BTEC Inc.

Gas Turbine Emissions Test Report

Prepared for:

Wayne County Airport Authority

Source Address:

Detroit Metropolitan Wayne County Airport
Building 611 (Powerhouse)
Detroit, Michigan 48232

Project No. 05-3464.00
November 16, 2015

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

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT
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RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Natural Resources and Environment, Air Quality Division upon request.

Source Name: Detroit Metropolitan Wayne County Airport — County: Wayne

Source Address: L.C. Smith Building, Mezzanine — City: Romulus

AQD Source ID (SRN): M4174 — ROP No.: MI-ROP-M4174-2010 — ROP Section No.:

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

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Reporting period (provide inclusive dates): From July 1, 2015 To Dec. 31, 2015

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

EUTurbine Emissions Test Report (Testing Conducted 10/1/15)

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Bryan C. Wagoner	Dir. - Dept. of Env. & Sust.	(734) 247-3686
Name of Responsible Official (print or type)	Title	Phone Number

Bryan C. Wagoner — 11/24/15

Signature of Responsible Official — Date

* Photocopy this form as needed.

EQP 5736 (Rev 2-10)

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by the Wayne County Airport Authority to evaluate nitrogen oxides (NOx) and carbon monoxide (CO) emission rates from a single gas turbine operating at two different load conditions. Triplicate 21-minute tests were conducted at a load of 14.3 MW. The emissions test program was conducted on October 1, 2015. The results of the emission test program are summarized by Table I.

Table I
Emission Test Program Results Summary

Emission Unit Identification	Pollutant	Test Result (11.0 MW)	Limit
EUTURBINE	NOx @ 15% O_2 (ppm)	9.3	25
	NOx (lb/MMBtu)	0.03	0.06
	NOx (lb/hr)	5.4	8.7
	CO (lb/MMBtu)	0.007	0.061
	CO (lb/hr)	1.1	8.8

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The Air Quality Division (AQD) of Michigan's Department of Environmental Quality has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). This document is provided as Appendix A. The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Field sampling for the emissions compliance test program was conducted on October 1, 2015 at the Building 611 Powerhouse located at Detroit Metropolitan Wayne County Airport (DTW). The emission test program included the evaluation of NOx and CO emission rates from one natural gas-fired turbine.

1.b Purpose of Testing

Michigan Permit to Install No. 175-10 limits the turbine to (1) 25 ppm NOx corrected to 15% O_2, (2) 0.06 lbs NOx per MMBtu, (3) 8.7 lbs NOx per hour; (4) 0.061 lbs CO per MMBtu, and (5) 8.8 lbs CO per hour.

1.c Source Description

The emission unit is a Titan 130-20501S Axial gas turbine manufactured by Solar Turbines. The turbine is equipped to fire natural gas only. Additional information regarding the Titan 130-20501S Axial gas turbine as well as the associated SoLoNOx dry emissions control technology are provided in Appendix B.

1.d Test Program Contact

The contact for information regarding the test program as well as the test report is as follows:

Mr. Bryan C. Wagoner
Airport Environmental Administrator
Detroit Metropolitan Wayne County Airport
L.C. Smith Termial, 2nd Floor
Detroit, Michigan 48232
(734) 247-3686

1.e Testing Personnel

Names and affiliations for relevant personnel who were present during the testing program are summarized by Table 1.

Table 1
Testing Personnel

Name	Affiliation
John Philbrook	DTW
Todd Wessel	BTEC
Randal Tysar	BTEC
Mark Dziadosz	MDEQ
Steve Weis	MDEQ

2. Summary of Results

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

2.a Operating Data

Turbine operating load (kW) and natural gas flowrate (lb/hr) were monitored throughout the emissions test program and are summarized in Appendix E.

2.b Applicable Permit

Michigan Permit to Install No. 175-10 was issued for the turbine.

2.c Results

The results of the emissions test program are summarized by Table 2. Detailed results for each test run are summarized by Tables 3 and 4.

2.d Emission Regulation Comparison

Emission limitations for the turbine are summarized in Section 1.b.

3. Source Description

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

3.a Process Description

The Titan 130-20501S Axial turbine is a single shaft gas turbine that is regulated by electrical load only. Air to fuel mix ratios are controlled automatically with slightly higher turbine loads possible during periods of higher ambient air density.

The turbine is nominally rated for a maximum of 145 MMBtu/hr heat input and the generator is rated for a maximum power load of 15 MW.

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

The raw material used is natural gas.

3.d Process Capacity

The turbine is nominally rated for a maximum of 145 MMBtu/hr heat input and the generated is rated for a maximum power load of 15 MW.

3.e Process Instrumentation

Process instrumentation relevant to the emissions test program includes natural gas flowrate (lbs/hr) and electrical load (MW). Relevant data is summarized in Appendix E.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used to verify emission rates from the turbine.

4.a Sampling Train and Field Procedures

The NOx content of the gas stream was measured using a TECO Model 42C NOx gas analyzer, the CO content of the gas stream was measured using a TECO Model 48i CO gas analyze, and the O_2 content was measured using a M&C Products PMA 100-L O_2 gas analyzer. A sample of the gas stream will be 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 a Universal Analyzers 3080PV electronic sample conditioner to remove the moisture from the sample before it enters the analyzer. Data will be recorded at 4-second intervals on a PC equipped with data acquisition software.

Sampling and analysis procedures will utilize 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*"
- Method 7E, "*Determination of Nitrogen Oxide Emissions from Stationary Sources*"
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Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates"

Exhaust gas flowrates were calculated using turbine natural gas flowrate data (provided by DTW), the gross heating value and density of the natural gas (as provided by the natural gas utility from a recent sampling and analysis, see Appendix E), and the equations included in Method 19.

4.b Recovery and Analytical Procedures

Recovery procedures are described in section 4.a.

4.c Sampling Ports

Exhaust gas sampling was conducted in the turbine exhaust stack. The stack is round and 72 inches in diameter, and is equipped with two test ports positioned at 90 degrees.

4.d Traverse Points

The absence of stratification was verified by traversing the stack at Method 1 locations with the probe moved at two-minute intervals during the first test run. During the test run, each individual O_2 reading was within 0.3 percent of the overall mean.

5. Test Results and Discussion

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

5.a Results Tabulation

The results of the emissions test program are summarized by Table 2.

Table 2
Emission Test Program Results Summary

Emission Unit Identification	Pollutant	Test Result (11.0 MW)	Limit
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5.b Discussion of Results

Emission limitations and the results of the emissions test program are summarized by Table 2 (see section 5.a).

5.c Sampling Procedure Variations

No sampling procedure variations were used during the emissions test program.

5.d Process or Control Device Upsets

No process or control device upsets occurred during the emissions testing.

5.e Control Device Maintenance

The Solar turbine is not equipped with an add-on emissions control device.

5.f Audit Sample Analyses

Audit samples are not applicable to this emissions test program.

5.g Calibration Sheets

Certificates of analysis for the calibration gases used during testing are provided as Appendix C.

5.h Sample Calculations

Sample calculations are provided as Appendix D.

5.i Field Data Sheets

Copies of field data sheets and relevant field notes are provided as Appendix F.

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There are no laboratory results for this test program.

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5.g Calibration Sheets

Certificates of analysis for the calibration gases used during testing are provided as Appendix C.

5.h Sample Calculations

Sample calculations are provided as Appendix D.

5.i Field Data Sheets

Copies of field data sheets and relevant field notes are provided as Appendix F.

5.j Laboratory Data

There are no laboratory results for this test program.

TABLES

Table 3
EU-Turbine Detailed Emission Test Results Summary
Detroit Metropolitan Wayne County Airport
BTEC Project No. 05-3464
14.3 MW Load Condition
Sampling Date: October 1, 2015

	Parameter	Run 1	Run 2	Run 3	Average
	Test Run Date	10/1/2015	10/1/2015	10/1/2015	
	Test Run Time	10:25-11:01	11:16-11:36	11:51-12:11	
14.3 MW Load	Oxides of Nitrogen Concentration (ppmv)	9.07	9.09	8.93	9.03
	Oxygen concentration (%)	15.26	15.26	15.27	15.26
	Oxygen concentration (%) (corrected as per USEPA 7E)	15.29	15.32	15.33	15.31
	Natural Gas Flowrate (kscf/hr)	152.3	151.8	151.2	151.8
	Natural Gas Heating Value (Btu/scf)	1033	1033	1033	1033
	NOx Concentration (ppmv, corrected as per USEPA 7E)	8.91	8.87	8.75	8.84
	NOx Concentration (lb/dscf, corrected as per USEPA 7E)	1.1E-06	1.1E-06	1.0E-06	1.1E-06
	NOx Emission Factor (lb/MMBtu, corrected as per USEPA 7E)	0.035	0.035	0.034	0.034
	NOx Emission Rate (lb/hr) (corrected as per USEPA 7E)	**5.4**	**5.4**	**5.3**	**5.4**
	NOx Concentration (ppmv@15% O2)	**9.4**	**9.4**	**9.3**	**9.3**
14.3 MW Load	Carbon Monoxide Concentration (ppmv)	3.56	3.48	3.46	3.50
	Oxygen concentration (%)	15.26	15.26	15.27	15.26
	Oxygen concentration (%) (corrected as per USEPA 7E)	15.29	15.32	15.33	15.31
	Natural Gas Flowrate (kscf/hr)	152.3	151.8	151.2	151.8
	Natural Gas Heating Value (Btu/scf)	1033	1033	1033	1033
	CO Concentration (ppmv, corrected as per USEPA 7E)	2.96	2.83	2.81	2.87
	CO Concentration (lb/dscf, corrected as per USEPA 7E)	2.2E-07	2.1E-07	2.0E-07	2.1E-07
	CO Emission Factor (lb/MMBtu, corrected as per USEPA 7E)	0.007	0.007	0.007	0.007
	CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	**1.1**	**1.1**	**1.0**	**1.1**

FIGURES

BTEC Inc.

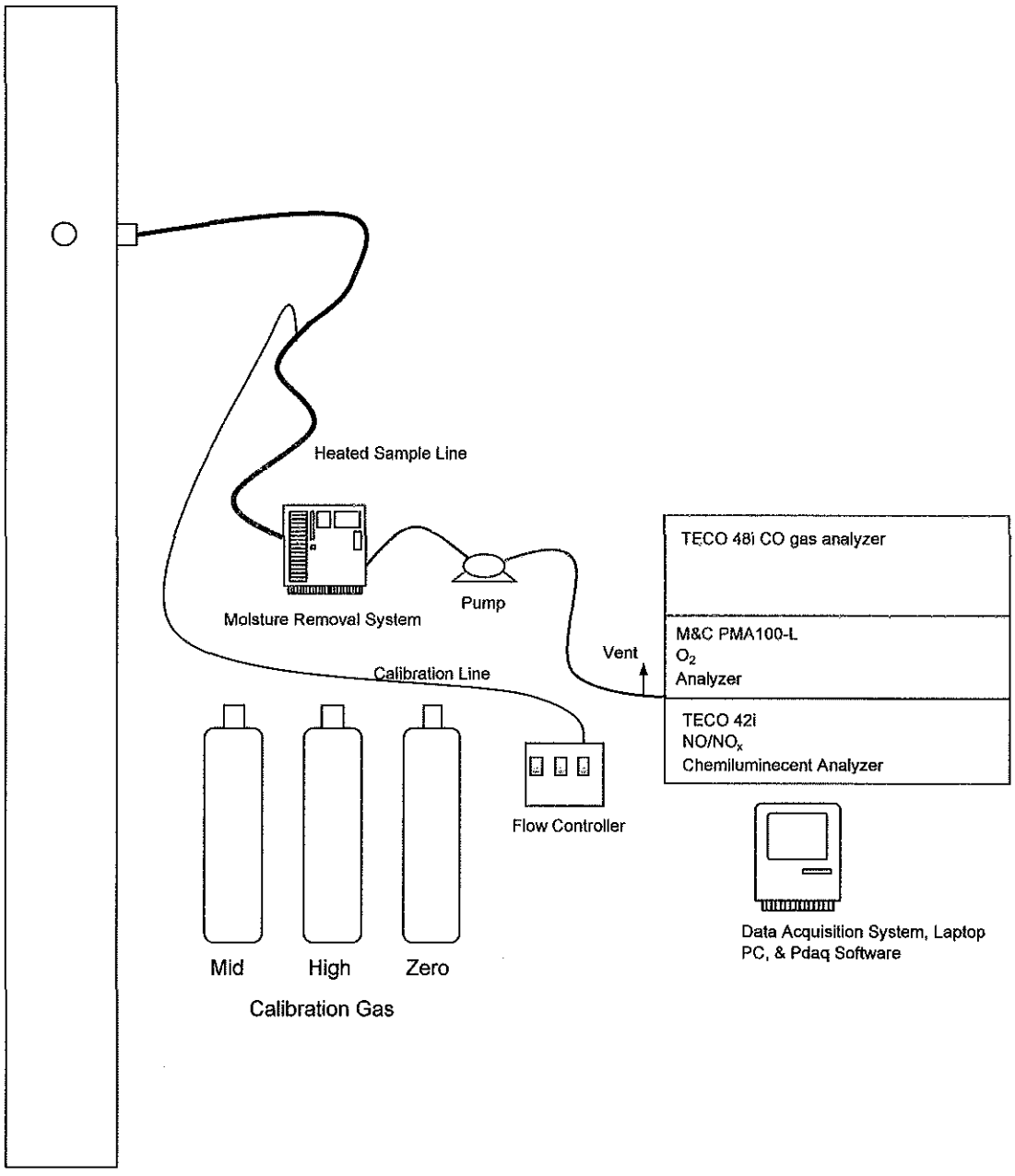

Figure 1

Site: **USEPA Methods 3A, 7E, and 10** **Test Date: October 1, 2015** **Detroit Metropolitan Wayne County Airport** **Detroit, Michigan**	**BT Environmental Consulting Inc.** **4949 Fernlee Avenue** **Royal Oak MI 48073**