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MONTENAY POWER CORP.

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December 17, 2002

Mr. Stan Ganthier
Florida Dept. of Environmental Protection
Air Program Section
P.O. Box 15425
West Palm Beach, FL 33416

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WEST PALM BEACH

Re: Dade County Resources Recovery Facility
SNCR System

Sub: Nitrogen Oxide Reduction System
FuelTech, Inc.
Performance Test Report

Gentlemen,

Pursuant to our earlier conversation wherein you requested a copy of the performance test report for the SNCR system furnished and installed by Fuel-Tech, Inc. for the purpose of reducing nitrogen oxide (NOx) emissions at this facility. Enclosed you will find one (1) copy of the final test report as submitted in February 2001.

Should you have any questions regarding this matter please contact me or Mr. Gonzalo Aleman.

Sincerely,

Richard Sardo
Contract Administrator

enclosure

cc: G. Aleman
C. Braun
B. Gilbert
H. Green
file

6990 N.W. 97th avenue - miami - fl 33178 - **Tel.: 305 593 7000 - Fax: 305 593 7114**

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FUELTECH™
Technology for a renewed environment™

NO_xOUT® System Final Report

For

Montenay-Dade County Units #1-4

Fuel Tech Project 480P

Performance Testing Conducted
January-February 2001

Table of Contents

Summary	Section 1
Equipment Start-Up and Optimization Test Results	Section 2
Injector Arrangement and Ammonia Slip	Section 3
Performance Testing and Results	Section 4
Trending and Scaling	Section 5
Conclusion	Section 6

1.0 Summary

Performance testing of the NO_xOUT® System for Montenay-Dade County Units #1-4 was conducted on January 24-25, 2001 and February 13-14, 2001. The objectives of the testing were to:

- Control NO_x emissions, calculated as NO_2, to 150 ppmd or less (Dry at 7% O_2), based on uncontrolled NOx emissions not exceeding 170 ppmd (Dry at 7% O2) or approximately 12% reduction

- Achieve the required performance at a per-hour Reagent flow rate of less than 6 gallons per hour per unit averaged over 24 hours

- Control ammonia slip to below 15 ppm

The objectives were accomplished during the compliance test period as documented in the report. Subsequent to the optimization testing, additional improvements in performance were observed. This improvement can be expected as operators gain experience in running the unit under conditions with the NO_xOUT system in operation.

Ammonia slip emissions were controlled to well below 15 ppm under optimized conditions. Testing was conducted on all four boilers to ensure that slip emissions were below the specified 15 ppm limit.

2.0 Equipment Start-up and Optimization Test Results

Start-up of the NO_xOUT system began in late November 2000 and ended in mid-December 2000. During this period, Fuel Tech personnel were on site to perform preliminary system checkout prior to commencement of optimization. This work included testing of individual metering modules and the circulation module for proper wiring to individual chemical pumps and water pumps, setting of sliders and camlocks in proper positions on injectors, and testing of control and boiler signals to each metering module and the circulation module. Testing on the customer supplied chemical tank was performed to determine if leaks were present in the tank itself or in the piping leading to the circulation house. Additional testing was performed on the pumping modules to check for leaks as well. A few days at the end of this time period were dedicated to some preliminary optimization.

Fuel Tech personnel returned in January 2001 to commence optimization of the NO_xOUT systems. Testing was conducted over 7 days between January 9th and January 17th. Boiler operating conditions, injection zone settings, and values from flue gas species and emissions analyzers were recorded. Test data collected January 9th through the 12th was used to setup control tables in each metering module. Ammonia slip testing was also conducted on these days. Operation in automatic control was tested from January 15th to January 17th. While no data was recorded during automatic control, minor changes were made to control tables for each unit. All optimization data from each unit is listed in Tables 2.1 through 2.4.

Project Name: Montenny-Dade County

Project Description: NOxOut Startup

fd	9102	sfc(dry)/MMBtu	
Ref O2	7	%	
Reference Load	20	MW	
Reference GHI	302	mBTU/Hr	

Boiler Load						Zone 1 Injection								Analyzers				Summary of Results							
Test No.	Test Type	Test Time	Steam Load KLB/HR	Gross Load MW	Load MMBtu per hr	# of Inj's	Tip Type	Liquid Flow [gpm]	Flow / inj [gpm]	Air P [psig]	"A" @ Flow [gph]	50% NSR	Droplet Size [µm]	NOx ppmd	CO ppmd	O2 %(dry)	NH3 ppm	NOx ppmdc	Calc # NOX /MMBtu	BL # NOX /MMBtu	Total NSR	% Red	% Util	Test No.	COMMENTS
UNIT 1																									
December 12, 2000																									
1.01	Baseline	9:00	133.20	16	241.9	0	inj	0.0	N/A	0	0	0.00	N/A		140	15.4	N/A	167	0.273	0.273	0.00	0.0%	N/A	1.01	
1.02		11:00	155.50	16.5	249.5	5	C00	4.5	0.90	45	2	0.21	383		159	9.3	N/A	118	0.193	0.273	0.21	29.4%	137.2%	1.02	
1.03	Baseline	13:00	161.90	16	241.9	0	inj	0.0	N/A	0	0	0.00	N/A		127	14.5	N/A	188	0.307	0.307	0.00	-0.1%	N/A	1.03	
1.04		13:45	152.00	16	241.9	5	C00	4.5	0.90	45	2.5	0.25	383		825	14.2	N/A	110	0.180	0.307	0.25	41.5%	168.9%	1.04	
January 11, 2001																									
2.01	Baseline	10:00	165.00	14	211.7	0	inj	0.0	N/A	0	0	0.00	N/A		100	7.0	N/A	130	0.212	0.212	0.00	-0.2%	N/A	2.01	
2.02		11:25	160.00	14	211.7	5	C30	4.8	0.96	40	2.5	0.41	378		90	8.0	N/A	115	0.188	0.212	0.41	11.4%	28.0%	2.02	P(H20) = 70 psi
2.03		12:00	160.00	14	211.7	5	C30	4.8	0.96	40	3	0.49	378		80	8.5	N/A	105	0.172	0.212	0.49	19.1%	39.1%	2.03	P(H20) = 70 psi
2.04	Baseline	13:35	160.00	14	211.7	0	inj	0.0	N/A	0	0	0.00	N/A		90	8.5	N/A	135	0.221	0.221	0.00	0.2%	N/A	2.04	
2.05		14:45	160.00	14	211.7	5	C30	4.8	0.96	40	2.7	0.42	378		85	8.0	N/A	105	0.172	0.221	0.42	22.4%	53.1%	2.05	
2.06		15:35	165.00	14	211.7	5	C30	5.0	1.00	40	2.7	0.42	381		70	8.0	N/A	110	0.180	0.221	0.42	18.7%	44.4%	2.06	
January 12, 2001																									
3.01	Baseline	8:00	165.00	15	226.8	0	inj	0.00	N/A	0	0	0.00	N/A		80	7.8	N/A	130.0	0.212	0.212	0.00	-0.2%	N/A	3.01	Baseline
3.02		9:20	165.00	15	226.8	5	C30	4.90	0.98	40	2.5	0.38	380		115	7.0	1.4	100.0	0.163	0.212	0.38	22.9%	60.5%	3.02	
3.03		10:20	170.00	15	226.8	5	C30	5.00	1.00	40	2.5	0.38	381		85	7.0	1.5	105.0	0.172	0.212	0.38	19.1%	50.3%	3.03	
3.04		12:00	148.00	13.5	204.1	5	C30	4.70	0.94	40	1.6	0.27	377		84	7.4	N/A	98.0	0.160	0.212	0.27	24.5%	90.7%	3.04	
3.05	Baseline	12:40	150.00	13.5	204.1	0	inj	0.00	N/A	0	0	0.00	N/A		85	7.2	N/A	122.0	0.199	0.199	0.00	0.2%	N/A	3.05	

Fig. 2.1

Project Name: Montenay-Dade County
Project Description: NOxOut Start-up

fd	9102	sfc(dry)/MMBtu	
Ref O2	7	%	
Reference Load	20	MW	
Reference GHI	302	mBTU/ft	

Boiler Load						Zone 1 Injection								Analyzers				Summary of Results							
Test No.	Test Type	Test Time	Steam Load KLB/HR	Gross Load MW	Load MMBtu per hr	# of Inj's	Tip Type	Liquid Flow [gpm]	Flow / inj [gpm]	Air P [psig]	"A" @ Flow [gph]	50% NSR	Droplet Size [µm]	NOx ppmd	CO ppmd	O2 %(dry)	NH3 ppm	NOx ppmdc	Calc # NOX MMBtu	BL # NOX MMBtu	Total NSR	% Red	% Util	Test No.	COMMENTS
UNIT 2																									
January 9, 2001																									
1.01	Baseline	14:10	160.00	11	166.3	0	inj	0.0	N/A	0	0	0.00	N/A		88	7.0	N/A	181	0.296	0.296	0.00	0.1%	N/A	1.01	
1.02	Test 1	14:20	180.00	11	166.3	5	C30	4.5	0.90	50	3.0	0.44	362		110	7.0	N/A	140	0.229	0.296	0.44	22.7%	51.1%	1.02	
1.03	Test 2	15:30	180.00	11	166.3	5	C30	3.5	0.70	60	3.0	0.44	507		75	7.0	N/A	145	0.237	0.296	0.44	20.0%	44.9%	1.03	
1.04	Test 3	16:15	130.00	11	166.3	5	C30	5.3	1.06	40	3.0	0.44	385		300	9.5	2.2	165	0.270	0.296	0.44	8.9%	20.1%	1.04	
1.05	P(H2O) = 75	16:45	170.00	11	166.3	5	C30	5.3	1.06	40	3.0	0.44	385		200	8.0	N/A	140	0.229	0.296	0.44	22.7%	51.1%	1.05	
1.06	P(H2O) = 70	17:10	162.00	11	166.3	5	C30	4.8	0.96	40	3.0	0.44	378		65	7.5	N/A	140	0.229	0.296	0.44	22.7%	51.1%	1.06	
1.07	P(H2O) = 65	17:35	170.00	11	166.3	5	C30	4.3	0.86	40	3.0	0.44	370		65	6.5	N/A	135	0.221	0.296	0.44	25.5%	57.3%	1.07	
1.08	P(H2O) = 65	17:55	170.00	11	166.3	5	C30	4.3	0.86	40	2.5	0.37	370		100	9.0	0.6	150	0.245	0.296	0.37	17.2%	46.4%	1.08	
January 10, 2001																									
2.01	Baseline	13:15	165.00	12.5	189.0	0	Inj	0.0	N/A	0	0	0.00	N/A		100	9	N/A	190	0.310	0.310	0.00	-0.1%	N/A	2.01	Baseline
January 11, 2001																									
3.01	Baseline	8:10	175.00	15.3	231.3	0	inj	0.00	N/A	0	0.0	0.00	N/A		70	8.5	N/A	185.0	0.302	0.302	0.00	-0.1%	N/A	3.01	Baseline
3.02	Full Load	9:00	180.00	15.2	229.8	5	C30	4.50	0.90	40	2.5	0.26	373		40	7.5	4.5	175.0	0.286	0.302	0.26	5.3%	20.2%	3.02	Water Pressure = 70 psi; Furnace Temp Avg = 1450 F
3.03	Full Load	9:40	165.00	15.2	229.8	5	C30	4.80	0.96	40	2.5	0.26	378		70	8.5	0.6	155.0	0.253	0.302	0.26	16.1%	61.4%	3.03	Water Pressure = 65 psi; Furnace Temp Avg = 1425 F
3.04	Baseline	11:30	170.00	15.2	229.8	0	inj	0.00	N/A	0	0.0	0.00	N/A		70	8.5	N/A	175.0	0.286	0.286	0.00	0.0%	N/A	3.04	
3.05		12:10	165.00	15.2	229.8	5	C30	4.80	0.96	40	2.5	0.28	378		90	8.2	N/A	145.0	0.237	0.286	0.28	17.2%	61.9%	3.05	
3.06	Baseline	13:35	180.00	15.2	229.8	0	inj	0.00	N/A	0	0.0	0.00	N/A		60	8.5	N/A	180.0	[illegible]	[illegible]	[illegible]	[illegible]	N/A	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		60	8.0	N/A	140.0	0.229	0.294	0.32	22.2%	68.5%	3.07	
3.08		15:30	180.00	15.2	229.8	5	C30	4.30	0.86	40	2.5	0.27	370		100	7.5	N/A	140.0	0.229	0.294	0.27	22.2%	82.2%	3.08	
[illegible]	Baseline	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		70	7.5	N/A	143.0	0.233	0.286	0.28	18.3%	65.1%	3.10	
3.11		18:40	175.00	15	226.8	5	C30	4.75	0.95	40	2.7	0.30	377		70	8.0	N/A	140.0	0.229	0.286	0.30	20.0%	65.9%	3.11	
3.12	Baseline	19:00	168.00	15	226.8	0	inj	0.00	N/A	0	0.0	0.00	N/A		65	7.8	N/A	168.0	0.275	0.275	0.00	0.2%	N/A	3.12	
January 12, 2001																									
4.01	Baseline	8:00	160.00	14	211.7	0	inj	0.0	N/A	0	0	0.00	N/A		68	8.0	N/A	182.0	0.297	0.297	0.00	-0.1%	N/A	4.01	Baseline
4.02		9:40	177.00	14	211.7	5	C30	4.8	0.96	40	2.8	0.32	378		70	7.2	N/A	140.0	0.229	0.297	0.32	23.0%	70.7%	4.02	
4.03		11:00	185.00	14	211.7	5	C30	4.9	0.98	40	2.7	0.31	380		120	7.0	1.0	140.0	0.229	0.297	0.31	23.0%	73.4%	4.03	
4.04		12:15	170.00	14.5	219.2	5	C30	4.8	0.96	40	2.4	0.27	378		57	7.5	0.9	142.0	0.232	0.297	0.27	21.9%	81.4%	4.04	
4.05	Baseline	1:00	185.00	14	211.7	0	inj	0.0	N/A	0	0	0.00	N/A		65	7.0	N/A	165.0	0.270	0.270	0.00	0.1%	N/A	4.05	
4.06		2:00	170.00	14	211.7	5	C30	4.6	0.92	40	2.6	0.33	375		65	9.0	N/A	165.0	0.270	0.270	0.33	0.1%	0.4%	4.06	Several Metering Module shutdowns; Load dropped 60 K halfway through test.

Fig. 2.2

Project Name: Montenay/Dade County
Project Description: NOxOut Start-up

fd	9102	sfc(dry)/MMBtu	
Ref O2	7	%	
Reference Load	20	MW	
Reference GHI	302	mBTU/Hr	

Boiler Load						Zone 1 Injection								Analyzers				Summary of Results							
Test No.	Test Type	Test Time	Steam Load KLB/HR	Gross Load MW	Load MMBtu per hr	# of Inj's	Tip Type	Liquid Flow [gpm]	Flow / inj [gpm]	Air P [psig]	"A" @ 50% Flow [gph]	NSR	Droplet Size [μm]	NOx ppmd	CO ppmd	O2 %(dry)	NH3 ppm	NOx ppmdc	Calc # NOX MMBtu	BL # NOX MMBtu	Total NSR	% Red	% Util	Test No.	COMMENTS
UNIT 3																									
December 12, 2000																									
1.01	Baseline	9:00	171.10	15	226.8	0	inj	0.0	N/A	0	0.0	0.00	N/A		310	5.6	N/A	168	0.275	0.275	0.00	0.2%	N/A	1.01	
1.02		9:30	164.50	16	241.9	5	C00	4.5	0.90	45	2.0	0.22	383		85	7.1	N/A	154	0.252	0.275	0.22	8.5%	38.8%	1.02	
1.03		10:20	165.60	12.5	189.0	5	C00	4.6	0.92	45	2.5	0.35	385		119	6.3	N/A	142	0.232	0.275	0.35	15.6%	44.5%	1.03	
1.04		11:00	167.80	12	181.4	5	C00	4.6	0.92	45	3.0	0.44	385		78	7.6	N/A	133	0.217	0.275	0.44	21.0%	47.8%	1.04	
1.05	Baseline	13:05	169.50	12	181.4	0	inj	0.0	N/A	45	0.0	0.00	N/A		123	5.3	N/A	177	0.289	0.289	0.00	-0.1%	N/A	1.05	
1.06	Full Load	13:45	185.80	12.5	189.0	5	C00	4.5	0.90	45	3.5	0.47	383		456	3.2	N/A	111	0.181	0.289	0.47	37.2%	79.7%	1.06	
1.07		14:40	163.50	7.5	113.4	5	C00	4.5	0.90	45	4.0	0.89	383		76	8.4	N/A	135	0.221	0.289	0.89	23.7%	26.6%	1.07	
1.08	Baseline	15:15	160.90	14	211.7	0	inj	0.0	N/A	0	0.0	0.00	N/A		70	7.3	N/A	157	0.257	0.257	0.00	0.2%	N/A	1.08	
January 11, 2001																									
2.01	Baseline	8:10	165.00	14.5	219.2	0	inj	0.0	N/A	0	0.0	0.00	N/A		45	8.3	N/A	180	0.294	0.294	0.00	0.0%	N/A	2.01	
2.02		9:45	165.00	14.5	219.2	5	C30	4.5	0.90	50	3.0	0.34	362		40	8.3	N/A	150	0.245	0.294	0.34	16.6%	49.0%	2.02	P(H20) = 70 psi
2.03		10:45	165.00	14.5	219.2	5	C30	4.0	0.80	50	2.9	0.32	354		60	7.5	N/A	155	0.253	0.294	0.32	13.9%	43.0%	2.03	P(H20) = 70 psi
2.04		11:25	165.00	14.5	219.2	5	C30	3.6	0.72	50	2.9	0.33	347		50	8.3	N/A	155	0.253	0.294	0.33	13.9%	42.2%	2.04	P(H20) = 65 psi
2.05		12:00	170.00	14.5	219.2	5	C30	4.1	0.82	45	2.8	0.32	361		45	8.5	N/A	155	0.253	0.294	0.32	13.9%	43.7%	2.05	
2.06	Baseline	13:30	165.00	14.5	219.2	0	inj	0.0	N/A	0	0.0	0.00	N/A		30	8.5	N/A	185	0.302	0.302	0.00	-0.1%	N/A	2.06	
2.07		14:35	165.00	14.5	219.2	5	C30	4.6	0.92	45	2.5	0.28	369		40	8.5	5.4	155	0.253	0.302	0.28	16.1%	58.6%	2.07	
2.08		15:25	165.00	14.5	219.2	5	C30	4.7	0.94	45	2.5	0.28	370		85	8.3	0.5	145	0.237	0.302	0.28	21.5%	78.2%	2.08	
2.09	Baseline	16:15	167.00	15	226.8	0	inj	0.0	N/A	0	0.0	0.00	N/A		27	8.4	N/A	176	0.288	0.288	0.00	0.1%	N/A	2.09	Baseline
2.10		17:35	165.00	15	226.8	5	C30	3.7	0.74	50	2.8	0.31	349		65	8.5	0.6	150	0.245	0.288	0.31	14.9%	47.6%	2.10	
2.11		18:35	162.50	15	226.8	5	C30	4.6	0.92	40	2.7	0.30	375		80	8.5	0.7	147	0.240	0.288	0.30	16.6%	55.1%	2.11	
2.12	Baseline	19:00	165.00	15	226.8	0	inj	0.0	N/A	0	0.0	0.00	N/A		40	8.3	N/A	175	0.286	0.286	0.00	0.0%	N/A	2.12	
January 12, 2001																									
3.01	Baseline	8:00	175.00	16	241.9	0	inj	0.0	N/A	0	0	0.00	N/A		49	8.0	N/A	178	0.291	0.291	0.00	0.1%	N/A	3.01	Baseline
3.02		10:50	165.00	16	241.9	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.02	
3.03		12:15	162.00	14.5	219.2	5	C30	4.8	0.96	40	2.2	0.25	[illegible]		[illegible]										
3.04		1:00	165.00	15	226.8	5	C30	4.7	0.94	40	2.1	0.23	377		150	8.8	1.5	[illegible]	0.237	0.291	0.23	[illegible]	[illegible]	[illegible]	
3.05		1:50	162.50	15	226.8	5	C30	4.7	0.94	40	2.1	0.23	377		80	8.5	2.0	145	0.237	0.291	0.23	18.6%	80.1%	3.05	
3.06	Baseline	3:10	162.50	15	226.8	0	inj	0.0	N/A	0	0	0.00	N/A		85	8.7	N/A	175	0.286	0.286	0.00	0.0%	N/A	3.06	

Fig 2.3

Project Name: Monteray/Dade County

Project Description: NOxOut Start-up

fd	9102	sfc(dry)/MMBtu
Ref O2	7	%
Reference Load	20	MW
Reference GHI	302	mBTU/Hr

Boiler Load						Zone 1 Injection								Analyzers				Summary of Results							
Test No.	Test Type	Test Time	Steam Load KLB/HR	Gross Load MW	Load MMBtu per hr	# of Inj's	Tip Type	Liquid Flow [gpm]	Flow / inj [gpm]	Air P [psig]	"A" @ Flow [gph]	50% NSR	Droplet Size [μm]	NOx ppmd	CO ppmd	O2 %(dry)	NH3 ppm	NOx ppmdc	Calc # NOX /MMBtu	BL # NOX /MMBtu	Total NSR	% Red	% Util	Test No.	COMMENTS
UNIT 4																									
December 12, 2000																									
1.01	Baseline	9:00	168.40	15	226.8	0	inj	0.0	N/A	0	0.0	0.00	N/A		376	8.1	N/A	177	0.289	0.289	0.00	-0.1%	N/A	1.01	
1.02		9:30	165.70	16	241.9	5	C00	4.2	0.84	45	2.0	0.21	377		427	10.7	N/A	182	0.297	0.289	0.21	-2.9%	-13.9%	1.02	
1.03		10:20	135.30	12.5	189.0	5	C00	4.3	0.86	45	2.5	0.33	379		430	10.4	N/A	142	0.232	0.289	0.33	19.7%	59.1%	1.03	
1.04		11:00	161.50	12	181.4	5	C00	4.4	0.88	45	3.0	0.42	381		145	8.7	N/A	130	0.212	0.289	0.42	26.5%	63.5%	1.04	
1.05	Baseline	13:10	105.50	12	181.4	0	inj	0.0	N/A	0	0.0	0.00	N/A		1262	14.2	N/A	190	0.310	0.310	0.00	-0.1%	N/A	1.05	
1.06		13:45	107.10	12.5	189.0	5	C00	4.4	0.88	45	3.5	0.44	381		734	13.3	N/A	137	0.224	0.310	0.44	27.8%	63.8%	1.06	
1.07		14:40	157.10	7	105.8	5	C00	4.5	0.90	45	4.0	0.89	383		173	8.3	N/A	116	0.190	0.310	0.89	38.9%	43.7%	1.07	
1.08	Baseline	15:15	153.90	14	211.7	0	inj	0.0	N/A	45	0.0	0.00	N/A		218	8.9	N/A	162	0.265	0.265	0.00	0.1%	N/A	1.08	
1.09		16:00	149.90	13.5	204.1	5	C00	4.5	0.90	50	2.0	0.27	375		358	8.8	N/A	145	0.237	0.265	0.27	10.6%	39.3%	1.09	
January 9, 2001																									
2.01	Baseline	10:15	140.00	11	166.3	5	inj	0.0	0.00	0	0	0.00	N/A	---	174	9.0	2.4	177	0.289	0.289	0.00	-0.1%	N/A	2.01	Comments
2.02	Test 1.1	11:35	150.00	11	166.3	5	C30	4.8	0.96	40	3.1	0.47	378	---	175	8.5	2.4	139	0.226	0.289	0.470	21.6%	46.0%	2.02	
2.03	Baseline	14:15	140.00	11	166.3	0	inj	0.0	N/A	0	0	0.00	N/A	---	280	9.0	--	180	0.294	0.294	0.00	0.0%	N/A	2.03	
2.04	Test 1.2	14:40	162.00	11	166.3	5	C30	4.8	0.96	40	3.1	0.46	378	---	350	9.0	1.9	135	0.221	0.294	0.46	25.0%	54.0%	2.04	
2.05	Baseline	17:10	140.00	11	166.3	0	inj	0.0	N/A	0	0	0.00	N/A	---	120	8.5	--	160	0.261	0.261	0.00	-0.2%	N/A	2.05	
2.06	Test 1.3	17:50	137.50	11	166.3	5	C30	3.5	0.70	50	2	0.34	345	---	95	8.2	--	145	0.237	0.261	0.34	9.2%	27.4%	2.06	
2.07	Baseline	18:15	145.00	11	166.3	0	inj	0.0	N/A	0	0	0.00	N/A	---	90	8.2	--	140	0.229	0.229	0.00	0.1%	N/A	2.07	
[illegible]																									
3.01	Baseline	5:30	140.00	10	151.2	0	inj	0.0	N/A	0	0.0	0.00	N/A	---	91	9.5	--	178	0.291	0.291	0.00	0.1%	N/A	3.01	Comments
3.02	----	9:00	135.00	10	151.2	5	C30	3.8	0.76	40	2.0	0.33	362	---	165	9.0	--	145	0.237	0.291	0.33	18.6%	56.1%	3.02	Furnace Temp = 1200 deg F
3.03	----	10:15	145.00	10	151.2	5	C30	3.9	0.78	40	1.7	0.28	363	---	75	8.5	--	140	0.229	0.291	0.28	21.4%	75.9%	3.03	
3.04	Baseline	13:25	140.00	10	151.2	0	inj	0.0	N/A	0	0.0	0.00	N/A	---	85	9.0	--	175	0.286	0.286	0.00	0.0%	N/A	3.04	
3.05	----	14:25	145.00	10	151.2	5	C30	3.8	0.76	50	2.2	0.37	350	---	70	8.5	--	140	0.229	0.286	0.37	20.0%	53.9%	3.05	
3.06	Baseline	16:45	153.00	14	211.7	0	inj	0.0	N/A	0	0.0	0.00	N/A	---	32	7.6	--	162	0.265	0.265	0.00	0.1%	N/A	3.06	Baseline
3.07	----	17:30	140.00	14	211.7	5	C30	3.7	0.74	50	1.5	0.20	349	---	45	8.0	--	135	0.221	0.265	0.20	16.8%	85.9%	3.07	
3.08	----	18:25	140.00	13.5	204.1	5	C30	4.4	0.88	40	1.9	0.26	372	---	45	7.6	--	130	0.212	0.265	0.26	19.8%	77.5%	3.08	
3.09	Baseline	19:00	135.00	13.5	204.1	0	inj	0.0	N/A	0	0.0	0.00	N/A	---	44	8.0	--	154	0.252	0.252	0.00	0.1%	N/A	3.09	

Fig. 2.4

3.0 Injector Arrangements and Ammonia Slip

Injector arrangement and operating conditions were selected to achieve the required performance while minimizing ammonia slip. Table 3.1 defines the optimized injector arrangement and operating conditions. The orientation of injectors with sprays offset at an angle is described in terms of a clock face. Standing behind the injector looking inward to the furnace, an orientation fully upward is as if pointing to 12 on a clock. Right is at 3, down is at 6, left is at 9, etc.

The injectors for all units used angled full cone nozzles with the angled spray aimed fully downward (at 6 o'clock). Full cone straight tips were initially used during pre-optimization testing, but it was determined that injecting into that zone was too cold for proper utilization of the NO_xOUT reagent, so the tips were changed to 30 degree angled full cone tips pointed downward because of higher temperatures below the level of injection. The change was also made because reagent slip tends to result where the temperatures are low and the residence time is short.

The atomizing air pressure setting is 40 psig. The injector flow rate is 0.9 gpm to 1.1 gpm of mixed chemical per injector for all units.

The ammonia slip values are listed in table 3.2. Ammonia values were taken on one unit at a time until it was determined the ammonia slip requirements had been met on that particular unit. All data was taken prior to filling out of control tables on each metering module. Slip was controlled to 15 ppm or less for all units.

Project Name Montenay-Dade County

Project Description Optimization

Date: 1/12/2001 **Injector Orientation**

Tip Codes:

AC=Angled Cone (30 deg)

Orientation is based on the operator's view looking into the furnace at the installed injectors' spray pattern

Unit 1	Tip	Orientation
1A	AC	6:00
1B	AC	6:00
1C	AC	6:00
1D	AC	6:00
1E	AC	6:00

Atomization setting: 40 psig

Flow/Inj.= 0.9 to 1.1 gpm

Unit 2	Tip	Orientation
2A	AC	6:00
2B	AC	6:00
2C	AC	6:00
2D	AC	6:00
2E	AC	6:00

Atomization setting: 40 psig

Flow/Inj.= 0.9 to 1.1 gpm

Unit 3	Tip	Orientation
3A	AC	6:00
3B	AC	6:00
3C	AC	6:00
3D	AC	6:00
3E	AC	6:00

Atomization setting: 40 psig

Flow/Inj.= 0.9 to 1.1 gpm

Unit 4	Tip	Orientation
4A	AC	6:00
4B	AC	6:00
4C	AC	6:00
4D	AC	6:00
4E	AC	6:00

Atomization setting: 40 psig

Flow/Inj.= 0.9 to 1.1 gpm

Note: Air should be left on installed injectors at all times (whether the NOxOUT System is running or not).

Table 3.1

FUEL TECH

Project Name: Montenay - Dade County

Project Description: NOxOUT Optimization

Date: January 9-12, 2001 **Ammonia Slip Results**

Date		01/09/01							
	Slope	Conc.	mV	Log 10					
	55	0.0002	9.9	-3.69897	Intercept	-3.52[illegible]4			
	47.9	0.002	-45.1	-2.69897	Slope	-0.01[illegible]6			
		0.02	-93	-1.69897					
Test #	Start Time	Stop Time	Port Loc.	Gas Vol	Abs.Vol	Tem[illegible] C	mV	PPMv	BOILER
9.01	11.34	11.54	A/H/INLET	30	100	2[illegible]	51.6	2.4	4
9.02	14.39	15.01	"	30	100	2[illegible]	57.1	1.9	4
9.03	16.22	16.42	"	30	100	2[illegible]	53.2	2.2	2
9.04	17.59	18:20	"	30	100	2[illegible]	83.5	0.6	2

Date		01/11/01							
	Slope	Conc.	mV	Log 10					
	48.5	0.0002	39.2	-3.69897	Intercept	-2.89[illegible]62			
	49.5	0.002	-9.3	-2.69897	Slope	-0.02[illegible]407			
		0.02	-58.8	-1.69897					
Test #	Start Time	Stop Time	Port Loc.	Gas Vol	Abs.Vol	Temp, C	mV	PPMv	BOILER
11.01	8:40	11.54	A/H/INLET	30	100	2[illegible]	66.9	4.4	2
11.02	9:57	10.21	"	30	100	2[illegible]	110.8	0.6	2
11.03	13:40	14:00	"	30	100	34	63.7	5.4	3
11.04	14:51	15.11	"	30	100	32	114.7	0.5	3
11.05	17:02	17.23	"	30	100	31	109.9	0.6	3
11.06	18:02	18.23	"	30	100	32	105.6	0.7	3

Date		01/12/01							
	Slope	Conc.	mV	Log 10					
	51.5	0.0002	50.5	-3.69897	Intercept	-2.718387			
	51.5	0.002	-1	-2.69897	Slope	-0.019417			
		0.02	-52.5	-1.69897					
Test #	Start Time	Stop Time	Port Loc.	Gas Vol	Abs.Vol	Temp, C	mV	PPMv	BOILER
12.01	9.03	9.24	inlet.econ	30	100	25	105.8	1.4	1
12.02	9.44	10.04	"	30	100	28	103.9	1.5	1
12.03	10.34	10.55	A/H/INLET	30	100	30	113.5	1.0	2
12.04	11.18	11.38	"	30	100	32	115.7	0.9	2
12.05	12.49	13.09	"	30	100	30	104.3	1.5	3
12.06	13.25	13.45	"	30	100	29	97.6	2.0	3

Table 3.2

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4.0 Performance Testing and Results

Performance testing of the NO_xOUT System for Montenay-Dade County was conducted on January 24-25, 2001 for Units #1 and #2 and February 13-14, 2001 for Units #3 and #4. Performance results and notes are tabulated in Tables 4.1 and 4.2.

Testing was performed for a period of twenty-four (24) hours, exclusive of the time necessary to establish uncontrolled NO_x. The testing consisted of four baseline runs and three consecutive 8-hour operations of the equipment, thus providing the twenty-four (24) hours of testing. A successful test was based on meeting performance guarantees established in Section 1.0.

Figures 4.3, 4.5, 4.7, and 4.9 show average baseline and controlled NO_x emissions for Units 1 through 4 respectively. Figures 4.4, 4.6, 4.8, and 4.10 show average reagent chemical flows for each 8-hour test for Units 1 through 4 respectively.

As is shown in Figures 4.7 and 4.8, all NO_x emission performance guarantees and reagent flow rates were met on Unit #3. Baseline NO_x emissions were above 170 ppmdc while controlled NO_x emissions were below 150 ppmdc while having a reagent flow rate of between 2.0 and 2.5 gph. Figures 4.9 and 4.10 show similar results for Unit #4, with baseline NOx emissions around 170 ppmdc while controlled NO_x emissions were well below 150 ppmdc. Reagent flow rates for Unit #4 fell between 1.7 and 2.0 gph. It should be noted that since no baseline data was provided from the performance testing for Units #3 and #4, average baseline data from optimization results was used instead.

Results for Units #1 and #2 were different from those seen on Units #3 and #4. Figure 4.3 shows average baseline NO_x emissions for Unit #1 around 115 ppmdc while controlled NO_x emissions were around 95 ppmdc. However, though baseline emissions were below those stated in the performance guarantee, average emissions reductions of between 15 and 20 percent were achieved. Reagent flow rate guarantees were also met on Unit #1, as shown in Figure 4.2.

Results for Unit #2 were different than the results seen on Unit #1. Figure 4.5 shows average baseline NO_x emissions around 210 ppmdc, above the expected 170 ppmdc, while controlled NO_x emissions were around 165 ppmdc, slightly above the expected 150 ppmdc. Despite the high baseline averages, performance guarantees on controlled emissions were nearly met, with average reductions around 20 percent. The reagent flow rate was higher than that seen in Units #1, #3, and #4, but far below the performance guarantee requirements, as shown in Figure 4.6.

Project Name Montenay-Dade County

Project Description NOxOUT Start-up

Date: January 24-25, 2001 **Performance Test Results Units 1&2**

UNIT 1

Test	Time	NOx ppm (Avg)	Reagent Flow (gph)	Notes
Baseline 1	06:45 - 07:45	118	N/A	N/A
Test 1	08:00 - 16:00	89	2.5	System in calibration 08:00 - 08:40; lost load at 10:42 - 10:46 and 13:47 - 14:09.
Baseline 2	16:45 - 17:45	120	N/A	N/A
Test 2	17:30 - 00:30	99	2.0	Lost load at 20:15, 23:43, and 00:06.
Baseline 3	00:45 - 01:45	108	N/A	N/A
Test 3	02:05 - 10:05	96	2.0	System in calibration 08:00 - 08:40; lost load at 04:40 - 04:50, 05:50 - 05:55, and 06:10 - 06:15.
Baseline 4	10:15 - 11:15	116	N/A	N/A

UNIT 2

Test	Time	NOx ppm (Avg)	Reagent Flow (gph)	Notes
Baseline 1	06:45 - 07:45	229	N/A	N/A
Test 1	08:00 - 16:00	155	4.0	System in calibration 08:20 - 09:00; Lost load 15:10 - 15:25
Baseline 2	16:15 - 17:15	205	N/A	N/A
Test 2	17:30 - 00:30	160	4.0	Lost load at 17:51, 18:22, 22:30 - 23:40
Baseline 3	00:45 - 01:45	197	N/A	N/A
Test 3	02:05 - 10:05	152	4.0	System in calibration 08:20 - 09:00; lost load at 06:38 - 06:43, and 07:03.
Baseline 4	10:15 - 11:15	205	N/A	N/A

Table 4.1

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Project Name Montenay-Dade County

Project Description NOxOUT Start-up

Date: February 13-14, 2001 **Performance Test Results Units 3&4**

UNIT 3

Test	Time	NOx ppm (Avg)	Reagent Flow (gph)	Notes
Baseline 1	09:00 - 10:00	175*	N/A	N/A
Test 1	10:15 - 18:15	142	2.2	None
Baseline 2	18:25 - 19:25	175*	N/A	N/A
Test 2	19:30 - 03:30	138	2.3	Lost load at 01:42 - 01:50 and 02:47.
Baseline 3	03:35 - 04:25	175*	N/A	N/A
Test 3	04:30 - 12:30	140	2.5	System in calibration from 08:40 - 09:20.
Baseline 4	12:45 - 13:45	175*	N/A	N/A

UNIT 4

Test	Time	NOx ppm (Avg)	Reagent Flow (gph)	Notes
Baseline 1	09:00 - 10:00	169*	N/A	N/A
Test 1	10:15 - 18:15	135	1.9	NOxOut system off from 10:55 - 14:15; lost load at 14:49, 15:36, 15:57, and 16:17 - 16:23.
Baseline 2	18:25 - 19:25	169*	N/A	N/A
Test 2	19:30 - 03:30	125	1.8	NOxOut system off from 19:30 - 19:51; lost load at 20:38 - 20:48, 22:21-22:25, 22:39-22:43, 22:53-22:57, 23:10, 01:30-02:00, 02:05-02:14, 02:28-02:37, 02:48-02:58, 03:05
Baseline 3	03:35 - 04:35	169*	N/A	N/A
Test 3	04:30 - 12:30	125	1.8	System in calibration from 09:00-09:40; lost load at 05:26-05:36, 06:39, 08:16-08:23, 09:13-09:30, 10:20-10:45
Baseline 4	12:45 - 13:45	169*	N/A	N/A

*Note: Baseline data from units #3 and #4 taken from optimization data.

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Table 4.2

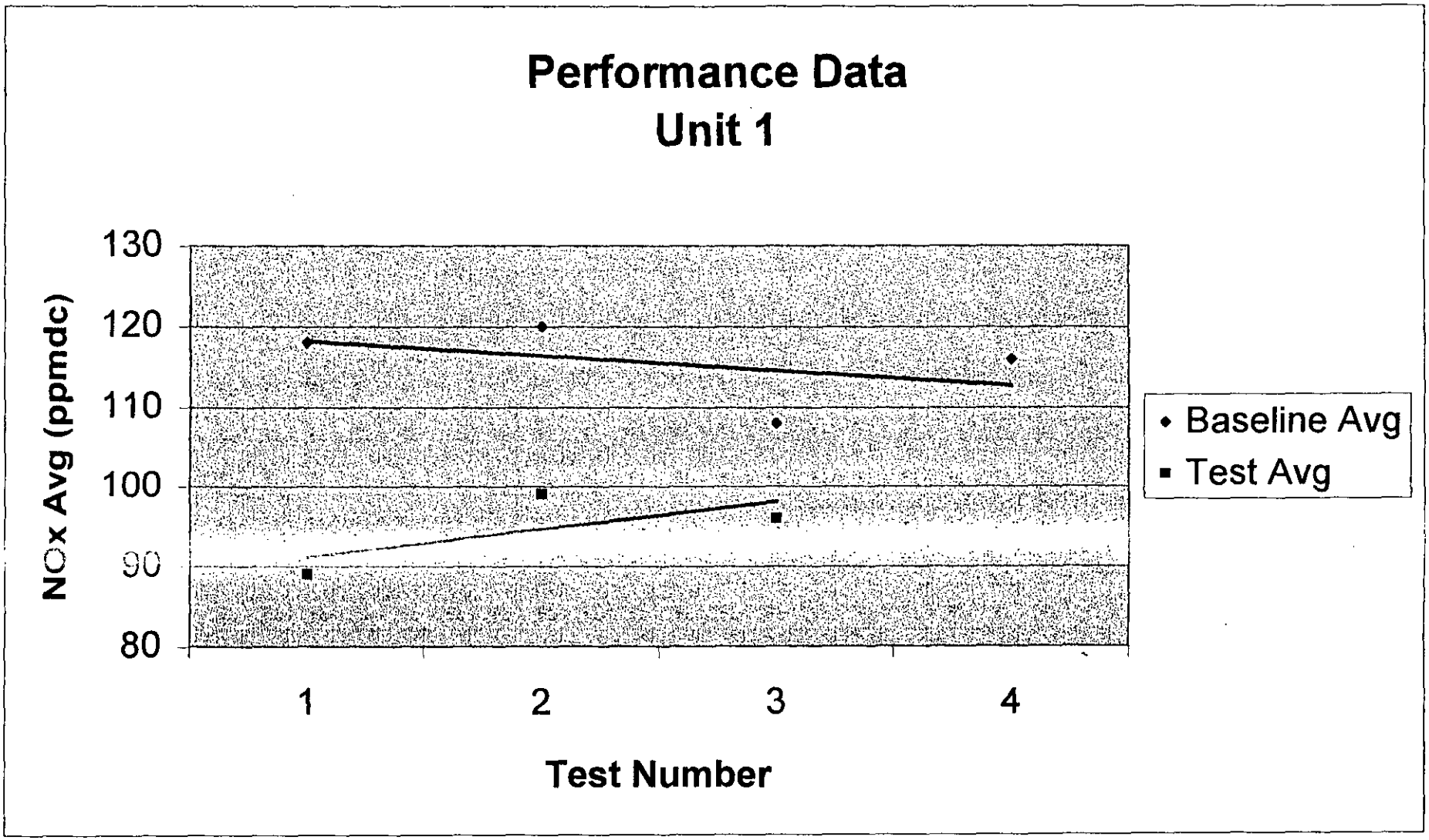
Performance Data
Unit 1
NOx Avg (ppmdc)
130
120
110
100
90
80
1
2
3
4
Test Number
Baseline Avg
Test Avg

Fig 4.3

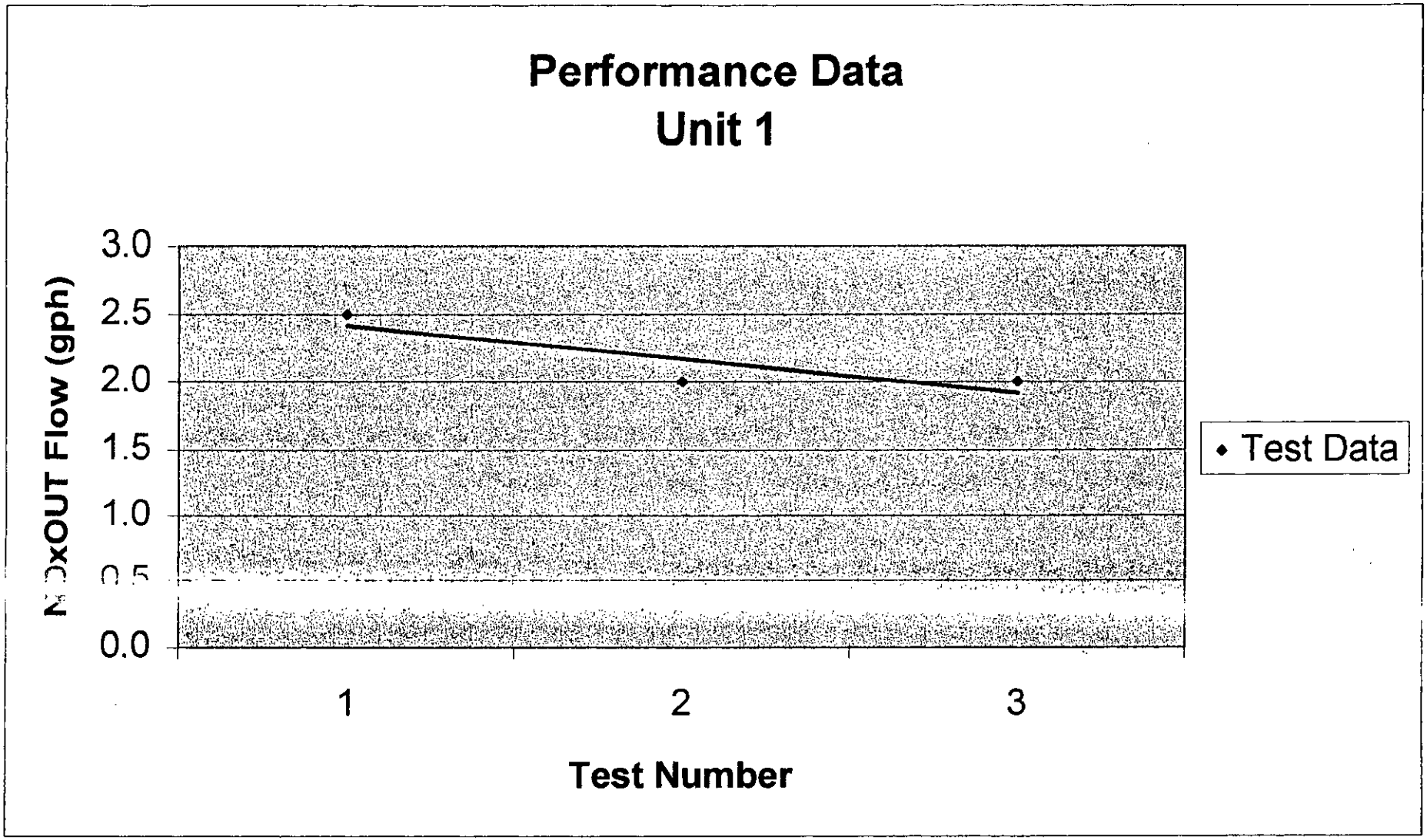
Performance Data
Unit 1
3.0
2.5
2.0
1.5
1.0
0.5
0.0
NOxOUT Flow (gph)
1
2
3
Test Number
Test Data

Fig 4.4

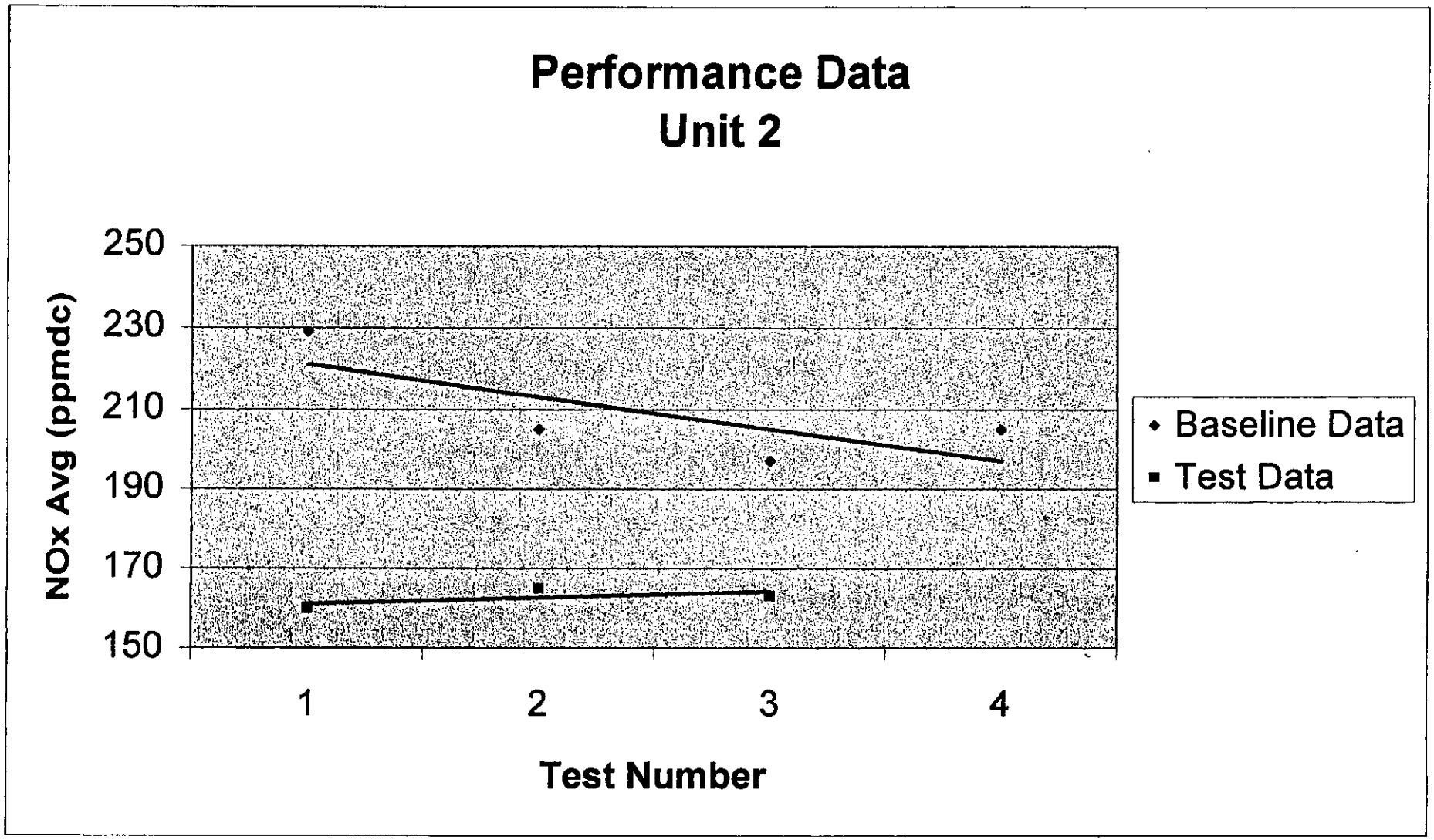
Performance Data
Unit 2
NOx Avg (ppmdc)
250
230
210
190
170
150
1
2
3
4
Test Number
Baseline Data
Test Data

Fig 4.5

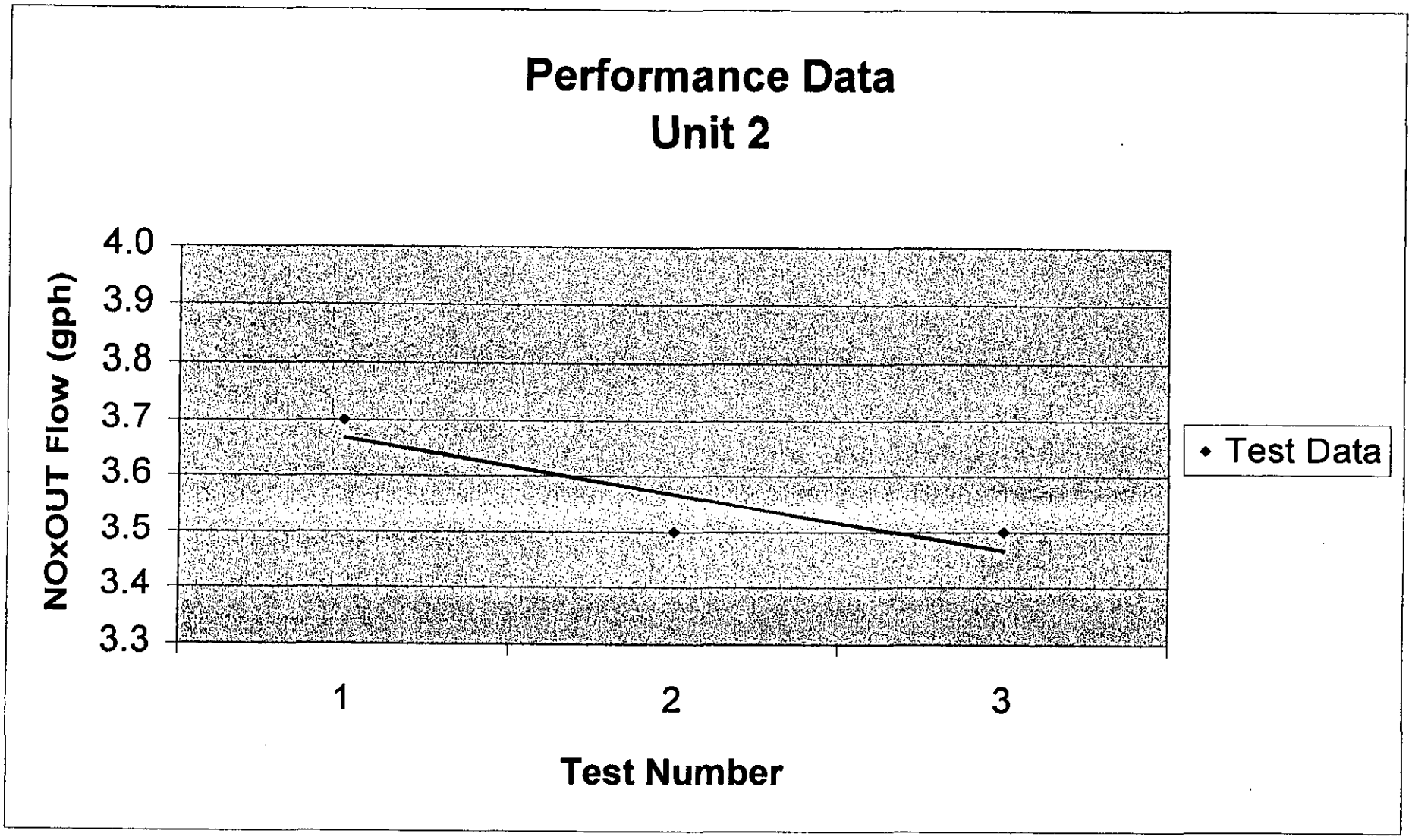
Performance Data
Unit 2
NOxOUT Flow (gph)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
1
2
3
Test Number
Test Data

Fig 4.6

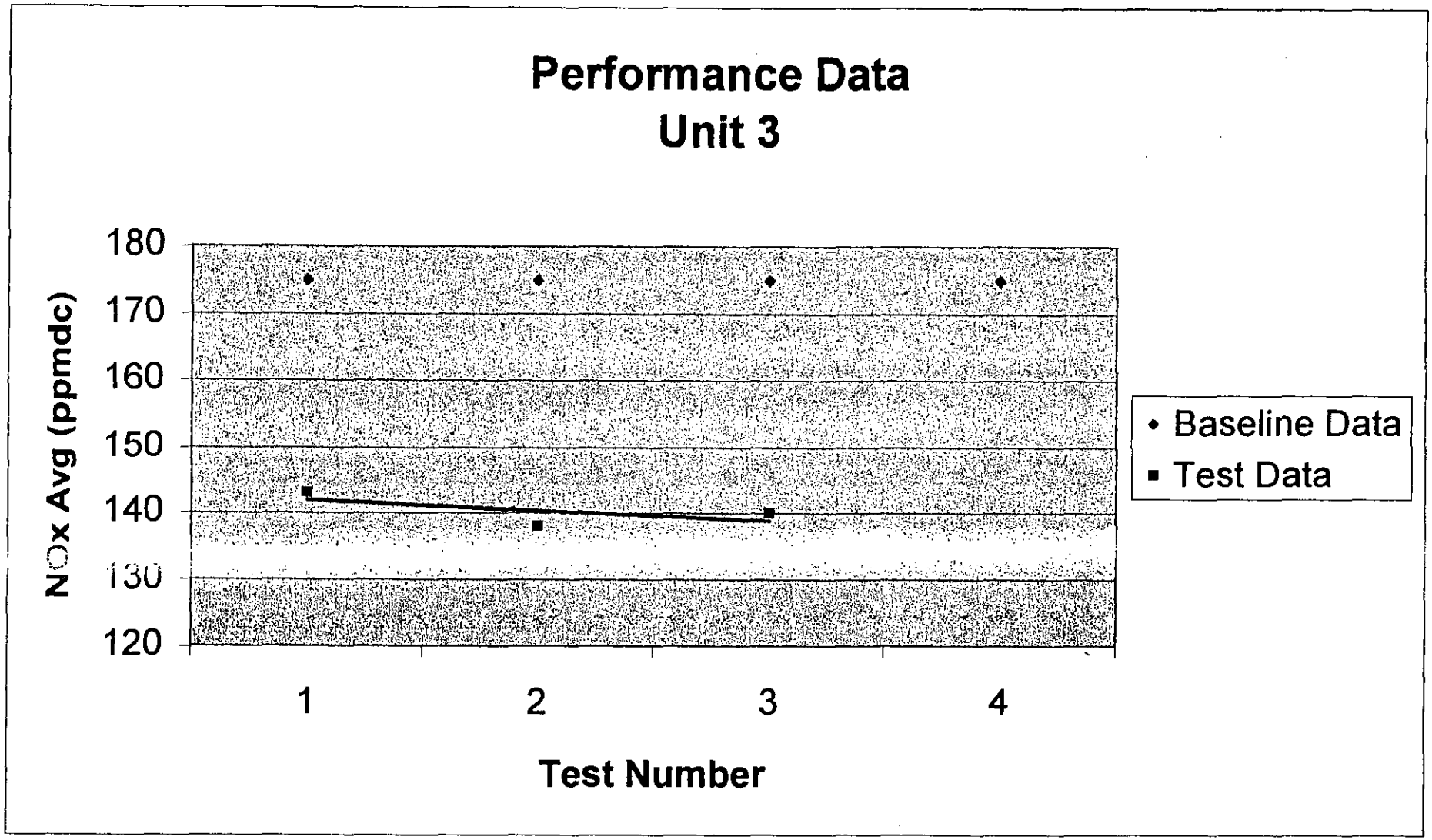
Performance Data
Unit 3
NOx Avg (ppmdc)
180
170
160
150
140
130
120
1
2
3
4
Test Number
Baseline Data
Test Data

Fig 4.7

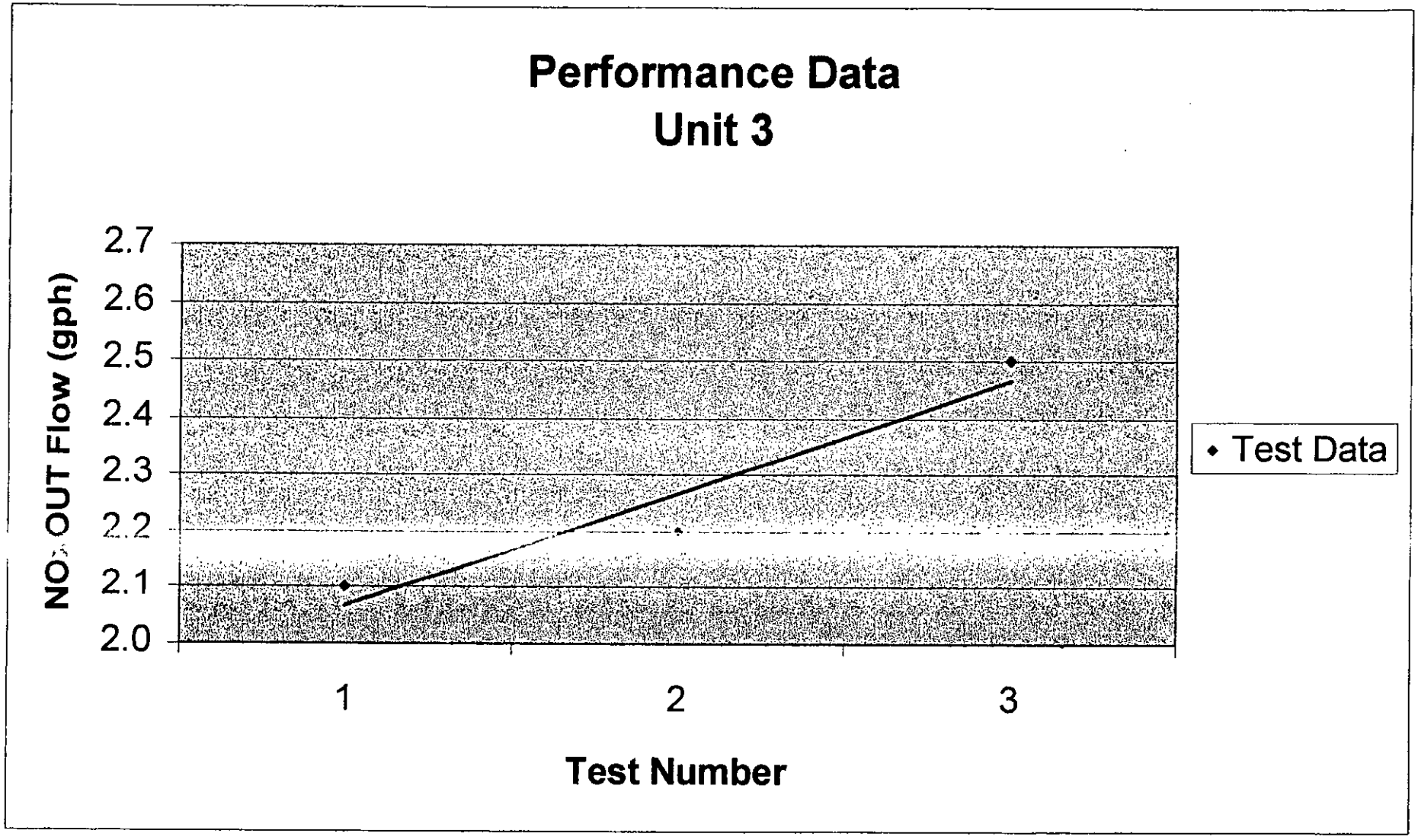
Performance Data
Unit 3
NO3 OUT Flow (gph)
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1
2
3
Test Number
Test Data

Fig 4.8

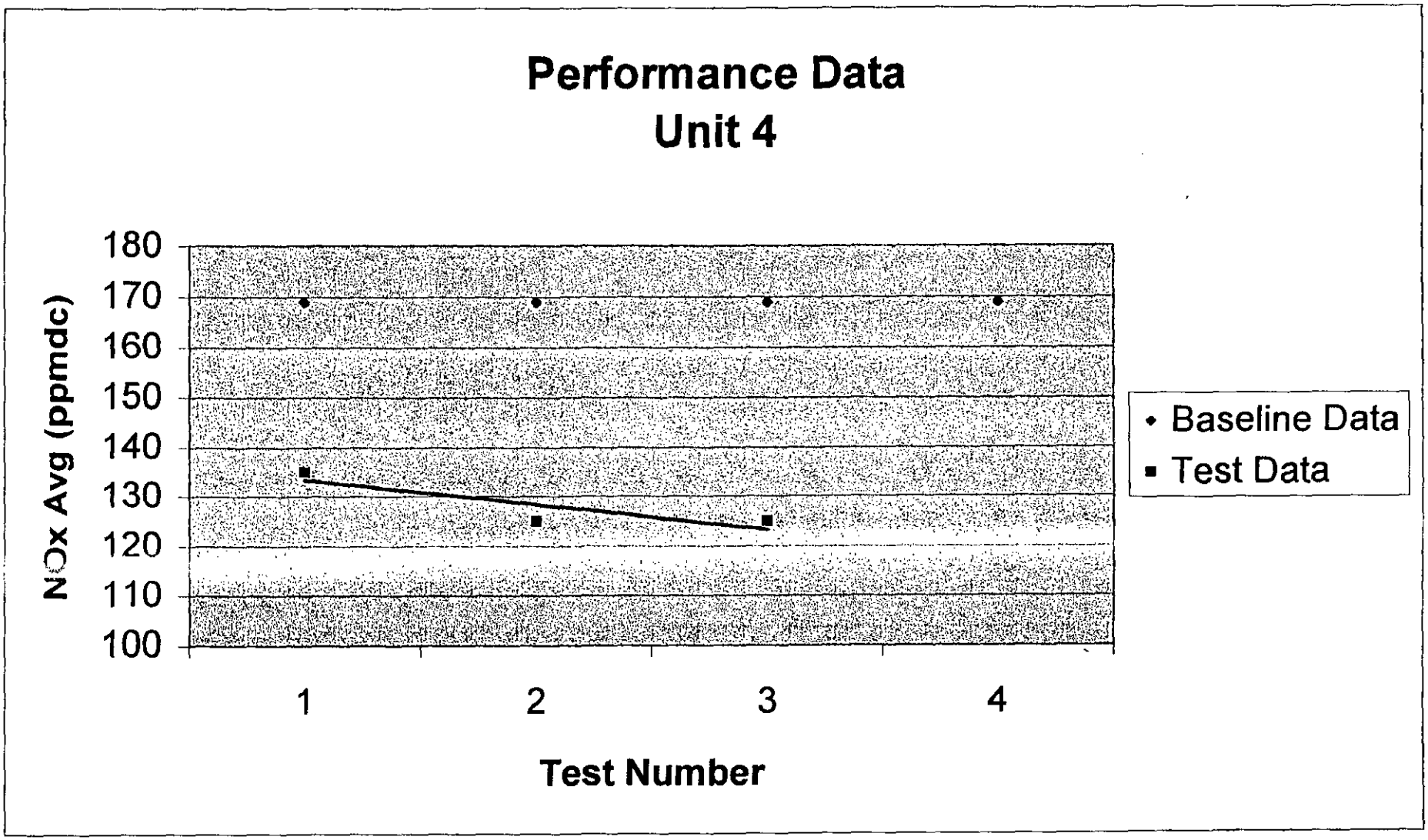
Performance Data
Unit 4
NOx Avg (ppmdc)
180
170
160
150
140
130
120
110
100
1
2
3
4
Test Number
Baseline Data
Test Data

Fig 4.9

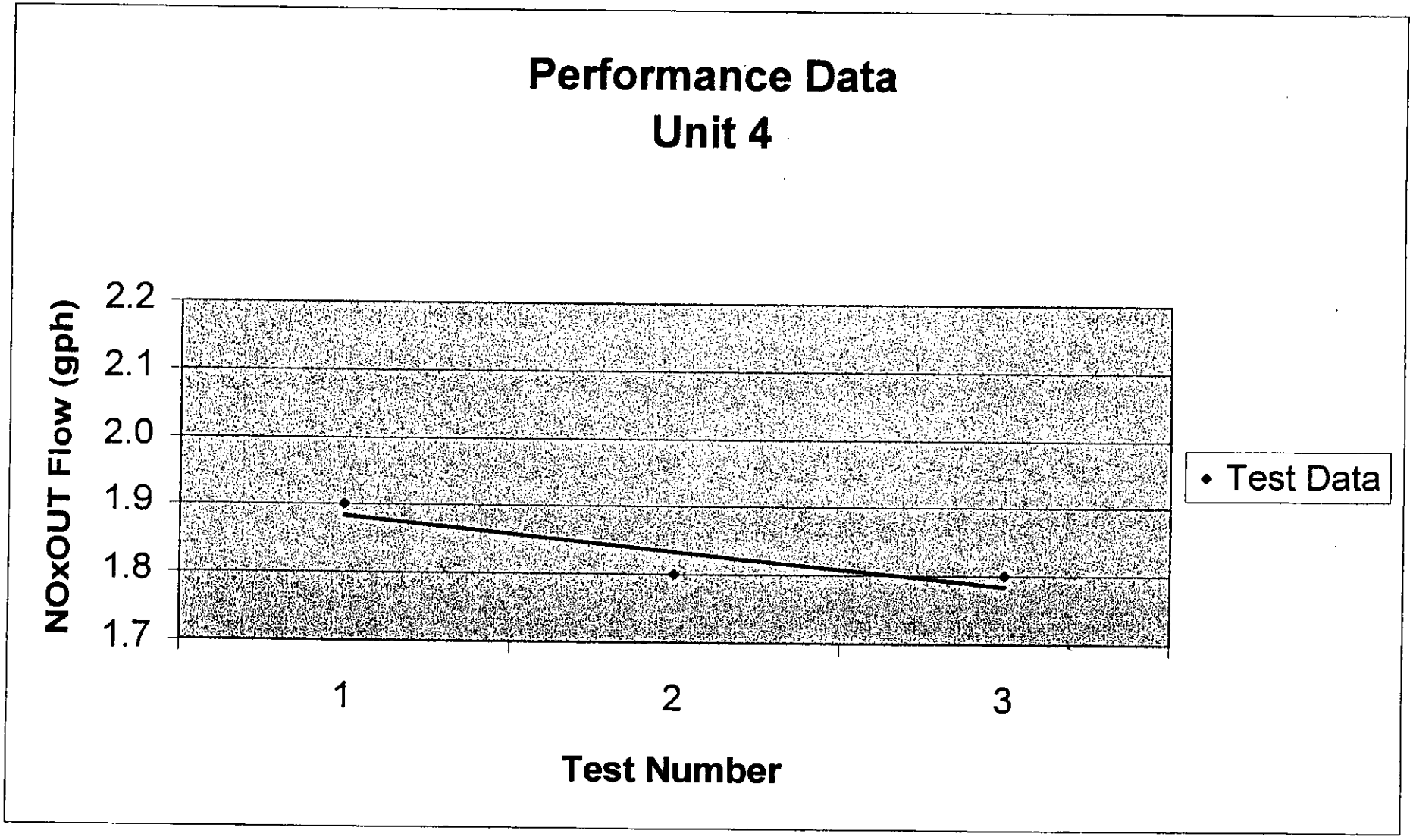
Performance Data
Unit 4
NOxOUT Flow (gph)
2.2
2.1
2.0
1.9
1.8
1.7
1
2
3
Test Number
Test Data

Fig 4.10

5.0 Trending and Scaling

The trending of several performance parameters was programmed into the Bailey system in order to aid in the optimization work and to have a continuous record of these parameters at all times. The scaling was set up for each individual parameter during testing, and a color was assigned along with the scaling in order to further differentiate each parameter from the others.

The parameters were further separated into two separate trends: boiler conditions and reagent conditions. Boiler condition parameters consisted of steam flow, corrected NOx, percent oxygen in the stack, carbon dioxide and furnace temperature. Reagent conditions consisted of level 1 chemical flow, level 1 water flow, and level 1 water pressure. Parameters for level 2 reagent condition were included in the trend view, but are not currently used. They were added for possible future use only.

The trending data can be read in two different ways. The parameters can be read with their corresponding scale by clicking on the color to the left of the parameter on the trending screen or they can be read with the general scale (in black). Table 5.1 shows the scaling for each parameter as it corresponds to the general scale.

Project Name Montenay - Dade County Units 1-4

Project Description NOxOut Startup

Date: 1/12/2001 **Parameter Scaling**

	General Scale	Boiler Condition Parameters					Reagent Condition Parameters		
Parameter	N/A	Steam Flow	NOx Corrected	Oxygen	CO	Furnace Temp	Level 1 Chem Flow	Level 1 Water Flow	Level 1 Water Pressure
Units	N/A	Klbs/hr	ppmdc	% (dry)	ppmd	degrees F	gph	gpm	psi
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.00	50.00	100.00	5.00	100.00	380.00	5.00	5.00	30.00
	40.00	100.00	200.00	10.00	200.00	760.00	0.00	10.00	60.00
	60.00	150.00	300.00	15.00	300.00	1140.00	15.00	15.00	90.00
	80.00	200.00	400.00	20.00	400.00	1520.00	20.00	20.00	10.00
	100.00	250.00	500.00	25.00	500.00	1900.00	25.00	25.00	50.00

Table 5.1

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6.0 Conclusion

As shown in this report, the NO_xOUT systems have been successfully commissioned on the four units at Montenay-Dade County and the systems are operating in full automatic mode. The NO_x emissions are being controlled below the required level of 150 ppmdc and all contractual provisions of the contract between Fuel Tech, Inc and Montenay-Dade County have been met.