



**Eastern Michigan University
EU-POWERGENERATION
Emissions Test Report**

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JUL 20 2018

AIR QUALITY DIVISION

Prepared for:

Eastern Michigan University Heating Plant

Ypsilanti, Michigan

Heating Plant
West Circle Drive
Ypsilanti, Michigan

Project No. 049AS-243416
July 13, 2018

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Eastern Michigan University (EMU) to conduct an emissions test program for nitrogen oxides emission rates from a single gas turbine (EU-POWERGENERATION) located at the EMU Heating Plant in Ypsilanti, Michigan. The emissions test program was conducted on May 22, 2018.

Testing of the turbine consisted of triplicate 21-minute test runs while firing natural gas. The emissions test program was required by MDEQ Air Quality Division Permit to Install No. 46-17. The results of the emission test program are summarized by Table I. As summarized by Table I, the testing indicated that the turbine is in compliance with corresponding emission limitations and was performed in accordance with BTEC test plan 049AS-243416 and the MDEQ test plan approval letter.

**Table I
Overall Emission Summary
Test Date: May 22, 2018**

Source	NOx Emission Average	Emission Limit
EU-POWERGENERATION	7.6 ppm @ 15% O2	25 ppm @ 15% O2

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Eastern Michigan University (EMU) to conduct an emissions test program for nitrogen oxides emission rates from a single gas turbine (EU-POWERGENERATION) at the EMU Heating Plant facility located in Ypsilanti, Michigan. The emissions test program was conducted on May 22, 2018.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (March 2018). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document. All testing was performed in accordance with BTEC test plan 049AS-243416 and the MDEQ test plan approval letter.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on May 22, 2018 at the EMU Heating Plant facility located in Ypsilanti, Michigan. The test program included evaluation of NO_x emissions from one turbine.

1.b Purpose of Testing

AQD issued Permit to Install No. 46-17 to EMU. The permit limits emissions from the turbine as summarized by Table 1.

Table 1
NO_x Emission Limitations
Eastern Michigan University-Heating Plant

Source	Emission Limit
EU-POWERGENERATION	25 ppm @ 15% O ₂

1.c Source Description

The emission unit is one Solar turbine with heat recovery steam generator (HRSG). The turbine is a Solar Taurus 70-10801S Axial turbine fired with natural gas. The turbine is equipped with So-Lo-Nox technology for the control of NO_x emissions. The turbine has a rated heat release of 90.3 MMBtu/hr. This emission unit also includes a 62.2 MMBtu/hr duct burner and heat recovery boiler fired with natural gas. Exhaust from the cogeneration system is routed to atmosphere through SV-POWERGENERATION.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. Mark Monarch
Manager
Eastern Michigan University
Technical & Mechanical Trades and Utilities
875 Ann Street
Ypsilanti, Michigan 48197
(734) 323-4321

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Randal Tysar Senior Environmental Engineer	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Matthew Young Client Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(586) 744-9133
Mr. Mark Monarch Manager	EMU 875 Ann Street Ypsilanti, MI 48197	(734) 323-4321
Mr. Geoff McGowan Heating Plant Foreman	EMU Heating Plant Ypsilanti, MI 48197	(248) 660-6535

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

Process data is discussed in Section 5.k.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit to Install No. 46-17.

2.c Results

The tests for NO_x were below the limit of 25 ppm @ 15% O₂.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

See section 1.c.

3.b Process Flow Diagram

Due to the simplicity of the turbine, a flow diagram is not necessary.

3.c Raw and Finished Materials

The raw material is natural gas.

3.d Process Capacity

The turbine is rated for a maximum power generation capacity of 7.965 MW and the duct burner is rated for a maximum heat input capacity of 62.2 MMBtu/hr.

3.e Process Instrumentation

The turbine is regulated by electric power load (KW) and the duct burner for the waste heat boiler is regulated based on steam header pressure.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Sampling and analysis procedures utilized the following test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 3A, "*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources*", was used to measure the O₂ concentration of the exhaust gas.
- Method 7E, "*Determination of Nitrogen Oxide Emissions from Stationary Sources*", was used to measure the NO_x concentration of the exhaust gas.

Turbine exhaust NO_x content of the gas stream was measured using a TECO Model 42c NO_x gas analyzer, and the O₂ content was measured using a Servomex 4100 O₂ gas analyzer. A sample of the gas stream was drawn through an insulated stainless-steel probe with an in-line glass fiber filter to remove any particulate, a heated Teflon® sample line, and through an electronic sample conditioner to remove the moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with data acquisition software. A schematic of the sampling train is provided as Figure 1.

In accordance with Method 7E, a 3-point (zero, mid, and high) bias check and calibration check was performed on the NO_x analyzer prior to initiating the test program. Following each test run, a 2-point (zero and high) calibration drift check was performed. The NO_x analyzer was operated in the 0-50 ppm range. The NO_x converter efficiency was verified as specified by Method 7E 16.2.2.

In accordance with Method 3A, a 3-point (zero, mid, and high) bias check and calibration check was performed on the O₂ analyzer prior to initiating the test program. Following each test run, a 2-point (zero and high) calibration drift check was performed. The O₂ analyzer was operated in the 0-25 ppm range.

Exhaust gas concentrations were calculated using pollutant and diluent concentrations. A Method 7E 12-point stratification check was performed during the first run on EU-POWERGENERATION. The results of the stratification test were within 0.5 ppm for the NO_x and within 0.3% for the O₂, allowing for the use of single point sampling.

4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

4.c Sampling Ports

A diagram of the stack showing sampling ports is included as Figure 2.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 2.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 3. Detailed results for the emissions test program are summarized by Tables 4.

Table 3
Overall Emission Summary
Test Date: May 22, 2018

Source	NOx Emission Average	Emission Limit
EU-POWERGENERATION	7.6 ppm @ 15% O2	25 ppm @ 15% O2

5.b Discussion of Results

All of the test runs for NOx were below the limit of 25 ppm @15% O2.

5.c Sampling Procedure Variations

There were no procedure variations. In addition, the test program did not include any aborted test runs or test runs that included failed quality assurance results.

5.d Process or Control Device Upsets

There were no upsets.

5.e Control Device Maintenance

The turbine is newly installed and has not had any maintenance performed.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix A.

5.i Sample Calculations

Sample calculations are provided in Appendix B.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

5.k Laboratory Data

There are no laboratory results for this test program. Raw CEMS and process data are provided in Appendix C.

MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

All testing performed was done in conformance to the ASTM D7036-04 standard. The information and opinions rendered in this report are exclusively for use by EMU. BTEC will not distribute or publish this report without EMU's consent except as required by law or court order. BTEC accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:


Matthew Young
Client Project Manager

This report was reviewed by:



Brandon Chase
QA/QC Manager

Table 4
EU-POWERGENERATION
NOx Emission Rates
Eastern Michigan University
Ypsilanti, Michigan
BTEC Project No. 049AS-243416
Sampling Dates: 5/22/2018

Parameter	Run 1	Run 2	Run 3	Average
	Strat Test			
Test Run Date	5/22/2018	5/22/2018	5/22/2018	
Test Run Time	8:30-9:00	9:10-9:31	9:39-10:00	
Oxygen Concentration (%)	14.7	14.8	14.7	14.7
Oxygen Concentration (%; drift corrected as per USEPA 7E)	14.7	14.7	14.7	14.7
Outlet Oxides of Nitrogen Concentration (ppmv)	8.0	7.8	8.8	8.2
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	7.8	7.5	8.6	8.0
Outlet NOx Concentration (ppmv, corrected to 15% O ₂)	7.5	7.2	8.1	7.6

O ₂ Correction			
Co	0.08	0.09	0.09
Cma	10.06	10.06	10.06
Cm	10.08	10.12	10.14

NOx Correction			
Co	0.21	0.27	0.22
Cma	24.79	24.79	24.79
Cm	24.76	24.93	24.96

ppmv = parts per million on a volume-to-volume basis

Equations

$$\text{Conc}_{@15\%O_2} = \text{Conc} * (20.9 - 15) / (20.9 - \%O_2)$$

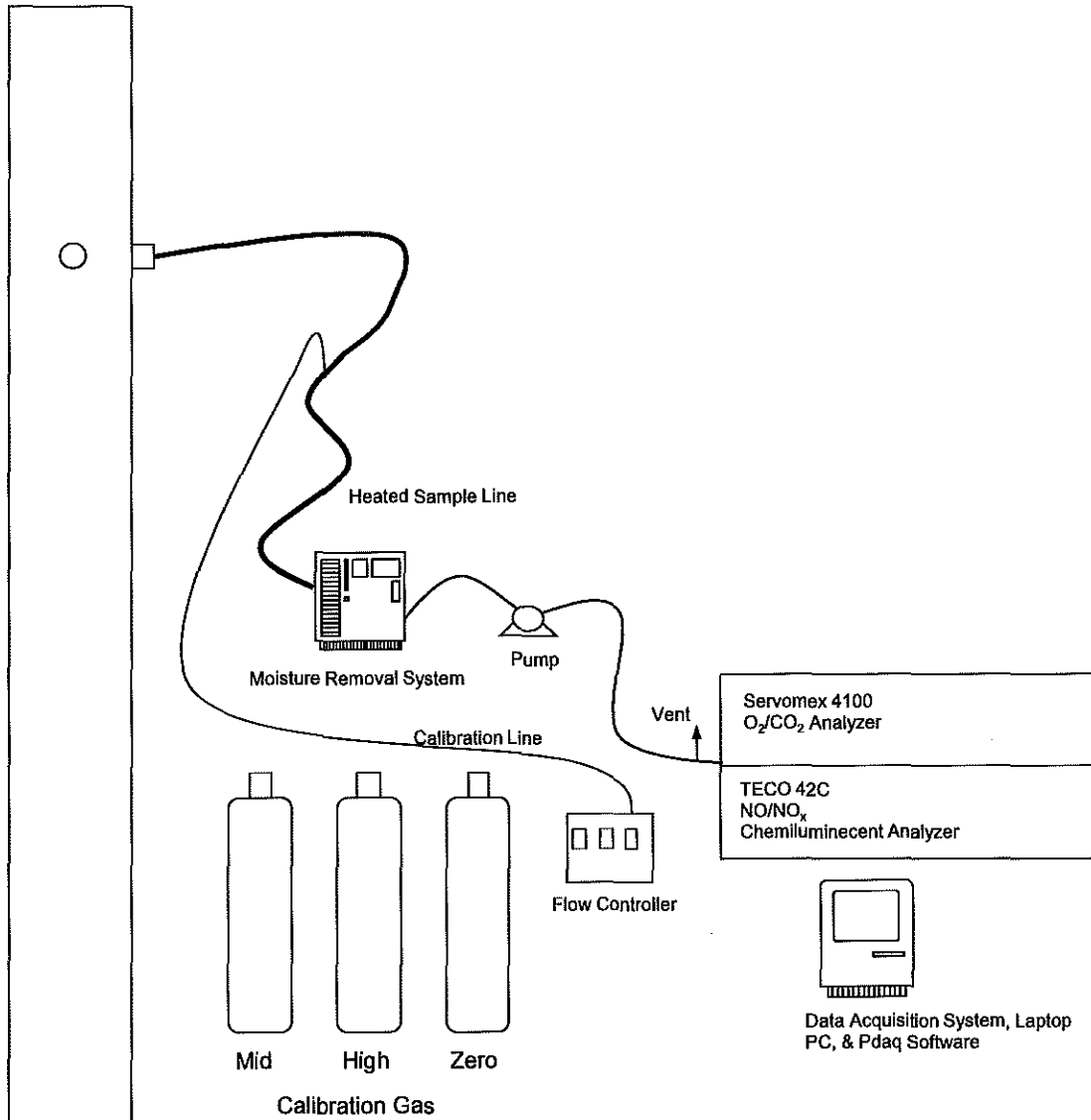


Figure No. 1

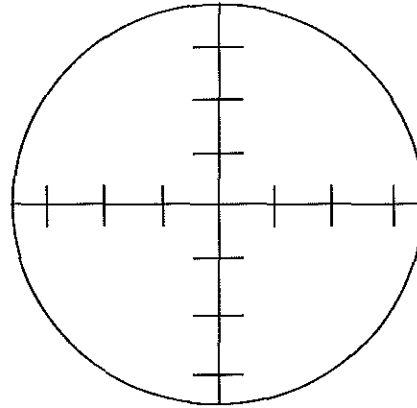
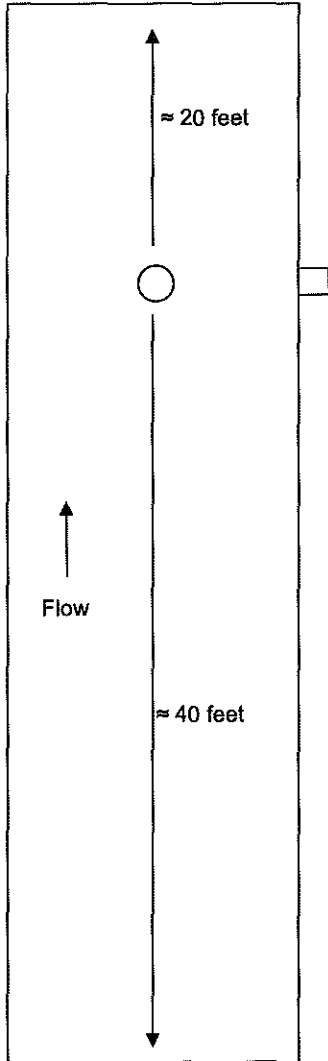
Site:
USEPA Method 7E and 3A
Eastern Michigan University
Ypsilanti, Michigan

Sampling Date:
May 22, 2018

BT Environmental Consulting Inc.
4949 Fernlee Avenue
Royal Oak, MI 48073



diameter = 60 inches



Not to Scale

Points	Distance "
1	2.6
2	8.8
3	17.8
4	42.2
5	51.2
6	57.4

Figure No. 2

Site:
EU-POWERGENERATION
Eastern Michigan University
Ypsilanti, Michigan

Sampling Date:
May 22, 2018

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