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# Compliance Emissions Test Report

## Lansing Board of Water and Light
## REO Town Cogeneration Facility
## Emergency Internal Combustion Engine
## Lansing, Michigan
## September 13, 2018

## Report Submittal Date
## October 9, 2018



## Project No. M183605

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

# 1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a compliance emissions test program for Lansing Board of Water and Light on September 13, 2018 at the REO Town Cogeneration Facility on the Emergency Internal Combustion Engine in Lansing, Michigan. This report summarizes the results of the test program and test methods used.

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

| Test Location | Test Date | Test Parameters |
|---|---|---|
| Emergency Internal Combustion Engine | September 13, 2018 | Nitrogen Oxides ($NO_x$), Carbon Monoxide (CO), Carbon Dioxide ($CO_2$), Oxygen ($O_2$), Volatile Organic Compounds (VOCs), Filterable Particulate Material (FPM), Condensable Particulate Matter (CPM), and Total Particulate Matter (TPM) |

The purpose of the test program was to evaluate the emissions of the above test parameters with the regulation permit limits. Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

| TEST RESULTS | | | | |
|---|---|---|---|---|
| **Test Location** | **Test Date** | **Test Parameter** | **Emission Limits** | **Emission Rates** |
| Emergency Internal Combustion Engine | September 13, 2018 | VOC (as $C_3H_8$) | 0.81 g/bhp-hr | 0.61 g/bhp-hr |
| | | CO | 2.5 g/bhp-hr | 2.3 g/bhp-hr |
| | | $NO_x$ | 0.5 g/bhp-hr | 0.5 g/bhp-hr |
| | | FPM | 0.12 lb/hr | 0.053 lb/hr |
| | | CPM | N/A | 0.122 lb/hr |
| | | TPM | 0.13 lb/hr | 0.175 lb/hr |

Emissions on g/bhp-hr basis were calculated using Kilowatt data supplied by Lansing Board of Water and Light. 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<br>1232 Haco Drive<br>P.O. Box 13007<br>Lansing , Michigan 48912 | Ms. Lori Myott<br>Manager, Environmental Services<br>(517) 702-6639 (phone)<br>Lori.myott@lbwl.com |
| Test Facility | REO Town Cogeneration Facility<br>1110 S. Pennsylvania Avenue<br>Building E<br>Lansing, Michigan | |
| Testing Company Representative | Mostardi Platt<br>888 Industrial Drive<br>Lansing, Michigan 60126 | Mr. Paul F. Coleman<br>Project Manager<br>(630) 993-2100 (phone)<br>pcoleman@mp-mail.com |

The test crew consisted of Messrs. H. Mendoza, J. Kukla, C. Eldridge and P. Coleman of Mostardi Platt.

# 2.0 TEST METHODOLOGY

Emission testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A. Schematics of the test section diagrams and sampling trains used are included in Appendix A and B, respectively. Calculation examples and nomenclature are included in Appendix C. Copies of analyzer print-outs and field data sheets for each test run are included in Appendices F and G, respectively.

The following methodologies were used during the test program:

## Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1A for volumetric flow. The characteristics of the measurement location are summarized below.

| TEST POINT INFORMATION | | | | | |
|---|---|---|---|---|---|
| Location | Duct Diameter (Feet) | Area (Square Feet) | Upstream Disturbance Diameter | Downstream Disturbance Distance | Number of Sampling Points |
| Emergency Internal Combustion Engine | 1.125 | 0.994 | 9.0 | 44.0 | 12 |

An absence of cyclonic flow test was performed and the test location met the less than 20 degree angle requirement.

## Gaseous Sampling Plan

Three points along 17%, 50%, and 83% of the stack diameter were used to sample gaseous emissions.

## Method 2 Volumetric Flowrate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate. An S-type pitot tube, differential pressure gauge, Thermal couple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

## Method 3A Oxygen ($O_2$)/Carbon Dioxide ($CO_2$) Determination

Stack gas $O_2$ and $CO_2$ were determined in accordance with Method 3A. Servomex analyzers were used to determine stack gas oxygen and carbon dioxide content. All of the equipment used was calibrated in accordance with the specifications of the Method and calibration data are included in Appendix H. Copies of the gas cylinder certifications are included in Appendix I.

## Method 5 Particulate Determination

Stack gas particulate concentrations and emission rates were determined in accordance with Method 5, 40 CFR, Part 60, Appendix A at the test location. An Environmental Supply Company, Inc. sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method. Particulate matter in the sample probe was recovered using an acetone rinse. The probe wash and filter catch were analyzed by Mostardi Platt in accordance with the Method in the Elmhurst, Illinois laboratory. Laboratory data are found in Appendix D. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

## Method 202 Condensable Particulate Determination

Stack gas condensable particulate matter concentrations and emission rates were determined in accordance with USEPA Method 202, in conjunction with Method 5 filterable particulate sampling. This method applies to the determination of condensable particulate matter (CPM) emissions from stationary sources. It is intended to represent condensable matter as material that condenses after passing through a filter and as measured by this method.

The CPM was collected in the impinger portion of the Method 5 (Appendix A, 40CFR60) type sampling trains. The impinger contents were immediately purged after each run with nitrogen ($N_2$) to remove dissolved sulfur dioxide ($SO_2$) gases from the impinger contents. The impinger solution was then extracted with hexane. The organic and aqueous fractions were then taken to dryness and the residues weighed. A correction was made for any ammonia present due to laboratory analysis procedures. The total of both fractions represents the CPM.

All sample recovery was performed at the test site by the test crew. Mostardi Platt personnel at the laboratory in Elmhurst, Illinois, performed all final particulate sample analyses. Laboratory data are found in Appendix D. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

## Method 7E Nitrogen Oxide ($NO_X$) Determination

Stack gas nitrogen oxide concentrations and emission rates were determined in accordance with Method 7E. A Thermo Fisher 42i nitrogen oxide analyzer was used to determine nitrogen oxide concentrations, in the manner specified in the Method.

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 certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix H. Copies of calibration gas certifications can be found in Appendix I.

## Method 10 Carbon Monoxide (CO) Determination

Stack gas carbon monoxide concentrations and emission rates were determined in accordance with Method 10. A Thermo Fisher 48i carbon monoxide analyzer was used to determine carbon monoxide concentrations, in the manner specified in the Method.

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 certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix H. Copies of calibration gas certifications can be found in Appendix I.

## Method 18/25A Volatile Organic Compound (VOC) Determination

Non-methane hydrocarbon (NMHC) concentrations and emission rates and methane ($CH_4$) concentrations were determined in accordance with Methods 18 and 25A. A Thermo 55i Gas Chromatograph/Flame Ionization Detector (GC/FID) was used to determine NMHC concentrations and $CH_4$ concentrations. Stack gas was delivered to the system via a Teflon® sampling line, heated to a minimum temperature of 300°F.

The system was calibrated before and after each test run using certified calibration gases of propane for the NMHC determination and methane for the $CH_4$ determination. Calibration data are presented in Appendix F, field sheets are presented in Appendix G, and copies of gas certifications are presented in Appendix I.

# 3.0 TEST RESULT SUMMARY

**Client:** Lansing Board of Water and Light
**Facility:** REO Town Cogeneration Facility
**Test Location:** Emergency Internal Combustion Engine Stack
**Test Method:** 5/202

| | | | | |
|---|---|---|---|---|
| Source Condition | Normal | Normal | Normal | |
| Date | 9/13/18 | 9/13/18 | 9/13/18 | |
| Start Time | 9:25 | 12:20 | 15:00 | |
| End Time | 11:30 | 14:25 | 17:04 | |
| | Run 1 | Run 2 | Run 3 | Average |
| **Stack Conditions** | | | | |
| Average Gas Temperature, °F | 769.1 | 773.1 | 769.9 | 770.7 |
| Flue Gas Moisture, percent by volume | 11.0% | 12.5% | 12.8% | 12.1% |
| Average Flue Pressure, in. Hg | 29.40 | 29.40 | 29.40 | 29.40 |
| Gas Sample Volume, dscf | 78.46 | 79.811 | 79.078 | 79.116 |
| Average Gas Velocity, ft/sec | 168.592 | 170.309 | 169.645 | 169.515 |
| Gas Volumetric Flow Rate, acfm | 10,055 | 10,157 | 10,118 | 10,110 |
| Gas Volumetric Flow Rate, dscfm | 3,778 | 3,740 | 3,724 | 3,747 |
| Gas Volumetric Flow Rate, scfm | 4,245 | 4,274 | 4,269 | 4,263 |
| Average %$CO_2$ by volume, dry basis | 6.8 | 6.8 | 6.8 | 6.8 |
| Average %$O_2$ by volume, dry basis | 9.4 | 9.5 | 9.4 | 9.4 |
| Isokinetic Variance | 101.9 | 104.7 | 104.2 | 103.6 |
| Standard Fuel Factor Fd, dscf/mmBtu | 8,710.0 | 8,710.0 | 8,710.0 | 8,710.0 |
| **Filterable Particulate Matter (Method 5)** | | | | |
| grams collected | 0.01780 | 0.00375 | 0.00387 | 0.00847 |
| grains/acf | 0.0013 | 0.0003 | 0.0003 | 0.0006 |
| grains/dscf | 0.0035 | 0.0007 | 0.0008 | 0.0017 |
| lb/hr | 0.113 | 0.023 | 0.024 | 0.053 |
| **Condensable Particulate Matter (Method 202)** | | | | |
| grams collected | 0.02052 | 0.01706 | 0.02057 | 0.01938 |
| grains/acf | 0.0015 | 0.0012 | 0.0015 | 0.0014 |
| grains/dscf | 0.0040 | 0.0033 | 0.0040 | 0.0038 |
| lb/hr | 0.131 | 0.106 | 0.128 | 0.122 |
| **Total Particulate Matter (5/202)** | | | | |
| grams collected | 0.03832 | 0.02081 | 0.02444 | 0.02786 |
| grains/acf | 0.0028 | 0.0015 | 0.0018 | 0.0020 |
| grains/dscf | 0.0075 | 0.0040 | 0.0048 | 0.0054 |
| lb/hr | 0.244 | 0.129 | 0.152 | 0.175 |

Lansing Board of Water and Light
REO Town Cogeneration Facility
Emergency Internal Combustion Engine
Gaseous Summary
Normal Load

| Test No. | Date | Start Time | End Time | Kilowatts | Brake Horse Power | $NO_x$ ppmvd | CO ppmvd | $O_2$ % (dry) | Moisture % | Flowrate, DSCFM | NMHC (VOC) ppm as $C_3H_8$ (wet) | $CH_4$ ppm as $CH_4$ (wet) | NMHC (VOC) ppm as $C_3H_8$ (dry) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 09/13/18 | 09:25 | 11:01 | 1202.5 | 1612.6 | 65.6 | 499.1 | 9.4 | 11.0 | 3,778 | 68.8 | 990.6 | 77.3 |
| 2 | 09/13/18 | 12:20 | 13:55 | 1200.0 | 1609.2 | 67.1 | 502.4 | 9.4 | 12.5 | 3,740 | 75.6 | 1,118.8 | 86.4 |
| 3 | 09/13/18 | 15:00 | 16:36 | 1199.0 | 1607.9 | 67.2 | 506.1 | 9.4 | 12.8 | 3,724 | 77.5 | 1,092.2 | 88.9 |
| Average | | | | 1200.5 | 1609.9 | 66.6 | 502.5 | 9.4 | 12.1 | 3,747 | 74.0 | 1,067.2 | 84.2 |

Emission Rate Summary

| Test No. | Date | Start Time | End Time | Fd Factor, dscf/MMBtu | $O_2$ based NOx lb/MMBtu | $O_2$ based CO lb/MMBtu | $O_2$ based NMHC as C3H8 lb/MMBtu | $NO_x$ lb/hr | CO lb/hr | NMHC (VOC) as $C_3H_8$ lb/hr | $NO_x$ g/bhp-hr * | CO g/bhp-hr * | NMHC (VOC) g/bhp-hr * |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 09/13/18 | 09:25 | 11:01 | 8,710 | 0.124 | 0.574 | 0.140 | 1.78 | 8.22 | 2.00 | 0.5 | 2.3 | 0.56 |
| 2 | 09/13/18 | 12:20 | 13:55 | 8,710 | 0.127 | 0.578 | 0.156 | 1.80 | 8.19 | 2.21 | 0.5 | 2.3 | 0.62 |
| 3 | 09/13/18 | 15:00 | 16:36 | 8,710 | 0.127 | 0.582 | 0.161 | 1.79 | 8.22 | 2.27 | 0.5 | 2.3 | 0.64 |
| Average | | | | 8,710 | 0.126 | 0.578 | 0.152 | 1.79 | 8.21 | 2.16 | 0.5 | 2.3 | 0.61 |

# 4.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to Lansing Board of Water and Light. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

## CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT

Paul F. Coleman _____ Program Manager

Jeffrey M. Crivlare _____ Quality Assurance