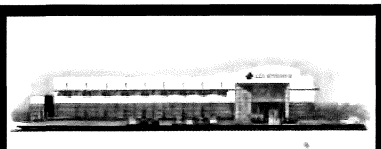
AIR HYGIENE, INC.

Testing Solutions for a Better World

EMISSION COMPLIANCE TEST
FOR THE
GENERAL ELECTRIC, FRAME 5N, UNIT #EU-CTG2
PREPARED FOR
WOLVERINE POWER SUPPLY COOPERATIVE, INC.
AT THE
GAYLORD GENERATING STATION
GAYLORD, OTSEGO COUNTY, MICHIGAN
JULY 18, 2019

Permit No: MI-ROP-N6833-2015



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Matt McBride, QSTI
Sr. Project Manager
certify that this testing was conducted and this report was created in conformance with the requirements of ASTM D7036

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Emissions Compliance Test
General Electric, Frame 5N, Unit #EU-CTG2
Wolverine Power Supply Cooperative, Inc.
Gaylord Generating Station
Gaylord, Otsego County, Michigan
July 18, 2019

1.0 INTRODUCTION

Air Hygiene International, Inc. (Air Hygiene) has completed the Emissions Compliance Test for nitrogen oxides (NOx) and oxygen (O_2) from the exhaust of the General Electric, Frame 5N, Unit #EU-CTG2 for Wolverine Power Supply Cooperative, Inc. at the Gaylord Generating Station in Gaylord, Otsego County, Michigan. This report details the background, results, process description, and the sampling/analysis methodology of the stack sampling survey conducted on July 18, 2019.

1.1 TEST PURPOSE AND OBJECTIVES

The purpose of the test was to conduct a periodic compliance emission test to document levels of selected pollutants at three test loads (Low, Mid, and High). The information will be used to confirm compliance with the operating permit issued by the Michigan Department of Environmental Quality (MDEQ). The specific objective was to determine the emission concentration of NOx and O_2 from the exhaust of Wolverine Power Supply Cooperative, Inc.'s General Electric, Frame 5N, Unit #EU-CTG2 at Low, Mid, and High loads.

1.2 SUMMARY OF TEST PROGRAM

The following list details pertinent information related to this specific project:

1.2.1 Participating Organizations
- Michigan Department of Environmental Quality (MDEQ)
- Wolverine Power Supply Cooperative, Inc. (WPC)
- Fishbeck Thompson Carr & Huber, Inc. (FTCH)
- Air Hygiene

1.2.2 Industry
- Electric Utility / Electric Services

1.2.3 Air Permit
- Permit Number: MI-ROP-N6833-2015

1.2.4 Plant Location
- Gaylord Generating Station in Gaylord, Otsego County, Michigan
  - GPS Coordinates [Latitude 45.010936, Longitude -84.761972]
  - 2700 Millbocker Road, Gaylord, Michigan 49735
  - Federal Registry System / Facility Registry Service (FRS) No. – 110021100191
  - Source Classification Code (SCC) – 20100209

1.2.5 Equipment Tested
- General Electric, Frame 5N, Unit #EU-CTG2

1.2.6 Emission Points
- Exhaust from the General Electric, Frame 5N, Unit #EU-CTG2
- For all gases, one sample point in the exhaust duct from the General Electric, Frame 5N, Unit #EU-CTG2, determined after conducting a stratification test

1.2.7 Emission Parameters Measured
- NOx
- O_2

1.2.8 Date of Emission Test
- July 18, 2019

1.2.9 Federal Certifications
- Stack Testing Accreditation Council AETB Certificate No. 3796.02
- International Standard ISO/IEC 17025:2005 Certificate No. 3796.01

1.3 KEY PERSONNEL

WPC:	Laura Hoisington (lhoisington@wpsci.com)	231-775-5700 x3369
WPC:	Cornelius Bornman (cbornman@wpsci.com)	989-705-7079
WDEQ:	David Patterson (PattersonD2@michigan.gov)	517-256-4388
WDEQ:	Karen Kajiya-Mills (Kajiya-MillsK@michigan.gov)	517-256-0880
FTCH:	Stephanie A. Jarrett (sajarrett@ftch.com)	248-324-2146
Air Hygiene:	Matt McBride (mmcbride@airhygiene.com)	918-307-8865
Air Hygiene:	James Reynolds	918-307-8865

2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on Wolverine Power Supply Cooperative, Inc.'s General Electric, Frame 5N, Unit #EU-CTG2 located at the Gaylord Generating Station on July 18, 2019 are summarized in the following table and relate only to the items tested.

The results of all measured pollutant emissions were below the required limits. All testing was performed without any real or apparent errors. All testing was conducted according to the approved testing protocol.

TABLE 2.1
SUMMARY OF GENERAL ELECTRIC, FRAME 5N, UNIT #EU-CTG2 RESULTS

Parameter	Low Load	Mid Load	High Load	Permit Limits
Start Time (hh:mm:ss)	8:02:25	10:05:25	11:52:25	--
End Time (hh:mm:ss)	9:51:55	11:26:55	13:12:55	--
Run Duration (min / run)	31	21	21	--
Bar. Pressure (in. Hg)	28.53	28.50	28.47	--
Amb. Temp. (°F)	74	81	82	--
Rel. Humidity (%)	73	65	67	--
Spec. Humidity (lb water / lb air)	0.013742	0.015620	0.016481	--
Load Designator	LOW	MID	HIGH	--
Comb. Inlet Pres. (psig)	102.1	106.4	111.1	--
Turbine Fuel Flow (SCFH)	182,985	219,076	260,079	--
Stack Flow (RM19) (SCFH)	11,272,087	10,975,183	10,845,607	--
Heat Input (MMBtu/hr)	192.1	230.0	273.1	--
Power Output (megawatts)	11.1	15.0	19.0	--
CD Temp (°F)	282.01	644.89	650.03	--
NOx (ppmvd)	34.62	47.01	65.13	--
NOx (ppm@15%O_2)	65.82	72.69	83.84	--
NOx (lb/hr)	46.60	61.61	84.37	168.5
NOx (lb/MMBtu)	0.243	0.268	0.309	0.48
O_2 (%)	17.80	17.08	16.32	--

3.0 SOURCE OPERATION

3.1 PROCESS DESCRIPTION

Wolverine Power Supply Cooperative, Inc. (WPC) owns and operates the Gaylord Generating Station located in Gaylord, Otsego County, Michigan. The station consists of three General Electric (GE) Frame 5N simple cycle combustion turbines, designated as EU-CTG1, EU-CTG2, and EU-CTG3. Each CTG has a nominal rating of 23.4 MW, with a peak heat input of 351 MMBtu/hr, an exhaust flow rate of ~596,000 scfm (at 100% load), and an exhaust gas temperature of ~900 °F. The interest of this report is EU-CTG2.

3.2 SAMPLING LOCATION

The EU-CTG2 stack is vertical, rectangular and measure 12.25 feet (ft) (147 inches) wide and 10.2 feet (ft) (122 inches) deep at the 7 test ports which are approximately 37 ft above grade level with an exit elevation of approximately 45 ft above grade level. The test ports are located approximately 26 ft (312 inches) downstream and approximately 8 ft (96 inches) upstream from the nearest disturbances. All exhaust samples for gaseous emissions were continuously drawn from the exhaust system at the sample ports from a single point determined after conducting a stratification test. The stratification test used Method 20 criteria to determine the sample point. During the stratification test two points were traversed from each of the seven ports. The probe was allowed to remain at a point for two times the system response time.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

The emission test on the General Electric, Frame 5N, Unit #EU-CTG2 at the Gaylord Generating Station was performed following United States Environmental Protection Agency (EPA) methods described by the Code of Federal Regulations (CFR). Table 4.1 outlines the specific methods performed on July 18, 2019.

TABLE 4.1
SUMMARY OF SAMPLING METHODS

Pollutant or Parameter	Sampling Method	Analysis Method
Sample Point Location	EPA Method 1	Equal Area Method
Oxygen	EPA Method 3A	Paramagnetic Cell
Nitrogen Oxides	EPA Method 7E	Chemiluminescent Analyzer
Stack Flow Rate	EPA Method 19	Dry Oxygen F Factor

4.2 INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS

The sampling and analysis procedures used during these tests conform with the methods outlined in the Code of Federal Regulations (CFR), Title 40, Part 60, Appendix A, Methods 1, 3A, 7E, and 19.

Figure 4.1 depicts the sample system used for the real-time gas analyzer tests. The gas sample was continuously pulled through the probe and transported, via heat-traced Teflon® tubing, to a stainless steel minimum-contact condenser designed to dry the sample. Transportation of the sample, through Teflon® tubing, continued into the sample manifold within the mobile laboratory via a stainless steel/Teflon® diaphragm pump. From the manifold, the sample was partitioned to the real-time analyzers through rotameters that controlled the flow rate of the sample.

Figure 4.1 shows that the sample system was also equipped with a separate path through which a calibration gas could be delivered to the probe and back through the entire sampling system. This allowed for convenient performance of system bias checks as required by the testing methods.

All instruments were housed in a climate controlled, trailer-mounted mobile laboratory. Gaseous calibration standards were provided in aluminum cylinders with the concentrations certified by the vendor. EPA Protocol No. 1 was used to determine the cylinder concentrations where applicable (i.e. NOx calibration gases).

Table 4.2 provides a description of the analyzers used for the instrument portion of the tests. All data from the continuous monitoring instruments were recorded on a Logic Beach Portable Data Logging System which retrieves calibrated electronic data from each instrument every one second and reports an average of the collected data every 30 seconds.

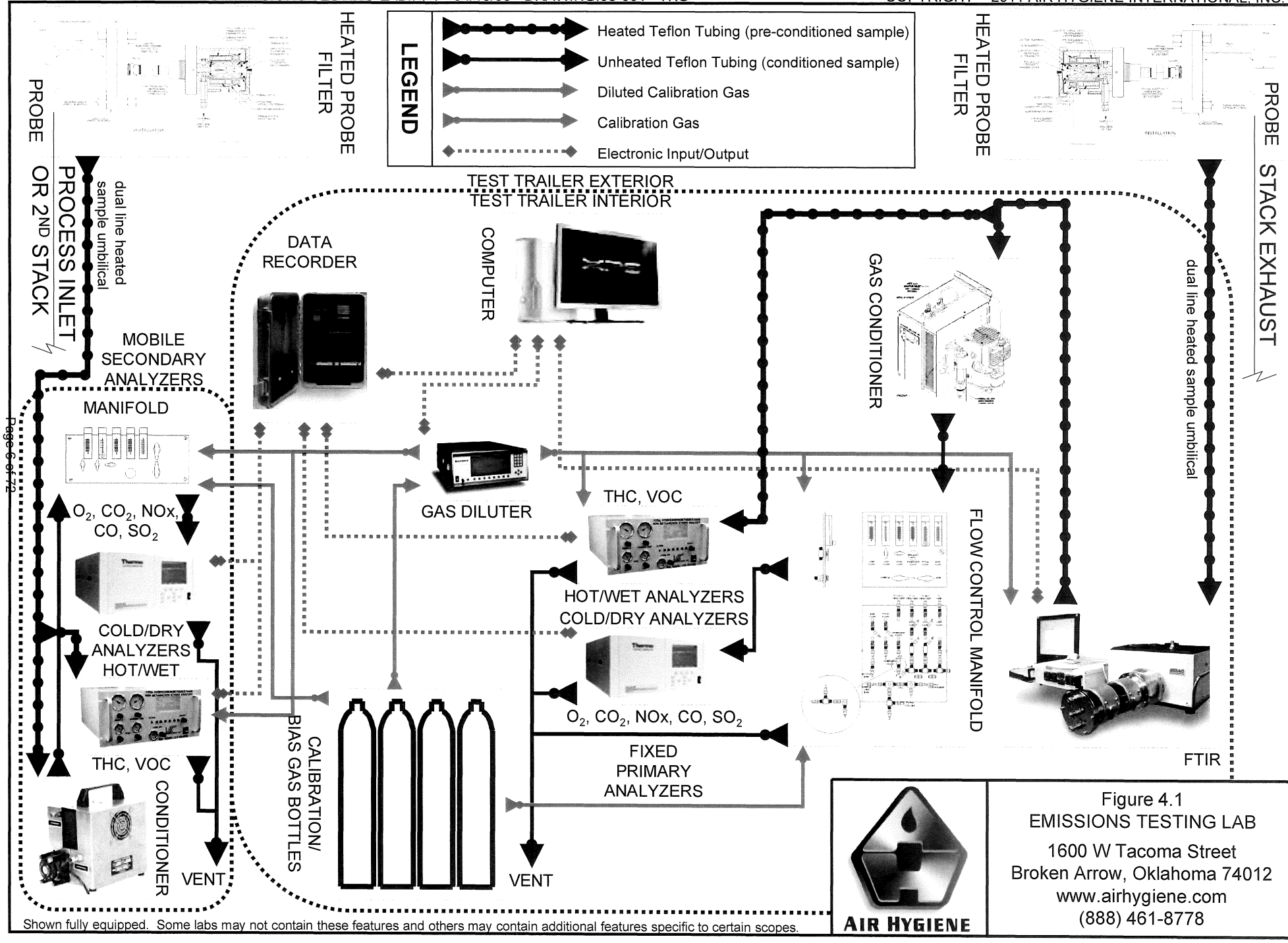
Three test runs of at least 21 minutes each were conducted on the General Electric, Frame 5N, Unit #EU-CTG2 at each of the multiple test loads for NOx and O_2.

The stack gas analysis for O_2 concentrations was performed in accordance with procedures set forth in EPA Method 3A. The O_2 analyzer uses a paramagnetic cell detector.

EPA Method 7E was used to determine concentrations of NOx. A chemiluminescent analyzer was used to determine the nitrogen oxides concentration in the gas stream. A NO_2 in nitrogen certified gas cylinder was used to verify at least a 90 percent NO_2 conversion on the day of the test.

TABLE 4.2
ANALYTICAL INSTRUMENTATION

Parameter	Manufacturer and Model	Range	Sensitivity	Detection Principle
NOx	THERMO 42 series	User may select up to 5,000 ppm	0.1 ppm	Thermal reduction of NO_2 to NO. Chemiluminescence of reaction of NO with O_3. Detection by PMT. Inherently linear for listed ranges.
O_2	SERVOMEX 1440	0-25%	0.1%	Paramagnetic cell, inherently linear.



Shown fully equipped. Some labs may not contain these features and others may contain additional features specific to certain scopes.

AIR HYGIENE

Figure 4.1
EMISSIONS TESTING LAB

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