PREFACE

I, Karl Mast, do hereby certify that the source emissions testing conducted at TC Energy in Mancelona, Michigan was performed in accordance with the procedures set forth by the United States Environmental Protection Agency, and that the data and results submitted within this report are an exact representation of the testing.

Karl Mast
Test Supervisor

I, Karl Mast, do hereby attest that all work on this project was performed under my direct supervision, and that this report accurately and authentically presents the source emissions testing conducted at ANR's Blue Lake Compressor Station in Mancelona, Michigan.

Karl Mast
Test Supervisor

SUMMARY

The compliance emissions testing was performed on Generator Engines EGBLGEN-A (A), EGBLGEN-B (B), and EGBLGEN-C (C), in fulfillment of Michigan Department of Environmental Quality, Air Quality Division, permit no. MI-ROP-B7198-2014a. The testing was performed utilizing USEPA Methods 1, 3A, 7E, 10, 18, 19 and 25A at the Exhaust Stack sampling locations. The results of the testing are detailed in the following tables.

Engine A Emission Test Results Lb/Hour			
Run No.	CO Emissions (lb/hr)	NOx Emissions (lb/hr)	VOC Emissions (lb/hr)
1	0.0912	2.0149	0.000
2	0.0948	2.0999	0.000
3	0.0991	1.9841	0.000
Average	0.0950	2.0330	0.000
Emission Limit	1.6	5.7	0.9

Engine A Emission Test Results G/BHP/Hour as Propane			
Run No.	CO Emissions (g/bhp/hr)	NOx Emissions (g/bhp/hr)	VOC Emissions (g/bhp/hr)
1	0.0568	1.2557	0.000
2	0.0579	1.2839	0.000
3	0.0604	1.2092	0.000
Average	0.0584	1.2496	0.000
Emission Limit	1.4	2.0	0.55

Engine B Emission Test Results Lb/Hour			
Run No.	CO Emissions (lb/hr)	NOx Emissions (lb/hr)	VOC Emissions (lb/hr)
1	0.1155	0.4422	0.000
2	0.1148	0.3701	0.000
3	0.1157	0.4109	0.000
Average	0.1153	0.4077	0.000
Emission Limit	1.6	5.70	0.9

Engine B Emission Test Results G/BHP/Hour as Propane			
Run No.	CO Emissions (g/bhp/hr)	NOx Emissions (g/bhp/hr)	VOC Emissions (g/bhp/hr)
1	0.0702	0.2688	0.000
2	0.0705	0.2273	0.000
3	0.0707	0.2511	0.000
Average	0.0705	0.2491	0.000
Emission Limit	1.4	2.0	0.55

Engine C Emission Test Results Lb/Hour			
Run No.	CO Emissions (lb/hr)	NOx Emissions (lb/hr)	VOC Emissions (lb/hr)
1	0.0790	0.8560	0.1536
2	0.0842	0.8630	0.2247
3	0.0911	0.8432	0.2137
Average	0.0847	0.8541	0.1974
Emission Limit	1.6	5.7	0.9

Engine C Emission Test Results G/BHP/Hour as Propane			
Run No.	CO Emissions (g/bhp/hr)	NOx Emissions (g/bhp/hr)	VOC Emissions (g/bhp/hr)
1	0.0485	0.5262	0.0944
2	0.0518	0.5315	0.1384
3	0.0565	0.5231	0.1326
Average	0.0523	0.5269	0.1218
Emission Limit	1.4	2.0	0.55

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A – Field Test Data
B – Process Operating Data
C – Gas Certifications
D – Sample Calculations
E – Correspondence

1. INTRODUCTION

This report presents the results of the source emissions testing conducted by Environmental Quality Management, Inc. (EQM) for TC Energy's ANR (ANR) Blue Lake Compressor Station, near Mancelona, MI in fulfillment of Michigan Department of Environmental Quality, Air Quality Division, permit no. MI-ROP-B7198-2014a, the testing was performed utilizing USEPA Methods 1, 3A, 7E 18, 19 and 25A at the Exhaust Stack sampling location.

To ensure that compliance with the emission limits is maintained, TC Energy's ANR Pipeline Company contracted Environmental Quality Management, Inc. (EQM) to perform source emissions testing on Generator Engines A and B. The primary purpose of this testing program was to conduct emissions testing of the internal combustion reciprocating Engines A, B, and C with each having an emission limit of 5.7 lbs/hr or 2.0 g/bhp/hr of NO_x, 1.6 lbs/hr or 1.4 g/bhp/hr of CO, and 0.9lbs/hr or 0.55 g/bhp/hr of VOC .

EQM's responsibility was to conduct the compliance testing for the CO, NOx and VOC emissions rates and perform data reduction for conformance evaluation. ANR's responsibility was to maintain process operating parameters and to assist in providing process operating data per compliance test requirements.

The following report provides information pertaining to TC Energy's process operations, and Compliance testing. The Compliance testing conducted on Generator Engine C was performed on November 24, 2020, from 9:50 A.M. to 1:29 P.M. The Compliance testing conducted on Generator Engine B was performed on November 24, 2020, from 2:40 P.M. to 5:57 P.M The Compliance testing conducted on the Generator Engine A was performed on November 25, 2020, from 9:30 A.M. to 1:29 P.M.

The following requirements were specific for the testing program:

1. Equipment calibrations performed and calibration data provided.
2. Three (3) one (1) -hour, minimum, NOx, and O_2 test runs performed at the Engines A, B, and C pursuant to EPA Reference methods as described in 40 CFR, Part 60, Appendix A.
3. Three (3) one (1) -hour, minimum, CO test runs performed at the Engines A, B, and C pursuant to EPA Reference methods as described in 40 CFR, Part 60, Appendix A.
4. Three (3) one (1) -hour, minimum, VOC test runs performed at the A, B, and C pursuant to EPA Reference methods as described in 40 CFR, Part 60, Appendix A.
5. Process manufacturing operations maintained at 100% of capacities and

production and fuel consumption rates recorded during the emissions testing periods.

6. All testing and analyses performed in accordance with current EPA test methodologies and analytical procedures for CO, NOx, O_2 and VOC, emissions determinations.

The testing program was approved by and/or coordinated with Tyrah Lydia, TC Energy's ANR Pipeline Company. The emission testing was managed by Karl Mast, Manager Air Emissions Measurement. The testing was conducted by Zach Hill, Field Activities Lead, EQM, and Kameron King, Test Technician, EQM. The emission testing was observed by Jeremy Howe and Becky Radulski, MEGLE.

2. TEST RESULTS SUMMARY

The compliance testing was performed on Generator Engines A and B in fulfillment of Michigan Department of Environmental Quality, Air Quality Division, permit no. MI-ROP-B7198-2014a. A summary of the test results is given below:

Table 1. Engine A Emission Test Results Lb/Hr			
Run No.	CO Emissions (lb/hr)	NOx Emissions (lb/hr)	VOC Emissions (lb/hr)
1	0.0912	2.0149	0.000
2	0.0948	2.0999	0.000
3	0.0991	1.9841	0.000
Average	0.0950	2.0330	0.000
Emission Limit	1.6	5.70	0.9

Table 2. Engine A Emission Test Results-G/Bhp/Hr			
Run No.	CO Emissions (g/bhp/hr)	NOx Emissions (g/bhp/hr)	VOC Emissions (g/bhp/hr)
1	0.0568	1.2557	0.000
2	0.0579	1.2839	0.000
3	0.0604	1.2092	0.000
Average	0.0584	1.2496	0.000
Emission Limit	1.4	2.0	0.55

Table 3. Engine B Emission Test Results Lb/Hr			
Run No.	CO Emissions (lb/hr)	NOx Emissions (lb/hr)	VOC Emissions (lb/hr)
1	0.1155	0.4422	0.000
2	0.1148	0.3701	0.000
3	0.1157	0.4109	0.000
Average	0.1153	0.4077	0.000
Emission Limit	1.6	5.70	0.9

Table 4. Engine B Emission Test Results-G/Bhp/Hr			
Run No.	CO Emissions (g/bhp/hr)	NOx Emissions (g/bhp/hr)	VOC Emissions (g/bhp/hr)
1	0.0702	0.2688	0.000
2	0.0705	0.2273	0.000
3	0.0707	0.2511	0.000
Average	0.0705	0.2491	0.000
Emission Limit	1.4	2.0	0.55

Table 5. Engine C Emission Test Results Lb/Hr			
Run No.	CO Emissions (lb/hr)	NOx Emissions (lb/hr)	VOC Emissions (lb/hr)
1	0.0790	0.8560	0.1536
2	0.0842	0.8630	0.2247
3	0.0911	0.8432	0.2137
Average	0.0847	0.8541	0.1974
Emission Limit	1.6	5.70	0.9

Table 6. Engine C Emission Test Results-G/Bhp/Hr			
Run No.	CO Emissions (g/bhp/hr)	NOx Emissions (g/bhp/hr)	VOC Emissions (g/bhp/hr)
1	0.0485	0.5262	0.0944
2	0.0518	0.5315	0.1384
3	0.0565	0.5231	0.1326
Average	0.0523	0.5269	0.1218
Emission Limit	1.4	2.0	0.55

Based on the information provided above, the Engines A, B and C met the acceptance criteria during the course of the testing. A complete list of performance parameters for each test run that was performed at the stack sampling locations can be found in Tables 7-15.

Table 7. Engine Operating & Ambient Conditions-Engine A

Run	1	2	3	AVERAGES
Date	11/25/20	11/25/20	11/25/20	
Time	9:50-10:49	11:10-12:09	12:30-13:29	
Condition	High A3	High A3	High A3	
Engine Operating Conditions				
Kilowatts	542.75	553.25	555.00	550.3
Unit Horsepower from Control Panel	727.8	741.9	744.3	738.0
Unit Speed	1,200.0	1,200.0	1,200.0	1,200.0
% Load	63.3	64.5	64.7	64.2
% Torque	63.3	64.5	64.7	64.2
Heat Rate (BTU/HP-hr)	8,645.917	8,704.140	7,389.570	8,246.542
Heat Rate (KJ/Watt-Hr)	12.228	12.310	10.451	11.663
Ambient Conditions				
Ambient Temperature (°F)	37.00	38.00	39.00	38.00
Barometric Pressure ("Hg)	29.48	29.47	29.46	29.47
Ambient Relative Humidity (%)	89.00	86.00	89.00	88.00

Table 8. Emissions Concentrations/Calculated Mass Emissions -Engine A

Run	1	2	3	AVERAGES
Date	11/25/20	11/25/20	11/25/20	
Time	9:50-10:49	11:10-12:09	12:30-13:29	
Condition	High A3	High A3	High A3	
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	172.14	175.36	164.21	170.57
NO_X g/BHP-HR	1.2557	1.2839	1.2092	1.2496
NO_X LB/HR	2.0149	2.0999	1.9841	2.0330
NO_X (ppm @ 15% O_2)	78.6088	79.8321	74.8716	77.7709
Nox Tons/Year	8.8254	9.1977	8.6904	8.9045
Nox lbs/scf fuel	2.9340E-04	2.9797E-04	2.7945E-04	2.9027E-04
NOx LB/MMBTU	2.8920E-01	2.9370E-01	2.7545E-01	2.8611E-01
CO ppm (BIAS Corrected) Outlet	12.80	13.00	13.47	13.09
CO g/BHP-HR	0.0568	0.0579	0.0604	0.0584
CO LB/HR	0.0912	0.0948	0.0991	0.0950
CO LB/MMBTU **	1.3090E-02	1.3253E-02	1.3754E-02	1.3366E-02
CO (ppm @ 15% O_2)	5.8452	5.9182	6.1417	5.9684
Post-Catalyst Emissions Concentrations				
Non-Methane/Non-Ethane VOCs ppmvd (As Propane)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VOC LB/HR (As Propane) ** - Using Method 25A Measured THC	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VOC g/BHP-hr (As Propane) ** - Using Method 25A Measured THC	0.00E+00	0.00E+00	0.00E+00	0.00E+00
% O_2 (BIAS Corrected)	7.98	7.94	7.96	7.96
Calculated Emissions Concentrations				
% H_2O	16.88	16.4700	14.5400	15.9633
Calculated Flows				
Fuel Flow - (SCFM)	114.4583	117.4583	118.3333	116.7500
Fuel Flow - (SCFH)	6,867.5000	7,047.5000	7,100.0000	7,005.0000
Fuel Flow (LB/HR)	305.3508	313.3541	315.6884	311.4644
Exhaust Flow (LB/HR)	7,014.3993	7,179.6806	7,247.8206	7,147.3001
Exhaust Flow (WSCFM)	2,384.3138	2,446.8076	2,465.0350	2,432.0521
Exhaust Flow (DSCFM)	1,633.8943	1,671.5443	1,686.5992	1,664.0126
Exhaust Gas Volume (ACFM)	5,077.9286	5,241.4549	5,294.3295	5,204.5710
Air Flow (WSCFM)	1,579.9646	1,616.3898	1,630.9389	1,609.0978
BSAC, #/BHP-hr	9.8932	9.9292	9.9870	9.9365
Fuel Flow Measurements				
Fuel Flow (SCFH)	6867.50	7047.50	7100.00	7005.00
** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION				
* BASED ON CARBON BALANCE (STOICH. + O2)				
- A/F IS TOTAL MASS RATIO				

Table 9. Engine Operating & Ambient Conditions-Engine B

Run	1	2	3	AVERAGES
Date	11/24/20	11/24/20	11/24/20	
Time	14:40-15:39	15:48-16:47	16:58-17:57	
Condition	High B2	High B2	High B2	
Engine Operating Conditions				
Kilowatts	556.5	550.75	553.50	553.6
Unit Horsepower from Control Panel	746.3	738.6	742.3	742.4
% Load	64.9	64.2	64.5	64.6
Heat Rate (BTU/HP-hr)	8,926.5	9,146.9	7,389.6	8,487.6
Heat Rate (KJ/Watt-Hr)	12.625	12.936	10.451	12.0
Ambient Conditions				
Ambient Temperature (°F)	32.00	32.00	32.00	32.00
Barometric Pressure ("Hg)	29.46	29.45	29.45	29.45
Ambient Relative Humidity (%)	85.00	88.00	85.00	86.00

Table 10. Emissions Concentrations/Calculated Mass Emissions -Engine B

Run	1	2	3	AVERAGES
Date	11/24/20	11/24/20	11/24/20	
Time	14:40-15:39	15:48-16:47	16:58-17:57	
Condition	High B2	High B2	High B2	
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	34.17	28.30	30.31	30.93
NO_X g/BHP-HR	0.2832	0.2408	0.2612	0.2617
NO_X LB/HR	0.4660	0.3920	0.4275	0.4285
NO_X (ppm @ 15% O_2)	17.1723	14.2466	15.2715	15.5635
Nox Tons/Year	2.0409	1.7171	1.8724	1.8768
Nox lbs/scf fuel	6.4094E-05	5.3174E-05	5.7000E-05	5.8089E-05
NOx LB/MMBTU	6.3176E-02	5.2412E-02	5.6183E-02	5.7257E-02
CO ppm (BIAS Corrected) Outlet	13.92	13.61	13.48	13.67
CO g/BHP-HR	0.0702	0.0705	0.0707	0.0705
CO LB/HR	0.1155	0.1148	0.1157	0.1153
CO LB/MMBTU **	1.5666E-02	1.5343E-02	1.5210E-02	1.5406E-02
CO (ppm @ 15% O_2)	6.9956	6.8515	6.7918	6.8796
Post-Catalyst Emissions Concentrations				
Non-Methane/Non-Ethane VOCs ppmvd (As Propane)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VOC LB/HR (As Propane) ** - Using Method 25A Measured THC	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VOC g/BHP-hr (As Propane) ** - Using Method 25A Measured THC	0.00E+00	0.00E+00	0.00E+00	0.00E+00
% O_2 (BIAS Corrected)	9.16	9.18	9.19	9.18
Calculated Emissions Concentrations				
% H_2O	15.5400	14.6200	15.0600	
Calculated Flows				
Fuel Flow - (SCFM)	121.1667	122.8750	125.0000	123.0139
Fuel Flow - (SCFH)	7,270.0000	7,372.5000	7,500.0000	7,380.8333
Fuel Flow (LB/HR)	323.2472	327.8046	333.4737	328.1752
Exhaust Flow (LB/HR)	8,063.5584	8,203.4788	8,345.4419	8,204.1597
Exhaust Flow (WSCFM)	2,524.0570	2,559.6437	2,603.9102	2,562.5370
Exhaust Flow (DSCFM)	1,903.5054	1,933.6371	1,968.7573	1,935.2999
Exhaust Gas Volume (ACFM)	5,379.1923	5,486.8917	5,594.5006	5,486.8616
Air Flow (WSCFM)	1,840.0073	1,869.1211	1,903.0629	1,870.7304
BSAC, #/BHP-hr	11.2369	11.5338	11.6849	11.4852
Fuel Flow Measurements				
Fuel Flow (SCFH)	7270.00	7372.50	7500.00	7380.83
** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION				
* BASED ON CARBON BALANCE (STOICH. + O2)				
- A/F IS TOTAL MASS RATIO				

Table 11. Engine Operating & Ambient Conditions-Engine C

Run	1	2	3	AVERAGES
Date	11/24/20	11/24/20	11/24/20	
Time	9:30-10:29	10:45-11:44	12:08-13:07	
Condition	High C1	High C1	High C1	
Engine Operating Conditions				
Kilowatts	550.25	549.25	545.25	
Unit Horsepower from Control Panel	737.9	736.6	731.2	735.2
% Load	64.2	64.0	63.6	63.9
Heat Rate (BTU/HP-hr)	7,494.3	7,660.3	7,389.6	7,514.7
Heat Rate (KJ/Watt-Hr)	10.599	10.834	10.451	10.6
Ambient Conditions				
Ambient Temperature (°F)	29.00	34.00	32.00	31.67
Barometric Pressure ("Hg)	29.47	29.46	29.45	29.46
Ambient Relative Humidity (%)	20.00	64.00	69.00	51.00

Table 12. Emissions Concentrations/Calculated Mass Emissions -Engine C

Run	1	2	3	AVERAGES
Date	11/24/20	11/24/20	11/24/20	
Time	9:30-10:29	10:45-11:44	12:08-13:07	
Condition	High C1	High C1	High C1	
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	78.39	78.04	79.25	78.56
NO_X g/BHP-HR	0.5262	0.5404	0.5431	0.5366
NO_X LB/HR	0.8560	0.8774	0.8755	0.8697
NO_X (ppm @ 15% O_2)	38.0034	38.1788	38.8029	38.3283
Nox Tons/Year	3.7494	3.8432	3.8347	3.8091
Nox lbs/scf fuel	1.4184E-04	1.4250E-04	1.4483E-04	1.4306E-04
NOx LB/MMBTU	1.3981E-01	1.4046E-01	1.4275E-01	1.4101E-01
CO ppm (BIAS Corrected) Outlet	11.88	12.30	13.54	12.57
CO g/BHP-HR	0.0485	0.0518	0.0565	0.0523
CO LB/HR	0.0790	0.0842	0.0911	0.0847
CO LB/MMBTU **	1.2898E-02	1.3475E-02	1.4846E-02	1.3740E-02
CO (ppm @ 15% O_2)	5.76	6.02	6.63	6.14
Post-Catalyst Emissions Concentrations				
Non-Methane/Non-Ethane VOCs ppmvd (As Propane)	14.6490	20.8124	20.1467	18.5361
VOC LB/HR (As Propane) ** - Using Method 25A Measured THC	1.536E-01	2.247E-01	2.137E-01	1.974E-01
VOC g/BHP-hr (As Propane) ** - Using Method 25A Measured THC	9.444E-02	1.384E-01	1.326E-01	1.218E-01
% O_2 (BIAS Corrected)	8.73	8.84	8.85	8.81
Calculated Emissions Concentrations				
% H_2O	15.9900	16.3000	16.3800	16.2233
Calculated Flows				
Fuel Flow - (SCFM)	100.5833	102.6250	100.7500	101.3194
Fuel Flow - (SCFH)	6035.0000	6157.5000	6045.0000	6079.1667
Fuel Flow (LB/HR)	268.3352	273.7819	268.7798	270.2990
Exhaust Flow (LB/HR)	6390.7917	6645.6141	6536.5881	6524.3313
Exhaust Flow (WSCFM)	2095.2797	2137.8103	2098.7516	2110.6139
Exhaust Flow (DSCFM)	1524.3142	1569.4407	1542.0451	1545.2667
Exhaust Gas Volume (ACFM)	4463.8803	4581.0875	4509.1675	4518.0451
Air Flow (WSCFM)	1473.6738	1517.2478	1490.7584	1493.8933
BSAC, #/BHP-hr	9.1019	9.3881	9.2919	9.2606
Fuel Flow Measurements				
Fuel Flow (SCFH)	6035.00	6157.50	6045.00	6079.17
** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION				
* BASED ON CARBON BALANCE (STOICH. + O2)				
- A/F IS TOTAL MASS RATIO				

3. FACILITY AND PROCESS DESCRIPTION

TC Energy's ANR Blue Lake Compressor Station is located in Maneclona, MI and operates a natural gas fired compressor station. The plant is located at 10000 Pflum Road, Mancelona, MI, which is located in Antrim County.

The Generator Engines A, B, and C are all Caterpillar G-3516 generator engines used to satisfy the electrical needs at the station. The Caterpillar G-3516 is a four-stroke lean-burn natural gas fired internal combustion reciprocating engine driving gas compressors. The energy released during the combustion process drives integral reciprocating gas compressors, thus raising the pressure of the incoming natural gas to inject or withdraw natural gas from a natural gas storage field.

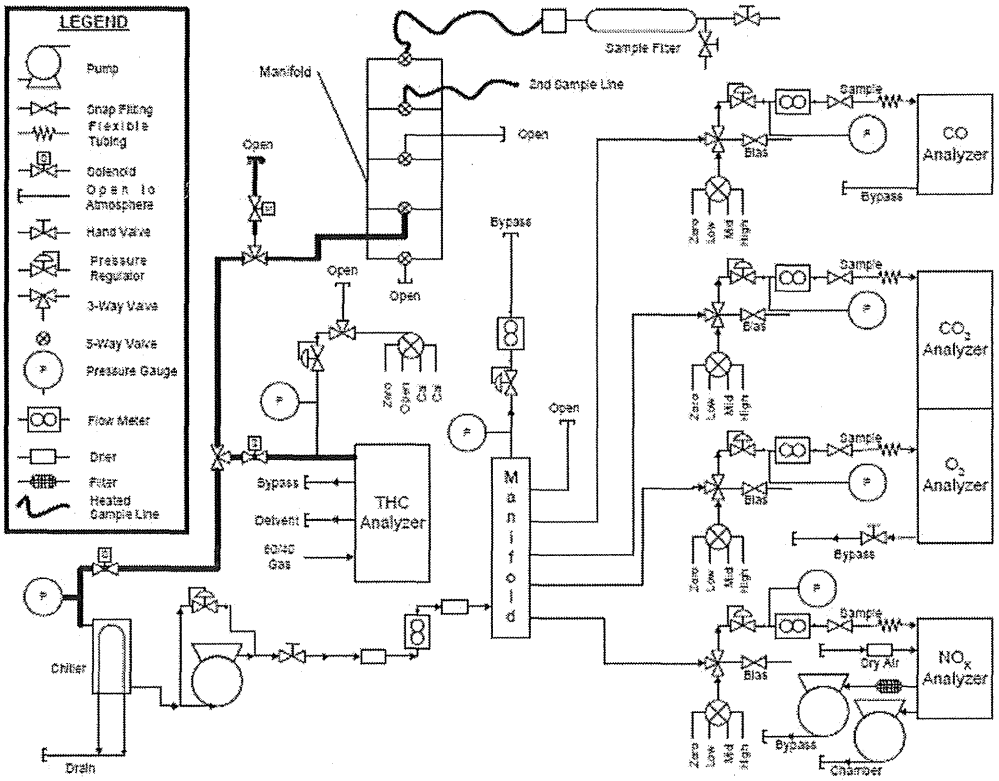
The following tables provide a summary of the production rates for the Engines A thru C during the tests:

Table 13. Engine A Production Data (HP)	
Run No.	Horsepower
1	727.8
2	741.9
3	744.3
Average	738.0

Table 14. Engine B Production Data (HP)	
Run No.	Horsepower
1	746.3
2	738.6
3	742.3
Average	742.4

Table 15. Engine C Production Data (HP)	
Run No.	Horsepower
1	737.9
2	736.6
3	731.2
Average	735.2

Figure 1. Engines A. B. and C-Flow Schematic



4. TEST PROCEDURES

EQM and EQM's affiliates and subcontractors use current U.S. EPA accepted testing methodologies in their Air Quality Programs as listed in the U.S. Code of Federal Regulations, Title 40, Part 60, Appendix A. For this testing program, the following specific methodologies were utilized:

- U.S. EPA Method 3A – Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)
- U.S. EPA Method 4 – Determination of Moistures From Stationary Sources (hot and wet oxygen monitor Instrumental Analyzer Procedure)
- U.S. EPA Method 7E – Determination of Nitrogen Oxides Emissions From Stationary Sources (Instrumental Analyzer Procedure)
- U.S. EPA Method 10 – Determination of Carbon Monoxide Emissions From Stationary Sources (Instrumental Analyzer Procedure)
- U.S. EPA Method 18 – Determination of VOC Emissions From Stationary Sources (Instrumental Analyzer Procedure)
- U.S. EPA Method 25A – Determination of VOC Emissions From Stationary Sources (Instrumental Analyzer Procedure)

USEPA Methods 3A, 4, 7E, 10, 18 and 25A were performed at the Exhaust Stack sampling location by continuously extracting a gas sample from the stack through a single point stainless steel sample probe. The extracted sample was pulled through a series of filters to remove any particulate matter. Directly after the probe, the sample was conditioned by a series of refrigeration dryers to remove moisture from the gas stream. After the refrigeration dryers, the sample was transported through a Teflon® line to the analyzers. The flow of the stack gas sample was regulated at a constant rate to minimize drift.

At the start of the day, each monitor was checked for calibration error by introducing zero, mid-range and high-range EPA Protocol 1 gases to the measurement system at a point upstream of the analyzers. In this report, the calibration error test is referred to as instrument calibration. The gas was injected into the sampling valve located at the outlet of the sampling probe. The bias test was conducted before and after each consecutive test run by introducing zero and upscale calibration gases for each monitor. The upscale calibration gases used for each monitor were the high calibration gases.

Measurement System Performance Specifications were as follows:

- Analyzer Calibration Error - Less than +/- 2% of the span of the zero, mid-range and high-range calibration gases.
- Sampling System Bias - Less than +/-5% of the span for the zero, mid-range and high-range calibration gases.

- Zero Drift - Less than +/-3% of the span over the period of each test run.
- Calibration Drift - Less than +/-3% of the span over the period of each set of runs.

Calculations that were used in this testing event for the Engines A, B, and C are as follows:

Calibration Correction

$$C_{GAS} = (C_R - C_O)\frac{C_{MA}}{C_M - C_O}$$

Where:

C_{GAS}:	Corrected flue gas concentration (ppmvd)
C_R:	Flue gas concentration (ppmvd)
C_O:	Average of initial and final zero checks (ppmvd)
C_M:	Average of initial and final span checks (ppmvd)
C_{MA}:	Actual concentration of span gas (ppmvd)

EPA F-Factor

$$F_d = \frac{\left[(3.64 \cdot H_{Wt\%} \cdot 100) + (1.53 \cdot C_{Wt\%} \cdot 100)\right]}{\frac{GCV}{\rho_{FuelGas}}} \cdot 10^6 + \frac{\left[(0.14 \cdot N_{2Wt\%} \cdot 100) - (0.46 \cdot O_{2Wt\%} \cdot 100)\right]}{\frac{GCV}{\rho_{FuelGas}}} \cdot 10^6$$

Where:

F_d:	Fuel specific F-factor, dscf/MMBtu
$H_{Wt\%}$:	Hydrogen weight percent
$C_{Wt\%}$:	Carbon weight percent
$N_{2Wt\%}$:	Nitrogen weight percent
$O_{2Wt\%}$:	Oxygen weight percent
GCV:	Heating value of the fuel, BTU/dscf
$\rho_{Fuel\ Gas}$:	Density of the fuel gas, lb/scf

NOx Mass Emissions Calculations g/bhr/hr

$$NOx_{\frac{g}{bhp\text{-}hr}} = C_d \times F_d \times \frac{20.9}{20.9 - \%O_2} \times Q_h \times \frac{GCV}{10^6} \times \frac{4536}{Bhp}$$

Where:

C_d:	Pollutant concentration, lb/scf
F_d:	Fuel specific F-factor, dscf/MMBtu
Q_h:	Fuel flow, scf/hr
$\%O_2$:	Oxygen concentration in percent, measured on a dry basis
GCV:	Upper dry heating value of fuel, Btu/dscf

NOx Mass Emission Calculations lb/hr

$$NOx_{\frac{lb}{hr}} = C_d \times F_d \times \frac{20.9}{20.9 - \%O_2} \times Q_h \times \frac{GCV}{10^6}$$

Where:

C_d:	Pollutant concentration, lb/scf
F_d:	Fuel specific F-factor, dscf/MMBtu
Q_h:	Fuel flow, scf/hr
$\%O_2$:	Oxygen concentration in percent, measured on a dry basis
GCV:	Upper dry heating value of fuel, Btu/dscf

NO_x Corrected to 15% O_2

$$Em = NO_X \left(\frac{5.9}{20.9 - \%O_2} \right)$$

Where:

E_m: Pollutant concentration corrected to 15% O_2, ppm
NO_X: Pollutant concentration, ppm
$\%O_2$: Oxygen concentration in percent, measured on a dry basis

NO Interference Response

$$INO = \left[\left(\frac{R_{NO-NO2}}{C_{NO2G}} \times \frac{C_{NO2S}}{C_{NOxS}}\right)\right] \times 100$$

Where:

I_{NO}: NO interference response (%)
R_{NO-NO2}: NO response to NO2 span gas (ppm NO)
C_{NO2G}: Concentration of NO_2 span gas (ppm NO2)
C_{NO2S}: Concentration of NO_2 in stack gas (ppm NO_2)
C_{NOxS}: Concentration of NO_x in stack gas (ppm NO_x)

CO Mass Emissions Calculations lb/hr

$$CO_{\frac{g}{bhp-hr}} = C_d \times F_d \times \frac{20.9}{20.9 - \%O_2} \times Q_h \times \frac{GCV}{10^6}$$

Where:

C_d: Pollutant concentration, lb/scf
F_d: Fuel specific F-factor, dscf/MMBtu
Q_h: Fuel flow, scf/hr
$\%O_2$: Oxygen concentration in percent, measured on a dry basis
GCV: Upper dry heating value of fuel, Btu/dscf

CO Mass Emissions Calculations g/bhp/hr

$$CO_{\frac{g}{bhp-hr}} = C_d \times F_d \times \frac{20.9}{20.9 - \%O_2} \times Q_h \times \frac{GCV}{10^6} \times \frac{453.6}{BHP}$$

Where:

C_d:	Pollutant concentration, lb/scf
F_d:	Fuel specific F-factor, dscf/MMBtu
Q_h:	Fuel flow, scf/hr
$\%O_2$:	Oxygen concentration in percent, measured on a dry basis
GCV:	Upper dry heating value of fuel, Btu/dscf

VOC ppm

$$VOC_{ppmvd} = \frac{THC_{ppmvw} - \frac{1}{3}CH_{4\,ppmvd} - \frac{2}{3}C_2H_{6\,ppmvd}}{1 - \left(\frac{\%H_2O}{100}\right)}$$

Where:

C_d:	Pollutant concentration, lb/scf
F_d:	Fuel specific F-factor, dscf/MMBtu
Q_h:	Fuel flow, scf/hr
$\%O_2$:	Oxygen concentration in percent, measured on a dry basis
GCV:	Upper dry heating value of fuel, Btu/dscf

VOC Mass Emissions Calculations lb/hr

$$VOC_{\frac{g}{bhp-hr}} = C_d \times F_d \times \frac{20.9}{20.9 - \%O_2} \times Q_h \times \frac{GCV}{10^6}$$

Where:

C_d:	Pollutant concentration, lb/scf
F_d:	Fuel specific F-factor, dscf/MMBtu
Q_h:	Fuel flow, scf/hr
$\%O_2$:	Oxygen concentration in percent, measured on a dry basis
GCV:	Upper dry heating value of fuel, Btu/dscf

Where VOC measurement registered as a negative emission, it was reported as a zero. This was the case for Units A and B during the testing event.

5. QUALITY ASSURANCE PROCEDURES

Each reference method presented in the U.S. Code of Federal Regulations details the instrument calibration requirements, sample recovery and analysis, data reduction and verification, types of equipment required, and the appropriate sampling and analytical procedures to ensure maximum performance and accuracy. EQM and EQM's affiliates and subcontractors adhere to the guidelines for quality control set forth by the United States Environmental Protection Agency. These procedures are outlined in the following documents:

- Code of Federal Regulations, Title 40, Part 51
- Code of Federal Regulations, Title 40, Part 60
- Quality Assurance Handbook, Volume 1, EPA 600/9-76-005
- Quality Assurance Handbook, Volume 2, EPA 600/4-77-027a
- Quality Assurance Handbook, Volume 3, EPA 600/4-77-027b

6. CONCLUSIONS

An Emissions Test was conducted on the internal combustion reciprocating Engines A, B, and C at TC energy's ANR Pipeline Company's Blue Lake Compressor Station located in Mancelona, Michigan. The testing was conducted on November 24-25, 2020.

During the course of the testing, the Engines A, B, and C conformed to the requirements of Code of Federal Regulations, Title 40, Part 60, Appendix A, National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

The usefulness and/or significance of the emissions values presented in this document as they relate to the compliance status of the Engines A, B, and C emissions shall be determined by others.

For additional information pertaining to the testing program see Appendix E of this report.