
**COMPLIANCE TEST REPORT
GLGT-BOYNE FALLS COMPRESSOR STATION (CS 11)
NATURAL GAS-FIRED TURBINE NO. EU-UNIT 1101
NATURAL GAS-FIRED TURBINE NO. EU-UNIT 1102**

Prepared for:



Great Lakes Gas Transmission Company, LP
Boyne Falls Compressor Station
10339 Great Lakes Road
Boyne Falls, MI 49713

SRN: B8573
ROP #: MI-ROP-B8573-2019

Prepared by:



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PREFACE

I, Karl Mast, do hereby certify that the source emissions testing conducted at TC Energy in Boyne Falls, 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 TC Energy's Great Lakes Gas Transmission Ltd.'s Boyne Falls Compressor Station in Boyne Falls, MI.

Karl Mast
Project Manager



SUMMARY

The compliance testing was performed on the Combustion Turbines No. 1101 and 1102 systems in accordance with the requirements of the Code of Federal Regulations, Title 40, Part 60, Appendix A and in fulfillment of Michigan Department of Environment, Great Lakes, and Energy (MEGLE) permit no. MI-ROP-B8573-2019. A summary of the test results is given below:

Turbine 1101 and Turbine 1102			
Parameter	1101	1102	Emission Limit
NOx ppm @ 15% O2	67.794	79.825	82.0
NOx – Lb/Hr	38.736	47.954	61.2
CO ppm @ 15% O2	108.472	89.871	300.0
CO – Lb/Hr	37.729	32.865	140.0

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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 Great Lakes Gas Transmission, LP's, (GLGT) Boyne Falls compressor station 11, near Boyne Falls, MI, which is located in Charlevoix County.

The primary purpose of this testing program was to conduct emissions testing to determine compliance with operating permit No. MI-ROP-B8573-2019 for the Natural Gas-Fired Turbines No. EU-Unit 1101 (1101) and EU-Unit 1102 (1102) at TC Energy's GLGT gas compressor facility. Units 1101 and 1102 are both Rolls Royce, model Avon 76G stationary gas turbine burning only pipeline quality natural gas. The units peak load HP rating is 16,000 at ISO conditions. The units are a simple cycle, natural gas fired, single-shaft turbines. In a simple cycle turbine, filtered atmosphere air is first compressed by the axial flow compressor. The hot compressed air is then fired with natural gas in the combustor. The hot exhaust gases expand through two turbine stages. The gas producer (G.P.) turbine drives the axial flow air while the power turbine (P.T.) drives the centrifugal pipeline compressor. The pipeline gas compressor moves natural gas through the pipeline by compressing it from an initial "suction" state to a more compressed "discharge" state.

EQM's responsibility was to conduct the compliance testing for the CO, O₂ and NO_x emissions rates during specified operating conditions and perform data reduction for conformance evaluation. TC Energy's GLGT'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 Combustion Turbine No. 1101 was performed on October 25, 2021, from 5:30 P.M. to 8:37 P.M. The Compliance testing conducted on the Combustion Turbine No. 1102 was performed on October 25, 2021 from 1:00 P.M. to 4:16 P.M.

The following requirements were specific for the testing program:

1. Equipment calibrations performed and calibration data provided.
2. Three (3) (60) -minute, minimum, CO, O₂, and NO_x test runs performed at the Combustion Turbines 1101 and 1102 pursuant to EPA, Title 40, Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A.
3. Process manufacturing operations maintained at required load condition. Production 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 NO_x and CO emissions determinations.
5. Stratification was found to be less than 5% in turbine exhaust.



The testing program was approved by and/or coordinated with Tyrah Lydia, TC Energy's GLGT Ltd. Partnership. The emission testing was performed by Karl Mast, Manager, Emission Measurement and Project Manager, EQM, and Zach Hill, Field Activities Lead, EQM. The emission testing was observed by Jeremy Howe, Dave Bowman, and Becky Radulski, MEGLE.



2. TEST RESULTS SUMMARY

The compliance testing was performed on the Combustion Turbines No. 1101 and 1102 systems in accordance with the requirements of the Code of Federal Regulations, Title 40, Part 60, Appendix A. A summary of the test results is given below:

Table 1. Turbine 1101 and Turbine 1102-NO_x & CO Results			
Parameter	1101	1102	Emission Limit
NO _x ppm @ 15% O ₂	67.794	79.825	82.0
NO _x – Lb/Hr	38.736	47.954	61.2
CO ppm @ 15% O ₂	108.472	89.871	300.0
CO – Lb/Hr	37.729	32.865	140.0

Based on the information provided above, the Combustion Turbines 1101 and 1102 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 through 4.

Additional testing information may be found in Appendix A.

Table 2. Operating & Ambient Conditions, Concentrations, Emissions, & Flows



Turbine 1101

Run	4	5	6	
Date	10/25/21	10/25/21	10/25/21	
Time	17:30	18:39	19:48	
Engine Operating Conditions	High 1101	High 1101	High 1101	Averages
Unit Speed (rpm) CT/GG/GP/Jet	7,499.9	7,494.8	7,497.9	7,497.5
% CT Speed	100.0	99.9	100.0	100.0
Gas Compressor Speed (rpm) PT/Booster	4,986.1	5,057.9	5,082.8	5,042.2
% PT Speed	86.3	87.6	88.0	87.3
Turbine Exhaust Temp T5	987.4	987.0	988.9	987.7
Compressor Suction Pressure (PSIG)	725.6	711.6	708.7	715.3
Compressor Suction Temperature (°F)	36.9	36.9	37.0	36.9
Compressor Discharge Pressure (PSIG)	928.0	935.0	935.6	932.9
Compressor Discharge Temperature (°F)	97	99.9	100.7	99.2
Compressor Flow (MMSCF/D)	1,168.0	1093.4	1086.3	1,115.9
Ambient Conditions				
Ambient Temperature (°F)	47.89	48.15	47.10	47.71
Barometric Pressure (psi)	14.18	14.18	14.19	14.18
Ambient Relative Humidity (%)	71.00	72.00	74.00	72.33
Absolute Humidity (grains/LB)	36.26	37.14	36.67	36.69
Emissions Concentrations & Calculated Mass Emissions				
NO _x ppm (BIAS Corrected)	39.500	39.210	38.490	39.067
NO _x LB/HR	39.208	38.844	38.157	38.736
NO _x (ppm @ 15% O ₂)	68.544	68.242	66.596	67.794
NO _x (ppm @ 15% O ₂ , ISO)	70.511	70.312	68.721	69.848
NO _x Tons/Year	171.731	170.139	167.128	169.666
CO ppm (BIAS Corrected)	61.640	62.420	63.470	62.510
CO LB/HR	37.243	37.641	38.301	37.729
CO (ppm @ 15% O ₂)	106.964	108.637	109.816	108.472
CO (ppm @ 15% O ₂ , ISO)	110.032	111.932	113.321	111.762
CO Tons/Year	163.126	164.870	167.757	165.251
% O ₂ (BIAS Corrected)	17.500	17.510	17.490	17.500
Calculated Flows				
Fuel Flow - (SCFM)	2493.50	2481.33	2497.67	2490.83
Fuel Flow - (SCFH)	149,610	148,880	149,860	149,450
Exhaust Flow Method 19 (wscfm)	138,277	138,008	138,102	138,129
Fuel Flow Measurements				
Fuel Flow From Screen(MSCFH)	149.61	148.88	149.86	149.45
** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION	Run 4	Run 5	Run 6	
* BASED ON CARBON BALANCE (STOICH. + O2)				
- A/F IS TOTAL MASS RATIO				

Table 3. Operating & Ambient Conditions, Concentrations, Emissions, & Flows



Turbine 1102

Run	1	2	3	
Date	10/25/21	10/25/21	10/25/21	
Time	13:00	14:10	15:20	
Engine Operating Conditions	High 1102	High 1102	High 1102	Averages
Unit Horsepower from Control Panel	14,942.1	15,324.7	15,267.4	15,178.1
% Load	93.4	95.8	95.4	94.9
Unit Speed (rpm) CT/GG/GP/Jet	7,421.7	7,447.1	7,445.2	7,438.0
% CT Speed	99.0	99.3	99.3	99.2
Gas Compressor Speed (rpm) PT/Booster	5,065.2	5,160.4	5,191.2	5,139.0
% PT Speed	87.7	89.4	89.9	89.0
Turbine Exhaust Temp T5	1,032.5	1,039.4	1,040.6	1,037.5
Compressor Suction Pressure (PSIG)	729.1	711.6	704.6	715.1
Compressor Suction Temperature (°F)	53.8	54.2	54.3	54.1
Compressor Discharge Pressure (PSIG)	944.7	945.5	943.1	944.4
Compressor Discharge Temperature (°F)	92.9	96.7	97.7	95.8
Compressor Flow (MMSCF/D)	1143.9	1073.4	1053.3	1,090.2
Ambient Conditions				
Ambient Temperature (°F)	45.52	46.18	45.91	45.87
Barometric Pressure (psi)	14.16	14.16	14.16	14.16
Ambient Relative Humidity (%)	100.00	73.00	72.00	81.67
Absolute Humidity (grains/LB)	46.89	35.00	34.16	38.68
Emissions Concentrations & Calculated Mass Emissions				
NO _x ppm (BIAS Corrected)	51.430	50.600	49.680	50.570
NO _x LB/HR	49.778	47.623	46.461	47.954
NO _x (ppm @ 15% O ₂)	83.362	78.979	77.135	79.825
NO _x (ppm @ 15% O ₂ , ISO)	88.959	81.443	79.426	83.276
NO _x Tons/Year	218.027	208.587	203.497	210.037
CO ppm (BIAS Corrected)	56.680	56.180	58.000	56.953
CO LB/HR	33.393	32.185	33.017	32.865
CO (ppm @ 15% O ₂)	91.871	87.688	90.053	89.871
CO (ppm @ 15% O ₂ , ISO)	98.040	90.424	92.727	93.731
CO Tons/Year	146.263	140.971	144.616	143.950
% O ₂ (BIAS Corrected)	17.260	17.120	17.100	17.160
Calculated Flows				
Fuel Flow - (SCFM)	2603.00	2628.50	2625.67	2619.06
Fuel Flow - (SCFH)	156,180	157,710	157,540	157,143
Exhaust Flow Method 19 (wscfm)	134,832	131,110	130,279	132,074
Fuel Flow Measurements				
Fuel Flow From Screen(MSCFH)	156.18	157.71	157.54	157.14
** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION	Run 1	Run 2	Run 3	
* BASED ON CARBON BALANCE (STOICH. + O2)				
- A/F IS TOTAL MASS RATIO				



3. PROCESS DESCRIPTION

TC Energy’s GLGT Boyne Falls Compressor Station #11 is located at 10339 Great Lakes Road, Boyne Falls, MI. The plant operates two Rolls Royce, model Avon 76G stationary gas turbine burning only pipeline quality natural gas. The units peak load HP rating is 16,000 at ISO conditions. The units are a simple cycle, natural gas fired, single-shaft turbines. In a simple cycle turbine, filtered atmosphere air is first compressed by the axial flow compressor. The hot compressed air is then fired with natural gas in the combustor. The hot exhaust gases expand through two turbine stages. The gas producer (G.P.) turbine drives the axial flow air while the power turbine (P.T.) drives the centrifugal pipeline compressor. The pipeline gas compressor moves natural gas through the pipeline by compressing it from an initial “suction” state to a more compressed “discharge” state.

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

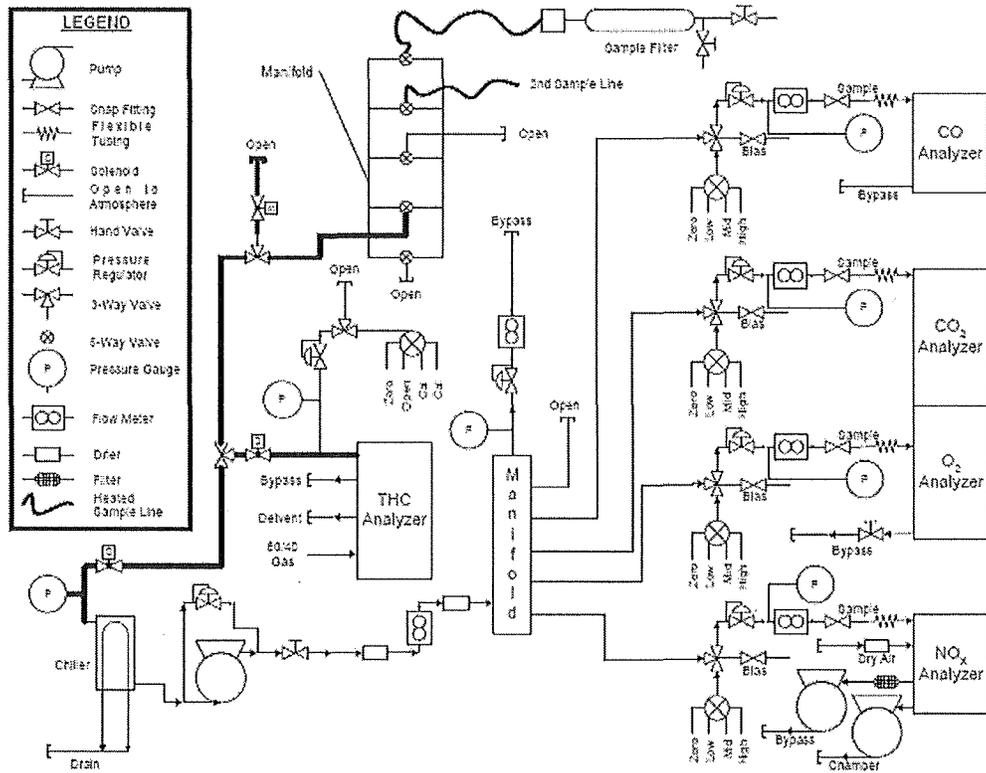
Table 4. Turbines 1101 & 1102 Production Data		
Run	¹ 1101 GG Speed	1102 HP
1	7,499.9	14,942.1
2	7,494.8	15,324.7
3	7,497.9	15,267.4
Average	7,497.5	15,178.1

The above production represents rates that are evenly spaced based on ambient conditions at the proper load capacity over the period of the testing. Accordingly, the testing was conducted under conditions acceptable for Compliance testing.

¹ The load is based on the GG speed for unit 1 since it was close to unit 2 and near the max rated.

All plant data may be found in Appendix B.

Figure 1. Flow 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 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)

USEPA Methods 3A, 7E, and 10 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 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

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

$\rho_{FuelGas}$

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

No_x Corrected to 15% O₂**Where:**

- E_m : Pollutant concentration corrected to 15% O₂, ppm
 NO_x : Pollutant concentration, ppm
 $\%O_2$: Oxygen concentration in percent, measured on a dry basis



Mass Emissions Calculations

The F-factor Method and guidance from Part 75 will be used to calculate the mass emissions rates.

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

Where:

- Em: Pollutant emission rate, lb/hr
- Cd: Pollutant concentration, lb/scf
- Fd: Fuel specific F-factor, dscf/MMBtu
- %O₂: Oxygen concentration, dry basis
- Qh: Fuel rate from calibrated AGA specified Meter, scfh
- GCV: Heating value of the fuel, Btu/scf

To Convert from:	To	Multiply by:
ppm CO	lb/scf	7.268 x 10 ⁻⁸
ppm NO _x	lb/scf	1.194 x 10 ⁻⁷

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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

A compliance test was conducted at GLGT – Boyne Falls Compressor Station (CS11) on gas-fired turbines No. 1101 and 1102 on October 25, 2021. During the course of the testing, the Gas-Fired Turbines No. 1101 and 1102 conformed to the requirements of Code Of Federal Regulations, Title 40, Part 60, Appendix A.

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



A. FIELD TEST DATA

Date 10/25/2021
 Client TC Energy
 Location Boyne Falls MI
 Test Location Unit 1102 & 1101
 Analyzer Horiba PG-350 Horiba PG-350 Horiba PG-350
 Serial Number 272US0C5 272US0C5 272US0C5
 Upscale Response < 60 < 60 < 60
 Downscale Response < 60 < 60 < 60
 CHANNEL LABEL O2 Nox CO
 ON=1 OFF=0 1 1 1

Min			
1	17.123	283.2	
2		283.2	
3	17.136	283.2	
4		283.2	
5	17.103	283.2	
6		283.2	
7		283.2	
8		283.2	
9		282.1	
10		283.1	
11		283.1	
12		283.1	
13		283.1	
14		283.1	
15		283.1	
16		283.1	
17		283.0	
18		283.0	
19		283.0	
20		283.0	
21		283.0	
22		283.0	
23		283.0	
24		283.0	
25		283.0	
26		283.0	
27		283.0	
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60			

High 283.200
 Low 282.100
 Average Converter Percent 99.61%

12:39 Strat % 1 17.630 -0.06% Under 5% or .5 ppm
 12:41 Strat % 2 17.640 0.00% Single point
 12:43 Strat % 3 17.650 0.06%
 Average 17.64

Leak Check Pre Test Pass
 Leak Check Post Test Pass

Units 1102 & 1101

Calibration Gasses

	Scale	High	Mid	Low	Zero
O2	21.80	ER0004758	21.80	RN1429	12.10
Nox	486.00	LL197684	486.00	KN0081	212.000
CO	502.00	LL193983	502.00	LL125036	249.00
					0.00

Select Bias Gasses

	High	Mid	Low
O2		1	
Nox		1	
CO		1	
		1	

Calibration Error Test

	High	Mid	Low	Zero
O2	21.80	12.10		0.00
	21.80	12.00	-0.5%	0.00
	0.0%			0.0%
Nox	486.00	212.00		0.00
	486.20	212.00	0.0%	0.10
	0.0%			0.0%
CO	502.00	249.00	0.00	0.00
	499.70	250.00	0.00	0.50
	-0.5%	0.2%	0.0%	0.1%

Beginning Bias Check 1

	Span	Bias	Zero	Bias
O2	12.00		0.00	
	12.01	0.0%	0.01	0.0%
Nox	212.00		0.10	
	212.20	0.0%	0.20	0.0%
CO	250.00		0.50	
	252.00	0.4%	0.70	0.0%

Ending Calibration Averages

	High	Mid	Low	Zero
O2	21.80	12.00		0.00
Nox	486.20	212.00		0.10
CO	499.70	250.00		0.50

Beginning Bias Averages

	Span	Zero
O2	12.01	0.01
Nox	212.20	0.20
CO	252.00	0.70



UNIT 1101

Date 10/25/2021
 Client TC Energy
 Location Boyne Falls MI
 Test Location 1101.00
 Run 4

Start Time	CHANEL LABEL	Min	O2	Nox	CO	
17:30	1	17.24	41.41	62.87		
	2	17.26	41.10	63.16		
	3	17.28	41.10	62.87		
	4	17.29	41.03	63.33		
	5	17.30	41.03	63.05		
	6	17.30	41.03	62.88		
	7	17.29	40.96	63.16		
	8	17.30	41.11	62.88		
	9	17.30	41.04	63.11		
	10	17.31	40.97	63.00		
	11	17.31	41.05	63.41		
	12	17.31	40.90	63.59		
	13	17.32	41.05	62.45		
	14	17.31	40.91	63.03		
	15	17.31	40.99	63.21		
	16	17.31	40.92	63.33		
	17	17.32	40.92	62.88		
	18	17.32	40.93	63.29		
	19	17.33	40.86	63.18		
	20	17.33	40.79	63.30		
	17:50	21	17.32	40.86	63.20	
		22	17.33	40.64	63.67	
		23	17.33	40.64	63.79	
		24	17.33	40.72	64.08	
		25	17.33	40.73	64.09	
		26	17.33	40.65	64.84	
		27	17.33	40.66	63.70	
		28	17.33	40.74	63.94	
		29	17.34	40.51	64.00	
		30	17.34	40.44	64.12	
	31	17.34	40.44	64.13		
32	17.31	40.89	62.70			
33	17.33	41.05	62.42			
34	17.32	41.05	62.25			
35	17.32	41.13	62.55			
36	17.33	40.98	64.55			
37	17.33	40.98	62.55			
38	17.35	41.13	62.67			
39	17.36	40.99	62.45			
40	17.35	40.84	63.14			
41	17.36	40.84	62.86			
42	17.37	40.84	62.40			
43	17.36	40.84	62.69			
44	17.37	40.62	63.04			
45	17.37	40.77	62.88			
46	17.37	40.70	63.05			
47	17.37	40.63	63.17			
48	17.37	40.63	63.18			
49	17.37	40.56	63.18			
50	17.37	40.56	63.02			
51	17.37	40.72	62.34			
52	17.37	40.80	62.63			
53	17.38	40.80	62.35			
54	17.38	40.73	62.36			
55	17.36	40.81	62.77			
56	17.37	40.73	62.77			
57	17.37	40.58	62.96			
58	17.38	40.66	62.67			
59	17.38	40.66	62.97			
18:29	60	17.38	40.51	62.92		
		17.335	40.835	63.12		
Corrected Avg			17.50	39.50	61.64	

Actual Bias Gasses

	High	Mid	Low
O2		12.10	
Nox		212.00	
CO		249.00	

Ending	Bias Check	4			Zero	Drift	Bias
O2	Span	12.02			0.12		
		12.02	0.0%	0.1%	0.08	-0.2%	0.3%
Nox	Span	213.60			1.50		
		210.80	-0.6%	-0.2%	1.70	0.0%	0.3%
CO	Span	250.90			1.90		
		251.40	0.1%	0.3%	0.60	-0.3%	0.0%

Ending Bias Averages

	span	zero
O2	12.02	0.08
Nox	210.80	1.70
CO	251.40	0.60

Date 10/25/2021
 Client TC Energy
 Location Boyne Falls MI
 Test Location 1101.00
 Run 5

CHANEL LABEL	O2	Nox	CO
Start Time	Min		
18:39	1	17.37	40.16
	2	17.37	39.94
	3	17.37	40.16
	4	17.38	40.01
	5	17.35	40.39
	6	17.35	40.62
	7	17.36	40.55
	8	17.35	40.40
	9	17.34	40.55
	10	17.37	40.55
	11	17.37	40.48
	12	17.36	40.55
	13	17.36	40.63
	14	17.36	40.71
	15	17.37	40.71
	16	17.36	40.71
	17	17.36	40.64
	18	17.37	40.64
	19	17.37	40.65
	20	17.37	40.72
18:59	21	17.37	40.73
	22	17.36	40.73
	23	17.38	40.73
	24	17.38	40.73
	25	17.38	40.58
	26	17.37	40.58
	27	17.37	40.66
	28	17.37	40.66
	29	17.37	40.59
	30	17.37	40.74
	31	17.39	40.59
	32	17.38	40.59
	33	17.38	40.74
	34	17.39	40.59
	35	17.38	40.59
	36	17.38	40.51
	37	17.39	40.59
	38	17.39	40.59
	39	17.38	40.59
	40	17.38	40.67
	41	17.38	40.74
	42	17.38	40.67
	43	17.38	40.52
	44	17.37	40.74
	45	17.38	40.59
	46	17.37	40.59
	47	17.38	40.60
	48	17.38	40.60
	49	17.38	40.60
	50	17.38	40.60
	51	17.37	40.52
	52	17.38	40.52
	53	17.38	40.37
	54	17.38	40.37
	55	17.38	40.37
	56	17.38	40.37
	57	17.38	40.30
	58	17.38	40.30
	59	17.38	40.30
19:38	60	17.38	40.37
		17.373	40.544
Corrected Avg		17.51	39.21

Actual Bias Gasses

	High	Mid	Low
O2		12.10	
Nox		212.00	
CO		249.00	

Ending Bias Check 5

	Span	Drift	Bias	Zero	Drift	Bias
O2	12.02 12.04	0.1%	0.2%	0.08 0.10	0.1%	0.4%
Nox	210.80 211.30	0.1%	-0.1%	1.70 2.00	0.1%	0.4%
CO	251.40 251.90	0.1%	0.4%	0.60 0.80	0.0%	0.0%

Ending Bias Averages

	span	zero
O2	12.04	0.10
Nox	211.30	2.00
CO	251.90	0.80



UNIT 1102

Date 10/25/2021
 Client TC Energy
 Location Boyne Falls MI
 Test Location 1101.00
 Run 6

Start Time	CHANEL LABEL	O2	Nox	CO
19:48	1	17.39	40.30	65.03
	2	17.38	40.15	64.86
	3	17.38	40.30	64.75
	4	17.39	40.22	64.86
	5	17.39	40.22	64.46
	6	17.38	40.14	65.04
	7	17.38	40.14	65.04
	8	17.38	40.22	64.75
	9	17.38	40.29	64.64
	10	17.38	40.22	65.04
	11	17.39	40.06	64.18
	12	17.37	40.14	65.21
	13	17.37	40.14	65.50
	14	17.39	40.06	64.58
	15	17.37	40.06	64.93
	16	17.39	40.21	64.93
	17	17.37	40.14	65.05
	18	17.39	40.14	64.65
	19	17.39	40.06	64.76
	20:08	20	17.38	40.14
21		17.39	40.21	64.93
22		17.38	40.13	64.87
23		17.38	40.13	65.33
24		17.38	40.13	65.62
25		17.38	40.13	65.05
26		17.38	40.05	65.05
27		17.38	40.06	65.05
28		17.38	40.06	65.51
29		17.39	40.05	65.79
30		17.39	40.05	64.87
31		17.39	39.98	65.62
32		17.38	39.83	65.05
33		17.39	40.05	65.04
34		17.39	40.21	64.76
35		17.38	40.13	65.05
36		17.39	40.13	64.30
37		17.39	40.13	64.76
38		17.38	39.98	64.76
39		17.38	40.06	64.93
40	17.37	40.29	64.47	
41	17.39	40.21	64.35	
42	17.38	40.14	64.35	
43	17.37	40.29	64.87	
44	17.39	40.14	64.75	
45	17.38	40.14	64.47	
46	17.38	40.06	65.33	
47	17.38	40.14	65.61	
48	17.38	40.14	65.04	
49	17.38	40.07	64.92	
50	17.38	39.99	65.15	
51	17.38	40.14	65.15	
52	17.39	40.06	64.75	
53	17.39	40.06	64.75	
54	17.38	40.21	65.33	
55	17.38	40.06	65.16	
56	17.38	40.06	65.04	
57	17.39	39.99	65.44	
58	17.39	40.14	64.99	
59	17.38	40.06	65.04	
20:37	60	17.37	40.08	64.87
		17.383	40.122	64.96
	Corrected Avg	17.49	38.49	63.47

Actual Bias Gasses

	High	Mid	Low
O2		12.10	
Nox		212.00	
CO		249.00	

Ending Bias Check 6

	Span	Drift	Bias	Zero	Drift	Bias
O2	12.04			0.10		
	12.06	0.1%	0.3%	0.06	-0.2%	0.2%
Nox	211.30			2.00		
	211.70	0.1%	-0.1%	2.20	0.0%	0.4%
CO	251.90			0.80		
	252.50	0.1%	0.5%	1.00	0.0%	0.1%

Ending Bias Averages

	span	zero
O2	12.06	0.06
Nox	211.70	2.20
CO	252.50	1.00

Date 10/25/2021
 Client TC Energy
 Location Boyne Falls MI
 Test Location 1102
 Run 1

Start Time	CHANEL LABEL	O2	Nox	CO
13:00	1	17.12	52.24	59.82
	2	17.15	52.26	60.12
	3	17.14	52.11	60.32
	4	17.11	53.28	58.33
	5	17.10	53.13	58.52
	6	17.09	53.15	57.88
	7	17.08	52.99	57.01
	8	17.11	52.91	57.10
	9	17.10	52.80	57.85
	10	17.11	52.54	58.09
	11	17.10	52.53	58.45
	12	17.11	52.45	58.02
	13	17.11	52.29	58.04
	14	17.11	52.47	57.77
	15	17.10	52.39	57.62
	16	17.10	52.32	57.81
	17	17.10	52.33	58.10
	18	17.11	52.18	57.73
	19	17.12	52.35	57.01
	20	17.11	52.03	57.77
13:20	21	17.12	52.05	57.73
	22	17.12	51.97	57.74
	23	17.13	51.74	57.20
	24	17.12	51.83	57.79
	25	17.13	51.76	57.13
	26	17.13	51.60	57.66
	27	17.13	51.45	58.24
	28	17.13	51.21	58.71
	29	17.15	51.30	58.62
	30	17.14	51.23	58.59
	31	17.14	51.15	59.18
	32	17.15	51.08	57.78
	33	17.15	51.08	59.10
	34	17.14	51.17	59.13
	35	17.15	51.09	59.32
	36	17.15	51.18	58.88
	37	17.15	50.94	58.90
	38	17.11	52.03	58.06
	39	17.12	51.95	57.80
	40	17.12	51.71	57.65
	41	17.13	51.80	57.55
	42	17.13	52.06	56.88
	43	17.14	51.98	56.67
	44	17.13	51.99	57.14
	45	17.12	51.99	57.05
	46	17.12	51.92	57.18
	47	17.13	51.84	56.91
	48	17.13	52.01	56.63
	49	17.12	52.00	56.53
	50	17.13	52.00	56.55
	51	17.14	52.08	56.45
	52	17.12	51.83	57.03
	53	17.13	51.92	56.58
	54	17.12	52.25	56.59
	55	17.12	52.09	56.88
	56	17.13	52.01	56.89
	57	17.12	51.85	57.19
	58	17.12	51.94	57.31
	59	17.12	51.86	57.04
13:59	60	17.12	51.70	57.34
		17.122	52.003	58.166
	Corrected Avg	17.26	51.43	56.68

Actual Bias Gasses

	High	Mid	Low
O2		12.10	
Nox		212.00	
CO		249.00	

Ending Bias Check 1

Ending	Span			Zero	Drift	Bias
	Span	Drift	Bias			
O2	12.01			0.01		
	12.03	0.1%	0.1%	0.10	0.4%	0.5%
Nox	212.20			0.20		
	210.00	-0.5%	-0.4%	1.90	0.3%	0.4%
CO	252.00			0.70		
	251.60	-0.1%	0.3%	1.50	0.2%	0.2%

Ending Bias Averages

	span	zero
O2	12.03	0.10
Nox	210.00	1.90
CO	251.60	1.50

Date 10/25/2021
 Client TC Energy
 Location Boyne Falls MI
 Test Location 1102
 Run 2

Start Time	CHANEL LABEL	O2	Nox	CO
14:10	1	17.04	51.87	58.02
	2	17.05	51.67	57.87
	3	17.06	51.97	57.38
	4	17.05	51.69	57.35
	5	17.07	51.74	57.48
	6	17.08	51.71	57.73
	7	17.08	51.53	57.81
	8	17.07	51.60	58.23
	9	17.07	51.61	57.92
	10	17.07	51.63	57.90
	11	17.07	51.81	57.88
	12	17.07	51.49	58.15
	13	17.08	51.59	57.98
	14	17.08	51.86	57.86
	15	17.08	51.79	57.69
	16	17.07	51.73	57.69
	17	17.07	51.50	57.71
	18	17.06	51.93	58.16
	19	17.06	51.78	57.83
	14:30	20	17.07	51.56
21		17.07	51.57	58.47
22		17.07	51.67	57.86
23		17.07	51.60	57.47
24		17.08	51.70	57.32
25		17.07	51.71	57.79
26		17.06	51.64	57.52
27		17.08	51.66	57.25
28		17.08	51.51	57.55
29		17.08	51.60	57.68
30		17.08	51.53	56.84
31		17.08	51.79	57.42
32		17.07	51.80	57.61
33		17.07	51.73	57.28
34		17.08	51.74	57.30
35		17.08	51.66	57.88
36		17.07	51.92	57.50
37		17.07	51.77	57.80
38		17.07	51.60	58.27
39		17.07	51.70	58.00
40	17.08	51.95	57.21	
41	17.07	51.71	57.85	
42	17.07	51.71	57.40	
43	17.08	51.71	58.05	
44	17.08	51.63	58.46	
45	17.07	51.72	58.06	
46	17.07	51.47	58.19	
47	17.08	51.56	58.20	
48	17.07	51.56	57.92	
49	17.07	51.32	59.07	
50	17.09	51.32	57.93	
51	17.08	51.41	58.06	
52	17.09	51.41	57.95	
53	17.07	51.25	58.81	
54	17.09	51.34	58.14	
55	17.09	51.34	58.26	
56	17.10	51.26	57.98	
57	17.09	51.35	58.27	
58	17.09	51.35	58.39	
59	17.09	51.19	58.57	
15:09	60	17.09	51.02	59.15
		17.075	51.609	57.89
	Corrected Avg	17.12	50.60	56.18

Actual Bias Gasses

	High	Mid	Low
O2		12.10	
Nox		212.00	
CO		249.00	

Ending Bias Check 2

	Span	Drift	Bias	Zero	Drift	Bias
O2	12.03			0.10		
	12.18	0.7%	0.8%	0.14	0.2%	0.6%
Nox	210.00			1.90		
	211.30	0.3%	-0.1%	1.60	-0.1%	0.3%
CO	251.60			1.50		
	250.50	-0.2%	0.1%	1.70	0.0%	0.2%

Ending Bias Averages

	span	zero
O2	12.18	0.14
Nox	211.30	1.60
CO	250.50	1.70

Date 10/25/2021
 Client TC Energy
 Location Boyne Falls MI
 Test Location 1102
 Run 3

Start Time	CHANEL LABEL	Min	O2	Nox	CO
15:20	1		16.94	52.24	60.65
	2		17.00	52.06	59.90
	3		16.97	51.62	59.94
	4		16.99	51.52	60.15
	5		17.00	51.43	59.73
	6		17.01	51.17	60.58
	7		17.02	51.17	60.28
	8		17.05	51.18	59.81
	9		17.03	51.18	59.41
	10		17.03	51.27	59.51
	11		17.03	51.19	59.79
	12		17.04	51.20	59.96
	13		17.04	51.04	59.79
	14		17.04	50.97	60.35
	15		17.05	50.97	60.36
	16		17.05	50.82	60.36
	17		17.06	50.83	60.36
	18		17.06	50.67	60.36
	19		17.05	50.67	60.94
	20		17.05	50.77	60.37
15:40	21		17.05	50.60	60.89
	22		17.05	50.69	60.55
	23		17.05	50.78	60.39
	24		17.05	50.62	60.22
	25		17.05	50.71	60.68
	26		17.03	50.80	59.95
	27		17.03	51.06	59.67
	28		17.05	51.14	59.22
	29		17.04	51.07	59.68
	30		17.04	51.24	59.52
	31		17.04	51.07	59.41
	32		17.04	51.08	58.73
	33		17.04	51.16	59.25
	34		17.05	51.17	59.14
	35		17.04	50.92	59.43
	36		17.04	51.10	59.27
	37		17.04	50.94	58.99
	38		17.04	51.11	58.99
	39		17.05	51.11	59.12
	40		17.05	50.86	59.30
	41		17.05	50.79	59.88
	42		17.05	50.80	59.31
	43		17.05	50.88	59.61
	44		17.05	50.81	59.90
	45		17.07	50.73	59.51
	46		17.06	50.57	60.49
	47		17.07	50.41	59.93
	48		17.08	50.41	60.05
	49		17.08	50.50	60.40
	50		17.07	50.58	60.23
	51		17.07	50.42	60.13
	52		17.06	50.59	59.96
	53		17.07	50.93	59.11
	54		17.06	50.93	59.12
	55		17.07	51.02	58.84
	56		17.07	50.94	58.67
	57		17.07	51.03	58.57
	58		17.07	50.95	58.86
	59		17.07	50.87	59.44
16:19	60		17.07	50.87	59.51
			17.045	50.970	59.77
	Corrected Avg		17.10	49.68	58.00

Actual Bias Gasses

	High	Mid	Low
O2		12.10	
Nox		212.00	
CO		249.00	

Ending Bias Check 3

	Span	Drift	Bias	Zero	Drift	Bias
O2	12.18 12.02	-0.7%	0.1%	0.14 0.12	-0.1%	0.5%
Nox	211.30 213.60	0.5%	0.3%	1.60 1.50	0.0%	0.3%
CO	250.50 250.90	0.1%	0.2%	1.70 1.90	0.0%	0.2%

Ending Bias Averages

	span	zero
O2	12.02	0.12
Nox	213.60	1.50
CO	250.90	1.90



B. PROCESS OPERATING DATA

Pipeline	Chromatograph	Date Time	BTU
GLG	Fortune Lake	10/25/2021 00:00:00	1041.1076

Gravity	Carbon Dioxide	Nitrogen	Methane
0.5872	0.6304	0.4967	94.0192

Ethane	Propane	N Butane	Iso Butane
4.7361	0.1097	0.0032	0.0042

Pentane	Iso Pentane	Neo Pentane	Hexane Plus
0.0000	0.0005	0.0000	0.0000

REVIEWED
By Anova Frasure at 1:54 pm, Nov 16, 2021