FINAL REPORT

DTE ELECTIC COMPANY

CARSON CITY, MICHIGAN

DTE RENAISSANCE POWER PLANT:
FG-TURBINE4SC

RWDI #2305396

October 4, 2023

SUBMITTED TO

Mark Grigereit
Principal Engineer
mark.grigereit@dteenergy.com

DTE Energy
7940 Livernois
Detroit, Michigan 48210

M: 313.412.0305

FACILITY ADDRESS:

DTE Renaissance Power Plant
950 N. Division Street
Carson City, Michigan 48811

SUBMITTED BY

Brad Bergeron, A.Sc.T., d.E.T.
Technical Director | Principal
Brad.Bergeron@rwdi.com | ext. 2428

Steve Smith, QSTI
Project Manager
Steve.Smith@rwdi.com | ext. 3706

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

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

EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) has been retained by DTE Energy (DTE) to complete the emission sampling program at the Renaissance Power Plant (RENPP) located in Carson City, Michigan. RWDI completed testing as outlined in the Michigan Renewable Operating Permit (ROP) MI-ROP-N6873-2020 compliance emissions testing of compressor turbine FG-TURBINE4SC (Unit 4) for particulates less than 10 microns, volatile organic compounds (VOC), and formaldehyde (HCOH). Unit 4 was tested at a base load (70%) and a high load (100%) for each pollutant. Testing was completed August 22-24, 2023.

Executive Summary Table i: Summary of Particulate Emissions – Unit 4 Base Load (70% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Particulate (PM_{10}) lb/hr	North – 1.74 South – 0.96 Total - 2.70	North – 2.65 South – 2.43 Total - 5.08	North – 2.52 South – 2.17 Total - 4.69	Total - 4.16	9.0
Particulate (PM_{10}) lb/MMBTU	North – 0.0031 South – 0.0012 Total - 0.0043	North – 0.0049 South – 0.0030 Total - 0.0079	North – 0.0049 South – 0.0027 Total - 0.0076	Total - 0.0066	-

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

Executive Summary Table ii: Summary of Particulate Emissions – Unit 4 High Load (100% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Particulate (PM_{10}) lb/hr	North – 1.75 South – 2.16 Total - 3.91	North – 1.46 South – 5.23 Total - 6.69	North – 2.52 South – 2.17 Total - 6.41	Total - 5.67	9.0
Particulate (PM_{10}) lb/MMBTU	North – 0.0029 South – 0.0020 Total - 0.0049	North - 0.0023 South – 0.0047 Total – 0.0070	North – 0.0061 South – 0.0022 Total - 0.0083	Total - 0.0067	-

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

Executive Summary Table iii: Summary of Formaldehyde Emissions – Unit 4 Base Load (70% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
HCOH (lb/hr)	0.49	0.43	0.38	0.43	6.5 tons/yr (all turbines combined)
HCOH (lb/MMBTU)	0.00036	0.00032	0.00028	0.00032	
HCOH (lb/mmscf	3.71E-07	3.26E-07	2.89E-07	3.29E-07	

Executive Summary Table iv: Summary of Formaldehyde Emissions – Unit 4 High Load

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
HCOH (lb/hr)	0.54	0.57	0.41	0.50	6.5 tons/yr (all turbines combined)
HCOH (lb/MMBTU)	0.00032	0.00034	0.00025	0.00030	
HCOH (lb/mmscf	3.32E-07	3.50E-07	2.52E-07	3.11E-07	

Executive Summary Table v: Summary of Volatile Organic Compound Emissions – Unit 4 Base Load

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
VOC (as NMOC) (ppmd @ 15% O_2)	0.00	0.00	0.00	0.00	2

Note: NMOC – Non-Methane Organic Compounds. For tests 1, 2, and 3, the values were negative so a result of 0.00 is being reported.

Executive Summary Table vi: Summary of Volatile Organic Compound Emissions – Unit 4 High Load

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
VOC (as NMOC) (ppmd @ 15% O_2)	0.00	0.00	0.04	0.00	2

Note: NMOC – Non-Methane Organic Compounds. For tests 1 and 2, the values were negative so a result of 0.00 is being reported.

TABLE OF CONTENTS

LIST OF TABLES

(In Report)

LIST OF TABLES

(Table Section)

LIST OF FIGURES

(in Report)

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 Renaissance Power Plant (RENPP) located in Carson City, Michigan. RWDI completed testing as outlined in the Michigan Renewable Operating Permit (ROP) MI-ROP-N6873-2020 compliance emissions testing of compressor turbine FG-TURBINE4SC (Unit 4) for particulates less than 10 microns, volatile organic compounds (VOC), and formaldehyde (HCOH). Unit 4 was tested at a base load (70%) and a high load (100%) for each pollutant. Testing was completed August 22-24, 2023.

1.1 Location and Dates of Testing

The test program was completed August 22nd-24th, 2023 at the DTE Renaissance Power Plant located in Carson City, Michigan

1.2 Purpose of Testing

The emissions test program is required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) for the Renaissance Power Plant that operates under Permit MI-ROP-N6873-2020.

1.3 Description of Source

The Renaissance Power Plant (RENPP) is a DTE facility located in Carson City, Michigan. RENPP is a peaking plant that produces electricity from four (4) Westinghouse simple cycle natural gas-fired turbines designated as FG-TURBINE1SC - FG-TURBINE4SC. Each turbine set consists of a compressor, combustion turbine, and generator. Mechanical energy is generated at the combustion turbine by drawing in ambient air by means of burning fuel and expanding the hot combustion gases in a four-stage turbine. The mechanical energy is converted to electrical energy through the generator. Each turbine has a nominal heat input rating of 19 million Btu per hour and can produce 215 megawatts of electricity. Each turbine is equipped with dry low-NOX burners. Each unit has its own dedicated exhaust stack.

1.4 Personnel Involved in Testing

Table 1.4: Testing Personnel

Mark Grigereit Principal Engineer	**DTE Energy** 7940 Livernois Detroit, MI 48210	Mark.Grigereit@dteenergy.com 313.412.0305
Brad Bergeron Technical Director	**RWDI USA LLC** 2239 Star Court Rochester Hills, MI 48309	Brad.Bergeron@rwdi.com 248.234.3885
Mason Sakshaug Supervisor		Mason.Sakshaug@rwdi.com 989.323.0355
Ben Durham Senior Field Technician		Steve.Smith@rwdi.com 971.940.5038
Michael Nummer Senior Field Technician		Michael.Nummer@rwdi.com 586.863.8237
Dave Trahan Senior Field Technician		David.Trahan@rwdi.com 586.292.8119
Hunter Griggs Field Technician		Hunter.Griggs@rwdi.com 810.441.8351
Kate Strang Field Technician		Kate.Strang@rwdi.com 518.257.0117
Cade Smith Field Technician		Cade.Smith@rwdi.com 734.552.7270
Jermy Howe AQD Supervisor	**Michigan Department of Environment, Great Lakes, and Energy**	HowelJ1@michigan.gov 231.878.6687

2 SUMMARY OF RESULTS

2.1 Operating Data

Process data collected during the testing included fuel flow rate and megawatt output. Data collected during each day of testing included the following:

- Load
- Fuel usage
- Fuel BTU content
- Compressor discharge pressure
- Compressor discharge temperature

This information can be found in **Appendix A.**

2.2 Applicable Permit Number

RENPP operates under Permit MI-ROP-N6837-2020.

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

Unit 4 has a single outlet. The exhaust stack diagram can be found in the **Figure Section**.

3.3 Type and Quantity of Raw and Finished Materials

Raw materials in use consist of pipeline quality natural gas for fuel.

3.4 Normal Rated Capacity of Process

Full load conditions for each combustion turbine are nominally 215 MW. Testing occurred at a 70% load and a 100% load.

3.5 Process Instrumentation Monitored During the Test

Monitored data during the testing consisted of CEMs data (O_2, CO_2, and Load).

4 SAMPLING AND ANALYTICAL PROCEDURES

The emission test program utilized the following test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- **Method 1** – Sample and Velocity Traverses for Stationary Sources
- **Method 2** – Determination of Stack Gas Velocity and Volumetric Flowrate
- **Method 3A** – Determination of Molecular Weight of Dry Stack Gases (Instrumental)
- **Method 4** – Determination of Moisture Content in Stack Gases
- **Method 5** – Determination of Particulate Matter Emissions from Stationary Sources
- **Method 19** - Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates
- **Method 25A** – Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
- **Method 202** – Determination of Condensable Particulate Emissions from Stationary Sources
- **Method 320** – Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy

4.1 Stack Velocity, Temperature, and Volumetric Flow Rate Determination (USEPA Method 1, 2, and 19)

The exhaust velocities were determined following the US EPA Method 2, "Determination of Stack Gas Velocity and Flow Rate (Type S Pitot Tube)". Velocity measurements were taken with a pre-calibrated S-Type pitot tube and manometer. Sample point selection was determined following the equal area method as outlined in US EPA Method 1. Temperature measurements were made simultaneously with the velocity measurements and were conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

A cyclonic flow check was performed on the stack during the initial flow monitor certification. There was no cyclonic flow present during testing.

Due to the size of the emission stack, each test consists of two trains being operated at opposing side of the stack. With the two probes, all points can be sampled and an appropriate traverse was completed for each test.

US EPA Method 19 was used to calculate volumetric flowrate based on the natural gas F_d calculations.

4.2 Oxygen and Carbon Dioxide (USEPA Method 3A)

O_2 and CO_2 concentrations were determined utilizing RWDI's continuous emissions monitoring (CEM) system. Prior to testing, a 3-point analyzer calibration error check was conducted using USEPA protocol gases. The calibration error check was performed by introducing zero, mid and high-level calibration gases directly into the analyzer. The calibration error check was performed to confirm that the analyzer response is within ±2% of the certified calibration gas introduced. Prior to each test run, a system-bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each test run a system-bias check was performed to evaluate the percent drift from pre and post-test system bias checks. The system bias checks were used to confirm that the analyzer did not drift greater than ±3% throughout a test run.

Zero and upscale calibration checks were conducted both before and after each test run 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 O_2 and CO_2 analyzers. Each of these analyzers measured the respective gas concentrations on a dry volumetric basis.

O_2 and CO_2 were monitored during all testing including particulate matter, VOC, and formaldehyde testing.

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. Moisture data was used for Particulate Matter runs. Refer to Section 4.6 for USEPA Method 320 for moisture determination during Formaldehyde and VOC sample runs.

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 train 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.

After completion of the final leak test for each test, the filter was recovered and the probe, nozzle, and the front half of the filter holder assembly were brushed and rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The container was labeled with the test number, location, test date, and level of liquid was marked. Immediately after recovery, the samples were placed in a storage container for safe handling. The condensable impingers are weighed in field and the liquids collected in the 1st knockout are transferred to the 2nd impinger for the nitrogen purge. The nitrogen purge was completed for a 1-hour period following USEPA Method 202. After purge, all condensable portion (back half of Method 5 filter to front half of CPM filter, are rinsed with deionized water, acetone and hexane. Deionized water catch is collected in a separate container than the acetone/hexane rinses. The CPM filter is removed and stored in a separate container for transfer to the laboratory. Triplicate 240-minute tests were performed for each load.

For Method 5, the acetone rinses were transferred to clean pre-weighed beakers and evaporated to dryness. The beakers and filters were desiccated for 24 hours and weighed to a constant weight (within 0.5 mg).

The collection of field blanks consists of a blank filter and acetone solution blank for USEPA Method 5 and deionized water, acetone/hexane and CPM filter for Method 202. The reagent blanks are collected from the rinse bottle used during sample recovery. In addition, a recovery blank was completed after Test 2 following the procedure outlined in USEPA Method 202.

Method 5 acetone rinse and filters were analyzed by RWDI's inhouse laboratory. The Method 202 samples were analyzed by Bureau Veritas Laboratory in Mississauga, Ontario.

4.5 Volatile Organic Compounds (USEPA Method 25A)

The measurements were taken continuously following the USEPA Method 25A on the inlet and outlet (using a non-methane/methane analyzer). As outlined in Method 25A, the measurement location was taken at the centroid of each source.

The compliance test consisted of a triplicate 60-minute tests at each load. Regular performance checks on the CEMS were carried out by zero and span calibration checks using USEPA Protocol calibration gases. These checks verified the ongoing precision of the monitor with time by introducing pollutant-free (zero) air followed by known calibration gas (span) into the monitor. The response of the monitor to pollutant-free air and the corresponding sensitivity to the span gases was reviewed frequently as an ongoing indication of analyzer performance.

Prior to testing, a 4-point analyzer calibration error check was conducted using USEPA protocol gases. The calibration error check was performed by introducing zero, low, mid, and high-level calibration gases up the heated line to the probe tip. The calibration error check was performed to confirm that the analyzer response is within ±5% of the certified calibration gas introduced. At the conclusion of each test run a system-bias check was performed to evaluate the percent drift from pre- and post-test system bias checks. The system bias checks were used to confirm that the analyzer did not drift greater than ±3% throughout a test run.

Zero and mid gas calibration checks were conducted both before and after each test run to quantify measurement system calibration drift and sampling system bias. 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 the gas analyzer, 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 or heated filter system. 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 is designed to maintain the gas temperature above 250°F to prevent condensation of stack gas moisture within the line.

Each analyzer was able to monitor Total Hydrocarbon (as propane) and Methane concurrently for each test. The response factor for Methane to Propane (for each system) was determined via obtaining the concurrent response to methane calibration standard as both methane and THC (as Propane). This response factor was applied to each for the methane results to determine the total methane on the outlets of sources as Propane. During each run for each source, the Total Hydrocarbon (as Propane) and the Methane (corrected to as Propane) was determined and the methane response (as Propane) was subtracted from the Total Hydrocarbon (as Propane) value. This resulted in obtaining the Total Non-Methane Organic Compound (NMOC) values from each for the sources.

4.6 Formaldehyde (USEPA Method 320)

HCOH concentrations was determined utilizing RWDI's continuous emissions monitoring system (CEM) which consists of the FTIR and oxygen analyzer (measuring on wet basis).

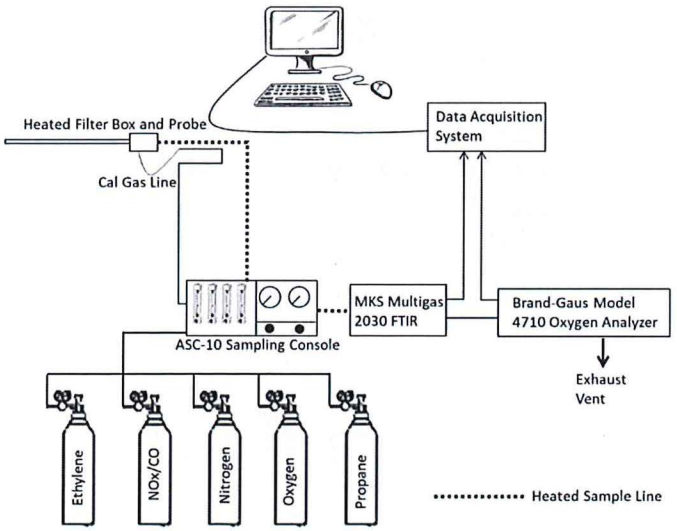
Stack gas concentrations for HCOH and O_2 was measured using EPA Reference Methods 320 and 3A.

Oxygen measurements were taken continuously following USEPA Method 3A on the outlet (using a wet oxygen analyzer or equivalent).

Regular performance checks on the CEMS were carried out by zero and span calibration checks on the oxygen analyzer and necessary QA procedures on the FTIR using USEPA Protocol calibration gases. These checks will verify the ongoing precision of the FTIR with time by introducing pollutant-free (zero) air followed by known calibration gas (span) into the FTIR. The response of the monitor to pollutant-free air and the corresponding sensitivity to the span gases was reviewed frequently as an ongoing indication of analyzer performance.

Monitoring was conducted by drawing a sample stream of flue gases through a stainless-steel probe attached to a heated filter and a heated sample line that is attached to the MAX Analytical ASC-10ST sampling console. Lengths of unheated sample line was kept to a minimum and insulated. The ASC-10ST sampling console delivers a continuous sample to the MKS MultiGas 2030 FTIR and oxygen analyzer for analysis. The heated filter and line were maintained at approximately 191°C (375°F) and the MKS MultiGas 2030 FTIR and ASC-10ST gas components were kept at 191°C (375°F). The end of the probe was connected to a heated Teflon sample line, which will deliver the sample gases from the stack to the FTIR system. The heated sample line was designed to maintain the gas temperature at approximately 375°F to prevent condensation of stack gas moisture within the line and condition air to the same temperature as the FTIR. A schematic of the sampling system setup is depicted in **Figure 4.6a.**

Figure 4.6a: MKS 2030 Multigas FTIR/ASC-10ST/Model 4710 Oxygen Analyzer Sampling System Schematic



The ASC-10ST was used to deliver calibration gases (Calibration Transfer Standard (CTS), QA Spike and Nitrogen) to the FTIR in direct (to analyzer) and system (to probe) modes.

A laptop computer was utilized for operating the MKS MultiGas 2030 FTIR and MAX Analytical ASC-10ST sampling console and logging the multi-gas FTIR data. Data was logged as one-minute averages for the actual test period (FTIR PRN files and Spectra). All concentration data was determined using the MKS 2030 MultiGas FTIR software. A typical MKS 2030 FTIR and ASC-10 ST configuration is depicted in **Figure 4.6b.**

For oxygen measurement only, prior to testing, a 3-point analyzer calibration error check was conducted using USEPA protocol gases. The calibration error check was performed by introducing zero, mid and high-level calibration gases directly into the analyzer. The calibration error check was performed to confirm that the analyzer response is within ±2% of the certified calibration gas introduced. Prior to each test run, a system-bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each test run a system-bias check was performed to evaluate the percent drift from pre and post-test system bias checks. The system bias checks were used to confirm that the analyzer did not drift greater than ±3% throughout a test run. The analyzer will measure the respective gas concentrations on a wet volumetric basis which was converted to a dry volumetric number.

The probe tip was equipped with a heated filter for particulate removal. The end of the probe was connected to a heated Teflon sample line, which will deliver the sample gases from the stack to the FTIR/4710 Oxygen analyzer system. The heated sample line was designed to maintain the gas temperature at approximately 375°F to prevent condensation of stack gas moisture within the line.

Figure 4.6b: Typical MKS 2030 Multigas FTIR and ASC-10ST Configuration

4.7 Description of Recovery and Analytical Procedures

All sample recovery and analytical procedures following the prescribed methods of USEPA Method 1 to 5, 25A, 202, and 320.

4.8 Sampling Port Description

A stack diagram can be found in the **Figure Section**.

5 TEST RESULTS AND DISCUSSION

5.1 Detailed Results

Detailed results can be found in the following appendices:

- Appendix B – Particulate Matter
- Appendix D – Formaldehyde
- Appendix E – VOC

The following tables give a summary of testing results.

Table 5.1.1: Summary of Particulate Emissions – Unit 4 Base Load (70% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Particulate (PM_{10}) lb/hr	North – 1.74 South – 0.96 Total - 2.70	North – 2.65 South – 2.43 Total - 5.08	North – 2.52 South – 2.17 Total - 4.69	Total - 4.16	9.0
Particulate (PM_{10}) lb/MMBTU	North – 0.0031 South – 0.0012 Total - 0.0043	North – 0.0049 South – 0.0030 Total - 0.0079	North – 0.0049 South – 0.0027 Total - 0.0076	Total - 0.0066	-

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

Table 5.1.2: Summary of Particulate Emissions – Unit 4 High Load (100% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
Particulate (PM_{10}) lb/hr	North – 1.75 South – 2.16 Total - 3.91	North – 1.46 South – 5.23 Total - 6.69	North – 2.52 South – 2.17 Total - 6.41	Total - 5.67	9.0
Particulate (PM_{10}) lb/MMBTU	North – 0.0029 South – 0.0020 Total - 0.0049	North - 0.0023 South – 0.0047 Total – 0.0070	North – 0.0061 South – 0.0022 Total - 0.0083	Total - 0.0067	-

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

Table 5.1.3: Summary of Formaldehyde Emissions – Unit 4 Base Load (70% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
HCOH (lb/hr)	0.49	0.43	0.38	0.43	6.5 tons/yr (all turbines combined)
HCOH (lb/MMBTU)	0.00036	0.00032	0.00028	0.00032	
HCOH (lb/mmscf	3.71E-07	3.26E-07	2.89E-07	3.29E-07	

Table 5.1.4: Summary of Formaldehyde Emissions – Unit 4 High Load (100% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
HCOH (lb/hr)	0.54	0.57	0.41	0.50	6.5 tons/yr (all turbines combined)
HCOH (lb/MMBTU)	0.00032	0.00034	0.00025	0.00030	
HCOH (lb/mmscf	3.32E-07	3.50E-07	2.52E-07	3.11E-07	

Table 5.1.5: Summary of Volatile Organic Compound Emissions – Unit 4 Base Load (70% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
VOC (as NMOC) (ppmd @ 15% O_2)	0.00	0.00	0.00	0.00	2

Note: NMOC – Non-Methane Organic Compounds. For tests 1, 2, and 3, the values were negative so a result of 0.00 is being reported.

Table 5.1.6: Summary of Volatile Organic Compound Emissions – Unit 4 High Load (100% Load)

Test Number	Summary of Results				ROP Limit
	Test 1	Test 2	Test 3	Average	
VOC (as NMOC) (ppmd @ 15% O_2)	0.00	0.00	0.04	0.00	2

Note: NMOC – Non-Methane Organic Compounds. For tests 1 and 2, the values were negative so a result of 0.00 is being reported.

5.2 Discussion of Results

The results for all tested pollutants show compliance with the applicable permit.

5.3 Variations in Testing Procedures

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

5.4 Process Upset Conditions During Testing

No process upsets during testing period.

5.5 Maintenance Performed in Last Three Months

Normal routine maintenance only was completed.

5.6 Re-Test

This was not a retest.

5.7 Audit Samples

This test did not require any audit samples.

5.8 Process Data

Process data can be found in **Appendix A.**

5.9 Particulate, Flows and Moisture

Results can be found in **Appendix B.**

5.10 Oxygen and Carbon Dioxide

Results can be found in **Appendix C**.

5.11 Formaldehyde

Results can be found in **Appendix D**.

5.12 VOC

Results can be found in **Appendix E**.

5.13 Calibration Documents

Calibration can be found in **Appendix F**.

5.14 Example Calculations

Example calculations can be found in **Appendix G.**

5.15 Analytical Data

Laboratory data can be found in **Appendix H**.

TABLES

Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Load	Sampling Parameter	Sampling Method
EU-TURBINE4SC	3	Velocity, Temperature and Flow Rate	U.S. EPA [1] Methods 1-4
	3	Oxygen & Carbon Dioxide	U.S. EPA [1] Method 3A
	3	PM, PM10 and PM2.5	U.S. EPA [1] Method 5/202
	3	Volatile Organic Compounds	U.S. EPA [1] Method 25A
	3	Formaldehyde	U.S. EPA [1] Method 320

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
EU-TURBINE4SC1 - Particulate Matter				
Test 1 70% Load North	22-Aug-23	7:31	12:37	QZ7
Test 2 70% Load North	22-Aug-23	13:28	17:57	QZ5
Test 3 70% Load North	23-Aug-23	6:41	11:58	QZ15
Test 1 70% Load South	22-Aug-23	7:31	12:37	QZ6
Test 2 70% Load South	22-Aug-23	13:28	17:57	QZ8
Test 3 70% Load South	23-Aug-23	6:41	11:58	QZ16
Test 1 100% Load North	23-Aug-23	12:30	17:03	QZ101
Test 2 100% Load North	24-Aug-23	6:43	11:16	QZ99
Test 3 100% Load North	24-Aug-23	11:58	16:28	QZ13
Test 1 100% Load South	23-Aug-23	12:30	17:03	QZ14
Test 2 100% Load South	24-Aug-23	6:43	11:16	QZ12
Test 3 100% Load South	24-Aug-23	11:58	16:28	QZ111
Blank North	24-Aug-23	--	--	QZ22
Blank South	8/248/2023	--	--	QZ102
EU-TURBINE4SC - VOCs				
Test #1 - 70% Load	22-Aug-23	7:31	8:30	--
Test #2 - 70% Load	22-Aug-23	8:47	9:46	--
Test #3 - 70% Load	22-Aug-23	10:02	11:01	--
Test #1 - 100% Load	24-Aug-23	6:43	7:42	--
Test #2 - 100% Load	24-Aug-23	7:58	8:57	--
Test #3 - 100% Load	24-Aug-23	9:07	10:06	--
EU-TURBINE4SC - Formaldehyde				
Test #1 -70% Load	22-Aug-23	7:40	8:39	--
Test #2 - 70% Load	22-Aug-23	9:30	10:29	--
Test #3 - 70% Load	22-Aug-23	11:10	12:09	--
Test #1 - 100% Load	23-Aug-23	13:25	14:24	--
Test #2 - 100% Load	23-Aug-23	15:00	15:59	--
Test #3 - 100% Load	23-Aug-23	16:35	17:34	--

Table 3A: Sampling Summary - EU-TURBINE4SC - Particulate Matter

Stack Gas Parameter		Test No. 1			Test No. 2			Test No. 3			Average
Testing Date		22-Aug-23			22-Aug-23			23-Aug-23			–
Load Condition		70% Load			70% Load			70% Load			–
Location		North	South	Total Exhaust	North	South	Total Exhaust	North	South	Total Exhaust	–
Stack Temperature	°F	1113	1117	–	1108	1116	–	1124	1126	–	1117
Moisture	%	8.0%	8.4%	–	7.8%	7.7%	–	10.8%	7.9%	–	8.4%
Velocity	ft/s	136.7	195.0	331.7	126.7	189.0	315.7	120.6	191.6	312.2	319.9
Referenced Flow Rate (Method 19)	CFM	244,421	348,750	593,171	236,862	353,411	590,273	225,098	357,510	582,608	588,684
Sampling Isokinetic Rate	%	102.4	103.0	–	103.3	101.9	–	104.4	102.5	–	102.9
Particulate Matter	lb/hr	1.74	0.96	2.70	2.65	2.43	5.08	2.52	2.17	4.69	4.16
Particulate Matter	lb/MMBTU	0.0031	0.0012	0.0043	0.0049	0.0030	0.0079	0.0049	0.0027	0.0076	0.0066

Notes:

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

Stack Gas Parameter		Test No. 1			Test No. 2			Test No. 3			Average
Testing Date		23-Aug-23			24-Aug-23			24-Aug-23			–
Load Condition		100% Load			100% Load			100% Load			–
Location		North	South	Total Exhaust	North	South	Total Exhaust	North	South	Total Exhaust	–
Stack Temperature	°F	1113	1114	–	1101	1103	–	1106	1107	–	1107
Moisture	%	10.2%	9.5%	–	9.7%	8.9%	–	9.1%	9.6%	–	9.5%
Velocity	ft/s	134.0	238.4	372.4	137.8	238.4	376.2	136.6	214.6	351.2	366.6
Referenced Flow Rate (Method 19)	CFM	259,437	461,594	721,031	288,195	498,798	786,993	301,662	474,020	775,682	761,235
Sampling Isokinetic Rate	%	104.2	102.6	–	100.3	102.1	–	100.5	102.7	–	102.1
Particulate Matter	lb/hr	1.75	2.16	3.91	1.46	5.23	6.69	4.06	2.35	6.41	5.67
Particulate Matter	lb/MMBTU	0.0029	0.0020	0.0049	0.0023	0.0047	0.0070	0.0061	0.0022	0.0083	0.0067

Notes:

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

Table 3Bi: Summary of Formaldehyde Emissions - Unit 4 70% Load

DTE Renaissance

Facility: DTE Renaissance
City: Carson City, Michigan
Source: Unit 4 Base Load
Date: 8/22/2023

	Symbol	Units	Test 1	Test 2	Test 3	Average
Formaldehyde Concentration	CH2O	ppmvd	0.18	0.15	0.13	0.15
Oxygen Concentration	O_2	$\%_{wet}$	12.92	12.99	12.94	12.95
Oxygen Concentration	O_2	$\%_{dry}$	14.10	14.17	14.19	14.16
Formaldehyde Emission Rate	CH2O	pph	0.49	0.43	0.38	0.43
Formaldehyde Emission Rate	CH2O	lb/mmbtu	0.00036	0.00032	0.00028	0.00032
Formaldehyde Emission Rate	CH2O	lb/mmscf	3.71E-07	3.26E-07	2.89E-07	3.29E-07

Table 3Bii: Unit 4 70% Load Flow Rate Data

DTE Renaissance

Facility: DTE Renaissance
City: Carson City, Michigan
Source: Unit 4 Base Load

Parameter	Units	Tests 1-3	Test 2	Test 3	Average
Stack Gas Moisture	%	8.36	11.82	11.76	10.65
Dry Reference Flowrate	dscfm	602,004	604,766	602,917	603,229

Table 3Biii: Unit 4 70% Load Process Data

DTE Renaissance

Facility: DTE Renaissance
City: Carson City, Michigan
Source: Unit 4 Base Load

Parameter	Units	Test 1	Test 2	Test 3	Average
Natural Gas Usage	kscf/hr	1,327.1	1,319.5	1,311.5	1,319.4
Natural Gas Usage	scf/hr	1,327,103	1,319,469	1,311,525	1,319,366
Heat Input	BTU/scf	1,026	1,026	1,026	1,026
Heat Input	MMBTU/hr	1,361.6	1,353.8	1,345.6	1,353.7

Table 3Ci: Summary of Formaldehyde Emissions - Unit 4 100% Load

DTE Renaissance

Facility: DTE Renaissance
City: Carson City, Michigan
Source: Unit 4 High Load
Date: 8/23/2023

	Symbol	Units	Test 1	Test 2	Test 3	Average
Formaldehyde Concentration	CH2O	ppmvd	0.16	0.17	0.12	0.15
Oxygen Concentration	O_2	$\%_{wet}$	12.62	12.63	12.62	12.63
Oxygen Concentration	O_2	$\%_{dry}$	14.02	14.03	14.04	14.03
Formaldehyde Emission Rate	CH2O	pph	0.54	0.57	0.41	0.50
Formaldehyde Emission Rate	CH2O	lb/mmbtu	0.00032	0.00034	0.00025	0.00030
Formaldehyde Emission Rate	CH2O	lb/mmscf	3.32E-07	3.50E-07	2.52E-07	3.11E-07

Table 2Cii: Unit 4 High 100% Flow Rate Data

DTE Renaissance

Facility: DTE Renaissance
City: Carson City, Michigan
Source: Unit 4 High Load

Parameter	Units	Tests 1	Test 2	Test 3	Average
Stack Gas Moisture	%	9.93	9.95	10.03	9.97
Dry Reference Flowrate	dscfm	727,236	726,910	726,093	726,746

Table 3Ciii: Unit 4 High 100% Load Process Data

DTE Renaissance

Facility: DTE Renaissance
City: Carson City, Michigan
Source: Unit 4 High Load

Parameter	Units	Test 1	Test 2	Test 3	Average
Natural Gas Usage	kscf/hr	1,622.0	1,619.0	1,614.8	1,618.6
Natural Gas Usage	scf/hr	1,622,036	1,618,951	1,614,777	1,618,588
Heat Input	BTU/scf	1,026	1,026	1,026	1,026
Heat Input	MMBTU/hr	1,664.2	1,661.0	1,656.8	1,660.7

Table 3D: THC, Methane and NMOC Emissions Table

Source: DTE Renaissance Unit#4 - 70% Load
RWDI Project: 2305396

Parameter	Test 1	Test 2	Test 3	Average
Date	22-Aug-23	22-Aug-23	22-Aug-23	--
Start Time:	7:31	8:47	10:02	--
Stop Time:	8:30	9:46	11:01	--
Duration (mins):	60	60	60	--
Oxygen ($\%_{dry}$)	13.99	14.06	14.06	14.04
Moisture:	8.5%	8.3%	8.4%	8.4%
THC Concentration (as propane) ppm:	0.02	0.05	0.06	0.04
CH4 Concentration (as methane) ppm:	0.20	0.46	0.48	0.38
NMOC Concentration (minus methane) as Propane ppm	-0.06	-0.17	-0.17	-0.13
NMOC Concentration (minus methane) as Propane ppmd	-0.07	-0.19	-0.18	-0.15
NMOC Concentration (minus methane) as Propane ppmd @ 15% O_2	-0.06	-0.16	-0.16	-0.13
Response Factor	2.45	2.10	2.13	2.23
THC Concentration (as propane) ppm corrected per Method 7E:	-0.09	-0.05	-0.01	-0.05
CH4 Concentration (as methane) ppm corrected per Method 7E:	-0.19	-0.02	0.02	-0.06
NMOC Concentration (minus methane) ppm corrected per Method 7E as propane	-0.02	-0.04	-0.03	-0.03
NMOC Concentration (minus methane) as Propane ppmd	-0.02	-0.05	-0.03	-0.03
NMOC Concentration (minus methane) as Propane ppmd @ 15% O_2	-0.02	-0.04	-0.02	-0.03
Response Factor	2.45	2.10	2.13	2.23

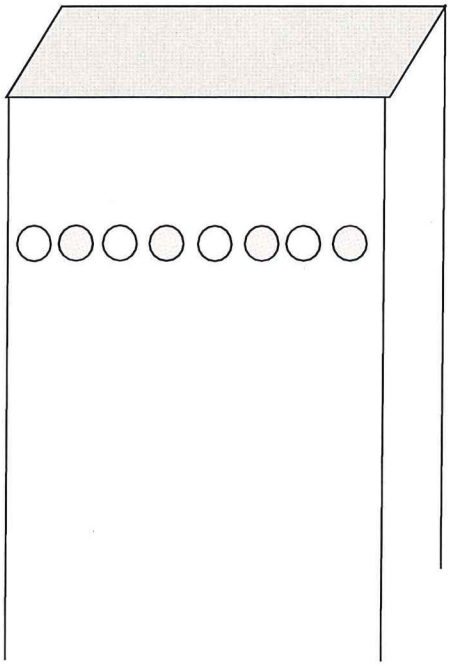
Table 3E: THC, Methane and NMOC Emissions Table

Source: DTE Renaissance Unit#4 - 100% Load
RWDI Project: 2305396

Parameter	Test 1	Test 2	Test 3	Average
Date	24-Aug-23	24-Aug-23	24-Aug-23	--
Start Time:	6:43	7:58	9:07	--
Stop Time:	7:42	8:57	10:06	--
Duration (mins):	60	60	60	--
Oxygen ($\%_{dry}$)	14.00	14.57	14.37	14.31
Moisture:	9.9%	9.9%	9.9%	9.9%
THC Concentration (as propane) ppm:	-0.17	0.02	0.00	-0.05
CH4 Concentration (as methane) ppm:	-0.07	-0.03	-0.19	-0.10
NMOC Concentration (minus methane) as Propane ppm	-0.14	0.04	0.08	-0.01
NMOC Concentration (minus methane) as Propane ppmd	-0.16	0.04	0.09	-0.01
NMOC Concentration (minus methane) as Propane ppmd @ 15% O_2	-0.14	0.04	0.08	-0.01
Response Factor	2.33	2.24	2.22	2.26
THC Concentration (as propane) ppm corrected per Method 7E:	-0.18	-0.03	-0.05	-0.09
CH4 Concentration (as methane) ppm corrected per Method 7E:	-0.09	-0.05	-0.21	-0.12
NMOC Concentration (minus methane) ppm corrected per Method 7E as propane	-0.14	-0.01	0.04	-0.04
NMOC Concentration (minus methane) as Propane ppmd	-0.16	-0.01	0.05	-0.04
NMOC Concentration (minus methane) as Propane ppmd @ 15% O_2	-0.13	-0.01	0.04	-0.03
Response Factor	2.33	2.24	2.22	2.26

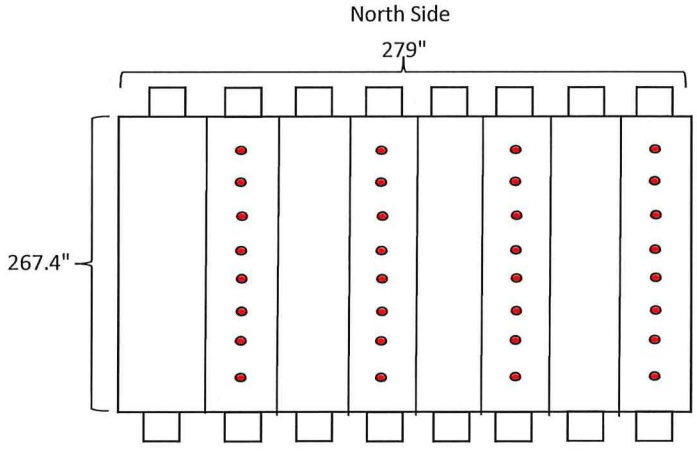
FIGURES

Figure No. 1: Unit 4 Exhaust Stack Diagram



Diameter: 279" x 267.4"

Sampling Points (in.)	
1	17.40
2	52.30
3	87.20
4	122.10



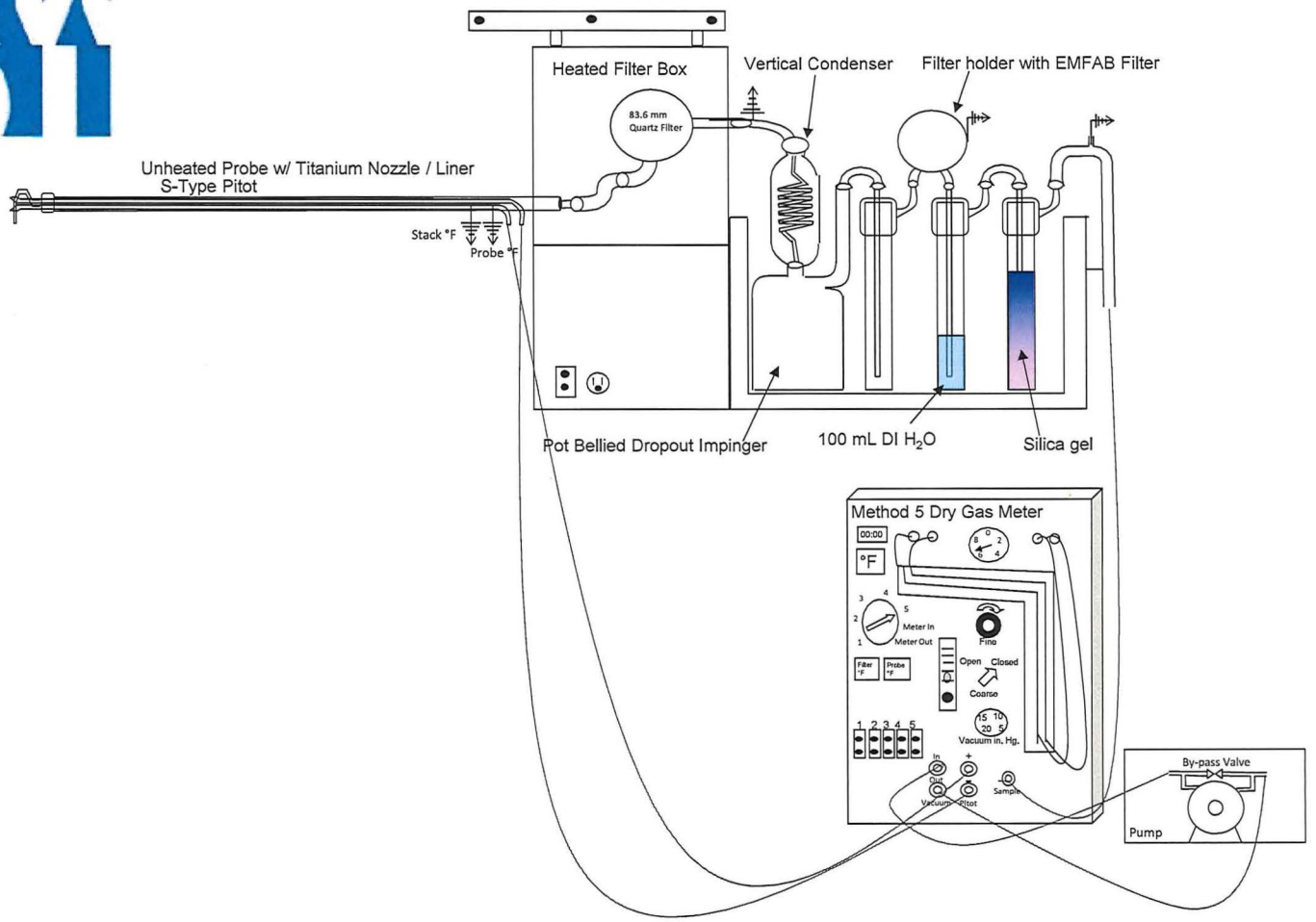
Not to scale

Unit 4
DTE Energy
Renaissance
Carson City, Michigan

Date:
August 22-24, 2023

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309

Figure No. 2 Schematic of USEPA Method 5/202



USEPA Method 5/202

DTE Energy

Renaissance Power Plant

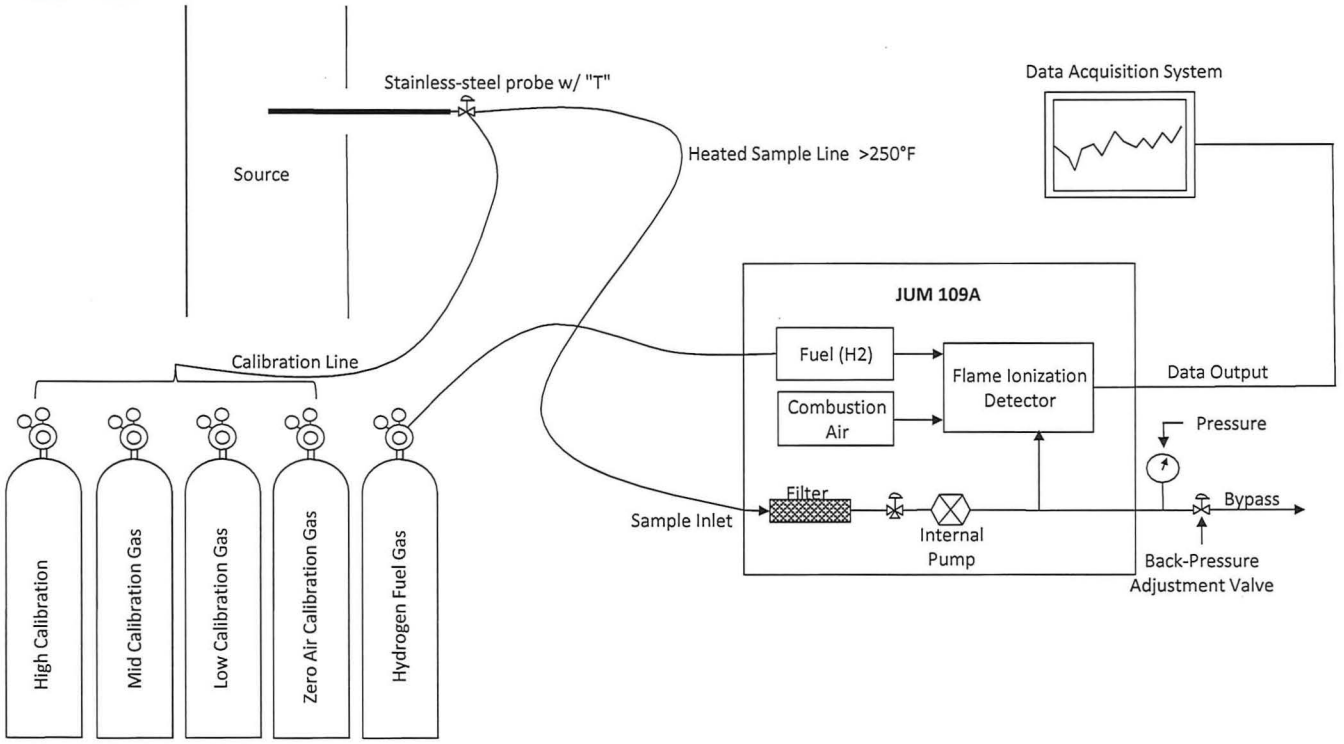
EU-TURBINE4SC

Carson City, MI

Project# 2305396

Date: Aug. 22nd to 24th, 2023

Figure No. 3: USEPA Method 25A Schematic



USEPA Method 25A

DTE Energy

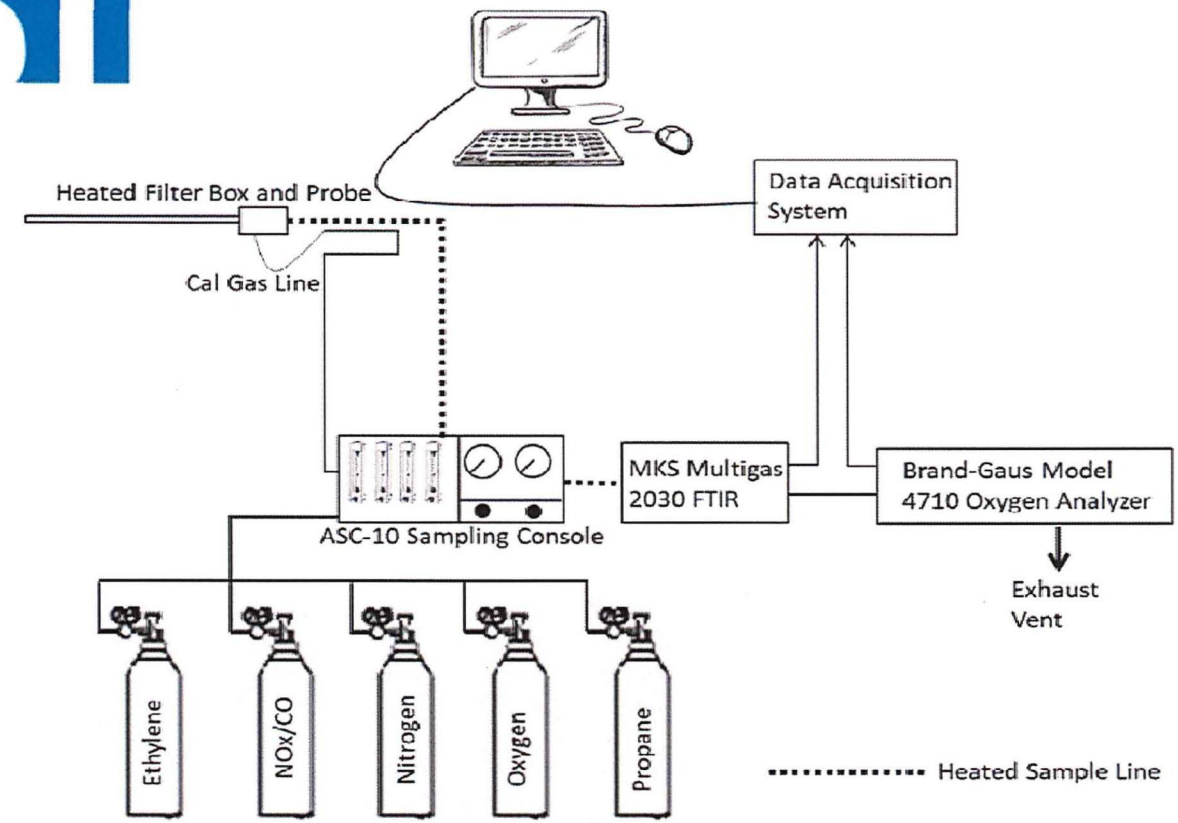
Renaissance Power Plant

Carson City, MI

Project# 2305396

Date: Aug. 22 & 24, 2023

Figure No. 4: Schematic of USEPA Method 320



USEPA Method 320

DTE Energy

Renaissance Power Plant

EU-TURBINE4SC

Carson City, MI

Project 2305396

Date: Aug. 22 & 24, 2023