FINAL REPORT

DETROIT THERMAL, L.L.C.

DETROIT, MICHIGAN

2024 RELATIVE ACCURACY AUDIT (RAA) TESTING: EUBOILER6 & EUBOILER7

RWDI #2407136

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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 Audit (RAA) at the Detroit Thermal Beacon Heating Plant located at 541 Madison Street, in Detroit, Michigan. The RAA was completed on May 7th, 2024, on EUBOILER6 (Boiler 6) & EUBOILER7 (Boiler 7) for Nitrogen Oxides (NO_x) and Oxygen (O_2) for the Predictive Emission Monitoring Systems (PEMS).

The RAA is conducted quarterly 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. The 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 three (3) 30-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 showing both Boilers 6 and 7 passed the RAA:

Executive Summary Table i: Summary of Results – EUBOILER6 and 7

Parameter	Boiler 6		Boiler 7	
	Relative Accuracy (RA) (Mean Difference from RM %)	Relative Accuracy (RA) (Absolute Difference from RM Concentration)	Relative Accuracy (RA) (Mean Difference from RM %)	Relative Accuracy (RA) (Absolute Difference from RM Concentration)
Oxides of Nitrogen (ppm)	3.5% (Pass – 20% Limit)	0.44 ppm (Pass – 2ppm Limit)	2.0% (Pass – 20% Limit)	0.23 ppm (Pass – 2ppm Limit)
Oxides of Nitrogen (lb/MMBTU)	0.6% (Pass – 20% Limit)	Not Applicable	0.1% (Pass – 20% limit)	Not Applicable
Oxygen (%)	6.3% (Pass – 20% Limit)	0.32% (Pass – 1% Limit)	3.5% (Pass – 20% Limit)	0.24% (Pass – 1% Limit)

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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 ports for the RAA testing were located on the common exhaust duct for Boiler 6 and Boiler 7 that discharge the emissions from each boiler. During the RAA, Detroit Thermal personnel were able to isolate each of the boilers so the RAA could be completed individually for each boiler.

Figure 3.1: RAA 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
RAA Methodology and Calculations	U.S EPA Performance Specifications 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 Audit

The reference test method procedures outlined above are instrumental test methods. They were conducted in accordance with 40 CFR 60, Appendix B, Performance Specifications 16. The relative accuracies were calculated according to the appropriate emission standards. To satisfy the RAA requirements of 40 CFR 60, Appendix B, the relative accuracy must not exceed 20.0% of the mean of the reference method since the concentration of NO_x was less than 100ppm. As outlined in Performance Specification 16, Section 13.5 the performance specifications for an RAA is as follows:

- The average of the three portable analyzer or RM determinations must not differ from the simultaneous PEMS average value by more than 2ppm of the criteria. Therefore, for NO_x, the evaluation of RA was compared to 2ppm of the criteria since the NOx values were less than 20ppm.
- For Oxygen concentrations, the data was compared to less than 1% absolute difference as the RAA criteria.

The RAA was conducted while the unit operated at a minimum of 50% capacity. The exhaust gas sample was withdrawn from the duct using a stainless-steel probe at a single centroid port along the duct. 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 CEMs for measurement.

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

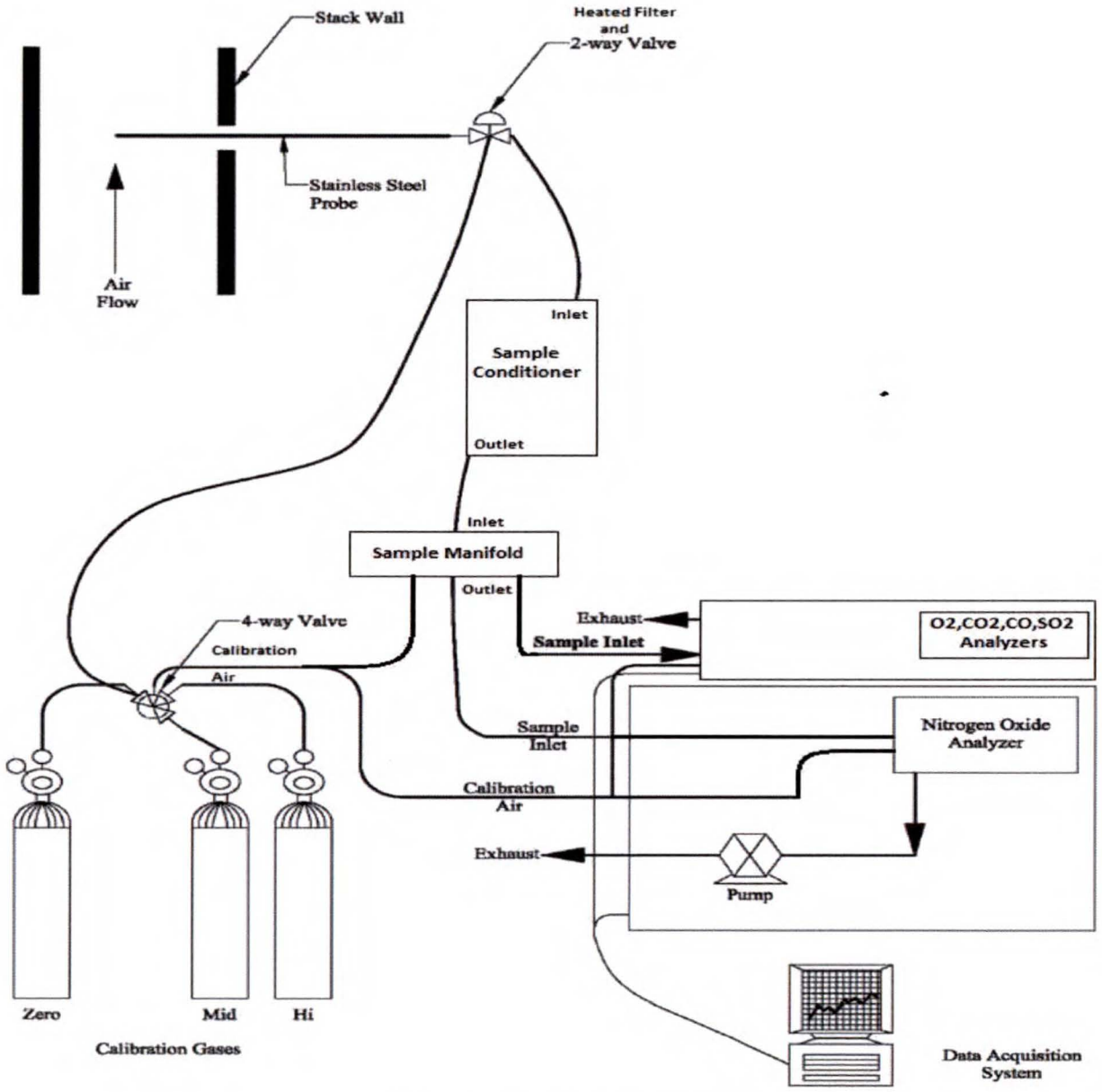

Figure 4.1.1: RWDI CEM Sampling System

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 – 25 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 Teledyne T200H NOx, O_2 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 & 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 Teledyne T200H NOx, O2 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
49.6	5/7/2024 Boiler 6 / 7	48.29	97.4%	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 (1.194×10^{-7}) was used for NO_x. Table 19-2 was used for the F-Factor (natural gas 8,710 dscf/10^6 BTU).

$$E = (1.194 \times 10^{-7}) \times C_d \times F_d \times ((20.9/(20.9-\%O_{2d}))$$

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 Gas Dilution (Method 205)

Calibration gases were mixed using an Environics 4040 Gas Dilution System. The mass flow controllers are factory calibrated using a primary flow standard traceable to the United States National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. The calibration is done yearly, and the records are provided in **Appendix E.** A multi-point EPA Method 205 check was executed in the field prior to testing to ensure accurate gas-mixtures. The gas dilution system consists of calibrated orifices or mass flow controllers and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and was evaluated for accuracy in the field in accordance with US EPA Method 205 "*Verification of Gas Dilution Systems for Field Instrument Calibrations*". The gas divider dilutions were measured to evaluate that the responses were within ±2% of predicted values. In addition, a certified mid-level calibration gas within ±10% of one of the tested dilution gases was introduced into the analyzer to ensure the response of the gas calibration is within ±2% of gas divider dilution concentration.

4.6 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. Additional calibration documents can be found in **Appendix E**.

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	10.00%	DT0047134
	High	21.16%	EB0103354
Nitrogen Oxides	Mid	12.5 ppm	DT0006731
	High	25.0 ppm	DT0006731
Nitrogen Dioxide	Converter Gas	49.6 ppm	DT0018386

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 Audit (RAA) Results

Three (3) 30-minute tests, were completed on the PEMS for NO_X and O_2 for each boiler 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. Below is a summary of the results showing both Boilers passed the RAA:

Table 5.1: Summary of Results – EUBOILER6 and 7

Parameter	Boiler 6		Boiler 7	
	Relative Accuracy (RA) (Mean Difference from RM %)	Relative Accuracy (RA) (Absolute Difference from RM Concentration)	Relative Accuracy (RA) (Mean Difference from RM %)	Relative Accuracy (RA) (Absolute Difference from RM Concentration)
Oxides of Nitrogen (ppm)	3.5% (Pass – 20% Limit)	0.44 ppm (Pass – 2ppm Limit)	2.0% (Pass – 20% Limit)	0.23 ppm (Pass – 2ppm Limit)
Oxides of Nitrogen (lb/MMBTU)	0.6% (Pass – 20% Limit)	Not Applicable	0.1% (Pass – 20% limit)	Not Applicable
Oxygen (%)	6.3% (Pass – 20% Limit)	0.32% (Pass – 1% Limit)	3.5% (Pass – 20% Limit)	0.24% (Pass – 1% Limit)

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. 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 2024 Quarter 2 RAA on the PEMS for EUBOILER6 (Boiler 6) and EUBOILER7 (Boiler 7). All analyzers passed the relative accuracy requirements set out in Performance Specification 16 in 40 CFR 60, Appendix B.