SOURCE TEST REPORT
2019 RAA TESTING
MARYSVILLE ETHANOL
EU-RTO&HSRG
MARYSVILLE, MICHIGAN

Prepared For:

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For Submittal To:

Michigan Department of Environment, Great Lakes, and Energy

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ACCREDITED
TO ASTM D7036 ONLY
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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

Executive Summary

Montrose Air Quality Services, LLC (MAQS) was retained by Marysville Ethanol to conduct a Relative Accuracy Audit (RAA) of the nitrogen oxides (NOx) Predictive Emissions Monitoring Systems (PEMS) serving the boiler \ regenerative thermal oxidizer \ heat steam recovery generator (Main Stack). The Main Stack fires natural gas (NG) and is designated as (EU-RTO&HSRG, Stack No. S-10). The RAA testing was conducted on August 13, 2019.

The RAA testing was conducted to satisfy the requirements of Performance Specification 16 (PS-16, *"Specifications and Test Procedures for Predictive Emission Monitoring Systems in Stationary Sources"*) codified at Title 40, Part 60, Appendix B of the Code of Federal Regulations. Testing of the main stack consisted of three, 30-minute test runs at normal load conditions.

The results of the RAA test program are summarized in the following Executive Summary Table E-1.

Table E-1
Summary of Marysville Ethanol Main Stack
NOx Lb/MMBtu PEMS RAA Results
Test Date: August 13, 2019

Source Name	RM NOx Lb/MMBtu	PEMS NOx Lb/MMBtu	% Relative Accuracy Audit	40 CFR Part 60 % Relative Accuracy Limit
Main Stack	0.044	0.044	1.0%	20

1.0 Introduction

Montrose Air Quality Services, LLC (MAQS) was retained by Marysville Ethanol to conduct a Relative Accuracy Audit (RAA) at the Marysville Ethanol facility located in Marysville, Michigan. The RAA was performed on an individual Predictive Emission Monitoring Systems (PEMS) serving the boiler \ regenerative thermal oxidizer \ heat steam recovery generator (Main Stack). The process fires natural gas (NG) and is designated as EU-RTO&HSRG, (Stack No. S-10).

The testing was performed to demonstrate compliance with Michigan Department of Environment, Great Lakes, and Energy Air Quality Division. (EGLE AQD) Permit to Install No. 175-05D and in accordance with Appendix A, 40 CFR, Part 60, subpart Db, U.S. EPA Reference Methods 3A and 7E found in 40 CFR, Part 60, Appendix A and Performance Specifications (PS) 2, 3 and 16 stipulated in 40 CFR, Part 60, Appendix B. The testing on the main stack consisted of three, 30-minute test runs while combusting pipeline NG. The test runs were performed to also be in accordance with Performance Specification 16 "Specifications and Test Procedures for Predictive Emission Monitoring Systems in Stationary Sources".

The RAA testing was conducted on August 13, 2019. Mr. Matthew Young and Mr. Michael Nummer with MAQS performed the testing.

2.0 Process Description

The Marysville Ethanol facility located in Marysville, Michigan operates two NG fired 45 MMBtu/hr dryers and a 125 MMBtu/hr natural gas fired recuperative thermal oxidizer (RTO) with a heat recovery steam generator (HRSG). The RTO controls emissions from several emission units. Low-NOx combustors minimize the emissions of nitrogen oxides from the process.

2.1 Predictive Emissions Monitoring System (PEMS) Description

The objective of the SmartCEMS predictive emissions monitoring system and Data eLements reporting Data Acquisition System (DAS) is to continuously document compliance with the regulations pertaining to the primary pollutants. The PEMS accomplishes this by continuously monitoring operating parameters and utilizing a statistical hybrid data model to estimate NOx ppm concentrations and emission rates data in real-time during unit operations.

The PEMS at Marysville, consists of three major subsystems: the interface to the plant control system with its sensors that provide input parameters for the model, the statistical hybrid PEMS model, and the PEMS server with its associated operating system software and applications (namely the Data eLements reporting application and operator interface). A description of these components and their location is as follows:

Interface to the Unit Controls and Unit Analytical Components (Field Devices)

Consisting of transmitters and transducers located on the boiler or unit ancillary equipment. There are 12 input parameters, per unit, that are monitored, of these, the

only critical input is the natural gas flow rate. There are additional unit parameters that are used by the model if available, but are not critical to the model's performance under the standard.

2.2 Statistical Hybrid PEMS Model (SmartCEM™)

This consists of a software module that runs for each unit. SmartCEM™ acquires the process data in real-time and generates NOx predictions based on the data that has been stored in the historical training dataset. There is a unique SmartCEM™ for each boiler unit that contains unit specific data for modeling purposes.

2.3 PEMS Hardware and Software

Consists of a Server such that any single hard drive failure does not bring the server down. The server is equipped with modem, mouse, keyboard, and network interface. The operating system software is a standard Windows 2012 Server R2 installation with associated components to support the applications including a SQL 2014 full license for the reporting package.

The following Serial Numbers apply to the SmartCEMS™-60 Analyzers at Marysville Ethanol:

Unit	Model	Serial Number
EU-RTO&HSRG	SmartCEM-60™ Analyzer	1.63870

Process data includes NOx ppm, O_2%, fuel flow rate, and steam load. The process data can be found in Appendix B. It should be noted that the PEMS run times are an hour behind Montrose's times due to daylight savings time.

3.0 Sampling and Analytical Methodologies

Sampling and analytical methodologies are summarized in Sections 3.1 through 3.3. A Schematic drawing of MAQS's continuous emissions monitoring system is presented as Figure 1. Traverse point locations for the Main Stack are illustrated in Figure 2.

3.1 Continuous Emissions Monitoring

Measurement of exhaust gas concentrations was conducted utilizing the following reference test methods codified at 40 CFR 60, Appendix A:

- Method 3A- Determinations of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources;
- Method 7E - Determination of Nitrogen Oxides Emissions From Stationary Sources;

- Performance Specification 2 – Specifications and Test Procedures for SO_2 and NO_x Continuous Emission Monitoring Systems in Stationary Sources;
- Performance Specification 3 – Specifications and Test Procedures for O_2 and CO_2 Continuous Emission Monitoring Systems in Stationary Sources; and,
- Performance Specification 16 – Specifications and Test Procedures for Predictive Emission Monitoring Systems in Stationary Sources.

MAQS's extractive monitors require that the effluent gas sample be conditioned to eliminate any possible interference (i.e., water vapor and/or particulate matter) before being transported and injected into each analyzer. All components of the sampling system that contact the sample were constructed of Type 316 stainless steel, Pyrex glass or Teflon®. The output signal from each monitor was recorded at 10-second intervals on a PC equipped with Labview® II data acquisition software (DAS). The samples were extracted from the stack using a heated sample probe/filter assembly, heated sample line, stack gas conditioner with a Teflon diaphragm pump and routed through a distribution manifold for delivery to the analyzers. The configuration of the sampling system allowed for the injection of calibration gases directly to the analyzers or through the sampling system. All monitors in use were calibrated with U.S. EPA Protocol No. 1 calibration gases and operated to insure that zero drift, calibration gas drift, and calibration error met the specified method requirements. Copies of the Protocol gas certificates can be found in Appendix C.

The sample gas was extracted at three points through a heated stainless steel probe positioned at approximately 16.7%, 50% and 83.3% of the sample stream diameter as described by 40 CFR Part 60, Appendix B Performance Specification 2 Section 8.1.3.2 and illustrated in Figure 2. Three 30-minute test runs were conducted on the PEM system. A diagram of the reference monitoring system is illustrated in Figure 1.

The boiler NO_X concentrations were measured in parts per million (ppm), converted to an emission rate and reported as Lb/MMBtu, using equation 19-1 of U.S. EPA Method 19 of Appendix A, 40 CFR 60. Oxygen concentrations are reported in percent (%).

3.2 Oxygen (USEPA Method 3A)

An M&C gas analyzer was used to measure O_2 concentrations following the guidelines of U.S. EPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from a Stationary Source (Instrumental Analyzer Procedure)", in conjunction with Performance Specification No. 3 of Appendix B, 40 CFR 60. The analyzers were set at 25% instrument span and calibrated before the RAA with zero nitrogen and high range USEPA Protocol 1 span gas (80 to 100% of span). Following calibration, a mid range USEPA Protocol 1 gas (40 to 60% of span) was introduced. The response error did not exceed 2% of the instrument span, as required by the method. Calibration error results are presented in Appendix A. Calibration drift checks were performed at the completion of each test run.

3.3 Nitrogen Oxides (USEPA Method 7E)

A Thermo Environmental Model 42c Chemiluminescence analyzer was used to measure parts per million of nitrogen oxides in the dry sample gas following the guidelines of U.S. EPA Method 7E, "Determination of Nitrogen Oxides from Stationary Sources (Instrumental Analyzer Procedure)", in conjunction with Performance Specification No. 2 of Appendix B, 40 CFR 60. The analyzer measures the concentration of NO_x by converting NO_x to NO and then measuring the light emitted by the reaction of NO with ozone. The NO_x analyzer was set at 0-100 ppm instrument span during the RAA. The NO_x sampling system was calibrated at three points: zero, mid range (40-60% of span), and high range (80-100% of span) with USEPA Protocol 1 calibration gases. MAQS conducted a NO_2 to NO conversion efficiency tests, as specified in U.S. EPA Method 7E on the analyzer. The results of the NO_2 to NO conversion efficiency test can be found on the enclosed compact disk.

4.0 Test Results

All PEMS associated with the Main Stack tested at Marysville Ethanol passed the Relative Accuracy Audit.

The Main Stack PEMS results are expressed in Lb/MMBtu. The 40 CFR Part 60 requires that relative accuracy for the NO_x system be less than or equal to 20% when expressed as a percentage of the average reference method result in Lb/MMBtu. The percent relative accuracy for the Main Stack PEMS NOx Lb/MMBtu was 1.0. Relative Accuracy was calculated utilizing equation 16-9 contained in PS-16.

The results of all testing are presented in Table 1. The following information is appended:

A MAQS Calibration Error and Drift Correction Data
B Marysville Ethanol PEMS RAA Data
C MAQS Field Data and Span Gas Certification Documentation
D Compact Disc with all MAQS's CEMS Data Files

Limitations

The information and opinions rendered in this report are exclusively for use by Marysville Ethanol. MAQS will not distribute or publish this report without Marysville Ethanol's consent except as required by law or court order. MAQS accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:_____
Jacob Young
Staff Engineer

This report was reviewed by:_____
Matthew Young
Client Project Manager

Tables

Table 1
Main Stack PEMS RAA Results Summary
Marysville Ethanol, LLC
Marysville, Michigan
Test Date: August 13, 2019

Test Run	RM NOx Concentration (ppmv)	PEMS NOx Concentration (ppmv)	RM O_2 Concentration (%)	PEMS O_2 Concentration (%)	RM NOx Emission Rate (lbs/MMBtu)	PEMS NOx Emission Rate (lbs/MMBtu)	Run Differences NOx Emission Rate (lbs/MMBtu)
1	34.90	31.18	4.02	4.630	0.045	0.042	0.003
2	34.10	36.07	4.00	4.738	0.044	0.049	-0.005
3	33.60	30.86	4.08	4.448	0.043	0.041	0.003
Averages:	34.20	32.70	4.03	4.61	0.044	0.044	0.000

Parameter	Relative Accuracy (RA)
NOx Emission Rate	1.0

F-Factor = 8710

40 CFR 60, Appendix B, Performance Specification 16, Equation 16-9:

$$RAA = \frac{(PEMS\ Avg. - RM\ Avg.)}{(RM\ Avg.)} \times 100$$

Figures

MONTROSE
AIR QUALITY SERVICES

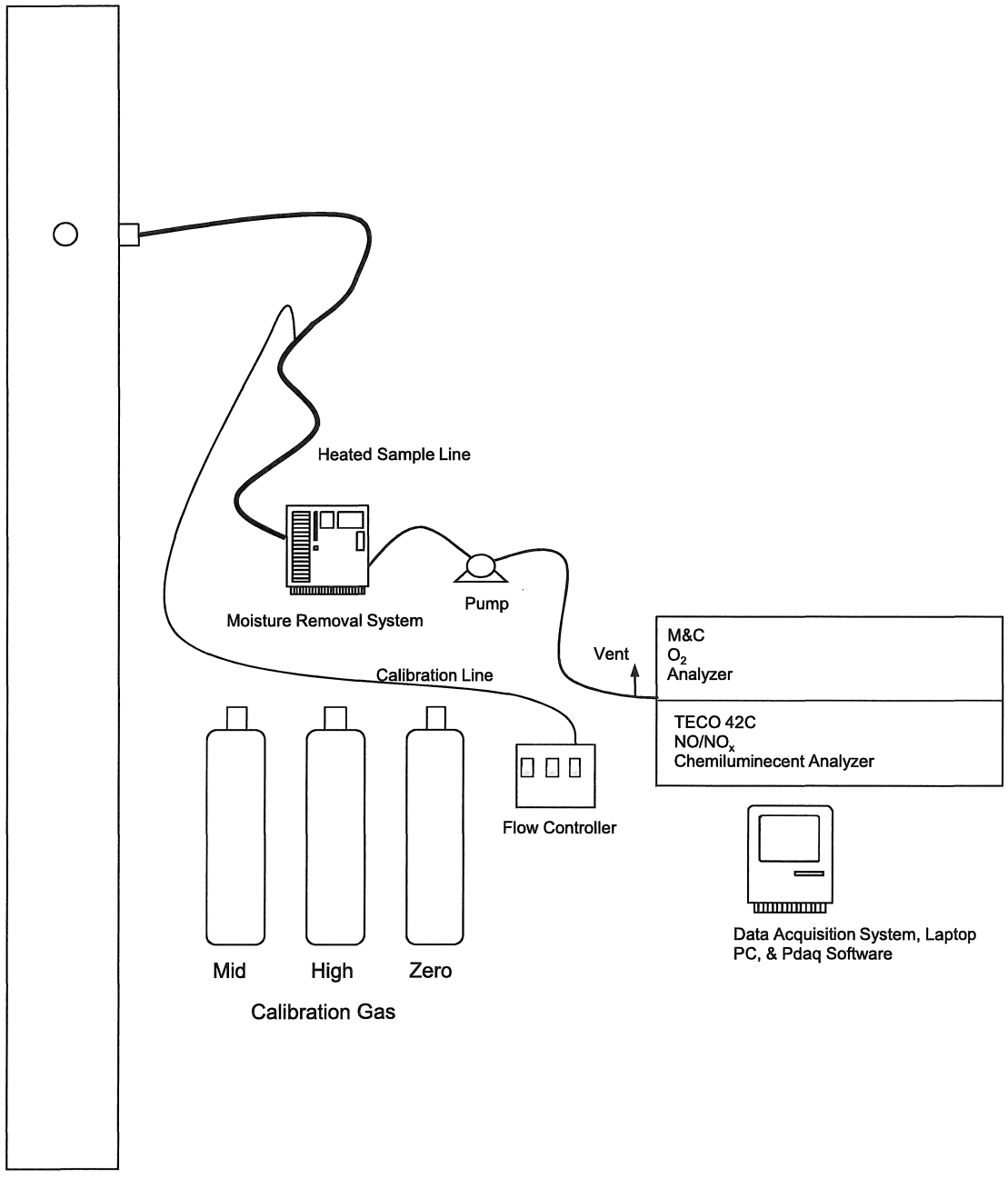

Figure No. 1

Site: **USEPA Method 3A and 7E** **Marysville Ethanol, LLC** **Marysville, Michigan**	**Sampling Date:** **August 13, 2019**	**Montrose Air Quality Services, LLC** **4949 Fernlee Ave** **Royal Oak, MI 48073**

MONTROSE
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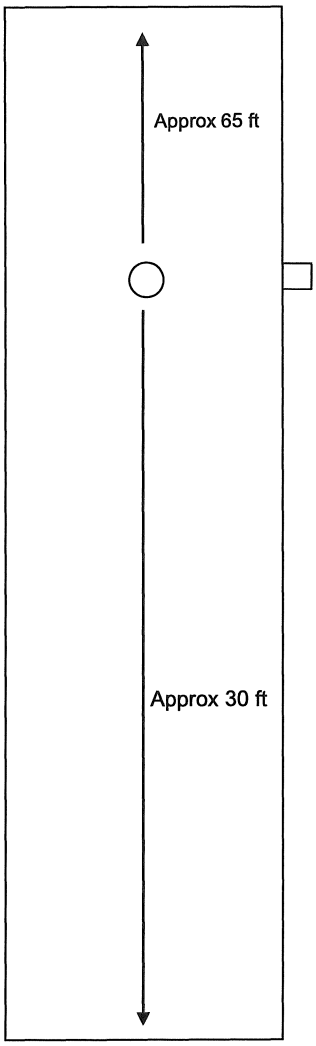
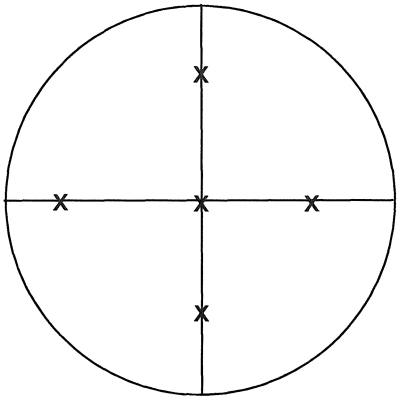
diameter = 83 inches





Not to Scale

Points	Distance "
1	13.9
2	41.5
3	69.1

Figure No. 2

Site:	Sampling Date:	
Main Stack **Marysville Ethanol, LLC** **Marysville, Michigan**	**August 13, 2019**	**Montrose Air Quality Services, LLC** **4949 Fernlee Avenue** **Royal Oak, MI 48073**