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## **COMPLIANCE TEST REPORT**

for

### **TOTAL PARTICULATE MATTER (PM) AND FINE PARTICULATE MATTER (PM<sub>10/2.5</sub>)**

**EU-BOILER6-SC**

**St. Clair Power Plant  
East China, Michigan**

**January 16-17, 2019**

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B2796-TEST-2019016

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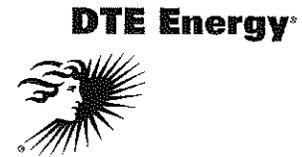


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- 1 Sampling Location – EU-BOILER6-SC
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## EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed particulate emissions testing on the exhaust of EU-BOILER6-SC at the St. Clair Power Plant, located in China Township, Michigan. Testing was required by the Michigan Department of Environmental Quality (MDEQ) Michigan Renewable Operating Permit (ROP) MI-ROP-B2796-2015b to verify total filterable particulate matter (PM), PM<sub>10</sub> (particulate matter less than 10 microns diameter), and PM<sub>2.5</sub> (particulate matter less than 2.5 microns diameter). Testing was conducted during the period of January 16-17, 2019.

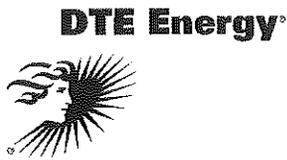
A summary of the emission test results is shown below:

### Emissions Testing Summary St. Clair Power Plant EU-BOILER6-SC January 16-17, 2019

Source	Filterable PM (lbs/1000 lbs @ 50% EA) <sup>(1)</sup>	Primary PM <sub>10</sub> (lbs/MMBtu) <sup>(2)</sup>	Primary PM <sub>2.5</sub> (lbs/MMBtu) <sup>(2)</sup>
EU-BOILER6-SC	0.0027	<0.0250	<0.0235

(1) EU-BOILER6-SC Permit Limit 0.15 lb/1000lbs @ 50% EA

(2) Primary PM<sub>10</sub>/2.5 is the sum of fractioned PM and condensables



## 1.0 INTRODUCTION

DTE Energy's Environmental Management and Resources (EM&R) Field Services Group performed particulate emissions testing on the exhaust of EU-BOILER6-SC at the St. Clair Power Plant, located China Township, Michigan. Testing was required by the Michigan Department of Environmental Quality (MDEQ) Michigan Renewable Operating Permit (ROP) MI-ROP-B2796-2015b to verify total filterable particulate matter (PM), PM<sub>10</sub> (particulate matter less than 10 microns diameter), and PM<sub>2.5</sub> (particulate matter less than 2.5 microns diameter) emissions while the unit was operated at greater than 85% of normal full load capacity. Testing was conducted during the period of January 16-17, 2019.

Testing was performed pursuant to Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40 CFR §60 App. A), Methods 1, 3, 4, 5B, 201A and 202.

The fieldwork was performed in accordance with EPA Reference Methods and DTE Energy Intent to Test, which was approved in a letter by Mr. Thomas Gasloli from the Michigan Department of Environmental Quality (MDEQ), dated August 27, 2018<sup>1</sup>. The following DTE Energy personnel participated in the testing program: Mr. Jason Logan, Environmental Specialist, Mr. Mark Westerberg, Senior Environmental Specialist, Mr. Frank Kurta, Environmental Technician, and Mr. Kenneth St. Amant, Senior Environmental Technician. Mr. Logan was the project leader. Mr. Joseph Neruda, Senior Environmental Specialist at the plant provided process coordination for the testing program.

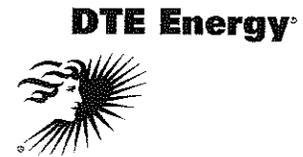
## 2.0 SOURCE DESCRIPTION

The St Clair Power Plant (SCPP) located at 4901 Pointe Drive in St. Clair, Michigan, employs the use of five (5) coal-fired boilers (Units 1-3, 6, and 7). Units 1-3 each have Babcock and Wilcox boilers capable of producing 1,070,000 pounds per hour of steam. Unit 1 is equipped with General Electric turbine generators each with a nominally rated capability of 167 megawatts (MW). Units 2 and 3 have Allis Chalmers turbine generators each with a nominally rated capability of 170 MW.

Units 6 and 7 have Combustion Engineering boilers capable of producing 2,100,000 and 3,580,000 pounds of steam per hour respectively. The turbine generators on each unit were manufactured by Westinghouse and have a nominally rated capability of 325 and 500 megawatts respectively. Full load capability for Units 6 and 7 while firing coal only is approximately 315 MW and 470 MW respectively.

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<sup>1</sup> MDEQ, Approval Letter, dated August 27, 2018. (Attached-Appendix A)



The air pollution control equipment on Units 1-3 consists of Wheelabrator Frye electrostatic precipitators on each unit that have design collection efficiencies of 99.6%. Each exhaust stack is 599 feet tall with an internal diameter of 13.3 feet. The air pollution control equipment on Unit 6 consists of Research Corporation electrostatic precipitators that have design collection efficiencies of 99.6%. The exhaust stack is 425 feet tall with an internal diameter of 19.0 feet. The air pollution control equipment on Unit 7 consists of an American Standard electrostatic precipitator that has design collection efficiency of 99.6%. The exhaust stack is 600 feet tall with an internal diameter of 16.0 feet

Testing occurred on EU-BOILER6-SC at greater than 85% of normal full load capability while burning coal and oil.

### 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* or listed as an approved "Other Test Method". 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 & CO <sub>2</sub>	Instrumental Analyzer Method
USEPA Method 4	Moisture Content	Gravimetric Analysis
USEPA Method 5B	Filterable Particulate Matter (Non-Sulfuric Acid)	Gravimetric Analysis
USEPA Method 201A	PM <sub>10/2.5</sub>	Gravimetric Analysis
USEPA Method 202	Condensable 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 four (4) points per port for a total of sixteen (16) sampling points. See Figure 1 for a diagram of the traverse/sampling points used.

A cyclonic flow check was performed during EU-BOILER6-SC's 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, a static pressure check was performed which confirmed that the null angle was 0°.

#### **3.1.2 Method 2 Sampling Equipment**

The EPA Method 2 sampling equipment consisted of a 0-10" incline manometer, calibrated S-type pitot tubes ( $C_p = 0.84$  &  $0.775$ ) and a type-K calibrated thermocouple. For the  $PM_{10/2.5}$  testing, the field data sheets show a pitot coefficient of 0.84. This was an error- a calibrated pitot with a coefficient of 0.775 was used in conjunction with the  $PM_{10}$  head.

### **3.2 OXYGEN AND CARBON DIOXIDE (USEPA Method 3A)**

#### **3.2.1 Sampling Method**

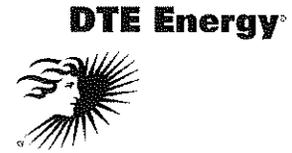
Stack gas Oxygen ( $O_2$ ) and Carbon Dioxide ( $CO_2$ ) emissions were evaluated using USEPA Method 3A, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight (Instrumental Analyzer Method)". The  $O_2$  /  $CO_2$  analyzers utilize paramagnetic sensors.

#### **3.2.2 $O_2$ / $CO_2$ Sampling Train**

$O_2$  /  $CO_2$  was analyzed using a Servomex 5200 MiniIMP gas analyzer. A PTFE line was connected to the front of the analyzer and gas was sampled from the exhaust of the dry gas meter during the isokinetic test periods.

#### **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". Exhaust moisture was collected in glass impingers as a component of the PM sampling trains and the percentage of moisture was then derived from calculations outlined in USEPA Method 4.

### **3.4 FILTERABLE PARTICULATE MATTER (USEPA Method 5B)**

#### **3.4.1 Sampling Method**

USEPA Method 5B, "Determination of Non-Sulfuric Acid Particulate Emissions from Stationary Sources" was used to measure the filterable (front-half) particulate emissions (see Figure 3 for a schematic of the sampling train). Triplicate, 64-minute test runs were conducted.

The Method 5B modular isokinetic stack sampling system consisted of the following:

- (1) PTFE coated stainless-steel button-hook nozzle
- (2) Heated glass-lined probe
- (3) Heated 3" glass filter holder with a quartz filter (maintained at a temperature of  $320 \pm 25$  °F)
- (4) Set of 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 quartz filters used in the sampling were initially baked for 3 hours at 320 °F, desiccated for 24 hours and weighed to a constant weight as described in Method 5B 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 baked for 6 hours at 320 °F, desiccated for 24 hours and weighed to a constant weight (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 5B 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 5B. All Method 1-4, and 5B calibration data is located in Appendix D.

#### **3.4.3 Data Reduction**

The filterable PM emissions data collected during the testing was calculated and reported as lb/1000lbs @ 50% excess air for comparison to the permitted emission limit.

### **3.5 PM<sub>10</sub> / PM<sub>2.5</sub> and CONDENSABLE PM (USEPA METHODS 201A/202)**

#### **3.5.1 Sampling Method**

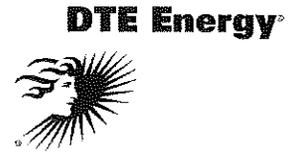
A combined USEPA Method 201A/USEPA Method 202 sampling train was used to collect fractionated and condensable particulate matter on the exhaust of EU-BOILER6-SC. Method 201A requires the use of Method 202 for measuring Primary PM<sub>10/2.5</sub> when exhaust temperature is above 85 °F. Triplicate, 120-minute test runs were conducted.

Figure 2 presents a schematic of the sampling train.

All Method 201A components were rinsed with acetone prior to use in the field. All Method 202 glassware was pre-cleaned prior to testing with soap and water, and rinsed using tap water, distilled de-ionized (DDI) water, acetone, and finally, hexane. After cleaning, the glassware was baked at 300 °C for 6 hours.

The Method 201A/202 sampling train consisted of the following:

- (1) PM<sub>10</sub> Cyclone with nozzle followed by a PM<sub>2.5</sub> cyclone
- (2) 47 mm quartz filter capable of capturing 0.3um size particulate



- (3) Stainless steel probe with glass liner with attached s-type pitot tube and Type K thermocouple
- (4) Independent heated filter box with filter bypass
- (5) Teflon tubing to connect the filter bypass to the Method 202 train
- (6) Method 23-type condenser capable of cooling exhaust gas between 65 and 85°F
- (7) Condensate dropout impinger (dry) without the bubbler tube
- (8) Modified Greenburg-Smith impinger (dry) with no taper as a backup impinger
- (9) 3" glass filter holder with a PTFE filter (maintained at a temperature between 65 and 85 °F)
- (10) Modified Greenburg-Smith impinger containing 100 millimeters (ml) of distilled de-ionized (DDI) water
- (11) Modified Greenburg-Smith impinger containing approximately 300 grams of silica gel desiccant
- (12) Method 5 umbilical and meter box

Prior to performing each test run, the entire sampling train was leak checked. The condensate dropout impinger and backup impinger were placed in an insulated box with a heated sheath maintained so that the gas stream temperature at the exit of the condensable filter holder was between 65 and 85 °F. The water and silica gel impingers were placed in an ice water bath to maintain the exit gas temperature from the silica gel impinger below 68°F.

At the completion of each test the cyclone was removed and a final leak was performed at the inlet of the probe. The sample probe and independent heated filter box were detached from the Method 202 condenser and impinger train. The Method 202 impinger train was then carefully disassembled and transported to the sample trailer. The glass probe liner, filter bypass, and Teflon tubing were rinsed with DDI water and the rinses added to the sample container. This was followed by rinsing with acetone, and two hexane rinses added to a second sample container. These components were then prepared to be used in the next test run. The sample containers were transported with the Method 202 impinger train to the sample trailer.

After the cyclone cooled, it was disassembled and two sections of the cyclone were rinsed with acetone and the filter was placed into a Petri dish which was sealed. The collected fractions were as follows:

- (1) PM between 10 and 2.5 microns – back half of PM<sub>10</sub> cyclone and front half of PM<sub>2.5</sub> Cyclone
- (2) PM <2.5 microns – Back half of PM<sub>2.5</sub> cyclone and 47mm filter.



The acetone rinses were collected into pre-cleaned sample containers. The containers were labeled with the test number, sample fraction, 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.

The liquid volume of each Method 202 impinger was measured (by weight) and recorded on the field data sheet. The silica gel was re-weighed, and any increase was recorded on the field data sheets. Moisture from the condensate dropout impinger was added to the second impinger. The Method 202 impinger train was purged with ultra-high purity compressed nitrogen at 14 liters per minute for 60 minutes. During the purge the condenser recirculation pump was operated and the first two impingers were heated/cooled to maintain the gas temperature exiting the CPM filter between 65 and 85 °F.

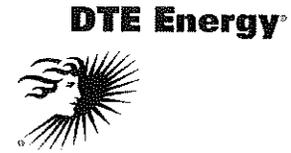
Contents from the dropout impinger and the impinger prior to the CPM filter were collected into a pre-cleaned sample container. The glassware, condenser, impingers and front-half of the CPM filter holder were rinsed with DDI water and the rinses added to the sample container. They were then rinsed with acetone followed by two rinses with hexane. The acetone and hexane rinses were collected into a pre-cleaned sample container. The CPM filter was recovered and placed into a labeled container. All containers were 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 Method 201A acetone rinses were transferred to clean pre-weighed beakers, and evaporated to dryness at ambient temperature and pressure. The beakers and filters were then desiccated for 24 hours and weighed to a constant weight. The data sheets containing the initial and final weights on the filters and beakers can be found in Appendix C.

Collected blanks consisted of a 47mm filter blank, Method 202 field recovery blank, acetone rinse blank, a DDI water rinse blank, and a hexane rinse blank taken directly from the bottles used during recovery of the samples. A proof blank was not required as the glassware was baked prior to use in the field.

Analysis of the Method 202 samples and blanks were conducted by Maxxam Analytics of Mississauga, Ontario. All analyses followed the procedures listed in Method 202. A complete laboratory report can be found in Appendix C.

Field data sheets for the Method 201A/Method 202 sampling can be found in Appendix B.



### **3.5.2 Quality Control and Assurance**

All sampling and analytical equipment was calibrated according to the guidelines referenced in EPA Methods 201A/202.

### **3.5.3 Data Reduction**

PM<sub>10/2.5</sub> sampling was performed utilizing Environmental Supply Company software. Emission rates were calculated utilizing this software as well. Fractioned and condensable particulate matter were combined to present Primary PM<sub>10</sub> and Primary PM<sub>2.5</sub> reported in pounds per thousand pounds exhaust gas at 50% excess air (lbs/1,000 lbs @ 50% EA), pounds per hour (lb/hr) and pounds per million British thermal unit (lbs/MMBtu).

## **4.0 OPERATING PARAMETERS**

The test program included the collection of boiler load and stack CEMs monitoring during each test run. Parameters recorded included gross Megawatts (MW), CO<sub>2</sub>, and CEMs PM.

Electrostatic Precipitator data was also collected including total power, sparks per minute, primary amps, primary voltage, secondary amps, secondary voltage, spark rate, and firing angle.

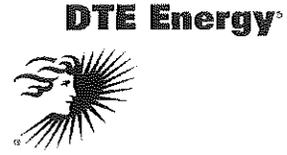
Coal samples were collected during sampling and subject to proximate and ultimate analysis.

Operational data and results of the fuel analysis can be referred to in Appendix F.

## **5.0 DISCUSSION OF RESULTS**

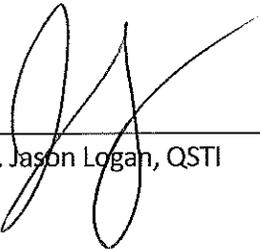
Table 1 presents the Particulate Emission testing results from EU-BOILER6-SC. Particulate emissions are presented in grain per dry standard cubic foot (gr/DSCF), pounds per hour (lbs/hr) pounds per 1000 pounds @ 50% excess air (lbs/1000lbs @ 50% excess air), and pounds per million British thermal unit (lb/MMBtu). Additional test data presented for each test includes the Unit load in gross megawatts (GMW), stack temperature in degrees Fahrenheit (°F), 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). USEPA Method 201A Section 13.3 contains detection limits of 1.44 mg for filterable PM<sub>10</sub> and 1.35 mg for PM<sub>2.5</sub>. If analysis of a PM<sub>10/2.5</sub> sample contained less weight than the specified detection limit, then the detection limit values were used and assumed to be "less than" the detection limit. The average filterable PM emissions from EU-BOILER6-SC were 0.0027 lbs/1000lbs @ 50% excess air which is less than the permit limit of 0.15 lbs/1000lbs @ 50% excess air.

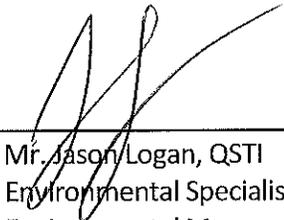
The average Primary PM<sub>2.5</sub> and Primary PM<sub>10</sub> emissions were <0.0235 and <0.0250 lbs/MMBtu, respectively.

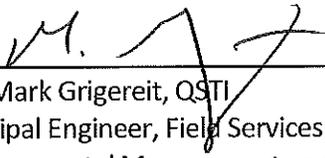


**6.0 CERTIFICATION STATEMENT**

"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."

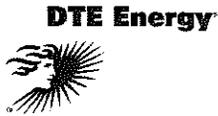
  
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## RESULTS TABLE



**Table No. 1**  
**PARTICULATE EMISSION TESTING SUMMARY**  
**St. Clair Power Plant**  
**EU-BOILER6-SC**  
**January 16-17, 2019**

**Unit 6 - Total Filterable PM**

Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Stack Velocity (ft/min)	Exhaust Gas Flowrates			PM Emissions		
						(ACFM)	(SCFM)	(DSCFM)	(grains/dscf)	(lbs/hr)	(lbs/1000lbs @ 50% EA) <sup>(1)</sup>
PM-1	16-Jan-19	10:35-11:45	310.2	289	4,334	1,228,700	852,122	775,212	0.0017	11.23	0.0033
PM-2	16-Jan-19	12:19-13:38	309.9	288	4,382	1,242,555	863,088	794,149	0.0015	10.21	0.0027
PM-3	16-Jan-19	13:51-15:01	<u>308.7</u>	<u>287</u>	<u>4,390</u>	<u>1,244,606</u>	<u>865,164</u>	<u>819,806</u>	<u>0.0011</u>	<u>7.62</u>	<u>0.0021</u>
<b>Average:</b>			<b>309.6</b>	<b>288</b>	<b>4,369</b>	<b>1,238,620</b>	<b>860,125</b>	<b>796,389</b>	<b>0.0014</b>	<b>9.69</b>	<b>0.0027</b>

(1) Permit Limit = 0.15 lbs/1000 lbs @ 50% excess air

**Unit 6 - Primary PM10**

Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Stack Velocity (ft/min)	Exhaust Gas Flowrates		Primary PM10 Emissions		
						(SCFM)	(DSCFM)	(grains/dscf)	(lbs/hr)	(lbs/MMBtu)
CPM-1	17-Jan-19	8:35-11:02	308.4	281	4,127	825,509	770,915	0.0129	85.66	0.0357
CPM-2	17-Jan-19	11:53-14:10	307.6	282	4,198	839,727	777,132	<0.0075	<49.61	<0.0205
CPM-3	17-Jan-19	14:40-16:54	<u>306.7</u>	<u>283</u>	<u>4,085</u>	<u>816,138</u>	<u>755,350</u>	<u>&lt;0.0068</u>	<u>&lt;44.04</u>	<u>&lt;0.0186</u>
<b>Average:</b>			<b>307.6</b>	<b>282</b>	<b>4,137</b>	<b>827,125</b>	<b>767,799</b>	<b>&lt;0.0091</b>	<b>&lt;59.77</b>	<b>&lt;0.0250</b>

**Unit 6 - Primary PM2.5**

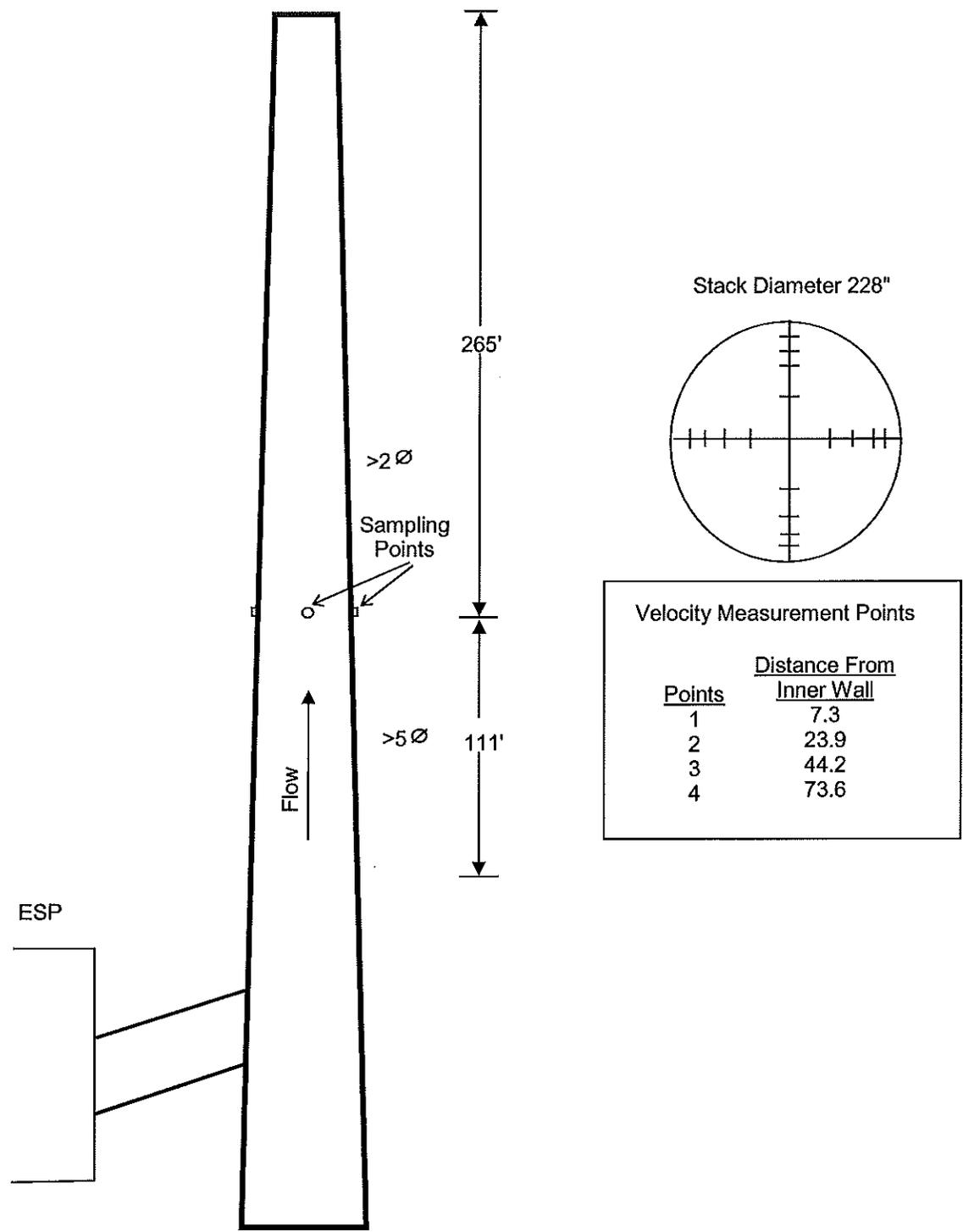
Test	Test Date	Test Time	Unit Load (GMW)	Stack Temperature (°F)	Stack Velocity (ft/min)	Exhaust Gas Flowrates		Primary PM2.5 Emissions		
						(SCFM)	(DSCFM)	(grains/dscf)	(lbs/hr)	(lbs/MMBtu)
CPM-1	17-Jan-19	8:35-11:02	308.4	281	4,127	825,509	770,915	<0.0124	<81.96	<0.0342
CPM-2	17-Jan-19	11:53-14:10	307.6	282	4,198	839,727	777,132	<0.0070	<46.30	<0.0192
CPM-3	17-Jan-19	14:40-16:54	<u>306.7</u>	<u>283</u>	<u>4,085</u>	<u>816,138</u>	<u>755,350</u>	<u>&lt;0.0063</u>	<u>&lt;40.71</u>	<u>&lt;0.0172</u>
<b>Average:</b>			<b>307.6</b>	<b>282</b>	<b>4,137</b>	<b>827,125</b>	<b>767,799</b>	<b>&lt;0.0086</b>	<b>&lt;56.32</b>	<b>&lt;0.0235</b>



**FIGURES**



Figure 1 – Sampling Location & Traverse Points  
St Clair Power Plant – EU-BOILER6-SC  
January 16-17, 2019



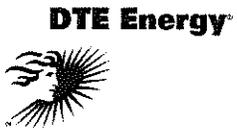
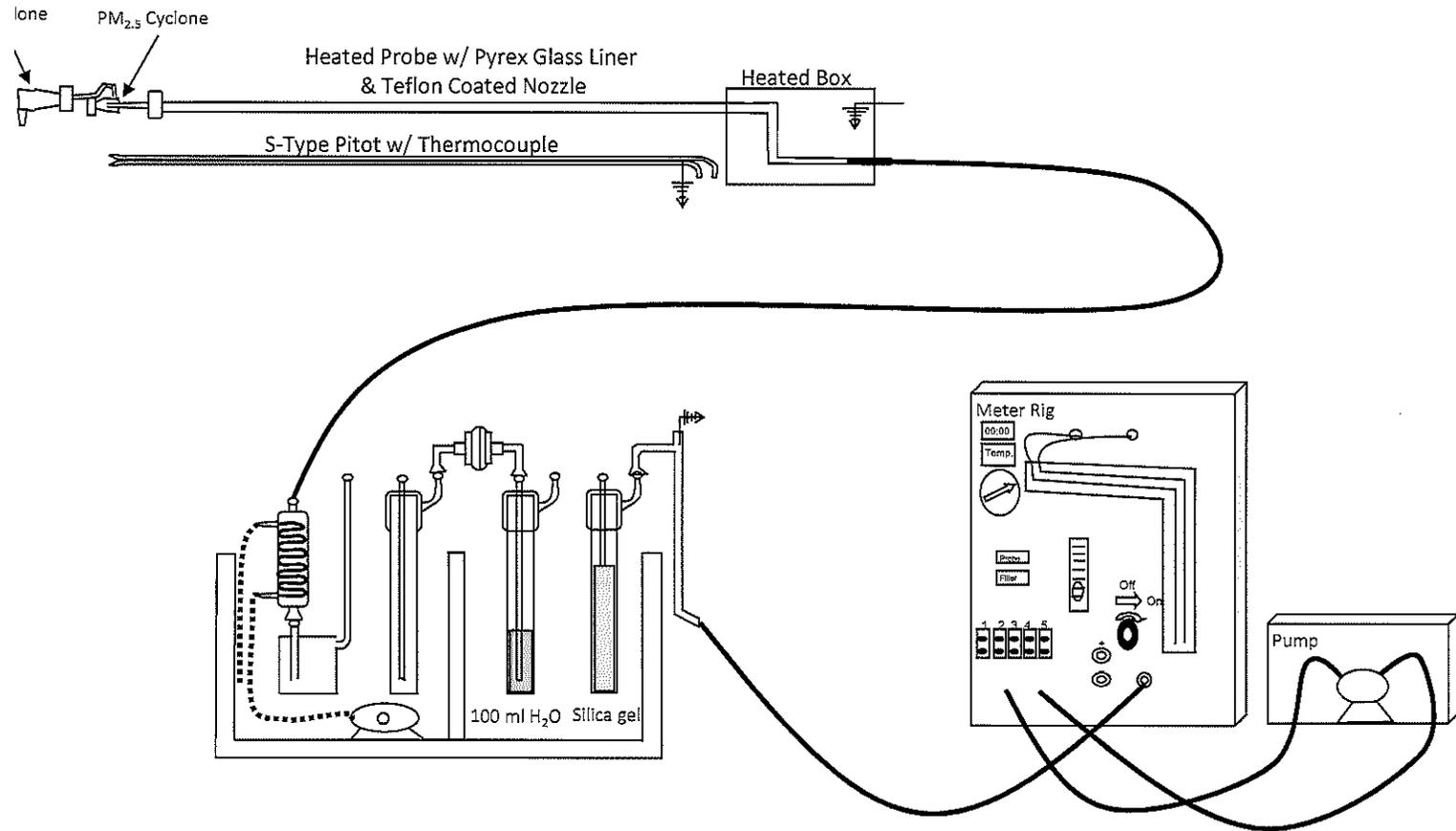


Figure 2 - EPA Methods 201A/202  
St Clair Power Plant – EU-BOILER6-SC  
January 16-17, 2019



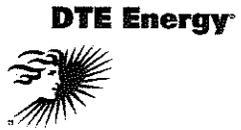
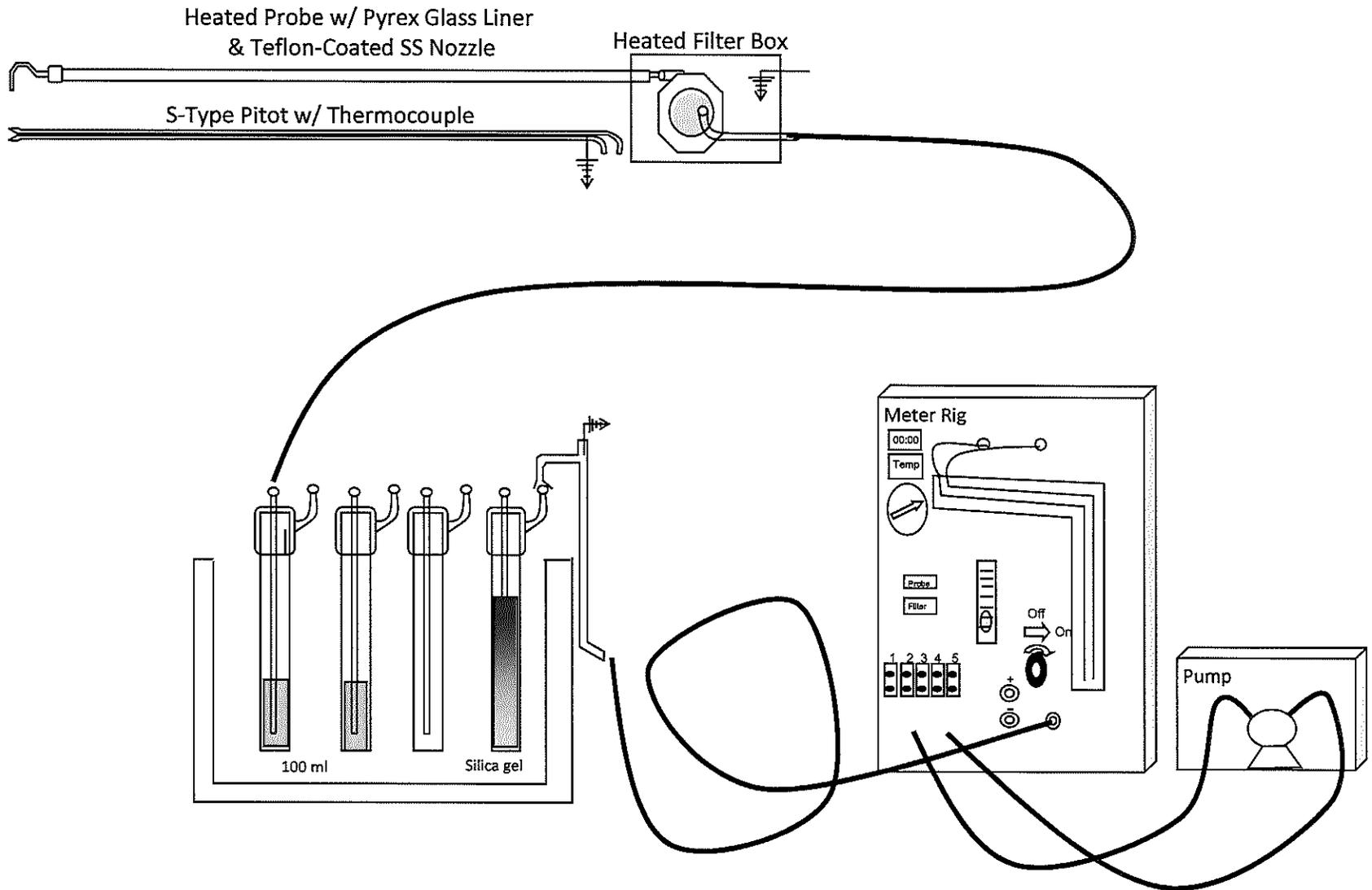


Figure 3– EPA Method 5B  
St Clair Power Plant – EU-BOILER6-SC  
January 16-17, 2019





**APPENDIX A**

**TEST PLAN APPROVAL LETTER**