MONTROSE
AIR QUALITY SERVICES

SOURCE TEST REPORT
2019 ANNUAL COMPLIANCE DEMONSTRATION
BLUEWATER GAS STORAGE, LLC.
BLUEWATER GAS STORAGE STATION
UCP1, UCP3 & UCP4
COLUMBUS, MICHIGAN

Prepared For:

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STAC
ACCREDITED
TO ASTM D7036 ONLY
CERT #3925.01

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REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature: Brandon Check Date: 10/17/2019

Name: Brandon Check Title: Client Project Manager

I have reviewed, technically and editorially, details calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature: Roy Slick Date: 10/17/2019

Name: Roy Slick Title: Reporting/QC Specialist

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1.0 PROJECT OVERVIEW

1.1 GENERAL

Montrose Air Quality Services, LLC (Montrose) located at 1371 Brummel Avenue, Elk Grove Village, Illinois was contracted by Bluewater Gas Storage, LLC to perform an air emission test program at the Bluewater Gas Storage Station located in Columbus, Michigan. Testing was performed to satisfy the requirements of the Michigan Department of Environmental -Quality (MDEQ) PTI , the United States Environmental Protection Agency (U.S. EPA), 40 CFR 63.6640 (c), Subpart ZZZZ, as applicable.

The specific objective of the test program is as follows:

- Determine the nitrogen oxides (NO_X) and carbon monoxide (CO) emissions from three natural gas fired, compressor engines at the Bluewater Gas Storage

Testing was performed on EU-COMPNORTH (UPC1) on September 10, 2019. Testing was performed on EU-COMPWEST (UPC3) on September 11, 2019. Testing was performed on EU-COMPEAST (UPC4) on September 10, 2019. Coordinating the field aspects of the test program were:

Shelly Heston – WEC Energy Group - (920) 433-1294

Frank Rasmussen – Bluewater Gas Storage - (810) 305-3912

Brandon Check – Montrose Air Quality Services, LLC – (630) 860-4740

1.2 EXECUTIVE SUMMARY

The results of the test program are summarized in the following table.

TABLE 1-1
EXECUTIVE SUMMARY

Location	NO_X (lb/hr)		CO (ppmdv@15%O_2)		CO (lb/hr)	
	Limit	Result	Limit	Result	Limit	Result
EU-COMPNORTH	**4.5**	**2.57**	**47**	**0.119**	**0.4**	**0.00189**
EU-COMPWEST	**7.4**	**5.89**	**47**	**3.50**	**1.85**	**0.273**
EU-COMPEAST	**7.4**	**5.83**	**47**	**19.0**	**1.85**	**1.40**

1.3 ASTM D7036-04(2011)

All applicable Montrose field personnel used on-site for this test program were compliant with ASTM D7036-04(2011) "Standard Practice for Competence of Air Emissions Testing Bodies" for all tests performed. This includes having the appropriate QSTI directly supervise the testing.

The following table summarizes the key personnel that were involved with this project:

TABLE 1-2
PROJECT PERSONNEL

Personnel	Position on Project	Date of QSTI Exam
Brandon Check, Q.S.T.I.	Client Project Manager	03/31/2016

1.4 METHODOLOGY

The concentrations of oxygen (O_2), NO_X, and CO at the exhaust of each engine was determined using EPA Methods 3A, 7E and 10. The sample gas was withdrawn from the outlet at a constant rate through a stainless steel probe, a glass fiber filter and a Teflon sample line. The probe, filter and sample line were operated at a minimum temperature of 250 °F to prevent the condensation of moisture. The sample gas passed through a gas cooler system. The gas cooler consists of two separate stages designed to lower the dew point of the sample gas to 35 °F, thus removing the moisture. Each stage of the gas cooler is designed to minimize contact of condensed moisture with the dry sample gas. The dry gas is then delivered to the O_2, NO_X and CO analyzers.

Three 15 minute test runs were performed at the outlet of each engine. Results from the analyzers were determined on a "dry" basis. Results are in parts per million dry volume (ppmdv), ppmdv at 15 percent (%) O_2 (ppmdv@15%) (CO only) and in pound per hour (lb/hr).

1.5 PARAMETERS

The following specific parameters were determined at each engine at the Bluewater Gas Storage Station test locations during each test run:

- oxygen concentration
- nitrogen oxides concentration
- carbon monoxide concentration

1.6 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is presented in the report appendices.

1.7 RESULTS

A complete summary of test results is presented in Tables 2-1 through 2-6.

Testing was performed according to Test Plan No. 023AS-575186-PP-17. The procedures outlined in that document were followed except where noted. Performance data is available upon request.

2.0 SUMMARY OF RESULTS

TABLE 2-1
SUMMARY OF EU-COMPNORTH RESULTS

Test Parameters	Run 1	Run 2	Run 3	Average
Date	9/10/2019	9/10/2019	9/10/2019	
Start Time	11:44	12:15	12:43	
Stop Time	11:59	12:30	12:58	
Gas Conditions				
Oxygen (% dry)	8.12	8.13	8.06	**8.10**
Fuel Factor, Fd	8614	8614	8614	
Heating Value (BTU)	1069.67	1069.59	1069.94	
Heat Input (MMBTU/hr)	7.34	7.15	6.98	
Nitrogen Oxides Results				
Concentration (ppmdv)	213	208	221	**214**
Emission rate, E (lb/mmBTU)	0.358	0.351	0.371	**0.360**
Emission rate (lb/hr)	2.62	2.51	2.59	**2.57**
Carbon Monoxide Results				
Concentration (ppmdv)	0.289	0.239	0.246	**0.258**
Concentration, C (ppmdv@15% O2)	0.133	0.110	0.113	**0.119**
Emission rate, E (lb/mmBTU)	0.000296	0.000245	0.000250	**0.000263**
Emission Rate (lb/hr)	0.00217	0.00175	0.00175	**0.00189**

TABLE 2-2
EU-COMPNORTH PROCESS DATA

Run	RMP/BHP	% Load	Catalyst Pressure drop	Catalyst inlet temperature	Fuel Flow (MSCFH)	Fuel Consumed (MSCF)
1	1065/708	72	5.2	787	6.87	1.72
2	1062/692	71	5.0	789	6.68	1.67
3	1063/672	69	4.8	788	6.53	1.63

TABLE 2-3
SUMMARY OF EU-COMPWEST RESULTS

Test Parameters	Run 1	Run 2	Run 3	Average
Date	9/11/2019	9/11/2019	9/11/2019	
Start Time	14:55	15:20	15:44	
Stop Time	15:10	15:35	15:59	
Gas Conditions				
Oxygen (% dry)	11.3	11.3	11.4	**11.3**
Fuel Factor, Fd	8614	8614	8614	
Heating Value (BTU)	1031.89	1042.02	1059.51	
Heat Input (MMBTU/hr)	35.1	35.2	35.4	
Nitrogen Oxides Results				
Concentration (ppmdv)	78.4	77.2	68.1	**74.6**
Emission rate, E (lb/mmBTU)	0.175	0.173	0.154	**0.167**
Emission rate (lb/hr)	6.14	6.07	5.45	**5.89**
Carbon Monoxide Results				
Concentration (ppmdv)	5.62	5.73	5.70	**5.68**
Concentration, C (ppmdv@15% O2)	3.44	3.52	3.53	**3.50**
Emission rate, E (lb/mmBTU)	0.00763	0.00780	0.00783	**0.00776**
Emission Rate (lb/hr)	0.268	0.274	0.277	**0.273**

TABLE 2-4
EU-COMPWEST PROCESS DATA

Run	RPM/BHP	% Load	Catalyst Pressure drop (in)	Catalyst inlet temperature (F)	Fuel Flow (MSCFH)	Fuel Consumed (MSCF)
1	990/4389	94	3.3	888	33.98	8.49
2	988/4382	94	3.3	887	33.74	8.44
3	988/4383	94	3.3	879	33.39	8.35

TABLE 2-5
SUMMARY OF EU-COMPEAST RESULTS

Test Parameters	Run 1	Run 2	Run 3	Average
Date	9/10/2019	9/10/2019	9/10/2019	
Start Time	13:43	14:08	14:32	
Stop Time	13:58	14:23	14:47	
Gas Conditions				
Oxygen (% dry)	11.2	11.2	11.2	**11.2**
Fuel Factor, Fd	8614	8614	8614	
Heating Value (BTU)	1069.86	1071.04	1072.42	
Heat Input (MMBTU/hr)	33.3	33.2	33.3	
Nitrogen Oxides Results				
Concentration (ppmdv)	79.7	78.2	78.9	**78.9**
Emission rate, E (lb/mmBTU)	0.177	0.174	0.175	**0.175**
Emission rate (lb/hr)	5.89	5.78	5.82	**5.83**
Carbon Monoxide Results				
Concentration (ppmdv)	31.3	31.3	30.8	**31.1**
Concentration, C (ppmdv@15% O2)	19.1	19.1	18.7	**19.0**
Emission rate, E (lb/mmBTU)	0.0423	0.0424	0.0415	**0.0421**
Emission Rate (lb/hr)	1.41	1.41	1.38	**1.40**

TABLE 2-6
SUMMARY OF EU-COMPEAST PROCESS DATA

Run	RPM/BHP	% Load	Catalyst Pressure drop (in)	Catalyst inlet temperature (F)	Fuel Flow (MSCFH)	Fuel Consumed (MSCF)
1	981/4363	94	3.0	897	31.13	7.78
2	981/4364	94	3.0	893	31.03	7.76
3	980/4361	94	3.0	899	31.01	7.75

3.0 TEST PROCEDURES

3.1 METHOD LISTING

The following EPA test methods were referenced for the test program. These methods can be found in 40 CFR Part 60 Appendix A and 40 CFR Part 63, Appendix A.

Method 3A Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

Method 7E Determination of nitrogen oxides emissions from stationary sources

Method 10 Determination of carbon monoxide emissions from stationary sources

Method 19 Determination of sulfur dioxide removal efficiency and particulate matter, sulfur dioxide, and nitrogen oxides emission rates

3.2 METHOD DESCRIPTIONS

3.2.1 Methods 3A, 7E and 10

The oxygen, nitrogen oxides and carbon monoxide concentrations at the test location were determined using EPA Methods 3A, 7E and 10. A schematic of the sample system is shown in Figure 1 in the Appendix.

The sample gas was withdrawn from the test location at a constant rate through an in-situ 0.3 micron stainless steel cintered frit, a stainless steel probe and Teflon sample line. The sample line was operated at a temperature of 250 °F to prevent the condensation of moisture. The sample gas passed through an M & C Type EC gas cooler system. The gas cooler is designed to unobtrusively lower the dewpoint of the sample gas to 35 °F, thus removing the moisture. The dry gas was then vented to the oxygen analyzer. Results from this analyzer were determined on a dry basis.

The analyzers that were used for this project are listed in the table below.

TABLE 3-1
ANALYZERS USED FOR PROJECT

Parameter	Manufacturer	Model Number	Operating Principle	Units Reported	Range to be used
Oxygen	Teledyne	T803	Paramagnetic	(%)	0-20.06
Nitrogen Oxides	Thermo	42i	Chemiluminescence	ppmd	0-492.2
Carbon Monoxide	Thermo	48i-tie	Infrared, Gas Filter Correlation	ppmd	0-50.49

Prior to sampling, a calibration error test was performed on the analyzer using EPA Protocol 1 gases. The zero and high-range calibration gases for each constituent was introduced directly into each analyzer. Each analyzer was then adjusted to the appropriate values. The mid-range

and low-range gases were introduced to each analyzer and the measured values were then recorded. The measured values for each calibration gas were compared to the calibration gas values and the differences were less than the method requirement of two percent of the span value.

A sample system bias check was performed, by introducing the zero and mid-range calibration gases into the sampling system at the base of the probe. The gas was drawn through the entire sampling system. The measured responses were compared to the calibration error test values to determine the bias in response due to the sampling system. In all cases, the sampling system bias was less than the method requirement of five percent of the span value. In addition, the system response time was determined by measuring the time required for each analyzer to reach 95 percent of its' high-range calibration gas value.

After each test run the instrument drift for the analyzer was determined by introducing the zero and mid-range calibration gases into the sampling system at the base of the probe. The gas was drawn through the entire sampling system. The measured responses were compared to the values from the previous test run to determine the analyzer drift. For all test runs, the analyzer drift was less than the method requirement of three percent of the span value.

3.2.2 Method 19

EPA Method 19 was used to calculate pollutant emission rates in terms of pounds per million Btu (lb/mmBtu). The calculation was based on the oxygen content of the sample gas and an appropriate F factor, which is the ratio of combustion gas volumes to heat inputs. For this project the F factor used was 8,614 dscf/mmBtu for natural gas.

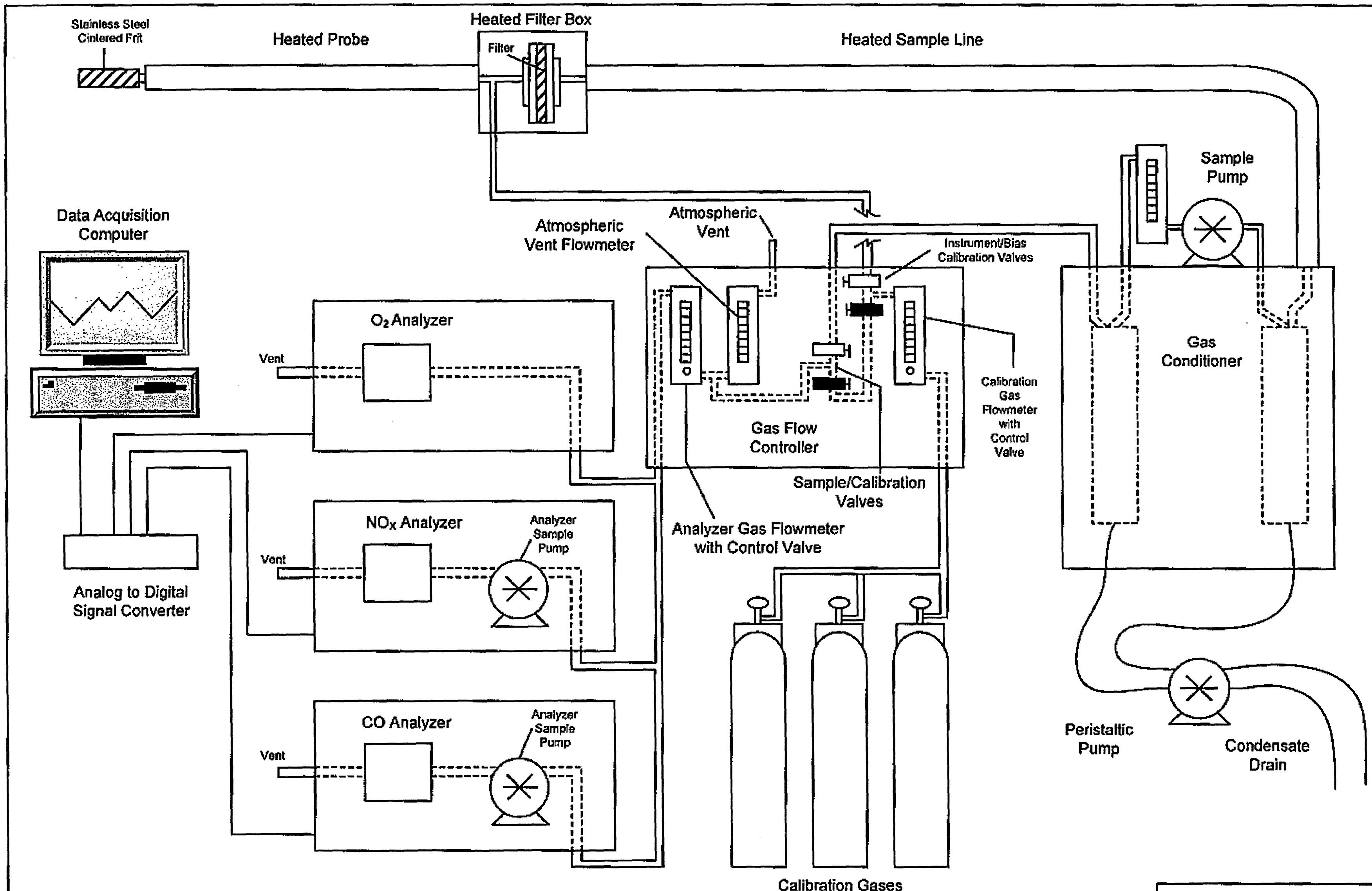
4.0 DESCRIPTION OF INSTALLATION

EU-COMPNORTH is a 10.1 MMBtu/hr heat input Caterpillar G3516 natural gas fired 4-stroke lean burn reciprocating internal combusition engine driving a compressor. It is controlled with a catalytic oxidation system.

EU-COMPEAST is a 31.9 MMBtu/hr heat input Caterpillar G3616 natural gas fired 4-stroke lean burn reciprocating internal combusition engine driving a compressor. It is controlled with a catalytic oxidation system.

EU-COMPWEST is a 31.9 MMBtu/hr heat input Caterpillar G3616 natural gas fired 4-stroke lean burn reciprocating internal combusition engine driving a compressor. It is controlled with a catalytic oxidation system.

APPENDIX A
FIGURES



EPA Methods 3A, 7E, and 10:
O_2, NO_X and CO Gas Sampling System

Figure 1