BTEC Inc.

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by DTE Energy Services (DTEES) to evaluate nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), hydrogen chloride (HCl), and volatile organic compound (VOC) emission rates from two engines at the Blue Water Renewables, Inc. (BWR) facility located in Smiths Creek, Michigan. The emissions test program was conducted on January 23-24, 2018.

Testing consisted of triplicate 60-minute test runs for NO_x, CO, SO_2, HCl, and VOC on each of the two engines. The emissions test program was required by permit 163-09D, and 40CFR Part 60 Subpart JJJ. The results of the emission test program are summarized by Table I.

Table I
EUICENGINE 1&2
Test Date: January 23-24, 2018

Pollutant	Emission Rates EUICENGINE 1	Emission Rates EUICENGINE 2	Emission Limits
Oxides of Nitrogen (NOx)	2.2 lbs/hr	2.8 lbs/hr	3.0 lbs/hr
	31.3 ppm @ 15% O_2	40.7 ppm @ 15% O_2	2.0 g/bhp-hr Or 150 ppm @ 15% O_2
Carbon Monoxide (CO)	10.1 lbs/hr	10.8 lbs/hr	16.3 lbs/hr
	236.4 ppm @ 15% O_2	255.3 ppm @ 15% O_2	5.0 g/bhp-hr Or 610 ppm @ 15% O_2
Non-Methane Organic Compounds (NMOC)	9.6 ppm @ 15% O_2	12.3 ppm @ 15% O_2	1.0 g/bhp-hr Or 80 ppm @ 15% O_2
Hydrogen Chloride (HCl)	0.02 lbs/hr	0.02 lbs/hr	0.51 lbs/hr
Sulfur Dioxide (SO_2)	1.0 lbs/hr	1.0 lbs/hr	6.21 lbs/hr

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APPENDIX

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by DTE Energy Services (DTEES) to evaluate nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), hydrogen chloride (HCl), and volatile organic compounds (VOC) emission rates from two engines at the Blue Water Renewables, Inc. (BWR) facility located in Smiths Creek, Michigan. The emissions test program was conducted on January 23-24, 2018.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 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 23-24, 2018 at the BWR facility located in Smiths Creek, Michigan. The test program included evaluation of NOx, CO, SO_2, HCl, and VOC emissions from two engines.

1.b Purpose of Testing

AQD issued Renewable Operating Permit No. 163-09D. This permit limits emissions from each Engine as summarized by Table 1.

Table 1
Permit No. 163-09D Emission Limits

Source	Pollutant	Emission Limit
Caterpillar G3520C Engines (EUICENGINE 1 & 2)	Oxides of Nitrogen (NO_x)	3.0 lb/hr*
		2.0 g/bhp-hr or 150 ppm @ 15% O_2*
	Carbon Monoxide (CO)	16.3 lb/hr*
		5.0 g/bhp-hr or 610 ppm @ 15% O_2*
	Non-Methane Organic Compounds (NMOC)	1.0 g/bhp-hr or 80 ppm @ 15% O_2*
	Hydrogen Chloride (HCl)	0.51 lb/hr*
	Sulfur Dioxide (SO_2)	6.21 lb/hr*

*Applies to each engine

1.c Source Description

Blue Water Renewables operates two Caterpillar G3520C Engines with associated generator sets. The Engines are fueled by landfill gas generated by the landfill and produce electricity which is sent to the electric grid.

1.d Test Program Contacts

The contact for the source and test report is:

Rob Sanch, CHMM
Environmental Supervisor
DTE Energy Resources
414 South Main Street
Suite 600
Ann Arbor, Michigan 48104
(734) 302-5383

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. Rob Sanch Environmental Supervisor	414 South Main St. Suite 600 Ann Arbor, MI 48104	(734)302-5383
Mr. David Patterson Environmental Quality Analyst	MDEQ Air Quality Division	(517)284-6782
Mr. Matthew Young Client Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(586)744-9133
Mr. Mike Nummer Field Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248)548-7980
Mr. Shane Rabideau Field Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248)548-7980

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 was collected during each test run at 15 minute intervals. This data included engine KW, speed, tourque, fuel flow, the engine serial number, and the total operating hours of the engine. This data is included in Appendix F.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit to Install No. 163-09D, and 40CFR Part 60 Subpart JJJJ.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a).

3. Source Description

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

3.a Process Description

Blue Water Renewables operates two Caterpillar G3520C Engines with associated generator sets. The Engines are fueled by landfill gas generated by the landfill and produce electricity which is sent to the electric grid.

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

The raw material used by the process is landfill gas.

3.d Process Capacity

Both engines are identical Spark ignition, lean burn, reciprocating internal combustion engine (Caterpillar G3520C, 2,233 bhp at 100% load) for combusting treated landfill gas to produce electricity (1.6 megawatt gross electrical output).

3.e Process Instrumentation

Process data was collected during each test run at 15 minute intervals. This data included engine KW, speed, tourque, fuel flow, the engine serial number, and the total operating hours of the engine. This data is included in Appendix F.

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

The following U.S. EPA reference test methods found in 40 CFR, Part 60, Appendix A were used:

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"*
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"*
- Method 3A - *"Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)"*
- Method 4 - *"Determination of Moisture Content in Stack Gases (FTIR)"*
- Method 25A - *"Determination of Total Gaseous Organic concentration using a flame ionization analyzer"*
- Method 320 - *"Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infared (FTIR) Spectroscopy"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2. S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2 were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The s-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned. One stack gas velocity traverse was conducted per test run.

Cyclonic flow checks were performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists.

USEPA Method 3A was used to determine the O_2 concentrations; BTEC used a zero gas along with US EPA protocol 1 calibration gases with 40-60%, and 80-100% of the span value. 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 a Universal Analyzers 3080PV 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 Labview® II data acquisition software. A schematic drawing of the sampling train is provided as Figure 1

USEPA Method 320 was used to measure NO_x, CO, Methane, Ethane, HCl, SO_2, and Moisture concentrations. The exhaust gas was measured using an MKS MultiGas 2030 FTIR spectrometer. A heated, 3 ft., 3/8 inch diameter, stainless steel probe, maintained at 191°C, was used to direct effluent gas to the FTIR. A heated filter box (191°C) will contain the connection from the probe to the filter assembly to a 100 ft., heated, 3/8 inch, Teflon transfer line. A 0.1µ glass filter was used for particulate matter removal. A schematic drawing of the sampling train is provided as Figure 2.

USEPA Method 25AVolatile Organic compound (VOC) concentrations were measured according to 40 CFR 60, Appendix A, Method 25A. A sample of the gas stream was drawn through a stainless steel probe with an in-line glass fiber filter to remove any particulate, and a heated Teflon® sample line to prevent the condensation of any moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with Labview® II data acquisition software. BTEC will use a JUM Model 109A Methane/Non-Methane or a VIG THC hydrocarbon analyzer to determine the VOC concentration.

In accordance with Method 25A, a 3-point (zero, mid, and high) calibration check was performed on the THC analyzer. Calibration drift checks were performed at the completion of each run.

4.b Recovery and Analytical Procedures

No sample recovery required for testing.

4.c Sampling Ports

Figures 1 and 2 show relevant sampling ports and traverse point locations.

4.d Traverse Points

The traverse points are included in the stack drawings as Figures 1 and 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 4-7.

Table 3
Riverview Energy Systems Overall Emission Summary
Test Date: January 23-24, 2018

Pollutant	Emission Rates EUICENGINE 1	Emission Rates EUICENGINE 2	Emission Limits
Oxides of Nitrogen (NOx)	2.2 lbs/hr	2.8 lbs/hr	3.0 lbs/hr
	31.3 ppm @ 15% O_2	40.7 ppm @ 15% O_2	2.0 g/bhp-hr Or 150 ppm @ 15% O_2
Carbon Monoxide (CO)	10.1 lbs/hr	10.8 lbs/hr	16.3 lbs/hr
	236.4 ppm @ 15% O_2	255.3 ppm @ 15% O_2	5.0 g/bhp-hr Or 610 ppm @ 15% O_2
Non-Methane Organic Compounds (NMOC)	9.6 ppm @ 15% O_2	12.3 ppm @ 15% O_2	1.0 g/bhp-hr Or 80 ppm @ 15% O_2
Hydrogen Chloride (HCl)	0.02 lbs/hr	0.02 lbs/hr	0.51 lbs/hr
Sulfur Dioxide (SO_2)	1.0 lbs/hr	1.0 lbs/hr	6.21 lbs/hr

5.b Discussion of Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a and detailed in tables 4-7.

5.c Process or Control Device Upsets

No upset conditions occurred during testing.

5.d Control Device Maintenance

There was no control equipment maintenance performed during the emissions test program.

5.e Re-Test

The emissions test program was not a re-test.

5.f Audit Sample Analyses

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

5.g Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.

5.h Sample Calculations

Sample calculations are provided in Appendix C.

5.i Field Data Sheets

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

5.j Laboratory Data

There are no laboratory results for this test program. Raw CEM data is provided electronically in Appendix E.

Table 4
Engine 1 NOx, SO2, VOC, and CO Emission Rates
DTE Blue Water Renewables
Smiths Creek, MI
BTEC Project No. 049AS-324444
Sampling Dates: 1/24/2018

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/24/2018	1/24/2018	1/24/2018	
Test Run Time	1030-1130	1203-1303	1330-1430	
Outlet Flowrate (dscfm)	4,005	4,065	4,025	**4,032**
Outlet Flowrate (scfm)	4,536	4,609	4,563	**4,569**
Oxygen Concentration (%)	8.1	8.1	8.1	**8.1**
Oxygen Concentration (%, drift corrected as per USEPA 7E)	8.2	8.2	8.2	**8.2**
Carbon Dioxide Concentration (%)	9.7	9.7	9.7	**9.7**
Carbon Dioxide Concentration (%, drift corrected as per USEPA 7E)	9.6	9.7	9.6	**9.6**
Outlet Oxides of Nitrogen Concentration (ppmv)	69.6	69.5	70.1	**69.7**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	68.4	66.8	66.8	**67.3**
NOx Emission Rate (lb/hr)	**2.3**	**2.3**	**2.3**	**2.3**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E)	**2.2**	**2.2**	**2.2**	**2.2**
Outlet NOx Concentration (ppmv, corrected to 15% O)	**31.7**	**31.1**	**31.0**	**31.3**
Outlet Carbon Monoxide Concentration (ppmv)	492.1	492.6	494.1	**492.9**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	509.4	508.0	510.2	**509.2**
CO Emission Rate (lb/hr)	**9.7**	**9.9**	**9.8**	**9.8**
CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	**10.0**	**10.2**	**10.1**	**10.1**
Outlet CO Concentration (ppmv, corrected to 15% O)	**236.0**	**236.7**	**236.5**	**236.4**
Outlet Sulfur Dioxide Concentration (ppmv)	20.5	20.5	20.6	**20.5**
Outlet SO_2 Concentration (ppmv, corrected as per USEPA 7E)	21.3	21.1	21.3	**21.2**
SO_2 Emission Rate (lb/hr)	**0.9**	**0.9**	**0.9**	**0.9**
SO_2 Emission Rate (lb/hr) (corrected as per USEPA 7E)	**1.0**	**1.0**	**1.0**	**1.0**
Outlet SO_2 Concentration (ppmv, corrected to 15 % O)	**9.9**	**9.8**	**9.9**	**9.9**
Outlet VOC Concentration (ppmv as propane)	544.7	538.9	562.8	**548.8**
Outlet Methane Concentration (ppmv as methane)	1152.6	1215.9	1261.3	**1210.0**
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	544.5	551.7	571.9	**556.0**
Outlet Methane Concentration (ppmv, corrected as per USEPA 7E)	1155.0	1247.2	1291.7	**1231.3**
Outlet VOC Concentration (ppmv propane, -Methane)	43.6	10.2	14.4	**22.7**
Outlet VOC Concentration (ppmv propane, -Methane, corrected to 15%O2)	**20.2**	**4.8**	**6.7**	**10.5**
Outlet VOC Concentration (ppmv propane, -Methane, corrected as per USEPA 7E)	42.3	9.5	10.2	**20.7**
Outlet VOC Concentration (ppmv propane, -Methane, corrected as per USEPA 7E, corrected to 15%O2)	**19.6**	**4.4**	**4.7**	**9.6**
VOC Emission Rate as Propane (lb/hr) (-Methane)	**1.4**	**0.3**	**0.5**	**0.7**
VOC Emission Rate as Propane(lb/hr) (-Methane) (corrected as per USEPA 7E)	**1.3**	**0.3**	**0.3**	**0.6**

O_2 Correction			
Co	0.00	0.00	0.00
Cma	10.01	10.01	10.01
Cm	9.93	9.82	9.88

CO_2 Correction			
Co	0.02	0.02	0.02
Cma	10.01	10.01	10.01
Cm	10.12	10.04	10.06

NOx Correction			
Co	0.41	0.70	0.76
Cma	89.8	89.8	89.8
Cm	91.20	93.15	93.91

CO Correction			
Co	0.45	0.62	0.67
Cma	399	399	399
Cm	385.57	387.04	386.52

SO_2 Correction			
Co	0.50	0.95	1.11
Cma	49.8	49.8	49.8
Cm	47.24	47.17	46.77

VOC Correction			
Co	1.77	3.08	3.14
Cma	995	995	995
Cm	993.92	969.27	976.99

Methane Correction			
Co	4.93	7.87	7.87
Cma	995	995	995
Cm	993.67	971.65	973.39

scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, SO_2 = 64.05, C_3H_8 = 44.10)
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
Response factor obtained from introducing propane into methane analyzer: **2.3**

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***scfm*** * 60
$Conc_{@15\%O2}$ = Conc * (20.9 -15)/(20.9 - $\%O_2$)

Table 5
Engine 1 HCl Emission Rates
DTE Blue Water Renewables
Smiths Creek, MI
BTEC Project No. 049AS-324444
Sampling Dates: 1/24/2018

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/24/2018	1/24/2018	1/24/2018	
Test Run Time	1030-1130	1203-1303	1330-1430	
Outlet Flowrate (scfm)	4,536	4,609	4,563	**4,569**
Outlet HCl Concentration (ppm)	0.87	0.87	0.86	**0.87**
HCl Emission Rate (lb/hr)	**0.02**	**0.02**	**0.02**	**0.02**

scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (HCl = 36.46)
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

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***scfm*** * 60 *for* HCl

Table 6
Engine 2 NOx, SO2, VOC, and CO Emission Rates
DTE Blue Water Renewables
Smiths Creek, MI
BTEC Project No. 049AS-324444
Sampling Dates: 1/23/2018

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/23/2018	1/23/2018	1/23/2018	
Test Run Time	11:15-12:15	12:55-13:55	14:37-15:37	
Outlet Flowrate (dscfm)	4,038	4,044	4,067	**4,050**
Outlet Flowrate (scfm)	4,568	4,574	4,601	**4,581**
Oxygen Concentration (%)	8.4	8.4	8.4	**8.4**
Oxygen Concentration (%, drift corrected as per USEPA 7E)	8.4	8.4	8.4	**8.4**
Carbon Dioxide Concentration (%)	9.3	9.4	9.4	**9.4**
Carbon Dioxide Concentration (%, drift corrected as per USEPA 7E)	9.4	9.5	9.5	**9.5**
Outlet Oxides of Nitrogen Concentration (ppmv)	85.9	86.6	86.9	**86.5**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	86.4	86.1	86.2	**86.2**
NOx Emission Rate (lb/hr)	**2.8**	**2.8**	**2.9**	**2.8**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E)	**2.8**	**2.8**	**2.8**	**2.8**
Outlet NOx Concentration (ppmv, corrected to 15% O_2)	**40.8**	**40.6**	**40.6**	**40.7**
Outlet Carbon Monoxide Concentration (ppmv)	524.0	525.1	525.5	**524.9**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	540.5	540.7	541.2	**540.8**
CO Emission Rate (lb/hr)	**10.4**	**10.4**	**10.5**	**10.5**
CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	**10.7**	**10.7**	**10.8**	**10.8**
Outlet CO Concentration (ppmv, corrected to 15% O_2)	**255.5**	**255.1**	**255.3**	**255.3**
Outlet Sulfur Dioxide Concentration (ppmv)	20.1	20.3	20.3	**20.2**
Outlet SO_2 Concentration (ppmv, corrected as per USEPA 7E)	22.0	22.5	22.1	**22.2**
SO_2 Emission Rate (lb/hr)	**0.9**	**0.9**	**0.9**	**0.9**
SO_2 Emission Rate (lb/hr) (corrected as per USEPA 7E)	**1.0**	**1.0**	**1.0**	**1.0**
Outlet SO_2 Concentration (ppmv, corrected to 15 % O_2)	**10.4**	**10.6**	**10.4**	**10.5**
Outlet VOC Concentration (ppmv as propane)	516.6	533.9	542.0	**530.8**
Outlet Methane Concentration (ppmv as methane)	1119.0	1181.8	1186.8	**1162.5**
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	515.1	542.6	550.4	**536.0**
Outlet Methane Concentration (ppmv, corrected as per USEPA 7E)	1112.0	1196.8	1210.0	**1173.0**
Outlet VOC Concentration (ppmv propane, -Methane)	30.1	20.1	26.0	**25.4**
Outlet VOC Concentration (ppmv propane, -Methane, corrected to 15%O2)	**14.2**	**9.5**	**12.3**	**12.0**
Outlet VOC Concentration (ppmv propane, -Methane, corrected as per USEPA 7E)	31.6	22.2	24.3	**26.1**
Outlet VOC Concentration (ppmv propane, -Methane, corrected as per USEPA 7E, corrected to 15%O2)	**15.0**	**10.5**	**11.5**	**12.3**
VOC Emission Rate as Propane (lb/hr) (-Methane)	**0.9**	**0.6**	**0.8**	**0.8**
VOC Emission Rate as Propane(lb/hr) (-Methane) (corrected as per USEPA 7E)	**1.0**	**0.7**	**0.8**	**0.8**

O_2 Correction			
Co	0.00	0.00	0.01
Cma	10.01	10.01	10.01
Cm	9.99	10.02	10.03

CO_2 Correction			
Co	0.01	0.03	0.04
Cma	10.01	10.01	10.01
Cm	9.91	9.91	9.90

NOx Correction			
Co	0.24	0.42	0.58
Cma	89.8	89.8	89.8
Cm	89.19	90.35	90.53

CO Correction			
Co	0.00	0.00	0.00
Cma	399	399	399
Cm	386.77	387.52	387.44

SO_2 Correction			
Co	0.19	0.46	0.49
Cma	49.8	49.8	49.8
Cm	45.16	44.54	45.22

VOC Correction			
Co	2.43	2.60	2.60
Cma	995	995	995
Cm	995.59	976.93	977.69

Methane Correction			
Co	2.44	2.87	2.75
Cma	995	995	995
Cm	1001.45	983.01	976.39

scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, SO_2 = 64.05, C_3H_8 = 44.10)
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
Response factor obtained from introducing propane into methane analyzer: **2.3**

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * *scfm* * 60
$Conc_{@15\%O2}$ = Conc * (20.9 -15)/(20.9 - $\%O_2$)

Table 7
Engine 2 HCl Emission Rates
DTE Blue Water Renewables
Smiths Creek, MI
BTEC Project No. 049AS-324444
Sampling Dates: 1/23/2018

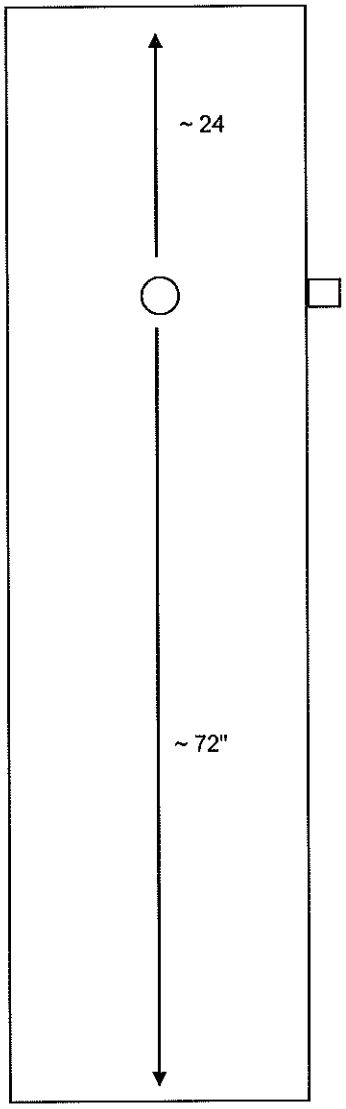
Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	1/23/2018	1/23/2018	1/23/2018	
Test Run Time	1115-1215	1255-1355	1437-1537	
Outlet Flowrate (scfm)	4,568	4,574	4,601	**4,581**
Outlet HCl Concentration (ppm)	1.03	0.93	0.85	**0.94**
HCl Emission Rate (lb/hr)	**0.03**	**0.02**	**0.02**	**0.02**

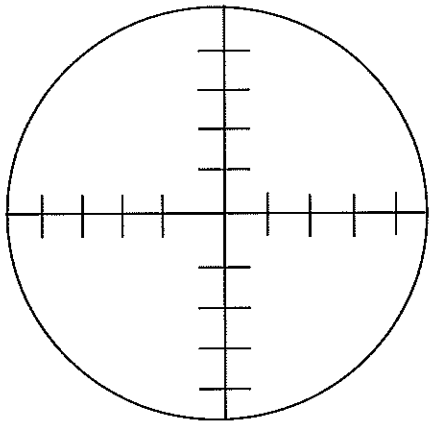
scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (HCl = 36.46)
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***scfm*** * 60 *for* HCl

BTEC Inc.

diameter = 15"





Not to Scale

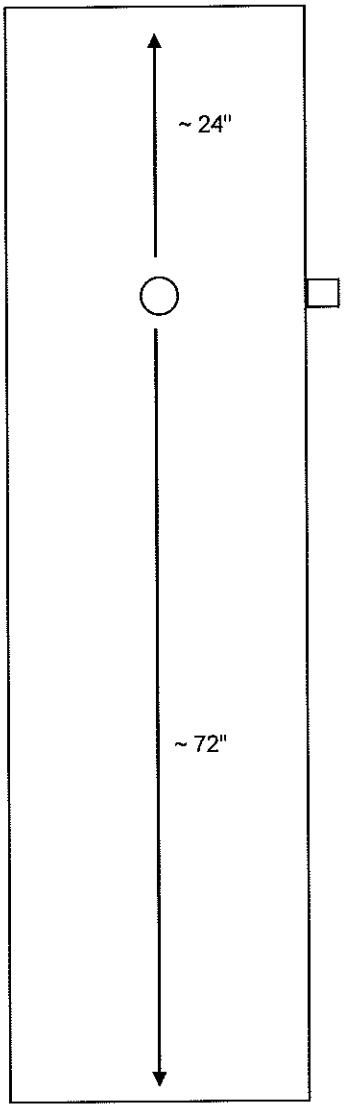
Points	Distance "
1	0.48
2	1.58
3	2.91
4	4.85
5	10.16
6	12.09
7	13.43
8	14.52

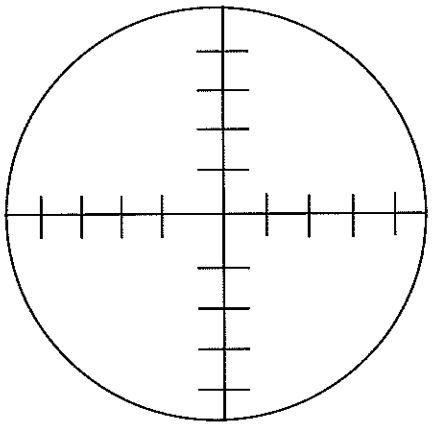
Figure No. 1

Site: **Engine 1** **DTE Energy, Blue Water Renewables** **Smiths Creek, Michigan**	**Sampling Date:** **January 24, 2018**
BT Environmental Consulting, Inc. **4949 Fernlee** **Royal Oak, Michigan**	

BTEC Inc.

diameter = 15"





Not to Scale

Points	Distance "
1	0.48
2	1.58
3	2.91
4	4.85
5	10.16
6	12.09
7	13.43
8	14.52

Figure No. 2

Site: **Engine 2** **DTE Energy, Blue Water Renewables** **Smiths Creek, Michigan**	**Sampling Date:** **January 23, 2018**
BT Environmental Consulting, Inc. **4949 Fernlee** **Royal Oak, Michigan**	