

RECEIVED

AUG 31 2018

AIR QUALITY DIVISION

*Consumers Energy*

*Count on Us<sup>®</sup>*

**Particulate Matter  
40 CFR 63 Subpart UUUUU  
LEE Demonstration  
EUBOILER01 and EUBOILER02**

CMS Enterprises  
TES Filer City Station  
700 Mee Street  
Filer City, Michigan 49634  
SRN: N1685

**Test Dates: July 30 through August 1, 2018**

**Report Date: August 28, 2018**

Test Performed by the Consumers Energy Company  
Regulatory Compliance Testing Section  
Air Emissions Testing Body  
Laboratory Services Section  
Work Order No. 4101981  
Version No. 0

## EXECUTIVE SUMMARY

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted filterable particulate matter (PM) testing of the single exhausts of coal-fired boilers EUBOILER01 and EUBOILER02 (Units 1 and 2) operating at the Tondu Energy Systems (TES) Filer City Station in Filer City, Michigan. The facility is a cogeneration power plant with a rated output of 60-megawatts net and 50,000 pounds of process steam per hour subject to 40 Code of Federal Regulations (CFR) Part 63, Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units, also known as the Mercury and Air Toxics (MATS) rule. The 3<sup>rd</sup> quarter 2018 air emissions tests were performed to (1) satisfy 40 CFR 63.10006(c) quarterly testing requirements, (2) evaluate compliance with the applicable emission limit of 0.030 lb/mmBtu PM, and (3) to evaluate if the sources qualify as Low Emitting EGUs (LEE) as specified 40 CFR 63.10005(h)(1)(i).

Three 120-minute PM test runs were performed at each boiler exhaust on July 30 through August 1, 2018 following the procedures described in the Test Protocol submitted by Consumers Energy to Michigan Department of Environmental Quality (MDEQ) on May 1, 2017 and subsequently approved by Mr. Jeremy Howe, MDEQ Environmental Quality Analyst, in his letter dated May 11, 2017. There were no deviations from the approved stack test protocol or the USEPA Reference Methods with the exception of implementing collection and analysis procedural changes for EGU diluent gases as specified in the March 6, 2018 USEPA guidance publication entitled *Alternative (ALT) Method 123* (ALT-123).

The average results of the tests are presented below:

- Unit 1: 0.0008 lb PM/mmBtu
- Unit 2: 0.0017 lb PM/mmBtu

The results of the testing indicate EUBOILER01 and EUBOILER02 are in compliance with the applicable MATS PM lb/mmBtu emission limit, and because the emissions were less than 50 percent of the limit, meet the LEE qualification criterion for the 8<sup>th</sup> consecutive calendar quarter.

Detailed results are presented in Appendix Tables 1 and 2. Sample calculations and field data sheets are presented in Appendices A and B. Laboratory data is presented in Appendix C. Boiler operating data and supporting documentation are provided in Appendices D and E.

## 1.0 INTRODUCTION

This report summarizes the results of compliance air emissions testing conducted from the exhausts of EUBOILER01 (Unit 1) and EUBOILER02 (Unit 2) at the Tondu Energy Systems (TES) Filer City Station in Filer City, Michigan July 30 through August 1, 2018.

This document follows the Michigan Department of Environmental Quality (MDEQ) format described in the March 2018 Format for Submittal of Source Emission Test Plans and Reports. Reproducing only a portion of this report may omit critical substantiating documentation or cause information to be taken out of context. If any portion of this report is reproduced, please exercise due care in this regard.

### 1.1 IDENTIFICATION, LOCATION, AND DATES OF TESTS

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted filterable particulate matter (PM) testing at the TES Filer City Station in Filer City, Michigan on July 30 through August 1, 2018.

A test protocol was submitted to the Michigan Department of Environmental Quality (MDEQ) on May 1, 2017 and subsequently approved by Mr. Jeremy Howe, MDEQ Environmental Quality Analyst, in his letter dated May 11, 2017. The preceding reflects a standing approval for all quarterly MATS PM tests as long as no modifications from the original protocol occur; however, updated and agency approved EGU diluent gas collection and analysis procedures in the March, 2018 USEPA publication ALT-123 were implemented.

### 1.2 PURPOSE OF TESTING

The 3<sup>rd</sup> quarter 2018 air emissions tests were performed to (1) satisfy 40 CFR 63.10006(c) quarterly testing requirements, (2) evaluate compliance with the applicable emission limit, and (3) to evaluate if the sources qualify as Low Emitting EGUs (LEE) as specified 40 CFR 63.10005(h)(1)(i). The applicable emission limits are summarized in Table 1-1.

The PM LEE demonstration requires quarterly sampling over a period of three consecutive years. The results of each quarterly test must be less than or equal to 50 percent of the applicable standard listed in Table 2 of the MATS rule, equating to 0.015 lb/mmBtu for PM. MATS LEE testing for PM commenced in the 4<sup>th</sup> quarter of 2015. However, the 3<sup>rd</sup> quarter 2016 PM results for both units were between 50% and 100% of the associated MATS emission limit, so the initial attempt at LEE qualification was ended and a new series of LEE qualification tests was commenced in the 4<sup>th</sup> quarter of 2016. This test program evaluated LEE status for the 8<sup>th</sup> consecutive calendar quarter.

**Table 1-1**  
**MATS PM Emission Limits**

Parameter	Emission Limit	Units	Applicable Requirement
PM	0.030	lb/mmBtu	Table 2 to Subpart UUUUU of Part 63- Emission Limits for Existing EGU's

lb/mmBtu: pound per million British thermal unit heat input

RECEIVED

AUG 31 2018

AIR QUALITY DIVISION

### 1.3 BRIEF DESCRIPTION OF SOURCE

TES Filer City Station is a cogeneration power plant consisting of two solid-fuel fired boilers. EUBOILER01 and EUBOILER02 are spreader stoker boilers that produce steam used to generate electricity and sold to an adjacent property, when needed.

### 1.4 CONTACT INFORMATION

Table 1-2 presents the test program organization, major lines of communication, and names and contact information of responsible individuals.

**Table 1-2  
Contact Information**

Program Role	Contact	Address
Regulatory Agency Representative	Ms. Karen Kajiya-Mills Technical Programs Unit Manager 517-335-4874 <a href="mailto:kajiya-millsk@michigan.gov">kajiya-millsk@michigan.gov</a>	Michigan Department of Environmental Quality Technical Programs Unit 525 W. Allegan, Constitution Hall, 2 <sup>nd</sup> Floor S Lansing, Michigan 48933
Regulatory Agency Inspector	Ms. Caryn Owens Environmental Engineer 231-876-4414 <a href="mailto:owensc1@michigan.gov">owensc1@michigan.gov</a>	Michigan Department of Environmental Quality Cadillac District 120 W. Chapin Street Cadillac, Michigan 49601
Regulatory Agency Representative	Mr. Jeremy Howe Environmental Engineer 231-876-4416 <a href="mailto:howej1@michigan.gov">howej1@michigan.gov</a>	Michigan Department of Environmental Quality Cadillac District 120 W. Chapin Street Cadillac, Michigan 49601
Responsible Official	Mr. Henry Hoffman General Manager 231-723-6573, Ext 102 <a href="mailto:henry.hoffman@cmsenergy.com">henry.hoffman@cmsenergy.com</a>	CMS Generation Filer City Operating, LLC Filer City Station 700 Mee Street Filer City, Michigan 49634
Plant Representative	Mr. Austin Swiatlowski Plant Operator 231-723-6573, Ext 108 <a href="mailto:austin.swiatlowski@cmsenergy.com">austin.swiatlowski@cmsenergy.com</a>	CMS Generation Filer City Operating, LLC Filer City Station 700 Mee Street Filer City, Michigan 49634
Test Team Representative	Mr. Thomas R. Schmelter, QSTI Senior Engineering Technical Analyst 616-738-3234 <a href="mailto:thomas.schmelter@cmsenergy.com">thomas.schmelter@cmsenergy.com</a>	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460
Test Team Representative	Mr. Brian E. Miska, QSTI Senior Engineering Technical Analyst 989-891-3415 <a href="mailto:brian.miska@cmsenergy.com">brian.miska@cmsenergy.com</a>	Consumers Energy Company D.E. Karn Power Plant 2742 N. Weadock Highway ESD Trailer #4 Essexville, Michigan 48732

## 2.0 SUMMARY OF RESULTS

### 2.1 OPERATING DATA

During the tests, the boilers were operated as close as possible to maximum normal operating load conditions. 40 CFR 63.10007(2) states the maximum normal operating load will be generally between 90 and 110 percent of design capacity but should be representative of site specific normal operations. The average steam flow during the test was 297.3 klbs/hr for Unit 1 and 299.5 klbs/hr for Unit 2 (93% load for Unit 1 and 94% load

for Unit 2, with a full load rating of 320 klbs/hr for each unit). Recorded operating data, including fuel blend firing rate and composite fuel factor data, is included in Appendix D.

## 2.2 APPLICABLE PERMIT INFORMATION

The TES Filer City Station is currently operating pursuant to the terms and conditions of State of Michigan Registration Number (SRN) N1685 air permit MI-ROP-N1685-2015b. The air permit incorporates state and federal regulations. The USEPA has assigned a Facility Registry Service (FRS) identification number of 110056958225. EUBOILER01 and EUBOILER02 are the emission unit sources listed within the permit and collectively comprise the FGBOILERS flexible group. Incorporated within the permit are the applicable requirements of 40 CFR 63, Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units.

## 2.3 RESULTS

The results of the air emissions testing indicate the 3-run average PM emission rates are in compliance with the applicable limit and both EUBOILER01 and EUBOILER02 are emitting PM below the LEE qualification threshold. Refer to Table 2-1 for a summary of the PM test results. Refer to Section 5.0 for further discussion.

**Table 2-1  
Summary of PM Test Results**

Source	Units	Run			Average	Emission Limit	
		1	2	3		MATS	MATS LEE
Unit 1	lb/mmBtu	0.0009	0.0008	0.0006	<b>0.0008</b>	<b>0.030</b>	<b>0.015</b>
	lb/hr	0.38	0.33	0.29	0.33	N/A	N/A
Unit 2	lb/mmBtu	0.0022	0.0013	0.0015	<b>0.0017</b>	<b>0.030</b>	<b>0.015</b>
	lb/hr	0.89	0.57	0.63	0.70	N/A	N/A

lb/mmBtu: pound per million British thermal heat input  
lb/hr: pound per hour

Detailed results are presented in Appendix Tables 1 and 2, following the report text. Sample calculations and field data sheets are presented in Appendices A and B. Laboratory data is presented in Appendix C. Boiler operating data and supporting documentation are provided in Appendices D and E, including boiler operator logs documenting when soot blowing was conducted.

## 3.0 SOURCE DESCRIPTION

TES Filer City Station is a cogeneration facility consisting of two solid-fuel fired boilers. The electricity output is sold pursuant to a long-term power purchase agreement with Consumers Energy Company. Process steam is sold to an adjacent industrial customer.

### 3.1 PROCESS

TES Filer City Station operates as a cogeneration electric power plant with a rated output of approximately 60-megawatts net (MW<sub>n</sub>) and is also capable of generating 50,000 pounds of process steam per hour. The electricity and process steam are sold under contract to public and/or private companies. The facility commenced commercial operations beginning in 1990.

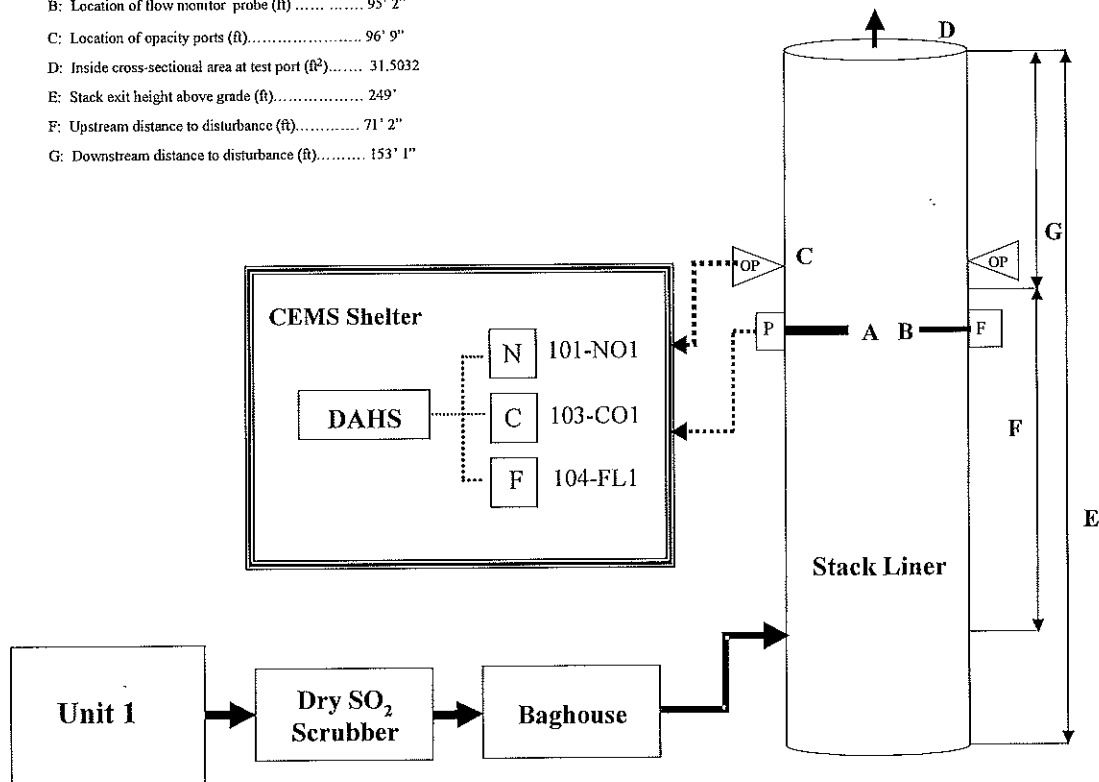
### 3.2 PROCESS FLOW

EUBOILER01 and EUBOILER02 are spreader stoker boilers used to generate steam. Each unit has a nominal heat input rating of approximately 384 mmBtu/hour and is currently allowed to combust coal, wood and wood waste, industrial construction/demolition wood waste, tire derived fuel, petroleum coke, and natural gas. Note that pursuant to an Administrative Consent Order with EPA, all petroleum coke has been removed from the site and the facility does not anticipate using this fuel in the future. The fuel is fired in the furnace where the combustion heats water within boiler tubes producing steam. At full load, each unit is capable of producing approximately 320,000 pounds per hour of steam. This steam is used to turn a common steam turbine that is connected to an electricity producing generator. The electricity is routed through the transmission and distribution system to customers.

The exhaust gas from each boiler is vented to a spray dryer absorber (SDA) flue gas desulfurization system for sulfur dioxide and acid gas control and a baghouse to control particulate matter. The abated exhaust gases are discharged through separate circular flues housed within a single exhaust stack. The separate flues discharge approximately 250 feet above grade. Refer to Figure 3-1 for a process flow diagram of Unit 1 which is also representative of Unit 2.

**Figure 3-1. Unit 1 Data Flow Diagram**

- A: Location of sample probe (ft) ..... 95' 11"
- B: Location of flow monitor probe (ft) ..... 95' 2"
- C: Location of opacity ports (ft)..... 96' 9"
- D: Inside cross-sectional area at test port (ft<sup>2</sup>)..... 31.5032
- E: Stack exit height above grade (ft)..... 249'
- F: Upstream distance to disturbance (ft)..... 71' 2"
- G: Downstream distance to disturbance (ft)..... 153' 1"



### 3.3 MATERIALS PROCESSED

At the time of testing, Units 1 and 2 were capable of firing mixtures of coal (bituminous and subbituminous), wood and wood waste, construction/demolition (C/D) material, tire-derived-fuel (TDF), petroleum coke and natural gas. As noted previously, the facility does not anticipate firing petroleum coke in the future. During the tests, coal, natural gas, TDF, and wood were fired. Refer to Appendix D for facility operating data recorded during the test program.

In March of 2016, two low NO<sub>x</sub> natural gas-fired burners were installed in each boiler. Natural gas is utilized as a clean startup fuel, flame stabilization, and other purposes.

### 3.4 RATED CAPACITY

EUBOILER01 and EUBOILER02 each have a nominally rated heat input capacity of 384 mmBtu/hr and a steam generation capacity of 320,000 lbs/hr; they can generate a combined net electrical output of approximately 60 MW<sub>n</sub> and 50,000 pounds of process steam per hour. The boilers normally operate in a continuous manner near their rated capacity in order to meet the contractual electrical and steam requirements of TES Filer City Station customers.

### 3.5 PROCESS INSTRUMENTATION

The process was continuously monitored by boiler operators, environmental technicians, and data acquisition systems during testing. The following operating parameters were recorded during the test program and are included in Appendix D:

- Carbon dioxide concentration (%)
- Fuel blend (coal, natural gas, TDF, and wood) firing rates (lb/hr) (scfm for natural gas)
- Steam load flow (1,000s lb/hr) and pressure (psia) [In lieu of electrical load, which is only determined on a combined basis.]
- Opacity (%)
- Total heat input (mmBtu/hr)
- Mixed fuel factor, F<sub>c</sub> (scf/mmBtu)
- SO<sub>2</sub> reduction (%)

Due to the various instrumentation monitoring systems, the facility instrumentation time stamps were correlated to reference method test times in local Eastern Daylight Time (EDT).

## 4.0 SAMPLING AND ANALYTICAL PROCEDURES

Consumers Energy RCTS tested for PM emissions using the USEPA test methods presented in Table 4-1. The sampling and analytical procedures associated with each parameter are described in the following sections.

**Table 4-1  
Test Methods**

Parameter	Method	USEPA Title
Sampling location and Traverse Points	1	Sample and Velocity Traverses for Stationary Sources
Stack Gas Velocity and Temperature	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight (O <sub>2</sub> and CO <sub>2</sub> )	3A/3B ALT-123	Alternative Test Method for Diluent Measurement to Support Particulate Matter Testing Under 40 CFR 63, Subpart UUUUU
Moisture	4	Determination of Moisture Content in Stack Gases
Filterable particulate matter	MATS 5	Determination of Particulate Matter Emissions from Stationary Sources (probe and filter temperatures set to 320±25°F)
Emission rate	19	Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

#### 4.1 DESCRIPTION OF SAMPLING TRAIN AND FIELD PROCEDURES

The test matrix presented in Table 4-2 summarizes the sampling and analytical methods performed for the specified parameters during this test program.

**Table 4-2  
Test Matrix**

Date (2018)	Run	Sample Type	Start Time (EDT)	Stop Time (EDT)	Test Duration (min)	EPA Test Method	Comment
July 30	1	Unit 1 PM	12:50	14:48	120	MATS5	Soot blow occurred at 13:10; Steam load reduced at 13:51 to address bad steam line support
July 30	2	Unit 1 PM	15:35	17:43	120	MATS5	Steam line support fixed at 15:34; steam load increased
July 31	3	Unit 1 PM	8:30	10:37	120	MATS5	No issues
July 31	1	Unit 2 PM	11:02	13:13	120	MATS5	Soot blow occurred at 11:33
July 31	2	Unit 2 PM	13:30	15:39	120	MATS5	No issues
August 1	3	Unit 2 PM	9:17	11:23	120	MATS5	No issues



#### 4.1.1 SAMPLE LOCATION AND TRAVERSE POINTS (USEPA METHOD 1)

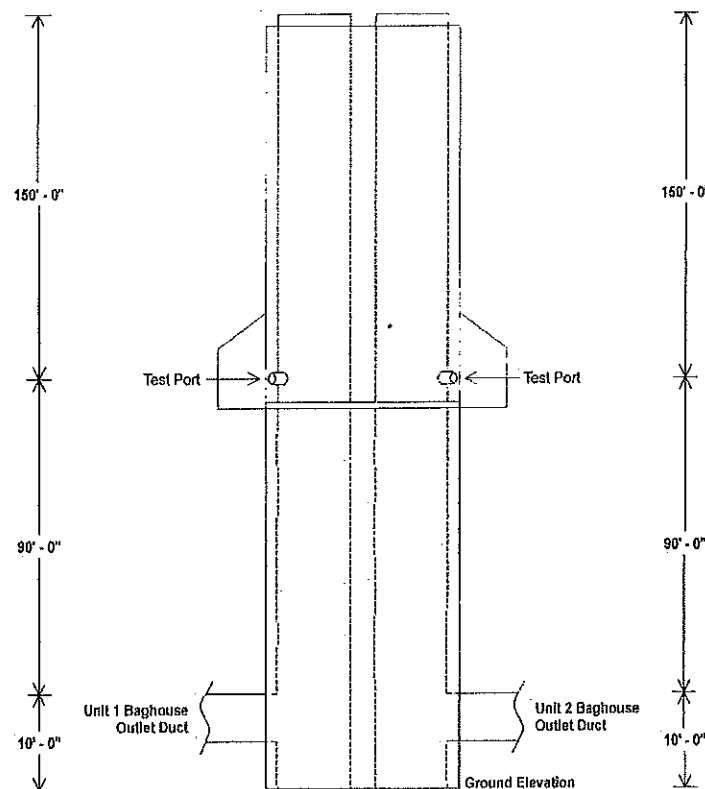
The selection of the measurement site was evaluated using the procedure in USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*. Each exhaust gas flue is 76 inches in diameter with two 6-inch internal diameter sample ports that extend 20 inches from the flue interior wall. The sample ports are situated:

- Approximately 90 feet or 14 duct diameters downstream of a duct bend disturbance where the combustion gases exit the baghouse and enter the exhaust stack, and
- Approximately 150 feet or 24 duct diameters upstream of the exhaust to atmosphere.

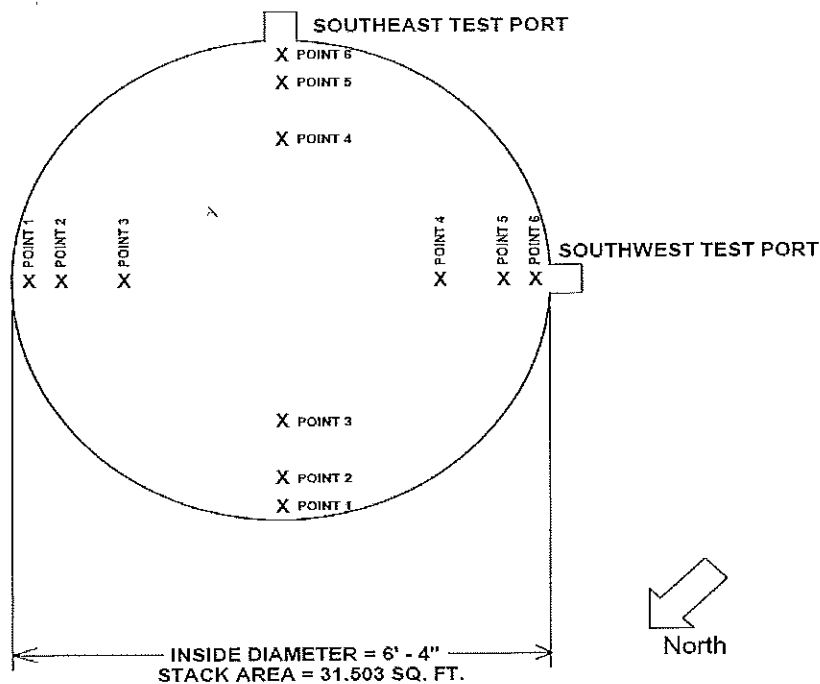
Because the sampling locations are at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame and meet the requirements of USEPA Method 1, flue gas measurements were collected from a total of 12 traverse points. The area of the exhaust duct was calculated and the cross-section divided into a number of equal areas based on distances to air flow disturbances. Flue gas was sampled for 10 minutes at six traverse points from the two sample ports for a total test duration of 120 minutes.

A dimensioned sketch of the sample location showing the sampling ports in relation to breeching and to upstream and downstream disturbances or obstructions in gas flow is presented as Figure 4-1. The Unit 1 duct cross section and sampling point detail is presented as Figure 4-2; Unit 2 is identical to Unit 1 with the exception the two test ports are located at the northeast and northwest compass positions.

**Figure 4-1. Unit 1 and 2 Sample Locations**



**Figure 4-2. Unit 1 Duct Cross Section and Sampling Point Detail**



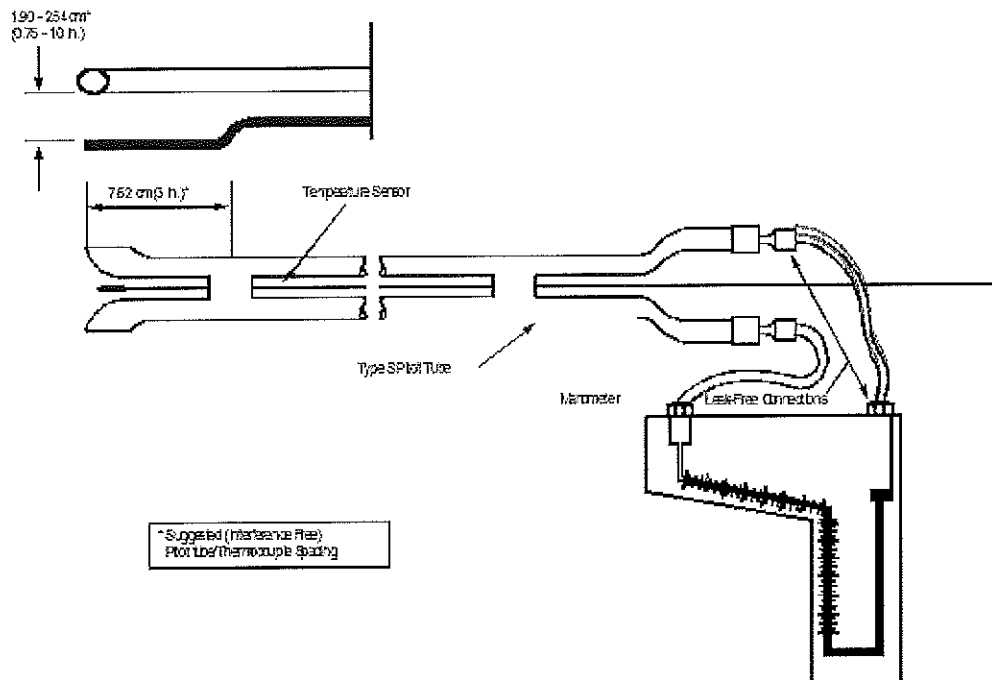
Probe Depths From  
Inside Stack Wall  
Flow Port Length = 20"

- Point 1 = 72.655"
- Point 2 = 64.904"
- Point 3 = 53.504"
- Point 4 = 22.496"
- Point 5 = 11.096"
- Point 6 = 3.344"

#### 4.1.2 VELOCITY AND TEMPERATURE (USEPA METHOD 2)

The exhaust gas velocity and temperature were measured using USEPA Method 2, *Determination of Stack Gas Temperature and Velocity (Type S Pitot Tube)*. The pressure differential ( $\Delta P$ ) across the positive and negative openings of the Pitot tube inserted in the exhaust duct at each traverse point were measured using an "S Type" (Stauscheibe or reverse type) Pitot tube connected to an appropriately sized oil filled inclined manometer. Exhaust gas temperatures were measured using a chromel/alumel "Type K" thermocouple and a temperature indicator. Refer to Figure 4-3 for a drawing of the Method 2 sample apparatus showing the Pitot tube and thermocouple configuration.

**Figure 4-3. Method 2 Sample Apparatus**



Flue gas velocity and velocity vector measurements (cyclonic flow evaluation) were measured following the procedures in USEPA Method 2 at the sampling locations. Cyclonic flow is defined as a flow condition with an average null angle greater than 20 degrees. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head reading—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20 degrees, the flue gas is considered to be cyclonic at that sampling location and an alternative location should be found.

Appendix B of this report includes cyclonic flow test data as verification of the absence of cyclonic flow at each test location. Method 1, § 11.4.2 indicates *if the average (null angle) is greater than 20°, the overall flow condition in the stack is unacceptable, and alternative methodology...must be used.* The average null yaw angle measured in August 2012 was 3.25° for Unit 1 and 8.25° for Unit 2, thus meeting the less than 20° requirement. Because there have been no significant ductwork and/or stack configuration changes, this null angle information is considered to be valid and additional cyclonic flow verification was not performed prior to the PM test.

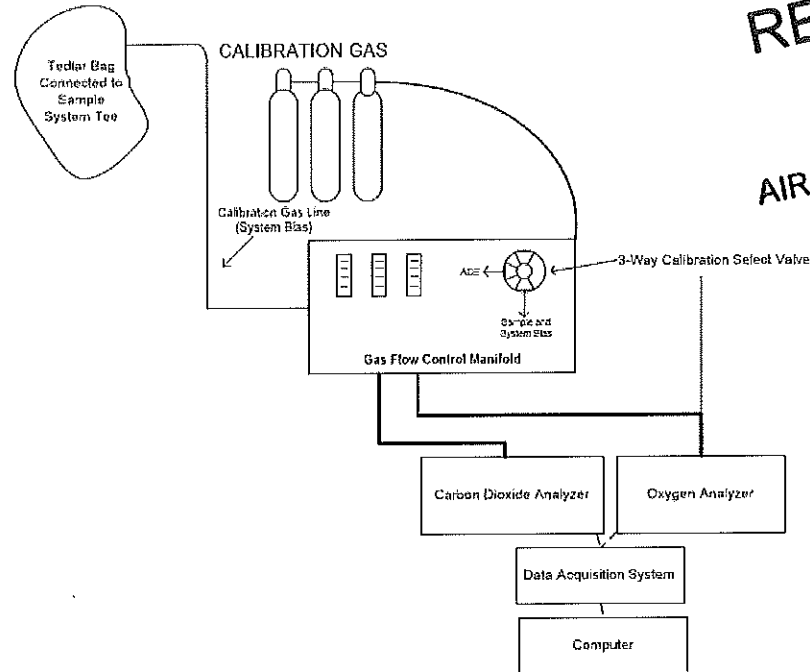
#### **4.1.3 MOLECULAR WEIGHT (USEPA ALT-123)**

The exhaust gas composition and molecular weight was measured using the sampling and analytical procedures of USEPA ALT-123, *Alternative Test Method for Diluent Measurement to Support Particulate Matter Testing Under 40 CFR 63, Subpart UUUUU*. ALT-123 combines the sample collection procedures of USEPA Method 3B, *Gas Analysis for the Determination of Emission Rate Correction Factor or Excess Air* with the analytical procedures of USEPA Method 3A, *Oxygen and Carbon Dioxide Concentrations from Stationary Sources – (Instrumental Analyzer Procedure.)* The flue gas oxygen and carbon dioxide concentrations

were used to calculate molecular weight, flue gas velocity, emissions in lb/mmBtu, and/or lb/1,000 lbs corrected to 50% excess air.

Flue gas was extracted from the stack during each test from each of the 12 traverse points through a stainless steel lined probe and inert tubing into a flexible sample bag. The sample was then withdrawn from the flexible bag and conveyed into a multi gas analyzer that measured oxygen and carbon dioxide concentrations. Figure 4-4 depicts the ALT-123 sampling system.

**Figure 4-4. Method 3A Sampling System**



Prior to sampling flue gas, the analyzer was calibrated by performing a calibration error test where zero-, mid-, and high-level calibration gases were introduced directly to the analyzer. The calibration error check was performed to evaluate if the analyzer response was within  $\pm 2.0\%$  of the calibration gas span. Analyzer system-bias and drift tests were performed by filling inert flexible sample bags with zero- and mid- or high- calibration gases and introducing these calibration standards into the gas analyzer to measure the ability of the system to respond to within  $\pm 5.0$  percent of span.

At the conclusion of the bag sample analysis, an additional system bias check was performed to evaluate the drift from the pre- and post-test system bias checks. The system-bias checks evaluated if the analyzer drift was within the allowable criterion of  $\pm 3.0\%$  of span from pre- to post-test system bias checks. The measured oxygen and carbon dioxide concentrations were corrected for analyzer drift. Refer to Appendices B and E for analyzer calibration data and supporting documentation.

#### **4.1.4 MOISTURE CONTENT (USEPA METHOD 4)**

The exhaust gas moisture content was determined using USEPA Method 4, *Determination of Moisture in Stack Gases* in conjunction with the MATS Method 5 sample apparatus. The sampled gas was conveyed through a series of impingers immersed in an ice bath to condense water in the flue gas. The amount of water condensed and collected in the impingers was measured gravimetrically and used with the volume of gas sampled to calculate the exhaust gas moisture content.

#### 4.1.5 PARTICULATE MATTER (USEPA METHOD 5)

Filterable particulate matter samples were collected isokinetically following the procedures of USEPA Method 5, *Determination of Particulate Matter Emissions from Stationary Sources* with the necessary modifications specified in the MATS Rule for low emitting EGU (LEE) status determinations. Specifically, the probe and filter temperatures were maintained at 320°F ±25°F, throughout the duration of each test run and a minimum of 2 dry standard cubic meters (dscm) or 70.629 dry standard cubic feet (dscf) of sample volume was collected.

As flue gas is withdrawn isokinetically from the stack, filterable PM is collected on a heated quartz-fiber filter. Moisture or water vapor in the gas condenses in a series of impingers following the heated filter. Figure 4-5 depicts the Method 5 sample apparatus and Table 4-3 provides the Method 5 impinger configuration detail.

**Table 4-3  
Method 5 Impinger Configuration**

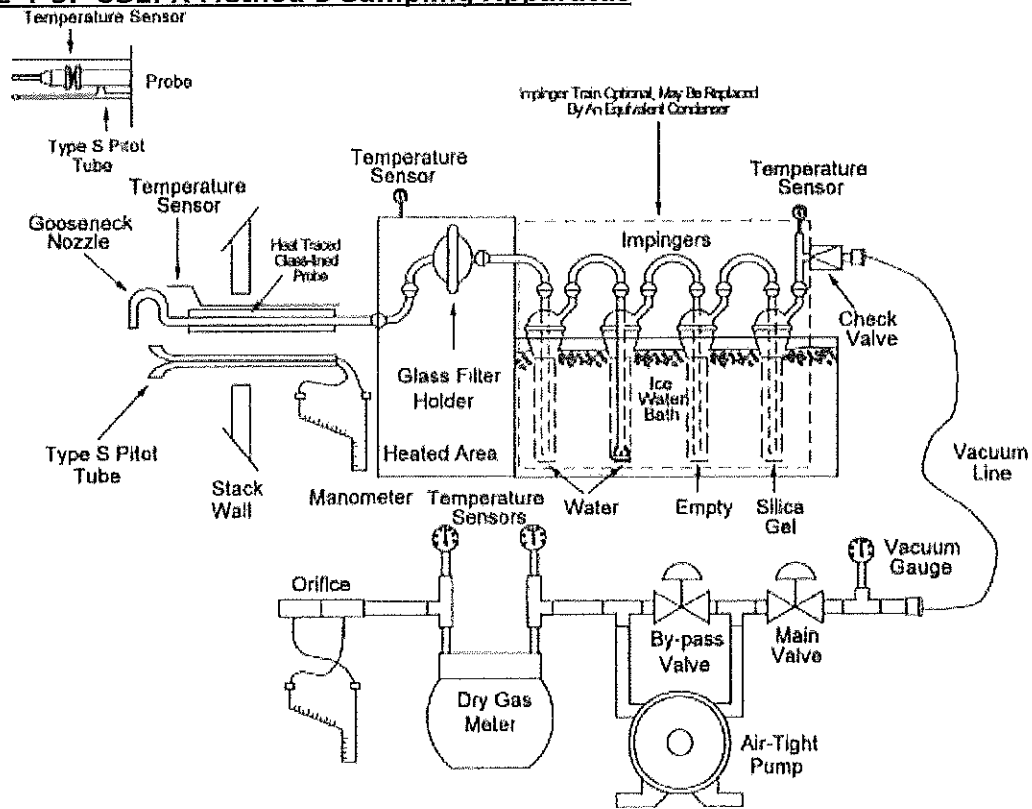
Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Amount (gram)
1	Modified	Water	100
2	Greenburg-Smith	Water	100
3	Modified	Empty	0
4	Modified	Silica gel desiccant	~200-300

Prior to testing, representative velocity head and temperature data was reviewed to calculate an ideal nozzle diameter allowing isokinetic sampling to be performed. The diameter of the selected nozzle was measured with a caliper across three cross-sectional chords; this data was used to calculate the cross-sectional area. Prior to testing, the nozzle was rinsed and brushed with deionized water and acetone, and connected to the sample probe.

The impact and static pressure openings of the S-Type Pitot tube were leak-checked at or above a velocity head of 3.0 inches of water for a minimum of 15 seconds. The PM sample apparatus was leak-checked by capping the nozzle tip and applying a vacuum of approximately 15 inches of mercury while the dry-gas meter was monitored for approximately 1 minute to verify the sample train leakage rate was less than 0.02 cubic foot per minute (cfm). The sample probe was then inserted into the sampling port to begin sampling.

After placing ice around the impingers, the probe and filter temperatures were allowed to stabilize to a temperature of 320±25°F. Once the desired operating conditions were coordinated with the facility, testing was initiated. Stack and sampling apparatus parameters (e.g., flue velocity head, temperature) were then monitored throughout each run to maintain an isokinetic rate of 100±10%. Refer to Appendix B for field data sheets.

**Figure 4-5. USEPA Method 5 Sampling Apparatus**

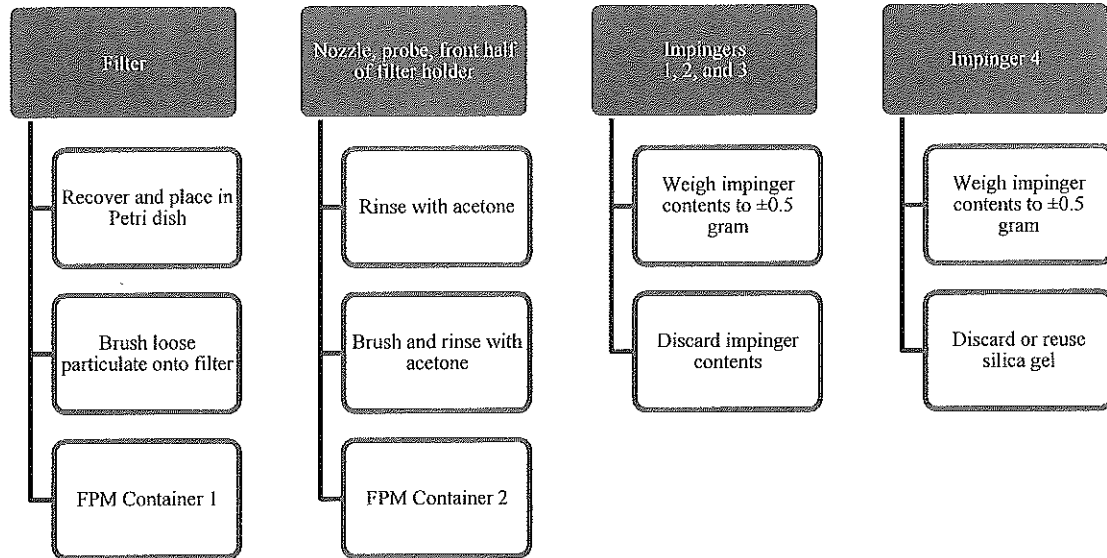


At the conclusion of a test run and post-test leak check, the sampling apparatus was disassembled and the impingers and filter housing were transported to the recovery area.

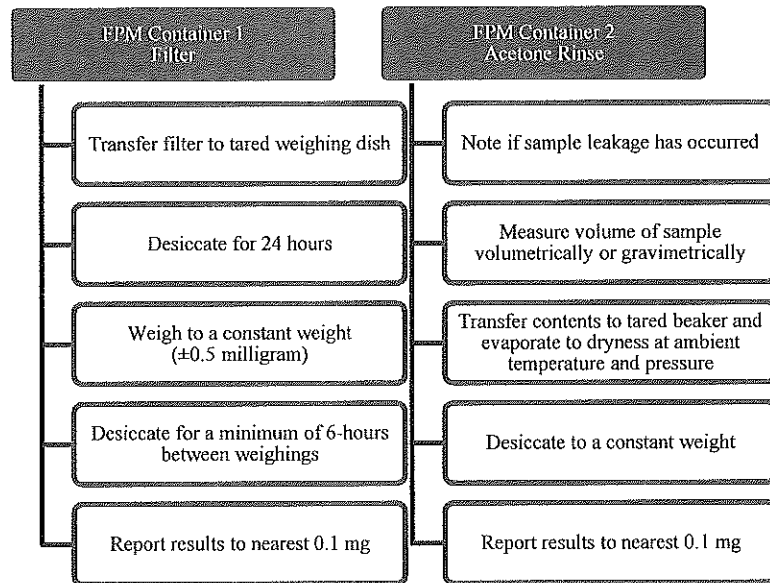
The filter was recovered from the filter housing and placed in a Petri dish, sealed with Teflon tape, and labeled as "FPM Container 1." The nozzle, probe liner, and the front half of the filter housing were triple rinsed with acetone to collect particulate matter. The acetone rinses were collected in pre-cleaned sample containers, sealed with Teflon tape, and labeled as "FPM Container 2." The weight of liquid collected in each impinger, including the silica gel impinger, was measured using an electronic scale; these weights were used to calculate the moisture content of the sampled flue gas. The contents of the impingers were discarded. Refer to Figure 4-6 for the USEPA Method 5 sample recovery scheme.

The sample containers, including a filter and acetone blank were transported to the laboratory for analysis. The sample analysis followed USEPA Method 5 procedures as summarized in the analytical scheme presented in Figure 4-7. Refer to Appendix C for laboratory data sheets.

**Figure 4-6. USEPA Method 5 Sample Recovery Scheme**



**Figure 4-7. USEPA Method 5 Analytical Scheme**



**4.1.6 EMISSION RATES (USEPA METHOD 19)**

USEPA Method 19, *Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates*, was used to calculate PM emission rates in units of lb/mmBtu. Measured carbon dioxide concentrations and F factors (ratios of combustion gas volumes to heat inputs) were used to calculate emission rates using equation 19-6 from the method. Figure 4-8 presents the equation used to calculate lb/mmBtu emission rate:

**Figure 4-8. USEPA Method 19 Equation 19-6**

$$E = C_d F_c \frac{100}{\%CO_{2d}}$$

Where:

- E = Pollutant emission rate (lb/mmBtu)
- C<sub>d</sub> = Pollutant concentration, dry basis (lb/dscf)
- F<sub>c</sub> = Volumes of combustion components per unit of heat content
- %CO<sub>2d</sub> = Concentration of carbon dioxide on a dry basis (% , dry)

Refer to Appendix A for example calculations and Appendix D for operating data that includes the calculated F<sub>c</sub> factor based on the fuels combusted during each test run.

## **5.0 TEST RESULTS AND DISCUSSION**

The test program results summarized in Section 2.3 indicate Units 1 and 2 are in compliance with the MATS Rule emission limits. Because the results are less than 50% of the applicable emission standard, both EUBOILER01 and EUBOILER02 met the MATS LEE qualification threshold for the 8<sup>th</sup> consecutive calendar quarter. Refer to Tables 1 and 2 for detailed results.

### **5.1 TABULATION OF RESULTS**

The results of the testing are tabulated in Appendix Tables 1 and 2 for EUBOILER01 and EUBOILER02, respectively. The Appendix Tables contain detailed tabulation of results, process operating conditions, and exhaust gas conditions. Additional tabulated supporting data is presented in Appendices B through E.

### **5.2 SIGNIFICANCE OF RESULTS**

The results of this test program indicate EUBOILER01 and EUBOILER02 are in compliance with the applicable MATS PM emission limit of 0.030 lb/mmBtu. Further, the PM emission rates for both units remain below the MATS LEE qualification threshold of 0.015 lb/mmBtu (i.e., 50% of the MATS PM emission limit).

### **5.3 VARIATIONS FROM SAMPLING OR OPERATING CONDITIONS**

No sampling or operating condition variations were encountered during the test program.

Soot blowing was conducted on both units during the Run 1 tests.

### **5.4 PROCESS OR CONTROL EQUIPMENT UPSET CONDITIONS**

The boiler and associated control equipment were operating under routine conditions and no upsets were encountered during testing.



## 5.5 AIR POLLUTION CONTROL DEVICE MAINTENANCE

No significant pollution control device maintenance occurred during the three months prior to the test. Optimization of the air pollution control devices is a continuous process to ensure compliance with regulatory emission limits.

## 5.6 RE-TEST DISCUSSION

Based on the results of this test program, a re-test is not required.

## 5.7 RESULTS OF AUDIT SAMPLES

Audit samples are not required for the reference methods utilized during this test program and are not available from USEPA Stationary Source Audit Sample Program providers. A list of QA/QC Procedures is listed below in Table 5-1.

**Table 5-1  
QA/QC Procedures**

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria
M1: Sampling Location	Evaluate if the sampling location is suitable for sampling	Measure distance from ports to downstream and upstream flow disturbances	Pre-test	$\geq 2$ diameters downstream; $\geq 0.5$ diameter upstream.
M1: Duct diameter/dimensions	Verify area of stack is accurately measured	Review as-built drawings and field measurement	Pre-test	Field measurement agreement with as-built drawings
M1: Cyclonic flow evaluation	Evaluate the sampling location for cyclonic flow	Measure null angles	Pre-test (if needed)	$\leq 20^\circ$
M2: Pitot tube inspection	Verify Pitot and thermocouple assembly is free of aerodynamic interferences	Inspection	Pre-test and post-test	Refer to Section 6.1 and 10.0 of USEPA Method 2
M2: Pitot tube leak check	Verify leak free sampling system	Apply minimum pressure of 3.0 inches of H <sub>2</sub> O to Pitot tube	Pre-test and Post-test	$\pm 0.01$ in H <sub>2</sub> O for 15 seconds at minimum 3.0 in H <sub>2</sub> O velocity head
M3A/ALT-123: Calibration gas standards	Ensure accurate calibration standards	Traceability protocol of calibration gases	Pre-test	Calibration gas uncertainty $\leq 2.0\%$
M3A/ALT-123: Calibration Error	Evaluates operation of analyzers	Calibration gases introduced directly into analyzers	Pre-test	$\pm 2.0\%$ of the calibration span
M3A/ALT-123: System Bias and Analyzer Drift	Evaluates ability of sampling system to deliver stack gas to analyzers	Calibration gases introduced at the sample conditioning system, and into analyzers	Pre-test and Post-test	$\pm 5.0\%$ of the analyzer calibration span for bias and $\pm 3.0\%$ of analyzer calibration span for drift
M3A/ALT-123: Multi-point integrated sample	Ensure representative sample collection	Insert probe into stack and purge sample system	Pre-test	Collect samples at traverse points

**Table 5-1  
QA/QC Procedures**

<b>QA/QC Activity</b>	<b>Purpose</b>	<b>Procedure</b>	<b>Frequency</b>	<b>Acceptance Criteria</b>
M5: nozzle diameter measurements	Verify nozzle diameter used to calculate sample rate	Measure inner diameter across three cross-sectional chords	Pre-test	Three measurements agree within $\pm 0.004$ inch
M5: sample rate	Ensure representative sample collection	Calculate isokinetic sample rate	During and post-test	$100 \pm 10\%$ isokinetic sample rate
M5: sample volume	Ensure sufficient sample volume is collected	Record pre- and post-test dry gas meter volume reading	Post test	$\geq 2$ dscm or 70.6 dscf (requirements for MATS PM LEE testing; twice the sampling volume in Table 2 to Subpart UUUUU)
M5: post-test leak check	Evaluate if the sample was affected by system leak	Cap sample train; monitor dry gas meter	Post-test	$\leq 0.020$ cfm
M5: post-test meter audits	Evaluates accurate measurement equipment for sample volume	Calibrate DGM pre- and post-test; compare calibration factors (Y)	Pre-test Post-test	$\pm 5\%$

## 5.8 CALIBRATION SHEETS

Calibration and inspection sheets for dry gas meter, Pitot tube, and other equipment are presented in Appendix E.

## 5.9 SAMPLE CALCULATIONS

Sample calculations and formulas used to compute emissions data are presented in Appendix A.

## 5.10 FIELD DATA SHEETS

Field data sheets are presented in Appendix B.

## 5.11 LABORATORY QUALITY ASSURANCE / QUALITY CONTROL PROCEDURES

Laboratory quality assurance and quality control procedures were performed in accordance with USEPA Method 5. Specific QA/QC procedures include evaluation of reagent and filter blanks, laboratory conditions, and the application of blank corrections. Refer to Appendix C for the laboratory data sheets.

### 5.11.1 QA/QC BLANKS

Reagent and media blanks were analyzed for the parameters of interest. The results of the blanks are presented in the Table 5-2.

**Table 5-2**  
**QA/QC Blanks**

<b>Sample Identification</b>	<b>Result</b>	<b>Comment</b>
Method 5 Acetone Field Blank	0.1 mg	Sample volume was 194 milliliters. Acetone blank corrections of ~0.01 mg were applied.
Method 5 Laboratory Filter Blank	0.2 mg	Reporting limit is 0.1 milligrams.

# Tables

---

Table 1 - Unit 1 Particulate Matter Results

Facility and Source Information		Units	Run 1	Run 2	Run 3	Average
Customer:			TES Filer City			
Source:			Unit 1			
Work Order:			4101981			
Date:			7/30/2018	7/30/2018	7/31/2018	
Steam Load:	klb/hr		291.5	301.6	298.6	297.3
Stack Diameter	inches		76.0	76.0	76.0	
Cross-sectional Area of Stack, A	ft <sup>2</sup>		31.50	31.50	31.50	
Source Pollutant Test Data		Units	Run 1	Run 2	Run 3	Average
Barometric Pressure, P <sub>bar</sub>	inches of Hg		29.40	29.40	29.38	29.39
Dry Gas Meter Calibration Factor, Y	dimensionless		0.999	0.999	0.999	0.999
Pitot Tube Coefficient, C <sub>p</sub>	dimensionless		0.84	0.84	0.84	0.84
Stack Static Pressure, P <sub>g</sub>	inches of H <sub>2</sub> O		-0.50	-0.50	-0.50	-0.50
Nozzle Diameter, D <sub>n</sub>	inches		0.212	0.212	0.212	0.212
Run Start Time	hr:mm		12:50	15:35	8:30	
Run Stop Time	hr:mm		14:58	17:43	10:37	
Duration of Sample, θ	minutes		120	120	120	120
Dry Gas Meter Leak Rate, L <sub>p</sub>	cfm		0.000	0.000	0.000	0.000
Dry Gas Meter Start Volume	ft <sup>3</sup>		687.27	779.80	874.63	780.57
Dry Gas Meter Final Volume	ft <sup>3</sup>		779.26	873.93	974.28	875.82
Average Pressure Difference across the Orifice Meter, ΔH	inches of H <sub>2</sub> O		1.93	2.01	2.29	2.08
Average Dry Gas Meter Temperature, T <sub>m</sub>	°F		87.2	94.3	79.3	86.9
Average Square Root Velocity Head, √ΔP	inches H <sub>2</sub> O		1.1356	1.1469	1.2365	1.1730
Stack Gas Temperature, T <sub>s(average)</sub>	°F		177.7	177.8	176.6	177.4
Source Moisture Data			Run 1	Run 2	Run 3	Average
Volume of Water Vapor Condensed in Silica Gel, V <sub>wsg(std)</sub>	scf		1.6	1.5	1.9	1.7
Total Volume of Water Vapor Condensed, V <sub>w(std)</sub>	scf		15.515	15.859	16.847	16.073
Volume of Gas Sample as Measured by the Dry Gas Meter, V <sub>m</sub>	dcf		91,990	94,130	99,650	95,257
Volume of Gas Sample Measured by the Dry Gas Meter corrected to STP, V <sub>m(std)</sub>	dscf		87,524	88,419	96,225	90,723
Volume of Gas Sample Measured by the Dry Gas Meter corrected to STP, V <sub>m(std)</sub>	dscm		2,479	2,504	2,725	2,569
Moisture Content of Stack Gas, B <sub>ws</sub>	% H <sub>2</sub> O		15.06	15.21	14.90	15.05
Gas Analysis Data			Run 1	Run 2	Run 3	Average
Carbon Dioxide, %CO <sub>2</sub>	%, dry		11.9	12.4	12.4	12.2
Oxygen, %O <sub>2</sub>	%, dry		7.0	6.4	6.7	6.7
Nitrogen, %N	%, dry		81.1	81.2	80.9	81.1
Dry Molecular Weight, M <sub>d</sub>	lb/lb-mole		30.18	30.24	30.26	30.22
Wet Molecular Weight, M <sub>w</sub>	lb/lb-mole		28.35	28.38	28.43	28.38
Percent Excess Air, %EA	%		48.83	42.73	45.74	45.70
Fuel F-Factor, F <sub>g</sub>	dimensionless		1.170	1.170	1.143	1.161
Fuel F-Factor, F <sub>c</sub>	scf/mmBtu		1,664.3	1,663.4	1,663.2	1,663.6
Gas Volumetric Flow Rate Data			Run 1	Run 2	Run 3	Average
Average Stack Gas Velocity, v <sub>s</sub>	ft/s		71.4	72.1	77.6	73.7
Stack Gas Volumetric Flow Rate, Q	acfm		134,917	136,210	146,612	139,246
Stack Gas Standard Volumetric Flow Rate, Q <sub>s</sub>	scfm		109,635	110,657	119,260	113,184
Stack Gas Dry Standard Volumetric Flow Rate, Q <sub>sd</sub>	dscfm		93,127	93,828	101,491	96,149
Percent of Isokinetic Sampling, I	%		100.7	101.0	101.6	101.1
Gas Concentrations and Emission Rates			Run 1	Run 2	Run 3	Average
Mass of Filterable PM Collected, m <sub>n</sub>	mg		2.69	2.38	2.09	2.38
Filterable PM Concentration, c <sub>s</sub>	gr/dscf		0.00047	0.00041	0.00033	0.00041
Filterable PM Concentration at Stack Conditions, c <sub>s@stack conditions</sub>	mg/wacm		0.748	0.655	0.530	0.644
Filterable PM Concentration, C <sub>s</sub> [Actual Conditions, Wet Basis]	lb/1,000 lbs		0.001	0.001	0.001	0.001
Filterable PM Concentration, C <sub>s50</sub> [Actual Conditions, Wet Basis]	lb/1,000 lbs @ 50% EA		0.001	0.001	0.001	0.001
Filterable PM Mass Emission Rate, E	lb/hr		0.38	0.33	0.29	0.33
Filterable PM, lb/mmBtu, E	lb/mmBtu		0.0009	0.0008	0.0006	0.0008
Filterable PM, tpy [Assumes 8,760 Hrs/Yr Operation]	tpy		1.65	1.46	1.27	1.46

**Table 2 - Unit 2 Particulate Matter Results**

Facility and Source Information		Units	Run 1	Run 2	Run 3	Average
Customer:			TES Filer City			
Source:			Unit 2			
Work Order:			4101981			
Date:			7/31/2018	7/31/2018	8/1/2018	
Steam Load:	klb/hr		299.0	299.8	299.7	299.5
Stack Diameter	inches		76.0	76.0	76.0	
Cross-sectional Area of Stack, A	ft <sup>2</sup>		31.50	31.50	31.50	
Source Pollutant Test Data		Units	Run 1	Run 2	Run 3	Average
Barometric Pressure, P <sub>bar</sub>	inches of Hg		29.40	29.38	29.25	29.34
Dry Gas Meter Calibration Factor, Y	dimensionless		0.999	0.999	0.999	0.999
Pitot Tube Coefficient, C <sub>p</sub>	dimensionless		0.84	0.84	0.84	0.84
Stack Static Pressure, P <sub>g</sub>	inches of H <sub>2</sub> O		-0.60	-0.60	-0.50	-0.57
Nozzle Diameter, D <sub>n</sub>	inches		0.212	0.212	0.212	0.212
Run Start Time	hr:mm		11:02	13:30	9:17	
Run Stop Time	hr:mm		13:13	15:39	11:23	
Duration of Sample, θ	minutes		120	120	120	120
Dry Gas Meter Leak Rate, L <sub>p</sub>	cfm		0.000	0.000	0.000	0.000
Dry Gas Meter Start Volume	ft <sup>3</sup>		976.12	78.30	181.50	411.97
Dry Gas Meter Final Volume	ft <sup>3</sup>		1077.55	180.94	279.78	512.76
Average Pressure Difference across the Orifice Meter, ΔH	inches of H <sub>2</sub> O		2.29	2.34	2.18	2.27
Average Dry Gas Meter Temperature, T <sub>m</sub>	°F		92.5	95.0	83.0	90.2
Average Square Root Velocity Head, √Δp	inches H <sub>2</sub> O		1.2269	1.2308	1.2047	1.2208
Stack Gas Temperature, T <sub>s(average)</sub>	°F		169.9	170.0	173.1	171.0
Source Moisture Data			Run 1	Run 2	Run 3	Average
Volume of Water Vapor Condensed in Silica Gel, V <sub>wsg(std)</sub>	scf		1.5	1.5	1.8	1.6
Total Volume of Water Vapor Condensed, V <sub>v(std)</sub>	scf		16.877	17.007	15.991	16.625
Volume of Gas Sample as Measured by the Dry Gas Meter, V <sub>m</sub>	dcf		101,430	102,640	98,280	100,783
Volume of Gas Sample Measured by the Dry Gas Meter corrected to STP, V <sub>m(std)</sub>	dscf		95,667	96,304	93,806	95,259
Volume of Gas Sample Measured by the Dry Gas Meter corrected to STP, V <sub>m(std)</sub>	dscm		2,709	2,727	2,657	2,698
Moisture Content of Stack Gas, B <sub>ws</sub>	% H <sub>2</sub> O		15.00	15.01	14.56	14.86
Gas Analysis Data			Run 1	Run 2	Run 3	Average
Carbon Dioxide, %CO <sub>2</sub>	%, dry		11.3	11.5	11.7	11.5
Oxygen, %O <sub>2</sub>	%, dry		8.0	7.8	7.3	7.7
Nitrogen, %N	%, dry		80.6	80.7	81.0	80.8
Dry Molecular Weight, M <sub>d</sub>	lb/lb-mole		30.14	30.16	30.16	30.15
Wet Molecular Weight, M <sub>w</sub>	lb/lb-mole		28.32	28.33	28.39	28.35
Percent Excess Air, %EA	%		60.36	57.38	51.88	56.54
Fuel F-Factor, F <sub>o</sub>	dimensionless		1,136	1,139	1,164	1,146
Fuel F-Factor, F <sub>c</sub>	scf/mmBtu		1,670.9	1,671.8	1,678.0	1,673.6
Gas Volumetric Flow Rate Data			Run 1	Run 2	Run 3	Average
Average Stack Gas Velocity, v <sub>s</sub>	ft/s		76.7	77.0	75.6	76.4
Stack Gas Volumetric Flow Rate, Q	acfm		144,974	145,452	142,867	144,431
Stack Gas Standard Volumetric Flow Rate, Q <sub>s</sub>	scfm		119,227	119,523	116,339	118,363
Stack Gas Dry Standard Volumetric Flow Rate, Q <sub>sd</sub>	dscfm		101,348	101,583	99,395	100,775
Percent of Isokinetic Sampling, I	%		101.2	101.6	101.1	101.3
Gas Concentrations and Emission Rates			Run 1	Run 2	Run 3	Average
Mass of Filterable PM Collected, m <sub>n</sub>	mg		6.38	4.08	4.48	4.98
Filterable PM Concentration, c <sub>s</sub>	gr/dscf		0.00103	0.00065	0.00074	0.00080
Filterable PM Concentration at Stack Conditions, c <sub>g@stack conditions</sub>	mg/wacm		1.647	1.044	1.173	1.288
Filterable PM Concentration, C <sub>s</sub> [Actual Conditions, Wet Basis]	lb/1,000 lbs		0.002	0.001	0.001	0.001
Filterable PM Concentration, C <sub>s50</sub> [Actual Conditions, Wet Basis]	lb/1,000 lbs @ 50% EA		0.002	0.001	0.001	0.001
Filterable PM Mass Emission Rate, E	lb/hr		0.89	0.57	0.63	0.70
Filterable PM, lb/mmBtu, E	lb/mmBtu		0.0022	0.0013	0.0015	0.0017
Filterable PM, tpy [Assumes 8,760 Hrs/Yr Operation]	tpy		3.91	2.49	2.74	3.05