EMISSIONS TEST REPORT

for

CARBON MONOXIDE (CO) EMISSIONS

PART 63 SUBPART ZZZZ

UNIT 1

DTE-Gas, Willow Compressor Station
Ypsilanti, Michigan

June 28, 2017

Prepared By
Environmental Management & Resources
Environmental Field Services Group
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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed emissions testing at the DTE-Gas, Willow Compressor Station, located in Ypsilanti, Michigan. The fieldwork, performed on June 28, 2017 was conducted according to the test method specified in 40CFR Part 63.6640(c). The emission test was performed on Unit 1 to demonstrate carbon monoxide (CO) destruction efficiency performance.

The results of the emissions testing are highlighted below:

CO Emissions Test Results
Willow Compressor Station - Unit 1
June 28, 2017

Unit 1 – Operating Load (Brake Horsepower)	Average CO Emission Rate (gram/BHp-Hr)	Average CO Destruction Efficiency (%)
3951	0.01	99.1

Permit Limits: CO = 2.5 grams/BHp-Hr
CO-DE = 93%

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed emissions testing at the DTE-Gas, Willow Compressor Station, located in Ypsilanti, Michigan. The fieldwork, performed on June 28, 2017 was conducted according to the test method specified in 40CFR Part 63.6640(c). The emission test was performed on Unit 1 to demonstrate carbon monoxide (CO) destruction efficiency performance.

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

The fieldwork was performed in accordance with EPA Reference Methods. The following EFS personnel participated in the testing program: Mark Grigereit, Principal Engineer ,Thom Snyder, Environmental Specialist and Fred Meinecke, Senior Engineering Technician-EM&R. Mr. Grigereit was the project leader. Emissions testing was observed by Mr. Brian Carley with the MDEQ.

2.0 SOURCE DESCRIPTION

The Willow Compressor Station located at 3020 East Michigan Avenue, Ypsilanti, Michigan, employs the use of a Caterpillar 3616 natural gas-fired 4,735 Horse Power reciprocating engine (Unit 1). The engine generates line pressure assisting the transmission of natural gas throughout the pipeline transmission system in SE Michigan.

The emissions from the engine are exhausted through a catalyst bed and to the atmosphere through an individual exhaust stack. The composition of the emissions from the engine depends both upon the speed of the engine and the torque delivered to the compressor. Ambient atmospheric conditions, as it affects the density of air, limit the speed and torque at which the engine can effectively operate.

During the emissions testing the engine was operated at maximum load possible for the time that the testing was performed.

A schematic representation of the engine exhaust and sampling locations are presented in Figure 1. Sampling was performed in the duct prior to and immediately following the catalyst bed.

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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	Instrumental Analyzer Method
USEPA Method 10	Carbon Monoxide	NDIR Instrumental Analyzer Method

3.1 OXYGEN AND CARBON MONOXIDE (USEPA METHODS 3A AND 10)

3.1.1 Sampling Method

Oxygen (O_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The O_2 analyzer utilizes a paramagnetic sensor.

Carbon monoxide (CO) emissions were evaluated using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources". The CO analyzer utilizes a NDIR detector.

3.1.2 O_2 and CO Sampling Train

The EPA Methods 3A and 10 sampling system (Figure 2) consisted of the following components:

(1) Single-point stainless steel sampling probe.
(2) Heated PTFE™ sampling line.
(3) MAK® gas conditioner with particulate filter.
(4) Flexible unheated PTFE™ sampling line.
(5) Servomex 1400 O_2/CO_2 gas analyzer and TECO 48i NDIR CO gas analyzer.
(6) Data Acquisition System.

Refer to Figure 2 for a schematic of the O_2 and CO sampling train.

3.1.3 Sampling Train Calibration

The O_2 / CO sampling trains were calibrated according to procedures outlined in USEPA Methods 3A & 10. Zero, span, and mid range calibration gases were introduced directly into the CO and O_2 analyzers to determine the instruments linearity. A zero and mid range span gas was then introduced through the entire sampling system to determine sampling system bias for each analyzer. Additional system calibrations were performed at the completion of each test.

3.1.4 Sampling Duration & Frequency

The emissions testing of the engine consisted of triplicate 15-minute samples at the inlet and exhaust of the catalyst. Testing was conducted at three points across the diameter of the duct. Sampling was performed simultaneously for O_2 and CO and data was recorded as 1-minute averages.

3.1.5 Quality Control and Assurance (O_2 and CO)

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 3A and 10. Calibration gases were EPA Protocol 1 gases. The CO analyzers spans were 0-488.6 ppm and 0-47.57 ppm ranges. The O_2 analyzers spans were 0-17.93% and 0-17.85% ranges.

Calibration gas certification sheets are located in Appendix C.

3.1.6 Data Reduction

The O_2 and CO emission readings in percent (%) and parts per million (ppm) respectively were recorded at 10-second intervals and averaged to 1-minute increments. The CO emissions were reported in grams per Brake Horsepower Hour (g/BHp-Hr) and percent Destruction Efficiency (DE) as required by the Method. Emission calculations are based upon calculations found in USEPA Methods 3A, 7E, 10 and 19. Example calculations are located in Appendix D.

The 1-minute readings collected are located in Appendix B.

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4.0 OPERATING PARAMETERS

The test program included the collection of engine speed (RPM), engine load (%), fuel flow (scfh), catalyst inlet and outlet temperature (°F), catalyst pressure drop ("H2O), and generator operating hours (kW-hour) along with other engine data. Operational data collected during the testing is located in Appendix E.

5.0 RESULTS

Table 1 presents the CO emission testing results from Unit 1. The CO emissions are presented in grams per brake horsepower hour (g/Bhp-Hr), prior to and after the catalyst, and the destruction efficiency in percent (%). Also presented are the Unit load in percent (%), speed (rpm), brake horsepower, and heat input (MMBtu/Hr) for each test. The Results of the testing indicate that Unit 1 is in compliance all applicable federal and state permit requirements for CO. Measured concentrations of CO emissions are 0.01 g/BHp-Hr (limit - 2.5 g/BHp-Hr) and 99.1% destruction efficiency (limit – 93% DE).

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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."

Mark Grigereit, QSTI

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Carbon Monoxide (CO) Emissions Testing Results
Engine 1 - Willow Compressor Station
DTE Gas
Ypsilanti, Michigan

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	06/28/17	06/28/17	06/28/17	
Sampling Start Time	8:55-9:10	9:20-9:35	9:43-9:58	
Gross Dry BTU	1023	1023	1023	
Load (%)	83.0	84.0	84.0	
Speed (RPM)	998.0	996.0	998.0	
Brake-HP	3,922	3,961	3,969	
Fuel Flow (100 scf/hr)	285.83	291.43	291.82	
Heat Input Rate (MMBtu/Hr)	29.24	29.81	29.85	
Average Inlet O_2 Concentration (%, dry)	11.5	11.6	11.5	11.5
Average Inlet O_2 Concentration (%, dry, corrected)[1]	11.6	11.8	11.7	11.7
Average Inlet CO Concentration (ppmv, dry)	355.9	358.2	354.2	356.1
Average Inlet CO Concentration (ppmv, dry, corrected)[1]	350.5	352.2	348.3	350.3
Average Inlet CO Concentration (lb/MMBtu)	0.499	0.512	0.502	0.504
Average Inlet CO Emission Rate (lb/hr, dry)	14.58	15.27	14.99	14.95
CO Emission Rate (gram/BHP-Hr, dry)	**1.69**	**1.75**	**1.71**	**1.72**
Average Outlet O_2 Concentration (%, dry)	11.7	11.7	11.7	11.7
Average Outlet O_2 Concentration (%, dry, corrected)[1]	11.7	11.7	11.7	11.7
Average Outlet CO Concentration (ppmv, dry)	2.4	2.8	4.0	3.1
Average Outlet CO Concentration (ppmv, dry, corrected)[1]	2.4	2.8	4.0	3.1
Average Outlet CO Concentration (lb/MMBtu)	0.003	0.004	0.006	0.004
Average Outlet CO Emission Rate (lb/hr, dry)	0.10	0.12	0.17	0.13
CO Emission Rate (gram/BHP-Hr, dry)	**0.01**	**0.014**	**0.020**	**0.01**
CO Destruction Efficiency	**99.3%**	**99.2%**	**98.9%**	**99.1%**

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

O_2 : oxygen

CO : carbon monoxide

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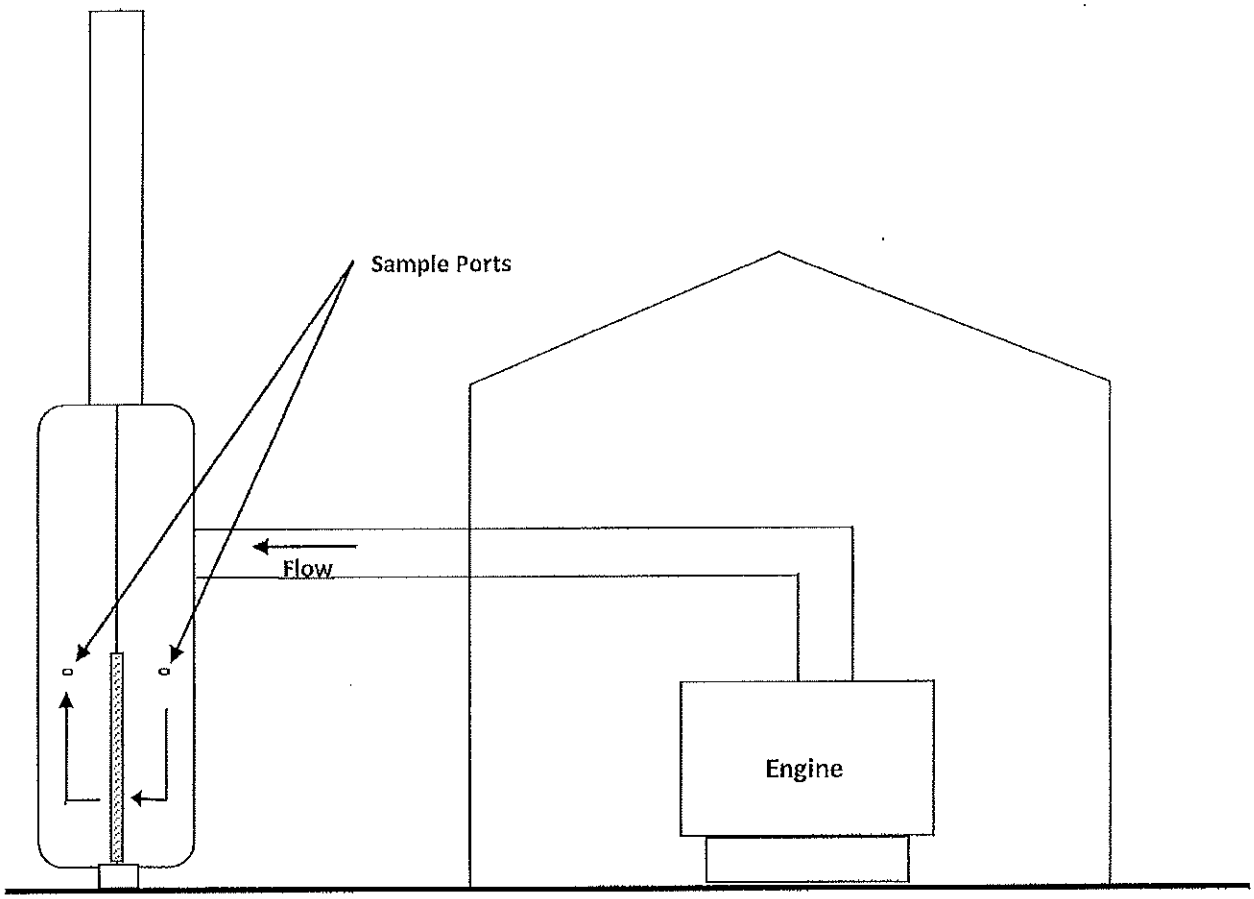
Figure 1 – Sampling Location
Willow Compressor Station
May 28, 2017



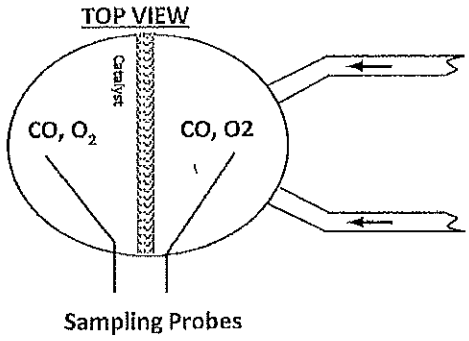


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Figure 2 – EPA Methods 3A/10
Willow Compressor Station
May 28, 2017