



Consumers Energy

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40 CFR Part 75 CEMS Relative Accuracy Test Audit Report

EUBOILER2

Consumers Energy Company
J.H. Campbell Generating Complex
17000 Croswell Street
West Olive, Michigan 49460
SRN: B2835
ORIS: 1710

August 12, 2024

Test Dates: July 9 and 10, 2024

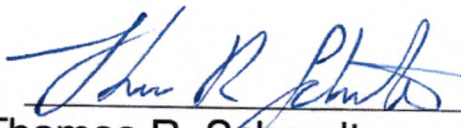
Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section
Air Emissions Testing Body
Laboratory Services Section
Work Order No. 41142651

CERTIFICATION FOR 40 CFR PART 75 TEST REPORT

(To be completed by authorized AETB firm representative and included in source test report)

Facility ID:	<u>ORIS 1710; SRN B2835</u>	Date(s) Tested:	<u>July 9 and 10, 2024</u>
Facility Name:	<u>J.H. Campbell Generating Complex Unit 2</u>		
Facility Address:	<u>17000 Croswell Street, West Olive, MI 49460</u>		
Equipment Tested:	<u>EUBOILER2; SO2, NOx-Diluent, CO2, and Volumetric Flow CEMS</u>		
AETB Firm:	<u>CECo/RCTS AETB</u>		
Business Address:	<u>135 W. Trail St., Jackson MI 49201</u>		
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As the legally authorized representative of the RCTS AETB, I certify that I have reviewed this test report in conjunction with the relevant Quality Manual Appendix D checklist. Having checked each item, the information provided in this test report is true, accurate, and complete.

Signature:		Date:	<u>August 12, 2024</u>
Name:	<u>Thomas R. Schmelter</u>	Title:	<u>AETB Technical Director</u>
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RELATIVE ACCURACY TEST REPORT CHECKLIST

	Description (Typical location(s) in report) [ASTM D 7036-04 Section Reference]
☐	Title (Title Page) [15.3.1]
☐	AETB name & address (QM App. D pg. D-2) [15.3.2]
☐	Unique identification number on each page and a clear identification of the end of the report (Headers & Footers; "End of Report" page) [15.3.3]
☐	Name and address of the customer (Title Page; QM App. D pg. D-2) [15.3.4]
☐	Date(s) the testing was performed (Title page; Introduction; QM App. D pg. D-2) [15.3.10]
☐	Identification of the units tested (Title page; Introduction) [15.3.9]
☐	Identification of regulatory personnel that observed testing (Introduction; Appendix D1) [Note 13]
☐	Clear identification of the pollutants/parameters tested (Summary & Discussion) [15.3.5]
☐	Identification of the test methods used (Sampling and Analytical Procedures) [15.3.8]
☐	Identification of the sampling location, including diagrams, sketches, or photographs (Figures) [15.3.6]
☐	Detailed process description and process operations for each test run (Source and Monitor Description; Appendix B CEMS data sheets) [15.3.7]
☐	Reference to the test protocol and procedures used by the AETB (Introduction) [15.3.11]
☐	Test results and units of measure (Summary and Discussion) [15.3.12]
☐	Information on specific test conditions, including text description of process operations for each test run and description of any operational issues with the unit or the control device (Discussion of Test Results) [15.3.14]
☐	Discussion of the test results including the uncertainty associated with the test and discussion of possible errors or limiting conditions (Quality Assurance Procedures) [15.3.15]
☐	Reference Method analyzer calibrations for each RM gas RATA run. (Appendix B) [15.3.16]
☐	Raw plant CEMS data for each RATA run and each CEMS component (i.e., all gas analyzers, flow monitors). (Appendix B) [15.3.17]
☐	Raw Reference Method DAS data for each RM gas RATA run. (Appendix B) [15.3.17]
☐	CEMS "Operating Load Analysis" report. (Appendix C) [15.3.11]
☐	Meter box post-test calibration results (Appendix C) [15.3.16]
☐	NO _x converter check results (Appendix C) [15.3.16]
☐	Pitot calibrations and inspections (Appendix C) [15.3.16]
☐	FRRS/manometer/Magnehelic gage calibration results (Appendix C) [15.3.16]
☐	Reference Method calibration gas certificates of analysis (Appendix C) [15.3.16]
☐	RATA field data sheets verified against spreadsheet data (Field data sheets in project file) [15.3.17]
☐	RCTS AETB Letter of Certification (Appendix D1) [15.3.19]
☐	Completed QM Appendix F – "AETB Field Test Signature Form" (Appendix D1) [3.1.3; 3.1.9; 3.1.14; 8.3; Note 14; 12.2; 12.3; 12.4; 14.1.1]
☐	Deviations from, additions to, or exclusions from the test protocol, test methods, or AETB Quality Manual entered on QM App. F pg. F-2 (Appendix D2) [15.3.13]
☐	Names, titles, and signatures of persons authorizing the test report – "QM App. D pg. D-2" (After Title Page) [15.3.18]
☐	QSTI certificates for Qualified Individuals overseeing/performing the test (Appendix D2)
☐	Table of Contents is correct (Report Body) [Neatness & professionalism]
☐	Report Headers & Footers are correct (Report Body) [Neatness & professionalism]
☐	RM and CEMS run data in correct order (Appendix B) [Neatness & professionalism]

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1.0 INTRODUCTION

Consumers Energy Company (Consumers Energy), Regulatory Compliance Testing Section (RCTS) conducted continuous emission monitoring systems (CEMS) quality assurance (QA) audits associated with emission unit EUBOILER2 operating at the J.H. Campbell Generating Complex (JHC) located in West Olive, Michigan.

The relative accuracy test audits (RATA) conducted on July 9 and 10, 2024 satisfy requirements in Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) No. MI-ROP-B2835-2020b, Appendix 3, that incorporates requirements of United States Environmental Protection Agency (USEPA) Title 40, Code of Federal Regulations (40 CFR) Part 75, Appendices A and B. The 40 CFR Part 75 required monitoring plan designates EUBOILER2 as Unit/stack name: 2.

A test protocol describing the sampling, calibration, and QA procedures in USEPA Reference Methods (RM) 1, 2, CTM-041, 3, 3A, 4, 6C, 7E, and 19, in conjunction with Performance Specification (PS) 2 (for the SO₂ lb/MMBtu RATA) and 40 CFR 75, Appendices A and B, was submitted May 9, 2024 to the USEPA Region 5 and EGLE offices. The protocol was subsequently approved in a letter dated May 30, 2024, by EGLE representative Jeremy Howe.

The CEMS audits were performed by RCTS representatives Thomas Schmelter, David Kawasaki, and Thomas Duchane. Roger Vargo, Senior Equipment Technician with JHC, coordinated the tests with applicable plant personnel and provided support. No representative from EGLE was on-site during the field test.

RCTS operates as a self-accredited Air Emission Testing Body (AETB) as described in the AETB Letter of Certification contained in Appendix D of this report and is accordingly qualified to conduct 40 CFR Part 75 test programs. RCTS' AETB program is developed in accordance with the American Society for Testing and Materials (ASTM) D 7036-04, *Standard Practice for Competence of Air Emissions Testing Bodies*, in which the AETB is required during test projects to provide at least one qualified individual (QI), qualified in the specific methods for that project, to be on-site at all times. RCTS representatives Thomas Schmelter and David Kawasaki met these requirements and assumed the on-site lead QI roles for the duration of the Flow and Gas CEMS audits, respectively.

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

Table 1-1
Contact Information

Program Role	Contact	Address
EPA Regional Contact	r5ardreporting@epa.gov	USEPA Region 5 77 W. Jackson Blvd. Chicago, IL 60604
EGLE AQD Emissions Measurement Representative	Jeremy Howe Technical Programs Unit Supervisor 231-878-6687 howej1@michigan.gov	EGLE Technical Programs Unit 525 W. Allegan, Constitution Hall, 2 nd Floor S Lansing, Michigan 48933-1502
EGLE AQD District Supervisor	Heidi Hollenbach District Supervisor 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 Executive Director of Fossil Generation 616-738-5436 nathan.hoffman@cmsenergy.com	Consumers Energy Company J.H. Campbell Generating Complex 17000 Croswell Street West Olive, Michigan 49460
Site Environmental	Joseph J. Firlit Manager Engineering Support 616-836-9900 joseph.firlit@cmsenergy.com	
CEMS Technician	Roger Vargo Sr. Equipment Technician 616-738-3270 roger.vargo@cmsenergy.com	
Test Team Representative	Thomas Schmelter, QSTI Prin. Lab Technical Analyst 616-738-3234 thomas.schmelter@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460
	David Kawasaki, QSTI Sr. Engineering Technical Analyst 925-550-1632 david.kawasaki@cmsenergy.com	Consumers Energy Company Royal Oak Service Center 4600 Coolidge Highway Royal Oak, Michigan 48073

2.0 SUMMARY AND DISCUSSION

The J.H. Campbell EUBOILER2 volumetric airflow, carbon dioxide (CO₂), oxides of nitrogen (NO_x), and sulfur dioxide (SO₂) CEMS relative accuracy (RA) results indicate the CEMS meet the semi-annual RA frequency standards in 40 CFR 75, Appendix A and the annual reduced RA test frequency incentives in 40 CFR 75, Appendix B. In addition, the CEMS RA results comply with the Appendix 3 Monitoring Requirements in EGLE ROP MI-ROP-B2835-2020b. Results are presented in Tables 2-1 through 2-4 and Appendix B of this report.

RA equations and other applicable sample calculations are presented in Appendix A. Comprehensive test data are presented in Appendix B.

2.1 WALL ADJUSTMENT FACTOR

Prior to performing the May 2016 volumetric flowrate RATAs, the magnitude of flue gas velocity decay near the rectangular duct walls was determined using USEPA CTM-041, *Determination of Volumetric Gas Flow in Rectangular Ducts or Stacks Taking into Account Velocity Decay near the Stack or Duct Walls* to evaluate and calculate a site-specific wall effect adjustment factor (WAF). The results of those tests yielded a Unit 2 WAF of 0.9547, which when applied to the CEMS flow monitors, adjusts the duct area accordingly when calculating volumetric flow rates.

CTM-041 rectangular duct criteria allow a single operating load WAF to be applied for all operating loads and subsequent tests, unless the affected ductwork configuration was changed. As there have been no Unit 2 ductwork changes, the previously established WAF will continue to be utilized.

Accordingly, when reviewing the Appendix B RM 2 volumetric flow data, note the flue duct length and width dimensions measured in feet vs. calculated square foot area do not directly align. Specifically, the "Flue Duct Dimensions (ft)" entry represents the physical inner flue duct dimensions, while the "Flue Area (ft²)" entry represents the WAF adjusted flow area. For example, Unit 2 measures 9.5 feet by 28.4271 feet, or an actual physical area of 270.06 ft², which when multiplied by the respective 0.9547 WAF yields an area of 257.82 ft².

2.2 VOLUMETRIC FLOWRATE

The flow monitoring system on the duct consists of two ultrasonic volumetric air flow monitors configured in an X-pattern. These monitors are referred to as Unit 2 A Monitor (monitoring plan system identification 241, component identification F01) and Unit 2 B Monitor (242, F02). In this configuration, the dual monitor data is averaged to report primary volumetric flow (Unit 2 = System 240) and calculate continuous emissions, while each individual flow monitor also operates as a redundant backup. The data acquisition and handling system (DAHS) assigns the individual monitors for Unit 2 as FLO2ABAK and FLO2BBAK, with the average of both as primary flow U2FLOW. Relative accuracy test audits were performed on the primary system and each individual redundant backup system.

Volumetric flowrate RA was determined at two distinct operating loads: High and Mid. Trial runs evaluated the need to optimize, if necessary, the primary and both individual redundant backup flow CEMS, as allowed in 40 CFR 75, Appendix B §2.3.2(b)(2). All trial flow run results differed by no more than $\pm 10\%$ of the average RM value, which met the trial run RA criterion in 40 CFR 75.20(b)(3)(vii)(E)(2), thereby allowing the trial runs to be incorporated into the 12-run flow RATA result at each operating load.

The flow RATA results for each CEMS system met the annual reduced test frequency incentive standard of $\leq 7.5\%$ in 40 CFR 75, Appendix B §2.3.1.2(c). Table 2-1 summarizes the volumetric airflow RATA results.

Table 2-1
Summary of Volumetric Air Flow RATA Results

CEMS Make/Model	CEMS Duct Location & Serial Number	RATA Criteria	Required RATA Performance	Actual RATA Performance		
				Primary (A & B)	A Monitor	B Monitor
Teledyne Monitor Labs Model 150	Unit 2 A Monitor SN 1501593 B Monitor SN 1501572	Mid Load	$\leq 10\%$ of mean RM	5.60%	5.62%	5.59%
		High Load		5.72%	5.92%	5.52%
		Bias	$ d \leq CC = \text{Pass}$	Pass	Pass	Pass

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient

2.3 SO₂ GAS RATA

The facility operates a SO₂ dilution in-stack pulsed fluorescence CEMS at the exhaust duct to report continuous emissions. The SO₂ concentrations (ppm) are used in conjunction with flow data to support 40 CFR Part 75 mass emissions reporting and assess compliance with rolling SO₂ emission limits. The lb/MMBtu emission rates are used to evaluate compliance with the R 336.1401(3) SO₂ emission limits. Because the R 336.1401(3) SO₂ emission standard is greater than 0.30 lb/MMBtu and the reference method measured less than 50% of the emission standard, the 1.67 lb SO₂/MMBtu rolling average emission limit was used as the denominator in calculation of CEMS relative accuracy.

The SO₂ ppm RATA results met the $\leq 10\%$ RA specification in 40 CFR 75, Appendix A §3.3.1(a) and the reduced RATA test frequency incentive standard of $\leq 7.5\%$ RA in 40 CFR 75, Appendix B §2.3.1.2(a). The SO₂ lb/MMBtu RATA results met the $\leq 10\%$ RA criterion, when the emission limit is used as the denominator in the RA calculation, as required by 40 CFR 60, Appendices B and F. Table 2-2 summarizes the SO₂ RATA results.

Table 2-2
Summary of SO₂ RATA Results

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required RATA Performance	Actual RATA Performance
Thermo SO ₂ Model 43i	Unit 2 SN 1153170027	ppm	$\leq 10\%$ of mean RM or ± 15.0 ppm RM-CEMS difference	1.00%
		Bias (ppm)	$ d \leq CC = \text{Pass}$	-0.078 ppm
		lb/MMBtu ^{1, 2}	$\leq 10\%$ of emission limit	0.28%

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient

¹ SO₂ lb/MMBtu RA is reported to comply with the EGLE Air Pollution Control (APC) Rules, Part 4, R336.1401, *Emissions of Sulfur Dioxide from Power Plants*.

² As the SO₂ lb/MMBtu emission limit is greater than 0.30 lb/MMBtu, and the average emissions for the test were less than 50% of the 1.67 lb/MMBtu SO₂ emission standard, the limit was used in the denominator of the percent RA calculation in lieu of the average RM value per §13.2 of 40 CFR Part 60, Appendix B, Performance Specification 2.

2.4 NO_x GAS RATA

The facility operates NO_x dilution in-stack chemiluminescence CEMS at the exhaust duct to report continuous emissions. The NO_x emission rates (lb/MMBtu) are used in conjunction with heat input determinations (MMBtu/hr) to support 40 CFR Part 75 mass emissions reporting and to evaluate compliance with rolling NO_x emission limits.

The NO_x-diluent CEMS RA met the $\leq 10\%$ RA or the ± 0.020 lb/MMBtu mean difference criteria where the RM measured NO_x average emission rate is ≤ 0.200 lb/MMBtu of 40 CFR Part 75, App A, § 3.3.2. The NO_x-diluent CEMS also met the reduced test frequency incentives of $\leq 7.5\%$ RA or ± 0.015 lb/MMBtu mean difference criteria in 40 CFR Part 75, App. B § 2.3.1.2(f). Table 2-3 summarizes the NO_x RATA results.

Table 2-3
Summary of NO_x RATA Results

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required RATA Performance	Actual RATA Performance
Thermo NO _x Model 42i	Unit 2 SN 0801820991	lb/MMBtu	$\leq 10\%$ of mean RM or ± 0.020 lb/MMBtu RM-CEMS difference	5.04%
				-0.002 lb/MMBtu
		Bias	$ d \leq CC = \text{Pass}$	Pass

|d| average absolute difference between the RM and CEMS
|CC| confidence coefficient

2.5 CO₂ GAS RATA

The facility operates CO₂ dilution in-stack non-dispersive infrared CEMS at the exhaust duct. The CO₂ concentrations are used to calculate heat input and pollutant lb/MMBtu emission rates. The CO₂ RATA results met the $\leq 10\%$ RA and the mean difference of no greater than $\pm 1.0\%$ CO₂ specifications in 40 CFR 75, Appendix A § 3.3.3 and the reduced RATA test frequency incentive standard in 40 CFR 75, Appendix B § 2.3.1.2(a) and (h) where the RA is $\leq 7.5\%$ or the mean difference does not exceed $\pm 0.7\%$ CO₂, respectively. Table 2-4 summarizes the CO₂ RATA results.

Table 2-4
Summary of CO₂ RATA Results

CEMS Make and Model	CEMS Location & Serial Number	RATA Performance Criteria	Required Performance Criteria	Actual RATA Performance
Thermo CO ₂ 410i	Unit 2 SN 0801820994	%	$\leq 10\%$ of mean RM or $\pm 1.0\%$ CO ₂ RM-CEMS difference	1.29%
				0.078%

3.0 SOURCE AND MONITOR DESCRIPTION

The J.H. Campbell Generating Complex operates two coal-fired boilers that exhaust to a common stack. The boilers are Unit 1 Boiler (EUBOILER1), which is a dry bottom, tangential-fired boiler, and Unit 2 Boiler (EUBOILER2), which is a wall-fired (converted from cell burner) boiler. High-pressure steam from each boiler turns a dedicated turbine generator set to produce electricity.

The Unit 2 boiler typically operates while combusting a low sulfur western sub-bituminous pulverized coal and is rated to produce a maximum sustainable electrical output of 300 MW gross under this fuel scenario. When higher levels of Unit 2 output are required, blends of sub-bituminous and bituminous coals are fired and an electrical output of approximately 400 MW gross can be achieved.

Although Unit 2 exhausts to a common exhaust stack shared with Unit 1, Unit 2's Thermo Scientific (Thermo) dilution-extractive CO₂, SO₂ and NO_x and Teledyne ultrasonic air flow CEMS are installed in its dedicated exhaust duct prior to the common stack. The dual ultrasonic air flow CEMS (A and B) are installed in an X-pattern in its dedicated duct, allowing them to act in tandem as primary flow system components or as redundant backup flow systems, if necessary.

Unit 2 is equipped with low nitrogen oxides (NO_x) burners, over fire air (OFA), an activated carbon injection (ACI) system for mercury (Hg) reduction, a dry sorbent (lime) injection (DSI) system for control of sulfur dioxides (SO₂) and other acid gasses, and a pulse jet fabric filter (PJFF) baghouse to control particulate matter emissions. In addition, Unit 2 has a selective catalytic reduction (SCR) system for NO_x control.

The CEMS interface with a data acquisition and handling system (DAHS) manufactured by ESC Spectrum (ESC), responsible for recording data that includes exhaust gas flow rate, concentrations, emission rates, and operating parameters. Figure 1 illustrates the CEMS location, duct dimensions and approximate RM sampling locations.

The CEMS systems quality assured during this test program are summarized in Table 3-1.

Table 3-1
CEMS Information

Make and Model	System ID	Component ID	Span	Serial Number
Flow Teledyne Monitor Labs Model 150	240 241 242	F01 / F02 F01 F02	74,000 KSCFH	A Monitor SN 1501593 B Monitor SN 1501572
SO ₂ Thermo Model 43i	210	S02	L= 300 ppm H = 500 ppm	1153170027
NO _x Thermo Model 42i	221	N02	L =100 ppm H = 400 ppm	0801820991
CO ₂ Thermo Model 410i	230	C02	20%	0801820994

In preparation for the testing, an Operating Load Analysis was obtained encompassing a period of July 1, 2022, through June 30, 2024. Unit 2 had been offline for much of the time between August of 2023 and April of 2024; therefore, the four most recent quarters were not deemed representative of normal operation for the unit. Based on these eight quarters

of historical operating data, the first (i.e., normal) and second most frequently used load levels were determined to ensure the appropriate load levels were selected during the RATAs.

According to the Part 75 Monitoring Plan and the Operating Load Analysis reviewed for Unit 2, High (284.1 – 400 MW) and Mid (197.1 – 284.0) are the most frequently used load levels, with High designated as the normal operating level and Mid as the second most frequently used operating level. Therefore, the gas RATAs were conducted at High Load, while the flow RATAs were performed at High and Mid operating load conditions.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Specific test procedures detailed in 40 CFR Part 60, Appendix A, Reference Methods 1, 2, CTM-041, 3, 3A, 4, 6C, 7E, and 19 were followed in conjunction with Part 75 Appendices A and B to conduct 10 to 12 runs and calculate CEMS RA. CO₂, NO_x, and SO₂ concentrations were measured for 21-minutes during each gas RATA run. Flue gas velocity and temperature were measured for a minimum of 5 minutes during each flow RATA test run. The following sections provide the sampling and analytical procedures employed.

4.1 TRAVERSE POINTS (USEPA METHOD 1)

The number and location of traverse points used for determining exhaust gas velocity and flow RA was determined in accordance with USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources*. The exhaust duct area was calculated, and the cross-section divided into traverse points of equal area based on the location of existing airflow disturbances.

At Unit 2, 16 traverse points (4 traverse points in each of 4 test ports) were selected as illustrated in Figure 2.

Because the sampling location is at least 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance, and the duct is greater than 7.8 feet in equivalent diameter, CO₂, SO₂, and NO_x concentrations were measured for 7-minutes at each of three traverse points located at 15.7, 47.2, and 78.7 inches from the stack wall of the duct dimension parallel to the port during each gas RATA test.

4.2 VELOCITY AND VOLUMETRIC FLOW (USEPA METHOD 2 AND CTM-041)

The exhaust gas velocity and temperature measurements were conducted in accordance with USEPA Method 2, *Determination of Stack Gas Velocity and Volumetric Flow Rate*. The pressure differential across the positive and negative openings of an S-type Pitot tube connected to a pressure transducer was used to calculate exhaust gas velocity and volumetric flowrate. Refer to Figure 3 for an illustration of the volumetric flow RM apparatus.

As described in Section 2.1, the RM volumetric flow data incorporates the applicable WAF for Unit 2 as previously determined in accordance with USEPA Method CTM-041, *Determination of Volumetric Gas Flow in Rectangular Ducts or Stacks Taking into Account Velocity Decay near the Stack or Duct Walls*.

4.3 DILUENT/MOLECULAR WEIGHT (USEPA METHOD 3 AND 3A)

During the gas RATAs, CO₂ diluent concentrations were measured using a non-dispersive infrared (NDIR) analyzer following guidelines in USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from a Stationary Source (Instrumental Analyzer Procedure)*. Section 4.5 describes the sample apparatus configuration.

Oxygen (O₂) and CO₂ concentrations were measured to calculate flue gas composition during the flow RATA using USEPA Method 3, *Gas Analysis for the Determination of Dry Molecular Weight* using calibrated Fyrite gas analyzers. Triplicate grab samples were captured in absorbing fluid resulting in a proportional fluid rise to the gas concentration absorbed. Each sample concentration is read on the instrument scale, and the calculated dry molecular weight verified to not differ from the triplicate sample mean by more than 0.3 g/g-mole (0.3 lb/lb-mole), with the average result reported to the nearest 0.1 g/g-mole (0.1 lb/lb-mole).

4.4 MOISTURE CONTENT (USEPA METHOD 4)

Gas RATA moisture content was determined using USEPA Method 4, *Determination of Moisture in Stack Gases*. Exhaust gas was drawn at a constant rate through a series of impingers immersed in an ice bath to condense moisture, which was subsequently measured gravimetrically to calculate moisture content. Refer to Figure 4 for a drawing of the RM4 Moisture Apparatus.

4.5 CO₂, SO₂, AND NO_x CONCENTRATIONS (USEPA METHODS 3A, 6C, AND 7E)

Carbon dioxide, sulfur dioxide, and nitrogen oxides concentrations were measured using the following sampling and analytical procedures:

- USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*,
- USEPA Method 6C, *Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)*, and
- USEPA Method 7E, *Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)*.

The sampling procedures of the methods are similar except for the analyzers and analytical technique used to quantify the parameters of interest. Exhaust gas was extracted from the duct through a heated stainless-steel probe, heated Teflon® sample line, and passed through a gas conditioning system to remove water and dry the sample before entering a sample pump, manifold, and gas analyzers. Figure 5 depicts the Methods 3A, 6C and 7E sampling system.

Prior to sampling 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 analyzer response was within $\pm 2.0\%$ of the calibration gas span (i.e., high calibration gas). An initial system bias test was performed where the zero- and mid- or high- calibration gases were introduced at the sample probe to measure the ability of the system to respond accurately to within $\pm 5.0\%$ of span.

An NO₂ to NO conversion efficiency test was performed on the NO_x analyzer prior to the test program to verify the ability of the instrument to convert NO₂ to NO.

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 stack at the appropriate traverse point. After confirming the unit was operating at established conditions, the test run was initiated. Gas concentrations were recorded at 1-minute intervals throughout the 21-minute test run durations.

At the conclusion of the test run, a post-test system bias check was performed to evaluate analyzer bias and drift between the pre- and post-test system bias checks. The system-bias checks evaluated if the analyzer bias was within $\pm 5.0\%$ of span and drift was within $\pm 3.0\%$

of span. The analyzer responses were used to correct the measured gas concentrations for analyzer drift.

For the analyzer calibration error tests, bias tests and drift checks, these evaluations are also passed if the standard criteria are not achieved, but the absolute difference between the analyzer response and calibration gas is less than or equal to 0.5 ppmv for NO_x and SO₂ or 0.5% for CO₂.

The output signal from each analyzer was connected to a data acquisition system (DAS). Data collected from the RM analyzers were averaged for each run with NO_x and SO₂ concentrations measured in ppmvd. CO₂ concentrations were measured as percent by volume on a dry basis. Equation 19-6 from 40 CFR Part 60, Appendix A, Method 19 was used to calculate NO_x and SO₂ lb/MMBtu emission rates.

4.6 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 lb/MMBtu emission rates. Measured CO₂ and pollutant concentrations and F factors (ratios of combustion gas volume to heat input) were used to calculate emission rates using equation 19-6 from the method.

USEPA 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, (scf CO ₂ /MMBtu)
%CO _{2d}	=	Concentration of carbon dioxide on a dry basis (% , dry)

An F_c factor of 1,840 scf CO₂/MMBtu for sub-bituminous coal was used to calculate RM lb/MMBtu emissions and calculate CEMS relative accuracy. Refer to Appendix A for a RATA calculation summary presenting the calculations used in this report.

5.0 QUALITY ASSURANCE PROCEDURES

The objective of a Quality Assurance (QA) program is to produce data that are complete, representative, and of known precision and accuracy. Within the RATA test program, completeness can be defined as the percentage of the required field measurements and associated documentation achieved. Representativeness, defined as the "when," "how," and "how many" measurements taken, is typically specified within the regulations governing the source to be tested as well as the Test Protocol submitted to the regulatory agency prior to the test event. Precision and accuracy are measures of data quality and exist by design within each of the USEPA reference test methods and procedures incorporated during the RATA.

RCTS addresses these QA goals by operating within a Quality System in compliance with ASTM D 7036-04, *Standard Practice for Competence of Air Emissions Testing Bodies*; a practice specifying the general competence requirements applicable to all AETB staff

engaged in air emission testing at stationary sources, regardless of testing scope. By employing these requirements in conjunction with the precision and accuracy standards in each reference method, RCTS is better able to ensure consistently accurate data quality from an individual and AETB perspective. RCTS' AETB Letter of Accreditation and individual QSTI Certificates are contained in Appendix D.

5.1 PITOT TUBE, THERMOCOUPLE, AND PRESSURE EQUIPMENT

The Pitot tube-thermocouple assembly for measuring exhaust gas volumetric flow was inspected and/or calibrated according to procedures in RCTS' AETB Standard Operating Procedure 3-5 and Appendix O, USEPA RM 2, and Approved Alternative Method (ALT-011).

A Pitot tube inspection occurred before the field test to confirm there was no gross damage or excess misalignment of the Pitot openings. A post-test Pitot tube inspection and certification is performed to evaluate if the Pitot face openings are still aligned within acceptable tolerances.

ALT-011 describes the inherent accuracy and precision of a thermocouple within $\pm 1.3^{\circ}\text{F}$ in the range of -32°F and $2,500^{\circ}\text{F}$ and states that a system performing accurately at one temperature is expected to behave similarly at other temperatures. Therefore, a single point thermocouple calibration procedure to verify accuracy within $\pm 1.0\%$ of absolute temperature, taking into account the presence of disconnected wire junctions or a potential miscalibrated temperature display, was performed. After the test event, the accuracy of the thermocouple system was checked at ambient temperature, or other temperature, within the range specified by the manufacturer, using a reference thermometer. The temperatures of the thermocouple and reference thermometer(s) shall agree within $\pm 2^{\circ}\text{F}$.

The differential pressure transmitters and/or gauges used with Method 2 were calibrated in accordance with §6.2.1 of the method and RCTS AETB Standard Operating Procedure Appendix J-4. Refer to Appendix C for Pitot tube, thermocouple, differential pressure and barometer calibration or inspection records.

5.2 DRY GAS METERING CONSOLE

The DGM post-test calibration was performed in the field using Alternative Method 5 Post-Test Calibration (ALT-009) which incorporates the optional pretest orifice meter coefficient check principle of Method 5, § 9.2.1.1. Instead of determining the pretest DGM calibration check value Y_c , ALT-009 calculates a quality assured average Y_{qa} after three or more test runs are conducted, with that value required to be within 5 percent of the pre-test DGM calibration factor (Y). Note that field metering system and pump to console leak checks were performed per ALT-009 requirements and are included in Appendix C. Only two runs each were conducted for the Mid and High flow RATAs. The post-test calibration is met from the 10-run gas RATA test, which was conducted after the flow RATAs.

5.3 USEPA PROTOCOL GAS STANDARDS

USEPA Protocol gas standards used by RCTS were purchased from an outside vendor participating in the USEPA Protocol Gas Verification Program (PGVP) calibration gas audit program described 40 CFR Part 75 § 75.21(g) following RCTS AETB Standard Operating Procedure 2-10. The standards are certified to have a total relative uncertainty of no greater than $\pm 2.0\%$ according to the *USEPA Traceability Protocol for Assay & Certification of Gaseous Calibration Standards*; EPA – 600/R-97/121; September 1997 or the current version of the traceability protocol (EPA – 600/R-12/531; May 2012). Appendix C contains a summary of the PGVP calibration gas standards used during this test program.

5.4 ANALYZER CALIBRATIONS

The gaseous RM instruments were calibrated on-site and operated following manufacturer's specifications and the applicable reference method based in part on the quality assurance and quality control requirements contained in USEPA Methods 3A, 6C, and 7E. Refer to Section 4.5 for analyzer calibration procedures.

System response times were documented during the initial system bias tests. Calibration gas flow rates were maintained at the target sample rate. Analyzer bias and drift data is presented in Appendix B, while calibration data is in Appendix C.

6.0 DISCUSSION OF TEST RESULTS

The CEMS RATA results presented in Tables 2-1 through 2-4 and Appendix B indicate the CEMS operating at the J.H. Campbell EUBOILER2 exhaust duct meet the performance specifications in 40 CFR 75, Appendix A, and the annual reduced RATA test frequency incentive standards in 40 CFR 75, Appendix B. These data indicate compliance with the CEMS monitoring and recordkeeping requirements of the facility's air permit MI-ROP-B2835-2020b.

During the test event, no deviations were observed by the QIs in attendance. The criteria specified in the applicable Reference Methods and the agency-approved Test Protocol were followed. Hard copy and/or electronic field data were completed in the field and upon return to the office, verified for data precision and accuracy, further ensuring the appropriate AETB and Reference Method quality measures were met.

Quality Assurance data, such as protocol gas certificates of analysis, analyzer calibration error and system response time, NO₂ to NO CE check and instrument interference information are presented in Appendix C. Gas RATA instrument system bias/drift data is presented in Appendix B4. AETB certifications and signature forms are provided in Appendices D1 and D2.

6.1 CLOCK TIME SYNCHRONIZATION

The electronic timestamps recorded for RM RATA runs are on military time basis and synchronized to the CEMS DAHS, which is in Eastern Standard Time (EST). The RM clock was also adjusted to account for the difference in response times between the RM and CEMS data collection, if applicable. See Appendix C for system response times.

Figures

Figure 1 – J.H. Campbell Unit 2 Test Port Location

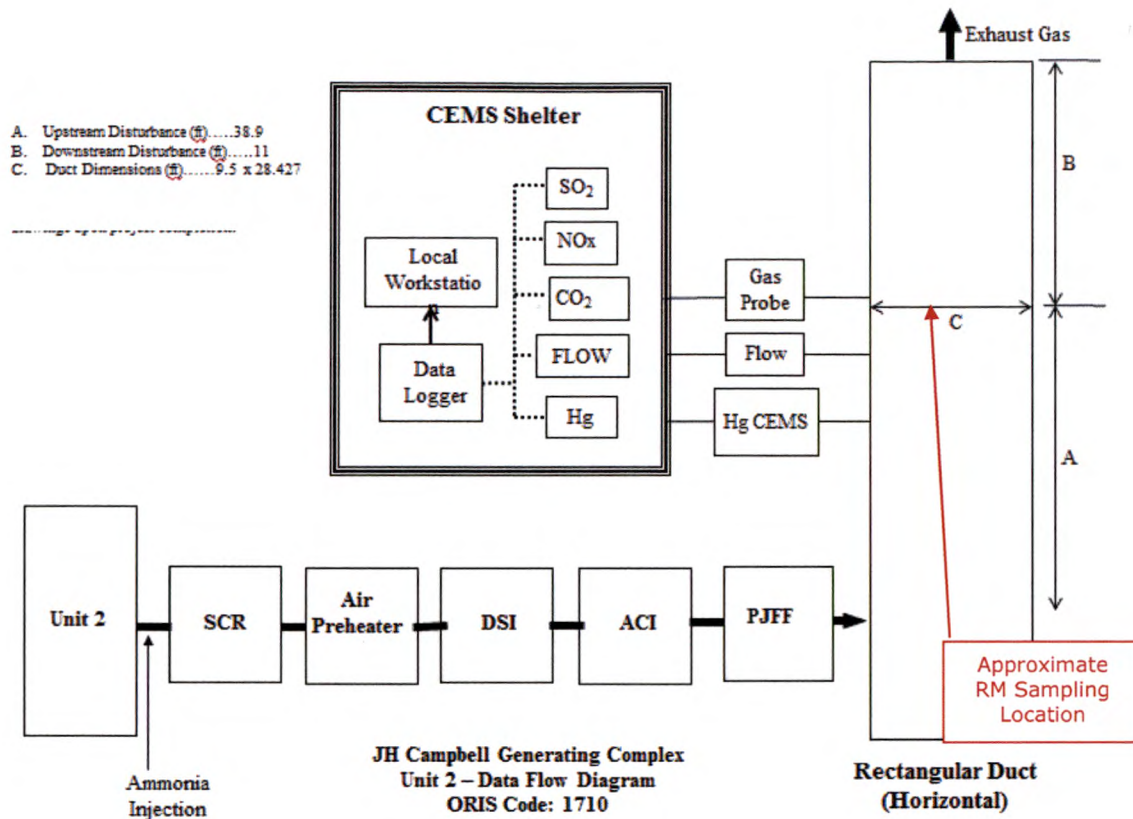


Figure 2 – J.H. Campbell Unit 2 Duct Cross Section and Test Port / Traverse Point Detail

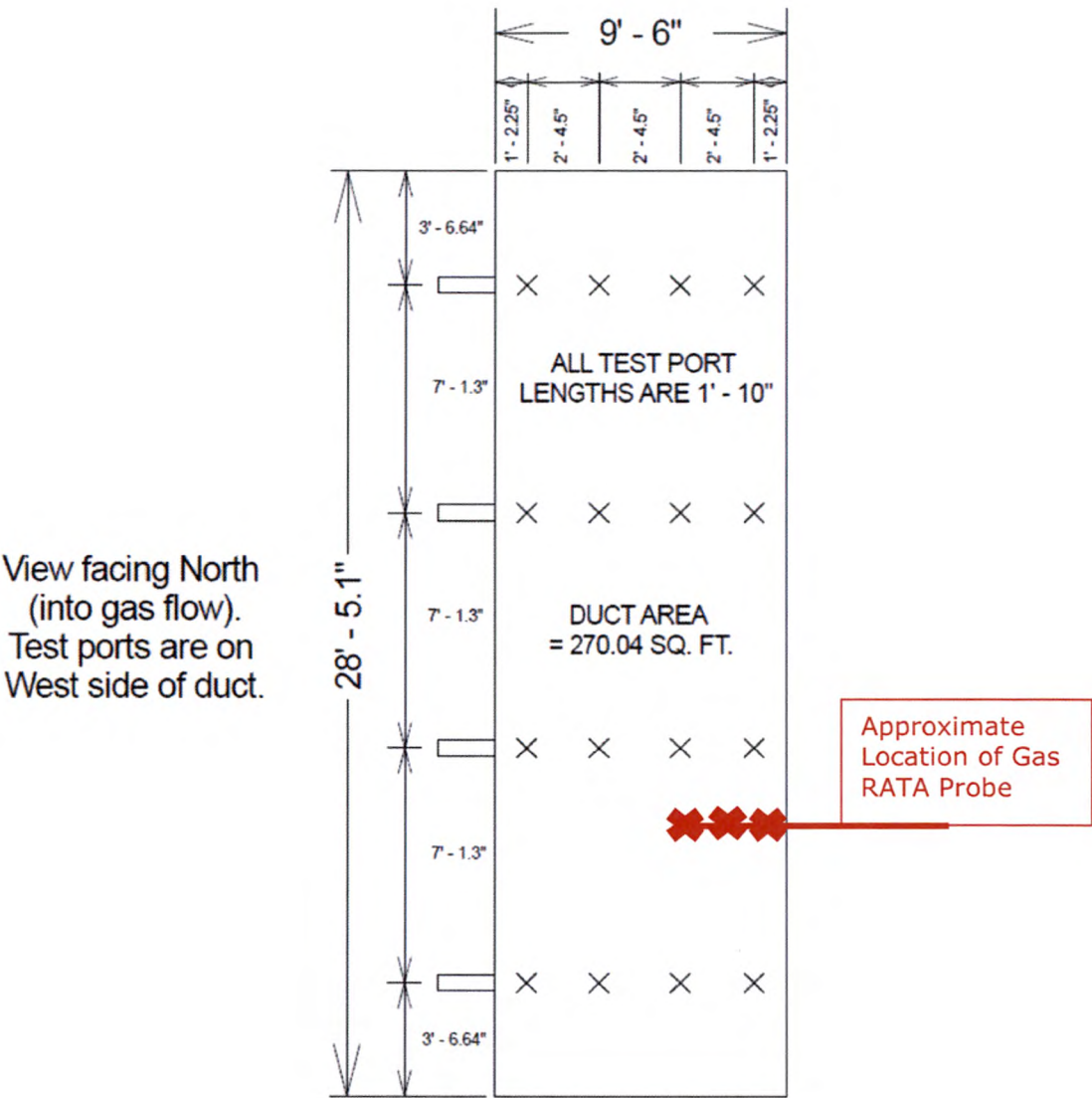


Figure 3 – Volumetric Airflow RATA Sample Apparatus

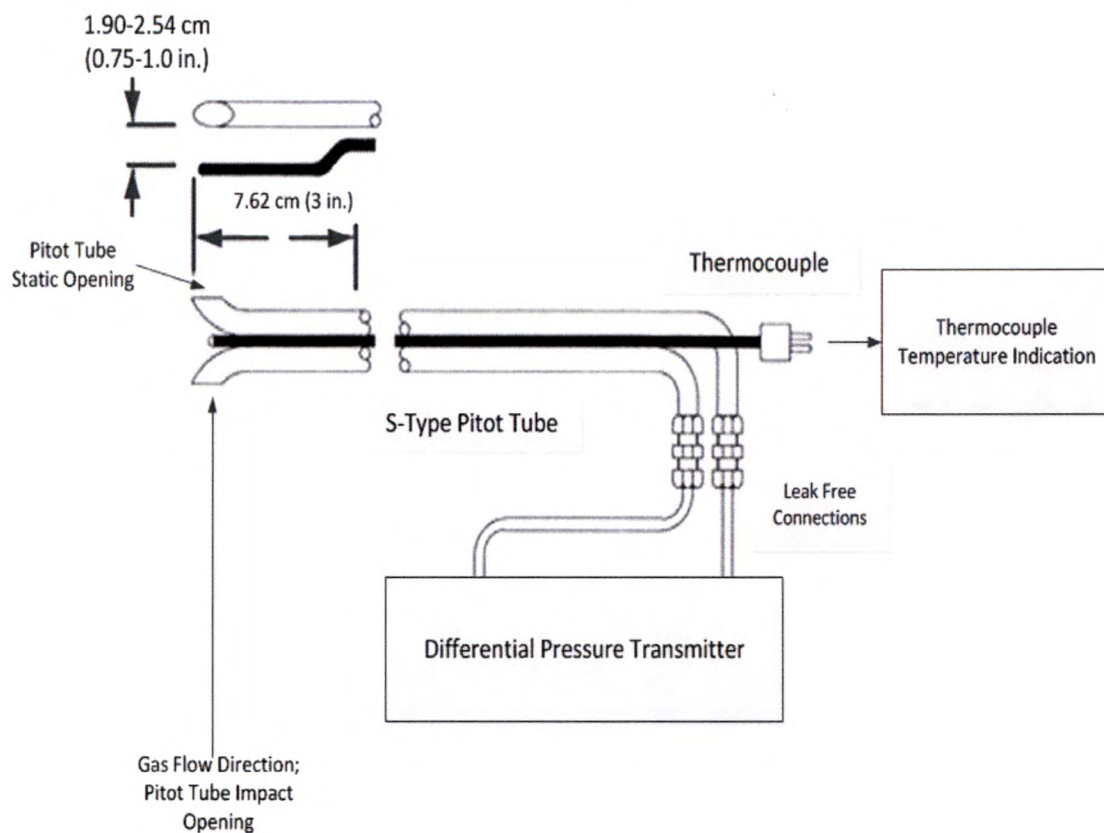


Figure 4 – Reference Method 4 Moisture Apparatus

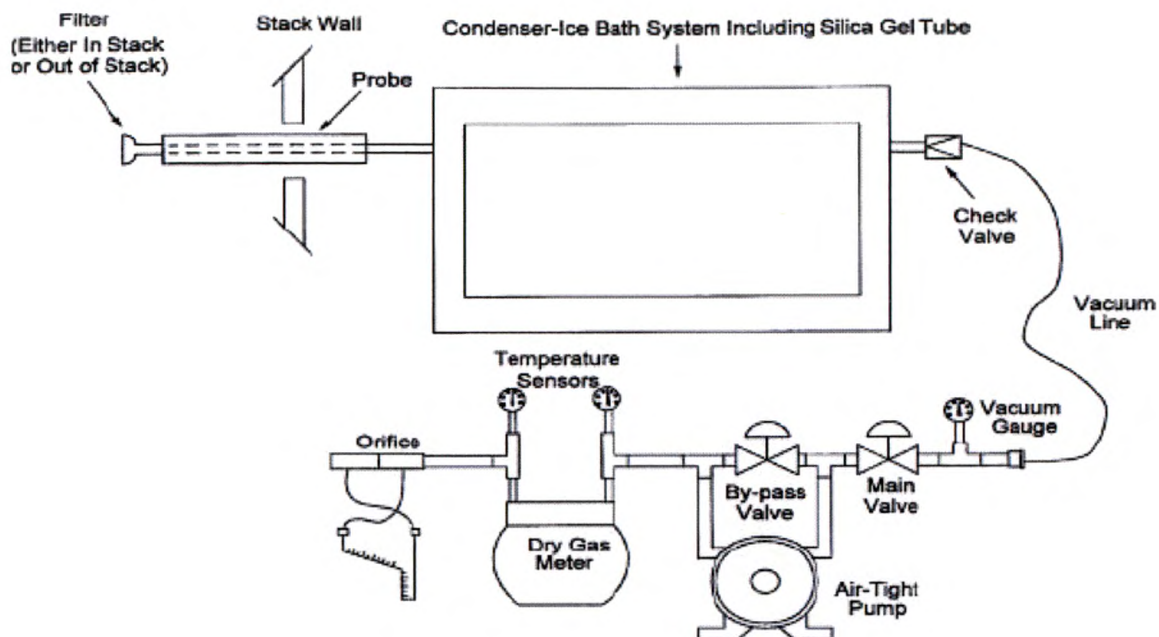


Figure 5 – Reference Method Gaseous RATA Sample Apparatus

