FINAL REPORT

DETROIT THERMAL, L.L.C.

DETROIT, MICHIGAN

2022 RELATIVE ACCURACY TEST AUDIT (RATA) TESTING: EUBOILER6 & EUBOILER7

RWDI #2202500

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SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Detroit Thermal Beacon Heating Plant (DTBHP) to conduct a Relative Accuracy Testing Audit (RATA) at the Detroit Thermal Beacon Heating Plant located at 541 Madison Street, in Detroit, Michigan. The RATA was completed on October 12, 2022, on EUBOILER6 (Boiler 6) & EUBOILER7 (Boiler 7) for Nitrogen Oxides (NO_x) and Oxygen (O_2) for the Predictive Emission Monitoring Systems (PEMS). Boiler 6 and Boiler 7 are fired by natural gas to generate steam that is used for process and comfort heating purposes.

The RATA is conducted annually and is a requirement under the facility permit MI-ROP- B2814-2014 and under United States Environmental Protection Agency (U.S. EPA) **Appendix A,** 40 CFR, Part 60, subparts Dd. NO_x and O_2 measurements were collected using U.S. EPA Methods 7E and 3A under 40 CFR, Part 60, **Appendix A** and Performance Specifications (PS) 2, 3, and 16 stipulated in 40 CFR, Part 60, **Appendix B**.

The PEMS audited during this testing program include oxides of nitrogen (NO_x) and oxygen (O_2). Data was collected for ten (10) 21-minute periods on each of the boilers (Boiler 6 & Boiler 7) while each boiler was fired by natural gas.

The table below presents a summary of the results.

Executive Summary Table i: Summary of Results – EUBOILER6 – October 12, 2022

Parameter	Boiler 6		
	Oxides of Nitrogen (ppm	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	7.6% ***(Limit 20%)***	4.0% ***(Limit 20%)***	10.7% ***(Limit 20%)***
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.79 ***(Limit <2.0ppm)***	0.0005 ***(Limit < 0.05 lb/MMBTU)***	0.54 ***(Limit <1.0%)***
Bias Present?	Yes	Yes	Yes
Bias Factor	0.94	0.97	1.11

Executive Summary Table ii: Summary of Results – EUBOILER7 – October 12, 2022

Parameter	Boiler 7		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	11.6% ***(Limit 20%)***	14.3% ***(Limit 20%)***	8.8% ***(Limit 20%)***
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	1.22 ***(Limit <2.0ppm)***	0.0023 ***(Limit < 0.05 lb/MMBTU)***	0.37% ***(Limit <1.0%)***
Bias Present?	Yes	Yes	Yes
Bias Factor	0.90	0.88	0.95

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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by Detroit Thermal Beacon Heating Plant to conduct a Relative Accuracy Testing Audit (RATA) at the Detroit Thermal Beacon Heating Plant located at 541 Madison Street in Detroit, Michigan. The RATA was completed on October 12, 2022, on EUBOILER6 (Boiler 6) & EUBOILER7 (Boiler 7) for Nitrogen Oxides (NO_x) and Oxygen (O_2) for the Predictive Emission Monitoring Systems (PEMS). RATA is conducted annually and is a requirement under the facility permit MI-ROP-B2814-2014 and under United States Environmental Protection Agency (U.S. EPA) **Appendix A**, 40 CFR, Part 60. NO_x and O_2 measurements were collected using U.S. EPA Methods 7E and 3A under 40 CFR, Part 60, **Appendix A** and Performance Specifications (PS) 2, 3, and 16 stipulated in 40 CFR, Part 60, **Appendix B.**

Boiler 6 and Boiler 7 are fired by natural gas to generate steam that is used for process and comfort heating purposes.

The monitors audited during this testing program include oxides of nitrogen (NO_X) and oxygen (O_2). The relative accuracy requirements are set-out in the applicable Performance Specification in 40 CFR 60, **Appendix B**.

Table 1.2: Test Personnel

Company	Position	Individual
RWDI	Project Supervisor	Brad Bergeron
RWDI	Senior Lead	Ben Durham
RWDI	Scientist	Juan Vargas
DTBHP	Engineering Manager	Dale Lane
DTBHP	Plant Manager	Phil Malara

2 PLANT AND SOURCE DESCRIPTION

2.1 Plant Overview

Detroit Thermal Beacon Heating Plant located at 541 Madison Street in Detroit Michigan, operates two (2) natural gas fired boilers. Each of the boilers (Boiler 6 and Boiler 7) has a maximum heat input rating of 180.2 MMBTU while firing on natural gas. The steam from the boilers is distributed to the Detroit network for use in process and comfort heating systems. Each of the boilers are equipped with low-NO_x burners to control the NO_x emissions from the boilers.

2.2 Predictive Emission Monitors Specifications Boiler 6 & Boiler 7

Boiler 6 & Boiler 7 are equipped with the AMP-Cherokee Prologix P60TM PEMS. The P60TM PEMS is a PLC-based system which calculates pollutant emissions from sensors inputs using high-order polynomial equations. The process sensor inputs are read by the PLC via signals from the facility distributive control system (DCS). Sensor data is validated, and predicted gas concentrations for each sensor are calculated using relationships that are defined by calculating a weighted average of the individual predictions. The PEMS hardware is comprised of four (4) basic components: the PLC, a touch panel PC, a data historian, and report server.

The AMP-Cherokee Prologix P60TM PEMS records data continuously and generates reports in compliance with 40 CFR Part 60 regulations. These reports can be operated on any workstation on the local area network and provide the operators information on compliance status of the boilers in real-time.

The AMP-Cherokee Prologix P60TM PEMS at Detroit Thermal have the following Serial Numbers:

Unit	Model	Serial Number
Boiler 6	AMP-Cherokee Prologix P60™	608A9509
Boiler 7	AMP-Cherokee Prologix P60™	607D6B13

3 SAMPLING LOCATION

The sampling port for the RATA testing was located outside within the exhaust duct. Boiler 6 and Boiler 7 share a common duct for the discharge of the emissions from each of the boilers. During the RATA, Detroit Thermal personnel were able to isolate each of the boilers so the RATA would be completed on each boiler individually.

Figure 3.1: RATA Sampling Location

4 REFERENCE METHOD SAMPLING

The following section provides an overview of the sampling methodologies employed by the sampling program. The table below summarizes the reference methods used in this study.

Table 4.1: Summary of Sampling Methodologies

Parameter	Reference Method
RATA Methodology and Calculations	U.S EPA Performance Specifications 2,3, and 16
Oxides of Nitrogen	U.S. EPA Method 7E
Oxygen	U.S. EPA Method 3A
Nitrogen Oxide Emission Rates	U.S. EPA Method 19

4.1 Relative Accuracy Testing Audit

The reference test method procedures outlined above are instrumental test methods. Testing was conducted in accordance with 40 CFR 60, **Appendix B**, Performance Specifications 2, 3, and 16. The relative accuracies were calculated according to the appropriate emission standards. To satisfy the RATA requirements of 40 CFR 60, **Appendix B**, the RATA must not exceed 20.0% of the mean of the reference method if the concentration of NO_x is between 10ppm to 100ppm. As outlined in Performance Specification 16, Section 13.5 notes that for RATAs, "The average of the ten (10) RM determinations must not differ from the simultaneous PEMS average value by more than 10 percent of the analyzer or RM for concentrations greater than 100 ppm or 20 percent for concentrations between 100 and 20 ppm, or the test is failed. For measurements at 20 ppm or less, this difference must not exceed 2 ppm for a pollutant PEMS and 1 percent absolute for a diluents PEMS."

The RATA was conducted while the unit operated at greater than 50% capacity (both Boiler 6 and Boiler 7 were operated at an approximately 67% of capacity during the RATA). The traverse sampling points were located along a "measurement line" that passed through the centroidal area of the duct. As noted in the approval letter, in lieu of a stratification check, three-point sampling was performed during each test period. Each point was measured for 7 minutes for a total of 21 minutes per test. The exhaust gas sample was withdrawn from the duct using a stainless steel probe. The sample proceeded through a heated filter where particulate matter was removed. The sample was then transferred via a heated Teflon® line maintained at a temperature of 250°F to a sample conditioner. The sample conditioner removed any moisture from the exhaust gas. The sample was then routed through a manifold system and introduced to the individual CEM's for measurement.

Appendix A and **Appendix C** of this report contains detailed information on the Reference Method RATA test runs, including; a summary of results, raw PEMs data, corrected CEM data and pre- and post-test calibration information for all parameters, respectively for Boiler 6 and 7. **Appendix B** and **Appendix D** of this report contain 1-minute averages of Detroit Thermal PEMS system, respectively for Boiler 6 and Boiler 7. **Appendix E** contains calibration gas Certificates of Accuracy. Below is a schematic of the RWDI reference method sampling system.

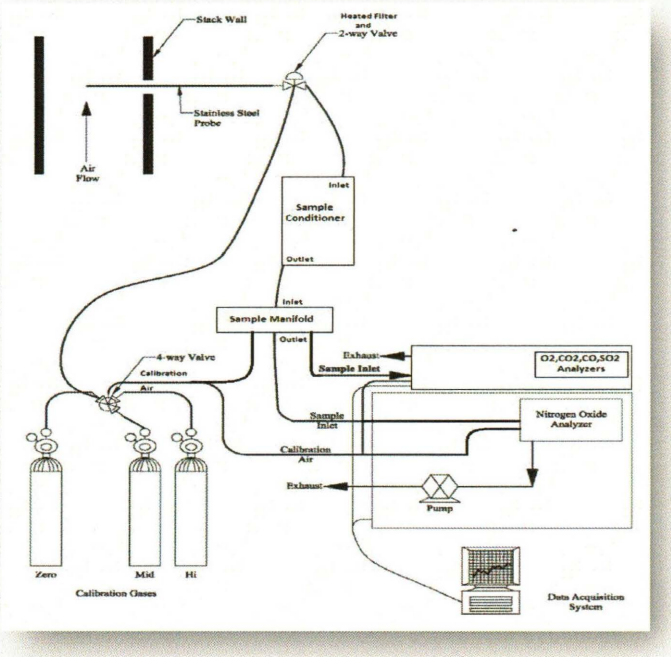

Figure 4.1.1: RWDI CEM Sampling System

Table 4.1.1: RWDI CEM Analyzers (RM)

RWDI CEM Analyzers					
Parameter	**Unit**	**Location**	**Range**	**Analyzer**	**Serial Number**
O_2	6/7	Stack	0 - 25%	Teledyne T200H NOx, O2	851
NOx	6/7	Stack	0 – 100 ppm	Teledyne T200H NOx, O2	851

4.2 Oxygen (US EPA method 3A)

US EPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure)", was used to measure the oxygen concentration of the flue gas. A Rosemount Model NGA2000 paramagnetic analyzer was used for oxygen measurements.

Prior to testing, a 3-point analyzer calibration error check was conducted using US EPA protocol gases. The calibration error check was performed by introducing zero, mid and high-level calibration gases directly into the analyzer. The calibration error check was performed to confirm that the analyzer response was within ±2% of the certified calibration gas introduced. Prior to each test run, a system-bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each test run a system-bias check was performed to evaluate the percent drift from pre-and post-test system bias checks. The system bias checks confirmed that the analyzer did not drift greater than ±3% throughout a test run.

Data acquisition was provided using a data logger system programmed to collect and record data at one second intervals. Average one minute concentrations were calculated from the one second measurements.

4.3 Oxides of Nitrogen (US EPA method 7E)

NO_x emissions were measured following USEPA Method 7E, "Determination of Nitrogen Oxides Emissions from Stationary Sources." The NO_x concentration was measured using a TECO 42iHL Chemiluminescence gas analyzer

A NO/NO_2 conversion check was performed prior to each new source by introducing NO_2 gas into the NOx analyzer. The analyzers NO_x concentration readout was greater than 90% of the introduced calibration gas; therefore, the conversion met the converter efficiency requirement of section 13.5 of USEPA Method 7E. NO/NO_2 conversion data is outlined in the table below

Table 4.3.1: NO/NO_2 Converter Efficiency

Certified Calibration Gas Value (ppmv)	Date/ Boiler	Analyzer Response Peak Value (ppmv)	NO_2 to NO Converter Efficiency (%)	Efficiency: Pass/Fail
99.0	10/12/2022 Boiler 6 / 7	100.02	101%	PASS

Note: *Converter Efficiency must be >90%*

4.4 Nitrogen Oxides Emission Rate Calculation (US EPA Methods 19)

USEPA Method 19, "Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide and Nitrogen Oxide Emission Rates," was used to calculate a NO_x emission factor based on Oxygen concentrations and appropriate F-factors. Equation 19-1 from the method was used. Table 19-1 was used to determine the conversion factor for concentration ($1.194x10^{-7}$) was used for NO_x. Table 19-2 was used for the F-Factor (natural gas 8,710 $dscf/10^6$ BTU).

$$E = (1.194x10^{-7}) \times C_d \times F_d \times ((20.9/(20.9-\%O_{2d}))$$

Where:

E = Pollutant Emission Rate ($lb./10^6$ BTU)

C_d = Pollutant Concentration, Dry Basis (ppm)

F_d = Fuel Factor, Dry Basis ($dscf/10^6$ BTU)

$\%O_{2d}$ = Oxygen Concentration, Dry Basis (%)

4.5 Quality Assurance and Quality Control Procedures

Quality assurance measures were implemented during the sampling program to ensure the integrity of the results. These measures included detailed documentation of field data, and equipment calibrations for all measured parameters.

Quality control procedures specific to the CEM monitoring included linearity checks, to determine the instrument performance, and reproducibility checks prior to its use in the field. Regular performance checks on the analyzers were also carried out during the testing program by performing zero and span calibration checks using EPA Protocol 1 gas standards. Sample system bias checks were also conducted. These checks were used to verify the ongoing precision of the monitor and sampling system over time. Pollutant-free (zero) air was introduced to perform the zero checks, followed by a known calibration (span) gas into the monitor. The response of the monitor to pollutant-free air and the corresponding sensitivity to the span gas were recorded regularly during the tests. The tables below outline the QA/QC procedures and calibration gas summary.

Table 4.5.1: Summary of QA/QC Procedures

Summary of QA/QC Procedures				
Test Method	**QA/QC Procedure**	**QA/QC Objective**	**QA/QC Results**	**Status of QA/QC**
US EPA 3A & 7E	Initial Calibration Error Test	< ±2%	< ±2%	Acceptable
	System Bias Test	< ±5%	< ±5%	Acceptable
	Drift Test	< ±3%	< ±3%	Acceptable
US EPA 7E	NOx Converter Checks	>90% conversion efficiency	>90%	Acceptable

Table 4.5.2: Reference Method Calibration Gas Values

Reference Method Calibration Gas Values			
Parameter	**Span Level**	**Calibration Gas Value**	**Calibration Gas Serial Number**
Oxygen	Mid	10.0%	EB0119091
	High	21.05%	EB0001454
Nitrogen Oxides	Mid	12 ppm	DT0032147
	High	24.8 ppm	CC350586
Nitrogen Dioxide	Converter Gas	99 ppm	SA15110

5 RESULTS

The overall results from the testing are discussed in this section. Detailed results of each individual Reference Method test and individual PEMS tests may be found in **Appendices A - D**.

5.1 Summary Relative Accuracy Testing Audit (RATA) Results

Ten (10) 21-minute tests, were completed on the PEMS for NO_X and O_2 for each boiler. All ten (10) runs were used in the statistical calculations. For more detailed tables presenting individual test runs refer to **Appendix A** through **Appendix D** of this report. **Appendix E** contains the calibration gas certifications and **Appendix F** contains the field notes. **Appendix B** and **Appendix D** contain the process data for natural gas usage and steam flow vales. **Appendix G** contains a copy of the Source Testing Plan and Acknowledgement Letter from the State of Michigan Environment, Great Lakes and Energy (EGLE). Mr. Sam Liveson was on-site during the testing for Boiler #7 on the morning of October 12, 2022. Below is a summary of the results.

Table 5.1.1: Summary of Results – EUBOILER6 – October 12, 2022

Parameter	Boiler 6		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	7.6% ***(Limit 20%)***	4.0% ***(Limit 20%)***	10.7% ***(Limit 20%)***
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	0.79 ***(Limit <2.0ppm)***	0.0005 ***(Limit < 0.05 lb/MMBTU)***	0.54 ***(Limit <1.0%)***
Bias Present?	Yes	Yes	Yes
Bias Factor	0.94	0.97	1.11

Table 5.1.2: Summary of Results – EUBOILER7 – October 12, 2022

Parameter	Boiler 6		
	Oxides of Nitrogen (ppm)	Oxides of Nitrogen (lb/MMBTU)	Oxygen (%)
Relative Accuracy (RA) (Mean Difference from RM %)	11.6% **(Limit 20%)**	14.3% **(Limit 20%)**	8.8% **(Limit 20%)**
Relative Accuracy (RA) (Absolute Difference from RM Concentration)	1.22 **(Limit <2.0ppm)**	0.0023 **(Limit < 0.05 lb/MMBTU)**	0.37 **(Limit <1.0%)**
Bias Present?	Yes	Yes	Yes
Bias Factor	0.90	0.88	0.95

6 BOILER OPERATING CONDITIONS

Operating conditions during the sampling were monitored by Detroit Thermal personnel. Testing was performed while each of the boilers operated at greater than 50% load (Boiler 6 & Boiler 7 were operated at approximately 67% capacity during the RATA). Contact was kept between RWDI and boiler operators to ensure the boiler was running at all times during the testing.

7 CONCLUSIONS

The purpose of the study was to perform 2022 Quarter 4 RATA on the PEMS for EUBOILER6 (Boiler 6) and EUBOILER7 (Boiler 7). PEMS determine concentrations for NO_X and O_2 and NO_x emission rate.

All analyzers meet the relative accuracy requirements set out in Performance Specification in 40 CFR 60, Appendix B.