R-276

R-48-02-0-002H

FINAL

EMISSIONS COMPLIANCE TESTING ON COMPRESSOR ENGINE NO. C301B

AT

GSF ENERGY, INC.

McCARTY ROAD PLANT

JANUARY 17, 1990

PREPARED BY

NUS CORPORATION

FEBRUARY 1990

NUS PROJECT NUMBER 9$89

NUS CORPORATION

A Halliburton Company

GSF Energy Inc.
5455 Garden Grove Blvd.
Suite 355
Westminster, California
92683

Wen L. Kuo, Ph.D.
Environmental Engineering
(714) 373-3016

February 14, 1990

Texas Air Control Board
5555 West Loop, Suite 300
Bel Aire, Texas 71401

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FEB 22 1990
REGION 7
TEXAS AIR CONTROL BOARD

Attention: Mr. Don Holloway

Re: Permit C-9635
Landfill Gas Recovery Facility
Houston, Harris County

Dear Mr. Holloway:

Attached is GSF Energy Inc.'s McCarty Road Landfill Gas Recovery Facility Stack Test Report as required by the Texas Air Control Board Permit C-9135. The report summarizes engine exhaust emissions data from IC Engine C-301B as performed by NUS on January 17, 1990.

The maximum allowable emission rate of NOx in the exhaust of Ingersoll-Rand KVGR gas-fired compressor engine C-301B is found to be 3.08 grams/hp-hr with an average of 2.80 grams/hp-hr, meeting the special provisions 3A of subject Permit C-9635. However, the catalytic performance of the NOx converter is only averaged 9.83% and falls below the required 60% reduction efficiency.

As you will recall, GSF installed these new Engelhard NOx catalytic converters on both IR engines on 4-19-89 at a cost of in excess of $40,000. Subsequent retesting of the same engine on 4-26-89 indicated a 83% NOx reduction efficiency for the new catalytic converters. However in a short time span of nine months from 4-19-89 to 1-17-90, the performance of these platinum-based catalyst has deteriorated rather drastically down to 9.83%. This suggests that the exhaust gas from IC engines using landfill gas as fuel is particularly harmful and detrimental to the performance of the NOx reduction catalysts.

GSF has brought these facts to the attention of your Mr. Robert Todd, the responsible permit engineer, at TACB Headquarters in Austin, Texas and has submitted a request for permit amendment on February 14, 1990, to remove the 60% NOx reduction requirement of the catalytic converters in Special Provisions 3C.

Since these IR compressor engines are already producing NOx emission below the allowable emission limit of 5 grams/hp-hr at McCarty Road Plant with the disabled catalytic converters, it is requested that you withhold issuance of permit violation pending the resolution of our application for permit amendment. Your cooperation is greatly appreciated.

If you have any questions with regard to the test report, please contact me at 714 373-3016.

Sincerely,

Wen L. Kuo

Wen L. Kuo, Ph.D.
Environmental Engineering

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Attachment

cc: M. Kapitan
R. A. McCarty
G. P. Wilkinson

hollowaywlk/nk

NUS CORPORATION
16360 PARK TEN PLACE, SUITE 300
HOUSTON, TEXAS 77084
713-492-1888

R-48-02-0-002H

FINAL

EMISSIONS COMPLIANCE TESTING

COMPRESSOR ENGINE NO. C301B

AT

GSF ENERGY, INC.

McCARTY ROAD PLANT

JANUARY 17, 1990

BY

NUS CORPORATION

NUS PROJECT NUMBER 9$89

FEBRUARY 1990

SUBMITTED FOR NUS BY:

DUANE PIERCE, Ph.D.
PROJECT CONSULTANT

REVIEWED AND APPROVED BY:

WILLIAM J. COLE, P.E.
TECHNICAL DIRECTOR

QA REPRESENTATIVE APPROVAL:

PATRICIA M. SCHELINE
QA MANAGER

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Company Name GSF Energy TACB Account No. H6-1399-S

City Houston County Harris TACB Region 7

Testing required by: Texas Air Control Board (TACB) Permit # C-9635

TACB Permit No. C-9635 PSD Permit No. N/A NSPS Subpart N/A

(INCLUDE A COPY OF PERMIT SPECIAL PROVISIONS)

Source Tested Compressor No. C301B Exhaust TACB E. I. Point No. 6 B

Stack Height 30 feet Stack Diameter 14" inches

Sampling Ports Location:

Downstream Distance to Obstruction 5.1 Upstream Distance to Obstruction 1.0

Checked for cyclonic flow? X Yes ___ No Cyclonic Flow Present? ___ Yes X No

(INCLUDE A DRAWING OF STACK SHOWING SAMPLING PORTS AND MEASUREMENTS)

Design Operating Rate 1100 Horsepower Maximum Operating Rate 1100 Horsepower

Normal Operating Rate 1100 Horsepower Operating Schedule Continuous

TACB Test Observer None

I.

Pollutant Sampled: Oxides of Nitrogen (NO & NO_2)

	Run No. 1	Run No. 2	Run No. 3	Run No. 4	Results
Date Sampled	1/17/90	1/17/90	1/17/90		
Time					
No. of Points Sampled	1	1	1		
Operating/Feed Rate (hp)	1100	1100	1100		1100
% Operating Rate (Maximum)	100%	100%	100%		100%
Stack Temperature (°F)	990	992	994		992
Stack Flow Rate (DSCFM)	1007	1011	1005		1008
Percent Moisture	19.4	18.7	18.5		18.9
Percent Oxygen	0.9	0.7	0.7		0.8
Percent Carbon Dioxide	10.9	10.9	11.0		10.9
Percent Isokinetic	N/A	N/A	N/A		N/A
Excess Air					
Pollutant Concentration	1591	1457	1286		1445
Mass Emission Rate (gm/hp-hr)	3.08	2.84	2.49		2.80
Emissions (NSPS Units)					
TACB Permit Allowable Rate (gm/hp-hr)	5.0	5.0	5.0		5.0
NSPS Allowable Emissions					
Regulation Allowable Rate					
TACB Regulation No.					

	Date
Dry Gas Meter Calibrated	12/08/90
Pitot Tube Calibrated	12/08/90
Nozzle Calibrated	N/A

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1.0 INTRODUCTION

NUS Corporation, Houston, Texas, was contracted by GSF Energy, Inc.(GSF), Westminster, California, to perform emission testing at one gas-fired Ingersoll-Rand (IR) KVGR compressor engine located at the GSF Energy McCarty Road Plant at 9416 Ley Road in Houston, Texas. The objective of the testing was to determine the efficiency of the catalytic convertor for NO_X removal and to quantify the NO_X mass emissions rate from the engine exhaust stack in terms of grams per horsepower- hour (g/HP-hr). This was done in order to demonstrate compliance with special provisions to Texas Air Control Board (TACB) Permit No. C-9635.

Prior to sampling, the protocol outlining the proposed sampling and analytical methods was discussed by NUS and the Texas Air Control Board (TACB) at GSF's facilities. In attendance at the pre-test meeting were Mr. Don Holloway (TACB), Stuart Smith (NUS), and Morry Kapitan (GSF). This sampling protocol was strictly followed during the actual sampling event.

The sampling and analyses were conducted on the stack of Compressor Engine No. C301B on January 17, 1990. The test was conducted in order to demonstrate compliance with Special Provision Number 3 of Texas Air Control Board (TACB) Permit No. C-9635. The articles of Special Provision No. 3 to the TACB permit which pertains to these tests, specify that when the performance of the catalytic convertor fails to achieve the emission limit of 5 g/HP-hr, the catalyst shall be cleaned, or replaced, as necessary. In addition, the catalytic convertor is required to demonstrate a minimum of 60 percent conversion efficiency.

2.0 SUMMARY OF RESULTS

Table 2-1, Inlet to Catalytic Converter, and Table 2-2, Outlet to Catalytic Convertor, summarize the analytical results for each of the three test runs. Additional compressor engine operational data is tabulated in Table 2-3. The test results indicate the compressor exhaust emissions are below the 5 grams/horsepower-hour compliance limit, but the catalytic convertor efficiency failed to meet the 60% destruction level as specified in the permit.

TABLE 2-1

GSF ENERGY, INC.
EMISSIONS SUMMARY DATA
INLET TO CATALYTIC CONVERTOR

Test Series/ Condition	Time	ORSAT DATA			ANALYZER DATA		NO_x (g/HP-hr)
		CO_2 %	O_2 %	CO %	CO (ppm)	NOx (ppm)	
1	1040 - 1140	10.9	0.9	0.8	6650	1780	3.45
2	1200 - 1300	11.0	0.7	1.0	9270	1623	3.16
3	1320 - 1420	11.0	0.6	1.2	off-scale	1408	2.73

TABLE 2-2

GSF ENERGY, INC.
HOURLY AVERAGE EMISSIONS FROM ENGINE C301B
JANUARY 17, 1990
OUTLET TO CATALYTIC CONVERTOR

Test Number	Time	ORSAT DATA			ANALYZER DATA		NOx (g/HP-hr)	Catalyst Efficiency %
		CO_2 %	O_2 %	CO %	CO (ppm)	NO_x (ppm)		
1	1040 - 1140	10.9	0.9	0.8	6650	1591	3.08	10.6
2	1200 - 1300	10.9	0.7	1.0	9180	1457	2.84	10.2
3	1320 - 1420	11.0	0.7	1.2	off-scale	1286	2.49	8.7

TABLE 2-3

GSF ENERGY, INC.
COMPRESSOR ENGINE OPERATIONAL DATA

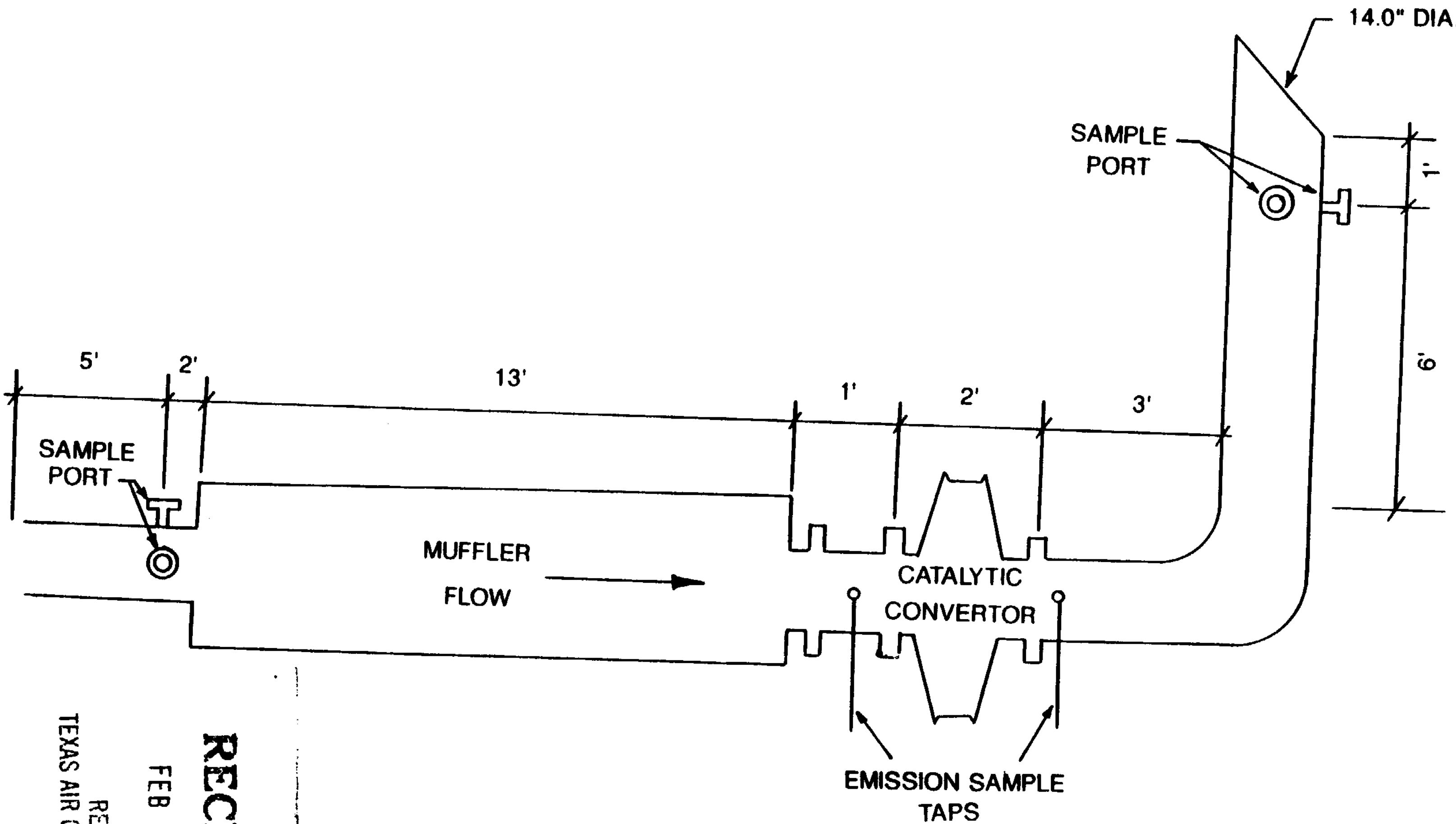
Time	Intake Manifold Pressure (in Hg)	Intake Manifold Temperature (°F)	Fuel Header Pressure (in H_2O)	Engine Speed (rpm)	Ignition Timing*
10:30	-3.9	82	6.5	332	19
11:00	-3.9	83	6.5	333	19
11:30	-3.9	81	6.5	333	20
12:00	-3.9	83	6.5	333	19
12:30	-3.9	84	6.5	333	19
13:00	-4.3	82	6.5	332	20
13:30	-4.3	82	6.5	334	19
14:00	-4.3	83	6.5	333	19
14:30	-4.3	83	6.5	333	19

* Degrees before top dead center

3.0 SAMPLING LOCATIONS

Inlet and outlet flue gas samples were taken from a 1/4 inch stainless steel sample tap located immediately before and after the catalytic convertor. The two sample lines were then routed to a two-way valve that was periodically switched so that discrete inlet/outlet samples could be routed to the mobile emissions laboratory for analysis (see Figure 3-1).

Stack gas volumetric flow rate determinations were performed at the two 3-inch sample ports spaced 90° apart on the stack from the compressor exhaust. The sample ports were 5.1 stack diameters downstream and 1.0 diameters upstream from the nearest point of flow disturbance. A total of eight sample points on each axis were used to determine flow measurements in accordance with CFR 40 Part 60 Appendix A, Method 1. The inlet 3-inch sample ports, which were located upstream of the muffler, proved to be unsuitable for stack gas velocity determinations because of extreme turbulence in the duct.



DRAWN BY	J. JOHNSON
DATE	FEB. 1990
ENGINEER	S. SMITH
DATE	FEB. 1990
CAD DWG. NO.	

GSF ENERGY
COMPRESSOR ENGINE
EXHAUST SCHEMATIC

SCALE: NTS | NUS DWG. NO. | REV.

NUS CORPORATION
HOUSTON

4.0 SAMPLING AND ANALYTICAL PROCEDURES

The specific sampling and analytical procedures used in this testing event are described in the following sections. Appendix A contains the field data sheets, Appendix B contains the calculations and Appendix C contains the calibration data.

4.1 STACK FLOW DETERMINATIONS

Stack flow, temperature and moisture was determined in accordance with 40 CFR 60 Appendix A, Methods 1-4. A Method 4 sample train was used to collect moisture samples. Flow, temperature and moisture determinations were made over three one-hour sample periods concurrently with CO and NO_X monitoring at the incinerator exhaust and inlet sample locations.

4.2 CARBON MONOXIDE (CO) DETERMINATIONS

Carbon monoxide analysis at both the inlet and outlet to the catalytic convertor were performed utilizing EPA Method 10 sampling protocol. A two-way valve was installed on the sample line so that both the inlet and outlet gases could be analyzed from one sample line extending down from the exhaust flue duct. The sample gases were then directed to a Horiba NDIR CO analyzer and the output was recorded on a dual channel strip chart. During each one-hour sample period, the excess flue gas sample was captured in a Tedlar bag for subsequent Orsat Analysis. This procedure was utilized for both the inlet and outlet gas samples. National Bureau of Standards (NBS) traceable calibration gases were used for both pre-test and post-test calibration procedures.

4.3 OXIDES OF NITROGEN (NO_X) DETERMINATIONS

Oxides of nitrogen analysis at both the inlet and outlet to the catalytic convertor were performed utilizing EPA Method 7E sampling protocol. The same sample delivery system described above was used to provide flue gas samples to a Thermo Electron Chemiluminescence NO_X Analyzer. The results were also recorded on the dual channel recorder. NBS traceable calibration gases were used in the pre-test and post-test calibration procedures.

4.4 COMPRESSOR ENGINE OPERATIONAL DATA

Concurrently with each sample run, flue gas volumetric flow rate determinations were performed in accordance with EPA/TACB protocol. In conjunction with the overall test program, process operational data was recorded. Intake manifold pressure, intake manifold temperature, fuel header pressure, engine speed (rpm), and ignition timing were recorded every 30 minutes by GSF personnel (see Table 2-3). A volumetric flow rate determination was attempted at the inlet to the muffler, but the violent pulsating effect of the compressor exhaust precluded any relevant data from being gathered.

5.0 NUS' APPROACH TO QUALITY ASSURANCE

It is the policy of NUS Corporation, Environmental Management Group, Emissions Sampling Department, to perform all field sampling work, laboratory analyses, data reduction, and record storage in accordance with corporate and divisional quality assurance programs. Listed below are some of the areas in which procedures are provided:

- Preparation and distribution of work instructions.
- Control of purchased items and services.
- Control of measuring and test equipment.
- Documenting chain-of-custody.
- Storage and retrieval of quality assurance records.
- Review of all calculations.

The implementation of these quality assurance procedures insures that all work performed will conform to and support a high level of quality. NUS maintains complete quality assurance records on file. Appendix D contains the resumes of the NUS personnel directly involved in this project.

APPENDIX A

FIELD DATA

NUS CORPORATION
A Halliburton Company

SOURCE SAMPLING FIELD DATA

Prepared by: SS/ML
Checked by: ______
Date: 1/17/90

PLANT GSF Energy — STACK Compressor Engine Exhaust

DATE 1/17/90 — OPER. SS + ML — RUN NO. 1 — STACK HEIGHT 35'

STACK DIA. (exit) 14" — STACK DIA. (port) 14" — STACK PRESS."H_2O +0.3 — BAR.PRESS."Hg 30.03

PROBE NO. — — PTCF 0.848 — DGMCF 0.988 — NOZZLE NO. N/A

NOZZLE AREA — — FILTER NO. — — SILICA GEL NO. 1 — PUMP LEAK RATE —

METER NO. SGI 3 — ΔH @ 1.86 — BOX NO. ______ — UNIT LEAK RATE 0.000

PROCESS DATA yes — ASSUM. MOIST. — — NOM. REF. PT. — — PROBE LINER SS

PT	Mins. Clock Time	Ft³ Dry Gas Meter Reading	In. H_2O ΔP	In. H_2O ΔH	°F Probe Temp.	Dry Gas Meter Temp. °F Inlet	Dry Gas Meter Temp. °F Outlet	In.Hg Gauge Line Vacuum	Temp. °F Box	Temp. °F Ts Stack	Temp. °F Last Imp.	√ΔP
8	10:40	560.11	.25	1.5		82	76	4		981		
7	10:50		.28	1.5		83	77	4		986		
6	11:00		.30	1.5		83	77	4		990		
5	11:10		.32	1.5		84	76	4		993		
4	11:20		.32	1.5		84	78	4		989		
3	11:30		.33	1.5		82	78	4		995		
2	11:40		.33	1.5		82	78	4		997		
1		599.71	.31							986		
8			0.26							987		
7			0.29							986		
6			0.29							983		
5			0.31							991		
4			0.32							995		
3			0.34							997		
2			0.35							996		
1			0.33							992		

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SAMPLE TIME	NET VOL.	AVG ΔH	AVG METER TEMP	AVG STACK TEMP. °F	AVG √ΔP
	39.6	1.5	80.0	990.3	0.5545

NUS CORPORATION
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SOURCE SAMPLING FIELD DATA

Prepared by: SS
Checked by: ______
Date: 1/17/90

PLANT GSF Energy STACK F.R. Compressor Engine Exhaust
DATE 1/17/90 OPER. SS & ML RUN NO. 2 STACK HEIGHT 35'
STACK DIA.(exit) 14" STACK DIA.(port) 14" STACK PRESS."H_2O +0.3 BAR.PRESS."Hg 30.03
PROBE NO. — PTCF 0.848 DGMCF 0.985 NOZZLE NO. N/A
NOZZLE AREA — FILTER NO. — SILICA GEL NO. 2 PUMP LEAK RATE 0.001
METER NO. 3GI-3 ΔH @ 1.86 BOX NO. — UNIT LEAK RATE 0.000
PROCESS DATA ______ ASSUM. MOIST. — NOM. REF. PT. — PROBE LINER ______

PT	Mins. Clock Time	Ft3 Dry Gas Meter Reading	In. H_2O ΔP	In. H_2O ΔH	°F Probe Temp.	Dry Gas Meter Temp. °F Inlet	Dry Gas Meter Temp. °F Outlet	In.Hg Gauge Line Vacuum	Temp. °F Box	Temp. °F Ts Stack	Temp. °F Last Imp.	√ΔP
8	12:00	660.000	0.25	1.4		80	78			990		
7	12:10		0.27			81	79			986		
6	12:20		0.29			80	79			993		
5	12:30		0.33			81	78			991		
4	12:40	63	0.33			82	80			997		
3	12:50		0.33			82	80			996		
2	13:00	695.200	0.32			82	80			987		
1			0.30							991		
8			0.26							993		
7			0.28							982		
6			0.29							991		
5			0.31							990		
4			0.33							997		
3			0.35							999		
2			0.35							989		
1			0.32							996		

SAMPLE TIME	NET VOL.	AVG ΔH	AVG METER TEMP	AVG STACK TEMP.°F	AVG √ΔP
	35.2	1.40	80.1	991.8	0.5533

240 .. 225.4

NUS CORPORATION
A Halliburton Company

SOURCE SAMPLING FIELD DATA

Prepared by: SS
Checked by: ______
Date: 1/17/90

PLANT GSF Energy		STACK I.K. Compressor Engine Exhaust	
DATE 1/10/90	OPER. SS & M.L	RUN NO. 3	STACK HEIGHT 35'
STACK DIA. (exit) 14"	STACK DIA. (port) 14"	STACK PRESS. "H_2O 0.3	BAR. PRESS. "Hg 30.03
PROBE NO. ______	PTCF 0.848	DGMCF 0.988	NOZZLE NO. —
NOZZLE AREA —	FILTER NO. —	SILICA GEL NO. 3	PUMP LEAK RATE 0.000
METER NO. 36E-3	ΔH @ 1.86	BOX NO. —	UNIT LEAK RATE —
PROCESS DATA —	ASSUM. MOIST. —	NOM. REF. PT. —	PROBE LINER —

PT	Mins. Clock Time	Ft³ Dry Gas Meter Reading	In. H_2O ΔP	In. H_2O ΔH	°F Probe Temp.	Dry Gas Meter Temp. °F Inlet	Dry Gas Meter Temp. °F Outlet	In. Hg Gauge Line Vacuum	Temp. °F Box	Temp. °F Ts Stack	Temp. °F Last Imp.	$\sqrt{\Delta P}$
8	1320	635.30	0.24	1.2		81	78	4		987		
7	1330		0.27	1.2		80	78	4		983		
6	1340		0.31	1.2		81	79	4		991		
5	1350		0.32	1.2		82	78	4		998		
4	1400		0.33	1.2		81	79	4		999		
3	1410		0.32	1.2		81	79	4		986		
2	1420	665.80	0.29	1.2		81	79	4		990		
1			0.30							993		
8			0.26							1003		
7			0.28							1001		
6			0.31							1005		
5			0.32							995		
4			0.33							994		
3			0.35							991		
2			0.31							990		
1			0.29							1001		

SAMPLE TIME	NET VOL.	AVG ΔH	AVG METER TEMP	AVG STACK TEMP. °F	AVG $\sqrt{\Delta P}$
	30.50	1.20	79.8	994.2	0.5494

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A Halliburton Company

EPA-SOURCE SAMPLING
ANALYTICAL DATA

Prepared by: ______
Date: ______

PLANT GSF Energy SOURCE I.R. Compressor
CITY Houston
BOX ______ RUN NO. 1 DATE 1/17/90

PARTICULATES: Filter No. N/A
Wt. Filter - Final "
Wt. Filter - Tare "
Net Increase "

Silica Gel No. See Below
Final Weight "
Initial Weight "
Net Increase (TS) " g

Impinger Catch
Wt. - Final N/A
Wt. - Tare "
Net Increase "

Probe Wash Particulate
Wt. - Final N/A
Wt. - Tare "
Net Increase "

Weight Total Particulate (GPC) ______ g.

MOISTURE:

	Flask 1	Flask 2	Flask 3	Flask 4	Flask 5	Flask 6
Container ID	H_2O	H_2O	Dry	S.G		
Final Volume	827.6	742.3	0.0	697.5		
Initial Volume	690.0	698.5	0.0	681.9		
Net Increase	137.6	43.8	0.0	15.6		

Total Water Collected (TWW) 197.0 ml

$$\% \text{ MOISTURE} = \frac{(0.04707 \times TWW) \times 100}{Vm\ (Std) + (0.04707 \times TWW)} = 19.3$$

ORSAT:

Time ______

				Avg.
CO_2				
O_2				
CO				

Convert to ml by dividing by the density of water (1 g/ml)

MOLECULAR WEIGHT: (MWSG) g/mole

H_2O - .193 x 18 = 3.474
CO_2 - .807 x .10 x 44 = 3.5508
O_2 - .807 x .005 x 32 = 0.1291
CO - .807 x .895 x 28 =
N_2 - .807 x .895 x 28 = 20.2234
27.377

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A Halliburton Company

EPA-SOURCE SAMPLING
ANALYTICAL DATA

Prepared by: SS
Date: 1/17/90

PLANT GSF Energy SOURCE I-R Compressor Engine Exhaust
CITY Houston
BOX ______ RUN NO. 2 DATE 1/17/90

PARTICULATES: Filter No. N/A
Wt. Filter - Final "
Wt. Filter - Tare "
Net Increase "

Silica Gel No. See Below
Final Weight "
Initial Weight "
Net Increase (TS) " g

Impinger Catch
Wt. - Final N/A
Wt. - Tare "
Net Increase "

Probe Wash Particulate
Wt. - Final N/A
Wt. - Tare "
Net Increase "

Weight Total Particulate (GPC) N/A g.

MOISTURE:

	Flask 1	Flask 2	Flask 3	Flask 4	Flask 5	Flask 6
Container ID	H_2O	H_2O		S. G.		
Final Volume	751.7	725.9		697.2		
Initial Volume	678.4	641.7		687.5		
Net Increase						

Total Water Collected (TWW) 167.2 ml

$$\% \text{ MOISTURE} = \frac{(0.04707 \times TWW) \times 100}{Vm\ (Std) + (0.04707 \times TWW)} =$$

ORSAT:

Time ______

				Avg.
CO_2				
O_2				
CO				

Convert to ml by dividing by the density of water (1 g/ml)

MOLECULAR WEIGHT: (MWSG) g/mole

H_2O -	x 18		=
CO_2 -	x	x 44	=
O_2 -	x	x 32	=
CO -	x	x 28	=
N_2 -	x	x 28	=

NUS CORPORATION
A Halliburton Company

EPA-SOURCE SAMPLING
ANALYTICAL DATA

Prepared by: S.S.
Date: 1/17/90

PLANT GSF Energy SOURCE I.R. Compressor Engine Exhaust
CITY Houston
BOX RUN NO. 3 DATE 1/17/90

PARTICULATES: Filter No. N/A

Wt. Filter - Final "
Wt. Filter - Tare "
Net Increase "

Silica Gel No. See Below
Final Weight "
Initial Weight "
Net Increase (TS) " g

Impinger Catch
Wt. - Final N/A
Wt. - Tare "
Net Increase "

Probe Wash Particulate
Wt. - Final N/A
Wt. - Tare "
Net Increase "

Weight Total Particulate (GPC) N/A g.

MOISTURE:	Flask 1	Flask 2	Flask 3	Flask 4	Flask 5	Flask 6
Container ID	H_2O	H_2O		S. G.		
Final Volume	780.5	684.3		678.8		
Initial Volume	669.2	663.3		668.4		
Net Increase						

Total Water Collected (TWW) 142.7 ml

$$\% \text{ MOISTURE} = \frac{(0.04707 \times TWW) \times 100}{Vm\ (Std) + (0.04707 \times TWW)} =$$

ORSAT:

Time ______

				Avg.
CO_2				
O_2				
CO				

Convert to ml by dividing by
the density of water (1 g/ml)

MOLECULAR WEIGHT: (MWSG) g/mole

H_2O -	x 18		=
CO_2 -	x	x 44	=
O_2 -	x	x 32	=
CO -	x	x 28	=
N_2 -	x	x 28	=

NUS CORPORATION
A Halliburton Company

ORSAT FIELD DATA SHEET

GSF

Prepared by: MAL
Checked by: ______
Date: 01/17/90

Time ______
Run 1 Inlet — Sample A, Sample B, Sample C — F_o Factor ______ — Equip./Analyzer Ck.

%	Sample A	%	Sample A	%	Sample B	%	Sample B	%	Sample C	%	Sample C	%	Equip./Analyzer Ck.	%	Equip./Analyzer Ck.
CO_2	10.9	CO_2		CO_2	10.9	CO_2		CO_2	10.9	CO_2	0.9	CO_2		CO_2	
$CO_2 + O_2$	11.8	O_2	0.9	$CO_2 + O_2$	11.8	O_2	0.9	$CO_2 + O_2$	11.8	O_2	0.8	$CO_2 + O_2$		O_2	
$CO_2 + O_2 + CO$	12.6	CO	0.8	$CO_2 + O_2 + CO$	12.6	CO	0.8	$CO_2 + O_2 + CO$	12.6	CO	0.8				

Time ______
Run 1 Outlet — Sample A, Sample B, Sample C — F_o Factor ______ — Equip./Analyzer Ck.

%	Sample A	%	Sample A	%	Sample B	%	Sample B	%	Sample C	%	Sample C	%	Equip./Analyzer Ck.	%	Equip./Analyzer Ck.
CO_2	10.9	CO_2	10.9	CO_2	10.8	CO_2	10.8	CO_2	10.9	CO_2	10.9	CO_2		CO_2	
$CO_2 + O_2$	11.8	O_2	0.9	$CO_2 + O_2$	11.8	O_2	1.0	$CO_2 + O_2$	11.8	O_2	0.9	$CO_2 + O_2$		O_2	
$CO_2 + O_2 + CO$	12.5	CO	0.7	$CO_2 + O_2 + CO$	12.6	CO	0.8	$CO_2 + O_2 + CO$	12.6	CO	0.8				

Time ______
Run 2 Inlet — Sample A, Sample B, Sample C — F_o Factor ______ — Equip./Analyzer Ck.

%	Sample A	%	Sample A	%	Sample B	%	Sample B	%	Sample C	%	Sample C	%	Equip./Analyzer Ck.	%	Equip./Analyzer Ck.
CO_2	11.0	CO_2		CO_2	11.0	CO_2		CO_2	11.0	CO_2		CO_2		CO_2	
$CO_2 + O_2$	11.7	O_2	0.7	$CO_2 + O_2$	11.7	O_2	0.7	$CO_2 + O_2$	11.8	O_2	0.8	$CO_2 + O_2$		O_2	
$CO_2 + O_2 + CO$	12.7	CO	1.0	$CO_2 + O_2 + CO$	12.7	CO	1.0	$CO_2 + O_2 + CO$	12.7	CO	0.9				

Time ______
Run 2 Outlet — Sample A, Sample B, Sample C — F_o Factor ______ — Equip./Analyzer Ck.

%	Sample A	%	Sample A	%	Sample B	%	Sample B	%	Sample C	%	Sample C	%	Equip./Analyzer Ck.	%	Equip./Analyzer Ck.
CO_2	10.9	CO_2	10.9	CO_2	10.9	CO_2	10.9	CO_2	10.9	CO_2	10.9	CO_2		CO_2	
$CO_2 + O_2$	11.6	O_2	0.7	$CO_2 + O_2$	11.6	O_2	0.7	$CO_2 + O_2$	11.5	O_2	0.6	$CO_2 + O_2$		O_2	
$CO_2 + O_2 + CO$	12.6	CO	1.0	$CO_2 + O_2 + CO$	12.6	CO	1.0	$CO_2 + O_2 + CO$	12.5	CO	1.0				

$$F_o = \frac{20.9 - \%O_{2d}}{\%CO_{2d}}$$

*Fuel Type ______
F_o Given ±5 ______
O_2 Value 20.9 ± 0.3

NUS CORPORATION
A Halliburton Company

ORSAT FIELD DATA SHEET

GSF

Prepared by: MAL
Checked by: ____
Date: 01/17/90

Run 1

Time ____ Run: 3 Inlet

F_o Factor ____
Equip./Analyzer Ck.

Sample	% CO_2	% $CO_2 + O_2$	% $CO_2 + O_2 + CO$	% CO_2	% O_2	% CO
A	11.0	11.6	12.8		0.6	1.2
B	11.0	11.6	12.8		0.6	1.2
C	11.0	11.6	12.8		0.6	1.2

	%
CO_2	
$CO_2 + O_2$	
CO_2	
O_2	

Run 2

Time ____ Run: 3 Outlet

F_o Factor ____
Equip./Analyzer Ck.

Sample	% CO_2	% $CO_2 + O_2$	% $CO_2 + O_2 + CO$	% CO_2	% O_2	% CO
A	11.0	11.7	12.9	11.0	0.7	1.2
B	11.0	11.6	12.8	11.0	0.6	1.2
C	11.0	11.7	12.9	11.0	0.7	1.2

	%
CO_2	
$CO_2 + O_2$	
CO_2	
O_2	

Run 3

Time ____ Run ____

F_o Factor ____
Equip./Analyzer Ck.

Sample	% CO_2	% $CO_2 + O_2$	% $CO_2 + O_2 + CO$	% CO_2	% O_2	% CO
____						
____						
____						

	%
CO_2	
$CO_2 + O_2$	
CO_2	
O_2	

Run 4

Time ____ Run ____

F_o Factor ____
Equip./Analyzer Ck.

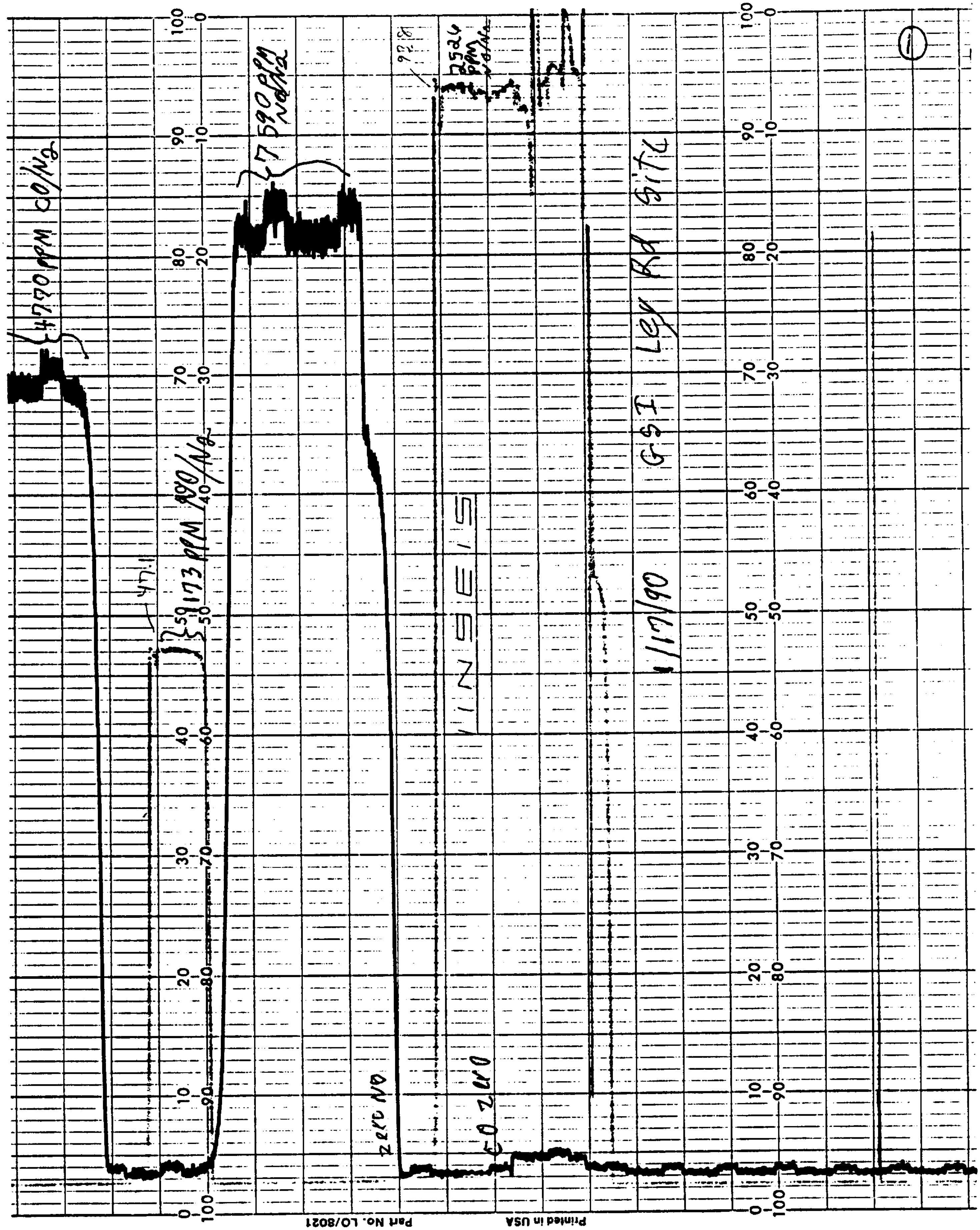
Sample	% CO_2	% $CO_2 + O_2$	% $CO_2 + O_2 + CO$	% CO_2	% O_2	% CO
____						
____						
____						

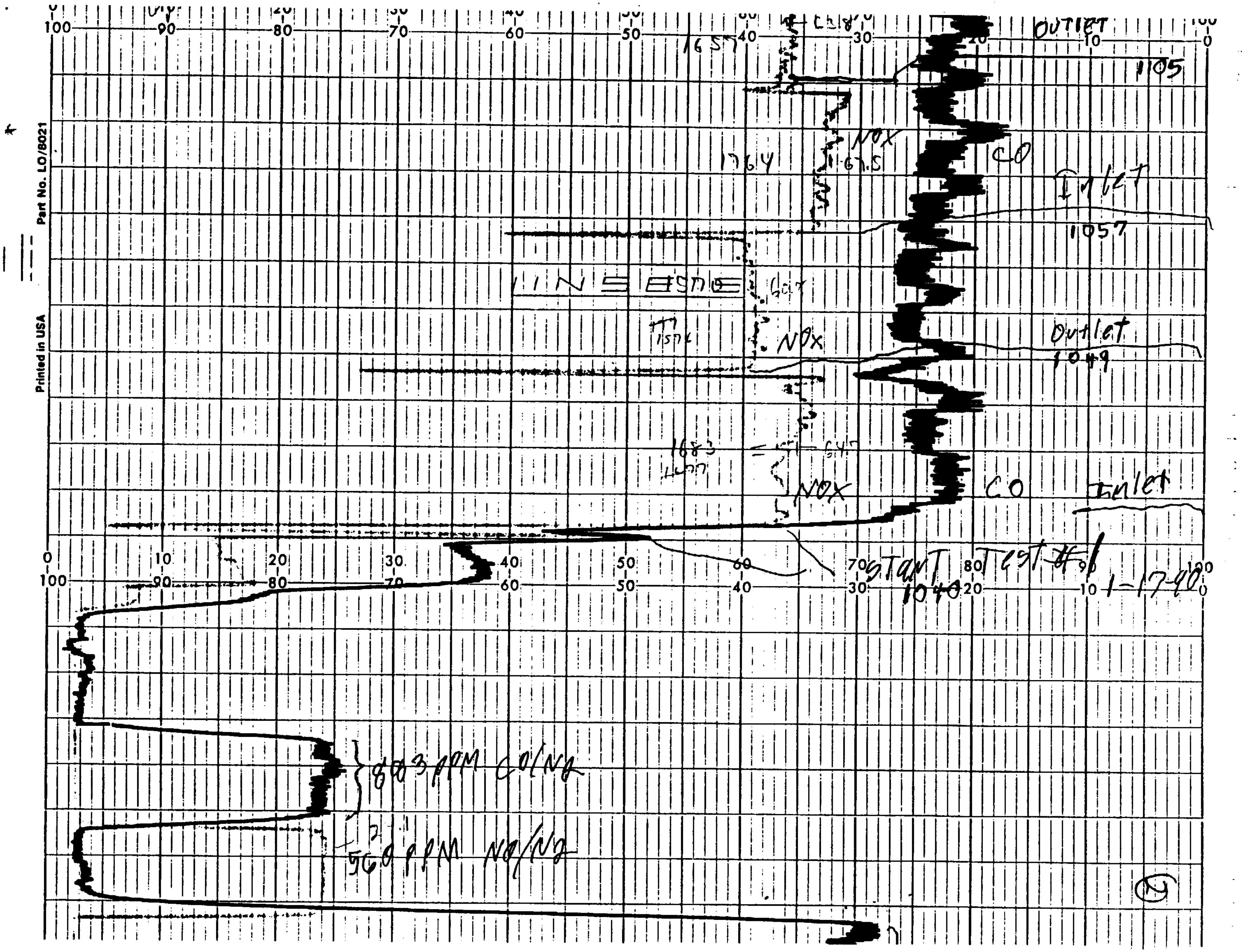
	%
CO_2	
$CO_2 + O_2$	
CO_2	
O_2	

$$F_o = \frac{20.9 - \%O_{2d}}{\%CO_{2d}}$$

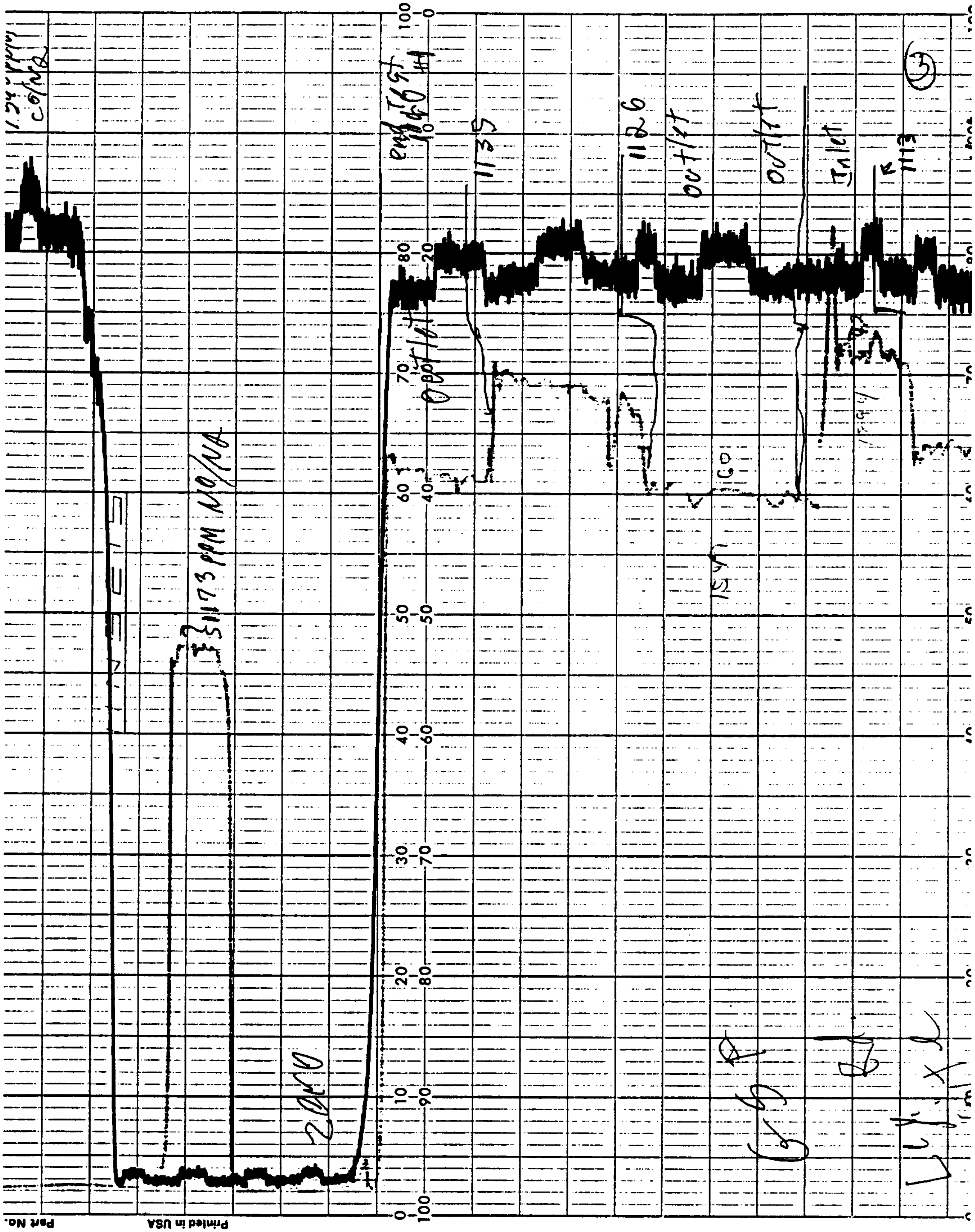
*Fuel Type ____
F_o Given ±5 ____
O_2 Value 20.9 ± 0.3

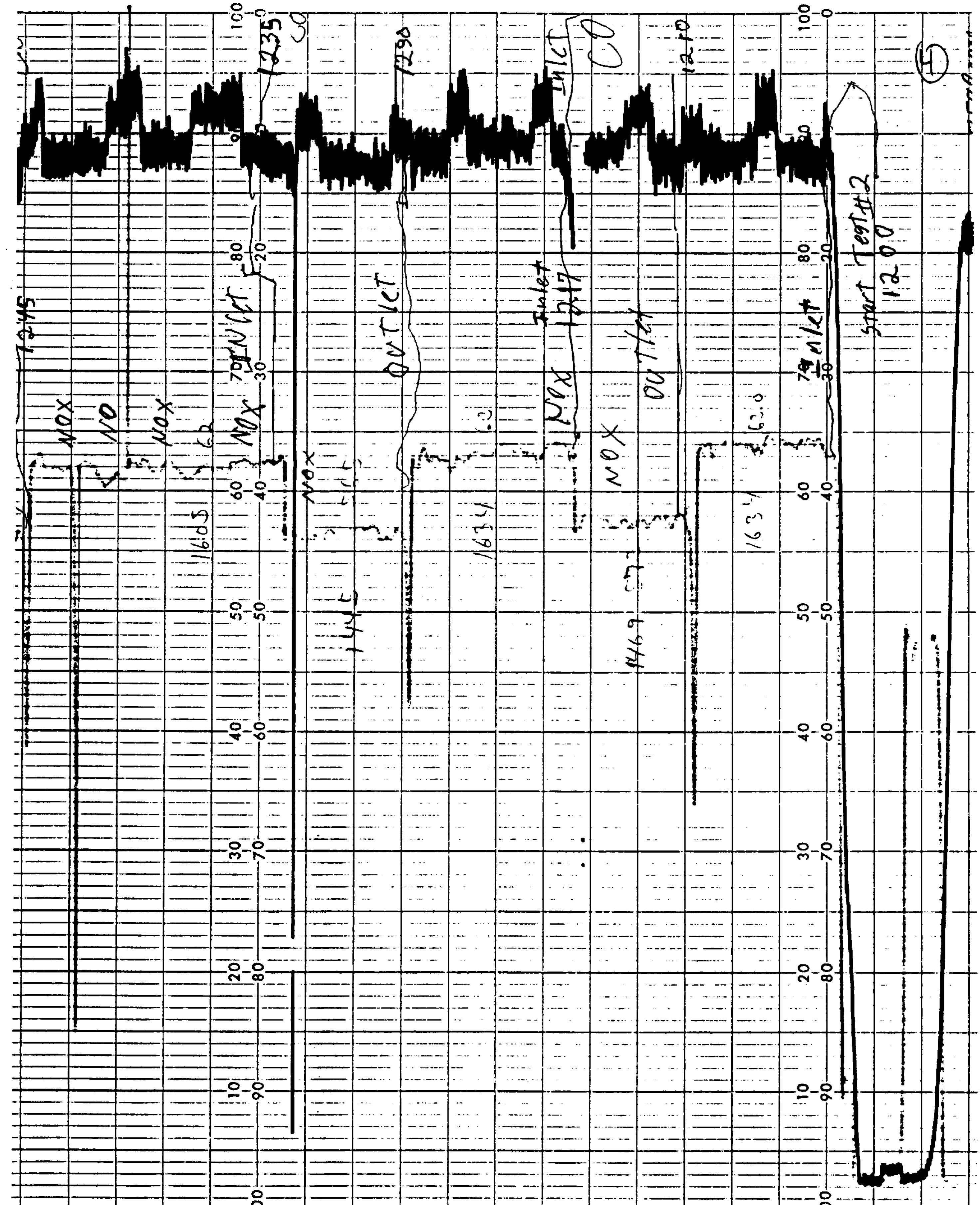
INSTRUMENT STRIP CHART RECORDINGS


4770 PPM CO/N2
7590 PPM NO/N2
173 PPM NO/N2
zero NO
CO zero
7526 PPM
GSI Ley Rd Site
1/17/90
LINSEIS
Part No. LO/8021
Printed in USA



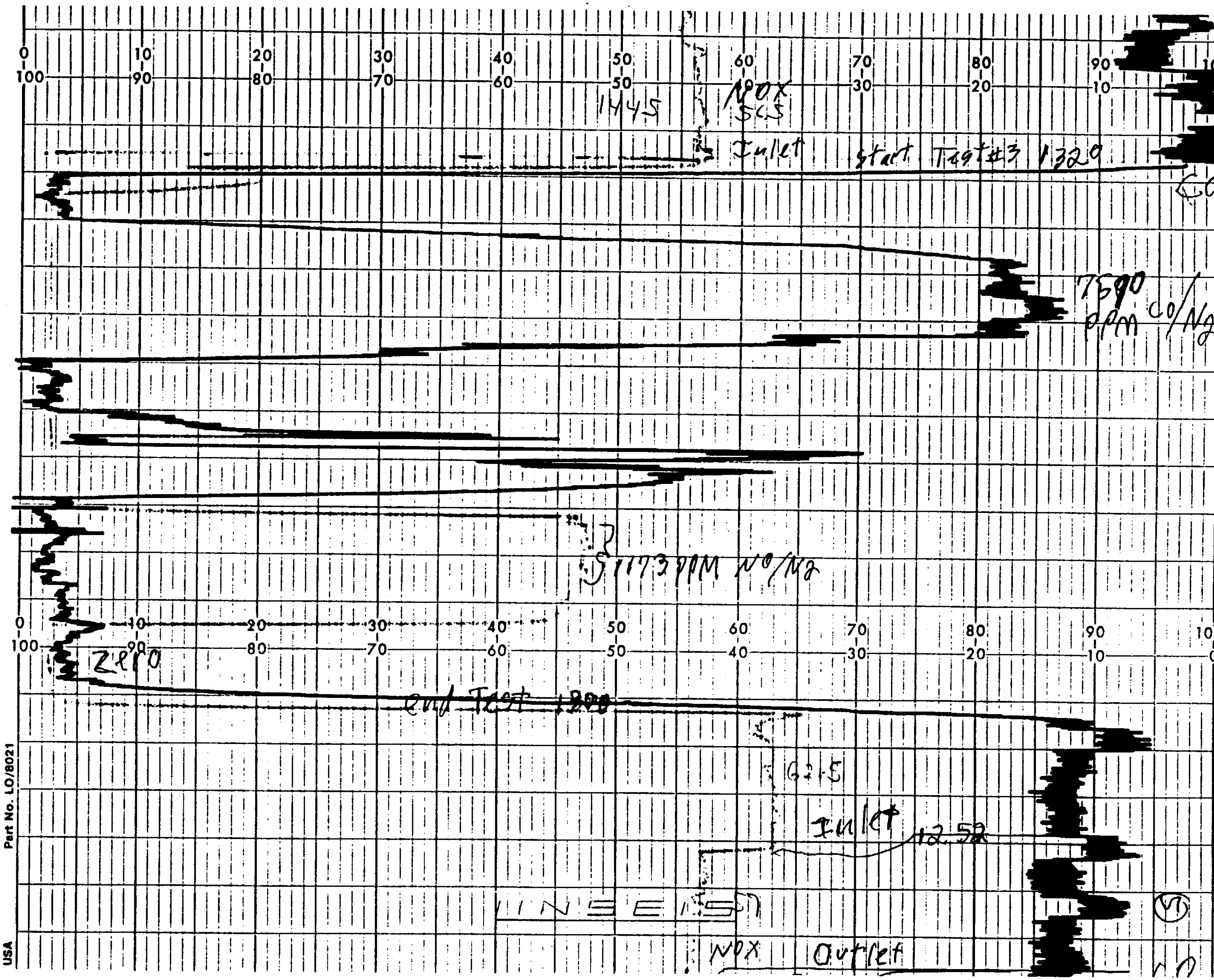
OUTLET
1105
NOX
CO
Inlet
1057
Outlet
1049
NOX
CO
Inlet
START 1040
Test #1
1-17-90
803 PPM CO/N2
560 PPM NO/N2
Part No. LO/8021
Printed in USA

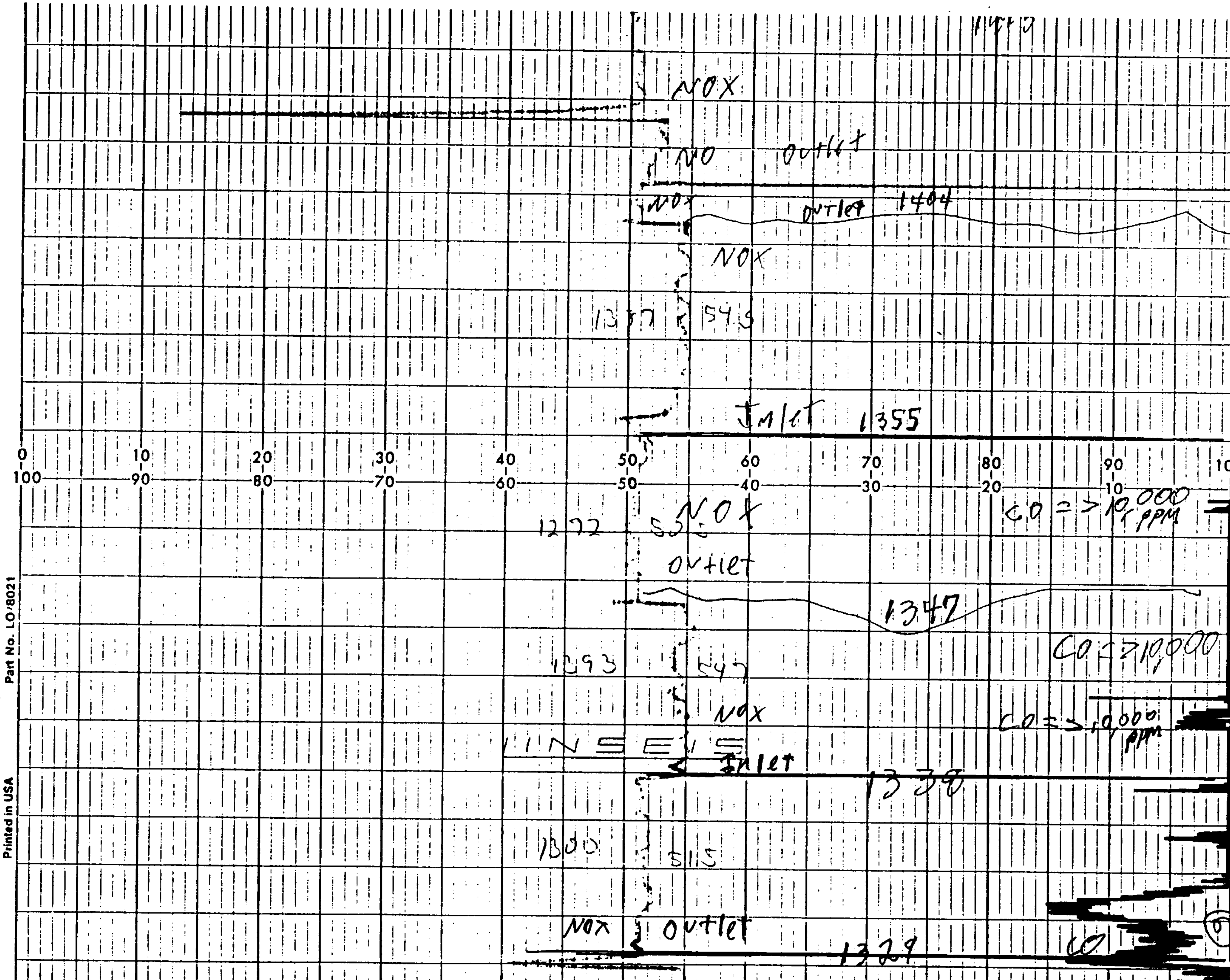

Printed in USA
Part No.



Printed in

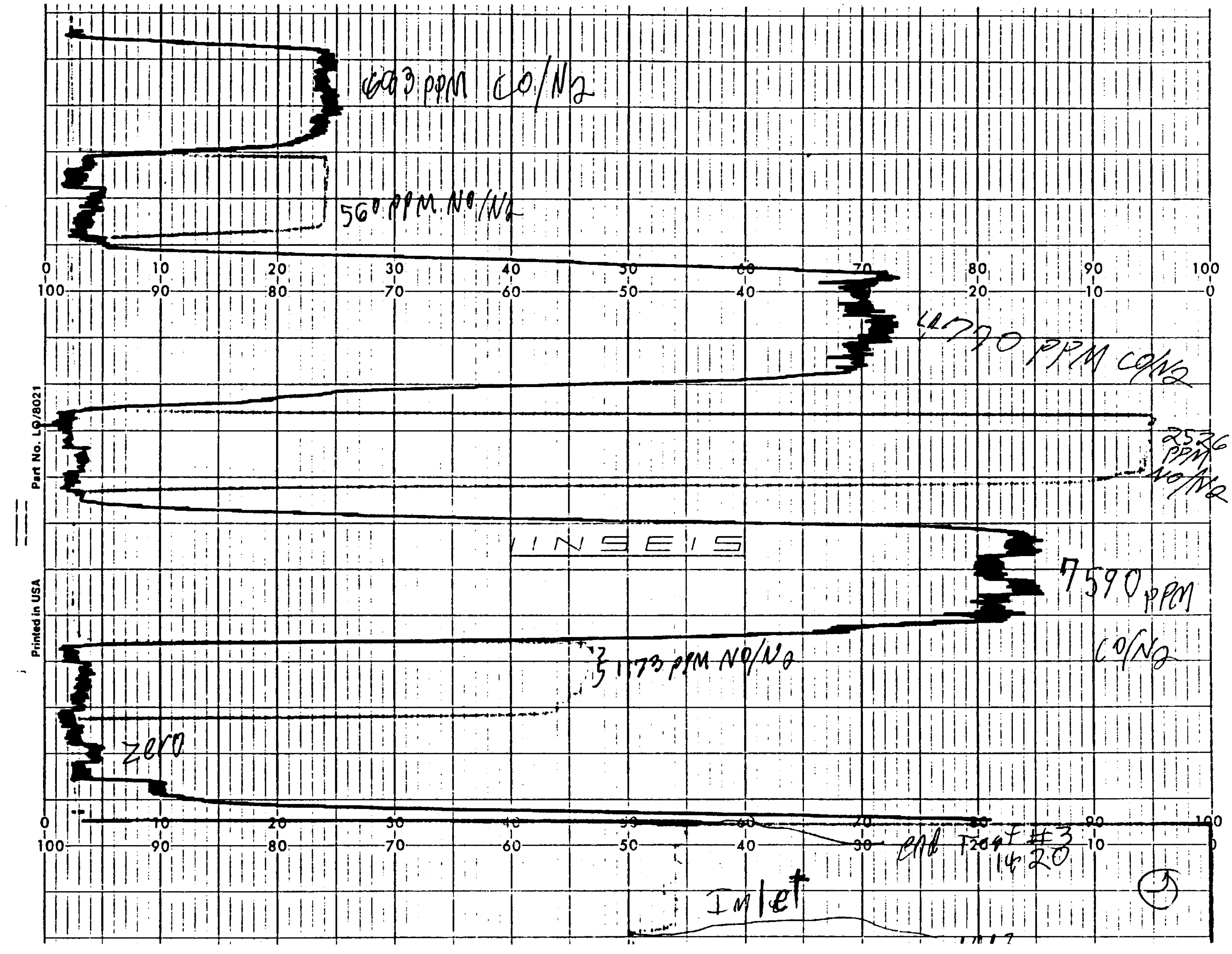
LO/8021


1445
NOX 565
Inlet
start Test #3 1320
CO
7590 ppm CO/N2
1173 PPM NO/N2
Zero
end Test
Inlet 12.5
NOX Outlet
Part No. LO/8021
USA



Part No. LO/8021

Printed in USA



560 PPM NO/N2
2526 PPM NO/N2
LINSEIS
7590 PPM CO/N2
Zero
End Test #3
1420
Inlet
Part No. LO/8021
Printed in USA

RECEIVED

FEB 22 1990

REGION 7
TEXAS AIR CONTROL BOARD

APPENDIX B

CALCULATIONS

1

FIELD DATA CALCULATIONS

Prepared By:	SAS	Data Inputs Checked By:	[signature]
Date:	01-22-90	Date:	1/23/90
Plant:	GSF ENERGY	Run No.:	ONE
Source:	COMPRESSOR EXHAUST	Date:	01-17-90
Stack Dia.(inches):	14.00	Nozzle Dia.(inches):	0
Static Pres.(in.H2O):	0.30	Dgmcf:	0.988
Bar. Pres.(in. Hg):	30.03	Ptcf:	0.848
Begin Time:	10:40	End Time:	11:40

Pt.	Sample Time (Min.)	Dry Gas Meter Reading Cu. Ft.	(In. H2O) D P	(In. H2O) D H	Stack Temp. Deg.F	Dry Gas Meter Deg. F In	Dry Gas Meter Deg. F Out	Square Root D P
8	0	560.110	0.25	1.50	981	82	76	0.5000
7	10		0.28	1.50	986	83	77	0.5292
6	20		0.30	1.50	990	83	77	0.5477
5	30		0.32	1.50	993	84	76	0.5657
4	40		0.32	1.50	989	84	78	0.5657
3	50		0.33	1.50	995	82	78	0.5745
2	60	599.710	0.33	1.50	997	82	78	0.5745
1			0.31		986			0.5568
STOP								
8			0.26		987			0.5099
7			0.29		986			0.5385
6			0.29		983			0.5385
5			0.31		991			0.5568
4			0.32		995			0.5657
3			0.34		997			0.5831
2			0.35		996			0.5916
1			0.33		992			0.5745
STOP								
	60	39.600		1.50	990.3		80.0	0.5545
	Tim1	Net Vol		D H	Ts		Tm	SQRT(DP)

L

FIELD DATA CALCULATIONS

****

Prepared By:	SAS	Data Inputs Checked By:	SS
Date:	01-22-90	Date:	1/22/90
Plant:	GSF ENERGY	Run No.:	TWO
Source:	COMPRESSOR EXHAUST	Date:	01-17-90
Stack Dia.(inches):	14.00	Nozzle Dia.(inches):	0
Static Pres.(in.H20):	0.30	Dgmcf:	0.988
Bar. Pres.(in. Hg):	30.03	Ptcf:	0.848
Begin Time:	12:00	End Time:	13:00

****

Pt.	Sample Time (Min.)	Dry Gas Meter Reading Cu. Ft.	(In. H20) D P	D H	Stack Temp. Deg.F	Dry Gas Meter Deg. F In	Out	Square Root D P
8	0	600.000	0.25	1.40	990	80	78	0.5000
7	10		0.27	1.40	986	81	79	0.5196
6	20		0.29	1.40	993	80	79	0.5385
5	30		0.33	1.40	991	81	78	0.5745
4	40		0.33	1.40	997	82	80	0.5745
3	50		0.33	1.40	996	82	80	0.5745
2	60	635.200	0.32	1.40	987	82	80	0.5657
1			0.30		991			0.5477
STOP								
8			0.26		993			0.5099
7			0.28		982			0.5292
6			0.29		991			0.5385
5			0.31		990			0.5568
4			0.33		997			0.5745
3			0.35		999			0.5916
2			0.35		989			0.5916
1			0.32		996			0.5657
STOP								
	72							
	72	35.200		1.40	991.8		80.1	0.5533
	Tim1	Net Vol		D H	Ts		Tm	SQRT(DP)

FIELD DATA CALCULATIONS

Prepared By:	SAS	Data Inputs Checked By:	SS
Date:	01-22-90	Date:	1/25/90
Plant:	GSF ENERGY	Run No.:	THREE
Source:	COMPRESSOR EXHAUST	Date:	01-17-90
Stack Dia.(inches):	14.00	Nozzle Dia.(inches):	0
Static Pres.(in.H20):	0.30	Dgmcf:	0.988
Bar. Pres.(in. Hg):	30.03	Ptcf:	0.848
Begin Time:	13:20	End Time:	14:20

Pt.	Sample Time (Min.)	Dry Gas Meter Reading Cu. Ft.	(In. H20) D P	(In. H20) D H	Stack Temp. Deg.F	Dry Gas Meter Deg. F In	Dry Gas Meter Deg. F Out	Square Root D P
8	0	635.300	0.24	1.20	987	81	78	0.4899
7	10		0.27	1.20	983	80	78	0.5196
6	20		0.31	1.20	991	81	79	0.5568
5	30		0.32	1.20	998	82	78	0.5657
4	40		0.33	1.20	999	81	79	0.5745
3	50		0.32	1.20	986	81	79	0.5657
2	60	665.800	0.29	1.20	990	81	79	0.5385
1			0.30		993			0.5477
STOP								
8			0.26		1003			0.5099
7			0.28		1001			0.5292
6			0.31		1005			0.5568
5			0.33		995			0.5745
4			0.33		994			0.5745
3			0.35		991			0.5916
2			0.31		990			0.5568
1			0.29		1001			0.5385
STOP								

Tim1	Net Vol	D H	Ts	Tm	SQRT(DP)
60	30.500	1.20	994.2	79.8	0.5494

NET SAMPLE VOLUME CALCULATIONS

****

Prepared by:	SAS	Date:	01-22-90
Plant:	UCC	Run no.:	ONE
Source:	VA-5 INCINERATOR	Date:	01-17-90

****

PM = Pbar + (DH / 13.6)

= 30.03 + (1.50 / 13.6) = 30.14 in Hg

TM = Tm (deg. F) + 460

= 80.0 + 460 = 540.0 deg. R

$$VMSTD = Net\ Vol * Dgmcf * \frac{528}{TM} * \frac{PM}{29.92}$$

$$= 39.600 * 0.988 * \frac{528}{540.0} * \frac{30.14}{29.92} = 38.537\ DSCF$$

VDG = Net Vol * Dgmcf

= 39.600 * 0.988 = 39.125 cu. ft.

PS = Pbar + (SP / 13.6)

= 30.03 + (0.30 / 13.6) = 30.05 in Hg

TS = Ts (deg. F) + 460

= 990.3 + 460 = 1450.3 deg. R

L

NET SAMPLE VOLUME CALCULATIONS

Prepared by:	SAS	Date:	01-22-90
Plant:	UCC	Run no.:	TWO
Source:	VA-5 INCINERATOR	Date:	01-17-90

$$PM = Pbar + (DH / 13.6)$$

$$= 30.03 + (1.40 / 13.6) = 30.13 \text{ in Hg}$$

$$TM = Tm\,(deg.\ F) + 460$$

$$= 80.1 + 460 = 540.1 \text{ deg. R}$$

$$VMSTD = Net\ Vol * Dgmcf * \frac{528}{TM} * \frac{PM}{29.92}$$

$$= 35.200 * 0.988 * \frac{528}{540.1} * \frac{30.13}{29.92} = 34.237 \text{ DSCF}$$

$$VDG = Net\ Vol * Dgmcf$$

$$= 35.200 * 0.988 = 34.778 \text{ cu. ft.}$$

$$PS = Pbar + (SP / 13.6)$$

$$= 30.03 + (0.30 / 13.6) = 30.05 \text{ in Hg}$$

$$TS = Ts\,(deg.\ F) + 460$$

$$= 991.8 + 460 = 1451.8 \text{ deg. R}$$

NET SAMPLE VOLUME CALCULATIONS

****

Prepared by:	SAS	Date:	01-22-90
Plant:	UCC	Run no.:	THREE
Source:	VA-5 INCINERATOR	Date:	01-17-90

****

$$PM = Pbar + (DH / 13.6)$$

$$= 30.03 + (1.20 / 13.6) = 30.12 \text{ in Hg}$$

$$TM = Tm \text{ (deg. F)} + 460$$

$$= 79.8 + 460 = 539.8 \text{ deg. R}$$

$$VMSTD = \text{Net Vol} * Dgmcf * \frac{528}{TM} * \frac{PM}{29.92}$$

$$= 30.500 * 0.988 * \frac{528}{539.8} * \frac{30.12}{29.92} = 29.672 \text{ DSCF}$$

$$VDG = \text{Net Vol} * Dgmcf$$

$$= 30.500 * 0.988 = 30.134 \text{ cu. ft.}$$

$$PS = Pbar + (SP / 13.6)$$

$$= 30.03 + (0.30 / 13.6) = 30.05 \text{ in Hg}$$

$$TS = Ts \text{ (deg. F)} + 460$$

$$= 994.2 + 460 = 1454.2 \text{ deg. R}$$

MOISTURE AND MOLECULAR WEIGHT CALCULATIONS

Prepared By:	SAS	Checked by:	SS
Date:	01-22-90	Date:	1/23/90
Plant:	GSF ENERGY	Run No.:	ONE
Source:	VA-5 INCINERATOR	Date:	01-17-90

MOISTURE	Flask 1	Flask 2	Flask 3	Flask 4	Flask 5	Flask 6
Container I.D.	H20	H20	DRY	SG	N/A	N/A
Final Weight	827.6	742.3	0.0	697.5	0.0	0.0
Initial Weight	690.0	698.5	0.0	681.9	0.0	0.0
Net Increase	137.6	43.8	0.0	15.6	0.0	0.0

Total Water Collected (gm), MWC = 197.0

$$\frac{1.335 * MWC}{(1.335 * MWC) + (VDG)(528/TM)(PM/29.92)(28.32\ L\ /\ cu\ ft)} \quad \%\ Moist.$$

$$\frac{1.335 * 197.0 * 100}{(1.355 * 197.0) + (39.125)(528/TM)(PM/29.92)(28.32)} \quad 19.42\ \%$$

Bdg = 1 - (% Mo isture / 100) = 0.806

Time: 10:40 - 11:40

	Sample No.	1	2	3	Avg.
ORSAT ANALYSIS	% CO2	10.9	10.8	10.9	10.9
	% O2	0.9	1.0	0.9	0.9
	% CO	0.7	0.8	0.8	0.8

MOLECULAR WEIGHT OF STACK GAS

	% VOLUME (DRY BASIS)		MOISTURE / GAS FRACTION		COMPONENT MOL. WT.		DRY MOLECULAR WT. (lb/lb mole)
H20:			0.194	*	18	=	3.495
CO2:	0.109	*	0.806	*	44	=	3.853
O2:	0.009	*	0.806	*	32	=	0.241
CO:	0.008	*	0.806	*	28	=	0.173
N2:	0.874	*	0.806	*	28	=	19.727
					MWSG	=	27.489

I.

MOISTURE AND MOLECULAR WEIGHT CALCULATIONS

****

Prepared By:	SAS	Checked by:	SS
Date:	01-22-90	Date:	1/25/90
Plant:	GSF ENERGY	Run No.:	TWO
Source:	VA-5 INCINERATOR	Date:	01-17-90

****

MOISTURE	Flask 1	Flask 2	Flask 3	Flask 4	Flask 5	Flask 6
Container I.D.	H20	H20	DRY	SG	N/A	N/A
Final Weight	751.7	725.9	0.0	697.2	0.0	0.0
Initial Weight	678.4	641.7	0.0	687.5	0.0	0.0
Net Increase	73.3	84.2	0.0	9.7	0.0	0.0

Total Water Collected (gm), MWC = 167.2

$$\% \text{ Moist.} = \frac{1.335 * \text{MWC}}{(1.335 * \text{MWC}) + (\text{VDG})(528/\text{TM})(\text{PM}/29.92)(28.32 \text{ L / cu ft})}$$

$$\frac{1.335 * 167.2 * 100}{(1.355 * 167.2) + (34.778)(528/\text{TM})(\text{PM}/29.92)(28.32)} = 18.71 \%$$

Bdg = 1 - (% Mo isture / 100) = 0.813

****

Time: 12:00 - 13:00

ORSAT ANALYSIS	Sample No.	1	2	3	Avg.
	% CO2	10.9	10.9	10.9	10.9
	% O2	0.7	0.7	0.6	0.7
	% CO	1.0	1.0	1.0	1.0

****

MOLECULAR WEIGHT OF STACK GAS

	% VOLUME (DRY BASIS)		MOISTURE / GAS FRACTION		COMPONENT MOL. WT.		DRY MOLECULAR WT. (lb/lb mole)
H20:			0.187	*	18	=	3.368
CO2:	0.109	*	0.813	*	44	=	3.899
O2:	0.007	*	0.813	*	32	=	0.173
CO:	0.010	*	0.813	*	28	=	0.228
N2:	0.874	*	0.813	*	28	=	19.900
					MWSG	=	27.568

MOISTURE AND MOLECULAR WEIGHT CALCULATIONS

Prepared By:	SAS	Checked by:	SS
Date:	01-22-90	Date:	1/25/90
Plant:	GSF ENERGY	Run No.:	THREE
Source:	VA-5 INCINERATOR	Date:	01-17-90

MOISTURE	Flask 1	Flask 2	Flask 3	Flask 4	Flask 5	Flask 6
Container I.D.	H20	H20	DRY	SG	N/A	N/A
Final Weight	780.5	684.3	0.0	678.8	0.0	0.0
Initial Weight	669.2	663.3	0.0	668.4	0.0	0.0
Net Increase	111.3	21.0	0.0	10.4	0.0	0.0

Total Water Collected (gm), MWC = 142.7

$$\frac{1.335 * MWC}{(1.335 * MWC) + (VDG)(528/TM)(PM/29.92)(28.32 \text{ L / cu ft})} \quad \text{\% Moist.}$$

$$\frac{1.335 * 142.7 * 100}{(1.355 * 142.7) + (30.134)(528/TM)(PM/29.92)(28.32)} \quad 18.48 \%$$

Bdg = 1 - (% Mo isture / 100) = 0.815

Time: 13:20 - 14:20

ORSAT ANALYSIS	Sample No.	1	2	3	Avg.
	% CO2	11.0	11.0	11.0	11.0
	% O2	0.7	0.6	0.7	0.7
	% CO	1.2	1.2	1.2	1.2

MOLECULAR WEIGHT OF STACK GAS

	% VOLUME (DRY BASIS)		MOISTURE / GAS FRACTION		COMPONENT MOL. WT.		DRY MOLECULAR WT. (lb/lb mole)
H20:			0.185	*	18	=	3.327
CO2:	0.110	*	0.815	*	44	=	3.946
O2:	0.007	*	0.815	*	32	=	0.174
CO:	0.012	*	0.815	*	28	=	0.274
N2:	0.871	*	0.815	*	28	=	19.889
					MWSG	=	27.608

FLOW AND MASS EMISSION RATE CALCULATIONS

****

Prepared by:	SAS	Date:	01-22-90
Plant:	GSF ENERGY	Run no.:	ONE
Source:	COMPRESSOR EXHAUST	Date:	01-17-90

****

AVEL = 85.48 * Ptcf * Sq rt (dp) * Sq rt (TS / (MWSG * PS))

= 85.48 * 0.848 * 0.5545 * Sq rt (1450 / (27.489 * 30.05)) = 53.26 fps

ACFM = AVEL * Stack Area (ft^2) * 60

= 53.26 * 1.07 * 60 = 3416 acfm

SCFM = ACFM * (528 / TS) * PS / 29.92)

= 3416.2 * (528 / 1450) * 30.05 / 29.92) = 1,249 scfm

DSCFM = SCFM * BDG

= 1249.1 * 0.806 = 1,007 dscfm

QSD = DSCFM * 60

= 1006.6 * 60 = 60,394 dscf/hr

$$\frac{LB}{HR} = \frac{\text{PARTS}}{10^6} * \frac{\text{MW (lb)}}{\text{(lb-mole)}} * \frac{\text{(lb-mole)}}{385.33\ (ft^3)} * \frac{\text{STACK FLOW (dscf)}}{\text{(hr)}}$$

$$\frac{LB}{HR} = \frac{1591}{10^6} * \frac{30\ \text{(lb)}}{\text{(lb-mole)}} * \frac{\text{(lb-mole)}}{385.33\ (ft^3)} * \frac{60394\ \text{(dscf)}}{\text{(hr)}} = 7.48\ \text{lb/hr}$$

$$\frac{GM}{HP\text{-}HR} = \frac{\text{(lb)}}{\text{(hr)}} * \frac{453.6\ \text{(gm)}}{\text{(lb)}} * \frac{1}{1100\ \text{(hp)}}$$

$$\frac{GM}{HP\text{-}HR} = \frac{7.48\ \text{(lb)}}{\text{(hr)}} * \frac{453.6\ \text{(gm)}}{\text{(lb)}} * \frac{1}{1100\ \text{(hp)}} = 3.08\ \text{gm/hp-hr}$$

FLOW AND MASS EMISSION RATE CALCULATIONS

****

Prepared by: SAS — Date: 01-22-90

Plant: GSF ENERGY — Run no.: TWO

Source: COMPRESSOR EXHAUST — Date: 01-17-90

****

AVEL = 85.48 * Ptcf * Sq rt (dp) * Sq rt (TS / (MWSG * PS))

= 85.48 * 0.848 * 0.5533 * Sq rt (1452 / (27.568 * 30.05)) = 53.09 fps

ACFM = AVEL * Stack Area (ft^2) * 60

= 53.09 * 1.07 * 60 = 3405 acfm

SCFM = ACFM * (528 / TS) * PS / 29.92)

= 3405.5 * (528 / 1452) * 30.05 / 29.92) = 1,244 scfm

DSCFM = SCFM * BDG

= 1243.9 * 0.813 = 1,011 dscfm

QSD = DSCFM * 60

= 1011.1 * 60 = 60,668 dscf/hr

$$\frac{LB}{HR} = \frac{PARTS}{10^6} * \frac{MW\ (lb)}{(lb\text{-}mole)} * \frac{(lb\text{-}mole)}{385.33\ (ft^3)} * \frac{STACK\ FLOW\ (dscf)}{(hr)}$$

$$\frac{LB}{HR} = \frac{1457}{10^6} * \frac{30\ (lb)}{(lb\text{-}mole)} * \frac{(lb\text{-}mole)}{385.33\ (ft^3)} * \frac{60668\ (dscf)}{(hr)} = 6.88\ lb/hr$$

$$\frac{GM}{HP\text{-}HR} = \frac{(lb)}{(hr)} * \frac{453.6\ (gm)}{(lb)} * \frac{1}{1100\ (hp)}$$

$$\frac{GM}{HP\text{-}HR} = \frac{6.88\ (lb)}{(hr)} * \frac{453.6\ (gm)}{(lb)} * \frac{1}{1100\ (hp)} = 2.84\ gm/hp\text{-}hr$$

FLOW AND MASS EMISSION RATE CALCULATIONS

****

Prepared by:	SAS	Date:	01-22-90
Plant:	GSF ENERGY	Run no.:	THREE
Source:	COMPRESSOR EXHAUST	Date:	01-17-90

****

AVEL = 85.48 * Ptcf * Sq rt (dp) * Sq rt (TS / (MWSG * PS))

= 85.48 * 0.848 * 0.5494 * Sq rt (1454 / (27.608 * 30.05)) = 52.72 fps

ACFM = AVEL * Stack Area (ft^2) * 60

= 52.72 * 1.07 * 60 = 3382 acfm

SCFM = ACFM * (528 / TS) * PS / 29.92)

= 3381.7 * (528 / 1454) * 30.05 / 29.92) = 1,233 scfm

DSCFM = SCFM * BDG

= 1233.2 * 0.815 = 1,005 dscfm

QSD = DSCFM * 60

= 1005.3 * 60 = 60,317 dscf/hr

$$\frac{LB}{HR} = \frac{PARTS}{10^6} * \frac{MW\ (lb)}{(lb\text{-}mole)} * \frac{(lb\text{-}mole)}{385.33\ (ft^3)} * \frac{STACK\ FLOW\ (dscf)}{(hr)}$$

$$\frac{LB}{HR} = \frac{1286}{10^6} * \frac{30\ (lb)}{(lb\text{-}mole)} * \frac{(lb\text{-}mole)}{385.33\ (ft^3)} * \frac{60317\ (dscf)}{(hr)} = 6.04\ lb/hr$$

$$\frac{GM}{HP\text{-}HR} = \frac{(lb)}{(hr)} * \frac{453.6\ (gm)}{(lb)} * \frac{1}{1100\ (hp)}$$

$$\frac{GM}{HP\text{-}HR} = \frac{6.04\ (lb)}{(hr)} * \frac{453.6\ (gm)}{(lb)} * \frac{1}{1100\ (hp)} = 2.49\ gm/hp\text{-}hr$$

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TEXAS AIR CONTROL BOARD

APPENDIX C

CALIBRATION DATA

BIG THREE INDUSTRIAL GAS, INC.

MIXED AND SPECIALTY GASES

P.O. Box 1026
11426 Fairmont Pkwy.
La Porte, Texas 77572-1026

Phone (713) 474-8400
Texas (800) 392-5841
USA (800) 231-7095
FAX (713) 474-8419

19 October 1989

P.O. Number: 24 27637

Customer: NUS CORPORATION

CERTIFICATION OF CYLINDER # AL 2046

Component	mol ppm
Nitric Oxide	1173. ppm
Other Nitrogen Oxides	<5. ppm
NITROGEN	Balance

Expiration date 19 October 1990

Analyst

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BIG THREE INDUSTRIAL GAS, INC.

MIXED AND SPECIALTY GASES

P.O. Box 1026
11426 Fairmont Pkwy.
La Porte, Texas 77572-1026

Phone (713) 474-8400
Texas (800) 392-5841
USA (800) 231-7095
FAX (713) 474-8419

19 October 1989

P.O. Number: 24 27637

Customer: NUS CORPORATION

CERTIFICATION OF CYLINDER # AL 1451

Component	mol ppm
Nitric Oxide	2526. ppm
Other Nitrogen Oxides	<25. ppm
NITROGEN	Balance

Expiration date 19 October 1990

Analyst

BIG THREE INDUSTRIAL GAS, INC.

MIXED AND SPECIALTY GASES

P.O. Box 1026
11426 Fairmont Pkwy.
La Porte, Texas 77572-1026

Phone (713) 474-8400
Texas (800) 392-5841
USA (800) 231-7095
FAX (713) 474-8419

19 October 1989

P.O. Number: 24 27637

Customer: NUS CORPORATION

CERTIFICATION OF CYLINDER # AL 1531

Component	mol ppm
Nitric Oxide	560. ppm
Other Nitrogen Oxides	<5. ppm
NITROGEN	Balance

Expiration date 19 October 1990

Analyst

BIG THREE INDUSTRIAL GAS, INC.

MIXED AND SPECIALTY GASES

P.O. Box 1026
11426 Fairmont Pkwy.
La Porte, Texas 77572-1026

Phone (713) 474-8400
Texas (800) 392-5841
USA (800) 231-7095
FAX (713) 474-8419

07 August 1989

P.O. Number:

Customer: N U S Corp.

CERTIFICATION OF CYLINDER # H 88341

Component	Mole %
Carbon Monoxide	7590.0 ppm
Nitrogen	Balance

Recertified 8-7-1989

Expiration date 07 August 1990

Analyst

1.

BIG THREE INDUSTRIAL GAS, INC.

MIXED AND SPECIALTY GASES

P.O. Box 1026
11426 Fairmont Pkwy.
La Porte, Texas 77572-1026

Phone (713) 474-8400
Texas (800) 392-5841
USA (800) 231-7095
FAX (713) 474-8419

08 August 1989

P.O. Number:

Customer: NUS CORPORATION

CERTIFICATION OF CYLINDER # MM 14107

Component	mol ppm
Carbon Monoxide	4770. ppm
NITROGEN	Balance

Expiration date 08 August 1990

Analyst

BIG THREE INDUSTRIAL GAS, INC.

MIXED AND SPECIALTY GASES

P.O. Box 1026
11426 Fairmont Pkwy.
La Porte, Texas 77572-1026

Phone (713) 474-8400
Texas (800) 392-5841
USA (800) 231-7095
FAX (713) 474-8419

08 August 1989

P.O. Number:

Customer: NUS Corporation

CERTIFICATION OF CYLINDER # CC 7766

Component	mol ppm
Carbon Monoxide	883. ppm
Nitrogen	Balance

Expiration date 08 August 1990

Analyst

NUS CORPORATION A Halliburton Company	PITOT TUBE CALIBRATION	Prepared by: MAL Checked by: ____ Approved by: ____ Date: ____

PITOT TUBE IDENTIFICATION NUMBER: 3' #20 DATE: 12-18-89

CALIBRATED BY: [illegible signature]

RUN NO.	"A" SIDE CALIBRATION Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(A)$
1	.31	.42	.850	
2	.31	.42	.850	
3	.31	.42	.850	
		$\bar{C}_p$ (SIDE A)	.850	

RUN NO.	"B" SIDE CALIBRATION Δp_{std} cm H_2O (in. H_2O)	$\Delta p_{(s)}$ cm H_2O (in. H_2O)	$C_{p(s)}$	DEVIATION $C_{p(s)} - \bar{C}_p(B)$
1	.31	.42	.850	
2	.31	.42	.850	
3	.31	.42	.850	
		$\bar{C}_p$ (SIDE B)	.850	

$$\text{AVERAGE DEVIATION} = \sigma(\text{A OR B}) = \frac{\sum_{1}^{3} \left| C_p(s) - \bar{C}_p(\text{A OR B}) \right|}{3} \leftarrow \text{MUST BE} < 0.01$$

$$\left| \bar{C}_p(\text{SIDE A}) - \bar{C}_p(\text{SIDE B}) \right| \leftarrow \text{MUST BE} < 0.01$$

Figure 2-9. Pitot tube calibration data.

$$Cp(s) = Cp(std)\sqrt{\frac{\Delta p(std)}{\Delta ps}}; \text{ where } Cp(std) = 0.99$$

NUS CORPORATION

Page ____ of ____

CONTROL UNIT CALIBRATION

BOX NO. 5G I #3

~~DRY~~ Standard GAS METER NO. 55162

DATE 12-8-89

Barometric Pressure, P_b 30.13 in. Hg

Orifice Manometer setting ΔH, in. H_2O	Gas Volume wet test meter V_w, ft^3	Gas Volume dry gas meter V_d, ft^3	Temperature: Wet Test Meter t_w, °F	Temperature: Dry Gas Meter: Inlet t_{di}, °F	Temperature: Dry Gas Meter: Outlet t_{do}, °F	Temperature: Dry Gas Meter: Average t_d, °F	Time min.-sec.	Time Θ min.	γ	ΔH@
0.5	116.100 111.100 5.000	273.[illegible] 268.[illegible] 5.043	61 61	60 62	60 62	61	1300	13.00	.990	1.87
1.0	121.520 116.520 5.000	279.450 274.368 5.082	61 61	61 62	61 62	62	725	7.25	.993	1.87
2.0	132.100 12.002	2[illegible] 2[illegible] 10.103	60 60	62 68	62 68	~~[illegible]~~ 65	1258	12.97	.992	1.83
4.0										
6.0										
								Average	.988	1.86

Calculations

ΔH	$\frac{\Delta H}{13.6}$	γ: $\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$	ΔH@: $\frac{0.0317\ \Delta H}{P_b\ (t_d + 460)} \left[\frac{(t_w + 460)\Theta}{V_w}\right]^2$
0.5	0.0368	(5)(30.13)(521) / (5.043)(30.17)(521) 0.990	(.0317)(.5) / (30.13)(521) ((521)(13.00) / (5))^2
1.0	0.0736	(5) (30.13)(522) / (5.092)(30.20)(521) 0.993	(.0317)(1) / (30.13)(522) ((521)(9.25) / (5))^2
2.0	0.1471	10.000 (30.13) 525 / 10.103 (30.28) 521 .992	(.0317)(2) / (30.13)(525) (521 12.97 / 10)^2
4.0	0.2942		

ENVIRONMENTAL SERVICE CENTER
2525 W. BELLFORT, SUITE 150
HOUSTON, TX 77054

Checked By ____________________

NUS CORPORATION

[signature]

CARL POE CO., INC.   99 REINERMAN ST. • HOUSTON, TEXAS 77007 • 713-861-3816

October 20, 1989

NUS Corporation
16360 Park Ten Place
Suite 300
Houston, TX 77084

Dear Sir:

This is to certify that your Rockwell Model S-190 Test Meter, Serial No. 55962, has been calibrated with an American 5 foot bell prover, serial no, 2260, It is traceable to the Bureau of Standards, reference no. 106870, PI-TAPE,

Test Results are as follows:

Flow Rate	Percent Error
50 CFH	0.2%+
20 CFH	0.2%+

Sincerely,

CARL POE CO., INC.

Carl W. Poe
CNP/mp

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APPENDIX D

RESUMES

WILLIAM J. COLE, P.E.

PRINCIPAL ENVIRONMENTAL ENGINEER

EDUCATION

Graduate Work - Mechanics of Fluids and Industrial Administration - Warrington Technical College, England - 1964

Higher National Certificate - Mechanical Engineering -- Warrington Technical College, England - 1960

ADDITIONAL EDUCATION

Hazardous Waste Management Safety Practices -- 1985
GRCDA -- Hazardous Waste Management -- 1981
Institute for Boiler Improvement -- Boiler Efficiency -- 1978
Fundamentals of Industrial Hygiene -- 1977
AICHE -- Primer on Environmental Impact Statements -- 1975
AICHE -- Introduction to Pollution Control -- 1975

Additional Short Courses in:
Hazardous Waste Management 1981 - 1985
Water and Wastewater Management
Air Pollution Control
Professional Management

REGISTRATION

Professional Engineer, Texas, 1972

EXPERIENCE

NUS CORPORATION, 1987-Present
William J. Cole & Associates, 1984-1987
Southwestern Laboratories, Inc., 1975-1984
Langford Engineering, Inc., 1972-1975
Turner, Collie and Braden, Inc., 1964-1972

As Principal Environmental Engineer, is responsible for technical administrative aspects of environmental projects involving environmental compliance. Typical projects: site remediation, RCRA facility closures, wastewater collection and treatment, surface water drainage, surface water treatment, groundwater monitoring, hazardous waste management, air pollution evaluaton and emissions control, air emissions permitting, incineration facility permitting. Areas of expertise:

- Provides technical lead in: air testing programs; surface water drainage studies; surface water treatment; and process wastewater management; incineration feasibility and permitting studies; RCRA compliance; site remediation.

- Development and management of ambient air and source emissions testing programs to assess organic and inorganic emissions and personnel exposure to such emissions.

- Preparation of permit applications for Part A and Part B hazardous wastes, air emissions, and wastewater discharge.
- Development and management of; health and safety programs, remedial site investigations, RCRA waste treatability studies, incineration feasibility investigations, closure plans, hazardous waste incinerator trial burns, surface water and wastewater collection and treatment programs, air permitting and air toxics testing programs.
- Development of innovative and cost-effective solutions for difficult to handle wastes and environmental control problems.
- Management of environmental compliance audits and corrective action programs.
- Effective interaction with regulatory agency personnel at all levels.
- Technical lead in the development of waste materials testing and air emissions testing.

Client programs include RCRA remediation projects, and permitting activities which require major interaction between NUS, the Client, local, state, and Federal agencies to assure compliance with applicable regulations.

Was responsible for preparation of Part B Permits, Closure Plans, and Environmental Exposure Assessments for surface impoundments operated by the U.S. Navy, San Diego, California. Performed remedial investigations and prepared closure plans for contaminated waste sites in Texas, Louisiana, and California, under the auspices of state regulatory agencies.

Was responsible for design of surface water treatment facilities for the Cities of: Houston, Eagle Pass, Seguin, and Bell County Water Improvement District. Also responsible for design of surface water collection and treatment systems for Gulf Coast Industrial Clients.

Directed treatability studies of surface waters from Lake Houston and the San Jacinto, Trinity, Guadalupe, Rio Grande, and Brazos Rivers, in preparation for surface water treatment.

Evaluated sludge drier performance and sludge handling facilities for a major municipal sewage treatment facility in order to assess air toxic emissions and adequacy of sludge treatment.

Developed testing programs for Superfund Projects to provide: Waste materials evaluations, groundwater monitoring, air emissions emissions. Also developed waste cleanup and site closure programs for: petroleum petrochemical, wood preserving, iron and steel production, and metals finishing facilities.

Supervised the investigation of a surface impoundment liner failure in a brine holding pond, for a major natural gas storage and terminaling facility.

Developed personnel exposure monitoring programs for waste management sites and industrial manufacturing processes.

Designed and supervised procedures for field sampling, ambient air testing, laboratory analyses and clean up of: PCB spills, leaking underground storage facilities, surface impoundments, refining wastes, industrial wastewater treatment facilities, and agricultural chemical wastes.

Project manager involving site investigations, development of sampling, analytical and remedial investigations for major wood preserving facilities in east Texas. Coordinated project investigations with groundwater hydrologists, drilling crews, laboratory operations, insurance carriers, and Texas Department of Water Resources (now TWC).

Project manager RI/FS for wood preserving facilities in; Houston, Livingston, Conroe and Jasper, Texas.

Directed groundwater monitoring activities at an agricultural chemicals manufacturing facility waste landfill site. Prepared monthly, quarterly, and annual reports for submittal to regulatory agencies.

Performed environmental audits for NASA Dryden facility, Edwards, California.

Coordinated and made presentation before regulatory agencies in Texas, Louisiana, Ohio, Pennsylvania, New Jersey, and California on Hazardous Waste Management, Air Emissions, Potable Water and Wastewater projects.

Was principal of the Environmental Engineering Management firm of William J. Cole & Associates (Cole Assoc.) which was formed to provide specialized consulting services in; permitting, evaluation and management of: indoor and outdoor air pollution and work place safety, industrial air and water pollution control systems, wastewater treatment, solid and hazardous waste treatment. Cole Assoc. provided environmental consulting services to clients throughout the Continental United States.

Was Manager of Environmental Engineering Services, responsible for marketing and directing, environmental engineering and testing services to industrial and municipal clients throughout the southern United States, for a major engineering testing laboratory. Services included engineering and analytical evaluation of: Industrial air pollutants, potable water and wastewater systems, health and safety programs, solid and hazardous wastes from industrial and municipal sources. This position entailed extensive interaction between the client and the regulatory agencies in permitting industrial and municipal pollution control facilities.

Was Project Manager for two major A/E firms, responsible for permitting, engineering design, and construction management of; municipal and industrial potable water gathering systems, surface water treatment and distribution systems, wastewater collection and treatment systems throughout the State of Texas.

MEMBERSHIPS

Air Pollution Control Association
Water Pollution Control Federation
Institute of Mechanical Engineers
National Society of Professional Engineers
Texas Society of Professional Engineers
American Society of Mechanical Engineers

H07059

I.

MARK A. LESTER

EQUIPMENT TECHNICIAN

EDUCATION

H.S. Carrick High School, 1977 (electronics specialization)
Connelley Skills Learning Center, 1978 (electronics)
2nd Class FCC License (with radar endorsement)
Monitor Lab's Technical Training Course, 1978
(sulfur dioxide, nitrogen oxides, ozone, and
data acquisition systems)
Thermo Electron Technical Training Course, 1981
(sulfur dioxide, nitrogen oxide)

EXPERIENCE

NUS CORPORATION, 1983-Present
Energy Impact Associates, Inc., 1978 - 1982

NUS Corporation - Air Quality Equipment Technician, and Field Team Leader responsibilities included:

- Running stack sampling jobs for EPA and state compliance.
- Performing accurate and defensible calibration of instruments, electronic and mechanical.
- Setup, maintain, and calibrate continuous emissions monitors for NO, NO_2, CO, O_2, SO_2, H_2S and total hydrocarbons.
- Designed and constructed various sample conditioners and collection devices for ambient and source testing.
- Setup and calibrated numerous portable and stationary meteorological stations.
- Design and constructed various mobile labs.
- Conducted Calderon sampling at municipal landfill sites in California.
- Performed groundwater sampling at numerous locations.

Previous experience as an air quality technician, include being responsible for installation, operation and maintenance of air quality/meteorological monitoring networks for the utility and steel industry and processing and validating data. Specific projects included:

- Installation and maintenance of an air quality/meteorological system for Niagara-Mohawk Power Company to investigate the affects of air pollutants on agricultural products (1978 - 1981). Equipment included: SO_2 analyzers and O_3 analyzers, wind speed and direction, delta temperature, dew point temperature, soil moisture gauges, electronic precipitation gauges, associated calibration devices, strip chart recorders and computer data loggers.
- Conducted performance audits on air quality networks with sulfur dioxide analyzers and high volume particulate samplers (hi-vol).
- Conducted field tests with isokinetic sampler to assess fugitive emissions from road surfaces and material storage piles in integrated steel mills.

CERTIFICATIONS

NUS Corporation 40 hours of instruction in Hazardous Waste Operations

Visible Emissions Evaluator, Texas Air Control Board

H08168

V. DUANE PIERCE

CONSULTING SCIENTIST

EDUCATION

Earlham College,
A.B., Biology, 1969

University of Houston - Clear Lake
M.S., Environmental Management ,1987

Ohio University,
Ph.D., Ecology, 1975

EXPERIENCE

NUS Corporation, 1988 - Present
Source Environmental Sciences, 1985 - 1988
Various Teaching and Research Projects, 1972 - 1985

Responsible for the technical management of the air sciences staff in the Houston office. Duties include business development, project management, and technical oversight of projects involving ambient air sampling and analysis, meterological sampling, air emission sampling and analysis, regulatory analysis and interpretation, permitting and compliance studies, air dispersion modeling, incinerator source testing, and risk assessment.

Previous experience includes:

- As Senior Associate/Scientist/Director of Technical Operations was responsible for: staff supervision and project management; preparation of emission inventories and environmental permit applications for petroleum refineries, petrochemical complexes and other industries; preparation of air quality impact studies (air dispersion modeling) for industrial and hazardous waste facilities; preparation of biological assessments; development of computer software for managing environmental data; implementation of VOC leak monitoring programs; and client compliance with environmental regulations for air, water, wastes and toxics.

- Lecturer, School of Business and Public Administration, University of Houston-Clear Lake: teaching in Environmental Management Program, both graduate and undergraduate.

- Assistant Professor of Natural Sciences, University of Houston-Downtown: taught courses in the sciences including environmental science, ecology, biology, and field research; developed new courses and degree programs; served on numerous committees including the Chair of the Academic Affairs Committee.

- Visiting Instructor, Jamestown Community College: taught ecology, biology and botany; developed auto-tutorial modules for general biology laboratories.

- Assistant Professor of Biology, Shippensburg State College: taught ecology, biology and field research in biology, directed student research.
- Researcher, Ohio Biological Survey: conducted research on the impact of acid mine drainage on flood plain communities of southeastern Ohio.
- Consultant to Stony Creek Environmental Coalition, Harrisburg, Pennsylvania: conducted an analysis of the woody vegetation of Stony Creek Valley.
- Consultant to N.L. Industries, MacIntyre Development, Tahawus, New York: conducted an analysis of revegetation attempts on mine waste disposal sites.

PROJECTS

- NO_x and CO Emission Testing for Gas Compressors, Texas City, Texas.
- NO_x Emission Testing and Catalytic Convertor Efficiency Determination, Houston, Texas.
- Air Permit Application and Air Quality Impact Analysis for Health Effects for Chemical Plant Expansion, Texas City, Texas.
- Sources Testing for Ethylene Oxide Emissions from Batch and Continuous Reactor Systems, Texas City, Texas.
- Source Testing for Formaldehyde Emissions from a Gas Scrubber System, Deer Park, Texas.
- RCRA Part B Application for Hazardous Waste Boiler Feed Storage Tanks, Houston, Texas.
- Air Quality Impact Analysis for Health Impacts of VOCs from a Petrochemical Complex, Odessa, Texas.
- Prevention of Significant Deterioration Permit Application for Cracking Furnace and Utility Boilers, Odessa, Texas.
- Air Quality Impact Analysis for Several Compressor Stations, Louisiana.
- Air Permit Application for Hydrocarbon Recovery System and Loading Facility, Odessa, Texas.
- Air Addendum to Permit Application for Municipal Landfill and Air Quality Impact Analysis, Ft. Bend County, Texas.
- Air Quality Impact Analysis of Isoprene Emissions, Deerpark, Texas.
- Air Permit Amendment Application for Styrene Monomer Plant, Odessa, Texas.
- Environmental Impact Assessment for Small Airport, Waller County, Texas.
- Air Quality Impact Analysis for Compressor Station, Colorado.
- Air Permit Application for Polypropylene Plant, Odessa, Texas.

- Air Permit Amendment Application for Amorphous Polyalpha Olefins Plant, Odessa, Texas.
- Prevention of Significant Deterioration Permit Application for Utility Boilers, Pasadena, Texas.
- Prevention of Significant Deterioration Permit Application for Cogeneration Facility, Odessa, Texas.
- Air Quality Impact Analysis for a Gas Processing Plant, New Mexico.
- Numerous Air Contaminant Emission Inventories.
- Environmental Impact Assessment, Proposed Site Preparation for Artificial Pine Regeneration, Sam Houston National Forest, Texas.
- Air Quality Impact Analysis for Two Separate Congeneration Facilities, Houston, Texas.
- VOC Leak Monitoring Program Manual for Petrochemical Plants.
- Air Quality Impact Analysis for RCRA Incinerator and Associated Facilities, Houston, Texas.
- Prevention of Significant Deterioration Permit Application for Cogeneration Plant, Harris County, Texas.
- Air Permit Amendment Application for Utility Boiler for Hazardous Waste Combustion, Vol. I-III., Odessa, Texas.
- Industrial Hazardous Waste RCRA Part B Application for Rotary Kiln, Houston, Texas.
- Air Monitoring Management System, Software for VOC Leak Monitoring Programs.
- EITemplate, A Lotus 1-2-3 Template for Air Emission Calculations and Inventories, numerous forms and specific applications.
- Environmental Impact Assessment for a Proposed Dormitory, Houston, Texas.
- Quantitative Study of the Revegetation Attempt on Mine Waste Disposal Areas, Tahawus, New York.
- Study of the Effects of Commercial Fertilizer on the Vegetation of Open Pit Mine Waste Disposal Sites, Tahawus, New York.
- Vegetation Analysis of Reservoir Sites, Ohio.

MEMBERSHIPS

Air Pollution Control Association
Texas Hazardous Waste Management Society
Water Pollution Control Federation

H11108

STUART A. SMITH

ENVIRONMENTAL SCIENTIST

EDUCATION

University of Texas, Arlington, Texas
Bachelor of Science, Environmental Science, 1975

EXPERIENCE

NUS CORPORATION, 1986-Present
TRACKER MOUNTS, 1983-1985
KVB ENGINEERING, 1978-1983
APOLLO TECHNOLOGIES, 1976-1978

Provides general technical support for waste management projects. Responsibilities include managing source sampling emissions testing, ambient air emissions testing, personal exposure to ambient emissions. Manages multiple projects including preparation of work plans, client interfaces, environmental agency negotiations, and write/review of final reports. Current responsibilities also include preparation of Texas Air Control Board permit applications including emissions calculations and air dispersion modeling.

- Performed pre-trial burn testing on a RCRA hazardous waste incinerator for industrial client in Texas, including data reduction, data analysis and report writing.

- Performed source emissions testing for many industrial and utility clients covering a wide variety of source and fugitive emissions including: NO_2, NO_3, SO_2, SO_3, O_2, CO, PCB's, acetic acid, formaldehyde, malic acid, particulate. Project experience includes data reduction, data analysis and report writing for emissions testing programs.

- Provided permitting assistance for a major chemical terminal facility in Texas. This involved monthly emissions calculations, obtaining new permits and amendments for existing ones from the Texas Air Control Board, and various wastewater and hazardous waste consulting activities.

- Prepared RCRA Part B permit amendment for hazardous waste facility in Texas. Facility disposal methods included surface impoundments, landfarms, landfills, storage tanks, container storage areas, and incinerators.

- Managed a project involving performing pre-TWC inspections, providing guidelines for preparation of, and consulting during the RCRA facility assessment of a major marine terminal in Texas.

- Perform tank integrity assessments and subsequent certifications as required by the new storage and treatment tank system standards (July 14, 1986 FR) including the supervision of static fluid leak tests.

- Worked on a plant-wide hydraulic study of a major chemical plant. Evaluated process wastewater and stormwater management methods and made recommendations for system improvements.

- Preparation of air amendment packages for Texas Air Control Board including emissions calculations, air dispersion modeling, Table 7, and Form PI-1.

- Conducted ambient air monitoring program for manufacturing client that was attempting to have their product certified as BACT (Best Available Control Technology) for particulate emissions.

Electric utility emissions reductions and performance improvement experience (7 years) includes:

- Managed emission reduction programs for five major fossil fuel fired steam-electric stations in Texas.
- Managed performance improvement projects for same five five steam boilers above. Includes fuel use optimization and heat release optimization to minimize combustion related tube failure problems.
- Provided technical expertise in major electro-static precipitator overhauls and performance improvement projects for an electric utility in West Virginia.

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B