

**TEST REPORT
2018 ROP PM
We ENERGIES
PRESQUE ISLE POWER PLANT FACILITY ID 1769
BOILER 7
MARQUETTE, MICHIGAN**

Prepared For:

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MONTROSE AIR QUALITY SERVICES, LLC

1.0 PROJECT OVERVIEW

1.1 GENERAL

Montrose Air Quality Services, LLC (Montrose) formerly known as Airtech Environmental Services Inc. (Airtech) located at 1371 Brummel Avenue, Elk Grove Village, Illinois was contracted by We Energies to perform an air emissions test program at the Presque Isle Power Plant (PIPP) located in Marquette, Michigan. The objective of the test program was to perform testing for filterable particulate matter (PM) from the exhaust of Unit 7. Testing was conducted to meet the requirements of We Energies, the Michigan Department of Quality (MDEQ) and the United States Environmental Protection Agency (U.S. EPA); and 40 CFR Part 60 and 63, Subpart UUUUU, as applicable.

Testing was performed on April 26, 2018. Coordinating the field aspects of the test program were:

Cynthia Brandt - We Energies - (920) 433-1830

Rob Bregger - We Energies - (414) 221-4772

Blu Kaput – Montrose Air Quality Services, LLC – (630) 860-4740

1.2 EXECUTIVE SUMMARY

The results of the Method 5 PM testing are summarized in the table below.

TABLE 1 – 1 EXECUTIVE SUMMARY

Constituent	Run 1	Run 2	Run 3	Average	Limit
Emission Rate (lb/MMBtu, F _d)	0.00207	0.000872	0.00185	0.00159	0.03
Emission Rate (lb/hr)	1.61	0.699	1.52	1.27	
Emission Rate Dry (lbs/1000 lbs gas)	0.00179	0.000771	0.00167	0.00141	
Emission Rate Wet (lbs/1000 lbs gas)	0.00165	0.000721	0.00156	0.00131	
Emission Rate Dry (lbs/1000 lbs at 50% Excess Air)	0.00193	0.000824	0.00179	0.00152	
Emission Rate Wet (lbs/1000 lbs at 50% Excess Air)	0.00179	0.000771	0.00167	0.00141	

1.3 ASTM D7036-04(2011)

All applicable Montrose field personnel used on-site for this test program were compliant with ASTM D7036-04(2011) "Standard Practice for Competence of Air Emissions Testing Bodies" for all tests performed. This includes having the appropriate QSTI directly supervise the testing.

The following table summarizes the key personnel that were involved with this project:

**TABLE 1 – 2
PROJECT PERSONNEL**

Personnel	Position on Project	Date of QSTI Exam
Brandon Check, Q.S.T.I.	Project Manager	3/31/2016
Blu Kaput, Q.S.T.I.	Overall Test Leader	5/5/2017

1.4 METHODOLOGY

1.4.1 Particulate Matter Testing Methodology

EPA Method 5 was used to determine the PM concentrations at the test location in a combined sample train. In Method 5, a sample of the gas stream was withdrawn isokinetically from the stack. The PM in the sample gas stream was collected in a glass lined sample probe and on a glass fiber filter. The weight of PM collected with the sample train combined with the volume of dry gas withdrawn from the stack was used to calculate the particulate concentration. Particulate testing was conducted while hydrogen chloride testing was also being performed for another regulatory requirement.

In order to convert the concentration of each constituent to a mass emissions rate, the volumetric gas flow rate through the test location was determined concurrently with each test run, using EPA Methods 1, 2, 3A and 4.

Results for PM are expressed in units of pounds per million British thermal units (lb/mmBtu), pounds per hour (lb/hr), pounds per 1,000 pounds of gas (lbs/1000 lbs. gas) wet and dry and pounds per 1,000 lbs. gas at 50 % excess air (lbs/1000lbs@50%EA) wet and dry. Three (3) test runs were conducted for PM at the test location. Testing was conducted as close to maximum load as possible.

The PM test was conducted using a probe temperature of 248°F (+/- 25°F) as allowed by the EPA in letters dated May 11, 2016 and March 8, 2017 and the MDEQ dated May 5, 2017. The volume collected was increased nominally by a factor of two as required for conducting emissions testing to demonstrate LEE status.

1.5 SPECIAL CONSIDERATIONS

Per the requirements of 40 CFR Part 63, Subpart UUUUU, the following strategies were utilized:

- Under §63.10005(h)(2)(i), the minimum sample volume specified in Table 2 was increased nominally by a factor of two (i.e. 2x1.00 dscm; 2x0.75)
- Under §63.10007(A) (2), the unit was operated at maximum normal operating load conditions during each periodic (e.g., quarterly) performance test. Maximum normal operating load was generally between 90 and 110 percent of design capacity but was representative of site specific normal operations during each test run.

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- Under Table 5 (1) (f) and 5 (3) (f), emissions concentrations for PM were converted to lb/MMBtu or lb/MWh emissions rates, using the calculations found in EPA Method 19. The F-factor was 9,820 for subbituminous coal.

1.6 PARAMETERS

The following parameters were determined at the Unit 7 test location during each test run:

- gas velocity
- gas temperature
- oxygen concentration
- carbon dioxide concentration
- moisture content
- filterable particulate matter concentration

1.4 RESULTS

A complete summary of test results may be found in Table 2-1¹.

¹MEASUREMENT UNCERTAINTY STATEMENT

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 through the use of 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 the Montrose Quality Manual and ASTM D7036-04. 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.

2.0 SUMMARY OF RESULTS

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TABLE 2 – 1
SUMMARY OF UNIT 7 PM RESULTS

Test Parameters	Run 1	Run 2	Run 3	Average
Date	4/26/18	4/26/18	4/26/18	
Start Time	12:35	15:03	17:28	
Stop Time	14:44	17:12	19:36	
Fd Factor	9,820	9,820	9,820	
Gas Conditions				
Temperature (°F)	311	310	315	312
Volume Metered Standard, $V_{m(std)}$ (ft ³)	85.96	85.43	87.52	86.30
Volumetric Flow Rate (acfm)	329,200	325,800	328,600	327,900
Volumetric Flow Rate (scfm)	217,500	215,400	216,100	216,300
Volumetric Flow Rate (dscfm)	191,400	192,900	192,500	192,300
Carbon Dioxide (% dry)	12.4	12.7	13.2	12.8
Oxygen (% dry)	7.0	6.7	6.3	6.7
Moisture (%)	12.0	10.5	11.0	11.2
Particulate Results				
Concentration (grains/dscf)	0.000980	0.000422	0.000919	0.000774
Emission Rate (lb/MMBtu, F_d)	0.00207	0.000872	0.00185	0.00159
Emission Rate (lb/hr)	1.61	0.699	1.52	1.27
Emission Rate Dry (lbs/1000 lbs gas)	0.00179	0.000771	0.00167	0.00141
Emission Rate Wet (lbs/1000 lbs gas)	0.00165	0.000721	0.00156	0.00131
Emission Rate Dry (lbs/1000 lbs at 50% EA)	0.00193	0.000824	0.00179	0.00152
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3.0 TEST PROCEDURES

3.1 METHOD LISTING

The following EPA test methods were referenced for the test program. These methods can be found in 40 CFR Part 60 Appendix A.

Method 1	Sample and velocity traverse for stationary sources
Method 2	Determination of stack gas velocity and volumetric flow rate (type S pitot tube)
Method 3A	Determination of oxygen and carbon dioxide concentrations in emissions from stationary sources (Instrumental analyzer procedure)
Method 4	Determination of moisture content in stack gases
Method 5	Determination of particulate emissions from stationary sources
Method 19	Determination of sulfur dioxide removal efficiency and particulate matter, sulfur dioxide, and nitrogen oxides emission rates

3.2 METHOD DESCRIPTIONS

3.2.1 Method 1

Method 1 was used to determine the suitability of each test location and to determine the sample points used for the gas velocity and particulate concentration determinations. Each test location conformed to the minimum requirements of being located at least 2.0 diameters downstream and at least 0.5 diameters upstream from the nearest flow disturbance.

The Unit 7 test location is a round, vertical duct with a diameter of 114 inches. Three points in each of the four test ports were traversed for each volumetric flow test run. The test location was located approximately 15.8 diameters downstream and approximately 10.5 diameters upstream from the nearest flow disturbance. A cross-section of the test location, indicating the traverse points is shown in Figure 1 of the Appendix.

3.2.2 Method 2

Method 2 was used to determine the gas velocity through the test location using a Type-S pitot tube and an incline plane oil manometer. The values measured in Method 2, along with the measurements made in Methods 3A and 4, were used to calculate the volumetric flow rate through the test locations. A diagram of the Method 2 apparatus is shown as part of the Method 5 sampling train in Figure 2 of the Appendix.

The manometer was leveled and "zeroed" prior to each test run. The sample train was leak checked before and after each run by pressurizing the positive side, or "high" side, of the pitot tube, creating a deflection on the manometer of at least three inches H₂O. The leak check was considered valid if the manometer remained stable for 15 seconds. This procedure was repeated on the negative side by generating a vacuum of at least three inches H₂O. The velocity head pressure and gas temperature were then determined at

each point specified in Method 1. The static pressure of the stack was measured using a water filled U-tube manometer. In addition, the barometric pressure was measured and recorded.

3.2.3 Method 3A

The carbon dioxide and oxygen contents were determined at the test location using EPA Method 3A. A gas sample was collected into a Tedlar bag from the back of each sample train for the duration of each test run. Analysis was performed using a Teledyne infrared carbon dioxide analyzer/paramagnetic oxygen analyzer. The analyzers were calibrated immediately prior to analysis of the bag samples using the procedures outlined in Method 3A using EPA Protocol calibration gases.

The carbon dioxide content and oxygen content were used to calculate the dry molecular weight of the gas stream. The molecular weight was then used, along with the moisture content determined by EPA Method 4, for the calculation of the volumetric flow rate. For these calculations, the balance of the gas stream was assumed to be nitrogen since the other gas stream components are insignificant for the purposes of calculating molecular weight.

3.2.4 Method 4

The moisture content at the test location was determined using Method 4. A known volume of sample gas was withdrawn from the source and the moisture was condensed and measured. The dry standard volume of the sample gas was then compared to the volume of moisture collected to determine the moisture content of the sample gas. A diagram of the Method 4 apparatus is shown as part of the Method 5 train in Figure 2 of the Appendix.

To condense the water vapor the gas sample passed through a series of impingers. The impingers were charged as outlined in each individual method. The sample train was leak checked prior to the test run by capping the probe tip and pulling a vacuum greater than the highest vacuum expected during the test run. A leak check was considered valid if the leak rate was below 0.02 cubic feet per minute.

The volume of dry gas exiting the gas condenser system was measured with a dry gas meter. After leaving the dry gas meter, the sample stream passed through an orifice used to meter the flow rate through the sample train. The pressure drop across the orifice was measured with an incline plane, oil manometer. The gas meter reading, gas meter inlet and outlet temperatures, gas meter static pressure and pump vacuum were recorded for each sample point.

After the test run, the sample train was leak checked at the highest vacuum encountered during the test run. The tests were considered valid since the leak rate was less than 0.02 cfm. The amount of water collected in the condenser system was measured gravimetrically. The net weight gain of water was converted to a volume of wet gas and then compared to the amount of dry gas sampled to determine the moisture content.

3.2.5 Methods 5

EPA Methods 5 was used to determine the PM concentrations at the test location. A sample of the gas stream was withdrawn isokinetically from the stack and the PM in the sample gas stream was collected in a glass probe and on a glass fiber filter. A diagram of the Method 5 sample train is shown in Figure 2 in the Appendix.

To prevent contamination, all components of the sample train were constructed of glass with no metal connections. Prior to testing the components were washed using detergent and then rinsed with tap water, deionized water and lastly with acetone. After drying, all components were sealed with parafilm or Teflon tape.

The sample probe that was used consisted of a glass liner and glass nozzle. Sample gas passed through the nozzle and probe assembly and then through a glass fiber filter heated to 248°F (+/- 25°F). After exiting the filter, the sample gas was passed through a series of four glass impingers. The first and second impingers each contained 100 ml of 0.1 N H₂SO₄. The third impinger was initially empty. The fourth contained a known weight of silica gel to absorb any remaining water vapor. The dry gas exiting the moisture condenser system then passed through a sample pump and a dry gas meter to measure the gas volume. After leaving the dry gas meter, the sample stream passed through an orifice, which was used to meter the flow rate through the sample train. The pressure drop across the orifice was measured with an incline plane oil manometer.

85mm Whatman quartz filters were used as the substrate for the particulate sampling. The filter was loaded into a glass filter holder with a Teflon support screen that was prepared in the same manner as the other components of the sample train. Prior to the test run, the filter was desiccated for at least 24 hours and then weighed to the nearest 0.0001g until a constant weight was achieved. The weight of the filter was considered constant only when two consecutive weights taken at least six hours apart are within 0.0005g of each other.

The probe was thoroughly pre-cleaned with acetone and the probe wash saved prior to each test run as a quality assurance check. The impingers were pre cleaned with distilled water and loaded with the appropriate impinger contents. The sample train was leak checked prior to the test run by capping the probe tip and pulling a vacuum of at least 15 in.Hg. A leak check was considered valid if the leak rate was below 0.02 cfm. When not in operation inside the stack, the nozzle was sealed with Teflon tape.

The probe tip was placed at each of the sample points determined in Method 1. The velocity at the sample point was determined using Method 2 by reading the velocity pressure from the manometer. Sample was withdrawn from the source at a rate such that the velocity at the opening of the nozzle matched the velocity of the stack gas at the sample point (isokinetically). During the test run the train was moved to each of the Method 1 sample points. The sample time at each point was calculated based on the number of sample points and the maximum allowable run time. The gas velocity pressure (ΔP), gas meter reading, gas meter inlet and outlet temperatures, gas meter orifice pressure (ΔH) and pump vacuum was recorded for each sample point.

After the test run the train was leak checked at the highest vacuum encountered during the test run. The probe liner and nozzle were washed with acetone and the rinse saved.

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The filter was removed from the filter holder, transferred to a container and sealed. The H₂SO₄ impinger contents were recovered separately and stored in HDPE sample jars.

Analysis of the samples for particulate matter was performed at the Montrose laboratory located in Elk Grove Village, Illinois. The probe rinses were transferred to a tared beaker, evaporated to dryness under ambient temperature and pressure conditions, desiccated for 24 hours and weighed to a constant weight. The filters were desiccated for 24 hours and weighed to a constant weight. The weight gain of the probe rinse and filters yield the total weight of particulate collected. To eliminate interference in establishing a constant weight, both the analytical balance and the desiccators were equipped with an ion generating polonium strip designed to eliminate static electricity that may collect on the samples.

3.2.6 Method 19

The equations in EPA Method 19 were used to calculate the emission rates of various pollutants from the test location in units of pounds per million British thermal units (lb/mmBtu). The calculations were based on the O₂ concentration of the sample gas and an appropriate F factor, which is the ratio of combustion gas volumes to heat inputs. In order to calculate the pounds per million Btu (lb/mmBtu) emission rate, an Fd factor of 9,820 dscf/mmBtu was used as per 40CFR Part 75 for sub-bituminous coal.

4.0 DESCRIPTION OF INSTALLATION

Boilers #7-9 are Riley pulverized coal wall fired dry bottom utility boilers which use distillate oil start-up guns. Each boiler's nameplate steam capacity rating is 615,000 lb/hr with a heat input capacity of approximately 1010 MMBTU/hr. Each boiler serves a GE steam turbine/generator set rated at 78,982 KW. Mercury emissions from Boilers #7, #8, and #9 are controlled with a TOXECON™ mercury control demonstration system installed in 2005. Each boiler is equipped with an electrostatic precipitator and the TOXECON™ fabric filter baghouse common to Boilers #7 through #9.