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Report of...

Compliance Emission Sampling

Performed for...

Lowell Light & Power
Lowell, Michigan

On the

Gas Fired Solar Turbine

May 30, 2014

299.01

Network Environmental, Inc.
Grand Rapids, MI

I. INTRODUCTION

Network Environmental, Inc. was retained by Lowell Light & Power of Lowell, Michigan, to conduct an emission study at their Lowell, Michigan facility. NO_x and CO emissions were determined from the gas fired turbine exhaust. The purpose of the study was to determine compliance with Michigan Department of Environmental Quality (MDEQ) – Air Quality Division Permit to Install No. 112-12. The system was tested at 100% and 75% of capacity for NO_x and CO.

Permit No. 112-12 has established the following emission limits for the turbine:

EUTURBINE	
Pollutant	Emission Limit
NO _x	144.0 PPM @15% O ₂ and 27.0 Lb/Hr
CO	125 PPM @15% O ₂ and 14.3 Lb/Hr

The following reference test methods were employed to conduct the emission sampling:

- NO_x - U.S. EPA Method 7E
- CO - U.S. EPA Method 10
- Exhaust Gas Parameters (air flow rate, temperature, moisture & density) – U.S. EPA Reference Methods 1 through 4.

The sampling was performed on May 30, 2014 by Stephan K. Byrd, R. Scott Cargill and Richard D. Eerdmans of Network Environmental, Inc. Assisting in the study was Mr. Doug Barnes of Lowell Light & Power.

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II. PRESENTATION OF RESULTS

**II.1 TABLE 1
EMISSION RESULTS
GAS FIRED TURBINE EXHAUST
LOWELL LIGHT & POWER
LOWELL, MICHIGAN
MAY 30, 2014**

Condition	Sample	Time	NO _x		CO	
			PPM ⁽¹⁾	Lbs/Hr.	PPM ⁽¹⁾	Lbs/Hr.
100%	1	09:25-10:25	70.0	16.29	35.9	5.08
	2	10:41-11:41	73.0	16.72	6.3	0.87
	3	11:53-12:53	74.5	17.07	5.1	0.71
	Average		72.5	16.69	15.8	2.22
75%	1	13:08-14:08	75.7	9.99	9.1	0.73
	2	14:21-15:21	75.6	10.21	8.8	0.72
	3	15:34-16:34	76.4	10.32	7.9	0.65
	Average		75.9	10.17	8.6	0.70

(1) = PPMV @ 15% O₂

III. DISCUSSION OF RESULTS

The results of the emission sampling are summarized in Table 1 (Section II,1). The results are presented as follows:

III.1 NO_x and CO Emission Results Summary (Table 1)

Table 1 summarizes the particulate emission results for the gas fired turbine as follows:

- Sample
- Time
- NO_x Concentrations (PPMV on a dry basis corrected to 15% O₂)
- NO_x Mass Emission (Lbs/hr) – Pounds per Hour
- CO Concentrations (PPMV on a dry basis corrected to 15% O₂)
- CO Mass Emission Rates (Lbs/Hr) – Pounds per Hour.

IV. SAMPLING AND ANALYTICAL PROTOCOL

The sampling location for the gas fired turbine exhaust was on the 53 inch diameter exhaust at a location approximately 4 duct diameters downstream and greater than 2 duct diameters upstream from the nearest disturbances. There are 2 sample ports. Twelve (12) sampling points (6 per port) were used for the velocity traverses. The sampling point dimensions were as follows:

<u>Sample Point</u>	<u>Dimension (Inches)</u>
1	2.33
2	7.74
3	15.69
4	37.31
5	45.26
6	50.67

Prior to the emission testing, preliminary velocity/cyclonic (turbulent) flow measurements/checks were conducted. The sampling location and flows passed the requirements of Methods 1 and 2.

IV.1 Oxides of Nitrogen - The NO_x sampling was conducted in accordance with U.S. EPA Reference Method 7E. A Thermo Environmental Model 42H gas analyzer was used to monitor the exhaust. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the NO_x concentrations (PPM). The analyzer was operated on the 0-500 ppm scale.

The analyzer was calibrated by direct injection prior to the testing. A span gas of 486.9 PPM was used to establish the initial instrument calibration. Calibration gases of 251.5 PPM and 125.0 PPM were used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 125.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 125.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the exhaust. A diagram of the sampling train is shown in Figure 1. Three (3) samples, each sixty (60) minutes in duration, were collected at each of the two conditions.

IV.2 Carbon Monoxide - The CO sampling was conducted in accordance with U.S. EPA Reference Method 10. A Thermo Environmental Model 48H gas analyzer was used to monitor the exhaust. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the CO concentrations (PPM). The analyzer was operated on the 0-500 PPM scale.

The analyzer was calibrated by direct injection prior to the testing. A span gas of 492.5 PPM was used to establish the initial instrument calibration. Calibration gases of 250.2 and 169.2 PPM was used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 169.2 PPM gas to determine the system bias. After each sample, a system zero and system injection of 169.2 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

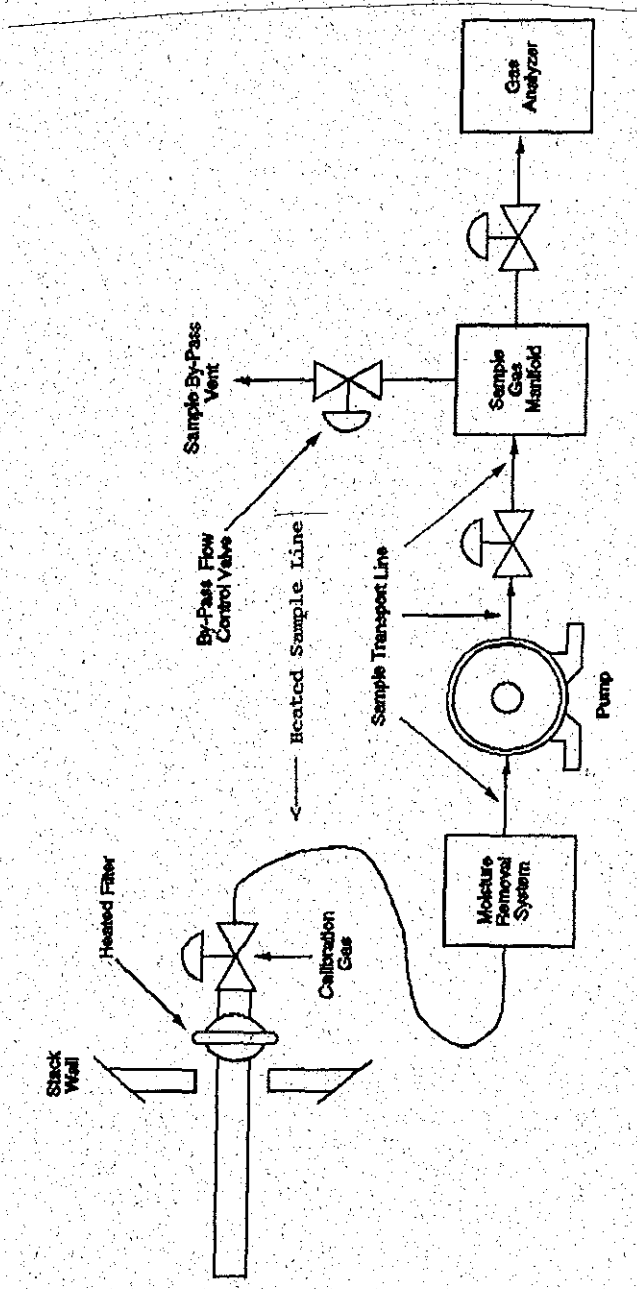


Figure 1

NO_x, CO, O₂ and CO₂ Sampling Train