

1.0 INTRODUCTION AND SUMMARY

1.1 PROGRAM OBJECTIVES

Montrose Air Quality Services, LLC (Montrose) was contracted by DTE Energy (DTE) to perform a series of air emission tests at the Renaissance Power Station (RPS) facility located in Carson City, MI. The compliance tests were conducted on two (2) Siemens EUTURBINE1SC (Unit 1) and EUTURBINE2SC (Unit 2) simple cycle gas turbine generators, to determine compliance with the source testing conditions of the Michigan Department of Environment, Great Lakes and Energy (EGLE).

The testing was conducted by Mr. Robert Burton, Mr. Barry Boulianne, Mr. Mike Nummer, Mr. Shane Rabideau, Mr. Ryan McWhinnie, Mr. David Koponen, Mr. Trevor Tilmann, Mr. Zach Le Fever, Mr. Scott Dater, Mr. Ben Durham, and Mr. Craig Blohm of Montrose on November 17th thru 25th, 2020. Mr. Robert Burton was the qualified individual on site, his QI Certifications are located in Appendix A. Mr. Mark Grigereit of DTE Energy coordinated the testing program. The tests were conducted according to a Protocol dated October 12, 2020 which was submitted to EGLE. Ms. Gina Angellotti and Ms. Lindsey Wells from EGLE were onsite and observed the testing program. Montrose performed the tests to measure the following emission parameters:

- Emission Compliance:
 - VOC (ppmvd @ 15% O₂)
 - PM (total) as PM_{10/2.5} (lb/hr)
 - Formaldehyde (lb/hr)
 - O₂ and CO₂ (% volume dry) – for molecular weight & dilution calculations
 - Stack volumetric flow rate (dscfm per Method 19) and moisture content (% by volume)
- Fuel analysis (“F_d” factor, HHV, sulfur content)

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits and performance specifications in Table 1-1 and Table 1-2. Detailed results for individual test runs can be found in Section 5.0. All supporting data can be found in the appendices.

TABLE 1-1
SUMMARY OF AVERAGE COMPLIANCE RESULTS
DTE RENAISSANCE POWER STATION
TURBINE UNITS 1 and 2
70% CONDITION

Parameter	Unit 1 (11/17/20 thru 11/19/20)	Unit 2 (11/22/20 thru 11/23/20)	Permit Limit
Unit Data:			
Fuel Heat Input (MMBtu/hr)	744.22	767.4	--
VOC Emissions:			
ppmvd as C ₃ H ₈ @ 15% O ₂	0.06	0.08	2.0
Total Particulate Matter (PM2.5/PM10):			
PM 10 lb/hr	8.67	5.00	9.0
Formaldehyde:			
ppmvw lb/hr	0.0606	0.1757	--

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS
DTE RENAISSANCE POWER STATION
TURBINE UNITS 1 and 2
BASE CONDITION

Parameter	Unit 1 (11/20/20 thru 11/21/20)	Unit 2 (11/24/20 thru 11/25/20)	Permit Limit
Unit Data:			
Fuel Heat Input (MMBtu/hr)	944.13	971.07	--
VOC Emissions:			
ppmvd as C ₃ H ₈ @ 15% O ₂	0.00	0.00	2.0
Total Particulate Matter (PM2.5/PM10):			
PM 10 lb/hr	6.87	10.60	9.0
Formaldehyde:			
ppmvw lb/hr	0.1143	0.0791	--

2.2 Process Operating Data

During each test run, fuel flow and fuel heat input to the gas turbine were continuously recorded on a data acquisition system. The data is averaged for each test run in the final report.

2.3 SAMPLING LOCATIONS

A total of sixteen 6" flanged sample ports are installed on each unit with 8 installed on each the north and south walls of the exhaust ducts. Eight ports were selected for use on this program, 4 on each side.

The test locations on Unit 1 and Unit 2 at RNPP do not meet the minimum dimensional criteria of EPA Method1 (>2stack equivalent diameters downstream and > 0.5 diameters upstream from flow disturbances. The available sample locations are in fact inside of an area for the exhaust system contains silencer baffles that are separated with gaps where the exhaust gases pass between them. In addition to the complications related to the silencer baffles, the situation is further complicated by the relatively large overall dimensions of the exhaust ducting which is approximately 20' x 20' square with parts installed on opposing walls. A diagram of the sample plane is shown below. The figure shows 16 sample ports providing access to 8 gas path openings, arranged into 8 opposing pairs.

Traverse Points

A simplified diagram of the traverse points is provided in Figure 1.

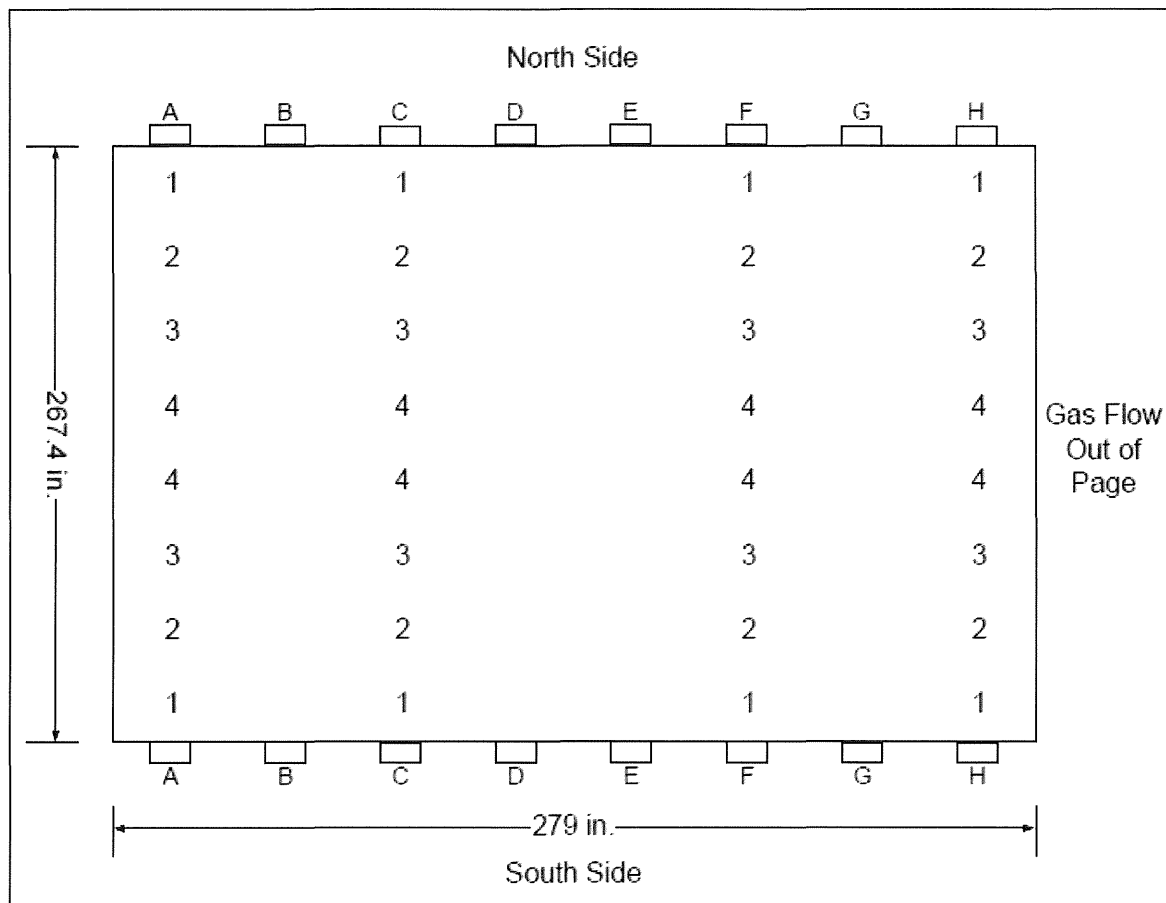


Figure 1
Sample Point Layout

3.0 TEST DESCRIPTION

3.1 PROGRAM OBJECTIVES

The objective of this test program was to prove compliance of Units 1 and 2 with the permit limits. The results are presented in units consistent with those stated in the permit.

3.2 TEST CONDITIONS

Emission tests were performed while the source units were operating at the conditions required by the permit. Tests were performed at the following conditions:

- Condition 1: Base Load
- Condition 2: 70% Load

Plant personnel established the test conditions and collected all applicable unit-operating data. Montrose monitored the collection of process data.

3.3 TEST PROGRAM SCHEDULE

The test program schedule is presented in Table 3-1.

**TABLE 3-1
TEST MATRIX AND SCHEDULE**

Date	Source ID/ Activity	Sample Runs	Sample Duration
November 16, 2020	Set-up	--	--
November 17, 2020	Unit 1 Stack 70% O ₂ & CO ₂ PM	1 Voided 1 Voided	4 hour 4 hour
November 18, 2020	Unit 1 Stack 70% O ₂ & CO ₂ PM	2 2	4 hour 4 hour
November 19, 2020	Unit 1 Stack 70% O ₂ , CO ₂ , VOC, CH ₂ O O ₂ & CO ₂ PM	1-3 3-4 3-4	1 hour 4 hour 4 hour
November 20, 2020	Unit 1 Stack Base O ₂ , CO ₂ , VOC, CH ₂ O O ₂ & CO ₂ PM	1-3 1-2 1-2	1 hour 4 hour 4 hour
November 21, 2020	Unit 1 Stack Base O ₂ & CO ₂ PM	3 3	4 hour 4 hour
November 22, 2020	Unit 2 Stack 70% O ₂ & CO ₂ PM O ₂ & CO ₂ PM	1 Voided 1 Voided 2 2	4 hour 4 hour 4 hour 4 hour
November 23, 2020	Unit 2 Stack 70% O ₂ , CO ₂ , VOC, CH ₂ O O ₂ & CO ₂ PM	1-3 3-4 3-4	1 hour 4 hour 4 hour
November 24, 2020	Unit 2 Stack Base O ₂ , CO ₂ , VOC, CH ₂ O O ₂ & CO ₂ PM	1-3 1-2 1-2	1 hour 4 hour 4 hour
November 25, 2020	Unit 2 Stack Base O ₂ & CO ₂ PM	3 3	4 hour 4 hour

3.4 MONTROSE TEST PROCEDURES

The test procedures used for this test program are summarized in Table 3-2 below. Additional information regarding specific applications or modifications to standard procedures is presented in the following sub-sections.

**TABLE 3-2
TEST PROCEDURES**

Parameter	Measurement Principle	Reference Method
Volumetric flow rate	Pitot/temperature traverse	EPA 1, 2
Volumetric flow rate	Stoichiometric calculation	EPA 19
O ₂	Paramagnetism	EPA 3A
CO ₂	Non-dispersive infrared	EPA 3A
VOC	FID, Tedlar bag / GC	EPA 25A/18
Moisture	Impinger weight gain	EPA 4
Particulate Matter	Gravimetry with condensable analysis	EPA 5/202
Formaldehyde	FTIR	EPA 320

3.4.1 Gaseous Emissions

Concentrations of the gaseous constituents of stack gas carbon dioxide (CO₂) and oxygen (O₂) were measured using Montrose's dry extractive reference method (RM) monitor system in accordance with Methods 3A. This system meets the requirements of EPA method for gaseous species. Pertinent information regarding the performance of the method is presented below:

- Method Deviations: None
 - Method Options: N/A

Source gas was sampled for a period of 60 minutes for each of the conditions per source.

3.4.2 Volatile Organic Compounds

Concentrations of volatile organic compounds (VOCs) were measured by gas chromatograph and flame ionization detector of sample gas collected per EPA Method 18 and 25A. Pertinent information regarding the performance of the method is presented below:

- Method Deviations: Method 320 was performed for Methane and Ethane, and this was approved at the site by EGLE.
 - Target Analytes: Total non-methane, non-ethane hydrocarbons

3.4.3 Particulate Matter Emissions

Emissions of total particulate matter (PM) were measured using a combination of EPA Methods 5 and 202. Pertinent information regarding the performance of the methods are presented below:

- Method Deviations: Test 1 on Unit 1 at 70% condition was voided because of an extended shut down period during an outage this unit. Test 1 on Unit 2 at 70% condition was voided because of a malfunction with Montrose's equipment and an issue with a graphite ferrule. This data is presented in Appendices B and C.
 - Method Options: A field train recovery blank was collected on-site; the glassware was baked for 6 hours prior to use. Additionally, pressurized nitrogen was used to purge all trains
 - Target and/or Minimum Required Sample Duration: 240 Minutes
 - Target and/or Minimum Required Sample Volume: >120 dscf
 - Analytical Laboratory: Montrose Elk Grove Village, IL

3.4.4 Volumetric Flow Rate

Stack gas volumetric flow rates were determined by the procedures outlined in EPA Method 19. Pertinent information regarding the performance of the method is presented below:

- F Factor: Oxygen based F factor, dry basis (F_d)
 - F Factor Source: Analysis of fuel samples
 - Heat Input Data: Calculated based on fuel flow rate and higher heating value
 - Higher Heating Value Source: Analysis of fuel samples.

Volumetric flow rates and moisture content were determined using EPA Methods 2 and 4 in conjunction with each particulate matter test. The calculated Method 19 flow rates were used to calculate emissions in lb/hr.

3.4.5 Formaldehyde - *StarBoost™ FTIR Method 320 Instrumental Configuration & Sample Collection*

FTIR data were collected using an MKS MultiGas 2030 FTIR spectrometer configured with a StarBoost system. The StarBoost technology consists of a 5-micron infrared detector, optical filtration and signal amplification. It is designed to optimize signal response and limit instrument noise for low detection limit applications. The FTIR was equipped with a temperature-controlled, 5.11-meter multipass gas cell maintained at 191°C. All data were collected in differential mode with 2 cm⁻¹ resolution sample data and 8 cm⁻¹ resolution background. Each FTIR spectrum was derived from the coaddition of 200 scans, with a new data point generated approximately every 60 seconds.

Sample gas continuously flew through the FTIR gas cell via heated head sampling pump. Total sample flow was approximately eight liters per minute. Gas flow and sampling system pressure were monitored using a rotameter and pressure transducer. See Table 1 below for sampling system details.

- Analytical Laboratory: Prism Analytical Technologies - Mount Pleasant, MI

3.4.6 Fuel Analysis

Sample gas from the facility's ethane blend natural gas fuel supply pipeline was collected and submitted for analysis. Pertinent information regarding the fuel analysis is presented below:

- Analytical Method: ASTM D-1945/ASTM D-3246
 - Sample Containers: Teflon-coated pressurized fuel bombs
 - Analytical Laboratory: Texas Oil Tech Laboratories, Inc., Houston

3.4.7 Process Data

The plant's unit operating data was used to document process conditions during the test runs. Unit operating data was provided by DTE personnel. Data presented in this report includes the following:

- Power output
- CEMS data
- Heat Input
- Fuel Flow

4.0 QUALITY ASSURANCE AND REPORTING

4.1 SAMPLING AND ANALYTICAL QA/QC

Montrose has instituted a rigorous QA/QC program for all of its air pollution testing. Quality assurance audits are performed as part of the test program to ensure that the final results are calculated from the highest quality data. The program ensures that the emission data reported are as accurate as possible. The procedures included in the cited reference methods were followed for all steps of preparation, sampling, calibration, and analysis. Montrose was responsible for preparation, calibration and cleaning of the sampling apparatus. Montrose also conducted the sampling and sample recovery, storage, and shipping.

Contract laboratories conducted some of the preparation and sample analyses as needed. The laboratories that were used are established leaders in development and performance of the reference methods for which they have been selected. Their credentials for adherence to the required quality assurance procedures are well known.

4.2 QUALITY CONTROL PROCEDURES

Our Quality Assurance Program provides our equipment maintenance and calibration schedule, quality control acceptance limits, and any corrective action that may be needed. For additional quality control, Montrose followed the procedures outlined below and in the method write-ups in Section 3.4.

4.2.1 Equipment Inspection and Maintenance

- Each critical piece of field equipment was assigned a unique identification number to allow tracking of its calibration history
 - All field equipment was visually inspected prior to testing and included pre-test calibration checks

4.3 DATA ANALYSIS, VALIDATION, AND UNCERTAINTY

The raw data collected during the sampling and analysis procedures were used to calculate the results of the testing program. The analysis or reduction of the data to the final results followed these steps, where appropriate to the test method:

- Check field-sampling data for accuracy and calculate appropriate data averages (e.g., temperatures, pressures, volumes, etc.).
 - Double check calculation of the data averages.
 - Review all in-house and contract laboratory reports and ensure that appropriate and/or required QA/QC steps were followed.
 - Enter field and laboratory data to established and verified computer spreadsheets for calculation of volumetric flow rates, mass emission rates or other appropriate results.
 - Double-check all lab and field data inputs.
 - Perform example calculations by hand using raw data on a single test run for each type of emission result reported.
 - Compile summary tables of results and review all table inputs.

This report includes copies of spreadsheet printouts (data input and results output) and example calculation checks. The field data sheets with average data calculations are also included. Standard conditions used for data reduction are 29.92 inches of mercury and 68 °F.

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose personnel reduce the impact of these uncertainty factors by using approved and validated test methods. In addition, Montrose personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

5.0 DISCUSSION OF RESULTS

5.1 DETAILED DISCUSSION OF RESULTS

The average results are compared to the performance specifications in Table 1-1. Detailed results from the individual compliance test runs are presented in Tables 5-1 through 5-20.

Additional information is included in the appendices. Appendix A presents the quality assurance information, including instrument calibration data. Data sheets and plant data is included in Appendix B. Appendix C presents the general and specific equations used for the emissions calculations and computer spreadsheets. Appendix D presents the outside lab results.

5.2 PROBLEMS/DEVIATIONS/EXCEPTIONS

The testing on Unit 2 at Base load didn't meet the permit requirements for particulate lb/hr and will need to be retested.