BTEC Inc.

Diesel Generator Emissions Test Summary Report

Prepared for:

Detroit Metropolitan Wayne County Airport

Detroit Metropolitan County Airport
L.C. Smith Terminal, 3rd Floor
Romulus, Michigan

Project No. 05-3464.00

February 27, 2015

BT Environmental Consulting, Inc.
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MICHIGAN DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT
AIR QUALITY DIVISION

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 Terminal, 3rd Floor — 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.

☐ 2. 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, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

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

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☒ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From Jan. 1, 2015 To June 30, 2015

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

EUENGINE2, EUENGINE13, and EUENGINE14 Emissions Test Report (Testing conducted January 6, 7, and 8, 2015

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	Airport Env. Administrator	(734) 247-3686
Name of Responsible Official (print or type)	Title	Phone Number
Bryan C. Wag		030715
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 Detroit Metropolitan Wayne County Airport (DTW) to evaluate nitrogen oxides (NOx) and oxygen (O_2) emission rates from three emergency generator sets located at DTW. The first emergency generator (EUENGINE2) set is located inside a semi-truck trailer that is normally located in the parking lot outside the DTW Airport Maintenance Building (Building 703). The other two generators (EUENGINE13 and EUENGINE14) are located at the North and South ends of the McNamara Terminal Parking Deck. The engines are located in Romulus, Michigan. The emissions test program was conducted on January 6, 7, and 8, 2015.

Testing of all three engines consisted of triplicate 60-minute test runs while each unit was operating above 90%. The emissions test program was required by MDEQ Air Quality Division Renewable Operating Permit (ROP) No. MI-ROP-M4174-2010. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: January 6, 7, and 8, 2015

EUENGINE2 Driver's Side		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	380 lbs/1,000 gal	550 lbs/1,000 gal
EUENGINE2 Passenger's Side		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	390 lbs/1,000 gal	550 lbs/1,000 gal
EUENGINE13		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	397 lbs/1,000 gal	515 lbs/1,000 gal
EUENGINE14		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	395 lbs/1,000 gal	515 lbs/1,000 gal

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Detroit Metropolitan Wayne County Airport (DTW) to evaluate nitrogen oxides (NOx) and oxygen (O_2) emission rates from three emergency generator sets located at DTW. The first emergency generator (EUENGINE2) set is located inside a semi-truck trailer that is normally located in the parking lot outside the DTW Airport Maintenance Building (Building 703). The other two generators (EUENGINE13 and EUENGINE14) are located at the North and South ends of the McNamara Terminal Parking Deck. The engines are located in Romulus, Michigan. The emissions test program was conducted on January 6, 7, and 8, 2015.

Triplicate 60-minute test runs were conducted on each engine. EUENGINE2 is equipped with two exhaust pipes. Each test run of EUENGINE2 consist of 30 minutes of monitoring of each exhaust pipe.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (January, 2013). 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

Sampling and analysis for the emission test program was conducted on January 6, 7, and 8, 2015 at the DTW facility located in Romulus, Michigan. The test program included evaluation of NOx and O_2 emissions from EUENGINE2, EUENGINE13, and EUENGINE14.

1.b Purpose of Testing

AQD issued Renewable Operating Permit No. MI-ROP-M4174-2010 to DTW. This permit limits emissions from each engine as summarized by Table 1.

1.c Source Description

EUENGINE2 is a diesel emergency generator set manufactured by Cummins-Onan. The generator set (Model KTA50 G9) is rated for a maximum of 1,500 kW at a gross engine power output of 2,220 bhp.

EUENGINE 13 and EUENGINE 14 are identical diesel emergency generator sets manufactured by Caterpillar. The generator sets (Model SR4B) are rated for a maximum of 1,500 kW at a gross engine power output of 2,153 bhp.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. Bryan C. Wagoner
Airport Environmental Administrator
Detroit Metropolitan Wayne County Airport
L.C. Smith Terminal, 3rd Floor
Romulus, Michigan 48232
(734) 247-3686

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

2. Summary of Results

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

2.a Operating Data

Operating data for the emissions test program is summarized by the documents included in Appendix A.

2.b Applicable Permit

The applicable permit for this emissions test program is Renewable Operating Permit (ROP) No. MI-ROP-M4174-2010.

2.c Results

The overall results of the emission test program are summarized by Table 3. NOx emissions from each engine were below the corresponding limit of 550 lbs/1,000gal for EUENGINE2. NOx emissions were also below the limit of 515 lbs/1,000gal for EUENGINE13 and EUENGINE14.

3. Source Description

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

3.a Process Description

EUENGINE2 is a diesel emergency generator set manufactured by Cummins-Onan. The generator set (Model KTA50 G9) is rated for a maximum of 1,500 kW at a gross engine power output of 2,220 bhp.

EUENGINE 13 and EUENGINE 14 are identical diesel emergency generator sets manufactured by Caterpillar. The generator sets (Model SR4B) are rated for a maximum of 1,500 kW at a gross engine power output of 2,153 bhp.

3.b Process Flow Diagram

Due to the simplicity of the diesel engine, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The only raw material supplied to the generator sets is diesel fuel. EUENGINE2 is rated for a maximum diesel fuel combustion rate of 103.6 gallons per hour. EUENGINE13 and EUENGINE14 are rated for a maximum diesel fuel combustion rate of 107.9 gallons per hour.

3.d Process Capacity

All three generators are rated for a maximum load of 1,500 kW.

3.e Process Instrumentation

Process data was not monitored during the emissions test program.

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

Engine exhaust NOx content was measured using a Teledyne Model T-200H NOx gas analyzer 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 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.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United State's National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A schematic of the sampling train is provided as Figure 1.

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 O_2 concentration of the exhaust gas.

- Method 7E, *"Determination of Nitrogen Oxide Emissions from Stationary Sources"*, was used to measure the NOx concentration of the exhaust gas.

All analyzers were calibrated in accordance with the procedures of Methods 3A and 7E. For the purpose of converting the NOx and O_2 concentrations to units consistent with the emission limitations, the emission rates were converted to lbs/MMBtu using Method 19, Equation 19-1 and the distillate oil F-Factor of 9,190 dscf/MMBtu listed in Method 19, Table 19-2. A sample of the fuel oil was collected from the EUENGINE2 tank and analyzed for gross heating value and density. These values were then used to convert the results to pounds of NOx per 1,000 gallons of fuel for all three engines (fuel tanks for all three engines are filled by a truck that takes its fuel from a single tank).

The accuracy of the gas dilution system was verified using the procedures detailed by Method 205 and the NOx converter efficiency was verified as specified by Method 7E.

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

Exhaust gas was sampled from the center of the duct with the sampling probe inserted into the end of the exhaust pipe.

4.d Traverse Points

See section 4.c.

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 through 7.

5.b Discussion of Results

NOx emissions from the engines were less than the corresponding emission limits of 550 lbs/1,000gal for EUENGINE2 and 515 lbs/1,000gal for EUENGINE13 and EUENGINE14.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

5.d Process or Control Device Upsets

No process or control device upsets occurred during testing.

5.e Control Device Maintenance

The engines are not equipped with add-on emissions control equipment.

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 B.

5.i Sample Calculations

Sample calculations are provided in Appendix C.

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 CEM data is provided electronically in Appendix D.

Table 1
NOx Emission Limitations
DTW
Test Date: January 6, 7, and 8, 2015

EUENGINE2	
Pollutant	**Emission Limit**
NOx	550 lbs/1,000 gal
EUENGINE13 and EUENGINE14	
Pollutant	**Emission Limit**
NOx	515 lbs/1,000 gal

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Ken Lievense Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Randal Tysar Senior Environmental Engineer	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Paul Molenda Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Thomas Maza Environmental Quality Analyst	MDEQ-AQD 3058 West Grand Boulevard Detroit, Michigan 48202	(313) 456-4700

Table 3
Overall Emission Summary
Test Date: January 6, 7, and 8, 2015

EUENGINE2 Driver's Side		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	380 lbs/1,000 gal	550 lbs/1,000 gal
EUENGINE2 Passenger's Side		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	390 lbs/1,000 gal	550 lbs/1,000 gal
EUENGINE13		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	397 lbs/1,000 gal	515 lbs/1,000 gal
EUENGINE14		
Pollutant	**Average Emission Rate**	**Emission Limit**
NOx	395 lbs/1,000 gal	515 lbs/1,000 gal

Table 4
Engine 2 NOx Emission Rate - Drivers Side Exhaust
DTW

Sampling Dates: 1/6/15

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/6/2015	1/6/2015	1/6/2015	
Test Run Time	8:50-9:20	10:38-11:08	12:00-12:30	
Outlet NOx Concentration (ppmv)	1119.7	1091.2	1080.1	1097.0
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	1167.2	1163.2	1168.7	1166.4
Outlet O_2 Concentration (%)	10.7	10.8	10.7	10.7
Outlet O_2 Concentration (%, corrected as per USEPA 7E)	11.2	11.2	11.0	11.1
Method 19 F-Factor for Distillate Fuel Oil (dscf/10^6 Btu): F	9,190	9,190	9,190	9,190
Assumed Diesel Fuel Heating Value (Btu/gal): H	139,423	139,423	139,423	139,423
NOx Emission Rate (lbs/1,000 gal):	383	382	377	381

NOx Correction			
Co	6.18	6.70	5.87
Cma	998.00	998.00	998.00
Cm	958.25	937.19	923.15

O_2 Correction			
Co	0.00	0.00	0.00
Cma	9.95	9.95	9.95
Cm	9.57	9.59	9.68

ppmv = parts per million on a volume-to-volume basis
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Co= Average of initial and final zero gases
Cma=Actual concentration of the calibration gas
Cm= Average of initial and final calibration gases

Equations
lb/1,000 gal = ppmv * $1.194*10^{-7}$ * F * 20.9/(20.9 - O_2%) * $1/10^6$ * H * 1000

Table 5
Engine 2 NOx Emission Rate - Passenger Side Exhaust
DTW

Sampling Dates: 1/6/15

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/6/2015	1/6/2015	1/6/2015	
Test Run Time	9:22-9:52	10:06-10:36	11:25-11:55	
Outlet NOx Concentration (ppmv)	1157.4	1144.5	1134.9	1145.6
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	1206.8	1220.3	1228.4	1218.5
Outlet O_2 Concentration (%)	10.5	10.7	10.5	10.6
Outlet O_2 Concentration (%, corrected as per USEPA 7E)	10.9	11.1	10.8	10.9
Method 19 F-Factor for Distillate Fuel Oil (dscf/10^6 Btu): F	9,190	9,190	9,190	9,190
Assumed Diesel Fuel Heating Value (Btu/gal): H	139,423	139,423	139,423	139,423
NOx Emission Rate (lbs/1,000 gal):	386	397	389	391

NOx Correction			
Co	6.18	6.70	5.87
Cma	998.00	998.00	998.00
Cm	958.25	937.19	923.15

O_2 Correction			
Co	0.00	0.00	0.00
Cma	9.95	9.95	9.95
Cm	9.57	9.59	9.68

ppmv = parts per million on a volume-to-volume basis
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Co= Average of initial and final zero gases
Cma=Actual concentration of the calibration gas
Cm= Average of initial and final calibration gases

Equations
lb/1,000 gal = ppmv * $1.194*10^{-7}$ * F * 20.9/(20.9 - O_2%) * $1/10^6$ * H * 1000

Table 6
Engine 13 NOx Emission Rate
DTW

Sampling Dates: 1/8/15

Parameter	Run 2	Run 3	Run 4	Average
Test Run Date	1/7/2015	1/7/2015	1/7/2015	
Test Run Time	11:12-11:48 12:15-12:39	12:53-13:53	14:08-14:20 14:30-15:18	
Outlet NOx Concentration (ppmv)	1158.2	1176.7	1158.3	1164.4
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	1186.0	1178.4	1165.8	1176.7
Outlet O_2 Concentration (%)	11.4	11.4	11.4	11.4
Outlet O_2 Concentration (%, corrected as per USEPA 7E)	11.4	11.4	11.5	11.4
Method 19 F-Factor for Distillate Fuel Oil (dscf/10^6 Btu): F	9,190	9,190	9,190	9,190
Assumed Diesel Fuel Heating Value (Btu/gal): H	139,423	139,423	139,423	139,423
NOx Emission Rate (lbs/1,000 gal):	400	398	395	398

NOx Correction			
Co	2.94	6.53	6.81
Cma	998.00	998.00	998.00
Cm	975.04	997.58	992.53

O_2 Correction			
Co	0.02	0.02	0.02
Cma	9.90	9.90	9.90
Cm	9.86	9.84	9.84

ppmv = parts per million on a volume-to-volume basis
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Co= Average of initial and final zero gases
Cma=Actual concentration of the calibration gas
Cm= Average of initial and final calibration gases

Equations

lb/1,000 gal = ppmv * $1.194*10^{-7}$ * F * 20.9/(20.9 - O_2%) * $1/10^6$ * H * 1000

Table 7
Engine 14 NOx Emission Rate
DTW

Sampling Dates: 1/8/15

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/8/2015	1/8/2015	1/8/2015	
Test Run Time	10:28-11:12 11:28-11:36	11:49-12:49	13:03-14:03	
Outlet NOx Concentration (ppmv)	1157.5	1139.7	1137.0	1144.8
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	1152.9	1146.5	1154.9	1151.4
Outlet O_2 Concentration (%)	11.6	11.4	11.4	11.5
Outlet O_2 Concentration (%, corrected as per USEPA 7E)	11.7	11.6	11.6	11.6
Method 19 F-Factor for Distillate Fuel Oil (dscf/10^6 Btu): F	9,190	9,190	9,190	9,190
Assumed Diesel Fuel Heating Value (Btu/gal): H	139,423	139,423	139,423	139,423
NOx Emission Rate (lbs/1,000 gal):	400	393	395	396

NOx Correction			
Co	8.99	9.16	9.20
Cma	998.00	998.00	998.00
Cm	1003.23	993.31	983.78

O_2 Correction			
Co	0.05	0.05	0.05
Cma	9.90	9.90	9.90
Cm	9.81	9.80	9.79

ppmv = parts per million on a volume-to-volume basis
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Co= Average of initial and final zero gases
Cma=Actual concentration of the calibration gas
Cm= Average of initial and final calibration gases

Equations
lb/1,000 gal = ppmv * $1.194*10^{-7}$ * F * 20.9/(20.9 - O_2%) * $1/10^6$ * H * 1000

BTEC Inc.

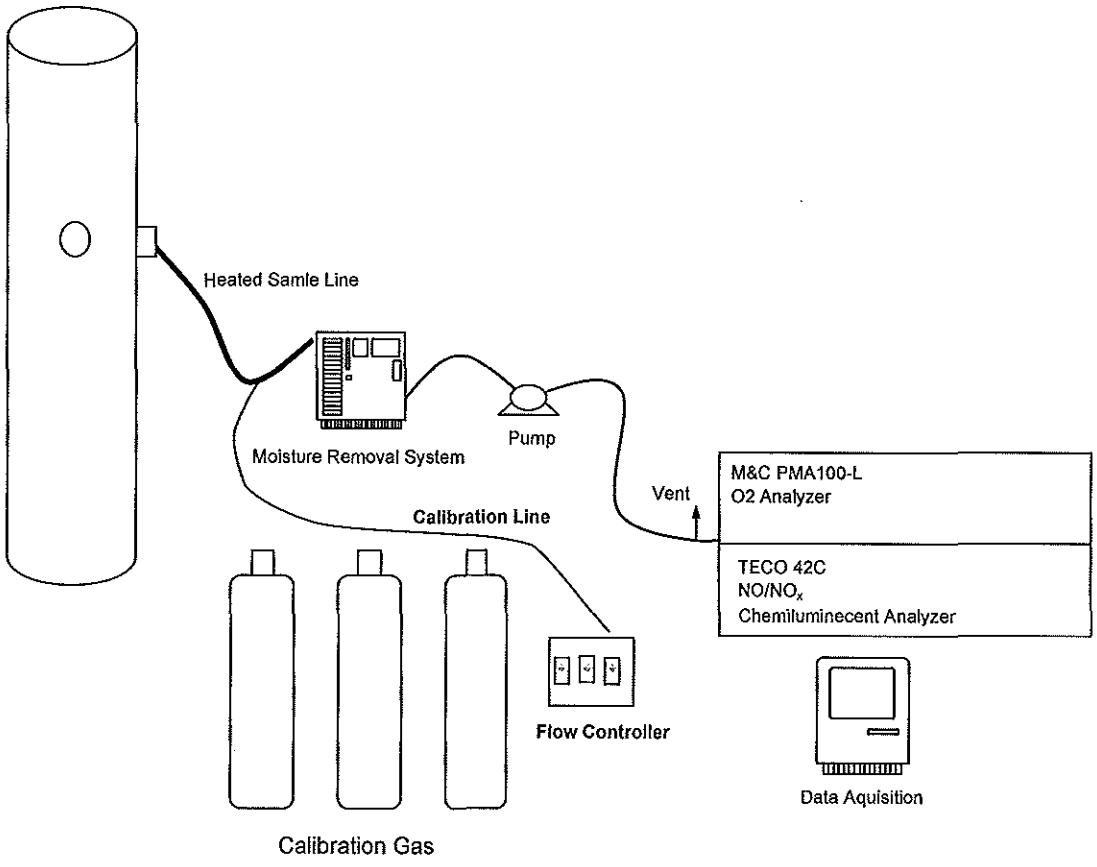

Figure 1

Site:	Sampling Date:	
USEPA Method 3A & 7E EUENGINE2,13,14 DTW Romulus, Michigan	January 6-8, 2015	BT Environmental Consulting Inc. 4949 Fernlee Ave. Royal Oak, MI