Consumers Energy
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PM CEMS
Relative Response Audit
Test Report
EUBOILER3

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

November 8, 2023

Test Date: September 25, 2023

Test performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Department
Work Order No. 41142207
Version No.: 0

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EXECUTIVE SUMMARY

Consumers Energy Regulatory Compliance Testing Section (RCTS) conducted filterable particulate matter (PM) testing at the single dedicated exhaust of coal-fired boiler EUBOILER3 (Unit 3), an electric utility steam generating unit (EGU) at the J.H. Campbell Generating Complex in West Olive, Michigan. The test program was performed on September 25, 2023, to:

1) Ensure the continued validity of the existing PM continuous emissions monitoring system (CEMS) correlation curve by conducting the annual relative response audit (RRA) as required in 40 CFR 63, Subpart UUUUU, "National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units," (aka Mercury and Air Toxics Rule [MATS]).

Three, 60-minute PM test runs were conducted following procedures in United States Environmental Protection Agency (USEPA) Reference Methods (RM) 1, 2, 3A, 4, 5, and 19 in 40 CFR 60, Appendix A; Appendix B Performance Specification (PS) 11; and Appendix F, Procedure 2, § 10.3(6). There were no RM or other deviations from the Consumers Energy test protocol dated July 21, 2023, as approved by Trevor Drost with the State of Michigan Department of Environment, Great Lakes, and Energy (EGLE) on September 20, 2023.

The RM measurements were compared to simultaneous PM CEMS responses during the RRA. While no specific boiler operating load is required for the RRA, testing was performed with the boiler at high operating load, which allowed for PM measurements greater than the RM method detection limit and for ancillary results to be compared to renewable operating permit (ROP) MI-ROP-B2835-2020b PM emission limits. The Unit 3 results are shown in the following tables and graphs.

Table E-1
Summary of PM CEMS RRA Results

Run	Unit Load	Reference Method Results	PM CEMS Response
	MW	mg/wacm	
EUBOILER3		**Linear Correlation Curve: $Y = 0.556X + 0.359$**	
1	898	0.953	0.176
2	898	1.079	0.176
3	899	0.247	0.148

Table E-2
Summary of PM CEMS RRA Results

Regulation	Section and Criteria	Result
40 CFR 60, Appendix F – Procedure 2	10.4(6)(i) **CRITERION:** For all three data points, the PM CEMS response value can be no greater than the greatest PM CEMS response value used to develop your correlation curve (19.818 mg/wacm).	**PASSING:** Maximum PM CEMS response of 0.176 mg/wacm during Runs 1 and 2 ≤ 19.818 mg/wacm measured during initial correlation.
	10.4(6)(ii) **CRITERION:** At least two of the three sets of PM CEMS and reference method measurements must fall within the same specified area on a graph of the correlation regression line. The specified area on the graph of the correlation regression line is defined by two lines parallel to the correlation regression line, offset at a distance of ±25% of the numerical emission limit value from the correlation regression line. When assessing PM CEMS performance in relation to the "emissions limit," the MATS PM emission limit of 0.030 lb/mmBtu is used.	**PASSING:** Each of the 3 collected data points fell within ±25% of the emission limit relative to the applicable correlation curve.

Figure E-1. PM CEMS Relative Response Audit Curve and Results

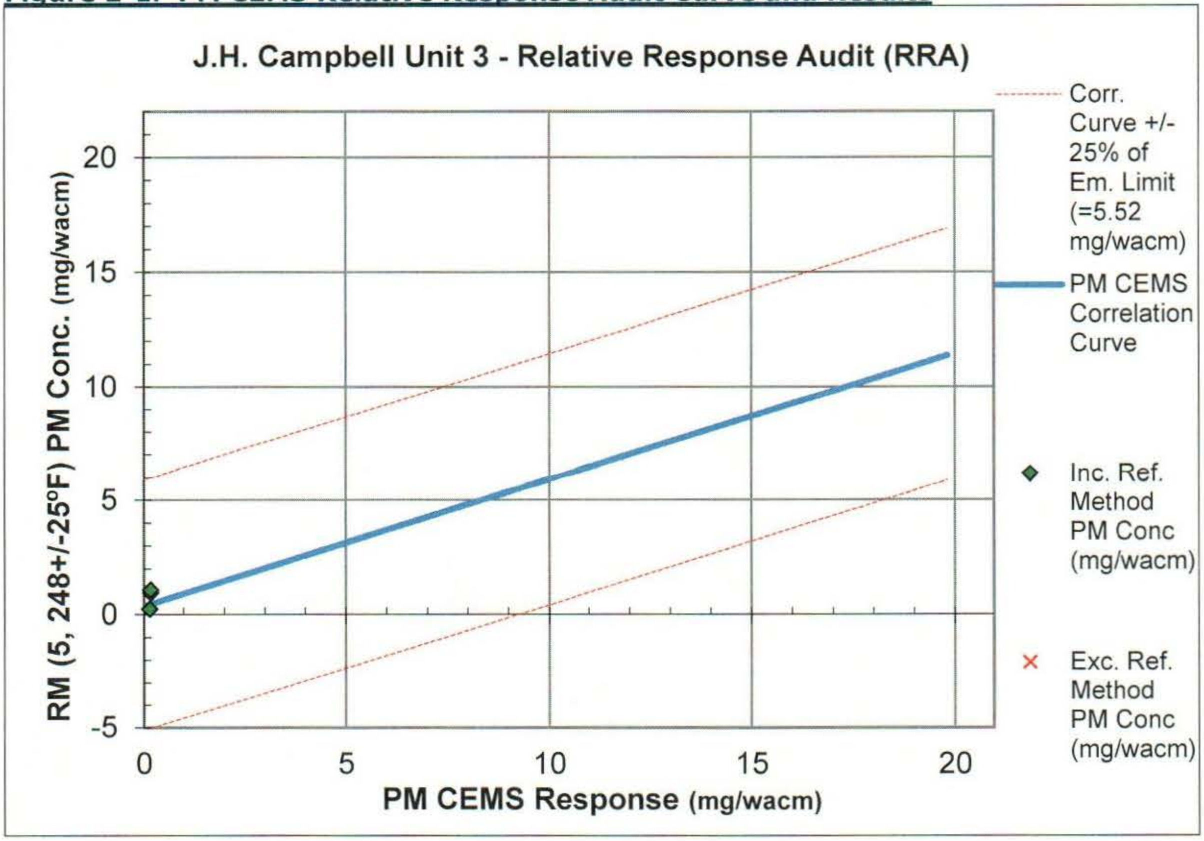

Table E-3
Summary of Ancillary PM Results

Parameter	Units	Run			Average	Emission Limit
		1	2	3		
PM	lb/mmBtu	0.0012	0.0014	0.0003	**0.0010**	**0.10**
PM	lb/hr	10.6	11.8	2.7	**8.4**	**370**
PM	tpy	46.25	51.88	11.71	**36.61**	**1080[a]**

[a]: based on 12-month rolling time period as determined at the end of each calendar month

The test results indicate the PM CEMS met the criteria specified in §10.4(6) in Procedure 2 of 40 CFR 60, Appendix F; thus, the existing PM CEMS correlation used for determining compliance with emission standards or operating permit limits continues to be valid. Furthermore, the EUBOILER3 PM emissions are in compliance with applicable ROP limits.

Detailed results are presented within the Appendix Tables section of this report. Sample calculations, field data sheets, and laboratory data are presented in Appendices A, B, and C. Boiler operating data and supporting documentation are provided in Appendices D and E.

1.0 INTRODUCTION

This report summarizes the results of the particulate matter (PM) emissions testing and continuous emission monitoring system (CEMS) relative response audit conducted September 25, 2023, on EUBOILER3 operating at the Consumers Energy J.H. Campbell Generating Complex in West Olive, Michigan.

This document was prepared following guidance in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Air Quality Division, *Format for Submittal of Source Emission Test Plans and Reports* published in November of 2019. 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 PM tests at the dedicated exhaust of coal-fired boiler EUBOILER3 (Unit 3) operating at the J.H. Campbell Generating Complex in West Olive, Michigan on September 25, 2023.

A test protocol was submitted to EGLE on July 21, 2023, and subsequently approved by Trevor Drost, Environmental Quality Analyst with EGLE, in a letter dated September 20, 2023.

1.2 Purpose of Testing

The purpose of the test program was to:

1) Ensure the continued validity of the existing PM CEMS correlation curve by conducting the annual relative response audit (RRA) as required in 40 CFR 63, Subpart UUUUU, "National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units," (aka Mercury and Air Toxics Rule [MATS]).

Because the tests were performed while the boiler was at high operating level, ancillary results (i.e., lb/mmBtu, lb/hr, and tpy) were also compared to renewable operating permit (ROP) MI-ROP-B2835-2020b PM emission limits.

1.3 Brief Description of Source

EUBOILER3 is a coal fired EGU that operates to provide electricity to the regional grid and Consumers Energy customers.

1.4 Contact Information

Table 1-1 presents the names, addresses, and telephone numbers of the contacts for information regarding the test and the test report, and names and affiliation of personnel involved in conducting the testing.

Table 1-1
Contact Information

Program Role	Contact	Address
EPA Regional Contact	John Mooney Director, Air and Radiation Division 312-886-6043 mooney.john@epa.gov	USEPA Region 5 77 W. Jackson Blvd. (AR-18J) Chicago, IL 60604-3507
EGLE AQD Emissions Measurement Representative	Jeremy Howe Technical Programs Unit Supervisor Environmental Manager 231-878-6687 howej1@michigan.gov	EGLE Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933-1502
EGLE AQD Site Inspector	Heidi Hollenbach Air Quality Manager Grand Rapids District 616-540-1136 hollenbachh@michigan.gov	EGLE Grand Rapids District Office 350 Ottawa Avenue NW, Unit 10 Grand Rapids, Michigan 49503-2316
Responsible Official	Nathan J. Hoffman Director of Plant Operations 616-738-5436 nathan.hoffman@cmsenergy.com	Consumers Energy Company J.H. Campbell Power Plant 17000 Croswell Street West Olive, Michigan 49460
Site Environmental	Kevin Starken Senior Electrical Engineer 616-738-3241 kevin.starken@cmsenergy.com	Consumers Energy Company J.H. Campbell Power Plant 17000 Croswell Street West Olive, Michigan 49460
CEMS Technician	Joe Mason Senior Equipment Technician 616-738-3278 joe.mason@cmsenergy.com	Consumers Energy Company J.H. Campbell Power Plant 17000 Croswell Street West Olive, Michigan 49460
Test Team Representative	Thomas Schmelter, QSTI Sr. Engineering Technical Analyst 616-738-3234 thomas.schmelter@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

During the performance test, the boiler fired 100% western coal and operated at maximum normal load conditions. The test runs were performed while the boiler was operating within the range of 887 MW to 911 MW (97.5-100.1% of the rated capacity of 910 MW). Note that for RRA testing of PM CEMS, there is no stipulated operating load requirement. Refer to Attachment D for detailed operating data. The data is recorded in Eastern Standard Time (EST).

2.2 Applicable Permit Information

The J.H. Campbell Generating Complex, State of Michigan Registration Number (SRN) B2835, operates in accordance with ROP No. MI-ROP-B2835-2020b, which incorporates State and Federal air regulations, including applicable MATS Rule requirements. EUBOILER3 is the emission unit source in the permit. The facility is assigned Facility Registry Service (FRS) ID: 110000411108.

2.3 RESULTS

The test results indicate PM CEMS met the criteria specified in §10.4(6) in Procedure 2 of 40 CFR 60, Appendix F; thus, the existing PM CEMS correlation used for determining compliance with emission standards or operating permit limits continues to be valid. Furthermore, the EUBOILER3 PM emissions are in compliance with applicable ROP regulation limits.

Refer to Table 2-1 for a summary of the overall RM, PM, and PM CEMS results. Table 2-2 contains a summary of the PM CEMS RRA Results. Figure 2-1 depicts the PM RRA data plot relative to the existing correlation curve for the Procedure 2 passage criterion in Section 10.4(6)(i). Finally, Table 2-3 provides a summary of the ancillary PM results in comparison to the applicable ROP PM emission limits.

Table 2-1
Summary of PM CEMS RRA Results

Run	Unit Load	Reference Method Results	PM CEMS Response
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	10.4(6)(ii) **CRITERION:** At least two of the three sets of PM CEMS and reference method measurements must fall within the same specified area on a graph of the correlation regression line. The specified area on the graph of the correlation regression line is defined by two lines parallel to the correlation regression line, offset at a distance of ±25% of the numerical emission limit value from the correlation regression line. When assessing PM CEMS performance in relation to the "emissions limit", the MATS PM emission limit of 0.030 lb/mmBtu is used.	**PASSING:** Each of the 3 collected data points fell within ±25% of the emission limit relative to the applicable correlation curve.

Figure 2-1. PM CEMS Relative Response Audit Curve and Results

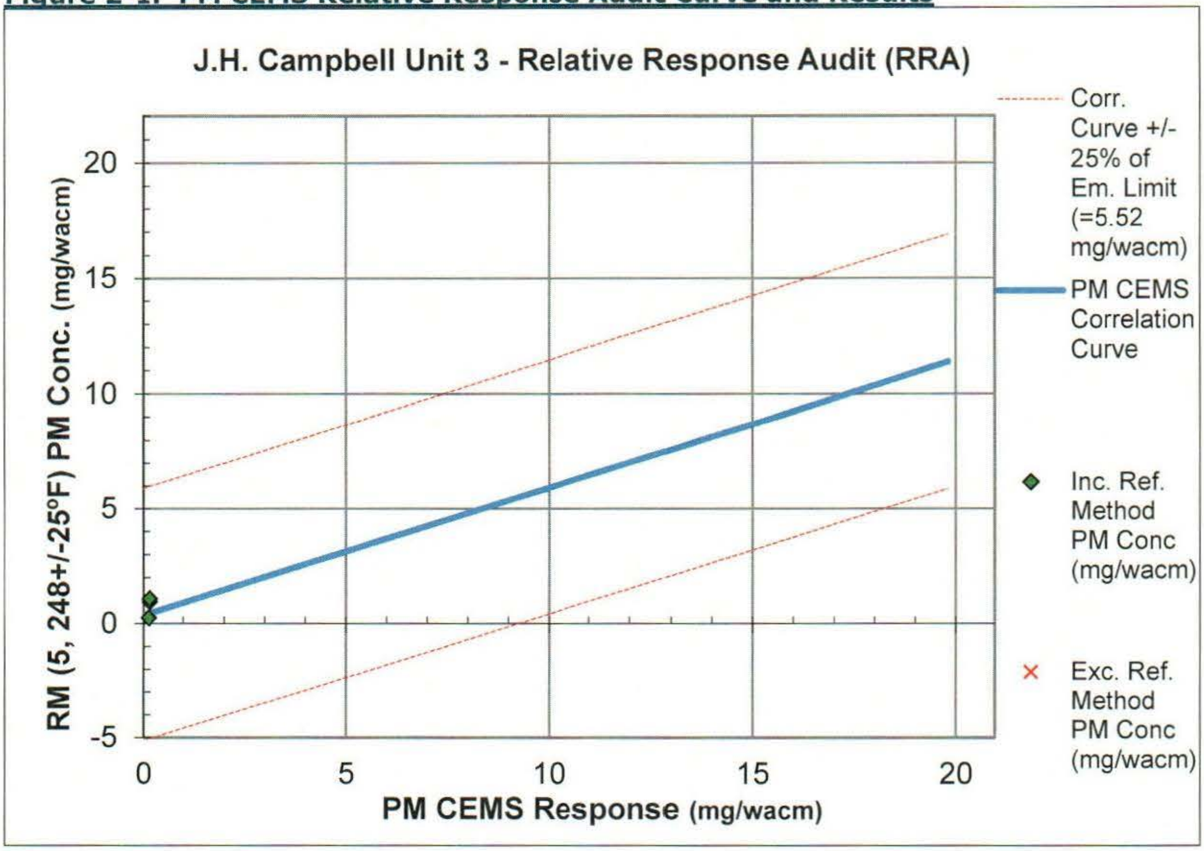

Table 2-3
Summary of Ancillary PM Results

Parameter	Units	Run			Average	Emission Limit
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[a]: based on 12-month rolling time period as determined at the end of each calendar month

Detailed results are presented within the Appendix Table section of this report. Sample calculations, field data sheets, and laboratory results are presented in Appendices A, B, and C. Boiler operating data and supporting information are provided in Appendices D and E.

3.0 SOURCE DESCRIPTION

EUBOILER3 is a coal-fired EGU that turns a turbine connected to an electricity-producing generator.

3.1 PROCESS

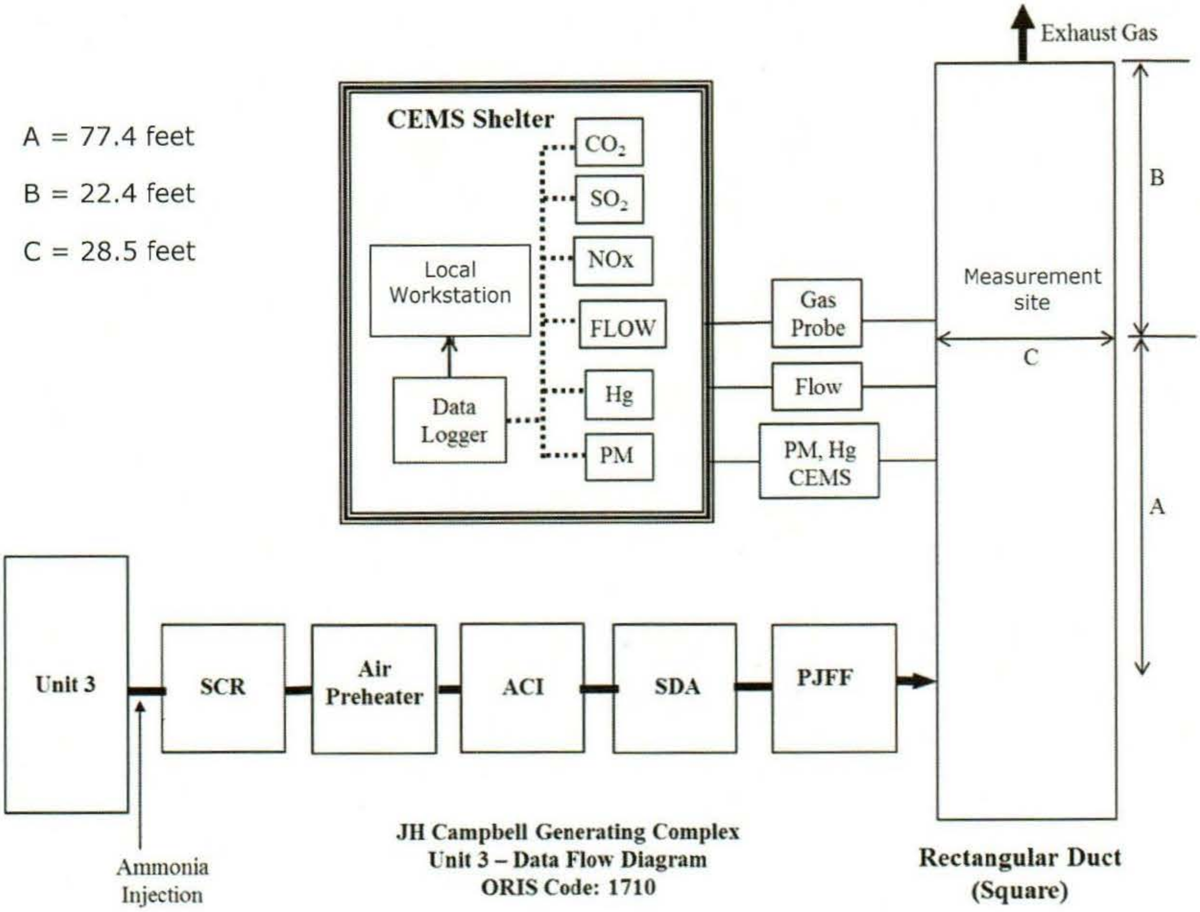
Unit 3 is a dry bottom, wall-fired boiler for which construction began in 1974 and which combusts pulverized sub-bituminous coal as the primary fuel and oil as an ignition/flame stabilization fuel. The source classification code (SCC) is 10100222.

Coal is fired in the furnace where the combustion heats boiler tubes containing water, producing steam. The steam is used to turn a turbine that is connected to an electricity-producing generator. The electricity is routed through the transmission and distribution system to consumers.

3.2 PROCESS FLOW

Unit 3 emissions are controlled by low-NO_x burners, over-fire air, and selective catalytic reduction (SCR) for NO_x control, activated carbon injection (ACI) for mercury (Hg) control, four spray dry absorber (SDA) modules for control of acid gases (e.g., sulfur oxides (SO_x), hydrochloric acid (HCl)), and a low pressure/high volume pulse jet fabric filter (PJFF) system baghouse for particulate matter control. Refer to Figure 3-1 for the Unit 3 Data Flow Diagram.

Figure 3-1. Unit 3 Data Flow Diagram



3.3 Materials Processed

The normal fuel utilized in Unit 3 is 100% western subbituminous coal. The boiler is classified as a coal-fired unit not firing low rank virgin coal as described in Table 2 to Subpart UUUUU. For this test program, Unit 3 was burning 100% western subbituminous coal.

3.4 Rated Capacity

Unit 3 has a nominally rated heat input capacity of 8,240 mmBtu/hr and can generate a gross electrical output of approximately 910 megawatts (MW). The boiler operates in a continuous manner to meet the electrical demands of Midcontinent Independent System Operator, Inc. (MISO) and Consumers Energy's customers. EUBOILER3 is considered a baseload unit because it is designed to operate 24 hours a day, 365 days a year.

3.5 Process Instrumentation

The process was continuously monitored by boiler operators, environmental technicians, and data acquisition systems during testing. One-minute boiler operating and PM CEMS data parameters were collected during each PM test run. Refer to Appendix D for operating data.

The facility measured particulate concentrations using a SICK Dusthunter SP100 PM CEMS system with data recorded by an ESC Spectrum (ESC) data acquisition and handling system (DAHS). Table 3-1 provides a summary of the PM CEMS audited during this test program.

Table 3-1
PM CEMS Specifications

Unit	Manufacturer and Model Number	Serial Number
EUBOILER3	SICK Dusthunter SP100	15308348

4.0 SAMPLING AND ANALYTICAL PROCEDURES

RCTS tested for PM 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
Sample/traverse point locations	1	Sample and Velocity Traverses for Stationary Sources
Flow rate	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 content	4	Determination of Moisture Content in Stack Gases
Filterable particulate matter	5	Determination of Particulate Matter Emissions from Stationary Sources
Emission rates	19	Sulfur Dioxide Removal and Particulate, Sulfur Dioxide and Nitrogen Oxides from Electric Utility Steam Generators

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 (2023)	Run	Sample Type	Start Time (EST)	Stop Time (EST)	Test Duration (min)	EPA Test Method	Comment
Sept. 25	1	Flow rate O_2/CO_2 Moisture PM	09:20	11:12	60	1 2 3A 4 5 19	Traversed duct at 30 sample points with boiler operating at >95% of maximum capacity
	2		11:35	13:21	60		
	3		13:48	15:31	60		

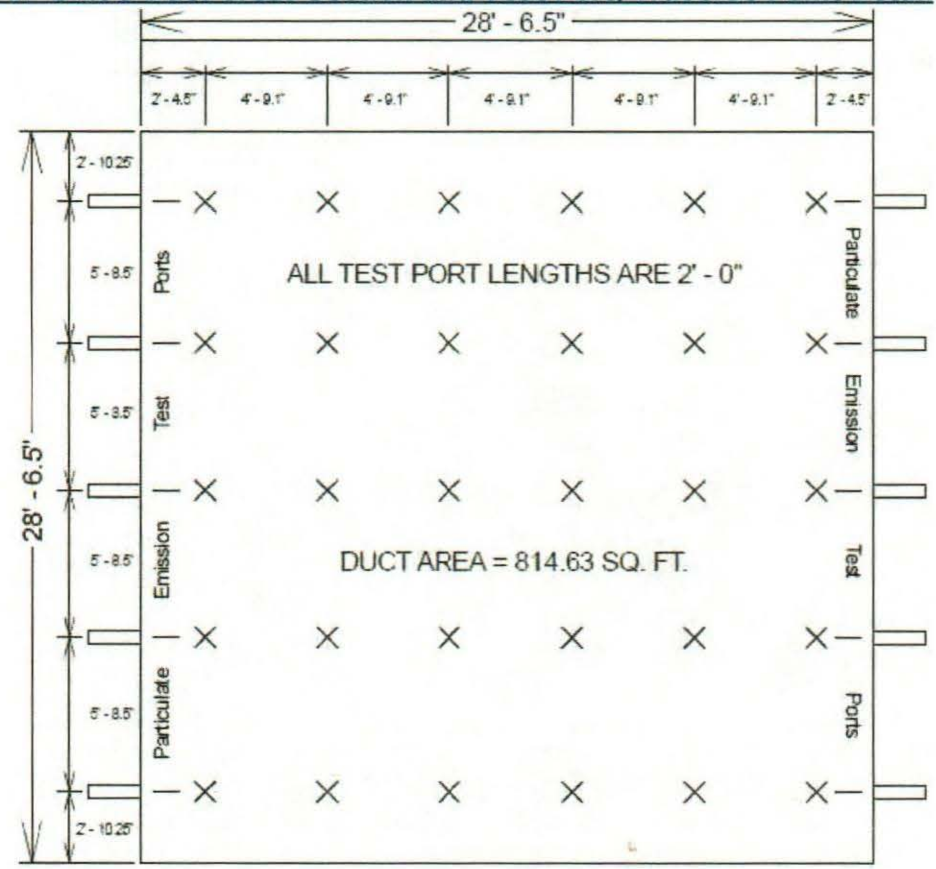
4.1.1 Sample Location and Traverse Points (USEPA Method 1)

The number and location of traverse points for determining exhaust gas velocity and volumetric airflow was determined in accordance with USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources.* Five test ports are in the horizontal plane on the east and west side of the 28 feet 6.5-inch square duct. The duct has an equivalent duct diameter of 28 feet 6.5 inches. As shown in Figure 3-1, the reference method sampling location is situated approximately:

- 77.4 feet or 2.7 duct diameters downstream of a sound deadening silencer flow disturbance, and
- 22.4 feet or 0.8 duct diameters upstream of a flow disturbance caused by a curve in the duct as it enters the vertical exhaust stack.

The sample ports are 6-inches in diameter and extend 2 feet beyond the duct wall. The area of the exhaust duct was calculated, and the cross-sectional area divided into several equal rectangular areas based on distances to air flow disturbances. Flue gas for particulate matter was sampled for two minutes at each of the traverse points accessed from the ten sample ports. Three traverse points were accessed from each test port located on the east and west sides of the duct for a total of 30 sample points and test duration of 60 minutes. A drawing of the Unit 3 exhaust test port and traverse point locations is presented as Figure 4-1.

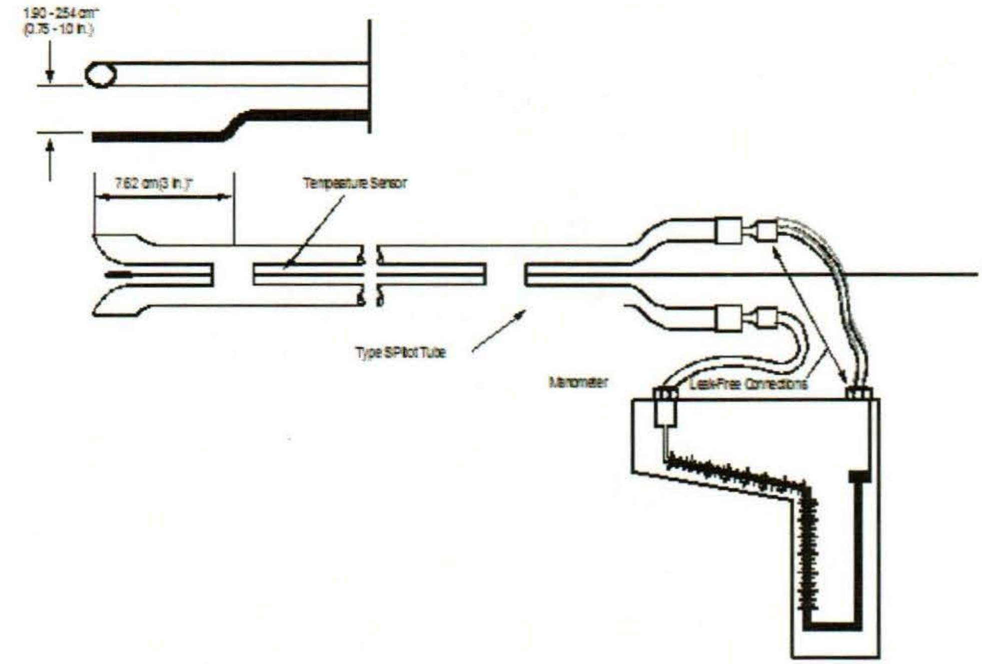
Figure 4-1. Unit 3 Duct Cross Section and Test Port/Traverse Point Detail



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 (ΔP) across the positive impact and negative static 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 nickel-chromium/nickel-alumel "Type K" thermocouple and a temperature indicator. Refer to Figure 4-2 for the Method 2 Pitot tube, thermocouple, and inclined oil-filled manometer configuration.

Figure 4-2. Method 2 Sample Apparatus



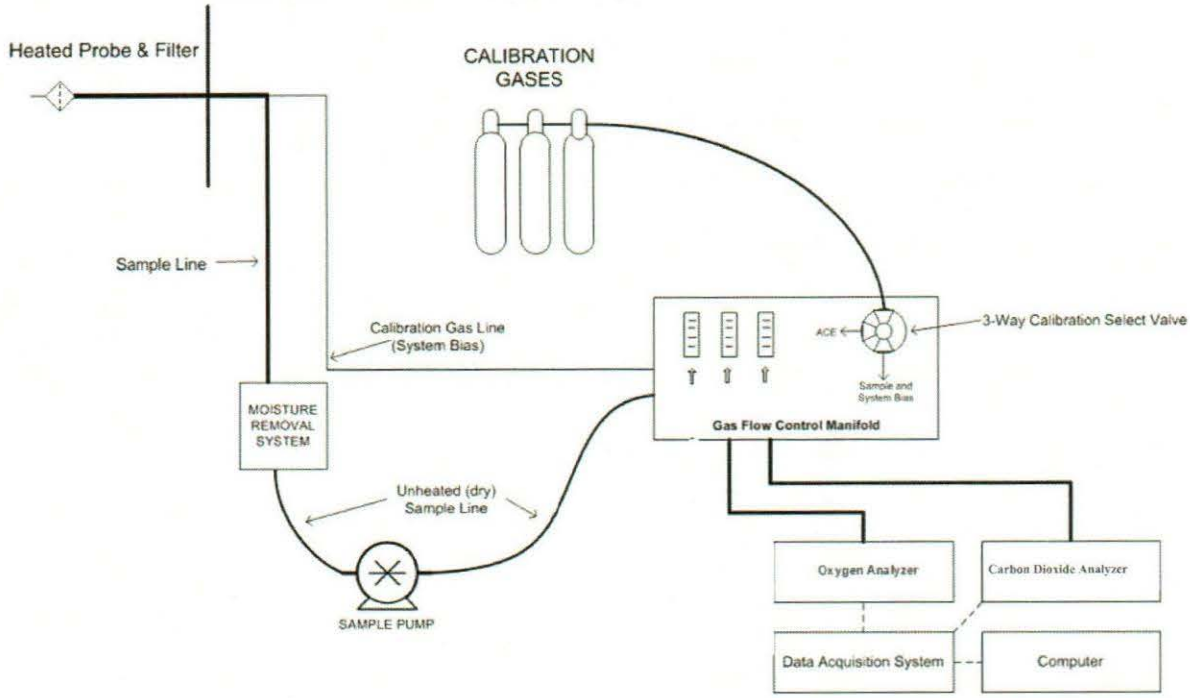
Appendix B of this report includes cyclonic flow test data as verification of the absence of cyclonic flow at the sample location. Method 1, § 11.4.2 states "if the average (null angle) is greater than 20°, the overall flow condition in the stack is unacceptable, and alternative methodology...must be used." The average null yaw angle measured at the Unit 3 exhaust on August 7, 2017, was observed to be 2.97°, thus meeting the less than 20° requirement. In the absence of ductwork and/or stack configuration changes, this null angle information is considered valid and additional cyclonic flow verification was not performed.

4.1.3 Molecular Weight (USEPA Method 3A)

Oxygen (O_2) and carbon dioxide (CO_2) concentrations were measured using the sampling and analytical procedures of USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*. The measured concentrations were used to calculate lb/mmBtu emissions rates using USEPA Method 19 (refer to Section 4.1.6). The method 3A sample line was attached to stainless steel tubing on the method 5 sample probe to measure O_2 and CO_2 concentrations at each of the 30 traverse points simultaneously with PM measurements.

Flue gas was sampled from the stack through a stainless-steel probe, Teflon® sample line, and through a gas conditioning system to remove water and dry the sample before entering a sample pump, flow control manifold, and paramagnetic and infrared gas filter correlation gas analyzers. Figure 4-3 depicts the Method 3A sampling system.

Figure 4-3. USEPA Method 3A Sampling System



Prior to sampling boiler exhaust gas, the analyzers were calibrated by performing a calibration error test where zero-, mid-, and high-level calibration gases were introduced directly 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 or high calibration gas concentration or ±0.5% absolute difference to be acceptable.

An initial system bias check was then performed by measuring the instrument response while introducing zero- and mid- or high-level (upscale) calibration gases at the probe, upstream of all sample conditioning components, and drawing it through the various sample components in the same manner as flue gas. The initial system bias check is acceptable if the instrument response at the zero and upscale calibration is within ±5.0% of the calibration span or ±0.5% absolute difference.

Upon successful completion of the calibration error and initial system bias tests, sample flow rates and component temperatures were verified, and the probe was inserted into the duct at the appropriate traverse point. After confirming the boiler was operating at established conditions, the test run was initiated. O_2 and CO_2 concentrations were recorded at 1-minute intervals throughout the test run, however data collected during port changes were excluded from the test run average.

At the conclusion of the test run, a post-test system bias check was performed to evaluate analyzer bias and drift from the pre- and post-test system bias checks. The system-bias checks evaluate if the analyzers bias was within ±5.0% of span or ±0.5% absolute difference and that drift was within ±3.0%. The analyzers responses were used to correct the measured oxygen and carbon dioxide concentrations for analyzer drift. The corrected concentrations were used to calculate molecular weight and emission rates. Refer to Appendix E for analyzer calibration supporting documentation.

4.1.4 Moisture Content (USEPA Method 4)

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

4.1.5 Particulate Matter (USEPA Method 5)

Filterable particulate matter samples were collected isokinetically by withdrawing a sample of the flue gas through a pre-weighed filter following the procedures of USEPA Method 5, *Determination of Particulate Matter Emissions from Stationary Sources.*

Consumers Energy received a letter from USEPA on April 12, 2016, in response to a letter sent February 10, 2016, from Consumers Energy to USEPA requesting a MATS testing alternative. Specifically, Consumers Energy requested and USEPA approved the use of USEPA Method 5 (probe and filter temperature set points at 248±25°F) as an alternative to MATS 5 (probe and filter temperature set points at 320±25°F) to avoid having to conduct compliance tests using multiple test methods. Documentation of this approval was included as an attachment to the test notice and provided in Appendix E.

In the Method 5 sampling apparatus, the flue gas was passed through a nozzle, heated probe, quartz-fiber filter, and into a series of impingers with the configuration presented in Table 4-3. The filter collected filterable particulate matter while the impingers collected water vapor and/or condensable particulate matter. Figure 4-4 depicts the USEPA Method 5 sampling apparatus.

Table 4-3
USEPA Method 5 Impinger Configuration

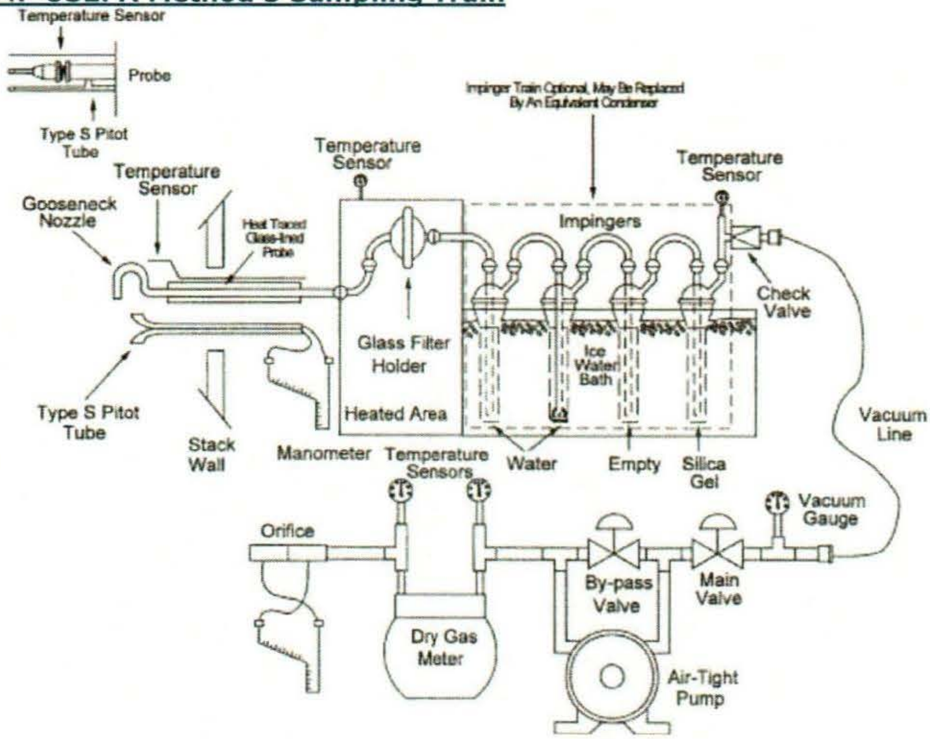
Impinger Order (Upstream to Downstream	Impinger Type	Impinger Contents	Amount (gram)
1	Modified	Water	~100
2	Greenburg-Smith	Water	~100
3	Modified	Empty	-
4	Modified	Silica Gel Desiccant	~200-300

Before testing, representative flow data from previous measurements were reviewed to calculate an ideal nozzle size that allowed isokinetic sampling to be performed. A pre-cleaned nozzle having an inner diameter approximating the calculated value was measured with calipers across three cross-sectional chords, rinsed and brushed with acetone, and connected to the sample probe.

The impact and static pressure openings of the Pitot tube were leak-checked at or above a velocity head of 3.0 inches of water for a minimum of 15 seconds. The sampling train was leak-checked by capping the nozzle opening and applying a vacuum of approximately 15 inches of mercury. The dry-gas meter was monitored for approximately 1 minute to verify the sample apparatus 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.

Ice and water were placed around the impingers, and the probe and filter temperatures were allowed to stabilize to a temperature of 248±25°F before sampling. After the desired operating conditions were coordinated with the facility, testing was initiated. Stack and sampling apparatus parameters (e.g., flue velocity, temperature) were monitored to establish the isokinetic sampling rate to within 100±10% for the duration of the test.

Figure 4-4. USEPA Method 5 Sampling Train



Due to the size and configuration of the Unit 3 duct, 3 traverse points were accessed from each test port located on the east and west sides of the duct, using a hoist system. After sampling was complete on the east or west side of the duct, the sampling apparatus was positioned atop the duct where a mid-test leak check was performed. The mid-test leak check evaluated the system for leaks, validated the first half of the test run, and allowed the nozzle to be rotated 180° to resume sampling in the opposite duct side. The volume of air associated with the mid-test leak check was deducted from the overall test run sample volume based on the start and end dry gas meter volume readings. After concluding each test run and post-test leak check, the sampling train 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 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, were measured using an electronic scale; with these weights used to calculate the moisture content of the sampled flue gas. The contents of the impingers were then discarded. Refer to Figure 4-5 for the USEPA Method 5 sample recovery scheme.

The sample containers, including blanks, were transported to the laboratory for analysis. The sample analysis followed the USEPA Method 5 Analytical Scheme as summarized in Figure 4-6.

Figure 4-5. USEPA Method 5 Sample Recovery Scheme

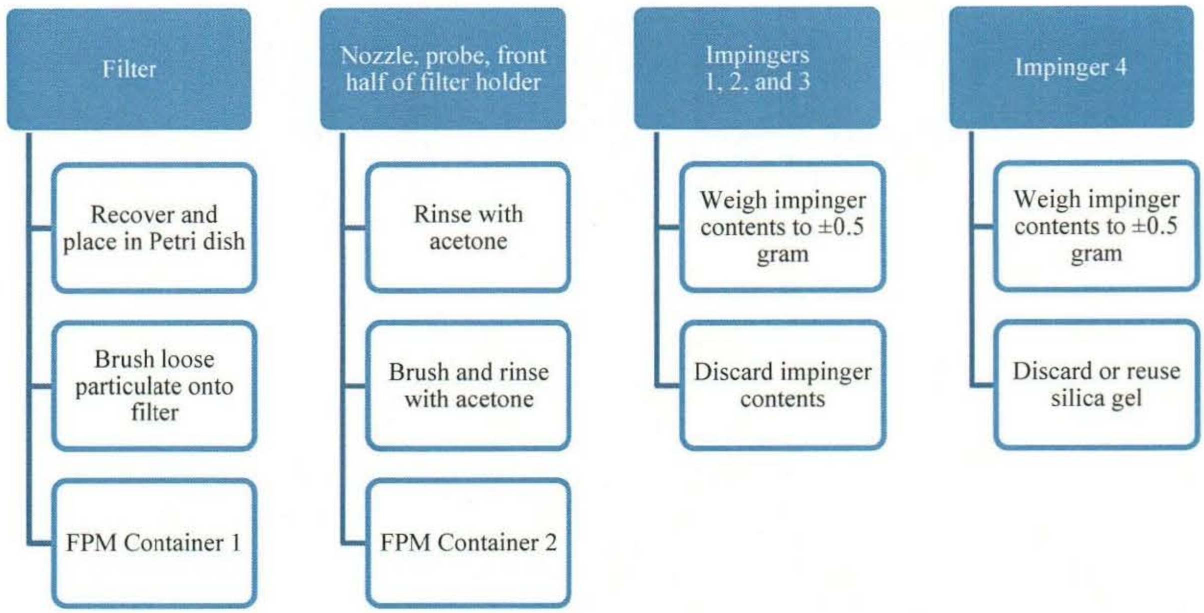
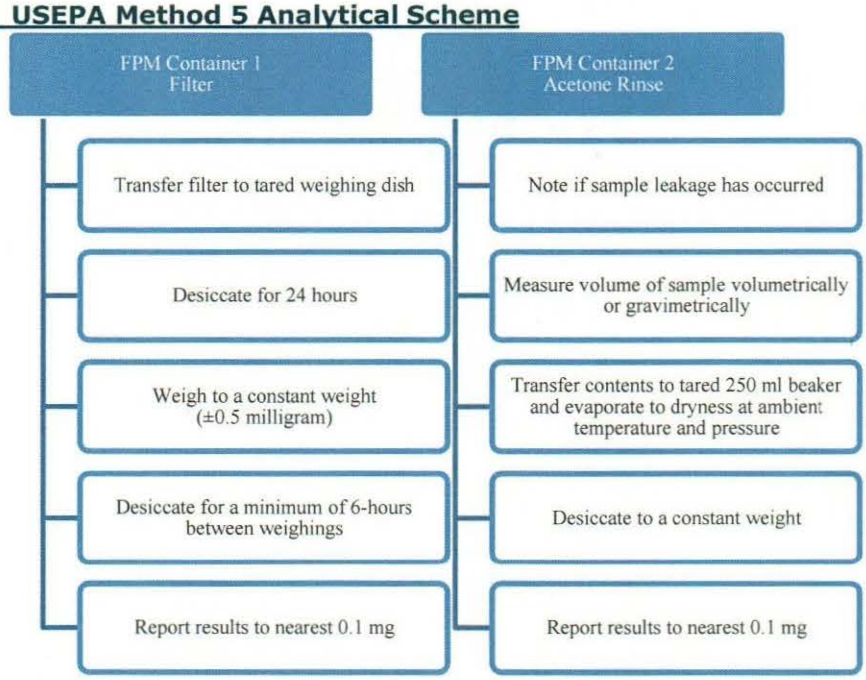


Figure 4-6. USEPA Method 5 Analytical Scheme



4.1.6 Emission Rates (USEPA Method 19)

Although not required by EGLE or the ROP during this test program, USEPA Method 19, *Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates*, was used to calculate ancillary PM emission rates in units of lb/mmBtu. Measured CO_2 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 4-7 presents the equation used to calculate lb/mmBtu emission rate:

Figure 4-7. USEPA Method 19 Equation 19-6

$$Eq. 19-6 \quad E = C_d F_c \frac{100}{\%CO_{2d}}$$

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 1,840 scf CO_2/mmBtu for subbituminous coal from 40 CFR 75, Appendix F, Table 1
$\%CO_{2d}$	=	Concentration of carbon dioxide on a dry basis (%, dry)

5.0 TEST RESULTS AND DISCUSSION

The PM testing was performed on September 25, 2023, to evaluate the continued validity of the PM CEMS correlation curve by conducting an RRA as required by MATS. While no specific load was required for the RRA, testing was performed while the boiler was at high operating level, which allowed PM to be measured above the RM method detection limit and ancillary results to be compared to ROP PM emission limits.

The test results indicate the PM CEMS met the criteria specified in §10.4(6) in Procedure 2 of 40 CFR 60 Appendix F; thus, the existing PM CEMS correlation curve used for determining compliance with emission standards or operating permit limits continues to be valid. Furthermore, the EUBOILER3 PM emissions are in compliance with applicable ROP limits.

5.1 Tabulation of Results

Tables 2-1, 2-2, and 2-3 in Section 2 of this report summarize the results of the testing. The table in the Appendix of this report contains detailed tabulations of results, process operating conditions (i.e., boiler load), and exhaust gas conditions.

Appendix D contains a summary table for the CEMS related information that was collected, including CO_2 (Vol-%), Load (MW), opacity (%), and PM CEMS raw response (mg/wacm). Tables with 1-minute averages for the preceding parameters are presented for each test run, along with the test run averages, however the 1-minute data associated with port changes have been excluded. In addition, CEMS data for CO_2, NO_x, and SO_2 from 10:17 to 10:28 are excluded as the CEMS were momentarily removed from service due to a calibration bottle change.

When comparing the start and stop times between the RM test runs and the CEMS data, note that the last minute of the CEMS run average data is one minute ahead of the RM run end time. This is due to a difference in reporting convention, where the end minute recorded for each RM run reflects when the last reading was taken, but not the last minute during which sampling occurred. For example, the times for RM Run 1 are listed as 09:20 to 11:12. While the last RM Run 1 value was recorded at 11:12, the last full minute of sampling was actually 11:11.

5.2 Significance of Results

The PM and RRA results indicate compliance with ROP permit limits and support the continued validity of the existing PM CEMS correlation curve; therefore, the PM CEMS linear correlation equation of Y = 0.556X + 0.359 will remain the same. By passing the RRA, the

PM CEMS is operating within specifications, and the data will continue to be used to demonstrate emission compliance and meet minimum data availability requirements. The PM CEMS continuously monitors compliance with the MATS PM limit of 0.030 lb/mmBtu.

Ongoing PM CEMS data assessment via implementation of the QA/QC program incorporating 40 CFR 60, Appendix F, Procedure 2 requirements were performed. In accordance with 40 CFR 63.10010(i)(2)(i), a subsequent PM CEMS RRA will be performed at least once annually. Note, a relative correlation audit (RCA) may be performed in lieu of an RRA based on required QA frequency.

5.3 Variations from Sampling or Operating Conditions

Consumers Energy received a letter from USEPA on April 12, 2016, in response to a letter sent February 10, 2016, from Consumers Energy to USEPA requesting a MATS testing alternative. Specifically, Consumers Energy requested and USEPA approved the use of USEPA Method 5 (probe and filter temperature set points at 248±25°F) as an alternative to MATS 5 (probe and filter temperature set points at 320±25°F) to avoid having to conduct compliance tests using multiple test methods. This PM CEMS RRA test was performed using USEPA Method 5 with probe and filter temperature set points at 248±25°F, in lieu of the MATS temperature set points of 320±25°F. Documentation of this approval is included in Appendix E.

To present test data on a consistent basis, O_2 and CO_2 (diluent) concentrations, boiler operating parameters, and PM CEMS concentrations were averaged according to PM sampling start and stop times, omitting sample port changes and accounting for Method 3A response times after those port changes.

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

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. To limit emissions fluctuations, the boiler load, activated carbon injection rate, and spray dry absorbers were operated in steady-state configurations.

CEMS data for CO_2, NO_x, and SO_2 from 10:17 to 10:28 are excluded, as the CEMS were momentarily removed from service due to a calibration bottle change.

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 equipment 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. The next required PM CEMS RRA test event will be conducted by the end of 2024. A response correlation audit (RCA) may be performed instead of the RRA during the period when the RRA is required.

5.7 Results of Audit Samples

5.7.1 Performance Audit Sample

A performance audit (PA) sample (if available) for each test method employed is required, unless waived by the administrator for regulatory compliance purposes as described in 40 CFR 63.7(c)(2)(iii). A PA sample consists of blind audit sample(s), as supplied by an accredited audit sample provider (AASP), which are analyzed with the performance test samples to provide a measure of test data bias. Currently, a particulate matter performance audit sample(s) is not available for USEPA Method 5.

5.7.2 Reference Method Audits

The USEPA reference methods performed state reliable results are obtained by persons equipped with a thorough knowledge of the techniques associated with each method. 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 were included in this test program. Table 5-1 summarizes the primary field quality assurance and quality control activities that were performed. Refer to Appendix E for supporting documentation.

Table 5-1
QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria
M1: Sampling Location	Evaluates 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.
M1: Duct diameter/ dimensions	Verifies area of stack/duct is accurately measured	Review as-built drawings and field measurement	Pre-test	Field measurement agreement with as-built drawings
M1: Cyclonic flow evaluations	Evaluate the sampling location for cyclonic flow	Measure null angles	Pre-test	≤20°
M2: Pitot tube calibration and standardization	Verifies construction and alignment of Pitot tube	Inspect Pitot tube, assign coefficient value	Pre-test and after each field use	Method 2 alignment and dimension requirements
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
M3A: Calibration gas standards	Ensures accurate calibration standards	Traceability protocol of calibration gases	Pre-test	Calibration gas uncertainty ≤2.0%
M3A: Calibration Error	Evaluates operation of analyzers	Introduce calibration gas directly into analyzers	Pre-test	±2.0% of the calibration span or ±0.5% absolute difference

Table 5-1
QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria
M3A: System Bias and Analyzer Drift	Evaluates analyzer and sample system integrity and accuracy	Calibration gas introduced at the probe, upstream of all sample conditioning components	Pre-test and Post-test	±5.0% of the analyzer calibration span or ±0.5% absolute difference for bias and ±3.0% of analyzer calibration span for drift
M3A: Multi-point integrated sample	Ensure representative sample collection	Insert probe into stack and purge sample system	Pre-test and during test	Collect samples at traverse points
M4: Field balance calibration	Verify moisture measurement accuracy	Use Class 6 weight to check balance accuracy	Daily before use	The field balance must measure the weight within ±0.5 gram of the certified mass
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
M5: Sample rate	Ensure representative sample collection	Calculate isokinetic sample rate	During and post-test	100±10% isokinetic rate
M5: Apparatus Temperature	Ensure sample is gaseous through probe and filter	Set probe & filter heat controllers to 248°F±25°F	Verify prior to and during each run	Apparatus temperature must be 248°F±25°F
M5: Post-test leak check	Evaluate if system leaks biased the sample	Cap sample train; monitor DGM	Post-test	≤0.020 cfm leak rate
M5: Post-test meter audit	Evaluates sample volume accuracy	DGM pre- and post-test; compare calibration factors (Y and Yqa)	Pre-test Post-test	±5%

5.8 Calibration Sheets

Calibration sheets, including dry gas meter, gas protocol sheets, and nozzle and Pitot tube inspection sheets are presented in Appendix E. Analyzer quality control and assurance check information is also 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

The method specific quality assurance and quality control procedures in each method employed during this test program were followed, without deviation. 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 analysis are presented in the Table 5-2. Laboratory QA/QC and blank results data are contained in Appendix C.

Table 5-2
QA/QC Blanks

Sample Identification	Result	Comment
Method 5 Acetone Blank	-1.1 mg	Sample volume was 200 milliliters. Acetone blank corrections were not applied.
Method 5 Filter Blank	-0.2 mg	Blank corrections were not applied.