COMPLIANCE TEST REPORT

Great Lake Gas Transmission Partnership Company
Crystal Falls Compressor Station #8
Combustion Turbine No. 802

Prepared for:

TransCanada
In business to deliver

TransCanada's Great Lakes Gas Transmission Partnership
Crystal Falls, MI

Prepared by:

EQM

Environmental Quality Management, Inc.
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PN: 050614.0057

April 2017

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: GLGT Crystal Falls Compressor Station — County: Iron

Source Address: 151 Oss Road — City: Crystal Falls, MI

AQD Source ID (SRN): N3760 — RO Permit No.: MI-ROP-N3760-2016 — RO Permit Section No.: 1

Please check the appropriate box(es):

☐ **Annual Compliance Certification** (General Condition No. 28 and No. 29 of the RO Permit)

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification** (General Condition No. 23 of the RO Permit)

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 6/2/2016 To 6/2/2021

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Test of NOx and CO limits per permit condition Unit 802, Section C.V

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

Richard Connor	Director-Great Lakes Region	(231) 527-2122
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official — Date: 5/2/2017

* Photocopy this form as needed.

EQP 5736 (Rev 9/01)

1. INTRODUCTION

This report presents the results of the source emissions testing conducted by Environmental Quality Management, Inc. (EQ) for TransCanada's Great Lakes Gas Transmission Partnership (GLGT) at Crystal Falls compressor station, near Crystal Falls, MI, which is located in Iron County.

The primary purpose of this testing program was to conduct emissions testing to determine compliance with operating permit No. MI-ROP-N3760-2016 for Combustion EU-UNIT 802 Turbine (No. 802) at GLGT's gas compressor facility.

EQ's responsibility was to conduct the compliance testing for the O2, CO, and NOx emissions rates and perform data reduction for conformance evaluation. Great Lakes Gas Transmission Partnership'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 TransCanada's process operations, and Compliance testing. The Compliance testing conducted on the Combustion Turbine No. 802 was performed on Wednesday, March 8, 2107, from 12:17 P.M. to 5:11 P.M.

The following requirements were specific for the testing program:

1. Equipment calibrations performed and calibration data provided.
2. Three (3) twenty (20) minute O_2, CO, and NOx test runs performed at the Combustion Turbine No. 802 at four (4) load conditions, with the highest load at maximum achievable horsepower considering pipeline conditions and ambient temperature pursuant to EPA, Title 40, Code of Federal Regulations, Part 60 Subpart GG.
3. Process manufacturing operations maintained at 100%-50% of capacities and 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 O_2 CO, and NOx emissions determinations.
5. Stratification was found to be less than 5% in both turbine exhausts.

PREFACE

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

Karl Mast
Test Supervisor

SUMMARY

The compliance testing was performed on the Combustion Turbine No.802 system in accordance with the requirements of the Title 40, Code of Federal Regulations, Part 60, Subpart GG, §60.335(B)(2) and at ambient temperature greater than 0 °F. The results of the testing are detailed in the following tables.

EU-UNIT 802, Turbine GE LM1600. GLGT Crystal Falls				
Parameter	Load 1 High	Load 2 Mid High	Load 3 Mid Low	Load 4 Low
HP	22,659	15,780	11,784	9,444
% Load	98.5	68.6	51.2	41.1

EU-UNIT 802 Permit Limit NOx: 175.2 ppmvd @ 15% O_2 - 89.0 lb/hr				
Parameter	Load 1 High	Load 2 Mid High	Load 3 Mid Low	Load 4 Low
NOx ppmvd @ 15% O_2	141.79	115.70	93.89	81.46
NOx lb/hr	77.85	52.10	34.49	26.29

EU-UNIT 802 Permit Limit CO: 31.9 ppmvd - 14.8 lb/hr				
Parameter	Load 1 High	Load 2 Mid High	Load 3 Mid Low	Load 4 Low
CO ppmvd	8.34	5.32	6.66	11.22
CO lb/hr	3.01	1.75	1.69	3.05

The testing program was approved by and/or coordinated with Roy Cannon, TransCanada's GLGT Partnership. The emission testing was managed by Karl Mast, Manager, Emission Measurement and Project Manager, EQ, Zach Hill, Team Leader, EQ and Jeff Cavanaugh, Test Technician, The emission testing was observed by local Michigan DEQ.

2. TEST RESULTS SUMMARY

The compliance testing was performed on the Combustion Turbine No. 802 system in accordance with the requirements of the Title 40, Code of Federal Regulations, Part 60, Subpart GG, §60.335(B)(2) and at ambient temperature greater than 0 °F. A summary of the test results is given below:

Table 1. Test Results Summary-Operating Parameters-Turbine No. 802

EU-UNIT 802, Turbine GE LM1600. GLGT Crystal Falls				
Parameter	Load 1 High	Load 2 Mid High	Load 3 Mid Low	Load 4 Low
HP	22,659	15,780	11,784	9,444
% Load	98.5	68.6	51.2	41.1

Table 2. Test Results Summary-NO_x-Turbine No. 802

EU-UNIT 802 Permit Limit NOx: 175.2 ppmvd @ 15% O_2 - 89.0 lb/hr				
Parameter	Load 1 High	Load 2 Mid High	Load 3 Mid Low	Load 4 Low
NOx ppmvd @ 15% O_2	141.79	115.70	93.89	81.46
NOx lb/hr	77.85	52.10	34.49	26.29

Table 3. Test Results Summary-CO-Turbine No. 802

EU-UNIT 802 Permit Limit CO: 31.9 ppmvd - 14.8 lb/hr				
Parameter	Load 1 High	Load 2 Mid High	Load 3 Mid Low	Load 4 Low
CO ppmvd	8.34	5.32	6.66	11.22
CO lb/hr	3.01	1.75	1.69	3.05

Based on the information provided above, the Combustion Turbine No. 802 and 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 4-14.

Additional testing information may be found in Appendix A.

Table 4. Operating Parameters and Ambient Conditions-High Load-Turbine No. 802

Run	1	2	3	Load 1 Average
Date	3.8.17	3.8.17	3.8.17	
Time	12:17-12:37	12:37-12:57	12:57-13:17	
Condition	HIGH	HIGH	HIGH	
Operating Parameters				
Turbine				
Horsepower	23,139.0	23,336.2	21,501.0	22,658.7
% Ambient Load	100.6	101.5	93.5	98.5
GP RPM	15,414.1	15,409.2	15,414.1	15,412.5
% GP Speed	93.7	93.7	93.7	93.7
PT RPM	6,307.2	6,313.6	6,341.6	6,320.8
% PT Speed	85.8	85.9	86.3	86.0
Compressor				
Measured Turbine Inlet Temperature Average - MGT (°F)	25.0	25.0	25.0	25.0
Compressor Suction Pressure (PSIG)	759.9	748.1	736.0	748.0
Compressor Suction Temperature (°F)	38.4	37.9	37.5	37.9
Compressor Discharge Pressure (PSIG)	828.7	834.1	838.4	833.7
Compressor Discharge Temperature (°F)	79.8	81.3	80.1	80.1
PCD_{obs} Observed Combustor Inlet Pressure, (PSIG)	297.1	296.2	297.2	296.8
PCD_{obs} Observed Combustor Inlet Pressure, (PSIA)	311.3	310.4	311.4	311.1
Ambient Conditions				
Ambient Temperature (°F)	26.00	25.79	27.73	26.51
Barometric Pressure ("Hg)	28.95	28.96	28.96	28.96
Ambient Relative Humidity (%)	41.00	49.00	46.00	45.33

Table 5. Emissions Concentrations, Calculated Mass Emissions/Calculated & Fuel Flows High Load-Turbine No. 802

Run	1	2	3	Load 1 Average
Date	3.8.17	3.8.17	3.8.17	
Time	12:17-12:37	12:37-12:57	12:57-13:17	
Condition	HIGH	HIGH	HIGH	
Emissions Concentrations & Calculated Mass Emissions				
NO_X ppm (BIAS Corrected)	132.09	130.64	130.91	131.21
NO_X g/BHP-HR	1.54	1.50	1.64	1.56
NOx lb/MMBTU factor	0.525	0.520	0.521	0.52
NO_X LB/HR	78.48	77.33	77.73	77.85
NO_X (ppm @ 15% O_2)	142.73	141.17	141.46	141.79
NO_X (ppm @ 15% O_2, ISO)	161.19	159.46	159.06	159.90
NOx LB/MMBTU	0.526	0.521	0.522	0.52
CO ppm (BIAS Corrected)	7.95	8.81	8.27	8.34
CO g/BHP-HR	0.06	0.06	0.06	0.06
CO LB/HR	2.88	3.17	2.99	3.01
CO (ppm @ 15% O_2)	8.59	9.52	8.94	9.02
% O_2 (BIAS Corrected)	15.44	15.44	15.44	15.44
Calculated Emissions Concentrations				
Calculated Flows				
Fuel Flow - (SCFM)	2,426.0	2,417.0	2,424.3	2,422
Fuel Flow - (SCFH)	145,560	145,020	145,460	145,347
Exhaust Flow (LB/HR)	376,693	376,982	377,490	377,055
Exhaust Flow (WSCFM)	87,542	87,218	87,482	87,414
Air Flow (WSCFM)	79,689	79,393	79,634	79,572
Heat Rate (BTU/HP-HR)	5,822	5,751	6,261	5,944
Fuel Flow Measurements				
Fuel Gas Differential Pressure ("H_2O)	51.4	51.0	51.3	51.2
Fuel Gas Static Pressure (PSIG)	453.2	453.2	453.4	453.3
Fuel Gas Temperature (°F)	22.2	22.5	22.7	22.5

** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION
* BASED ON CARBON BALANCE (STOICH. + O2)
- A/F IS TOTAL MASS RATIO

Table 6. Operating Parameters and Ambient Conditions-Mid High Load-Turbine No. 802

Run	4	5	6	Load 2 Average
Date	3.8.17	3.8.17	3.8.17	
Time	1338-1358	1358-1418	1418-1438	
Condition	MID HIGH	MID HIGH	MID HIGH	
Operating Parameters				
Turbine				
Horsepower	15,807.4	15,794.7	15,736.6	15,779.6
% Ambient Load	68.7	68.7	68.4	68.6
GP RPM	15,013	14,994	14,974	14,993.6
% GP Speed	91.3	91.1	91.0	91.1
PT RPM	5,871	5,875	5,873	5,873.3
% PT Speed	79.9	79.9	79.9	79.9
Compressor				
Measured Turbine Inlet Temperature Average - MGT (°F)	28.1	26.99	26.99	27.34
Compressor Suction Pressure (PSIG)	718	707	698	707
Compressor Suction Temperature (°F)	37.0	36.7	36.6	36.7
Compressor Discharge Pressure (PSIG)	840	843	845	843
Compressor Discharge Temperature (°F)	75.5	76.5	77.7	76.6
PCD_{abs} Observed Combustor Inlet Pressure, (PSIG)	257.8	257.1	256.1	257.0
PCD_{abs} Observed Combustor Inlet Pressure, (PSIA)	272.0	271.3	270.2	271.2
Ambient Conditions				
Ambient Temperature (°F)	26.52	26.86	28.96	27.45
Barometric Pressure ("Hg)	28.96	28.96	28.69	28.87
Ambient Relative Humidity (%)	50.00	46.00	43.00	46.33

Table 7. Emissions Concentrations, Calculated Mass Emissions/Calculated & Fuel Flows Mid High Load-Turbine No. 802

Run	4	5	6	Load 2 Average
Date	3.8.17	3.8.17	3.8.17	
Time	1338-1358	1358-1418	1418-1438	
Condition	MID HIGH	MID HIGH	MID HIGH	
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	96.70	96.54	96.02	96.42
NO_X g/BHP-HR	1.50	1.50	1.49	1.50
NOx lb/MMBTU factor	0.426	0.426	0.426	0.43
NO_X LB/HR	52.33	52.18	51.78	52.10
NO_X (ppm @ 15% O_2)	115.73	115.77	115.62	115.70
NO_X (ppm @ 15% O_2, ISO)	156.30	156.08	160.31	157.56
NOx LB/MMBTU	0.427	0.427	0.426	0.43
CO ppm (BIAS Corrected)	5.18	5.56	5.22	5.32
CO g/BHP-HR	0.05	0.05	0.05	0.05
CO LB/HR	1.71	1.83	1.71	1.75
CO (ppm @ 15% O_2)	6.20	6.67	6.29	6.38
% O_2 (BIAS Corrected)	15.97	15.98	16.00	15.98
Calculated Emissions Concentrations				
Calculated Flows				
Fuel Flow - (SCFM)	1,995.0	1,988.7	1,976.0	1,987
Fuel Flow - (SCFH)	119,700	119,320	118,560	119,193
Exhaust Flow (LB/HR)	345,853	344,615	343,212	344,560
Exhaust Flow (WSCFM)	71,990	71,761	71,304	71,685
Air Flow (WSCFM)	72,504	72,419	72,249	72,391
Heat Rate (BTU/HP-HR)	7,008	6,991	6,972	6,990
Fuel Flow Measurements				
Fuel Gas Differential Pressure ("H_2O)	34.72	34.56	34.16	34.48
Fuel Gas Static Pressure (PSIG)	454.99	454.8	454.99	454.9
Fuel Gas Temperature (°F)	23.6	24.14	24.7	24.1
** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION			29.96	
* BASED ON CARBON BALANCE (STOICH. + O2)				
- A/F IS TOTAL MASS RATIO				

Table 8. Operating Parameters and Ambient Conditions-Mid Low Load-Turbine No. 802

Run	7	8	9	Load 3 Average
Date	3.8.17	3.8.17	3.8.17	
Time	1503-1523	1523-1543	1543-1603	
Condition	MID LOW	MID LOW	MID LOW	
Operating Parameters				
Turbine				
Horsepower	11,982.3	11,731.6	11,638.1	11,784.0
% Ambient Load	52.1	51.0	50.6	51.2
GP RPM	14,563	14,549	14,549	14,553.7
% GP Speed	88.5	88.4	88.4	88.5
PT RPM	5,381	5,388	5,381	5,383.5
% PT Speed	73.2	73.3	73.2	73.2
Compressor				
Measured Turbine Inlet Temperature Average - MGT (°F)	28.0	28.0	28.1	28
Compressor Suction Pressure (PSIG)	686	682	676	681
Compressor Suction Temperature (°F)	36.7	36.6	36.6	37
Compressor Discharge Pressure (PSIG)	844	845	846	845
Compressor Discharge Temperature (°F)	74.7	74.8	75.5	75.0
PCD_{obs} Observed Combustor Inlet Pressure, (PSIG)	220.2	219.3	219.10	219.5
PCD_{obs} Observed Combustor Inlet Pressure, (PSIA)	234.4	233.5	233.3	233.8
Ambient Conditions				
Ambient Temperature (°F)	26.62	26.95	27.15	26.91
Barometric Pressure ("Hg)	28.96	28.96	28.96	28.96
Ambient Relative Humidity (%)	45.00	44.00	44.00	44.33

Table 9. Emissions Concentrations, Calculated Mass Emissions/Calculated & Fuel Flows Mid Low Load-Turbine No. 802

Run	7	8	9	Load 3 Average
Date	3.8.17	3.8.17	3.8.17	
Time	1503-1523	1523-1543	1543-1603	
Condition	MID LOW	MID LOW	MID LOW	
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	71.13	70.66	70.49	70.76
NO_X g/BHP-HR	1.31	1.34	1.33	1.33
NOx lb/MMBTU factor	0.347	0.346	0.344	0.35
NO_X LB/HR	34.71	34.54	34.21	34.49
NO_X (ppm @ 15% O_2)	94.31	93.90	93.46	93.89
NO_X (ppm @ 15% O_2, ISO)	126.76	126.77	126.31	126.61
NOx LB/MMBTU	0.348	0.346	0.345	0.35
CO ppm (BIAS Corrected)	6.77	6.60	6.61	6.66
CO g/BHP-HR	0.08	0.08	0.08	0.07
CO LB/HR	2.01	1.96	1.95	1.69
CO (ppm @ 15% O_2)	8.98	8.77	8.76	7.56
% O_2 (BIAS Corrected)	16.45	16.46	16.45	15.70
Calculated Emissions Concentrations				
Calculated Flows				
Fuel Flow - (SCFM)	1,623.8	1,623.0	1,615.0	1,621
Fuel Flow - (SCFH)	97,430	97,380	96,900	97,237
Exhaust Flow (LB/HR)	311,844	312,191	309,933	311,323
Exhaust Flow (WSCFM)	58,596	58,566	58,277	58,480
Air Flow (WSCFM)	65,308	65,420	64,953	65,227
Heat Rate (BTU/HP-HR)	7,525	7,682	7,705	7,637
Fuel Flow Measurements				
Fuel Gas Differential Pressure ("H_2O)	23.07	23.07	22.85	22.99666667
Fuel Gas Static Pressure (PSIG)	456.12	456.1	456.0	456.1
Fuel Gas Temperature (°F)	25.8	26.0	26.2	26.0

Table 10. Operating Parameters and Ambient Conditions-Low Load-Turbine No. 802

Run	10	11	12	Load 4 Average
Date	3.8.17	3.8.17	3.8.17	
Time	1611-1631	1631-1651	1651-1711	
Condition	LOW	LOW	LOW	
Operating Parameters				
Turbine				
Horsepower	9,544.1	9,421.5	9,367.2	9,444.3
% Ambient Load	41.5	41.0	40.7	41.1
GP RPM	14,307	14,307	14,293	14,302
% GP Speed	87.0	87.0	86.9	86.9
PT RPM	5,055	5,061	5,048	5,055
% PT Speed	68.8	68.9	68.7	68.8
Compressor				
Measured Turbine Inlet Temperature Average - MGT (°F)	28.1	29.0	29.0	28.7
Compressor Suction Pressure (PSIG)	675	671	668	671
Compressor Suction Temperature (°F)	36.7	36.8	36.8	36.8
Compressor Discharge Pressure (PSIG)	843	843	843	843
Compressor Discharge Temperature (°F)	73.7	73.9	74.5	74.0
PCD_{obs} Observed Combustor Inlet Pressure, (PSIG)	196.7	196.6	196.6	196.6
PCD_{obs} Observed Combustor Inlet Pressure, (PSIA)	210.9	210.8	210.8	210.9
Ambient Conditions				
Ambient Temperature (°F)	26.4	26.4	28.2	27.00
Barometric Pressure ("Hg)	28.96	28.96	28.96	28.96
Ambient Relative Humidity (%)	45.0	43.0	46.0	44.67

Table 11. Emissions Concentrations, Calculated Mass Emissions/Calculated & Fuel Flows Low Load-Turbine No. 802

Run	10	11	12	Load 4 Average
Date	3.8.17	3.8.17	3.8.17	
Time	1611-1631	1631-1651	1651-1711	
Condition	LOW	LOW	LOW	
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	59.23	58.81	58.54	58.86
NO_X g/BHP-HR	1.27	1.27	1.25	1.26
NOx lb/MMBTU factor	0.303	0.299	0.298	0.30
NO_X LB/HR	26.63	26.34	25.90	26.29
NO_X (ppm @ 15% O_2)	82.23	81.26	80.89	81.46
NO_X (ppm @ 15% O_2, ISO)	117.71	116.45	115.16	116.44
NOx LB/MMBTU	0.303	0.300	0.298	0.30
CO ppm (BIAS Corrected)	11.17	11.19	11.31	11.22
CO g/BHP-HR	0.15	0.15	0.15	0.15
CO LB/HR	3.06	3.05	3.05	3.05
CO (ppm @ 15% O_2)	15.51	15.46	15.63	15.53
% O_2 (BIAS Corrected)	16.65	16.63	16.63	16.64
Calculated Emissions Concentrations				
Calculated Flows				
Fuel Flow - (SCFM)	1,429.2	1,430.2	1,412.7	1,424
Fuel Flow - (SCFH)	85,750	85,810	84,760	85,440
Exhaust Flow (LB/HR)	287,797	286,193	283,303	285,764
Exhaust Flow (WSCFM)	51,572	51,608	50,976	51,385
Air Flow (WSCFM)	60,151	59,915	59,182	59,749
Heat Rate (BTU/HP-HR)	8,315	8,429	8,374	8,372
Fuel Flow Measurements				
Fuel Gas Differential Pressure ("H_2O)	17.91	17.94	17.51	17.79
Fuel Gas Static Pressure (PSIG)	456.3	456.4	456.4	456.4
Fuel Gas Temperature (^oF)	27.0	27.1	27.2	27.1

** BASED ON FUEL SPECIFIC DRY F-FACTOR CALCULATION
* BASED ON CARBON BALANCE (STOICH. + O2)
- A/F IS TOTAL MASS RATIO

Table 12. Gas Composition-AGA Standard Conditions-Turbines No. 802

GAS COMPOSITION	(Based on AGA standard conditions of 14.73 psia and 60 F)				
Constituent	Mol. Fraction	MW	weighted MW	DENSITY	Weighted Density
NITROGEN	0.009635	28.0134	0.2699	0.07399	0.00071
CARBON DIOX.	0.01004	44.01	0.4419	0.11624	0.00117
METHANE	0.9511	16.04315	15.2586	0.04237	0.04030
ETHANE	0.021265	30.0703	0.6394	0.07942	0.00169
PROPANE	0.003842	44.0975	0.1694	0.11647	0.00045
I-BUTANE	0.001104	58.1246	0.0642	0.15352	0.00017
N-BUTANE	0.001015	58.1246	0.0590	0.15352	0.00016
I-PENTANE	0.000632	72.1518	0.0456	0.19057	0.00012
N-PENTANE	0.000315	72.1518	0.0227	0.19057	0.00006
HEXANE +	0.000649	95.958	0.0623	0.32000	0.00021
	0.9996	17.0330	17.0330		0.04503

Upper Dry Heat Value	1026	btu/dscf
Low Dry Heat Value	925	btu/dscf
Specific Gravity	0.5891	
DENSITY	0.0450	lb/cf

Total Carbons	1.032753454	Total H	4.004366

Constituent	LHV ideal	LHV(i) ideal	LHV(i) real	HHV ideal	HHV(i) ideal	HHV(i) real
NITROGEN		0.00	0.00		0	0
CARBON DIOX.		0.00	0.00		0	0
METHANE	911.5	866.93	868.81	1012	962.5132	964.60
ETHANE	1622.4	34.50	34.58	1773.7	37.7177305	37.80
PROPANE	2320.3	8.91	8.93	2522.1	9.6899082	9.71
I-BUTANE	3007.3	3.32	3.33	3260.5	3.599592	3.61
N-BUTANE	3017.8	3.06	3.07	3270.1	3.3191515	3.33
I-PENTANE	3707.6	2.34	2.35	4011.1	2.5350152	2.54
N-PENTANE	3715.5	1.17	1.17	4018.2	1.265733	1.27
HEXANE +	4900.5	3.18	3.19	5288.8	3.4324312	3.44
		LHV real	925.42		HHV real	1026.29

Constituent	SG	SG(i) ideal	b	b(i)	
NITROGEN	0.96723	0.009319261	0.0044	0.000042394	
CARBON DIOX.	1.51955	0.015256282	0.0197	0.000197788	Compressibility
METHANE	0.55392	0.526833312	0.0116	0.01103276	0.997835865
ETHANE	1.03824	0.022078174	0.0239	0.000508234	
PROPANE	1.52256	0.005849676	0.0344	0.000132165	
I-BUTANE	2.00684	0.002215551	0.0458	5.05632E-05	
N-BUTANE	2.00684	0.002036943	0.0478	0.000048517	
I-PENTANE	2.49115	0.001574407	0.0581	3.67192E-05	
N-PENTANE	2.49115	0.000784712	0.0631	1.98765E-05	
HEXANE +	3.3127	0.002149942	0.0802	5.20498E-05	
	SG real	0.589132101		0.012121066	
					8.46546E-07

Table 13. Gas Composition-EPA Standard Conditions-Turbines No. 802

GAS COMPOSITION	(Based onEPA standard conditions of 14.696 psia and 68 F)		
Constituent	**Mol. Fraction**	**MW**	**weighted MW**
NITROGEN	0.0096	28.0134	0.2699
CARBON DIOX.	0.0100	44.01	0.4419
METHANE	0.9511	16.04315	15.2586
ETHANE	0.0213	30.0703	0.6394
PROPANE	0.0038	44.0975	0.1694
I-BUTANE	0.0011	58.1246	0.0642
N-BUTANE	0.0010	58.1246	0.0590
I-PENTANE	0.0006	72.1518	0.0456
N-PENTANE	0.0003	72.1518	0.0227
HEXANE +	0.0006	95.958	0.0623
	0.9996	MW	17.0330

Upper Dry Heat Value	1024	btu/dscf	**Mole Weight**	17.0330	btu/dscf
Low Dry Heat Value	927	btu/dscf	**A F-Factor (calc)**	8702	dscf/MMbtu
Specific Gravity	0.5891				
Density	0.0452	lb/scf			
Total Carbons	1.0328	Total H	4.0053		

Constituent	LHV ideal	LHV(i) ideal	LHV(i) real	HHV ideal	HHV(i) ideal	HHV(i) real
NITROGEN		0.00	0.00		0	0
CARBON DIOX.		0.00	0.00		0	0
METHANE	913	868.35	870.24	1010	960.611	962.69
ETHANE	1624	34.53	34.61	1769.6	37.630544	37.71
PROPANE	2322	8.92	8.94	2516.1	9.6668562	9.69
I-BUTANE	3010	3.32	3.33	3251.9	3.5900976	3.60
N-BUTANE	3020	3.07	3.07	3262.3	3.3112345	3.32
I-PENTANE	3711	2.35	2.35	4000.9	2.5285688	2.53
N-PENTANE	3718	1.17	1.17	4008.9	1.2628035	1.27
HEXANE +	4904	3.18	3.19	5278	3.425422	3.43
		LHV real	926.90		HHV real	1024.24

Constituent	SG	SG(i) ideal	b	b(i)	
NITROGEN	0.96723	0.009319261	0.0044	0.000042394	
CARBON DIOX.	1.51955	0.015256282	0.0197	0.000197788	Compressibility
METHANE	0.55392	0.526833312	0.0116	0.01103276	0.997835865
ETHANE	1.03824	0.022078174	0.0239	0.000508234	
PROPANE	1.52256	0.005849676	0.0344	0.000132165	
I-BUTANE	2.00684	0.002215551	0.0458	5.05632E-05	
N-BUTANE	2.00684	0.002036943	0.0478	0.000048517	
I-PENTANE	2.49115	0.001574407	0.0581	3.67192E-05	
N-PENTANE	2.49115	0.000784712	0.0631	1.98765E-05	
HEXANE +	3.3127	0.002149942	0.0802	5.20498E-05	
	SG real	0.589132101		0.012121066	

3. PROCESS DESCRIPTION

TransCanada's GLGT Crystal Falls Compressor Station is located in Crystal Falls, Michigan and operates a General Electric Model LM1600 stationary gas turbine, labeled EU-Unit 802, and burns only pipeline quality natural gas. The unit peak load HP rating is 23,000 at ISO conditions. The plant is located at 151 Oss Road, Crystal Falls, MI

The General Electric LM1600 gas turbine is a simple cycle, natural gas fired, split-shaft turbine. 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 Turbine No. 802 during the test:

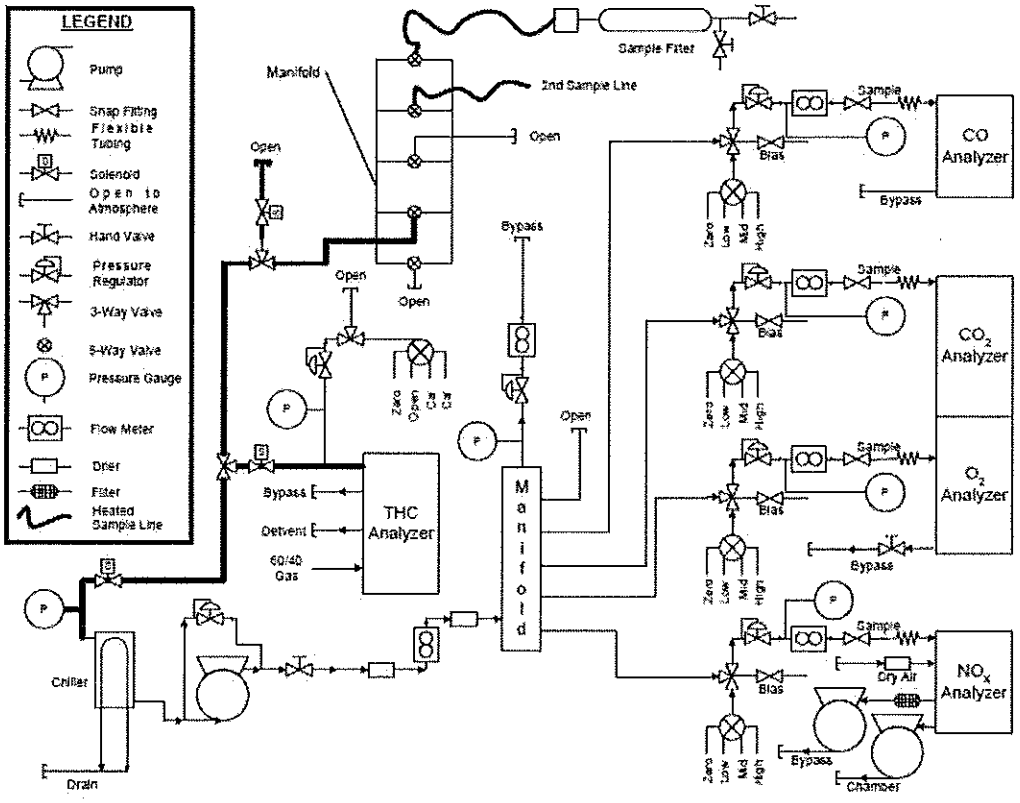
Table 14. Production Data-Horse Power (HP)

Turbine No. 802 Horse Power (HP)	
Load No.	**Turbine No. 802**
1	22,659
2	15,780
3	11,784
4	9,444
Rated HP	23,000

Table 15. Turbine No. 802- Rated Information

		Rated GG RPM:	16,450	RPM
		Rated PT RPM:	7,350	RPM
Company:	glgt	Rated BHP:	23,000	BHP
Station:	Crystal Falls			
Unit:	802			
Turbine Type:	lm 1600	AGA UDHV :	1,026	btu/dscf
Date:	3.8.17	AGA LDHV :	925	btu/dscf
		PCD_{ref} :	342.0	PSIG
		PCD_{ref} :	356.1	PSIA

Figure 1. Flow Schematic



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

4. TEST PROCEDURES

EQ and EQ'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 for the Unit No. 802 are as follows:

Calibration Correction

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

Where:

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

EPA F-Factor

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

Where:

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

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

Mass Emissions Calculations

The F-factor Method and guidance from Part 75 was 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:

E_m:	Pollutant emission rate, lb/hr
C_d:	Pollutant concentration, lb/scf
F_d:	Fuel specific F-factor, dscf/MMBtu
$\%O_2$:	Oxygen concentration, dry basis
Q_h:	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	7.268×10^{-8}
ppm NO_x	lb/scf	1.194×10^{-7}

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. EQ and EQ'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 Turbine No. 802 at TransCanada's GLGT Pipeline Company's Crystal Falls Compressor Station located in Crystal Falls, MI. The testing was conducted on March 8, 2017.

During the course of the testing, the Turbine No. 802 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 Turbine No. 802 emissions shall be determined by others.

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