City of Tallahassee
Your Own Utilities℠

300 South Adams Street, Tallahassee, Florida 32301, (850) 891-4YOU (4968), talgov.com

May 12, 2006 Hand Delivered

Trina Vielhauer
Chief, Bureau of Air Regulation
Florida Department of Environmental Protection
2600 Blair Stone Road, M.S. 5000
Tallahassee, Florida 32399

Re: Report on Gas Turbine and SCR Testing
Combustion Turbine Unit Nos. HC3 (EU-031) and HC4 (EU-032)
Arvah B. Hopkins Electric Generating Station
Air Construction Permit No. 0730003-005-AC

Dear Ms. Vielhauer:

In accordance with the Florida Department of Environmental Protection's (Department) April 4, 2006, letter authorizing the City of Tallahassee (City) to perform additional testing and tuning on the Arvah B. Hopkins Electric Generating Station Combustion Turbine Unit Nos. HC3 (EU-031) and HC4 (EU-032), the City submits the following summary report.

The authorized testing and tuning activities were initiated by General Electric and Deltak, the manufacturers of the combustion turbines and selective catalytic reduction (SCR) systems, respectively, on April 18, 2006. This testing lasted a total of approximately eight (8) operating days and was concluded on April 25, 2006. The City thereafter performed additional confirmatory testing and made any necessary refinements until May 2, 2006.

Please find attached a report summarizing the testing and tuning activities prepared by General Electric which includes the new ammonia injection curves developed. In addition, please also find attached the oxides of nitrogen (NOx) data recorded by the continuous emissions monitoring systems during the testing, and graphs prepared by the City demonstrating the post-tuning NOx emissions (ppmvd) versus unit output (megawatts).

While the testing and tuning activities were successful in improving the ability of the SCR systems to track NOx concentrations, the City would like to meet with the Department's Bureau of Air Regulation at its earliest convenience to discuss potential minor permit revisions which may be appropriate to ensure that these peaking units, the first LM6000 simple-cycle combustion turbines in Florida equipped with SCR, maintain compliance with the Department's requirements.

Thank you again for your assistance with this matter. Please do not hesitate to contact me at (850) 891-8851, if you have any questions or would like additional information regarding this report.

Sincerely,

John K. Powell
Interim Environmental and Safety Manager

Attachments

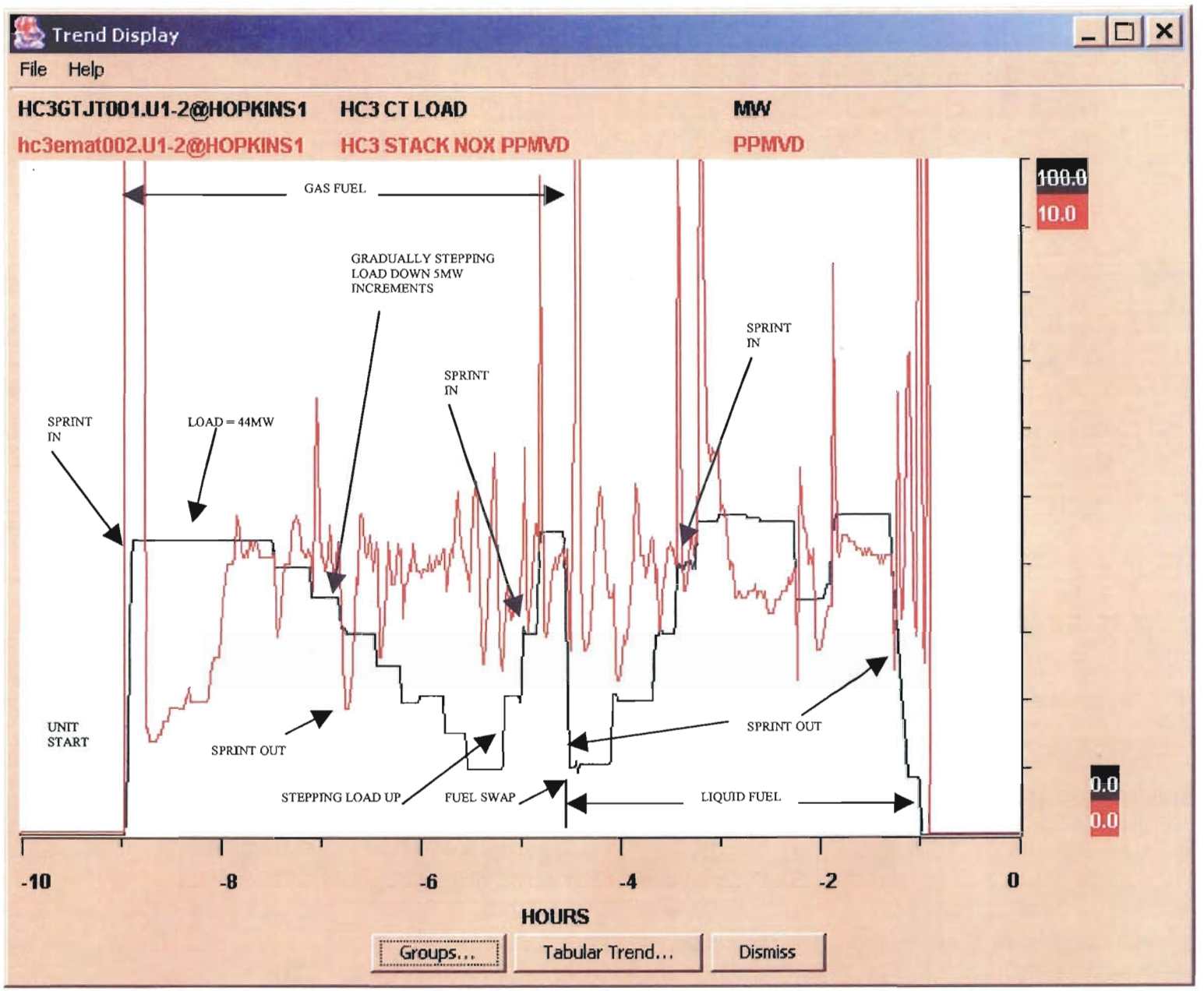
cc: Jeff Koerner, FDEP
Sandra Veazey, FDEP (Certified Mail No. 70041160000059423730)
Rick Bradburn, FDEP
Rob McGarrah, COT
Cynthia Barber, COT
Triveni Singh, COT
Phil Bucci, COT

ATTACHMENT A

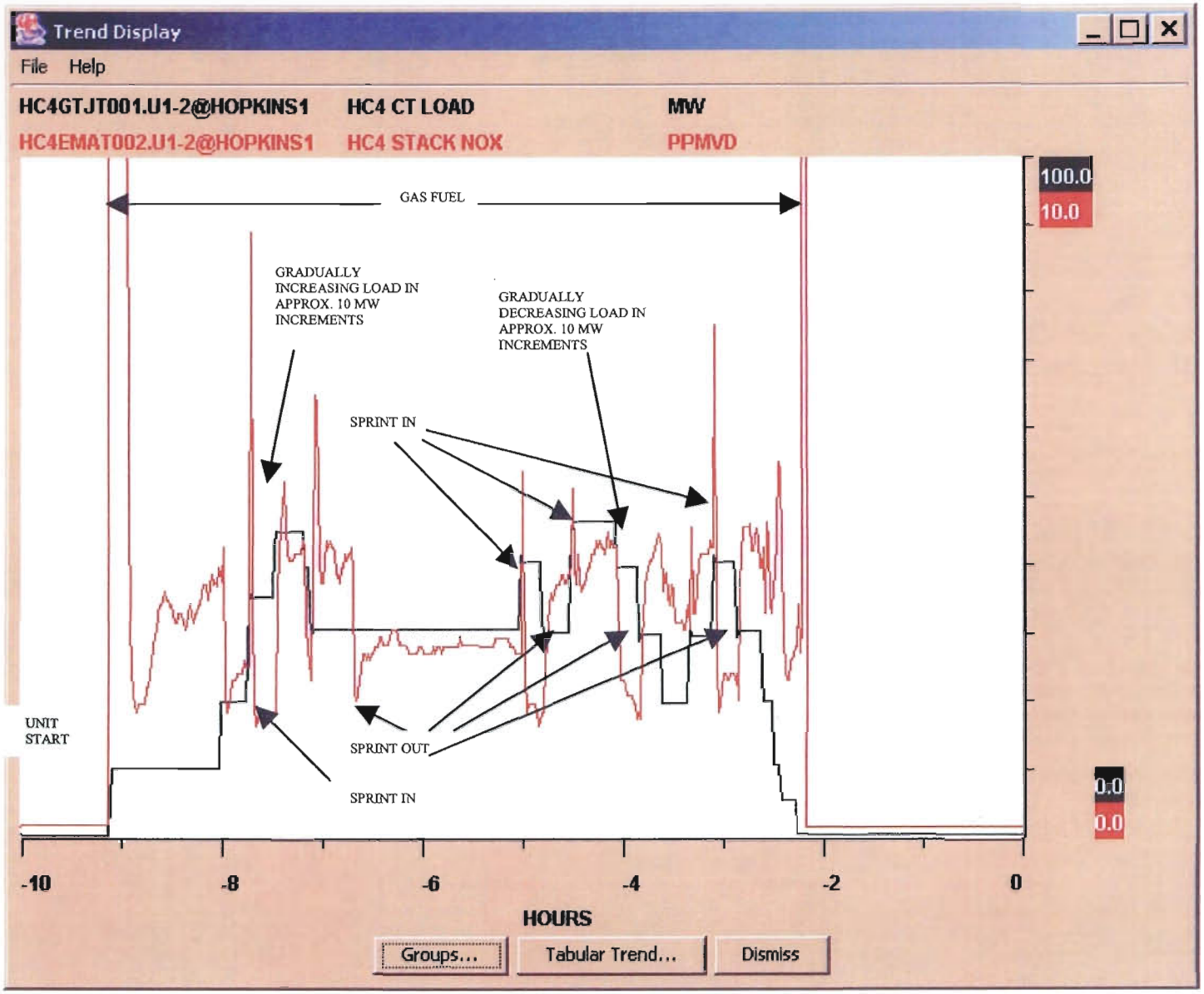
Post-Tuning Graph of Oxides of Nitrogen versus Output

(Prepared by City of Tallahassee)

City of Tallahassee
HC3 – April 26, 2006



City of Tallahassee
HC4 – April 26, 2006



ATTACHMENT B

Tuning and Testing Summary Report

(Prepared by General Electric)

Hopkins Generating Station – GE LM6000 with SCRs

Background

• The original SCR control system consisted of a direct acting NOx PID control loop monitoring the NOx level measured at the exhaust stack, a straight line curve providing a baseline level of ammonia injection and a PID controller adjusting the position of the ammonia control valve to regulate the amount of ammonia injected into the system.

• The baseline level of ammonia injection derived from the straight line curve provided a small amount of feed-forward control by biasing the level of ammonia injection as the turbine power output changed. The output of the NOx PID control was added to the value derived from the curve to create an ammonia flow setpoint for the ammonia valve controller.

• The methodology used to perform the CEMs measurement of the NOx level in the exhaust stack combined with the physical method of injecting ammonia and achieving the chemical/catalytic NOx reduction contains inherent delays (approx. 2-3 minute measurement time) that affect operation of the NOx control system.

Hopkins Generating Station – GE LM6000 with SCRs

SCR Changes

•The SCR control system was revised to allow operation over a wide range of turbine output power. The straight-line curve was replaced by four different curves. The four curves are:

1. Gas Fuel without Sprint water injection.
2. Liquid Fuel without Sprint water injection.
3. Gas Fuel with Sprint water injection.
4. Liquid Fuel with Sprint water injection.

• The active curve is selected by the SCR control based on signals from the turbine control panel indicating the type of fuel in use and whether Sprint water is being injected or not. During setup of the system, the amount of ammonia required to reduce emissions to the NOx setpoint was determined for turbine operating points ranging from 20% to 100% of the turbine power level. The values for all four curves were determined during the testing period and stored in the controller

• The use of the new curves allows the controller to inject a preset amount of ammonia based on turbine operating power without waiting for the stack Nox measurement delay, resulting in a faster response time.

Hopkins Generating Station – GE LM6000 with SCRs

Tuning Process

•The tuning process established a set of readings for NH3 demand (pounds per hour) to control NOX at different GT loads, based on the GT fuel flow (both gas and liquid), with and without sprint water injection. The readings were recorded and adjusted slightly so they would be useable for all weather conditions. The adjustment was required because the NOX generated is dependent on environmental air conditions, specifically air temperature and humidity. For example, test results showed the NH3 consumption was less during cooler weather, compared to warmer weather, at the same GT load and same NOX controller set point.

Hopkins Generating Station – GE LM6000 with SCRs

S04107 and S04119 PID Tuning and Setup Parameters			
Values as set 4/27/06.			
	S04107	S04119	
Date	4/27/2006	4/27/2006	Units
NOx PID Tuning			%R400
Proportional Gain	0.05	0.05	%/%
Integral Rate (Reset)	0.001	0.001	repeats/sec.
Derivative Gain (Rate)	0	0	sec.
slew	40	40	sec.
NOx Setpoint	4.2	4.2	ppm
NH3 PID Tuning			%R460
Proportional Gain	2	2	%/%
Integral Rate (Reset)	0.15	0.15	repeats/sec.
Derivative Gain (Rate)	0	0	sec.
slew	0	0	sec.
Heater PID Tuning			%R230
Proportional Gain	300	0.05	%/%
Integral Rate (Reset)	1	0.001	repeats/sec.
Derivative Gain (Rate)	0	0	sec.
slew	5	5	sec.
Heater Setpoint	300	300	°F

Hopkins Generating Station – GE LM6000 with SCRs

S04119 Final Ammonia Injection Curves

Final Curve values from 4/27/06 are plotted.

FS Ammonia Flow =	200	lb/hr
FS Gas Fuel Flow =	18213	SCFM
FS Liq Fuel Flow =	100	GPM
Turbine Power:100%=	60	MW

For all curves, the actual ammonia injection value is the sum of the Ammonia Injection amount determined from the curve and the output of the NOx PID controller. Operation with the original curve allowed the PID controller to vary the ammonia flow from 0

The new curves are based on fuel flow, either gas or Liquid, which is related to turbine power. When Sprint water injection is operating, the turbine fuel flow decreases for a given power level and the ammonia injection curves for Sprint water operation

Original Injection Curve

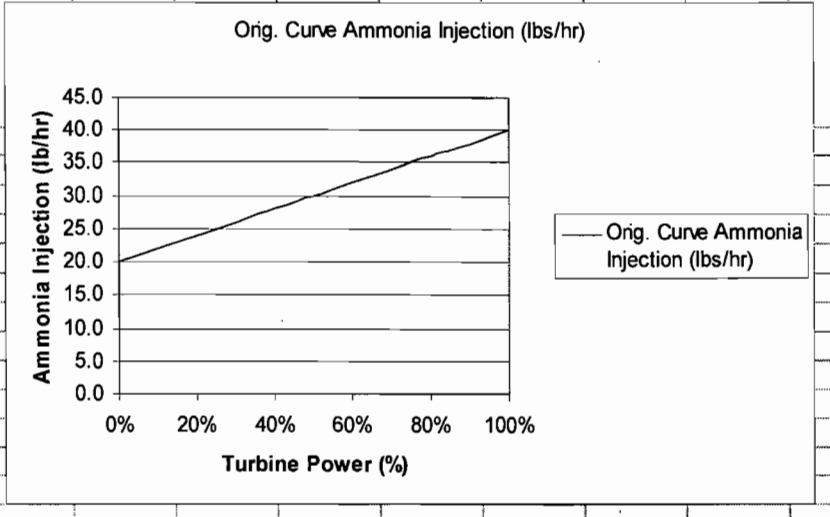
based on equation y=mx+b

b=ammonia required at turbine idle (approx. 5MW)

m=turbine power factor used to bias ammonia injection

				m=	10.0%	=	3200	counts
				b=	10.0%	=	3200	counts

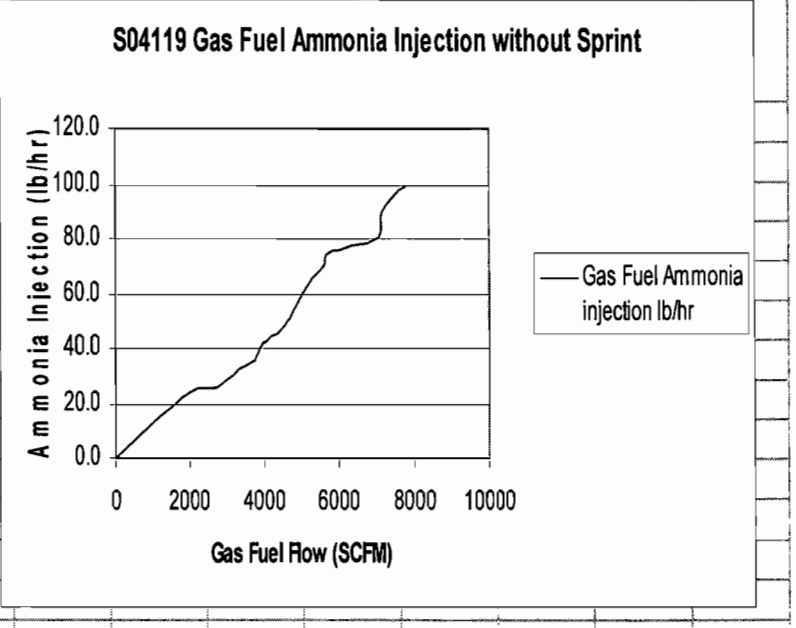
Turbine Power (%)	Turbine Power (MW)	Orig. Injection Curve Addition to PID (PLC Counts)	Orig. Curve Ammonia Injection (lbs/hr)
0%	0.0	3200	20.0
20%	12.0	3840	24.0
40%	24.0	4480	28.0
50%	30.0	4800	30.0
55%	33.0	4960	31.0
60%	36.0	5120	32.0
65%	39.0	5280	33.0
70%	42.0	5440	34.0
75%	45.0	5600	35.0
80%	48.0	5760	36.0
83%	49.8	5856	36.6
85%	51.0	5920	37.0
90%	54.0	6080	38.0
95%	57.0	6240	39.0
100%	60.0	6400	40.0



Hopkins Generating Station – GE LM6000 with SCRs

S04119 New Gas Fuel Curve Ammonia Injection without Sprint

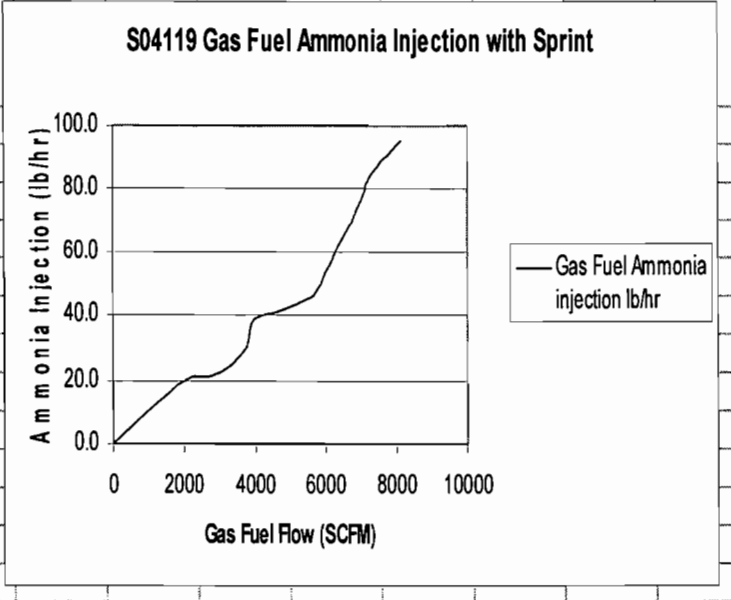
Gas fuel flow (SCFM)	Gas fuel flow (%FS)	Gas Fuel Ammonia injection lb/hr
0	0%	0.0
2000	11%	23.5
2705	15%	25.5
3310	18%	32.0
3750	21%	35.5
3980	22%	41.5
4526	25%	48.0
5180	28%	63.0
5600	31%	70.0
5735	31%	75.0
7007	38%	80.0
7158	39%	90.0
7458	41%	95.0
7797	43%	100.0



Hopkins Generating Station – GE LM6000 with SCRs

S04119 New Gas Fuel Curve Ammonia Injection with Sprint

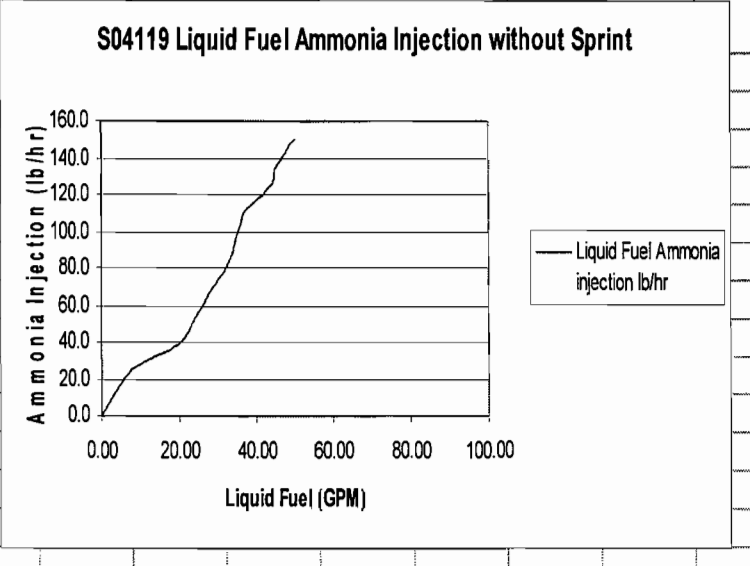
Gas fuel flow (SCFM)	Gas fuel flow (%FS)	Gas Fuel Ammonia injection lb/hr
0	0%	0.0
2000	11%	19.5
2705	15%	21.1
3310	18%	24.7
3750	21%	30.5
3980	22%	39.0
4526	25%	41.0
5180	28%	44.0
5600	31%	46.0
5735	31%	48.0
7007	38%	76.0
7158	39%	82.0
7500	41%	87.0
8150	45%	95.0



Hopkins Generating Station – GE LM6000 with SCRs

S04119 New Liquid Fuel Curve Ammonia Injection without Sprint

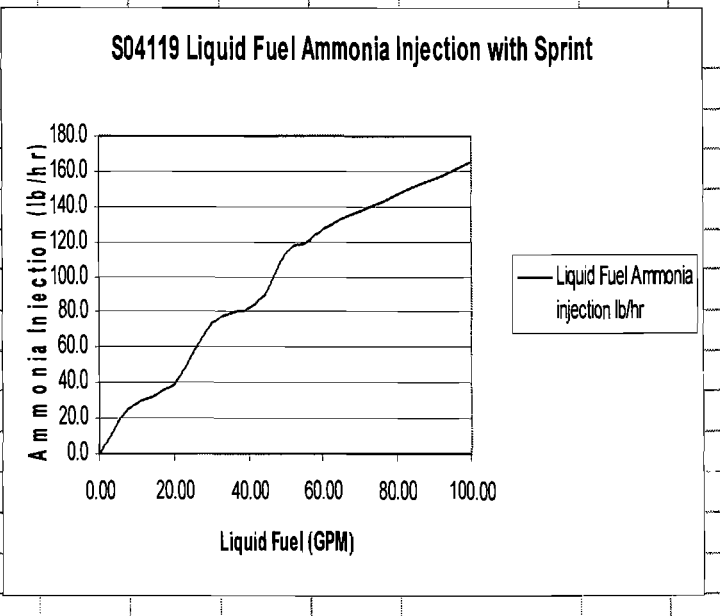
Liquid fuel flow (GPM)	Liquid fuel flow (%FS)	Liquid Fuel Ammonia injection lb/hr
0.00	0%	0.0
8.00	8%	26.0
20.00	20%	39.0
24.20	24%	53.9
28.10	28%	67.0
32.80	33%	83.0
36.90	37%	109.5
39.50	40%	114.8
44.50	45%	126.5
45.15	45%	135.0
50.00	50%	150.0
50.00	50%	150.0
50.00	50%	150.0
50.00	50%	150.0



Hopkins Generating Station – GE LM6000 with SCRs

S04119 New Liquid Fuel Curve Ammonia Injection with Sprint

Liquid fuel flow (GPM)	Liquid fuel flow (%FS)	Liquid Fuel Ammonia injection lb/hr
0.00	0%	0.0
8.00	8%	26.0
20.00	20%	39.0
24.20	24%	53.9
28.10	28%	67.0
32.80	33%	78.0
36.90	37%	80.5
39.50	40%	82.5
44.50	45%	90.5
50.50	51%	114.5
55.50	56%	119.5
60.50	61%	127.5
70.00	70%	137.5
100.00	100%	165.0



Hopkins Generating Station – GE LM6000 with SCRs

S04107 Final Ammonia Injection Curves

Final Curve values from 4/27/06 are plotted.

For all curves, the actual ammonia injection value is the sum of the Ammonia Injection amount determined from the curve and the output of the NOx PID controller. Operation with the original curve allowed the PID controller to vary the ammonia flow from 0

FS Ammonia Flow =	200	lb/hr
FS Gas Fuel Flow =	18213	SCFM
FS Liq Fuel Flow =	100	GPM
Turbine Power:100%=	60	MW

The new curves are based on fuel flow, either gas or Liquid, which is related to turbine power. When Sprint water injection is operating, the turbine fuel flow decreases for a given power level and the ammonia injection curves for Sprint water operation

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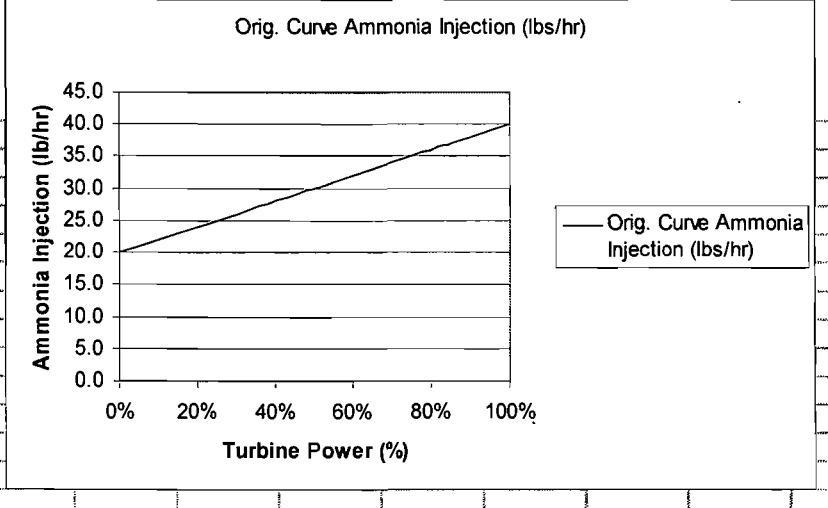
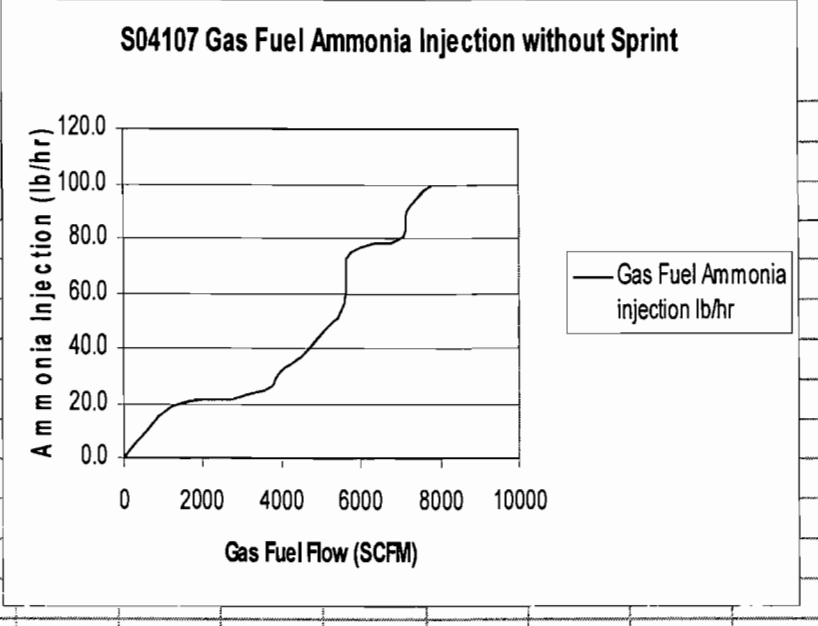
Turbine Power (%)	Turbine Power (MW)	Orig. Injection Curve Addition to PID (PLC Counts)	Orig. Curve Ammonia Injection (lbs/hr)
0%	0.0	3200	20.0
20%	12.0	3840	24.0
40%	24.0	4480	28.0
50%	30.0	4800	30.0
55%	33.0	4960	31.0
60%	36.0	5120	32.0
65%	39.0	5280	33.0
70%	42.0	5440	34.0
75%	45.0	5600	35.0
80%	48.0	5760	36.0
83%	49.8	5856	36.6
85%	51.0	5920	37.0
90%	54.0	6080	38.0
95%	57.0	6240	39.0
100%	60.0	6400	40.0



Hopkins Generating Station – GE LM6000 with SCRs

S04107 New Gas Fuel Curve Ammonia Injection without Sprint

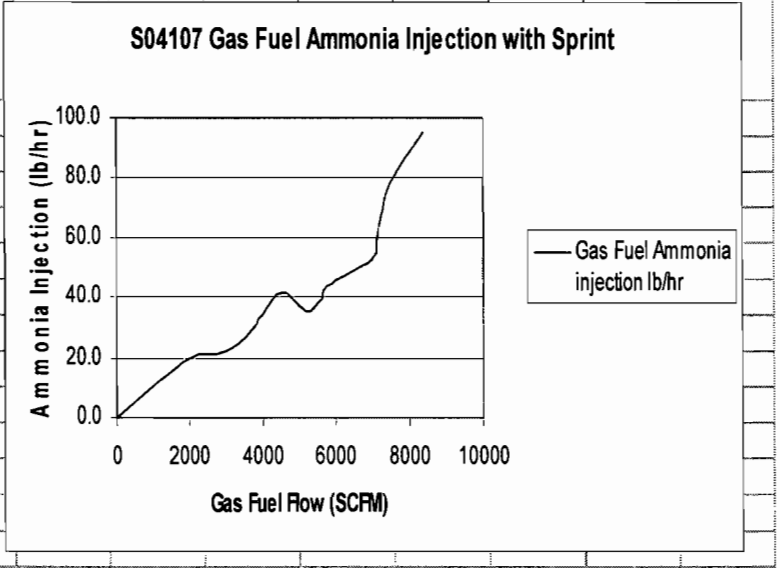
Gas fuel flow (SCFM)	Gas fuel flow (%FS)	Gas Fuel Ammonia injection lb/hr
0	0%	0.0
1200	7%	18.5
2705	15%	21.5
3310	18%	23.5
3750	21%	26.5
3980	22%	31.5
4526	25%	37.5
5180	28%	47.5
5600	31%	56.0
5735	31%	75.0
7007	38%	80.0
7158	39%	90.0
7458	41%	95.0
7797	43%	100.0



Hopkins Generating Station – GE LM6000 with SCRs

S04107 New Gas Fuel Curve Ammonia Injection with Sprint

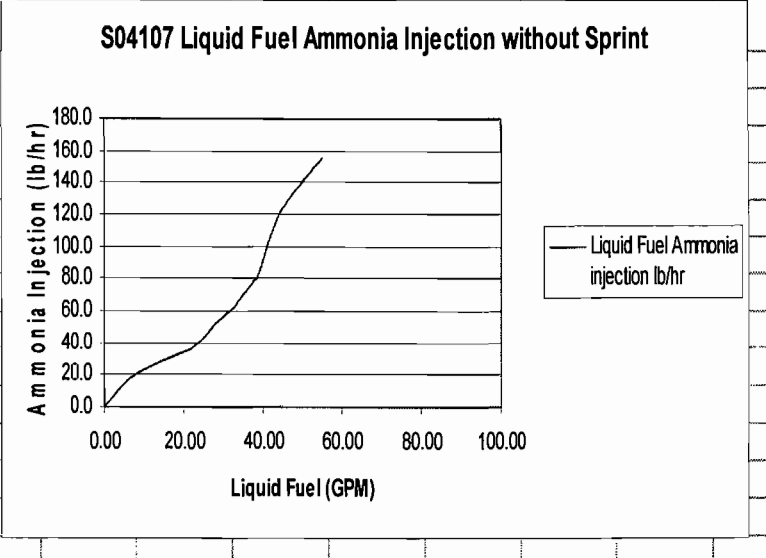
Gas fuel flow (SCFM)	Gas fuel flow (%FS)	Gas Fuel Ammonia injection lb/hr
0	0%	0.0
2000	11%	19.5
2705	15%	21.1
3310	18%	24.7
3750	21%	30.5
3980	22%	34.0
4526	25%	41.8
5180	28%	35.0
5600	31%	39.0
5735	31%	44.0
7007	38%	53.0
7158	39%	61.0
7500	41%	78.0
8400	46%	95.0



Hopkins Generating Station – GE LM6000 with SCRs

S04107 New Liquid Fuel Curve Ammonia Injection without Sprint

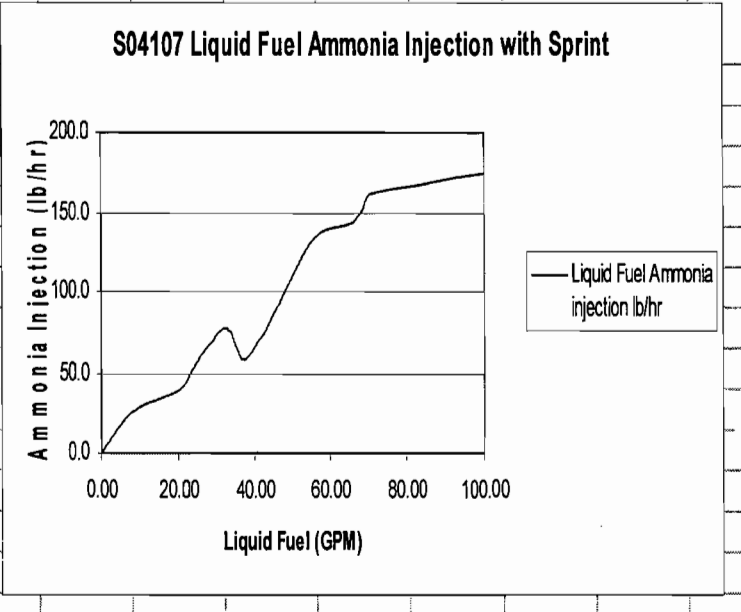
Liquid fuel flow (GPM)	Liquid fuel flow (%FS)	Liquid Fuel Ammonia injection lb/hr
0.00	0%	0.0
8.00	8%	21.0
20.00	20%	34.0
24.20	24%	41.5
28.10	28%	51.5
32.80	33%	62.5
36.90	37%	75.5
39.50	40%	84.5
44.50	45%	121.0
55.00	55%	155.0
55.00	55%	155.0
55.00	55%	155.0
55.00	55%	155.0
55.00	55%	155.0



Hopkins Generating Station – GE LM6000 with SCRs

S04107 New Liquid Fuel Curve Ammonia Injection with Sprint

	Liquid fuel flow (GPM)	Liquid fuel flow (%FS)	Liquid Fuel Ammonia injection lb/hr
	0.00	0%	0.0
	8.00	8%	26.0
	20.00	20%	39.0
	24.20	24%	53.9
	28.10	28%	67.0
	32.80	33%	78.0
	36.90	37%	58.5
	39.50	40%	62.5
	44.50	45%	82.5
	56.00	56%	134.0
	66.00	66%	143.5
	70.00	70%	160.5
	70.00	70%	160.5
	100.00	100%	175.0



ATTACHMENT C

Daily Oxides of Nitrogen Emissions During Tuning and Testing

(From Continuous Emissions Monitor System)

City of Tallahassee
Hopkins CT4
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006 Reporting Period
Time: 12:24:59 Day: 04/18/2006

Time	NOx Corrected 15% O2	Reasons
0000	OFFLINE	
0100	OFFLINE	
0200	OFFLINE	
0300	OFFLINE	
0400	OFFLINE	
0500	OFFLINE	
0600	OFFLINE	
0700	OFFLINE	
0800	OFFLINE	
0900	OFFLINE	
1000	OFFLINE	
1100	OFFLINE	
1200	OFFLINE	
1300	5.9 E	STARTUP
1400	4.9	
1500	3.7	
1600	4.1	
1700	4.3	
1800	4.2	
1900	4.2	
2000	4.6	
2100	OFFLINE	
2200	OFFLINE	
2300	OFFLINE	
AVERAGE	4.3	

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT4
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006
Time: 12:25:33

Reporting Period
Day: 04/19/2006

Time	NOx Corrected 15% O2	Reasons
0000	OFFLINE	
0100	OFFLINE	
0200	OFFLINE	
0300	OFFLINE	
0400	OFFLINE	
0500	OFFLINE	
0600	OFFLINE	
0700	OFFLINE	
0800	6.4 E	STARTUP
0900	4.5	
1000	3.2	
1100	4.5	
1200	4.3	
1300	4.0	
1400	4.3	
1500	4.3	
1600	4.2	
1700	4.2	
1800	4.1	
1900	6.7 E	No Exceedance Found
2000	OFFLINE	
2100	OFFLINE	
2200	OFFLINE	
2300	OFFLINE	
AVERAGE	4.2	

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT4
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006 — Reporting Period
Time: 12:25:50 — Day: 04/20/2006

Time	NOx Corrected 15% O2	Reasons
0000	OFFLINE	
0100	OFFLINE	
0200	OFFLINE	
0300	OFFLINE	
0400	OFFLINE	
0500	OFFLINE	
0600	OFFLINE	
0700	OFFLINE	
0800	OFFLINE	
0900	OFFLINE	
1000	6.5 *	STARTUP
1100	5.5 *	UNKNOWN
1200	5.5 *	UNKNOWN
1300	5.2 *	UNKNOWN
1400	8.4 E	UNKNOWN
1500	4.4	
1600	4.1	
1700	4.2	
1800	4.2	
1900	3.9	
2000	4.2	
2100	4.7	
2200	OFFLINE	
2300	OFFLINE	
AVERAGE	4.8	

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT4
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006
Time: 12:26:10

Reporting Period
Day: 04/21/2006

Time	NOx Corrected 15% O2	Reasons
0000	OFFLINE	
0100	OFFLINE	
0200	OFFLINE	
0300	OFFLINE	
0400	OFFLINE	
0500	OFFLINE	
0600	OFFLINE	
0700	OFFLINE	
0800	OFFLINE	
0900	OFFLINE	
1000	OFFLINE	
1100	OFFLINE	
1200	OFFLINE	
1300	7.1 E	UNKNOWN
1400	8.0 E	FUEL SWITCHING
1500	4.0	
1600	4.0	
1700	4.0	
1800	4.0	
1900	4.1	
2000	4.1	
2100	OFFLINE	
2200	OFFLINE	
2300	OFFLINE	
AVERAGE	4.0	

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT4
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006
Time: 12:26:29

Reporting Period
Day: 04/22/2006

Time	NOx Corrected 15% O2		Reasons
0000	OFFLINE		
0100	OFFLINE		
0200	OFFLINE		
0300	OFFLINE		
0400	OFFLINE		
0500	OFFLINE		
0600	OFFLINE		
0700	OFFLINE		
0800	OFFLINE		
0900	19.5	E	UNKNOWN
1000	12.6	*	UNKNOWN
1100	10.7	*	UNKNOWN
1200	10.0	*	UNKNOWN
1300	12.8	E	UNKNOWN
1400	5.6	*	UNKNOWN
1500	3.1		
1600	4.1		
1700	OFFLINE		
1800	OFFLINE		
1900	OFFLINE		
2000	OFFLINE		
2100	OFFLINE		
2200	OFFLINE		
2300	OFFLINE		
AVERAGE	7.7		

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT4
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006
Time: 12:26:49

Reporting Period
Day: 04/23/2006

Time	NOx Corrected 15% O2	Reasons
0000	OFFLINE	
0100	OFFLINE	
0200	OFFLINE	
0300	OFFLINE	
0400	OFFLINE	
0500	OFFLINE	
0600	OFFLINE	
0700	OFFLINE	
0800	OFFLINE	
0900	9.2 E	UNKNOWN
1000	5.0	
1100	4.9	
1200	4.1	
1300	4.6	
1400	4.1	
1500	4.5	
1600	4.0	
1700	OFFLINE	
1800	OFFLINE	
1900	OFFLINE	
2000	OFFLINE	
2100	OFFLINE	
2200	OFFLINE	
2300	OFFLINE	
AVERAGE	4.5	

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT3
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006
Time: 12:28:28

Reporting Period
Day: 04/24/2006

Time	NOx Corrected 15% O2	Reasons
0000	OFFLINE	
0100	OFFLINE	
0200	OFFLINE	
0300	OFFLINE	
0400	OFFLINE	
0500	OFFLINE	
0600	OFFLINE	
0700	OFFLINE	
0800	OFFLINE	
0900	OFFLINE	
1000	OFFLINE	
1100	OFFLINE	
1200	OFFLINE	
1300	OFFLINE	
1400	OFFLINE	
1500	14.0 E	UNKNOWN
1600	10.5 E	UNKNOWN
1700	9.3 *	SHUTDOWN
1800	OFFLINE	
1900	OFFLINE	
2000	OFFLINE	
2100	OFFLINE	
2200	OFFLINE	
2300	OFFLINE	
AVERAGE	9.3	

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT4
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 04/27/2006
Time: 06:39:07

Reporting Period
Day: 04/24/2006

Time	NOx Corrected 15% O2		Reasons
0000	OFFLINE		
0100	OFFLINE		
0200	OFFLINE		
0300	OFFLINE		
0400	OFFLINE		
0500	OFFLINE		
0600	OFFLINE		
0700	OFFLINE		
0800	OFFLINE		
0900	OFFLINE		
1000	OFFLINE		
1100	4.8		
1200	3.7		
1300	5.9	E	STARTUP
1400	4.6		
1500	3.6		
1600	5.6	E	STARTUP
1700	4.0		
1800	4.3		
1900	4.5		
2000	OFFLINE		
2100	OFFLINE		
2200	OFFLINE		
2300	OFFLINE		
AVERAGE	4.2		

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT3
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006
Time: 12:28:51

Reporting Period
Day: 04/25/2006

Time	NOx Corrected 15% O2	Reasons
0000	OFFLINE	
0100	OFFLINE	
0200	OFFLINE	
0300	OFFLINE	
0400	OFFLINE	
0500	OFFLINE	
0600	OFFLINE	
0700	OFFLINE	
0800	OFFLINE	
0900	OFFLINE	
1000	10.0 E	STARTUP
1100	9.1 *	STARTUP
1200	8.9 *	STARTUP
1300	8.7 *	STARTUP
1400	4.0	
1500	4.0	
1600	4.1	
1700	7.3 *	UNKNOWN
1800	7.1 *	UNKNOWN
1900	OFFLINE	
2000	OFFLINE	
2100	OFFLINE	
2200	OFFLINE	
2300	OFFLINE	
AVERAGE	6.7	

* - Exceedance E - Excluded Exceedance

City of Tallahassee
Hopkins CT3
Tallahassee, FL
NOx 24 Hour Block Report

Today's Date: 05/08/2006
Time: 12:29:10

Reporting Period
Day: 04/25/2006

Time	NOx Corrected 15% O2		Reasons
0000	OFFLINE		
0100	OFFLINE		
0200	OFFLINE		
0300	OFFLINE		
0400	OFFLINE		
0500	OFFLINE		
0600	OFFLINE		
0700	OFFLINE		
0800	OFFLINE		
0900	OFFLINE		
1000	10.0	E	STARTUP
1100	9.1	*	STARTUP
1200	8.9	*	STARTUP
1300	8.7	*	STARTUP
1400	4.0		
1500	4.0		
1600	4.1		
1700	7.3	*	UNKNOWN
1800	7.1	*	UNKNOWN
1900	OFFLINE		
2000	OFFLINE		
2100	OFFLINE		
2200	OFFLINE		
2300	OFFLINE		
AVERAGE	6.7		

* - Exceedance E - Excluded Exceedance