

**AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM AN ENCLOSED FLARE AND
AN OPEN FLARE**

**Prepared for:
Ameresco Woodland Meadows Romulus LLC
SRN M4449**

Test Dates: June 27-28, 2024

**ICT Project No.: 2400082
August 15, 2024**





MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
AIR QUALITY DIVISION

**RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION**

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environment, Great Lakes, and Energy, Air Quality Division upon request.

Source Name Ameresco Woodland Meadows Romulus LLC County Wayne

Source Address 4620 Hannan Road City Canton

AQD Source ID (SRN) M4449 ROP No. MI-ROP-M4449- ROP Section No. 2024

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

- ☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.
- ☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

- ☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.
- ☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From _____ To _____

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Air Emission Test Report for emission units EUHBTUENCL and EUHBTUOPEN.

The testing was conducted in accordance with the submitted Stack Test Protocol and

Addendum, and the facility operated in compliance with the permit conditions and at the
maximum routine operating conditions for the facility.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Harold Stewart Authorized Representative (508) 661-2200
Name of Responsible Official (print or type) Title Phone Number

Harold Stewart 8/9/2024
Signature of Responsible Official Date

* Photocopy this form as needed.

EQP 5736 (Rev 04/30/2019)

Report Certification

AIR EMISSION TEST REPORT FOR THE VERIFICATION OF AIR POLLUTANT EMISSIONS FROM AN ENCLOSED FLARE AND AN OPEN FLARE

**Ameresco Woodland Meadows Romulus LLC
Canton, MI**

Report Certification

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

Impact Compliance & Testing, Inc.



Tyler J. Wilson
Senior Project Manager

Table of Contents

1.0 INTRODUCTION.....	1
2.0 SUMMARY OF TEST RESULTS AND OPERATING CONDITIONS	2
2.1 Purpose and Objective of the Tests.....	2
2.2 Operating Conditions During the Compliance Tests	2
2.3 Summary of Air Pollutant Sampling Results	2
3.0 SOURCE AND SAMPLING LOCATION DESCRIPTION.....	4
3.1 General Process Description	4
3.2 Rated Capacities and Air Emission Controls	4
3.3 Sampling Locations	4
4.0 SAMPLING AND ANALYTICAL PROCEDURES.....	5
4.1 Summary of Sampling Methods.....	5
4.2 Exhaust Gas O ₂ Determination (USEPA Method 3A)	5
4.3 Exhaust Gas Moisture Content (USEPA Method 4).....	5
4.4 Measurement of NMOC (USEPA Method 25A / ALT-097)	6
4.5 Determination of Total Sulfur to Sulfur as H ₂ S (ASTM Method D5504).....	6
4.6 Calculating SO ₂ Emissions.....	7
5.0 QA/QC ACTIVITIES.....	8
5.1 Gas Divider Certification (USEPA Method 205).....	8
5.2 Instrumental Analyzer Interference Check.....	8
5.3 Instrument Calibration and System Bias Checks	8
5.4 System Response Time	9
5.5 Methane/NMHC Separation Study	9
5.6 Meter Box Calibrations	9
6.0 RESULTS	10
6.1 Test Results and Allowable Limits	10
6.2 Variations from Normal Sampling Procedures or Operating Conditions	10

List of Tables

2.1	Average enclosed flare operating conditions during the test periods.....	3
2.2	Measured NMOC concentrations and calculated SO ₂ emissions for the enclosed flare (three-test average).....	3
6.1	Measured exhaust gas conditions, measured NMOC concentrations, and calculated SO ₂ emissions for the enclosed flare (EUHBTUENCL)	11

List of Appendices

APPENDIX 1	OPEN FLARE DEMONSTRATION REPORT
APPENDIX 2	ENCLOSED FLARE OPERATING CONDITIONS
APPENDIX 3	DIAGRAM OF ENCLOSED FLARE SAMPLING LOCATION
APPENDIX 4	ENCLOSED FLARE O ₂ , NMOC, AND SO ₂ CALCULATIONS
APPENDIX 5	INSTRUMENTAL ANALYZER RAW DATA FOR ENCLOSED FLARE
APPENDIX 6	ENCLOSED FLARE MOISTURE CALCULATIONS AND DATA SHEETS
APPENDIX 7	TRS LABORATORY REPORT, FIELD DATA SHEETS, & ENVISION DATA
APPENDIX 8	ENCLOSED FLARE TESTING QA/QC RECORDS

1.0 Introduction

Ameresco Woodland Meadows Romulus LLC (Ameresco) operates an enclosed flare identified as emission unit EUHBTUENCL and an open flare identified as emission unit EUHBTUOPEN at its high Btu (HBtu) facility in Canton, Wayne County, Michigan.

The State of Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division (EGLE-AQD) has issued to Ameresco a Renewable Operating Permit (MI-ROP-M4449-2024) and a Permit to Install (MI-PTI-M4449-2024) for operation of the facility, which consists of:

- One (1) enclosed flare identified as emission unit EUHBTUENCL; and
- One (1) open flare identified as emission unit EUHBTUOPEN.

Air emission compliance testing was performed pursuant to MI-ROP-M4449-2024 and MI-PTI-M4449-2024.

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, Renee Fromwiller, and Alexis Fahey performed the field sampling and measurements on June 27-28, 2024.

The enclosed flare performance tests consisted of triplicate, one-hour sampling periods for non-methane organic compounds (NMOC, as non-methane hydrocarbons (NMHC)). Exhaust gas moisture and oxygen (O₂) content were determined for each test period to calculate NMOC concentrations, corrected to parts per million by volume, dry basis (ppmvd) as hexane @ 3% O₂, for comparison to the permit limit. Sulfur samples were collected for each inlet gas stream throughout each one-hour test period. Measured inlet gas sulfur content and inlet gas flowrates were used to calculate an SO₂ emission rate (pounds per hour, lb/hr).

The open flare demonstration consisted of one (1) 30-minute observation (visible emissions) and sampling period (inlet gas sampling).

The exhaust gas sampling and analysis and inlet gas sampling and analysis were performed using procedures specified in the Stack Test Protocol dated February 15, 2024, that was reviewed and approved by EGLE-AQD, and the Stack Test Protocol Addendum dated May 24, 2024 that was submitted to EGLE-AQD. Mr. Jonathan Lamb, Mr. Andrew Riley, and Ms. Amanda Battershell of EGLE-AQD observed portions of the compliance testing.

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

Tyler J. Wilson
Senior Project Manager
Impact Compliance & Testing, Inc.
37660 Hills Tech Drive
Farmington Hills, MI 48331
(734) 357-8046
Tyler.Wilson@impactCandT.com

Mr. Andrew McClelland
Environmental Compliance Manager
Ameresco
111 Speen Street, Suite 410
Framingham, MA 01701
amcclelland@ameresco.com
(508) 661-2242

2.0 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

Conditions of MI-ROP-M4449-2024, MI-PTI-M4449-2024, and/or 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/or the federal National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills (40 CFR Part 63, Subpart AAAA) require Ameresco to test the enclosed flare (EUHBTUENCL) for NMOC concentration and sulfur dioxide (SO₂) emissions, and perform an open flare demonstration for the open flare (EUHBTUOPEN). EUHBTUENCL and EUHBTUOPEN were tested during this compliance test event.

The open flare demonstration report for EUHBTUOPEN is presented in Appendix 1.

2.2 Operating Conditions During the Compliance Tests

The enclosed flare testing was performed while EUHBTUENCL operated at maximum achievable operating capacity based on the amount of fuel gas that was available at the time of testing. Ameresco representatives provided fuel use (standard cubic feet per minute, scfm) in 15-minute increments for each test period. The average fuel use for EUHBTUENCL was 2,268 scfm (CO₂ tail gas) and 169 scfm (LFG) during test periods.

Enclosed flare combustion zone chamber temperature (°F) was also recorded by Ameresco representatives in 15-minute increments for each test period.

Appendix 2 provides operating records provided by Ameresco representatives for the enclosed flare test periods.

Average fuel flowrates and combustion zone chamber temperature for the enclosed flare is presented in Table 2.1 and Table 6.1.

2.3 Summary of Air Pollutant Sampling Results

The gas exhausted from the sampled enclosed flare (EUHBTUENCL) was sampled for four (4) one-hour test periods during the compliance testing performed June 27-28, 2024. One (1) of the four (4) test periods (Test No. 2) was discarded due to an unexpected enclosed flare malfunction during the test. Sulfur samples were collected for each inlet gas stream throughout each one-hour test period.

Table 2.2 presents the average measured NMOC concentration and average calculated SO₂ emissions for the enclosed flare (average of the three test periods).

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

Table 2.1 Average enclosed flare operating conditions during the test periods

Enclosed Flare Parameter	EUHBTUENCL
LFG fuel use (scfm)	169
CO ₂ tail gas fuel use (scfm)	2,268
Combustion zone chamber temperature (°F)	1,732

Table 2.2 Measured NMOC concentrations and calculated SO₂ emissions for the enclosed flare (three-test average)

Emission Unit	NMOC	SO ₂
	(ppmvd as hexane @ 3% O ₂)	(lb/hr)
EUHBTUENCL	78.2	12.4
<i>Permit Limit</i>	<i>20</i>	<i>16.8</i>

3.0 Source and Sampling Location Description

3.1 General Process Description

The Waste Management Woodland Meadows Recycle and Disposal Facility (RDF) accepts and landfills municipal solid waste. The landfill generates LFG, which is collected using an active landfill gas collection system.

A portion of the collected LFG is routed to the Ameresco facility where it is processed for sale by compressing, dehydrating, and conditioning the gas in a two-stage pressure swing adsorption (PSA) system to remove carbon dioxide (CO₂), nitrogen (N₂), and other impurities. The gas is then further conditioned by removing any remaining oxygen (O₂) using a catalytic oxidation process before additional dehydration and pressurization and final delivery to a Detroit Edison Company Remote Metering Station.

The first stage of the PSA system (CO₂ PSA) removes CO₂ along with siloxanes, hydrocarbons, sulfides, and sulfur compounds. These compounds are removed from the process during regeneration of the PSA media and sent to an enclosed flare for destruction. Approximately 8% of the waste gas is methane. Because of the low Btu value of the waste gas, the enclosed flare uses LFG or waste gas from the second stage of the PSA as supplementary fuel.

The gas going to the second stage of the PSA (N₂ PSA) normally has negligible amounts of organics, sulfides, and other hydrocarbons, so the waste gas stream is primarily N₂, CO₂, trace amounts of O₂, and approximately 28-37% methane. The waste gas from the N₂ PSA is sent to the open flare for destruction.

3.2 Rated Capacities and Air Emission Controls

The enclosed flare has a rated design capacity of 2,600 cubic feet per minute (cfm).

The enclosed flare serves as a control device for LFG and waste gas at the Ameresco facility. The enclosed flare itself is not equipped with add-on emission control equipment.

3.3 Sampling Locations

The enclosed flare exhaust gas is released to the atmosphere through a dedicated vertical exhaust stack with a vertical release point.

The enclosed flare exhaust stack sampling ports are located in the vertical exhaust stack, with an inner diameter of 66.5 inches. The stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location at least 0.5 duct diameters upstream and at least 2.0 duct diameters downstream from any flow disturbance and satisfies the USEPA Method 1 criteria for a representative sample location.

The enclosed flare sample port location was determined in accordance with USEPA Method 1.

Appendix 3 provides a diagram of the enclosed flare emission test sampling location 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. A Stack Test Protocol Addendum for the air emission testing was submitted to EGLE-AQD. This section provides a summary of the sampling and analytical procedures that were used during the enclosed flare testing periods.

4.1 Summary of Sampling Methods

USEPA Method 4	Exhaust gas moisture was determined based on the water weight gain in chilled impingers.
USEPA Method 3A	Exhaust gas O ₂ content was determined using a paramagnetic instrumental analyzer.
USEPA Method 25A / ALT-097	Exhaust gas NMOC (as NMHC) concentration was determined using a flame ionization analyzer equipped with methane separation column.
ASTM Method D5504	Fuel gas sulfur content was determined using analysis by gas chromatography and chemiluminescence

4.2 Exhaust Gas O₂ Determination (USEPA Method 3A)

O₂ content in the enclosed flare exhaust gas stream was measured continuously throughout each test period in accordance with USEPA Method 3A. The O₂ 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 analyzer; therefore, measurement of O₂ 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 analyzer continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instrument was 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 O₂ calculation sheets. Raw instrument response data are provided in Appendix 5.

4.3 Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the enclosed flare 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.

Appendix 6 provides moisture content calculations and field data sheets.

4.4 Measurement of NMOC (USEPA Method 25A / ALT-097)

The NMOC concentration in the enclosed flare exhaust gas stream was measured continuously throughout each test period in accordance with USEPA Method 25A / ALT-097. NMOC pollutant concentration was determined using a Thermo Environmental Instruments, Inc. (TEI) Model 55i Methane / non-methane hydrocarbon (non-methane organic compound) analyzer. The TEI 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components. The concentration of NMOC 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 LFG fueled sources (ALT-097).

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, NMOC 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 NMOC calculation sheets. Raw instrument response data for the NMHC analyzer is provided in Appendix 5.

4.5 Determination of Total Sulfur to Sulfur as H₂S (ASTM Method D5504)

Sampling and analysis were performed according to ASTM Method to measure the concentration of H₂S and other sulfur-bearing compounds in the inlet gas used to fuel the enclosed flare. TRS content was calculated based on the sum of all sulfur-bearing compounds in the sample. Fixed gas analysis was performed according to EPA Method 3C to determine the inlet gas methane content, and to verify the integrity of the samples.

Samples of the inlet gas that is used as fuel for the enclosed flare were obtained from the common header for the CO₂ tail gas streams and from the LFG gas stream, at locations after the discharge side of the gas blowers. The samples were collected using summa canisters and shipped via FedEx by ICT to a contract laboratory (Atmospheric Analysis & Consulting, Inc. located in Ventura, CA) for total sulfur content analysis.

Prior to sample collection, colorimetric Draeger tubes were used to verify sulfur content for the inlet gas streams. Prior to and after sample collection, a calibrated Envirovision 200B series gas analyzer (Envirovision) was used to verify the quality of the inlet gas streams.

Appendix 7 provides a copy of the laboratory analytical report for TRS in the enclosed flare inlet gas streams, and field data sheets and Envirovision data from sulfur sampling.

4.6 Calculating SO₂ Emissions

The hourly SO₂ mass emission rate (lb/hr) was calculated using the measured sulfur concentration (in the TRS sample) and the measured inlet gas flowrate.

The inlet gas sample was analyzed for TRS by a contract laboratory (Atmospheric Analysis & Consulting, Inc. located in Ventura, CA). It is assumed that all measured TRS is converted to SO₂. The SO₂ emission factor was calculated using the following equation:

$$\text{SO}_2 \text{ lb/hr} = [(C_{\text{TRS}}) * (Q_G) * (60 \text{ min/hr}) * 64 \text{ lb SO}_2/379 \text{ scf}] / 10^6$$

Where:

- C_{TRS} = Concentration of total sulfur in fuel (ppmv)
- Q_G = Inlet fuel gas flowrate (scfm)

The measured TRS in the inlet gas streams (ppmv) and the recorded inlet gas combusted during the tests (scfm, measured by Ameresco flow meters) were used to determine the SO₂ emission rate in units of lb/hr for comparison to the permit limit (16.8 lb/hr).

5.0 QA/QC Activities

5.1 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.

5.2 Instrumental Analyzer Interference Check

The instrumental analyzer used to measure O₂ has had an interference response test preformed prior to its 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 the analyzer, separately and as a mixture with the analyte that the analyzer is designed to measure. The analyzer exhibited a composite deviation of less than 2.5% of the span for all measured interferent gases. No major analytical components of the analyzer have been replaced since performing the original interference test.

5.3 Instrument Calibration and System Bias Checks

At the beginning of the day of the testing program, an initial three-point instrument calibration was performed for the O₂ analyzer by injecting calibration gas directly into the inlet sample port for the 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 the 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 O₂ instrument was calibrated with USEPA Protocol 1 certified concentrations of O₂ in nitrogen and zeroed using hydrocarbon free nitrogen. The NMHC (NMOC) 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.

5.4 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.

5.5 Methane/NMHC Separation Study

A demonstration of the TEI Model 55i methane / non-methane hydrocarbon (non-methane organic compound) separation efficiency was performed onsite. The analyzer was challenged with a Certified Standard Spec blend gas containing 995.1 ppmv methane and 11.03 ppmv non-methane compounds (specifically propane) for the demonstration. The TEI Model 55i instrumental analyzer was calibrated using certified cylinders of 2,516 ppmv methane and 83.46 ppmv propane. The blend gas was then injected into the analyzer and the measured methane and non-methane concentrations were recorded using a data logger. The measured methane concentration stabilized at 987.4 ppmv and the measured NMHC/NMOC concentration stabilized at 10.90 ppmv. The demonstrations indicate that the non-methane components (propane) did not elute with the methane (i.e., the internal column is highly efficient in separating methane and non-methane compounds).

5.6 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 8 presents test equipment quality assurance data (instrument calibration and system bias check records, calibration gas certifications, interference test results, meter box calibration records, and field equipment calibration records).

6.0 Results

6.1 Test Results and Allowable Limits

Enclosed flare operating data, NMOC concentration measurement results, and calculated SO₂ results for each one-hour test period are presented in Table 6.1.

The enclosed flare has the following allowable limits specified in MI-ROP-M4449-2024 and MI-PTI-M4449-2024:

- 20 ppmvd as hexane @ 3% O₂ for NMOC; and
- 16.8 lb/hr for SO₂.

The measured NMOC concentration for the enclosed flare / EUHBTUENCL is greater than the allowable limit specified in MI-ROP-M4449-2024 and MI-PTI-M4449-2024. The calculated SO₂ emissions for the enclosed flare / EUHBTUENCL is less than the allowable limit specified in MI-ROP-M4449-2024 and MI-PTI-M4449-2024.

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 and the submitted Stack Test Protocol Addendum.

The testing was performed while the enclosed flare operated at maximum achievable operating capacity based on the amount of fuel gas that was available at the time of testing.

Test No. 2 for the enclosed flare was discarded due to an unexpected malfunction that occurred during the test. Due to the malfunction, the enclosed flare maximum achievable operating conditions were limited to less than 50% load. Test No. 2 was still finished (for a full test of at least 60-minutes). Following repair, the enclosed flare returned to normal operating conditions (greater than 90% load), and Test Nos. 3 and 4 were performed. All 3-test averages presented in this report include measured and recorded data from Test Nos. 1, 3, and 4. All measured and recorded data from Test No. 2 are presented in this report for informational purposes.

A stratification test was not performed for the enclosed flare sampling location during this compliance test event, due to the unsafe conditions (extreme heat/flames from both flares) for an ICT test crew member to be at sample port level for extended periods of time. This was discussed with EGLE-AQD representative, Mr. Andrew Riley, while onsite. NMOC and O₂ concentrations and moisture content were measured at the centroid of the enclosed flare stack, as discussed with EGLE-AQD representatives in the April 22, 2024 meeting and in the Stack Test Protocol Addendum dated May 24, 2024.

Table 6.1 Measured exhaust gas conditions, measured NMOC concentrations, and calculated SO₂ emissions for the enclosed flare (EUHBTUENCL)

Test No.	1	2*	3	4	
Test Date	06/27/2024	06/27/2024	06/28/2024	06/28/2024	
Test Period (24-hr clock)	1252-1352	1425-1525	1411-1511	1536-1636	Three-Test Average**
LFG fuel flowrate (scfm)	189	179	157	160	169
CO ₂ tail gas fuel flowrate (scfm)	2,265	1,695	2,267	2,273	2,268
Combustion temperature (°F)	1,737	1,732	1,728	1,732	1,732
<u>Exhaust Gas Composition</u>					
O ₂ content (% vol)	3.04	4.87	2.50	2.02	2.52
Moisture (% vol)	9.8	10.7	8.6	12.5	10.3
<u>Non-Methane Organic Compounds</u>					
NMOC conc. (ppmv) ¹	22.6	8.52	186	260	156
NMOC emissions (ppmvd as C ₆) ²	12.6	5.33	98.8	123	78.2
NMOC permit limit (ppmvd as C ₆) ²	-	-	-	-	20
<u>Sulfur Dioxide</u>					
TRS conc. (ppmv) in CO ₂ fuel	183	504	595	829	536
SO ₂ emissions (lb/hr) ³ from CO ₂ fuel	4.20	8.66	13.7	19.1	12.3
TRS conc. (ppmv) in LFG fuel	4.31	2.80	195	13.8	71.0
SO ₂ emissions (lb/hr) ³ from LFG fuel	0.01	0.01	0.31	0.02	0.11
Total SO ₂ emissions (lb/hr) ³	4.21	8.66	14.0	19.1	12.4
SO ₂ permit limit (lb/hr)	-	-	-	-	16.8

1. Measured as non-methane hydrocarbons, as propane.

2. Parts per million by volume, dry basis (ppmvd) as hexane (C₆) @ 3% oxygen.

3. Calculated emission rate based on the equation provided in Section 4.6 of this document.

* Test No. 2 was discarded, due to an enclosed flare malfunction that occurred during the test.

**The three-test average presents the average values for Test Nos. 1, 3, and 4.

APPENDIX 1

- Open Flare Demonstration Report

OPEN FLARE PERFORMANCE TEST REPORT

Prepared for:

Ameresco Woodland Meadows Romulus LLC

SRN M4449

ICT Project No. 2400082

August 1, 2024



Report Certification

Open Flare Demonstration

Ameresco Woodland Meadows Romulus LLC
4620 Hannan Road, Canton, Wayne County, 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:



Tyler Wilson
Senior Project Manager

Table of Contents

1	INTRODUCTION.....	1
2	SUMMARY OF RESULTS.....	2
3	SAMPLING AND ANALYTICAL PROCEDURES	3
3.1	Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flare (Method 22, Alternative 42).....	3
3.2	Determination of Net Heating Value of the Landfill Gas (Method 3C, Alternative 42)	3
3.3	Volumetric Flow Rate (Method 2C, Alternative 55)	3
4	TEST RESULTS AND DISCUSSION	4
4.1	Method 22, Alternative 42	4
4.2	Method 3C, Alternative 42	4
4.3	Method 2D, Alternative 55	5
4.4	Conclusions	5

ATTACHMENTS

ATTACHMENT A EGLE-AQD APPROVAL LETTER

ATTACHMENT B FIELD DATA

ATTACHMENT C AAC ANALYTICAL RESULTS

ATTACHMENT D NET HEATING VALUE CALCULATIONS

ATTACHMENT E ON-SITE GAS ANALYSIS ENVISION RESULTS

List of Tables, Figures and Drawings

1.1 Contact Information 1

4.1 Results Summary 2

4.2 Laboratory and On-Site Results 2

1 Introduction

Ameresco Woodland Meadows Romulus LLC (Ameresco) contracted Impact Compliance & Testing, Inc. (ICT) to conduct a non-enclosed (open) flare demonstration for its 1,440 standard cubic feet per minute (scfm) open flare identified as EUHBTUOPEN at its high Btu (HBtu) facility located in Canton, Wayne County, Michigan. The open flare is utilized as a control device for the pressure swing adsorption (PSA) system waste gas stream (nitrogen (N₂) tail gas).

The test was performed as required by the State of Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division (EGLE-AQD) Renewable Operating Permit (ROP) No. MI-ROP-M4449-2024, Permit to Install (PTI) No. MI-PTI-M4449-2024, and/or 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/or 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 for the open flare. The test was conducted on June 27, 2024, in accordance with the Stack Test Protocol dated February 15, 2024, that was submitted to and approved by EGLE-AQD.

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
Andrew McClelland Environmental Compliance Manager	Ameresco 111 Speen Street, Suite 41 Framingham, MA 01701	(508) 661-2242
Renee Fromwiller Environmental Consultant	ICT 37660 Hills Tech Dr, Farmington Hills MI	(313) 920-1116

2 Summary of Results

The open flare, identified as EUHBTUOPEN, is designed to meet the performance requirements of ROP No. MI-ROP-M4449-2024, PTI No. MI-PTI-M4449-2024, and 40 CFR 60.18 at flows up to 1,440 scfm.

Results of the testing performed on June 27, 2024 show:

- There were no visible emissions for the 30-minute observation period.
- The average net heating value of the gas being combusted is 19.25 mega joules per cubic meter (MJ/m³).
- The average exhaust gas exit velocity is 24.3 feet per second (ft/sec) at the average landfill gas flowrate of 1,145 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/m³ or greater, and a maximum exit velocity less than 60 ft/sec.

The test results demonstrate EUHBTUOPEN meets the performance requirements of 40 CFR 60.18 and the conditions of ROP No. MI-ROP-M4449-2024 and PTI No. MI-PTI-M4449-2024.

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 Attachment 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 (CO₂), methane (CH₄), nitrogen (N₂), and oxygen (O₂) per USEPA Method 3C. The AAC analytical report is presented in Attachment 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 Envirovision 200B series prior to, and after, the laboratory samples were obtained. These results are included in Attachment 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	19.25 MJ/m ³	Greater than 7.45 MJ/m ³
Exit Velocity	24.3 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 Attachment 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 Attachment 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) (%)
6/27/2024 8:59	On-site	52.2	2.6	0.4	44.8
6/27/2024 9:00-9:30	Laboratory	51.0	3.12	0.86	45.0
6/27/2024 9:41	On-site	52.3	2.4	0.3	45

Calculations of the net heating value in accordance with 40 CFR 60.18(f)(3) can be found in Attachment 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/m³

and therefore is in compliance with 40 CFR 60.18(f)(3). The results of the on-site measurements are included in Attachment B.

4.3 Method 2C, Alternative 55

The actual exhaust velocity of the open flare was determined by Method 2C, Alternative 55 to be 24.3 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 Attachment 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 Ameresco 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.