FINAL REPORT

DTE GAS COMPANY

MILFORD, MICHIGAN

MILFORD COMPRESSOR STATION: EUTURBINE1

RWDI #2301539

September 22, 2023

SUBMITTED TO

Mark Grigereit
Principal Engineer
mark.grigereit@dteenergy.com

DTE Energy
7940 Livernois
Detroit, Michigan 48210

M: 313.412.0305

FACILITY ADDRESS:

Milford Compressor Station
3515 Childs Lake Road
Milford, MI 48381

SUBMITTED BY

Brad Bergeron, A.Sc.T., d.E.T.
Senior Project Manager | Principal
Brad.Bergeron@rwdi.com | ext. 2428

Mason Sakshaug, QSTI
Supervisor | Associate
Mason.Sakshaug@rwdi.com | ext. 3703

RWDI USA LLC
Consulting Engineers & Scientists
2239 Star Court
Rochester Hills, Michigan 48309

T: 248.841.8442
F: 519.823.1316

EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) has been retained by DTE Energy (DTE) to complete the emission sampling program at the Milford Compressor Station (MCS) located in Milford, Michigan. RWDI completed testing as outlined in the Michigan Renewable Operating Permit (ROP) MI-ROP-B7221-2020 compliance emissions testing of compressor turbine (EUTURBINE1) for particulates less than 10 and 2.5 micron (PM10/2.5) and carbon monoxide (CO).

Per Permit condition:

V.3. Testing/Sampling

> "Upon written approval of the AQD District Supervisor, subsequent testing may be conducted for a single unit of FGTURBINES as a representative unit."

DTE Gas requested that EUTURBINE1 be tested this year as a representative unit of the three operating turbines at the Milford Compressor Station. This was completed on August 15, 2023.

Executive Summary Table i: Summary of Particulate Emissions

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Particulate (PM_{10} & $PM_{2.5}$) lb/hr	0.33	0.35	0.24	0.30	--
Particulate (PM_{10} & $PM_{2.5}$) lb/MMBTU	0.0042	0.0045	0.0031	0.0039	0.015
Fuel Usage (ft^3/hr)	74314.6	74034.1	74012.7	74120.5	--
Higher Heating Value (BTU/scf)	1038.87				--
MMBTU/hr	77.2	76.9	76.9	77.0	--

Notes: **lb/hr –** pounds per hour
lb/MMBTU – pounds per million British Thermal Units

Executive Summary Table ii: Summary of Carbon Monoxide Emissions

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Carbon Monoxide (ppmvd @ 15% O_2)	1.4	1.4	1.4	1.4	25

Notes: ppmvd – parts per million dry @ 15% O_2

TABLE OF CONTENTS

LIST OF TABLES

(Table Section)

LIST OF FIGURES

(Figure Section)

LIST OF APPENDICES

1 INTRODUCTION

RWDI USA LLC (RWDI) has been retained by DTE Energy (DTE) to complete the emission sampling program at the Milford Compressor Station (MCS) located in Milford, Michigan. RWDI completed testing as outlined in the Michigan Renewable Operating Permit (ROP) MI-ROP-B7221-2020 compliance emissions testing of compressor turbine (EUTURBINE1) for particulates less than 10 and 2.5 micron (PM10/2.5) and carbon monoxide (CO).

Per Permit condition:

V.3. Testing/Sampling

> "Upon written approval of the AQD District Supervisor, subsequent testing may be conducted for a single unit of FGTURBINES as a representative unit."

DTE Gas requested that EUTURBINE1 be tested this year as a representative unit of the three operating turbines at the Milford Compressor Station.

1.1 Location and Dates of Testing

The test program was completed on August 15th, 2023.

1.2 Purpose of Testing

The emissions test program is required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) for Milford Compressor Station, SRN B7221, that operates under Permit MI-ROP-B7221-2020.

1.3 Description of Source

The DTE Gas Milford Compressor Station located at 3515 Childs Lake Road, employs the use of three natural gas-fired 10,504 Horsepower combustion turbines (EUTURBINE1-3) with low NOx combustor for NOx control. The turbines generate line pressure assisting the transmission of natural gas to and from the pipeline transmission system in SE Michigan.

3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

Refer to Section 1.3 for a description of the process and controls.

3.2 Process Flow Sheet or Diagram

EUTURBINE1 has a single outlet. The figures can be found in the **Figure Section**.

3.3 Type and Quantity of Raw and Finished Materials

The compressor turbines are natural gas fired. Fuel consumption varies with operating parameters and was measured throughout the emissions test.

3.4 Normal Rated Capacity of Process

Testing was performed while the turbines are operated at maximum routine operating conditions in accordance with MI-ROP-B7221-2020 and consisted of triplicate 120-minute tests for particulates and triplicate 60-minute tests for CO.

3.5 Process Instrumentation Monitored During the Test

Operating parameters used to regulate the compressor turbines include gas producer speed, fuel flow, compressor discharge pressure, compressor discharge temperature, and horsepower. Operating parameters were documented during each test and included in **Appendix A**.

Zero and upscale calibration checks were conducted both before and after each test run in order to quantify measurement system calibration drift and sampling system bias. Upscale is either the mid- or high-range gas, whichever most closely approximates the flue gas level. During these checks, the calibration gases were introduced into the sampling system at the probe outlet so that the calibration gases were analyzed in the same manner as the flue gas samples.

A gas sample was continuously extracted from the stack and delivered to a series of gas analyzers, which measure the pollutant or diluent concentrations in the gas. The analyzers were calibrated on-site using EPA Protocol No. 1 certified calibration mixtures. The probe tip was equipped with a sintered stainless-steel filter for particulate removal. The end of the probe was connected to a heated Teflon sample line, which delivered the sample gases from the stack to the CEM system. The heated sample line was designed to maintain the gas temperature above 250°F in order to prevent condensation of stack gas moisture within the line.

Before entering the analyzers, the gas sample was passed directly into a refrigerated condenser, which cools the gas to approximately 35°F to remove the stack gas moisture. After passing through the condenser, the dry gas enters a Teflon-head diaphragm pump and a flow control panel, which delivers the gas in series to the CO, O_2 and CO_2 analyzers. Each of these analyzers measured the respective gas concentrations on a dry volumetric basis.

4.3 Moisture Determination (USEPA Method 4)

Determination of the moisture content of the exhaust gas was performed using USEPA Method 4, "Determination of Moisture Content in Stack Gases". The moisture was collected in the USEPA Method 5/202 glass impingers and the percentage of water was then derived from the calculations outlined in USEPA Method 4.

4.4 Particulate Matter (USEPA Method 5/202)

Particulate matter ($PM/PM_{10}/PM_{2.5}$) was sampled following procedures outlined in USEPA Modified Method 5/202. A stack sample was withdrawn isokinetically from the source, particulate emissions were collected in the probe and on a heated filter. Since the filtration temperature exceeded 85°F, Method 202 was followed for recovery of condensable. Nitrogen purges were completed post sample to remove sulphates for any of the sampling prior to the Method 202 sample being analyzed. All glassware for condensables were baked as outlined in USEPA Method 202 prior to testing. In addition, as outlined in the testing plan, a proof blank was also collected and submitted. The proof blank consisted of RWDI building a completed training and recovering the train as per USEPA Method 202 and submitting to laboratory for analysis. The proof blank is designed to validate the condition of the glassware prior to sampling.

Filterable Particulate Matter testing was performed using USEPA Method 5 "Determination of Particulate Emissions from Stationary Sources" to measure the filterable (front half) particulate emissions. Quartz filters were used for the Method 5 sampling train.

5 TEST RESULTS AND DISCUSSION

5.1 Detailed Results

Detailed results for $PM/PM_{10}/PM_{2.5}$ are provided in **Appendix B** and for Carbon Monoxide in **Appendix C**.

Table 5.1.1: Summary of Particulate Emissions

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Particulate (PM_{10} & $PM_{2.5}$) lb/hr	0.33	0.35	0.24	0.30	--
Particulate (PM_{10} & $PM_{2.5}$) lb/MMBTU	0.0042	0.0045	0.0031	0.0039	0.015
Fuel Usage (ft^3/hr)	74314.6	74034.1	74012.7	74120.5	--
Higher Heating Value (BTU/scf)	1038.87				--
MMBTU/hr	77.2	76.9	76.9	77.0	--

Notes: **lb/hr -** pounds per hour
lb/MMBTU - pounds per million British Thermal Units

Table 5.1.2: Summary of Carbon Monoxide Emissions

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Carbon Monoxide (ppmvd @ 15% O_2)	1.4	1.4	1.4	1.4	25

Notes: ppmvd - parts per million dry @ 15% O_2

5.2 Discussion of Results

The detailed results can be found in the following Appendix:

- **Appendix B -** Summary of Particulate Matter Results
- **Appendix C -** Summary of Carbon Monoxide, Oxygen and Carbon Dioxide Results

5.3 Variations in Testing Procedures

No deviations from the approved test plan were completed during the testing period.

TABLES

Table 1: Summary of Sampling Parameters and Methodology EUTURBINE 1

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
EUTURBINE1	3	Velocity, Temperature and Flow Rate	U.S. EPA [1] Methods 1-4
	3	Carbon Monoxide	U.S. EPA [1] Method 10
	3	PM, PM10 and PM2.5	U.S. EPA [1] Method 5/202
	3	Oxygen & Carbon Dioxide	U.S. EPA [1] Method 3A

Notes:

[1] U.S. EPA - United States Environmental Protection Agency

Table 2: Sampling Summary and Sample Log

Source and Test #	Sampling Date	Start Time	End Time	Filter ID / Trap ID
EUTURBINE 1 - Particulate Matter				
Test #1	15-Aug-23	7:20	9:31	QZ 104
Test #2	15-Aug-23	10:04	12:13	QZ 106
Test #3	15-Aug-23	13:08	15:18	QZ 107
Blank	15-Aug-23	--	--	QZ 103
EUTURBINE 1 - Carbon Monoxide				
Test #1	15-Aug-23	7:20	8:19	--
Test #2	15-Aug-23	10:04	11:03	--
Test #3	15-Aug-23	13:08	14:09	--

Table 3: Sampling Summary - Flow Characteristics - EUTURBINE1

Stack Gas Parameter		Test No. 1	Test No. 2	Test No. 3	Average
Testing Date		15-Aug-23	15-Aug-23	15-Aug-23	
Stack Temperature	°F	955	957	960	957
Moisture	%	7.8%	8.0%	7.7%	7.8%
Velocity	ft/s	139.40	139.20	141.50	140.03
Referenced Flow Rate	CFM	43,862	43,628	44,410	43,967
Sampling Isokinetic Rate	%	102.7	100.4	100.3	101.1

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

Table 4: Summary of Particulate Matter Results

Company	DTE Milford			
Source	2100 - EUTURBINE1			
Date	15-Aug-23	15-Aug-23	15-Aug-23	
Test Number	**Test 1**	**Test 2**	**Test 3**	**Average**
Start Time:	7:20	10:04	13:08	--
Stop Time:	9:31	12:13	15:18	--
Stack Information				
Flow ft3 (Actual)	133,054	132,831	135,075	133,653
Flow ft3 (Standard Wet)	47,560	47,410	48,111	47,694
Flow ft3 (Standard Dry)	43,862	43,628	44,410	43,967
Flow m3 (Standard Dry)	1,242	1,235	1,258	1,245
Percent Moisture	7.8	8.0	7.7	7.8
Pressure Ps ("Hg)	28.66	28.66	28.66	28.66
Average Stack Temperature Ts (F)	954.7	956.8	959.8	957.1
Molecular Weight of Stack Gas dry (Md)	29.14	29.14	29.14	29.14
Molecular Weight of Stack Gas wet (Ms)	28.27	28.25	28.28	28.27
Stack Gas Specific Gravity (Gs)	1.0	1.0	1.0	1.0
Water Vapor Volume Fraction	0.1	0.1	0.1	0.1
Average Stack Velocity Vs (ft/sec)	139.4	139.2	141.5	140.1
Area of Stack (ft2)	15.9	15.9	15.9	15.9
Percent Carbon Dioxide	3.3	3.4	3.4	3.3
Percent Oxygen	15.1	15.1	15.1	15.1
Percent Carbon Monoxide	0.0	0.0	0.0	0.0
Percent Excess Air at Test Location	237.2	236.2	234.9	236.1
Meter Info				
Isokinetic Variation I	102.7	100.4	100.3	101.1
Meter Pressure Pm ("Hg)	28.9	28.9	28.9	28.9
Meter Temperature Tm (F)	63.8	68.1	70.3	67.4
Measured Sample Volume Vm	100.43	98.55	100.61	99.86
Sample Volume (Vm St ft3)	96.13	93.54	95.12	94.93
Sample Volume (Vm St m3)	2.72	2.65	2.69	2.69
Total Weight of Sampled Gas (m g lbs) wet	7.62	7.42	7.53	7.52
Total Weight of Sampled Gas (m g lbs) dry	7.24	7.05	7.16	7.15
Gas Density Ps wet	0.07	0.07	0.07	0.07
Gas Density Ps dry	0.08	0.08	0.08	0.08
Condensate Volume	8.11	8.11	7.93	8.05
Nozzle Size	0.00029	0.00029	0.00029	0.00029
Impinger Gain	139.1	144.0	135.8	139.6
Silica Gel Gain	32.8	28.0	32.3	31.0
Total Gas Sampled (vm st ft3 + condensate volume)	104.24	101.65	103.04	102.98
Particulate Results				
Nozzle/Probe/Filter Weight (mg)	3.9	3.3	2.2	3.1
Organic Condensible Particulate (mg)	1.0	1.1	1.0	1.0
Inorganic Condensible Particulate (mg)	2.5	3.2	2.6	2.8
Condensible Blank Correction (mg)	2.0	2.0	2.0	2.0
Total Particulate (mg)	5.4	5.6	3.8	4.9
lb/hr	0.33	0.35	0.24	0.30
lb/1000 lb (wet)	0.0016	0.0017	0.0011	0.0014
lb/1000 lb (dry)	0.0016	0.0018	0.0012	0.0015
mg/dscm (dry)	1.98	2.11	1.41	1.84
gr/dscf	0.0009	0.0009	0.0006	0.0008
Average Natural Gas Usage (scf/min)	74314.6	74034.1	74012.7	74120.5
Heating Value of Natural Gas (BTU/scf)	1038.87	1038.87	1038.87	1038.87
MMBTU//hr	77.2	76.9	76.9	77.0
lb/MMBtu	0.0042	0.0045	0.0031	0.0039
mg/acm	0.660	0.700	0.468	0.609
lbs/1,000 lbs Gas @ 50% EA (wet)	0.0035	0.0037	0.0025	0.0032

ROP Limit	% ROP Limit
0.015	26.2%

Table 5: Summary of Carbon Monoxide, Oxygen and Carbon Dioxide Results

RWDI Project #2301539

EUTURBINE 1				O_2	CO	CO (corrected to 15%)	Natural Gas Used	ROP Limit for CO (Corrected to 15% O2)
Test ID	Date	Start	End	%	ppm	ppm	ft^3/hr	ppm
1	2023-08-15	7:20	8:19	15.1	1.3	1.4	74,315	25
2	2023-08-15	10:04	11:03	15.1	1.4	1.4	74,034	
3	2023-08-15	13:08	14:07	15.1	1.4	1.4	74,013	
		Average		15.1	1.4	1.4	74,120	

Flow Rate dry, ref (ft^3/min)

Test 1 = 43,862

Test 2 = 43,628

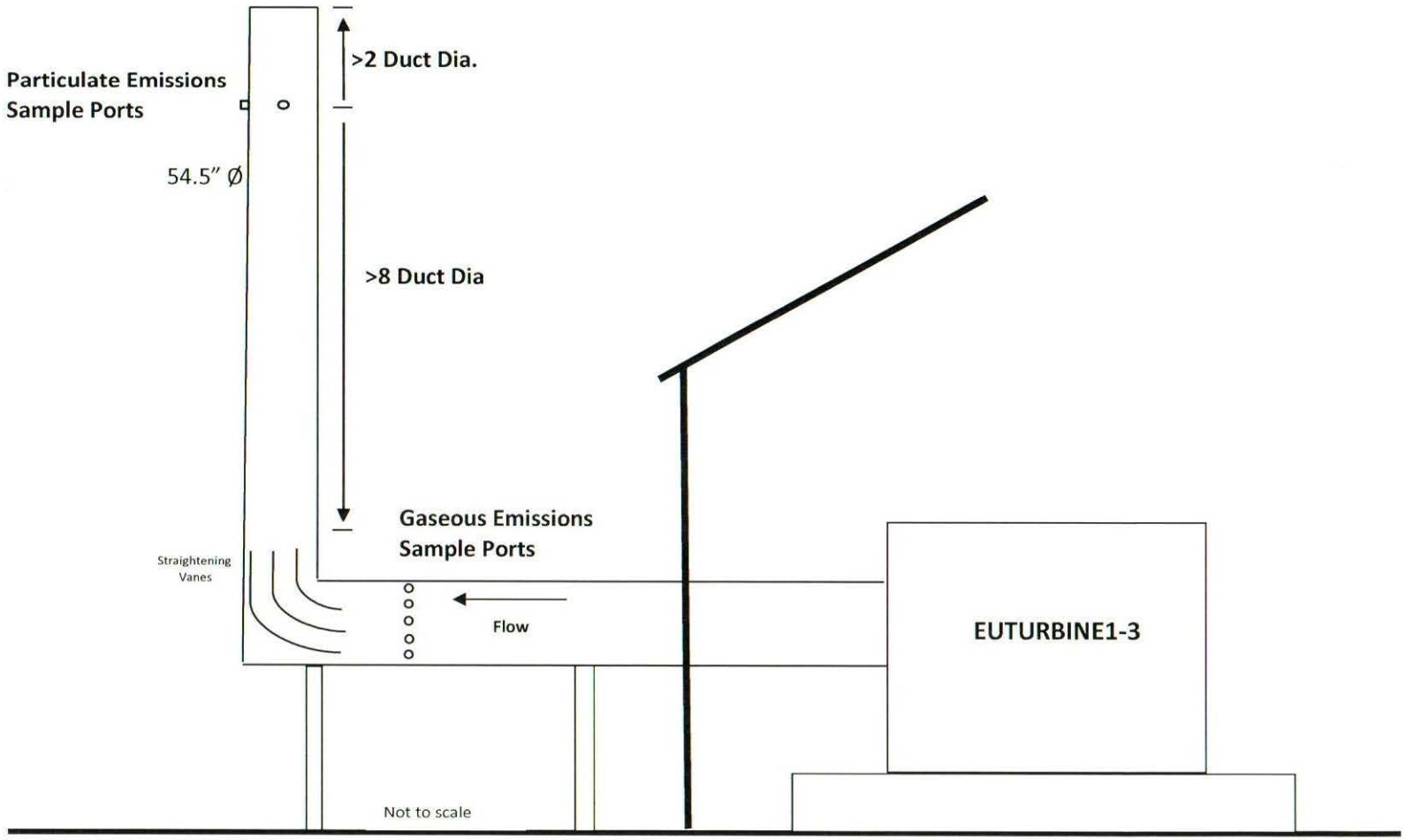
Test 3 = 44,410

dscf = dry standard cubic foot

Caloric value for natural gas used 1038.87 btu/ft^3

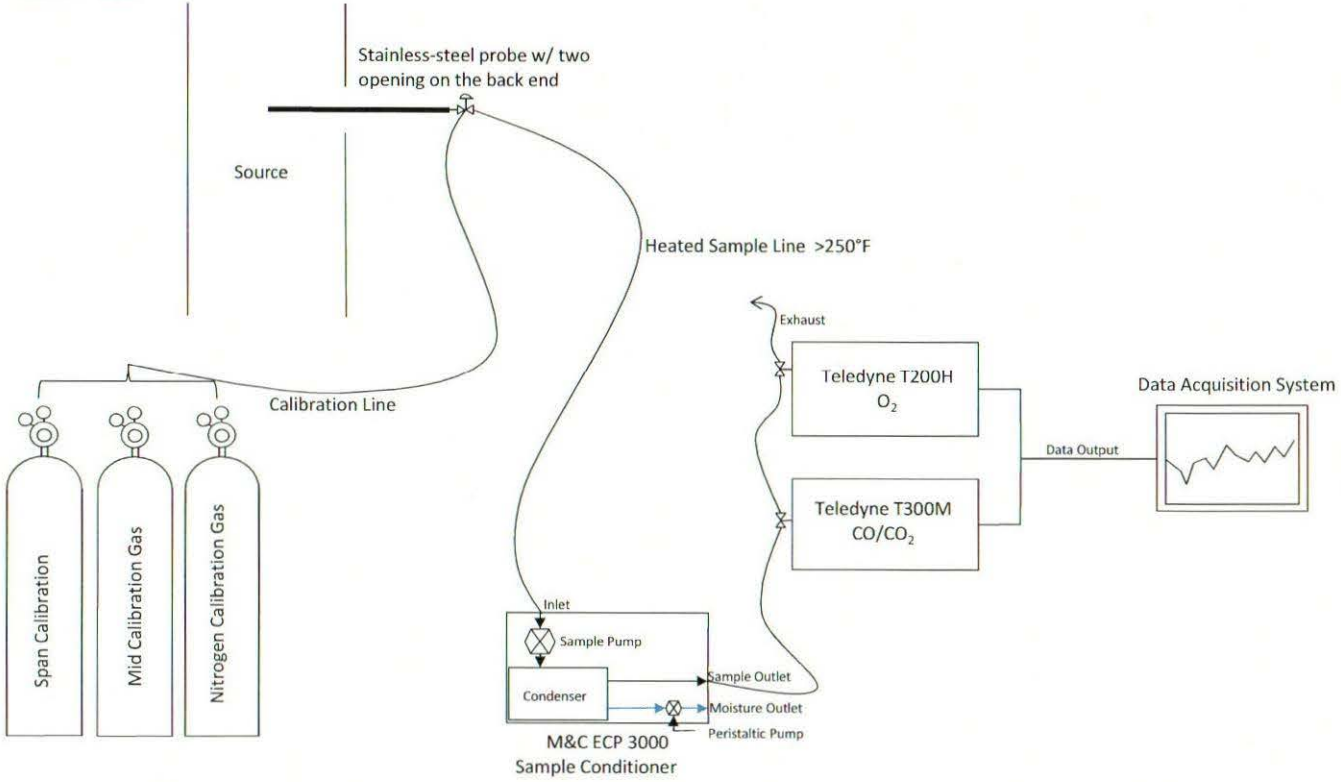
FIGURES

Figure 1 – Stack Diagram
DTE Milford Compressor Station – EUTURBINE1-3
August, 2023



DTE

Figure No. 3: USEPA Method 3A and 10 Schematic



USEPA Method 3A,6C,7E,10

DTE Energy

Milford Compressor Turbine

EUTURBINE1

Milford, MI

Project# 2301539

Date: August 15, 2023