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

NORTH AMERICAN NATURAL RESOURCES
AUTUMN HILLS GENERATING STATION

1.0 INTRODUCTION

North American Natural Resources (NANR) operates gas-fired reciprocating internal combustion engine (RICE) electricity generator sets at the Autumn Hills Generating Station located in Zeeland, Ottawa County, Michigan. The RICE are fueled by landfill gas (LFG) that is recovered from the Autumn Hills Landfill, which is owned and operated by Waste Management of Michigan. The recovered gas is transferred to NANR where it is treated and used as fuel.

The Michigan Department of Environment, Great Lakes and Energy-Air Quality Division (EGLE-AQD) has issued to NANR a Renewable Operating Permit (MI-ROP-N6006-2018) and Permit to Install (PTI No. 86-19) for operation of the renewable electricity generation facility, which consists of:

- One (1) Caterpillar (CAT®) Model No. 3516LE RICE-generator set identified as emission unit EUENGINE1; and
- Two (2) CAT® Model No. G3520C RICE-generator sets identified as emission units EUENGINE2R and EUENGINE4.

Air emission compliance testing was performed pursuant to the conditions of MI-ROP-N6006-2018, PTI No. 86-19 and the federal Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (the SI-RICE NSPS; 40 CFR Part 60 Subpart JJJJ). Conditions of PTI No. 86-19 for EUENGINE2R state:

1. *Within 180 days after commencement of initial startup and every 5 years after the initial test, the permittee shall verify NOx, SO2, CO, VOC, and formaldehyde emission rates from EUENGINE2R by testing at owner's expense, in accordance with Department requirements.*

The testing performed on EUENGINE2R satisfies the requirement to test within 180 days after commencement of initial startup.

Conditions of PTI No. 86-19 for EUENGINE4 state:

1. *Within 5 years from the date of the previous stack test, the permittee shall verify NOx, CO, SO2, VOC and formaldehyde emission rates from EUENGINE4 at maximum routine operating conditions, by testing at owner's expense, in accordance with Department requirements.*

Formaldehyde emission testing was most recently performed on February 17, 2015 and was repeated for EUENGINE4 within five (5) years of the previous test. NOx, CO and VOC emission testing was most recently completed on July 11, 2019.

The compliance testing presented in this report was performed by Impact Compliance and Testing, Inc. (ICT), a Michigan-based environmental consulting and testing company. ICT representatives Andrew Eisenberg, Robert Harvey and Andrew Rusnak performed the field sampling and measurements February 13, 2020.

The engine emission performance tests consisted of triplicate, one-hour sampling periods for nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), formaldehyde (CHOH) volatile organic compounds (VOC, as non-methane hydrocarbons). 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 Test Plan dated January 10, 2020 that was reviewed and approved by the EGLE-AQD. Mr. David Patterson of the EGLE-AQD observed portions of the compliance testing.

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 NANR employees or representatives. This test report has been reviewed by NANR representatives and approved for submittal to the EGLE-AQD.

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:

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2.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS

2.1 Purpose and Objective of the Tests

The conditions of MI-ROP-N6006-2018, PTI No. 86-19 and 40 CFR Part 60 Subpart JJJJ require NANR to test engine EUENGINE2R and EUENGINE4 for CO, NOx, SO_2, CHOH and VOC emissions.

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 capacity for the two CAT® Model G3520C engine generator sets (EUENGINE2R and EUENGINE4) is 1,600 kW electricity output. NANR representatives provided kW output in 15-minute increments for each test period. The EUEGINE2R generator kW output ranged between 1,600 and 1,609 kW and the EUENGINE4 generator kW output ranged between 1,600 and 1,605 kW for each test period.

Fuel flowrate (cubic feet per minute) and fuel methane content (%) were also recorded by NANR representatives in 15-minute increments for each test period. The EUENGINE2R fuel consumption rate ranged between 375 and 377 scfm and the fuel methane content was 51%. The EUENGINE4 fuel consumption rate ranged between 341 and 357 scfm ant the fuel methane content was 51%.

Appendix 2 provides operating records provided by NANR 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) / gen. efficiency / (0.7457 kW/hp)

Where gen. efficiency = 0.961 (CAT® G3520C)

Table 2.1 presents a summary of the average engine operating conditions during the test periods.

2.3 Summary of Air Pollutant Sampling Results

The gases exhausted from the sampled LFG fueled RICE (EUENGINE2R and EUENGINE4) were sampled for three (3) one-hour test periods during the compliance testing performed February 13, 2020.

Table 2.2 presents the average measured CO, NO_X, SO_2, CHOH 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	EUENGINE2R CAT®3520C	EUENGINE4 CAT® G3520C
Generator output (kW)	1,604	1,603
Engine output (bhp)	2,238	2,237
Engine LFG fuel use (scfm)	376	350
LFG methane content (%)	51	51
Exhaust temperature (°F)	955	956

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

Emission Unit	EUENGINE2R		EUENGINE4	
	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
CO Emission Rates	10.9	2.21	13.4	2.72
Permit Limit	***16.3***	***3.3***	***16.3***	***3.3***
NOx Emission Rates	1.86	0.38	2.13	0.43
Permit Limit	***2.97***	***0.6***	***2.97***	***0.6***
SO_2 Emission Rates	1.74	--	1.73	--
Permit Limit	***5.16***	***--***	***5.16***	***--***
CHOH Emission Rates	1.35	--	1.24	--
Permit Limit	***2.20***	***--***	***2.20***	***--***
VOC Emission Rates	*0.52*	*0.11*	*0.57*	*0.12*
Permit Limit	***3.20***	***1.0***	***3.20***	***1.0***

3.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

3.1 General Process Description

NANR is permitted to operate three RICE-generator sets at its Auburn Hills Generating station; one (1) CAT® Model No. 3516LE and two (2) CAT® Model No. 3520C. 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® G3520C engine generator set has a rated design capacity of:

- Engine Power; 2,242 bhp
- Electricity Generation; 1,600 kW

Each engine is equipped with an air-to-fuel ratio (AFR) controller that blends the appropriate ratio of combustion air and treated LFG fuel. The CAT® G3520C engine is 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.

3.3 Sampling Locations

The 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 stack sampling ports for the CAT® Model G3520C engine (EUENGINE4) are located before the muffler in a horizontal exhaust duct with an inner diameter of 13.5 inches. The duct is equipped with two (2) sample ports, opposed 90°, that provide a sampling location 49 inches (3.6 duct diameters) upstream and 113 inches (8.4 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.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A test 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 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
ASTM Method D6348	Exhaust gas CHOH, SO_2 and moisture content was determined using a FTIR instrumental analyzer

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 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 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 California Analytics Fuji ZRF single beam single wavelength (SBSW) infrared gas analyzer. The O_2 content of the exhaust was monitored using a California Analytics Fuji ZFK3 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 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 Analytics Fuji Model ZRF 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.

4.5 Measurement of Volatile Organic Compounds (USEPA Method 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 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.

4.6 Measurement of Formaldehyde and Sulfur Dioxide via FTIR (ASTM D6348)

Formaldehyde, sulfur dioxide and moisture concentration in the exhaust gas streams was determined using an MKS Multi-Gas 2030 Fourier transform infrared (FTIR) spectrometer in accordance with test method ASTM D6348.

The USEPA New Source Performance Standard (NSPS) for landfill gas fired engines (Subpart JJJJ) specifies ASTM D6348 as an acceptable test method for moisture concentration determinations. Additionally, the USEPA National Emissions Standard for Hazardous Air Pollutants (NESHAP) for landfill gas fired engines (Subpart ZZZZ) specifies ASTM D6348 as an acceptable test method for moisture and formaldehyde concentration determinations.

Samples of the exhaust gas were delivered directly to the instrumental analyzer using a Teflon® heated sample line to prevent condensation. The sample to the FTIR analyzer was not conditioned to remove moisture. Therefore, measurements correspond to standard conditions with no moisture correction (wet basis).

A calibration transfer standard (CTS), ethylene standard, and nitrogen zero gas were analyzed before and after each test run. Analyte spiking, of each engine, with acetaldehyde and sulfur dioxide was performed to verify the ability of the sampling system to quantitatively deliver a sample containing the compound of interest from the base of the probe to the FTIR. Data was collected at 0.5 cm-1 resolution. Instrument response was recorded using MG2000 data acquisition software.

Appendix 4 provides CHOH and SO_2 calculation sheets. Raw instrument response data for the FTIR analyzer is provided in Appendix 6.

5.0 QA/QC ACTIVITIES

5.1 Flow Measurement Equipment

Prior to arriving onsite, the instruments used during the source test to measure exhaust gas properties and velocity (barometer and Pitot tube) 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 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_x concentration is within 90% of the expected value.

The NO_2 – NO conversion efficiency test satisfied the USEPA Method 7E criteria (measured NO_x concentration was greater than 90% 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 NO_x, CO, O_2 and CO_2 concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the RICE exhaust gas was considered to be unstratified and the compliance test sampling was performed at a single sampling location within each RICE exhaust stack.

5.7 FTIR QA/QC Activities

At the beginning of each day a calibration transfer standard (CTS, ethylene gas), analyte of interest (acetaldehyde and sulfur dioxide) and nitrogen calibration gas was directly injected into the FTIR to evaluate the unit response.

Prior to and after each test run the CTS was analyzed. The ethylene was passed through the entire system (system purge) to verify the sampling system response and to ensure that the sampling system remained leak-free at the stack location. Nitrogen was also be passed through the sampling system to ensure the system is free of contaminants.

Analyte spiking, of the emission unit, with acetaldehyde and sulfur dioxide was performed to verify the ability of the sampling system to quantitatively deliver a sample containing the compound of interest from the base of the probe to the FTIR and assure the ability of the FTIR to quantify that compound in the presence of effluent gas.

As part of the data validation procedure, reference spectra were manually fit to that of the sample spectra (two spectra from each test period) and a concentration was determined. Concentration data was manually validated using the MKS MG2000 method analyzer software. The software used multi-point calibration curves to quantify each spectrum. The software-calculated results were compared with the measured concentrations to ensure the quality of the data.

Appendix 7 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, FTIR QA/QC data, Pitot tube calibration records, and stratification checks).

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 EUENGINE2R and EUENGINE4 are less than the allowable limits specified in PTI No. 86-19.

EUENGINE2R and EUENGINE4

- 3.3 g/bhp-hr and 16.3 lb/hr for CO;
- 0.6 g/bhp-hr and 2.97 lb/hr for NOx;
- 5.16 lb/hr for SO_2;
- 2.20 lb/hr for CHOH; and
- 1.0 g/bhp-hr and 3.20 lb/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. The engine-generator sets were operated within 10% of maximum output (1,600 kW generator output for CAT® 3520C) and no variations from normal operating conditions occurred during the engine test periods.

Table 6.1 Measured exhaust gas conditions and air pollutant emission rates for Engine No. 2R (EUENGINE2R)

Test No. Test date Test period (24-hr clock)	1 2/13/20 1421-1521	2 2/13/20 1541-1641	3 2/13/20 1700-1800	Three Test Average
Fuel flowrate (scfm)	375	376	376	376
Generator output (kW)	1,603	1,605	1,604	1,604
Engine output (bhp)	2,237	2,240	2,238	2,238
LFG methane content (%)	50.8	50.8	50.7	50.7
<u>Exhaust Gas Composition</u>				
CO_2 content (% vol)	11.2	11.2	11.2	11.2
O_2 content (% vol)	8.38	8.36	8.36	8.37
Moisture (% vol)	11.0	11.1	10.9	11.0
Exhaust gas temperature (^oF)	956	955	955	955
Exhaust gas flowrate (dscfm)	4,031	4,133	3,958	4,041
Exhaust gas flowrate (scfm)	4,527	4,647	4,444	4,540
<u>Nitrogen Oxides</u>				
NO_X conc. (ppmvd)	64.2	64.3	64.1	64.2
NO_X emissions (lb/hr)	1.85	1.91	1.82	1.86
Permit Limit (lb/hr)	-	-	-	*2.97*
NO_X emissions (g/bhp*hr)	0.38	0.39	0.37	0.38
*Permit Limit (g/bhp*hr)*	-	-	-	*0.6*
<u>Carbon Monoxide</u>				
CO conc. (ppmvd)	614	619	620	618
CO emissions (lb/hr)	10.8	11.2	10.7	10.9
Permit Limit (lb/hr)	-	-	-	*16.3*
CO emissions (g/bhp*hr)	2.19	2.26	2.17	2.21
*Permit Limit (g/bhp*hr)*	-	-	-	*3.3*
<u>Volatile Organic Compounds</u>				
VOC conc. (ppmv)	16.6	17.0	16.9	16.8
VOC emissions (lb/hr)	0.52	0.54	0.52	0.52
Permit Limit (lb/hr)	-	-	-	*3.20*
VOC emissions (g/bhp*hr)	0.10	0.11	0.11	0.11
*Permit Limit (g/bhp*hr)*	-	-	-	*1.0*

Table 6.1 Measured exhaust gas conditions and air pollutant emission rates for Engine No. 2R (EUENGINE2R), Continued

Test No. Test date Test period (24-hr clock)	1 2/13/20 1421-1521	2 2/13/20 1541-1641	3 2/13/20 1700-1800	Three Test Average
Formaldehyde				
CHOH conc. (ppmvd)	59.4	64.8	65.7	63.3
CHOH emissions (lb/hr)	1.29	1.36	1.41	1.35
Permit Limit (lb/hr)	-	-	-	*2.20*
Sulfur Dioxide				
SO_2 conc. (ppmvd)	37.7	38.8	38.2	38.2
SO_2 emissions (lb/hr)	1.75	1.74	1.75	1.74
Permit Limit (lb/hr)	-	-	-	*5.16*

Table 6.2 Measured exhaust gas conditions and air pollutant emission rates for Engine No. 4 (EUENGINE4)

Test No.	1	2	3	
Test date	2/13/20	2/13/20	2/13/20	Three Test
Test period (24-hr clock)	935-1035	1056-1156	1217-1317	Average
Fuel flowrate (scfm)	352	351	347	350
Generator output (kW)	1,602	1,602	1,604	1,603
Engine output (bhp)	2,236	2,236	2,238	2,237
LFG methane content (%)	50.7	50.8	50.8	50.8
Exhaust Gas Composition				
CO_2 content (% vol)	11.2	11.2	11.2	11.2
O_2 content (% vol)	8.29	8.30	8.34	8.31
Moisture (% vol)	11.3	11.0	11.3	11.2
Exhaust gas temperature (^oF)	956	954	957	956
Exhaust gas flowrate (dscfm)	4,049	4,070	4,024	4,048
Exhaust gas flowrate (scfm)	4,565	4,575	4,536	4,559
Nitrogen Oxides				
NO_X conc. (ppmvd)	73.3	73.4	73.7	73.5
NO_X emissions (lb/hr)	2.13	2.14	2.13	2.13
Permit Limit (lb/hr)	-	-	-	*2.97*
NO_X emissions (g/bhp*hr)	0.43	0.43	0.43	0.43
*Permit Limit (g/bhp*hr)*	-	-	-	*0.6*
Carbon Monoxide				
CO conc. (ppmvd)	751	763	764	759
CO emissions (lb/hr)	13.3	13.6	13.4	13.4
Permit Limit (lb/hr)	-	-	-	*16.3*
CO emissions (g/bhp*hr)	2.69	2.75	2.72	2.72
*Permit Limit (g/bhp*hr)*	-	-	-	*3.3*
Volatile Organic Compounds				
VOC conc. (ppmv)	18.2	18.0	18.4	18.2
VOC emissions (lb/hr)	0.57	0.57	0.57	0.57
Permit Limit (lb/hr)	-	-	-	*3.20*
VOC emissions (g/bhp*hr)	0.12	0.11	0.12	0.12
*Permit Limit (g/bhp*hr)*	-	-	-	*1.0*

Table 6.2 Measured exhaust gas conditions and air pollutant emission rates for Engine No. 4 (EUENGINE4), Continued

Test No. Test date Test period (24-hr clock)	1 2/13/20 935-1035	2 2/13/20 1056-1156	3 2/13/20 1217-1317	Three Test Average
Formaldehyde				
CHOH conc. (ppmvd)	61.0	61.6	52.0	58.2
CHOH emissions (lb/hr)	1.29	1.34	1.08	1.24
Permit Limit (lb/hr)	-	-	-	*2.20*
Sulfur Dioxide				
SO_2 conc. (ppmvd)	37.5	38.6	38.7	38.2
SO_2 emissions (lb/hr)	1.69	1.79	1.72	1.73
Permit Limit (lb/hr)	-	-	-	*5.16*