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Appendices

I. INTRODUCTION

Network Environmental, Inc. was retained by the Michigan Sugar Company to perform a Relative Accuracy Test Audit (RATA) on the Continuous Emissions Monitoring Systems (CEMS) that service Boilers #6, #7 & #8 at their Bay City, Michigan facility. The CEMS on the boilers are for oxides of nitrogen (NO_x) and oxygen (O_2).

The RATA was performed over the period of December 4-5, 2023. Stephan K. Byrd and Richard D. Eerdmans of Network Environmental, Inc. conducted the RATA in accordance with 40 CFR Part 60 Appendix B Performance Specifications 2 for NO_x and 3 for O_2. Assisting with the RATA was Ms. Meaghan Martuch of Michigan Sugar.

II. PRESENTATION OF RESULTS

<table>
<tr><td colspan="8" align="center">

II.1 TABLE 1
NOx RELATIVE ACCURACY TEST AUDIT RESULTS
BOILER #6
MICHIGAN SUGAR COMPANY
BAY CITY, MICHIGAN
DECEMBER 4, 2023

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</table>

Run #	Time	REFERENCE METHOD			CEM	DIFF
		NOx(1)	O2(2)	#/MMBtu	#/MMBtu	
1	09:41-10:06	74.8	4.0	0.096	0.087	0.009
2	10:15-10:40	73.7	4.1	0.095	0.087	0.008
3	10:49-11:14	74.1	4.1	0.096	0.088	0.008
4	11:23-11:48	73.3	4.0	0.094	0.088	0.006
5	11:57-12:22	74.2	4.0	0.095	0.09	0.005
6	12:30-12:55	74.9	4.0	0.096	0.091	0.005
7	13:03-13:28	74.3	4.0	0.096	0.09	0.006
8	13:36-14:01	75.7	4.0	0.097	0.09	0.007
9	14:10-14:35	75.6	4.0	0.097	0.09	0.007

Mean Reference Value   0.95778

Absolute Value of the Mean of the Difference   0.00678

Standard Deviation   0.00139

Confidence Co-efficient   0.00107

Relative Accuracy = **8.20%** of mean of reference method

(1) = Concentration in term of PPM by volume on a dry basis
(2) = Concentration in terms of %

II.2 TABLE 2
NOₓ RELATIVE ACCURACY TEST AUDIT RESULTS
BOILER #7
MICHIGAN SUGAR COMPANY
BAY CITY, MICHIGAN
DECEMBER 4, 2023

| Run # | Time | REFERENCE METHOD | | | CEM | DIFF |
		$NOx^{(1)}$	$O_2^{(2)}$	#/MMBtu	#/MMBtu	
1	15:02-15:27	98.9	3.5	0.123	0.116	0.007
2	15:35-16:00	98.6	3.5	0.123	0.116	0.007
3	16:10-16:35	97.3	3.5	0.121	0.115	0.006
4	16:44-17:09	96.1	3.5	0.120	0.115	0.005
5	17:17-17:42	98.5	3.5	0.123	0.115	0.008
6	17:52-18:17	99.4	3.5	0.124	0.116	0.008
7	18:25-18:50	99.4	3.4	0.123	0.115	0.008
8	18:59-19:24	99.3	3.4	0.123	0.115	0.008
9	19:32-19:57	96.9	3.4	0.120	0.114	0.006

Mean Reference Value 0.12222

Absolute Value of the Mean of the Difference 0.00700

Standard Deviation 0.00112

Confidence Co-efficient 0.00086

Relative Accuracy = **6.43%** of mean of reference method

(1) = Concentration in term of PPM by volume on a dry basis
(2) = Concentration in terms of %

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II.3 TABLE 3
NO$_x$ RELATIVE ACCURACY TEST AUDIT RESULTS
BOILER #8
MICHIGAN SUGAR COMPANY
BAY CITY, MICHIGAN
DECEMBER 5, 2023

| Run # | Time | REFERENCE METHOD | | | CEM | DIFF |
		NO$_x$[1]	O$_2$[2]	#/MMBtu	#/MMBtu	
1	09:01-09:26	36.5	3.7	0.046	0.042	0.004
2	09:41-10:06	37.9	3.7	0.048	0.045	0.003
3	10:16-10:41	36.4	3.7	0.046	0.042	0.004
4	10:50-11:15	36.9	3.7	0.047	0.044	0.003
5	11:23-11:48	36.8	3.7	0.046	0.043	0.003
6	11:57-12:22	34.2	3.8	0.044	0.041	0.003
7	12:30-12:55	34.9	3.8	0.044	0.041	0.003
8	13:04-13:29	34.7	3.8	0.044	0.041	0.003
9	13:38-14:03	34.7	3.8	0.044	0.041	0.003

Mean Reference Value   0.04544

Absolute Value of the Mean of the Difference   0.00322

Standard Deviation   0.00044

Confidence Co-efficient   0.00034

Relative Accuracy = **7.84%** of mean of reference method

(1) = Concentration in term of PPM by volume on a dry basis
(2) = Concentration in terms of %

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III. DISCUSSION OF RESULTS

III.1 Boiler #6 NO$_x$ RATA – The results of the NO$_x$ RATA for Boiler #6 can be found in Table 1 (Section II.1). The relative accuracy calculations were performed in terms of #/MMBtu in accordance with U.S. EPA Reference Method 19. The #/MMBtu results were calculated using the formula found in Section 2.1 of Method 19 for O$_2$ on a dry basis. The F factor used was 8,710. Nine (9) twenty-five (25) minute samples were collected from the boiler exhaust. Raw DAS output results were corrected per Equation 7E-5.

The relative accuracy for the NO$_x$ CEMS was 8.20% of the mean of the reference method samples.

According to Performance Specification 2 in 40 CFR Part 60 Appendix B, "The relative accuracy (RA) of the CEMS shall be no greater than 20 percent of the mean value of the reference method test data in terms of the units of the emission standard or 10 percent of the applicable standard, whichever is greater."

III.2 Boiler #7 NO$_x$ RATA – The results of the NO$_x$ RATA for Boiler #7 can be found in Table 2 (Section II.2). The relative accuracy calculations were performed in terms of #/MMBtu in accordance with U.S. EPA Reference Method 19. The #/MMBtu results were calculated using the formula found in Section 2.1 of Method 19 for O$_2$ on a dry basis. The F factor used was 8,710. Nine (9) twenty-five (25) minute samples were collected from the boiler exhaust. Raw DAS output results were corrected per Equation 7E-5.

The relative accuracy for the NO$_x$ CEMS was 6.43% of the mean of the reference method samples.

According to Performance Specification 2 in 40 CFR Part 60 Appendix B, "The relative accuracy (RA) of the CEMS shall be no greater than 20 percent of the mean value of the reference method test data in terms of the units of the emission standard or 10 percent of the applicable standard, whichever is greater."

III.3 Boiler #8 NO$_x$ RATA – The results of the NO$_x$ RATA for Boiler #8 can be found in Table 3 (Section II.3). The relative accuracy calculations were performed in terms of #/MMBtu in accordance with U.S. EPA Reference Method 19. The #/MMBtu results were calculated using the formula found in Section 2.1 of Method 19 for O$_2$ on a dry basis. The F factor used was 8,710. Nine (9) twenty-five (25) minute samples were collected from the boiler exhaust. Raw DAS output results were corrected per Equation 7E-5.

The relative accuracy for the NO$_x$ CEMS was 7.84% of the mean of the reference method samples.

According to Performance Specification 2 in 40 CFR Part 60 Appendix B, "The relative accuracy (RA) of the CEMS shall be no greater than 20 percent of the mean value of the reference method test data in terms of the units of the emission standard or 10 percent of the applicable standard, whichever is greater."

IV. SOURCE DESCRIPTION

CEMS service gas-fired boilers with rated capacities of 120,000 pounds per hour of steam. The boilers were manufactured by Nebraska Boiler and are equipped with economizers. The boilers were operated above 50% of rated capacity during the testing.

V. CONTINUOUS MONITORING SYSTEM DESCRIPTION

The continuous emission monitoring systems (CEMS) servicing the boilers are comprised of NO_x and O_2 monitors as follows:

Boiler #6 – The NO_x monitor is a Thermo Fisher, Model 42iLS, Serial No. 1153270045, with a span of 0-250 PPM full scale. The O_2 monitor is a Brand Gaus, Model 4710, Serial No. 11429 with a span of 0-25% full scale. All analyzers measure concentrations on a dry basis.

Boiler #7 – The NO_x monitor is Thermo Fisher, Model 42iLS, Serial No. 1153210073, with a span of 0-80 PPM full scale. The O_2 monitor is a Brand Gaus, Model 4710, Serial No. 11370 with a span of 0-25% full scale. All analyzers measure concentrations on a dry basis.

Boiler #8 – The NO_x monitor is a Thermo Fisher, Model 42iHL, Serial No. 609716090, with a span of 0-250 PPM full scale. The O_2 monitor is a Brand Gaus, Model 4710, Serial No. 11673 with a span of 0-25% full scale. All analyzers measure concentrations on a dry basis.

The data produced by the CEMS is collected on a computer system that converts one minute analog averages to the appropriate hourly average in terms of the emission limits for the boiler (#/MMBtu). The system also produces a thirty-day average for daily NO_x emissions.

VI. SAMPLING AND ANALYTICAL PROTOCOL

The RATA's were performed in accordance with 40 CFR Part 60 Appendix B Performance Specifications 2 for NO_x and 3 for O_2. The sampling methods used for the reference method determinations were as follows:

VI.1 Oxides of Nitrogen – The NO_x sampling was conducted in accordance with U.S. EPA Reference Method 7E. A Thermo Environmental Model 42H gas analyzer was used to monitor the boiler exhausts. A heated probe was used to extract the sample gases from the exhaust stacks. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the NO_x concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 191 or 55.6 PPM was used to establish the initial instrument calibration. Calibration gases of 25.1 PPM, 55.6 PPM and 101 PPM were used to determine the calibration error of the analyzer. A direct injection of 50.9 PPM nitrogen dioxide (NO_2) was performed to show the conversion efficiency of the monitor. The conversion efficiency data can be found in Appendix E. The sampling system (from the back of the stack probe to the analyzer) was injected using the 25.1 or 101 PPM gas to determine the system bias. After each sample, a system zero and system injection of 25.1 or 101 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boilers.

VI.2 Oxygen – The O_2 sampling was conducted in accordance with U.S. EPA Reference Method 3A. A Servomex Model 1400M portable stack gas analyzer was used to monitor the boiler exhausts. A heated probe was used to extract the sample gases from the stacks. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the O_2 concentrations (%).
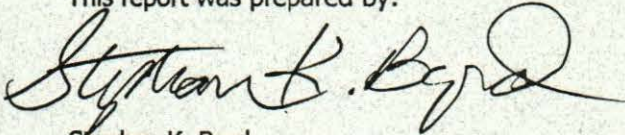
The analyzer was calibrated by direct injection prior to the testing. A span gas of 21.0% was used to establish the initial instrument calibration. Calibration gases of 11.8% and 6.05% were used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the

analyzer) was injected using the 6.05% gas to determine the system bias. After each sample, a system zero and system injection of 6.05% were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boilers.
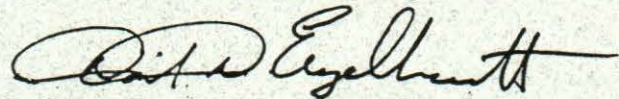
VI.3 Sampling Locations – The sampling locations met the minimum requirement of Performance Specification 2 (2 duct diameters downstream and 0.5 duct diameters upstream from the nearest disturbances).
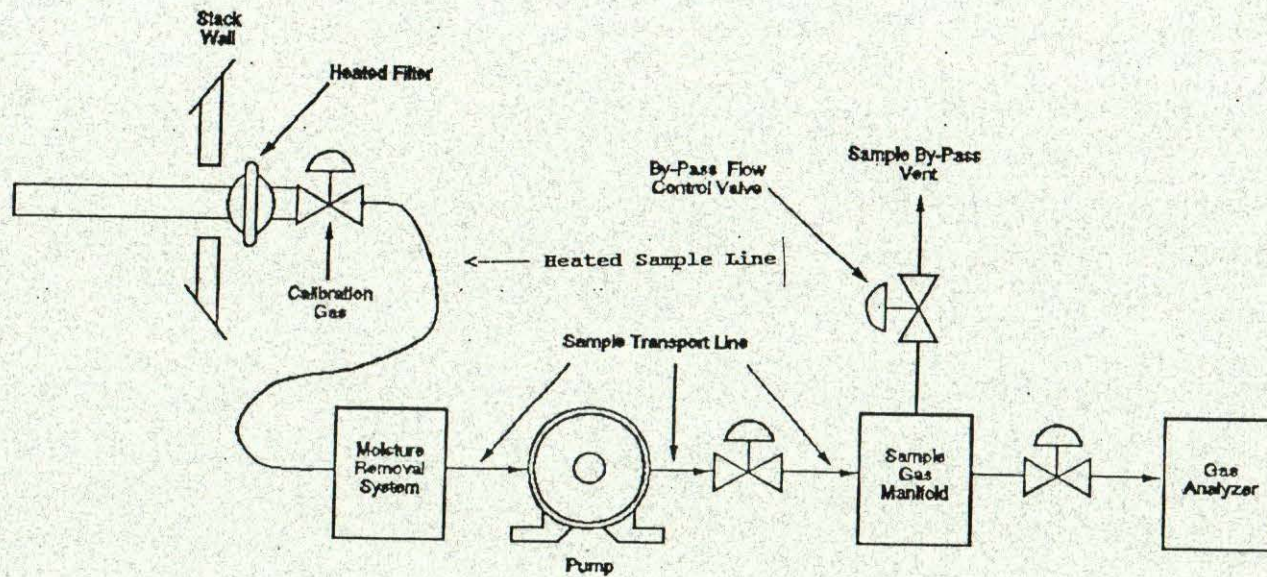
This report was prepared by:

Stephan K. Byrd
President

This report was reviewed by:

David D. Engelhardt
Vice President

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Stack Wall

Heated Filter

Calibration Gas

Heated Sample Line

By-Pass Flow Control Valve

Sample By-Pass Vent

Sample Transport Line

Moisture Removal System

Pump

Sample Gas Manifold

Gas Analyzer

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Figure 1

NOx & O2 Sampling Train