EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Sebewaing Light and Water (SLW) to complete the source testing program at their Pine Street Power Plant located at Sebewaing, Michigan. SLW operates two (2) engines (referred to as EUGEN2 or Engine 7 and EUGEN1 or Engine 8) that burns natural gas for electrical power generation. This test report covers the retest program on Engine 8 in order to fulfill the requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) Air Permit to Install (PTI) number 146-17A. The previous testing period was completed on July 23rd, 2020. This test included measurements of total oxides of nitrogen (NO_x) on Engine 8. Emissions were calculated while the engine was operated within 10% of 100% peak load (or highest achievable load) combusting natural gas. And lastly, exhaust air flow rate was determined on Engine 8 at the exhaust test ports.

Testing was conducted on May 10, 2021.

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

Summary of Engine#8 Retest Emission Data:

Parameter	Symbol	Units	Average	Corrected to 15% O_2	Limits
Nitrogen Oxides	NO_x	ppmvd	59.0	36.7	82
Oxygen	O_2	$\%_{dry}$	11.3	-	-
Nitrogen Oxides	NO_x	g/HP-hr	0.4	-	0.5

Summary of Engine#8 Retest Exhaust Data and Power Ratings:

Parameter	Units	Average
Stack Gas Temperature	°F	642
Stack Gas Moisture	%	9.9
Velocity	ft/min	98.3
Actual Flowrate	cfm	23,460
Dry Reference Flowrate	dscfm	9,967
Average Horsepower	HP	4,600 (100% of Full Load)

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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by Sebewaing Light and Water (SLW) to complete the source testing program at their Pine Street Power Plant located at Sebewaing, Michigan. SLW operates two (2) engines (referred to as EUGEN2 or Engine 7 and EUGEN1 or Engine 8) that burn natural gas for electrical power generation. This test report covers the retest for Engine 8. The test program was conducted to fulfill the requirements of the Michigan Department of Environment, Great Lakes and Energy (EGLE) Air Permit to Install (PTI) number 146-17A.

A copy of the PTI is provided in **Appendix A** along with the Test Protocol and correspondence from the State of Michigan Department of Environment, Great Lakes and Energy (EGLE). The test program included measurements of total oxides of nitrogen (NO_x) on Engine 8. These emissions were calculated while the engine was operated within 10% of 100% peak load (or highest achievable load) combusting natural gas. Exhaust air flow rate was determined during each test run.

Testing was conducted on May 10, 2021. Results from the sampling program are presented in the **Tables Section** of the report, with more detailed sampling results provided in the **Appendices**.

This stack testing study consisted of the following parameters:

- Velocity, flow rate, and temperature;
- Nitrogen oxides (NO_x);
- Oxygen (O_2); and
- Moisture (%).

This test program is a retest to demonstrate compliance on Engine#8 NOx only, which was last tested during the July 2020 source testing program.

2 SOURCE DESCRIPTION

2.1 Facility Description

SLW- Pine Street Plant is a power generation facility that operates two (2) natural gas fired, four-cycle lean-burn internal combustion reciprocating engines. Both engines are equipped with an oxidation catalyst that controls engine exhaust before venting into the atmosphere.

3 SAMPLING LOCATION

3.1 Sample Location Description

The sampling location is located outside on the roof of the building. Exhaust was analyzed for O_2, NO_x, flow rate, and moisture. 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 Stack Velocity, Temperature, and Volumetric Flow Rate Determination

The exhaust velocities and flow rates were determined following the US EPA Method 2, "Determination of Stack Gas Velocity and Flow Rate (Type S Pitot Tube)". Velocity measurements were taken with a pre-calibrated S-Type pitot tube and incline manometer. Volumetric flow rates were determined following the equal area method as outlined in US EPA Method 1. Temperature measurements were made simultaneously with the velocity measurements and will be conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in US EPA Method 3, "Determination of Molecular Weight of Dry Stack Gas". Stack moisture content was determined using an extractive Fourier Transform Infrared (FTIR) spectroscopy and according to US EPA Method 320, "Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR Spectroscopy)". Moisture was collected at a single point during each test.

4.2 Continuous Emissions Monitoring for O_2 and NO_x

Testing for O_2 and NO_X was accomplished using continuous emission monitors (CEM) and the FTIR. The exhaust gas sample was sampled by drawing a sample stream of flue gases through a stainless-steel probe attached to a heated filter and a heated sample line that is attached to the Automated Sampling Console (ASC-10ST). The ASC-10ST sampling console delivers a continuous sample to the MKS MultiGas 2030 FTIR for analysis. The heated filter and line were maintained at approximately 375°F and the MKS MultiGas 2030 FTIR and MAX Analytical ASC-10ST gas components were at 375°F. The end of the probe was connected to a heated Teflon sample line, which delivers the sample gases from the stack to the FTIR system. The heated sample line is designed to maintain the gas temperature at approximately 375°F in order to prevent condensation of stack gas moisture within the line. The sample was then routed through a manifold system and introduced to the individual CEM's for measurement. As recommended by EGLE, the sample line and heated filter were heated to 375°F.

The ASC-10ST was used to deliver calibration gases (Calibration Transfer Standard (CTS), QA Spike and Nitrogen) to the FTIR in direct (to analyzer) and system (to probe) modes.

A laptop computer was utilized for operating the MKS MultiGas 2030 FTIR and MAX Analytical ASC-10ST sampling console and logging the multi-gas FTIR data. Data was logged as one-minute averages for the actual test period (FTIR PRN files and Spectra). All concentration data were determined using the MKS 2030 MultiGas FTIR software. A typical MKS 2030 FTIR and ASC-10 ST configuration is depicted in **Figure 1**. For oxygen measurement, an EPA Method 3A compliant Brand Gaus Model 4710 wet O_2 analyzer was used. Prior to testing, sample system bias checks and instrument linearity checks (calibration error) were completed in compliance with EPA Method 3A. In addition, the analysers were calibrated (zeroed and span checked) at the completion of each run. A data logger system programmed to collect and record data at 1- second intervals was used to compute and record one-minute average concentrations. The average was drift corrected using pre and post drift checks and changed from wet to dry using stack moisture content.

Figure 1: MKS MultiGas 2030 FTIR and ASC-10ST

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 (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. Pre and post test leak checks were done on the flow system by pressurizing and plugging the positive and negative side of the pitot separately. Daily temperature sensor audits were completed by noting the ambient temperature, as measured by a reference thermometer, and comparing these values to those obtained from the stack sensor.

The FTIR test method follows the US EPA Method 320 test procedures. The primary control check for the FTIR (EPA Method 320) is a Calibration Transfer Standard (CTS) check which was performed before and after each test run.

Initial background spectrum using dry nitrogen gas was obtained per Section 8.5 of EPA Method 320. A CTS was performed pre-test using procedures outlined in Section 8.6.1 of EPA Method 320. A post-test CTS per source was also performed. CTS result averages were measured to be within ±5% of the calibration gas standard.

In addition, a known calibration spike was introduced into the FTIR once per day for the source to confirm the FTIR is working properly and verify the ability to quantify the target analytes in the presence of the stack gas. Three replicate data sets of QA spike were measured during the testing period.

A known calibration spike gas was introduced prior to the first run to measure FTIR analyzer response as part of the quality assurance (QA) spiking procedure. The FTIR analyzer response is required to be between 70% and 130% of the expected value and as such determined to be acceptable (Section 8.6.2 of EPA Method 320 requires the average QA spiked percent recovery to be between 70% and 130%). Results of this procedure is provided in the final test report.

NO_x (mixed with SF_6 as a tracer) was used as the spiked recovery gas for NO_x testing. Also, ethylene was used as the CTS gas.

Finally, the off-site QA/QC included a data review and a data comparison using MKS "Method Analyzer" software. Method validation was conducted for each test run by pulling a random spectrum sample and results have been included in the appendices.

5 RESULTS

The flow and 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
Stack Gas Characteristics	2	B and C
Nitrogen Oxides	1	B
Oxygen	1	B

Field notes are presented in **Appendix D**. All calibration information for the equipment used for the program is included in **Appendix E**. Detailed example calculations for each measured pollutant is provided in **Appendix G**.

5.1 Discussion of Results

The measured concentrations for NO_x were less than the maximum limits outlined in Michigan Department of Environmental Quality (MDEQ) Air Permit to Install (PTI) number 146-17A.

6 OPERATING CONDITIONS

Operating conditions during the sampling were monitored by SLW Operations. SLW Operations recorded the load output (either HP or kW), fuel flow (SCF/hr, if available), engines speed (RPM), catalyst temperature (inlet and outlet, if available) and differential pressure (inches of water) across the catalyst. All process data is provided in **Appendix F**.

Engine torque (%) was not available during the stack test and is not included with the process data.

Radio 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 May 10th of 2021. All sources were tested in accordance with referenced methodologies following the EGLE approved test protocol.

All specified pollutants were quantified using methods set forth 40 CFR 60 Part A and measured concentrations were within compliance limits.