EMISSIONS TEST REPORT

for

CARBON MONOXIDE (CO) DESTRUCTION EFFICIENCY

EURICE1-3

DTE-Gas Willow Compressor Station
Ypsilanti, Michigan

December 4-5, 2019

Prepared By
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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 December 4-5, 2019 was conducted to satisfy requirements of the Michigan Permit to Install No. 44-16A and 40 CFR Part 63 Subpart ZZZZ. Carbon monoxide (CO) destruction efficiency testing was performed on EURICE1-3 across each catalyst.

A summary of results of the emissions testing are highlighted below:

CO DE Emissions Test Results
Willow Run Compressor Station – EURICE1-3
Ypsilanti, Michigan
December 4-5, 2019

Emission Unit	Load (% of rated bhp)	CO_{in} (ppmvd at 15% O_2)	CO_{out} (ppmvd at 15% O_2)	CO DE (%)
EURICE1	96%	164.2	3.0	98%
EURICE2	96%	141.1	4.2	97%
EURICE3	94%	155.1	6.2	96%
Permit Limit	-	-	-	**>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 December 4-5, 2019 was conducted to satisfy requirements of the Michigan Permit to Install No. 44-16A and 40 CFR Part 63 Subpart ZZZZ. Carbon monoxide (CO) destruction efficiency testing was performed on EURICE1-3 across each catalyst.

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 EMR's Intent to Test[1], Test Plan Submittal. The following EM&R Field Services personnel participated in the testing program: Mr. Jason Logan, Environmental Specialist and Mr. Mark Westerberg, Senior Environmental Specialist. Mr. Logan was the project leader. Mr. Mark Dziadosz with the Air Quality Division of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) witnessed portions of the testing. Mr. Dziadosz approved the Test Plan[2].

2.0 SOURCE DESCRIPTION

The Willow Compressor Station located at 3020 East Michigan Avenue, Ypsilanti, Michigan, employs the use of three natural gas fired reciprocating internal combustion engines denoted as EURICE1-3 in PTI 44-16A. EURICE1-2 are nominally rated at 2,500 HP. EURICE3 is nominally rated at 5,000 HP. The engines generate line pressure assisting the transmission of natural gas throughout the pipeline transmission system in SE Michigan.

The emissions from each engine are exhausted through a catalyst bed and to the atmosphere through individual exhaust stacks. 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 each engine was operated within 10% of its highest achievable load.

A schematic representation of the engine exhaust and sampling locations are presented in Figure 1.

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[1] EGLE, Test Plan, Submitted Oct 17, 2019. (Attached-Appendix A)

[2] EGLE, Approval Letter, Received Nov 25, 2019. (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	Paramagnetic
USEPA Method 10	Carbon Monoxide	NDIR

3.1 OXYGEN (USEPA METHOD 3A)

3.1.1 Sampling Method

Oxygen (O_2) emissions were evaluated using USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)". The analyzer utilizes a paramagnetic sensor.

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

(1) Stainless-steel sampling probe
(2) Heated Teflon™ sampling line
(3) Gas conditioner with particulate filter
(4) Flexible unheated Teflon™ sampling line
(5) Servomex 1400 O_2/CO_2 gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System

Two identical systems were used to measure O_2 on the inlet and the outlet of the catalyst.

3.1.2 Sampling Train Calibration

The O_2 analyzer was 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 was then introduced through the entire sampling system to determine sampling system bias 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 emissions were recorded in percent (%). The 1-minute readings collected during the testing can be found in Appendix B.

3.2 CARBON MONOXIDE (USEPA METHOD 10)

3.2.1 Sampling Method

Carbon monoxide (CO) emissions were evaluated using USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)". The CO analyzer utilizes an NDIR detector. Triplicate 60-minute tests were performed on the inlet and outlet of the catalyst.

The EPA Method 10 sampling system (Figure 3) consisted of the following:

(1) Stainless-steel sample probe
(2) Heated Teflon™ sampling line
(3) Gas conditioner with particulate filter
(4) Flexible unheated Teflon™ sampling line
(5) TECO 48i NDIR CO gas analyzer
(6) Appropriate USEPA Protocol 1 calibration gases
(7) Data Acquisition System.

Two identical systems were used to measure CO on the inlet and the outlet of the catalyst.

3.2.2 Sampling Train Calibration

The CO sampling train was calibrated per procedures outlined in USEPA Method 10. 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 was then introduced through the entire sampling system to determine sampling system bias.

3.2.3 Quality Control and Assurance

All sampling and analytical equipment was calibrated per the guidelines referenced in Method 10. Calibration gases were EPA Protocol 1 gases and the concentrations were

within the acceptable ranges (40-60% mid range and span). Calibration gas certification sheets are located in Appendix C.

3.2.4 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 readings on the inlet and outlet of the engine catalysts were reduced to parts by million by volume, dry, adjusted to 15% O_2 in accordance with 40 CFR Part 63 Subpart ZZZZ. The outlet concentration was divided by the inlet concentration to calculate percent destruction efficiency.

4.0 OPERATING PARAMETERS

For each test period, operators took screenshots of the process collection software. Once at the beginning of a test, once in the middle, and once at the end of a test period. Process data includes fuel flow (scfh), catalyst pre and post temperature (°F), pressure drop across the catalyst ("H_2O), BHP, and torque.

Operational data is located in Appendix D.

5.0 DISCUSSION OF RESULTS

The results of the CO DE testing for EURICE1-3 are presented in Tables 1-3. The CO emissions on the inlet and outlet of the catalyst were reduced to ppmvd adjusted to 15% O_2. The outlet concentration was then divided by the inlet concentration to calculate percent destruction efficiency.

The results of the testing indicate that EURICE1-3 meet the emissions limits established in Michigan Permit to Install No. 44-16A and 40 CFR Part 63 Subpart ZZZZ. This is the second consecutive passing test event for these engines. Therefore testing will now move to an annual schedule as opposed to semi-annual in accordance with the PTI and NESHAP regulations.

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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
CO EMISSIONS TEST RESULTS
DTE Gas - Willow Run Compressor Station
EURICE1 (Engine 2300)
December 4, 2019

Test	Test Time	Unit Load (% of rated HP)[2]	O_2 Inlet (%, dry)[1]	O_2 Outlet (%, dry)[1]	CO Inlet (ppmvd @ 15% O_2)	CO Outlet (ppmvd @ 15% O_2)	CO Destruction Eff. (%, outlet/inlet)
1	12:50-13:50	96%	11.6	11.6	164.7	2.6	98.4%
2	14:00-15:00	96%	11.6	11.6	164.1	3.2	98.1%
3	15:13-16:13	96%	11.6	11.6	163.9	3.2	98.0%
	Three Test Average:	96%	11.6	11.6	164.2	3.0	98.2%
				Permit Limit:			***>93%***

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

[2] calculated as actual average horse power divided by 2,500 (nominal rated horsepower)

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TABLE NO. 2
CO EMISSIONS TEST RESULTS
DTE Gas - Willow Run Compressor Station
EURICE2 (Engine 2200)
December 4, 2019

Test	Test Time	Unit Load (% of rated HP)[2]	O_2 Inlet (%, dry)[1]	O_2 Outlet (%, dry)[1]	CO Inlet (ppmvd @ 15% O_2)	CO Outlet (ppmvd @ 15% O_2)	CO Destruction Eff. (%, outlet/inlet)
1	8:37-9:37	95%	11.3	11.2	141.8	3.3	97.7%
2	9:49-10:49	97%	11.3	11.3	141.1	4.5	96.8%
3	11:00-11:54; 12:00-12:08	96%	11.4	11.3	140.5	4.6	96.7%
	Three Test Average:	96%	11.3	11.3	141.1	4.2	97.0%
				Permit Limit :			***>93%***

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

[2] calculated as actual average horse power divided by 2,500 (nominal rated horsepower)

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TABLE NO. 3
CO EMISSIONS TEST RESULTS
DTE Gas - Willow Run Compressor Station
EURICE3 (Engine 2100)
December 5, 2019

Test	Test Time	Unit Load (% of rated HP)[2]	O_2 Inlet (%, dry)[1]	O_2 Outlet (%, dry)[1]	CO Inlet (ppmvd @ 15% O_2)	CO Outlet (ppmvd @ 15% O_2)	CO Destruction Eff. (%, outlet/inlet)
1	9:10-10:10	93%	11.2	11.1	155.8	5.8	96.3%
2	10:20-11:20	94%	11.2	11.2	156.4	5.8	96.3%
3	11:31-12:31	95%	11.2	11.2	153.1	7.0	95.4%
	Three Test Average:	94%	11.2	11.1	155.1	6.2	96.0%
				Permit Limit :			***>93%***

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

[2] calculated as actual average horse power divided by 5,000 (nominal rated horsepower)

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FIGURES

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Figure 1 – Sampling Locations
EURICE1-3
Willow Run Compressor Station
December 4-5, 2019

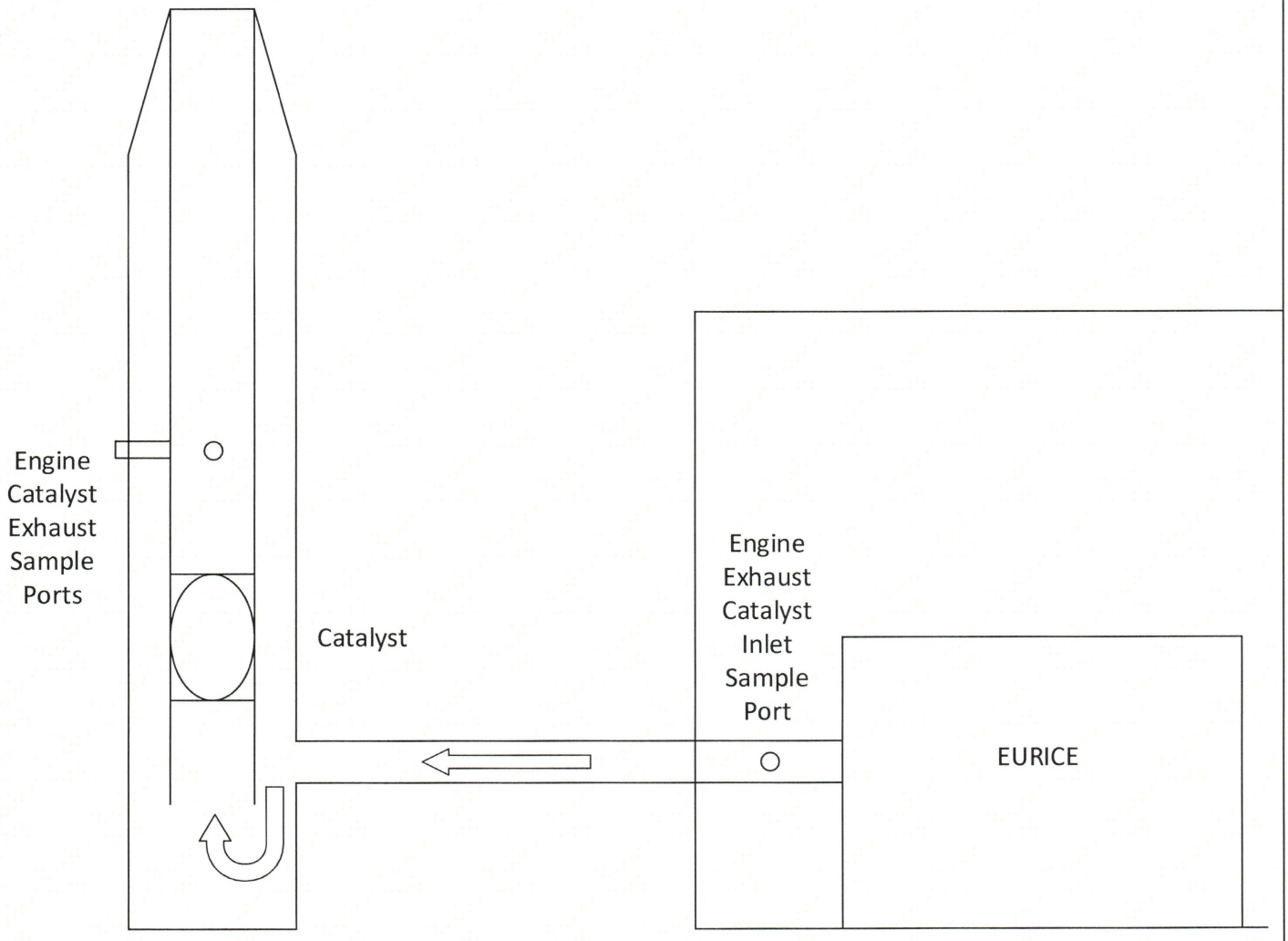

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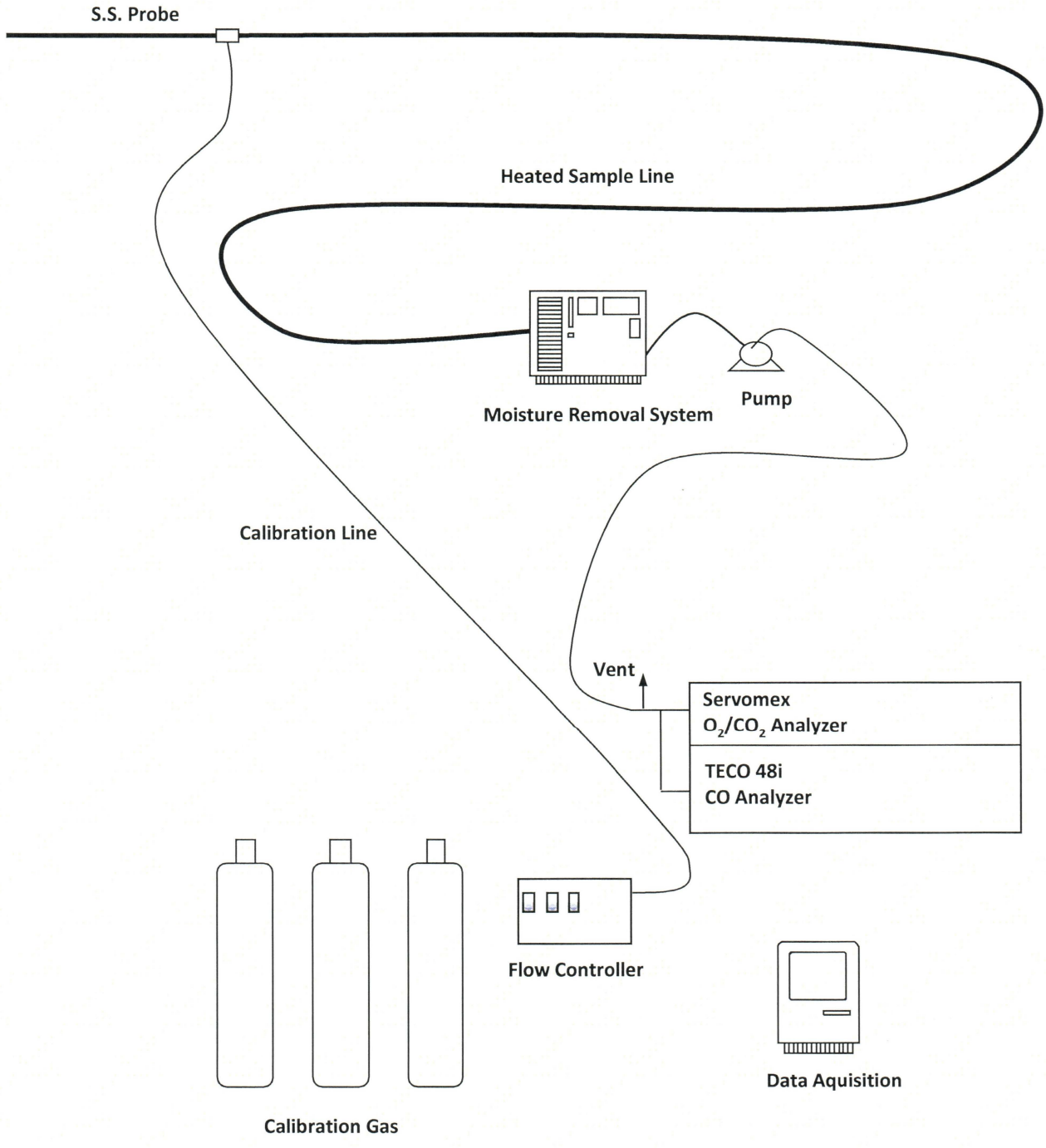
Figure 2 – EPA Methods 3A/10
Willow Run Compressor Station
December 4-5, 2019



Two identical sampling systems for catalyst inlet and outlet.