Testing Solutions for a Better World

EMISSION COMPLIANCE TEST
FOR THE
GENERAL ELECTRIC, COMBUSTION TURBINE
(FRAME 5N), UNIT #EU-TURBINE01
PREPARED FOR
WOLVERINE POWER SUPPLY COOPERATIVE, INC.
AT THE
GAYLORD GENERATING STATION
GAYLORD, OTSEGO COUNTY, MICHIGAN
JULY 16, 2024

Permit No: MI-ROP-N6833-2021
Report Date: July 24, 2024

Corporate Headquarters
1600 W. Tacoma Street
Broken Arrow, OK 74012

AIR HYGIENE, INC.

(918) 307-8865 or (888) 461-8778
www.airhygiene.com

Remote Testing Offices
Chicago, IL
Shreveport, LA
Las Vegas, NV
Pittsburgh, PA
Fort Worth, TX
Salt Lake City, UT

EMISSION COMPLIANCE TEST
FOR THE
GENERAL ELECTRIC, COMBUSTION TURBINE
(FRAME 5N), UNIT #EU-TURBINE01
PREPARED FOR
WOLVERINE POWER SUPPLY COOPERATIVE, INC.
AT THE
GAYLORD GENERATING STATION
GAYLORD, OTSEGO COUNTY, MICHIGAN
JULY 16, 2024

Prepared and Reviewed by:

Thomas K. Graham, PE, QSTI
Director of AHU

Darin Grimes
Sr. Testing Solutions Specialist

Kimberly Graham
Report Writer

I, David Moore, QI
Staff Technician
certify that this testing was conducted and this report was created in conformance with the requirements of ASTM D7036

(this page intentionally left blank)

CERTIFICATION OF INFORMATION

I certify under penalty of law that I believe the information provided in this document is true, accurate and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate, or incomplete information.

David Moore, QI
Staff Technician
Air Hygiene International, Inc.

July 24, 2024
Date

FACILITY CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attached documents and, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate, or incomplete information.

I am the responsible official with direct knowledge and overall responsibility for the information contained in this report.

_____
Name

_____
Title

_____
Signature

_____
Date

(this page intentionally left blank)

Table of Contents

1.0 INTRODUCTION ____ *1*

1.1 TEST PURPOSE AND OBJECTIVES ____ 1

1.2 SUMMARY OF TEST PROGRAM ____ 1

1.2.1 Participating Organizations ____ 1
1.2.2 Industry ____ 1
1.2.3 Air Permit and Federal Requirements ____ 1
1.2.4 Plant Location ____ 1
1.2.5 Equipment Tested ____ 1
1.2.6 Emission Points ____ 2
1.2.7 Emission Parameters Measured ____ 2
1.2.8 Date of Emission Test ____ 2
1.2.9 Federal Certifications ____ 2

1.3 KEY PERSONNEL ____ 2

2.0 SUMMARY OF TEST RESULTS ____ *2*

3.0 SOURCE OPERATION ____ *3*

3.1 PROCESS DESCRIPTION ____ 3

3.2 SAMPLING LOCATION ____ 3

4.0 SAMPLING AND ANALYTICAL PROCEDURES ____ *3*

4.1 TEST METHODS ____ 3

4.2 INSTRUMENT CONFIGURATION AND OPERATIONS FOR GAS ANALYSIS ____ 4

APPENDICES

Appendix A Test Results and Calculations

Appendix B Emission Data Records

Appendix C Calibration Gas Certifications

Appendix D Quality Assurance and Quality Control Data

Appendix E Stratification Test Data

Emissions Compliance Test
General Electric, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01
Wolverine Power Supply Cooperative, Inc.
Gaylord Generating Station
Gaylord, Otsego County, Michigan
July 16, 2024

1.0 INTRODUCTION

Air Hygiene International, Inc. (Air Hygiene) has completed the Emissions Compliance Test for nitrogen oxides (NOx) from the exhaust of the General Electric, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01 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 16, 2024.

1.1 TEST PURPOSE AND OBJECTIVES

The purpose of the test was to conduct the periodic 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 air quality permit requirements. The specific objective was to determine the emission concentration of NOx from the exhaust of Wolverine Power Supply Cooperative, Inc.'s General Electric, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01.

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 Environment, Great Lakes, and Energy (EGLE)
- Wolverine Power Supply Cooperative, Inc.
- Fishbeck
- Air Hygiene

1.2.2 Industry
- Electric Utility / Electric Services

1.2.3 Air Permit
- Permit Number: MI-ROP-N6833-2021

1.2.4 Plant Location
- Gaylord Generating Station in Gaylord, Otsego County, Michigan
  - GPS Coordinates [Latitude 45.01098, Longitude -84.762004]
  - Physical Address: 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, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01

1.2.6 Emission Points
- Exhaust from the General Electric, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01
- For all gases, one sample point in the exhaust duct from the General Electric, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01, determined after conducting a stratification test

1.2.7 Emission Parameters Measured
- NOx

1.2.8 Date of Emission Test
- July 16, 2024

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

Wolverine Power Supply Cooperative, Inc.:	Nathan Sayers (nsayers@wpsci.com)	231-429-8616
Wolverine Power Supply Cooperative, Inc.:	Zack Ackerman (zackerman@wpsci.com)	231-779-3352
EGLE:	Becky Radulski (radulskir@michigan.gov)	989-217-0051
Fishbeck:	Stephanie A. Jarrett (sajarrett@fishbeck.com)	248-324-2146
Air Hygiene:	David Moore (dmoore@airhygiene.com)	918-307-8865
Air Hygiene:	Kelton Carter	918-307-8865
Air Hygiene:	Simarjot Singh	918-307-8865

2.0 SUMMARY OF TEST RESULTS

Results from the sampling conducted on Wolverine Power Supply Cooperative, Inc.'s General Electric, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01 located at the Gaylord Generating Station on July 16, 2024 are summarized in the following table and relate only to the items tested.

TABLE 2.1
SUMMARY OF GENERAL ELECTRIC, FRAME 5N, UNIT #EU-TURBINE01 RESULTS

Parameter	Low (50%) Load	Mid (75%) Load	High (100%) Load	Permit Limits
Start Time (hh:mm:ss)	12:24:20	13:42:20	14:58:20	--
End Time (hh:mm:ss)	13:26:50	14:44:50	16:00:50	--
Run Duration (min / run)	21	21	21	--
Comb. Inlet Pres. (psig)	97.1	102.4	108.1	--
Turbine Fuel Flow (SCFH)	178,520	217,620	261,600	--
Stack Flow (RM19) (SCFH)	10,151,401	10,297,453	10,268,042	--
Heat Input (MMBtu/hr)	195.0	236.0	286.0	--
Power Output (megawatts)	11.0	15.0	19.5	--
CD Temp (°F)	561.33	575.00	587.67	--
NOx (ppmvd)	35.41	46.96	65.33	--
NOx (ppmvd@15%O_2)	62.15	68.59	79.15	--
NOx (ppmvd@15%O_2&ISO)	66.03	73.27	84.10	--
NOx (lb/hr)	42.93	57.76	80.12	168.5
NOx (lb/MMBtu)	0.229	0.253	0.292	0.48

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.

3.0 SOURCE OPERATION

3.1 PROCESS DESCRIPTION

Wolverine Power Supply Cooperative, Inc. (WP) 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-TURBINE01, EU-TURBINE02, and EU-TURBINE03. 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-TURBINE01.

3.2 SAMPLING LOCATION

The EU-TURBINE01 stack is rectangular and measures 10.1 feet (ft) (121 inches) deep and 10.2 ft (122 inches) wide at the 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) [2.6 dia] downstream and approximately 8 ft (96 inches) [0.8 dia] upstream from the nearest disturbances. Air Hygiene has field verified the measurable dimensions. Non-field verified dimensions are provided by Wolverine Power Supply Cooperative, Inc. 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. During the stratification test two points were traversed from each of the seven ports. The probe was allowed to remain at a point for at least two times the system response time.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

4.1 TEST METHODS

The emission test on the General Electric, Combustion Turbine (Frame 5N), Unit #EU-TURBINE01 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 16, 2024.

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 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.

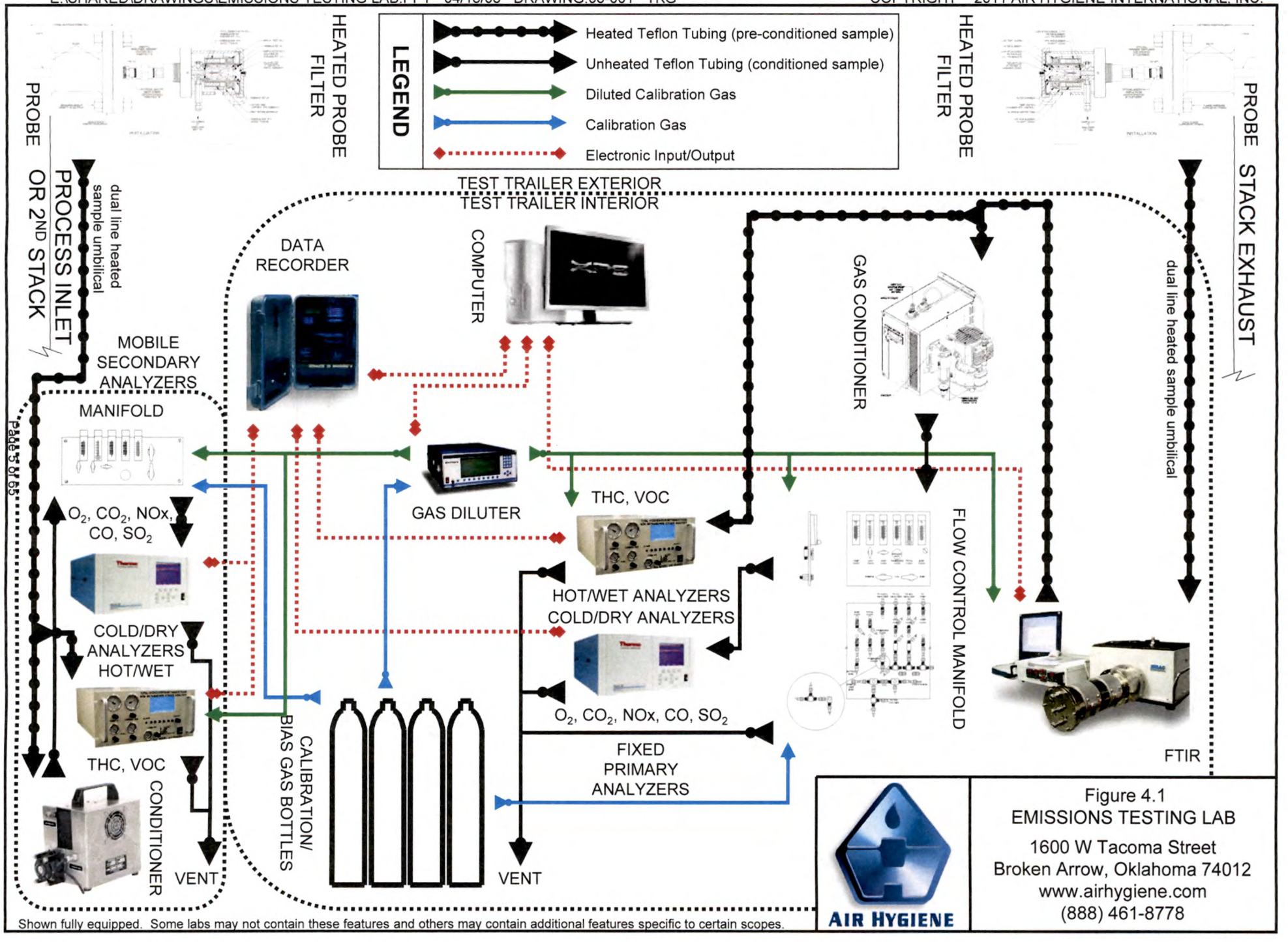
The stack gas analysis for O_2 concentrations was performed in accordance with procedures set forth in EPA Method 3A. The O_2 analyzer uses a paramagnetic cell detector.

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 air manufacturer-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.

COPYRIGHT © 2011 AIR HYGIENE INTERNATIONAL, INC.



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

1600 W Tacoma Street
Broken Arrow, Oklahoma 74012
www.airhygiene.com
(888) 461-8778