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CO, NOx and Particulate Matter Emissions Test Report

Prepared for:

Zeeland Farm Services, Inc.

Zeeland, Michigan

Source Address:

Zeeland Farm Services. Inc.
2525 84th Avenue
Zeeland, Michigan 49464

Project No. 15-4761.00
January 4, 2016

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
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EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Zeeland Farm Services, Inc. (ZFS) to evaluate filterable particulate matter (PM), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and condensable particulate matter (CPM) from two emission sources and carbon monoxide (CO) and nitrogen oxides (NOx) concentrations and emission rates from two emissions sources at the ZFS facility located in Zeeland, Michigan. Triplicate 60–minute emission test runs were conducted for each parameter. Testing was conducted on November 4-6, 2015. Table E-I summarizes the results of the emissions test program.

Table E-I
Zeeland Farm Services
Test Program Results Summary

Source	Pollutant	Emission Rate	Emission Limit
VSC	PM	0.011 lb/1,000 lb exhaust gas, dry	0.05 lb/1,000 lb exhaust gas, dry
	PM_{10}	0.37 lb/hr	2.0 lb/hr
	$PM_{2.5}$	0.37 lb/hr	1.4 lb/hr
EUDTDC[1]	PM	0.003 lb/1,000 lb exhaust gas, dry	0.034 lb/1,000 lb exhaust gas, dry
	PM_{10}	0.23 lb/hr	3.03 lb/hr
	$PM_{2.5}$	0.23 lb/hr	2.42 lb/hr
	VOC	4.27 lb/hr	14.6 lb/hr
EULF/NGVLR5	NOx	0.16 lb/hr	0.82 lb/hr when burning LFG or Natural Gas
	CO	0.00 lb/hr	0.53 lb/hr when burning LFG or Natural Gas
EUREFBOILER	NOx	0.38 lb/hr	2.18 lb/hr when burning LFG or Natural Gas
	CO	0.00 lb/hr	1.42 lb/hr when burning LFG or Natural Gas

1: All PM is reported as $PM_{2.5}$

BTEC Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SUMMARY TABLES

FIGURES

APPENDIX

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Zeeland Farm Services, Inc. (ZFS) to evaluate filterable particulate matter (PM), particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and condensable particulate matter (CPM) from two emission sources and carbon monoxide (CO) and nitrogen oxides (NOx) concentrations and emission rates from two emissions sources at the ZFS facility located in Zeeland, Michigan. Triplicate 60–minute emission test runs were conducted for each parameter. Testing was conducted on November 4-6, 2015.

The Air Quality Division (AQD) of Michigan's Department of Natural Resources and Environment 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 outlined by the AQD document.

1.a Identification, Location, and Dates of Test

Field-sampling for this emission test program was conducted on November 4-6, 2015 at 2525 84th Avenue in Zeeland, Michigan. The purpose of this report is to document the results of the emissions determined during the compliance test program.

1.b Purpose of Testing

AQD issued Permit No. MI-ROP-M4204-2012a, Permit to Install 62-15, and Permit to Install 165-14 to ZFS. These permits limit emissions from each source as summarized by Table 2.

1.c Test Program Contact

The contact for the test program is:

Ms. Bridgette Rillema, P.E.
Environmental Manager
Zeeland Farm Services, Inc.
2525 84th Ave
Zeeland, Michigan 49464
(616) 879-1711

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 included in Appendix E.

2.b Applicable Permit

The sources are included in Permit No. MI-ROP-M4204-2012a.

2.c Results

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

3. Source Description

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

3.a Process Description

ZFS operates a soybean oil extraction process at their Zeeland, Michigan facility. The soybeans are cleaned, conditioned, dehulled and processed into flakes. The oil is then extracted from the soybean flakes with hexane. The hexane is later removed from the flakes by distillation. The flakes are then toasted, desolventized, dried, cooled and ground into protein meal. The oil is sent off for refining.

The soybeans are passed through a processing area (EUPREPEQUIPMENT). A maximum rated capacity of 1,050 tons of soybeans per day are conditioned, cleaned, cracked and dehulled, ground, conditioned, flaked, and loaded out within this area.
Emissions from EUPREPEQUIPMENT are controlled by the VSC Cyclone and the Prepequipment baghouse.

After the oil is extracted from the soybeans, the oil is separated from the solids, called meal. The meal is processed by the Desolventizer, Toaster Dryer/Cooler (DTDC) system. Vapors from the desolventizer/toaster are controlled by the mineral oil absorption system where hexane is recovered for reuse. The meal then passes through three (3) separate drying trays and a cooling tray. The drying and cooling is accomplished by blowing heated air in the drying section (dryer trays) and using ambient air to cool the meal in the cooling section. Each dryer and cooler has its own exhaust stream which is routed to its own cyclone. Once leaving the each cyclone, the four exhaust streams are then combined in one stack (SVDTDC).

The desolventized, dried and cooled meal leaves the DTDC via the DTDC discharge conveyor and is sent back to EUPREPEQUIPMENT for grinding and sizing.

Several boilers at the facility provide steam heat to the soybean processing and refining portions of the facility. The boilers use landfill gas and natural gas as fuel.

3.b Raw and Finished Materials

The raw materials processed by the VSC and DTDC are soybeans. The boilers are fed with either landfill gas (LFG) or natural gas. For purposes of this testing, both boilers, EUREFBOILER and EULF/NGBLR5, will be fueled with landfill gas.

3.c Process Capacity

The soybean process (including the VSC and the DTDC) is permitted at 1,050 tons of soybeans per day. EUREFBOILER is rated at 0.16.8 MMBtu/hr and EULF/NFBLR5 is rated at 6.27 MMBtu/hr.

3.d Process Instrumentation

Basic operating parameters used to regulate the process.

Unit	Operating Parameters
EUDTDC	• Amount of Soybeans processed • Temperature of meal entering the meal dryer
VSC	• Amount of Soybeans processed
EUREBOILER	• Amount of landfill gas consumed • Methane content of the landfill gas
EULF/NGBLR5	• Amount of landfill gas consumed • Methane content of the landfill gas

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 sources.

4.a Sampling Train and Field Procedures

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

- Method 1 - *"Sample and Velocity Traverses for Stationary Sources"* was used to determine the sampling locations and the stack traverse points.
- Method 2 - *"Determination of Stack Gas Velocity and Volumetric Flowrate"* was used to determine average exhaust gas velocity.
- Method 3 - *"Gas Analysis for Determination of Dry Molecular Weight" (Fyrite Method)* was used to evaluate the molecular weight of the exhaust gas.
- Method 4 - *"Determination of Moisture Content in Stack Gases"* was used to determine the moisture content of the exhaust gas.
- Method 5 - *"Determination of Particulate Emissions from Stationary Sources"* was used to determine the concentration of particulate in the exhaust gas (SEM analysis used on some sources to differentiate between PM2.5, PM10, and PM greater than 10 microns)
- Method 7E – *"Determination of Nitrogen Oxides Emissions from Stationary Sources" (Instrumental Analyzer Procedure)*

- Method 10 – "*Determination of Carbon Monoxide Emissions from Stationary Sources*"

- Method 202 - "*Determination of Condensible Particulate Matter from Stationary Sources*" was used to determine the concentration of condensible particulate in the exhaust gas

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figures 4-7 present the test port and traverse/sampling point locations used. A cyclonic flow evaluation was conducted at each sampling location. An S-type pitot tube and thermocouple assembly calibrated in accordance with Method 2, Section 4.1.1 was used to measure exhaust gas velocity pressures and temperatures during testing. Because the pitot tube dimensions outlined in Sections 2.6 through 2.8 were within the specified limits, the baseline pitot tube coefficient of 0.84 (dimensionless) was assigned for this testing.

Molecular weight determinations were conducted according to Method 3. The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Moisture content was determined from the condensate collected in the PM sampling trains according to Method 4.

Method 5/202 was used to measure particulate concentrations and calculate particulate emission rates from VSC and EUDTDC. BTEC's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a glass nozzle, (2) a heated borosilicate glass lined probe, (3) a heated filter holder, (4) a vertical condenser, (5) an empty pot bellied impinger, (6) an empty modified Greenburg-Smith (GS) impinger, (7) unheated filter holder with a teflon filter, (8) a second modified GS impinger with 100 ml of deionized water, and a third modified GS impinger containing approximately 300 g of silica gel desiccant, (9) a length of sample line, and (10) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The impinger train was then purged with nitrogen for one hour at a flow rate of 14 liters per minute. The CPM filter was recovered and placed in a petri dish. The back half of the filter housing, the condenser, the pot bellied impinger, the moisture drop out impinger, and the front half of the CPM filter housing and all connecting glassware were double rinsed with deionized water which was collected in a pre-cleaned sample container. The same glassware was then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware was then double rinsed with hexane which was added to the same organic fraction sample bottle.

An additional 20-minute test run was performed using a polycarbonate filter in place of a glass fiber filter after each Method 5/202 test run on EUDTDC. The polycarbonate filters were analyzed using scanning electron microscopy (SEM) to determine PM mass distribution according to particle size. The PM emission rates for EUDTDC are so low when compared to emission limitations that filterable PM was not divided into different particle sizes and instead just reported as all $PM_{2.5}$.

Exhaust NOx content was measured using a Teledyne Model T-200H NOx gas analyzer, and the CO content was measured using a Teledyne Model 300EM 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 analyzer. Data was recorded at 4-second intervals on a PC equipped with data acquisition software.

The VOC content of the exhaust was measured using a VIG Model 20 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 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 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.

4.b Recovery and Analytical Procedures

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

4.c Sampling Ports

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 4-7.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 4-7.

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 2. Detailed test run emission test results are summarized by Tables 3-7.

5.b Discussion of Results

As summarized by Table 2, all emission rates are below permitted limitations.

5.c Sampling Procedure Variations

11-4-15

EUDTDC Run 3 VOC post calibration was outside the allowable limit of 3% analyzer drift. Run 3 was discarded, the analyzer was recalibrated, and Run 4 was performed with passing calibrations.

The polycarbonate filter used during the particle sizing Run 1 on EUDTDC was melted due to high heat in the filter box and was unsuitable for analysis. The temperature of the filter box was lowered during subsequent particle sizing test runs. It should be noted that due to the low emission rate compared to the emission limits it was unnecessary to apply the particle sizing distribution results to the filterable portion to obtain a passing emission rate. All PM emissions for EUDTDC are reported as $PM_{2.5}$.

11-5-15

EUREFBOILER Run 1 NOx mid-level post calibration exceeded the allowable limits of 5% calibration error and analyzer drift of 3% and was discarded. The NOx analyzer was recalibrated and testing was resumed.

11-6-15

UELF/NGBLR5 Run 4 NOx mid-level post calibration was within the allowable bias of 5%, but outside the 3% allowable for analyzer drift. As per section 8.5.5 of Method 7E the run data are valid, but a 3-point calibration error test and system bias must be performed and passed before any more test runs are conducted. No more test runs were conducted and the analyzer was not recalibrated.

5.d Process or Control Device Upsets

EUREFBOILER Run 1 was discarded due to production issues.

5.e Control Device Maintenance

No control device maintenance was performed during the testing.

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

Laboratory analysis is provided in Appendix D.

Table 1
Test Personnel Summary

Name	Affiliation
Todd Wessel	BTEC
Paul Molenda	BTEC
Shane Rabideau	BTEC
Bridgette Rillema	ZFS
Tom Gasloli	MDEQ

Table 2
Overall Test Results Summary

Source	Pollutant	Emission Rate	Emission Limit
VSC	PM	0.011 lb/1,000 lb exhaust gas, dry	0.05 lb/1,000 lb exhaust gas, dry
	PM_{10}	0.37 lb/hr	2.0 lb/hr
	$PM_{2.5}$	0.37 lb/hr	1.4 lb/hr
EUDTDC[1]	PM	0.003 lb/1,000 lb exhaust gas, dry	0.034 lb/1,000 lb exhaust gas, dry
	PM_{10}	0.23 lb/hr	3.03 lb/hr
	$PM_{2.5}$	0.23 lb/hr	2.42 lb/hr
	VOC	4.27 lb/hr	14.6 lb/hr
EULF/NGVLR5	NOx	0.16 lb/hr	0.82 lb/hr when burning LFG or Natural Gas
	CO	0.00 lb/hr	0.53 lb/hr when burning LFG or Natural Gas
EUREFBOILER	NOx	0.38 lb/hr	2.18 lb/hr when burning LFG or Natural Gas
	CO	0.00 lb/hr	1.42 lb/hr when burning LFG or Natural Gas

1: All PM is reported as $PM_{2.5}$

Table 3
VSC Particulate Matter Emission Rates

Company	**ZFS**			
Source Designation	**VSC**			
Test Date	**11/3/2015**	**11/3/2015**	**11/3/2015**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	86.0	90.4	94.3	90.2
Meter Pressure - Pm (in. Hg)	29.5	29.5	29.5	29.5
Measured Sample Volume (Vm)	50.5	49.8	51.1	50.5
Sample Volume (Vm-Std ft3)	48.5	47.4	48.4	48.1
Sample Volume (Vm-Std m3)	1.37	1.34	1.37	1.36
Condensate Volume (Vw-std)	4.291	4.734	4.899	4.641
Gas Density (Ps(std) lbs/ft3) (wet)	0.0723	0.0720	0.0720	0.0721
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	3.81	3.76	3.83	3.80
Total weight of sampled gas (m g lbs) (dry)	3.62	3.53	3.60	3.58
Nozzle Size - An (sq. ft.)	0.000177	0.000177	0.000177	0.000177
Isokinetic Variation - I	100.2	101.0	101.2	100.8
Stack Data				
Average Stack Temperature - Ts (F)	127.8	130.1	129.8	129.2
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.0	27.9	27.8	27.9
Stack Gas Specific Gravity (Gs)	0.965	0.962	0.961	0.963
Percent Moisture (Bws)	8.13	9.08	9.20	8.80
Water Vapor Volume (fraction)	0.0813	0.0908	0.0920	0.0880
Pressure - Ps ("Hg)	29.2	29.2	29.2	29.2
Average Stack Velocity -Vs (ft/sec)	94.5	93.0	94.7	94.1
Area of Stack (ft2)	1.7	1.7	1.7	1.7
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	9,737	9,585	9,758	9,693
Flowrate ft^3 (Standard Wet)	8,532	8,366	8,522	8,474
Flowrate ft^3 (Standard Dry)	7,839	7,607	7,738	7,728
Flowrate m^3 (standard dry)	222	215	219	219
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	15.4	13.0	19.4	15.9
Organic Condensible Particulate	0.0	0.0	0.0	0.0
Inorganic Condensible Particulate	2.9	2.9	2.8	2.9
Condensible Blank Correction	1.3	1.3	1.3	1.3
Total Condensible Particulate	1.6	1.6	1.5	1.6
Total Filterable and Condensible Particulate	17.0	14.6	20.9	17.5
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.009	0.008	0.011	0.009
lb/1000 lb (dry)	0.009	0.008	0.012	0.010
mg/dscm (dry)	11.2	9.7	14.2	11.7
gr/dscf	0.0049	0.0042	0.0062	0.0051
Filterable Particulate Emission Rate				
lb/ hr	0.33	0.28	0.41	0.34
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.001	0.001	0.001	0.001
mg/dscm (dry)	1.2	1.2	1.1	1.2
gr/dscf	0.0005	0.0005	0.0005	0.0005
Condensible Particulate Emission Rate				
lb/ hr	0.03	0.03	0.03	0.03
Total Particulate Concentration				
lb/1000 lb (wet)	0.010	0.009	0.012	0.010
lb/1000 lb (dry)	0.010	0.009	0.013	0.011
mg/dscm (dry)	12.4	10.9	15.3	12.8
gr/dscf	0.0054	0.0048	0.0067	0.0056
Total Particulate Emission Rate				
lb/ hr	0.36	0.31	0.44	0.37

Table 4
EUDTDC Particulate Matter Emission Rates

Company	**ZFS**			
Source Designation	**EUDTDC**			
Test Date	**11/4/2015**	**11/4/2015**	**11/4/2015**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	74.8	83.9	84.1	80.9
Meter Pressure - Pm (in. Hg)	29.6	29.6	29.6	29.6
Measured Sample Volume (Vm)	55.6	55.4	56.4	55.8
Sample Volume (Vm-Std ft3)	54.8	53.6	54.6	54.3
Sample Volume (Vm-Std m3)	1.55	1.52	1.55	1.54
Condensate Volume (Vw-std)	8.944	7.063	8.963	8.324
Gas Density (Ps(std) lbs/ft3) (wet)	0.0706	0.0713	0.0706	0.0708
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	4.50	4.32	4.49	4.44
Total weight of sampled gas (m g lbs) (dry)	4.08	3.99	4.07	4.05
Nozzle Size - An (sq. ft.)	0.000325	0.000325	0.000325	0.000325
Isokinetic Variation - I	100.6	98.7	100.1	99.8
Stack Data				
Average Stack Temperature - Ts (F)	136.6	137.7	138.3	137.5
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	27.3	27.6	27.3	27.4
Stack Gas Specific Gravity (Gs)	0.943	0.952	0.943	0.946
Percent Moisture (Bws)	14.04	11.64	14.10	13.26
Water Vapor Volume (fraction)	0.1404	0.1164	0.1410	0.1326
Pressure - Ps ("Hg)	29.3	29.3	29.3	29.3
Average Stack Velocity -Vs (ft/sec)	62.5	60.7	62.8	62.0
Area of Stack (ft2)	5.4	5.4	5.4	5.4
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	20,276	19,706	20,379	20,120
Flowrate ft^3 (Standard Wet)	17,586	17,061	17,625	17,424
Flowrate ft^3 (Standard Dry)	15,118	15,074	15,139	15,110
Flowrate m^3 (standard dry)	428	427	429	428
Total Particulate Weights (mg)				
Total Nozzle/Probe/Filter	4.7	4.2	5.1	4.7
Organic Condensible Particulate	0.0	0.0	0.0	0.0
Inorganic Condensible Particulate	2.9	2.9	2.8	2.9
Condensible Blank Correction	1.3	1.3	1.3	1.3
Total Condensible Particulate	1.6	1.6	1.5	1.6
Total Filterable and Condensible Particulate	6.3	5.8	6.6	6.2
Filterable Particulate Concentration				
lb/1000 lb (wet)	0.002	0.002	0.003	0.002
lb/1000 lb (dry)	0.003	0.002	0.003	0.003
mg/dscm (dry)	3.0	2.8	3.3	3.0
gr/dscf	0.0013	0.0012	0.0014	0.0013
Filterable Particulate Emission Rate				
lb/ hr	0.17	0.16	0.19	0.17
Condensible Particulate Concentration				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.001	0.001	0.001	0.001
mg/dscm (dry)	1.0	1.1	1.0	1.0
gr/dscf	0.0005	0.0005	0.0004	0.0004
Condensible Particulate Emission Rate				
lb/ hr	0.06	0.06	0.06	0.06
Total Particulate Concentration				
lb/1000 lb (wet)	0.003	0.003	0.003	0.003
lb/1000 lb (dry)	0.003	0.003	0.004	0.003
mg/dscm (dry)	4.1	3.8	4.3	4.1
gr/dscf	0.0018	0.0017	0.0019	0.0018
Total Particulate Emission Rate				
lb/ hr	0.23	0.22	0.24	0.23

Table 5
EUDTDC VOC Emission Rates
ZFS
Zeeland, Michigan
BTEC Project No. 15-4761
Sampling Dates: November 4, 2015

Parameter	Run 1	Run 2	Run 4	Average
Test Run Date	11/4/2015	11/4/2015	11/4/2015	
Test Run Time	9:50-10:21, 10:32-11:01	11:50-12:49	15:24-16:23	
Outlet Flowrate (scfm)	17,586	17,061	17,625	**17,424**
Outlet VOC Concentration (ppmv as propane)	33.87	34.87	38.45	**35.73**
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	33.67	35.43	38.20	**35.77**
VOC Emission Rate as Propane (lb/hr)	**4.08**	**4.07**	**4.64**	**4.26**
VOC Emission Rate as Propane(lb/hr) (corrected as per USEPA 7E)	**4.05**	**4.14**	**4.61**	**4.27**

VOC Correction			
Co	0.60	1.39	0.34
Cma	50	50	50
Cm	50.00	48.64	50.23

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

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

Table 6
EULF/NGBLR5 NOx and CO Emission Rates
ZFS
Zeeland, Michigan
BTEC Project No. 15-4761
Sampling Dates: November 5, 2015

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	11/5/2015	11/5/2015	11/5/2015	
Test Run Time	14:18-15:17	15:46-16:45	17:09-18:08	
Outlet Flowrate (dscfm)	931	980	956	**956**
Outlet Oxides of Nitrogen Concentration (ppmv)	24.23	23.19	23.02	**23.48**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	23.85	22.93	22.49	**23.09**
NOx Emission Rate (lb/hr)	**0.16**	**0.16**	**0.16**	**0.16**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E)	**0.16**	**0.16**	**0.15**	**0.16**
Outlet Carbon Monoxide Concentration (ppmv)	1.26	1.19	1.14	**1.20**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)*	*0.00*	*0.00*	*0.00*	**0.00**
CO Emission Rate (lb/hr)	**0.01**	**0.01**	**0.00**	**0.00**
CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	**0.00**	**0.00**	**0.00**	**0.00**

*Note: Runs 1-3 drift corrected CO values were negative and have been assumed to be zero for calculations

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)
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 * ***dcfm*** * 60

Table 7
EUREFBOILER NOx and CO Emission Rates
ZFS
Zeeland, Michigan
BTEC Project No. 15-4761
Sampling Dates: November 5-6, 2015

Parameter	Run 2	Run 3	Run 4	Average
Test Run Date	11/5/2015	11/6/2015	11/6/2015	
Test Run Time	12:44-13:43	8:53-9:52	10:08-11:07	
Outlet Flowrate (dscfm)	2,909	2,960	2,867	**2,912**
Outlet Oxides of Nitrogen Concentration (ppmv)	19.23	17.59	17.99	**18.27**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	18.74	18.08	18.00	**18.27**
NOx Emission Rate (lb/hr)	**0.40**	**0.37**	**0.37**	**0.38**
NOx Emission Rate (lb/hr) (corrected as per USEPA 7E)	**0.39**	**0.38**	**0.37**	**0.38**
Outlet Carbon Monoxide Concentration (ppmv)	2.40	0.47	0.54	**1.14**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)*	0.45	*0.00*	*0.00*	**0.15**
CO Emission Rate (lb/hr)	**0.03**	**0.01**	**0.01**	**0.01**
CO Emission Rate (lb/hr) (corrected as per USEPA 7E)	**0.01**	**0.00**	**0.00**	**0.00**

*Note: Run 3 and Run 4 drift corrected CO values were negative and have been assumed to be zero for calculations

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)
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 * ***dcfm*** * 60