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 EUTURBINE3SC (Unit 3) 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. John Hamner, Mr. Thomas Cassin, Mr. Mike Nummer, Mr. Shane Rabideau, Mr. Nicholas Woltcamp, Mr. Mathew Ojile, Mr. Trevor Tilmann, Mr. Zach Le Fever, Mr. Scott Dater, Mr. Ben Durham, and Mr. Craig Blohm of Montrose on March 18th thru 21st, 2021. Mr. John Hamner 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 PM10/2.5 (lb/hr)
  - Formaldehyde (lb/hr)
  - O_2 and CO_2 (% 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. 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 UNIT 3
70% CONDITION

Parameter	Unit 3 (3/18/21 thru 3/21/21)	Permit Limit
Unit Data:		
Fuel Heat Input (MMBtu/hr)	1,549.7	--
VOC Emissions:		
ppmvd as C_3H_8 @ 15% O_2	0.00	2.0
Total Particulate Matter (PM2.5/PM10):		
PM 10 lb/hr	3.86	9.0
Formaldehyde:		
ppmvw lb/hr	0.186	--

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS
DTE RENAISSANCE POWER STATION
TURBINE UNIT 3
BASE CONDITION

Parameter	Unit 3 (3/19/21 thru 3/20/21)	Permit Limit
Unit Data:		
Fuel Heat Input (MMBtu/hr)	1,910.3	--
VOC Emissions:		
ppmvd as C_3H_8 @ 15% O_2	0.00	2.0
Total Particulate Matter (PM2.5/PM10):		
PM 10 lb/hr	4.80	9.0
Formaldehyde:		
ppmvw lb/hr	0.264	--

1.2 PROJECT CONTACTS

A list of project participants is included below:

Facility Information

Source Location:	Renaissance Power Plant 950 N. Division Street Carson City, MI 48811
Project Contact:	Mr. Mark Grigereit
Company:	DTE Energy
Telephone:	(313) 412-0305
Email:	Mark.grigereit@dteenergy.com

Agency Information

Regulatory Agency:	Michigan Department of Environment, Great Lakes and Energy	
Agency Contact:	Ms. Gina Angellotti	Ms. Lindsey Wells
Telephone:	(313) 418-0895	(517) 282-2345
Email:	AngellottiR1@michigan.gov	Wellsl8@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC (Montrose)	
Contact:	Barry Boulianne	John Hamner
Title:	VP Sales and Marketing	Client Project Manager
Telephone:	(313) 449-2361	(630) 715-3259
Email:	bboulianne@montrose-env.com	jhamner@montrose-env.com

2.0 SOURCE LOCATION INFORMATION

2.1 FACILITY DESCRIPTION

The plant provides electric power when requested to do so during periods of peak power demand or system need, and does not operate outside of those system requests so its operation is batch like. During periods of operation, there is not significant emissions variability.

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 is equipped with dry low-NOX burners. Each unit has its own dedicated exhaust stack areas. Each turbine has a nominal heat input rating of 1,900 million Btu per hour, and is capable of producing 215 megawatts of electricity. The facility is equipped with a Distributed Control System (DCS) to monitor heat input. NOx emissions from the exhaust are continuously monitored as required by 40 CFR, Part 75. Carbon Monoxide (CO) stack emissions are continuously monitored per 40 CFR, Part 60

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

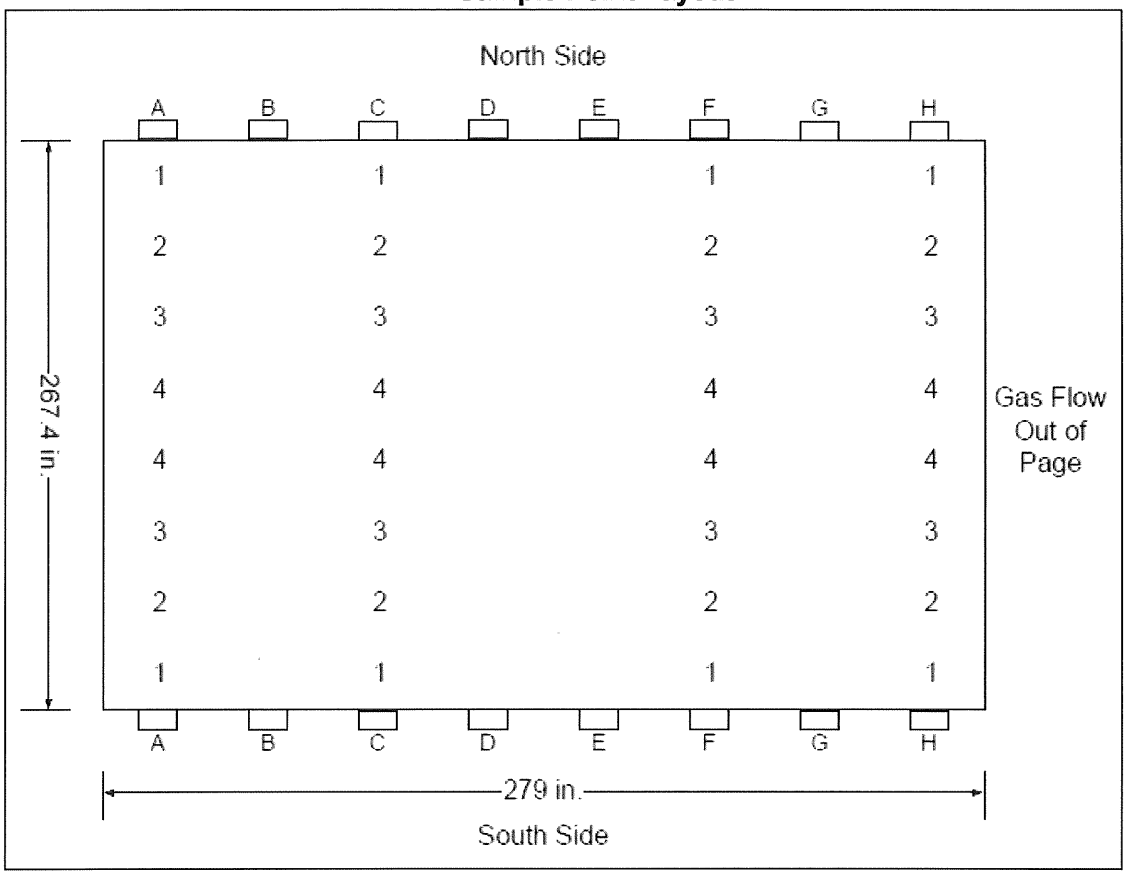
A total of sixteen 6" flanged sample ports are installed on each unit with 8 installed on each the north and south walls of the exhaust ducts. Eight ports were selected for use on this program, 4 on each side.

The test locations on Unit 3 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 ports 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 Unit 3 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
March 15, 2021	Set-up	--	--
March 18, 2021	**Unit 3 Stack 70%**		
	O_2 & CO_2	1	4 hour
	PM	1	4 hour
March 19, 2020	**Unit 3 Stack 70%**		
	O_2, CO_2, VOC, CH_2O	1-3	1 hour
	O_2 & CO_2	2	4 hour
	PM	2	4 hour
March 19, 2020	**Unit 3 Stack Base**		
	O_2, CO_2, VOC, CH_2O	1-3	1 hour
	O_2 & CO_2	1	4 hour
	PM	1	4 hour
March 20, 2020	**Unit 3 Stack Base**		
	O_2 & CO_2	2-3	4 hour
	PM	2-3	4 hour
March 21, 2020	**Unit 3 Stack 70%**		
	O_2 & CO_2	3	4 hour
	PM	3	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, FTIR	EPA 25A/ EPA 320
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 (CO_2) and oxygen (O_2) 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. All Method 25A data was drift corrected and the moisture from Method 320 was used for correcting the wet data to dry data.
    - 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: During Test 2 on the North Side at Base load, the Method 5 filter had tear in it. This was discussed with DTE and EGLE at site. The test was accepted as a compliance test.
    - 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.

Velocity 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 5-10.

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

- During Test 2 on the North Side at Base load, the Method 5 filter had tear in it. This was discussed with DTE and EGLE at site. The test was accepted as a compliance test.

TABLE 5-1
GASEOUS TEST RESULTS
UNIT 3 70%

Reference Method Test Run Data

Client:	DTRE
Facility:	Renaissance
Source:	GT 3
Test Location:	Stack
Condition/Load:	70% & Base
Project Number:	049AS-006795

Test Start Date:	Friday, March 19, 2021
Test Completion Date:	3/19/2021
Operator:	Tom Cassin

F Factor Information

F_c	-
F_d	8710
Reference Method Measurement Basis:	Dry - Extractive
CEMS Analyzer Measurement Basis:	-

Uncorrected Reference Method Analyzer Results

Run Number	Test Date	Start Minute	End Minute	CO (ppmvd)	NO_x (ppmvd)	SO_2 (ppmvd)	O_2 (% v/v Dry)	CO_2 (% v/v Dry)
1 70%	03/19/21	9:15	10:15	-	-	-	13.84	4.05
2 70%	03/19/21	10:40	11:40	-	-	-	13.88	4.02
3 70%	03/19/21	12:05	13:05	-	-	-	13.90	3.99

Calibration Corrected Reference Method Analyzer Results

Moisture Basis As Measured

Run Number	Test Date	Start Minute	End Minute	CO (ppmvd)	NO_x (ppmvd)	SO_2 (ppmvd)	O_2 (% v/v Dry)	CO_2 (% v/v Dry)
1 70%	03/19/21	9:15	10:15	-	-	-	13.85	4.00
2 70%	03/19/21	10:40	11:40	-	-	-	13.91	4.02
3 70%	03/19/21	12:05	13:05	-	-	-	13.96	3.97

TABLE 5-2
VOC TEST RESULTS
UNIT 3 70%

Method 25A - Non-Methane Hydrocarbon - NMHC- Data

Client:	DTE
Facility:	Renaissance
Test Location:	Stack GT 3
Project Number:	049AS-006795
Test Date:	Friday, March 19, 2021
Operator:	Tom Cassin

Location	Source 1			
Test Run Number	1	2	3	Average
Condition	70%	70%	70%	
Test Date	3/19/2021	3/19/2021	3/19/2021	
Test Start	9:15	10:40	12:05	
Test End	10:15	11:40	13:05	
Test Duration (Minutes)	1:00	1:00	1:00	1:00:00
THC (ppmvw as Propane)	0.10	0.10	0.10	0.03
Volumetric Flow Rate (dscfm)	649950.9	655044.2	659424.7	654807
THC (ppmvd as Propane)	0.11	0.11	0.11	0.04
Methane/Ethane (ppmvd as Propane)	0	0	0	0.00
NMHC (ppmvd as Propane)	0.11	0.11	0.11	0.04
NMHC (lb/hr as Propane)	0.48	0.49	0.49	0.16
NMHC (lb/hr as Carbon)	0.39	0.40	0.40	0.13
Moisture Content (%)	7.65	7.68	7.6	7.64
Oxygen (% Dry)	13.85	13.91	13.96	13.91
F_0	8622	8622	8622	8622
NMHC (lb/MMBtu) - F_0 Basis	-3.1604E-04	-3.1885E-04	3.2087E-04	-1.0467E-04
THC (ppmvd as Propane @15% O2)	-0.05	-0.05	0.05	-0.02

TABLE 5-3
CH_2O TEST RESULTS
UNIT 3 70%

Condition	Calculation	H2O (%v)	Methane (ppmv wet)	Ethane (ppmv wet)	Formaldehyde (ppmv wet)
3/19/2021 GT-3 - 70% Load - Run 1 09:15 - 10:15	Minimum	7.61	< 0.5	< 2.0	0.043
	Maximum	7.73	< 0.5	< 2.0	0.076
	Average	7.65	< 0.5	< 2.0	0.059
3/19/2021 GT-3 - 70% Load - Run 2 10:40 - 11:40	Minimum	7.63	< 0.5	< 2.0	0.043
	Maximum	7.74	< 0.5	< 2.0	0.074
	Average	7.68	< 0.5	< 2.0	0.058
03/19/2021 GT-3 - 70% Load - Run 3 12:05 - 13:05	Minimum	7.44	< 0.5	< 2.0	0.043
	Maximum	7.72	< 0.5	< 2.0	0.081
	Average	7.60	< 0.5	< 2.0	0.065

	GT3 3/19/2021 70% Load 9:15-10:15 T1	GT3 3/19/2021 70% Load 10:40-11:40 T2	GT3 3/19/2021 70% Load 12:05-13:05 T3	
Formaldehyde (ppm)	0.059	0.058	0.065	
MW Formaldehyde	30.031	30.031	30.031	
O2 (%)	13.85	13.91	13.96	
Fd	8621.6	8621.6	8621.6	
Formaldehyde (lb/MMBtu)	1.1754E-04	0.000116535	0.00013154	
Fuel Heat Input (MMBTU/hr)	1525.8	1524.6	1523.8	**Average**
Formaldehyde (lb/hr)	**0.179**	**0.178**	**0.200**	**0.186**

TABLE 5-4
PARTICULATE TEST RESULTS
UNIT 3 NORTH 70%

Client				DTE
Unit/Location				RENPP#3-North 70%
A (stack area), ft²				239.785
T_{std} (reference temperature), °F				68
Test number	Run 1	Run 2	Run 3	Average
Date	3/18/21	3/19/21	3/27/21	--
Start/ Stop time	8:08-12:38	8:11-12:35	7:59-12:26	--
F_d (fuel 'F' factor @ 68°F), dscf/MMBtu	8621.60	8616.50	8616.80	--
F_d (fuel 'F' factor @ T_{std}), dscf/MMBtu	8621.60	8616.50	8616.80	--
Fuel Density, lb/scf (fuel std condition 60°F	0.0459	0.0454	0.0454	--
HHV (fuel higher heating value), Btu/scf	1052.20	1048.98	1048.68	--
Fuel Flow Rate, lb/sec	9.20	9.15	9.20	--
Fuel Heat Input, MMBTU/hr	759.2	761.1	765.0	--
Meter box number	CS7	CS9	CS9	--
C_p (pitot coefficient), dimensionless	0.8400	0.8400	0.8400	0.8400
Y (meter calibration factor), dimensionless	0.9970	0.9720	0.9720	0.980
θ (sample time), min	240.00	240.00	240.00	240.00
Nozzle diameter, in	0.190	0.190	0.190	0.190
P_{bar} (barometric pressure), in Hg	29.99	30.49	30.45	30.31
V_m (meter box volume), acf	147.178	157.970	152.158	152.435
V_{lc} (impinger liquid), g	247.3	241.6	249.2	246.0
T_m (meter temperature), °F	53.0	54.3	52.8	53.4
ΔH (meter pressure), in. H_2O	1.304	1.576	1.486	1.455
ΔP (velocity head), in. H2O	3.3196	3.3139	3.1478	3.2604
P_s (static pressure), in. Hg	0.83	0.85	0.85	0.84
T_s (stack temperature), °F	1097.5	1097.4	1098.3	1097.7
%O_2 (oxygen stack gas), % volume dry	13.81	13.92	13.91	13.88
%CO_2 (carbon dioxide stack gas), % volume dry	4.08	3.99	4.01	4.03
m_n (F½ particulate matter catch - filter), g	0.0009	0.0025	0.0002	0.0012
m_a (F½ particulate matter catch - acetone rinse), g	0.0017	0.0004	0.0006	0.0009
m_{ctc} (B½ particulate matter catch - total condensible, blank	0.0035	0.0047	0.0024	0.0035
m_t (total particulate matter catch), g	0.0061	0.0076	0.0032	0.0056
% $V_{m(std)}$ (standard sample volume), dscf	151.855	161.266	155.531	156.219
% $V_{w(std)}$ (water vapor volume), scf	11.658	11.390	11.747	11.598
% B_{ws} (moisture fraction), non-dimensional	0.0713	0.0660	0.0702	0.0692
Moisture, %	7.13	6.60	7.02	6.92
% MW_d (stack gas molecular weight), dry	29.205	29.195	29.198	29.199
% MW_w (stack gas molecular weight), wet	28.406	28.457	28.412	28.425
% P_s (absolute stack pressure), in Hg	30.051	30.553	30.513	30.372
% V_s (stack gas velocity), ft/sec	176.442	174.675	170.541	173.886
Q_s (fuel heat input), dscfm	321.597	327.269	328.505	325.790
% I (isokinetic ratio), %	96.02	100.72	100.14	98.96
% G (F½ grain loading), gr/dscf	0.000264	0.000277	0.000079	0.000207
% M (F½ mass emissions), lb/hr	0.73	0.78	0.22	0.58
% E (F½ mass emissions), lb/MMBtu	0.000956	0.001020	0.000291	0.000756
% G (B½ grain loading), gr/dscf	0.000356	0.000450	0.000238	0.000349
% M (B½ mass emissions), lb/hr	0.98	1.26	0.67	0.97
% E (B½ mass emissions), lb/MMBtu	0.001287	0.001654	0.000874	0.001272
% G (total grain loading), gr/dscf	0.000620	0.000727	0.000317	0.000556
% M (total mass emissions), lb/hr	1.71	2.04	0.89	1.55
% E (total mass emissions), lb/MMBtu	0.00224	0.00267	0.001166	0.002028

TABLE 5-5
PARTICULATE TEST RESULTS
UNIT 3 SOUTH 70%

Client				DTE
Unit / Location				RENPP#3 70% South
A_s (stack area), ft^2				239.785
T_{std} (reference temperature), °F				68
Test number	Run 1	Run 2	Run 3	Average
Date	3/18/21	3/19/21	3/21/21	--
Start / Stop time	8:09-12:39	8:11-12:35	7:59-12:26	--
F_d (fuel 'F' factor @ 68°F), dscf/MMBtu	8621.60	8616.50	8616.80	--
F_d (fuel 'F' factor @ T_{std}), dscf/MMBtu	8621.60	8616.50	8616.80	--
Fuel Density, lb/scf (fuel std condition 60°F	0.0453	0.0454	0.0454	--
HHV (fuel higher heating value), Btu/scf	1052.20	1048.98	1048.68	--
Fuel Flow Rate, lb/sec	9.20	9.15	9.20	--
Fuel Heat Input, MMBTU/hr	759.2	761.1	765.0	--
Meter box number	CS4	CS4	CS4	--
C_p (pitot coefficient), dimensionless	0.8400	0.8400	0.8400	0.8400
Y (meter calibration factor), dimensionless	1.0240	1.0240	1.0240	1.024
θ (sample time), min	240.00	240.00	240.00	240.00
Nozzle diameter, in	0.178	0.178	0.178	0.178
P_{bar} (barometric pressure), in Hg	29.93	30.49	30.45	30.31
V_m (meter box volume), acf	137.170	139.260	139.030	138.487
V_{lc} (impinger liquid), g	234.8	217.9	228.9	227.2
T_m (meter temperature), °F	58.1	64.2	68.5	63.6
ΔH (meter pressure), in. H_2O	1.140	1.154	1.153	1.149
ΔP (velocity head), in. H2O	3.4244	3.5149	3.4193	3.4529
P_g (static pressure), in. Hg	0.87	0.87	0.87	0.87
T_s (stack temperature), °F	1103.0	1094.9	1093.6	1097.1
%O_2 (oxygen stack gas), % volume dry	13.81	13.92	13.91	13.88
%CO_2 (carbon dioxide stack gas), % volume dry	4.08	3.99	4.01	4.03
m_f (F½ particulate matter catch - filter), g	0.0002	0.0002	0.0015	0.0006
m_a (F½ particulate matter catch - acetone rinse), g	0.0049	0.0044	0.0042	0.0045
m_{cw} (B½ particulate matter catch - total condensible, blank	0.0033	0.0027	0.0020	0.0027
m_n (total particulate matter catch), g	0.0084	0.0073	0.0077	0.0078
% $V_{m(std)}$ (standard sample volume), dscf	143.863	146.777	145.143	145.263
% $V_{w(std)}$ (water vapor volume), scf	11.072	10.274	10.791	10.712
% B_{ws} (moisture fraction), non-dimensional	0.0715	0.0654	0.0692	0.0687
Moisture, %	7.15	6.54	6.92	6.87
% MW_d (stack gas molecular weight), dry	29.205	29.195	29.198	29.199
% MW_w (stack gas molecular weight), wet	28.404	28.463	28.423	28.430
% P_s (absolute stack pressure), in Hg	30.054	30.554	30.514	30.374
% V_s (stack gas velocity), ft/sec	179.516	179.726	177.434	178.892
Q_s (fuel heat input), dscfm	321,597	327,269	328,505	325,790
% I (isokinetic ratio), %	102.24	101.29	101.92	101.81
% G (F½ grain loading), grd/scf	0.000547	0.000484	0.000606	0.000546
% M (F½ mass emissions), lb/hr	1.51	1.36	1.71	1.52
% E (F½ mass emissions), lb/MMBtu	0.001980	0.001778	0.002225	0.001995
% G (B½ grain loading), grd/scf	0.000354	0.000284	0.000213	0.000283
% M (B½ mass emissions), lb/hr	0.98	0.80	0.60	0.79
% E (B½ mass emissions), lb/MMBtu	0.001281	0.001044	0.000781	0.001035
% G (total grain loading), grd/scf	0.000901	0.000767	0.000819	0.000829
% M (total mass emissions), lb/hr	2.48	2.15	2.30	2.31
% E (total mass emissions), lb/MMBtu	0.00326	0.00282	0.003006	0.003030

TABLE 5-6
GASEOUS TEST RESULTS
UNIT 3 BASE

Reference Method Test Run Data

Client:	DTRE
Facility:	Renaissance
Source:	GT 3
Test Location:	Stack
Condition/Load:	70% & Base
Project Number:	049A5-006795

Test Start Date:	Friday, March 19, 2021
Test Completion Date:	3/19/2021
Operator:	Tom Cassin

F Factor Information

F_c	-
F_d	8710

Reference Method Measurement Basis:	Dry - Extractive
CEMS Analyzer Measurement Basis:	-

Uncorrected Reference Method Analyzer Results

Run Number	Test Date	Start Minute	End Minute	CO (ppmvd)	NO_x (ppmvd)	SO_2 (ppmvd)	O_2 (% v/v Dry)	CO_2 (% v/v Dry)
1 Base	03/19/21	13:30	14:30	-	-	-	13.75	4.05
2 Base	03/19/21	15:00	16:00	-	-	-	13.76	4.06
3 Base	03/19/21	16:20	17:20	-	-	-	13.81	4.04

Calibration Corrected Reference Method Analyzer Results

Moisture Basis As Measured

Run Number	Test Date	Start Minute	End Minute	CO (ppmvd)	NO_x (ppmvd)	SO_2 (ppmvd)	O_2 (% v/v Dry)	CO_2 (% v/v Dry)
1 Base	03/19/21	13:30	14:30	-	-	-	13.86	4.04
2 Base	03/19/21	15:00	16:00	-	-	-	13.85	4.05
3 Base	03/19/21	16:20	17:20	-	-	-	13.87	4.03

TABLE 5-7
VOC TEST RESULTS
UNIT 3 BASE

Method 25A - Non-Methane Hydrocarbon - NMHC- Data

Client:	DTE
Facility:	Renaissance
Test Location:	Stack GT 3
Project Number:	049A5-006795
Test Date:	Friday, March 19, 2021
Operator:	Tom Cassin

Location	Source 1			
Test Run Number	1	2	3	Average
Condition	Base	Base	Base	
Test Date	3/19/2021	3/19/2021	3/19/2021	
Test Start	13:30	15:00	16:20	
Test End	14:30	16:00	17:20	
Test Duration (Minutes)	1:00	1:00	1:00	1:00:00
THC (ppmvw as Propane)	-0.10	0.00	-0.10	-0.07
Volumetric Flow Rate (dscfm)	822044.7	815394	813361	816933
THC (ppmvd as Propane)	-0.11	0.00	-0.11	-0.07
Methane/Ethane (ppmvd as Propane)	0	0	0	0.00
NMHC (ppmvd as Propane)	-0.11	0.00	-0.11	-0.07
NMHC (lb/hr as Propane)	-0.61	0.00	-0.60	-0.40
NMHC (lb/hr as Carbon)	-0.50	0.00	-0.49	-0.33
Moisture Content (%)	7.7	7.55	7.49	7.58
Oxygen (% Dry)	13.86	13.85	13.87	13.86
F_o	8622	8622	8622	8622
NMHC (lb/MMBtu) - F_o Basis	-3.1666E-04	0.0000E+00	-3.1639E-04	-2.1102E-04
THC (ppmvd as Propane @ 15% O2)	-0.05	0.00	-0.05	-0.03

TABLE 5-8
CH_2O TEST RESULTS
UNIT 3 BASE

Condition	Calculation	H2O (%v)	Methane (ppmv wet)	Ethane (ppmv wet)	Formaldehyde (ppmv wet)
3/19/2021 GT-3 - 100% Load - Run 1 13:30 - 14:30	Minimum	7.56	< 0.5	< 2.0	0.045
	Maximum	7.78	< 0.5	< 2.0	0.082
	Average	7.70	< 0.5	< 2.0	0.065
3/19/2021 GT-3 - 100% Load - Run 2 15:00 - 16:00	Minimum	7.41	< 0.5	< 2.0	0.050
	Maximum	7.60	< 0.5	< 2.0	0.093
	Average	7.55	< 0.5	< 2.0	0.074
3/19/2021 GT-3 - 100% Load - Run 3 16:20 - 17:20	Minimum	7.38	< 0.5	< 2.0	0.049
	Maximum	7.62	< 0.5	< 2.0	0.083
	Average	7.49	< 0.5	< 2.0	0.068

	GT3 3/19/2021 Base Load 13:30-14:30 T1	GT3 3/19/2021 Base Load 15:00-16:00 T2	GT3 3/19/2021 Base Load 16:20-17:20 T3	
Formaldehyde (ppm)	0.065	0.074	0.068	
MW Formaldehyde	30.031	30.031	30.031	
O2 (%)	13.86	13.85	13.87	
Fd	8621.6	8621.6	8621.6	
Formaldehyde (lb/MMBtu)	0.000129672	0.000147417	0.00013585	
Fuel Heat Input (MMBTU/hr)	1927.0	1914.1	1903.9	**Average**
Formaldehyde (lb/hr)	**0.250**	**0.282**	**0.259**	**0.264**

TABLE 5-9
PARTICULATE TEST RESULTS
UNIT 3 NORTH BASE

Client				DTE
Unit / Location				RENPPV3 North Base
A_s (stack area), ft²				238.785
T_{std} (reference temperature), °F				68
Test number	Run 1	Run 2	Run 3	Average
Date	3/19/21	3/20/21	3/20/21	--
Start / Stop time	13:34-17:57	7:30-12:03	12:57-17:29	--
F_d (fuel "F" factor @ 68°F), dscf/MMBtu	8616.50	8616.90	8616.90	--
F_d (fuel "F" factor @ T_{std}), dscf/MMBtu	8616.50	8616.90	8616.90	--
Fuel Density, lb/scf (fuel std condition 60°F	0.0454	0.0455	0.0455	--
HHV (fuel higher heating value), Btu/scf	1048.98	1048.99	1048.99	--
Fuel Flow Rate, lb/sec	11.50	11.75	11.25	--
Fuel Heat Input, MMBTU/hr	956.6	975.2	933.7	--
Meter box number	CS9	CS9	CS9	--
C_p (pitot coefficient), dimensionless	0.8400	0.8400	0.8400	0.8400
Y (meter calibration factor), dimensionless	0.9720	0.9720	0.9720	0.972
θ (sample time), min	240.00	240.00	240.00	240.00
Nozzle diameter, in	0.190	0.190	0.190	0.190
P_{bar} (barometric pressure), in Hg	30.56	30.59	30.59	30.58
V_m (meter box volume), scf	160.052	151.767	155.874	155.898
V_{lc} (impinger liquid), g	252.2	307.1	241.3	266.9
T_m (meter temperature), °F	75.7	53.9	79.6	69.8
ΔH (meter pressure), in H_2O	1.425	1.384	1.446	1.418
ΔP (velocity head), in H_2O	2.9994	2.9551	2.9033	2.9526
P_s (static pressure), in Hg	1.60	1.80	1.70	1.70
T_s (stack temperature), °F	1051.4	1052.4	1052.7	1052.2
%O_2 (oxygen stack gas), % volume dry	13.81	13.82	13.90	13.84
%CO_2 (carbon dioxide stack gas), % volume dry	4.03	4.06	4.01	4.03
m_n (F½ particulate matter catch - filter), g	0.0016	0.0031	0.0014	0.0020
m_a (F½ particulate matter catch - acetone rinse), g	0.0012	0.0015	0.0011	0.0013
m_{con} (B½ particulate matter catch - total condensible, blank c	0.0024	0.0032	0.0022	0.0026
m_n (total particulate matter catch), g	0.0052	0.0078	0.0047	0.0059
fn $V_{m(std)}$ (standard sample volume), dscf	157.155	155.463	152.039	154.886
fn $V_{wc(std)}$ (water vapor volume), scf	11.892	14.478	11.379	12.583
fn B_{ws} (moisture fraction), non-dimensional	0.0703	0.0852	0.0696	0.0751
Moisture, %	7.03	8.52	6.96	7.51
fd MW_{dry} (stack gas molecular weight), dry	29.197	29.202	29.198	29.199
fs MW_{wet} (stack gas molecular weight), wet	28.409	28.248	28.418	28.358
fp P_g (absolute stack pressure), in Hg	30.678	30.722	30.705	30.702
fp V_s (stack gas velocity), ft/sec	163.511	162.695	160.845	162.350
Q_s (fuel heat input), dscfm	404,941	413,441	400,371	406,251
fs I (isokinetic ratio), %	101.82	102.79	100.06	101.56
26 G (F½ grain loading), gr/dscf	0.000275	0.000457	0.000254	0.000328
26 M (F½ mass emissions), lb/hr	0.95	1.62	0.87	1.15
26 E (F½ mass emissions), lb/MMBtu	0.000995	0.001655	0.000930	0.001194
26 G (B½ grain loading), gr/dscf	0.000236	0.000318	0.000223	0.000259
26 M (B½ mass emissions), lb/hr	0.82	1.13	0.77	0.90
26 E (B½ mass emissions), lb/MMBtu	0.000853	0.001151	0.000819	0.000941
26 G (total grain loading), gr/dscf	0.000511	0.000774	0.000477	0.000588
26 M (total mass emissions), lb/hr	1.77	2.74	1.64	2.05
26 E (total mass emissions), lb/MMBtu	0.00185	0.00281	0.001749	0.002135

TABLE 5-10
PARTICULATE TEST RESULTS
UNIT 3 SOUTH BASE

Client				DTE
Unit / Location				RENPP3 Base-South
A (stack area), ft²				239.785
T_{std} (reference temperature), °F				68
Test number	Run 1	Run 2	Run 3	Average
Date	3/19/21	3/20/21	3/20/21	--
Start / Stop time	13:34-17:57	7:30-12:03	12:57-17:29	--
F_d (fuel "F" factor @ 68°F), dscf/MMBtu	8616.50	8616.90	8616.90	--
F_d (fuel "F" factor @ T_{std}), dscf/MMBtu	9616.50	8616.90	8616.90	--
Fuel Density, lb/scf (fuel std condition 60°F)	0.0454	0.0455	0.0455	--
HHV (fuel higher heating value), Btu/scf	1048.98	1048.93	1048.93	--
Fuel Flow Rate, lb/sec	11.50	11.75	11.25	--
Fuel Heat Input, MMBTU/hr	956.6	975.2	933.7	--
Meter box number	CS4	CS4	CS4	--
C_p (pitot coefficient), dimensionless	0.8400	0.8400	0.8400	0.8400
Y (meter calibration factor), dimensionless	1.0240	1.0240	1.0240	1.024
θ (sample time), min	240.00	240.00	240.00	240.00
Nozzle diameter, in	0.178	0.178	0.178	0.178
P_{bar} (barometric pressure), in Hg	30.56	30.59	30.58	30.58
V_m (meter box volume), scf	178.620	176.700	171.830	175.717
V_{lc} (impinger liquid), g	287.4	293.7	281.1	287.4
T_m (meter temperature), °F	73.0	64.0	74.8	70.6
ΔH (meter pressure), in H_2O	1.925	1.866	1.773	1.855
ΔP (velocity head), in. H2O	5.5049	5.5899	5.1056	5.4035
P_s (static pressure), in. Hg	1.95	1.95	1.95	1.95
T_s (stack temperature), °F	1081.4	1078.6	1087.4	1082.5
%O_2 (oxygen stack gas), % volume dry	13.81	13.82	13.90	13.84
%CO_2 (carbon dioxide stack gas), % volume dry	4.03	4.06	4.01	4.03
m_1 (F½ particulate matter catch - filter), g	0.0002	0.0016	0.0002	0.0007
m_2 (F½ particulate matter catch - acetone rinse), g	0.0040	0.0053	0.0096	0.0063
m_{cn} (B½ particulate matter catch - total condensible, blank	0.0023	0.0029	0.0020	0.0024
m_t (total particulate matter catch), g	0.0065	0.0098	0.0118	0.0094
% $V_{m(std)}$ (standard sample volume), dscf	185.939	187.233	178.315	183.829
% $V_{w(std)}$ (water vapor volume), scf	13.549	13.849	13.254	13.551
% B_{ws} (moisture fraction), non-dimensional	0.0679	0.0689	0.0692	0.0687
Moisture, %	6.79	6.89	6.92	6.87
% MW_d (stack gas molecular weight), dry	29.197	29.202	29.198	29.199
% MW_w (stack gas molecular weight), wet	28.437	28.431	28.423	28.430
% P_s (absolute stack pressure), in Hg	30.703	30.733	30.723	30.720
% V_s (stack gas velocity), ft/sec	223.503	225.129	215.644	221.425
Q_s (fuel heat input), dscfm	404,941	413,441	400,371	406,251
% I (isokinetic ratio), %	102.06	101.85	101.91	101.94
G (F½ grain loading), gr/dscf	0.000349	0.000569	0.000848	0.000588
M (F½ mass emissions), lb/hr	1.21	2.02	2.91	2.05
E (F½ mass emissions), lb/MMBtu	0.001262	0.002062	0.003109	0.002144
G (B½ grain loading), gr/dscf	0.000191	0.000239	0.000173	0.000201
M (B½ mass emissions), lb/hr	0.66	0.85	0.59	0.70
E (B½ mass emissions), lb/MMBtu	0.000691	0.000866	0.000635	0.000731
G (total grain loading), gr/dscf	0.000539	0.000808	0.001021	0.000786
M (total mass emissions), lb/hr	1.87	2.86	3.50	2.75
E (total mass emissions), lb/MMBtu	0.00195	0.00293	0.003744	0.002875