AIR EMISSION TEST REPORT

FOR THE

VERIFICATION OF AIR POLLUTANT EMISSIONS

FROM AN ENCLOSED FLARE

Prepared for:

Ameresco Woodland Meadows Romulus LLC

SRN M4449

Test Date: December 11, 2024

ICT Project No. 2400082

December 23, 2024

IMPACT
COMPLIANCE & TESTING

Report Certification

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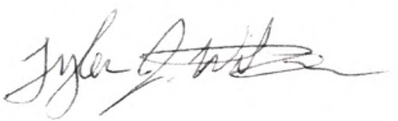
VERIFICATION OF AIR POLLUTANT EMISSIONS
FROM AN ENCLOSED FLARE

Ameresco Woodland Meadows Romulus LLC
Canton, Michigan

This document was prepared by Impact Compliance & Testing, Inc. and reviewed by Ameresco Woodland Meadows Romulus LLC representatives and approved for submittal to the State of Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division as part of the air emission test report.

IMPACT COMPLIANCE & TESTING, INC.



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1 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 for EUHBTUENCL, pursuant to MI-ROP-M4449-2024 and MI-PTI-M4449-2024.

EUHBTUOPEN was not tested during this compliance test event. Testing for EUHBTUOPEN was conducted on June 27, 2024, to demonstrate compliance with performance requirements specified in MI-ROP-M4449-2024, MI-PTI-M4449-2024, and 40 CFR 60.18. The test results demonstrated that EUHBTUOPEN met the performance requirements.

EUHBTUENCL was not tested for non-methane organic compounds (NMOC) during this compliance test event. NMOC testing for EUHBTUENCL was conducted August 14, 2024, to demonstrate compliance with performance requirements specified in MI-ROP-M4449-2024, MI-PTI-M4449-2024, 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 test results demonstrated that EUHBTUENCL met the performance requirements for NMOC.

The compliance testing presented in this report was performed by Impact Compliance & Testing, Inc. (ICT), a Michigan-based environmental consulting and testing company. ICT representative Renee Fromwiller performed the field sampling and measurements on December 11, 2024.

The enclosed flare performance tests consisted of triplicate, one-hour sulfur sampling periods, for each enclosed flare inlet gas stream. Measured inlet gas sulfur content and inlet gas flowrates were used to calculate an SO_2 emission rate (pounds per hour, lb/hr).

Plant inlet gas sulfur sampling was also performed for this compliance test event.

The inlet gas sampling and analysis were performed using procedures specified in the Stack Test Protocol dated November 8, 2024, that was reviewed and approved by EGLE-AQD.

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

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2 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

Conditions of MI-ROP-M4449-2024 and MI-PTI-M4449-2024 require Ameresco to test the enclosed flare (EUHBTUENCL) for sulfur dioxide (SO_2) emissions. The EUHBTUENCL inlet gas streams were sampled for sulfur during this compliance test event, to calculate SO_2 emissions. Plant inlet gas sulfur sampling was also performed for this compliance test event.

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 2,387 scfm (CO2 tail gas) and 253 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.

Attachment 1 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 5.1.

2.3 Summary of Air Pollutant Sampling Results

The enclosed flare (EUHBTUENCL) inlet gas streams were each sampled for three (3) one-hour test periods during the compliance testing performed December 11, 2024.

The plant inlet gas stream was sampled for three (3) grab samples during the compliance testing performed December 11, 2024.

Table 2.2 presents the average calculated SO_2 emissions for the enclosed flare (average of the three test periods).

Table 2.3 presents the average measured total reduced sulfur (TRS) content for the plant inlet gas stream (average of the three test periods).

Table 5.2 presents the average measured TRS content for the plant inlet gas stream.

Test results for each one-hour enclosed flare sampling period and comparison to the permitted limits are presented in Section 5.0 of this report.

Table 2.1 Average enclosed flare operating conditions during the test periods

Enclosed Flare Parameter	EUHBTUENCL
LFG fuel use (scfm)	523
CO_2 tail gas fuel use (scfm)	2,387
Combustion zone chamber temperature (°F)	1,750

Table 2.2 Measured air pollutant concentrations for the enclosed flares (three-test average)

	SO_2
Emission Unit	**(lb/hr)**
EUHBTUENCL	14.6
Permit Limit	***16.8***

Table 2.3 Measured TRS content for the plant (three-test average)

	TRS
Sampling Location	**(ppmv)**
Plant	204

3 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 (CO_2), nitrogen (N_2), and other impurities. The gas is then further conditioned by removing any remaining oxygen (O_2) 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 (CO_2 PSA) removes CO_2 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 N_2, CO_2, trace amounts of O_2, and approximately 28-37% methane. The waste gas from the N_2 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 inlet gas sampling locations are in pipes (one (1) pipe for CO_2 tail gas; one (1) pipe for LFG) located near the enclosed flare.

The plant inlet gas sampling location is in a pipe located at the facility's blower station.

Attachment 2 provides a diagram of the enclosed flare with actual stack dimension measurements.

4 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 enclosed flare testing periods.

4.1 Summary of Sampling Methods

ASTM Method D5504	Fuel gas sulfur content was determined using analysis by gas chromatography and chemiluminescence.

4.2 Determination of Total Sulfur to Sulfur as H_2S (ASTM Method D5504)

Sampling and analysis were performed according to ASTM Method D5504 to measure the concentration of H_2S and other sulfur-bearing compounds in the inlet gas used to fuel the enclosed flare and in the plant inlet gas. 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 CO_2 tail gas streams and from the LFG gas stream, at locations after the discharge side of the gas blowers. Samples of the plant inlet gas were obtained from the sampling location located at the blower station. The samples were collected using Tedlar bags and transported by ICT to a contract laboratory (Analytical Solution, Inc. located in Willowbrook, IL) 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 Envision 200B series gas analyzer (Envision) was used to verify the quality of the inlet gas streams.

Attachment 3 provides a copy of the laboratory analytical report for TRS content in the inlet gas streams, field data sheets, and Envision data from sulfur sampling.

4.3 Calculating Enclosed Flare SO_2 Emissions

The enclosed flare hourly SO_2 mass emission rate (lb/hr) was calculated using the measured sulfur concentration (in the TRS sample) and the measured enclosed flare inlet gas flowrate.

The enclosed flare inlet gas sample was analyzed for TRS content by a contract laboratory (Analytical Solution, Inc. located in Willowbrook, IL). It is assumed that all measured TRS is converted to SO_2. The SO_2 emission factor was calculated using the following equation:

SO_2 lb/hr = [(CTRS) * (QG) * (60 min/hr) * 64 lb SO2/379 scf)] / 106

Where:

- CTRS = Concentration of total sulfur in fuel (ppmv)
- QG = Inlet fuel gas flowrate (scfm)

The measured TRS in the enclosed flare inlet gas streams (ppmv) and the recorded enclosed flare inlet gas combusted during the tests (scfm, measured by Ameresco flow meters) were used to determine the enclosed flare SO_2 emission rate in units of lb/hr for comparison to the permit limit (16.8 lb/hr).

Attachment 4 provides SO_2 calculation sheets.

5 Results

5.1 Test Results and Allowable Emission Limits

Enclosed flare operating data and calculated SO_2 results for each one-hour test period are presented in Table 5.1.

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

- 16.8 lb/hr for SO2.

The calculated SO_2 emissions for the enclosed flare / EUHBTUENCL is less than the allowable limit specified in MI-ROP-M4449-2024 and MI-PTI-M4449-2024.

5.2 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 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.

Due to a miscommunication at Analytical Solution, Inc., the samples were analyzed outside of the 24-hour hold time recommended by ASTM Method D5504, by between 1 hour and 31 minutes and 4 hours and 49 minutes.

Analytical Solution, Inc. analyzed the LFG duplicate backup sample instead of the LFG sample for Test No. 3. The measured TRS in the LFG duplicate backup sample was used for the Test No. 3 SO_2 emissions calculations.

Table 5.1 Recorded process operating data and calculated SO_2 emissions for the enclosed flare (EUHBTUENCL)

Test No. Test date Test period (24-hr clock) – LFG stream Test period (24-hr clock) – CO_2 stream	1 12/11/2024 741-841 742-842	2 12/11/2024 846-946 844-944	3 12/11/2024 815[1] 953-1053	Three Test Average
LFG fuel flowrate (scfm)	253	253	253[1]	253
CO_2 tail gas fuel flowrate (scfm)	2,387	2,388	2,387	2,387
Combustion temperature (°F)	1,751	1,750	1,751	1,750
Sulfur Dioxide				
TRS conc. (ppmv) in CO_2 fuel	553	613	576	581
SO_2 emissions (lb/hr)[2] from CO2 fuel	13.4	14.8	13.9	14.0
TRS conc. (ppmv) in LFG fuel	196	219	230[1]	215
SO_2 emissions (lb/hr)[2] from LFG fuel	0.50	0.56	0.59	0.55
Total SO_2 emissions (lb/hr)[2]	13.9	15.4	14.5	14.6
SO_2 permit limit (lb/hr)	-	-	-	*16.8*

1. Duplicate backup sample.
2. Calculated emission rate based on the equation provided in Section 4.3 of this document.

Table 5.2 Measured TRS content in the plant inlet gas stream

Test No. Test date Test period (24-hr clock)	1 12/11/2024 1107	2 12/11/2024 1109	3 12/11/2024 1110	Three Test Average
TRS conc. (ppmv)	199	206	206	204

Attachment 1
Enclosed Flare Operating Conditions

Enclosed Flare
Process Operating Data

Facility: Ameresco-Woodland Meadows
Location: Canton, MI
Date: 12/11/2024
Unit ID: EUHBTUENCL

Date	EUHBTUENCL	Test #	Combustion Zone Chamber Temp. (°F)	CO_2 Fuel Flow (scfm)	LFG Fuel Flow (scfm)
12/11/2024	7:41	1	1,744		253
	7:42	1	1,755	2,323	254
	7:43	1	1,750	2,378	254
	7:44	1	1,746	2,404	253
	7:45	1	1,758	2,363	253
	7:46	1	1,747	2,401	253
	7:47	1	1,747	2,386	252
	7:48	1	1,759	2,384	253
	7:49	1	1,752	2,419	253
	7:50	1	1,757	2,340	253
	7:51	1	1,758	2,404	253
	7:52	1	1,749	2,434	253
	7:53	1	1,748	2,363	253
	7:54	1	1,745	2,401	253
	7:55	1	1,749	2,364	253
	7:56	1	1,751	2,379	253
	7:57	1	1,746	2,417	253
	7:58	1	1,753	2,345	253
	7:59	1	1,746	2,390	253
	8:00	1	1,740	2,452	253
	8:01	1	1,751	2,358	254
	8:02	1	1,744	2,395	253
	8:03	1	1,743	2,373	253
	8:04	1	1,753	2,374	253
	8:05	1	1,744	2,408	253
	8:06	1	1,746	2,385	254
	8:07	1	1,753	2,388	253
	8:08	1	1,747	2,443	253
	8:09	1	1,749	2,360	253
	8:10	1	1,750	2,389	253
	8:11	1	1,749	2,380	253
	8:12	1	1,750	2,376	253
	8:13	1	1,747	2,416	254
	8:14	1	1,755	2,399	253
	8:15	1	1,753	2,391	253
	8:16	1	1,747	2,436	253
	8:17	1	1,759	2,344	253
	8:18	1	1,753	2,388	253
	8:19	1	1,744	2,384	253
	8:20	1	1,757	2,367	254
	8:21	1	1,746	2,402	254
	8:22	1	1,748	2,414	254
	8:23	1	1,756	2,381	254
	8:24	1	1,746	2,415	254
	8:25	1	1,746	2,341	254
	8:26	1	1,747	2,397	254
	8:27	1	1,745	2,391	253
	8:28	1	1,747	2,368	253
	8:29	1	1,747	2,409	254
	8:30	1	1,754	2,409	253
	8:31	1	1,751	2,385	253
	8:32	1	1,749	2,421	254
	8:33	1	1,760	2,323	254
	8:34	1	1,755	2,382	254
	8:35	1	1,752	2,425	254
	8:36	1	1,764	2,368	254
	8:37	1	1,753	2,403	254
	8:38	1	1,753	2,370	253
	8:39	1	1,761	2,382	254
	8:40	1	1,752	2,411	254
	8:41	1	1,754	2,342	254
	8:42	1	1,754	2,391	
	Average	**1**	**1,751**	**2,387**	**253**

12/11/2024	EUHBTUENCL	Test #	Combustion Zone Chamber Temp. (°F)	CO_2 Fuel Flow (scfm)	LFG Fuel Flow (scfm)
	8:44	2	1,747	2,358	
	8:45	2	1,747	2,394	
	8:46	2	1,751	2,363	254
	8:47	2	1,752	2,379	254
	8:48	2	1,747	2,420	254
	8:49	2	1,756	2,359	254
	8:50	2	1,751	2,394	254
	8:51	2	1,744	2,453	254
	8:52	2	1,756	2,361	254
	8:53	2	1,748	2,398	254
	8:54	2	1,744	2,379	254
	8:55	2	1,753	2,376	254
	8:56	2	1,742	2,408	254
	8:57	2	1,745	2,391	254
	8:58	2	1,752	2,386	254
	8:59	2	1,746	2,434	254
	9:00	2	1,747	2,356	253
	9:01	2	1,748	2,387	253
	9:02	2	1,749	2,376	253
	9:03	2	1,750	2,371	254
	9:04	2	1,744	2,414	254
	9:05	2	1,751	2,403	254
	9:06	2	1,751	2,386	253
	9:07	2	1,743	2,432	254
	9:08	2	1,756	2,336	253
	9:09	2	1,748	2,383	253
	9:10	2	1,744	2,386	253
	9:11	2	1,755	2,367	253
	9:12	2	1,745	2,401	253
	9:13	2	1,745	2,428	254
	9:14	2	1,756	2,385	253
	9:15	2	1,745	2,418	253
	9:16	2	1,747	2,343	253
	9:17	2	1,749	2,404	253
	9:18	2	1,747	2,380	253
	9:19	2	1,752	2,366	253
	9:20	2	1,750	2,404	254
	9:21	2	1,756	2,383	253
	9:22	2	1,753	2,378	253
	9:23	2	1,747	2,416	253
	9:24	2	1,758	2,325	253
	9:25	2	1,754	2,374	253
	9:26	2	1,752	2,430	252
	9:27	2	1,764	2,364	253
	9:28	2	1,752	2,398	253
	9:29	2	1,748	2,365	253
	9:30	2	1,757	2,377	254
	9:31	2	1,747	2,409	254
	9:32	2	1,750	2,350	253
	9:33	2	1,753	2,391	253
	9:34	2	1,748	2,440	253
	9:35	2	1,749	2,355	253
	9:36	2	1,748	2,393	253
	9:37	2	1,748	2,365	253
	9:38	2	1,748	2,377	253
	9:39	2	1,744	2,416	254
	9:40	2	1,751	2,367	253
	9:41	2	1,747	2,398	254
	9:42	2	1,743	2,448	253
	9:43	2	1,755	2,359	253
	9:44	2	1,749	2,397	254
	9:45	2	1,747		254
	9:46	2	1,758		253
	Average	**2**	**1,750**	**2,388**	**253**

12/11/2024	EUHBTUENCL	Test #	Combustion Zone Chamber Temp. (°F)	CO_2 Fuel Flow (scfm)	LFG Fuel Flow (scfm)
	9:50	3	1,750		253
	9:51	3	1,751		253
	9:52	3	1,751		253
	9:53	3	1,748	2,369	253
	9:54	3	1,746	2,365	253
	9:55	3	1,748	2,404	253
	9:56	3	1,758	2,404	253
	9:57	3	1,753	2,377	253
	9:58	3	1,747	2,422	253
	9:59	3	1,760	2,335	253
	10:00	3	1,754	2,383	253
	10:01	3	1,746	2,399	253
	10:02	3	1,756	2,371	253
	10:03	3	1,746	2,407	253
	10:04	3	1,748	2,431	253
	10:05	3	1,760	2,389	253
	10:06	3	1,749	2,427	253
	10:07	3	1,749	2,339	253
	10:08	3	1,754	2,407	254
	10:09	3	1,749	2,396	253
	10:10	3	1,751	2,367	253
	10:11	3	1,749	2,407	253
	10:12	3	1,753	2,373	253
	10:13	3	1,751	2,380	253
	10:14	3	1,746	2,415	254
	10:15	3	1,755	2,329	253
	10:16	3	1,747	2,370	254
	10:17	3	1,744	2,448	254
	10:18	3	1,756	2,361	253
	10:19	3	1,745	2,396	253
	10:20	3	1,744	2,365	253
	10:21	3	1,754	2,378	253
	10:22	3	1,744	2,411	253
	10:23	3	1,747	2,367	254
	10:24	3	1,754	2,389	253
	10:25	3	1,748	2,456	254
	10:26	3	1,750	2,360	254
	10:27	3	1,752	2,395	254
	10:28	3	1,752	2,373	253
	10:29	3	1,755	2,381	253
	10:30	3	1,750	2,417	253
	10:31	3	1,761	2,371	253
	10:32	3	1,756	2,392	253
	10:33	3	1,750	2,434	254
	10:34	3	1,762	2,351	253
	10:35	3	1,750	2,391	253
	10:36	3	1,747	2,382	254
	10:37	3	1,756	2,372	254
	10:38	3	1,746	2,400	254
	10:39	3	1,748	2,405	254
	10:40	3	1,758	2,385	254
	10:41	3	1,749	2,417	254
	10:42	3	1,751	2,348	254
	10:43	3	1,751	2,373	254
	10:44	3	1,746	2,371	253
	10:45	3	1,748	2,364	253
	10:46	3	1,749	2,406	253
	10:47	3	1,753	2,413	253
	10:48	3	1,748	2,381	253
	10:49	3	1,743	2,420	254
	10:50	3	1,753	2,326	253
	10:51	3	1,745	2,381	
	10:52	3	1,742	2,411	
	10:53	3	1,753	2,370	
	Average	**3**	**1,751**	**2,387**	**253**

12/11/2024	EUHBTUENCL	Test #	Combustion Zone Chamber Temp. (°F)	CO_2 Fuel Flow (scfm)	LFG Fuel Flow (scfm)
	8:15	Duplicate	N/A	N/A	253

12/11/2024	EUHBTUENCL	Combustion Zone Chamber Temp. (°F)	CO_2 Fuel Flow (scfm)	LFG Fuel Flow (scfm)
	3-Test Average	1,750	2,387	253