COMPLIANCE TEST REPORT

for

PARTICULATE MATTER (PM)

EUBOILER1

Greenwood Energy Center
Avoca, Michigan

July 9, 2019

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EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed particulate matter (PM) emissions testing on the exhaust of EUBoiler1 at the Greenwood Energy Center, in Avoca, Michigan. The testing was required by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP – B6145-2018). Testing was conducted during normal boiler operating conditions while firing natural gas. The testing was conducted on July 9, 2019.

A summary of the emission test results is shown below:

PM Emissions Testing Summary
Greenwood Energy Center EUBoiler1
July 9, 2019

	PM (lb/1000 lbs @ 50% EA)
EUBoiler1	**0.001**
Permit Limit	***0.10***

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1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed particulate matter (PM) emissions testing on the exhaust of EUBoiler1 at the Greenwood Energy Center, in Avoca, Michigan. The testing was required by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP – B6145-2018). Testing was conducted during normal boiler operating conditions while firing natural gas. The testing was conducted on July 9, 2019.

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 1-4, and 17.

The fieldwork was performed in accordance with EPA Reference Methods and EM&R's Intent to Test[1], which was approved in a letter by Mr. David Patterson with the Michigan Department of Environment, Great Lakes, and Energy (EGLE), dated June 21, 2019. The following EM&R Field Services personnel participated in the testing program: Mr. Mark Grigereit, Principal Engineer, Mr. Thomas Snyder, Environmental Specialist, and Mr. Shawn Farrell, Summer Student. Mr. Grigereit was the project leader. Mr. Ed Paquette, with DTE GWEC, provided process coordination for the testing program. Mr. Patterson and Ms. Kaitlyn Leffert with EGLE observed the testing.

2.0 SOURCE DESCRIPTION

The Greenwood Energy Center (GWEC) located at 7000 Kilgore Road in Avoca, Michigan, employs the use of one (1) 815 GMW boiler (EUBoiler1) fired with either No. 6 fuel oil, No. 2 fuel oil, Specification Used Oil, and/or Natural gas. The unit has a Foster Wheeler boiler capable of producing 5,500,000 pounds per hour of steam (lb/hr steam). The unit is equipped with a General Electric turbine generator.

See Figure 1 for a diagram of the Unit sampling locations and stack dimensions.

The air pollution control equipment consists of a flue gas injection (FGI) fan to assist in the controlling NO_x. The Unit's exhaust stack is 496 feet tall with an internal diameter of 23.25 feet.
During the PM emission testing, the Unit was fired with natural gas.

[1] EGLE, Test Plan, Submitted March 15, 2019. (Attached-Appendix A)
[2] EGLE, Approval Letter. (Attached-Appendix A)

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3.0 SAMPLING AND ANALYTICAL PROCEDURES

DTE Energy obtained emissions measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources*. The sampling and analytical methods used in the testing program are indicated in the table below

Sampling Method	Parameter	Analysis
USEPA Methods 1-2	Exhaust Gas Flow Rates	Field data analysis and reduction
USEPA Method 3A	Oxygen & CO2	Instrumental Analyzer Method
USEPA Method 4	Moisture Content	Field data analysis and reduction
USEPA Method 17	Particulate Matter	Gravimetric Analysis

3.1 STACK GAS VELOCITY AND FLOWRATES (USEPA MethodS 1-2)

3.1.1 Sampling Method

Stack gas velocity traverses were conducted in accordance with the procedures outlined in USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources," and Method 2, "Determination of Stack Gas Velocity and Volumetric Flowrate." Four (4) sampling ports were utilized, sampling at three (3) points per port for a total of twelve (12) sampling points. See Figure 1 for a diagram of the traverse/sampling points used.

Cyclonic flow checks were performed on the stack during the initial flow monitor certification RATA. Testing at the sampling location demonstrated that no cyclonic flow was present. No changes to the Stack have occurred since the cyclonic flow check was performed. Additionally, static pressure checks performed confirmed that the null angle was at 0°.

3.1.2 Method 2 Sampling Equipment

The EPA Method 2 sampling equipment consisted of a 0-10" incline manometer, S-type pitot tube (C_p = 0.841) and a type-K calibrated thermocouple.

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3.2 OXYGEN AND CARBON DIOXIDE (USEPA Method 3A)

3.2.1 Sampling Method

Stack gas Oxygen (O_2) and Carbon Dioxide (CO_2) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The O_2 / CO_2 analyzers utilize paramagnetic sensors.

3.2.2 O_2 / CO_2 Sampling Train

The Method 3A sampling system consisted of collecting an integrated dry gas sample in a Tedlar bag during each test. The Tedlar bag was then analyzed using a Servomex 1400 O_2/CO_2 gas analyzer.

3.2.3 Sampling Train Calibration

The O_2/CO_2 analyzer was calibrated according to procedures outlined in USEPA Method 7E. Zero, span, and mid-range calibration gases were introduced directly into the analyzer to verify the instruments linearity. The O_2/CO_2 concentrations were recorded on the field data sheets.

3.3 MOISTURE DETERMINATION (USEPA Method 4)

3.3.1 Sampling Method

Determination of the moisture content of the exhaust gas was performed using the method described in USEPA Method 4, "Determination of Moisture Content in Stack Gases". The moisture was collected in glass impingers and the percentage of moisture was then derived from calculations outlined in USEPA Method 4.

3.4 PARTICULATE MATTER (USEPA METHOD 17)

3.4.1 Filterable Particulate Sampling Method

USEPA Method 17, "Determination of Particulate Emissions from Stationary Sources – In-situ Filtration" was used to measure the filterable particulate emissions (see Figure 2 for a schematic of the sampling train). Four, 60-minute sample runs were conducted. Run 1 was voided due to a data input error which resulted in an isokinetic sampling rate of 125. Results from the discarded sampling run are included in Appendix B.

The Method 17 modular isokinetic stack sampling system (Figure 2) consisted of the following:

(1) Stainless-steel button-hook nozzle
(2) Stainless Steel Filter Holder with 47 mm quartz filter
(3) Un-heated glass-lined probe and PTFE sample line
(4) Set of glass impingers for the collection of condensate for moisture determination
(5) Length of sample line
(6) Environmental Supply® control case equipped with a pump, dry gas meter, and calibrated orifice.

The filters used in the sampling were initially weighed to a constant weight as described in the Method to obtain the initial tare weight.

After completion of the final leak test for each test run, the filter was recovered, and the probe, nozzle and the front half of the filter holder assembly were brushed and rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container. The container was labeled with the test number, test location, test date, and the level of liquid marked on the outside of the container. Immediately after recovery, the sample containers were placed in a cooler for storage.

At the laboratory the acetone rinses were transferred to clean pre-weighed beakers and evaporated to dryness at ambient temperature and pressure. The beakers and filters were then placed in a desiccator for a minimum of 24 hours prior to their initial final weight. Final weights were taken at 6 hour or greater intervals until two weights agreed within 0.5 mg. The data sheets containing the initial and final weights on the filters and beakers can be found in Appendix C.

Collected field blanks consisted of a blank filter and acetone solution blank. The acetone blank was collected from the rinse bottle used in sample recovery. The blank filter and acetone were collected and analyzed following the same procedures used to recover and analyze the field samples. Field data sheets for the Method 17 sampling can be found in Appendix B.

3.4.2 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in EPA Method 5 (see Appendix D for equipment calibrations).

3.4.3 Data Reduction

Particulate data collected during the emissions testing was calculated and reported as pounds per hour (lbs/hr) and pounds per 1000 pounds, wet, at 50% excess air (lbs/1000 $lb_{(w)}$ @ 50% EA).

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The PM emission calculations are based on calculations located in USEPA Method 5. Example calculations are presented in Appendix F.

4.0 OPERATING PARAMETERS

The test program included the collection of boiler load and stack emissions CEMs data during each test run. Parameters recorded included gross Megawatts (MW), and CEMs data (SO_2, NO_x, CO_2, and Opacity).

Operational data can be found in Appendix E.

5.0 DISCUSSION OF RESULTS

Table 1 presents the Particulate Emission testing results from EUBoiler1 while firing Natural Gas. Particulate (Total Filterable) emissions are presented in pounds per hour (lbs/hr) and pounds per 1000 pounds, wet, @ 50% excess air ($lb/1000lb_{(w)}$ @ 50% EA). Additional test data presented for each test includes the Unit load in gross megawatts (GMW), stack temperature in degrees Fahrenheit (°F), stack moisture in percent (%), stack gas velocity in feet per minute (ft/min), and stack gas flow rate in actual cubic feet per minute (ACFM), standard cubic feet per minute (SCFM) and dry standard cubic feet per minute (DSCFM).

The average total filterable PM emissions from EUBoiler1 was 0.001 $lbs/1000lb_{(w)}$@ 50% EA which is less than the permit limit of 0.10 $lbs/1000lbs_{(w)}$@ 50% EA.

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6.0 CERTIFICATION STATEMENT

"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally accepted in the trade."

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his report prepared by: _____

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RESULTS TABLES

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TABLE NO. 1
FILTERABLE PARTICULATE EMISSION TESTING RESULTS
Greenwood Energy Center - EUBoiler1
July 9, 2019

Test[2]	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Stack Moisture (%)	Stack Velocity (ft/min)	Exhaust Gas Flowrates (ACFM)	(SCFM)	(DSCFM)	Filterable PM Emissions (lbs/hr)	(lbs/1000lb @ 50% Excess Air)[1]
PM-2	**9-Jul-19**	9:09-10:19	751.2	274.3	14.7	5,825	2,473,249	1,768,834	1,509,687	5.89	0.001
PM-3		10:33-11:38	751.3	275.2	15.5	5,885	2,498,496	1,784,865	1,508,087	6.20	0.001
PM-4		11:48-12:54	751.3	275.6	15.4	5,864	2,489,418	1,777,373	1,503,600	6.98	0.001
	Average:		***751.3***	***275.0***	***15.2***	***5,858***	***2,487,054***	***1,777,024***	***1,507,125***	***6.36***	***0.001***

(1) Permit Limit = 0.10 lb/1000lb Gas @ 50% Excess Air

(2) Run 1 Voided, Sampling Rate Error

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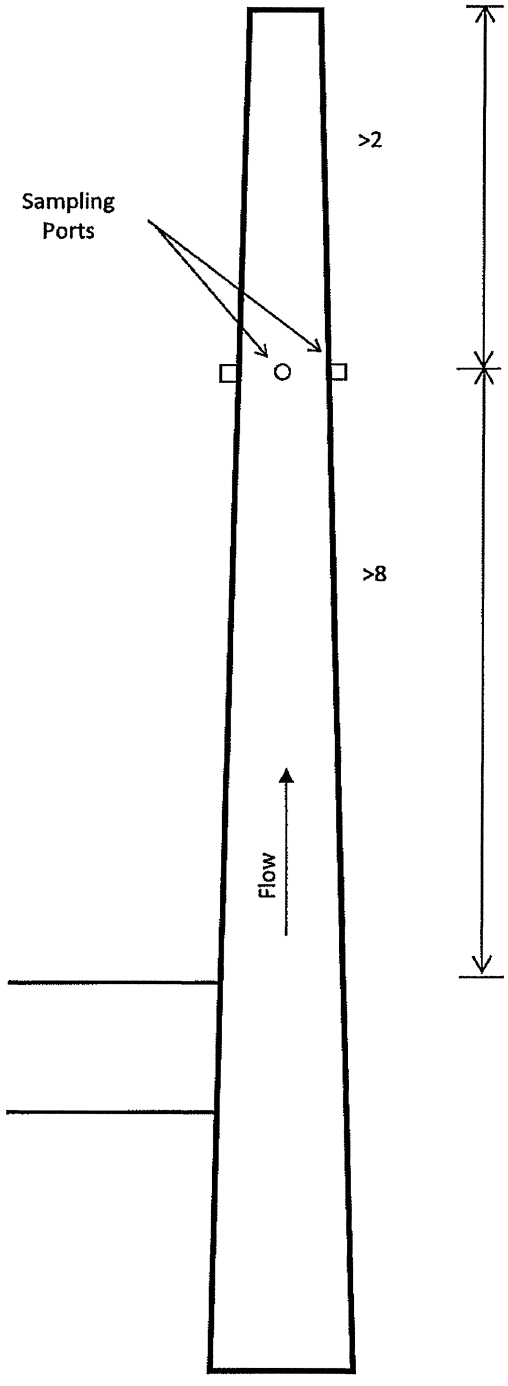
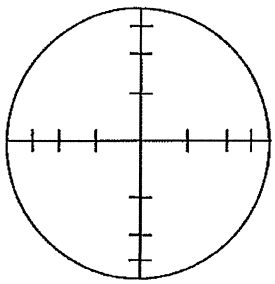
FIGURES

Figure 1 – Sampling Location & Traverse Points
Greenwood Energy Center – EUBOILER1
July 9, 2019





Sample Points
Point 1 - 12.28"
Point 2 - 40.73"
Point 3 - 82.58"

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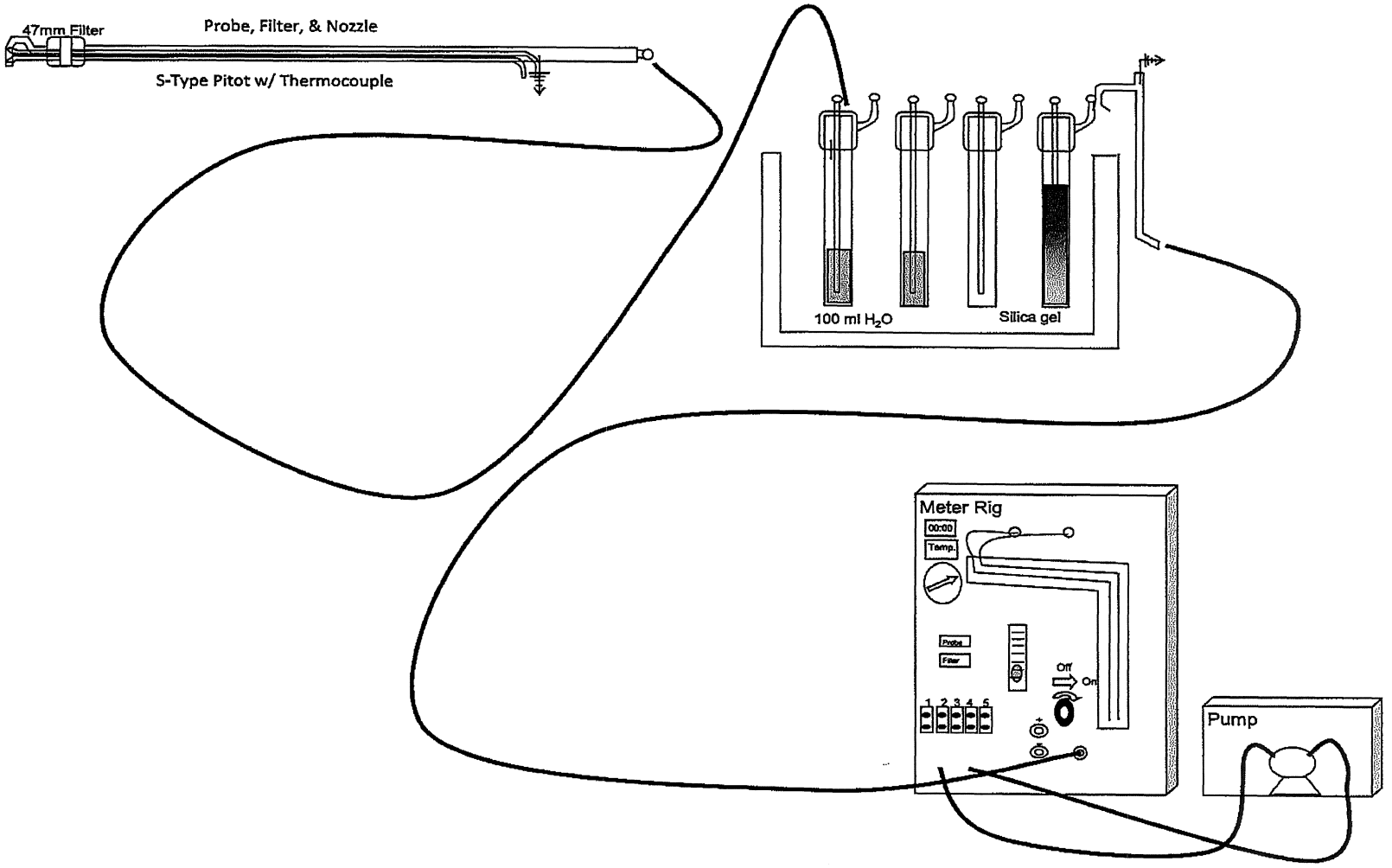
Figure 2 – EPA Method 17
Greenwood Energy Center – EUBOILER1
July 9, 2019



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APPENDIX A

EGLE TEST PLAN