AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM
LANDFILL GAS FIRED ENGINE – GENERATOR SETS

Prepared for:

North American Natural Resources
Autumn Hills Generating Station
SRN N6006

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IMPACT COMPLIANCE & TESTING

Report Certification

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FROM
LANDFILL GAS FIRED ENGINE – GENERATOR SETS

North American Natural Resources
Autumn Hills Generating Station
Zeeland, Michigan

The material and data in this document were prepared under the supervision and direction of the undersigned.

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1.0 Introduction

North American Natural Resources (NANR) operates gas-fired reciprocating internal combustion engine and electricity generator sets (RICE gensets) at the Autumn Hills Generating Station in Zeeland, Ottawa County, Michigan. The RICE are fueled by landfill gas (LFG) that is recovered from the Autumn Hills Landfill solid waste disposal facility and treated prior to use.

The State of Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division (EGLE-AQD) has issued to NANR a Renewable Operating Permit (MI-ROP-N6006-2018a) for operation of the renewable electricity generation facility, which consists of:

- Two (2) Caterpillar (CAT®) Model No. G3520C RICE gensets identified as emission units EUENGINE2R (Engine No. 2R) and EUENGINE4 (Engine No. 4), and one (1) CAT® Model No. G3516LE RICE genset identified as emission unit EUENGINE1 (Engine No. 1). The RICE gensets are collectively identified as Flexible Group (FGSIRICEMACT).

Air emission compliance testing was performed pursuant to conditions of ROP No. MI-ROP-N6006-2018a and the federal Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (the SI-RICE NSPS; 40 CFR Part 60 Subpart JJJJ), which requires that testing be performed every 8,760 operating hours or three years, whichever occurs first (unless the engine has been certified by the manufacturer as specified in the SI-RICE NSPS). The limits presented in this report are the most stringent for each pollutant and may be less than the SI-RICE NSPS standards.

The compliance testing presented in this report was performed by Impact Compliance & Testing, Inc. (ICT), a Michigan-based environmental consulting and testing company. ICT representatives Tyler Wilson and Clay Gaffey performed the field sampling and measurements April 12, 2022.

The engine emission performance tests consisted of triplicate, one-hour sampling periods, per engine, for nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOC, as non-methane hydrocarbons (NMHC or NMOC)). Exhaust gas velocity, moisture, oxygen (O_2) content, and carbon dioxide (CO_2) content were determined for each test period to calculate pollutant mass emission rates.

The exhaust gas sampling and analysis was performed using procedures specified in the Stack Test Protocol dated February 23, 2022, that was reviewed and approved by EGLE-AQD. Mr. Michael Cox of EGLE-AQD observed portions of the compliance testing.

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2.0 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

Conditions of MI-ROP-N6006-2018a and 40 CFR Part 60, Subpart JJJJ, Standards of Performance for New Stationary Sources for Stationary Spark Ignition Internal Combustion Engines require NANR to test each engine in FGSIRICEMACT for CO, NOx, and VOC emissions. Engine Nos. 1, 2R, and 4 (EUENGINE1, EUENGINE2R, and EUENGINE4, respectively) were tested during this compliance test event.

2.2 Operating Conditions During the Compliance Tests

The testing was performed while the NANR engine/generator sets were operated at maximum operating conditions (within 10% of rated capacity). The rated capacities for the one (1) CAT® Model No. G3516LE (EUENGINE1) and two (2) CAT® Model No. G3520C engine generator sets (EUENGINE2R and EUENGINE4) are 800 kilowatt (kW) and 1,600 kW electricity output, respectively. NANR representatives provided kW output in 15-minute increments for each test period.

Fuel flowrate (standard cubic feet per minute, scfm or pounds per hour, lb/hr), fuel methane content (%), and fuel inlet pressure (psi) were also recorded by NANR representatives in 15-minute increments for each test period. Additionally, inlet manifold pressure (psi) was recorded by NANR representatives in 15-minute increments for the EUENGINE2R and EUENGINE4 test periods.

Appendix 2 provides operating records provided by NANR representatives for the test periods.

Table 2.1 and Tables 6.1-6.3 present engine operating conditions during the test periods.

2.3 Summary of Air Pollutant Sampling Results

The gases exhausted from the sampled LFG fueled RICE (EUENGINE1, EUENGINE2R, and EUENGINE4) were each sampled for three (3) one-hour test periods during the compliance testing performed April 12, 2022.

Table 2.2 presents the average measured CO, NO_X, and VOC emission rates for each engine (average of the three test periods).

Test results for each one-hour sampling period and comparison to the permitted emission rates are presented in Section 6.0 of this report.

Table 2.1 Average engine operating conditions during the test periods

Engine Parameter	EUENGINE1 CAT® G3516LE	EUENGINE2R CAT® G3520C	EUENGINE4 CAT® G3520C
Generator output (kW)	794	1,580	1,589
Engine LFG fuel use (scfm)	325	--	--
Engine LFG fuel use (lb/hr)	--	2,632	2,490
LFG methane content (%)	50.7	50.7	50.8
Fuel inlet pressure (psi)	16.0	16.0	16.0
Fuel manifold pressure (psi)	--	48.4	47.6

Table 2.2 Average measured emission rates for each engine (three-test average)

	CO		NOx		VOC	
Emission Unit	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EUENGINE1	5.09	2.04	1.19	0.47	0.50	0.20
Permit Limit	-	***3.1***	-	***2.0***	-	***0.41***
EUENGINE2R	10.2	2.09	1.10	0.23	0.76	0.16
EUENGINE4	9.75	1.99	1.16	0.24	0.67	0.14
Permit Limit	***16.3***	***3.3***	***2.97***	***0.6***	***3.20***	***1.0***

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3.0 Source and Sampling Location Description

3.1 General Process Description

NANR is permitted to operate three (3) RICE-generator sets at its facility; two (2) CAT® Model No. G3520C RICE gensets identified as emission units EUENGINE2R (Engine No. 2R) and EUENGINE4 (Engine No. 4), and one (1) CAT® Model No. G3516LE RICE genset identified as emission unit EUENGINE1 (Engine No. 1). The RICE gensets are collectively identified as Flexible Group (FGSIRICEMACT). The units are fired exclusively with LFG that is recovered from the Autumn Hills Landfill solid waste disposal facility and treated prior to use.

3.2 Rated Capacities and Air Emission Controls

The CAT® Model No. G3520C engine generator sets have a rated design capacity of:

- Engine Power: 2,242 brake horsepower (bhp)
- Electricity Generation: 1,600 kW

The CAT® Model No. G3516LE engine generator set has a rated design capacity of:

- Engine Power: 1,148 bhp
- Electricity Generation: 800 kW

Each engine is equipped with an air-to-fuel ratio (AFR) controller that automatically blends the appropriate ratio of combustion air and treated LFG fuel. For the CAT® Model No. G3516LE, the AFR controller is set based on the gas quality (methane or heat content) of the treated fuel. The CAT® Model No. G3520C engines are equipped with an electronic AFR controller that monitors engine performance parameters and automatically adjusts the AFR and ignition timing to maintain efficient fuel combustion.

The RICE are not equipped with add-on emission control devices. The AFR controller maintains efficient fuel combustion, which minimizes air pollutant emissions. Exhaust gas is exhausted directly to atmosphere through a noise muffler and vertical exhaust stack for each engine.

3.3 Sampling Locations

Each RICE exhaust gas is directed through a muffler and is released to the atmosphere through a dedicated vertical exhaust stack with a vertical release point.

The exhaust stacks for the CAT® Model No. G3520C RICE (EUENGINE2R and EUENGINE4) are identical. The exhaust stack sampling ports are located in individual horizontal exhaust ducts, each with an inner diameter of 13.0 inches, before each engine muffler. The stacks are each equipped with two (2) sample ports, opposed 90°, that provide a sampling location 40.0 inches (3.1 duct diameters) upstream and 240 inches (18.5 duct diameters) downstream from any flow disturbance.

The exhaust stack sampling ports for the CAT® Model No. G3516LE RICE (EUENGINE1) is located in a horizontal exhaust duct, with an inner diameter of 10.0 inches, before the

engine muffler. The stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location 40.0 inches (4.0 duct diameters) upstream and 240 inches (24.0 duct diameters) downstream from any flow disturbance.

All sample port locations satisfy 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 locations with actual stack dimension measurements.

4.0 Sampling and Analytical Procedures

A Stack Test Protocol for the air emission testing was reviewed and approved by 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 content was determined by gravimetric analysis of moisture 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 infrared 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 period. 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 throughout the test periods to verify the integrity of the measurement system.

The absence of significant cyclonic flow at the sampling location 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 each 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 Servomex 1440D infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 1440D 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 each RICE exhaust gas was determined in accordance with USEPA Method 4 using a chilled impinger sampling train. Exhaust gas moisture content measurements were performed concurrently with the instrumental analyzer sampling periods. 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. Moisture sampling was performed from a single centroid sampling location for each RICE exhaust stack.

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 42i High Level chemiluminescence NO_X analyzer and a TEI Model 48i 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 NO_X calculation sheets. Raw instrument response data are provided in Appendix 5.

4.6 Measurement of VOC (USEPA Method 25A / ALT-096)

The VOC emission rate was determined by measuring the nonmethane hydrocarbon (NMHC or NMOC) 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 an alternate test method approving the use of the TEI 55i-series analyzer as an effective instrument for measuring NMOC from gas-fueled RICE (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 (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 Flow Measurement Equipment

Prior to arriving onsite (or onsite prior to beginning compliance testing), the instruments used during the source test to measure exhaust gas properties and velocity (pyrometer, Pitot tube, and scale) were calibrated to specifications in the sampling methods.

The absence of cyclonic flow for each sampling location was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each of the velocity traverse points 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 NO_x Converter Efficiency Test

The NO_2 – NO conversion efficiency of the TEI Model 42i 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 instrumental analyzer will be deemed acceptable if the measured NOx concentration is at least 90% of the expected value (within 10%).

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_x concentration was 101.2% of the expected value).

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 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 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.

5.6 Determination of Exhaust Gas Stratification

A stratification test was performed for each 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 stacks indicated 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 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 Clean Air 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, stratification tests, and field equipment 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 through 6.3.

EUENGINE1 has the following allowable emission limits specified in MI-ROP-N6006-2018a:

- 3.1 grams per brake horsepower hour (g/bhp-hr) for CO;
- 2.0 g/bhp-hr for NOx; and
- 0.41 g/bhp-hr for VOC.

EUENGINE2R and EUENGINE4 each have the following allowable emission limits specified in MI-ROP-N6006- 2018a:

- 16.3 lb/hr and 3.3 g/bhp-hr for CO;
- 2.97 lb/hr and 0.6 g/bhp-hr for NOx; and
- 3.20 lb/hr and 1.0 g/bhp-hr for VOC.

The measured air pollutant concentrations and emission rates for EUENGINE1, EUENGINE2R, and EUENGINE4 are less than the allowable limits specified in MI-ROP-N6006-2018a.

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 Stack Test Protocol. The engine-generator sets were operated within 10% of maximum output (1,600 kW generator output for CAT® G3520C RICE and 800 kW generator output for CAT® G3516LE RICE) and no variations from normal operating conditions occurred during the engine test periods.

Test No. 1 for EUENGINE1 was paused for 13-minutes from 8:02-8:14 because the test trailer lost power. Once power to the test trailer was restored (using a different power source, to avoid another loss of power), and once in-stack raw analyzer air pollutant concentration data was logged for at least twice the greatest system response time, the test was resumed, and data was logged for at least 60-minutes for the test.

Table 6.1 Measured exhaust gas conditions and air pollutant emission rates for Engine No. 1 (EUENGINE1)

Test No. Test date Test period (24-hr clock)	1 04/12/2022 0725-0838*	2 04/12/2022 0855-0955	3 04/12/2022 1008-1108	Three Test Average
Fuel flowrate (scfm)	325	325	324	325
Generator output (kW)	791	793	798	794
Engine output (bhp)	1,129	1,132	1,140	1,134
LFG methane content (%)	50.7	50.7	50.7	50.7
Fuel inlet pressure (psi)	16.0	16.0	16.0	16.0
Exhaust Gas Composition				
CO_2 content (% vol)	12.5	12.6	12.6	12.6
O_2 content (% vol)	7.51	7.40	7.37	7.43
Moisture (% vol)	8.82	12.7	12.7	11.4
Exhaust gas flowrate (dscfm)	2,636	2,555	2,507	2,566
Exhaust gas flowrate (scfm)	2,890	2,926	2,871	2,896
Exhaust gas temperature (°F)	886	894	895	892
Nitrogen Oxides				
NO_X conc. (ppmvd)	55.9	65.5	72.6	64.7
NO_X emissions (lb/hr)	1.06	1.20	1.30	1.19
NO_X emissions (g/bhp-hr)	0.42	0.48	0.52	0.47
Permit Limit (g/bhp-hr)	-	-	-	*2.0*
Carbon Monoxide				
CO conc. (ppmvd)	451	453	461	455
CO emissions (lb/hr)	5.19	5.05	5.04	5.09
CO emissions (g/bhp-hr)	2.08	2.02	2.01	2.04
Permit Limit (g/bhp-hr)	-	-	-	*3.1*
Volatile Organic Compounds				
NMHC conc. (ppmv)	25.5	25.1	25.1	25.2
NMHC emissions (lb/hr)	0.51	0.51	0.49	0.50
NMHC emissions (g/bhp-hr)	0.20	0.20	0.20	0.20
Permit Limit (g/bhp-hr)	-	-	-	*0.41*

Note: Test No. 1 was paused from 08:02-08:14 because the test trailer lost power.

Table 6.2 Measured exhaust gas conditions and air pollutant emission rates for Engine No. 2R (EUENGINE2R)

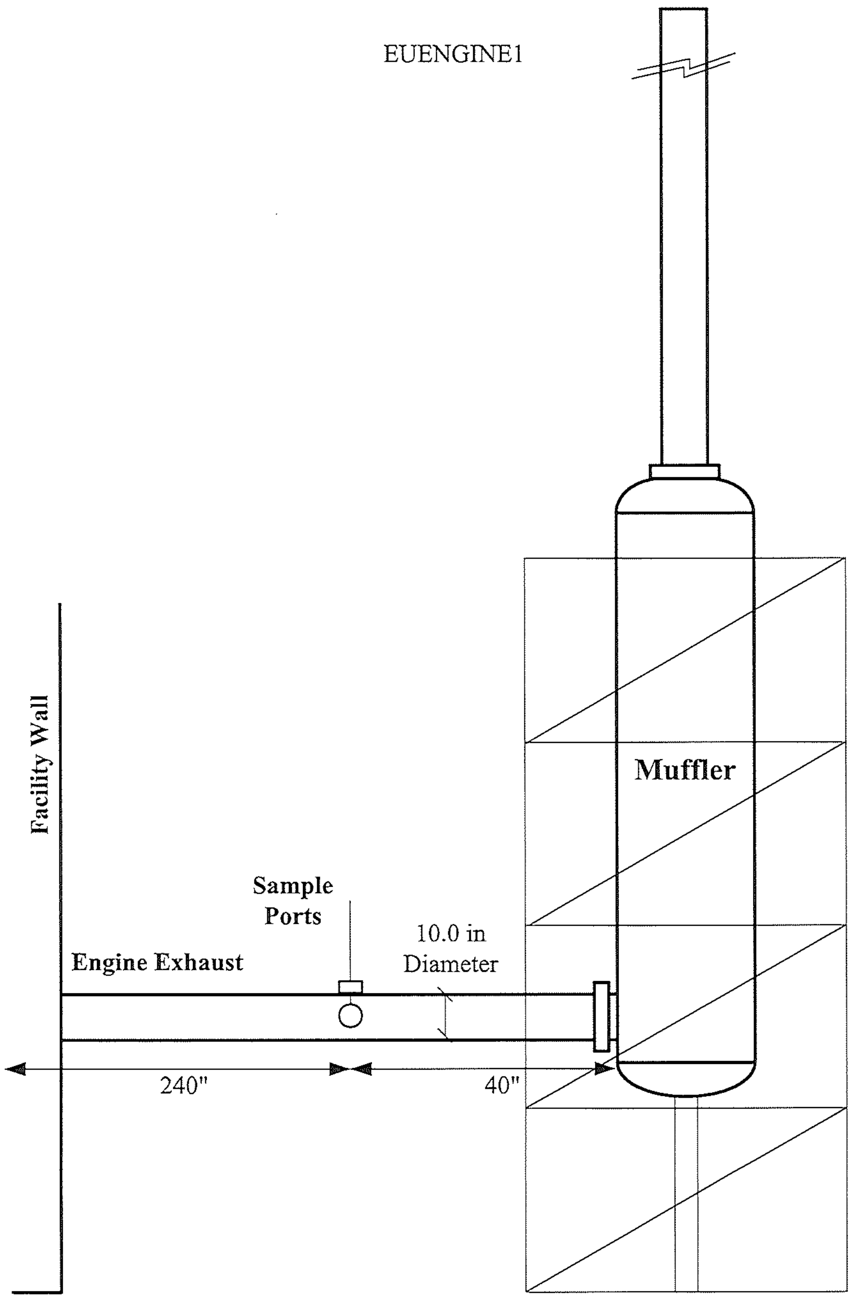
Test No. Test date Test period (24-hr clock)	1 04/12/2022 1122-1222	2 04/12/2022 1237-1337	3 04/12/2022 1349-1449	Three Test Average
Fuel flowrate (lb/hr)	2,636	2,633	2,626	2,632
Generator output (kW)	1,580	1,579	1,580	1,580
Engine output (bhp)	2,205	2,204	2,205	2,204
LFG methane content (%)	50.7	50.7	50.8	50.7
Fuel inlet pressure (psi)	16.0	16.0	16.0	16.0
Fuel manifold pressure (psi)	48.1	48.3	48.6	48.4
Exhaust Gas Composition				
CO_2 content (% vol)	11.4	11.5	11.4	11.4
O_2 content (% vol)	8.77	8.89	8.94	8.87
Moisture (% vol)	10.7	10.8	11.6	11.0
Exhaust gas flowrate (dscfm)	4,394	4,350	4,364	4,369
Exhaust gas flowrate (scfm)	4,919	4,875	4,936	4,910
Exhaust gas temperature (°F)	921	929	922	924
Nitrogen Oxides				
NO_X conc. (ppmvd)	34.6	34.8	35.7	35.0
NO_X emissions (lb/hr)	1.09	1.09	1.12	1.10
Permit Limit (lb/hr)	-	-	-	*2.97*
NO_X emissions (g/bhp-hr)	0.22	0.22	0.23	0.23
Permit Limit (g/bhp-hr)	-	-	-	*0.6*
Carbon Monoxide				
CO conc. (ppmvd)	533	532	533	533
CO emissions (lb/hr)	10.2	10.1	10.2	10.2
Permit Limit (lb/hr)	-	-	-	*16.3*
CO emissions (g/bhp-hr)	2.10	2.08	2.09	2.09
Permit Limit (g/bhp-hr)	-	-	-	*3.3*
Volatile Organic Compounds				
NMHC conc. (ppmv)	22.6	22.5	22.9	22.6
NMHC emissions (lb/hr)	0.76	0.75	0.78	0.76
Permit Limit (lb/hr)	-	-	-	*3.20*
NMHC emissions (g/bhp-hr)	0.16	0.15	0.16	0.16
Permit Limit (g/bhp-hr)	-	-	-	*1.0*

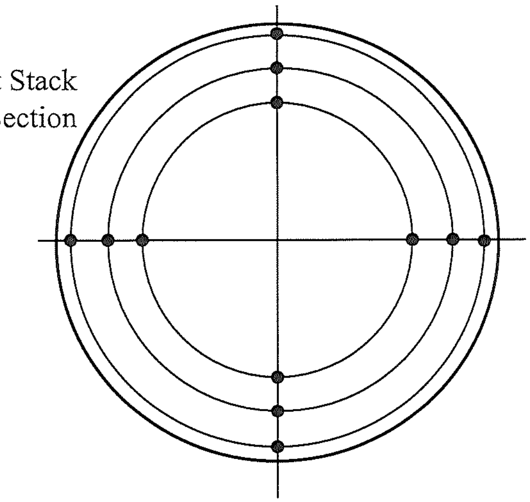
Table 6.3 Measured exhaust gas conditions and air pollutant emission rates for Engine No. 4 (EUENGINE4)

Test No. Test date Test period (24-hr clock)	1 04/12/2022 1502-1602	2 04/12/2022 1614-1714	3 04/12/2022 1726-1826	Three Test Average
Fuel flowrate (lb/hr)	2,496	2,488	2,485	2,490
Generator output (kW)	1,591	1,586	1,590	1,589
Engine output (bhp)	2,230	2,222	2,229	2,227
LFG methane content (%)	50.8	50.8	50.9	50.8
Fuel inlet pressure (psi)	16.0	16.0	16.0	16.0
Fuel manifold pressure (psi)	47.9	47.5	47.6	47.6
Exhaust Gas Composition				
CO_2 content (% vol)	11.5	11.5	11.5	11.5
O_2 content (% vol)	8.66	8.65	8.62	8.65
Moisture (% vol)	10.6	11.1	10.9	10.9
Exhaust gas flowrate (dscfm)	4,240	4,181	4,191	4,204
Exhaust gas flowrate (scfm)	4,745	4,704	4,704	4,718
Exhaust gas temperature (°F)				
Nitrogen Oxides				
NO_X conc. (ppmvd)	39.1	38.2	38.4	38.5
NO_X emissions (lb/hr)	1.19	1.14	1.15	1.16
Permit Limit (lb/hr)	-	-	-	*2.97*
NO_X emissions (g/bhp-hr)	0.24	0.23	0.23	0.24
Permit Limit (g/bhp-hr)	-	-	-	*0.6*
Carbon Monoxide				
CO conc. (ppmvd)	531	530	532	531
CO emissions (lb/hr)	9.83	9.67	9.74	9.75
Permit Limit (lb/hr)	-	-	-	*16.3*
CO emissions (g/bhp-hr)	2.00	1.97	1.98	1.99
Permit Limit (g/bhp-hr)	-	-	-	*3.3*
Volatile Organic Compounds				
NMHC conc. (ppmv)	20.5	20.8	20.6	20.6
NMHC emissions (lb/hr)	0.67	0.67	0.67	0.67
Permit Limit (lb/hr)	-	-	-	*3.20*
NMHC emissions (g/bhp-hr)	0.14	0.14	0.14	0.14
Permit Limit (g/bhp-hr)	-	-	-	*1.0*

APPENDIX 1

- RICE Engine Sample Port Diagrams

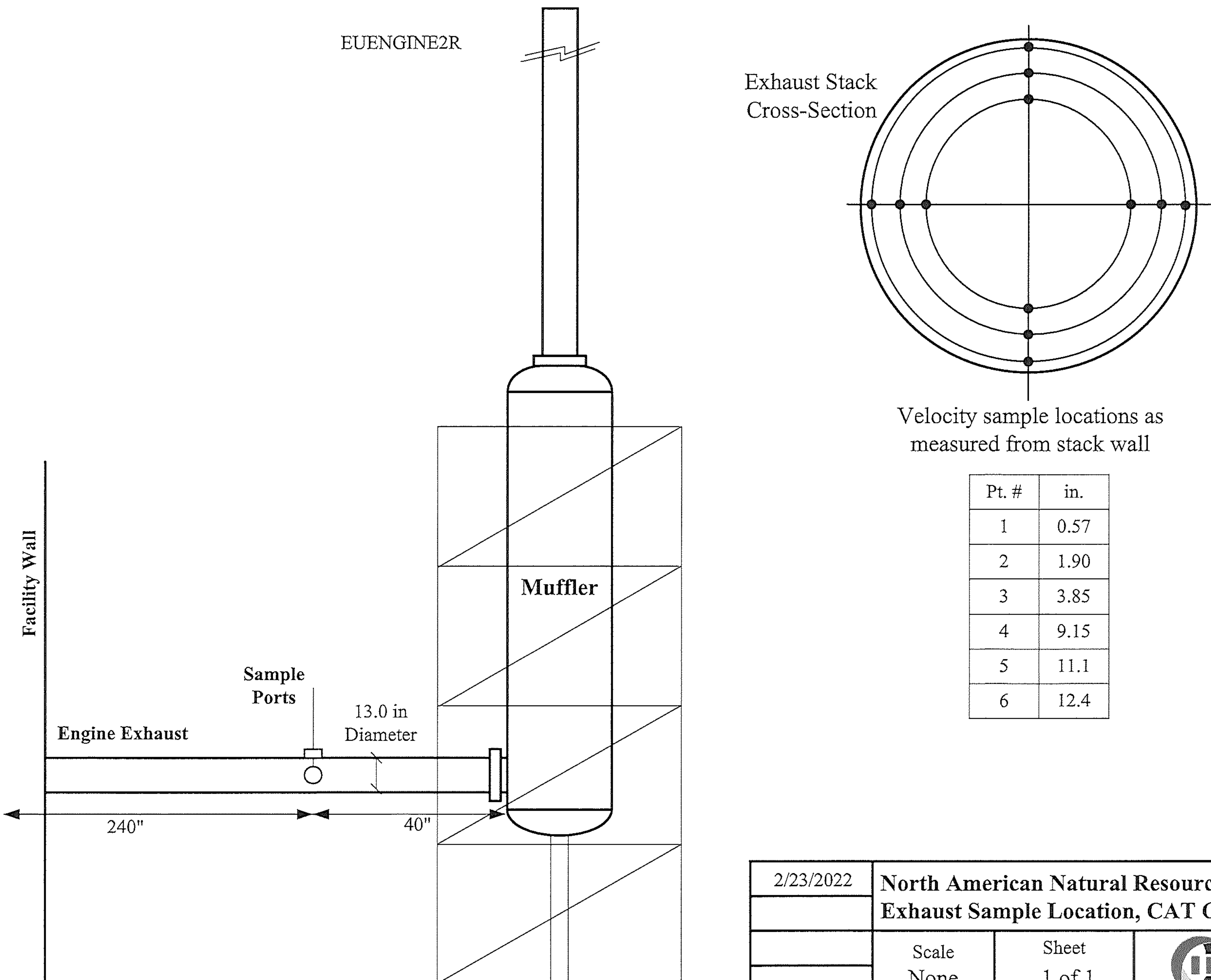




Velocity sample locations as measured from stack wall

Pt. #	in.
1	0.50
2	1.46
3	2.96
4	7.04
5	8.54
6	9.50

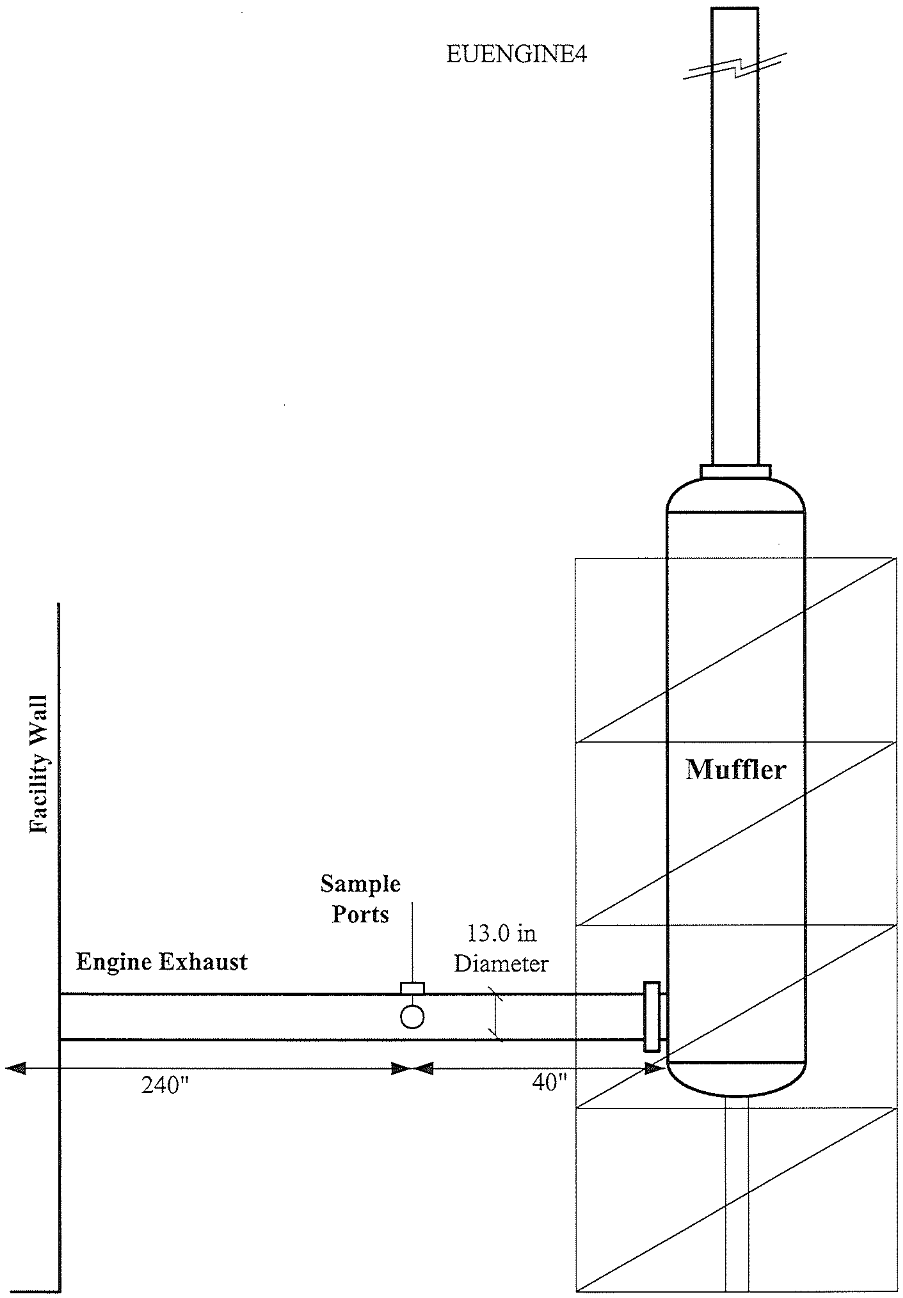
2/23/2022	**North American Natural Resources (NANR)** **Exhaust Sample Location, CAT G3516LE RICE**		
	Scale None	Sheet 1 of 1	IMPACT COMPLIANCE & TESTING

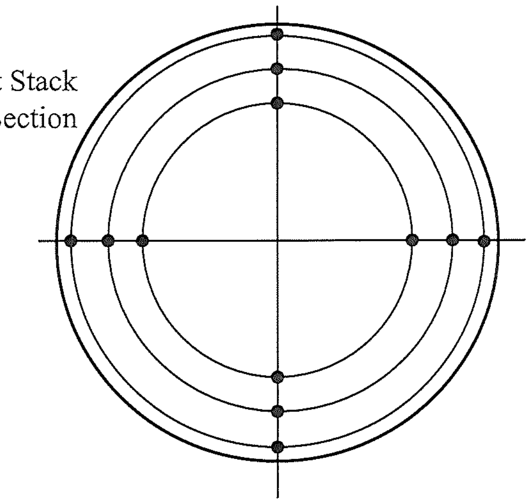


Velocity sample locations as measured from stack wall

Pt. #	in.
1	0.57
2	1.90
3	3.85
4	9.15
5	11.1
6	12.4

2/23/2022	North American Natural Resources (NANR) Exhaust Sample Location, CAT G3520C RICE		
	Scale: None	Sheet: 1 of 1	IMPACT COMPLIANCE & TESTING





Velocity sample locations as measured from stack wall

Pt. #	in.
1	0.57
2	1.90
3	3.85
4	9.15
5	11.1
6	12.4

2/23/2022	North American Natural Resources (NANR) Exhaust Sample Location, CAT G3520C RICE		
	Scale None	Sheet 1 of 1	IMPACT COMPLIANCE & TESTING