ANNUAL RELATIVE ACCURACY TEST REPORT #23033R
Text and Appendices

PERFORMED FOR:

VICINITY ENERGY
Grand Rapids, Michigan

at the

Kent County Waste-To-Energy Facility
Grand Rapids, Michigan
Units 1 & 2 SDA Inlets and Stacks
June 2023

by

TESTAR Engineering, PC
5100 Unicon Drive, Suite 102
Wake Forest, North Carolina 27587
License Number C-3896
919/957-9500

PE CERTIFICATION
REPORT #23033R

I hereby certify that I have personally examined and am familiar with the information submitted herein. Based upon my own knowledge and my inquiry of those individuals responsible for obtaining the information presented, the foregoing information is true, accurate and complete. I am aware that this information is being requested for the purpose of determining compliance with local, state, and federal laws and may be submitted to appropriate governmental regulatory agencies for those purposes. I am aware that there are significant penalties for submitting false information to such agencies, including the possibility of fine and imprisonment.

Signature: _____ Date: 7/31/23

Gary L. Williams, PE, QSTI
Director

Professional Engineer, State of North Carolina

Seal Number 025432

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1 INTRODUCTION

1.1 General

Vicinity Energy contracted TESTAR Engineering, PC to conduct an Annual Relative Accuracy Test Audit (RATA) on the CEM systems serving Units 1 and 2 at the Kent County Waste-to-Energy Facility in Grand Rapids, Michigan. The RATA test results satisfied the requirements of 40 CFR Part 60, Appendix B and F. The testing program was conducted between June 20 and 21, 2023 by TESTAR Engineering, PC under the supervision of Ms. Rachael Underwood of Vicinity Energy.

1.2 Test Personnel

Table 1-1 presents the personnel from that were involved in the testing program.

Table 1-1
Test Personnel

Affiliation	Personnel Responsibility
Vicinity Energy	Rachael Underwood Test Coordinator
	Randy Lohr Test Coordinator
Michigan EGLE; Air Quality Division	Jeremy Howe Test Observer
	Trevor Drost Test Observer
TESTAR Engineering, PC	Herb Dixon, Jr., PE Project Director
	Charles Nahrebecki CEMS Operator

2 SUMMARY OF RESULTS

2.1 Report Organization

The results of the testing project are summarized in Section 2. The process tested is discussed in Section 3. The sampling and analytical methods utilized are discussed in Section 4 while the Quality Assurance/Quality Control results are presented in Section 5. Appendix A contains detailed results of the testing program. Appendix B contains Reference Method Field Data for O_2, SO_2, NO_x, and CO. Appendix C contains the Source Data CEMS Printouts for O_2, SO_2, NO_x, and CO. Appendix D contains all reference method calibration data. Refer to the Table of Contents and the List of Tables for a complete reference with appropriate page numbers.

2.2 Presentation of Results

Table 2-1 presents the results of the Relative Accuracy Test Audit (RATA) conducted on Units 1 and 2. Table 2-2 presents the results of the Relative Accuracy Test Audit (RATA) conducted on the Backup monitors on Units 1 and 2. A more detailed summary of the results is presented in Appendix A.

2.3 Backup Monitors

A RATA was conducted on the Backup monitors on Units 1 and 2. The RATA consisted of O_2, SO_2, NO_x, and CO on the Stacks.

Table 2-1
RATA Test Summary

Parameter	Serial Number	Location	Units	Result	Specification
Oxygen	N3P2187b	Unit 1 Inlet	Dry Volume %	0.0 %	≤ 1.0% Absolute Mean Difference [1]
Sulfur Dioxide	N3P2187a	Unit 1 Inlet	ppm @ 7% O_2	8.2 %	≤ 20% Relative Accuracy [2]
Oxygen	N3P2185b	Unit 1 Stack	Dry Volume %	0.2 %	≤ 1.0% Absolute Mean Difference [1]
Sulfur Dioxide	N3P2185a	Unit 1 Stack	ppm @ 7% O_2	6.3 %	≤ 20% of the applicable standard[2]
Nitrogen Oxides	A2P6980Tb	Unit 1 Stack	ppm @ 7% O_2	7.3 %	≤ 20% Relative Accuracy [2]
Carbon Monoxide	A2P6980Ta	Unit 1 Stack	ppm @ 7% O_2	3.6 ppm	≤ 5 ppm Absolute Mean Difference [3] (includes confidence coefficient)
Oxygen	N3P2188b	Unit 2 Inlet	Dry Volume %	0.1 %	≤ 1.0% Absolute Mean Difference [1]
Sulfur Dioxide	N3P2188a	Unit 2 Inlet	ppm @ 7% O_2	4.5 %	≤ 20% Relative Accuracy [2]
Oxygen	N3P2186b	Unit 2 Stack	Dry Volume %	0.1 %	≤ 1.0% Absolute Mean Difference [1]
Sulfur Dioxide	N3P2186a	Unit 2 Stack	ppm @ 7% O_2	1.1 %	≤ 20% of the applicable standard [2]
Nitrogen Oxides	A2P6981Tb	Unit 2 Stack	ppm @ 7% O_2	6.5 %	≤ 20% Relative Accuracy [2]
Carbon Monoxide	A2P6981Ta	Unit 2 Stack	ppm @ 7% O_2	3.4 ppm	≤ 5 ppm Absolute Mean Difference [3] (includes confidence coefficient)

1 40CFR60, Appendix B, Performance Specification 3 for O_2 and CO_2, Section 13.2.
2 40CFR60, Appendix B, Performance Specification 2 for NO_x and SO_2, Section 13.2.
3 40CFR60, Appendix B, Performance Specification 4A for CO, Section 13.2.

Table 2-2
Backup Monitors RATA Test Summary

Parameter	Serial Number	Location	Units	Result	Specification
Oxygen	4052-O2s	Unit 1 Stack	Dry Volume %	0.1 %	≤ 1.0% Absolute Mean Difference [1]
Sulfur Dioxide	4052-SO2s	Unit 1 Stack	ppm @ 7% O_2	4.5 %	≤ 20% of the applicable standard [2]
Nitrogen Oxides	4052-NOxs	Unit 1 Stack	ppm @ 7% O_2	2.8 %	≤ 20% Relative Accuracy [2]
Carbon Monoxide	4052-COs	Unit 1 Stack	ppm @ 7% O_2	1.3 %	≤ 5% of the applicable standard [3]
Oxygen	4051-O2s	Unit 2 Stack	Dry Volume %	0.0 %	≤ 1.0% Absolute Mean Difference [1]
Sulfur Dioxide	4051-SO2s	Unit 2 Stack	ppm @ 7% O_2	3.9 %	≤ 20% of the applicable standard [2]
Nitrogen Oxides	4051-NOxs	Unit 2 Stack	ppm @ 7% O_2	1.1 %	≤ 20% Relative Accuracy [2]
Carbon Monoxide	4051-COs	Unit 2 Stack	ppm @ 7% O_2	2.6 ppm	≤ 5 ppm Absolute Mean Difference [3] (includes confidence coefficient)

1 40CFR60, Appendix B, Performance Specification 3 for O_2 and CO_2, Section 13.2.
2 40CFR60, Appendix B, Performance Specification 2 for NO_x and SO_2, Section 13.2.
3 40CFR60, Appendix B, Performance Specification 4A for CO, Section 13.2.

3 PROCESS DESCRIPTION AND OPERATION

The Kent County Waste-to-Energy Facility processes up to 625 tons of solid waste each day, generating up to 18 megawatts of electricity or up to 116,000 lbs per hour exported steam. The facility is operated by Vicinity Energy. Each of the two (2) Martin GmbH waterwall furnaces processes up to 312.5 tons of waste per day. Waste is combusted at furnace temperatures exceeding 1,800 degrees Fahrenheit and reduced to an inert ash residue. Before leaving the facility, combustion air is directed through technologically advanced air pollution control equipment consisting of spray dryer absorbers (SDA) and fabric filter baghouses. During the relative accuracy testing the units were operating at greater than 50% of capacity.

The CEMS serving Units 1and 2 are dedicated dry extractive systems that consist of O_2, SO_2, NO_x, and CO analyzers, a dry extractive sampling system, and a microcomputer based DAHS. Descriptions of the analyzers are listed in Table 3-1 and Table 3-2.

Table 3-1
Source CEMS Analyzers

Pollutant Monitor	Unit	Location	Range	Analyzer	Serial Number
O_2	1	Inlet	0 - 25 %	CAI ZRE	N3P2187b
SO_2	1	Inlet	0 - 500 ppm	CAI ZRE	N3P2187a
O_2	1	Stack	0 - 25 %	CAI ZRE	N3P2185b
SO_2	1	Stack	0 - 200 ppm	CAI ZRE	N3P2185a
NO_x	1	Stack	0 - 500 ppm	CAI ZRE	A2P6980Tb
CO	1	Stack	0 - 5000 ppm	CAI ZRE	A2P6980Ta
O_2	2	Inlet	0 – 25 %	CAI ZRE	N3P2188b
SO_2	2	Inlet	0 - 500 ppm	CAI ZRE	N3P2188a
O_2	2	Stack	0 – 25 %	CAI ZRE	N3P2186b
SO_2	2	Stack	0 - 200 ppm	CAI ZRE	N3P2186a
NO_x	2	Stack	0 - 500 ppm	CAI ZRE	A2P6981Tb
CO	2	Stack	0 - 5000 ppm	CAI ZRE	A2P6981Ta

Table 3-2
Source Backup CEMS Analyzers

Pollutant Monitor	Unit	Location	Range	Analyzer	Serial Number
O_2	1	Stack	0 - 25 %	Altech MIR	4052-O2s
SO_2	1	Stack	0 - 200 ppm	Altech MIR	4052-SO2s
NO_x	1	Stack	0 - 500 ppm	Altech MIR	4052-NOxs
CO	1	Stack	0 - 5000 ppm	Altech MIR	4052-COs
O_2	2	Stack	0 – 25 %	Altech MIR	4051-O2s
SO_2	2	Stack	0 - 200 ppm	Altech MIR	4051-SO2s
NO_x	2	Stack	0 - 500 ppm	Altech MIR	4051-NOxs
CO	2	Stack	0 - 5000 ppm	Altech MIR	4051-COs

4 SAMPLING AND ANALYTICAL METHODS

An annual Relative Accuracy Test Audit (RATA) was conducted on the oxygen (O_2), sulfur dioxide (SO_2), nitrogen oxides (NOx), and carbon monoxide (CO) monitors on the inlet and stack of Units 1 and 2.

4.1 Relative Accuracy Test Equipment

The extractive measurement system and all sampling and data reduction procedures conformed with the requirements of Appendix B, Performance Specifications 2, 3, 4A, 6, and EPA Methods 3A, 6C, 7E, and 10 of 40 CFR 60, and the Quality Assurance Procedures of Appendix F.

The effluent gas sample was conditioned to eliminate interference from water vapor and particulate matter before being introduced into each analyzer. All components of the sampling system that contact the sample were either glass, stainless steel, or Teflon. A heated probe and particulate filter, heated sample lines, primary moisture removal trap, sample pump, secondary moisture removal system and distribution manifold board were used to deliver a sample of flue gas to the analyzers. The sampling probe and filter housing were constructed of Type 316 stainless steel and was heated to maintain the sample temperature above the dew point.

The condenser was an ice bath with a Teflon or glass coil condenser that provided excellent condensate separation and optimum drying of the sample gas. A peristaltic pump continuously removed condensate from a knockout at the base of the coil.

The dry sample exiting the condenser was then transported through unheated 3/8-inch O.D. Teflon tubing by way of a Teflon-lined sample pump to the flow distribution manifold board, where the flow to the analyzers was monitored and controlled.

A three-way valve located on the manifold board delivered calibration gas to two locations: (1) immediately upstream of the analyzers for calibration error checks, and (2) at the outlet of the probe for the sampling system bias and calibration drift checks.

Table 4-1 lists the gas analyzers that were used during the test program.

Table 4-1
Reference Method Analyzers

Parameter	Analyzer	Model	Serial #	Range	Operational Principle
O_2 Inlet	Servomex	1400	01420/B527	0 – 25 %	Paramagnetic
SO_2 Inlet	Ametek/Western Research	921	AC-921-SO11	0 – 500 ppm	Ultraviolet Differential Absorption
O_2 Outlet	M & C	PMA 22	0002082	0 – 25 %	Paramagnetic
SO_2 Outlet	Ametek/Western Research	921	AD-921-9396-4	0 – 100 ppm	Ultraviolet Differential Absorption
NO_x Outlet	TECO	42i-HL	0627118620	0 – 250 ppm	Chemiluminescence
CO Outlet	TECO	48i	1007841345	0 – 100 ppm	Gas Filter Correlation

4.2 Relative Accuracy Test Procedures

The reference test method procedures used for the RATA test program were instrumental test methods. They were conducted in accordance with 40 CFR 60, Appendix B, Performance Specifications 2, 3, and 4A. Relative accuracies were calculated according to the appropriate emission standards. To satisfy the RATA requirements of 40 CFR 60, Appendix B and F, the relative accuracy must not exceed 20 percent of the mean of the reference method or 10 percent of the applicable standard for NO_x, and must not exceed 10 percent of the mean of the reference method, 5% of the applicable standard, or a mean difference of $\pm$5ppm plus the confidence coefficient for CO. To satisfy the RATA requirements of 40 CFR 60, Appendix B, the relative accuracy must not exceed 20 percent of the mean of the reference method or 20 percent of the applicable standard for SO_2 since the source qualifies as a low emitter with an applicable emission standard of ~0.1 Lb/MMBtu. The relative accuracy for O_2 must not exceed an absolute mean difference of $\pm$1.0%.

The RATA was conducted while the units operated at greater than 50% of capacity. The traverse sampling points were located so as to establish a "measurement line" through the centroidal area of the duct. The test points for the RATAs were located at 16.7%, 50.0%, and 83.3% of the internal diameter of the duct. Figure 4-1 presents a schematic of the sampling point locations for the SDA Inlet. Figure 4-2 presents a schematic of the sampling point locations for the Stack.

EPA Test Methods 3A, 6C, 7E, and 10 were used as the reference method for measuring O_2, SO_2, NO_x, and CO. These methods are instrumental procedures. A sample was continuously extracted from the effluent stack gas stream. A portion of the sample stream was conveyed to each analyzer for the determination of O_2, SO_2, NO_x, and CO.

For each EPA Reference Method determination, the flue gas was sampled at three traverse points. The difference between the reference method sample and the monitor's reading was evaluated from a minimum of nine test runs.

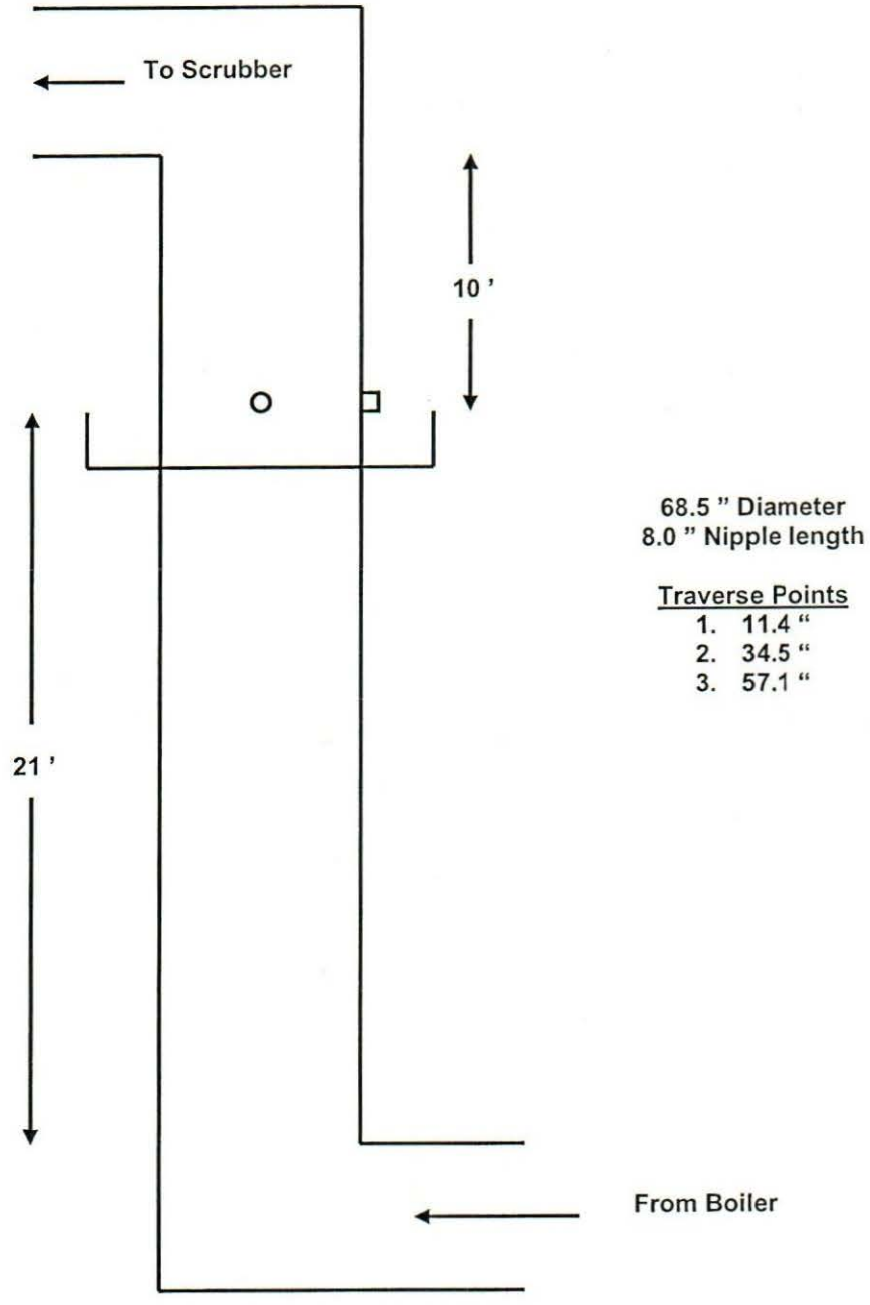

Figure 4-1. Units 1 and 2 SDA Inlet Sampling Location

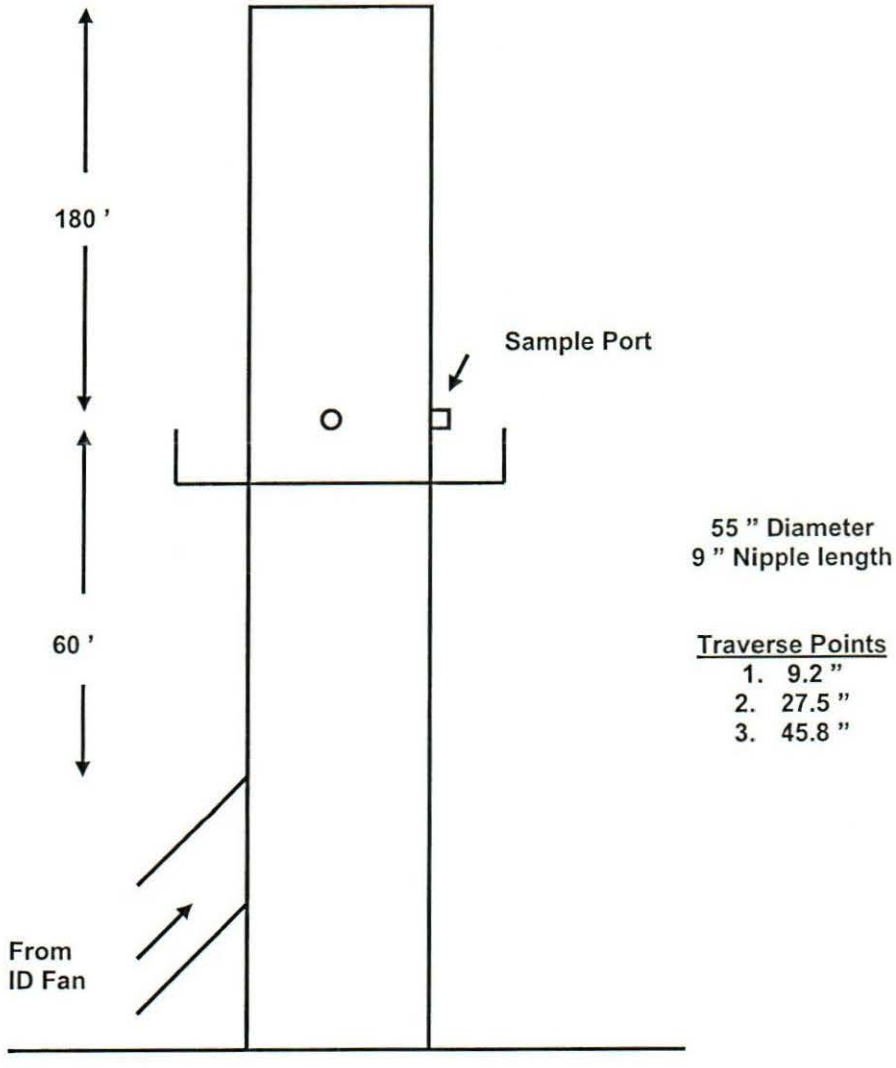

Figure 4-2. Units 1 and 2 Stack Sampling Location

5 QA/QC RESULTS

5.1 QA/QC Policy Procedures

The calibration and quality assurance procedures of EPA Methods 3A, 6C, 7E, and 10 were followed throughout the test program and are summarized in Table 5-1. The results of sampling system bias and calibration drift tests for each test run are calculated and presented in Appendix B. The cylinder gas manufacturer's analyses of the O_2, SO_2, NO_x, and CO calibration gases were conducted according to EPA Protocol 1 requirements. The certificates of analysis are included in the test report. A summary of the calibration gases used during the test program is presented in Table 5-2.

Table 5-1
Summary of QA/QC Procedures

Test Method	QA/QC Procedure	QA/QC Objective	QA/QC Results	Status of QA/QC
EPA M3A, 6C, 7E and 10	Initial Calibration Error Test	< ±2 %	< ±2 %	Acceptable
	System Bias Test	< ±5 %	< ±5 %	Acceptable
	Drift Test	< ±3 %	< ±3 %	Acceptable
Pre-test	NOx Converter Checks	> 90 % Conversion Efficiency	98.7 %	Acceptable
Post-test	NOx Converter Checks	> 90 % Conversion Efficiency	98.3 %	Acceptable

Table 5-2
Reference Method Calibration Gas Values

Parameter	Span Level	Calibration Gas Value	Expiration Date	Calibration Gas Serial Number
Oxygen	Mid	9.981 %	05/15/31	ALM-054754
	High	22.01 %	05/08/31	SG9142305BAL
Sulfur Dioxide Outlet	Mid	44.31 ppm	05/08/27	CC703777
	High	94.73 ppm	09/26/30	CC140917
Sulfur Dioxide Inlet	Mid	242.6 ppm	01/19/30	AAL069108
	High	475.7 ppm	04/29/30	CC51865
Nitrogen Dioxide	Converter Gas	50.39 ppm	05/16/25	CC511444
Nitrogen Oxides	Mid	122.4 ppm	05/08/27	CC703777
	High	242.3 ppm	09/26/30	CC140917
Carbon Monoxide	Mid	45.47 ppm	05/08/27	CC703777
	High	96.27 ppm	09/26/30	CC140917