Derenzo Environmental Services
Consulting and Testing *Over 25 Years of Service*

Executive Summary

ENERGY DEVELOPMENTS AT THE SOUTH KENT LANDFILL
CAT® G3520C LANDFILL GAS FUELED IC ENGINE EMISSION RESULTS

Energy Developments contracted Derenzo Environmental Services to conduct a performance demonstration for the determination of nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOC) concentrations and emission rates from two (2) Caterpillar (CAT®) Model No. G3520C landfill gas-fired reciprocating internal combustion engines and electricity generator sets (EUICEENGINE1 – 2) operated at the South Kent Landfill in Byron Center, Kent County, Michigan.

Michigan Department of Environmental Quality (MDEQ) Air Quality Division (AQD) Renewable Operating Permit No. MI-ROP-N1324-2012 requires that performance testing be performed on the CAT® G3520C engines within 180 days of startup and every 8,760 hours of operation (or every three years) in accordance with the provisions of 40 CFR Part 60 Subpart JJJJ (NSPS for spark ignition internal combustion engines). The performance testing was conducted on December 5, 2016.

The following table presents the emissions results from the performance demonstration.

Emission Unit	NOx Emission Rates (lb/hr)	NOx Emission Rates (g/bhp-hr)	CO Emission Rates (lb/hr)	CO Emission Rates (g/bhp-hr)	VOC Emission Rate (g/bhp-hr)
EUICEENGINE1	2.36	0.48	12.8	2.60	0.13
EUICEENGINE2	2.86	0.58	9.94	2.02	0.11
Permit Limits	4.92	1.0	16.23	3.3	1.0

lb/hr = pounds per hour, g/bhp-hr = grams per brake horse power-hour

The following table presents the operating data recorded during the performance demonstration.

Emission Unit	Generator Output (kW)	Engine Output (bhp)	LFG Fuel Use (scfm)	LFG CH_4 Content (%)	Exhaust Temp. (°F)
EUICEENGINE1	1,601	2,235	526	52.6	812
EUICEENGINE2	1,596	2,228	522	52.6	854

scfm=standard cubic feet per minute, kW=kilowatt, bHp-hr=brake horse power hour, psi=pounds per square inch

The data presented above indicate that EUICEENGINE1 and EUICEENGINE2 were tested while the units operated within 10% of its maximum capacity (2,233 bhp and 1,600 kW) and are in compliance with the emission standards specified in 40 CFR 60.4233(e) and MDEQ-AQD ROP No. MI-ROP-N1324-2012.

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AIR EMISSION TEST REPORT

Title	AIR EMISSION TEST REPORT FOR THE LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES OPERATED AT THE SOUTH KENT LANDFILL FACILITY
Report Date	January 8, 2018
Test Dates	December 5, 2017

Facility Information	
Name	Energy Developments at the South Kent Landfill
Street Address	10300 South Kent Drive SW
City, County	Byron Center, Kent

Facility Permit Information			
ROP No.:	MI-ROP-N1324-2012	Facility SRN :	N1324

Testing Contractor	
Company	Derenzo Environmental Services
Mailing Address	39395 Schoolcraft Road Livonia, MI 48150
Phone	(734) 464-3880
Project No.	1709007

AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM
LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES

ENERGY DEVELOPMENTS AT THE SOUTH KENT LANDFILL

1.0 INTRODUCTION

Energy Developments (EDL) operates two (2) Caterpillar (CAT®) Model No. G3520C gas fueled internal combustion (IC) engines and electricity generator sets at the South Kent Landfill in Byron Center, Kent County, Michigan. The two (2) landfill gas (LFG) fueled IC engine-generator sets are identified as emission units EUICEENGINE1 and EUICEENGINE2 (collectively flexible emission group FGICEENGINES) in Section 2 of Michigan Renewable Operating Permit (ROP) No. MI-ROP-N1324-2012 issued by the Michigan Department of Environmental Quality (MDEQ).

The conditions of MI-ROP-N1324-2012:

1. Allow for the installation and operation of two (2) spark ignition, lean burn reciprocating internal combustion (IC) engine and electricity generation sets (CAT® Model G3520C) that have a rated horsepower (hp) output of 2,233 at full load.

2. Specify that … *Except as provided in 40 CFR 60.4243, the permittee shall conduct an initial performance test for each engine in FGENGINES within one year after startup of the engine and every 8760 hours of operation or three years, whichever occurs first, to demonstrate compliance unless the engines have been certified by the manufacturer as required by 40 CFR Part 60 Subpart JJJJ and the permittee maintains the engine as required by 40 CFR 60.4243(a)(1). If a performance test is required, the performance tests shall be conducted according to 40 CFR 60.4244.*

The compliance testing was performed by Derenzo Environmental Services, a Michigan-based environmental consulting and testing company. Derenzo Environmental Services representatives Andy Rusnak and Clay Gaffey performed the field sampling and measurements December 5, 2017.

The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan dated September 20, 2017 that was reviewed and approved by the Michigan Department of Environmental Quality (MDEQ). Mr. Dave Morgan of the MDEQ-AQD was onsite to observe 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 Environmental Services based on field sampling data collected by Derenzo Environmental Services. Facility process data were collected and provided by EDL employees or representatives. This test report has been reviewed by EDL representatives and approved for submittal to the MDEQ. A test report certification form (EQP 5736) is attached at the head of the report.

I certify that the testing was conducted in accordance with the specified test methods and submitted 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:

Clay Gaffey
Environmental Consultant
Derenzo Environmental Services

Reviewed By:

Andy Rusnak, QSTI
Technical Manager
Derenzo Environmental Services

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 General Process Description

Landfill gas (LFG) containing methane is generated in the South Kent 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 EDL LFG power station 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. G3520C RICE has a rated output of 2,233 brake-horsepower (bhp) and the connected generator has a rated electricity output of 1,600 kilowatts (kW). The engine is designed to fire low-pressure, lean fuel mixtures (e.g., LFG) and is equipped with an 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 horizontal release points. The two (2) CAT® Model G3520C RICE exhaust stacks are identical.

The exhaust stack sampling ports for the CAT® Model G3520C engines (EUICEENGINE1 – EUICEENGINE2) are located in individual exhaust stacks with an inner diameter of 13.5 inches. Each stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location greater than 360.0 inches (26.6 duct diameters) upstream and greater than 240.0 inches (17.8 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 1 provides diagrams of the emission test sampling location.

3.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS

3.1 Purpose and Objective of the Tests

The conditions of ROP No. MI-ROP-N1324-2012 and 40 CFR Part 60 Subpart JJJJ require EDL to test each engine contained in FGENGINES for carbon monoxide (CO), nitrogen oxides (NOx) and volatile organic compounds (VOCs) every 8,760 hours of operation.

3.2 Operating Conditions During the Compliance Tests

The testing was performed while the engine/generator sets were operated at maximum operating conditions (1,600 kW electricity output +/- 10%). EDL representatives provided the generator electricity output (kW) in 15-minute increments for each test period. The generator kW output ranged between 1,585 and 1,613 kW during the test periods.

Fuel flowrate (pounds per hour) and fuel methane content (%), were also recorded by EDL representatives in 15-minute increments for each test period. The FGENGINES fuel consumption rate ranged between 518 and 529 scfm and fuel methane content ranged between 52.6 and 52.7%

In addition, the engine serial number and operating hours at the beginning of test No. 1 were recorded by the facility operators.

Appendix 2 provides operating records provided by EDL 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 G3520C generator efficiency (96.1%), and the unit conversion factor for kW to horsepower (0.7457 kW/hp).

Engine output (bhp) = Electricity output (kW) / (0.961) / (0.7457 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 sampled LFG fueled RICE (EUICEENGINE1 and EUICEENGINE2) were each sampled for three (3) one-hour test periods during the compliance testing performed December 5, 2017.

Table 3.2 presents the average measured CO, NO_x and VOC emission rates for the engines (average of the three test periods for each engine).

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

Engine Parameter	EUICEENGINE1	EUICEENGINE2
Generator output (kW)	1,601	1,596
Engine output (bhp)	2,235	2,228
Engine LFG fuel use (scfm)	526	522
LFG methane content (%)	52.6	52.6
Exhaust temperature (°F)	812	854

Table 3.2 Average measured emission rates for each engine (three-test average)

	CO Emission Rates		NOx Emission Rates		VOC Emission Rates	
Emission Unit	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
Engine No. 1	12.8	2.60	2.36	0.48	0.63	0.13
Engine No. 2	9.94	2.02	2.86	0.58	0.52	0.11
Permit Limit	16.23	3.3	4.92	1.0	--	1.0

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 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 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 chemiluminescence instrumental analyzers.
USEPA Method 10	Exhaust gas CO concentration was measured using an NDIR instrumental analyzer
USEPA Method 25A / ALT-096	Exhaust gas VOC (as NMHC) concentration was determined using a flame ionization analyzer equipped with methane separation 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 during 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 leak-checked periodically 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 stream was measured continuously throughout each test period with a Servomex Model 1440D analyzer in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a single beam single wavelength (SBSW) infrared gas analyzer. The O_2 content of the exhaust was monitored using a gas analyzer that uses a paramagnetic sensor.

During each sampling period, a continuous sample of the IC 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 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 non-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 NOx and CO Concentration Measurements (USEPA Methods 7E and 10)

NO_X and CO concentration in the RICE exhaust gas stream was measured continuously throughout each test period with a Thermo Environmental Inc. (TEI) Model 42c and TEI Model 48i, respectively, analyzer in accordance with USEPA Methods 7E and 10. The NO_X concentration was measured using a chemiluminescence analyzer and the CO concentration was measured using an infrared 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 25A/ALT-096)

VOC emission rate was determined by measuring the nonmethane hydrocarbon (NMHC) concentration in the IC engine exhaust gas. NMHC pollutant concentration was determined using a Thermo Environmental Instruments (TEI) Model 55i Methane / Nonmethane hydrocarbon analyzer. The TEI 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components and has been approved by the USEPA for measuring VOC relative to 40 CFR Part 60 Subpart JJJJ compliance test demonstrations (Alternative Test Method 096). 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.

Three (3) one-hour sampling periods were performed on each IC engine exhaust. Throughout each one-hour test period, a continuous sample of the IC 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 low-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.

5.0 QA/QC ACTIVITIES

5.1 NOx Converter Efficiency Test

The NO_2 – NO conversion efficiency of the chemiluminescence NOx 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 greater than 90% of the expected value.

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_2 concentration was 94.7% of the expected value, i.e., greater than 90% of the expected value as required by Method 7E).

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 last 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 NOx, CO, O_2 and CO_2 have had an interference response test preformed prior to their use in the field, 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 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 NOx, 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, NOx, 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.

5.5 Determination of Exhaust Gas Stratification

A stratification test was performed for the RICE exhaust stack. 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 the RICE exhaust stack indicated 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 the RICE exhaust stack.

5.6 Meter Box Calibrations

The metering 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 metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

Appendix 6 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, Pitot tube 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 and 6.2.

The measured air pollutant concentrations and emission rates for Engine Nos. 1 and 2 are less than the allowable limits specified in MI-ROP-N1324-2012 for Emission Unit Nos. EUICEENGINE1 and EUICEENGINE2:

- 1.0 g/bhp-hr and 4.92 lb/hr for NOx;
- 3.3 g/bhp-hr and 16.23 lb/hr for CO; and
- 1.0 g/bhp-hr for VOC.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the approved test protocol.

Table 6.1 Measured exhaust gas conditions and NO_x, CO and VOC air pollutant emission rates for Engine No. 1 (EUICEENGINE1)

Test No. Test date Test period (24-hr clock)	1 12/5/17 0838-0938	2 12/5/17 1001-1101	3 12/5/17 1120-1220	Three Test Average
Fuel flowrate (scfm)	526	525	526	526
Generator output (kW)	1,600	1,600	1,604	1,601
Engine output (bhp)	2,233	2,233	2,239	2,235
LFG methane content (%)	52.7	52.6	52.6	52.6
<u>Exhaust Gas Composition</u>				
CO_2 content (% vol)	11.0	10.9	11.0	11.0
O_2 content (% vol)	8.96	8.99	8.99	8.98
Moisture (% vol)	11.9	12.3	10.8	11.7
Exhaust gas temperature (°F)	812	811	811	812
Exhaust gas flowrate (dscfm)	4,397	4,245	4,360	4,334
Exhaust gas flowrate (scfm)	4,989	4,841	4,888	4,906
<u>Nitrogen Oxides</u>				
NO_X conc. (ppmvd)	75.9	76.2	75.7	76.0
NO_X emissions (lb/hr)	2.39	2.32	2.37	2.36
Permitted emissions (lb/hr)	-	-	-	*4.92*
NO_X emissions (g/bhp*hr)	0.49	0.47	0.48	0.48
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	669	679	682	677
CO emissions (lb/hr)	12.9	12.6	13.0	12.8
Permitted emissions (lb/hr)	-	-	-	*16.23*
CO emissions (g/bhp*hr)	2.61	2.56	2.63	2.60
*Permitted emissions (g/bhp*hr)*	-	-	-	*3.3*
<u>Volatile Organic Compounds</u>				
VOC conc. (ppmv)	18.8	18.8	18.6	18.7
VOC emissions (lb/hr)	0.64	0.63	0.62	0.63
VOC emissions (g/bhp*hr)	0.13	0.13	0.13	0.13
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*

Table 6.2 Measured exhaust gas conditions and NO_x, CO and VOC air pollutant emission rates for Engine No. 2 (EUICEENGINE2)

Test No.	1	2	3	
Test date	12/5/17	12/5/17	12/5/17	Three Test
Test period (24-hr clock)	1238-1338	1354-1454	1509-1609	Average
Fuel flowrate (scfm)	523	521	522	522
Generator output (kW)	1,603	1,593	1,593	1,598
Engine output (bhp)	2,237	2,223	2,223	2,228
LFG methane content (%)	52.6	52.6	52.6	52.6
Exhaust Gas Composition				
CO_2 content (% vol)	11.4	11.4	11.4	11.4
O_2 content (% vol)	8.50	8.47	8.52	8.50
Moisture (% vol)	11.6	11.3	11.3	11.4
Exhaust gas temperature (°F)	852	856	852	854
Exhaust gas flowrate (dscfm)	4,084	4,143	4,153	4,127
Exhaust gas flowrate (scfm)	4,619	4,668	4,684	4,657
Nitrogen Oxides				
NOx conc. (ppmvd)	96.9	97.3	95.8	96.7
NOx emissions (lb/hr)	2.84	2.89	2.85	2.86
Permitted emissions (lb/hr)	-	-	-	*4.92*
NOx emissions (g/bhp*hr)	0.58	0.59	0.58	0.58
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*
Carbon Monoxide				
CO conc. (ppmvd)	552	552	552	552
CO emissions (lb/hr)	9.84	9.98	10.0	9.94
Permitted emissions (lb/hr)	-	-	-	*16.23*
CO emissions (g/bhp*hr)	2.00	2.04	2.04	2.02
*Permitted emissions (g/bhp*hr)*	-	-	-	*3.3*
Volatile Organic Compounds				
VOC conc. (ppmv)	16.2	16.7	16.3	16.4
VOC emissions (lb/hr)	0.51	0.53	0.52	0.52
VOC emissions (g/bhp*hr)	0.10	0.11	0.11	0.11
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*