COMPLIANCE TEST REPORT
ANR PIPELINE-LINCOLN COMPRESSOR STATION
EMERGENCY GENERATOR APU

January 24, 2023

Prepared for:

TC Energy

TC Energy's ANR Pipeline Company
Lake George, MI

Prepared by:

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PREFACE

I, Karl Mast, do hereby certify that the source emissions testing conducted at TC Energy in Lake George, 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 Lincoln Compressor Station in Lake George, MI.

Karl Mast
Test Supervisor

SUMMARY

The compliance testing was performed on the Caterpillar 3412C natural gas fired Generator labeled Emergency Engine (APU) in accordance with the requirements of Permit # ROP-N5586-2019 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	41.45	41.47	40.83	41.25	160	Pass
CO ppmvd @ 15% O_2	3.91	3.14	2.47	3.17	540	Pass
VOC ppmvd @ 15% O_2	39.86	39.87	39.21	39.65	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 Lincoln compressor station, near Lake George, Michigan, which is located in Clare County. The primary purpose of this testing program was to conduct emissions testing to determine compliance with Permit # ROP-N5586-2019 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 Caterpillar 3412C Generator was performed on January 24, 2023, from 10:45 A.M. to 1:55 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. For determination of VOC concentrations, samples were analyzed as prescribed in Reference Method 18 and Method 25A per 40 CFR 60, Subpart JJJJ to reduce methane levels.
3. 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.
4. All testing and analyses performed in accordance with current EPA test methodologies and analytical procedures for O_2, CO, VOC and NOx emissions determinations.
5. Stratification was found to be less than 5% in the turbine exhausts.
6. Diluent corrected stratification test was performed in accordance with Subpart JJJJ.

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, Zach Hill, Field Activities Lead, EQM, and Eli Mergle, Test Technician, EQM. Michigan CAT was contracted to supply the load bank for the testing. The emission testing was observed by Nathanael Gentle, MEGLE.

2. TEST RESULTS SUMMARY

The compliance testing was performed on the Generator APU2 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	41.45	41.47	40.83	41.25	160	Pass
CO ppmvd @ 15% O_2	3.91	3.14	2.47	3.17	540	Pass
VOC ppmvd @ 15% O_2	39.86	39.87	39.21	39.65	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 Lincoln 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	*1/24/2023*	*1/24/2023*	*1/24/2023*	*Average*
	RUN START	*10:45*	*11:50*	*12:56*	
	MEASURED DATA				
P_{bar}	Barometric Pressure, inches Hg	28.904	28.891	28.874	28.89
B_{ws}	Moisture, % by volume	16.66	16.74	16.65	16.7
	Kilowatts	**453.0**	**453.0**	**453.0**	**453.0**
	Oxygen				
O_2	**Concentration PPM Dry**	**8.42**	**8.39**	**8.39**	**8.40**
	Nitrogen Oxides				
NO_x	**Concentration PPM Dry**	**87.67**	**87.92**	**86.58**	**87.39**
NO_x	**Concentration PPM Dry @ 15% O_2**	**41.45**	**41.47**	**40.83**	**41.25**
	Carbon Monoxide				
CO	**Concentration PPM Dry**	**8.28**	**6.65**	**5.23**	**6.72**
CO	**Concentration PPM Dry @ 15% O_2**	**3.91**	**3.14**	**2.47**	**3.17**
	Total Hydrocarbons				
THC	**Concentration PPM Wet C1**	**1357.15**	**1325**	**1253.43**	**1311.86**
THC	**Concentration PPM Dry C1**	**1583.25**	**1546.81**	**1462.13**	**1530.73**
CH_4	**Concentration PPM Bag Sample**	**1330.3**	**1293.2**	**1212.7**	**1278.73**
VOC	**Concentration PPM Dry C1**	**252.95**	**253.61**	**249.43**	**251.99**
VOC	**Concentration PPM Dry C3**	**84.32**	**84.54**	**83.14**	**84.00**
VOC	**Concentration PPM Dry @ 15% O_2**	**39.86**	**39.87**	**39.21**	**39.65**

3. PROCESS DESCRIPTION

TC Energy's ANR Lincoln Compressor Station is located at 3991 South Hickory, Lake George, MI, Clare County. The plant operates a Caterpillar 3412C natural gas fired internal combustion reciprocating engine utilized for supporting energy needs for the station. It is rated at 755 HP and 500 KW.

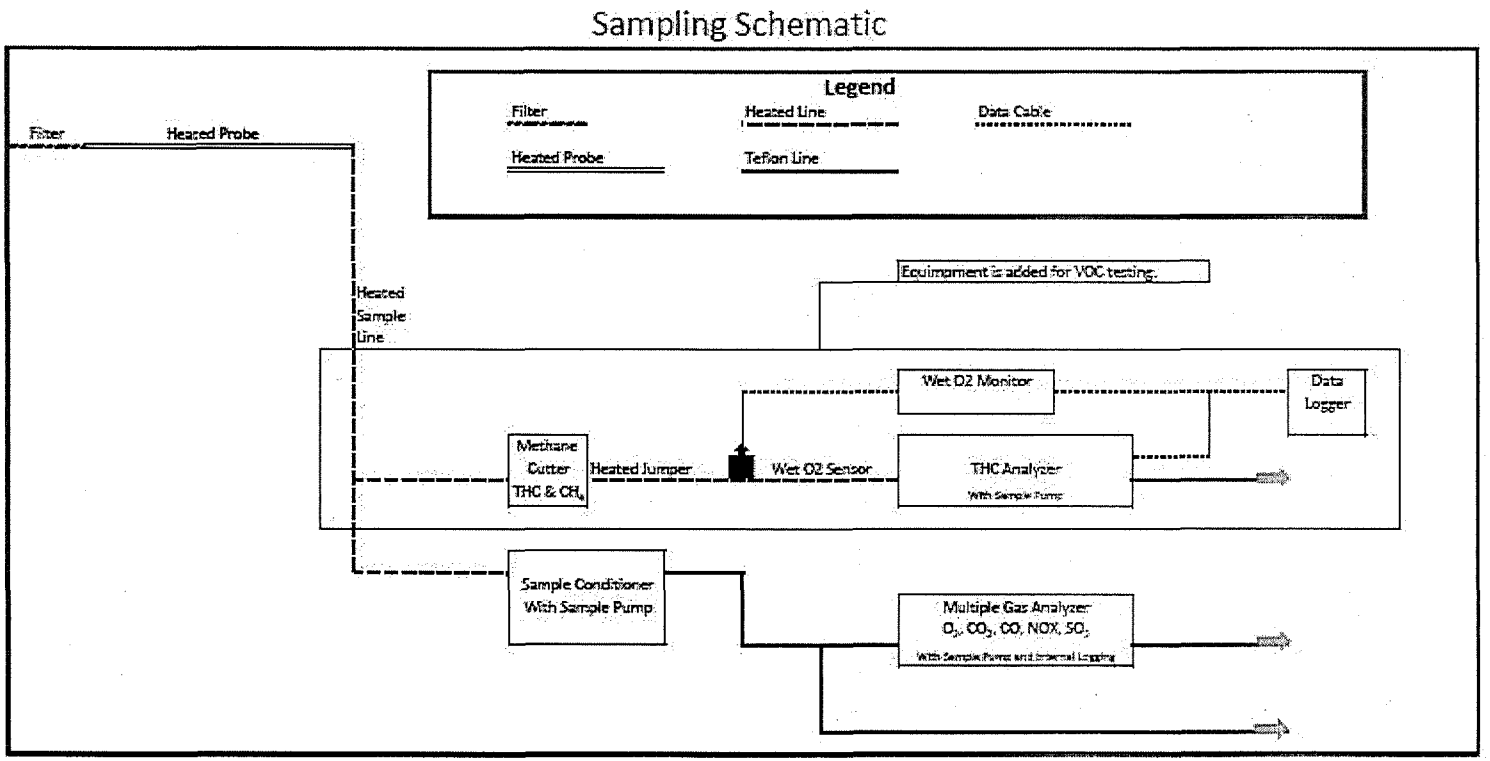
The following tables provide a summary of the production rates for the Emergency Generator during the test:

Table 3. Generator APU Production Data

Unit/Measurement	Run 1	Run 2	Run 3	Average	Rated	% Load
[1]APU-HP	607.48	607.48	607.48	607.48	755 HP	80.46
APU-KW	453.0	453.0	453.0	453.0	500 KW	90.60

[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. Moistures were 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

$$Em = Cd \times Fd \times \frac{20.9}{(20.9 - \%O_2)} \times Qh \times \frac{GCV}{10^6} \times \frac{453.6}{BHP}$$

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 (%)
$R_{NO\text{-}NO2}$: 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)

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

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

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

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

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 Lincoln Compressor Station located in Lake George, MI. The testing was conducted on January 24, 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.

A. FIELD TEST DATA

Date	1/24/2023					
Client	TC Energy					
Location	Lincoln MI					
Test Location	Generator-APU					
Analyzer	Horiba PG-350	VIG	METHANE CUTTER			
Serial Number	3480D6F4	3480D6F4	3480D6F4	3480D6F4	3480D6F4	
Upscale Reponse	< 60	< 60	< 60	< 60	< 60	
Downscale Response	< 60	< 60	< 60	< 60	< 60	
CHANEL LABEL	**O2**	**Nox**	**CO**	**VOC**	**Wet O2**	
ON=1 OFF=0	1	1	1	1	1	
Min						**Bags**
1	8.231	126.3				**R1**
2		126.3				1329
3	8.337	126.3				1330
4		126.3				1330
5	8.440	126.3				1331
6		126.3				1330
7		126.3				1330
8		126.2				1331
9		126.2				1331
10		126.2				1331
11		126.2				1330
12		126.2				**1330.3**
13		126.2				**R2**
14		126.2				1293
15		126.2				1293
16		126.1				1293
17		126.1				1293
18		126.1				1294
19		126.1				1294
20		126.1				1293
21		126.1				1293
22		126				1293
23		126				1293
24		126				**1293.2**
25		126				**R3**
26		126				1213
27		126				1212
28		126				1213
29		126				1213
30		126				1212
31						1213
32						1213
33						1213
34						1213
35						1212
36						**1212.7**
37						
38						
39						
40						
41						
42						
43						
44						
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47						
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49						
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60						

High		126.300	
Low		126.000	
Average			
Converter Percent		**99.76%**	
Strat % 1	8.231	**-1.25%**	Under 5% or .5 ppm
Strat % 2	8.337	**0.01%**	Single point
Strat % 3	8.440	**1.25%**	
Arverage	**8.34**		
Leak Check Pre Test		Pass	
Leak Check Post Test		Pass	

Generator-APU

Calibration Gasses

	Scale		High		Mid		Low	Zero
O2	21.90	RN1467	21.90	QN0066	11.90			
Nox	515.90	LL197491	515.90	BR0013976	259.000			
CO	507.70	LL197491	507.70	BR0013976	255.00			
VOC	1490.00	RN1480	1490.00	BR0013976	745.000	LL197491	453.00	
Wet O2	21.90	RN1467	21.90	QN0066	11.90			
								BR0011147 0.00

Select Bias Gasses

	High	Mid	Low
O2		1	
Nox		1	
CO		1	
VOC		1	
Wet O2		1	

Calibration Error Test

	High		Mid		Low		Zero	
O2	21.90		11.90				0.00	
21.90	21.92	0.1%	11.79	-0.5%			0.00	0.0%
Nox	515.90		259.00				0.00	
515.90	516.10	0.0%	258.00	-0.2%			1.00	0.2%
CO	507.70		255.00		0.00		0.00	
507.70	508.00	0.1%	254.00	-0.2%	0.00	0.0%	3.00	0.6%
VOC	1490.00		745.00		453.00		0.00	
1490.00	1493.00	0.2%	747.00	0.1%	451.00	-0.1%	1.00	0.1%
Wet O2	21.90		11.90		0.00		0.00	
21.90	21.93	0.1%	11.90	0.0%	0.00	0.0%	0.00	0.0%

Beginning Bias Check 1

	Span	Bias	Zero	Bias
O2	11.79		0.00	
	11.94	0.7%	0.02	0.1%
Nox	258.00		1.00	
	257.00	-0.2%	3.00	0.4%
CO	254.00		3.00	
	249.00	-1.0%	6.00	0.6%
VOC	747.00		1.00	
	748.00	0.1%	2.50	0.1%
Wet O2	11.90		0.00	
	11.91	0.0%	0.03	0.1%

Ending Calibration Averages

	High	Mid	Low	Zero
O2	21.92	11.79		0.00
Nox	516.10	258.00		1.00
CO	508.00	254.00		3.00
VOC	1493.00	747.00	451.00	1.00
Wet O2	21.93	11.90		0.00

Beginning Bias Averages

	Span	Zero
O2	11.94	0.02
Nox	257.00	3.00
CO	249.00	6.00
VOC	748.00	2.50
Wet O2	11.91	0.03

Methane Cutter

Response Test	0.00
Propane Cal Gas CC 318494	457

Date	1/24/2023
Client	TC Energy
Location	Lincoln MI
Test Location	Generator-APU
Run	1

Start Time	CHANEL LABEL / Min		O2	Nox	CO	VOC	Wet O2	% Moisture
10:45		1	8.23	93.04	25.59	1375.47	7.11	15.78
		2	8.22	94.25	21.46	1335.25	7.19	14.42
		3	8.34	93.00	18.35	1416.83	7.40	12.71
		4	8.41	93.35	16.12	1301.41	7.50	12.21
		5	8.44	87.03	14.80	1340.77	7.04	19.84
		6	8.45	87.07	14.06	1321.93	7.20	17.45
		7	8.48	86.82	14.37	1405.63	7.16	18.50
		8	8.48	86.84	13.19	1343.84	7.05	20.29
		9	8.46	87.43	13.06	1323.15	7.41	14.24
		10	8.49	88.58	13.75	1322.73	7.01	21.14
		11	8.48	86.42	12.77	1361.21	7.17	18.21
		12	8.49	86.75	12.06	1317.12	7.44	14.06
		13	8.49	89.30	11.87	1390.75	7.41	14.51
		14	8.47	90.21	12.93	1397.26	7.47	13.45
		15	8.47	90.27	12.53	1404.04	7.12	19.02
		16	8.48	89.23	12.37	1329.22	7.04	20.45
		17	8.46	89.86	12.27	1326.44	7.32	15.70
		18	8.47	91.31	12.25	1372.24	7.23	17.28
		19	8.49	91.94	12.40	1389.05	7.37	15.13
		20	8.50	86.99	12.42	1373.43	7.19	18.27
11:05		21	8.48	91.24	12.87	1408.55	7.36	15.16
		22	8.47	92.43	12.88	1307.37	7.49	13.15
		23	8.47	91.39	12.76	1368.57	7.22	17.26
		24	8.49	90.06	12.91	1411.30	7.21	17.78
		25	8.48	92.92	12.92	1397.78	7.03	20.70
		26	8.49	88.22	12.93	1334.55	7.38	15.02
		27	8.49	88.84	12.81	1343.25	7.27	16.78
		28	8.48	92.26	12.20	1395.39	7.26	16.82
		29	8.48	92.32	12.38	1345.97	7.27	16.63
		30	8.49	89.01	12.39	1376.46	7.16	18.57
		31	8.46	92.72	12.85	1317.39	7.02	20.46
		32	8.49	87.14	12.73	1416.71	7.25	17.03
		33	8.49	86.90	12.29	1342.35	7.17	18.42
		34	8.47	90.60	12.30	1350.86	7.45	13.63
		35	8.46	90.91	12.30	1319.32	7.46	13.39
		36	8.47	89.83	12.74	1311.11	7.49	13.15
		37	8.45	92.11	12.63	1337.02	7.34	15.16
		38	8.48	87.06	11.88	1400.85	7.48	13.33
		39	8.48	86.50	12.19	1351.61	7.47	13.56
		40	8.46	91.58	12.20	1315.40	7.18	17.86
		41	8.47	88.20	13.11	1404.83	7.16	18.23
		42	8.46	90.46	12.21	1363.93	7.09	19.32
		43	8.48	88.77	12.21	1325.73	7.00	21.16
		44	8.47	91.30	12.22	1316.74	7.06	20.04
		45	8.46	91.58	12.81	1361.04	7.22	17.19
		46	8.45	92.42	12.53	1379.79	7.14	18.33
		47	8.46	91.01	12.68	1408.11	7.33	15.48
		48	8.48	91.57	12.09	1409.14	7.05	20.33
		49	8.48	89.31	12.54	1408.78	7.33	15.62
		50	8.48	89.03	12.09	1359.86	7.37	15.12
		51	8.47	89.32	12.40	1309.34	7.43	13.96
		52	8.48	90.73	12.86	1413.90	7.46	13.65
		53	8.46	92.14	13.00	1329.38	7.20	17.50
		54	8.47	87.91	12.69	1331.76	7.30	16.04
		55	8.46	90.17	12.10	1418.29	7.30	15.97
		56	8.44	91.58	11.96	1418.33	7.26	16.21
		57	8.46	87.63	12.10	1348.03	7.17	18.06
		58	8.45	89.04	11.65	1349.04	7.21	17.19
		59	8.46	91.57	11.34	1365.90	7.24	16.86
		60	8.44	90.71	11.22	1401.60	7.24	16.60
	Average		8.459	89.819	13.455	1,362.05	7.26	16.66
	Corrected Avg		**8.42**	**87.67**	**8.28**	**1,357.15**	**7.23**	

Actual Bias Gasses

	High	Mid	Low
O2		11.90	
Nox		259.00	
CO		255.00	
VOC		745.00	
Wet O2		11.90	

Ending Bias Check 1

	Span	Drift	Bias	Zero	Drift	Bias
O2	11.94			0.02		
	11.96	**0.1%**	**0.8%**	0.01	**0.0%**	**0.0%**
Nox	257.00			3.00		
	260.00	**0.6%**	**0.4%**	4.00	**0.2%**	**0.6%**
CO	249.00			6.00		
	252.00	**0.6%**	**-0.4%**	5.00	**-0.2%**	**0.4%**
VOC	748.00			2.50		
	750.00	**0.1%**	**0.2%**	3.30	**0.1%**	**0.2%**
Wet O2	11.91			0.03		
	11.94	**0.1%**	**0.2%**	0.02	**0.0%**	**0.1%**

Ending Bias Averages

	span	zero
O2	11.96	0.01
Nox	260.00	4.00
CO	252.00	5.00
VOC	750.00	3.30
Wet O2	11.94	0.02

Date	1/24/2023
Client	TC Energy
Location	Lincoln MI
Test Location	Generator-APU
Run	2

Start Time	CHANEL LABEL / Min	O2	Nox	CO	VOC	Wet O2	% Moisture
11:50	1	8.44	90.38	13.01	1318.34	7.07	19.33
	2	8.48	87.85	12.42	1324.52	7.22	17.32
	3	8.45	92.63	12.87	1303.09	7.05	19.84
	4	8.45	91.79	13.78	1322.14	7.27	16.21
	5	8.46	91.50	12.76	1323.04	7.36	14.86
	6	8.47	92.35	11.83	1323.58	7.35	15.33
	7	8.46	87.84	12.73	1358.91	7.31	15.83
	8	8.46	89.24	12.28	1343.64	7.47	13.25
	9	8.49	91.50	11.23	1357.04	7.47	13.64
	10	8.48	88.96	11.38	1351.08	7.31	16.13
	11	8.47	91.22	13.48	1303.83	7.50	13.00
	12	8.46	88.68	13.51	1321.63	7.22	17.19
	13	8.47	91.22	13.09	1364.00	7.02	20.60
	14	8.46	93.75	13.37	1368.25	7.44	13.76
	15	8.46	91.23	11.70	1368.93	7.22	17.18
	16	8.47	89.82	12.75	1314.29	7.15	18.43
	17	8.45	92.35	13.38	1368.05	7.35	14.97
	18	8.48	90.38	11.84	1323.70	7.01	20.99
	19	8.47	89.82	12.61	1329.65	7.43	14.07
	20	8.48	90.67	12.30	1344.03	7.07	19.83
12:10	21	8.47	90.94	11.85	1337.95	7.21	17.49
	22	8.46	93.47	12.31	1319.81	7.04	20.22
	23	8.47	90.09	11.71	1358.86	7.02	20.63
	24	8.47	89.25	12.17	1302.10	7.40	14.39
	25	8.47	89.54	12.31	1360.73	7.02	20.62
	26	8.50	92.08	11.86	1317.84	7.10	19.80
	27	8.46	90.39	12.17	1345.93	7.25	16.65
	28	8.47	88.99	12.18	1357.38	7.29	16.12
	29	8.45	90.69	13.54	1368.87	7.42	13.88
	30	8.45	91.26	12.32	1354.09	7.42	13.90
	31	8.44	91.55	12.50	1350.22	7.46	13.07
	32	8.47	91.84	12.04	1310.09	7.00	21.03
	33	8.46	90.99	11.73	1348.79	7.42	14.07
	34	8.46	93.25	11.42	1359.22	7.12	18.90
	35	8.45	92.41	12.19	1345.05	7.21	17.11
	36	8.45	94.38	12.36	1343.20	7.17	17.82
	37	8.45	89.88	12.65	1327.85	7.27	16.38
	38	8.45	91.30	12.82	1338.97	7.06	19.70
	39	8.45	89.33	13.42	1324.31	7.01	20.58
	40	8.46	91.02	12.82	1337.84	7.46	13.42
	41	8.47	89.90	13.42	1359.54	7.34	15.45
	42	8.47	89.89	11.74	1307.84	7.14	18.57
	43	8.47	91.57	11.74	1320.18	7.26	16.66
	44	8.47	89.88	11.74	1319.46	7.38	14.74
	45	8.46	90.44	12.97	1311.03	7.24	16.80
	46	8.53	90.71	12.20	1364.12	7.10	20.17
	47	8.45	93.53	13.28	1335.46	7.30	15.83
	48	8.47	94.10	12.37	1353.08	7.40	14.41
	49	8.48	89.87	12.06	1364.51	7.05	20.34
	50	8.50	87.90	12.97	1349.99	7.36	15.39
	51	8.48	90.16	11.60	1348.43	7.46	13.72
	52	8.45	92.13	11.46	1319.46	7.16	18.04
	53	8.46	91.01	12.06	1316.76	7.28	16.33
	54	8.46	89.04	12.21	1320.45	7.19	17.67
	55	8.44	88.48	13.29	1345.72	7.39	14.22
	56	8.45	95.52	12.84	1324.18	7.42	13.75
	57	8.43	89.88	12.38	1323.32	7.36	14.67
	58	8.43	92.42	12.84	1310.93	7.16	17.82
	59	8.46	89.88	12.98	1305.12	7.04	20.06
	60	8.43	93.82	13.30	1300.92	7.50	12.49
	Average	8.463	90.933	12.47	1,335.69	7.25	16.74
	Corrected Avg	**8.39**	**87.92**	**6.65**	**1,325.00**		

Actual Bias Gasses

	High	Mid	Low
O2		11.90	
Nox		259.00	
CO		255.00	
VOC		745.00	
Wet O2		11.90	

Ending Bias Check 2

Ending	Span	Drift	Bias	Zero	Drift	Bias
O2	11.96			0.01		
	12.00	0.2%	1.0%	0.07	0.3%	0.2%
Nox	260.00			4.00		
	259.00	-0.2%	0.2%	4.60	0.1%	0.3%
CO	252.00			5.00		
	256.00	0.8%	0.4%	7.00	0.4%	0.2%
VOC	750.00			3.30		
	756.00	0.4%	0.6%	5.80	0.2%	0.2%
Wet O2	11.94			0.02		
	11.97	0.1%	0.3%	0.05	0.1%	0.1%

Ending Bias Averages

	span	zero
O2	12.00	0.07
Nox	259.00	4.60
CO	256.00	7.00
VOC	756.00	5.80
Wet O2	11.97	0.05

Date	1/24/2023
Client	TC Energy
Location	Lincoln MI
Test Location	Generator-APU
Run	3

	CHANEL LABEL		O2	Nox	CO	VOC	Wet O2	5 Moisture	
Start Time	Min								
12:56		1	8.42	91.03	13.62	1280.63	7.39	13.92	
		2	8.44	91.31	13.76	1277.85	7.29	15.77	
		3	8.48	89.06	12.08	1303.97	7.49	13.27	
		4	8.48	88.78	11.94	1258.18	7.31	15.96	
		5	8.44	93.00	11.94	1264.07	7.08	19.31	
		6	8.46	88.50	12.57	1317.50	7.07	19.72	
		7	8.49	90.47	11.94	1274.41	7.27	16.70	
		8	8.47	90.47	12.54	1281.21	7.31	15.99	
		9	8.47	89.62	11.49	1275.59	7.47	13.42	
		10	8.44	95.25	12.72	1278.52	7.37	14.44	
		11	8.44	93.00	13.32	1295.87	7.36	14.61	
		12	8.48	88.48	12.09	1283.59	7.08	19.67	
		13	8.45	92.71	12.86	1272.88	7.09	19.24	
		14	8.49	93.55	12.40	1270.56	7.45	13.98	
		15	8.47	89.89	12.09	1305.77	7.38	14.70	
		16	8.48	88.76	11.63	1278.15	7.48	13.35	
		17	8.47	88.20	12.40	1304.47	7.40	14.44	
		18	8.45	91.58	13.17	1266.56	7.13	18.51	
		19	8.46	90.45	12.86	1254.14	7.01	20.63	
		20	8.46	88.77	13.31	1254.43	7.39	14.41	
13:16		21	8.49	90.74	12.25	1285.24	7.08	19.89	
		22	8.48	92.15	11.94	1256.16	7.48	13.34	
		23	8.47	91.60	12.40	1298.79	7.15	18.50	
		24	8.46	91.60	12.71	1265.77	7.30	15.77	
		25	8.46	89.35	13.63	1316.30	7.07	19.68	
		26	8.46	91.89	12.71	1283.46	7.36	14.97	
		27	8.48	91.04	11.80	1317.02	7.06	20.11	
		28	8.47	92.73	12.26	1267.98	7.06	19.98	
		29	8.47	91.32	12.40	1270.66	7.23	17.07	
		30	8.50	85.68	11.94	1293.82	7.37	15.36	
		31	8.48	92.44	12.40	1299.46	7.34	15.64	
		32	8.50	88.77	11.80	1255.74	7.13	19.18	
		33	8.49	89.33	11.48	1280.87	7.49	13.39	
		34	8.47	92.70	12.25	1273.48	7.18	18.10	
		35	8.48	87.91	12.40	1301.63	7.41	14.58	
		36	8.47	91.29	12.25	1272.21	7.40	14.35	
		37	8.45	95.24	13.03	1254.30	7.09	19.13	
		38	8.50	90.46	11.34	1261.45	7.07	20.19	
		39	8.46	91.31	12.26	1291.15	7.08	19.51	
		40	8.44	91.60	13.48	1281.33	7.17	17.76	
		41	8.48	88.51	13.17	1318.36	7.16	18.46	
		42	8.47	93.59	13.17	1252.43	7.48	13.21	
		43	8.50	89.09	11.80	1281.85	7.25	17.21	
		44	8.48	88.25	12.72	1277.48	7.04	20.40	
		45	8.48	92.21	12.57	1259.81	7.34	15.50	
		46	8.48	91.08	11.80	1312.38	7.35	15.41	
		47	8.47	90.25	13.35	1271.86	7.41	14.18	
		48	8.47	90.81	13.04	1285.15	7.26	16.64	
		49	8.50	90.82	12.58	1279.29	7.17	18.46	
		50	8.49	93.38	12.27	1293.13	7.20	17.93	
		51	8.50	89.15	11.81	1305.60	7.13	19.19	
		52	8.48	88.60	13.04	1313.55	7.47	13.55	
		53	8.48	91.71	12.13	1258.29	7.18	17.97	
		54	8.47	90.02	12.59	1253.59	7.22	17.31	
		55	8.47	92.01	12.73	1254.63	7.33	15.63	
		56	8.49	90.04	11.67	1273.03	7.29	16.56	
		57	8.47	88.35	12.27	1254.33	7.11	19.25	
		58	8.48	88.92	13.05	1276.18	7.41	14.56	
		59	8.49	88.36	12.13	1274.01	7.47	13.65	
		60	8.48	90.34	12.28	1255.17	7.35	15.32	
	Average		8.472	90.626	12.46	1,279.59	7.27	16.65	
	Corrected Avg		**8.39**	**86.58**	**5.23**	**1,253.43**	**7.20**		

Actual Bias Gasses

	High	Mid	Low
O2		11.90	
Nox		259.00	
CO		255.00	
VOC		745.00	
Wet O2		11.90	

Ending Bias Check 3

	Span	Drift	Bias	Zero	Drift	Bias
O2	12.00			0.07		
	11.98	-0.1%	0.9%	0.09	0.1%	0.3%
Nox	259.00			4.60		
	263.10	0.8%	1.0%	5.50	0.2%	0.5%
CO	256.00			7.00		
	257.00	0.2%	0.6%	7.70	0.1%	0.3%
VOC	756.00			5.80		
	770.00	0.9%	1.5%	6.30	0.0%	0.3%
Wet O2	11.97			0.05		
	11.95	-0.1%	0.2%	0.08	0.1%	0.2%

Ending Bias Averages

	span	zero
O2	11.98	0.09
Nox	263.10	5.50
CO	257.00	7.70
VOC	770.00	6.30
Wet O2	11.95	0.08

REVIEWED
By Anova Frasure at 2:48 pm, Feb 03, 2023

Michigan CAT

LOAD BANK TEST

ENGINE DIVISION
1-800-833-1789

CUSTOMER NAME				W.O. #
Environmental Quality Management				RF-WO-1439165
GENERATOR SET LOCATION	UNIT.	CONTACT		TELEPHONE NO.
Lake Gorge		Karol Mast		219-776-6056
ENGINE MODEL	SERIAL NO.	SERVICE METER	START 163	END 167
G3412C	SPP00267			
GENERATOR MODEL	SERIAL NO. & SPEC NO.	KW RATING	VOLTS	SERVICE LEVEL
D150	SPY00266	500	480	
GENERATOR PACKAGE NUMBER	SERIAL NO.	TIME		DATE
		START 10:45 A.M	END 02:45 P.M	1/24/2023

			VOLTS			AMPS						
TIME	Hz	KW	A	B	C	A	B	C	OIL PRESS	COOLANT TEMP	AMBIENT TEMP	% LOAD
0	59	455	479	479	478	550	548	547	71	192	27	91%
0.5	59	454	479	479	478	549	549	546	64	192	27	91%
1	59	455	479	479	478	550	549	547	64	192	27	91%
1.5	59	454	479	478	478	549	549	547	64	192	27	91%
2	59	454	479	478	478	549	549	547	64	192	34	91%
2.5		455	480	479	478	550	549	547	64	192	34	91%
3		455	480	479	478	549	549	547	64	192	34	91%
3.5		456	480	480	478	550	549	547	64	192	34	91%
4		0										0%
4.5		0										0%
5		0										0%
5.5		0										0%
6		0										0%
6.5		0										0%
7		0										0%
7.5		0										0%
8		0										0%

COMMENTS, RECOMMENDATIONS

Load engine to 91-92% load while performing emission test.

SERVICE TECHNICIAN	Kevin Curtiss	DATE	####	CUSTOMER REPRESENTATIVE	

Average Volts	Average Amps	Equals	times 1.732/1000
478.666667	548.333333	262468.8889	454.5961156
478.666667	548	262309.3333	454.3197653
478.666667	548.666667	262628.4444	454.8724658
478.333333	548.333333	262286.1111	454.2795444
478.333333	548.333333	262286.1111	454.2795444
479	548.666667	262811.3333	455.1892293
479	548.333333	262651.6667	454.9126867
479.333333	548.666667	262994.2222	455.5059929
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

B. PROCESS OPERATING DATA

TC lincoln MI | 1 24 23

1045

B1

KW's	453	Boro	28.904
KW's	453	PSI	14.195
KW's	453	AT	29
KW's	453	RH	91

B2 1150

KW's	453	Boro	28.891
KW's	453	PSI	14.189
KW's	453	AT	33
KW's	453	RH	79

B3

KW's	453	Boro	28.874
KW's	453	PSI	14.181
KW's	453	AT	33
KW's	453	RH	76

C. GAS CERTIFICATIONS

TIER 5 LABS
5353 W. SOUTHERN AVE.
INDIANAPOLIS, IN 46241
317-536-5590

Cylinder Number:	RN1467	Certification Date:	08 January 2020
Mixture Grade:	EPA Protocol Standard Gas Mixture	Expiration Date:	08 January 2028
Certificate Number:	3659A-05T5-C01	Lot Number:	3659A-05T5
Cylinder Fill Pressure:	2216 PSIG	Customer Part Number:	T5E 4800001-A8-1

Do not use below 100 psi (0.7 megapascals)

EPA Traceability Protocol for Gaseous Calibration Standards Procedure G2, EPA/600/R-12/531 May 2012

Certified Concentrations

Component	Concentration	Uncertainty	Assay Dates
Carbon Dioxide	18.0%	+/- 0.10% (absolute)	1/8/2020
Oxygen	21.9%	+/- 0.10% (absolute)	1/8/2020
Nitrogen	Balance		

Analytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
Carbon Dioxide	GC-TCD	Shimadzu	GC-8A	C10495021497SA	12/27/2019
Oxygen	GC-TCD	Shimadzu	GC-8A	C10495021497SA	12/12/2019

Reference Standards

Serial Number	Lot	Expiration	Type	Component	Balance	Concentration	Uncertainty (%)	NIST Reference
D685003	VSL	3/15/2024	PRM	CO2	N2	18.00%	0.018	VSL
D685109	VSL	9/14/2023	PRM	O2	N2	21.00%	0.100	VSL

The calibration results published in this certificate were obtained using equipment and standards capable of producing results that are traceable to National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI). The expanded uncertainties, if included on this certificate, use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. If uncertainties are not included on this certificate, they are available upon request. The nitrogen used as a component or balance gas as well as the oxygen used in air mixtures meets the requirements set forth in EPA 1065.750. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from the calibration facility. Calibration certificates without signatures are not valid. This calibration meets the requirements of ISO/IEC 17025-2005

Preparer: Allison Martinez

Reviewer: Abigail Helman

Production Laboratory:
Tier 5 Labs, LLC
5353 W. Southern Ave.
Indianapolis, IN 46241
PGVP Vendor ID R12020

Cylinder Number:	QN0066	Certification Date:	9/19/2022
Mixture Grade:	EPA Protocol Calibration Gas 1	Issuance Date:	9/21/2022
Certificate Number:	25222C-04T5-C03	Expiration Date:	9/19/2030
Final Pressure:	2215 PSIG	Batch Number:	25222C-04T5
		Part Number:	T5E 4800001-A8-2

Do not use below 100 psi (0.7 megapascals)

EPA Traceability Protocol for Gaseous Calibration Standards Procedure G1, EPA/600/R-12/531 May 2012

Certified Concentrations

Component	Concentration	Analytical Uncertainty		Assay Dates
Carbon Dioxide	10.1 %	0.1 %	Absolute	9/16/2022
Oxygen	11.9 %	0.1 %	Absolute	9/19/2022
Nitrogen	Balance			

Anaytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
Carbon Dioxide	NDIR	Servomex	4100	900033	9/13/2022
Oxygen	GC-TCD	Shimadzu	GC-8A	C10495021497SA	9/12/2022

Reference Standards

Serial Number	Lot	Expiration	Type	Component	Balance	Concentration	Units	Uncertainty	Reference
CC466360	2287A-05T5	1/26/2028	GMIS	CO2	N2	16.17	%	0.156	VSL
CC478959	0716A-01T5	2/19/2028	GMIS	O2	N2	20.87	%	0.113	VSL

Cylinder serial numbers in this batch: BR0013997 BR0013996 QN0066 TN10460

The calibration results published in this certificate were obtained using equipment and standards capable of producing results that are traceable to National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI). The expanded uncertainties, if included on this certificate, use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. If uncertainties are not included on this certificate, they are available upon request. The nitrogen used as a component or balance gas as well as the oxygen used in air mixtures meets the requirements set forth in 40CFR1065.750. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from the calibration facility. Calibration certificates without signatures are not valid. This calibration meets the requirements of ISO/IEC 17025-2017.

Analytical Chemist Carlie Peacock

Facility Manager John Schoolcraft

Production Laboratory:
Tier 5 Labs
PGVP Vendor ID R12022
5353 W Southern Ave
Indianapolis, IN 46241

Cylinder Number:	RN1480	Certification Date:	9/15/2021
Mixture Grade:	EPA Protocol Calibration Gas 2	Issuance Date:	9/15/2021
Certificate Number:	23621A-02T5-C01	Expiration Date:	9/15/2029
Final Pressure:	2015 PSIG	Batch Number:	23621A-02T5
		Part Number:	T5E 67M0001-A8-3

Do not use below 100 psi (0.7 megapascals)

EPA Traceability Protocol for Gaseous Calibration Standards Procedure G2, EPA/600/R-12/531 May 2012

Certified Concentrations

Component	Concentration	Analytical Uncertainty		Assay Dates
Carbon Monoxide	994 ppm	2 PPM	Absolute	9/2/2021
Methane	1490 ppm	10 ppm	Absolute	8/31/2021
Nitric Oxide	982 ppm	2 ppm	Absolute	8/30/2021, 9/8/2021, 9/15/2021
Nitrogen	Balance			

Anaytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
Carbon Monoxide	NDIR	Horiba	VA-3111	PC062W1E	8/24/2021
Methane	GC-TCD/FID	Shimadzu	GC-2014	C11945605925	8/31/2021
Nitric Oxide	Chemiluminescence	Thermo	42i-HL	1101346887	9/10/2021

Reference Standards

Serial Number	Lot	Expiration	Type	Component	Balance	Concentration	Units	Uncertainty	Reference
EB0047969	3378A-03T5	4/2/2028	GMIS	CO	N2	970.96	PPM	0.261	2637a
D791204	VSL	1/7/2025	VSL	CH4	N2	1	%	0.2	VSL
D791257	VSL	1/8/2025	VSL	NO	N2	1501.7	PPM	0.2	VSL

NOx = 992 PPM REFERENCE STANDARD ONLY

The calibration results published in this certificate were obtained using equipment and standards capable of producing results that are traceable to National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI). The expanded uncertainties, if included on this certificate, use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. If uncertainties are not included on this certificate, they are available upon request. The nitrogen used as a component or balance gas as well as the oxygen used in air mixtures meets the requirements set forth in 40CFR1065.750. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from the calibration facility. Calibration certificates without signatures are not valid. This calibration meets the requirements of ISO/IEC 17025-2017.

Analytical Chemist Carlie Peakcock

Quality Manager Allison Martinez

Production Laboratory:
Tier 5 Labs
PGVP Vendor ID R12021
5353 W Southern Ave
Indianapolis, IN 46241

AWG GASES & WELDING SUPPLIES

Certificate of Analysis – EPA Protocol Gas

Customer:
American Welding & Gas
5353 W Southern Ave
Indianapolis, IN 46241

PO Number: 436242
Reference#: CGS-10-24084 (2 of 5)
Date Filled: 7/19/2022
Customer Part #: CSG E76M001-A6-1

Cylinder Number	Size	Concentration Basis	Standard type	Certificate ID
LL197491	ALQ	Mole	EPA Protocol	05-08172201

Certified Concentration

Carbon Monoxide =	507.7 ppm	+/- 3.8 ppm
Nitric Oxide =	510.5 ppm	+/- 6.6 ppm
NOx =	515.9 ppm	
Methane =	453.0 ppm	+/- 4.1 ppm
Nitrogen =	Balance Gas	

Analytical Information

Component	Analyzer Make/Model/SN	Analytical Principle	Last Calibration Date
Carbon Monoxide	Thermo Nicolet 6700 APW100179	FT-IR	7/11/2022
Nitric Oxide	Thermo Nicolet 6700 APW100179	FT-IR	8/8/2022
Methane	Thermo Nicolet 6700 APW100179	FT-IR	8/5/2022

First Assay Date 8/9/2022 **Second Assay Date** 8/17/2022

Reference Standard(s)

Component	GMIS #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	10-17515	CC482675	501.2 ppm	+/- 3.8 ppm	11/5/2025
Nitric Oxide	10-17553	CC337204	483.0 ppm	+/- 4.9 ppm	11/13/2022
NOx	10-17553	CC337204	485.2 ppm		11/13/2022
Methane	10-22906-7	EB0001615	599.9 ppm	+/- 2.0 ppm	3/17/2030
Nitrogen			Balance Gas		

CO, NO, and CH4 GMIS's certified by;

Component	SRM #	N.I.S.T. Sample #	Cylinder #	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	1680b	2-J-46	CAL017888	490.4 ppm	+/- 2.0 ppm	9/20/2021
Nitric Oxide	1686b	42-M-40	CAL017952	493.1 ppm	+/- 2.2 ppm	4/6/2023
Nitrogen Oxides (NOx)	1686b	42-M-40	CAL017952	493.7 ppm	+/- 2.3 ppm	4/6/2023
Methane	PRM		D970443	600.6 ppm	+/- 1.8 ppm	9/15/2026
Nitrogen				Balance Gas		

This calibration standard has been certified per the 2012 EPA Traceability Protocol, Document EPA 600/R-12/531, using the procedure G1.

Do Not Use This Standard Below 100 psig (0.7 Megapascals).

Valve Outlet Connection CGA: 660
Max Pressure(psig)@70F: 1700
Certification Date: 8/17/2022
Shelf Life: 3 years
Expiration date: 8/17/2025

Certified By: Kelley Nap

Reviewed By: Derek Hindman

Produced By:
Coastal Specialty Gas: (409) 981-7700
2150 Interstate 10 East, Beaumont, TX 77703
Coastal Specialty Gas PGVP Vendor ID: 012022

Certificate of Analysis – EPA Protocol Gas

Customer:		**PO Number:**	436242
American Welding & Gas		**Reference#:**	CGS-10-24064 (3 of 5)
6353 W Southern Ave		**Date Filled:**	7/19/2022
Indianapolis, IN 46241		**Customer Part #:**	CSG E6M7001-A8-1

Cylinder Number	Size	Concentration Basis	Standard type	Certificate ID
BR0013976	ALQ	Mole	EPA Protocol	05-08152201

Certified Concentration

Carbon Monoxide =	255 ppm	+/- 1.6 ppm
Nitric Oxide =	258 ppm	+/- 1.4 ppm
NOx =	259 ppm	
Methane =	745 ppm	+/- 2 ppm
Nitrogen =	Balance Gas	

Analytical Information

Component	Analyzer Make/Model/SN			Analytical Principle	Last Calibration Date
Carbon Monoxide	MKS	2031DJG2EKVS13T	017146467	FT-IR	8/3/2022
Nitric Oxide	Thermo	42iQ-HL	1192604297	Chemiluminescence	7/25/2022
Nitric Oxide	Thermo	42i-HL	1152610017	Chemiluminescence	8/0/2022
Methane	MKS	2031DJG2EKVS13T	017146467	FT-IR	8/8/2022

First Assay Date 8/8/2022 **Second Assay Date** 8/15/2022

Reference Standard(s)

Component	GMIS #	Cylinder #	N.I.S.T. Reference	Concentration	Uncertainty	Expiration Date
Carbon Monoxide	CC734707.20200508	CC734707	SRM 1681b	705 ppm	+/- 2.8 ppm	11/9/2029
Carbon Monoxide	EB0026553.20191025	EB0026553	SRM 1680b	347 ppm	+/- 1.2 ppm	4/28/2028
Nitric Oxide	ALM047128.20211021	ALM047128	SRM 1687b	285 ppm	+/- 1.5 ppm	3/22/2030
Nitric Oxide	ALM066143.20211021	ALM066143	SRM 1687b	284 ppm	+/- 1.5 ppm	6/8/2030
Methane	EB0011684.20190103	EB0011684	SRM 2751	95.0 ppm	+/- 0.2 ppm	1/11/2028
Nitrogen				Balance Gas		

This calibration standard has been certified per the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531, using procedure G2.

Do Not Use This Standard Below 100 psig (0.7 Megapascals).

Valve Outlet Connection CGA	660
Max Pressure(psig)@70F	1900
Certification Date	8/15/2022
Shelf Life	8 years
Expiration date	8/13/2030

Certified By: Kelley Nagy

Reviewed By: Joshua Self

Produced By:
Red Ball Technical Gas Service: (800) 551-8150
555 Craig Kennedy Way, Shreveport, LA 71107
PGVP Vendor ID: G12022

AMERICAN WELDING AND GAS
3977 W. 83RD PL.
MERRILLVILLE, IN 46410
219-750-9851

Product:	Nitrogen CEM	Minimum Purity:	99.9995%
		Certification Date:	08 May 2019
Mixture Grade:	5.5	Expiration Date:	09 May 2027
		Lot Number:	1289C-02T5
Cylinder Fill Pressure:	2216 PSIG	Customer Part Number:	NI 80CEM

Do not use below 100 psi (0.7 megapascals)

Purity Specification

Analyte	Concentration	Assay Dates
Oxygen	< 0.67 PPM	5/8/2019
Moisture	< 0.375 PPM	5/8/2019
Total Hydrocarbons	< 0.05 PPM	5/8/2019
Total NOx	< 0.02 PPM	5/8/2019
Nitrous Oxide	< 0.02 PPM	5/8/2019
Carbon Monoxide	< 1 PPM	5/8/2019
Carbon Dioxide	< 10 PPM	

Cylinders in Lot

BR0011147	LL191154	LL20486

40 CFR1065.750 Compliant

The calibration results published in this certificate were obtained using equipment and standards capable of producing results that are traceable to National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI). The expanded uncertainties, if included on this certificate, use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. If uncertainties are not included on this certificate, they are available upon request. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from the calibration facility. Calibration certificates without signatures are not valid. This calibration meets the requirements of ISO/IEC 17025-2005

Analyst: Eric Frymier

Reviewer: Abby Helman

Production Laboratory:
Tier 5 Labs, LLC
5353W. Southern Ave.
Indianapolis, IN 46241
PGVP Vendor ID R12019

PRAXAIR
Making our planet more productive

DocNumber: 299856

Praxair Distribution, Inc.
6055 Brent Drive
Toledo OH 43611
Tel: +1 (419) 729-7732
Fax: +1 (419) 729-2411
PGVP ID: F12020

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG CINCINNATI OH HP
8376 READING RD
CINCINNATI OH 45237-1407

Certificate Issuance Date: 02/17/2020
Praxair Order Number: 71235316
Part Number: AI PR450E-AS
Customer PO Number: 79223913

Fill Date: 01/30/2020
Lot Number: 700010030GB
Cylinder Style & Outlet: AS CGA 590
Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

ProSpec EZ Cert

Expiration Date:	02/14/2028	NIST Traceable
Cylinder Number:	CC318494	Expanded Uncertainty
457 ppm	Propane	± 4 ppm
Balance	Air	

For Reference Only: *Oxygen 20.8 %*

Certification Information: *Certification Date:* 02/14/2020 *Term:* 96 Months *Expiration Date:* 02/14/2028

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Uncertainty above is expressed as absolute expanded uncertainty at a level of confidence of approximately 95% with a coverage factor k = 2. Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. ***Component:*** **Propane**

Requested Concentration: 450 ppm
Certified Concentration: 457 ppm
Instrument Used: MKS 2030
Analytical Method: FTIR
Last Multipoint Calibration: 01/27/2020

Reference Standard: Type / Cylinder #: GMIS / CC239388
Concentration / Uncertainty: 1017 ppm ±7 ppm
Expiration Date: 05/25/2024
Traceable to: SRM # / Sample # / Cylinder #: 2646a / 103-C-40 / XF000887B
SRM Concentration / Uncertainty: 979.1 PPM / ±6.6 ppm
SRM Expiration Date: 03/04/2019

First Analysis Data:							Date	02/14/2020
Z:	0	R:	1008	C:	454	Conc:	458	
R:	1008	Z:	0	C:	453	Conc:	457	
Z:	0	C:	453	R:	1008	Conc:	457	
UOM:	ppm				Mean Test Assay:		457	ppm

Second Analysis Data:							Date	
Z:	0	R:	0	C:	0	Conc:	0	
R:	0	Z:	0	C:	0	Conc:	0	
Z:	0	C:	0	R:	0	Conc:	0	
UOM:	ppm				Mean Test Assay:			ppm

Analyzed By: Mike Monnette

Certified By: Edward E Zucal

D. SAMPLE CALCULATIONS

NOx Gaseous Emissions Example Calculations

Client	TC Lincoln CS	Run	1	Test Time	10:45 A.M.		
Unit	Generator APU	Test Date	1/24/2023				
Load	100%						

Sample Train Data

					ppm @ 15% O2
Reference Temperature, °R	528	T_{ref}= (°F plus 460)			Reported 41.45
Concentration of gaseous species, ppmvd	87.67	C			Example 41.45
Molecular weight of gaseous species, lb/lb mole	46.01	MW_s	MW_s=	28.01 for CO	% Difference 0.01
Stack O_2 % volume dry	8.42	O_2		46.01 fo NOx	
				64.06 for SOx	
Kilowatts	453	kW			
Grams in a pound	453.592				
Specific molar volume of an ideal gas at standard conditions, ft^3/lb mole	385.3	SV			

Gaseous Emissions

a. Concentration, ppm @ 15% O2 dry

$$C_3 = (C)\left[\frac{(20.9 - 15.0)}{(20.9 - \%O_2)}\right]$$

$$C_3 = 87.67\left[\frac{(20.9 - 15.0)}{12.48}\right]$$

$$C_3 = \mathbf{41.45} \text{ ppm @ 15\% O2}$$

CO Gaseous Emissions Example Calculations

Client	TC Lincoln CS	Run	1	Test Time	10:45 A.M.		
Unit	Generator APU	Test Date	1/24/2023				
Load	100%						
Sample Train Data							

					ppm @ 15% O2
Reference Temperature, °R	528	T_{ref}= (°F plus 460)			
Concentration of gaseous species, ppmvd	8.28	C		Reported	3.91
Molecular weight of gaseous species, lb/lb mole	28.08	MW_s	MW_s= 28.01 for CO	Example	3.91
Stack O_2 % volume dry	8.42	O_2	46.01 fo NOx	% Difference	0.00
			64.06 for SOx		
Kilowatts	453	kW			
Grams in a pound	453.592				
conditions, ft^3/lb mole	385.3	SV			

Gaseous Emissions

a. Concentration, ppm @ 15% O2 dry

$$C_3 = (C)\left[\frac{(20.9 - 15.0)}{(20.9 - \%O_2)}\right]$$

$$C_3 = 8.28\left[\frac{(20.9 - 15.0)}{12.48}\right]$$

$$C_3 = \mathbf{3.91} \text{ ppm @ 15\% O2}$$

VOC Gaseous Emissions Example Calculations

Client	TC Lincoln CS	Run	1	Test Time	10:45 A.M.		
Unit	Generator APU	Test Date	1/24/2023				
Load	100%						

Sample Train Data

						ppm @ 15% O2
Reference Temperature, °R	528	T_{ref}= (°F plus 460)			Reported	39.86
Concentration of gaseous species, ppmvd	84.32	C			Example	39.86
Molecular weight of gaseous species, lb/lb mole	44.1	MW_s	MW_s=	28.01 for CO	% Difference	-0.01
Stack O_2 % volume dry	8.42	O_2		46.01 fo NOx		
				64.06 for SOx		
Kilowatts	453	kW		44.1 C3H8		
Grams in a pound	453.592			16.04 for CH_4		

Gaseous Emissions

a. Concentration, ppm @ 15% O2 dry

$$C_3 = (C)\left[\frac{(20.9 - 15.0)}{(20.9 - \%\,O_2)}\right]$$

$$C_3 = 84.32\left[\frac{(20.9 - 15.0)}{12.48}\right]$$

$$C_3 = \mathbf{39.86}\ \text{ppm @ 15\% O2}$$

E. CORRESPONDENCE

EMISSION TEST PLAN DOCUMENTATION

Air Quality Test Plan Submittal Form

EGLE | MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

This form is for facilities and/or testing companies to submit test plans to the Michigan Department of Environment, Great Lakes, and Energy's (EGLE), Air Quality Division. Once submitted, the information will be automatically shared with the AQD District Office and Technical Programs Unit staff. If you have questions about this form or your submittal, please contact Jeremy Howe at HoweJ1@Michigan.gov or 231-878-6687.

Facility Information

Facility Name*

ANR Pipeline-Lincoln CS

State Registration Number (SRN)*

N5586

Where will the test take place?

Address*

3991 South Hickory

City*

Lake George

ZIP Code*

48633

County*

Clare

EGLE District:

Bay City District

This is based on the county you select. This helps your submittal form get to the right people.

Facility Contact Person*

Pedro Amieva

Facility Contact Email*

Pedro_Amieva@tcenergy.com

Facility Contact Phone Number*

832 320-5839

Test Company Information

Test Company Name*

Environmental Quality Management, Inc.

Test Company Contact Person*

Karl Mast

Test Company Contact Email*

kmast@eqm.com

Test Company Contact Phone Number*

219 776-6056

Test Details

Test Start Date*

1/24/2023

Permit Number (PTI or ROP)*

If no permit, state "No Permit"

ROP-N5586-2019

What Emission Unit(s)/Flexible Group(s) ID (List all) will be tested?*

COMPLIANCE TEST REPORT
ANR PIPELINE-LINCOLN COMPRESSOR STATION
EMERGENCY GENERATOR APU

January 24, 2023

Prepared for:

TC Energy

TC Energy's ANR Pipeline Company
Lake George, MI

Prepared by:

Environmental Quality Management, Inc.
1280 Arrowhead Court
Suite 2
Crown Point, IN 46307
(219) 661-9900
www.eqm.com

PN: 050816.0004

February 2023

PREFACE

I, Karl Mast, do hereby certify that the source emissions testing conducted at TC Energy in Lake George, 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 Lincoln Compressor Station in Lake George, MI.

Karl Mast
Test Supervisor

SUMMARY

The compliance testing was performed on the Caterpillar 3412C natural gas fired Generator labeled Emergency Engine (APU) in accordance with the requirements of Permit # ROP-N5586-2019 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	41.45	41.47	40.83	41.25	160	Pass
CO ppmvd @ 15% O_2	3.91	3.14	2.47	3.17	540	Pass
VOC ppmvd @ 15% O_2	39.86	39.87	39.21	39.65	86	Pass

CONTENTS

TABLES

FIGURES

APPENDICES

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 Lincoln compressor station, near Lake George, Michigan, which is located in Clare County. The primary purpose of this testing program was to conduct emissions testing to determine compliance with Permit # ROP-N5586-2019 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 Caterpillar 3412C Generator was performed on January 24, 2023, from 10:45 A.M. to 1:55 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. For determination of VOC concentrations, samples were analyzed as prescribed in Reference Method 18 and Method 25A per 40 CFR 60, Subpart JJJJ to reduce methane levels.
3. 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.
4. All testing and analyses performed in accordance with current EPA test methodologies and analytical procedures for O_2, CO, VOC and NOx emissions determinations.
5. Stratification was found to be less than 5% in the turbine exhausts.
6. Diluent corrected stratification test was performed in accordance with Subpart JJJJ.

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, Zach Hill, Field Activities Lead, EQM, and Eli Mergle, Test Technician, EQM. Michigan CAT was contracted to supply the load bank for the testing. The emission testing was observed by Nathanael Gentle, MEGLE.

2. TEST RESULTS SUMMARY

The compliance testing was performed on the Generator APU2 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	41.45	41.47	40.83	41.25	160	Pass
CO ppmvd @ 15% O_2	3.91	3.14	2.47	3.17	540	Pass
VOC ppmvd @ 15% O_2	39.86	39.87	39.21	39.65	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 Lincoln 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	*1/24/2023*	*1/24/2023*	*1/24/2023*	*Average*
	RUN START	*10:45*	*11:50*	*12:56*	
	MEASURED DATA				
P_{bar}	Barometric Pressure, inches Hg	28.904	28.891	28.874	28.89
B_{ws}	Moisture, % by volume	16.66	16.74	16.65	16.7
	Kilowatts	**453.0**	**453.0**	**453.0**	**453.0**
	Oxygen				
O_2	**Concentration PPM Dry**	**8.42**	**8.39**	**8.39**	**8.40**
	Nitrogen Oxides				
NO_x	**Concentration PPM Dry**	**87.67**	**87.92**	**86.58**	**87.39**
NO_x	**Concentration PPM Dry @ 15% O_2**	**41.45**	**41.47**	**40.83**	**41.25**
	Carbon Monoxide				
CO	**Concentration PPM Dry**	**8.28**	**6.65**	**5.23**	**6.72**
CO	**Concentration PPM Dry @ 15% O_2**	**3.91**	**3.14**	**2.47**	**3.17**
	Total Hydrocarbons				
THC	**Concentration PPM Wet C1**	**1357.15**	**1325**	**1253.43**	**1311.86**
THC	**Concentration PPM Dry C1**	**1583.25**	**1546.81**	**1462.13**	**1530.73**
CH_4	**Concentration PPM Bag Sample**	**1330.3**	**1293.2**	**1212.7**	**1278.73**
VOC	**Concentration PPM Dry C1**	**252.95**	**253.61**	**249.43**	**251.99**
VOC	**Concentration PPM Dry C3**	**84.32**	**84.54**	**83.14**	**84.00**
VOC	**Concentration PPM Dry @ 15% O_2**	**39.86**	**39.87**	**39.21**	**39.65**

3. PROCESS DESCRIPTION

TC Energy's ANR Lincoln Compressor Station is located at 3991 South Hickory, Lake George, MI, Clare County. The plant operates a Caterpillar 3412C natural gas fired internal combustion reciprocating engine utilized for supporting energy needs for the station. It is rated at 755 HP and 500 KW.

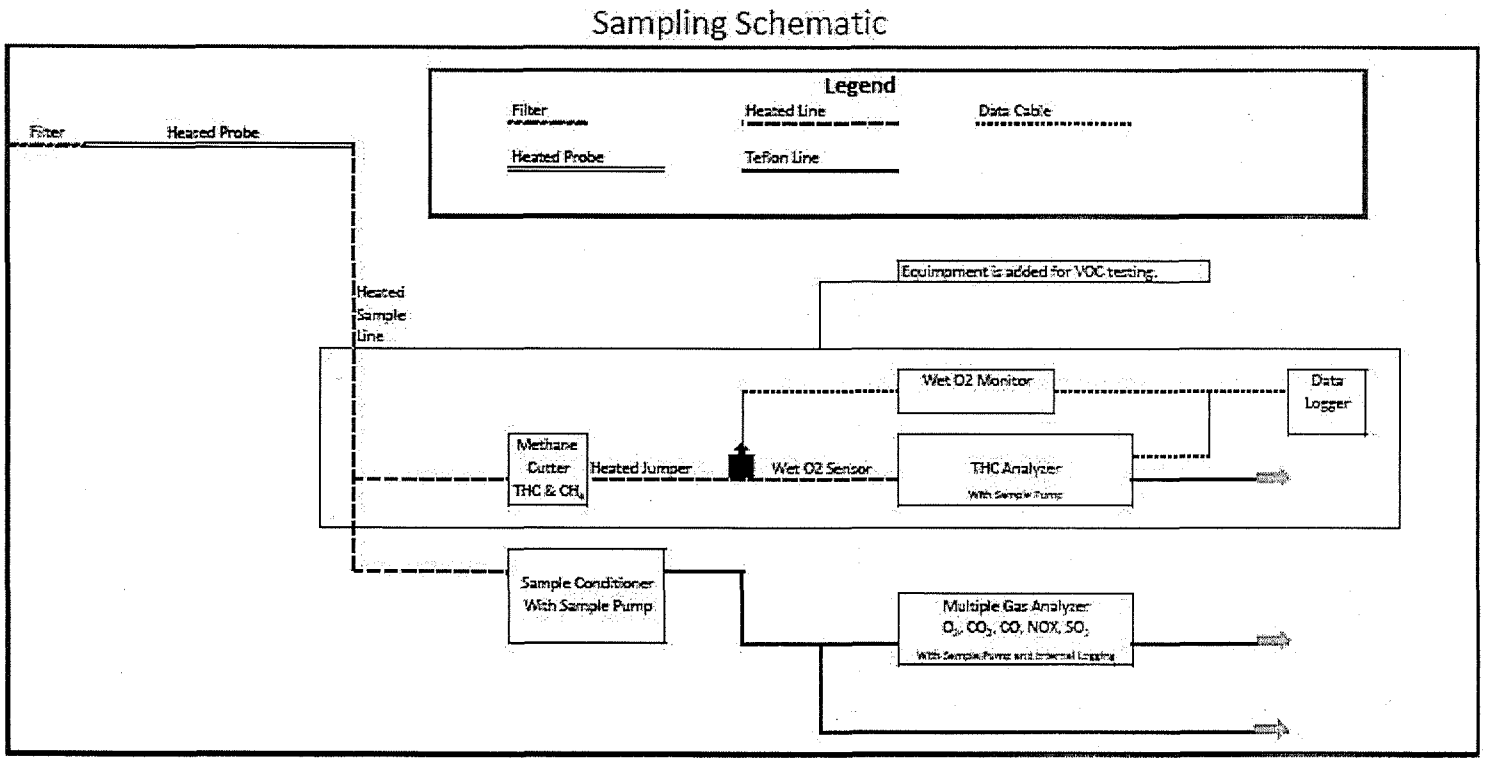
The following tables provide a summary of the production rates for the Emergency Generator during the test:

Table 3. Generator APU Production Data

Unit/Measurement	Run 1	Run 2	Run 3	Average	Rated	% Load
[1]APU-HP	607.48	607.48	607.48	607.48	755 HP	80.46
APU-KW	453.0	453.0	453.0	453.0	500 KW	90.60

[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. Moistures were 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

$$Em = Cd \times Fd \times \frac{20.9}{(20.9 - \%O_2)} \times Qh \times \frac{GCV}{10^6} \times \frac{453.6}{BHP}$$

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

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

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 (%)
$R_{NO\text{-}NO2}$: 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)

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 Lincoln Compressor Station located in Lake George, MI. The testing was conducted on January 24, 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.