

EMISSIONS TEST REPORT

for

FORMALDEHYDE (CH₂O) EMISSIONS

SRN: N7421

EUTURBINE1

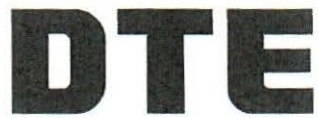
40CFR Part 63, Subpart YYYY and MI-ROP-N7421-2022

**DTE Gas Company – Willow Compressor Station
Ypsilanti, Michigan**

February 14, 2024

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

DTE



CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	IV
1.0 INTRODUCTION	1
2.0 SOURCE DESCRIPTION	1
3.0 SAMPLING AND ANALYTICAL PROCEDURES	1
3.1 OXYGEN (USEPA METHOD 3A)	2
3.1.1 Sampling Method.....	2
3.1.2 Sampling Train.....	2
3.1.3 Sampling Train Calibration	2
3.1.4 Sampling Duration & Frequency	3
3.1.5 Quality Control and Assurance.....	3
3.1.6 Data Reduction.....	3
3.2 FORMALDEHYDE (CH ₂ O) (USEPA METHOD 320).....	3
3.2.1 Sampling Method.....	3
3.2.2 Sampling Train Calibration	4
3.2.3 Quality Control and Assurance.....	5
3.2.4 Data Reduction.....	5
4.0 OPERATING PARAMETERS	6
5.0 RESULTS	6
6.0 CERTIFICATION STATEMENT	7

DTE

RESULTS TABLE

Table No. 1.....EUTURBINE1 CH₂O Test Results

FIGURES

- 1 EUTURBINE1 Stack Drawing & Sampling Location
- 2 USEPA Method 320 Sampling Train

APPENDICES

- A EGLE Test Plan
- B Raw Analyzer Data
- C Equipment and Analyzer Calibration Data
- D Example Calculations
- E Operational Data
- F FTIR Data Validation Report



EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Safety (EM&S) Ecology, Monitoring, and Remediation performed emissions testing at the DTE Gas Company – Willow Compressor Station, located in Ypsilanti, Michigan. The fieldwork, performed February 14, 2024, was conducted to satisfy requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Michigan Renewable Operating Permit MI-ROP-N7421-2022 and 40 CFR Part 63 Subpart YYY. Emissions tests were performed on Solar Turbine (EUTURBINE1) for formaldehyde (CH₂O).

The results of the emissions testing are highlighted below:

Emissions Test Results Willow Compressor Station EUTURBINE1 February 14, 2024

Emission Unit	O ₂ (%)	CH ₂ O (ppbvd @ 15% O ₂)
EUTURBINE1	15.6	10.4
<i>Permit Limit</i>		<i>91</i>



1.0 INTRODUCTION

DTE Energy's Environmental Management and Safety (EM&S) Ecology, Monitoring, and Remediation performed emissions testing at the DTE Gas Company – Willow Compressor Station, located in Ypsilanti, Michigan. The fieldwork, performed February 14, 2024, was conducted to satisfy requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Michigan Renewable Operating Permit MI-ROP-N7421-2022 and 40 CFR Part 63 Subpart YYY. Emissions tests were performed on Solar Turbine (EUTURBINE1) for formaldehyde (CH₂O).

The fieldwork was performed in accordance with EPA Reference Methods and DTE Energy's Intent to Test¹ document. The following DTE Energy personnel participated in the testing program: Mr. Thomas Snyder, Senior Environmental Specialist, and Mr. Mark Grigereit, Principal Engineer. Mr. Snyder was the project leader. Mr. Brad Piontek, operator, and repair technician at the station, provided process coordination for the testing program.

2.0 SOURCE DESCRIPTION

The Willow Compressor Station located at 3020 East Michigan Avenue, Ypsilanti, Michigan, employs the use of one Solar natural gas-fired 7,700 Horse-Power combustion turbine (EUTURBINE1) with a low NO_x combustor for NO_x control. The turbine generates line pressure assisting with the transmission of natural gas through the pipeline transmission system in SE Michigan. Testing for CH₂O emissions was performed while the turbine operated in the LoNO_x mode at an average of 79.6% load.

The turbine exhausts directly to the atmosphere through a rectangular exhaust duct. Sampling was performed in the round horizontal section of the ductwork located inside the building.

Figure 1 presents a schematic of the sampling location for the turbine.

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:

¹ EGLE, Test Plan, Submitted December 8, 2023. (Attached-Appendix A)

Sampling Method	Parameter	Analysis
USEPA Method 3A	Oxygen	Paramagnetic Analyzer
USEPA Method 320	Formaldehyde	Fourier Transform Infrared (FTIR)

3.1 OXYGEN (USEPA METHOD 3A)

3.1.1 Sampling Method

Exhaust Oxygen (O₂) content was measured using USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)". The O₂ analyzer utilizes a paramagnetic sensor. Triplicate 60-minute tests were performed on the turbine exhaust. O₂ Testing was performed simultaneously with the gaseous emissions testing.

Samples were measured on a dry basis (i.e. sample was conditioned prior to introduction into the diluent analyzers).

3.1.2 Sampling Train

The EPA Methods 3A sampling system consisted of the following components:

- (1) Single-point sampling probe
- (2) Heated Teflon™ sampling line
- (3) MAK® gas conditioner with particulate filter
- (4) Flexible unheated Teflon™ sampling line.
- (5) Servomex 4900 O₂/CO₂ gas analyzer
- (6) Appropriate USEPA Protocol 1 calibration gases
- (7) Data Acquisition System.

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

3.1.3 Sampling Train Calibration

The O₂ 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 determine the instruments linearity. Then a zero and mid-range span gas was introduced through the entire sampling system to determine sampling system bias. System calibrations were performed prior to, and at the conclusion of, each test period.

DTE

3.1.4 Sampling Duration & Frequency

Oxygen (O₂) sampling was performed during all CH₂O sampling. Concentration averages were logged at 10-second intervals.

3.1.5 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. Calibration gas concentrations were within the acceptable ranges specified in Method 7E.

Field calibration data sheets and gas certification sheets are in Appendix C.

3.1.6 Data Reduction

The O₂ (%) readings were logged at 10-second intervals and averaged in 1-minute increments. CH₂O emissions are reported in parts per billion, dry, corrected to 15% O₂ (ppb @ 15% O₂) for comparison to the emission limit.

Raw CEM data is presented in Appendix B.

3.2 FORMALDEHYDE (CH₂O) (USEPA METHOD 320)

3.2.1 Sampling Method

Formaldehyde (CH₂O) emissions were evaluated using USEPA Method 320, "Measurement of Vapor Phase Organic Emissions by Extractive Fourier Transform Infrared (FTIR)". Triplicate 60-minute test runs were performed.

The Method 320 sampling system (Figure 2) consisted of the following:

- (1) Single-point sampling probe
- (2) Flexible heated PTFE sampling line
- (3) Air Dimensions Heated Head Diaphragm Pump
- (4) ThermoFisher™ MAX-iR with Starboost™ FTIR spectrometer
- (5) ThermoFisher™ Thermal Oxidizer Module
- (6) Appropriate calibration gases
- (7) Data Acquisition System

The FTIR was equipped with a temperature controlled, 10-meter, high throughput, multipass gas cell maintained at 191°C. Gas flows and sampling system pressures were monitored using a rotometer and pressure transducer. All data was collected at 1 cm⁻¹ resolution.

DTE

3.2.2 Sampling Train Calibration

The FTIR was calibrated per procedures outlined in Method 320. Direct measurements of formaldehyde (CH₂O) gas standards were made at the test location to confirm concentrations.

A calibration transfer standard (CTS) was analyzed before and after testing at each location. The concentration determined for all CTS runs were within ±5% of the certified value of the standard. Ethylene was passed through the entire system to determine the sampling system response time and to ensure that the entire sampling system was leak-free.

Nitrogen was purged through the sampling system at each test location to confirm the system was free of contaminants. Formaldehyde (CH₂O) gas standards were passed through the sampling system at each test location to determine the response time and confirm recovery.

Formaldehyde (CH₂O) spiking with Thermal Oxidizer Module in bypass mode was performed to verify the ability of the sampling system to quantitatively deliver a sample containing CH₂O from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR to quantify CH₂O in the presence of effluent gas.

Formaldehyde (CH₂O) spiking with Thermal Oxidizer Module activated was performed to verify target analyte removal, and to demonstrate the efficiency of the Thermal Oxidizer Module.

As part of the spiking procedure, samples from each engine were measured to determine CH₂O concentrations to be used in the spike recovery calculations. The determined nitrous oxide (N₂O) concentration in the spiked and unspiked samples was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked CH₂O. The following equation illustrates the percent recovery calculation.

$$DF = \frac{N_2O(\text{spike})}{N_2O(\text{direct})} \quad (\text{Sec. 9.2.3 (3) Method 320})$$

$$CS = DF * \text{Spike}_{\text{dir}} + \text{Unspike} * (1 - DF) \quad (\text{Sec. 9.2.3 (4) Method 320})$$

DF = Dilution factor of the spike gas

N₂O_(direct) = N₂O concentration measured directly in undiluted spike gas

N₂O_(spike) = Diluted N₂O concentration measured in a spiked sample

Spike_{dir} = Concentration of the analyte in the spike standard measured by the FTIR directly

CS = Expected concentration of the spiked samples

Unspike = Native concentration of analytes in unspiked samples

DTE

All analyte spikes were introduced using an instrument grade stainless steel rotometer. The spike target dilution ratio was 1:10 or less. All CH₂O spike recoveries were within the EPA Method 320 allowance of $\pm 30\%$.

3.2.3 Quality Control and Assurance

The method validation procedure in Method 320 Section 13 was completed on July 26, 2022 at Milford Compressor Station. The validation source was a combustion gas turbine fired with natural gas equipped with like-kind emission controls as the unit/units tested in this report. Each validation spiked sample was preceded and followed by an unspiked sample. The results of the study were provided in the 2022 Milford Compressor Station YYYY compliance report which was approved by EGLE. The results of the validation study showed no significant bias, therefore emissions data is not corrected to %R.

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within $\pm 5\%$ agreement. If there is a difference greater than $\pm 5\%$, the spectra are reviewed for possible spectral interferences or any other possible causes that might lead to inaccurately quantified data. PRISM Analytical Technologies, Inc. validated the FTIR data. The data validation reports are in Appendix E.

Previous testing at the stack location has demonstrated the source is unstratified. There have been no modifications to the exhaust ducts, or operational changes to the turbines.

3.2.4 Data Reduction

Each spectrum was derived from the coaddition of 55 scans, with a new data point generated approximately every minute. The CH₂O emissions were recorded in parts per billion (ppb) wet volume basis. Moisture content (%) was also recorded. The O₂ emissions were recorded in percent (%) dry volume basis.

The O₂ (%) and CH₂O (ppbvd) readings were logged at 10-second intervals and recorded in 1-minute increments. CH₂O emissions are reported in parts per billion dry, corrected to 15% O₂ (ppbvd @ 15% O₂) for comparison to the emission limit.

DTE

4.0 OPERATING PARAMETERS

The test program included the collection of turbine operating data during each test run. Parameters recorded included % Load (reported as horsepower), gross dry BTU, fuel gas flow, inlet air temperature, compressor discharge pressure, and compressor discharge temperature.

Operational data can be found in Appendix E.

5.0 RESULTS

Testing was performed while the turbine was operated in LoNO_x mode while operating within at the highest achievable load (79.6%). The results of the Formaldehyde (CH₂O) emissions testing conducted on EUTURBINE1 are presented in Results Table No. 1.

EUTURBINE1 demonstrated compliance with the 40 CFR Part 63, Subpart YYY form aldehyde (CH₂O) emission limit of 91 ppb @ 15% O₂.



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. Thomas Snyder, QSTI

This report prepared by:

Mr. Thomas Snyder, QSTI
Sr. Environmental Specialist,
Ecology, Monitoring, & Remediation
Environmental Management & Safety
DTE Energy Corporate Services, LLC

This report reviewed by:

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

DTE

RESULTS TABLE



TABLE NO. 1
FORMALDEHYDE EMISSIONS TEST RESULTS
DTE Gas -Willow Compressor Station
EUTURBINE1 (Unit 1200)
February 14, 2024

Test	Test Time	Unit Load (%) ²	O ₂ Concentration (% dry) ¹	CH ₂ O Concentration (ppbvd)	CH ₂ O Concentration (ppbvd @ 15% O ₂)
1	9:01-10:01	77%	15.7	6.7	7.5
2	10:13-11:13	80%	15.6	16.5	18.5
3	11:30-12:30	82%	15.6	4.5	<u>5.1</u>
				Ave:	10.4
				Permit Limit:	91

¹corrected for analyzer drift as per USEPA Method 7E

²calculated as actual average horse power divided by 7,700 (nominal rated horsepower)

DTE

FIGURES

DTE

Figure 1 – Sampling Location
EUTURBINE1
Willow Run Compressor Station
February 14, 2024

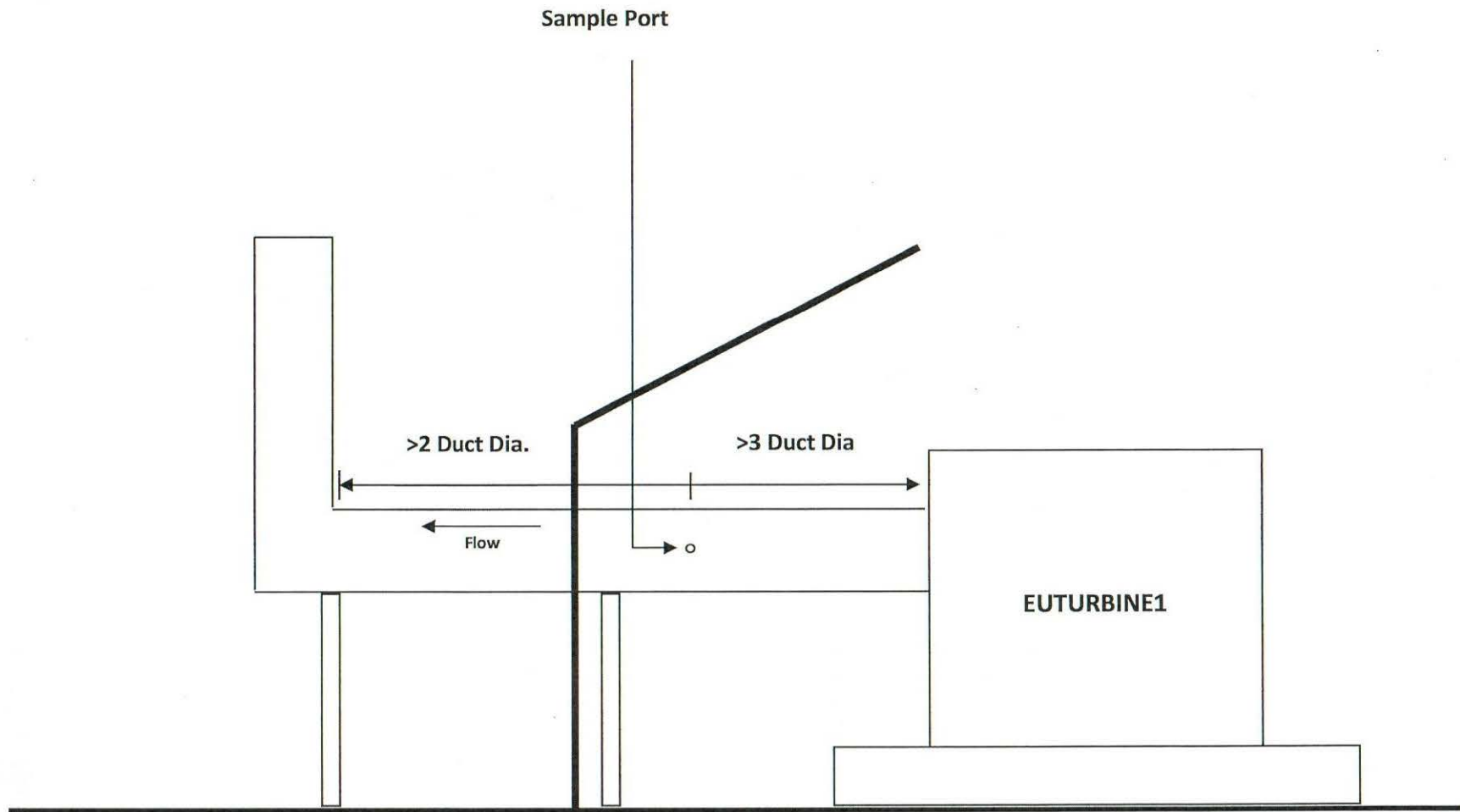


Figure 2. Method 320/3A
Willow Compressor Station
EUTURBINE1
February 14, 2024

