

Prepared For:

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Kalamazoo, MI 49008

For Submittal To:

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EXECUTIVE SUMMARY

Montrose Air Quality Services, LLC (Montrose) was retained by NTH Consultants (NTH) to measure carbon monoxide (CO) and oxygen (O₂) concentrations from a single catalytic converter controlling emissions from Western Michigan University's (WMU's) (State Registration No.: K2131) peaking engine at the Robert M. Beam Power Plant located at the WMU campus at 1903 Western Michigan Avenue in Kalamazoo, Michigan. The facility operates under Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit No. MI-ROP-K2131-2021a.

The generator set is owned and operated by WMU and is included in Permit No. MI-ROP-K2131-2021a as EU-02-PEAKGEN. The emissions testing is required by the National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines codified at Title 40, Part 63, Subpart ZZZZ of the Code of Federal Regulations (40 CFR 63, Subpart ZZZZ). This standard requires either (1) a CO control efficiency across the catalyst bed of at least 93% or (2) a maximum CO emission rate of less than or equal to 47 ppmvd at 15% O₂.

The emission test program was conducted on February 17, 2023. The results of the emission test program are summarized in the following table.

SUMMARY OF AVERAGE COMPLIANCE RESULTS - EU-02-PEAKGEN FEBRUARY 17, 2023

Parameter/Units	Average Results	Emission Limits
Carbon Monoxide (CO) ppmvd @ 15% O ₂	9.5	47
Carbon Monoxide (CO) Reduction Efficiency (RE) %	94.2	93

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1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Montrose Air Quality Services, LLC (Montrose) was retained by NTH Consultants (NTH) to measure carbon monoxide (CO) and oxygen (O₂) concentrations from a single catalytic converter controlling emissions from Western Michigan University's (WMU's) (State Registration No.: K2131) peaking engine at the Robert M. Beam Power Plant located at the WMU campus at 1903 Western Michigan Avenue in Kalamazoo, Michigan. The tests were conducted to satisfy the annual testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit No. MI-ROP-K2131-2021a and 40 CFR §63.6640(c).

The emissions testing is required by the National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines codified at Title 40, Part 63, Subpart ZZZZ of the Code of Federal Regulations (40 CFR 63, Subpart ZZZZ). This standard requires either (1) a CO control efficiency across the catalyst bed of at least 93% or (2) a maximum CO emission rate of less than or equal to 47 ppmvd at 15% O₂.

The specific objectives were to:

- Verify the carbon monoxide (CO) concentrations corrected to 15% oxygen (O₂) from the oxidation catalyst (CAT-OX) serving EU-02-PEAKGEN
- Verify the CO reduction efficiency (RE) of the CAT-OX controlling emissions from EU-02-PEAKGEN
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

**TABLE 1-1
SUMMARY OF TEST PROGRAM**

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
2/17/2023	EU-02-PEAKGEN CAT-OX Inlet Duct	O ₂	EPA 3A	1	15
2/17/2023	EU-02-PEAKGEN CAT-OX Inlet Duct	CO	EPA 10	1	15
2/17/2023	EU-02-PEAKGEN CAT-OX Exhaust Stack	O ₂	EPA 3A	1	15
2/17/2023	EU-02-PEAKGEN CAT-OX Exhaust Stack	CO	EPA 10	1	15

To simplify this report, a list of Units and Abbreviations is included in Appendix C.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-3. The tests were conducted according to the Intent-to-Test notification.

**TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EU-02-PEAKGEN
FEBRUARY 17, 2023**

Parameter/Units	Average Results	Emission Limits
Carbon Monoxide (CO) ppmvd @ 15% O ₂	9.5	47
CO Reduction Efficiency (RE) %	94.2	93

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	Western Michigan University Robert M. Beam Power Plant (on Stadium Drive) 1903 West Michigan Avenue Kalamazoo, MI 49008	
Project Contact:	George Jarvis	Mark Weiss
Role:	Power Plant Director	Director of EHS
Company:	WMU	WMU
Telephone:	269-387-8548	269-387-5588
Email:	george.jarvis@wmich.edu	mark.weiss@wmich.edu

Agency Information

Regulatory Agency: EGLE
Agency Contact: Acting Technical Programs
Supervisor

Testing Company Information

Testing Firm: Montrose Air Quality Services, LLC
Contact: John Nestor
Title: Client Project Manager
Telephone: 248-765-5032
Email: jonestor@montrose-env.com

Subcontractor Information

Company: NTH Consultants, Ltd.
Contact: Chloe Palajac, P.E.
Telephone: 616-451-6243
Email: CPalajac@nthconsultants.com

Test personnel and observers are summarized in Table 1-3.

**TABLE 1-3
TEST PERSONNEL AND OBSERVERS**

Name	Affiliation	Role/Responsibility
John Nestor	Montrose	Client Project Manager, QI
Shane Rabideau	Montrose	Field Technician
George Jarvis	Western Michigan University	Observer/Client Liaison/Test Coordinator
Chloe Palajac	NTH Consultants, Ltd.	Observer

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATION, AND CONTROL EQUIPMENT

The Robert M. Beam Power Plant operates a natural gas-fired peaking and black start generator (EU-02-PEAKGEN). The emission unit is a Caterpillar Model 3516 four stroke lean-burn generator set rated for a maximum load of 771 kW. An oxidation catalyst was installed to control CO emissions. Generator set specifications are provided in Appendix B.

2.2 FLUE GAS SAMPLING LOCATIONS

O₂ (%) and CO (ppm) concentrations were measured at the inlet duct and exhaust duct of the CAT-OX associated with EU-02-PEAKGEN during the test event. See Appendix A for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while the generator was operating at the conditions required by the permit.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Engine Output, kW
- Catalyst Temperature, °F

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3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

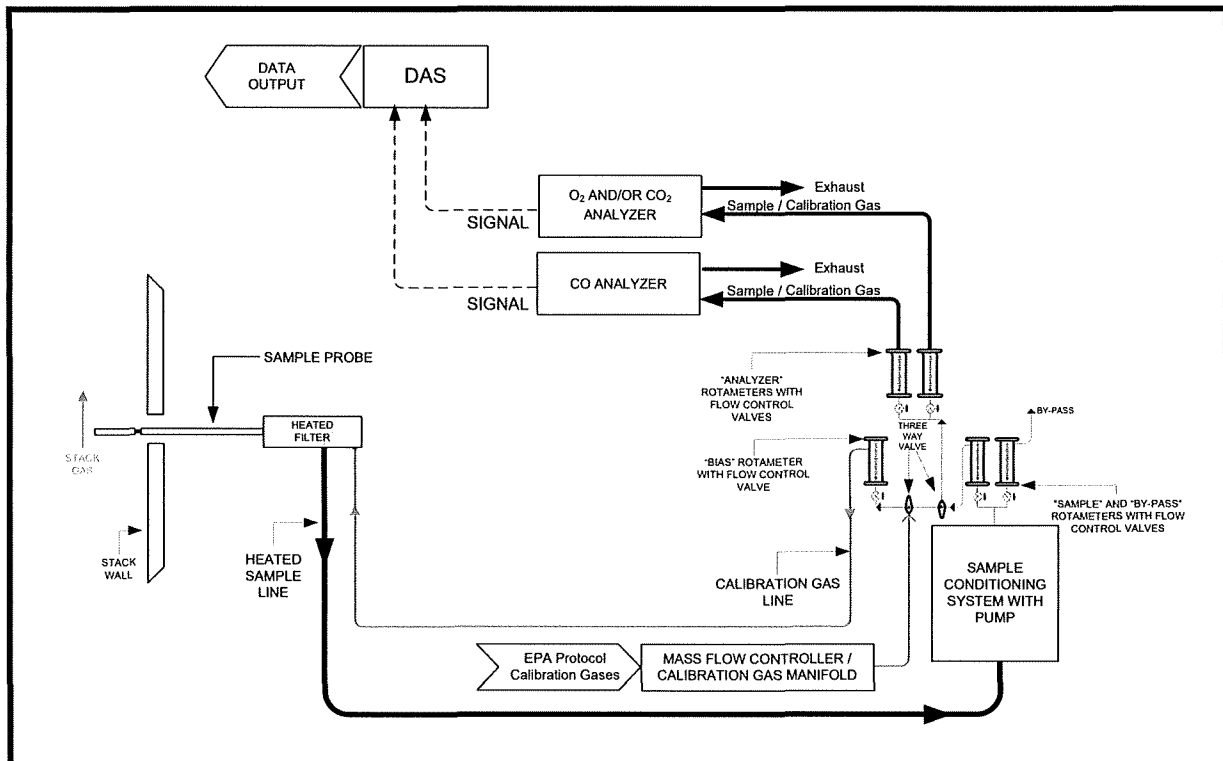
The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 3A, Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 3A is an instrumental test method used to measure the concentration of O₂ and CO₂ in stack gas. The effluent gas is continuously or intermittently sampled and conveyed to analyzers that measure the concentration of O₂ and CO₂. The performance requirements of the method must be met to validate data. Only O₂ was measured for this test event.

This method was paired with EPA Method 10. The typical sampling system is detailed in Figure 3-1.

**FIGURE 3-1
EPA METHODS 3A AND 10 SAMPLING TRAIN**



3.1.2 EPA Method 10, Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 10 is an instrumental test method used to continuously measure emissions of CO. Conditioned gas is sent to an analyzer to measure the concentration of CO. The performance requirements of the method must be met to validate the data.

This method was paired with EPA Method 3A. The typical sampling system is detailed in Figure 3-1.

3.2 PROCESS TEST METHODS

The test plan did not require that process samples be collected during this test program; therefore, no process sample data are presented in this test report.

4.0 TEST DISCUSSION AND RESULTS

4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

No field deviations or exceptions from the test plan or test methods occurred during this test program.

4.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Table 1-2. The results of individual compliance test runs performed are presented in Table 4-1. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

**TABLE 4-1
 CO AND CO RE EMISSIONS RESULTS -
 EU-02-PEAKGEN**

Run Number	CAT-OX INLET DUCT	CAT-OX EXHAUST STACK
Date	2/17/2023	2/17/2023
Time	10:05-10:19	10:05-10:19
Process Data		
Engine Output, kW	--	748
Flue Gas Parameters		
O ₂ , % volume dry	5.10	5.99
Carbon Monoxide (CO)		
ppmvd	444.6	24.1
ppmvd @ 15% O ₂	166.0	9.5
CO Reduction Efficiency (RE)		
%	--	94.2

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

EPA Method 3A and 10 calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks.

5.2 QA/QC DISCUSSION

All QA/QC criteria were met during this test program.

5.3 QUALITY STATEMENT

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

APPENDIX A FIELD DATA AND CALCULATIONS

Appendix A.1 Sampling Locations

EU-02-PEAKGEN SAMPLING LOCATION SCHEMATIC

