IMPACT COMPLIANCE & TESTING

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AIR EMISSION TEST REPORT

Title:	AIR EMISSION TEST REPORT FOR THE VERIFICATION OF AIR POLLUTANT EMISSIONS FROM LANDFILL GAS FUELED INTERNAL COMBUSTION ENGINES
Report Date:	January 28, 2020
Test Date:	December 11, 2019

Facility Information	
Name:	Pine Tree Acres, Inc. and Sumpter Energy Associates, LLC
Street Address:	36450 29 Mile Road
City, County:	Lenox Township, Macomb
SRN:	N5984

Facility Permit Information	
Renewable Operating Permit No.:	MI-ROP-N5984-2019
Emission Unit ID:	EU-ICENGINE8 & EU-ICENGINE9

Testing Contractor	
Company:	Impact Compliance & Testing, Inc.
Mailing Address:	37660 Hills Tech Drive Farmington Hills, MI 48331
Phone:	(734) 464-3880
Project No.:	1900231

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

PINE TREE ACRES, INC. AND SUMPTER ENERGY ASSOCIATES, LLC

1.0 INTRODUCTION

Sumpter Energy Associates (SEA) operates two landfill gas (LFG) to energy facilities at the Pine Tree Acres (PTA) Landfill in Lenox Township, Macomb County, Michigan. The two (2) Sumpter Energy facilities, referred to as SEA Phase I and SEA Phase II, have been issued Renewable Operating Permit (ROP) No. MI-ROP-N5984-2019 by the Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division (EGLE-AQD).

The SEA Phase II facility consists of two (2) Caterpillar (CAT®) Model G3520C LFG-fueled reciprocating internal combustion engines (RICE) and electricity generator sets that are identified in ROP No. MI-ROP-N5984-2019 as Emission Unit ID: EU-ICENGINE8 and EU-ICENGINE9 (Flexible Group ID: FG-ICENGINE2).

Air emission compliance testing was performed pursuant to Special Condition No. V.1. of ROP No. MI-ROP-N5984-2019, which states:

> *Except as provided in 40 CFR 60.4243(b), the permittee shall conduct an initial performance test for each engine in FG-ICENGINE2 within one year after startup of the engine and every 8760 hours of operation (as determined through the use of a non-resettable hour meter) or three years, whichever occurs first, to demonstrate compliance with the emission limits in 40 CFR 60.4233(e)...*

The compliance testing was performed by Impact Compliance & Testing, Inc. (ICT), a Michigan-based environmental consulting and testing company. ICT representatives Tyler Wilson and Rob Harvey performed the field sampling and measurements December 11, 2019.

The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan that was reviewed and approved by the EGLE-AQD in the December 9, 2019 Test Plan Approval Letter. EGLE-AQD representatives Mr. Mark Dziadosz and Mr. Robert Joseph 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 ICT based on field sampling data collected by ICT. Facility process data were collected and provided by SEA employees or representatives. This test report has been reviewed by SEA representatives and approved for submittal to the State of Michigan EGLE-AQD.

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
Senior Project Manager
Impact Compliance & Testing, 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
Aria Energy

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 General Process Description

Landfill gas (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-PTA LFG to energy facility where it is treated and used as fuel for the two (2) RICE. Each RICE is connected to an electricity generator that produces electricity that is transferred to the local utility.

2.2 Rated Capacities and Air Emission Controls

The CAT® Model No. 3520C RICE generator set has a rated output of 2,242 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 employs lean-burn technology for efficient fuel combustion and to minimize emissions. The engine is also 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. 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 two (2) CAT® Model 3520C RICE exhaust stacks are identical.

The exhaust stack sampling ports for the CAT® Model 3520C engines (EU-ICENGINE8 and EU-ICENGINE9) are located in individual exhaust stacks with an inner diameter of 15.0 inches. Each stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location 66.0 inches (4.4 duct diameters) upstream and 144.0 inches (9.6 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 <u>SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS</u>

3.1 Purpose and Objective of the Tests

The conditions of ROP No. MI-ROP-N5984-2019 require SEA to test each RICE (EU-ICENGINE8 and EU-ICENGINE9) for carbon monoxide (CO), nitrogen oxides (NOx), and volatile organic compounds (VOC) emissions within 180 days after issuance of the ROP (the permit was issued July 30, 2019) and every 8,760 hours of operation. Measurements were performed for each RICE exhaust to determine CO, NOx, and VOC (as non-methane hydrocarbons (NMHC)) 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 1,600 kW electricity output. SEA representatives provided kW output data at 15-minute intervals for each test period. EU-ICENGINE8 generator kW output ranged between 1,556 and 1,583 kW and EU-ICENGINE9 generator kW output ranged between 1,552 and 1,581 kW during the test periods (97% of maximum capacity or greater).

Fuel flowrate (cubic feet per minute (scfm)), fuel methane content (%), and air/fuel ratio were also recorded by SEA representatives in 15-minute intervals for each test period. EU-ICENGINE8 fuel consumption rate ranged between 539 and 562 scfm and EU-ICENGINE9 fuel consumption rate ranged between 543 and 560 scfm. Fuel methane content ranged between 53.4 and 52.2% during the EU-ICENGINE8 test periods and fuel methane content ranged between 51.4 and 52.3% during the EU-ICENGINE9 test periods. EU-ICENGINE8 air/fuel ratio ranged between 8.0 and 8.2. EU-ICENGINE9 air/fuel ratio ranged between 8.1 and 8.4. 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 SEA 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 3520C generator efficiency (95.7%), and the unit conversion factor for kW to horsepower (0.7457 kW/hp).

Engine output (bhp) = Electricity output (kW) / (0.957) / (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 EU-ICENGINE8 and EU-ICENGINE9 were each sampled for three (3) one-hour test periods during the compliance testing performed December 11, 2019.

Table 3.2 presents the average measured CO, NOx, and VOC 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-N5984-2019. 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. (^oF)
EU-ICENGINE9	1,564	2,192	552	51.9	472	898
EU-ICENGINE8	1,566	2,195	554	51.7	470	879

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		VOC Emission Rates	
	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EU-ICENGINE9	13.7	2.84	1.90	0.39	0.74	0.15
EU-ICENGINE8	14.2	2.93	2.37	0.49	0.78	0.16
Emission Limit	16.3	3.3	3.0	0.6	-	1.0

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A protocol for the air emission testing was reviewed and approved by the EGLE-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 VOC (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 & 2)

The RICE exhaust stack gas velocity and volumetric flow rate was determined using USEPA Method 2 once for 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 onsite, prior to the test event, 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 California Instruments (CAI) Fuji ZRF 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 VOC (USEPA Methods 25A & ALT-096)

The VOC emission rate was determined by measuring the nonmethane hydrocarbon (NMHC) concentration in the engine 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 reciprocating internal combustion engines (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, VOC measurements correspond to standard conditions with no moisture correction (wet basis).

Prior to, and at the conclusion of each test, the instrument was calibrated using mid-range calibration (propane) and zero gas to determine analyzer calibration error and system bias.

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

5.0 <u>QA/QC ACTIVITIES</u>

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 (once before each test day). 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 or equal to 90% of the expected value.

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

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.

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 (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 (once before each test day). The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values for both of the field evaluations.

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 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 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 reintroduced 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 each of the two (2) 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 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 6.2. The serial number (SN) for each RICE is presented at the top of each table.

The measured average air pollutant concentrations and emission rates for Engine Nos. 8 through 9 (EU-ICENGINE8 and EU-ICENGINE9) are less than the allowable limits specified in ROP No. MI-ROP-N5984-2019 for the engines:

- 3.3 grams per brake-horsepower hour (g/bhp-hr) CO;
- 16.3 pounds per hour (lbs/hr) CO;
- 0.6 g/bhp-hr NO_x;
- 3.0 lb/hr NO_x; and
- 1.0 g/bhp-hr VOC.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

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

There were multiple facility shutdowns during emissions testing of Engine Nos. 9 and 8 due to issues at the landfill. Following each facility shutdown, testing was resumed (after each engine was brought back up to load) following data collection of in-stack pollutant concentrations for at least twice the maximum system response time. At least 60-minutes of data were collected for each of the test periods for Engine Nos. 9 and 8. EGLE-AQD representatives Mr. Mark Dziadosz and Mr. Robert Joseph were both onsite and approved this procedure.

Table 6.1 Measured exhaust gas conditions and NO_x, CO, and VOC air pollutant emission rates SEA-PTA Landfill Engine No. 9 (EU-ICENGINE9), SN: GZJ00199

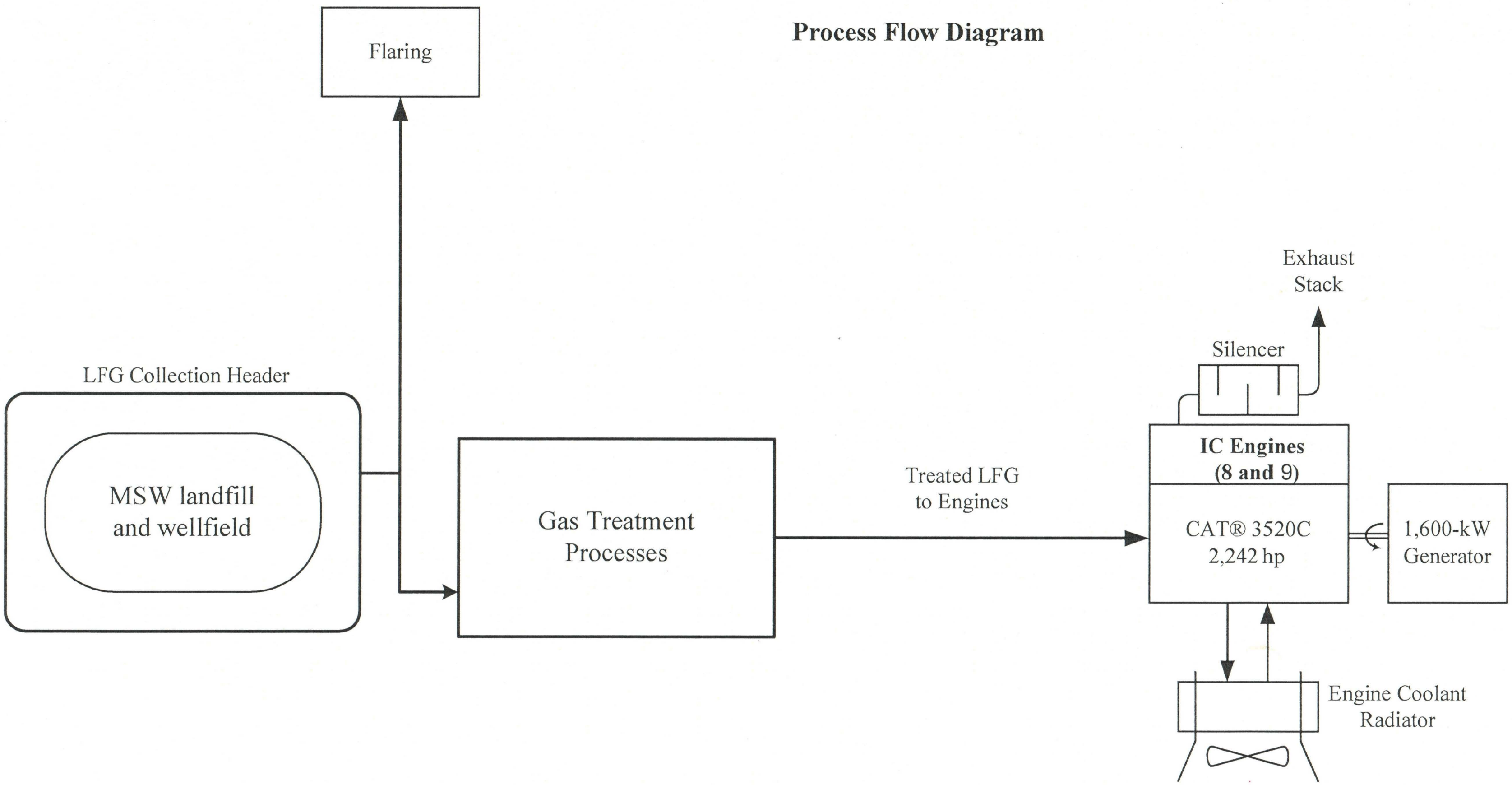
Test No. Test date Test period (24-hr clock)	1 12/11/18 0757-0857	2 12/11/18 0920-1041	3 12/11/18 1100-1200	Three Test Average
Fuel flowrate (scfm)	552	551	552	552
Generator output (kW)	1,568	1,565	1,559	1,564
Engine output (bhp)	2,197	2,194	2,185	2,192
LFG methane content (%)	51.8	51.8	52.2	51.9
LFG LHV heat content (Btu/scf)	471	471	475	472
Air / Fuel ratio	8.1	8.2	8.2	8.2
Exhaust Gas Composition				
CO_2 content (% vol)	11.6	11.5	11.5	11.5
O_2 content (% vol)	8.61	8.66	8.68	8.65
Moisture (% vol)	12.3	10.8	11.1	11.4
Exhaust gas temperature (^oF)	900	897	896	898
Exhaust gas flowrate (dscfm)	4,281	4,301	4,316	4,299
Exhaust gas flowrate (scfm)	4,880	4,820	4,853	4,851
Nitrogen Oxides				
NO_X conc. (ppmvd)	61.5	62.7	60.9	61.7
NO_X emissions (g/bhp*hr)	0.39	0.40	0.39	0.39
NO_X emissions (lb/hr)	1.89	1.93	1.88	1.90
Carbon Monoxide				
CO conc. (ppmvd)	738	731	727	732
CO emissions (g/bhp*hr)	2.84	2.84	2.84	2.84
CO emissions (lb/hr)	13.8	13.7	13.7	13.7
Volatile Organic Compounds				
VOC conc. (ppmv)	21.6	22.3	22.8	22.2
VOC emissions (g/bhp*hr)	0.15	0.15	0.16	0.15
VOC emissions (lb/hr)	0.72	0.74	0.76	0.74

Table 6.2 Measured exhaust gas conditions and NO_x, CO, and VOC air pollutant emission rates SEA-PTA Landfill Engine No. 8 (EU-ICENGINE8), SN: GZJ00189

Test No.	1	2	3	
Test date	12/11/19	12/11/19	12/11/19	Three Test
Test period (24-hr clock)	1220-1340	1400-1500	1520-1649	Average
Fuel flowrate (scfm)	553	555	555	554
Generator output (kW)	1,563	1,565	1,571	1,566
Engine output (bhp)	2,190	2,193	2,201	2,195
LFG methane content (%)	51.7	51.5	51.7	51.7
LFG LHV heat content (Btu/scf)	470	469	470	470
Air / Fuel ratio	8.1	8.0	8.1	8.1
<u>Exhaust Gas Composition</u>				
CO_2 content (% vol)	11.5	11.5	11.4	11.5
O_2 content (% vol)	8.74	8.91	8.75	8.80
Moisture (% vol)	11.4	10.8	11.2	11.1
Exhaust gas temperature (^{o}F)	878	877	882	879
Exhaust gas flowrate (dscfm)	4,222	4,269	4,304	4,265
Exhaust gas flowrate (scfm)	4,765	4,786	4,845	4,799
<u>Nitrogen Oxides</u>				
NO_X conc. (ppmvd)	80.4	73.9	77.8	77.4
NO_X emissions (g/bhp*hr)	0.50	0.47	0.49	0.49
NO_X emissions (lb/hr)	2.43	2.26	2.40	2.37
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	764	762	760	762
CO emissions (g/bhp*hr)	2.92	2.94	2.94	2.93
CO emissions (lb/hr)	14.1	14.2	14.3	14.2
<u>Volatile Organic Compounds</u>				
VOC conc. (ppmv)	23.4	23.7	23.7	23.6
VOC emissions (g/bhp*hr)	0.16	0.16	0.16	0.16
VOC emissions (lb/hr)	0.77	0.78	0.79	0.78

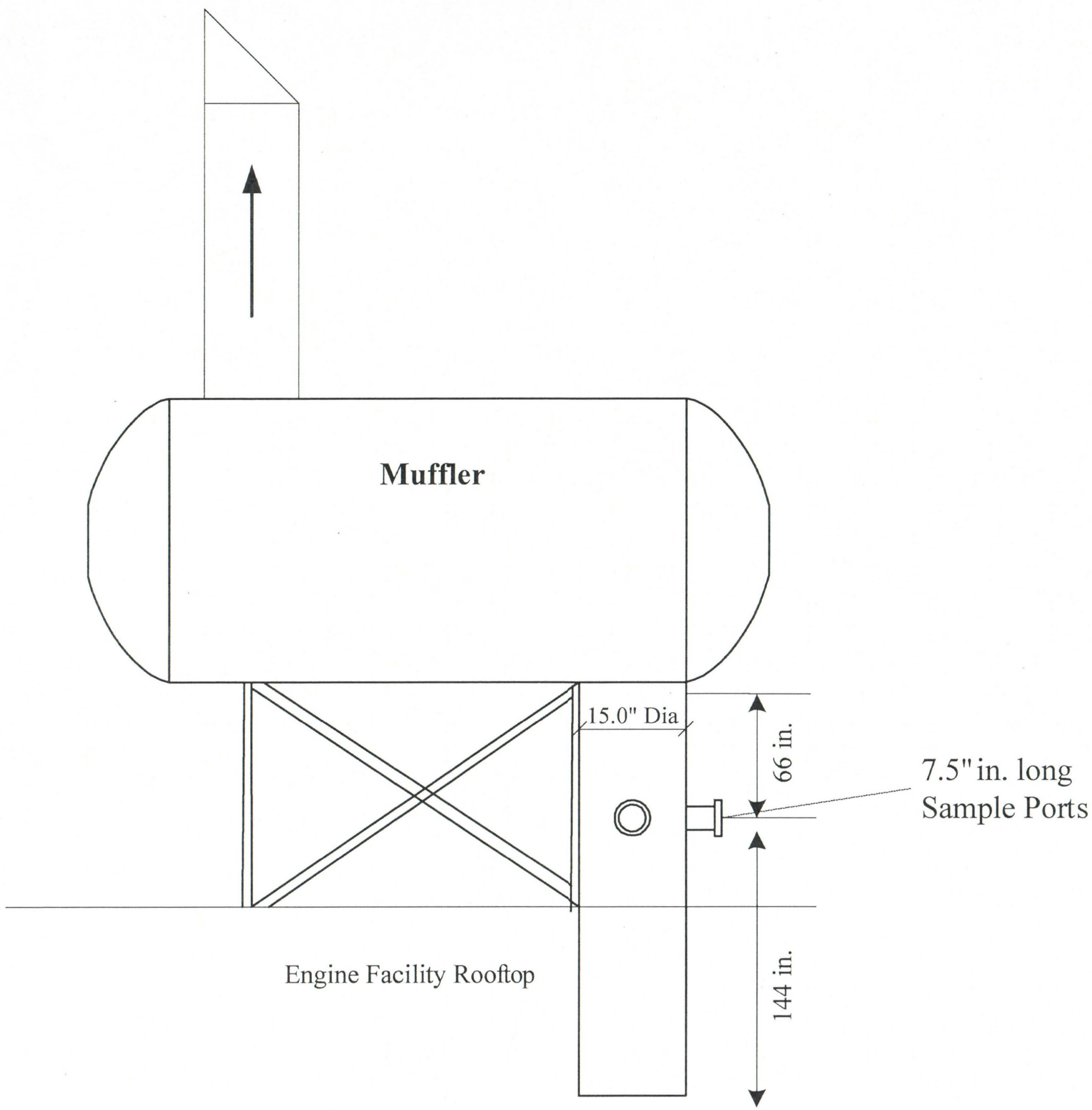
APPENDIX A

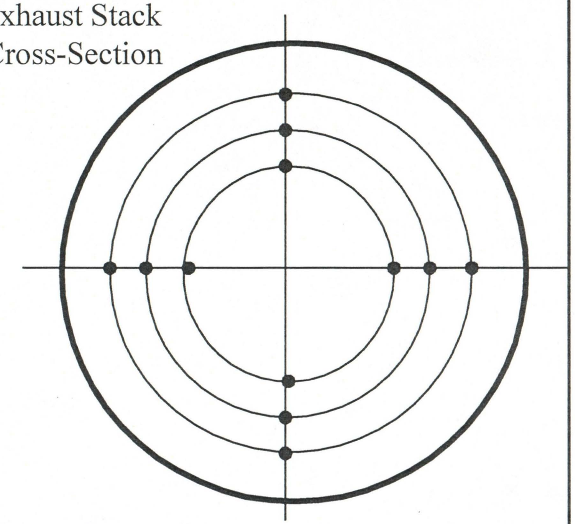
- Figure A-1 – Process Flow Diagram
- Figure A-2 – IC Engines Sample Port Diagram



12/8/2014	**Figure A-1. SEA Facility Process Flow Diagram**		
	Scale None	Sheet 1 of 1	

Engine Exhausts





Velocity Sample Location as Measured from Stack Wall

Sample Port	
Pt. #	in.
1	0.66
2	2.19
3	4.44
4	10.56
5	12.81
6	14.34

Attachment A-2

Pine Tree Acres Facility
Exhaust Sample Locations

Scale	Sheet	
None	1 of 1	IMPACT COMPLIANCE & TESTING