EXECUTIVE SUMMARY

Montrose Air Quality Services (Montrose) was retained by DTE Energy (DTE) to evaluate the particulate compounds emissions on EUTURBINE4SC at the DTE Renaissance Power Plant in Carson City, Michigan. The emissions test program was conducted from December 17th, 2019 to December 19th, 2019. Testing consisted of triplicate 240-minute test runs for PM_{10}. The results of the emission test program are summarized by Table I.

The purpose of this report is to document the results of the test program which are summarized in Tables I and II below.

Table I
Overall Results Summary

Source	Test Dates	PM10[1] (lb/hr)	Permit Limit
EUTURBINE4SC	December 17-19, 2019	6.77	9.0

[1] Measured as Filterable PM + Condensable PM.

Table II
Compliance Emissions Test Program Summary

System/Stack ID	Exhaust Gas Parameters to be Evaluated	Test Methods
EUTURBINE4SC	Stack Gas Flow Rate, Molecular Weight, Moisture Content, and PM_{10} (as FPM + CPM)	1, 2, 3, 4, 5, 19, and 202

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SUMMARY TABLES

FIGURES

APPENDIX

1. Introduction

Montrose Air Quality Services (Montrose) was retained by DTE Energy (DTE) to evaluate the particulate compounds emissions from 4 combustion turbines located at;

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

One turbine was selected as a representative unit upon which to base the compliance status of all four units at this location.

1.a Identification, Location, and Dates of Test

Table 1-1
Test Matrix

System/Stack ID	Exhaust Gas Parameters Evaluated	Date
EUTURBINE4SC	Stack Gas Flow Rate, Molecular Weight, Moisture Content, and PM_{10} (measured as FPM + CPM)	December 17, 18, & 19, 2019

1.b Purpose of Testing

The purpose of the emissions test program was to determine the compliance status of the facility relative to emissions limits contained in the permit for the facility.

1.c Source Description

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 EUTURBINE1SC - EUTURBINE4SC.

1.d Testing Personnel

Names and affiliations for personnel involved in the emissions test program are summarized by Table 1-2.

Table 1-2
Test Personnel

Name and Title	Affiliation	Telephone
Mr. John Hamner Project Manager	Montrose Air Quality Services, LLC 1351 Brummel Avenue, Elk Grove Village, IL 60007	(630) 715-3259

Mr. Barry Boulianne Vice President	Montrose Air Quality Services, LLC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Mr. Bob Finken Senior Vice President	Montrose Air Quality Services, LLC 1Park Plaza, Suite 101 Irvine CA 92614	(714) 448-6150
Mr. Mike Nummer Senior Field Technician	Montrose Air Quality Services, LLC4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Mr. Paul Diven Senior Field Technician	Montrose Air Quality Services, LLC 4949 Fernlee Ave. Royal Oak, MI	(248) 548-8070
Zach Lefever Senior Field Technician	Montrose Air Quality Services, LLC Chicago South	(216) 990-1113
Richard Colin Oakes Field Project Manager	Montrose Air Quality Services, LLC Chicago South	(765) 413-1773
Craig Blohm Field Technician	Montrose Air Quality Services, LLC Pittsburgh, PA	(412) 652-4674
John Wilson Jr. Senior Field Technician	Montrose Air Quality Services, LLC Pittsburgh, PA	(412) 652-4679
Mr. Thomas Durham Manager, Field Services	DTE Energy 6100 West Warren, G4 Detroit, MI 48210	(313) 897-0298
Mr. Matt Kaleyta Plant Supervisor (DTE Renaissance Power)	Renaissance Power Plant 950 N. Division St. Carson City, MI 48811	(989) 584-2333
Mr. Tom Gasloli Technical Programs Unit Air Quality Division	Michigan Department of Environmental Quality SE Michigan District 27700 Donald Ct Warren, MI 48092	(517) 284-6778

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions test program.

2.a Operating Data

Process operating data for this emissions test program is provided in Table 2-1 and in Appendix D.

Table 2-1
Process Operating Data

Date	Gas Flow (kscf/hr)	Heat Input (MMBtu/hr)	Megawatts	Water Flow (klb/hr)	Injection Ratio
12/17/2019	1824.1	1932.8	186.2	3.42	0.04
12/18/2019	1906.8	2020.4	195.9	3.43	0.04
12/19/2019	1886.9	1999.3	193.0	3.49	0.04

2.b Applicable Permit

The applicable permit for this emissions test program is Permit No. MI-ROP-N6873-2015.

2.c Results

The results of the emissions test program are summarized by Table 2-2. Detailed data for each test run can be found in Tables 2-3 and 2-4.

Table 2-2
Results Summary

Source	Location	Test Dates	PM10 (lb/hr)
EUTURBINE4SC	GT4 North	December 17, 18, & 19, 2019	2.71
EUTURBINE4SC	GT4 South	December 17, 18, & 19, 2019	4.06
EUTURBINE4SC	GT4 Total	December 17, 18, & 19, 2019	6.77

Table 2-3
South Side Results Summary

SOURCE TEST DATA SUMMARY

Client	DTE
Unit / Location	RENPP/4-South
A (stack area), ft^2	239.785
T_{ref} (reference temperature), °F	68

Test number	Run 1	Run 2	Run 3	Average
Date	12/17/19	12/18/19	12/19/19	--
Start / Stop time	13:40-18:08	9:26-13:46	8:35-12:52	--
F_d (fuel "F" factor @ 68°F), dscf/MMBtu	8609.80	8609.70	8609.80	--
F_d (fuel "F" factor @ T_{ref}), dscf/MMBtu	8609.80	8609.70	8609.80	--
Fuel Density, lb/scf (fuel std condition 60°F	0.0451	0.0451	0.0451	--
HHV (fuel higher heating value), Btu/scf	1057.55	1056.76	1056.86	--
Fuel Flow Rate, lb/sec	12.36	12.76	12.38	--
Fuel Heat Input, MMBTU/hr	1043.4	1076.3	1044.4	--
T_s (stack temperature), °F	1077.5	1051.9	1075.2	1068.2
$\%O_2$ (oxygen stack gas), % volume dry	14.26	14.25	14.14	14.22
$\%CO_2$ (carbon dioxide stack gas), % volume dry	3.89	3.99	3.95	3.94
m_f (F½ particulate matter catch - filter), g	0.0000	0.0000	0.0000	0.0000
m_r (F½ particulate matter catch - acetone rinse), g	0.0043	0.0035	0.0045	0.0041
m_{cpm} (B½ particulate matter catch - total condensible, blank corrected), g	0.0052	0.0069	0.0065	0.0062
m_n (total particulate matter catch), g	0.0095	0.0104	0.0110	0.0103
1g V_s (stack gas velocity), ft/sec	224.962	221.565	221.688	222.738
Q_{ds} (fuel heat input), dscfm	471,265	485,416	463,346	473.343
1k I (isokinetic ratio), %	100.06	100.67	100.80	100.51
3c M (F½ mass emissions), lb/hr	1.69	1.40	1.75	1.61
3c M (B½ mass emissions), lb/hr	2.05	2.76	2.52	2.44
3c M (total mass emissions), lb/hr	3.74	4.16	4.27	4.06

Table 2-4
North Side Results Summary

SOURCE TEST DATA SUMMARY

Client	DTE
Unit / Location	RENPP/4-North
A (stack area), ft^2	239.785
T_{ref} (reference temperature), °F	68

Test number	Run 1	Run 2	Run 3	Average
Date	12/17/19	12/18/19	12/19/19	--
Start / Stop time	13:40-18:12	9:26-12:48	8:35-12:54	--
F_d (fuel "F" factor @ 68°F), dscf/MMBtu	8609.80	8609.70	8609.80	--
F_d (fuel "F" factor @ T_{ref}), dscf/MMBtu	8609.80	8609.70	8609.80	--
Fuel Density, lb/scf (fuel std condition 60°F	0.0451	0.0451	0.0451	--
HHV (fuel higher heating value), Btu/scf	1057.55	1056.76	1056.86	--
Fuel Flow Rate, lb/sec	10.16	10.76	10.89	--
Fuel Heat Input, MMBTU/hr	857.7	907.6	918.7	--
T_s (stack temperature), °F	1080.3	1074.1	1075.5	1076.6
$\%O_2$ (oxygen stack gas), % volume dry	14.26	14.25	14.14	14.22
$\%CO_2$ (carbon dioxide stack gas), % volume dry	3.89	3.99	3.95	3.94
m_f (F½ particulate matter catch - filter), g	0.0000	0.0000	0.0000	0.0000
m_r (F½ particulate matter catch - acetone rinse), g	0.0045	0.0021	0.0034	0.0033
m_{cpm} (B½ particulate matter catch - total condensible, blank corrected), g	0.0053	0.0033	0.0041	0.0042
m_n (total particulate matter catch), g	0.0098	0.0054	0.0075	0.0076
1g V_s (stack gas velocity), ft/sec	184.927	186.872	195.043	188.947
Q_{ds} (fuel heat input), dscfm	387,383	409,332	407,580	401,432
1k I (isokinetic ratio), %	101.16	103.35	103.30	102.60
3c M (F½ mass emissions), lb/hr	1.61	0.78	1.19	1.19
3c M (B½ mass emissions), lb/hr	1.90	1.22	1.44	1.52
3c M (total mass emissions), lb/hr	3.51	2.00	2.63	2.71

2.d Emission Regulation Comparison

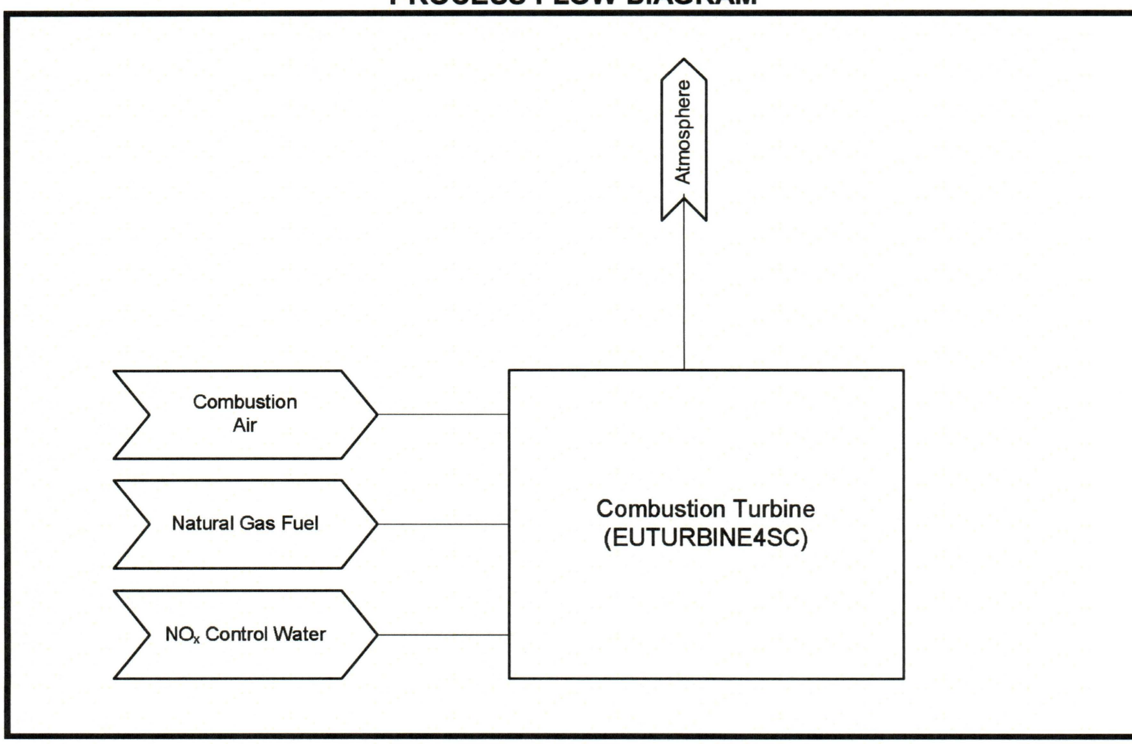
NA

3. Source Description

Sections 3.a through 3.d provide a detailed description of the process.

3.a Process Flow Diagram

FIGURE 3-1
PROCESS FLOW DIAGRAM



3.b Process 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.

3.c Raw and Finished Materials

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

3.d Process Capacity

Each turbine has a nominal heat input rating of 2,147 million Btu per hour, and is capable of producing 215 megawatts of electricity.

3.e Process Instrumentation

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

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used to verify emission rates and removal efficiency.

4.a Sampling Train and Field Procedures

USEPA Methods 1- 4

Stack gas velocity traverses were conducted in accordance with the procedures outlined in USEPA Methods 1 and 2. An S-type pitot tube with a thermocouple assembly, calibrated in accordance with USEPA Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures at each traverse location. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

Exhaust gas molecular weight was determined utilizing multipoint sampling procedures outlined in USEPA Method 3 where tedlar bag samples were collected. The bag samples were then analyzed for CO_2 and O_2 content utilizing USEPA Method 3A procedures.

Exhaust gas moisture content was evaluated using USEPA Method 4 as part of the USEPA Method 5 and 202 procedures. Exhaust gas was extracted and passed through impingers. Exhaust gas moisture content was then determined gravimetrically.

Additional details including modifications to the basic methods are discussed in section 5b.

USEPA Methods 5 & 202

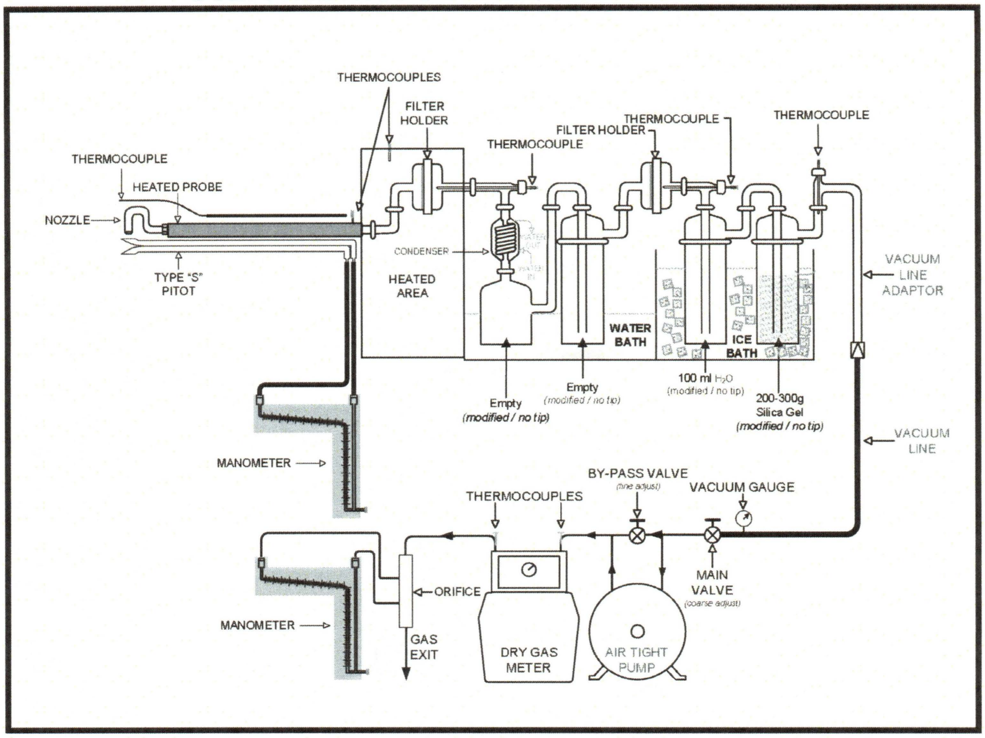
The above procedures were used in conjunction with the procedures of 40 CFR 60, Appendix A, Method 5, *"Determination of Particulate Emissions from Stationary Sources"* and 40 CFR 60, Appendix A, Method 202, *"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"* was used to measure PM10 concentrations and calculate PM10 emission rates. Figure 4-1 displays the USEPA Methods 5 & 202 sampling train schematic. Triplicate 240-minute test runs were conducted for each source.

Montrose's modular isokinetic stack sampling system consisted of (1) a titanium nozzle, (2) a titanium lined probe, (3) a heated filter holder, (4) a vertical condenser, (5) an empty pot-bellied impinger, (6) an empty modified Greenburg-Smith (GS) impinger, (7) unheated filter holder with a Teflon filter, (8) a second modified GS impinger with 100 ml of deionized water, and a third modified GS impinger containing approximately 300 g of silica gel desiccant, (9) a length of sample line, and (10) a control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The impinger train was then purged with nitrogen for one hour at a flow rate of 14 liters per minute. The CPM filter was recovered and placed in a petri dish. The back half of the filter housing, the condenser, the pot-bellied impinger, the moisture dropout impinger, and the front half of the CPM filter housing and all connecting glassware were triple rinsed with deionized water which was collected in a pre-cleaned sample container. The same glassware was then rinsed with acetone which was collected in a pre-cleaned sample container labeled as the organic fraction. The glassware was then double rinsed with hexane which was added to the same organic fraction sample bottle.

Montrose labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition, blank samples of the acetone, DI water, hexane, and filter were collected. Montrose personnel carried all samples to Montrose's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan. DI water and organic samples were hand delivered to MAQS Chicago South laboratory in Elk Grove Village, Illinois, for analysis.

FIGURE 4-1
USEPA METHODS 5 & 202 SAMPLING TRAIN



4.b Recovery and Analytical Procedures

All recoveries were performed according to the correct USEPA Method.

4.c Sampling Ports

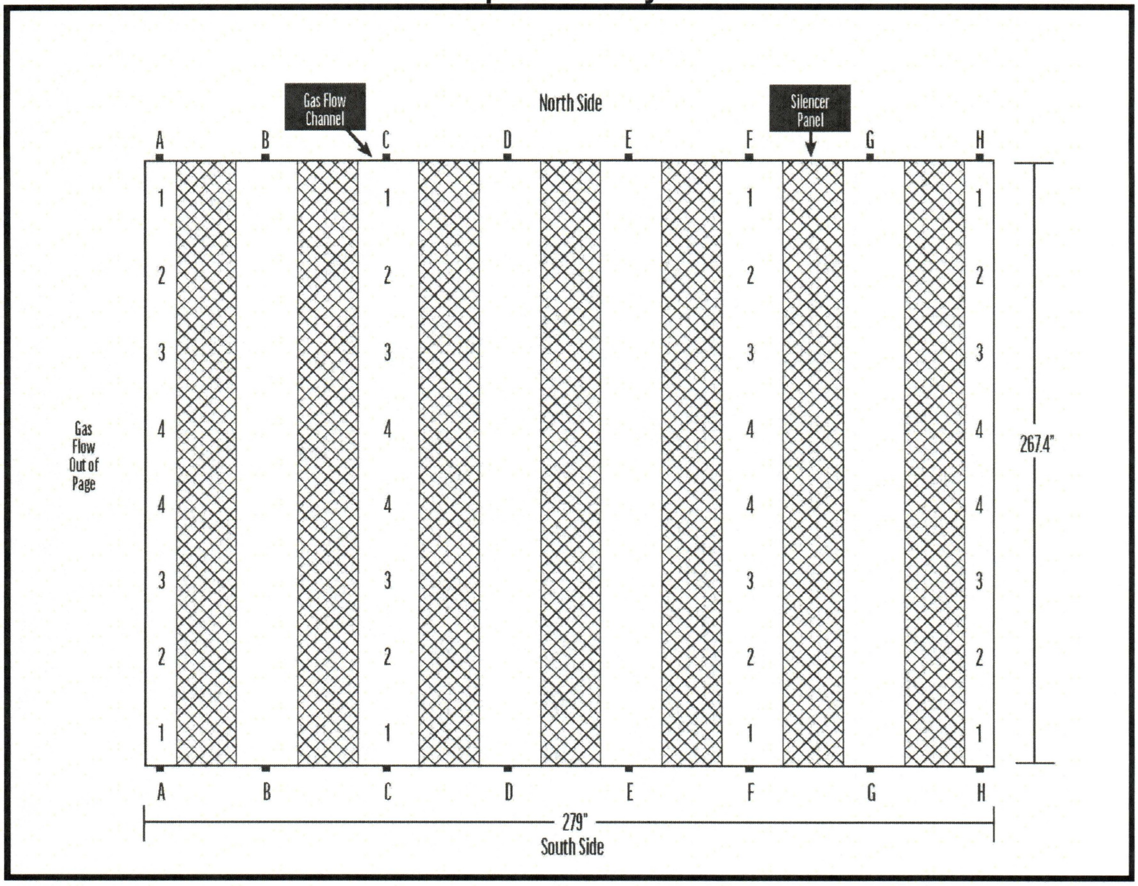
A total of sixteen 6" flanged sample ports are installed on each unit with 8 installed on each the north and south walls of the exhaust ducts. Eight ports were selected for use on this program, 4 on each side.

The test locations on the 4 CT units 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 the 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.

4.d Traverse Points

A simplified diagram of the traverse points is provided in Figure 4-3.

FIGURE 4-2
Sample Point Layout



5. Test Results and Discussion

No field test changes or problems occurred during the performance of this test that would bias the accuracy of the results of this test. A decision was made on site with MAQS, DTE, and EGLE to reduce the planned 320-minute sample durations to 240 minutes in consideration of safety and consistency.

5.a Results Tabulation

The results of the emission test program are summarized by Table 2-1 (see section 2c). Detailed data for each test run can be found in Tables 2-2 and 2-3.

5.b Sampling Procedure Variations

USEPA Methods 1 & 2

The physical characteristics of the sample location preclude the use of typical stack testing methodologies for stack flow rate and emission rate determinations and require modifications to the standard applications of EPA methods 2 and 5. Briefly stated, EPA Method 2 was used to determine the local velocity for the purpose of isokinetic sampling and EPA Method 19 was used to determine exhaust gas flow rate and emission rates.

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. An S-type pitot tube with a thermocouple assembly, calibrated in accordance with Method 2, Section 4.1.1, was used to measure exhaust gas velocity pressures (using a manometer) and temperatures at each traverse location. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

It was reported to MAQS that a cyclonic flow check was performed in July 2019 by another test contractor and the results demonstrated the absence of cyclonic flow conditions.

USEPA Methods 5 & 202

As a result of the complications described above the following measurement strategies were employed;

- Sampling was conducted using 2 simultaneous sampling trains for each test; one for the 4 ports accessible from the ports on the north wall and another for the ports located on the south wall
- The 8 gas path sections were renamed for this program as A, B, C, D, E, F, G, from west to east
- 4 gas path sections were selected for sampling (A, C, F, & H) to represent the cross section of the duct
- Fuel flow rate information was obtained from the Plant CEMS
- Fuel Samples were obtained and analyzed for HHV for each test
- Oxygen concentrations were obtained from integrated bag samples and analyzed on site by EPA method 3A.
- Fuel flow rate, fuel analysis, and oxygen data were used to calculate total exhaust flow for each test according
- Measured average stack gas velocity data from each of the simultaneous trains was used to apportion the fuel flow rate and resulting calculated total stack flow rate to the corresponding Method 5 PM concentration results to obtain a weighted emission rate for the separate trains
- The results from each pair of trains are summed to calculate a total emission rate in lb/hour.
- All collected Particulate Matter (PM) is assumed to be PM10 for the purpose of this test.

5.c Process or Control Device Upsets

No upset conditions occurred during testing.

5.d Control Device Maintenance

There has been no major maintenance performed during the past three months.

5.e Retest

This test program is a re-test of several other attempts to demonstrate compliance.

5.f Audit Sample Analyses

No audit samples were collected as part of the test program.

5.g Calibration Sheets

Relevant equipment calibration documents are provided as Appendix B.

5.h Sample Calculations

Sample calculations are provided in Appendix C.

5.i Field Data Sheets

Field documents are presented as well as raw analyzer test data are located in Appendix A.

5.j Laboratory Data

The laboratory data can be found in Appendix E.