Consumers Energy
Count on Us®

Particulate Matter Test

EUBOILER1

Consumers Energy Company
J.H. Campbell Plant
17000 Croswell Street
West Olive, Michigan 49460
SRN: B2835
FRS: 110000411108

Test Date: November 9, 2016

January 5, 2017

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section – Air Emissions Testing Body
Laboratory Services Section
Work Order No. 27538841
Revision 0

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: Consumers Energy Company, J.H. Campbell Plant — County: Ottawa

Source Address: 17000 Croswell — City: West Olive

AQD Source ID (SRN): B2835 — ROP No.: MI-ROP-2835-2013a — ROP Section No.: 1

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 10/1/2016 To 12/31/2016

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Submittal of Unit 1 Particulate Matter stack test report for MATS compliance.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Norman J. Kapala	Executive Director of Coal Generation	(616) 738-3200
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official — Date: 1-6-2017

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

EXECUTIVE SUMMARY

Consumers Energy Company (Consumers Energy) Regulatory Compliance Testing Section (RCTS) conducted particulate matter (PM) testing at the single dedicated exhaust location of coal-fired boiler EUBOILER1 (Unit 1) operating at the J.H. Campbell Generating Station in West Olive, Michigan. The purpose of the test program was to demonstrate compliance with the applicable filterable particulate matter (FPM) limit per 40 CFR 63, Subpart UUUUU – *National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units* (aka the Mercury Air Toxics Standard [MATS]). This test was also performed to demonstrate qualification as a Low Emitting Electric Generating Unit (LEE) for FPM.

The 4th quarter 2016 test program was conducted on November 9, 2016 to satisfy MATS quarterly test requirements in § 63.10006(c), in accordance with the applicable requirements and sampling, calibration, and quality assurance procedures specified in 40 CFR 60, Appendix A, reference methods (RM) 1, 2, 3A, 4, 5, & 19. Three 125-minute RM5 tests were performed to measure filterable particulate matter while the boiler was operating under maximum normal operating load. The results are summarized in the following table.

Summary of Results, JH Campbell Unit 1

Run	PM Concentration (gr/dscf)	PM Emission Rate (lb/mmBtu)	MATS LEE Qualification Rate for FPM[1] (lb/mmBtu)
1	0.0013	0.003	-
2	0.0014	0.003	-
3	0.0014	0.003	-
Average	**0.0014**	**0.003**	**0.015**

[1] This emission rate is 50% of the applicable MATS FPM limit of 0.030 lb/mmBtu.

The individual run and three run average FPM results are below the MATS LEE qualification emission rate limit of 0.015 pounds of PM per million British thermal unit (mmBtu) heat input. Detailed results are presented in the FPM Results Summary Table following this report text.

Example calculations, field data sheets and laboratory data are presented in Appendices A - C.

1.0 INTRODUCTION

Consumers Energy Company (Consumers Energy) Regulatory Compliance Testing Section (RCTS) conducted particulate matter (PM) testing at the single dedicated exhaust location of coal-fired boiler EUBOILER1 (Unit 1) operating at the J.H. Campbell Generating Station in West Olive, Michigan. The purpose of the test program was to demonstrate compliance with the applicable filterable particulate matter (FPM) limit per 40 CFR 63, Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-fired Electric Utility Steam Generating Units (aka the Mercury Air Toxics Standard [MATS]). This test was also performed to demonstrate qualification as a Low Emitting Electric Generating Unit (LEE) for FPM. Applicable MATS Rule criteria are also incorporated into the Michigan Department of Environmental Quality (MDEQ) facility specific Renewable Operating Permit (ROP) MI-ROP-B2835-2013a.

The 4th quarter 2016 test was performed on November 9, 2016 to satisfy MATS quarterly test requirements in § 63.10006(c). Testing was conducted to demonstrate compliance with the 3.0E-02 FPM lb/mmBtu limit in MATS Table 2, § 2a, and to verify FPM emissions were less than 50 percent of the 3.0E-02 lb/mmBtu limit to qualify as a Low Emitting EGU (LEE) as specified in § 63.10005(h)(1)(i) and as demonstrated during the initial Unit 1 FPM test on August 2 – 3, 2016. The comparative FPM results from the August 2 – 3 test event suggested little if any lb/mmBtu emission rate difference between U.S. EPA Reference Method 5 (RM 5) and MATS 5 results, thus RM 5 was employed for the 4th quarter FPM test, as approved by the U.S. EPA in their letter dated April 12, 2016.

1.1 CONTACT INFORMATION

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

Figure 1-1. Test Program Organization

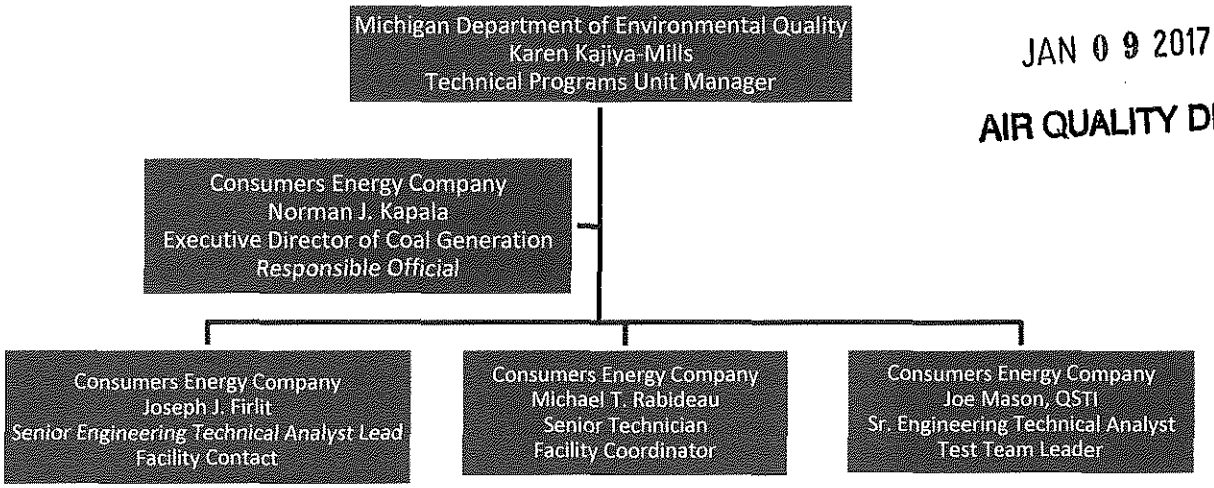


Table 1-1
Contact Information

Program Role	Contact	Address
Regulatory Agency Representative	Ms. Karen Kajiya-Mills Technical Programs Unit Manager 517-335-4874 Kajiya-Millsk@michigan.gov	Michigan Department of Environmental Quality Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
Responsible Official	Mr. Norman J. Kapala 616-738-3200 Executive Director of Coal Generation Norman.Kapala@cmsenergy.com	Consumers Energy Company J. H. Campbell Power Plant 17000 Croswell Street West Olive, Michigan 49460
Test Facility	Mr. Joseph J. Firlit 616-738-3260 Sr. Engineering Tech Analyst Lead Joseph.Firlit@cmsenergy.com	Consumers Energy Company J. H. Campbell Power Plant 17000 Croswell Street West Olive, Michigan 49460
Test Facility	Mr. Michael T. Rabideau 616-738-3273 Senior Technician Michael.Rabideau@cmsenergy.com	Consumers Energy Company J. H. Campbell Power Plant 17000 Croswell Street West Olive, Michigan 49460
Test Team Representative	Mr. Joe Mason, QSTI 616-738-3385 Sr. Engineering Technical Analyst II Joe.Mason@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460

2.0 SUMMARY OF RESULTS

2.1 OPERATING DATA

Unit 1 is a dry bottom, tangential-fired boiler with a nominal heat input capacity of 2,490 mmBtu/hr, and can generate a gross electrical output of approximately 274 gross megawatts (MW). The average gross load during the FPM test runs was approximately 272.7 MWg (99.5% of design capacity). Thus, unit operation was at maximum representative normal operating load conditions of between 90 and 110 percent of design capacity as specified in 40 CFR 63.10007(a)(2). Refer to Attachment D for detailed operating data, recorded on an Eastern Standard Time (EST) Basis.

2.2 APPLICABLE PERMIT INFORMATION

The J.H. Campbell Generating Station, State of Michigan Registration Number (SRN) B2835, operates in accordance with ROP Number MI-ROP-B2835-2013a, in which EUBOILER1 is identified as an emission unit and included in the FGBOILER12 flexible group. The applicable Unit 1 MATS Rule requirements are described in the ROP under *FGBOILER12 Flexible Group Conditions*, § IX, *Other Requirement(s)*. The J.H. Campbell facility is also associated with the comprehensive EPA Facility Registry Service (FRS) database, FRS number 110000411108.

2.3 RESULTS

As Table 2-1 indicates, the average Unit 1 FPM lb/mmBtu emission rate result is less than the MATS limit of 3.0E-02 lb/mmBtu and the MATS LEE qualification rate of 1.5E-02 lb/mmBtu. Detailed results are presented in the FPM Results Summary Table following this report text.

Table 2-1
Summary of Results, JH Campbell Unit 1

Run	PM Concentration (gr/dscf)	PM Emission Rate (lb/mmBtu)	MATS LEE Qualification Rate for FPM[1] (lb/mmBtu)
1	0.0013	0.003	-
2	0.0014	0.003	-
3	0.0014	0.003	-
Average	**0.0014**	**0.003**	**0.015**

Example calculations, field data sheets and laboratory data are presented in Appendices A - C.

3.0 SOURCE DESCRIPTION

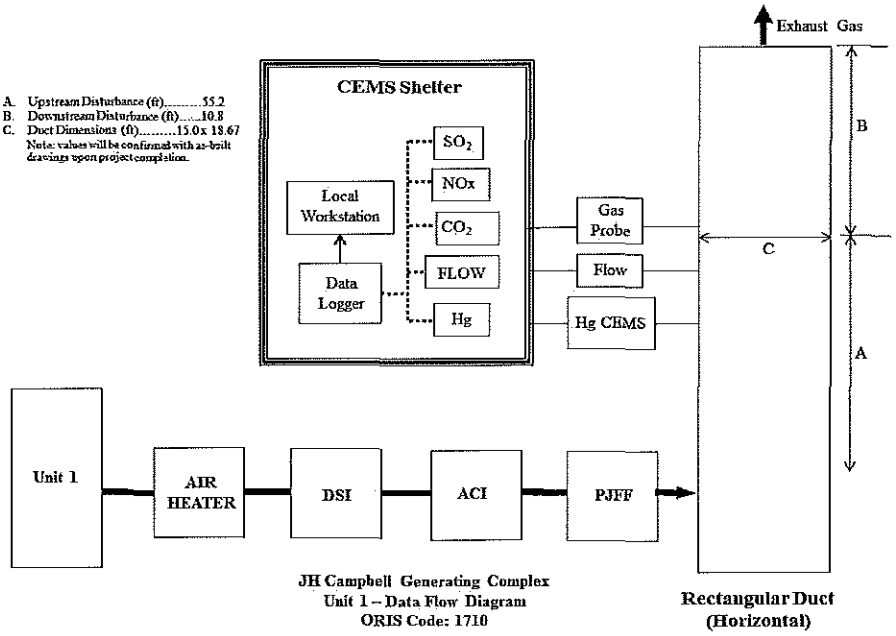
3.1 PROCESS

EUBOILER1 is a dry bottom tangentially-fired boiler constructed in 1958 which combusts pulverized sub-bituminous coal as the primary fuel and oil as an ignition/flame stabilization fuel. Campbell Unit 1 has a full load rating of 274 MW gross.

3.2 PROCESS FLOW

The flue gas generated through coal combustion is controlled by multiple pollution control devices as described in Figure 3-1. The unit is currently equipped with low nitrogen oxides (NO_x) burners and over fire air (OFA) for NO_x control, an activated carbon injection (ACI) system for mercury (Hg) reduction, a dry sorbent (lime) injection (DSI) system for control of sulfur dioxides (SO_2) and other acid gasses, and a pulse jet fabric filter (PJFF) baghouse to control particulate matter emissions.

Figure 3-1. Unit 1 Process Flow Diagram



3.3 PROCESS INSTRUMENTATION

The process was continuously monitored by boiler operators and environmental technicians. As the continuous emissions monitoring systems record data on an EST basis, sampling times (in Eastern Daylight Time [EDT]) were correlated to instrumentation time. As Daylight Savings Time ended on November 6, 2016, there was no time offset between the CEMS time and RM/process data times. Refer to Appendix D for detailed operating data.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Consumers Energy tested for filterable particulate matter using the U.S. EPA test methods presented in Table 4-1. Descriptions of the sampling and analytical procedures are presented in the following sections.

Table 4-1
Test Methods

Parameter	U.S. EPA	
	Method	Title
Sampling Location	1	Sample and Velocity Traverses for Stationary Sources
Traverse Points	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular Weight (O_2 and CO_2)	3A	Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)
Moisture	4	Determination of Moisture Content in Stack Gases
Filterable PM	5	Determination of Particulate Matter Emissions from Stationary Sources
Emission Rate	19	Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

4.1 DESCRIPTION OF SAMPLE APPARATUS AND FIELD PROCEDURES

Table 4-2 contains the test matrix summarizing the sampling and analytical methods performed for each applicable test program parameter.

Table 4-2
Unit 1 Test Matrix

No. of Runs	Sample/Type Pollutant	Test Method	Test Organization	Run Time (min)	Analytical Method	Analytical Laboratory
3	Sample location and traverse points	M1	CE	-	Duct measurement and area calculation	NA
	Velocity and Volumetric Flowrate	M2	CE	125	Velocity and temperature measurement	NA
	Molecular Weight (O_2 and CO_2)	M3A	CE	125	Instrumental	CE; RCTS Laboratory
	Moisture Content	M4	CE	125	Gravimetric	CE; RCTS Laboratory
	Filterable PM	M5	CE	125	Gravimetric	CE; RCTS Laboratory
3	Emission Rate	M19	CE	-	Stoichiometric	NA

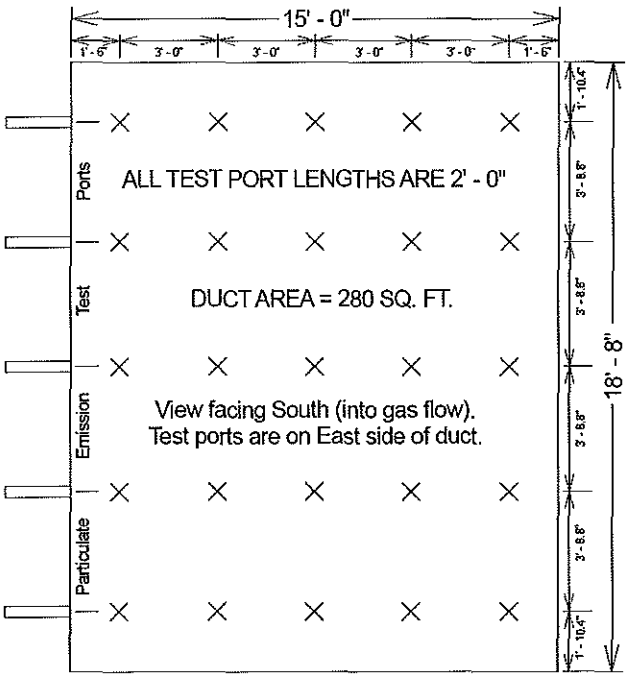
4.1.1 Sample Location and Traverse Points

The number and location of traverse points for determining exhaust gas velocity and volumetric air-flow was determined in accordance with U.S. EPA Method 1, *Sample and Velocity Traverses for Stationary Sources.* Five test ports are located in the horizontal plane on one side of the 15 feet by 18 feet 8-inch rectangular duct associated with Unit 1. The duct has an equivalent duct diameter of 16 feet 7.6 inches. The ports are situated:

- Approximately 55.2 feet or 3.3 duct diameters downstream of a sound deadening silencer flow disturbance, and
- Approximately 10.8 feet or 0.6 duct diameters upstream of flow disturbance caused by a curve in the duct as it enters the exhaust stack.

The sample ports are 6-inches in diameter and extend 2 feet beyond the stack wall. The area of the exhaust duct was calculated and the cross-section divided into a number of equal rectangular areas based on distances to air flow disturbances. Flue gas was sampled for five minutes at each of five traverse points from the five sample ports for a total of 25 sample points is presented as Figure 4-1 below.

Figure 4-1. Unit 1 Duct Cross Section and Test Port/Traverse Point Detail

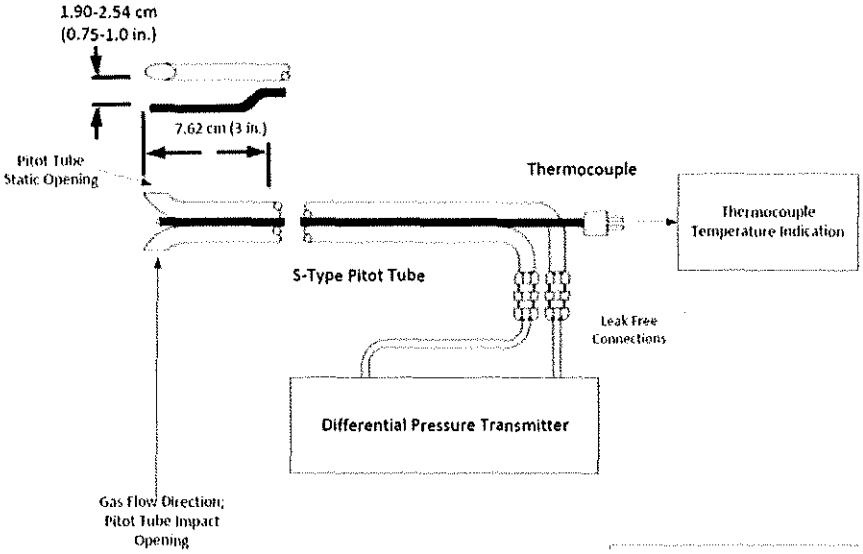


4.1.2 Velocity and Temperature

The exhaust gas velocity and temperature were measured using U.S. EPA Method 2, *Determination of Stack Gas Temperature and Velocity (Type S Pitot Tube).* The pressure differential (ΔP) 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 4-2 for the Method 2 Pitot tube and thermocouple configuration.

Figure 4-2. Method 2 Sample Apparatus



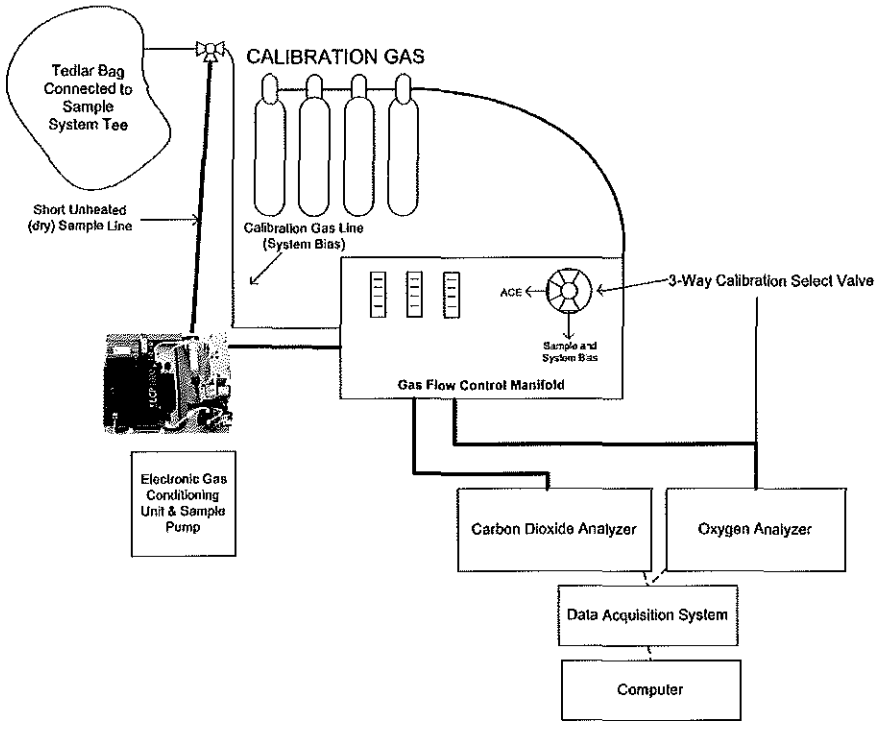
Flue gas velocity and velocity vector measurements (cyclonic flow evaluation) were measured following the procedures in U.S. EPA Method 2 at the sampling location. Cyclonic flow is defined as a flow condition with an average null angle greater than 20 degrees. The direction of flow can be determined by aligning the Pitot tube to obtain a 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 the Unit 1 stack test locations. 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 at the Unit 1 exhaust in September 2016 was observed to be 2.4°, thus meeting the less than 20° requirement and in the absence of 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

The exhaust gas composition and molecular weight was measured using the sampling and analytical procedures of U.S. EPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure).* The flue gas oxygen and carbon dioxide concentrations were used to calculate molecular weight, flue gas velocity, and emissions in lb/mmBtu and lb/1,000 lbs corrected to 50% excess air.

An integrated flue gas sample was collected during each FPM run from each of 25 traverse points into a stainless steel lined probe and Teflon® sample line into a flexible sample bag. Molecular weight analysis was performed by connecting the flexible bag to a gas sample conditioner which conveyed the sample to paramagnetic and infrared gas analyzers that measure oxygen and carbon dioxide concentrations. Figure 4-3 depicts the Method 3A sampling system.

Figure 4-3. Method 3A Sampling System



Prior to sampling flue gas, the analyzers were calibrated by performing a calibration error test where zero-, mid-, and high-level calibration gases are introduced to the back of the analyzers. The calibration error check was performed to evaluate if the analyzers response was within ±2.0% of the calibration gas span. A system-bias and drift test was performed where the zero- and mid- or high- calibration gases are introduced at the inlet to the gas conditioner to measure the ability of the system to respond to within ±5.0 percent of span.

At the conclusion of the third test run, 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 analyzers drift is within the allowable criterion of ±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 Appendix E for analyzer calibration supporting documentation.

4.1.4 Moisture Content

The exhaust gas moisture content was determined using U.S. EPA Method 4, *Determination of Moisture in Stack Gases* in conjunction with the Method 5 sample apparatus. The sampled gas was pumped 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 to calculate the exhaust gas moisture content.

4.1.5 Emission Rates (U.S. EPA Method 19)

U.S. EPA 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 4-4 presents the emissions calculation used:

Figure 4-4. U.S. EPA Method 19 Equation 19-6

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

Where:

E	=	Pollutant emission rate (lb/mmBtu)
C_d	=	Pollutant concentration, dry basis (lb/dscf)

F_c = Volumes of combustion components per unit of heat content

$\%CO_{2d}$ = Concentration of carbon dioxide on a dry basis (%, dry)

Refer to Appendix A for example calculations.

4.1.6 Filterable Particulate Matter

Filterable particulate matter samples were collected isokinetically following the procedures of U.S. EPA Method 5, *Determination of Particulate Matter Emissions from Stationary Sources.* As flue gas is withdrawn isokinetically from the duct, filterable PM adheres to the inside of a nozzle, heated probe, and 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 Method 5 impinger configuration detail.

Figure 4-5. U.S. EPA Method 5 Sampling Train

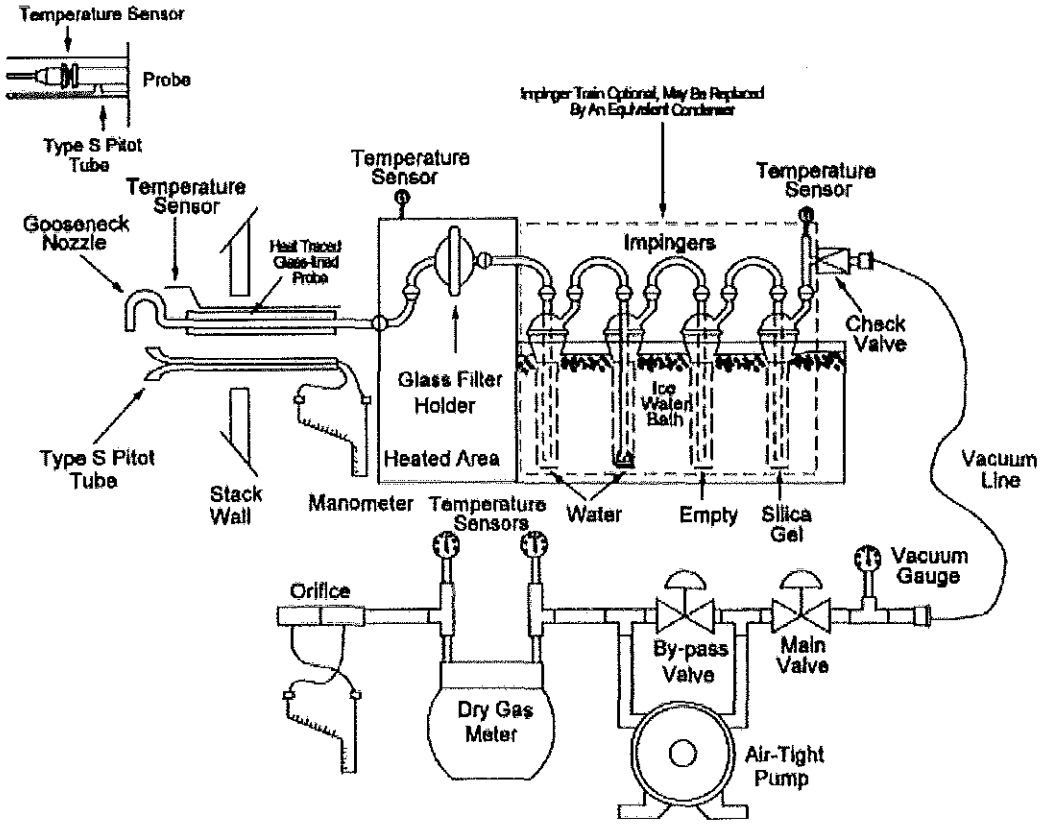


Table 4-3
Method 5 Impinger Configuration

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 from a recently performed high load relative accuracy test audit (RATA) was reviewed to calculate an ideal nozzle diameter allowing isokinetic sampling to be performed. The diameter of the selected nozzle was measured with a micrometer across three cross-sectional chords and 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.

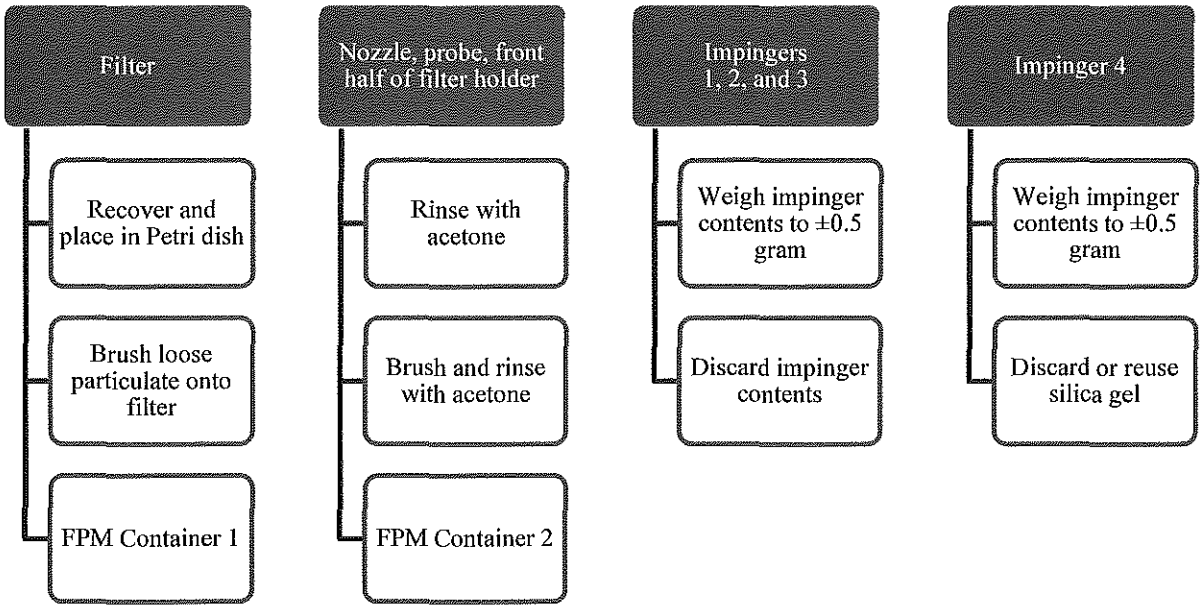
The impact and static pressure openings of the S-Type Pitot tube were leak-checked at or above a velocity head of 3.0 inches of water for a minimum of 15 seconds. The PM sample apparatus was leak-checked by capping the nozzle tip and applying a vacuum of approximately 15 inches of mercury while the dry-gas 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 248±25°F. Once the desired Unit 1 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 within 100±10 %. Refer to Appendix B for field data sheets.

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

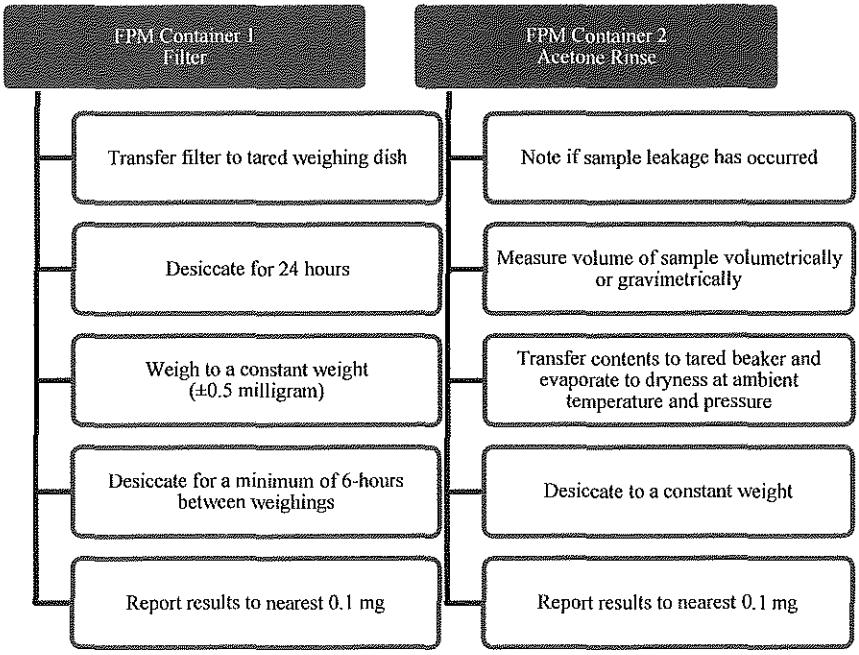
The filter was recovered from the filter housing and placed in a Petri dish, sealed with Teflon tape, and labeled as "FPM Container 1." The nozzle and probe liner, and the front half of the filter housing were triple rinsed with acetone to collect particulate matter. The acetone rinses were collected 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 U.S. EPA Method 5 sample recovery scheme.

Figure 4-6. U.S. EPA 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 U.S. EPA Method 5 procedures as summarized in the analytical scheme presented in Figure 4-7. Refer to Appendix C for laboratory data sheets.

Figure 4-7. U.S. EPA Method 5 Analytical Scheme



5.0 TEST RESULTS AND DISCUSSION

The Unit 1 FPM test program results described herein demonstrate compliance with MATS Rule quarterly performance testing requirements and emission limits as the average of three-run lb/mmBtu emission rates indicate. Furthermore, Unit 1 achieved MATS LEE criteria for the second consecutive calendar quarter.

5.1 VARIATIONS AND UPSET CONDITIONS

No sampling procedure or boiler operating condition variations that could have affected the results were encountered during the test program. The process and control equipment were operating under routine conditions and no upsets were encountered.

5.2 AIR POLLUTION CONTROL DEVICE MAINTENANCE

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

5.3 FIELD QUALITY ASSURANCE / QUALITY CONTROL PROCEDURES

The U.S. EPA reference methods performed state reliable results are obtained by persons equipped with a thorough knowledge of the techniques associated with each method. To that end, factors with the potential to cause measurement errors are minimized by implementing quality control (QC) and assurance (QA) programs into the applicable components of field testing. QA/QC components are included in this test program. Table 5-1 summarizes the primary field quality assurance and quality control activities performed. Refer to Appendix E for supporting documentation.

Table 5-1
QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria	QA/QC Met
M1: Sampling Location	Evaluate if the sampling location is suitable for sampling	Measure distance from ports to downstream and upstream flow disturbances	Pre-test	≥2 diameters downstream; ≥0.5 diameter upstream.	Yes
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	Yes
M1: Cyclonic flow evaluation	Evaluate the sampling location for cyclonic flow	Measure null angles	Pre-test	≤20°	Yes
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 U.S. EPA Method 2	Yes
M2: Pitot tube leak check	Verify leak free sampling system	Apply minimum pressure of 3.0 inches of H_2O to Pitot tube	Pre-test and Post-test	±0.01 in H_2O for 15 seconds at minimum 3.0 in H_2O velocity head	Yes
M3A: Calibration gas standards	Ensure accurate calibration standards	Traceability protocol of calibration gases	Pre-test	Calibration gas uncertainty ≤2.0%	Yes
M3A: Calibration Error	Evaluates operation of analyzers	Calibration gases introduces directly into analyzers	Pre-test	±2.0% of the calibration span	Yes
M3A: System Bias and Analyzer Drift	Evaluates ability of sampling system to delivery stack gas to analyzers	Calibration gases introduced into analyzers	Pre-test and Post-test	±5.0% of span for bias and ±3.0% of span for drift	Yes
M5: nozzle diameter measurements	Verify nozzle diameter used to calculate sample rate	Measure inner diameter across three cross-sectional chords	Pre-test	3 measurements agree within ±0.004 inch	Yes
M5: sample rate	Ensure representative sample collection	Calculate isokinetic sample rate	During and post-test	100±10% isokinetic rate	Yes
M5: sample volume	Ensure sufficient sample volume is collected	Record pre- and post-test dry gas meter volume reading	Post test	≥1.70 dscm	Yes
M5: post-test leak check	Evaluate if the sample was affected by system leak	Cap sample train; monitor dry gas meter	Post-test	≤0.020 cfm	Yes
M5: post-test meter audits	Evaluates accurate measurement equipment for sample volume	DGM pre- and post-test; compare calibration factors (Y and Y_{qa})	Pre-test Post-test	±5 %	Yes

5.3.1 Volumetric Flowrate QA/QC Checks

The S-Type Pitot tube used to measure flue gas velocity head pressures was inspected prior to and after emissions testing. The Pitot tube met the specifications of Section 6.1 of U.S. EPA Method 1. Refer to Appendix E for the Pitot tube inspection and certification sheet.

The S-Type Pitot tube and oil-filled incline manometer assembly were evaluated for leaks prior to testing. Testing was performed with leak free assembly. Refer to field data sheets for verification of Pitot tube leak checks.

5.3.2 Dry Gas Meter QA/QC Checks

The dry-gas meter calibration checks in comparison to the U.S. EPA tolerance were acceptable. Refer to the PM Results Summary Table for calibration data.

5.3.3 Thermocouple QA/QC Checks

The thermocouples used to measure the exhaust gas temperature were calibrated according to procedures outlined in the *Quality Assurance Handbook for Air Pollution Measurement Systems:* Volume III, Stationary Source-Specific Methods, Method 2, Type S Pitot Tube Inspection, and the *Alternative Method 2 Thermocouple Calibration Procedure* (ALT-011). ALT-011 describes the inherent accuracy and precision of the thermocouple within ±1.3°F in the range of -32°F and 2500°F and states that a system that performs accurately at one temperature is expected to behave similarly at other temperatures. Therefore, the two-point calibration described in Method 2 may be replaced with a single point calibration procedure that verifies a thermocouple system is operating within ± 1.0 percent of the absolute measured temperature, while taking into account the presence of disconnected wire junctions, other loose connections or a potential miscalibrated temperature display. Refer to the PM Results Summary Table for calibration data.

5.3.4 Nozzle QA/QC Checks

Prior to testing a micrometer was used to separately measure three different inner diameters of the nozzle. The average of the measurements was used to calculate the sampling velocity and isokinetic sampling rate. The nozzle was inspected for nicks, dents, or corrosion before connecting to the sample probe. Refer to Appendix E for the nozzle calibration sheet.

5.3.5 Oxygen and Carbon Dioxide Analyzer QA/QC Checks

The instrument analyzer sampling apparatus described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Refer to Appendix E for additional calibration data.

5.3.6 QA/QC Blanks

Reagent and filter 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

Sample Identification	Result (mg)	Comment
Method 5 Acetone Field Blank	0.4	Reagent volume: 124 milliliters Field blank correction applied
Method 5 Laboratory Filter Blank	0.0	Reporting limit: 0.1 milligrams

5.3.7 Laboratory Quality Assurance / Quality Control Procedures

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

6.0 CERTIFICATION

I hereby certify the statements and information in this test report and supporting enclosures are true, accurate, and complete, and the test program was performed in accordance with test methods specified in this report.

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Table

Regulatory Compliance Testing Services
Table 1 - Method 5 PM Results

Facility and Source Information				
Facility:	J.H. Campbell			
Source:	EUBOILER1		Unit Load:	High
Work Order:	17732205			
Date:	11/9/2016	11/9/2016	11/9/2016	
Stack Length, inches:	224	224	224	
Stack Width, inches:	180	180	180	
Stack Area, Square Feet:	280.00	280.00	280.00	
Source Pollutant Test Data	**Run 1**	**Run 2**	**Run 3**	**Average**
Barometric Pressure, inches mercury:	29.50	29.50	29.50	29.50
Meter Calibration Factor:	0.999	0.999	0.999	0.999
Pitot Tube Calibration Factor:	0.84	0.84	0.84	0.84
Stack Static Pressure, inches water:	2.50	2.50	2.50	2.50
Nozzle Diameter, inches:	0.281	0.281	0.281	0.281
Run Start Time:	8:05	11:40	14:45	
Run Stop Time:	10:30	14:04	17:01	
Duration of Sample, minutes:	125	125	125	125
Meter Leak Rate, ft3/min:	0.000	0.000	0.000	0.000
Meter Start Volume, cf:	177.11	297.25	421.93	298.76
Meter Final Volume, cf:	296.69	421.67	548.68	422.35
Average Meter Pressure, inches water:	3.18	3.44	3.50	3.37
Average Meter Temperature, degrees F:	59.8	66.3	70.7	65.6
Average Square Root Pitot Pressure, inches water:	0.9178	0.9532	0.9599	0.9437
Stack Gas Temperature, degrees F:	321.1	328.1	328.6	325.9
Source Moisture Data	**Run 1**	**Run 2**	**Run 3**	**Average**
Impinger Water Volume, W_{ic}:	277.5	291.2	281.3	283.3
Silica Gel Water Volume, W_{sg}:	34.9	32.7	35.9	34.5
Water Vapor Volume at STP, scf:	14.730	15.272	14.956	14.986
Meter Volume, Actual Cubic Feet:	119.580	124.420	126.750	123.583
Meter Volume, STP, dscf:	120.5	124.0	125.3	123.25
Meter Volume, STP, dscm:	3.414	3.511	3.547	3.49
Total Gas Sampled, scf:	135.27	139.23	140.21	138.24
Percent Stack Gas Moisture:	10.89	10.97	10.67	10.84
Gas Analysis Data	**Run 1**	**Run 2**	**Run 3**	**Average**
Percent Carbon Dioxide, dry:	12.66	12.54	12.77	12.66
Percent Oxygen, dry:	7.12	7.33	6.98	7.14
Percent Nitrogen:	80.22	80.14	80.25	80.20
Dry Molecular Weight, lb/lb-Mole:	30.310	30.299	30.323	30.311
Molecular Weight, at Stack Condition, lb/lb-Mole:	28.970	28.950	29.008	28.98
Calculated Fuel Factor, F_o:	1.088	1.083	1.090	1.087
Fuel F-Factor, F_d:	9820	9820	9820	9820
Percent Excess Air:	50.70	52.97	49.18	50.95
Gas Calculations	**Run 1**	**Run 2**	**Run 3**	**Average**
Density Dry at STP, lb/cf:	0.0784	0.0783	0.0784	0.0784
Density Wet at STP (68 deg. F, 29.92 in. Hg), lb/cf:	0.0749	0.0748	0.0750	0.075
Density Wet at Stack Cond, lb/cf:	0.0502	0.0497	0.0498	0.050
Pounds of Gas Sampled, Dry:	9.4454	9.7102	9.8191	9.658
Pounds of Gas Sampled, Wet:	10.1304	10.4203	10.5146	10.355
Gas Volumetric Flow Rate Data	**Run 1**	**Run 2**	**Run 3**	**Average**
Average Stack Gas Velocity, ft/s:	62.8	65.6	66.0	64.8
Stack Gas Flow Rate, ACFM:	1,055,333	1,101,335	1,108,244	1,088,304
Stack Gas Flow Rate, SCFM:	707,477	731,721	735,900	725,033
Stack Gas Flow Rate, DSCFM:	630,437	651,462	657,403	646,434
Percent of Isokinetic Sampling Rate:	99.5	99.0	99.1	99.19
Gas Concentrations and Emission Rates	**Run 1**	**Run 2**	**Run 3**	**Average**
Filterable PM Weight, mg:	10.32	11.55	11.58	11.15
Filterable PM, gr/dscf:	0.00132	0.00144	0.00143	0.00140
Filterable PM, lbs/hr:	7.14	8.03	8.04	7.74
Filterable PM, lb/mmBtu:	0.0028	0.0031	0.0030	0.0030
Dry Gas Metering System Calibration Check [1]	**Run 1**	**Run 2**	**Run 3**	**Average**
Dry Gas Meter Calibration Factor (Y_d):	0.999	0.999	0.999	0.999
Y_{qa} (calculated):	1.01	1.01	1.01	1.01
Assigned Δ H (@ 0.75 SCFM) of the meter system:	1.83	1.83	1.83	1.83
Allowable Y_{qa} (+/-) 5%:	0.949 to 1.049	0.949 to 1.049	0.949 to 1.049	-----
Actual Yds Deviation, %:	-0.69	-1.56	-1.00	-1.08
Dry Gas Metering System Thermocouple Calibration Check [2]	**Reference, °F**	**Module, °F**	**Difference**	**Requirement**
Stack	74	74	0	±2° F
Probe	74	74	0	±2° F
Filter	74	74	0	±2° F
Dryer	74	74	0	±2° F
Auxillary	74	74	0	±2° F

[1] Emission Measurement Center Approved Alternative Meter Calibration Method (ALT-009)

[2] Emission Measurement Center Approved Alternative Thermocouple Calibration Method (ALT-011)