EMISSIONS TEST REPORT

for

CARBON MONOXIDE (CO) DESTRUCTION EFFICIENCY
40 CFR Part 63 Subpart ZZZZ

EURICE 1 & 2

DTE-Gas Willow Compressor Station
Ypsilanti, Michigan

May 21-22, 2024

Prepared By
Environmental Management & Safety
Ecology, Monitoring, and Remediation Group
DTE Corporate Services, LLC
7940 Livernois Ave. G4-S
Detroit, MI 48210

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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Safety (EM&S), Ecology, Monitoring, and Remediation Group performed emissions testing at the DTE-Gas Willow Compressor Station, located in Ypsilanti, Michigan. The fieldwork performed May 21-22, 2024, was conducted to satisfy requirements of the Michigan Renewable Operating Permit MI-ROP-N7421-2022 and 40 CFR Part 63 Subpart ZZZZ. Emission tests were performed on Engines 2200 &2300 (EURICE 1 & 2) for carbon monoxide (CO). Carbon monoxide (CO-DE) destruction efficiency testing was performed on each engine.

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

CO DE Emissions Test Results
Willow Run Compressor Station – EURICE 1 & 2
Ypsilanti, Michigan
May 21-22, 2024

EURICE 1 & 2	Load (BHp)	BHp (%)	Carbon Monoxide (gram/B-Hp)	Carbon Monoxide (DE)
EURICE1	2,330	93.6	0.01	99.5%
EURICE2	2,279	92.0	0.01	99.4%
Permit Limit			**2.0**	**>93%**

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Safety (EM&S), Ecology, Monitoring, and Remediation Group, performed emissions testing at the DTE-Gas Willow Compressor Station, located in Ypsilanti, Michigan. The fieldwork performed May 21-22, 2024, was conducted to satisfy requirements of the Michigan Renewable Operating Permit MI-ROP-N7421-2022 and 40 CFR Part 63 Subpart ZZZZ. Emission tests were performed on EURICE 1 & 2 for carbon monoxide (CO). Carbon monoxide (CO-DE) destruction efficiency testing was performed on each engine.

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&S Field Services personnel participated in the testing program: Mr. Mark Westerberg, Senior Environmental Specialist and Mr. Fred Meinecke, Environmental Specialist. Mr. Westerberg was the project leader. Mr. Andrew The Air Quality Division of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) received the Test Plan on and witnessed portions or the testing

2.0 SOURCE DESCRIPTION

The Willow Compressor Station located at 3020 East Michigan Avenue, Ypsilanti, Michigan, employs the use of four natural gas fired reciprocating internal combustion engines, denoted as EUENGINE1 and EURICE 1 & 2 in ROP-N7421-2022. EUENGINE1 is nominally rated at 4,735 HP 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 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 engines can effectively operate.

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

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[1] EGLE, Test Plan, Submitted January 16, 2024. (Attached-Appendix A)

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A schematic representation of the engine exhaust and sampling locations are presented in Figures 1 and 2.

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 (CO)	NDIR

3.1 OXYGEN (USEPA METHOD 3A)

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 analyzer utilizes a paramagnetic sensor. Testing was performed simultaneously with the gaseous emissions testing.

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

(1) Single-point sampling probe
(2) Heated Teflon™ sampling line
(3) MAK® gas conditioner with particulate filter
(4) Flexible unheated Teflon™ 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 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 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 at the catalyst inlet and exhaust on EUENGINE1 and EURICE 1 & 2 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 EURICE exhaust.

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

(1) Stainless-steel sample probe
(2) Heated Teflon™ sampling line
(3) MAK® 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.

3.2.2 Sampling Train Calibration

The CO sampling trains were 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 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 calculations are based on calculations located in USEPA Method 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

For each test period, operators took screenshots of the process collection software. Once at the beginning and once at the end of a test period. Process data includes fuel flow (100scf/hr), catalyst pre and post temperature (°F), pressure drop across the catalyst ("H_2O), Brake-HP, and torque.

Operational data is in Appendix D.

5.0 DISCUSSION OF RESULTS

The Results of the CO testing for EURICE 1 & 2 are presented in Tables 1-2. The CO emissions are presented in parts per million (ppm) and grams per brake horsepower-hour (g/Bhp-Hr). Process data presented includes the Unit load in percent (%), as brake horsepower-hour (Brake-Hp), and Heat Input in Million British Thermal Unit per hour (MMBtu/hr) for each test.

The results of the testing indicate that EURICE 1 & 2 meet the emissions limits established in Michigan Renewable Operating Permit MI-ROP-N7421-2022 and 40 CFR Part 63 Subpart ZZZZ.

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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."

Mr. Mark Grigereit, QSTI

This report prepared by: _____

Mr. Mark Grigereit, QSTI
Principal Engineer, Ecology, Monitoring, and Remediation Group
Environmental Management and Safety
DTE Energy Corporate Services, LLC

This report reviewed by: _____

Mr. Mark Westerberg, QSTI
Senior Env. Specialist, Ecology, Monitoring, and Remediation Group
Environmental Management and Safety
DTE Energy Corporate Services, LLC

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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)
May 22, 2024

Test	Test Time	Unit Load (% of rated HP)[2]	Engine Speed (RPM)	Engine Torque (Brake-hp)	Fuel Flow (100 SCFH)	Heat Input (MMBtu/hr)	O_2 Inlet (%, dry)[1]	O_2 Outlet (%, dry)[1]	CO Inlet (ppmvd @ 15% O_2)	CO Outlet (ppmvd @ 15% O_2)	CO Destruction
1	07:00-08:00	45%	991	2,256	151.8	16.2	11.2	11.0	165.8	0.8	99.5%
2	08:08-09:08	46%	991	2,281	154.6	16.5	11.0	11.0	155.7	0.8	99.5%
3	09:21-10:21	46%	991	2,299	157.9	16.9	10.9	11.0	154.7	0.9	99.4%
	Three Test Average:	46%	*991*	*2,279*	*154.8*	*16.5*	11.0	11.0	158.7	0.8	99.5%
								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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TABLE NO. 2
CO EMISSIONS TEST RESULTS
DTE Gas - Willow Run Compressor Station
EURICE2 (Engine 2200)
May 21, 2024

Test	Test Time	Unit Load (% of rated HP)[2]	Engine Speed (RPM)	Engine Torque (Brake-hp)	Fuel Flow (100 SCFH)	Heat Input (MMBtu/hr)	O_2 Inlet (%, dry)[1]	O_2 Outlet (%, dry)[1]	CO Inlet (ppmvd @ 15% O_2)	CO Outlet (ppmvd @ 15% O_2)	CO Destruction
1	9:18-10:18	91%	993	2,269	161.2	17.2	11.0	11.0	147.3	0.9	99.4%
2	10:28-11:28	93%	996	2,326	165.5	17.7	11.1	11.0	150.2	0.9	99.4%
3	11:39-12:39	95%	999	2,370	169.3	18.1	11.0	11.1	149.0	1.1	99.2%
	Three Test Average:	93%	*996*	*2,321*	*165.3*	*17.7*	11.0	11.0	148.8	1.0	99.4%
								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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FIGURES

Figure 1 – Sampling Locations
EURICE1-3
Willow Compressor Station
May 2024

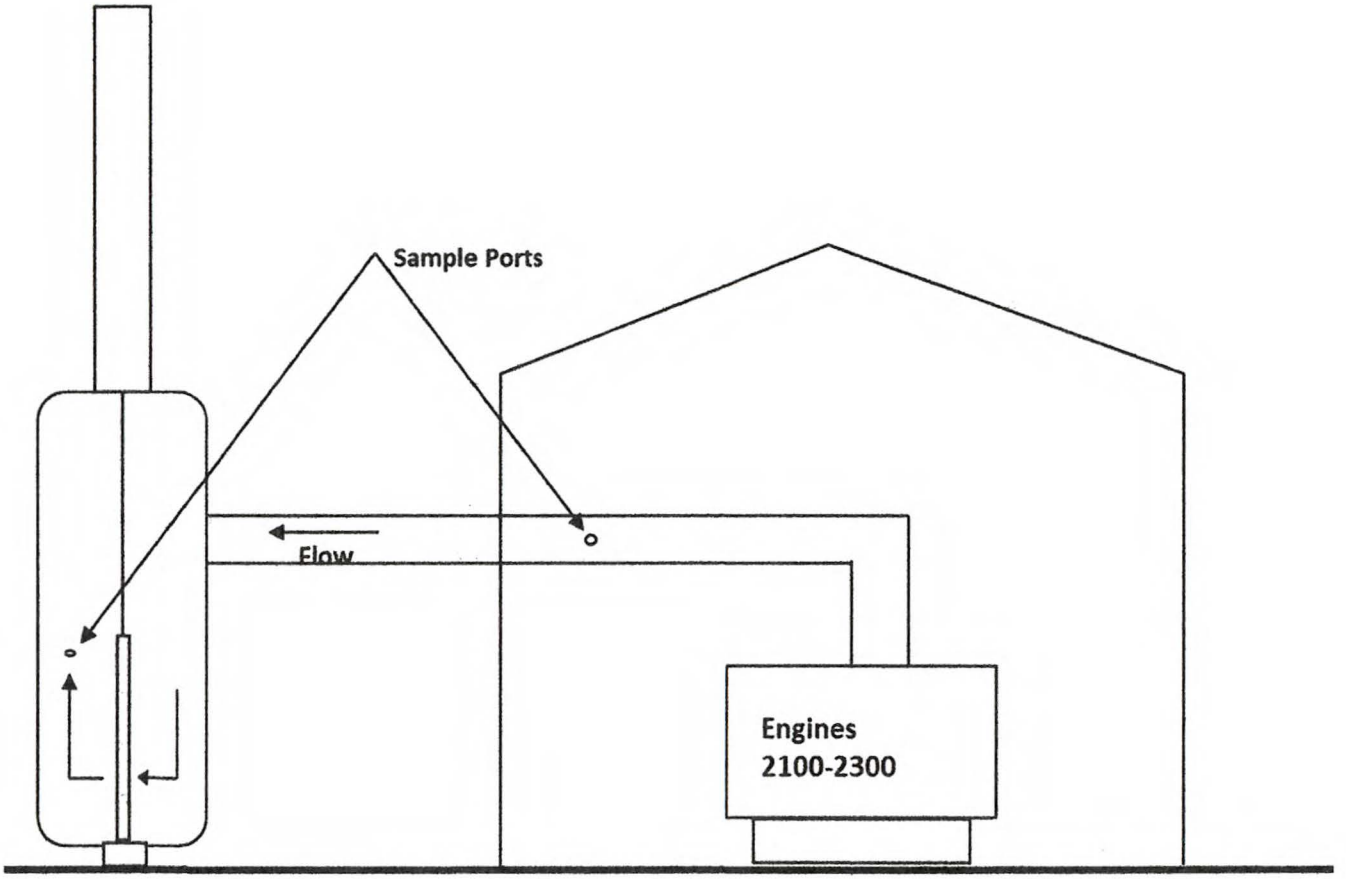

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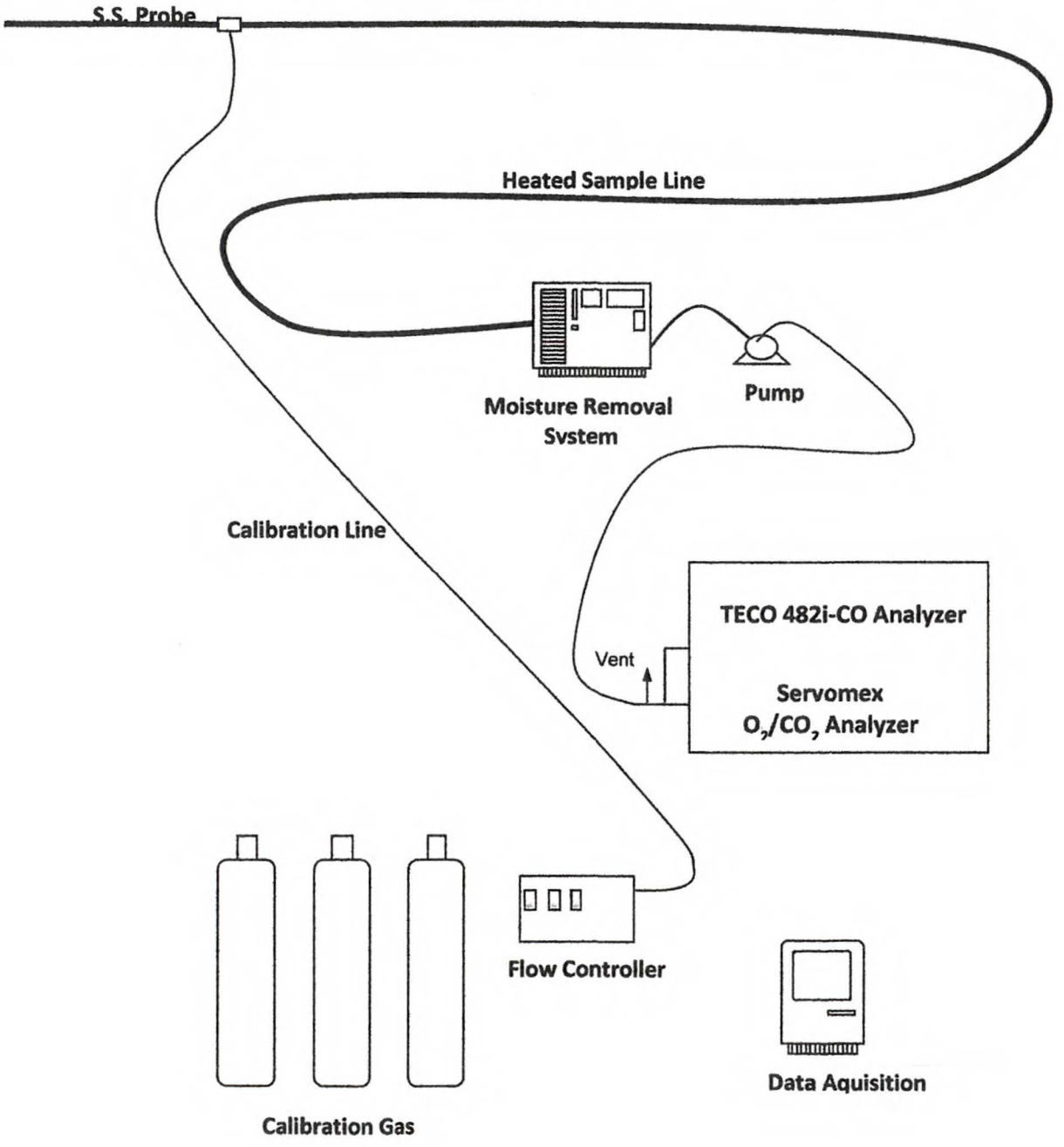
Figure 2 – EPA Methods 3A & 10
EURICE1-3
Willow Run Compressor Station
May 2024



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APPENDIX A

EGLE TEST PLAN AND ACCEPTANCE LETTER

DTE

January 16, 2024

Mr. Jeremy Howe
Michigan Department of Environment, Great Lakes, and Energy
Air Quality Division
Constitution Hall, 525 W. Allegan St.
Lansing, MI 48933

Subject: **Test Plan for CO emissions testing on EURICE1-3 at DTE Energy, Willow Run Compressor Station (N7421) in Ypsilanti, Michigan.**

Dear Mr. Howe:

The Environmental Management & Safety (EMS) Ecology, Monitoring, and Remediation Group of DTE Energy Corporate Services, LLC (DECS), is pleased to provide the following Test Plan for compliance emissions testing of three compressor engines for carbon monoxide (CO) Destruction Efficiency pursuant to 40 CFR Part 63 Subpart ZZZZ and Michigan MI-ROP-N7421-2022. The three engines are identified as EURICE1-3. The emission units are located at the Willow Run Compressor Station in Ypsilanti, Michigan. The purpose of this document is to provide the required testing information and to notify the Michigan Department of Environment, Great Lakes, and Energy (EGLE) of the upcoming testing. Testing will be performed by DTE Corporate Services personnel, or by a qualified third-party contractor if necessary, for DTE Gas Company.

Testing on EURICE1-3 is tentatively scheduled for March 26-28, 2024, pending approval of the test plan. What follows is an item-by-item description of the information required by the EPA for testing approval. Contact information is provided in the attached Test Protocol if you have any questions or need additional information.

Sincerely,
DTE ENERGY CORPORATE SERVICES, LLC

Thomas Snyder, QSTI
Senior Environmental Specialist, Field Services
Environmental Management & Safety (EM&S)
DTE Energy Corporate Services, LLC

Cc: Jackson District Supervisor, EGLE-AQD
Dan Fulara, DTE Gas
Chris Conley, DTE Gas
John Leonard, DTE Gas

Test Plan – DTE Energy Willow Run Compressor Station
EURICE1-3

1a. ***Names, titles, and telephone numbers for the personnel directly involved with this study are listed in the following table:***

Name and Title	Company	Contact Info
Mr. John Leonard Sr. Environmental Engineer (DTE Environmental)	DTE Gas 3515 Childs Lake Rd Milford MI 48381	John.Leonard@dteenergy.com (248) 508-4273
Mr. Mark Westerberg Sr. Environmental Specialist (DTE Environmental)	DTE Energy Corporate Services, LLC 7940 Livernois Ave. Room G4-S Detroit, MI 48210	Mark.westerberg@dteenergy.com (313) 410-9183
Mr. Chris Conley, Manager, Transmission & Storage Operations	DTE Gas 3515 Childs Lake Rd Milford MI 48381	Chris.Conley@dteenergy.com (248)529-0270
Mr. Daniel Fulara, Supervisor, Transmission Operations	DTE Gas 3515 Childs Lake Rd Milford MI 48381	Daniel.Fulara@dteenergy.com (248)675-5289

1b. ***Type of industrial process or combustion facility:***

The Willow Run Compressor Station located at 3020 East Michigan Avenue, Ypsilanti, Michigan 48198, employs the use of three (3) non-emergency natural gas-fired reciprocating internal combustion engines (RICE). The engines are identified as EURICE1-3 in MI-ROP-N7421-2022 (flexible group FGENGINES and FGENGMACT4Z). The units 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.

1c. ***Type and quantity of raw and finished materials used in the process:***

The compressor engines are natural gas-fired reciprocating units. Fuel consumption varies with operating parameters and will be measured throughout the emissions test.

1d. ***Description of any cyclical or batch operations which would tend to produce variable emissions with time:***

Each unit operates on an as needed basis providing pipeline pressure. Each engine will be tested at 100% (+/- 10%) rated capacity to meet ROP and federal testing requirements.

1e. ***Basic operating parameters used to regulate the process:***

Operating parameters used to regulate the engines include percent load (HP), speed (RPM), fuel flow, and catalyst inlet & exhaust temperature & pressure. Operating parameters will be documented during each test.

1f. Rated capacity of the process and process rate during the testing:

EURICE1 and EURICE2 are rated at 2,500 HP, and EURICE3 is rated at 5,000 HP. All three EURICE engines are natural gas-fired reciprocating engines.

Testing of the engines will be performed at maximum (>90% BHp) operating conditions and consist of triplicate 60-minute test periods.

2a. Type of control device associated with the process:

EURICE1-3 are equipped with oxidation catalysts which controls CO emissions.

2b. Operating parameters of the control device:

Operating parameters of the engine exhaust catalyst include inlet temperature and pressure drop across the catalyst.

2c. Rated capacity and efficiency of the control device:

The catalysts are permitted to reduce CO emissions by a minimum of 93%.

3. Applicable permit number and emission limits for the process to be tested:

EURICE1-3 exhaust emissions are regulated by State of Michigan MI-ROP-N7421-2022 and 40 CFR Part 63 Subpart ZZZZ. CO destruction efficiency limits as stated in the permit are as follows:

40 CFR Part 63 Subpart ZZZZ:

- Carbon Monoxide (CO) - >93% reduction across the catalyst (dry, adjusted to 15% O_2).

4. Identify all pollutants to be measured:

The engine exhausts will be measured for CO (inlet and outlet) per USEPA Method 10. Method 3A would be used to measure O_2.

5. Description of the sampling train(s) to be used, including schematic diagrams if appropriate:

Emissions testing will be performed via triplicate 60-minute test runs. Sampling will be performed utilizing USEPA Methods 3A (catalyst inlet and outlet) and 10 (catalyst inlet and outlet). Emission rates will be calculated utilizing USEPA Method 19 stoichiometric calculations.

6. **Detailed sampling and analysis procedures, including the applicable standard methods referenced:**
Sampling and analysis methods will include a combination of any of the following:

Parameter	Method	Analytical Method
O_2	USEPA Method 3A	Paramagnetic Analyzer
CO	USEPA Method 10	NDIR Analyzer
Emission Rate	USEPA Methods 19	Stoichiometric Calculations

USEPA Method 3A, ***"DETERMINATION OF OXYGEN AND CARBON DIOXIDE CONCENTRATIONS IN EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)"***, will be used to measure exhaust gas oxygen concentrations.

USEPA Method 10, ***"DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)"***, will be used to measure exhaust gas CO concentrations.

USEPA Method 19, ***"SULFUR DIOXIDE REMOVAL AND PARTICULATE, SULFUR DIOXIDE AND NITROGEN OXIDES FROM ELECTRIC UTILITY STEAM GENERATORS"***, will utilize fuel flow of natural gas during test periods to calculate emissions rates.

7. ***The number and length of sampling runs which will constitute a complete test:***
Engine emissions testing will consist of triplicate 60-minute test runs.

8. ***Dimensioned sketch showing all sampling ports in relation to the breeching and to upstream and downstream disturbances or obstructions of gas flow:***
Sampling will be conducted at a test location on the engine's exhaust stacks. See Figures 1 and 2 for a sketch showing sampling port locations. Stack parameters and sampling location will be measured and included with the test report.

9. ***Estimated flue gas conditions such as temperature, moisture and velocity:***
Temperature and velocity measurements are not required. Exhaust gas data has been estimated from previous test data. Analyzer calibrations will meet the criteria established in the USEPA methodologies being utilized. Method 19 will be used to determine emission rates.

10. ***Projected process operating conditions during which the tests will be run:***
Each engine will be tested during normal operations while burning natural gas and operating within 10% of rated capacity.

11. ***Description of any process or control equipment data to be collected during the testing:***
Data to be collected during each day of testing will include the following:

Speed & Torque
Horsepower
Heat Input
Fuel Usage
BTU Content of the fuel
Compressor engine inlet/exhaust temperature
Compressor engine inlet/exhaust pressure

12. ***Description of any monitoring data to be collected during the test period (eg – continuous emission monitoring data):***
N/A – The units do not have continuous emissions monitoring equipment.

13. ***Chain of Custody procedures:***
N/A – Chain of Custodies are not required for this testing.

14. ***Field quality assurance/quality control procedures (eg – field blanks, sample storage and transport methods):***
The sampling team will prepare and calibrate field-sampling equipment and perform quality assurance/quality control (QA/QC) consistent with the employed USEPA methodology. Testing will be performed utilizing appropriate analyzer calibration ranges that satisfy criteria stated in associated test methods.

15. ***Laboratory quality assurance/quality control procedures utilized as part of the testing:***
Calibrations will follow protocol stated in USEPA methods and will utilize appropriate calibration gases.

16. ***Names and titles of personnel who will be performing the testing:***
The testing will be performed by DTE Environmental Management & Safety's Ecology, Monitoring, and Remediation group.

Mr. Mark Westerberg, Senior Environmental Specialist, QSTI
Mr. Thomas Snyder, Senior Environmental Specialist, QSTI
Mr. Fred Meinecke, Environmental Specialist
Mr. Kenneth St. Amant, Environmental Specialist
Mr. Mark Grigereit, Principal Engineer, QSTI

The emission test report will include the items found on pages 3 and 4 of the EGLE/Air Quality Division's Format for Submittal of Source Emission Test Plans and Reports. Included in the report will be a site description with the reason for testing, source descriptions, a summary of results, our sampling and analytical procedures, and test results and discussion.

Figure 1 – Sampling Locations
EURICE1-3
Willow Compressor Station
March 2024

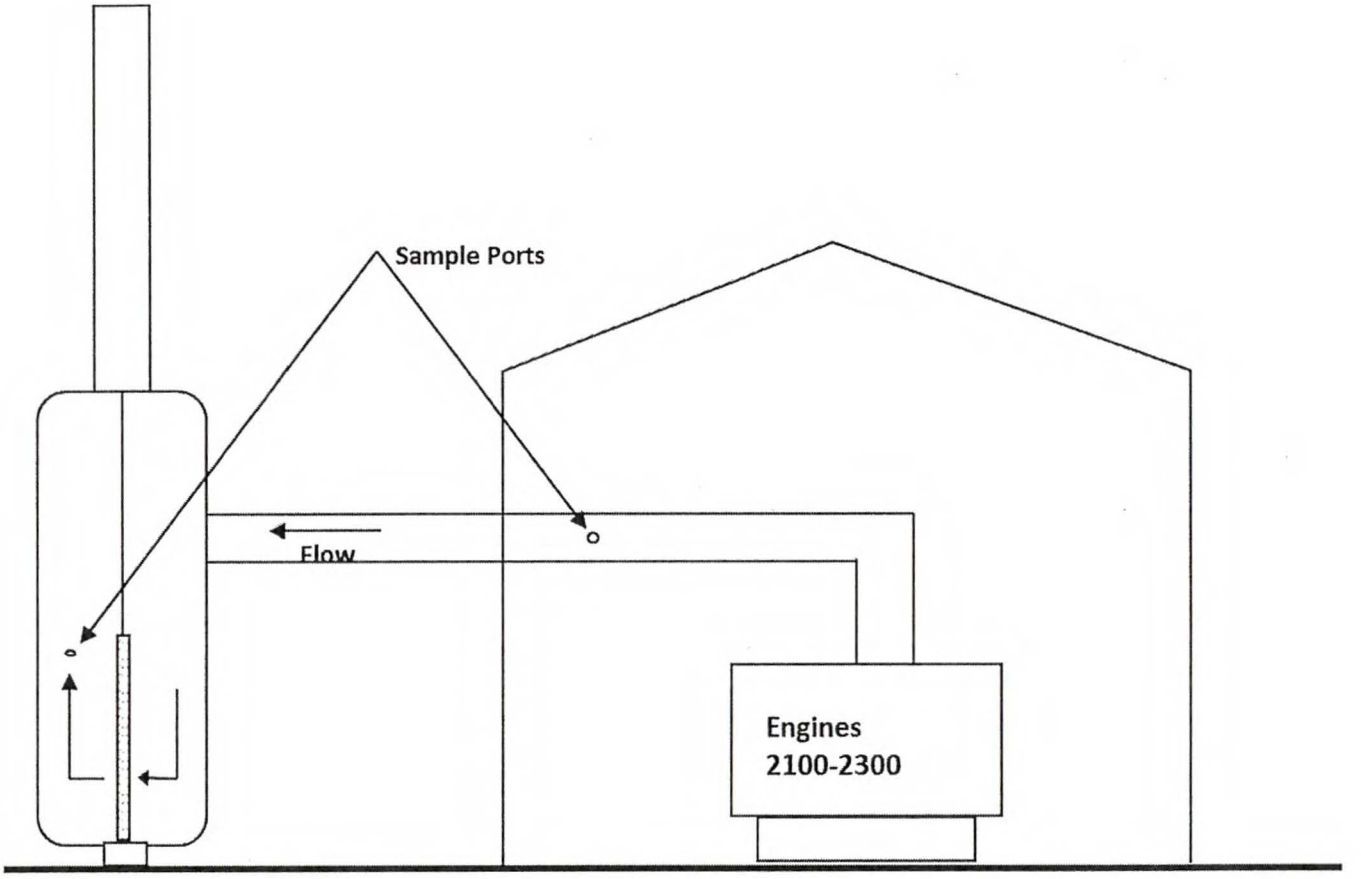

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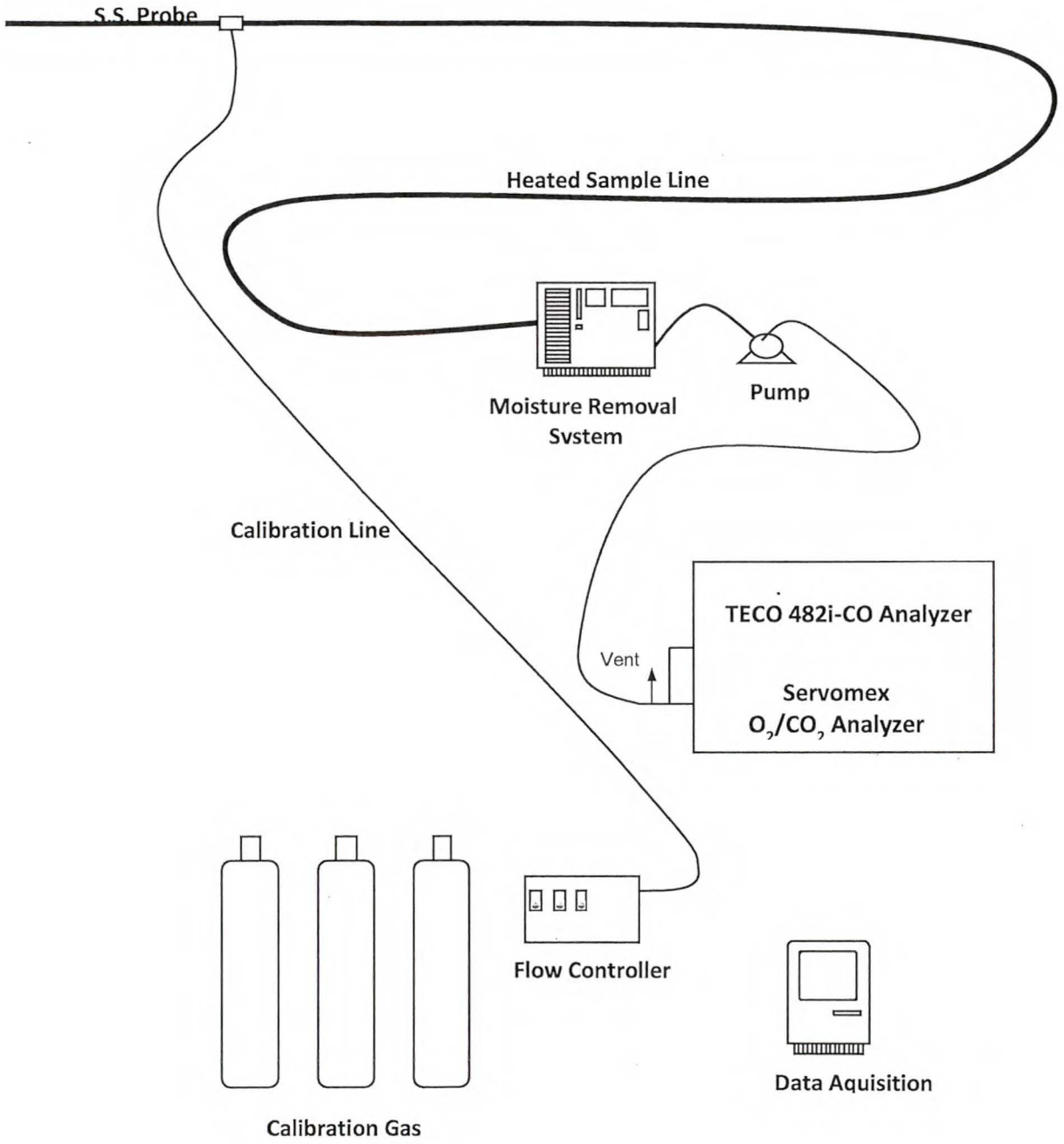
Figure 2 – EPA Methods 3A & 10
EURICE1-3
Willow Run Compressor Station
March 2024



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