Derenzo and Associates, Inc.
Environmental Consultants

AIR EMISSION TEST REPORT

Title	AIR EMISSION TEST REPORT FOR THE LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES OPERATED AT THE VENICE PARK RECYCLING AND DISPOSAL FACILITY
Report Date	July 2, 2014
Test Dates	May 13 – 14, 2014

Facility Information	
Name	Waste Management of Michigan, Inc. – Venice Park Recycling and Disposal Facility
Street Address	9536 Lennon Rd.
City, County	Lennon, Shiawassee
SRN	N5910

Facility Permit Information			
PTI No.:	166-11	ROP No. :	MI-ROP-N5910-2010

Source Information – FGENGINES1-2, 2 CAT® Model G3516 IC Engines		
Emission Unit	EUWMENGINE1	EUWMENGINE2
Serial Number	4EK02870	3RC00821

Testing Contractor	
Company	Derenzo and Associates, Inc.
Mailing Address	39395 Schoolcraft Road Livonia, MI 48150
Phone	(734) 464-3880
Project No.	1402013

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Waste Management of Michigan, Inc. - Venice Park RDF County Shiawassee

Source Address 9536 Lennon Rd. City Lennon

AQD Source ID (SRN) N5910 ROP No. MI-ROP-N5910-2010 ROP Section No. 01

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 5/13/14 To 5/14/14

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Certification for Air Emissions Test Report associated with compliance testing of emission units FGENGINES1-2, as specifed by Permit to Install No. 166-11. Testing was performed May 13 - 14, 2014.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

John Gall	District Manager	(810) 621-9080
Name of Responsible Official (print or type)	Title	Phone Number
Signature of Responsible Official		7-8-14 Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

AIR EMISSION TEST REPORT
FOR THE
LANDFILL GAS FUELED
INTERNAL COMBUSTION ENGINES
OPERATED AT THE
VENICE PARK RECYCLING AND DISPOSAL FACILITY

1.0 INTRODUCTION

Waste Management of Michigan, Inc. (WM) operates two (2) Caterpillar (CAT®) Model No. G3516 landfill gas (LFG) fueled reciprocating internal combustion engines (RICE) at the Venice Park Recycling and Disposal Facility (Venice Park RDF) gas to energy facility (Facility SRN: N5910) in Lennon, Shiawassee County, Michigan. The facility has been issued Permit to Install No. 166-11 and Renewable Operating Permit (ROP) No. MI-ROP-N5910-2010 by the Michigan Department of Environmental Quality (MDEQ).

The CAT® Model No. G3516 engines are identified in PTI No. 166-11 as Emission Unit ID: EUWMENGINE1 and 2 (Flexible Group ID: FGENGINES1-2).

Air emission compliance testing was performed to demonstrate compliance with FGENGINES1-2 Special Condition Nos. V.1. through V.3. of PTI No. 166-11 which state the following testing must be completed upon request from the MDEQ:

1. *...the permittee shall verify NOx, CO and/or PM2.5 emission rates from one or more engines in FGENGINES1-2...;*
2. *...the permittee shall verify formaldehyde emission rates from one or more engines in FGENGINES1-2...;* and
3. *...the permittee shall verify VOC emission rates from one or more engines in FGENGINES1-2...*

The MDEQ requested that emission testing be performed on both engines to demonstrate compliance with the air pollutant emission limits for FGENGINES1-2 specified in PTI 166-11. The compliance testing was performed by Derenzo and Associates, Inc. (Derenzo and Associates) and Prism Analytical Technologies, Inc. (PATI). PATI representative Ms. Lindsey Wells and Derenzo and Associates representatives Robert Harvey, Patrick Triscari, and Andrew Rusnak performed the field sampling and measurements May 13 – 14, 2014.

The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan that was reviewed and approved by the MDEQ in the March 18, 2014 test plan approval letter. MDEQ representatives Mr. Tom Gasloli, and Mr. Dan McGeen observed portions of the testing project.

Questions regarding this emission test report should be directed to:

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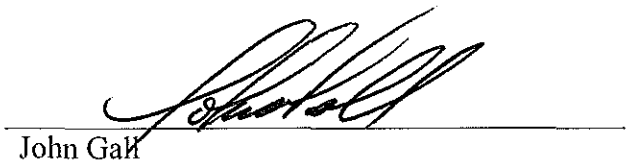
Report Certification

I certify under penalty of law that I believe the information provided in this document is true, accurate, and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for knowingly submitting false, inaccurate, or incomplete information.

Report Prepared By:

Andrew Rusnak, QSTI
Senior Environmental Engineer
Derenzo and Associates, Inc.

Responsible Official Certification:



John Gall
District Manager
Waste Management of Michigan, Inc.

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 General Process Description

LFG containing methane is generated in the Venice Park RDF from the anaerobic decomposition of disposed waste materials. The LFG is collected from both active and capped landfill cells using a system of wells (gas collection system). The collected LFG is transferred to the WM landfill gas-to-energy facility where it is treated and used as fuel for the two (2) RICE. Each RICE is connected to an electricity generator that produces electricity that is transferred to the local utility.

2.2 Rated Capacities and Air Emission Controls

The CAT® Model No. G3516 RICE has a rated output of 1,148 brake-horsepower (bhp) and the connected generator has a rated electricity output of 800 kilowatts (kW). The engine is designed to fire low-pressure, lean fuel mixtures (e.g., LFG) and has been equipped with an electronic air-to-fuel ratio controller that monitors engine performance parameters and automatically adjusts the air-to-fuel ratio and ignition timing to maintain efficient fuel combustion.

The engine/generator sets are not equipped with add-on emission control devices. Air pollutant emissions are minimized through the proper operation of the gas treatment system and efficient fuel combustion in the engines.

The fuel consumption rate is regulated automatically to maintain the heat input rate required to support engine operations and is dependent on the fuel heat value (methane content) of the treated LFG.

2.3 Sampling Locations

The RICE exhaust gas is directed through mufflers and is released to the atmosphere through dedicated vertical exhaust stacks with vertical release points. The two (2) CAT® Model G3516 RICE exhaust stacks are identical.

The exhaust stack sampling ports for the CAT® Model G3516 engines (EUWMENGINE1 and 2) are located in individual vertical exhaust stacks (located after the engine silencer) with an inner diameter of 11.75 inches. Each stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location greater than 120 inches (>10.2 duct diameters) upstream and 36.0 inches (3.0 duct diameters) downstream from any flow disturbance and satisfies the USEPA Method 1 criteria for a representative sample location.

Individual traverse points were determined in accordance with USEPA Method 1.

Appendix 1 provides diagrams of the emission test sampling locations.

3.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS

3.1 Purpose and Objective of the Tests

The conditions of PTI No. 166-11 (PTI has not been incorporated into ROP) require the WM Venice Park RDF facility to test one or more RICE (EUWMENGINE1 and 2) for carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOCs), particulate matter with diameters less than 2.5 microns ($PM_{2.5}$) and formaldehyde upon request from the MDEQ. The MDEQ provided WM a written notice that each RICE (EUWMENGINE1 and 2) shall be sampled for CO, NO_X, VOC, $PM_{2.5}$ and formaldehyde emissions and exhaust gas oxygen (O_2) and carbon dioxide (CO_2) content.

3.2 Operating Conditions During the Compliance Tests

The testing was performed while the engine/generator sets were operated at maximum operating conditions (800 kW electricity output +/- 10%). WM representatives provided the kW output in 15-minute increments for each test period. The RICE generator kW output ranged between 758 and 788 kW during the test periods.

Fuel flowrate (cubic feet per minute) and fuel methane content (%) were also recorded by WM representatives in 15-minute increments for each test period. The RICE fuel consumption rate ranged between 260 and 281 scfm and fuel methane content ranged between 51.3 and 52.5% during the test periods.

Appendix 2 provides operating records provided by WM representatives for the test periods.

A lower heating value of 910 Btu/scf was used to calculate the LFG heating value.

Table 3.1 presents a summary of the average engine operating conditions during the test periods.

3.3 Summary of Air Pollutant Sampling Results

The gases exhausted from the sampled LFG fueled RICE were each sampled for three (3) one-hour test periods during the NO_x, CO, VOC and formaldehyde compliance testing performed May 13, 2014. The gases exhausted from the sampled LFG fueled RICE were each sampled for three (3) one-hour test periods during the $PM_{2.5}$ compliance testing performed May 13 – 14, 2014 (i.e., some of the $PM_{2.5}$ test runs were conducted concurrently with sampling for the other pollutants on May 13, 2014 and the remainder of the $PM_{2.5}$ test runs were completed on May 14, 2014).

Table 3.2 presents the average measured CO, NO_X, VOC, $PM_{2.5}$ and formaldehyde emission rates for the engines (average of the three test periods for each engine) and applicable emission limits.

Results of the engine performance tests demonstrate compliance with emission limits specified in PTI No. 166-11.

Test results for each one hour sampling period and comparison to the permitted emission rates are presented in Section 6.0 of this report.

Table 3.1 Average engine operating conditions during the test periods

Emission Unit	Gen. Output (kW)	Fuel Use (scfm)	LFG CH_4 Content (%)	LFG Btu Content (Btu/scf)	Exhaust Temp. (°F)	Air to Fuel Ratio	Inlet Press. (psi)
EUWMENGINE1	771	272	52.3	476	677	7.57	30.8
EUWMENGINE2	772	275	52.1	474	664	7.55	31.0

Note: Values presented in Table 3.1 were measured during the 5/13/14 instrumental analyzer testing.

Table 3.2 Average measured emission rates for each tested WM Venice Park RDF RICE (three-test average)

Emission Unit	CO Emission Rates (lb/hr)	NO_x Emission Rates (lb/hr)	VOC Emission Rates (lb/hr)	$PM_{2.5}$ Emission Rates (lb/hr)	Formaldehyde Emission Rates (lb/hr)
EUWMENGINE1	4.25	3.30	0.83	0.04	0.58
EUWMENGINE2	4.29	3.57	0.84	0.03	0.60
Emission Limit	7.85	5.06	1.14	0.51	0.68

Note: VOC emission rate includes emissions of formaldehyde.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test protocol for the air emission testing was reviewed and approved by the MDEQ. This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

4.1 Summary of Sampling Methods

USEPA Method 2	Exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube.
USEPA Method 3A	Exhaust gas O_2 and CO_2 content was determined using zirconia ion/paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 4	Exhaust gas moisture was determined based on the water weight gain in chilled impingers.
USEPA Method 7E	Exhaust gas NOx concentration was determined using a chemiluminescence instrumental analyzer.
USEPA Method 10	Exhaust gas CO concentration was measured using a NDIR instrumental analyzer.
USEPA Method 5/202	Exhaust gas $PM_{2.5}$ concentration was measured using an isokinetic sample train for filterable and condensable particulate matter.
USEPA Method 320	Exhaust gas formaldehyde concentration was measured using a FTIR spectrometer analyzer.
USEPA Method ALT-096	Exhaust gas VOC (as NMHC) concentration was determined using a flame ionization analyzer equipped with a GC column.

4.2 Exhaust Gas Velocity Determination (USEPA Method 2)

The RICE exhaust stack gas velocities and volumetric flow rates were determined using USEPA Method 2 prior to and after each instrumental analyzer test (for NO_x, CO, VOC and formaldehyde mass emission calculations). The RICE exhaust stack gas velocity and volumetric flowrate was also determined using USEPA Method 2 during each isokinetic run (for $PM_{2.5}$ mass emission calculations). An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each traverse point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the Pitot tube. The Pitot tube and connective tubing were periodically leak-checked to verify the integrity of the measurement system.

The absence of significant cyclonic flow for the exhaust configuration was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point 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 exhaust gas flowrate calculations and field data sheets.

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

CO_2 and O_2 content in the RICE exhaust gas streams were measured continuously throughout each test period in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a Servomex 4900 single beam single wavelength (SBSW) infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 4900 gas analyzer that uses a paramagnetic sensor.

During each sampling period, a continuous sample of the engine exhaust gas stream was extracted from the stack using a stainless steel probe connected to a Teflon® heated sample line. The sampled gas was conditioned by removing moisture prior to being introduced to the analyzers; therefore, measurement of O_2 and CO_2 concentrations correspond to standard dry gas conditions. Instrument response data were recorded using an ESC Model 8816 data acquisition system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages.

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.

Appendix 4 provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix 5.

4.4 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the RICE exhaust gas was determined in accordance with USEPA Method 4 (as part of the USEPA Method 5/202 sample train) using a chilled impinger sampling train. During each sampling period a gas sample was extracted at an isokinetic rate from the source where moisture was removed from the sampled gas stream using impingers that were submersed in an ice bath. At the conclusion of each sampling period, the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

4.5 NO_x and CO Concentration Measurements (USEPA Methods 7E and 10)

NO_X and CO pollutant concentrations in the RICE exhaust gas streams were determined using a Thermo Environmental Instruments, Inc. (TEI) Model 42c High Level chemiluminescence NO_X analyzer and a TEI Model 48c infrared CO analyzer.

Throughout each test period, a continuous sample of the engine exhaust gas was extracted from the stack using the Teflon® heated sample line and gas conditioning system and delivered to the instrumental analyzers. Instrument response for each analyzer was recorded on an ESC Model 8816 data acquisition system that logged data as one-minute averages. 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.

Appendix 4 provides CO and NO_X calculation sheets. Raw instrument response data are provided in Appendix 5.

4.6 Measurement of Volatile Organic Compounds (USEPA Method ALT-096)

VOC emission rate was determined by measuring the nonmethane hydrocarbon (NMHC) concentration in the exhaust gas for each RICE. NMHC pollutant concentration was determined using TEI Model 55i Methane / Nonmethane hydrocarbon analyzer.

Throughout each one-hour test period, a continuous sample of the engine exhaust gas was extracted from the stack using the Teflon® heated sample line described in Section 4.3 of this document, and delivered to the instrumental analyzer. The sampled gas was not conditioned prior to being introduced to the analyzer; therefore, the measurement of NMHC concentration corresponds to standard wet gas conditions. Instrument NMHC (VOC) response for the analyzer was recorded on an ESC Model 8816 data logging system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages. Prior to, and at the conclusion of each test, the instrument was calibrated using mid-range calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document).

Appendix 4 provides VOC calculation sheets. Raw instrument response data for the NMHC analyzer is provided in Appendix 5.

4.7 Measurement of Total Particulate Matter Emissions (USEPA Method 5/202)

4.7.1 Filterable Particulate Matter Sample Train (USEPA Method 5)

Filterable PM was determined using USEPA Method 5. Exhaust gas was withdrawn from the exhaust stack at an isokinetic sampling rate using an appropriately-sized glass sample nozzle and heated probe. The collected exhaust gas was passed through a pre-tared glass fiber filter that was housed in a heated filter box. The back half of the filter housing was connected directly to the condensable PM impinger train.

4.7.2 Condensable Particulate Matter Sample Train (USEPA Method 202)

Condensable PM (CPM) concentrations were measured in accordance with USEPA Method 202. Following the Method 5 filter assembly, the sample gas travelled through an impinger train which consisted of an inline condenser, a knock-out impinger, a standard Greenberg-Smith (G-S) impinger (dry), a Teflon-coated CPM filter (with exhaust thermocouple), a modified G-S impinger containing 100 milliliters of deionized water, and a modified G-S impinger containing a known amount of indicating silica gel.

The CPM components of the Method 202 sampling train (dry knockout impinger and dry GS impinger) were placed in a tempered water bath and a pump was used to circulate water through the condenser. Crushed ice was used to maintain the temperature of the bath such that the CPM filter outlet temperature was between 65 and 85°F. Crushed ice was placed around the last two impingers to chill the gas to below 65°F.

4.7.3 Sample Recovery and Analysis (USEPA Method 5/202)

At the conclusion of each one-hour test period, the sample train was leak-checked and disassembled. The sample nozzle, glass probe liner, and filter holder were brushed and rinsed with acetone. The recovered particulate filter and acetone rinses were stored in sealed containers and sent to Bureau Veritas North America, Inc. (Novi, Michigan) for gravimetric measurements.

The impingers were transported to the recovery area where they were weighed. The exhaust gas contained significant amounts of moisture. Therefore, prior to recovery, the CPM portion of the sample train underwent the nitrogen purge step of Method 202. The glassware (between the particulate filter and CPM filter) was rinsed with DI water, acetone and hexane in accordance with the Method 202 sample recovery procedures. The CPM filter and recovered rinses were clearly and uniquely labeled and transferred to Bureau Veritas North America, Inc. for analysis.

The $PM_{2.5}$ sampling periods were performed simultaneous with some of the gaseous pollutant test periods and also as independent test runs. Diluent gas content (Method 3A O_2 and CO_2) measurements were performed with each of the $PM_{2.5}$ sampling periods.

Appendix 3 provides $PM_{2.5}$ calculation sheets. The $PM_{2.5}$ laboratory report is provided in Appendix 6.

4.8 Measurement of Formaldehyde Emissions (USEPA Method 320)

The concentration of formaldehyde in the RICE exhaust gas was determined by Extractive Fourier Transform Infrared (FTIR) using a MKS Multi-Gas 2030 FTIR spectrometer. Formaldehyde measurements were performed by Ms. Lindsey Wells of Prism Analytical Technologies, Inc.

Throughout each one-hour test period, a continuous sample of the engine exhaust gas was extracted from the stack using a Teflon® heated sample line and heated particulate filter, and delivered to the instrumental analyzer. The sampled gas was not conditioned prior to being introduced to the analyzer; therefore, the measurement of formaldehyde concentration corresponds to standard wet gas conditions. Instrument formaldehyde response for the analyzer was recorded with a data logging system that monitored the analog output of the instrumental analyzer continuously and logged data as one-minute averages. Prior to, and at the conclusion of each test, analyte spiking was performed to to verify the ability of the sampling system to quantitatively deliver a sample from the base of the probe to the FTIR (described in Appendix 7).

Appendix 4 provides formaldehyde calculation sheets. The formaldehyde report prepared by PATI is provided in Appendix 7.

5.0 QA/QC ACTIVITIES

5.1 NO_x Converter Efficiency Test

The NO_2 – NO conversion efficiency of the Model 42c analyzer was verified prior to the testing program. A USEPA Protocol 1 certified concentration of NO_2 was injected directly into the analyzer, following the initial three-point calibration, to verify the analyzer's conversion efficiency. The analyzer's NO_2 – NO converter uses a catalyst at high temperatures to convert the NO_2 to NO for measurement. The conversion efficiency of the analyzer is deemed acceptable if the measured NO_2 concentration is within 90% of the expected value.

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_2 concentration was -8.52% of the expected value, i.e., within 10% of the expected value as required by Method 7E).

5.2 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 42c analyzer exhibited the longest system response time at 65 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.

5.3 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 (on December 20, 2013) 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.

5.4 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure NO_X, CO, O_2 and CO_2 have had an interference response test preformed prior to their use in the field (July 26, 2006, June 21, 2011 and April 3, 2012), 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.

5.5 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 NO_x, CO, CO_2 and O_2 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.

At the beginning of each test day, appropriate high-range, mid-range, and low-range span gases followed by a zero gas were introduced to the NMHC analyzer, in series at a tee connection, which is installed between the sample probe and the particulate filter, through a poppet check valve. After each one hour test period, mid-range and zero gases were re-introduced in series at the tee connection in the sampling system to check against the method's performance specifications for calibration drift and zero drift error.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO_2, O_2, NO_x, and CO in nitrogen and zeroed using hydrocarbon free nitrogen. The NMHC (VOC) instrument was calibrated with USEPA Protocol 1 certified concentrations of propane in air and zeroed using hydrocarbon-free air. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

5.6 Determination of Exhaust Gas Stratification

A stratification test for each IC engine exhaust stack was performed during the performance test sampling periods. The stainless steel sample probe was positioned at sample points correlating to 16.7, 50.0 (centroid) and 83.3% of 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 IC engine exhaust stack gas indicate that the measured CO, NO_x, O_2 and CO_2 concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the stack gas of each IC engine was considered to be unstratified and the compliance test sampling was performed at a single sampling location within each IC engine exhaust stack.

5.7 Meter Box Calibrations

The Nutech Model 2010 sampling console, which was used for exhaust gas moisture content sampling, was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5.

The digital pyrometer in the Nutech metering consoles were calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

5.8 Particulate Matter Recovery and Analysis

All recovered particulate matter samples were stored and shipped in pre-rinsed glass sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with a permanent marker prior to shipment and the caps were secured closed with tape. Samples of the reagents used in the test event (200 milliliters each of deionized high-purity water, acetone and hexane) were sent to the laboratory for analysis to verify that the reagents used to recover the samples have low particulate matter residues.

The glassware used in the condensable PM impinger trains was washed and rinsed prior to use in accordance with the procedures of USEPA Method 202. The glassware was not baked prior to use; therefore, Derenzo and Associates used the field train proof blank option provided in USEPA Method 202. Analysis of the collected field train proof blank rinses (sample train rinse performed prior to use) indicated a total of 1.0 milligrams (mg) of recovered PM from the sample train. In addition, a field train recovery proof blank was performed following the second

sampling period. Analysis of the field train recovery proof blank resulted in 3.1 mg of recovered PM from the sample train. The reported condensable PM test results were blank-corrected (USEPA Method 202 allows a blank correction of up to 2 mg).

5.9 Laboratory QA/QC Procedures

The laboratory particulate matter analyses were conducted by a qualified third-party laboratory according to the appropriate QA/QC procedures specified in the associated USEPA test methods and are included in the final report provided by Bureau Veritas N.A. (Novi, Michigan).

Appendix 8 presents test equipment quality assurance data (NO_2 – NO conversion efficiency test data, instrument calibration and system bias check records, calibration gas and gas divider certifications, interference test results, meter box calibration records, stratification checks, cyclonic flow determinations sheets, Pitot tube and probe assembly calibration records).

6.0 RESULTS

6.1 Test Results and Allowable Emission Limits

Engine operating data and air pollutant emission measurement results for each one hour test period are presented in Tables 6.1 through 6.4.

The measured air pollutant concentrations and emission rates for Engine Nos. 1 and 2 (EUWMENGINE1 and 2) are less than the allowable limits specified in PTI No. 166-11 for the engines:

- 5.06 lb/hr for NO_X;
- 7.85 lb/hr for CO;
- 0.51 lb/hr for $PM_{2.5}$;
- 0.68 lb/hr for formaldehyde; and
- 1.14 lb/hr for VOC (including formaldehyde).

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with the approved test protocols. The engine-generator sets were operated within 10% of maximum output and no variations from the normal operating conditions of the RICE occurred during the engine test periods.

Table 6.1 Measured exhaust gas conditions and NO_x, CO, VOC and formaldehyde air pollutant emission rates Venice Park RDF Engine No. 1 (EUWMENGINE1)

Test No.	1	2	3	
Test date	5/13/14	5/13/14	5/13/14	Three Test
Test period (24-hr clock)	833 - 933	1008 - 1108	1137 - 1237	Average
Fuel flowrate (scfm)	271	274	271	272
Generator output (kW)	771	773	769	771
LFG methane content (%)	52.3	52.2	52.3	52.3
LFG LHV heat content (Btu/scf)	476	475	476	476
Air / Fuel Ratio	7.49	7.57	7.65	7.57
Inlet Pressure (psi)	30.6	30.8	31.0	30.8
Exhaust Gas Composition				
CO_2 content (% vol)	10.4	12.3	12.2	11.6
O_2 content (% vol)	8.99	6.76	6.83	7.53
Moisture (% vol)	14.5	14.4	13.6	14.2
Exhaust gas temperature (°F)	683	682	670	677
Exhaust gas flowrate (dscfm)	1,940	1,959	1,972	1,957
Exhaust gas flowrate (scfm)	2,269	2,278	2,282	2,276
Nitrogen Oxides				
NO_X conc. (ppmvd)	225	244	237	235
NO_X emissions (lb/hr)	3.13	3.42	3.36	3.30
Permitted emissions (lb/hr)	-	-	-	5.06
Carbon Monoxide				
CO conc. (ppmvd)	444	525	523	497
CO emissions (lb/hr)	3.76	4.49	4.50	4.25
Permitted emissions (lb/hr)	-	-	-	7.85
Volatile Organic Compounds				
VOC conc. (ppmv)	14.3	16.6	17.1	16.0
VOC emissions (lb/hr)	0.22	0.26	0.27	0.25
VOC emissions w/HCOH (lb/hr)	0.80	0.84	0.85	0.83
Permitted emissions (lb/hr)	-	-	-	1.14
Formaldehyde				
HCOH conc. (ppmv)	54.0	54.5	54.9	54.5
HCOH emissions (lb/hr)	0.57	0.58	0.59	0.58
Permitted emissions (lb/hr)	-	-	-	0.68

Table 6.2 Measured exhaust gas conditions and $PM_{2.5}$ air pollutant emission rates Venice Park RDF Engine No. 1 (EUWMENGINE1)

Test No.	1	2	3	
Test date	5/13/14	5/13/14	5/14/14	Three Test
Test period (24-hr clock)	843 - 1035	1147 - 1258	1236 – 1346	Average
Fuel flowrate (scfm)	271	271	272	271
Generator output (kW)	771	769	775	772
LFG methane content (%)	52.3	52.3	51.8	52.1
LFG LHV heat content (Btu/scf)	476	476	471	474
Air / Fuel Ratio	7.49	7.65	7.50	7.55
Inlet Pressure (psi)	30.6	31.0	30.3	30.6
Exhaust Gas Composition				
CO_2 content (% vol)	10.4	12.2	12.6	11.7
O_2 content (% vol)	8.99	6.83	6.49	7.44
Moisture (% vol)	14.5	14.4	13.6	14.2
Exhaust gas temperature (°F)	685	692	713	697
Exhaust gas flowrate (dscfm)	2,026	2,046	2,060	2,044
Exhaust gas flowrate (scfm)	2,370	2,392	2,384	2,382
Particulate Matter				
Sampled Volume (dscf)	56.2	55.2	56.4	55.9
Total Filterable Catch (mg)	5.6	2.6	3.3	3.8
Filterable Emission Rate (lb/hr)	0.03	0.01	0.02	0.02
Total CPM Catch (mg)	3.1	9.9	2.3	5.1
CPM Emission Rate (lb/hr)	0.01	0.05	0.01	0.02
Total $PM_{2.5}$ Emission Rate (lb/hr)	0.04	0.06	0.03	0.04
Permitted emissions (lb/hr)	-	-	-	0.51

Table 6.3 Measured exhaust gas conditions and NO_x, CO, VOC and formaldehyde air pollutant emission rates Venice Park RDF Engine No. 2 (EUWMENGINE2)

Test No.	1	2	3	
Test date	5/13/14	5/13/14	5/13/14	Three Test
Test period (24-hr clock)	1543 - 1643	1809 - 1909	1935 - 2035	Average
Fuel flowrate (scfm)	275	275	276	275
Generator output (kW)	772	769	774	772
LFG methane content (%)	52.2	52.1	52.0	52.1
LFG LHV heat content (Btu/scf)	475	474	473	474
Air / Fuel Ratio	7.59	7.52	7.55	7.55
Inlet Pressure (psi)	31.1	30.7	31.1	31.0
Exhaust Gas Composition				
CO_2 content (% vol)	12.9	12.9	12.8	12.9
O_2 content (% vol)	6.15	6.19	6.26	6.20
Moisture (% vol)	14.4	13.0	13.0	13.4
Exhaust gas temperature (°F)	662	663	666	664
Exhaust gas flowrate (dscfm)	1,967	2,004	1,995	1,989
Exhaust gas flowrate (scfm)	2,279	2,302	2,292	2,291
Nitrogen Oxides				
NO_X conc. (ppmvd)	251	243	257	250
NO_X emissions (lb/hr)	3.54	3.48	3.67	3.57
Permitted emissions (lb/hr)	-	-	-	5.06
Carbon Monoxide				
CO conc. (ppmvd)	497	494	491	494
CO emissions (lb/hr)	4.27	4.32	4.27	4.29
Permitted emissions (lb/hr)	-	-	-	7.85
Volatile Organic Compounds				
VOC conc. (ppmv)	15.6	14.9	15.4	15.3
VOC emissions (lb/hr)	0.24	0.24	0.24	0.24
VOC emissions w/HCOH (lb/hr)	0.85	0.84	0.84	0.84
Permitted emissions (lb/hr)	-	-	-	1.14
Formaldehyde				
HCOH conc. (ppmv)	56.6	56.1	56.0	56.2
HCOH emissions (lb/hr)	0.60	0.60	0.60	0.60
Permitted emissions (lb/hr)	-	-	-	0.68

Table 6.4 Measured exhaust gas conditions and $PM_{2.5}$ air pollutant emission rates Venice Park RDF Engine No. 2 (EUWMENGINE2)

Test No.	1	2	3	
Test date	5/13/14	5/14/14	5/14/14	Three Test
Test period (24-hr clock)	1831 - 1946	742 - 943	1033 – 1145	Average
Fuel flowrate (scfm)	275	274	277	275
Generator output (kW)	769	774	781	775
LFG methane content (%)	52.1	51.4	51.4	51.6
LFG LHV heat content (Btu/scf)	474	468	468	470
Air / Fuel Ratio	7.52	7.59	7.61	7.57
Inlet Pressure (psi)	30.7	31.2	31.5	31.1
Exhaust Gas Composition				
CO_2 content (% vol)	12.9	12.6	12.5	12.7
O_2 content (% vol)	6.19	6.55	6.51	6.42
Moisture (% vol)	14.5	14.4	13.6	14.2
Exhaust gas temperature (°F)	700	705	701	702
Exhaust gas flowrate (dscfm)	2,023	2,084	2,088	2,065
Exhaust gas flowrate (scfm)	2,361	2,395	2,399	2,385
Particulate Matter				
Sampled Volume (dscf)	57.1	56.3	57.1	56.8
Total Filterable Catch (mg)	3.2	2.5	4.6	3.4
Filterable Emission Rate (lb/hr)	0.02	0.01	0.02	0.02
Total CPM Catch (mg)	1.9	2.4	4.8	3.0
CPM Emission Rate (lb/hr)	0.01	0.01	0.02	0.01
Total $PM_{2.5}$ Emission Rate (lb/hr)	0.03	0.02	0.05	0.03
Permitted emissions (lb/hr)	-	-	-	0.51