EMISSIONS TEST REPORT

for

OXIDES OF NITROGEN (NO_X), CARBON MONOXIDE (CO), AND NON-METHANE ORGANIC COMPOUNDS (NMOC)

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UNITS 1 & 2

BLUE WATER RENEWABLES, LLC
Kimball, Michigan

January 21 & 25, 2016

Prepared By
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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EM&R), Field Services Group, performed emissions testing at Blue Water Renewables, LLC, located in Kimball, Michigan. The fieldwork, performed on January 21 & 25, 2016 was conducted to satisfy requirements of the Michigan Renewable Operating Permit No. MI-ROP-P0262-2012a and 40 CFR 60.4244 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines. Emissions tests were performed on Units 1 & 2 for oxides of nitrogen (NO_x), carbon monoxide (CO), and non-methane organic compounds (NMOC).

The results of the emissions testing are highlighted below:

Emissions Testing Summary – Units 1 & 2
Blue Water Renewables, LLC
Kimball, MI
January 21 & 25, 2016

	Oxides of Nitrogen (ppm[1])	Carbon Monoxide (ppm[1])	Non-Methane Organic Compounds (ppm[1])
Unit 1	35.6	236.7	ND
Unit 2	36.7	239.2	<2
Permit Limit	150	610	80

[1]ppm @ 15% $O_{2\,dry}$

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EM&R), Field Services Group, performed emissions testing at Blue Water Renewables, LLC, located in Kimball, Michigan. The fieldwork, performed on January 21 & 25, 2016, was conducted to satisfy requirements of the Michigan Renewable Operating Permit No. MI-ROP-P0262-2012a and 40 CFR 60.4244 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines.

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 3A, 7E, 10, 25A and 320.

The fieldwork was performed in accordance with EPA Reference Methods and EM&R's Intent to Test[1], which was approved by the Michigan Department of Environmental Quality (MDEQ)[2]. The following EM&R personnel participated in the testing program: Mr. Mark Grigereit, Principal Engineer, Mr. Fred Meinecke, Senior Environmental Technician, Mr. Thom Snyder, Senior Environmental Technician, and Mr. Ben Clark, Associate Environmental Technician. Mr. Grigereit was the project leader.

Mr. Jason Galbraith, DTE Energy, provided on-site support of the testing. Mr. Tom Gasloli, MDEQ, reviewed the Test Plan. Ms. Rebecca Loftus, MDEQ, observed the testing.

2.0 SOURCE DESCRIPTION

The Blue Water Renewables, LLC power generating facility, located at 6797 Smiths Creek Road, Kimball, MI is a power generating facility. The facility consists of two (2) landfill gas-fired internal combustion engines with associated electrical generators.

The systems are Caterpillar G3520C – 1200 RPM 1600 kW Gas Generator Sets. The purpose of the source is to utilize land fill gas from the Smiths Creek Landfill to produce energy that is sent to the electrical grid. Each unit was tested while operating at greater than 90% of full load conditions.

See Figure 1 for a diagram of the unit sampling locations and stack dimensions.

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[1] MDEQ, Test Plan, Submitted December 21, 2015. (Attached-Appendix A)

[2] MDEQ, Acceptance Letter, January 11, 2016. (Attached-Appendix A)

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3.0 SAMPLING AND ANALYTICAL PROCEDURES

DTE Energy obtained emissions measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources.* The sampling and analytical methods used in the testing program are indicated in the table below

Sampling Method	Parameter	Analysis
USEPA Method 3A	Oxygen & Carbon Dioxide	Instrumental Analyzer Method
USEPA Method 4	Moisture Content	Field data analysis and reduction
USEPA Method 7E	Oxides of Nitrogen	Chemiluminecent Instrumental Analyzer Method
USEPA Method 10	Carbon Monoxide	NDIR Instrumental Analyzer Method
USEPA Method 25A	Total Hydrocarbons	FID
USEPA Method 320	Gaseous Organic Compounds (Methane)	FTIR Analytical Method (Tedlar™ Bag Sample)

3.1 OXYGEN AND CARBON DIOXIDE (USEPA METHOD 3A)

3.1.1 Sampling Method

Oxygen (O_2) and Carbon Dioxide (CO_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The analyzers utilize paramagnetic sensors. Testing was performed simultaneously with the gaseous emissions testing.

The EPA Method 3A sampling system (Figure 2) consisted of the following:

(1) Single-point sampling probe (traversed across the exhaust stack)
(2) Heated PTFE sampling line

(3) MAK® gas conditioner with particulate filter
(4) Flexible unheated PTFE sampling line
(5) Servomax 1400 O_2/CO_2 gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System

3.1.2 Sampling Train Calibration

The O_2 and CO_2 analyzers were calibrated according to procedures outlined in USEPA Methods 3A and 7E. Zero, span, and mid-range calibration gases were introduced directly into the analyzer to verify the instruments linearity. A zero and mid-range span gas for each diluent was then introduced through the entire sampling system to determine sampling system bias for each analyzer at the completion of each test.

3.1.3 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 3A and 7E. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges (40-60% mid-range and span) specified in Method 7E. Calibration gas certification sheets are located in Appendix C.

3.1.4 Data Reduction

Data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. The O_2/CO_2 emissions were recorded in percent (%). The 1-minute readings collected during the testing are located in Appendix B.

3.2 MOISTURE DETERMINATION (USEPA METHOD 4)

3.2.1 Sampling Method

Determination of the moisture content of the exhaust gas was performed using USEPA Method 4, "Determination of Moisture Content in Stack Gases". The moisture was collected in glass impingers, and the percentage of water was then derived from calculations outlined in USEPA Method 4. Thirty minute moisture tests were conducted in conjunction with each gaseous emissions test.

The EPA Method 4 sampling system consisted of the following:

(1) Stainless-steel sample probe (located in centroid of the exhaust stack)
(2) Heated PTFE sampling line
(3) Set of four (4) Greenburg-Smith (GS) glass impingers:
    a. The first and second each containing 100 milliliters (mL) of water

b. The third impinger dry
c. The fourth impinger containing approximately 300 grams of silica gel desiccant

(4) Environmental Supply® control case equipped with a pump, dry gas meter, and calibrated orifice

Upon completion of each test, the impinger volumes were measured to determine moisture content of the gas stream using the calculations found in USEPA Method 4. After measuring and recording the liquid volumes, the solution was discarded.

Field data sheets for the Method 4 are located in Appendix B.

3.2.2 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in EPA Method 5. Calibration data are located in Appendix D.

3.3 OXIDES OF NITROGEN AND CARBON MONOXIDE (USEPA METHODS 7E AND 10)

3.3.1 Sampling Method

Oxides of nitrogen (NO_x) emissions were evaluated using USEPA Method 7E, "Determination of Oxides of Nitrogen Emissions from Stationary Sources". The NO_x analyzer utilizes a Chemiluminecent detector. Carbon monoxide (CO) emissions were evaluated using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources". The CO analyzer utilizes an NDIR detector. Triplicate 60-minute tests were performed on each engine exhaust.

The EPA Methods 7E and 10 sampling system (Figure 2) consisted of the following:

(1) Stainless-steel sample probe (traversed across the exhaust stack)
(2) Heated PTFE sampling line
(3) MAK® gas conditioner with particulate filter
(4) Flexible unheated PTFE sampling line
(5) TECO 42i Chemilumenecent NO/NO_x gas analyzer, and TECO 48i NDIR CO gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System.

3.3.2 Sampling Train Calibration

The NO_x / CO sampling trains were calibrated according to procedures outlined in USEPA Method 7E and 10. Zero, span, and mid-range calibration gases were introduced directly into each analyzer to verify the instruments linearity. A zero and mid-range span gas for each pollutant was then introduced through the entire sampling system to determine sampling system bias for each analyzer at the completion of each test.

3.3.3 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 7E and 10. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges (40-60% mid-range and span) specified in Method 7E. Calibration gas certification sheets are located in Appendix D.

DTE performed a NO_x converter efficiency test by directly challenging the NO_x analyzer with a nitrogen dioxide (NO_2) calibration gas of 48.11 ppm. Results from the converter efficiency test demonstrated that the analyzer met the requirements of Method 7E (Eq-1). Equation-1 shows the converter efficiency test performed for Units 1 & 2.

Eq. 1

$$Eff_{NO2} = \frac{C_{Dir}}{C_v} = \frac{45.7}{48.1} = 95\%$$

3.3.4 Data Reduction

Data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. The NO_x and CO emissions were recorded in parts per million (ppm). The 1-minute readings collected are located in Appendix C.

Emissions calculations, based on calculations located in USEPA Methods 7E, 10, and 19, are located in Appendix F. The NO_x and CO emissions data collected during the testing was calculated as parts per million corrected to 15% Oxygen on a dry basis (ppm@ $15\%O_{2\,dry}$).

3.4 METHANE (USEPA METHOD 320)

3.4.1 Sampling Method

Methane emissions were evaluated using a modified USEPA Method 320, "Measurement of Vapor Phase Organic Emissions By Extractive Fourier Transform

Infrared (FTIR)". DTE Energy collected integrated exhaust gas samples which were analyzed utilizing an FTIR. DTE collected exhaust gas in a Tedlar™ bag, which was then analyzed at an off-site laboratory. Samples were collected simultaneously with the Total Hydrocarbon (Method 25A) sampling. The vacuum pump flowrate was set to allow for a constant rate, integrated sample, collected for the duration of each test run.

The sampling system followed the procedures specified in Method 18 Section 8.2.1, Integrated Bag Sampling & Analysis.

The sampling system (Figure 3) consisted of the following:

(1) Stainless Steel Probe
(2) PTFE sampling line
(2) Sampling lung with 10-liter Tedlar™ bag
(3) Vacuum pump with regulator.

3.4.2 Sampling Train Calibration

The FTIR was calibrated according to procedures outlined in USEPA Methods 320. Nitrogen, methane, and ethylene gas standards were injected to confirm concentrations.

3.4.3 Data Reduction

Results from the methane sampling were used to determine the non-methane organic compound concentration from the source. Methane emissions were subtracted from total organic compound emissions (as determined by Method 25A).

The $CH_{4\ (as\ methane)}$ was converted to $CH_{4\ (as\ propane)}$ in order to subtract the CH_4 from the THC measured in the field (Eq-2). An analyzer response factor (RF) of 3 was applied to the CH_4 concentration in the exhaust gas, as determined by Method 18 sampling.

Eq. 2 $$NMOC = THC_{PPM(asC3H8)} - \left(\frac{CH_{4\,ppm(asCH4)}}{RF} \right)$$

3.5 TOTAL HYDROCARBON COMPOUNDS (USEPA METHOD 25A)

3.5.1 Sampling Method

Total hydrocarbon compound (THC) emissions were evaluated using USEPA Method 25A, "Determination of Total Hydrocarbon Emissions from Stationary Sources

(Instrumental Analyzer Method)". The THC analyzer utilizes a flame ionization detector (FID). The FID measures total hydrocarbon compounds (including Methane). Triplicate 60-minute tests were performed on each engine exhaust, simultaneously with the other gaseous emission testing.

The Method 25A sampling system (Figure 4) consisted of the following:

(1) Single-point sampling probe (placed in the center of the stack)
(2) Heated PTFE sampling line
(3) JUM 109A® Total Hydrocarbon gas analyzer
(4) Appropriate USEPA Protocol 1 calibration gasses
(5) Data Acquisition System

3.5.2 Sampling Train Calibration

In accordance with USEPA Method 25A, a 4-point (zero, low, mid, and high) calibration check was performed on the THC analyzer. The analyzer was calibrated with propane in the 0-1,000 ppm range. Calibration drift checks were performed at the completion of each run.

3.5.3 Quality Control and Assurance

The THC sampling equipment was calibrated with propane (C_3H_8) according to the guidelines referenced in Methods 25A. Calibration gases were EPA Protocol 1 gases and the concentrations were within the acceptable ranges (25-35% low range, 45-55% mid-range and 80-100% of span). Calibration gas certification sheets are located in Appendix D.

3.5.4 Data Reduction

Data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. The THC emissions were recorded in parts per million (ppm) as propane (C_3H_8). The 1-minute readings collected are located in Appendix C.

The NMOC emissions data collected during the testing was calculated and reported as a concentration, parts per million corrected to 15% Oxygen on a dry basis (ppm@ $15\%O_{2\ dry}$). Emissions calculations, based on equations located in USEPA Methods 25A and 19, are located in Appendix F.

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4.0 OPERATING PARAMETERS

The test program included the collection of generator load (kW), engine speed (RPM), inlet manifold air pressure (psi), fuel upper heating value (BTU), fuel flow (scfm) and generator operating hours (kW-hour).

Operational data is located in Appendix G.

5.0 DISCUSSION OF RESULTS

Table Nos. 1 and 2 present the emission testing results from Units 1 & 2 while operating at greater than 90% of full load conditions. The NO_x, CO, and NMOC emissions are presented in parts per million corrected to 15% Oxygen on a dry basis (ppm@ $15\%O_{2\ dry}$). Additional test data presented for each test includes the engine load in percentage (%), kilowatts generated (kW), and the air/fuel ratio. Units 1 & 2 are in compliance with NO_x, CO, and NMOC emission limits as stated in Michigan Renewable Operating Permit No. MI-ROP-P0262-2012a and 40 CFR60.4244 Subpart JJJJ.

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6.0 CERTIFICATION STATEMENT

"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally accepted in the trade."

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RESULTS TABLES

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TABLE NO. 1
EMISSION TESTING RESULTS - UNIT 1
Blue Water Renewables, LLC
Kimball, MI
January 21, 2016

Test	Test Date	Test Time	Engine Load (BHp)	Oxygen (%)	Oxides of Nitrogen (ppm)[1]	Carbon Monoxide (ppm)[1]	Non-Methane Organics (ppm)[1]
Test 1	**21-Jan-16**	8:30-9:30	2,233	8.3	35.7	238.2	ND
Test 2		9:50-10:50	2,233	8.3	35.5	236.3	ND
Test 3		11:05-12:05	2,233	8.4	35.5	235.5	ND
		Average:	***2,233***	***8.3***	***35.6***	***236.7***	***ND***

(1) Emissions reported as parts per million, dry corrected to 15% O_2

Permit Limits:

NO_x - 150 ppmd @ 15% O_2

CO - 610 ppmd @ 15% O_2

NMOC - 80 ppmd @ 15% O_2

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TABLE NO. 2
EMISSION TESTING RESULTS - UNIT 2
Blue Water Renewables, LLC
Kimball, MI
January 25, 2016

Test	Test Date	Test Time	Engine Load (BHp)	Oxygen (%)	Oxides of Nitrogen (ppm)[1]	Carbon Monoxide (ppm)[1]	Non-Methane Organics (ppm)[1]
Test 1	**25-Jan-16**	8:45-9:45	2,233	8.3	36.4	239.2	ND
Test 2		11:00-12:00	2,233	8.3	36.6	239.2	1.9
Test 3		11:20-12:20	2,233	8.3	37.1	239.1	ND
		Average:	***2,233***	***8.3***	***36.7***	***239.2***	***1.9***

(1) Emissions reported as parts per million, dry corrected to 15% O_2

Permit Limits:

NO_x - 150 ppmd @ 15% O_2

CO - 610 ppmd @ 15% O_2

NMOC - 80 ppmd @ 15% O_2

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FIGURES

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Figure 1 – Stack Drawing and Exhaust Sampling Point Location
Blue Water Renewables – Units 1 & 2
January 21 & 25, 2016

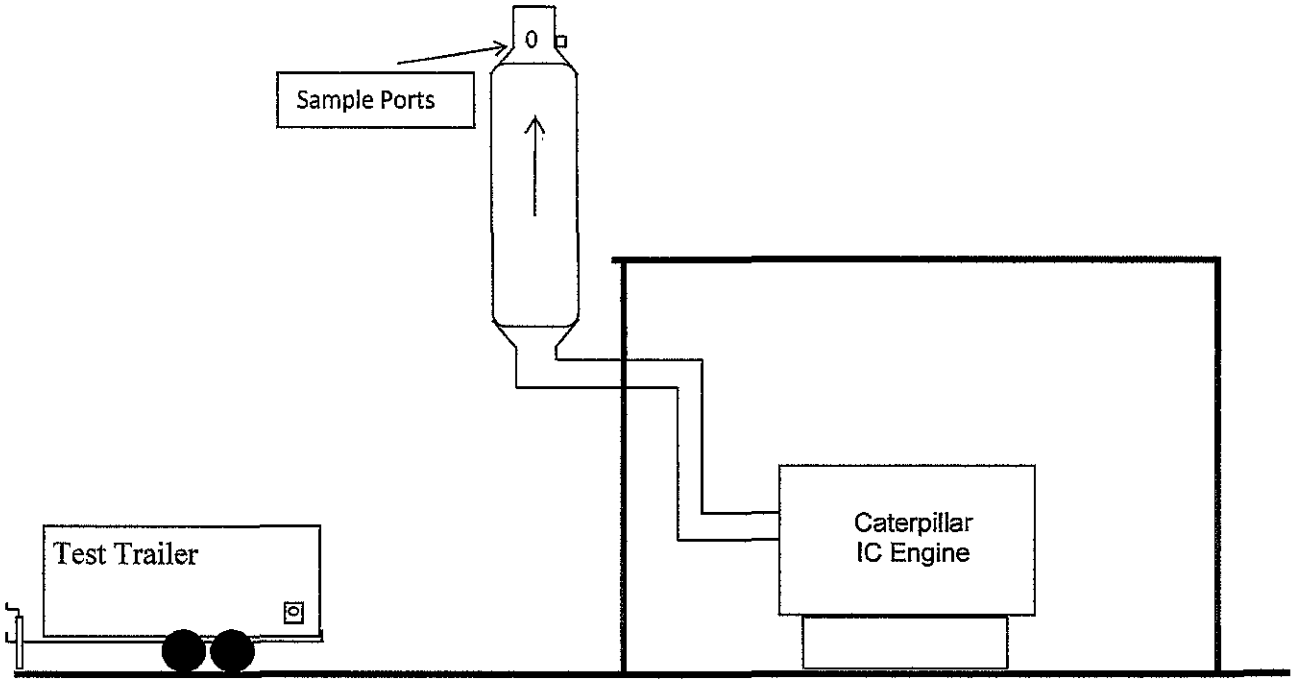

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Figure 2 – USEPA Method 3A/7E/10 Sampling Train
Blue Water Renewables
January 21 & 25, 2016

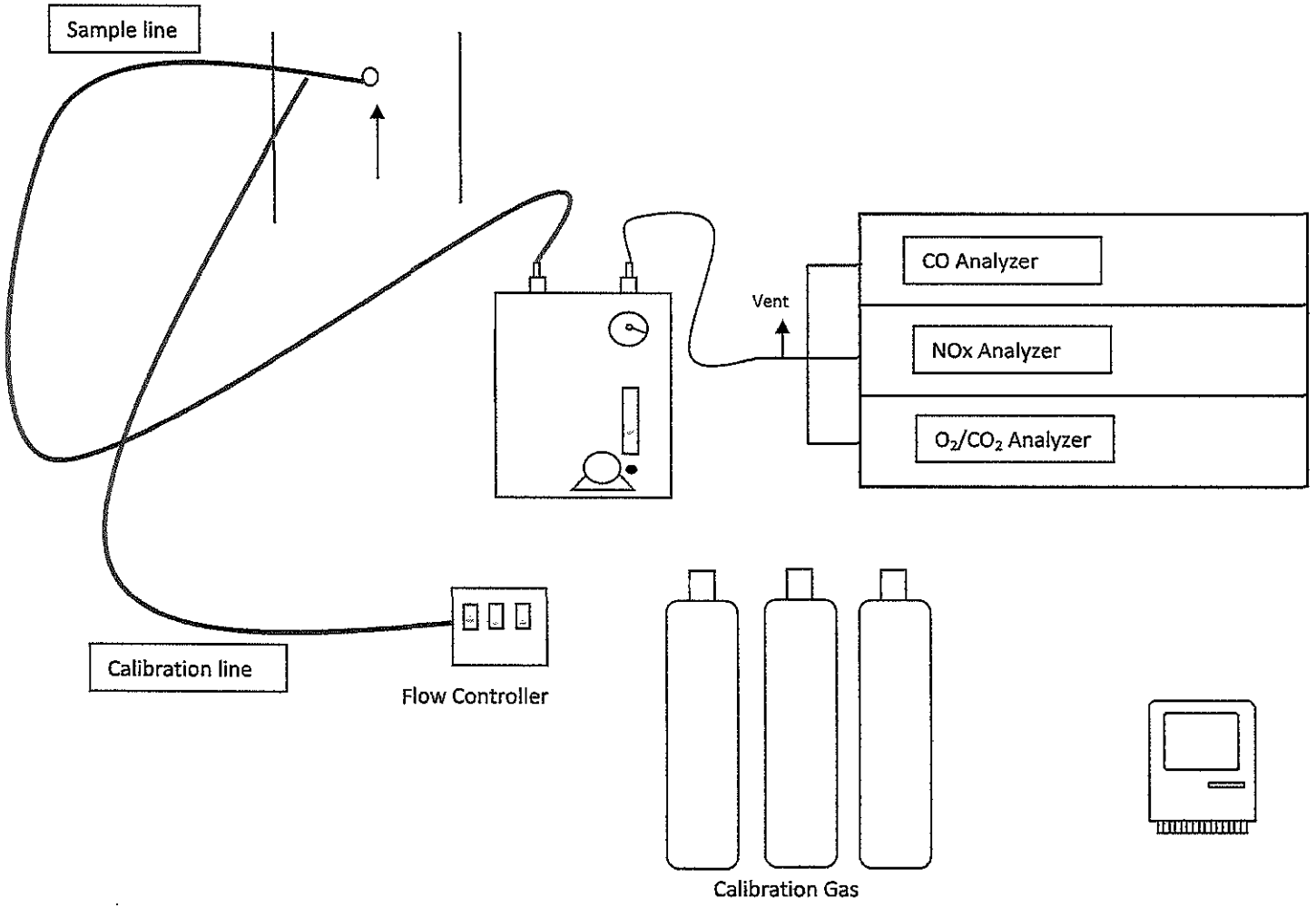

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Figure 3 – USEPA Method 320 Sampling Bags
Blue Water Renewables
January 21 & 25, 2016

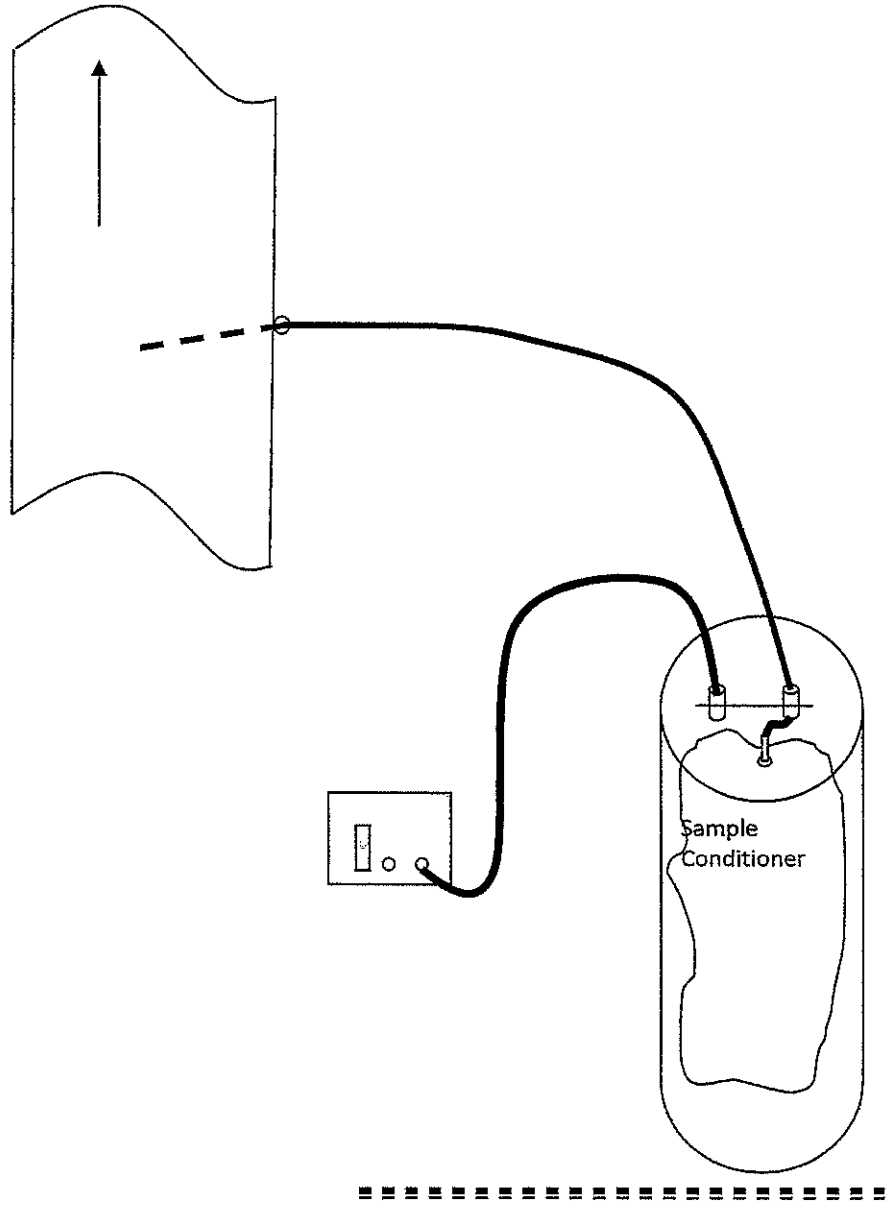

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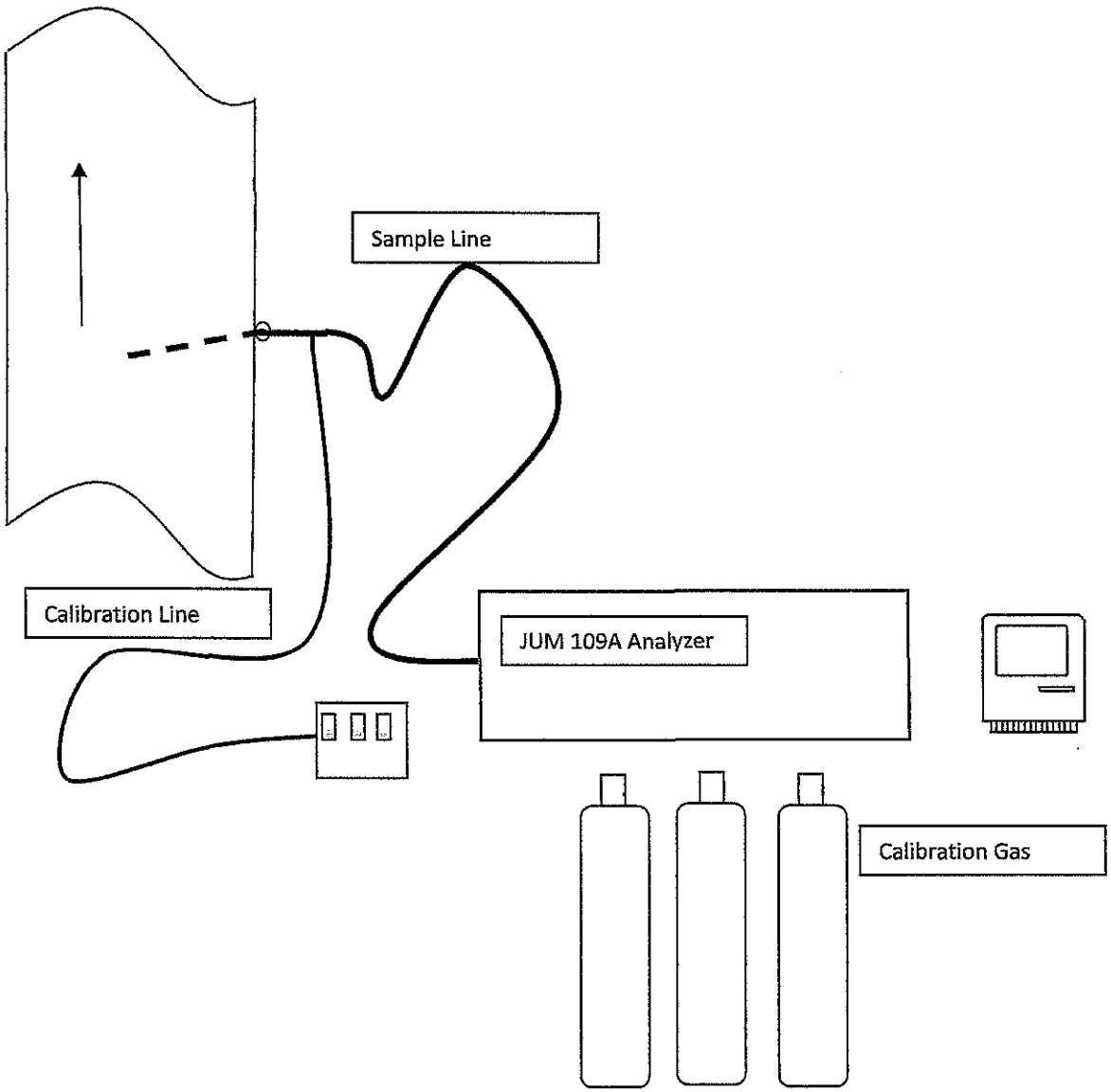
Figure 4 – USEPA Method 25A Sampling Train
Blue Water Renewables
January 21 & 25, 2016



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APPENDIX A

MDEQ TEST PLAN