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Appendices

I. INTRODUCTION

Network Environmental, Inc. was retained by the Tilden Mining Company, L.C. of Ishpeming, Michigan (SRN: B4885 - Marquette County) to perform carbon monoxide (CO) emission testing at the Tilden Mine located in National Mine, Michigan.

The purpose of the testing was to conduct CO compliance emission testing on the Gas Fired Boiler 4 (EU-BOILER4). The CO testing was performed in order to meet the requirements of Michigan Department of Environment, Great Lakes & Energy (EGLE), Air Quality Division ROP No. MI-ROP-B4885-2017b. EGLE - Air Quality Division ROP No. MI-ROP-B4885-2017b has established a CO emission limit of 0.0840 Lbs/MMBTU (pounds of CO per million BTU of heat input) for Boiler 4.

The CO testing was conducted at an operating load of approximately 80% of capacity.

The following reference test methods were used to conduct the sampling:

- Carbon Monoxide (CO) – U.S. EPA Method 10
- Oxygen (O_2) & Carbon Dioxide (CO_2) – U.S. EPA Method 3A

The sampling was performed on April 24, 2024 by Stephan K. Byrd, Richard D Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting with the testing were Mr. Thomas O'Brien of the Tilden Mining Company, L.C. and the operating staff of the facility. Mr. Joseph Scanlan of the Michigan Department of Environment, Greats Lakes & Energy (EGLE) – Air Quality Division was present to observe the sampling and source operation.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
CARBON MONOXIDE (CO) EMISSION RESULTS
BOILER 4 (EU-BOILER4)
TILDEN MINING COMPANY, L.C.
NATIONAL MINE, MICHIGAN
APRIL 24, 2024

Sample [1]	Time	CO PPM [1]	% O_2 [2]	CO Lbs/MMBTU [3]
1	08:48-09:48	7.4	4.8	0.0061
2	10:00-11:00	6.8	4.8	0.0056
3	11:13-12:13	6.4	5.0	0.0053
Average		**6.9**	**4.9**	**0.0057**

(1) PPM = Parts Per Million (v/v) On A Dry Basis
(2) % O_2 = Percent Oxygen On A Dry Basis
(3) Lbs/MMBTU = Pounds Of CO Per Million BTU Of Heat Input (Calculated Using Equation 2.1 From U. S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU).
(4) **EGLE - Air Quality Division ROP No. MI-ROP-B4885-2017b has established a CO emission limit of 0.0840 Lbs/MMBTU for Boiler 4.**

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III. DISCUSSION OF RESULTS

III.1 CO Emissions – The CO emissions are summarized in Table 1 (Section II.1) as follows:

- Sample
- Time
- CO Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- O_2 Concentration (%) – Percent On A Dry Basis
- CO Emission Rate (Lbs/MMBTU) – Pounds of CO Per Million BTU of Heat Input (Calculated Using Equation 2.1 From U.S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU)

III.2 Emission Limit – EGLE - Air Quality Division ROP No. MI-ROP-B4885-2017b has established a CO emission limit of 0.0840 Lbs/MMBTU (pounds of CO per million BTU of heat input) for Boiler 4.

IV. SOURCE DESCRIPTION

Boiler 4 is a natural gas-fired boiler with a rated capacity of 300 MMBTU/Hr of heat input. The boiler is equipped with low NO_x burners. Boiler 4 is used to provide process steam to the facility. During the CO testing periods, the boiler was operated at approximately 80% of capacity. Steam Load and Gas Flow data during the sampling can be found in Appendix B.

The boiler is exhausted to a stack through a four (4) foot by eight (8) foot breaching. A schematic diagram of the source and sampling location can be found in Appendix E.

V. SAMPLING AND ANALYTICAL PROTOCOL

The sampling methods used for the reference method determinations were as follows:

V.1 Carbon Monoxide – The CO sampling was conducted in accordance with U.S. EPA Reference Method

10. A Thermo Environmental Model 48C gas analyzer was used to monitor the boiler exhaust. A heated probe was used to extract the sample gases from the exhaust stack. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the CO concentrations (PPM). Three (3) samples, each sixty (60) minutes in duration, were collected from the boiler exhaust.

The analyzer was calibrated by direct injection prior to the testing. A span gas of 92.9 PPM was used to establish the initial instrument calibration. A calibration gas of 51.1 PPM was used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 51.1 PPM gas to determine the system bias. After each sample, a system zero and system injection of 51.1 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. A diagram of the CO sampling train is shown in Figure 1

V.2 Oxygen & Carbon Dioxide – The O_2 & CO_2 sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the boiler exhaust. A heated probe was used to extract the sample gas from the stack. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzers produce instantaneous readouts of the O_2 & CO_2 concentrations (%). Three (3) samples, each sixty (60) minutes in duration, were collected from the boiler exhaust.

The analyzer was calibrated by direct injection prior to the testing. Span gases of 21.0% O_2 and 21.05% CO_2 were used to establish the initial instrument calibrations. Calibration gases of 11.8% O_2 / 5.94% CO_2 and 6.05% O_2 / 11.7% CO_2 were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzer) was injected using the 6.05% O_2 / 11.7% CO_2 gas to determine the system bias. After each sample, a system zero and system injection of 6.05% O_2 / 11.7% CO_2 were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.
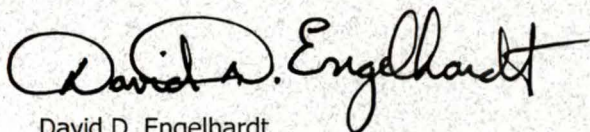
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The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. A diagram of the O_2 and CO_2 sampling train is shown in Figure 1.

V.3 Sampling Locations – Prior to the CO sampling (05/2019), a twenty-four (24) point stratification test (as described in U.S. EPA Method 7E) was performed for the exhaust breaching. The breaching is 48 inches deep by 96 inches high with 4 sampling ports. The dimensions used for the stratification test were as follows:

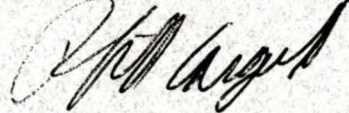| Traverse Point	Dimension (Inches)
1	4.00
2	12.00
3	20.00
4	28.00
5	36.00
6	44.00

The stratification test showed no stratification (< 5%), so a single sampling point (Port 3 - Point 3) was used for the gas sampling. The results of the stratification test can be found in Appendix A.

This report was prepared by:

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Vice President

This report was reviewed by:
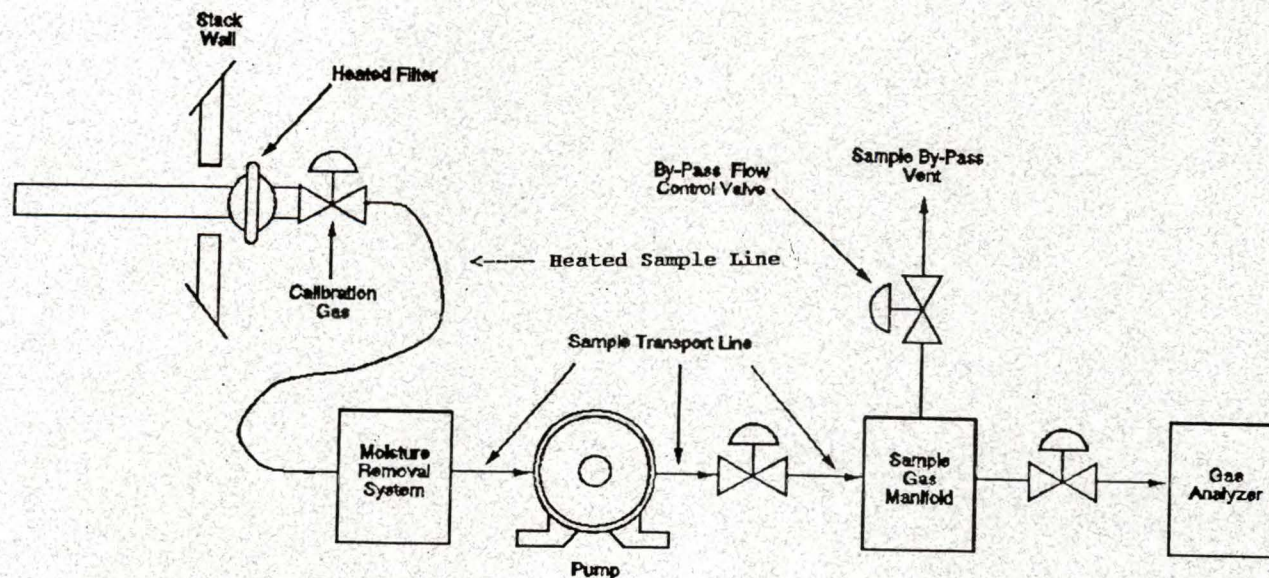
R. Scott Cargill
Project Manager

Figure 1.

CO, O_2 & CO_2
Sampling Train