AIR EMISSION TEST REPORT

Title	AIR EMISSION TEST REPORT FOR THE LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES OPERATED AT THE ORCHARD HILL GENERATING STATION
Report Date	March 22, 2018
Test Dates	January 30, 2018

Facility Information	
Name	Granger Electric of Watervliet, LLC Orchard Hill Generating Station
Street Address	3290 Hennesey Road
City, County	Watervliet, Berrien
Facility SRN	N5917

Facility Permit Information	
Permit No.:	MI-ROP-N5917-2016
Emission Units	EUICEENGINE1-S2 and EUICEENGINE2-S2

Testing Contractor	
Company	Derenzo Environmental Services
Mailing Address	39395 Schoolcraft Road Livonia, MI 48150
Phone	(734) 464-3880
Project No.	1710013

Executive Summary

GRANGER ELECTRIC OF WATERVLIET
CAT® G3520C LANDFILL GAS FUELED IC ENGINE EMISSION RESULTS

Granger Electric 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 Orchard Hill Sanitary Landfill in Watervliet, Berrien County, Michigan.

Michigan Department of Environmental Quality (MDEQ) Air Quality Division (AQD) Renewable Operating Permit No. MI-ROP-N5719-2016 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 January 30, 2018.

The following table presents a summary of the emission test results.

	NOx Emission Rates		CO Emission Rates		VOC Emission Rates	
Emission Unit	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EUICEENGINE1-S2	1.86	0.37	13.4	2.68	0.77	0.15
EUICEENGINE2-S2	2.08	0.41	13.7	2.73	0.78	0.15
Permit Limit	4.94	1.0	17.3	3.5	--	1.0

The following table presents the operating data recorded during the emission test periods.

Emission Unit	Generator Output (kW)	Engine Output (bhp)	LFG Fuel Use (scfm)	LFG CH_4 Content (%)	Exhaust Temp. (^oF)
EUICEENGINE1-S2	1,622	2,263	580	50.3	810
EUICEENGINE2-S2	1,628	2,272	560	51.0	802

The data presented above indicate that EUICEENGINE1-S2 and EUICEENGINE2-S2 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 permit No. MI-ROP-N5719-2016.

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

GRANGER ELECTRIC OF WATERVLIET
ORCHARD HILL GENERATING STATION

1.0 INTRODUCTION

Granger Electric of Watervliet (Granger) operates two (2) Caterpillar (CAT®) Model No. G3520C gas fueled reciprocating internal combustion engine (RICE) and electricity generator sets at the Orchard Lake Generating Station located in Watervliet, Berrien County, Michigan. The two (2) landfill gas (LFG) fueled RICE-generator sets are identified as emission units EUICEENGINE1-S2 and EUICEENGINE2-S2 (collectively flexible emission group FGICEENGINES-S2) in Section 2 of Michigan Renewable Operating Permit (ROP) No. MI-ROP-N5917-2016 issued by the Michigan Department of Environmental Quality (MDEQ).

The conditions of MI-ROP-N5917-2016:

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

2. Specify that ... *The permittee shall conduct an initial performance test for each engine in FGICEENGINES-S2, to verify NOx, CO, and VOC emission rates...and subsequent performance testing every 8760 hours of operation or three years, whichever occurs first, to demonstrate compliance.*

The compliance testing was performed by Derenzo Environmental Services (DES) representatives Jason Logan and Blake Beddow on January 30, 2018.

The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan dated December 20, 2017 that was reviewed and approved by the MDEQ. Mr. Dave Patterson of the MDEQ-AQD was onsite to witness portions of the test event.

Questions regarding this emission test report should be directed to:

Blake Beddow
Environmental Consultant
Derenzo Environmental Services
39395 Schoolcraft Road
Livonia, MI 48150
(734) 464-3880
bbeddow@derenzo.com

Dan Zimmerman
Director of North American Health & Safety
Energy Developments
3259 Holt Road
Mason, MI 48854-9318
(517) 896-4417
Dan.zimmerman@energydevelopments.com

Report Certification

This test report was prepared by Derenzo Environmental Services based on field sampling data collected by DES. Facility process data were collected and provided by Granger employees or representatives. This test report has been reviewed by Granger representatives and approved for submittal to the MDEQ. A test report certification form (EQP 5736) signed by the facility's Responsible Official accompanies this 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:

Blake Beddow
Environmental Consultant
Derenzo Environmental Services

Reviewed By:

Robert L. Harvey, P.E.
General 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 Orchard Hill Sanitary 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 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 RICE 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. The two (2) CAT® Model G3520C RICE exhaust stacks are identical.

The exhaust stack sampling ports for the CAT® Model G3520C engines (EUICEENGINE1-S2 – EUICEENGINE2-S2) are located in individual exhaust stacks with an inner diameter of 13.25 inches. Each stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location greater than 12 feet (>21 duct diameters) upstream and greater than 96.0 inches (>7.2 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-N5917-2016 and 40 CFR Part 60 Subpart JJJJ require Granger to test each engine contained in FGICEENGINES-S2 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 RICE generator sets were operated at maximum operating conditions (1,600 kW electricity output +/- 10%). Granger representatives provided the generator electricity output (kW) in 15-minute intervals for each test period. The generator kW output ranged between 1,578 and 1,655 kW during the test periods.

Fuel flowrate and fuel methane content (%), were also recorded by facility representatives at 15-minute intervals for each test period. The RICE fuel consumption rate ranged between 554 and 589 scfm and fuel methane content ranged between 49.4 and 51.4%

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 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 (96.1%), 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 LFG fueled RICE (EUICEENGINE1-S2 and EUICEENGINE2-S2) were each sampled for three (3) one-hour test periods during the compliance testing performed January 30, 2018.

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-S2	EUICEENGINE2-S2
Generator output (kW)	1,622	1,628
Engine output (bhp)	2,263	2,272
Engine LFG fuel use (scfm)	580	560
LFG methane content (%)	50.3	51.0
Exhaust temperature (°F)	810	802

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

	NOx Emission Rates		CO Emission Rates		VOC Emission Rates	
Emission Unit	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EUICEENGINE1-S2	1.86	0.37	13.4	2.68	0.77	0.15
EUICEENGINE2-S2	2.08	0.41	13.7	2.73	0.78	0.15
Permit Limit	4.94	1.0	17.3	3.5	--	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 once 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.

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 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 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 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 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 NOx and CO Concentration Measurements (USEPA Methods 7E and 10)

NO_X and CO pollutant concentrations in the RICE exhaust gas stream was determined using a chemiluminescence NO_X analyzer and an 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 NOx 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 RICE 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 RICE exhaust. Throughout each one-hour test period, a continuous sample of the RICE 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 Exhaust Gas Flow

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (barometer, pyrometer, and Pitot tube) were calibrated to specifications outlined in the sampling methods.

The Pitot tube and connective tubing were leak-checked periodically throughout the sampling event to verify the integrity of the measurement system.

The absence of significant cyclonic flow for the exhaust configurations were 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).

5.2 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 at least 90% of the expected value.

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_2 concentration was 100.2% of the expected value, i.e., greater than 90% of the expected value as required by Method 7E).

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 (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.

5.4 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 2.5% 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 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.

5.6 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 NOx 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.

5.7 Meter Box Calibrations

The dry gas 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-N5917-2016 for Emission Unit Nos. EUICEENGINE1-S2 and EUICEENGINE2-S2:

- 1.0 g/bhp-hr and 4.94 lb/hr for NO_X;
- 3.5 g/bhp-hr and 17.3 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-S2)

Test No. Test date Test period (24-hr clock)	1 1/30/18 0816-0916	2 1/30/18 0941-1041	3 1/30/18 1105-1205	Three Test Average
Fuel flowrate (scfm)	582	583	575	580
Generator output (kW)	1,623	1,620	1,624	1,622
Engine output (bhp)	2,264	2,260	2,266	2,264
LFG methane content (%)	50.2	49.9	50.6	50.3
Exhaust Gas Composition				
CO_2 content (% vol)	10.4	10.4	10.3	10.4
O_2 content (% vol)	8.82	8.89	8.96	8.89
Moisture (% vol)	11.7	11.2	10.3	11.1
Exhaust gas temperature (°F)	811	810	809	810
Exhaust gas flowrate (dscfm)	4,431	4,457	4,372	4,420
Exhaust gas flowrate (scfm)	5,018	5,019	4,872	4,970
<u>Nitrogen Oxides</u>				
NO_X conc. (ppmvd)	59.1	58.3	58.2	58.6
NO_X emissions (lb/hr)	1.88	1.86	1.83	1.86
Permitted emissions (lb/hr)	-	-	-	*4.94*
NO_X emissions (g/bhp*hr)	0.38	0.37	0.37	0.37
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	701	693	689	694
CO emissions (lb/hr)	13.6	13.5	13.2	13.4
Permitted emissions (lb/hr)	-	-	-	*17.3*
CO emissions (g/bhp*hr)	2.7	2.7	2.6	2.7
*Permitted emissions (g/bhp*hr)*	-	-	-	*3.5*
<u>Volatile Organic Compounds</u>				
VOC conc. (ppmv C_3)	22.7	22.5	22.6	22.6
VOC emissions (lb/hr)	0.78	0.78	0.76	0.77
VOC emissions (g/bhp*hr)	0.16	0.16	0.15	0.15
*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-S2)

Test No. Test date Test period (24-hr clock)	1 1/30/18 1252-1352	2 1/30/18 1413-1513	3 1/30/18 1532-1632	Three Test Average
Fuel flowrate (scfm)	564	554	563	560
Generator output (kW)	1,629	1,632	1,625	1,628
Engine output (bhp)	2,273	2,277	2,267	2,272
LFG methane content (%)	50.8	51.0	51.2	51.0
Exhaust Gas Composition				
CO_2 content (% vol)	10.6	10.7	10.6	10.6
O_2 content (% vol)	8.54	8.61	8.65	8.60
Moisture (% vol)	11.4	11.4	11.3	11.4
Exhaust gas temperature (^oF)	801	803	803	802
Exhaust gas flowrate (dscfm)	4,474	4,485	4,501	4,487
Exhaust gas flowrate (scfm)	5,050	5,063	5,074	5,062
Nitrogen Oxides				
NO_X conc. (ppmvd)	63.3	65.2	65.4	64.6
NO_X emissions (lb/hr)	2.03	2.10	2.11	2.08
Permitted emissions (lb/hr)	-	-	-	*4.94*
NO_X emissions (g/bhp*hr)	0.41	0.42	0.42	0.41
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*
Carbon Monoxide				
CO conc. (ppmvd)	699	699	699	699
CO emissions (lb/hr)	13.6	13.7	13.7	13.7
Permitted emissions (lb/hr)	-	-	-	*17.3*
CO emissions (g/bhp*hr)	2.7	2.7	2.8	2.7
*Permitted emissions (g/bhp*hr)*	-	-	-	*3.5*
Volatile Organic Compounds				
VOC conc. (ppmv C_3)	22.6	22.3	22.1	22.3
VOC emissions (lb/hr)	0.78	0.77	0.77	0.78
VOC emissions (g/bhp*hr)	0.16	0.15	0.15	0.15
*Permitted emissions (g/bhp*hr)*	-	-	-	*1.0*