Derenzo and Associates, Inc.
Environmental Consultants

AIR EMISSION TEST REPORT

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Title	AIR EMISSION TEST REPORT FOR THE LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES OPERATED AT PINE TREE ACRES LANDFILL
Report Date	May 28, 2014
Test Dates	April 22 – 25, 2014

Facility Information	
Name	Sumpter Energy Associates
Street Address	Pine Tree Acres Landfill 36450 29-Mile Rd.
City, County	Lenox Township, Macomb
SRN	N8004

Facility Permit Information	
Renewable Operating Permit No.	MI-ROP-N8004-2013
Emission Unit ID:	EUENGINE1 through EUENGINE7

Testing Contractor	
Company	Derenzo and Associates, Inc.
Mailing Address	39395 Schoolcraft Road Livonia, MI 48150
Phone	(734) 464-3880
Project No.	1401023

AIR EMISSION TEST REPORT
FOR THE
LANDFILL GAS FUELED
INTERNAL COMBUSTION ENGINES
OPERATED AT
PINE TREE ACRES LANDFILL

1.0 INTRODUCTION

Sumpter Energy Associates (SEA) operates seven (7) Caterpillar (CAT®) Model No. 3516 landfill gas (LFG) fueled reciprocating internal combustion engines (RICE) at its LFG-to-energy facility located at the Pine Tree Acres Landfill in Lenox Township, Macomb County, Michigan (SEA Pine Tree LFGTE, Facility, SRN N8004). The SEA Pine Tree LFGTE facility has been issued Renewable Operating Permit (ROP) No. MI-ROP-N8004-2013 by the Michigan Department of Environmental Quality (MDEQ).

The CAT® Model No. G3516 engines are identified in ROP No. MI-ROP-N8004-2013 as Emission Unit EUENGINE1 through EUENGINE7 (Flexible Group ID: FGENGINES). Air emission compliance testing was performed to demonstrate compliance with FGENGINES Special Condition No. V.6. of ROP No. MI-ROP-N8004-2013 which states:

> *Within 180 days after the issuance of this permit, the permittee shall verify NO_x, CO, and NMOC emission rates from EUENGINE1 through EUENGINE7...*

The compliance testing was performed by Derenzo and Associates, Inc. (Derenzo and Associates), a Michigan-based environmental consulting and testing company. Derenzo and Associates representatives Tyler Wilson and Jason Logan performed the field sampling and measurements April 22 – 25, 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 17, 2014 test plan approval letter. MDEQ representatives Mr. Mark Dziadosz and Mr. Sebastian Kallumkal observed portions of the testing project.

Questions regarding this emission test report should be directed to:

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Report Certification

This test report was prepared by Derenzo, Associates, Inc. based on field sampling data collected by Derenzo and Associates, Inc. Facility process data were collected and provided by Sumpter Energy employees or representatives. This test report has been reviewed by Sumpter Energy representatives and approved for submittal to the Michigan Department of Environmental Quality.

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:

Tyler J. Wilson
Environmental Consultant
Derenzo and Associates, Inc.

Reviewed By:

Robert L. Harvey, P.E.
General Manager
Derenzo and Associates, Inc.

I certify that the facility operating conditions were in compliance with permit requirements or were at the maximum routine operating conditions for the facility. Based on information and belief formed after reasonable inquiry, the statements and information in this report are true, accurate and complete.

Responsible Official Certification:

Dennis Plaster
Vice President of Operations
Landfill Energy Systems

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 General Process Description

LFG containing methane is generated in the Pine Tree Acres Landfill 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 SEA Pine Tree LFGTE facility where it is treated and used as fuel for the seven (7) 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. 3516 RICE generator set has a rated output of 1,138 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 employs lean-burn technology for efficient fuel combustion and to minimize emissions. The air-to-fuel ratio is set based on the gas quality (methane or heat content) of the treated fuel for the most efficient combustion. Exhaust gas is released directly to atmosphere through a noise muffler and vertical exhaust stack.

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.

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 seven (7) CAT® Model 3516 RICE exhaust stacks are identical.

The exhaust stack sampling ports for the CAT® Model 3516 engines (EUENGINE1 through 7) are located in individual exhaust stacks with an inner diameter of 12.0 inches. Each stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location 18.0 inches (1.5 duct diameters) upstream and 58.0 inches (4.8 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 A 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 ROP No. MI-ROP-N8004-2013 require Sumpter Energy to test each RICE (EUENGINE1 through 7) for carbon monoxide (CO), nitrogen oxides (NOx) and non-methane organic compound (NMOC) emissions within 180 days after issuance of the ROP (the permit was issued December 9, 2013). Measurements were performed for each RICE exhaust to determine CO, NO_X and NMOC concentrations, diluent gas content (oxygen and carbon dioxide) and volumetric flowrate.

3.2 Operating Conditions During the Compliance Tests

The testing was performed while the engine/generator sets were operated within at least 10% of maximum rated capacity of 800 kW electricity output. Sumpter Energy representatives provided kW output data at 15-minute intervals for each test period. The RICE generator kW output ranged between 760 and 770 kW during the test periods (95% of maximum capacity or greater).

Fuel flowrate (cubic feet per minute) and fuel methane content (%) were also recorded by Sumpter Energy representatives in 15-minute increments for each test period. The RICE fuel consumption rate ranged between 258 and 276 scfm and fuel methane content ranged between 49.5 and 51.1% during the test periods. A lower heating value of 910 Btu/scf was used to calculate the LFG heating value (Btu/scf LHV) based on the methane content.

Appendix B provides operating records provided by Sumpter Energy representatives for the test periods.

Engine output (bhp) cannot be measured directly and was calculated based on the recorded electricity output, the calculated CAT® Model 3516 generator efficiency (93.9%), and the unit conversion factor for kW to horsepower (0.7457 kW/hp).

$$\text{Engine output (bhp)} = \text{Electricity output (kW)} / (0.939) / (0.7457 \text{ kW/hp})$$

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 seven (7) LFG fueled RICE generator sets were each sampled for three (3) one-hour test periods during the compliance testing performed April 22 – 25, 2014.

Table 3.2 presents the average measured CO, NO_X and NMOC 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 ROP No. MI-ROP-N8004-2013. Test results for each one hour sampling period 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)	Engine Output (bHp)	Fuel Use (scfm)	LFG CH_4 Content (%)	LFG Btu Content (Btu/scf)	Exhaust Temp. (°F)	Inlet Press. (psi)
EUENGINE1	761	1,087	272	54.0	491	764	5.75
EUENGINE2	760	1,085	272	53.9	490	718	4.97
EUENGINE3	760	1,085	267	54.1	492	755	5.40
EUENGINE4	760	1,085	268	51.1	465	711	5.26
EUENGINE5	760	1,085	261	52.0	474	753	5.61
EUENGINE6	760	1,085	271	52.9	482	760	5.16
EUENGINE7	760	1,085	273	53.7	488	715	4.81

Table 3.2 Average measured emission rates for each LFG-fueled RICE generator set (three-test average)

Emission Unit	CO Emission Rates		NOx Emission Rates		NMOC Emission Rates	
	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EUENGINE1	5.6	2.3	2.3	1.0	0.4	0.2
EUENGINE2	6.3	2.6	1.8	0.8	0.4	0.2
EUENGINE3	5.1	2.1	1.7	0.7	0.5	0.2
EUENGINE4	5.1	2.2	1.3	0.5	0.4	0.2
EUENGINE5	5.2	2.2	1.3	0.5	0.5	0.2
EUENGINE6	5.2	2.2	1.5	0.6	0.4	0.2
EUENGINE7	5.1	2.1	1.4	0.6	0.4	0.2
Total	**37.6**	**2.2**	**11.1**	**0.7**	**3.0**	**0.2**
Emission Limit	51.1	-	35.2	-	8.8	-

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A protocol for the air emission testing was reviewed and approved by the MDEQ-AQD. 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 1	Exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1
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 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 an NDIR instrumental analyzer.
USEPA Method 25A /ALT-096	Exhaust gas NMOC (as NMHC) concentration was determined using a flame ionization analyzer equipped with an internal methane separation GC column.

4.2 Exhaust Gas Velocity Determination (USEPA Methods 1 and 2)

The RICE exhaust stack gas velocity and volumetric flow rate was determined using USEPA Method 2 prior to and after each test. 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 C 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 stream was measured continuously throughout each test period in accordance with USEPA Method 3A. The exhaust gas CO_2 content was monitored using a Servomex 4900 single beam single wavelength (SBSW) infrared gas analyzer. The exhaust gas O_2 content was monitored using a paramagnetic sensor within the Servomex 4900 gas analyzer.

During each sampling period, a continuous sample of the RICE 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 D provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix E.

4.4 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the RICE exhaust gas was determined in accordance with USEPA Method 4 using a chilled impinger sampling train. The moisture sampling was performed concurrently with the instrumental analyzer sampling. During each sampling period a gas sample was extracted at a constant 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 heated sample line and gas conditioning system described previously in this section. 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 D provides CO and NO_X calculation sheets. Raw instrument response data are provided in Appendix E.

4.6 Measurement of NMOCs (USEPA Method ALT-096)

The NMOC emission rate was determined by measuring the nonmethane hydrocarbon (NMHC) concentration in the RICE exhaust gas. NMHC pollutant concentration was determined using a TEI Model 55i Methane / Nonmethane hydrocarbon analyzer. The TEI 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components. The concentration of NMHC in the sampled gas stream, after separation from methane, is determined relative to a propane standard using a flame ionization detector in accordance with USEPA Method 25A.

The USEPA Office of Air Quality Planning and Standards (OAQPS) has issued several alternate test methods approving the use of the TEI 55-series analyzer as an effective instrument for measuring NMOC from gas-fueled RICE in that it uses USEPA Method 25A and 18 (ALT-066, ALT-078 and ALT-096).

Samples of the exhaust gas were delivered directly to the instrumental analyzer using the Teflon® heated sample line to prevent condensation. The sample to the NHMC analyzer was not conditioned to remove moisture. Therefore, NMOC measurements correspond to standard conditions with no moisture correction (wet basis).

The instrumental analyzer was calibrated using certified propane concentrations in hydrocarbon-free air to demonstrate detector linearity and determine calibration drift and zero drift error.

Appendix D provides NMOC calculation sheets. Raw instrument response data for the NMOC analyzer is provided in Appendix E.

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 -5.70% 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 75 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 (NMOC) 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 was performed for two (2) of the seven (7) identical RICE exhaust stacks. 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 concentration data for both RICE exhaust stacks indicate that the measured CO, O_2 and CO_2 concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the RICE exhaust gas was considered to be unstratified and the compliance test sampling was performed at a single sampling location within each RICE 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.

Appendix F 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 <u>RESULTS</u>

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 6.7. The serial number (SN) for each RICE is presented at the top of each table.

The measured total combined air pollutant concentrations and emission rates for Engine Nos. 1 through 7 (EUENGINE1 through 7) are less than the allowable limits specified in ROP No. MI-ROP-N8004-2013 for the engines:

- 35.2 lb/hr for NO_X;
- 51.1 lb/hr for CO; and
- 8.8 lb/hr for NMOC.

The permit conditions do not specify individual engine emission limits.

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.

Exhaust gas stratification tests were performed for two (2) of the seven (7) identical RICE exhaust stacks. Mr. Mark Dziadosz of the MDEQ-AQD requested that two (2) of the RICE exhaust stacks be sampled for stratification. Since both RICE (EUENGINE1-2) were considered to be unstratified, Mr. Dziadosz approved single point sampling for all seven (7) of the RICE exhaust stacks.

Table 6.1 Measured exhaust gas conditions and NO_x, CO and NMOC air pollutant emission rates PTA Landfill Engine No. 1 (EUENGINE1), SN: 3RC00663

Test No. Test date Test period (24-hr clock)	1 4/22/14 815 - 915	2 4/22/14 945 - 1045	3 4/22/14 1116 – 1216	Three Test Average
Fuel flowrate (scfm)	273	271	271	272
Generator output (kW)	760	762	762	761
Engine output (bhp)	1,085	1,088	1,088	1,087
LFG methane content (%)	53.5	54.1	54.2	54.0
LFG LHV heat content (Btu/scf)	487	492	493	491
Inlet Pressure (psi)	5.75	5.75	5.75	5.75
<u>Exhaust Gas Composition</u>				
CO_2 content (% vol)	13.0	13.0	13.1	13.0
O_2 content (% vol)	6.80	6.71	6.74	6.75
Moisture (% vol)	13.5	13.4	12.1	13.0
Exhaust gas temperature (°F)	765	764	762	764
Exhaust gas flowrate (dscfm)	2,309	2,368	2,419	2,365
Exhaust gas flowrate (scfm)	2,667	2,712	2,751	2,710
<u>Nitrogen Oxides</u>				
NO_X conc. (ppmvd)	141	127	140	136
NO_X emissions (g/bhp*hr)	1.0	0.9	1.0	1.0
NO_X emissions (lb/hr)	2.3	2.2	1.4	2.3
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	531	545	556	544
CO emissions (g/bhp*hr)	2.2	2.4	2.5	2.3
CO emissions (lb/hr)	5.4	5.6	5.9	5.6
<u>Non-Methane Organic Compounds</u>				
NMOC conc. (ppmv)	21.5	21.5	21.7	21.6
NMOC emissions (g/bhp*hr)	0.17	0.17	0.17	0.17
NMOC emissions (lb/hr)	0.39	0.40	0.41	0.40

Table 6.2 Measured exhaust gas conditions and NO_x, CO and NMOC air pollutant emission rates PTA Landfill Engine No. 2 (EUENGINE2), SN: 4EK00960

Test No. Test date Test period (24-hr clock)	1 4/22/14 1250 - 1350	2 4/22/14 1425 - 1525	3 4/22/14 1600 - 1700	Three Test Average
Fuel flowrate (scfm)	269	274	274	272
Generator output (kW)	760	760	760	760
Engine output (bhp)	1,085	1,085	1,085	1,085
LFG methane content (%)	54.3	53.4	54.0	53.9
LFG LHV heat content (Btu/scf)	494	486	491	490
Inlet Pressure (psi)	5.22	5.00	4.68	4.97
Exhaust Gas Composition				
CO_2 content (% vol)	12.5	12.4	12.3	12.4
O_2 content (% vol)	7.41	7.46	7.62	7.49
Moisture (% vol)	14.6	12.7	12.4	13.2
Exhaust gas temperature (^oF)	718	719	719	718
Exhaust gas flowrate (dscfm)	2,328	2,303	2,414	2,348
Exhaust gas flowrate (scfm)	2,698	2,633	2,756	2,696
Nitrogen Oxides				
NO_X conc. (ppmvd)	154	94.4	81.0	110
NO_X emissions (g/bhp*hr)	1.1	0.7	0.6	0.8
NO_X emissions (lb/hr)	2.6	1.6	1.4	1.8
Carbon Monoxide				
CO conc. (ppmvd)	633	610	588	610
CO emissions (g/bhp*hr)	2.7	2.6	2.6	2.6
CO emissions (lb/hr)	6.4	6.1	6.2	6.3
Non-Methane Organic Compounds				
NMOC conc. (ppmv)	23.5	24.1	23.8	23.8
NMOC emissions (g/bhp*hr)	0.18	0.18	0.19	0.18
NMOC emissions (lb/hr)	0.44	0.44	0.45	0.44

Table 6.3 Measured exhaust gas conditions and NO_x, CO and NMOC air pollutant emission rates PTA Landfill Engine No. 3 (EUENGINE3), SN: 4EK02088

Test No. Test date Test period (24-hr clock)	1 4/24/14 810 - 910	2 4/24/14 945 - 1045	3 4/24/14 1120 – 1220	Three Test Average
Fuel flowrate (scfm)	270	266	264	267
Generator output (kW)	760	760	760	760
Engine output (bhp)	1,085	1,085	1,085	1,085
LFG methane content (%)	53.4	54.2	54.7	54.1
LFG LHV heat content (Btu/scf)	486	493	498	492
Inlet Pressure (psi)	5.40	5.36	5.44	5.40
<u>Exhaust Gas Composition</u>				
CO_2 content (% vol)	13.2	13.3	13.0	13.2
O_2 content (% vol)	6.54	6.39	6.81	6.58
Moisture (% vol)	15.9	14.4	12.8	14.4
Exhaust gas temperature (^oF)	762	758	749	755
Exhaust gas flowrate (dscfm)	2,205	2,225	2,254	2,228
Exhaust gas flowrate (scfm)	2,600	2,575	2,584	2,586
<u>Nitrogen Oxides</u>				
NO_X conc. (ppmvd)	92.8	130	86.8	103
NO_X emissions (g/bhp*hr)	0.6	0.9	0.6	0.7
NO_X emissions (lb/hr)	1.5	2.1	1.4	1.7
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	512	548	509	523
CO emissions (g/bhp*hr)	2.1	2.2	2.1	2.1
CO emissions (lb/hr)	4.9	5.3	5.0	5.1
<u>Non-Methane Organic Compounds</u>				
NMOC conc. (ppmv)	24.3	25.1	26.5	25.3
NMOC emissions (g/bhp*hr)	0.18	0.19	0.20	0.19
NMOC emissions (lb/hr)	0.43	0.44	0.47	0.45

Table 6.4 Measured exhaust gas conditions and NO_x, CO and NMOC air pollutant emission rates PTA Landfill Engine No. 4 (EUENGINE4), SN: 4EK01546

Test No. Test date Test period (24-hr clock)	1 4/24/14 1300 - 1400	2 4/24/14 1435 - 1535	3 4/24/14 1610 – 1710	Three Test Average
Fuel flowrate (scfm)	266	268	269	268
Generator output (kW)	760	760	760	760
Engine output (bhp)	1,085	1,085	1,085	1,085
LFG methane content (%)	54.3	49.6	49.5	51.1
LFG LHV heat content (Btu/scf)	494	451	450	465
Inlet Pressure (psi)	5.55	5.14	5.10	5.26
<u>Exhaust Gas Composition</u>				
CO_2 content (% vol)	12.1	11.8	12.0	12.0
O_2 content (% vol)	7.71	8.01	7.81	7.84
Moisture (% vol)	12.3	12.1	11.6	12.0
Exhaust gas temperature (°F)	718	712	704	711
Exhaust gas flowrate (dscfm)	2,337	2,368	2,369	2,358
Exhaust gas flowrate (scfm)	2,662	2,686	2,679	2,676
<u>Nitrogen Oxides</u>				
NO_X conc. (ppmvd)	79.9	78.8	65.0	74.6
NO_X emissions (g/bhp*hr)	0.6	0.6	0.5	0.5
NO_X emissions (lb/hr)	1.3	1.3	1.1	1.3
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	504	496	499	500
CO emissions (g/bhp*hr)	2.2	2.1	2.2	2.2
CO emissions (lb/hr)	5.1	5.1	5.2	5.1
<u>Non-Methane Organic Compounds</u>				
NMOC conc. (ppmv)	22.5	21.7	22.8	22.3
NMOC emissions (g/bhp*hr)	0.17	0.17	0.18	0.17
NMOC emissions (lb/hr)	0.41	0.40	0.42	0.41

Table 6.5 Measured exhaust gas conditions and NO_x, CO and NMOC air pollutant emission rates PTA Landfill Engine No. 5 (EUENGINE5), SN: 4EK02485

Test No. Test date Test period (24-hr clock)	1 4/25/14 850 - 950	2 4/25/14 1030 - 1130	3 4/25/14 1210 - 1310	 Three Test Average
Fuel flowrate (scfm)	263	260	262	261
Generator output (kW)	760	760	760	760
Engine output (bhp)	1,085	1,085	1,085	1,085
LFG methane content (%)	51.7	52.3	52.1	52.0
LFG LHV heat content (Btu/scf)	470	476	474	474
Inlet Pressure (psi)	5.72	5.72	5.40	5.61
Exhaust Gas Composition				
CO_2 content (% vol)	12.5	12.2	12.1	12.3
O_2 content (% vol)	7.38	7.69	7.76	7.61
Moisture (% vol)	13.1	13.1	11.9	12.7
Exhaust gas temperature (^oF)	750	751	756	753
Exhaust gas flowrate (dscfm)	2,308	2,380	2,418	2,369
Exhaust gas flowrate (scfm)	2,657	2,722	2,746	2,708
Nitrogen Oxides				
NO_X conc. (ppmvd)	81.7	82.4	57.0	73.7
NO_X emissions (g/bhp*hr)	0.6	0.6	0.4	0.5
NO_X emissions (lb/hr)	1.4	1.4	1.0	1.3
Carbon Monoxide				
CO conc. (ppmvd)	518	507	490	505
CO emissions (g/bhp*hr)	2.2	2.2	2.2	2.2
CO emissions (lb/hr)	5.2	5.3	5.2	5.2
Non-Methane Organic Compounds				
NMOC conc. (ppmv)	26.7	25.8	27.0	26.5
NMOC emissions (g/bhp*hr)	0.20	0.20	0.21	0.21
NMOC emissions (lb/hr)	0.49	0.48	0.51	0.49

Table 6.6 Measured exhaust gas conditions and NO_x, CO and NMOC air pollutant emission rates PTA Landfill Engine No. 6 (EUENGINE6), SN: 4EK01551

Test No. Test date Test period (24-hr clock)	1 4/23/14 900 - 1000	2 4/23/14 1040 - 1140	3 4/23/14 1215 – 1315	Three Test Average
Fuel flowrate (scfm)	269	271	274	271
Generator output (kW)	760	760	760	760
Engine output (bhp)	1,085	1,085	1,085	1,085
LFG methane content (%)	52.8	53.1	5.29	5.29
LFG LHV heat content (Btu/scf)	480	483	481	482
Inlet Pressure (psi)	5.60	5.18	4.70	5.16
Exhaust Gas Composition				
CO_2 content (% vol)	12.9	12.4	12.2	12.5
O_2 content (% vol)	6.83	7.32	7.56	7.24
Moisture (% vol)	13.2	13.5	13.0	13.2
Exhaust gas temperature (^oF)	759	759	761	760
Exhaust gas flowrate (dscfm)	2,313	2,378	2,420	2,370
Exhaust gas flowrate (scfm)	2,668	2,740	2,781	2,730
Nitrogen Oxides				
NO_X conc. (ppmvd)	124	77.1	56.5	85.80
NO_X emissions (g/bhp*hr)	0.9	0.6	0.4	0.6
NO_X emissions (lb/hr)	2.1	1.3	1.0	1.5
Carbon Monoxide				
CO conc. (ppmvd)	557	486	464	502
CO emissions (g/bhp*hr)	2.4	2.1	2.1	2.2
CO emissions (lb/hr)	5.6	5.0	4.9	5.2
Non-Methane Organic Compounds				
NMOC conc. (ppmv)	18.3	20.3	21.5	20.1
NMOC emissions (g/bhp*hr)	0.14	0.16	0.17	0.16
NMOC emissions (lb/hr)	0.34	0.38	0.41	0.38

Table 6.7 Measured exhaust gas conditions and NO_x, CO and NMOC air pollutant emission rates PTA Landfill Engine No. 7 (EUENGINE7), SN: CTL00644

Test No. Test date Test period (24-hr clock)	1 4/23/14 1350 - 1450	2 4/23/14 1525 - 1625	3 4/23/14 1700 – 1800	Three Test Average
Fuel flowrate (scfm)	273	274	273	273
Generator output (kW)	760	760	760	760
Engine output (bhp)	1,085	1,085	1,085	1,085
LFG methane content (%)	54.1	53.6	53.3	53.7
LFG LHV heat content (Btu/scf)	492	488	485	488
Inlet Pressure (psi)	4.70	4.82	4.90	4.81
Exhaust Gas Composition				
CO_2 content (% vol)	11.9	11.8	11.7	11.8
O_2 content (% vol)	7.87	8.04	8.16	8.02
Moisture (% vol)	12.2	11.7	12.2	12.0
Exhaust gas temperature (^oF)	714	713	715	715
Exhaust gas flowrate (dscfm)	2,258	2,288	2,328	2,292
Exhaust gas flowrate (scfm)	2,565	2,599	2,651	2,605
Nitrogen Oxides				
NO_X conc. (ppmvd)	91.6	85.6	71.2	82.8
NO_X emissions (g/bhp*hr)	0.6	0.6	0.5	0.6
NO_X emissions (lb/hr)	1.5	1.4	1.2	1.4
Carbon Monoxide				
CO conc. (ppmvd)	515	504	498	506
CO emissions (g/bhp*hr)	2.1	2.1	2.1	2.1
CO emissions (lb/hr)	5.1	5.0	5.1	5.1
Non-Methane Organic Compounds				
NMOC conc. (ppmv)	22.8	23.0	23.3	23.0
NMOC emissions (g/bhp*hr)	0.17	0.17	0.18	0.17
NMOC emissions (lb/hr)	0.40	0.41	0.42	0.41