the zero gas, ppm
Zero F	=	final system calibration bias check response for the zero gas, ppm

SAMPLE CALCULATIONS (Continued)

2. CO_2 correction factor (straight oil) (Unit 1, Run 4)

	Fd	Fc
Natural Gas	8710	1040
Oil	9190	1420

$$Fo = \frac{(0.209)\ (Fd)}{Fc}$$

$$= \frac{(0.209)\ (9190)}{1420}$$

$$= 1.353$$

$$K_{CO_2} = \frac{5.9}{Fo}$$

$$= \frac{5.9}{1.353}$$

$$= 4.362$$

$$Cadj = Cd \left(\frac{K_{CO_2}}{KCO_2} \right)$$

$$= 842 \left(\frac{4.36}{6.6} \right)$$

$$= 556$$

Where: Fo = fuel factor on the ratio of oxygen volume to the ultimate CO_2 volume produced by the fuel at zero percent excess air, dimensionless

KCO_2 = CO_2 correction factor, percent

Cadj = pollutant concentration corrected to 15 percent O_2, ppm

SAMPLE CALCULATIONS (Continued)

3. Average Fd and Fc, 92% natural gas, 8% fuel oil

Fc avg = (1040 x 0.92) + (1420 x 0.08)

= 1070.4

Fd avg = (8710 x 0.92) + (9190 x 0.08)

= 8748

The combined fuel concentrations are determined in the same manner as the fuel oil calculations.

PARAMETERS

PERCENT CARBON DIOXIDE

DATE	10/25	10/25	10/25	10/25	10/25	10/25
UNIT	1	1	1	1	1	1
RUN NO	1	2	3	4	5	6
START	9:45 AM	10:35 AM	10:55 AM	12:25 PM	1:08 PM	1:23 PM
STOP	10:16 AM	10:47 AM	11:07 AM	1:01 PM	1:20 PM	1:40 PM
FUEL COMPOSITION						
NATURAL GAS %	92	92	92	0	0	0
DIESEL FUEL OIL %	8	8	8	100	100	100
ZERO I	0.06	0.05	0.06	0.04	0.05	0.04
CAL I	6.0	6.0	6.0	6.0	6.0	6.0
ZERO F	0.04	0.07	0.06	0.06	0.06	0.05
CAL F	6.0	6.0	6.0	6.0	6.0	6.0
PERCENT CO2	5.4	5.5	5.4	6.6	6.3	6.4
PERCENT CO2 (calibrated)	5.4	5.5	5.4	6.6	6.3	6.4
1	5.4	5.4	5.4	6.6	6.5	6.3
2	5.4	5.6	5.4	6.6	6.2	6.3
3	5.4	5.4	5.6	6.6	6	6.5
4	5.4	5.6	5.3	6.6	6.5	6.2
5	5.4	5.6	5.3	6.6	6.2	6.5
6	5.6	5.4	5.4	6.6	6.5	6.5
7	5.4	5.4	5.4	6.6	6	6.5
8	5.4	5.4	5.4	6.6	6.3	6.5

PERCENT CARBON DIOXIDE

DATE	10/25	10/25	10/25	10/25	10/25	10/25
UNIT	2	2	2	2	2	2
RUN NO	1	2	3	4	5	6
START	2:00 PM	2:41 PM	3:05 PM	3:53 PM	4:33 PM	4:50 PM
STOP	2:36 PM	2:53 PM	3:20 PM	4:21 PM	4:45 PM	5:02 PM
FUEL COMPOSITION						
NATURAL GAS %	92	92	92	0	0	0
DIESEL FUEL OIL %	8	8	8	100	100	100
ZERO I	0.04	0.03	0.06	0.03	0.08	0.03
CAL I	6.0	6.0	6.0	6.0	6.0	6.0
ZERO F	0.04	0.04	0.03	0.08	0.03	0.03
CAL F	6.0	6.0	6.0	6.0	6.0	6.0
PERCENT CO2	6.2	6.0	6.2	7.1	6.8	6.7
PERCENT CO2 (calibrated)	6.2	5.9	6.2	7.1	6.8	6.7
1	6.2	6	6.2	7.2	6.9	6.8
2	6.2	6	6.2	7.1	6.9	6.8
3	6.2	6	6.2	7.1	7.1	6.8
4	6.2	5.9	6.2	7.2	6.9	6.6
5	6.2	5.9	6.2	7.1	6.6	6.8
6	6.2	5.9	6.3	7.1	6.9	6.6
7	6.2	6	6	7.1	6.5	6.8
8	6.2	5.9	6.2	7.1	6.5	6.6

NITROGEN OXIDES EMISSIONS

DATE	10/25	10/25	10/25	10/25	10/25	10/25
UNIT	1	1	1	1	1	1
RUN NO	1	2	3	4	5	6
START	9:45 AM	10:35 AM	10:55 AM	12:25 PM	1:08 PM	1:23 PM
STOP	10:16 AM	10:47 AM	11:07 AM	1:01 PM	1:20 PM	1:40 PM
FUEL COMPOSITION						
NATURAL GAS %	92	92	92	0	0	0
DIESEL FUEL OIL %	8	8	8	100	100	100
ZERO I	2	3	5	3	5	2
CAL I	546	550	550	550	550	550
ZERO F	3	5	5	5	2	1
CAL F	550	555	550	550	553	550
PPM	535	538	534	840	810	838
PPM (calibrated)	537	535	534	842	809	838
PPM @ 15% CO2	342	337	341	556	562	570
1	530	520	530	850	820	810
2	540	540	550	850	800	830
3	540	540	550	830	780	850
4	540	550	510	840	830	820
5	530	540	510	840	790	840
6	540	530	540	840	850	850
7	530	540	540	840	790	850
8	530	540	540	830	820	850

NITROGEN OXIDES EMISSIONS

DATE	10/25	10/25	10/25	10/25	10/25	10/25
UNIT	2	2	2	2	2	2
RUN NO	1	2	3	4	5	6
START	2:00 PM	2:41 PM	3:05 PM	3:53 PM	4:33 PM	4:50 PM
STOP	2:36 PM	2:53 PM	3:20 PM	4:21 PM	4:45 PM	5:02 PM
FUEL COMPOSITION						
NATURAL GAS %	92	92	92	0	0	0
DIESEL FUEL OIL %	8	8	8	100	100	100
ZERO I	2	10	5	3	10	7
CAL I	550	550	550	550	550	550
ZERO F	1	5	5	10	7	7
CAL F	550	557	550	550	540	560
PPM	440	421	405	776	738	744
PPM (calibrated)	440	417	404	779	747	739
PPM @ 15% CO2	245	242	225	476	480	479
1	410	420	380	770	750	740
2	430	430	390	770	750	750
3	440	430	410	770	760	750
4	440	430	410	780	750	750
5	450	430	420	780	720	740
6	450	420	430	780	750	740
7	450	410	390	780	710	750
8	450	400	410	780	710	730

CALIBRATION DATA

SCOTT SPECIALTY GASES Scott Environmental Technology, Inc.
a division of
PLUMSTEADVILLE, PA 18949 PHONE : 215-766-8861 TWX: 510-665-9344

Shipped From : Scott Troy
Date Shipped :
Our Project # : 225996
Your P.O. # : 1819
Page ___ of ___
Expiration Date : 7-26-89

Customer :
ENVIRONMENTAL MONITORING
P.O. BOX 201
GILBERTS, ILLINOIS 60136-0201

**** CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES ****

Certified For Traceability
Protocol # 1

Procedure # 81 82 83 (CIRCLE)

Cylinder Number AAL10035

File # P0990

Cylinder Pressure 2000 psig

Certified Accuracy 1 % NBS Traceable

COMPONENT	CERTIFIED CONC.	REFERENCE STD: SRM # (CRM #)	REFERENCE STD: CYLINDER NUMBER	REFERENCE STD: CONC.	GAS ANALYZER: MAKE/MODEL/SERIAL #	GAS ANALYZER: LAST CALIBRATION DATE	GAS ANALYZER: ANALYTICAL PRINCIPLE
NITRIC OXIDE	849.2 PPM	1687B	CAL9057	951.0 PPM	MONI	1-13-88	CHEMILUMINESCENCE
		GMIS*	AAL15429	982.5 PPM			

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 13.70 PPM

FIRST ANALYSIS DATE : 1-20-88

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	INTERNAL STANDARD (GMIS*)	REFERENCE GAS (mV)	RESULTS PPM
0.00	84.80	847.5	982.5 PPM	98.30	982.5
0.00	84.80	847.5		98.30	982.5
0.00	84.80	847.5		98.00	979.5

CALCULATED 847.5
RESULTS 847.5
850.1

AVERAGE : 848.4 PPM

SECOND ANALYSIS DATE : 1-26-88

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	INTERNAL STANDARD (GMIS*)	REFERENCE GAS (mV)	RESULTS PPM
0.00	84.90	848.5	982.5 PPM	98.30	982.5
0.00	85.20	851.5		98.40	983.5
0.00	85.20	851.5		98.40	983.5
0.00	86.30 MOI	864.5			

CALCULATED 848.5
RESULTS 850.6
850.6 863.6 PPM MOI

AVERAGE : 849.9 PPM

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	GVM (mV)	FITTED VALUE	PERCENT ERROR
	982.5	100	98.30	982.5	.00
1687B	951.0	97	95.10	950.5	-0.05
	470.0	48	47.00	469.6	-0.10
	297.4	30	29.80	297.6	0.06
1685A	219.0	22	22.00	219.6	0.26
	197.7	20	19.80	197.6	-0.06
	0.0000	0	0.00	0.0000	0.00
GMIS	197.7	LOW	19.80	197.6	-0.06
N/A	982.5	GMIS*	98.30	982.5	.00

* GMIS - GAS MANUFACTURER'S INTERNAL STANDARD Analyst : [signature] Approved By : [signature]

NOV 19 '88 13:24 AQA/EMC, INC.

SCOTT SPECIALTY GASES — a division of Scott Environmental Technology, Inc.

PLUMSTEADVILLE, PA 18949 PHONE : 213-766-8861 TWX: 510-665-9344

Shipped From : [illegible]
Date Shipped : [illegible]
Our Project # : 923996
Your P.O. # : 1819
Page ___ of ___
Expiration Date : 7-26-89

Customer :
ENVIRONMENTAL MONITORING
P.O. BOX 201
GILBERTS, ILLINOIS 60136-0201

**** CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES ****

Certified Per Traceability Protocol # 1

Procedure # 01 02 03 (CIRCLE)

Cylinder Number AAL6417

File # P0991

Cylinder Pressure 2050 psig

Certified Accuracy : % NBS Traceable

COMPONENT	CERTIFIED CONC.	REFERENCE STD: SRM # (CRM #)	REFERENCE STD: CYLINDER NUMBER	REFERENCE STD: CONC.	GAS ANALYZER: MAKE/MODEL/SERIAL #	GAS ANALYZER: LAST CALIBRATION DATE	GAS ANALYZER: ANALYTICAL PRINCIPLE
NITRIC OXIDE	546.8 PPM	1687B	CAL9057	951.0 PPM	NORIDA	1-13-88	CHEMILUMINESCENCE
		GMIS*	AAL13283	513.1 PPM			

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 13.02 PPM

FIRST ANALYSIS — DATE : 1-20-88

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	INTERNAL STANDARD (GMIS*)	REFERENCE GAS (mV)	RESULTS PPM
0.00	54.10	540.5	513.1 PPM	50.90	508.5
0.00	54.30	542.5		50.90	508.5
0.00	54.30	542.5		51.00	509.5

CALCULATED RESULTS 545.4
547.4
546.3

AVERAGE : 546.8 PPM

SECOND ANALYSIS — DATE : 1-26-88

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	INTERNAL STANDARD (GMIS*)	REFERENCE GAS (mV)	RESULTS PPM
0.00	54.30	542.5	513.1 PPM	51.00	509.5
0.00	54.50	544.5		51.00	509.5
0.00	54.50	544.5		51.10	510.5
0.00	55.80 MAX	557.5			

CALCULATED RESULTS 546.3
548.3
547.3 560.3 PPM MAX

AVERAGE : 547.3 PPM

CALIBRATION CURVE — 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
	982.5	100	98.30	982.5	.00
1687B	951.0	97	95.10	950.5	-0.05
	470.0	48	47.00	469.6	-0.10
	297.4	30	29.80	297.6	0.06
1685b	219.0	22	22.00	219.6	0.26
	197.7	20	19.80	197.6	-0.06
	0.0000	0	0.00	0.0000	0.00
GMIS	197.7	LOW	19.80	197.6	-0.06
N/A	513.1	GMIS*	98.30	982.5	91.48

* GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : [signature]

Approved By : J. Shapiro

PROCESS DATA

NANCY HOLMES, ENVIR. MGR.
COGENERATION PARTNERS OF AMERICA

PAGE 1
ENG 1 DUAL FUEL

10/25/88 CAE

CROZER CHESTER MEDICAL CENTER

ENGINE #1 DUAL FUEL MODE

(PRIMARY OPERATING MODE FOR ENGINE)

START 9:45 AM FINISH 11:15

FUEL FLOW RATE

	NATURAL GAS		#2 FUEL OIL
			~~[illegible]~~
9:45 AM	107.4	CCFH	(READING AT 11:30 30770
10:00	107.4 ~~[illegible]~~	"	" " 9:15 30753
10:15	106.6	"	2.25 HRS. 17 GALS
10:30	106.6	"	7.56 [redacted] GALS/HR.
10:35	106.6	"	
10:50	106.6	"	
11:00	106.6	"	
11:05	107.4	"	
11:10	106.6	"	
11:15	107.4	"	

ELECTRIC OUTPUT AND OPERATING LOAD ARE THE SAME

9:45 AM	1100 KW	(MAX. ENGINE OUTPUT
10:00	1125 KW	IS 1175 KW)
10:15	1150 KW	
10:30	1150 KW	
10:35	1150 KW	
10:50	1150 KW	
11:00	1150 KW	
11:05	1150 KW	
11:10	1150 KW	

STEAM FLOW RATE

(STEAM FLOW RATE IS FOR BOTH ENGINES —
THERE IS ONLY 1 STEAM HEADER FOR THE SYSTEM)
STEAM IS PRODUCED FROM WASTE HEAT RECOVERY BOILERS.

9:45 AM 241.2 PPH X10
49.3 PSIG
~~[illegible]~~

10:00 245.1 PPH X10
50.0 PSIG

10:15 254.9 PPH X10
49.3 PSIG

10:30 245.1 PPH X10
50.0 PSIG

10:35 245.1 PPH X10
50.0 PSIG

10:50 247.1 PPH X10
50.0 PSIG

11:00 241.2 PPH X10
50.0 PSIG

11:05 247.1 PPH X10
50.0 PSIG

11:10 241.2 PPH X10
51.5 PSIG

11:15 247.1 PPH X10
50.0 PSIG

ENG. #1
DIESEL
①

ENGINE # 1 #2 (DIESEL) MODE

START 12:25 FINISH 1:40

(ENGINE RUNS ON #2 STARTING UP & IN EMERGENCIES)

FUEL FLOW RATE #2 82.8 GALS/HR.

NO NAT. GAS

ELECTRIC OUTPUT

12:25 1150 KW

12:40 1150 KW

12:55 1150 KW

1:10 1150 KW

1:25 1150 KW

1:40 1150 KW

ENG #2
DUAL FUEL
(1)

ENGINE #2 DUAL FUEL

FUEL FLOW RATE

	NAT. GAS	#2 FLOW RATE
2:00 PM	120.6 CCFH	4 GALS/HR.
2:15	120.6 CCFH	
2:30	120.6 CCFH	
2:45	120.6 CCFH	
3:00	121.3 CCFH	
3:15	120.6 CCFH	
3:25	120.6 CCFH	

ELECTRIC OUTPUT

2:00	1175 KW
2:15	1175 KW
2:30	1175 KW
2:45	1175 KW
3:00	1175 KW
3:15	1175 KW
3:25	1175 KW

ENG #2
DUAL FUEL
②

STEAM FLOW RATE

1:00	223.5	PPH X10
	53.7	PSIG
2:15	245.1	PPH X10
	51.5	PSIG
2:30	221.6	PPH X10
	53.7	PSIG
2:45	245.1	PPH X10
	52.9	PSIG
3:00	274.5	PPH X10
	53.7	PSIG
3:15	92.2	PPH X10
	55.9	PSIG
3:25	154.9	PPH X10
	56.6	PSIG

ENG #2
#2 FUEL OIL
①

ENGINE #2 (DIESEL) #2 FUEL OIL MODE

FUEL FLOW RATE

94.7 GALS/HR.

3:53
4:08
4:23
4:38
4:53
~~5:08~~

ELECTRIC OUTPUT

3:53	1175 KW
4:08	1175 KW
4:23	1175 KW
4:38	1175 KW
4:53	1175 KW
5:08 ~~5:08~~	1175 KW

STEAM FLOW RATE

3:53	70.6 PPH X10
	56.6 PSIG
4:08	84.3 PPH X10
	55.9 PSIG
4:23	170.6 PPH X10
	55.1 PSIG
4:38	190.2 PPH X10
	53.7 PSIG
4:53	209.8 PPH X10
	52.5 PSIG
5:08	223.5 PPH X10
	50.7 PSIG

FIELD DATA

Orsat Readings

Client/Owner [illegible]	$F_o = \frac{20.9 - \%O_2}{\%CO_2}$	Project Number
Plant [illegible] / Unit		
Date 10/20/93	F_o = 1.083 to 1.230 (for bituminous coal)	Fuel Type
Orsat ID / Leak Check?		

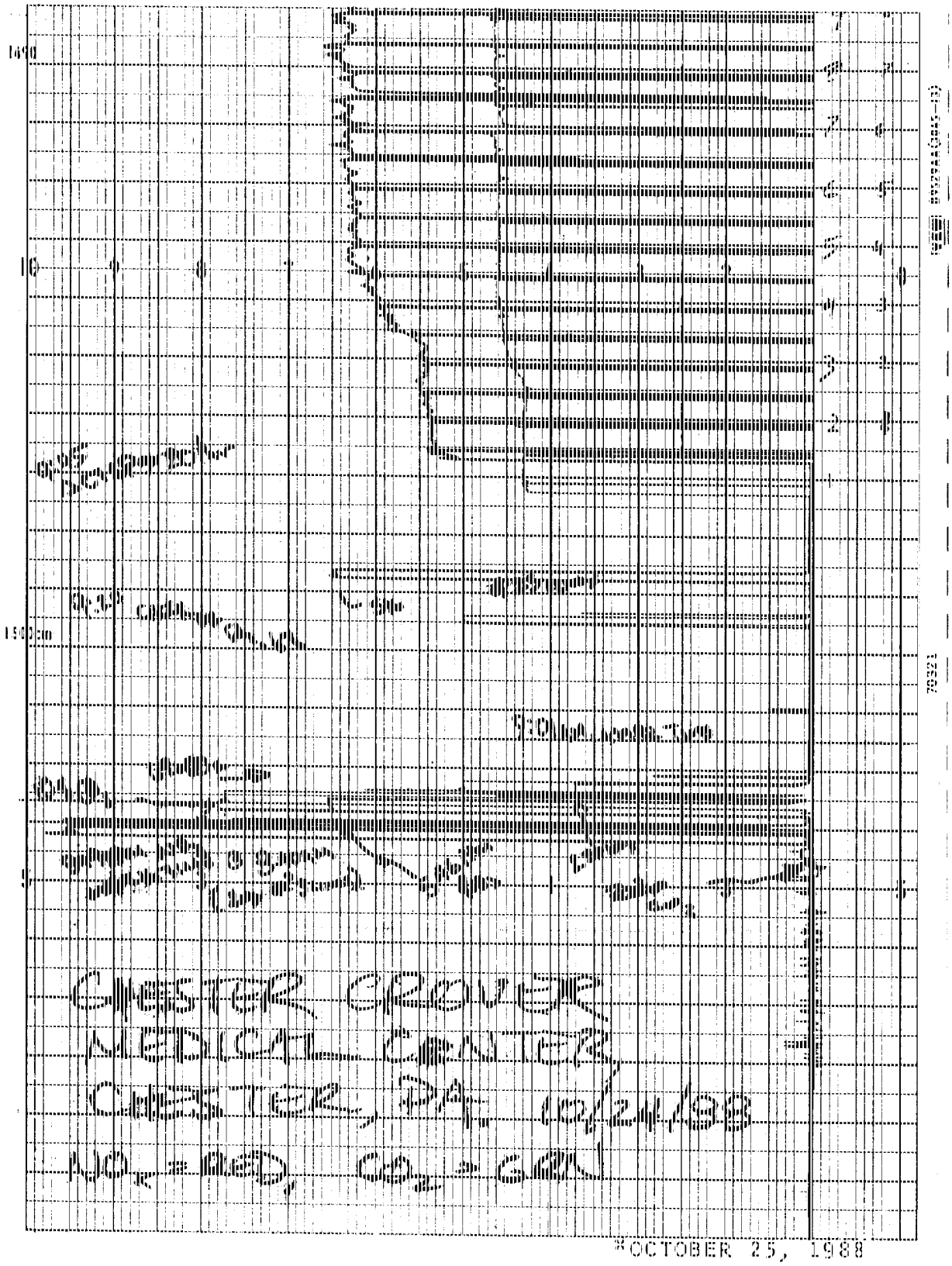
Run Number	Location	Bag ID	Trial	Percent CO_2	Percent $CO_2 + O_2$	Percent O_2	F_o	Sample Time	Analysis Time	Analyst
			1	6.0						
6.0 % CO_2			2	6.0						
			3	6.1						
			Avg.	6.0						
			1	10.2						
10.0 % CO_2			2	10.0						
			3	10.0						
			Avg.	10.0						
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							
			1							
			2							
			3							
			Avg.							

COGENERATION PARTNERS OF AMERICA
CAE Project No: 4492

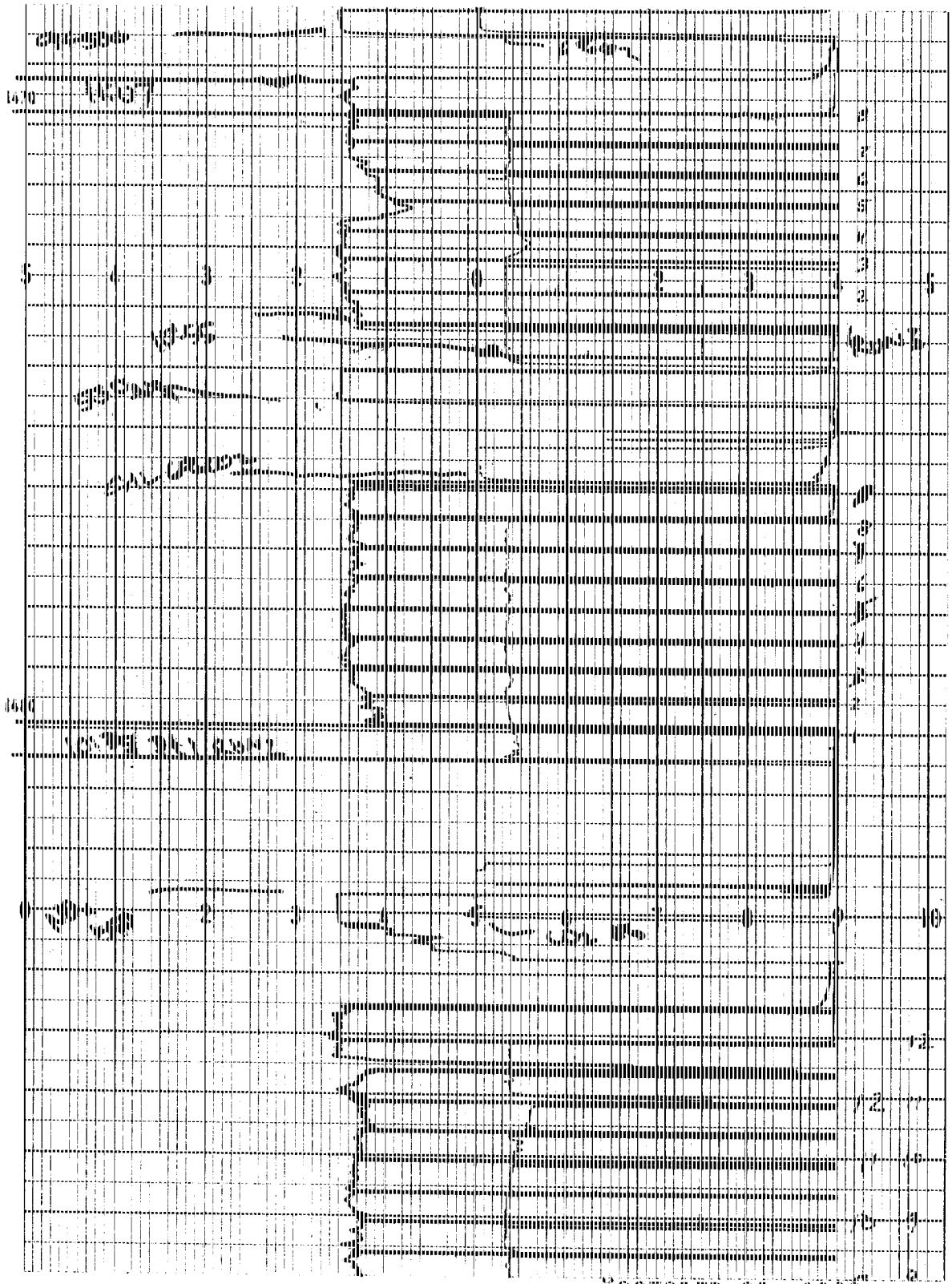
NOTE

All testing was performed on October 25, 1988. The strip charts for Unit 1 were misdated October 24, 1988.

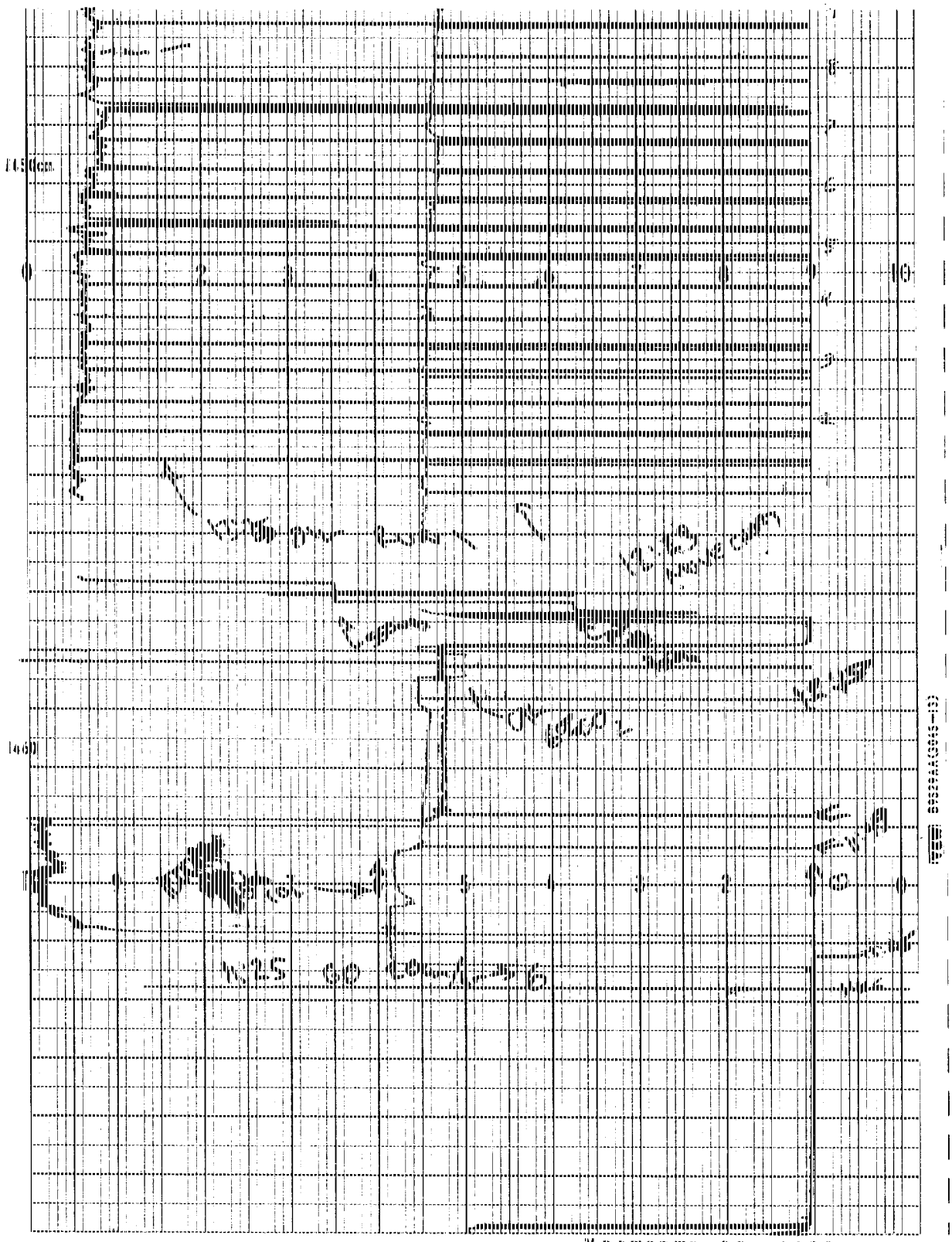
COGENERATION PARTNERS OF AMERICA
Testing at
CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 24, 1988:
Unit 1



COGENERATION PARTNERS OF AMERICA
Testing at
CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 24, 1988*
Unit 1

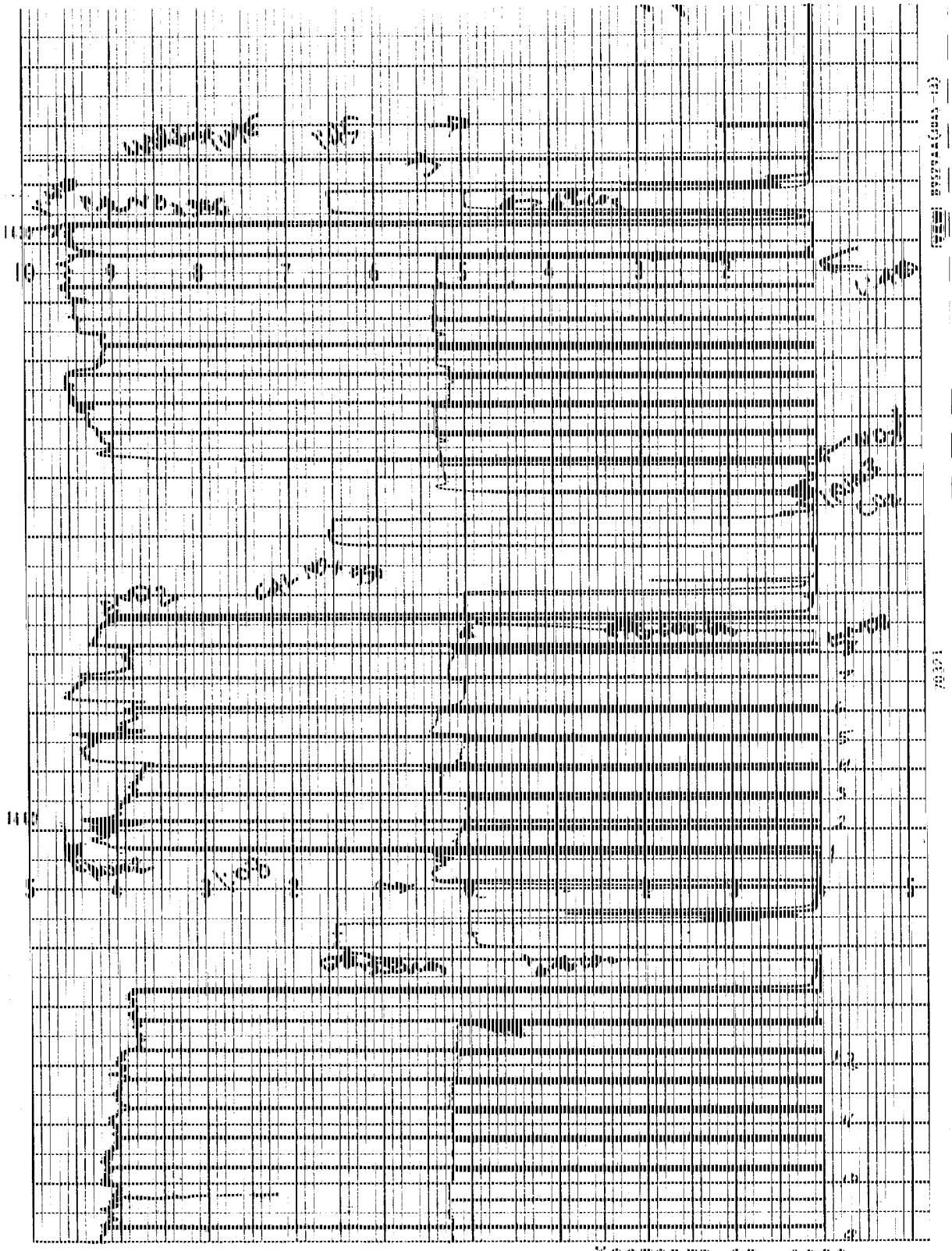


COGENERATION PARTNERS OF AMERICA
Testing at:
CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 24, 1988:
Unit 1



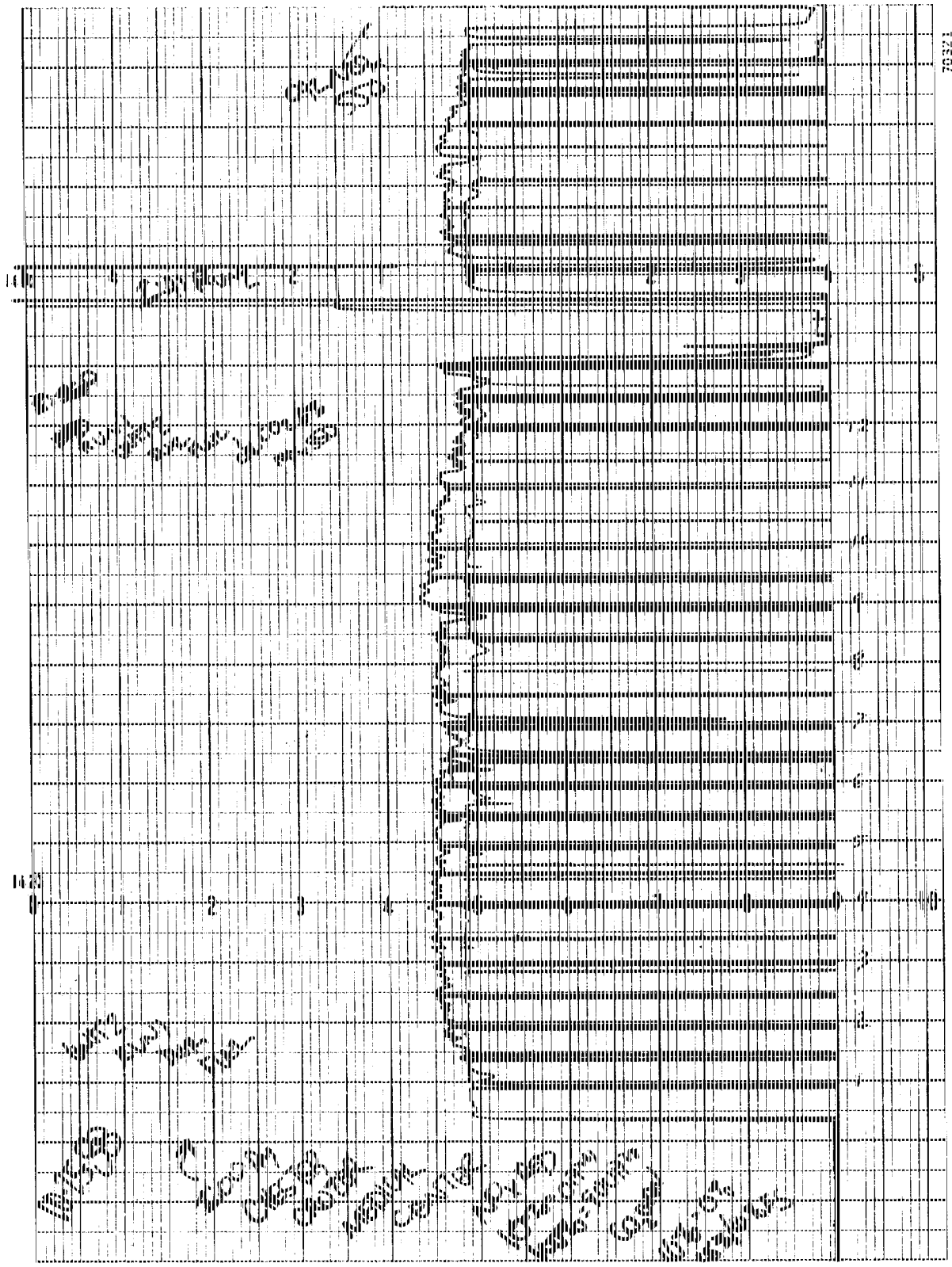
*OCTOBER 25, 1988

COGENERATION PARTNERS OF AMERICA
Testing at:
CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 24, 1988
Unit 1

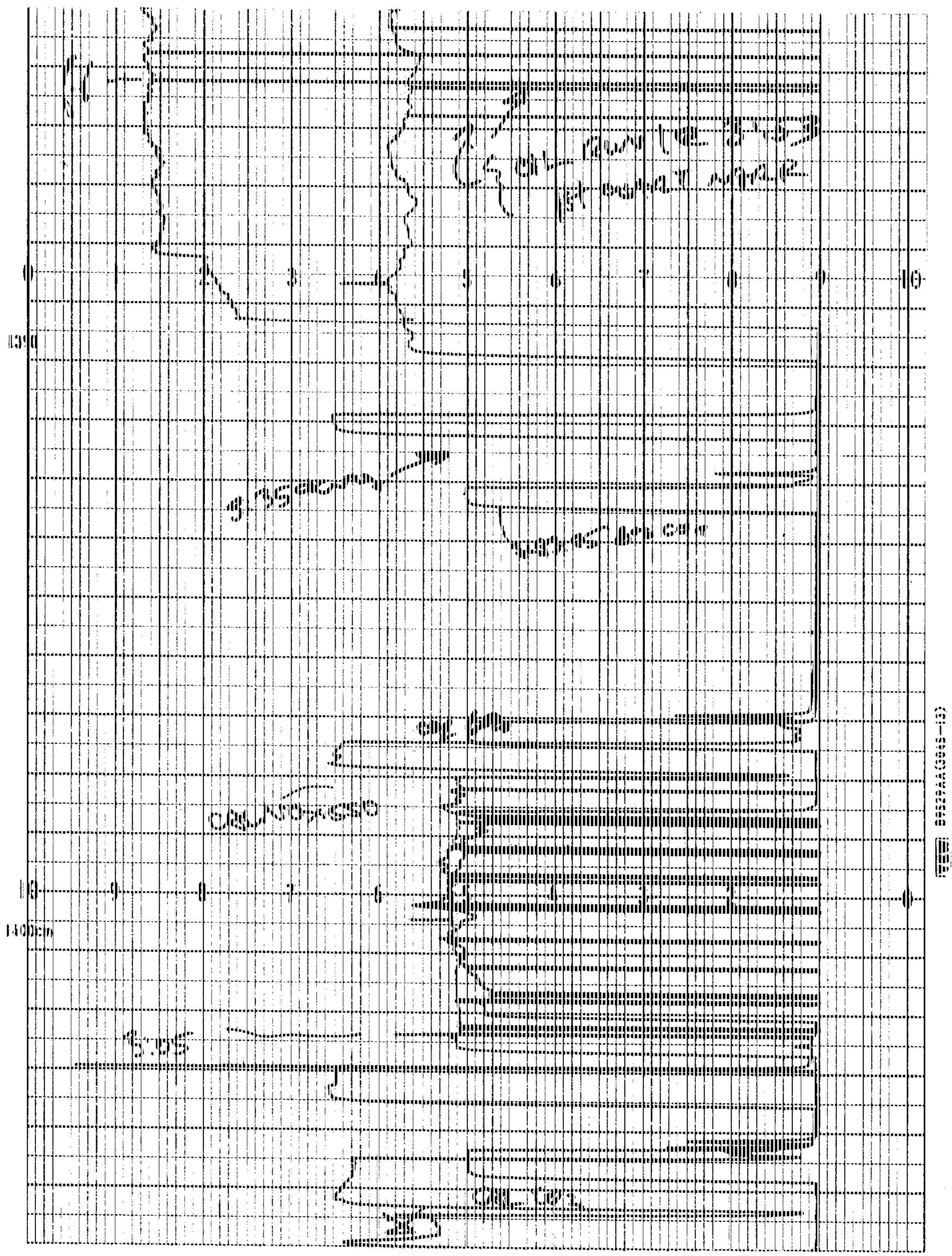


OCTOBER 25, 1988

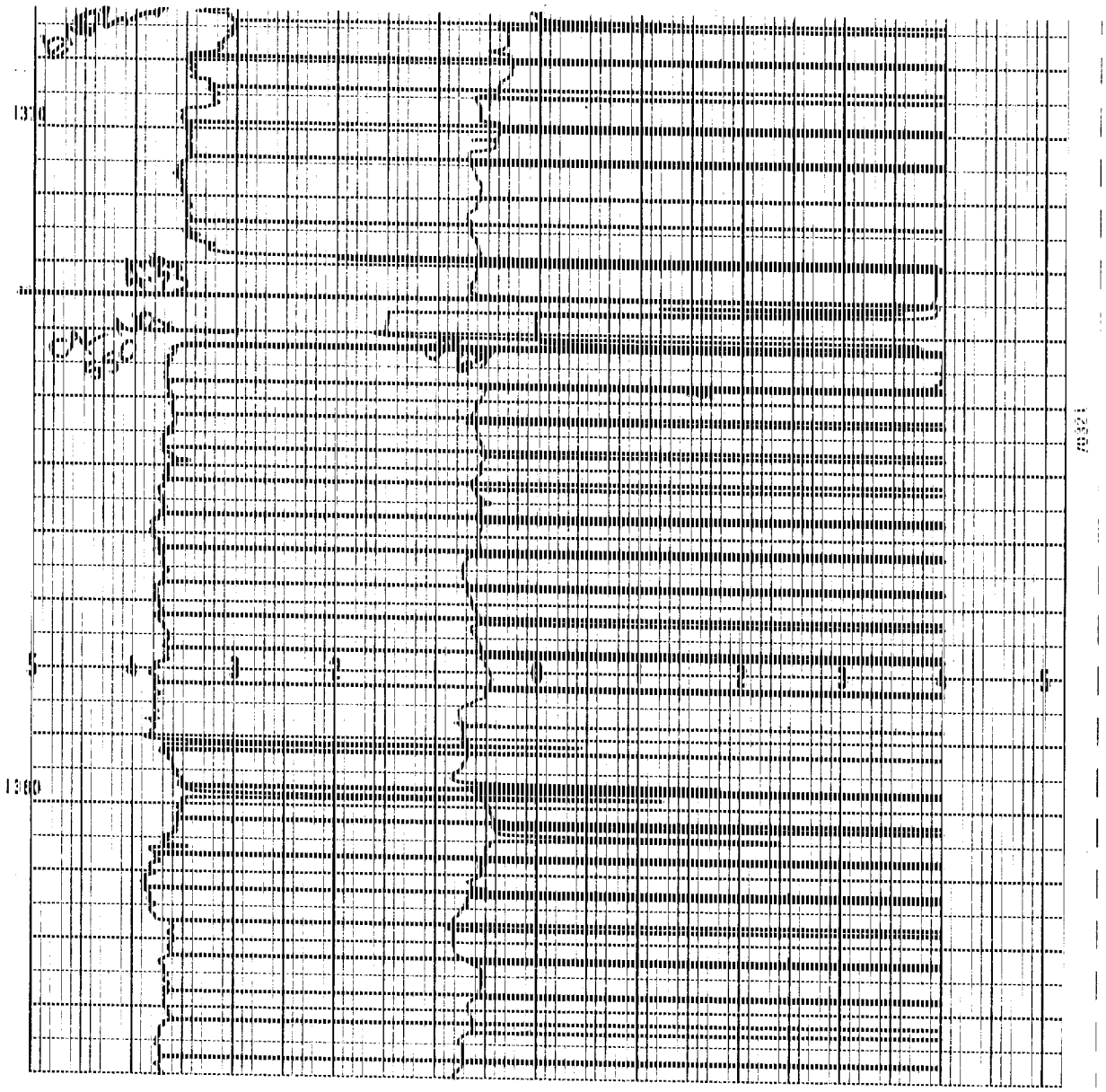
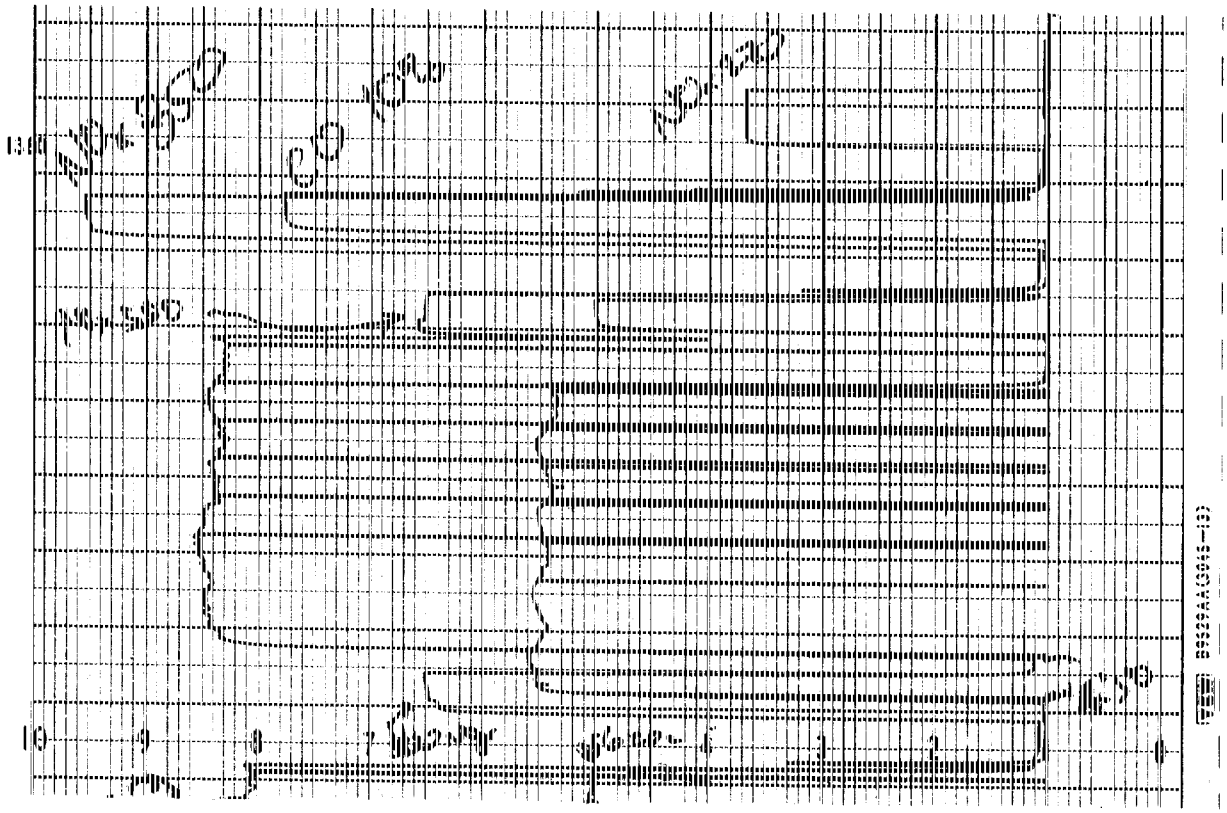
COGENERATION PARTNERS OF AMERICA
Testing at
CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 25, 1988
Unit 2



COGENERATION PARTNERS OF AMERICA
Testing at
CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 25, 1988
Unit 2



COGENERATION PARTNERS OF AMERICA
Testing at
CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 25, 1988
Unit 2



COGENERATION PARTNERS OF AMERICA
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CROZER-CHESTER MEDICAL CENTER RECIPROCATING ENGINES
NOx (red) and CO2 (green) Emissions
October 25, 1988
Unit 2