AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM A
LANDFILL GAS FIRED ENGINE – GENERATOR SET
AND
NON-ENCLOSED FLARE DEMONSTRATION

Prepared for:

Energy Developments Coopersville, LLC

SRN N3294

ICT Project No.: 2400125

June 17, 2024

IMPACT COMPLIANCE & TESTING

Report Certification

AIR EMISSION TEST REPORT

FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM A
LANDFILL GAS FIRED (LFG) ENGINE – GENERATOR SET
AND
NON-ENCLOSED (OPEN) FLARE DEMONSTRATION

Energy Developments Coopersville, LLC
Coopersville, MI

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

Report Prepared By:
Max Fierro Project Manager Impact Compliance & Testing, Inc.

Executive Summary

ENERGY DEVELOPMENTS COOPERSVILLE, LLC
LFG FUELED IC ENGINE
EMISSION TEST RESULTS
AND OPEN FLARE DEMONSTRATION

Energy Developments Coopersville, LLC (EDC) contracted Impact Compliance & Testing, Inc. (ICT) to conduct a performance demonstration for the determination of nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOC), emission rates from one (1) Caterpillar (CAT®) Model No. G3520C gas-fired reciprocating internal combustion engine identified as EUENGINE7 and an open flare demonstration for one (1) open flare identified as EUOPENFLARE, operated at the EDC facility located in Coopersville, Ottawa County, Michigan. The RICE and open flare are fueled with landfill gas (LFG) that is produced at the Ottawa County Farms Landfill.

Compliance testing was performed with regards to conditions specified in The State of Michigan Department of Environment, Great Lakes, and Energy-Air Quality Division (EGLE-AQD) Renewable Operating Permit (ROP) No. MI-ROP-N3294-2024, the federal Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (the SI-RICE NSPS; 40 CFR Part 60 Subpart JJJJ), the federal standards of Performance for Municipal Solid Waste Landfills That Commenced Construction, Reconstruction, or Modification After July 17, 2014 (40 CFR Part 60, Subpart XXX), and the federal National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills (40 CFR Part 63, Subpart AAAA). The performance testing was conducted May 7, 2024.

EUOPENFLARE performance test report and associated results are included as Appendix 1.

The following table presents the CAT® G3520C emissions results from the performance demonstration.

Emission Unit	NO_x (lb/hr)	NO_x (g/bhp-hr)	CO (lb/hr)	CO (g/bhp-hr)	VOC (lb/hr)	VOC (g/bhp-hr)
EUENGINE7	3.21	0.68	14.6	3.09	0.60	0.13
Permit Limits	*4.94*	*3.0*	*16.3*	*5.0*	*3.2*	*1.0*

The following table presents the operating data recorded during the performance demonstration.

Emission Unit	Generator Output (kW)	Engine Output (bhp)	LFG Fuel Use (lb/hr)	Fuel Inlet Pressure (psi)	Fuel CH_4 Content (%)
EUENGINE7	1,542	2,151	2,145	6	53.8

The data presented above indicates that EUENGINE7 was tested while the unit operated within 10% of maximum capacity (1,600 kilowatt (kW)) and is in compliance with the emission standards specific to the unit.

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1.0 Introduction

Energy Developments Coopersville, LLC (EDC) owns and operates a Caterpillar (CAT®) Model No. G3520C gas-fired reciprocating internal combustion engine and electricity generator set (RICE genset) identified as EUENGINE7 and a non-enclosed (open) flare identified as EUOPENFLARE located in Coopersville, Ottawa County, Michigan. The State of Michigan Department of Environment, Great Lakes, and Energy-Air Quality Division (EGLE-AQD) has issued EDC Renewable Operating Permit (ROP) No. MI-ROP-N3294-2024 for operation of the RICE genset and open flare.

Air emission compliance testing was performed pursuant to conditions specified in ROP No. MI-ROP-N3294-2024, Section 2 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 open flare demonstration was performed pursuant to ROP No. MI-ROP-N3294-2024, Section 2, the federal standards of Performance for Municipal Solid Waste Landfills That Commenced Construction, Reconstruction, or Modification After July 17, 2014 (40 CFR Part 60, Subpart XXX), and the federal National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills (40 CFR Part 63, Subpart AAAA). The open flare report is presented in Appendix 1.

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 Max Fierro and Renee Fromwiller performed the field sampling and measurements May 7, 2024.

The engine emission performance tests consisted of triplicate, one-hour sampling periods 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 April 3, 2024, that was reviewed and approved by EGLE-AQD on April 25, 2024.

Questions regarding this air emission test report should be directed to:

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2.0 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

Conditions of ROP No. MI-ROP-N3294-2024 and 40 CFR Part 60, Subpart JJJJ, Standards of Performance for New Stationary Sources for Stationary Spark Ignition Internal Combustion Engines require EDC to test EUENGINE7 for CO, NOx, and VOC emissions. Engine No. 7 (Emission Unit EUENGINE7) was tested during this compliance test event.

2.2 Operating Conditions During the Compliance Tests

The testing was performed while the EDC engine/generator set was operated at maximum operating conditions. EDC representatives provided kW output, landfill gas (LFG) fuel flowrate (pounds per hour, lb/hr), fuel inlet pressure (psi), and fuel methane content (%) in 15-minute increments for each test period.

Appendix 3 provides operating records provided by EDC representatives for the test periods.

Average output, fuel consumption, and fuel methane content for the RICE is presented in Table 2.1 and Table 6.1.

2.3 Summary of Air Pollutant Sampling Results

The gases exhausted from the RICE were sampled for three (3) one-hour test periods during the compliance testing performed May 7, 2024.

Table 2.2 presents the average measured CO, NO_X, and VOC emission rates for the 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	EUENGINE7
Generator output (kW)	1,542
Engine output (bhp)	2,151
Engine LFG fuel use (lb/hr)	2,145
LFG methane content (%)	53.8
Fuel inlet pressure (psi)	6
Exhaust temperature (°F)	848.5

Table 2.2 Measured Engine No. 7 (EUENGINE7) air pollutant emission rates (three-test average)

Emission Unit	CO		NOx		VOC	
	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)	(lb/hr)	(g/bhp-hr)
EUENGINE7	14.6	3.09	3.21	0.68	0.60	0.13
Permit Limit	*16.3*	*5.0*	*4.94*	*3.0*	*3.2*	*1.0*

3.0 Source and Sampling Location Description

3.1 General Process Description

LFG containing methane is produced in the Ottawa County Farms Landfill from the anaerobic decomposition of waste materials. The gas is collected and directed to the EDC gas-to-energy facility where it is used as fuel for the RICE genset that produces electricity.

The gas-to-energy facility primarily consists of gas treatment equipment and one (1) CAT® Model No. G3520C RICE that is connected to an electricity generator.

3.2 Rated Capacities and Air Emission Controls

The CAT® G3520C engine generator set has a rated design capacity of 1,600 kW.

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

The RICE is 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® G3520C engine are located in an individual exhaust stack (horizontal section of the stack before the noise muffler) with an inner diameter of 14.0 inches. The stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location 21.0 inches (1.50 duct diameters) upstream and >144 inches (>10.3 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 2 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 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 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 for each 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 4 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 were measured continuously throughout each test period in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a Servomex 4900 infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 4900 gas analyzer that uses a paramagnetic sensor.

During each sampling period, a continuous sample of the 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 8864 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 5 provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix 6.

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. 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.

4.5 NO_x and CO Concentration Measurements (USEPA Methods 7E and 10)

NO_X and CO pollutant concentrations in the RICE exhaust gas stream were determined using a Thermo Environmental Instruments, Inc. (TEI) Model 42i High Level chemiluminescence NO_X analyzer and a TEI 48i 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 8864 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 5 provides CO and NO_X calculation sheets. Raw instrument response data are provided in Appendix 6.

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 RICE 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 5 provides VOC calculation sheets. Raw instrument response data for the NMHC analyzer is provided in Appendix 6.

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 (barometer, Pitot tube, and scale) were calibrated to specifications in the sampling methods.

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 NOx concentration was 93.3% 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 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 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 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 the RICE exhaust stack.

5.7 System Response Time

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.

Sampling periods did not commence until the sampling probe had been in place for at least twice the greatest system response time.

5.8 Meter Box Calibrations

The dry gas meter sampling console used for moisture testing 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 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, meter box calibration records, stratification checks, 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 Table 6.1.

The RICE has the following allowable emission limits specified in ROP No. MI-ROP-N3294-2024, and/or the federal Standards of Performance for Stationary Spark Ignition Internal Combustion Engines (the SI-RICE NSPS; 40 CFR Part 60 Subpart JJJJ):

Emission Unit ID	CO Limits	NOx Limits	VOC Limits
EUENGINE7	16.3 lb/hr & 5.0 g/bhp-hr	4.94 lb/hr & 3.0 g/bhp-hr	3.2 lb/hr & 1.0 g/bhp-hr

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 RICE-generator set was operated within 10% of maximum output and no variations from normal operating conditions occurred during the engine test periods.

Table 6.1 Measured exhaust gas conditions and NOx, CO, and VOC air pollutant emission rates for Engine No. 7 (EUENGINE7)

Test No. Test date Test period (24-hr clock)	1 5/7/2024 0825-0925	2 5/7/2024 0946-1046	3 5/7/2024 1105-1205	Three Test Average
LFG flowrate (lb/hr)	2,157	2,136	2,140	2,145
Engine output (bhp)	2,138	2,151	2,165	2,151
Generator output (kW)	1,532	1,541	1,551	1,542
LFG methane content (%)	51.8	54.5	55.0	53.8
Exhaust Gas Composition				
CO_2 content (% vol)	10.6	10.6	10.6	10.6
O_2 content (% vol)	9.05	9.07	9.01	9.04
Moisture (% vol)	12.6	12.2	10.9	11.9
Exhaust gas temperature (°F)	843	852	850	848.5
Exhaust gas flowrate (dscfm)	4,689	4,566	4,609	4,621
Exhaust gas flowrate (scfm)	5,365	5,202	5,171	5,246
Nitrogen Oxides				
NO_X conc. (ppmvd)	98.2	96.1	96.2	96.8
NO_X emissions (lb/hr)	3.30	3.15	3.18	3.21
Permit limit (lb/hr)	-	-	-	*4.94*
NO_X emissions (g/bhp*hr)	0.70	0.66	0.67	0.68
*Permit limit (g/bhp*hr)*	-	-	-	*3.0*
Carbon Monoxide				
CO conc. (ppmvd)	725	725	727	726
CO emissions (lb/hr)	14.8	14.5	14.6	14.6
Permit limit (lb/hr)	-	-	-	*16.3*
CO emissions (g/bhp*hr)	3.15	3.05	3.06	3.09
*Permit limit (g/bhp*hr)*	-	-	-	*5.0*
Volatile Organic Compounds				
VOC conc. (ppmv C_3)	16.8	16.6	16.5	16.6
VOC emissions (lb/hr)	0.62	0.59	0.59	0.60
Permit limit (lb/hr)	-	-	-	*3.2*
VOC emissions (g/bhp*hr)	0.13	0.13	0.12	0.13
*Permit limit (g/bhp*hr)*	-	-	-	*1.0*

APPENDIX 1

- EUOPENFLARE Open Flare Demonstration Report

NON-ENCLOSED FLARE PERFORMANCE TEST REPORT

Prepared for:

Energy Developments Coopersville, LLC

SRN N3294

ICT Project No. 2400125

June 17, 2024

IMPACT
COMPLIANCE & TESTING

Report Certification

Open Flare Demonstration

Energy Developments Coopersville, LLC
15550 68th Avenue, Coopersville, Michigan

I certify that the testing was conducted in accordance with the referenced test methods unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

Prepared By:

Renee Fromwiller
Environmental Consultant

Reviewed By:

Max Fierro
Project Manager

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APPENDICES

List of Tables, Figures and Drawings

1 Introduction

Energy Developments Coopersville, LLC (EDC) contracted Impact Compliance & Testing, Inc. (ICT) to conduct a non-enclosed (open) flare demonstration for its 1,300 standard cubic feet per minute (scfm) open flare identified as EUOPENFLARE at its landfill gas to energy facility located at the Ottawa County Farms Landfill in Coopersville, Michigan. The open flare is utilized to control excess landfill gas or when the landfill gas to energy plant is down.

The test was performed as required by Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division (EGLE-AQD) Renewable Operating Permit (ROP) No. MI-ROP-N3294-2024, the federal standards of Performance for Municipal Solid Waste Landfills That Commenced Construction, Reconstruction, or Modification After July 17, 2014 (40 CFR Part 60, Subpart XXX), and the federal National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills (40 CFR Part 63, Subpart AAAA). The facility is required to demonstrate compliance with 40 CFR 60.18. The test was conducted on May 7, 2024, in accordance with the test plan that was submitted to and approved by EGLE-AQD on April 23, 2024.

Contact information of those involved with the test event are listed in Table 1.1 below:

Table 1.1 – Contact Information

Name and Title	Company/Address	Phone Number
Summer Hitchens Environmental Compliance Specialist	EDL 2501 Coolidge Rd, Suite 100 East Lansing, MI	(517) 604-1784
Max Fierro Project Manager	ICT 4180 Keller Rd. Suite B Holt, MI	(734) 357-8397
Renee Fromwiller Environmental Consultant	ICT 37660 Hills Tech Dr, Farmington Hills MI	(313) 920-1116

2 Summary of Results

The EDC open flare, identified as EUOPENFLARE in ROP No. MI-ROP-N3294-2024, serves as a back-up control device for when the landfill gas to energy plant is not operating or there is excess landfill gas. The flare is designed to meet the performance requirements of ROP No. MI-ROP-N3294-2024 and 40 CFR 60.18 at flows up to 1,300 scfm.

Results of the testing performed on May 7, 2024 show:

- There were no visible emissions for the 30-minute observation period.
- The average net heating value of the gas being combusted is 19.89 mega joules per cubic meter (MJ/m^3).
- The average exhaust gas exit velocity is 10.61 feet per second (ft/sec) at the averagelandfill gas flowrate of 499.9 standard cubic feet per minute (scfm)

The performance criteria are less than 5 minutes visible emissions in a 30-minute period, a net heating value of 7.45MJ/m^3 or greater, and a maximum exit velocity less than 60 ft/sec.

The test results demonstrate EUOPENFLARE meets the performance requirements of 40 CFR 60.18 and the conditions of ROP No. MI-ROP-N3294-2024.

3 Sampling and Analytical Procedures

ICT conducted the measurements in accordance with USEPA approved methods as explained in the test plan. The EGLE-AQD approval letter is included in Appendix A. The test procedures are summarized below.

3.1 Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flare (Method 22, Alternative 42)

ICT conducted a single, 30-minute observation of the open flare exhaust for smoke emissions. ICT observed continuously for 15 minutes, then took a break for 10 minutes, and resumed observation for another 15 minutes, to ensure completion of the full 30-minute observation period.

3.2 Determination the Net Heating Value of the Landfill Gas (Method 3C, Alternative 42)

ICT used Method 3C to determine the net heating value and major gases of the landfill gas. ICT obtained two (2) 30-minute integrated gas samples (one as a duplicate) and submitted to Atmospheric Analysis and Consulting, Inc. (AAC) in Ventura, California. AAC analyzed the compliance sample for carbon dioxide (CO_2), methane (CH_4), nitrogen (N_2), and oxygen (O_2) per USEPA Method 3C. The AAC analytical report is presented in Appendix C. Net heating values were then calculated based on the gas methane content in accordance with 40 CFR 60.754(e) for the laboratory analyzed sample.

The flare inlet (landfill gas) methane content was also verified on-site using a calibrated Envision 200B series prior to, and after, the laboratory samples were obtained. These results are included in Appendix E.

3.3 Volumetric Flow Rate (Method 2C, Alternative 55)

On May 20, 2009, USEPA approved the use of a mass flow meter in place of Method 2C to measure the flow rate to a utility flare. This alternative stipulated the calibration had to be 'recent.' ICT used the flare flow meter to measure the gas flow rate directed to the open flare. The measured flowrate was then divided by the open flare unobstructed cross-sectional areas to calculate flare tip exit velocity.

4 Test Results and Discussion

ICT performed the open flare demonstration in accordance with the test methods as proposed in the open flare test plan. The open flare operated as designated with no upset conditions during the test. This section presents a summary of the results and compliance status of the open flare.

Table 4.1 –Results Summary

Open Flare Criteria	Measured Result	Requirement in 40 CFR 60.18
Visible Emissions	0 minutes	Less than 5 minutes during observation
Net Heating Value	19.89 MJ/m^3	Greater than 7.45 MJ/m^3
Exit Velocity	10.61 ft/s	Less than 60 ft/s

4.1 Method 22, Alternative 42

A copy of observations including weather conditions and wind direction during the test are included with the field forms in Appendix B. No visible emissions were observed during either 15-minute period for the flare and therefore is in compliance with 40 CFR 60.18(f)(1). The field readings are included in the field data provided in Appendix B.

4.2 Method 3C, Alternative 42

The calculation of the net heating value of the gas being combusted in the flare was performed in accordance with Method 3C, Alternative 42. The results of the gas readings and laboratory analytical results are presented in table 5.2 below:

Table 4.2 – Laboratory and On-Site Results Summary

Date Time	Analysis	CH_4 (%)	CO_2 (%)	O_2 (%)	Balance (N_2) (%)
5/7/2024 13:00	On-site	57	35.5	0.7	6.8
5/7/202 13:05-13:35	Laboratory	52.7	32.8	1.3	13.2
5/7/2024 13:40	On-site	57	35.7	0.5	6.8

Calculations of the net heating value in accordance with 40 CFR 60.18(f)(3) can be found in Appendix D. As detailed in the above table and supporting calculations the net heating value for the landfill gas combusted in the open flare is greater than or equal to 7.45 MJ/m^3 and therefore is in compliance with 40 CFR 60.18(f)(3). The results of the on-site measurements are included in Appendix B.

4.3 Method 2C, Alternative 55

The actual exhaust velocity of the open flare was determined by Method 2C, Alternative 55 to be 10.61 ft/sec. The exhaust velocity was then determined by dividing the volumetric flow rate by the unobstructed cross-sectional area of the flare tip.

Sample calculations of the open flare exhaust velocity calculations and recorded flow information are included in Appendix D. As detailed in Table 4.1 and supporting calculations, the actual exhaust velocity is less than 60 ft/sec and is therefore in compliance with 40 CFR 60.18(f)(4)(i).

4.4 Conclusion

The test results demonstrate that the EDC open flare meets the performance requirements of 40 CFR 60.18, and thus also satisfies the requirements of 60.752(b)(2)(iii)(B), at the test flow rate.