EMISSIONS TEST REPORT

for

CARBON MONOXIDE (CO) EMISSIONS

EUENGINE4, EUENGINE5, & EUENGINE6

DTE Gas Washington 10 Compressor Station (N3391)
Washington Township, Michigan

June 4-6, 2019

Prepared By
Environmental Management & Resources
Environmental Field Services Group
DTE Corporate Services, LLC
7940 Livernois H-136
Detroit, MI 48210

DTE

DTE

CONTENTS

DTE

EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EM&R), Field Services Group, performed emissions testing at the DTE Gas Washington 10 Compressor Station, located in Washington Township, Michigan. The fieldwork, performed on June 4-6, 2019 was conducted to satisfy requirements of the Michigan Renewable Operating Permit No. N3391-2017. Emission testing was performed on EUENGINE4-6 (Engines 4-6) for carbon monoxide (CO) emission rates and destruction efficiencies.

The results of the emissions testing are highlighted below:

Emissions Testing Summary
Washington 10 Compressor Station
EUENGINE4-6
June 4-6, 2019

Parameter	EUENGINE4	EUENGINE5	EUENGINE6	Permit Limit
Average Inlet Carbon Monoxide Concentration (CO grams/BHp-hr)[1]	0.06	0.07	0.01	2.50
Average Carbon Monoxide Destruction Efficiency (%)	96.9	96.4	99.3	93.0

[1] BHp-hr – Brake horsepower per hour

DTE

1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EM&R), Field Services Group, performed emissions testing at the DTE Gas Washington 10 Compressor Station, located in Washington Township, Michigan. The fieldwork, performed on June 4-6, 2019, was conducted to satisfy requirements of the Michigan Air Renewable Operating Permit No. N3391-2017. Emission testing was performed on EUENGINE4-6 (Engines 4-6) for carbon monoxide (CO) emission rates and destruction efficiencies.

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 and EM&R's Intent to Test[1], Test Plan Submittal. The following EM&R personnel participated in the testing program: Mark Grigereit, Principal Engineer - Environmental and Mr. Thom Snyder, Environmental Specialist. Mr. Grigereit was the project leader. Ms. Regina Angelliotti and Ms. Kerry Kelly with the Air Quality Division of the Michigan Department of Environment, Great Lakes and Energy (EGLE) approved the Test Plan.[2] Ms. Kelly and Mr. Dave Paterson witnessed portions of the testing.

2.0 SOURCE DESCRIPTION

The Washington 10 Compressor Station located at 12700 E. 30 Mile Road, Washington Township, Michigan, employs the use of three natural gas-fired 4,735 Horse Power reciprocating engines (EUENGINES4-6). The engines generate line pressure assisting the transmission of natural gas into and out of the gas storage field as well as to and from the pipeline transmission system in SE Michigan.

The emissions from Engines 4, 5, & 6 are exhausted through a catalyst bed and to the atmosphere through individual exhaust stacks. The composition of the emissions from the engines depend both upon the speed of the engine and the torque delivered to the compressor. Ambient atmospheric conditions, as it affects the density of air, may limit the speed and torque at which the engines can effectively operate on a daily basis.

During the emissions testing each engine was operated within 10% of its highest achievable load.

[1] EGLE, Test Plan, Submitted March 5, 2019. (Attached-Appendix A)
[2] EGLE, Approval Letter, Received March 18, 2019. (Attached-Appendix A)

DTE

Schematic representations of each engine's exhaust and sampling locations are presented in Figure 1.

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

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) Stainless steel sampling probe.
(2) Heated PTFE sampling line.
(3) Sampling 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) USEPA Protocol 1 calibration gases.
(7) Data Acquisition System.

DTE

3.1.3 Sampling Duration & Frequency

The emissions testing of the engine consisted of triplicate 60-minute samples at the inlet and exhaust of the catalyst. Testing was conducted at three points across the diameter of the duct during each run. Sampling was performed simultaneously for O_2 and CO. Data was recorded at 10-second intervals.

3.1.4 Quality Control and Assurance (O_2 and CO)

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.

3.1.5 Data Reduction

Data collected during the emissions testing was recorded at 10-second intervals and averaged in 1-minute increments. The CO emissions were recorded in parts per million (ppm). The 1-minute readings collected can be found in Appendix B.

Emissions calculations are based on calculations located in USEPA Methods 7E, 10, and 19 and can be found in Appendix E. The CO emissions data collected during the testing was calculated as grams per brake horsepower-hour (g/BHp-Hr).

4.0 OPERATING PARAMETERS

The test program included the collection of engine torque (Hp), engine speed (RPM), inlet and exhaust manifold air temperature (°F) and pressure (psi), fuel upper heating value (BTU), and fuel flow (100 scfh).

Operational data is located in Appendix D.

5.0 DISCUSSION OF RESULTS

The results of the CO emission testing on Engines 4-6 are presented in Tables No 1-3. 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 (%). Process data presented includes the Unit load in percent (%), Engine Speed in revolutions per minute (RPM), Engine Torque in brake horsepower (Brake-hp), and Heat Input in million British Thermal Unit per hour (MMBtu/hr) for each test. The results of the testing indicate that Engines 4-6 are in compliance with permit requirements for CO of 2.5 g/BHp-Hr and 93% destruction efficiency.

DTE

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

This report prepared by:

Mr. Mark Grigereit, QSTI
Principal Engineer, Field Services Group
Environmental Management and Resources
DTE Energy Corporate Services, LLC

This report reviewed by:

Mr. Thomas Snyder, QSTI
Environmental Specialist, Field Services Group
Environmental Management and Resources
DTE Energy Corporate Services, LLC

DTE

RESULTS TABLES

DTE

TABLE NO. 1
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
EUENGINE 4 - Washington 10 Compressor Station
June 6, 2019

Test	Time	Load (%)	Speed (RPM)	Brake HP	Heat Input (MMBtu/Hr)	Oxygen [1]		CO Emissions [1]		Destruction Efficiency (%)
						Inlet (%)	Outlet (%)	Inlet (g/BHp-Hr)	Outlet (g/BHp-Hr)	
Run - 1	8:10-9:10	95.1	989.9	4,457	33.10	11.4	11.3	1.82	0.05	97.2
Run - 2	9:21-10:21	95.3	989.4	4,466	33.06	11.4	11.4	1.83	0.06	96.9
Run - 3	10:36-11:36	95.5	989.8	4,474	33.16	11.4	11.4	1.84	0.06	96.7
	Avg:	*95.3*	*989.7*	*4,466*	*33.11*	*11.4*	*11.4*	*1.83*	*0.06*	*96.9*

(1) Corrected for analyzer drift per USEPA method 7E

CO Permit Limits:

2.5 g/BHp-Hr (uncontrolled)
93% DE

DTE

TABLE NO. 2
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
EUENGINE5 - Washington 10 Compressor Station
June 5, 2019

Test	Time	Load (%)	Speed (RPM)	Brake-HP	Heat Input (MMBtu/Hr)	Oxygen [1] Inlet (%)	Oxygen [1] Outlet (%)	CO Emissions [1] Inlet (g/BHp-Hr)	CO Emissions [1] Outlet (g/BHp-Hr)	Destruction Efficiency (%)
Run - 1	8:31-9:31	96.9	961.1	4,408	30.92	11.5	11.5	1.90	0.07	96.2
Run - 2	9:40-10:40	96.3	964.6	4,397	30.89	11.5	11.5	1.9	0.06	96.9
Run - 3	10:51-11:51	98.0	941.9	4,369	30.57	11.5	11.5	1.9	0.07	96.2
	Avg:	*97.1*	*955.9*	*4,391*	*30.79*	*11.5*	*11.5*	*1.90*	*0.07*	*96.4*

(1) Corrected for analyzer drift per USEPA method 7E

CO Permit Limits:

2.5 g/BHp-Hr (uncontrolled)

93% DE

DTE

TABLE NO. 3
CARBON MONOXIDE (CO) EMISSION TESTING RESULTS
EUENGINBE6 - Washington 10 Compressor Station
June 4, 2019

Test	Time	Load (%)	Speed (RPM)	Brake-HP	Heat Input (MMBtu/Hr)	Oxygen [1] Inlet (%)	Oxygen [1] Outlet (%)	CO Emissions [1] Inlet (g/BHp-Hr)	CO Emissions [1] Outlet (g/BHp-Hr)	Destruction Efficiency (%)
Run - 1	7:55-8:55	97.4	938.6	4,329	30.83	11.3	11.3	1.55	0.01	99.3
Run - 2	9:06-10:06	95.6	956.8	4,333	30.92	11.4	11.4	1.60	0.01	99.3
Run - 3	10:18-11:18	96.5	943.9	4,312	30.73	11.4	11.4	1.62	0.01	99.2
	Avg:	*96.5*	*946.4*	*4,325*	*30.83*	*11.4*	*11.4*	*1.59*	*0.01*	*99.3*

(1) Corrected for analyzer drift per USEPA method 7E

CO Permit Limits:

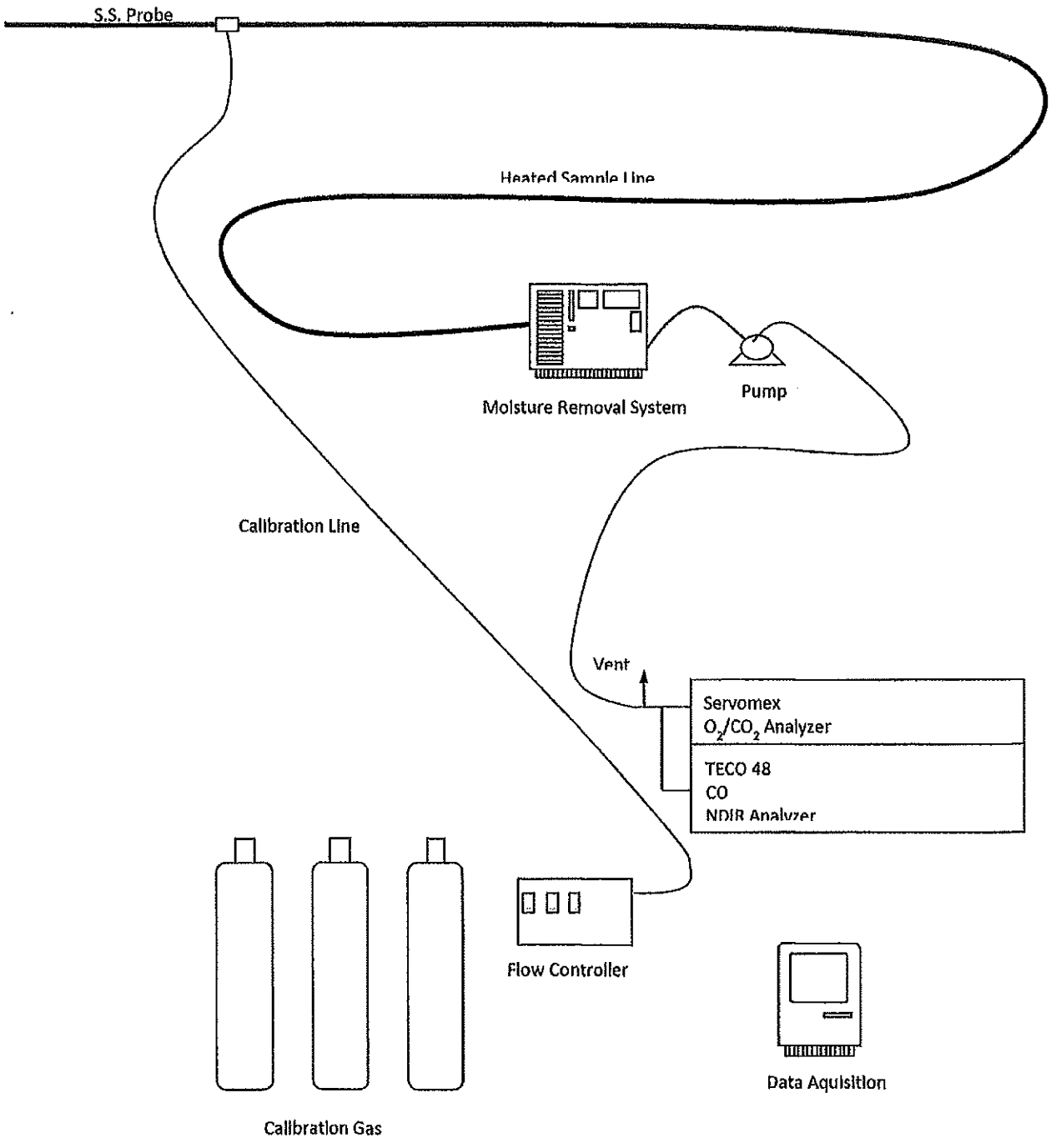
2.5 g/BHp-Hr (uncontrolled)

93% DE

DTE

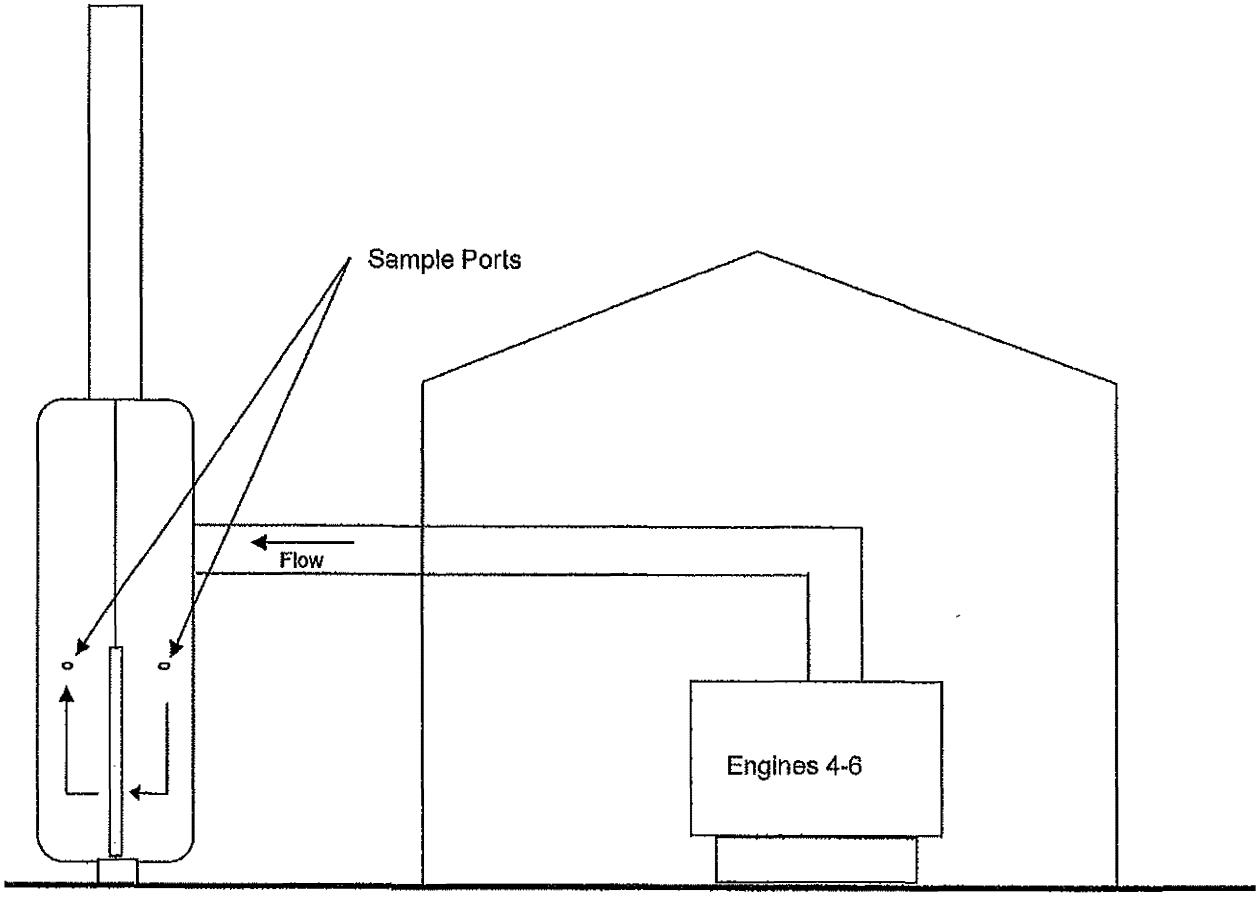
FIGURES

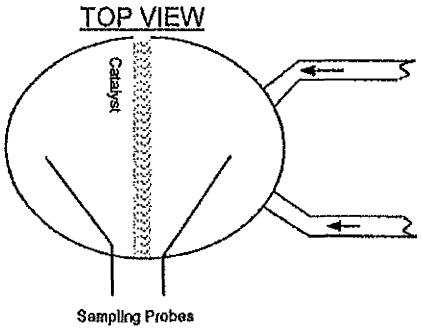
Figure 2 – Method 3A and 10
EUENGINE4-6
Washington 10 Compressor Station
June 4-6, 2019



DTE

Figure 1 – Sampling Locations
EUENGINE4-6
Washington 10 Compressor Station
June 4-6, 2019





DTE