FINAL REPORT

HENRY FORD HEALTH SYSTEM MACOMB HOSPITAL

CLINTON TOWNSHIP, MICHIGAN

SOURCE TESTING REPORT

RWDI #2205184

FEBRUARY 17, 2023

SUBMITTED TO

Technical Programs Unit Manager
Michigan Department of Environmental Quality - Air Quality Division Technical Programs Unit (TPU)
Constitution Hall 2nd Floor, South
525 West Allegan Street
Lansing, Michigan 48909-7760

Joyce Zhu
Michigan Department of Environmental Quality
Southeast Michigan District
27700 Donald Court
Warren, Michigan 48092-2793
Zhuj@michigan.gov

John March
Henry Ford Health System Macomb Hospital
15855 19 Mile Road
Clinton Twp, MI 48038

SUBMITTED BY

David Trahan, QSTI
Senior Field Technician | Associate
Dave.trahan@rwdi.com

Brad Bergeron, A.Sc.T., d.E.T
Senior Project Manager | Principal
Brad.bergeron@rwdi.com | ext. 2428

Mason Sakshaug, QSTI
Senior Scientist | Associate
Mason.sakshaug@rwdi.com | ext. 3703

RWDI USA LLC
Consulting Engineers & Scientists
2239 Star Court
Rochester Hills, Michigan 48309

T: 248.841.8442
F: 519.823.1316

EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Henry Ford Health Systems (HFHS) to complete the emission sampling program at the Macomb Hospital located at 15855 19 Mile Road, Clinton Township, Michigan. The facility operates a hospital that includes the use of natural gas and No. 2 fuel oil boilers (EUBOILER1, EUBOILER2, and EUBOILER3) that are covered under Flexible Group Conditions FGBOILERS in Permit to Install PTI-18-21. The boilers utilize natural gas primarily as fuel with the option for No. 2 fuel oil as back-up. All testing for oxides of nitrogen (NOx) was completed under firing of natural gas.

The testing consisted of triplicate 60-minute tests for NOx from EUBOILER2. As outlined in the PTI, the emissions are reported for NOx pounds per hour (lb/hr) and were determined using U.S. EPA Methods 7E and 19. Oxygen was measured during the testing following U.S. EPA Method 3A.

The following table represents a summary of the stack testing results:

EUBOILER2 Average Emission Data Summary:

Parameter	In-Stack Concentration & Emission Rates			
	Run 1	Run 2	Run 3	Average
NO_x (ppmvd)	27.1	29.8	29.2	28.7
NO_x (lb/hr)	0.68	0.78	0.75	0.74

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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by Henry Ford Health Systems (HFHS) to complete the emission sampling program at the Macomb Hospital located at 15855 19 Mile Road, Clinton Township, Michigan. The facility operates a hospital that includes the use of natural gas and No. 2 fuel oil boilers (EUBOILER1, EUBOILER2, and EUBOILER3) that are covered under Flexible Group Conditions FGBOILERS in Permit to Install PTI-18-21. The boilers utilize natural gas primarily as fuel with the option for No. 2 fuel oil as back-up. All testing for oxides of nitrogen (NOx) was completed under firing of natural gas.

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Testing was conducted on January 10th of 2023. Results from the sampling program are presented in the **Tables Section** of the report, with more detailed sampling results provided in the **Appendices**. Copies of the approval letter and related correspondence are provided in **Appendix A**.

This stack testing study consisted of the following parameters:

- Nitrogen oxides (NO_X);
- Oxygen (O_2)

2 SOURCE DESCRIPTION

2.1 Process Description

Each of the three (3) emission units (EUBOILER1, EUBOILER2, and EUBOILER3) are duel fueled fired, able to combust natural gas or No. 2 fuel oil. Each boiler exhausts gases are discharged to atmosphere. Each boiler is rated for a maximum of 800 HP with a maximum heat input rating of 32.7 MMBTU/hr. Boilers are primarily fired using natural gas with No. 2 Fuel Oil as backup. The process is designed to operate continuously. The process is regulated through monitoring of combustion temperature and fuel flowrate.

3 SAMPLING LOCATION

3.1 Sample Location Description

Emissions were recorded at the outlet of the EUBOILER2. The exhaust location for EUBOILER2 was located above roof level. Exhaust was analyzed for O_2 and NOx. Samples were extracted from sampling ports in the exhaust stack. The nearest upstream and downstream disturbances met the minimum distance criteria specified in EPA Method 1. The sampling point selection and stratification test was performed in accordance with EPA Reference Method 7E section 8.1.2. (applicable to instrumental analyzer methods).

4 SAMPLING METHODOLOGY

The following section provides an overview of the sampling methodologies used in this program.

4.1 Sampling for Oxides of Nitrogen (NOx) and Oxygen (O_2)

Oxygen (O_2) and oxides of nitrogen (NOx) concentrations were determined utilizing RWDI's continuous emissions monitoring (CEM) system. Prior to testing, a 3-point analyzer calibration error check was conducted using USEPA 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 is 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 confirm that the analyzer's response is within ±5% of the introduced calibration gas concentrations. At the conclusion of each test, a system-bias check was performed to evaluate the percent drift from pre and post-test system bias checks. The system bias checks were used to confirm that the analyzer did not drift greater than ±3% throughout a test run.

Zero and upscale calibration checks were conducted both before and after each test run in order to quantify measurement system calibration drift and sampling system bias. Upscale was the mid-range gas, as it most closely approximated the flue gas level. During these checks, the calibration gases were introduced into the sampling system at the probe outlet so that the calibration gases were analyzed in the same manner as the flue gas samples.

A gas sample was continuously extracted from the stack and delivered to a series of gas analyzers, which measure the pollutant or diluent concentrations in the gas. The analyzers were calibrated on-site using EPA Protocol No. 1 certified calibration mixtures. The probe tip was equipped with a sintered stainless-steel filter for particulate removal. The end of the probe was connected to a heated Teflon sample line, which delivered the sample gases from the stack to the CEM system. The heated sample line maintained the gas temperature above 250°F in order to prevent condensation of stack gas moisture within the line.

Before entering the analyzers, the gas sample passed directly into a refrigerated condenser, which cooled the gas to approximately 35°F to remove the stack gas moisture. After passing through the condenser, the dry gas entered a Teflon-head diaphragm pump and a flow control panel, which delivered the gas in series to the O_2 and NO_x analyzers. Each of these analyzers measured the respective gas concentrations on a dry volumetric basis.

4.2 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 (%)

4.3 Quality Assurance/Quality Control Activities

Applicable quality assurance measures were implemented during the sampling program to ensure the integrity of the results. These measures included detailed documentation of field data, equipment calibrations for all measured parameters, completion of Chain of Custody forms when submitting laboratory samples, and submission of field blank samples to laboratories, where applicable.

Quality control procedures specific to the CEM monitoring equipment included linearity checks to determine the instrument performance and reproducibility checks prior to its use in the field. Regular performance checks on the analyser were also carried out during the testing program by performing hourly zero checks and span calibration checks using primary gas standards. Sample system bias checks were also done. These checks were used to verify the ongoing accuracy of the monitor and sampling system over time. Pollutant-free nitrogen 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.

5 RESULTS

The emissions data for this study are presented in the '**Tables**' section of this report. Detailed information regarding each test run can be found in the corresponding appendix. Below is a summary of the applicable Table ID for each corresponding test parameter.

Parameter	Table	Appendix
Nitrogen Oxides	1	B

Field notes are presented in **Appendix C**. All calibration information for the equipment used for the program is included in **Appendix D**. Detailed example calculations for each measured pollutant is provided in within the report sections and **Appendix B** and **E**.

5.1 Discussion of Results

The measured concentrations for all contaminants were less than the maximum limits outlined in Michigan Department of Environment, Great Lakes and Energy (EGLE) covered under Flexible Group Conditions FGBOILERS in Permit to Install PTI-18-21.

6 OPERATING CONDITIONS

Operating conditions during the sampling were monitored by HFHS and RWDI as requested by EGLE for the following parameters:

- Natural gas usage;
- Boiler load (MMBTU/hr); and
- Natural gas F-factor.

All process data is provided in **Appendix B and F**.

Contact was maintained between the process operators and the sampling team throughout the testing. A member of the RWDI sampling team contacted the operator before each test, to ensure that the process was at normal operating conditions.

7 CONCLUSIONS

Testing was successfully completed on January 10th, 2023. The source was tested in accordance with referenced methodologies following the EGLE approved test protocol. All measured concentration were within applicable limits set out in the PTI.

TABLES

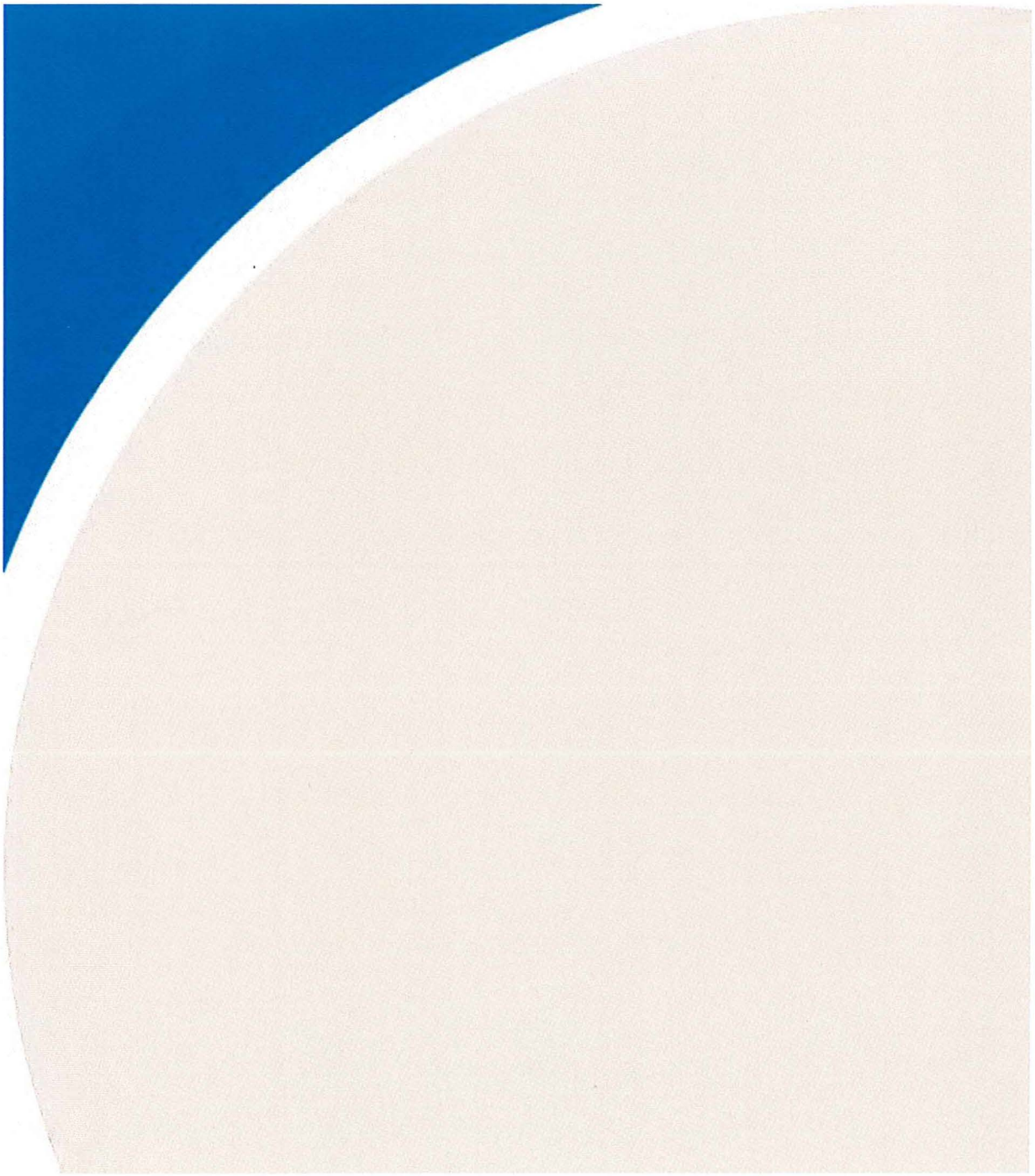


TABLE 1: Boiler 2 Emission Results

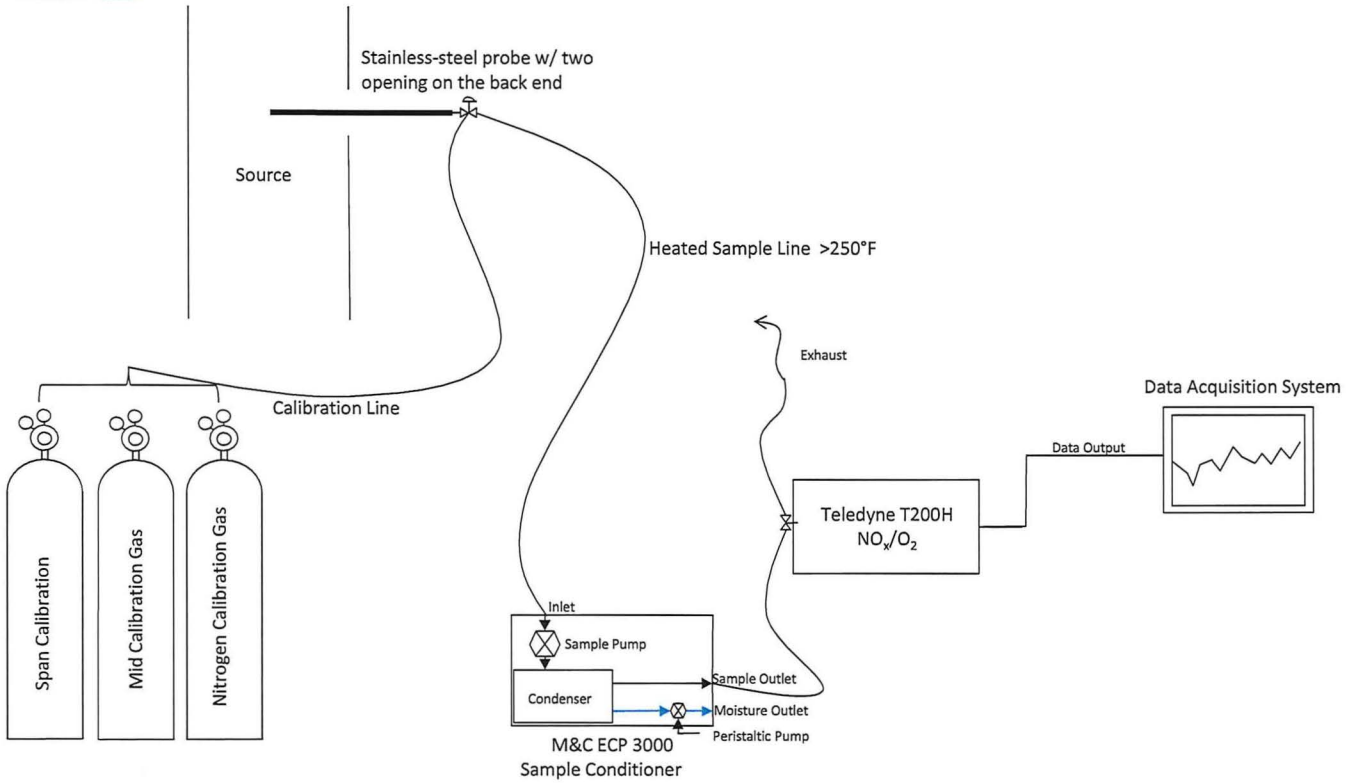
Henry Ford Health System Macomb Hospital

Facility: Henry Ford Health - Macomb
City: Clinton Twp., MI
Source: Boiler 2
Date: 01/10/2023

	Symbol	Units	Test #1	Test #2	Test #3	Average	Limits
Nitrogen Oxides Emission Rate	NO_x	lbs/hr	0.68	0.78	0.75	0.74	1.15
Nitrogen Oxides Concentration	NO_x	ppm	27.1	29.8	29.2	28.7	-

FIGURES

Figure No. #1: USEPA Method 3A, 7E Schematic



USEPA Method 3A,7E

Henry Ford Health System

Macomb Hospital

Clinton Twp., MI

Project# 2205184

Date: January 10, 2023