mostardi platt

Relative Accuracy Test Audit
Test Report

Lansing Board of Water and Light
REO Town Facility
HRSG #2 Stack
Lansing, Michigan 48901
October 25, 2017

Report Submittal Date
November 21, 2017

Project No. M174302B

888 Industrial Drive
Elmhurst, Illinois 60126
630-993-2100

1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a Continuous Emissions Monitoring System (CEMS) Relative Accuracy Test Audit (RATA) test program for Lansing Board of Water and Light at the REO Town Facility in Lansing, Michigan, on the HRSG #2 Stack on October 25, 2017. This report summarizes the results of the test program and test methods used in accordance with the Mostardi Platt test protocol dated September 6, 2017. Mostardi Platt is a self-certified air emissions testing body (AETB). A copy of Mostardi Platt's self-certification can be found in Appendix A.

The test location, test date, and test parameters are summarized below.

TEST INFORMATION		
Test Location	**Test Date**	**Test Parameters**
HRSG #2 Stack	October 25, 2017	Oxygen (O_2) and Nitrogen Oxides (NO_x)

The purpose of the test program was to demonstrate the relative accuracies of the HRSG #2 Stack O_2 and NO_x analyzers during the specified operating conditions. The test results from this test program indicate that each CEMS component meets the United States Environmental Protection Agency (USEPA) annual performance specification for relative accuracy as published in 40 Code of Federal Regulations Part 75 (40CFR75) and 40 Code of Federal Regulations (40CFR60).

RATA RESULTS						
Test Location	**Date**	**Parameter**	**Units**	**Relative Accuracy Acceptance Criteria**	**Relative Accuracy (RA)**	**Bias Adjustment Factor (BAF)**
HRSG #2 Stack	10/25/17	NO_x	lb/mmBtu	≤ 7.5% of the mean reference value	1.76%	1.000
		NO_x	ppm @ 15% O_2	≤ 20.0% of the mean reference value	1.79%	N/A
		O_2	% dry	≤ 7.5% of the mean reference value	0.62%	N/A

The gas cylinders used to perform the RATA are summarized below.

GAS CYLINDER INFORMATION				
Parameter	**Gas Vendor**	**Cylinder Serial Number**	**Cylinder Value**	**Expiration Date**
NO_x	Airgas	CC401436	0.0 ppm	5/25/2025
NO_x	Airgas	XC031629B	18.95 ppm	7/19/2020
NO_x	Airgas	CC325403	35.85 ppm	9/06/2019
O_2	Airgas	XC031629B	0.0%	7/19/2020
O_2	Airgas	CC401436	12.39%	5/25/2025
O_2	Airgas	CC283878	21.04%	1/26/2023

No deviations, additions, or exclusions from the test protocol, test methods, the Mostardi Platt Quality Manual, or the ASTM D7036-12 occurred. The specific test conditions encountered did not interfere with the collection of the data.

The identifications of the individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	**Address**	**Contact**
Test Coordinator	Lansing Board of Water and Light 1232 Haco Drive P.O. Box 13007 Lansing, Michigan 48912	Ms. Trista Gregorski Engineer, Environmental Services (517) 702-6865 (phone) trista.gregorski@lbwl.com
Test Facility	Lansing Board of Water and Light REO Town Facility 1201 S. Washington Avenue Lansing, Michigan 48917	
Testing Company Supervisor	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. Chris Eldridge Project Supervisor 630-993-2100 (phone) celdridge@mp-mail.com QI Group V (certified on 3/4/16)
Testing Company Personnel		Mr. Christopher Buglio Test Technician

Copies of the QI certifications for test personnel are included in Appendix B.

2.0 TEST METHODOLOGY

Emission testing was conducted following the United States Environmental Protection Agency (USEPA) methods specified in 40CFR75 and 40CFR60, Appendix A in addition to the Mostardi Platt Quality Manual and the test protocol. Schematics of the test section diagrams and sampling trains used are included in Appendix C and D respectively. Calculation and nomenclature are included in Appendix E. Copies of analyzer print-outs for each test run are included in Appendix F. CEM data and process data as provided by Lansing Board of Water and Light are included in Appendix G.

The following methodologies were used during the test program:

Method 3A Oxygen (O_2) Determination

Stack gas O_2 concentrations and emission rates were determined in accordance with USEPA Method 3A, 40CFR60, Appendix A. A Servomex analyzer was used to determine the O_2 concentrations in the manner specified in the Method. The instrument has a paramagnetic detector 21.04%. High-range calibrations were performed using USEPA Protocol gas. Zero nitrogen (a low ppm pollutant in balance nitrogen calibration gases) was introduced during other instrument calibrations to check instrument zero. High- and a mid-range % O_2 levels in balance nitrogen were also introduced. Zero and mid-range calibrations were performed using USEPA Protocol gas after each test run. Copies of the gas cylinder certifications are found in Appendix J. This testing met the performance specifications as outlined in the Method.

Method 7E Nitrogen Oxides (NO_x) Determination

Stack gas NO_x concentrations and emission rates were determined in accordance with USEPA Method 7E, 40CFR60, Appendix A. A Thermo Scientific Model 42C Chemiluminescence Nitrogen Oxides Analyzer was used to determine nitrogen oxides concentrations, in the manner specified in the Method. The instrument operated in the nominal range of 0 ppm to 50 ppm with the specific range determined by the high-level span calibration gas of 35.85 ppm.

The Model 42C High Level is based on the principle that nitric oxide (NO) and ozone (O_3) react to produce a characteristic luminescence with an intensity linearly proportional to the NO concentration. Infrared light emission results when electronically excited nitrogen dioxide (NO_2) molecules decay to lower energy states. Specifically,

$$NO+O_3 \rightarrow NO_2+O_2+h\upsilon$$

NO_2 must first be transformed into NO before it can be measured using the chemiluminescent reaction. NO_2 is converted to NO by a molybdenum NO_2-to-NO converter heated to about 326 °C. The flue gas air sample is drawn into the Model 42C High Level through the sample bulkhead. The sample flows through a particulate filter, a capillary, and then to the mode solenoid valve. The solenoid valve routes the sample either straight to the reaction chamber (NO mode) or through the NO_2-to-NO converter and then to the reaction chamber (NOx mode).

Dry air enters the Model 42C High Level through the dry air bulkhead, through a flow sensor, and then through a silent discharge ozonator. The ozonator generates the necessary ozone concentration needed for the chemiluminescent reaction. The ozone reacts with the NO in the ambient air sample to produce electronically excited NO_2 molecules. A photomultiplier tube (PMT) housed in a thermoelectric cooler detects the NO_2 luminescence.

The NO and NO_x concentrations calculated in the NO and NO_x modes are stored in memory. The difference between the concentrations are used to calculate the NO_2 concentration. The Model 42C High Level outputs NO, NO_2, and NO_x concentrations to both the front panel display and the analog outputs.

Stack gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the stack gas was removed using a refrigerated condenser. The entire system was calibrated in accordance with the Method, using USEPA Protocol gases introduced at the probe, before and after each test run. This testing met the performance specifications as outlined in the Method.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in Appendix H. Copies of the gas cylinder certifications are found in Appendix I. The NO_2 to NO converter test can be found in Appendix J. This testing met the performance specifications as outlined in the Method.

3.0 TEST RESULT SUMMARIES

Client: Lansing Board of Water and Light
Facility: REO Town Facility
Project #: M174302
Fuel Type: Natural Gas

Location: HRSG # 2 Stack
Date: 10/25/17
Test Method: 7E, 3A
Fuel Factor: 8710

O2 based NOx lb/mmBtu RATA

CEM Monitor Information

NO_x Monitor/Model:	Thermo Fisher Scientific	**NO_x Serial # :**	1207552011
O2 Monitor/Model:	Thermo Fisher Scientific	**O2 Serial # :**	1207552011

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NO_x lb/MMBtu	CEM NO_x lb/MMBtu	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
0	1	10/25/17	07:00	07:20	0.040	0.039	0.001	0.000
1	2	10/25/17	07:33	07:53	0.040	0.039	0.001	0.000
1	3	10/25/17	08:05	08:25	0.040	0.039	0.001	0.000
1	4	10/25/17	08:37	08:57	0.041	0.040	0.001	0.000
1	5	10/25/17	09:09	09:29	0.040	0.040	0.000	0.000
1	6	10/25/17	09:41	10:01	0.041	0.041	0.000	0.000
1	7	10/25/17	10:13	10:33	0.041	0.041	0.000	0.000
1	8	10/25/17	10:45	11:05	0.041	0.041	0.000	0.000
1	9	10/25/17	11:17	11:37	0.041	0.041	0.000	0.000
1	10	10/25/17	11:50	12:10	0.041	0.041	0.000	0.000

n	**9**	
t(0.025)	**2.306**	
Mean Reference Method Value	**0.041**	**RM avg**
Mean CEM Value	**0.040**	**CEM avg**
Sum of Differences	**0.003**	**di**
Mean Difference	**0.000**	**d**
Sum of Differences Squared	**0.000**	**di^2**
Standard Deviation	**0.001**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.000**	**cc**
Relative Accuracy	**1.76**	**RA**
Bias Adjustment Factor	**1.000**	**BAF**

Client: Lansing Board of Water and Light | **Location:** HRSG # 2 Stack
Facility: REO Town Facility | **Date:** 10/25/17
Project #: M174302 | **Test Method:** 7E, 3A

NOx ppmvd @ 15% O2 RATA

CEM Monitor Information

NO_x Monitor/Model:	Thermo Fisher Scientific	**NO_x Serial # :**	1207552011
O_2 Monitor/Model:	Thermo Fisher Scientific	**O_2 Serial # :**	1207552011

1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM NOx ppmvd @ 15 %O2	CEM NOx ppmvd @ 15 %O2	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
1	1	10/25/17	07:00	07:20	10.8	10.7	0.1	0.0
1	2	10/25/17	07:33	07:53	10.8	10.7	0.1	0.0
1	3	10/25/17	08:05	08:25	10.9	10.8	0.1	0.0
1	4	10/25/17	08:37	08:57	11.0	10.8	0.2	0.0
1	5	10/25/17	09:09	09:29	10.9	10.9	0.0	0.0
1	6	10/25/17	09:41	10:01	11.0	10.9	0.1	0.0
0	7	10/25/17	10:13	10:33	11.2	10.9	0.3	0.1
1	8	10/25/17	10:45	11:05	11.3	11.0	0.3	0.1
1	9	10/25/17	11:17	11:37	11.3	11.1	0.2	0.0
1	10	10/25/17	11:50	12:10	11.2	11.2	0.0	0.0

n	**9**	
t(0.975)	**2.306**	
Mean Reference Method Value	**11.022**	**RM avg**
Mean CEM Value	**10.900**	**CEM avg**
Sum of Differences	**1.100**	**di**
Mean Difference	**0.122**	**d**
Sum of Differences Squared	**0.210**	**di^2**
Standard Deviation	**0.097**	**sd**
Confidence Coefficient 2.5% Error (1-tail)	**0.075**	**cc**
Relative Accuracy	**1.79**	**RA**

Client: Lansing Board of Water and Light **Location:** HRSG # 2 Stack
Facility: REO Town Facility **Date:** 10/25/17
Project #: M174302 **Test Method:** 3A

O_2 % (dry) RATA

CEM Monitor Information

O_2 Monitor/Model:	Thermo Fisher Scientific				O_2 Serial # :		1207552011	
1=accept 0=reject	Test Run	Test Date	Start Time	End Time	RM O_2 % (dry)	CEM O_2 % (dry)	(RM-CEM) Difference (di)	(RM-CEM) Difference^2 (di^2)
0	1	10/25/17	07:00	07:20	15.4	15.3	0.1	0.01
1	2	10/25/17	07:33	07:53	15.4	15.3	0.1	0.01
1	3	10/25/17	08:05	08:25	15.4	15.3	0.1	0.01
1	4	10/25/17	08:37	08:57	15.4	15.3	0.1	0.01
1	5	10/25/17	09:09	09:29	15.4	15.4	0.0	0.00
1	6	10/25/17	09:41	10:01	15.4	15.4	0.0	0.00
1	7	10/25/17	10:13	10:33	15.4	15.4	0.0	0.00
1	8	10/25/17	10:45	11:05	15.5	15.4	0.1	0.01
1	9	10/25/17	11:17	11:37	15.5	15.4	0.1	0.01
1	10	10/25/17	11:50	12:10	15.4	15.4	0.0	0.00

n	9	
t(0.025)	2.306	
Mean Reference Method Value	15.422	RM avg
Mean CEM Value	15.367	CEM avg
Sum of Differences	0.500	di
Mean Difference	0.056	d
Sum of Differences Squared	0.050	di^2
Standard Deviation	0.053	sd
Confidence Coefficient 2.5% Error (1-tail)	0.041	cc
Relative Accuracy	0.62	RA