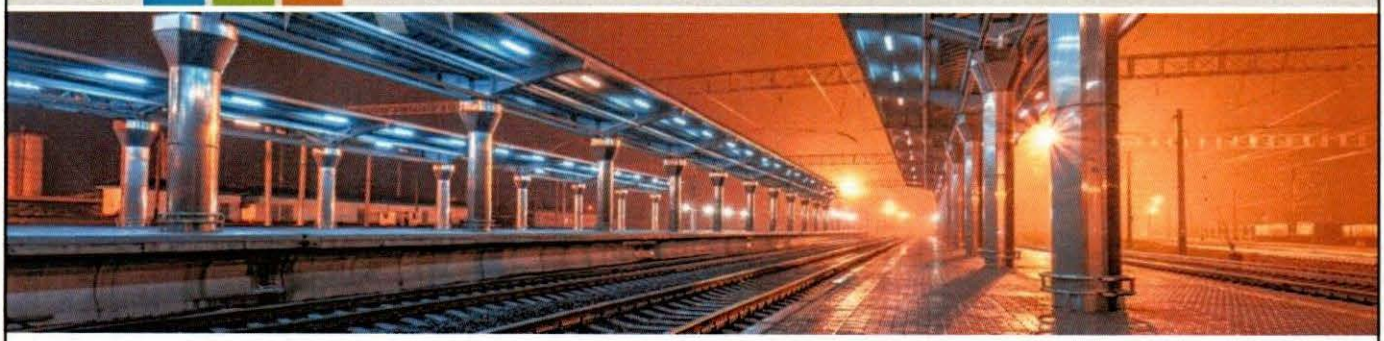
APEX COMPANIES, LLC



Air Emissions Report
EUBLR Relative Accuracy Test Audit
Cadillac Renewable Energy
Cadillac, Michigan

PREPARED FOR:
Cadillac Renewable Energy
1525 Miltner Street
Cadillac, Michigan 49601

Apex Project No. 23007574

October 10, 2023

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APEX

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Executive Summary

Cadillac Renewable Energy retained Apex Companies, LLC (Apex) to conduct air emissions testing at the Cadillac Renewable Energy facility in Cadillac, Michigan. The purpose of the air emission testing was to perform Relative Accuracy Test Audits (RATAs) on several analyzers associated with one wood-fired boiler (EUBLR). The source is regulated by Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) No. MI-ROP N1395-2021, effective January 8, 2021.

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 4, 3A, 7E, 10, 19, 205, and Performance Specifications PS-2, PS-3, PS-4, and PS-6.

Detailed results are presented in Tables 1 through 8 after the Tables Tab of this report. The following tables summarize the results of the testing conducted on August 22 and 23, 2023.

EUBLR Relative Accuracy Test Audit Results

Parameter	Average RM Result	Average CEMS Result	Difference between CEMS and RM	Relative Accuracy (%)	Performance Specification
Flowrate, Low Load (scf/hr)	4,672,349	4,593,262	79,087	**3.6%**	**≤10% RM†**
Flowrate, High Load (scf/hr)	7,787,903	7,599,109	188,794	**3.7%**	**≤10% RM†**
Moisture content (%)	20.4	17.5	2.9	**19.2%**	**≤10% RM†**
Oxygen (%)	6.50	6.56	-0.06	**1.5%**	**≤10% RM†**
Nitrogen oxides (ppm)	90.6	88.9	1.7	**4.7%**	**≤10% RM†**
Nitrogen oxides (lb/MMBtu)	0.1452	0.1430	0.0023	**4.6%**	**≤10% RM†**
Carbon monoxide (lb/hr)	8.37	8.83	-0.46	**0.4%**	**≤5% AS**
Carbon monoxide (lb/MMBtu)	0.0302	0.0319	-0.0018	**0.8%**	**≤5% AS**

CEMS: continuous emission monitoring system
scf/hr: standard cubic foot per hour
ppm: part per million
lb/MMBtu: pound per million British thermal unit
lb/hr: pound per hour
RM: Reference Method
AS: Applicable Standard
† Relative accuracy ≤10% RM requires semi-annual testing, and ≤7.5% RM requires annual testing

EUBLR Bias Test and BAF Results

Parameter	Mean difference, d	Confidence coefficient, |cc|	d < |cc|	BAF
Flowrate, Low Load (scf/hr)	79,087	88,409	Yes	**1.000**
Flowrate, High Load (scf/hr)	188,794	100,715	No	**1.025**
Nitrogen oxides (ppm)	1.7	2.57	Yes	**1.000**
Nitrogen oxides (lb/MMBtu)	0.0023	0.0044	Yes	**1.000**

BAF: Bias Adjustment Factor
scf/hr: standard cubic foot per hour
ppm: part per million
lb/MMBtu: pound per million British thermal unit

1.0 Introduction

1.1 Summary of Test Program

Cadillac Renewable Energy retained Apex Companies, LLC (Apex) to conduct air emissions testing at the Cadillac Renewable Energy facility in Cadillac, Michigan. The purpose of the air emission testing was to perform Relative Accuracy Test Audits (RATAs) on several analyzers associated with one wood-fired boiler (EUBLR). The source is regulated by Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit (ROP) No. MI-ROP N1395-2021, effective January 8, 2021.

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 4, 3A, 7E, 10, 19, 205, and Performance Specifications PS-2, PS-3, PS-4, and PS-6.

Table 1-1 lists the emission source tested, parameters, and test dates.

Table 1-1
Source Tested, Parameters, and Test Dates

Source	Test Parameter	Test Date(s)
EUBLR	Carbon monoxide (CO) Nitrogen oxides (NO_X) Oxygen (O_2) Moisture content Flowrate	August 22 and 23, 2023

1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-2. Mr. David Kawasaki, with Apex, led the emission testing program. Mr. Jeremy Quist, with Cadillac Renewable Energy, provided process coordination and recorded operating parameters Mr. Daniel Droste, with EGLE, witnessed the testing and verified production parameters were recorded.

Table 1-2
Key Contact Information

Cadillac Renewable Energy	Apex
Ryan Putvin O&M Manager **Cadillac Renewable Energy** 1525 Miltner Street Cadillac, Michigan 49601 Phone: 231.779.8609x3 rputvin@atlanticpower.com	Derek Wong, Ph.D., P.E. National Account Manager **Apex Companies, LLC** 46555 Humboldt Drive, Suite 103 Novi, Michigan 48377 Phone: 248.875.7581 derek.wong@apexcos.com
EGLE	
Jeremy Howe Supervisor, Technical Programs Unit **EGLE Air Quality Division** Constitution Hall, 2nd Floor South 525 West Allegan Street Lansing, Michigan 48933 Phone: 231.878.6687 howej1@michigan.gov	Dave Bowman Environmental Quality Analyst **EGLE Air Quality Division** 2100 West M-32 Gaylord, Michigan 49735 Phone: 989.395.6298 bowmand7@michigan.gov

2.0 Source and Sampling Locations

2.1 Process Description

Cadillac Renewable Energy operates a spreader-stoker design boiler (EUBLR), with a steam rating of 334,085 pound per hour (lb/hr) at 1,025 pound per square inch gage (psig) firing on wood fuel. The steam turbine/generator has a rated output of 39.6 megawatt (MW). Natural gas is used as a startup fuel.

Operating parameters were measured and recorded by Cadillac Renewable Energy personnel during testing. Table 2-1 summarizes the operating conditions during testing of EUBLR. Additional operating parameter data are included in Appendix E.

Table 2-1
Summary of EUBLR Electricity Production

Test Run	Boiler Low Load, Aug. 22 (MW)	Boiler High Load, Aug. 23 (MW)
1	14.0	34.3
2	14.2	34.1
3	14.4	34.1
4	14.2	34.6
5	14.5	35.0
6	14.5	35.5
7	14.4	34.6
8	14.5	34.5
9	14.6	34.4
Average	**14.4**	**34.6**

2.2 Control Equipment Description

A selective non-catalytic reduction (SNCR) system, a multiclone dust collector, and an electrostatic precipitator (ESP) serve as pollution control equipment for the EUBLR source. Air flow rates are monitored by a Dwyer Flow Gauge, serial number N44P-E.

The flow rate continuous emission rate monitoring system (CERMS) installed on the EUBLR exhaust stack is used to evaluate continuous compliance with permit limits.

2.3 Flue Gas Sampling Location

Four sampling ports oriented at 90° to one another are located in a straight section of a 96 inch-internal-diameter duct. The sampling ports are located:

- Approximately 36 feet (4.5 duct diameters) from the nearest downstream disturbance.
- Approximately 60 feet (7.5 duct diameters) from the nearest upstream disturbance.

The sampling ports are accessible from a platform on the stack. The platform is accessed via stairs and ladder. A photograph of the EUBLR outlet sampling location is presented in Figure 2-1. Figure 1 in the Appendix depicts the EUBLR outlet sampling ports and traverse point locations.

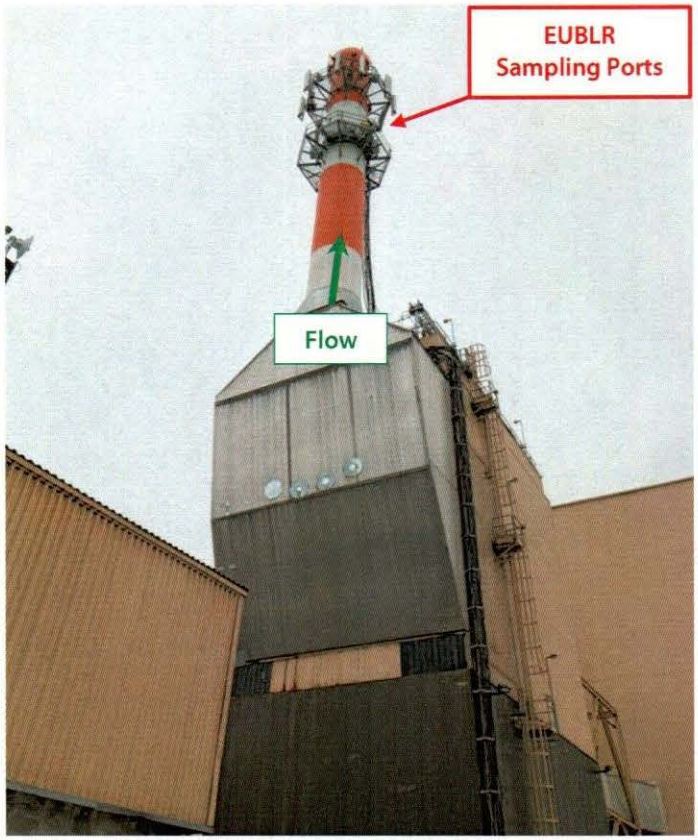

Figure 2-1. EUBLR Outlet Sampling Location

2.4 Process Sampling Locations

Process sampling was not required during this test program. A process sample is a sample that is analyzed for operational parameters, such as calorific value of a fuel (e.g., natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The objective of the testing was to perform RATAs on one flowrate analyzer, one moisture analyzer, one oxygen analyzer, one nitrogen oxides analyzer, and one carbon monoxide analyzer, that service the wood-fired boiler (EUBLR), in accordance with Parts 60 and 75 of Title 40 of the CFR.

Table 3-1 summarizes the sampling and analytical matrix.

Table 3-1
Sampling and Analytical Matrix

Sampling Location	Sample/Type of Pollutant	Sample Method	Date (2023)	Run	Start Time	End Time	Analytical Laboratory
EUBLR (Low Load)	Flowrate, molecular weight, moisture content, O_2, NO_x, CO	USEPA 1, 2, 3A, 4, 7E, 10, 19, 205, PS-2, PS-3, PS-4, PS-6	Aug. 22	1	0935	1000	Not applicable
				2	1014	1039	
				3	1107	1132	
				4	1146	1211	
				5	1224	1249	
				6	1304	1329	
				7	1653	1718	
				8	1729	1754	
				9	1806	1831	
EUBLR (High Load)	Flowrate, molecular weight, moisture content	USEPA 1, 2, 3, 4, PS-6	Aug. 23	1	0910	0922	Not applicable
				2	0922	0934	
				3	0934	0946	
				4	0957	1009	
				5	1009	1021	
				6	1021	1033	
				7	1042	1054	
				8	1054	1106	
				9	1106	1118	

3.2 Field Test Changes and Issues

Communication between Cadillac Renewable Energy, Apex, and EGLE allowed the testing to be completed as proposed in the June 15, 2023 Intent-to-Test Plan.

3.3 Summary of Results

The results of testing are presented in Tables 3-2 and 3-3. Detailed results are presented in the Appendix Tables 1 through 8 after the Tables Tab of this report. Graphs are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.

Table 3-2
EUBLR Relative Accuracy Test Audit Results

Parameter	Average RM Result	Average CEMS Result	Difference between CEMS and RM	Relative Accuracy (%)	Performance Specification
Flowrate, Low Load (scf/hr)	4,672,349	4,593,262	79,087	**3.6%**	**≤10% RM†**
Flowrate, High Load (scf/hr)	7,787,903	7,599,109	188,794	**3.7%**	**≤10% RM†**
Moisture content (%)	20.4	17.5	2.9	**19.2%**	**≤10% RM†**
Oxygen (%)	6.50	6.56	-0.06	**1.5%**	**≤10% RM†**
Nitrogen oxides (ppm)	90.6	88.9	1.7	**4.7%**	**≤10% RM†**
Nitrogen oxides (lb/MMBtu)	0.1452	0.1430	0.0023	**4.6%**	**≤10% RM†**
Carbon monoxide (lb/hr)	8.37	8.83	-0.46	**0.4%**	**≤5% AS**
Carbon monoxide (lb/MMBtu)	0.0302	0.0319	-0.0018	**0.8%**	**≤5% AS**

CEMS: continuous emission monitoring system
scf/hr: standard cubic foot per hour
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lb/MMBtu: pound per million British thermal unit
lb/hr: pound per hour
RM: Reference Method
AS: Applicable Standard
† Relative accuracy ≤10% RM requires semi-annual testing, and ≤7.5% RM requires annual testing

Table 3-3
EUBLR Bias Test and BAF Results

Parameter	Mean difference, d	Confidence coefficient, |cc|	d < |cc|	BAF
Flowrate, Low Load (scf/hr)	79,087	88,409	Yes	**1.000**
Flowrate, High Load (scf/hr)	188,794	100,715	No	**1.025**
Nitrogen oxides (ppm)	1.7	2.57	Yes	**1.000**
Nitrogen oxides (lb/MMBtu)	0.0023	0.0044	Yes	**1.000**

BAF: Bias Adjustment Factor
scf/hr: standard cubic foot per hour
ppm: part per million
lb/MMBtu: pound per million British thermal unit

4.0 Sampling and Analytical Procedures

Apex measured emissions in accordance with USEPA sampling methods. Table 4-1 presents the emissions test parameters and sampling methods.

Table 4-1
Emission Testing Methods

Parameter	EUBLR	USEPA Reference	
		Method	Title
Sampling ports and traverse points	•	1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	•	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight	•	3	Gas Analysis for the Determination of Dry Molecular Weight
Oxygen (O_2) and carbon dioxide (CO_2)	•	3A	Determination of Oxygen and Carbon Dioxide Emissions from Stationary Sources (Instrument Analyzer Procedure)
Moisture content	•	4	Determination of Moisture Content in Stack Gases
Nitrogen oxides (NO_X)	•	7E	Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrument Analyzer Procedure)
Carbon monoxide (CO)	•	10	Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure)
Emission rate	•	19	Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates
Gas dilution	•	205	Verification of Gas Dilution Systems for Field Instrument Calibrations
NO_X RATA	•	PS-2	Specifications and Test Procedures for SO_2 and NO_x Continuous Emission Monitoring Systems in Stationary Sources
O_2 RATA	•	PS-3	Specifications and Test Procedures for O_2 and CO_2 Continuous Emission Monitoring Systems in Stationary Sources
CO RATA	•	PS-4	Specifications and Test Procedures for Carbon Monoxide Continuous Emission Monitoring Systems in Stationary Sources
Flow RATA	•	PS-6	Specifications and Test Procedures for Continuous Emission Rate Monitoring Systems in Stationary Sources

4.1 Emission Test Methods

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources," was used to evaluate the sampling locations and the number of traverse points for sampling and the measurement of velocity profiles. Figure 1 in the Appendix depicts the source locations and traverse points.

USEPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrates. S-type Pitot tubes and thermocouple assemblies, calibrated in accordance with Method 2, Section 10.0, were used during testing. Because the dimensions of the Pitot tubes met the requirements outlined in Method 2, Section 10.1, and are within the specified limits, the baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned. The digital manometer and thermometer are calibrated using calibration standards that are traceable to National Institute of Standards and Technology (NIST). Pitot tube inspection sheets are included in Appendix A.

Cyclonic Flow Check. Apex evaluated whether cyclonic flow was present at the sampling location. Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head reading—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20°, the flue gas is considered to be cyclonic at that sampling location and an alternative location should be selected.

The average of the measured traverse point flue gas velocity null angles were less than 20° at the sampling location. The measurements indicate the absence of cyclonic flow.

Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.2 Molecular Weight (USEPA Method 3)

USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight," was used to determine the molecular weight of the flue gas. Flue gas was extracted from the stack through a probe and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by chemical absorption to within ±0.5%. The average CO_2 and O_2 results of the grab samples were used to calculate molecular weight.

4.1.3 Moisture Content (USEPA Method 4)

USEPA Method 4, "Determination of Moisture Content in Stack Gases" was used to determine the moisture content of the flue gas. Refer to Figure 4-1 for a drawing of the USEPA Method 4 sampling train.

Apex's modular USEPA Method 4 stack sampling system consists of:

- A stainless steel probe.
- Tygon® umbilical line connecting the probe to the impingers.
- A set of four impingers with the configuration shown in Table 4-2.
- A sampling line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Table 4-2
USEPA Method 4 Impinger Configuration

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

Prior to initiating a test run, the sampling train was leak-checked by capping the probe tip and applying a vacuum of at least 5 inches of mercury to the sampling train. The dry-gas meter was monitored for approximately 1 minute to verify the sample train leak rate was less than 0.02 cfm. The sample probe was then inserted into the sampling port near the centroid of the stack in preparation of sampling. Flue gas was extracted at a constant rate from the stack, with moisture removed from the sample stream by the chilled impingers.

At the conclusion of the test run, a post-test leak check was conducted and the impinger train was carefully disassembled. The weight of liquid or silica gel in each impinger was measured with a scale capable of measuring to the nearest 0.5 gram. The weight of water collected within the impingers and volume of flue gas sampled were used to calculate the percent moisture content.

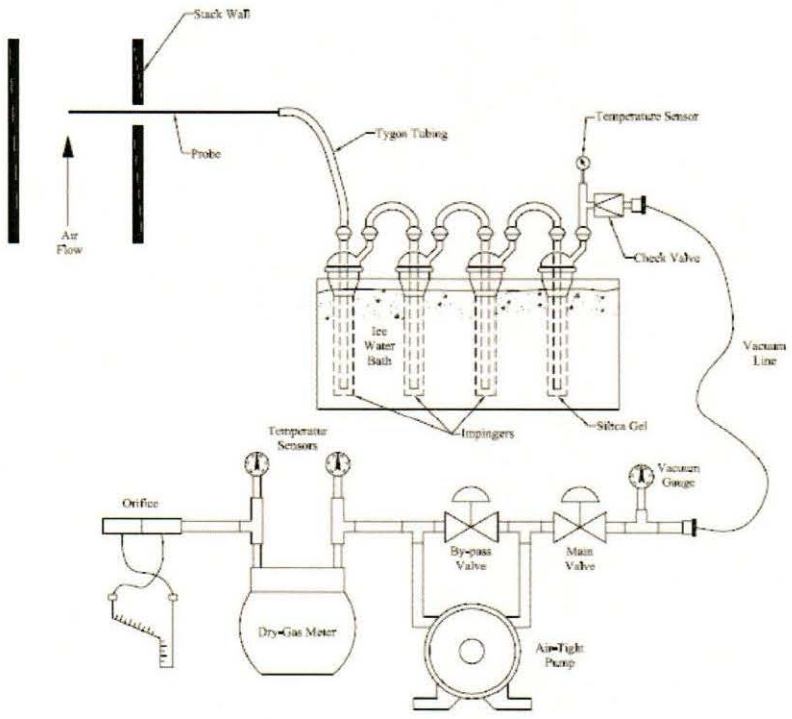

Figure 4-1. USEPA Method 4 Sampling Train

4.1.4 Oxygen, Carbon Dioxide, Nitrogen Oxides, and Carbon Monoxide (USEPA Methods 3A, 7E, and 10)

USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations from Stationary Sources (Instrumental Analyzer Procedure)," was used to measure oxygen (O_2) and carbon dioxide (CO_2) concentrations in the flue gas. USEPA Method 7E, "Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)," was used to measure nitrogen oxides (NO_X) concentrations in the flue gas. USEPA Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)," was used to measure carbon monoxide (CO) concentrations in the flue gas. Flue gas was continuously sampled in the stack and conveyed to an analyzer for concentration measurements. Flue gas was extracted from the stack through:

- A stainless-steel probe.
- Heated Teflon sample line to prevent condensation.
- A chilled Teflon impinger train (equipped with a peristaltic pump) to remove moisture from the sampled gas stream prior to entering the analyzer.
- O_2, CO_2, NOx, and CO analyzers.

Figure 4-2 depicts the USEPA Methods 3A, 7E, and 10 sampling train. Data was recorded at 1-second intervals on a computer equipped with data acquisition software. Recorded concentrations were averaged over the duration of each test run.

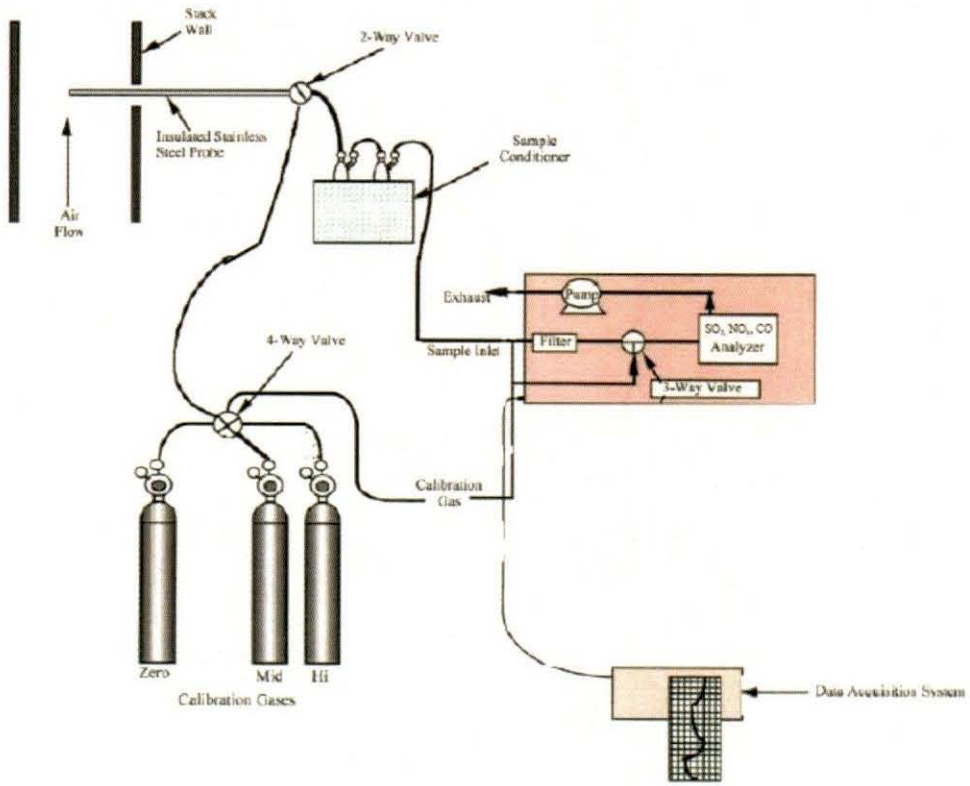

Figure 4-2. USEPA Methods 3A, 7E, and 10 Sampling Train

Testing was conducted along the 3-point short line, at depths of 4.4, 14.6, and 29.6 percent of the way across the stack.

The pollutant concentrations were measured using an analyzer calibrated with zero-, mid-, and high-USEPA-Traceability-Protocol-certified calibration gases. The mid-level gas was 40 to 60% of the high-level (also referred to as span) gas.

Calibration Error Check. A calibration error check was performed by introducing zero-, mid-, and high-level calibration gases directly into the analyzer. The calibration error check was performed to verify the analyzer response was within ±2% of the certified calibration gas introduced.

System Bias Test. Prior to each test run, a system bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if an analyzer's response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each test run, an additional system-bias check was performed to evaluate the analyzer drift from pre- and post-test system-bias checks. The system-bias check evaluates the analyzer drift against the ±3% quality assurance/quality control (QA/QC) requirement.

The analyzer drift data was used to correct the measured flue gas concentrations. Recorded concentrations were averaged over the duration of each test run.

NO/NO2 Conversion Check. An NO/NO_2 conversion check was performed prior to testing by introducing an NO_2 calibration gas into the NO_X analyzer. The analyzer's NO_X concentration response was greater than 90% of the introduced NO_2 calibration gas concentration and met the converter efficiency requirement of Section 13.5 of USEPA Method 7E.

4.1.5 Emission Rate (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 emission rates of PM, VOC, NO_X, and CO in pounds per million British thermal units. Oxygen concentrations and standard F-factors from USEPA Method 19, Table 19-2 were used to calculate emission rates using USEPA Method 19 Equation 19-1:

$$E = C_d F_d \left(\frac{20.9}{20.9 - \%O_{2d}}\right)$$

Where:

E	=	Pollutant emission rate (lb/MMBtu)
C_d	=	Pollutant concentration, dry basis (lb/dscf)
F_d	=	F factor (dscf/MMBtu)
$\%O_{2d}$	=	Oxygen concentration, dry basis (%, dry)

4.1.6 Gas Dilution (USEPA Method 205)

USEPA Method 205, "Verification of Gas Dilution Systems for Field Instrument Calibrations," was used to introduce known values of calibration gases into the analyzers. The gas dilution system consists of calibrated orifices or mass flow controllers and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and was evaluated for accuracy in the field in accordance with USEPA Method 205.

Prior to testing, the gas divider dilutions were measured to evaluate that they were within ±2% of predicted values. Two sets of three dilutions of the high-level calibration gas were performed. In addition, a certified mid-level

calibration gas was introduced into an analyzer; this calibration gas concentration was within ±10% of a gas divider dilution concentration.

4.2 Process Data

Cadillac Renewable Energy personnel recorded process data during testing. EGLE personnel verified the requested operating and process data were recorded. Process data are included in Appendix E.

5.0 Quality Assurance and Quality Control

5.1 QA/QC Procedures

Equipment used in this emissions test program passed Quality Assurance (QA) and Quality Control (QC) procedures. Refer to Appendix A for equipment calibrations. Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling method and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III, Stationary Source-Specific Methods."

5.2 QA/QC Audits

Onsite QA/QC procedures (i.e., Pitot tube inspections, nozzle size verifications, leak check, calculation of isokinetic sampling rates, calibrations) were performed in accordance with the respective USEPA sampling methods. Equipment inspection and calibration measurements are presented in Appendix A.

Offsite QA audits include dry-gas meter and thermocouple calibrations.

5.2.1 Sampling Train QA/QC

The sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. Table 5-1 summarizes the QA/QC audits conducted on each sampling train.

Table 5-1
USEPA Method 4 Sampling Train QA/QC

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
Moisture Content for High Load RATA					
Sampling train post-test leak check	0.005 ft^3 for 1 min at 5 in Hg	0.005 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		
Moisture Content for Low Load RATA					
Sampling train post-test leak check	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	0.001 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		
Parameter	**Run 4**	**Run 5**	**Run 6**	**Method Requirement**	**Comment**
Moisture Content for Low Load RATA					
Sampling train post-test leak check	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		
Parameter	**Run 7**	**Run 8**	**Run 9**	**Method Requirement**	**Comment**
Moisture Content for Low Load RATA					
Sampling train post-test leak check	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		

5.2.2 Instrument Analyzer QA/QC

The instrument analyzer sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Table 5-2 summarizes the gas cylinders used during this test program. Analyzer calibration, bias, and drift data are included in Appendix A.

Table 5-2
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Nitrogen	Airgas	CC354795	99.9995%	2/4/2029
Oxygen, Carbon dioxide	Airgas	CC58208	21.91% 22.27%	6/22/2030
Oxygen, Carbon dioxide	Airgas	SG9161438BAL	11.04% 11.10%	6/8/2024
Nitrogen oxides	Airgas	XC034410B	1,008 ppm	1/3/2026
Nitrogen oxides	Airgas	XC025037B	507.4 ppm	6/21/2031
Nitrogen dioxide	Airgas	CC500150	19.76 ppm	3/10/2024
Carbon monoxide	Airgas	ALM-055260	92.92 ppm	10/10/2030
Carbon monoxide	Airgas	CC27329.	1,005 ppm	12/26/2025

5.2.3 Dry-Gas Meter QA/QC

Table 5-3 summarizes the dry-gas meter calibration checks in comparison to the acceptable USEPA tolerance. Complete dry-gas meter calibrations are included in Appendix A.

Table 5-3
Dry-Gas Meter Calibration QA/QC

Dry-Gas Meter	Pre-test DGM Calibration Factor	Post-test DGM Calibration Factor	Difference Between Pre- and Post-test Calibrations	Acceptable Tolerance	Comment
1	1.002 (7/6/2023)	1.007 (8/25/2023)	0.005	±0.05	Valid

5.2.4 Thermocouple QA/QC

Temperature measurements using thermocouples and digital pyrometers were compared to a reference temperature prior to testing to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperature within ±1.5% of the reference temperatures and were within USEPA acceptance criteria. Thermocouple calibration sheets are included in Appendix A.

5.3 Data Reduction and Validation

The emissions testing Project Manager and/or the QA/QC Officer validated computer spreadsheets. The computer spreadsheets were used to ensure that field calculations were accurate. Random inspection of the field data sheets were conducted to verify data have been recorded appropriately. At the completion of a test, the raw field data were entered into computer spreadsheets to provide applicable onsite emissions calculations. The computer data were checked against the raw field sheets for accuracy during review of the report.

5.4 QA/QC Problems

Equipment audits and QA/QC procedures demonstrate sample collection accuracy and compliance for the test runs.

6.0 Limitations

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Tables

Table 1

EUBLR Moisture Relative Accuracy Test Audit Results

Cadillac Renewable Energy

Cadillac, Michigan

Apex Project No. 23007574

Sampling Date: August 22, 2023

Run	Date	Time	RM %	CERM %	Difference %
1	8/22/2023	09:35-10:00	20.4	16.3	4.2
2	8/22/2023	10:14-10:39	20.0	17.3	2.7
3	8/22/2023	11:07-11:32	20.4	18.0	2.3
4	8/22/2023	11:46-12:11	19.8	17.7	2.2
5	8/22/2023	12:24-12:49	20.1	18.2	1.8
6	8/22/2023	13:04-13:29	20.8	15.4	5.4
7	8/22/2023	16:53-17:18	20.4	18.0	2.3
8	8/22/2023	17:29-17:54	21.6	17.9	3.8
9	8/22/2023	18:06-18:31	20.2	18.5	1.7
Mean			20.4	17.5	2.9
Standard Deviation					1.3
Confidence Coefficient					1.0

Average RM value	20.4 %
Relative Accuracy	**19.2 %**

Relative Accuracy Performance Specification — **The RA of the CERMS must be no greater than 10 percent, or the difference of the CERMS must be no greater than 1.5%.**

Table 2

EUBLR Oxygen Relative Accuracy Test Audit Results

Cadillac Renewable Energy

Cadillac, Michigan

Apex Project No. 23007574

Sampling Date: August 22, 2023

Run	Date	Time	RM %	CERM %	Difference %
1	8/22/2023	09:35-10:00	6.65	6.81	-0.16
2	8/22/2023	10:14-10:39	6.87	6.91	-0.04
3	8/22/2023	11:07-11:32	6.60	6.67	-0.07
4	8/22/2023	11:46-12:11	6.71	6.84	-0.13
5	8/22/2023	12:24-12:49	6.51	6.54	-0.03
6	8/22/2023	13:04-13:29	6.47	6.44	0.03
7	8/22/2023	16:53-17:18	6.30	6.35	-0.05
8	8/22/2023	17:29-17:54	6.19	6.24	-0.05
9	8/22/2023	18:06-18:31	6.21	6.23	-0.02
Mean			6.50	6.56	-0.06
Standard Deviation					0.06
Confidence Coefficient					0.04

Average RM value	6.50 %
Relative Accuracy	**1.5 %**

Relative Accuracy Performance Specification The RA of the CERMS must be no greater than 10 percent

APEX

Table 3

EUBLR Nitrogen Oxides (ppm) Relative Accuracy Test Audit Results

Cadillac Renewable Energy

Cadillac, Michigan
Apex Project No. 23007574
Sampling Date: August 22, 2023

Run	Date	Time	Reference Method DSCFM	O2 (%)	ppm	lb/hr	lb/MMBtu	CERM ppm	Difference ppm
1	8/22/2023	09:35-10:00	63,374	6.6	89.4	40.63	0.1448	90.4	-1.0
2	8/22/2023	10:14-10:39	63,688	6.9	89.0	40.62	0.1463	88.6	0.3
3	8/22/2023	11:07-11:32	63,933	6.6	90.2	41.36	0.1457	89.1	1.1
4	8/22/2023	11:46-12:11	61,740	6.7	90.6	40.11	0.1474	88.5	2.1
5	8/22/2023	12:24-12:49	62,805	6.5	90.6	40.80	0.1453	89.5	1.1
6	8/22/2023	13:04-13:29	58,841	6.5	90.1	38.00	0.1441	79.8	10.3
7	8/22/2023	16:53-17:18	60,427	6.3	90.8	39.33	0.1435	91.3	-0.6
8	8/22/2023	17:29-17:54	58,969	6.2	93.3	39.44	0.1463	92.2	1.1
9	8/22/2023	18:06-18:31	63,997	6.2	91.6	42.01	0.1438	90.4	1.2
Mean			61,975		90.6	40.3	0.1452	88.9	1.7
Standard Deviation									3.3
Confidence Coefficient									2.57

Average RM value	90.6 ppm
Relative Accuracy	4.7 %

Relative Accuracy Performance Specification — **The RA of the CERMS must be no greater than 10 percent**

APEX

Table 4

EUBLR Nitrogen Oxides (lb/MMBtu) Relative Accuracy Test Audit Results

Cadillac Renewable Energy

Cadillac, Michigan
Apex Project No. 23007574
Sampling Date: August 22, 2023

Run	Date	Time	DSCFM	O2 (%)	Reference Method ppm	Reference Method lb/hr	Reference Method lb/MMBtu	CERM lb/MMBtu	Difference lb/MMBtu
1	8/22/2023	09:35-10:00	63,374	6.6	89.4	40.63	0.1448	0.1480	-0.0032
2	8/22/2023	10:14-10:39	63,688	6.9	89.0	40.62	0.1463	0.1461	0.0002
3	8/22/2023	11:07-11:32	63,933	6.6	90.2	41.36	0.1457	0.1445	0.0012
4	8/22/2023	11:46-12:11	61,740	6.7	90.6	40.11	0.1474	0.1452	0.0022
5	8/22/2023	12:24-12:49	62,805	6.5	90.6	40.80	0.1453	0.1438	0.0015
6	8/22/2023	13:04-13:29	58,841	6.5	90.1	38.00	0.1441	0.1272	0.0169
7	8/22/2023	16:53-17:18	60,427	6.3	90.8	39.33	0.1435	0.1448	-0.0013
8	8/22/2023	17:29-17:54	58,969	6.2	93.3	39.44	0.1463	0.1450	0.0013
9	8/22/2023	18:06-18:31	63,997	6.2	91.6	42.01	0.1438	0.1421	0.0017
Mean			61,975		90.6	40.3	0.1452	0.1430	0.0023
Standard Deviation									0.0057
Confidence Coefficient									0.0044

Average RM value 0.1452 lb/MMBtu
Relative Accuracy 4.6 %

Relative Accuracy Performance Specification The RA of the CERMS must be no greater than 10 percent

APEX

Table 5

EUBLR Carbon Monoxide (lb/hr) Relative Accuracy Test Audit Results

Cadillac Renewable Energy

Cadillac, Michigan
Apex Project No. 23007574
Sampling Date: August 22, 2023

Run	Date	Time	DSCFM	O2 (%)	Reference Method ppm	Reference Method lb/hr	Reference Method lb/MMBtu	CERM lb/hr	Difference lb/hr
1	8/22/2023	09:35-10:00	63,374	6.6	29.4	8.13	0.0290	8.55	-0.42
2	8/22/2023	10:14-10:39	63,688	6.9	35.4	9.83	0.0354	10.12	-0.29
3	8/22/2023	11:07-11:32	63,933	6.6	29.9	8.34	0.0294	8.36	-0.02
4	8/22/2023	11:46-12:11	61,740	6.7	31.8	8.58	0.0315	9.10	-0.52
5	8/22/2023	12:24-12:49	62,805	6.5	30.4	8.32	0.0296	8.46	-0.14
6	8/22/2023	13:04-13:29	58,841	6.5	29.5	7.58	0.0287	9.03	-1.45
7	8/22/2023	16:53-17:18	60,427	6.3	27.5	7.24	0.0264	7.69	-0.45
8	8/22/2023	17:29-17:54	58,969	6.2	30.5	7.85	0.0291	8.40	-0.55
9	8/22/2023	18:06-18:31	63,997	6.2	34.0	9.49	0.0325	9.80	-0.31
Mean			61,975		30.9	8.37	0.0302	8.83	-0.46
Standard Deviation									0.41
Confidence Coefficient									0.32

Applicable Standard (Permit Limit)	209.2 lb/hr
Average RM value (permit limit used if <50% of standard)	209.2 lb/hr
Relative Accuracy	0.4 %
Relative Accuracy Performance Specification	**The RA of the CERMS must be no greater than 5 percent**

APEX

Table 6

EUBLR Carbon Monoxide (lb/MMBtu) Relative Accuracy Test Audit Results

Cadillac Renewable Energy

Cadillac, Michigan
Apex Project No. 23007574
Sampling Date: August 22, 2023

Run	Date	Time	DSCFM	O2 (%)	Reference Method ppm	Reference Method lb/hr	Reference Method lb/MMBtu	CERM lb/MMBtu	Difference lb/MMBtu
1	8/22/2023	09:35-10:00	63,374	6.6	29.4	8.13	0.0290	0.0308	-0.0018
2	8/22/2023	10:14-10:39	63,688	6.9	35.4	9.83	0.0354	0.0362	-0.0008
3	8/22/2023	11:07-11:32	63,933	6.6	29.9	8.34	0.0294	0.0299	-0.0005
4	8/22/2023	11:46-12:11	61,740	6.7	31.8	8.58	0.0315	0.0383	-0.0068
5	8/22/2023	12:24-12:49	62,805	6.5	30.4	8.32	0.0296	0.0300	-0.0004
6	8/22/2023	13:04-13:29	58,841	6.5	29.5	7.58	0.0287	0.0314	-0.0027
7	8/22/2023	16:53-17:18	60,427	6.3	27.5	7.24	0.0264	0.0272	-0.0008
8	8/22/2023	17:29-17:54	58,969	6.2	30.5	7.85	0.0291	0.0295	-0.0004
9	8/22/2023	18:06-18:31	63,997	6.2	34.0	9.49	0.0325	0.0342	-0.0017
Mean			61,975		30.9	8.37	0.0302	0.0319	-0.0018
Standard Deviation									0.0020
Confidence Coefficient									0.0016

Applicable Standard (Permit Limit)	0.4000 lb/MMBtu
Average RM value (permit limit used if <50% of standard)	0.4000 lb/MMBtu
Relative Accuracy	0.8 %
Relative Accuracy Performance Specification	The RA of the CERMS must be no greater than 5 percent

Table 7

EUBLR Flowrate (Low Load) Relative Accuracy Test Audit Results

Cadillac Renewable Energy

Cadillac, Michigan

Apex Project No. 23007574

Sampling Date: August 22, 2023

Run	Date	Time	RM scfh	CERM scfh	Difference scfh
1	8/22/2023	09:35-10:00	4,777,364	4,568,842	208,522
2	8/22/2023	10:14-10:39	4,778,357	4,638,018	140,339
3	8/22/2023	11:07-11:32	4,816,205	4,618,821	197,384
4	8/22/2023	11:46-12:11	4,620,836	4,632,155	-11,319
5	8/22/2023	12:24-12:49	4,715,650	4,630,454	85,196
6	8/22/2023	13:04-13:29	4,459,599	4,514,335	-54,736
7	8/22/2023	16:53-17:18	4,552,904	4,583,676	-30,772
8	8/22/2023	17:29-17:54	4,515,459	4,555,251	-39,792
9	8/22/2023	18:06-18:31	4,814,768	4,597,808	216,960
Mean			4,672,349	4,593,262	79,087
Standard Deviation					115,015
Confidence Coefficient					88,409

Average RM value	4,672,349 scfh
Relative Accuracy	**3.6 %**

Relative Accuracy Performance Specification — **The RA of the CERMS must be no greater than 10 percent**

APEX

Table 8

EUBLR Flowrate (High Load) Relative Accuracy Test Audit Results

Cadillac Renewable Energy

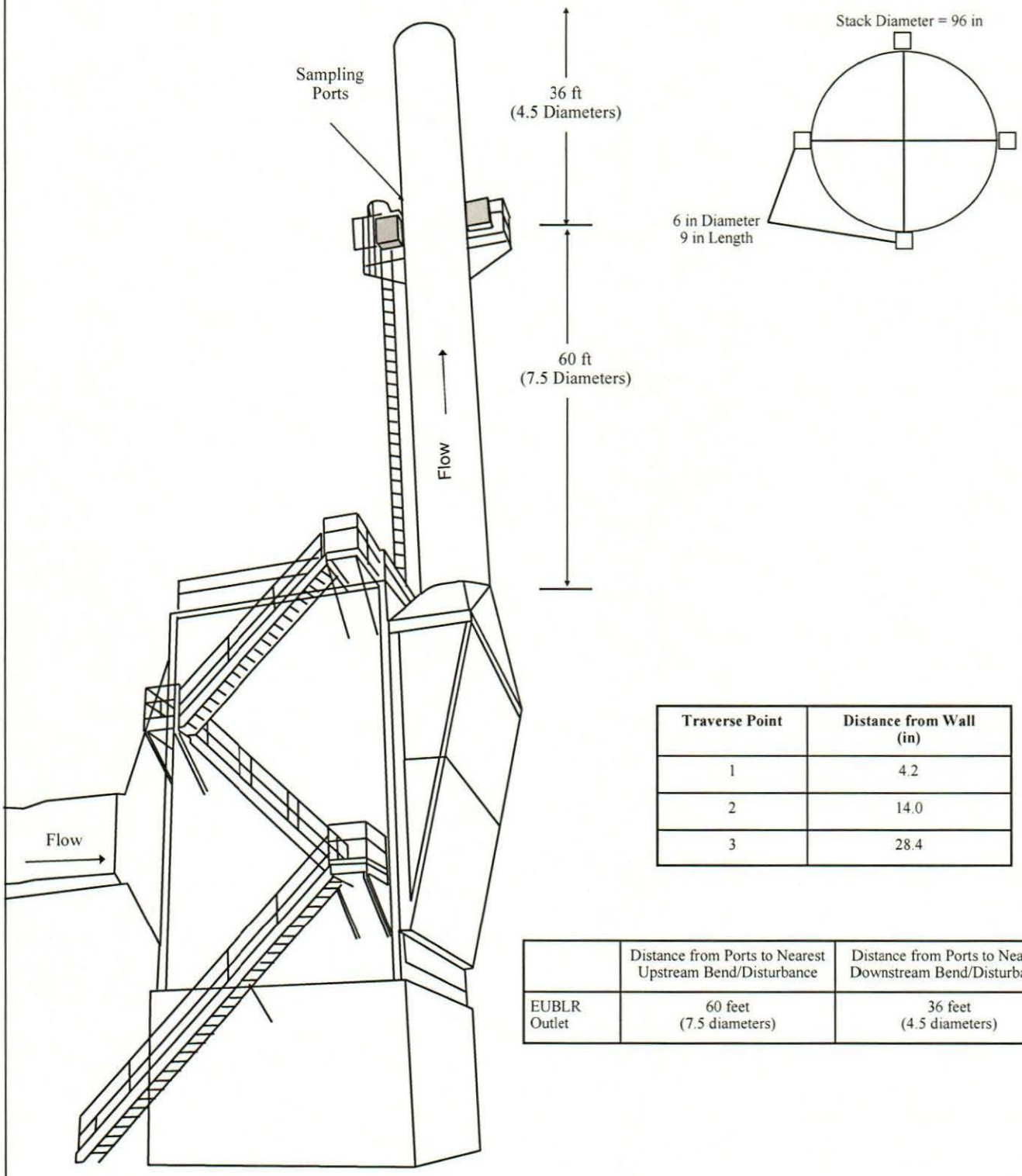
Cadillac, Michigan
Apex Project No. 23007574
Sampling Date: August 23, 2023

Run	Date	Time	RM scfh	CERM scfh	Difference scfh
1	8/23/2023	09:10-09:22	7,968,595	7,524,608	443,987
2	8/23/2023	09:22-09:34	7,777,324	7,542,921	234,403
3	8/23/2023	09:34-09:46	7,591,598	7,612,550	-20,952
4	8/23/2023	09:57-10:09	7,862,275	7,664,648	197,627
5	8/23/2023	10:09-10:21	7,838,075	7,664,925	173,150
6	8/23/2023	10:21-10:33	7,772,194	7,649,362	122,832
7	8/23/2023	10:42-10:54	7,695,128	7,619,194	75,934
8	8/23/2023	10:54-11:06	7,775,926	7,586,005	189,921
9	8/23/2023	11:06-11:18	7,810,009	7,527,769	282,240
Mean			7,787,903	7,599,109	188,794
Standard Deviation					131,026
Confidence Coefficient					100,715

Average RM value	7,787,903 scfh
Relative Accuracy	**3.7 %**

Relative Accuracy Performance Specification — **The RA of the CERMS must be no greater than 10 percent**

Figure



Traverse Point	Distance from Wall (in)
1	4.2
2	14.0
3	28.4

	Distance from Ports to Nearest Upstream Bend/Disturbance	Distance from Ports to Nearest Downstream Bend/Disturbance
EUBLR Outlet	60 feet (7.5 diameters)	36 feet (4.5 diameters)

Scale Not to Scale Date August 25, 2023 Project No. 23007574	**EUBLR Outlet Sampling Ports and Traverse Point Locations** **Cadillac Renewable Energy** **Cadillac, Michigan**	APEX	FIGURE 1