PREFACE

I, Karl Mast, do hereby certify that the source emissions testing conducted at TC Energy in Bridgman, MI 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 Pipeline's Bridgman Compressor Station in Bridgman, MI.

Karl Mast
Test Supervisor

SUMMARY

The compliance testing was performed on the Waukesha L36GL natural gas fired Generator labeled EUBG015 (Unit 15), which is an Emergency Engine (APU,) in accordance with the requirements of Permit PTI 92-20 in order to comply with Title 40, Code of Federal Regulations, Part 60, Subpart JJJJ. The results of the testing are detailed in the following tables.

APU-Summary Results						
Measured Unit	Run 1	Run 2	Run 3	Average	Permit Limit	Pass/Fail
NOx ppmvd @15% O2	91.66	89.11	95.37	92.05	160	Pass
CO ppmvd @ 15% O_2	143.14	145.19	143.56	143.96	540	Pass
VOC ppmvd @ 15% O_2	80.85	82.11	79.91	80.96	86	Pass

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1. INTRODUCTION

This report presents the results of the source emissions testing conducted by Environmental Quality Management, Inc. (EQM) for TC Energy's ANR Pipeline (ANR) at Bridgman Compressor Station, near Bridgman, Michigan, which is located in Berrien County. The primary purpose of this testing program was to conduct emissions testing to determine compliance with Permit to Install # 92-20 for the Emergency Generator APU at ANR Pipeline's gas compressor facility.

EQM's responsibility was to conduct the compliance testing for the O2, CO, VOC, and NOx emissions rates and perform data reduction for conformance evaluation. ANR Pipeline'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 the Waukesha Unit 15 Generator was performed on June 28, 2023, from 10:55 A.M. to 2:04 P.M.

The following requirements were specific for the testing program:

1. Equipment calibrations performed, and calibration data provided.
2. Three (3) sixty (60) -minute, minimum, O_2, CO, VOC and NOx test runs performed at Emergency Generator labeled Unit APU at maximum achievable load and speed according to pipeline conditions pursuant to EPA, Title 40, Code of Federal Regulations, Part 60, Subpart JJJJ.
3. For determination of VOC concentrations, bag samples were not analyzed as prescribed in Reference Method 18 and Method 25A per 40 CFR 60, Subpart JJJJ to reduce methane levels due to acceptable levels without reduction.
4. Process manufacturing operations maintained at 100 +/- 10 percent peak load condition, or at maximum achievable load according with ambient conditions, and fuel consumption rates recorded during the emissions testing periods.
5. All testing and analyses were performed in accordance with current EPA test methodologies and analytical procedures for O_2, CO, VOC and NOx emissions determinations.
6. Stratification was found to be less than 5% in the turbine exhausts.

7. Diluent corrected stratification test was performed in accordance with Subpart JJJJ.

8. Moistures were collected by Gas sampled in-sitiu (hot and wet) and out-sitiu (cold and dry) with two back-to-back zirconia cells for a moisture determination by subtraction of wet and dry oxygen measurements.

9. All process data was recorded electronically. Rush Power noted that that the generator horsepower is rated a bit lower than what the engine data tag was rated at. The testing was done at the lower rating. Therefore, the horsepower load averaged about 85% based on the plate rating.

The testing program was approved by and/or coordinated with Pedro Amieva, TC Energy's ANR Pipeline Company. The emission testing was performed by Karl Mast, Project Manager, and Jeff Cavanaugh, Test Technician, EQM. Rush Power was contracted to supply the load bank for the testing. The emission testing was not observed by Michigan Environment, Great Lakes, and Energy (MEGLE).

2. TEST RESULTS SUMMARY

The compliance testing was performed on Unit 15 in accordance with the requirements of the Title 40, Code of Federal Regulations, Part 60 (40 CFR 60, Appendix A [Subpart JJJJ]). A summary of the test results is given below:

Table 1. APU-Summary Results

Measured Unit	Run 1	Run 2	Run 3	Average	Permit Limit	Pass/Fail
NOx ppmvd @15% O2	91.66	89.11	95.37	92.05	160	Pass
CO ppmvd @ 15% O_2	143.14	145.19	143.56	143.96	540	Pass
VOC ppmvd @ 15% O_2	80.85	82.11	79.91	80.96	86	Pass

Based on the information provided above, the Generator 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 2-3.

Additional testing information may be found in Appendix A.

Table 2. Operating & Ambient Conditions, Concentrations, & Emissions
Unit APU

Summary of Stack Gas Parameters and Test Results Generator-APU TC Energy Bridgman Compressor Station US EPA Test Method 3A, 7, 10, 18, & 25A Page 1 of 1					
	RUN NUMBER	***O-1***	***O-2***	***O-3***	
	RUN DATE	***6/28/2023***	***6/28/2023***	***6/28/2023***	***Average***
	RUN START	***10:55***	***12:01***	***13:05***	
	MEASURED DATA				
P_{bar}	Barometric Pressure, inches Hg	29.43	29.41	29.43	29.42
B_{ws}	Moisture, % by volume	14.94	15.35	17.78	16.0
	Kilowatts	559.8	559.2	558.5	559.2
	Oxygen				
O_2	**Concentration PPM Dry**	7.45	7.52	7.58	7.52
O_2	**Concentration PPM Wet**	6.48	6.52	6.44	6.48
	Moisture	14.94	15.35	17.78	
	Nitrogen Oxides				
NO_x	**Concentration PPM Dry**	208.93	202.11	215.29	208.77
NO_x	**Concentration PPM Dry @ 15% O_2 160**	91.66	89.11	95.37	92.05
	Carbon Monoxide				
CO	**Concentration PPM Dry**	326.27	329.29	324.09	326.55
CO	**Concentration PPM Dry @ 15% O_2 540**	143.14	145.19	143.56	143.96
	Total Hydrocarbons				
THC	**Concentration PPM Wet C1**	481.02	484.32	459.46	474.93
THC	**Concentration PPM Dry C1**	552.90	558.65	541.16	550.90
VOC	**Concentration PPM Dry C1**	552.90	558.65	541.16	550.90
VOC	**Concentration PPM Dry C3**	184.30	186.22	180.39	183.63
VOC	**Concentration PPM Dry @ 15% O_2 86C3**	80.85	82.11	79.91	80.96

3. PROCESS DESCRIPTION

TC Energy's ANR Bridgman Compressor Station is located at 3372 Browntown Road, Bridgman, MI, Berrien County. The plant operates a natural gas-fired 4-stroke, lean burn Waukesha L36GL emergency engine rated at 880 hp and 620 kw, powering an electric generator.

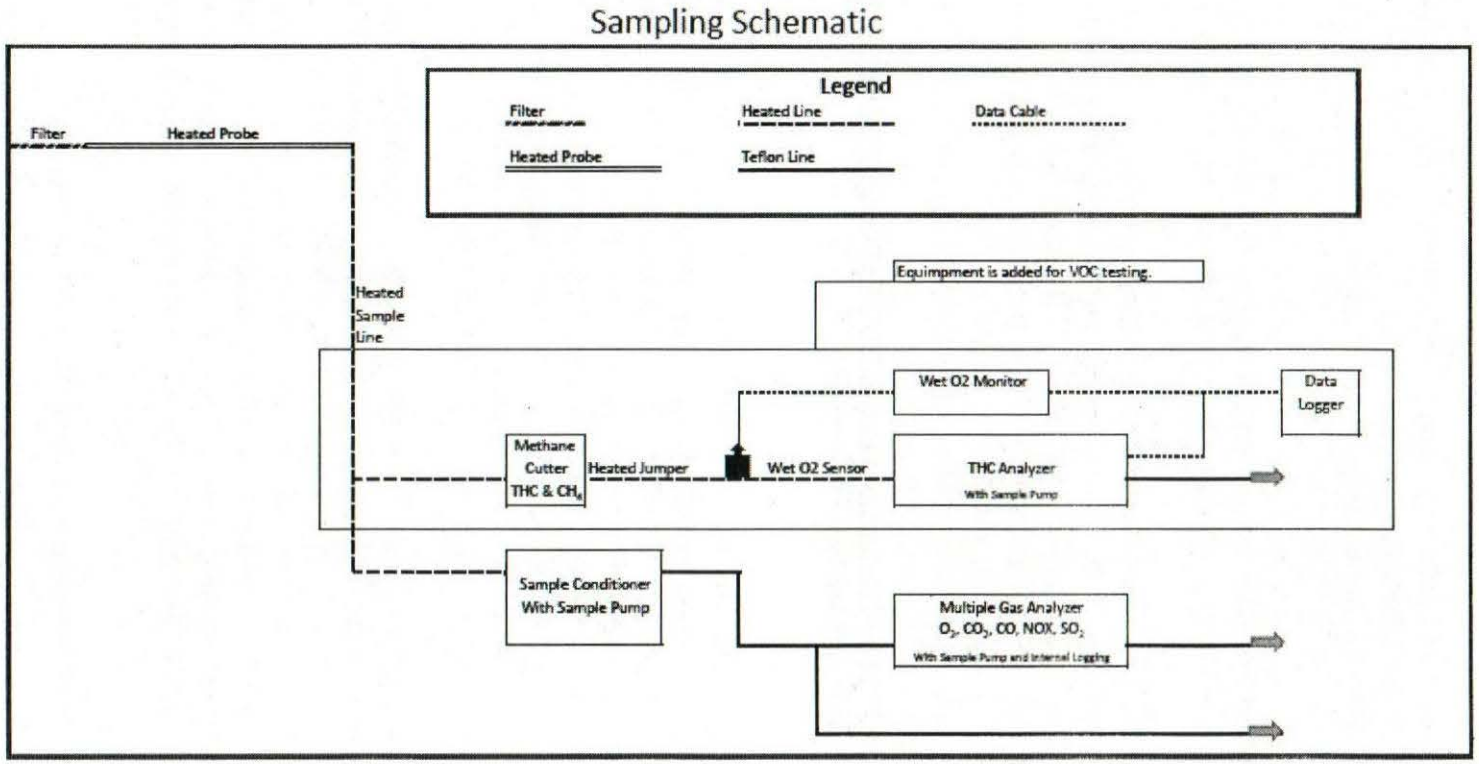
The following tables provide a summary of the production rates for the Emergency Generator during the test:

Table 3. Generator APU Production Data

Unit/Measurement	Run 1	Run 2	Run 3	Average	Rated	% Load
[1]APU-HP	750.70	749.93	748.93	749.85	880	85.21
APU-KW	559.8	559.2	558.5	559.2	620	90.19

[1]Horsepower was calculated based on Kilowatt output, which was within the 90-100% operating range. More information may be found in Appendix A.

Figure 1. Sampling Schematic



Additional Information pertaining to the Fuel Flows may be found in Appendix B.

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
- 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. Moisture was determined by Method 4 (hot and wet oxygen monitor).

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 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

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

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

Mass Emissions g/bhp-hr

$$Em = Cd \times Fd \times \frac{20.9}{(20.9 - \%O_2)} \times Qh \times \frac{GCV}{10^6} \times \frac{4536}{BHP}$$

Where:

E_m:	Pollutant concentration, $NOx_{(g/bhp\text{-}hr)}$
Cd:	Pollutant concentration, NOx lb/scf
$\%O_2$:	Oxygen concentration in percent, measured on a dry basis
Fd:	Fuel specific F-factor, dscf/MMBtu
Qh:	Fuel rate, scf/hr
GCV:	Heating value fuel, Btu/scf

To convert from ppmvd NOx to lb/scf NOx, multiply the ppmvd value by 1.194×10^{-7}

To convert from ppmvd CO to lb/scf CO, multiply the ppmvd value by 7.268×10^{-8}

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 (%)
$R_{N0\text{-}NO2}$: NO response to NO2 span gas (ppm NO)
$C_{N02G\text{-}}$: Concentration of NO_2 span gas (ppm NO2)
$C_{N02S\text{-}}$: Concentration of NO_2 in stack gas (ppm NO_2)
C_{N0xS}: Concentration of NO_x in stack gas (ppm NO_x)

VOC ppm

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

VOC mass emissions calculations g/bhp-hr

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

Where:
Cd: Pollutant concentration, lb/scf
Fd: Fuel specific F-factor, dscf/MMBtu
Qh: Fuel flow, scf/hr
%O2: 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:
Cd: Pollutant concentration, lb/scf
Fd: Fuel specific F-factor, dscf/MMBtu
Qh: Fuel flow, scf/hr
%O2: Oxygen concentration in percent, measured on a dry basis
GCV: Upper dry heating value of fuel, Btu/dscf

To convert ppm to lb/scf	Multiply by
NOx	1.194×10^{-7}
VOC	1.1444×10^{-7}

GVC: Heating value of the fuel, Btu/scf

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 Generator APU at TC Energy's ANR Pipeline Company's Bridgman Compressor Station located in Bridgman, MI. The testing was conducted on June 28, 2023.

During the course of the testing, the Generator APU conformed to the requirements of Code of Federal Regulations, Title 40, Part 60, Appendix A.

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

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