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EMISSION TEST REPORT

Report Title RESULTS OF THE RELATIVE ACCURACY TEST AUDIT OF
BOILER NO. 11 CONTINUOUS EMISSION MONITORING
SYSTEMS AND THE PARTICULATE MATTER EMISSION
RATE OF MSW PROCESSING LINES

Report Date November 16, 2015

Test Dates October 26 – 28, 2015

| Facility Information | |
|----------------------|---------------------------------|
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| Street Address | 5700 Russell St. |
| City, County | Detroit, Wayne County |

| Facility Permit Information | |
|-----------------------------|---------------------------------|
| State Registration No. | M4148 ROP No. MI-ROP-M4148-2011 |

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|--------------------|---|
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Environmental Consultants

RESULTS OF THE
RELATIVE ACCURACY TEST AUDIT
OF BOILER NO. 11
CONTINUOUS EMISSION MONITORING SYSTEMS
AND THE
PARTICULATE MATTER EMISSION RATE
OF MSW PROCESSING LINES

DETROIT RENEWABLE POWER, L.L.C.
DETROIT, MICHIGAN

1.0 INTRODUCTION

Detroit Renewable Power, L.L.C. (DRP) operates municipal solid waste (MSW) processing lines, three (3) refuse derived fuel (RDF) fired boilers, and an ash handling system at its Detroit, Michigan facility that are identified as flexible group FGMSWPROC-LINE, FGBOILERS011-013 and emission unit EUASH-HANDLING, respectively, in the State of Michigan Renewable Operating Permit MI-ROP-M4148-2011 issued to the facility.

Conditions of the operating permit require DRP to operate flowrate, nitrogen oxides (NO_x), oxygen (O₂), carbon dioxide (CO₂), carbon monoxide (CO) and sulfur dioxide (SO₂) continuous emission monitoring systems (CEMS) for each boiler contained in FGBOILERS011-013. This test report presents the results of the relative accuracy test audit (RATA) for the existing CEMS. The operating permit also requires DRP to perform particulate matter (PM) and opacity compliance testing on a primary and secondary shredder associated with FGMSWPROC-LINE.

The CEMS RATA determination testing and processing line emission testing was performed October 26 - 28, 2015 by Derenzo Environmental Services representatives Jason Logan, Daniel Wilson, Tyler Wilson, Blake Beddow, Jeff Schlaff and Andrew Rusnak. The project was coordinated by DRP representative Mr. William Alexander.

Mr. Tom Maza, Mr. Jeremy Howe and Ms. Joyce Zhu of the Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) were on-site to observe portions of the compliance demonstrations. The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan submitted to MDEQ-AQD dated September 24, 2015 and approved by the regulatory agency.

Appendix 1 provides a copy of the test plan approval letter issued by the MDEQ-AQD.

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Report Certification

This test report was prepared by Derenzo Environmental Services based on field sampling data collected by Derenzo Environmental Services. Facility process data were collected and provided by DRP employees or representatives. This test report has been reviewed by DRP representatives and approved for submittal to the Michigan Department of Environmental Quality (MDEQ).

I certify that the testing was conducted in accordance with the approved test plan unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

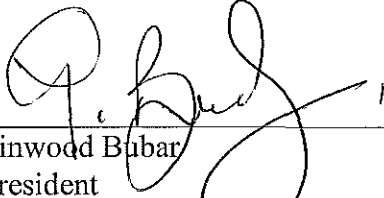
Report Prepared By:



Andy Rusnak, QSTI
Technical Manager
Derenzo Environmental Services

Based on information and belief formed after reasonable inquiry, I believe the statements and information in this report are true, accurate and complete. The testing was performed in accordance with the approved test plan and the facility was operated in compliance with the permit conditions, at or near maximum routine operating conditions, during the test periods.

Facility Certification By:



Linwood Bubar
President
Detroit Renewable Power, L.L.C.

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2.0 SUMMARY OF RESULTS

The CEMS RATA conducted on the EUBOILER011 exhaust and associated CEM systems, verified that the unit operated in compliance with the emission limits specified in ROP No. MI-ROP-M4148-2011. The particulate matter and opacity sampling conducted on the Line No. 1 primary and secondary shredders verified that the units operated in compliance with the emission limits specified in ROP No. MI-ROP-M4148-2011.

The following table presents a summary of the CEMS RATA. Detailed results are presented in Tables 6.1 – 6.8 of this report.

Table 2.1 Summary of CEMS RATA results

| RATA Parameter | Reference Method Average Result | Relative Accuracy Result | Allowable Limit |
|---|---------------------------------|--------------------------|-----------------|
| SO ₂ (ppm @7% O ₂) | 16.4 | 18.0% | 20% |
| CO (ppm @7% O ₂) | 199 | 7.4% | 10% |
| NO _x (ppm @7% O ₂) | 202 | 5.7% | 20% |
| O ₂ (% , dry) | 12.8 | 4.0% | 20% |
| CO ₂ (%) | 7.4 | 5.8% | 20% |
| Exhaust Flow (scfm) | 234,725 | 9.6% | 20% |
| CO ₂ (lb/min) | 1,727 | 2.7% | 20% |
| O ₂ (% , wet) | 11.2 | 6.9% | 20% |

1. CEMS RA results were calculated using the mean of the reference method results.

The following table presents a summary of the MSW Processing Line No. 100 sampling. Detailed results are presented in Tables 6.9 and 6.10 of this report.

Table 2.2 Summary of MSW Processing Line No. 1 Sampling

| Parameter | Reference Method Average Result | Allowable Limit |
|--|---------------------------------|-----------------|
| Primary Shredder PM (lb PM/1,000 lb gas) | 0.0016 | 0.0028 |
| Secondary Shredder PM (lb PM/1,000 lb gas) | 0.0011 | 0.0028 |
| Opacity (%) | 0 | 0 |

3.0 SOURCE DESCRIPTION

3.1 Sources Tested

DRP receives MSW at its Detroit facility and processes the waste to generate RDF. MSW is handled on one (1) of three (3) processing lines. The processed RDF is combusted in three (3) identical Combustion Engineering Model VU40 dual-fuel boilers which generate superheated steam. A portion of the steam is provided to a turbine which produces electricity for sale to the local utility. Steam is also provided to Detroit Thermal L.L.C. for central heating purposes. Ash produced by the combustion of RDF is collected, wetted and transported to a storage area prior to removal from the facility for disposal.

3.2 Type of Raw Materials Used

The primary raw material is MSW. The facility is permitted to process 20,000 tons of MSW per week and 1,043,000 tons annually. Each boiler is rated to produce 362,800 lb of steam per hour at a pressure of 900 psig and temperature of 825 °F. The steam turbine can produce up to 68 megawatts (MW) of electricity.

3.3 Emission Control System Description

Each individual MSW processing line is equipped with a fabric filter baghouse associated with the primary shredder and a cyclone and fabric filter baghouse associated with the secondary shredder. The RDF storage area is equipped with fabric roof vent filters to prevent fugitive emissions.

Emissions from the combustion of RDF in the boilers are controlled by a lime-injection dry flue gas scrubber and a fabric filter baghouse, installed in series to control emissions of acid gases, metals, organics and particulate matter. CO, NO_x and VOC emissions are minimized through good combustion practices.

Fugitive particulate matter emissions from the ash handling storage facility are controlled by the installation of dust filters on the exhaust fans, properly wetting the ash material and washing and covering the ash hauling vehicles.

3.4 Process Operating Conditions During the Compliance Testing

During the compliance test program, DRP was running greater than 50% of maximum capacity. The boiler produced an average of 305,750 lb steam/hr (84% of maximum steam output).

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During the compliance test program, the MSW processing lines operated were operated at maximum routine operating conditions. The average pressure drop across the primary shredder was 4.51 inH₂O. The average pressure drop across the secondary shredder was 6.37 inH₂O.

DRP representatives provided operating data (boiler steam production and baghouse pressure drop) for each test period.

Table 3.1 presents a summary of the recorded operating data for the boilers and processing lines.

Appendix 2 provides CEM system response data, boiler steam production and MSW processing line baghouse pressure drop records.

Table 3.1 Summary of Operating Conditions during Compliance Testing

| Unit | Parameter | Compliance Test Average | Units |
|-------------------------------|------------------|-------------------------|--------------------|
| MSW Line 1 Primary Shredder | Pressure Drop | 4.51 | inH ₂ O |
| MSW Line 1 Secondary Shredder | Pressure Drop | 6.37 | inH ₂ O |
| Boiler No. 11 | Steam Production | 305,750 | lb/hr |

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test plan for the compliance testing prepared by DRP and Derenzo and Associates and was reviewed by the MDEQ-AQD. This section provides a summary of the sampling and analytical procedures that were used during the test and presented in the test plan.

4.1 Summary of USEPA Test Methods

Derenzo Environmental Services performed the exhaust gas and pollutant measurements in accordance with the following USEPA reference test methods:

| Parameter / Analyte | Sampling Methodology | Analytical Methodology |
|----------------------------|-----------------------------|--|
| Velocity traverses | USEPA Method 1 | Selection of sample and velocity traverse locations by physical stack measurements |
| Volumetric flow rate | USEPA Method 2 | Measurement of velocity head using a Type-S Pitot tube and inclined manometer |
| Oxygen and Carbon dioxide | USEPA Method 3A | IR & Paramagnetic instrumental analyzers |
| Moisture | USEPA Method 4 | Gravimetric analysis |
| Sulfur dioxide | USEPA Method 6C | Ultraviolet (UV) fluorescence instrumental analyzer |
| Nitrogen oxides | USEPA Method 7E | Chemiluminescence instrumental analyzer |
| Visible Emissions | USEPA Method 9 | Certified observer of visible emissions |
| Carbon monoxide | USEPA Method 10 | Infrared (IR) instrumental analyzer |
| Particulate matter | USEPA Method 17 | Gravimetric analysis |

In addition to the measurement methods specified in the previous table:

- USEPA Method 205; *Verification of Dilution Systems for Field Instrument Calibrations*, was used to verify linearity of the calibration gas dilution system.
- USEPA Performance Specification (PS) 2, *Specifications for SO₂ and NO_x Continuous Emission Monitoring Systems in Stationary Sources*; was used to evaluate the acceptability the analyzer used to monitor the NO_x and SO₂ content of the gases exhausted from FGBOILERS011-013.
- USEPA Performance Specification (PS) 3, *Specifications and Test Procedures for O₂ and CO₂ Continuous Emission Monitoring Systems in Stationary Sources*; was used to evaluate the acceptability the analyzers used to monitor the O₂ and CO₂ content of the gases exhausted from FGBOILERS011-013.
- USEPA PS 4, *Specifications and Test Procedures for Carbon Monoxide Continuous Emission Monitoring Systems in Stationary Sources*; was used to evaluate the acceptability the analyzer used to monitor the CO content of the gases exhausted from FGBOILERS011-013.

4.2 CEMS RATA Testing

The CEMS RATA consisted of a minimum of nine (9) up to a maximum of twelve (12) test periods that were 21 minutes each (three (3) runs were discarded for the CO and SO₂ RATAs).

The Relative Accuracy (RA) for each pollutant / gas monitoring instrument was calculated and compared to the appropriate performance specification to determine the acceptability of the monitoring data.

4.2.1 Flow RATA Sampling Location

The locations of the velocity measurement ports meet the USEPA Method 1 criteria for a representative measurement location. The inner diameter of the stack is 91 inches. The stack is equipped with four (4) 9.0-inch sample ports, opposed 90°, that provided a sampling location 11.9 duct diameters downstream and greater than 26.4 duct diameters upstream from any flow disturbance.

Velocity pressure traverse locations for the sampling points were determined in accordance with USEPA Method 1.

Exhaust gas velocity pressure and temperature were measured at each sampling location in accordance with USEPA Method 2 using an S-type Pitot tube connected to a red-oil manometer.

A K-type thermocouple mounted to the Pitot tube was used for temperature measurements. The pitot tube and connective tubing were leak-checked prior to each set of velocity measurements to verify the integrity of the measurement system.

The absence of cyclonic flow for each sampling location was verified using the S-type pitot tube and oil manometer. The pitot tube was positioned at several representative velocity traverse points with the planes of the face openings of the pitot tube perpendicular to the stack cross-sectional plane. The pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

Appendix 3 provides diagrams of the test sampling locations.

Appendix 4 provides flowrate calculations and data sheets.

4.2.2 Reference Analyzer Sampling Location

A sampling probe was installed in the exhaust duct (74.5-inch diameter with an 18.5-inch sample port) for sampling gaseous pollutants (i.e., in the breach prior to the exhaust stack). The probe was positioned at 0.4 m, 1.2 m and 2.0 m. Samples of the exhaust gas were continuously delivered to the instrument analyzers using a heated Teflon® line. The heated Teflon® line and heated filter were equipped with a temperature controller which maintained the temperature of the sample line between 300°F to 320 °F in order to prevent moisture condensation.

The exhaust gas samples for the Method 3A (CO₂, O₂), Method 6C (SO₂), Method 7E (NO_x) and Method 10 (CO) instruments were conditioned (i.e., dried using a sample gas condenser) prior to being introduced to the instrument analyzers. Therefore, these measurements correspond to standard conditions with moisture correction (dry basis).

Appendix 3 provides diagrams of the test sampling locations.

4.2.3 Exhaust Gas Molecular Weight Determination (USEPA Method 3A)

CO₂ and O₂ content in the exhaust gas stream were measured continuously throughout each test period in accordance with USEPA Method 3A. The CO₂ content of the gas stream was monitored using a Servomex Model 1440D infrared (IR) gas analyzer. The O₂ content of the gas stream was monitored using a Servomex Model 1440D paramagnetic gas analyzer.

Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

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Appendix 5 provides O₂ and CO₂ calculation sheets. Raw instrument response data are provided in Appendix 6.

4.2.4 Determination of moisture content in stack gases (USEPA Method 4)

Moisture content of the exhaust gases was determined in accordance with the USEPA Method 4 chilled impinger method. The moisture content of the exhaust gases was determined as a separate measurement train that was performed throughout the RATA test periods (i.e., 60-minute moisture train sampling periods). The moisture sampling was conducted at the isokinetic sampling location (i.e., at the exhaust stack sampling ports). Moisture was removed from the sample stream using chilled impingers. The amount of moisture removed from the sample stream was determined gravimetrically by weighing the impinger contents before and after each test period.

4.2.5 SO₂ Concentration Measurements (USEPA Method 6C)

Exhaust gas SO₂ concentration measurements were performed at the CEM exhaust sampling location using a Thermo Environmental Instruments, Inc. (TEI) Model 43i that uses pulsed ultraviolet fluorescence technology in accordance with USEPA Method 6C for the measurement of SO₂ concentration.

Prior to, and at the conclusion of each test, the instrument was calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

Appendix 5 provides SO₂ calculation sheets. Raw instrument response data are provided in Appendix 6.

4.2.6 NO_x Concentration Measurements (USEPA Method 7E)

Exhaust gas NO_x concentration measurements were performed at the CEM exhaust sampling location using a TEI Model 42c chemiluminescence NO – NO₂ analyzer in accordance with USEPA Method 7E for the measurement of NO_x concentration.

Prior to, and at the conclusion of each test, the instrument was calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

Appendix 5 provides NO_x calculation sheets. Raw instrument response data are provided in Appendix 6.

4.2.7 CO Concentration Measurements (USEPA Method 10)

Exhaust gas CO concentration measurements were performed at the CEM exhaust sampling location using a TEI Model 48c infrared CO analyzer in accordance with USEPA Method 10 for the measurement of CO concentration.

Prior to, and at the conclusion of each test, the instrument was calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

Appendix 5 provides CO calculation sheets. Raw instrument response data are provided in Appendix 6.

4.2.8 Extractive gas sampling system

A sampling probe was installed in the exhaust duct (i.e., breach prior to the exhaust stack), immediately upstream from the CEM sample probe, for sampling gaseous pollutants. The test team used this sampling probe to obtain a sample of the exhaust gas for the reference analyzers. Samples of the exhaust gas were continuously delivered to the instrument analyzers using a heated Teflon® line. The heated Teflon® line and heated filter chamber were equipped with a temperature controller which maintained the temperature of the sample line between 300°F to 320 °F in order to prevent moisture condensation.

The exhaust gas samples for the Method 3A (CO₂, O₂), Method 6C (SO₂), Method 7E (NO_x) and Method 10 (CO) instruments were conditioned (i.e., dried using a sample gas condenser) prior to being introduced to the instrument analyzer. Therefore, these measurements correspond to standard conditions with moisture correction (dry basis).

4.2.9 Relative Accuracy Performance Specification (USEPA PS2, PS3 and PS4)

Performance of the relative accuracy testing included performing between nine (9) and twelve (12) separate tests where concentrations of O₂, CO₂, NO_x, SO₂ and CO were measured for 21 minutes and twelve (12) separate flowrates were taken.

The RA was calculated for each measurement system using the equations in Performance Specifications 2, 3 and 4. Performance of the CEMS was considered acceptable when compared against the following performance specifications:

- Calculated O₂, CO₂, NO_x and SO₂ RA is no greater than 20% (no greater than 10% for CO).

- Calculated NO_x and SO₂ RA is no greater than 10% (no greater than 5% for CO) if using the emission standard in the denominator of the RA calculation (when measured emissions are less than 50% of the standard).
- The O₂ and CO₂ results are also acceptable if the calculated absolute difference of the mean reference method and mean CEMS value is no greater than 1.0%.
- Calculated total flowrate RA is no greater than 20% or 10% if using the emission standard in the denominator of the RA calculation.

The O₂, CO₂, NO_x, SO₂, CO and flowrate CEMS RA results were calculated using the average measured reference analyzer results in the denominator of the calculation and compared against the 20% standard (10% standard for CO).

4.3 MSW Processing Line No. 1 Particulate Matter Testing

4.3.1 Sampling Location and Velocity Measurements (USEPA Methods 1 and 2)

The sampling location for the:

- Primary shredder was in the 18-inch diameter exhaust stack.
- Secondary shredder was in the 45-inch diameter exhaust stack.

The representative sample locations were determined in accordance with USEPA Method 1 based on the measured distance to upstream and downstream disturbances. The absence of significant cyclonic flow was determined at each sampling location.

Exhaust gas velocity was measured prior to sampling each stack using USEPA Method 2. Operation of the shredders presents an explosion risk, therefore, individuals are not allowed on the rooftop near the sampling point during operation. Results from the initial velocity traverse were computed and a representative single point was selected for the isokinetic sampling run (i.e., the isokinetic sample probe was positioned and operated at a single point throughout the entire 60-minute sample period). Initial velocity pressure measurements were performed at each stack traverse point using an S-type Pitot tube and red-oil manometer. Temperature measurements were performed at each traverse point using a K-type thermocouple and a calibrated digital thermometer.

Prior to performing the initial velocity traverse the S-type Pitot tube and manometer lines were leak-checked at the test site. These checks were made by blowing into the impact opening of the Pitot tube until 3 or more inches of water were recorded on the manometer, then capping the impact opening and holding it closed for 15 seconds to ensure that it was leak free. The static pressure side of the Pitot tube was leak-checked using the same procedure.

Appendix 3 provides drawings for each exhaust stack sampling location.

4.3.2 CO₂ and O₂ Determination (USEPA Method 3)

Exhaust gas CO₂ and O₂ content for both shredder stacks was relatively close to that of ambient air (20.9% O₂ and trace amounts of CO₂). The exhaust gas was sampled prior to sampling using a Fyrite® gas analyzer that contains scrubbing solutions to selectively remove O₂ and CO₂ from the gas sample. Samples were withdrawn from each air stream using a sample probe and hand-held aspirator and introduced to the Fyrite® solutions through the scrubbing tube inlet valve. The sampled gas was passed through the appropriate scrubbing solution several times and the gas concentration (O₂ or CO₂) is determined by the solution volume change as indicated by the calibrated scale on the Fyrite® scrubber chamber.

4.3.3 Moisture Determination (USEPA Method 4)

Moisture content was measured concurrently with the particulate matter sampling trains and determined in accordance with USEPA Method 4. Moisture from the gas sample was removed by the chilled impingers of the isokinetic sampling train. The net moisture gain from the gas sample was determined by gravimetric analytical techniques in the field. Percent moisture was calculated based on the measured net gain from the impingers and the metered gas sample volume of dry air.

4.3.4 Determination of Filterable Particulate Matter Emissions (USEPA Method 17)

USEPA Method 17 was used to determine filterable PM concentration in the primary shredder and secondary shredder exhaust gas. Exhaust gas was withdrawn from these emission unit exhaust stacks at an isokinetic sampling rate using an appropriately-sized sample nozzle. The collected exhaust gas was passed through an in-stack filter placed just after the “goose-neck” nozzle. PM in the sampled gas stream was collected onto a pre-tared glass fiber filter. The stainless steel in-stack filter holder was connected to a (unheated) sample probe. The outlet of the sample probe was directly connected to an impinger train (for moisture removal). The outlet of the impinger train was connected to a dry gas meter and metering console.

At the conclusion of each test, the filter was recovered and the nozzle and filter holder were brushed and rinsed with acetone. Recovered filters and acetone rinses of the nozzle, filter holder, and sample probe were sent to Bureau Veritas North America, Inc. (Novi, Michigan) for gravimetric measurements.

Appendix 7 provides PM calculation sheets. The laboratory report is provided in Appendix 8.

4.3.5 Opacity Observations (USEPA Method 9)

USEPA Method 9 procedures were used to evaluate the opacity of the exhaust gas during each 60-minute test period on each exhaust stack. In accordance with USEPA Method 9, the qualified observer stood at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. As much as possible, the line of vision was approximately perpendicular to the plume direction.

Opacity observations were made at the point of greatest opacity in the portion of the plume where condensed water vapor was not present. Observations were made at 15-second intervals for the duration of the 60-minute testing period.

All visible emissions determinations were performed by a qualified observer in accordance with USEPA Method 9, Section 3.

Appendix 9 provides the VE observation data sheets.

5.0 INTERNAL QA/QC ACTIVITIES

5.1 Sampling System Response Time Determination

The response time of the sampling system was determined prior to the compliance test program by introducing upscale gas and zero gas, in series, into the sampling system using a tee connection at the base of the sample probe. The elapsed time for the analyzer to display a reading of 95% of the expected concentration was determined using a stopwatch.

The TEI Model 43i SO₂ analyzer exhibited the longest system response time at 2 minutes 58 seconds. Results of the response time determinations were recorded on field data sheets. For each test period, test data were collected once the sample probe was in position for at least twice the maximum system response time.

The response time of the CEM system was approximately one (1) minute less than the reference monitor analyzers, therefore, appropriate adjustments were made to the sampling times (i.e., if the reference monitor test time began at 8:30 am, CEM data for comparison would begin at 8:29 am).

5.2 Gas Divider Certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the previous 12 months) with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.3 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure NO_x, CO, O₂ and CO₂ have had an interference response test performed prior to their use in the field (July 26, 2006, June 21, 2011 and June 12, 2014), pursuant to the interference response test procedures specified in USEPA Method 7E. The appropriate interference test gases (i.e., gases that would be encountered in the exhaust gas stream) were introduced into each analyzer, separately and as a mixture with the analyte that each analyzer is designed to measure. All of analyzers exhibited a composite deviation of less than 3.0% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

5.4 NO_x Converter Test

The NO₂ – NO conversion efficiency of the Model 42c analyzer was verified prior to the testing program. A USEPA Protocol 1 certified concentration of NO₂ was injected directly into the analyzer, following the initial three-point calibration, to verify the analyzer's conversion efficiency. The analyzer's NO₂ – NO converter uses a catalyst at high temperatures to convert the NO₂ to NO for measurement. The conversion efficiency of the analyzer is deemed acceptable if the measured NO₂ concentration is within 90% of the expected value.

The NO₂ – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO₂ concentration was -7.54% of the expected value, i.e., within 10% of the expected value as required by Method 7E).

5.5 Determination of Exhaust Gas Stratification

A stratification test for the exhaust stack configuration was performed prior to the test periods. The stainless steel sample probe was positioned at sample points correlating to 0.4m, 1.2m and 2.0m across the stack diameter. Pollutant concentration data were recorded at each sample point for a minimum of twice the maximum system response time.

The recorded data for each exhaust stack gas indicate that the measured NO_x, O₂ and CO₂ concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the stack gas was considered to be unstratified and the sampling was performed at three (3) sampling locations (0.4m, 1.2m and 2.0m) within the exhaust stack.

5.6 Instrument Calibration and System Bias Checks

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the SO₂, NO_x, CO, CO₂ and O₂ analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing the upscale calibration gas and zero gas into the sampling system (at the base of the stainless steel sampling probe prior to the particulate filter and Teflon® heated sample line) and determining the instrument response against the initial instrument calibration readings.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO₂, O₂, SO₂, NO_x and CO in nitrogen and zeroed using hydrocarbon free nitrogen. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

5.7 Isokinetic Sampling QA/QC

The Nutech® Model 2010 sampling consoles and dry gas meters, which were used to extract a metered amount of exhaust gas from the stacks were calibrated prior to and after the test event. The calibration procedure uses the critical orifice calibration technique presented in USEPA Method 5. The digital pyrometer in the Nutech metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator. The isokinetic variation was calculated for each one hour sampling period and determined to be within +/-10% of 100% as required by USEPA Method 17.

The Pitot tubes used for velocity pressure measurements was inspected for mechanical integrity and physical design prior to the field measurements. The gas velocity measurement train (Pitot tube, connecting tubing and incline manometer) was leak-checked prior to the field measurements and periodically throughout the testing period.

All recovered particulate matter samples were stored and shipped in HDPE sample bottles. The liquid level on each bottle was marked with permanent marker and the caps were secured closed with tape. Samples of the reagents used in the test project were sent to the laboratory for analysis to verify that the reagents used to recover the samples have low particulate matter residue values.

The laboratory analyses were conducted by a qualified third-party laboratory (Bureau Veritas North America, Inc.) according to the appropriate QA/QC procedures of the associated USEPA methodologies and are included on the final laboratory report.

Appendix 10 provides information and quality assurance data for the equipment and instrumental analyzers used for the RA test periods (calibration data, copies of calibration gas certificates, gas divider certification, Pitot tube integrity inspection sheets, meter box critical orifice calibration records, and interference study records).

6.0 TEST RESULTS AND DISCUSSION

6.1 Test Results and Allowable Emission Limits

Air pollutant emission measurement results for each CEMS RATA are presented in Tables 6.1 through 6.8.

Air pollutant emission measurement results for the primary and secondary shredder PM sampling are presented in Tables 6.9 and 6.10.

ROP No. MI-ROP-M4148-2011 requires DRP to install and operate each CEMS in accordance with the requirements detailed in the ROP and to use the CEMS data for determining compliance with emission limits specified in the ROP. The compliance demonstration performed on October 27 – 28, 2015 demonstrated:

- The relative accuracy for the total exhaust flowrate monitor was 9.6% (allowable relative accuracy limit is 20%);
- The relative accuracy for the SO₂ emission monitor was 18.0% (allowable relative accuracy limit is 20%);
- The relative accuracy for the CO emission monitor was 7.4% (allowable relative accuracy limit is 10%);
- The relative accuracy for the NO_x emission monitor was 5.7% (allowable relative accuracy limit is 20%);
- The relative accuracy for the CO₂ emission monitor was 5.8% (allowable relative accuracy limit is 20%);
- The relative accuracy for the O_{2, dry} emission monitor was 4.0% (allowable relative accuracy limit is 20%);
- The relative accuracy for the CO₂ emission rate monitor was 2.7% (allowable relative accuracy limit is 20%); and
- The relative accuracy for the O_{2, wet} emission monitor was 6.9% (allowable relative accuracy limit is 20%).

The test results confirmed that the O₂, CO₂, NO_x, CO, SO₂ and exhaust flowrate monitors are operated in compliance with the allowable relative accuracy limits specified in the respective performance specifications.

ROP No. MI-ROP-M4148-2011 requires DRP to perform particulate matter testing and evaluate visual emissions of the MSW Processing Line No. 1 primary and secondary shredders in accordance with the requirements in the ROP. The compliance demonstration performed on October 26, 2015 demonstrated:

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- The PM emission rate from the primary shredder was 0.0016 lb / 1,000 lb exhaust gas (allowable limit is 0.0028 lb / 1,000 lb exhaust gas);
- The PM emission rate from the secondary shredder was 0.0011 lb / 1,000 lb exhaust gas (allowable limit is 0.0028 lb / 1,000 lb exhaust gas);
- No visual emissions were observed from the primary and secondary shredder exhaust stacks (allowable limit is 0% opacity).

The test results confirmed that the primary and secondary shredders associated with MSW Processing Line No. 1 are operated in compliance with the allowable emission limits specified in the ROP.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed in accordance with the Test Plan dated September 24, 2015 and specified USEPA test methods. All instrument calibrations and sampling period results satisfied the quality assurance verifications required by USEPA.

CO Test Period No. 10 was discarded because the measured CO concentrations exceeded the allowable span. The facility was operated as described in the operating records presented in Table Nos. 6.1 through 6.10 and in Appendix 2.