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Executive Summary

GRANGER ELECTRIC COMPANY - WOOD STREET LANDFILL FACILITY
CAT® G3520C LANDFILL GAS FUELED IC ENGINES EMISSIONS RESULTS

Granger Electric Company contracted Derenzo and Associates, Inc., 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 three (3) Caterpillar (CAT®) Model No. G3520C landfill gas-fired reciprocating internal combustion engines and electricity generator sets (EUICEENGINE1-S1 – EUICEENGINE3-S1) operated at the Wood St. Landfill in Lansing, Michigan.

Michigan Department of Environmental Quality (MDEQ) Air Quality Division (AQD) Renewable Operating Permit No. MI-ROP-N5997-2013 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 April 15 – 16, 2014.

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

Emission Unit	NO_x Emission Rates (lb/hr)	(g/bhp-hr)	CO Emission Rates (lb/hr)	(g/bhp-hr)	VOC Emission Rate (g/bhp-hr)
EUICEENGINE1-S1	2.61	0.6	13.97	3.0	0.1
EUICEENGINE2-S1	3.15	0.7	13.16	2.8	0.1
EUICEENGINE3-S1	2.94	0.6	12.10	2.6	0.1
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)	Inlet Fuel Press. (psi)	Air to Fuel Ratio
EUICEENGINE1-S1	1,516	2,118	495	55.0	843	3.0	9.1
EUICEENGINE2-S1	1,527	2,134	490	54.5	805	3.0	8.9
EUICEENGINE3-S1	1,516	2,117	466	54.3	796	3.0	8.7

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

The data above indicates that EUICEENGINE1-S1 through EUICEENGINE3-S1 operated at normal base load conditions and comply with the emission standards presented in 40 CFR 60.4233(e) and MDEQ-AQD ROP No. MI-ROP-N5997-2013.

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 GRANGER WOOD STREET LANDFILL
Report Date	May 5, 2014
Test Dates	April 15 – 16, 2014

Facility Information	
Name	Granger Electric Company
Street Address	16980 Wood St.
City, County	Lansing, Ingham

Facility Permit Information			
ROP No.:	MI-ROP-N5997-2013	Facility SRN :	N5997

Testing Contractor	
Company	Derenzo and Associates, Inc.
Mailing Address	39395 Schoolcraft Road Livonia, MI 48150
Phone	(734) 464-3880
Project No.	1310009

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FOR THE
LANDFILL GAS FUELED
INTERNAL COMBUSTION ENGINES
OPERATED AT THE
GRANGER WOOD STREET LANDFILL

1.0 INTRODUCTION

Granger Electric Company (Granger) (Facility SRN: N5997) owns and operates four (4) Caterpillar (CAT®) Model No. G3516 landfill gas (LFG) fueled reciprocating internal combustion engines (RICE) and three (3) CAT® Model No. G3520C LFG fueled RICE at the Granger Wood St. Landfill in Lansing, Clinton County, Michigan. The CAT® Model No. G3516 engines are identified as Emission Unit ID: EUICE1-S1 – EUICE4-S1 (FGICE-S1) and the CAT® Model No. G3520C engines are identified as Emission Unit ID: EUICEENGINE1-S1 – EUICEENGINE3-S1 (FGICEENGINES-S1-S1) in Renewable Operating Permit (ROP) No. MI-ROP-N5997-2013. EUICEENGINE1-S1 through EUICEENGINE3-S1 are also referred to as Engine No. 5 through 7, respectively, in this report and by facility representatives.

Air emission compliance testing was performed to satisfy the following requirements contained in ROP No. MI-ROP-N5997-2013:

- Test air pollutant emissions for FGICEENGINES-S1-S1 in accordance with 40 CFR Part 60 Subpart JJJJ;

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, Patrick Triscari and Andrew Rusnak performed the field sampling and measurements April 15 – 16, 2014.

The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan dated January 7, 2014 that was reviewed and approved by the Michigan Department of Environmental Quality (MDEQ). 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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Granger Electric Company
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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:

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

Responsible Official Certification:

Marc Pauley
Operations Manager
Granger Electric Company

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 General Process Description

Landfill gas (LFG) containing methane is generated in the Granger Wood Street 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 Granger LFG power station 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. 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 three (3) CAT® Model G3520C RICE exhaust stacks are identical.

The exhaust stack sampling ports for the CAT® Model G3520C engines (EUICEENGINE1-S1 – EUICEENGINE3-S1) 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 120 inches (>8.88 duct diameters) upstream and greater than 120.0 inches (>8.88 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-N5997-2013 and 40 CFR Part 60 Subpart JJJJ require Granger to test each engine contained in FGICEENGINES-S1-S1 for carbon monoxide (CO), nitrogen oxides (NOx) and volatile organic compounds (VOCs) every 8,760 hours of operation. Therefore, each engine contained in FGICEENGINES-S1-S1 was sampled for CO, NO_X and VOC 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 Granger engine/generator sets were operated at maximum operating conditions (1,600 kW electricity output +/- 10%). Granger representatives provided the kW output in 15-minute increments for each test period. The FGICEENGINES-S1 generator kW output ranged between 1,480 and 1,559 kW for each test period.

Fuel flowrate (cubic feet per minute), fuel methane content (%), fuel inlet pressure (psi) and the air to fuel ratio were also recorded by Granger representatives in 15-minute increments for each test period. The FGICEENGINES-S1 fuel consumption rate ranged between 460 and 500 scfm, fuel methane content ranged between 54.2 and 55.0%, fuel inlet pressure was 3.0 psi and the air to fuel ratio ranged between 8.6 to 9.2 for each test period.

Appendix B provides operating records provided by Granger 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 (96.0%), and the unit conversion factor for kW to horsepower (0.7457 kW/hp).

Engine output (bhp) = Electricity output (kW) / (0.960) / (0.7457 kW/hp)

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 (EUICEENGINE1-S1 through EUICEENGINE3-S1) were each sampled for three (3) one-hour test periods during the compliance testing performed April 15 through April 16, 2014.

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 and comparison to the permitted emission rates is presented in Section 6.0 of this report.

Table 3.1 Average engine operating conditions during the test periods

Engine Parameter	Engine No. 5	Engine No. 6	Engine No. 7
Generator output (kW)	1,516	1,527	1,516
Engine output (bhp)	2,118	2,134	2,117
Engine LFG fuel use (scfm)	495	490	466
LFG methane content (%)	55.0	54.5	54.3
LFG lower heating value (Btu/scf)	500	496	494
Exhaust temperature (°F)	843	805	796
Inlet fuel pressure (psi)	3.0	3.0	3.0
Air to fuel ratio	9.1	8.9	8.7

Table 3.2 Average measured emission rates for each tested Granger Wood St. facility RICE (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. 5	14.0	2.99	2.61	0.56	0.67	0.14
Engine No. 6	13.2	2.80	3.15	0.67	0.63	0.13
Engine No. 7	12.1	2.59	2.94	0.63	0.56	0.12

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Test protocols for the air emission testing were reviewed and approved by the MDEQ. This section provides a summary of the sampling and analytical procedures that were used during the Granger 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 chemiluminescence instrumental analyzers.
USEPA Method 10	Exhaust gas CO concentration was measured using NDIR instrumental analyzers.
USEPA Method ALT-096	Exhaust gas VOC (as NMHC) concentration was determined using flame ionization analyzers equipped with GC columns.

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 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 prior to each traverse 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 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 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 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 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 D provides CO and NO_X calculation sheets. Raw instrument response data are provided in Appendix E.

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 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 mid-range calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document).

Appendix D provides VOC calculation sheets. Raw instrument response data for the NMHC 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 -3.17% of the expected value, i.e., within 10% 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 (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.

5.3 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.

5.4 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 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.

5.5 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, 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.

5.6 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, and Pitot tube calibration records).

6.0 RESULTS

6.6 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 6.3.

The measured air pollutant concentrations and emission rates for Engine Nos. 5 – 7 are less than the allowable limits specified in Permit to Install No. MI-ROP-N5997-2013 for Emission Unit Nos. EUICEENGINE1-S1 through EUICEENGINE3-S1:

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

6.7 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 (1,600 kW generator output) and no variations from the normal operating conditions of the RICE occurred during the engine test periods.

During the first test period performed on Engine No. 7 the braided line portion of the heated Teflon sample line prior to the stainless steel sample probe froze, due to below freezing weather conditions. The test was paused for thirty-three (33) minutes and resumed when the braided line portion of the heated Teflon sample line was thawed out. A full sixty (60) minutes of test data was recorded, and permission to use this test was granted by Mr. Tom Gasloli of the MDEQ-AQD.

Table 6.1 Measured exhaust gas conditions and NO_x, CO and VOC air pollutant emission rates Granger Wood Street Facility Engine No. 5 (EUICEENGINE1-S1)

Test No. Test date Test period (24-hr clock)	1 4/16/14 800 - 900	2 4/16/14 928 - 1028	3 4/16/14 1052 – 1152	Three Test Average
Fuel flowrate (scfm)	493	495	496	495
Generator output (kW)	1,502	1,531	1,514	1,516
Engine output (bhp)	2,098	2,139	2,115	2,118
LFG methane content (%)	55.0	55.0	54.9	55.0
LFG heat content (Btu/scf)	501	501	500	500
Fuel inlet pressure (psi)	3.0	3.0	3.0	3.0
Air to fuel ratio	8.7	8.7	8.7	8.7
Exhaust Gas Composition				
CO_2 content (% vol)	10.77	10.72	10.71	10.73
O_2 content (% vol)	8.21	8.33	8.36	8.30
Moisture (% vol)	11.2	11.4	11.6	11.4
Exhaust gas temperature (^{o}F)	844	845	842	843
Exhaust gas flowrate (dscfm)	4,061	4,102	4,107	4,090
Exhaust gas flowrate (scfm)	4,577	4,634	4,646	4,619
Nitrogen Oxides				
NO_X conc. (ppmvd)	89.5	91.0	86.0	88.8
NO_X emissions (g/bhp*hr)	0.6	0.6	0.5	0.6
Permitted emissions (g/bhp*hr)	-	-	-	1.0
NO_X emissions (lb/hr)	2.60	2.68	2.53	2.61
Permitted emissions (lb/hr)	-	-	-	4.92
Carbon Monoxide				
CO conc. (ppmvd)	779	783	786	783
CO emissions (g/bhp*hr)	3.0	3.0	3.0	3.0
Permitted emissions (g/bhp*hr)	-	-	-	3.3
CO emissions (lb/hr)	13.81	14.02	14.09	13.97
Permitted emissions (lb/hr)	-	-	-	16.23
Volatile Organic Compounds				
VOC conc. (ppmv)	20.9	21.4	21.1	21.2
VOC emissions (g/bhp*hr)	0.1	0.1	0.1	0.1
Permitted emissions (g/bhp*hr)	-	-	-	1.0

Table 6.2 Measured exhaust gas conditions and NO_x, CO and VOC air pollutant emission rates Granger Wood Street Facility Engine No. 6 (EUICEENGINE2-S1)

Test No. Test date Test period (24-hr clock)	1 4/15/14 1321 - 1421	2 4/15/14 1502 – 1602	3 4/15/14 1634 – 1734	Three Test Average
Fuel flowrate (scfm)	489	489	491	490
Generator output (kW)	1,526	1,531	1,525	1,527
Engine output (bhp)	2,132	2,139	2,130	2,134
LFG methane content (%)	54.5	54.5	54.6	54.5
LFG heat content (Btu/scf)	496	496	497	496
Fuel inlet pressure (psi)	3.0	3.0	3.0	3.0
Air to fuel ratio	8.9	8.9	8.9	8.9
Exhaust Gas Composition				
CO_2 content (% vol)	11.0	11.0	11.0	11.0
O_2 content (% vol)	8.59	8.59	8.58	8.59
Moisture (% vol)	11.2	11.2	11.5	11.3
Exhaust gas temperature (°F)	804	804	807	805
Exhaust gas flowrate (dscfm)	4,155	4,162	4,137	4,151
Exhaust gas flowrate (scfm)	4,678	4,695	4,675	4,683
Nitrogen Oxides				
NO_X conc. (ppmvd)	105.0	105.1	107.2	105.8
NO_X emissions (g/bhp*hr)	0.7	0.7	0.7	0.7
Permitted emissions (g/bhp*hr)	-	-	-	1.0
NO_X emissions (lb/hr)	3.13	3.14	3.18	3.15
Permitted emissions (lb/hr)	-	-	-	4.92
Carbon Monoxide				
CO conc. (ppmvd)	722	728	728	726
CO emissions (g/bhp*hr)	2.8	2.8	2.8	2.8
Permitted emissions (g/bhp*hr)	-	-	-	3.3
CO emissions (lb/hr)	13.09	13.23	13.15	13.16
Permitted emissions (lb/hr)	-	-	-	16.23
Volatile Organic Compounds				
VOC conc. (ppmv)	19.3	19.8	19.6	19.6
VOC emissions (g/bhp*hr)	0.1	0.1	0.1	0.1
Permitted emissions (g/bhp*hr)	-	-	-	1.0

Table 6.3 Measured exhaust gas conditions and NO_x, CO and VOC air pollutant emission rates Granger Wood Street Facility Engine No. 7 (EUICEENGINE3-S1)

Test No.	1	2	3	
Test date	4/15/14	4/15/14	4/15/14	Three Test
Test period (24-hr clock)	804 - 939	1012 - 1112	1149 – 1249	Average
Fuel flowrate (scfm)	465	466	468	466
Generator output (kW)	1,510	1,515	1,523	1,516
Engine output (bhp)	2,109	2,116	2,127	2,117
LFG methane content (%)	54.2	54.3	54.4	54.3
LFG heat content (Btu/scf)	493	494	495	494
Fuel inlet pressure (psi)	3.0	3.0	3.0	3.0
Air to fuel ratio	9.1	9.2	9.1	9.1
Exhaust Gas Composition				
CO_2 content (% vol)	10.9	10.8	10.8	10.9
O_2 content (% vol)	8.78	8.81	8.80	8.80
Moisture (% vol)	6.9	11.4	11.3	9.9
Exhaust gas temperature (^oF)	797	797	795	796
Exhaust gas flowrate (dscfm)	4,172	4,074	4,076	4,107
Exhaust gas flowrate (scfm)	4,593	4,598	4,596	4,596
Nitrogen Oxides				
NO_X conc. (ppmvd)	102.7	100.1	96.3	99.7
NO_X emissions (g/bhp*hr)	0.7	0.6	0.6	0.6
Permitted emissions (g/bhp*hr)	-	-	-	1.0
NO_X emissions (lb/hr)	3.07	2.92	2.81	2.94
Permitted emissions (lb/hr)	-	-	-	4.92
Carbon Monoxide				
CO conc. (ppmvd)	675	677	672	675
CO emissions (g/bhp*hr)	2.6	2.6	2.6	2.6
Permitted emissions (g/bhp*hr)	-	-	-	3.3
CO emissions (lb/hr)	12.28	12.04	11.96	12.10
Permitted emissions (lb/hr)	-	-	-	16.23
Volatile Organic Compounds				
VOC conc. (ppmv)	18.3	17.6	17.1	17.7
VOC emissions (g/bhp*hr)	0.1	0.1	0.1	0.1
Permitted emissions (g/bhp*hr)	-	-	-	1.0