SOURCE TEST REPORT
2019 $PM_{2.5}$ TESTING
DTE ENERGY
MONROE POWER PLANT
DC4A AND DC5A
MONROE, MI

Prepared For:

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STAC STACK TESTING ACCREDITATION COUNCIL

A2LA ACCREDITED TO ASTM D7036 ONLY CERT #3925.01

MONTROSE AIR QUALITY SERVICES

Executive Summary

Montrose Air Quality Services, LLC (MAQS) was retained by DTE Energy (DTE) to evaluate air pollutant emission rates at the DTE Monroe Power Plant (MONPP) facility located in Monroe, Michigan. The test program consisted of the evaluation of particulate matter smaller than 2.5 microns ($PM_{2.5}$) emission rates from the outlet of the DC4A and DC5A wet dust collectors at the DTE Monroe Power Plant. Testing for this project was conducted on September 4-5, 2019.

Testing consisted of triplicate 60 minute test runs for $PM_{2.5}$ at each source. Sampling and analysis was performed utilizing United States Environmental Protection Agency (USEPA) 40 CFR 60, Appendix A Reference Test Methods. The average results of the emissions test program are summarized by Table I.

Table I
Overall Results Summary

Source Identification	$PM_{2.5}$	
	(gr/dscf)	(lb/hr)
DC4A	0.002 gr/dscf	0.36 lb/hr
DC5A	0.001 gr/dscf	0.17 lb/hr

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1.0 Introduction

Montrose Air Quality Services, LLC (MAQS) was retained by DTE Energy (DTE) to evaluate air pollutant emission rates at the DTE Monroe Power Plant (MONPP) facility located in Monroe, Michigan. The test program consisted of the evaluation of particulate matter smaller than 2.5 microns ($PM_{2.5}$) emission rates from the exhaust of the DC4A and DC5A wet dust collectors at the DTE Monroe Power Plant. Testing for this project was conducted on September 4-5, 2019.

The following MAQS professionals participated in conducting this study: Mason Sakshaug, Field Project Manager and David Trahan, Field Technician. Mr. Chris Essex and Mr. Andy Dillon with DTE provided on-site coordination throughout this project.

2.0 Process Description

The DC4A wet dust collector / extraction system collects coal dust from nine (9) collection points along conveyor CVC8. The DC5A wet dust collector / extraction system collects coal dust from nine (9) collection points along a conveyor CVC8A. Conveyors CVC8 and CVC8A supply coal to silos 15-28 for Units 3 and 4. Coal and the corresponding dust generated is predominately low sulfur Powder River Basin (PRB) subbituminous type, with the balance being High-Sulfur Eastern (HSE), and/or Pet Coke.

3.0 Sampling and Analytical Methodologies

Sampling and analytical methodologies for the emissions test program can be separated into two categories as follows:

(1) Measurement of exhaust gas velocity, molecular weight, and moisture content; and
(2) Measurement of exhaust gas $PM_{2.5}$ concentrations using USEPA Method 201A;

Sampling and analytical methodologies by category are summarized by Sections 3.1 through 3.2, respectively.

3.1 Exhaust Gas Velocity, Molecular Weight, and Moisture Content

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference 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 3 - *"Gas Analysis for Determination of Dry Molecular Weight"(Fyrite)*
- Method 4 - *"Determination of Moisture Content in Stack Gases"*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Method 1 and Method 2. S-type pitot tubes with thermocouple assemblies, calibrated in accordance with Method 2, Section 4.1.1, were used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions outlined in Sections 2-6 through 2-8 were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned. Diagrams of the sample points are provided as Figures 1-2.

Cyclonic flow checks were performed at the exhaust stack. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

Molecular weight was measured according to Method 3. The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Carbon dioxide and oxygen content were analyzed using the Fyrite® procedure.

Exhaust gas was extracted as part of the Method 201A sampling train (see Section 3.2). Exhaust gas moisture content was determined gravimetrically.

3.2 $PM_{2.5}$ (USEPA Method 201A)

40 CFR 60, Appendix A, Method 201A *"Determination of PM10 and PM2.5 Emissions from Stationary Sources (Constant Sampling Rate Procedure)"* was used to measure filterable particulate matter concentrations and emission rates (see Figure 3 for a schematic of the sampling train). Sampling consisted of triplicate 60-minute test runs at the outlet the dust collector. A method 202 sampling train was utilized as per the submitted test plan, however, analysis for condensable particulate was not conducted due to the temperature of the exhaust gas not exceeding 85 °F. Recovery of the method 202 glassware included only moisture determination.

MAQS's Nutech® Model 2010 modular isokinetic stack sampling system consists of (1) a stainless-steel nozzle, (2) a stainless-steel PM2.5 head, (3) an in-stack stainless-steel filter housing, (4) a borosilicate glass probe liner, (5) a vertical condenser, (6) an empty pot bellied impinger, (7) an empty modified Greenburg-Smith (GS) impinger, (8) unheated borosilicate filter holder with a teflon filter and Teflon filter support, (9) 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, (10) a length of sample line, and (11) a Nutech® 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, probe, PM2.5 head, and front half of the filter housing brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container.

MAQS 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 and filter were collected. MAQS personnel transported all samples to the MAQS laboratory in Royal Oak, Michigan.

4.0 Test Results

The overall results of the emissions test program are summarized by Table 1.

Table 1
Overall Results Summary

Source Identification	$PM_{2.5}$	
	(gr/dscf)	(lb/hr)
DC4A	0.002 gr/dscf	0.36 lb/hr
DC5A	0.001 gr/dscf	0.17 lb/hr

Detailed test data for this project is presented in Tables 2-3. Field and computer generated data sheets are available in Appendix A. Equipment calibration information is available in Appendix B. Example calculations for equations covered in this report are presented in Appendix C. Laboratory data is presented in Appendix D.

Limitations

The information and opinions rendered in this report are exclusively for use by DTE Energy. MAQS will not distribute or publish this report without consent from DTE Energy except as required by law or court order. MAQS accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:

Jacob Young
Staff Environmental Engineer

This report was reviewed by:

Matthew Young
Client Project Manager

Table 2
DC4A PM2.5 Emission Rates

Company	**DTE Monroe**			
Source Designation	**DC4A**			
Test Date	**9/4/2019**	**9/4/2019**	**9/4/2019**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	87.9	88.6	89.3	88.6
Meter Pressure - Pm (in. Hg)	29.3	29.3	29.3	29.3
Measured Sample Volume (Vm)	24.9	24.9	25.3	25.0
Sample Volume (Vm-Std ft3)	23.8	23.9	24.2	23.9
Sample Volume (Vm-Std m3)	0.67	0.68	0.68	0.68
Condensate Volume (Vw-std)	1.070	0.759	1.117	0.982
Gas Density (Ps(std) lbs/ft3) (wet)	0.0733	0.0737	0.0733	0.0734
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	1.82	1.81	1.85	1.83
Total weight of sampled gas (m g lbs) (dry)	1.77	1.78	1.80	1.78
Nozzle Size - An (sq. ft.)	0.000167	0.000167	0.000167	0.000167
Isokinetic Variation - I	103.7	99.0	101.4	101.4
Stack Data				
Average Stack Temperature - Ts (F)	76.3	74.8	76.3	75.8
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.4	28.5	28.4	28.4
Stack Gas Specific Gravity (Gs)	0.980	0.984	0.979	0.981
Percent Moisture (Bws)	4.30	3.08	4.42	3.93
Water Vapor Volume (fraction)	0.0430	0.0308	0.0442	0.0393
Pressure - Ps ("Hg)	29.25	29.2	29.2	29.2
Average Stack Velocity -Vs (ft/sec)	40.4	41.3	41.5	41.1
Area of Stack (ft2)	9.8	9.8	9.8	9.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	23,719	24,236	24,359	24,105
Flowrate ft^3 (Standard Wet)	22,827	23,391	23,443	23,220
Flowrate ft^3 (Standard Dry)	21,845	22,670	22,407	22,307
Flowrate m^3 (standard dry)	619	642	634	632
Total Particulate Weights (mg)				
PM2.5	2.6	1.6	4.5	2.9
Total PM2.5 Concentration				
lb/1000 lb (wet)	0.003	0.002	0.005	0.003
lb/1000 lb (dry)	0.003	0.002	0.006	0.004
mg/dscm (dry)	3.9	2.4	6.6	4.3
gr/dscf	0.0017	0.0010	0.0029	0.0019
Total PM2.5 Emission Rate				
lb/ hr	0.317	0.202	0.554	0.357
lb/ton coal processed	0.00028	0.00017	0.00055	0.00034

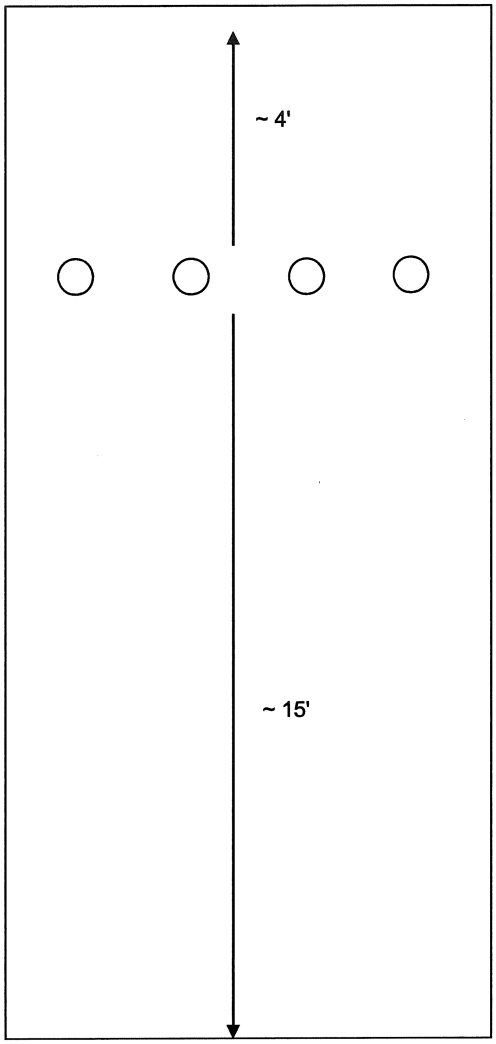
Table 3
DC 5A Outlet Particulate Matter Emission Rates

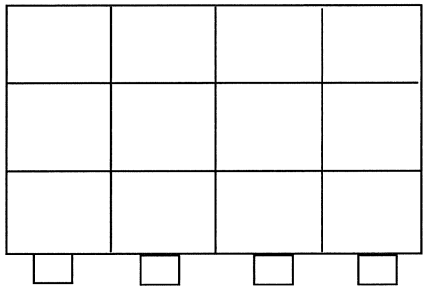
Company	**DTE Monroe**			
Source Designation	**DC5A**			
Test Date	**9/5/2019**	**9/5/2019**	**9/5/2019**	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	78.2	85.2	87.1	83.5
Meter Pressure - Pm (in. Hg)	30.2	30.2	30.2	30.2
Measured Sample Volume (Vm)	23.9	24.9	25.0	24.6
Sample Volume (Vm-Std ft3)	24.0	24.7	24.7	24.5
Sample Volume (Vm-Std m3)	0.68	0.70	0.70	0.69
Condensate Volume (Vw-std)	0.849	0.849	0.849	0.849
Gas Density (Ps(std) lbs/ft3) (wet)	0.0736	0.0736	0.0736	0.0736
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	1.83	1.88	1.88	1.86
Total weight of sampled gas (m g lbs) (dry)	1.79	1.84	1.84	1.82
Nozzle Size - An (sq. ft.)	0.000167	0.000167	0.000167	0.000167
Isokinetic Variation - I	108.4	106.4	104.6	106.5
Stack Data				
Average Stack Temperature - Ts (F)	72.3	74.4	73.4	73.4
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.5	28.5	28.5	28.5
Stack Gas Specific Gravity (Gs)	0.983	0.983	0.983	0.983
Percent Moisture (Bws)	3.41	3.32	3.32	3.35
Water Vapor Volume (fraction)	0.0341	0.0332	0.0332	0.0335
Pressure - Ps ("Hg)	30.1	30.1	30.1	30.1
Average Stack Velocity -Vs (ft/sec)	38.0	39.0	39.4	38.8
Area of Stack (ft2)	9.8	9.8	9.8	9.8
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	22,299	22,888	23,141	22,776
Flowrate ft^3 (Standard Wet)	22,278	22,774	23,069	22,707
Flowrate ft^3 (Standard Dry)	21,518	22,018	22,303	21,946
Flowrate m^3 (standard dry)	609	623	632	621
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	1.6	1.5	1.1	1.4
Total Particulate Concentration				
lb/1000 lb (wet)	0.002	0.002	0.001	0.002
lb/1000 lb (dry)	0.002	0.002	0.001	0.002
mg/dscm (dry)	2.4	2.1	1.6	2.0
gr/dscf	0.0010	0.0009	0.0007	0.0009
Total Particulate Emission Rate				
lb/ hr	0.190	0.177	0.132	0.167
lb/ ton coal processed	0.00016	0.00016	0.00011	0.00014

Figures

MONTROSE
AIR QUALITY SERVICES

Stack Dimensions: 44" X 32"





Not to Scale

Points	Distance "
1	5.5
2	16.5
3	27.5
4	38.5

Figure No. 1

Site: **DC4 & DC5 Outlet** **DTE Energy** **Monroe, Michigan**	**Sampling Date:** **September 4-5, 2019**	**Montrose Air Quality Services, LLC** **4949 Fernlee** **Royal Oak, Michigan**

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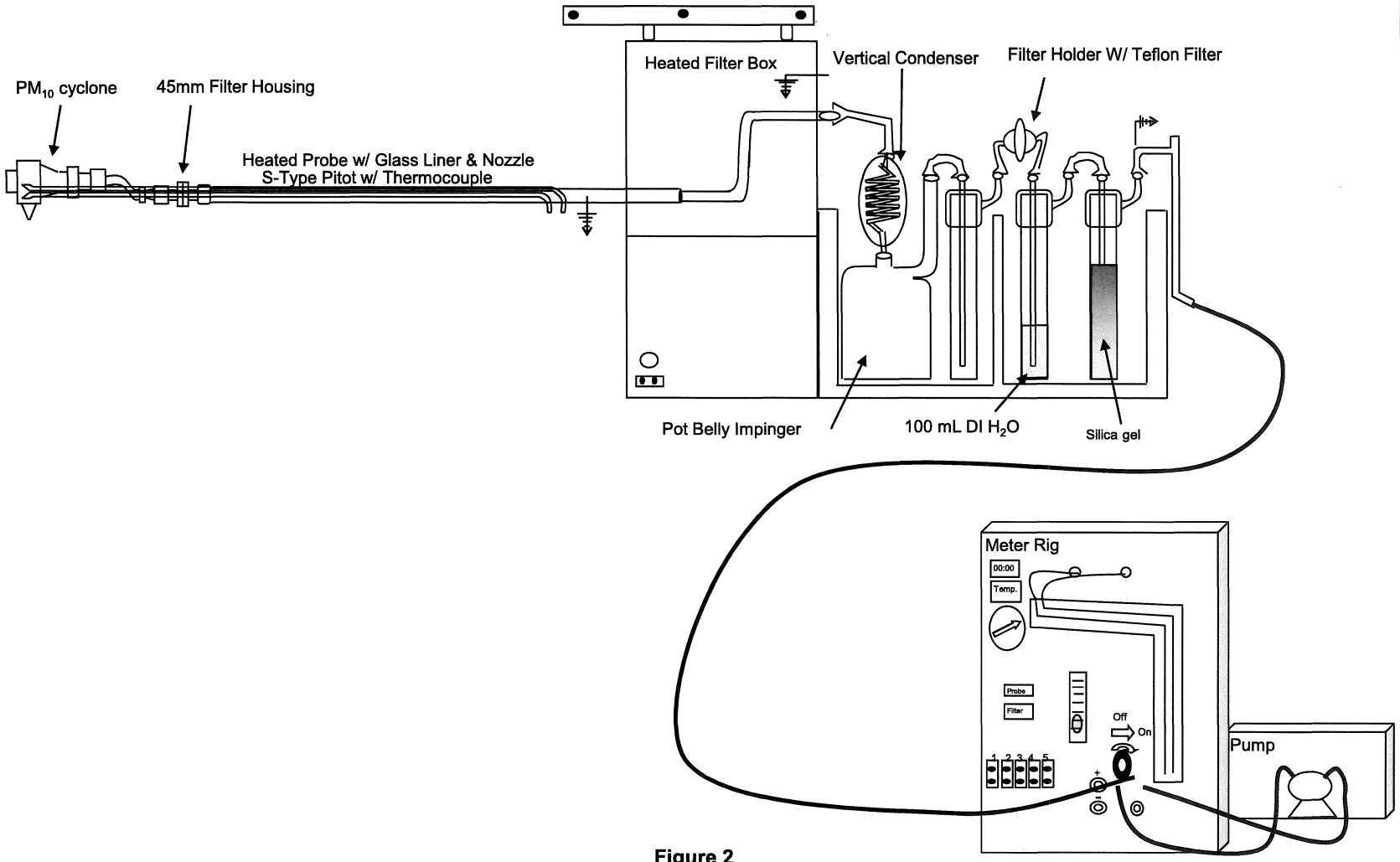

Figure 2

Site: **USEPA Method 201A** **DTE Energy** **Monroe, Michigan**	**Sampling Date:** **September 4-5, 2019**	**Montrose Air Quality Services, LLC** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**