Alliance
TECHNICAL GROUP

Source Test Report

Great Lakes Water Authority
Wastewater Resource Recovery Facility
9300 W. Jefferson Avenue
Detroit, Michigan 48209

Sources Tested: Multiple Heart Incinerator- Unit 14
(EUINC14)
Test Date: July 12, 2023

Project No. AST-2023-1997

Prepared By
Alliance Technical Group, LLC
Boston Office
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Regulatory Information

Permit No.	ROP No. MI-ROP-B2103-2014d
Regulatory Citations	40 CRF 60, Subpart MMMM, Rule 972
Regulatory Agency	Michigan Department of Environment, Great Lakes, and Energy (EGLE)

Source Information

Source Name	*Source ID*	*Target Parameter(s)*
Multiple Heart Incinerator- Unit 14	EUINC14	NO_x

Contact Information

Test Location
Great Lakes Water Authority
Water Resource Recovery Facility
9300 W. Jefferson Avenue
Detroit, MI 48209

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Alliance Technical Group, LLC (Alliance) has completed the source testing as described in this report. Results apply only to the source(s) tested and operating condition(s) for the specific test date(s) and time(s) identified within this report. All results are intended to be considered in their entirety, and Alliance is not responsible for use of less than the complete test report without written consent. This report shall not be reproduced in full or in part without written approval from the customer.

To the best of my knowledge and abilities, all information, facts, and test data are correct. Data presented in this report has been checked for completeness and is accurate, error-free, and legible. Onsite testing was conducted in accordance with approved internal Standard Operating Procedures. Any deviations or problems are detailed in the relevant sections in the test report.

This report is only considered valid once an authorized representative of Alliance has signed in the space provided below; any other version is considered draft. This document was prepared in portable document format (.pdf) and contains pages as identified in the bottom footer of this document.

Mike Kelley
Project Manager
Alliance Technical Group, LLC

08/03/23
Date

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Introduction

1.0 Introduction

Alliance Technical Group, LLC (Alliance) was retained by Great Lakes Water Authority (GLWA) to conduct compliance testing at the Water Resource Recovery Facility (WRRF) in Detroit, Michigan (MI). Portions of the facility are subject to 40 Code of Federal Regulations (CFR) Part 60 Subpart MMMM. The facility operates under the Renewable Operating Permit. (ROP) No. MI-ROP-B2103-2014d. Testing was conducted to determine the emission rate of Nitrogen Oxides (NOx), at the exhaust of Multiple Hearth Incinerator (MHI) 14.

1.1 Facility Description

GLWA operates an incineration complex. The incineration complex contains eight sewage sludge incinerators subject to the 40 CFR Part 60, Subpart MMMM emissions guidelines though Rule 972. Sludge is dewatered with belt filter presses and conveyed to the multiple hearth furnaces with belt conveyors. The sludge conveyors are equipped with weigh scales for continuous monitoring of the amount of sludge being incinerated. The dewatered sludge is introduced at the top hearth and rabbled down through successive hearths in a spiral path. The moisture in the sludge is evaporated in the upper hearths as hot combustion gases traveling concurrently from the middle hearths where combustion takes place. The maximum feed rate is 3.12 dry tons per hour at 25% solids and 75% volatiles condition. It is a continuous feed process. Under normal operating conditions each incinerator runs between 2.0 and 2.5 dry tons per hour with temperature of the solids between 50 and 80 °F. The furnace is equipped with auxiliary natural gas burners at hearths 2, 4, 6, 8, 10, and 12. The firing rate of the burners is modulated by a central control system to sustain the desired hearth temperatures.

1.2 Emission Unit and Control Unit Descriptions

Each air pollution control system is comprised of a Double Zero Hearth afterburner section of Hearths 1 and 2, a quench section, and EnviroCare® Venturi-Pak (venturi throat sections and mist eliminator) scrubber system. The total pressure-drop across the wet scrubber ranges between 25 and 40 inches of water column (in. wc). The total scrubber water flow should be greater than 1416 gallons per minute (gpm). Exhaust gases pass through this MHI via an induced draft (ID) fan and exit the scrubber at 100- 150 °F.

There have not been any equipment modifications, failures, or any significant adjustments or maintenance since the last performance test. There have not been any emissions-related engineering evaluations conducted on the system since the last performance test.

1.3 Project Team

Personnel involved in this project are identified in the following table.

Table 1-1: Project Team

Alliance Personnel	Brendan Kelley Kenny Huang

1.4 Test Protocol & Notification

Testing was conducted in accordance with the test protocol submitted to Michigan Department of Environment, Great Lakes, and Energy (EGLE) on June 1, 2023.

1.5 Test Program Notes

Testing was completed without any deviations.

Summary of Results

2.0 Summary of Results

Alliance conducted compliance testing at the GLWA WRRF facility in Detroit, MI on July 12, 2023. Testing consisted of determining the emission rates of NO_x at the exhaust of MHI 14.

Table 2-1 provides a summary of the emission testing results with comparisons to the applicable permit limits. Any difference between the summary results listed in the following table and the detailed results contained in appendices is due to rounding for presentation.

Table 2-1: Summary of Results MHI 14

Run Number	Run 1	Run 2	Run 3	Average
Date	7/12/23	7/12/23	7/12/23	
Start Time	9:16	10:41	12:11	
Stop Time	10:16	11:41	13:11	
Oxygen Data				
Concentration, % dry	12.77	12.30	12.42	12.50
Carbon Dioxide Data				
Concentration, % dry	6.74	7.20	7.13	7.02
Nitrogen Oxides Data				
Concentration, ppmvd	95.73	109.11	120.95	108.60
Concentration, ppmvd @ 7 % O_2	163.59	176.35	198.35	179.43
Permit Limit, ug ppmvd @ 7 % O_2	--	--	--	220
Percent of Limit, %	--	--	--	82

Testing Methodology

3.0 Testing Methodology

The emission testing program was conducted in accordance with the test methods listed in Table 3-1. Method descriptions are provided below while quality assurance/quality control data is provided in Appendix C.

Table 3-1: Source Testing Methodology

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Oxygen/Carbon Dioxide	3A	Instrumental Analysis
Nitrogen Oxides	7E	Instrumental Analysis

3.1 U.S. EPA Reference Test Method 3/3A – Oxygen/Carbon Dioxide

The oxygen (O_2) and carbon dioxide (CO_2) testing was conducted in accordance with U.S. EPA Reference Test Method 3A. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, heated Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. The quality control measures are described in Section 3.3.

3.2 U.S. EPA Reference Test Method 7E – Nitrogen Oxides

The nitrogen oxides (NOx) testing was conducted in accordance with U.S. EPA Reference Test Method 7E. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, heated Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. The quality control measures are described in Section 3.3.

3.3 Quality Assurance/Quality Control – U.S. EPA Reference Test Methods 3A and 7E

EPA Protocol 1 Calibration Gases

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Direct Calibration & Calibration Error Test

Low Level gas was introduced directly to the analyzer. After adjusting the analyzer to the Low-Level gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas. For the Calibration Error Test, Low, Mid, and High Level calibration gases were sequentially introduced directly to the analyzer. All values were within 2.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference.

System Bias and Response Time

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe and the time required for the analyzer reading to reach 95 percent or 0.5 ppmv/% (whichever was less restrictive) of the gas concentration was recorded. The analyzer reading was observed until it reached a stable value, and this value was recorded. Next, Low Level gas was introduced at the probe and the time required for the analyzer reading to decrease to a value within 5.0 percent or 0.5 ppmv/% (whichever was less restrictive) was recorded. If the Low-

Level gas was zero gas, the response was 0.5 ppmv/% or 5.0 percent of the upscale gas concentration (whichever was less restrictive). The analyzer reading was observed until it reached a stable value and this value was recorded. The measurement system response time and initial system bias were determined from these data. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference.

Post Test System Bias Checks
High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe. After the analyzer response was stable, the value was recorded. Next, Low Level gas was introduced at the probe, and the analyzer value recorded once it reached a stable response. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference or the data was invalidated and the Calibration Error Test and System Bias were repeated.

Post Test Drift Checks
Drift between pre- and post-run System Bias was within 3 percent of the Calibration Span or 0.5 ppmv/% absolute difference. If the drift exceeded 3 percent or 0.5 ppmv/%, the Calibration Error Test and System Bias were repeated.

Stratification Check
To determine the number of sampling points, a gas stratification check was conducted prior to initiating testing. The pollutant concentrations were measured at three points (16.7, 50.0 and 83.3 percent of the measurement line). Each traverse point was sampled for a minimum of twice the system response time.

If the pollutant concentration at each traverse point did not differ more than 5 percent or 0.5 ppmv/0.3% (whichever was less restrictive) of the average pollutant concentration, then single point sampling was conducted during the test runs. If the pollutant concentration did not meet these specifications but differed less than 10 percent or 1.0 ppmv/0.5% from the average concentration, then three (3) point sampling was conducted (stacks less than 7.8 feet in diameter - 16.7, 50.0 and 83.3 percent of the measurement line; stacks greater than 7.8 feet in diameter – 0.4, 1.0, and 2.0 meters from the stack wall). If the pollutant concentration differed by more than 10 percent or 1.0 ppmv/0.5% from the average concentration, then sampling was conducted at a minimum of twelve (12) traverse points. Copies of stratification check data can be found in the Quality Assurance/Quality Control Appendix.

NO_x Converter Check
An NO_2 – NO converter check was performed on the analyzer prior to initiating testing and at the completion of testing. An approximately 51 ppm nitrogen dioxide cylinder gas was introduced directly to the NOx analyzer and the instrument response was recorded in an electronic data sheet. The instrument response was within +/- 10 percent of the cylinder concentration.

Data Collection
A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the Alliance server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at Alliance's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.

Appendix A

Location: Great Lakes Water Authority - Detroit, MI
Source: Incinerator 14 (EUINC14)
Project No.: AST-2023-1997
Run No. /Method Run 1 / Method 3A

O_2 - Outlet Concentration (C_{O_2}), % dry

$$C_{O_2} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{(C_M - C_0)} \right)$$

where,

C_{obs}	12.4	= average analyzer value during test, % dry
C_o	0.0	= average of pretest & posttest zero responses, % dry
C_{MA}	10.0	= actual concentration of calibration gas, % dry
C_M	9.7	= average of pretest & posttest calibration responses, % dry
C_{O_2}	12.8	= O_2 Concentration, % dry

Location: Great Lakes Water Authority - Detroit, MI
Source: Incinerator 14 (EUINC14)
Project No.: AST-2023-1997
Run No. /Method Run 1 / Method 3A

CO_2 - Outlet Concentration (C_{CO_2}), % dry

$$C_{CO_2} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{(C_M - C_0)} \right)$$

where,

C_{obs}	6.5	= average analyzer value during test, % dry
C_o	0.2	= average of pretest & posttest zero responses, % dry
C_{MA}	10.0	= actual concentration of calibration gas, % dry
C_M	9.6	= average of pretest & posttest calibration responses, % dry
C_{CO_2}	6.7	= CO_2 Concentration, % dry

Location: Great Lakes Water Authority - Detroit, MI
Source: Incinerator 14 (EUINC14)
Project No.: AST-2023-1997
Run No. /Method Run 1 / Method 7E

NOx - Outlet Concentration (C_{NOx}), ppmvd

$$C_{NOx} = (C_{obs} - C_0) \times \left(\frac{C_{MA}}{(C_M - C_0)} \right)$$

where,

C_{obs}	96.7	= average analyzer value during test, ppmvd
C_o	1.9	= average of pretest & posttest zero responses, ppmvd
C_{MA}	239.1	= actual concentration of calibration gas, ppmvd
C_M	238.7	= average of pretest & posttest calibration responses, ppmvd
C_{NOx}	95.7	= NOx Concentration, ppmvd

NOx - Outlet Concentration (C_{NOxc7}), ppmvd @ 7% O_2

$$C_{NOxc7} = C_{NOx} \times \left(\frac{20.9 - 7}{20.9 - O_2} \right)$$

where,

C_{NOx}	95.7	= NOx - Outlet Concentration, ppmvd
C_{O_2}	12.8	= oxygen concentration, %
C_{NOxc7}	163.6	= ppmvd @7% O_2

Appendix B

Location Great Lakes Water Authority - Detroit, MI
Source Incinerator 14 (EUINC14)
Project No. AST-2023-1997

Run Number		Run 1	Run 2	Run 3	Average
Date		7/12/23	7/12/23	7/12/23	--
Start Time		9:16	10:41	12:11	--
Stop Time		10:16	11:41	13:11	--
Calculated Data - Outlet					
O_2 Concentration, % dry	C_{O_2}	12.77	12.30	12.42	12.50
CO_2 Concentration, % dry	C_{CO_2}	6.74	7.20	7.13	7.02
NOx Concentration, ppmvd	C_{NOx}	95.73	109.11	120.95	108.60
NOx Concentration, ppmvd @ 7 % O_2	C_{NOxc7}	163.59	176.35	198.35	179.43

Method 1 Data

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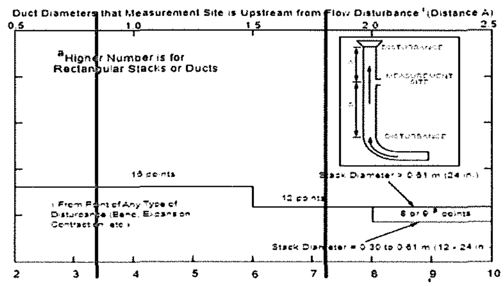
Location Great Lakes Water Authority - Detroit, MI
Source Incinerator 14 (EUINC14)
Project No. AST-2023-1997
Date: 07/11/23

Stack Parameters

Duct Orientation:	Vertical	
Duct Design:	Circular	
Distance from Far Wall to Outside of Port:	57.00	in
Nipple Length:	3.00	in
Depth of Duct:	54.00	in
Cross Sectional Area of Duct:	15.90	ft²
No. of Test Ports:	1	
Number of Readings per Point:	1	
Distance A:	8.0	ft
Distance A Duct Diameters:	1.8	(must be > 0.5)
Distance B:	15.0	ft
Distance B Duct Diameters:	3.3	(must be > 2)
Minimum Number of Traverse Points:	16	
Actual Number of Traverse Points:	3	
Measurer (Initial and Date):	KH 7/11/23	
Reviewer (Initial and Date):	BK 7/11/23	



CIRCULAR DUCT

	LOCATION OF TRAVERSE POINTS *Number of traverse points on a diameter*										
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	14.6	16.7	6.7	--	4.4	--	3.2	--	2.6	--	2.1
2	85.4	50.0	25.0	--	14.6	--	10.5	--	8.2	--	6.7
3	--	83.3	75.0	--	29.6	--	19.4	--	14.6	--	11.8
4	--	--	93.3	--	70.4	--	32.3	--	22.6	--	17.7
5	--	--	--	--	85.4	--	67.7	--	34.2	--	25.0
6	--	--	--	--	95.6	--	80.6	--	65.8	--	35.6
7	--	--	--	--	--	--	89.5	--	77.4	--	64.4
8	--	--	--	--	--	--	96.8	--	85.4	--	75.0
9	--	--	--	--	--	--	--	--	91.8	--	82.3
10	--	--	--	--	--	--	--	--	97.4	--	88.2
11	--	--	--	--	--	--	--	--	--	--	93.3
12	--	--	--	--	--	--	--	--	--	--	97.9

**Percent of stack diameter from inside wall to traverse point.*

Traverse Point	% of Diameter	Distance from inside wall	Distance from outside of port
1	16.7	9.02	12.02
2	50.0	27.00	30.00
3	83.3	44.98	47.98
4	--	--	--
5	--	--	--
6	--	--	--
7	--	--	--
8	--	--	--
9	--	--	--
10	--	--	--
11	--	--	--
12	--	--	--

Stack Diagram
A = 8 ft.
B = 15 ft.
Depth of Duct = 54 in.

Cross Sectional Area