

# **EMISSIONS TEST REPORT**

for

**40 CFR Part 63, Subpart YYYY  
FORMALDEHYDE (CH<sub>2</sub>O)**

**EUTURBINE1  
MI-ROP-N7421-2022**

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

**August 8 & 9, 2022**

**Prepared By  
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**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 August 8 & 9, 2022, 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 (CH<sub>2</sub>O).

The results of the emissions testing are highlighted below:

**Emissions Test Results  
Willow Compressor Station  
EUTURBINE1  
August 8-9, 2022**

<b>Emission Unit</b>	<b>O<sub>2</sub> (%)</b>	<b>CH<sub>2</sub>O (ppbvd @ 15% O<sub>2</sub>)</b>
EUTURBINE1	15.3	27.1
<i>Permit Limit</i>		<b>91</b>



## 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 August 8 & 9, 2022, 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 YYYYY. Emissions tests were performed on one Solar Turbine (EUTURBINE1) for formaldehyde (CH<sub>2</sub>O).

The following DTE personnel participated in the testing program: Thomas Snyder, Senior Environmental Specialist, and Matthew D'Anna.

## 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<sub>x</sub> combustor for NO<sub>x</sub> control. The turbine generates line pressure assisting with the transmission of natural gas through the pipeline transmission system in SE Michigan. Testing for CH<sub>2</sub>O emissions was performed while the turbine operated in the LoNO<sub>x</sub> mode at 95% gas producer speeds.

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:

Sampling Method	Parameter	Analysis
USEPA Method 3A	Oxygen	Instrumental Analyzer Method
USEPA Method 320	Formaldehyde	Instrumental Analyzer Method

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## 3.1 OXYGEN (USEPA METHOD 3A)

### 3.1.1 *Sampling Method*

Exhaust Oxygen (O<sub>2</sub>) content was measured using USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)". The O<sub>2</sub> analyzer utilizes a paramagnetic sensor.

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) Heated Teflon™ sampling line, drawing sample from FTIR exhaust.
- (2) Universal® gas conditioner with particulate filter.
- (3) Flexible unheated Teflon™ sampling line.
- (4) Instrumental gas analyzer bank.
- (5) Data Acquisition System.

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

### 3.1.3 *Sampling Train Calibration*

The O<sub>2</sub> 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.

### 3.1.4 *Sampling Duration & Frequency*

Oxygen (O<sub>2</sub>) sampling was performed during all CH<sub>2</sub>O 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 O<sub>2</sub> (%) readings were logged at 10-second intervals and recorded in 1-minute increments. CH<sub>2</sub>O emissions are reported in parts per billion, dry, corrected to 15% O<sub>2</sub> (ppb @ 15% O<sub>2</sub>) for comparison to the emission limit.

Raw CEM data is presented in Appendix B.

## **3.2 FORMALDEHYDE (CH<sub>2</sub>O) (USEPA METHOD 320)**

### **3.2.1 Sampling Method**

Formaldehyde (CH<sub>2</sub>O) 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) MAX Analytical MAX-iR with Starboost™ FTIR spectrometer
- (5) Appropriate calibration gases
- (6) 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<sup>-1</sup> resolution.

### **3.2.2 Sampling Train Calibration**

The FTIR was calibrated per procedures outlined in Method 320. Direct measurements of formaldehyde (CH<sub>2</sub>O) 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.

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Formaldehyde (CH<sub>2</sub>O) gas standards were passed through the sampling system at each test location to determine the response time and confirm recovery.

Formaldehyde (CH<sub>2</sub>O) spiking was performed to verify the ability of the sampling system to quantitatively deliver a sample containing CH<sub>2</sub>O from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR to quantify CH<sub>2</sub>O in the presence of effluent gas.

As part of the spiking procedure, samples from each engine were measured to determine CH<sub>2</sub>O concentrations to be used in the spike recovery calculations. The determined nitrous oxide (N<sub>2</sub>O) 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 CH<sub>2</sub>O. 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

N<sub>2</sub>O<sub>(direct)</sub> = N<sub>2</sub>O concentration measured directly in undiluted spike gas

N<sub>2</sub>O<sub>(spike)</sub> = Diluted N<sub>2</sub>O concentration measured in a spiked sample

Spike<sub>dir</sub> = 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

All analyte spikes were introduced using an instrument grade stainless steel rotometer. The spike target dilution ratio was 1:10 or less. All CH<sub>2</sub>O spike recoveries were within the EPA Method 320 allowance of ±30%.

### 3.2.3 Quality Control and Assurance

The method validation procedure in Method 320 Section 13 was completed prior to collection of test data, validation data and statistical treatment/analysis included in the report, and emissions data corrected for %R, if applicable. The validation source was a combustion gas turbine fired with natural gas equipped with like-kind emission controls as the unit to be tested. Each validation spiked sample was preceded and followed by an unspiked sample.

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



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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. MAX Analytical Technologies, Inc. validated the FTIR data. The data validation reports are in Appendix F.

### ***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 CH<sub>2</sub>O emissions were recorded in parts per million (ppb) wet volume basis. The O<sub>2</sub> emissions were recorded in percent (%) dry volume basis.

The O<sub>2</sub> (%) and CH<sub>2</sub>O (ppbvd) readings were logged at 10-second intervals and recorded in 1-minute increments. CH<sub>2</sub>O emissions are reported in parts per billion dry, corrected to 15% O<sub>2</sub> (ppbvd @ 15% O<sub>2</sub>) for comparison to the emission limit.



#### **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 feed rate, compressor exhaust pressure, and compressor exhaust temperature.

Operational data can be found in Appendix E.

#### **5.0 RESULTS**


The results of the Formaldehyde (CH<sub>2</sub>O) emissions testing conducted on EUTURBINE1 is presented in Results Table No. 1.


EUTURBINE1 demonstrated compliance with 40 CFR Part 63, Subpart YYYY CH<sub>2</sub>O emission rates. Testing was performed while the turbine was operated in LoNO<sub>x</sub> mode at full load.



**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."

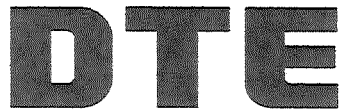
  
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**RESULTS TABLE**



**TABLE NO. 1**  
**FORMALDEHYDE EMISSIONS TEST RESULTS**  
**DTE Gas -Willow Compressor Station**  
**EUTURBINE1 (Turbine 1200)**  
**8/8-9/2022**

<b>Test</b>	<b>Test Time</b>	<b>Unit Load (%)<sup>2</sup></b>	<b>O<sub>2</sub> Concentration (% dry)<sup>1</sup></b>	<b>NOx Concentration (ppbv)<sup>1</sup></b>	<b>NOx Concentration (ppbv @ 15% O<sub>2</sub>)</b>
1-1	23:17-00:17	92%	15.3	23.0	24.1
1-2	00:27-01:27	92%	15.3	22.6	23.8
1-3	01:38-02:38	93%	15.3	31.7	<u>33.3</u>
				<b>Ave:</b>	<b>27.1</b>
				<b>Permit Limit :</b>	<b>91</b>

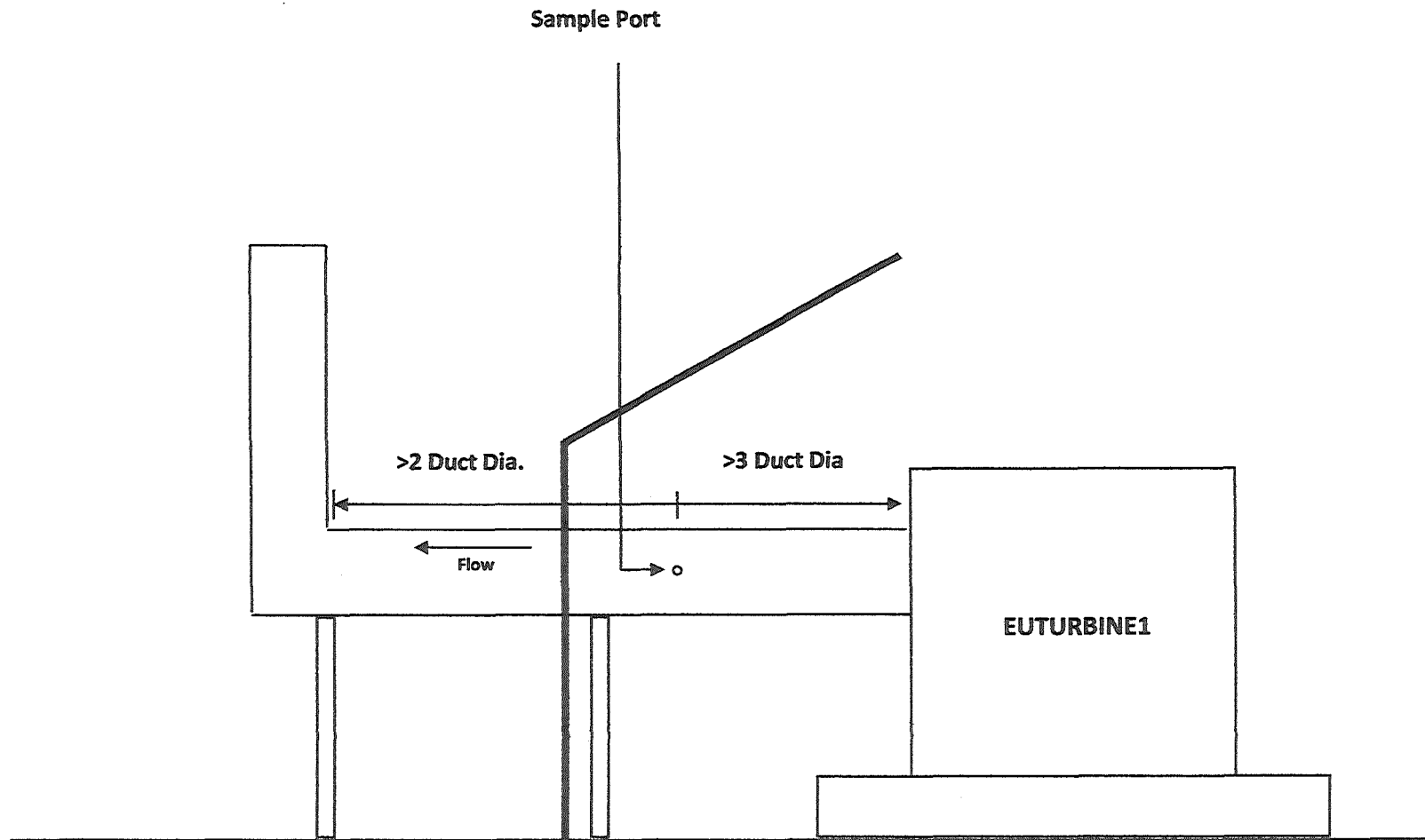
<sup>1</sup>corrected for analyzer drift as per USEPA Method 7E

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

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FIGURES

**Figure 1 – Sampling Location**  
**Willow Run Compressor Station – EUTURBINE1**



**Figure 2. Method 320/3A  
Willow Compressor Station  
EUTURBINE1**

