BTEC Inc.

Carbon Monoxide Destruction Efficiency Emissions Test Report

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Prepared for:

Newberry Water & Light Board

Newberry, Michigan

Newberry Water & Light Board
307 East McMillian Avenue
Newberry, Michigan 49868

Project No. 16-4935.00
October 28, 2016

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

BTEC Inc.

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Newberry Water & Light Board (NWLB) to evaluate emission rates from one diesel engine at the NWLB facility located at 307 East McMillian Avenue in Newberry, Michigan. The emissions test program was conducted on October 11, 2016.

Testing consisted of triplicate 60-minute test runs. The generator set is owned and operated by NWLB and is included in Permit to Install No. 272-09. The emissions testing was required by the National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines codified at Title 40, Part 63, Subpart ZZZZ of the Code of Federal Regulations (40 CFR 60, Subpart ZZZZ). Emission limitations included in Subpart ZZZZ that are applicable to this generator set are summarized in Table I in addition to test program summary results.

Table I
Newberry Water & Light Board
Diesel Generator Set
Compliance Test Program Results Summary

Source	Pollutant	Test Result (Destruction Efficiency)	Emission Limitation (Destruction Efficiency)
Diesel Engine	CO	91	70

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1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Newberry Water & Light Board (NWLB) to evaluate emission rates from one diesel engine at the NWLB facility located at 307 East McMillian Avenue in Newberry, Michigan. The emissions test program was conducted on October 11, 2016.

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, see Appendix A). The following is a summary of the emissions test program and results in the format outlined by the AQD document.

1.a Identification, Location, and Dates of Test

Field-sampling for this emission test program was conducted on October 11, 2016 at 307 East McMillian Avenue in Newberry, Michigan. The purpose of this report is to document the results of the emissions test program.

1.b Purpose of Testing

The generator set is owned and operated by NWLB and is included in Permit to Install No. 272-09. The emissions testing was required by the National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines codified at Title 40, Part 63, Subpart ZZZZ of the Code of Federal Regulations (40 CFR 60, Subpart ZZZZ). Pursuant to Subpart ZZZZ, the engine exhaust catalyst is required to achieve a CO destruction efficiency of 70%.

1.c Test Program Contact

The contacts for the test program are:

The contact for the source and test plan is:

Mr. Ken Uhlbeck
Newberry Water & Light Board
307 East McMillian
Newberry, Michigan 49868
(906) 293-5681

Mr. Barry P. Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, MI 48073
313-449-2361

1.d Test Personnel

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

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 provided in Appendix B.

2.b Applicable Permit

The generator set is owned and operated by NWLB and is included in Permit to Install No. 272-09. The emissions testing was required by the National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines codified at Title 40, Part 63, Subpart ZZZZ of the Code of Federal Regulations (40 CFR 60, Subpart ZZZZ).

2.c Results

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

2.d Emission Regulation Comparison

The emissions test result as well as the corresponding emission limitation is summarized by Table 2.

3. Source Description

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

3.a Process Description

The emission unit is a diesel generator set rated for a maximum of 3,000 kW.

3.b Raw and Finished Materials

The only raw material supplied to the generator set is diesel fuel.

3.c Process Capacity

The only raw material supplied to the generator set is diesel fuel. The generator is rated for a maximum of 3,000 kW.

3.d Process Instrumentation

Process instrumentation includes the devices necessary to measure the values listed in the process data summary included in Appendix B.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used to verify emissions from the generator engine.

4.a Sampling Train and Field Procedures

Sampling and analysis procedures followed the methodologies of the following emissions 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 evaluate the O_2 content of the engine exhaust
- Method 10 - *"Determination of Carbon Monoxide Emissions from Stationary Sources"* was used to measure CO concentrations in the exhaust gas

The inlet O_2 content and the inlet CO content were measured using a Teledyne 300E CO/O_2 gas analyzer. The outlet O_2 content was measured using a Servomex 4100 O_2 gas analyzer. The outlet CO content was measured using a Teledyne T300M CO 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 analyzers. Data was recorded at 4-second intervals on a PC equipped with data acquisition software. Schematic drawings of the Methods 3A and 10 sampling trains are provided as Figures 1 and 2.

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.

All analyzers were calibrated in accordance with the procedures of Methods 3A and 10.

4.b Recovery and Analytical Procedures

Recovery and analytical procedures were described in Section 4.a.

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4.c Sampling Ports

All sampling took place at the engine catalytic converter inlet and outlet.

4.d Traverse Points

An exhaust gas stratification traverse was conducted at the catalytic converter inlet and outlet sampling locations during the first test run. At both locations, the probe was moved to each of twelve Method 1 sampling points. Since the exhaust gas O_2 content was virtually the same at all sampling points, the ducts were considered not stratified and the probes were located at the duct centroid for the remainder of the emissions test program.

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.

5.b Discussion of Results

The emission limitation and test result are summarized by Table 2. Detailed emissions test results are summarized by Table 3.

5.c Sampling Procedure Variations

No sampling procedure variations occurred during testing.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

Preventative and corrective maintenance is performed per manufacturer recommendations.

5.f Audit Sample Analyses

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

5.g Calibration Sheets

All relevant equipment calibration documents are provided as Appendix C.

5.h Sample Calculations

Sample calculations are provided in Appendix D.

5.i Field Data Sheets

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

5.j Laboratory Data

All analysis was done live through the use of online Analyzers and as such there is no laboratory data. Raw analyzer data is provided in Appendix E.

Table 1
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Ken Uhlbeck	Newberry Water & Light Board 307 East McMillian Newberry, Michigan 49868	(906) 293-5681
Mr. Todd Wessel Senior Project Manager	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(616) 885-4013
Mr. Mason Sakshaug Environmental Technician	BTEC 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Ed Lancaster Environmental Quality Analyst	MDEQ Air Quality Division Upper Peninsula District Office	(906) 250-5124

Table 2
Newberry Water & Light Board
Diesel Generator Set
Compliance Test Program Results Summary

Source	Pollutant	Test Result (Destruction Efficiency)	Emission Limitation (Destruction Efficiency)
Diesel Engine	CO	91	70

Table 3
Carbon Monoxide (CO) Emissions Testing Results
Diesel Engine
Newberry Water & Light Board
Newberry, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	10/11/2016	10/11/2016	10/11/2016	
Sampling Start Time	9:15 - 10:15	10:40 - 11:40	12:02 - 13:02	
Average Inlet O_2 Concentration (%, dry)	13.91	13.92	13.93	13.92
Average Inlet O_2 Concentration (%, dry, corrected)[1]	13.86	13.89	13.89	13.88
Average Inlet CO Concentration (ppmv, dry)	210.03	174.46	178.69	187.73
Average Inlet CO Concentration (ppmv, dry, corrected)[1]	215.97	179.10	183.58	192.89
Average Inlet CO Concentration (ppmv@15%O2)	181.06	150.75	154.45	162.09
Average Outlet O_2 Concentration (%, dry)	13.86	13.82	13.78	13.82
Average Outlet O_2 Concentration (%, dry, corrected)[1]	13.54	13.85	13.82	13.74
Average Outlet CO Concentration (ppmv, dry)	26.93	17.70	12.09	18.91
Average Outlet CO Concentration (ppmv, dry, corrected)[1]	26.82	17.20	11.35	18.45
Average Outlet CO Concentraton (ppmv@15%)	21.50	14.40	9.46	15.12
CO Destruction Efficiency	**88.1%**	**90.5%**	**93.9%**	**90.8%**

[1]corrected for analyzer drift as per USEPA Method 7E

O_2 : oxygen

CO : carbon monoxide

$Conc_{@15\%O2} = Conc * (20.9 - 15)/(20.9 - \%O_2)$

$DE = (Conc_{in} - Conc_{out})/Conc_{in} * 100$

Drift Correction calculation

$$C_{gas} = (C - C_o)\frac{C_{ma}}{C_m - C_o}$$

Where:

Cgas =effluent gas concentration, dry basis, ppm

C = avg. gas concentration indicated by analyzer, dry basis, ppm

Co = avg. of initial and final system calibration bias check for the zero gas

Cm = avg. of initial and final system calibration bias check for the upscale calibration gas

Cma = actual concentration of the upscale calibration gas, ppm

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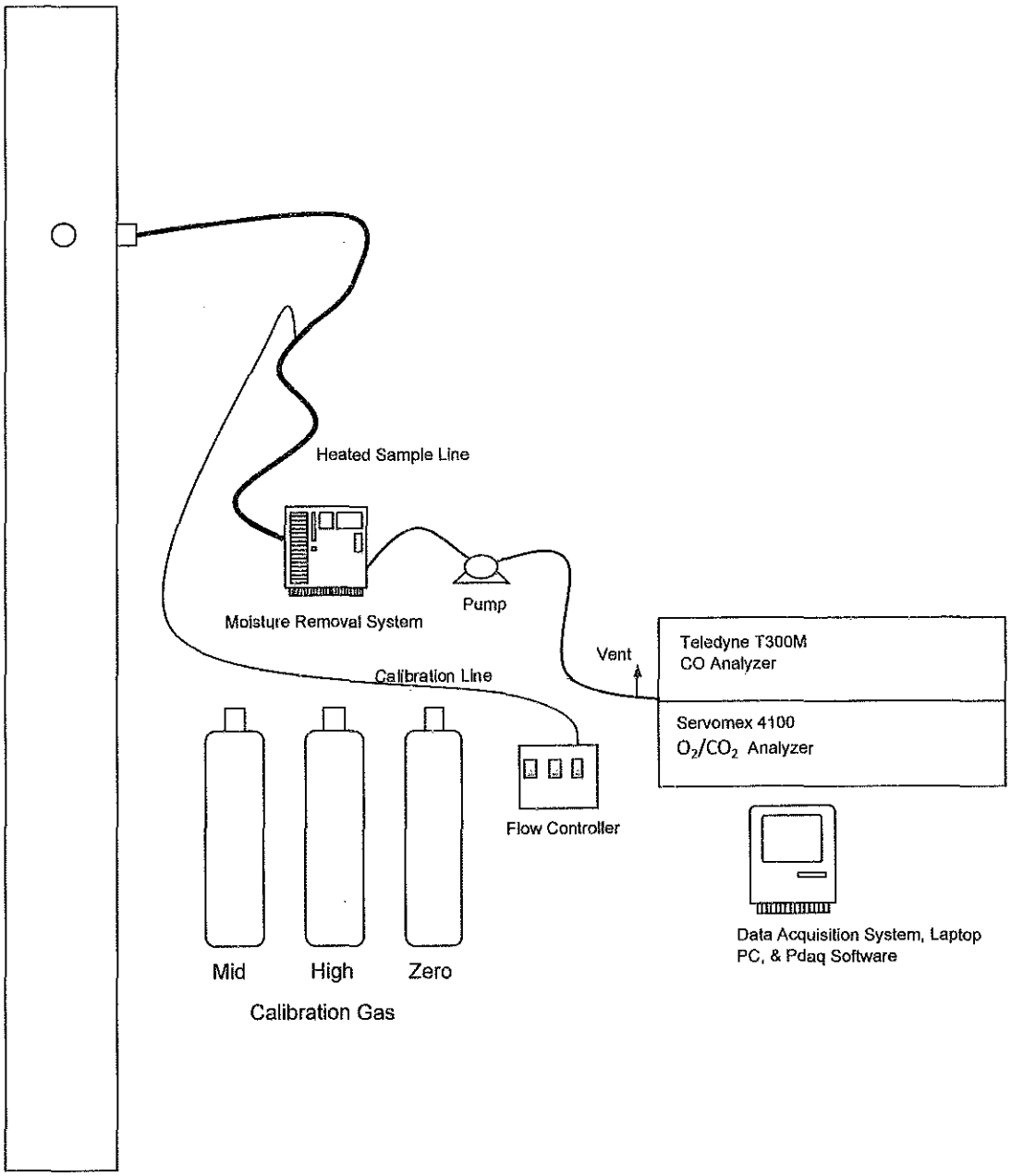

Figure 2

Site:	Sampling Date:	
USEPA Methods 3A and 10 Newberry Water & Light Board Newberry, Michigan	October 11, 2016	BT Environmental Consulting Inc. 4949 Fernlee Avenue Royal Oak, MI 48073