COMPLIANCE TEST REPORT
ANR-Blue Lake Compressor Station
Heaters EGBLHTR-A and EGBLHTR-B

Prepared for:

TransCanada
In business to deliver

TransCanada's ANR Pipeline Company
Mancelona, MI

Prepared by:

EQM

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January 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: ANR Pipeline Company, Blue Lake Compressor Station   County: Otsego

Source Address: 10000 Pflum Road   City: Mancelona

AQD Source ID (SRN): B7198   RO Permit No.: MI-ROP-B7198-2014a   RO Permit Section No.: 2

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 2/21/2012 To 12/8/2016

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

NOx & CO testing once every five years (FG BLHEATERS, Flexible Group Conditions, 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.

Randall Schmidgall	Vice President US Ops.	(832) 320-5511
Name of Responsible Official (print or type)	Title	Phone Number

[signature]
Signature of Responsible Official

1-25-2016
Date

* Photocopy this form as needed.

EQP 5736 (Rev 9/01)

PREFACE

I, Karl Mast, do hereby certify that the source emissions testing conducted at TransCanada in Mancelona, 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.

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Karl Mast
Test Supervisor

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

Karl Mast
Test Supervisor

SUMMARY

The compliance emissions testing was performed on heaters EGBLHTR-A (A) and EGBLHTR-B (B) to comply with the established NOx and CO standards pursuant to of Michigan Department of Environmental Quality, Air Quality Division, permit no. MI-ROP-B7198-2014a. The testing was performed utilizing USEPA Methods 1-4, 3A, 7E and 10 at the Exhaust Stack sampling location. The results of the testing are detailed in the following tables.

Heater A NO_x Emission Test Results		
Run No.	NO_x Emissions (lbs/hr)	NO_x Emissions (lbs/mmbtu)
1	0.84	0.09
2	0.86	0.09
3	0.84	0.09
Average	0.85	0.09
Emission Limit	2.8	0.14

Heater A CO Emission Test Results		
Run No.	CO Emissions (lbs/hr)	CO Emissions (lbs/mmbtu)
1	0	0
2	0	0
3	0	0
Average	0	0
Emission Limit	0.7	0.035

Heater B NO_x Emission Test Results		
Run No.	NO_x Emissions (lbs/hr)	NO_x Emissions (lbs/mmbtu)
1	0.74	0.08
2	0.78	0.08
3	0.77	0.08
Average	0.76	0.08
Emission Limit	2.8	0.14

Heater B CO Emission Test Results		
Run No.	**CO Emissions (lbs/hr)**	**CO Emissions (lbs/mmbtu)**
1	0	0
2	0	0
3	0	0
Average	0	0
Emission Limit	0.7	0.035

1. INTRODUCTION

This report presents the results of the source emissions testing conducted by Environmental Quality Management, Inc. (EQM) for TransCanada's ANR (ANR) Blue Lake Compressor Station, near Mancelona, MI. Testing was conducted to comply with the established NOx and CO standards pursuant to of Michigan Department of Environmental Quality, Air Quality Division, permit no. MI-ROP-B7198-2014a.

To ensure that compliance with the emission limits is maintained, the Air Compliance Team of TransCanada's ANR Pipeline Company contracted Environmental Quality Management, Inc. (EQM) to perform source emissions testing on Heaters EGBLHTR-A (A) and EGBLHTR-B (B). The primary purpose of this testing program was to conduct emissions testing of the Sivalls withdrawal gas heaters, with an emission limit of 2.8 lbs/hr of NOx, 0.14 lbs/mmbtu of NOx, 0.7 lbs/hr of CO, and 0.035 lbs/mmbtu of CO.

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

The following report provides information pertaining to TransCanada's process operations, and Compliance testing. The Compliance testing conducted on Heater A was performed on December 8, 2016 from 8:25 A.M. to 11:26 A.M. The Compliance testing conducted on Heater B was performed on December 8, 2016 from 12:10 P.M. to 3:11 P.M.

The following requirements were specific for the testing program:

1. Equipment calibrations performed and calibration data provided.
2. Three (3) one (1) -hour, minimum, NOx, CO, and O_2 test runs performed at the each heater pursuant to EPA Reference methods as described in 40 CFR, Part 60, Appendix A.
3. Process manufacturing operations maintained at 100% 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 NOx, CO, and O_2, emissions determinations.

The testing program was approved by and/or coordinated with Roy Cannon, TransCanada's ANR Pipeline Company. The emission testing was performed by Karl Mast, Manager Air Emissions, EQM and Zach Hill, Test Technician, EQM. The emission testing was observed by Michigan DEQ.

2. TEST RESULTS SUMMARY

The compliance testing was performed on Heater A and Heater B to with the established NOx and CO standards pursuant to of Michigan Department of Environmental Quality, Air Quality Division, permit no. MI-ROP-B7198-2014a. A summary of the test results is given below:

Table 1. Test Results Summary-NOx Test Results-Heater A

Heater A NO_x Emission Test Results		
Run No.	**NO_x Emissions (lbs/hr)**	**NO_x Emissions (lbs/mmbtu)**
1	0.84	0.09
2	0.86	0.09
3	0.84	0.09
Average	0.85	0.09
Emission Limit	2.8	0.14

Table 2. Test Results Summary-CO Test Results-Heater A

Heater A CO Emission Test Results		
Run No.	**CO Emissions (lbs/hr)**	**CO Emissions (lbs/mmbtu)**
1	0	0
2	0	0
3	0	0
Average	0	0
Emission Limit	0.7	0.035

Table 3. Test Results Summary-NOx Test Results-Heater B

Heater B NO_x Emission Test Results		
Run No.	NO_x Emissions (lbs/hr)	NO_x Emissions (lbs/mmbtu)
1	0.74	0.08
2	0.78	0.08
3	0.77	0.08
Average	0.76	0.08
Emission Limit	2.8	0.14

Table 4. Test Results Summary-CO Test Results-Heater B

Heater B CO Emission Test Results		
Run No.	CO Emissions (lbs/hr)	CO Emissions (lbs/mmbtu)
1	0	0
2	0	0
3	0	0
Average	0	0
Emission Limit	0.7	0.035

Based on the information provided above, the Heater A and Heater B 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 Table 5-12.

Additional testing information may be found in Appendix A.

Table 5. Ambient Conditions & Emissions Concentrations/Calculated Mass Emissions-Heater A

Run	1	2	3	AVERAGES
Date	12/08/16	12/08/16	12/08/16	
Time	8:25	9:26	10:27	
Condition	High	High	High	
Ambient Conditions				
Ambient Temperature (°F)	23.00	25.00	27.00	25.00
Barometric Pressure ("Hg)	28.52	28.52	28.52	28.52
Ambient Relative Humidity (%)	65.00	68.00	70.00	67.67
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	64.57	64.07	63.90	64.18
NO_X g/BHP-HR	0.050	0.049	0.048	0.05
NO_X LB/HR 2.8 Limit	0.84	0.86	0.84	0.85
NO_X (ppm @ 15% O_2)	24.93	24.95	24.87	24.92
Nox Tons/Year	3.69	3.76	3.67	3.70
Nox lbs/scf fuel	0.000093	0.000093	0.000092	0.00009
NOx LB/MMBTU .14 Limit	0.09	0.09	0.09	0.09
CO ppm (BIAS Corrected) Outlet	0.00	0.00	0.00	0.00
CO g/BHP-HR	0.000	0.000	0.000	0.00
CO LB/HR .7 Limit	0.00	0.00	0.00	0.00
CO LB/MMBTU ** .035 Limit	0.00	0.00	0.00	0.00
CO (ppm @ 15% O_2)	0.00	0.00	0.00	0.00
% O_2 (BIAS Corrected)	5.62	5.75	5.74	5.70

Table 6. Calculated Flows/Fuel Flow Measurements-Heater A

Calculated Flows				
Fuel Flow - (SCFM)	151.7	154.3	151.3	152.4
Fuel Flow - (SCFH)	9,100.0	9,260.0	9,080.0	9,146.7
Fuel Flow (LB/HR)	401.0	408.0	400.1	403.0
Exhaust Flow (LB/HR)	8,201.7	8,423.5	8,257.6	8,294.3
Exhaust Flow (WSCFM)	3,144.9	3,200.2	3,138.0	3,161.0
Exhaust Flow (DSCFM)	1,820.1	1,868.0	1,830.5	1,839.6
Exhaust Gas Volume (ACFM)	7,580.5	7,719.6	7,463.2	7,587.8
Air Flow (WSCFM)	1,760.9	1,807.2	1,770.9	1,779.6
BSAC, #/BHP-hr	1.0	1.0	1.0	1.0
Fuel Flow Measurements				
Fuel Flow (SCFH)	9100.00	9260.00	9080.00	9146.67

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

Table 7. AGA Gas Composition-Heater A

GAS COMPOSITION	(Based on AGA standard conditions of 14.73 psia and 60 F)					
Constituent	**Mol. Fraction**	**MW**	**weighted MW**	**DENSITY**	**Weighted Density**	
NITROGEN	0.0105700	28.0134	0.2961	0.07399	0.00078	
CARBON DIOX.	0.0076430	44.01	0.3364	0.11624	0.00089	
METHANE	0.9639000	16.04315	15.4640	0.04237	0.04084	
ETHANE	0.0157770	30.0703	0.4744	0.07942	0.00125	
PROPANE	0.0015010	44.0975	0.0662	0.11647	0.00017	
I-BUTANE	0.0001780	58.1246	0.0103	0.15352	0.00003	
N-BUTANE	0.0001710	58.1246	0.0099	0.15352	0.00003	
I-PENTANE	0.0000748	72.1518	0.0054	0.19057	0.00001	
N-PENTANE	0.0000356	72.1518	0.0026	0.19057	0.00001	
HEXANE +	0.0001490	95.958	0.0143	0.32000	0.00005	
	1.0000	16.6796	16.6796		0.04406	
Upper Dry Heat Value	1011.70	btu/dscf				
Low Dry Heat Value	912	btu/dscf				
Specific Gravity	0.5769					
DENSITY	0.0441	lb/cf				
Total Carbons	1.010545876	Total H	3.9691708			
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	878.59	880.41	1012	975.4668	977.49
ETHANE	1622.4	25.60	25.65	1773.7	27.9836649	28.04
PROPANE	2320.3	3.48	3.49	2522.1	3.7856721	3.79
I-BUTANE	3007.3	0.54	0.54	3260.5	0.580369	0.58
N-BUTANE	3017.8	0.52	0.52	3270.1	0.5591871	0.56
I-PENTANE	3707.6	0.28	0.28	4011.1	0.30003028	0.30
N-PENTANE	3715.5	0.13	0.13	4018.2	0.14304792	0.14
HEXANE +	4900.5	0.73	0.73	5288.8	0.7880312	0.79
		LHV real	911.75		HHV real	1011.70
Constituent	**SG**	**SG(i) ideal**	**b**	**b(i)**		
NITROGEN	0.96723	0.010223621	0.0044	0.000046508		
CARBON DIOX.	1.51955	0.011613921	0.0197	0.000150567	Compressibility	
METHANE	0.55392	0.533923488	0.0116	0.01118124	0.997934407	
ETHANE	1.03824	0.016380312	0.0239	0.00037707		
PROPANE	1.52256	0.002285363	0.0344	5.16344E-05		
I-BUTANE	2.00684	0.000357218	0.0458	8.1524E-06		
N-BUTANE	2.00684	0.00034317	0.0478	8.1738E-06		
I-PENTANE	2.49115	0.000186338	0.0581	4.34588E-06		
N-PENTANE	2.49115	8.86849E-05	0.0631	2.24636E-06		
HEXANE +	3.3127	0.000493592	0.0802	1.19498E-05		
	SG real	0.576851129		0.011841888		
					8.46546E-07	

Table 8. EPA Gas Composition-Heater A

GAS COMPOSITION (Based onEPA standard conditions of 14.696 psia and 68 F)

Constituent	Mol. Fraction	MW	weighted MW		
NITROGEN	0.0106	28.0134	0.2961		
CARBON DIOX.	0.0076	44.01	0.3364		
METHANE	0.9639	16.04315	15.4640	Carbon Wt. % :	0.727703
ETHANE	0.0158	30.0703	0.4744	Hydrogen Wt. % :	0.239882
PROPANE	0.0015	44.0975	0.0662	Oxygen Wt. % :	0.014663
I-BUTANE	0.0002	58.1246	0.0103	Nitrogen Wt. % :	0.017752
N-BUTANE	0.0002	58.1246	0.0099		1.0000
I-PENTANE	0.0001	72.1518	0.0054		
N-PENTANE	0.0000	72.1518	0.0026		
HEXANE +	0.0001	95.958	0.0143		
	1.0000	MW	16.6796		

Upper Dry Heat Value	1010	btu/dscf	Mole Weight	16.6796	btu/dscf
Low Dry Heat Value	913	btu/dscf	F-Factor (calc)	8690	dscf/MMbtu
Specific Gravity	0.5769				
Density	0.0443	lb/scf			
Total Carbons	1.0105	Total H	3.9694		

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	880.04	881.86	1010	973.539	975.55
ETHANE	1624	25.62	25.67	1769.6	27.9189792	27.98
PROPANE	2322	3.49	3.49	2516.1	3.7766661	3.78
I-BUTANE	3010	0.54	0.54	3251.9	0.5788382	0.58
N-BUTANE	3020	0.52	0.52	3262.3	0.5578533	0.56
I-PENTANE	3711	0.28	0.28	4000.9	0.29926732	0.30
N-PENTANE	3718	0.13	0.13	4008.9	0.14271684	0.14
HEXANE +	4904	0.73	0.73	5278	0.786422	0.79
		LHV real	913.23		HHV real	1009.69

Constituent	SG	SG(i) ideal	b	b(i)	
NITROGEN	0.96723	0.010223621	0.0044	0.000046508	
CARBON DIOX	1.51955	0.011613921	0.0197	0.000150567	Compressibility
METHANE	0.55392	0.533923488	0.0116	0.01118124	0.997934407
ETHANE	1.03824	0.016380312	0.0239	0.00037707	
PROPANE	1.52256	0.002285363	0.0344	5.16344E-05	
I-BUTANE	2.00684	0.000357218	0.0458	8.1524E-06	
N-BUTANE	2.00684	0.00034317	0.0478	8.1738E-06	
I-PENTANE	2.49115	0.000186338	0.0581	4.34588E-06	
N-PENTANE	2.49115	8.86849E-05	0.0631	2.24636E-06	
HEXANE +	3.3127	0.000493592	0.0802	1.19498E-05	
	SG real	0.576851129		0.011841888	

Table 9. Fuel Orifice Flow Calculations- Heater A

ORIFICE FLOW CALCULATIONS				
Run Number	1	2	3	AVERAGES
Supply Pressure	0.0	0.0	0.0	0.0
Differential	0.0	0.0	0.0	0.0
Temperature	0.0	0.0	0.0	0.0
Fuel Flow (scfh)				
Fuel Flow (scfm)				
PIPE I.D.	0	0	0	0
ORIFICE I.D.	0	0	0	0
PRESS TAP? (1-UP,2-DN)	2	2	2	2
SP. GRAVITY	0.583817634	0.5838176	0.5838176	0.58381763
Fpb	1	1	1	1
Ftb	1	1	1	1
Ftf	1.063263101	1.0632631	1.0632631	1.0632631
FG	1.308764167	1.3087642	1.3087642	1.30876417
Fpv	1.001761483	1.001756	1.001756	1.00175783
R	0	0	0	0

Table 10. Ambient Conditions & Emissions Concentrations/Calculated Mass Emissions-Heater B

Run	1	2	3	AVERAGES
Date	12/08/16	12/08/16	12/08/16	
Time	12:10	13:11	14:12	
Condition	High	High	High	
Ambient Conditions				
Ambient Temperature (°F)	29.00	30.00	30.00	29.67
Barometric Pressure ("Hg)	28.52	28.52	28.52	28.52
Ambient Relative Humidity (%)	89.00	90.00	95.00	91.33
Emissions Concentrations & Calculated Mass Emissions				
NO_x ppm (BIAS Corrected)	54.51	54.19	54.03	54.24
NO_X g/BHP-HR	0.044	0.045	0.045	0.04
NO_X LB/HR	0.74	0.78	0.77	0.77
NO_X (ppm @ 15% O_2)	23.00	22.82	22.79	22.87
Nox Tons/Year	3.25	3.43	3.37	3.35
Nox lbs/scf fuel	0.000085	0.000085	0.000085	0.00008
NOx LB/MMBTU	0.08	0.08	0.08	0.08
CO ppm (BIAS Corrected) Outlet	0.00	0.00	0.00	0.00
CO g/BHP-HR	0.000	0.000	0.000	0.00
CO LB/HR	0.00	0.00	0.00	0.00
CO LB/MMBTU **	0.00	0.00	0.00	0.00
CO (ppm @ 15% O_2)	0.00	0.00	0.00	0.00
% O_2 (BIAS Corrected)	6.92	6.89	6.91	6.91

Table 11. Calculated Flows/Fuel Flow Measurements-Heater B

Fuel Flow - (SCFM)	144.8	154.3	151.7	150.3
Fuel Flow - (SCFH)	8,690.0	9,260.0	9,100.0	9,016.7
Fuel Flow (LB/HR)	382.9	408.0	401.0	397.3
Exhaust Flow (LB/HR)	8,615.6	9,162.6	9,027.3	8,935.1
Exhaust Flow (WSCFM)	3,003.2	3,200.2	3,144.9	3,116.1
Exhaust Flow (DSCFM)	1,899.8	2,020.0	1,988.0	1,969.3
Exhaust Gas Volume (ACFM)	7,239.0	7,719.6	7,479.7	7,479.4
Air Flow (WSCFM)	1,837.4	1,953.8	1,922.7	1,904.6
BSAC, #/BHP-hr	1.1	1.1	1.1	1.1
Fuel Flow Measurements				
Fuel Flow (SCFH)	8690.00	9260.00	9100.00	9016.67

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

Table 12. AGA Gas Composition-Heater B

GAS COMPOSITION	(Based on AGA standard conditions of 14.73 psia and 60 F)					
Constituent	**Mol. Fraction**	**MW**	**weighted MW**	**DENSITY**	**Weighted Density**	
NITROGEN	0.0105700	28.0134	0.2961	0.07399	0.00078	
CARBON DIOX.	0.0076430	44.01	0.3364	0.11624	0.00089	
METHANE	0.9639000	16.04315	15.4640	0.04237	0.04084	
ETHANE	0.0157770	30.0703	0.4744	0.07942	0.00125	
PROPANE	0.0015010	44.0975	0.0662	0.11647	0.00017	
I-BUTANE	0.0001780	58.1246	0.0103	0.15352	0.00003	
N-BUTANE	0.0001710	58.1246	0.0099	0.15352	0.00003	
I-PENTANE	0.0000748	72.1518	0.0054	0.19057	0.00001	
N-PENTANE	0.0000356	72.1518	0.0026	0.19057	0.00001	
HEXANE +	0.0001490	95.958	0.0143	0.32000	0.00005	
	1.0000	16.6796	16.6796		0.04406	
Upper Dry Heat Value	1011.70	btu/dscf				
Low Dry Heat Value	912	btu/dscf				
Specific Gravity	0.5769					
DENSITY	0.0441	lb/cf				
Total Carbons	1.010545876	Total H	3.9691708			
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	878.59	880.41	1012	975.4668	977.49
ETHANE	1622.4	25.60	25.65	1773.7	27.9836649	28.04
PROPANE	2320.3	3.48	3.49	2522.1	3.7856721	3.79
I-BUTANE	3007.3	0.54	0.54	3260.5	0.580369	0.58
N-BUTANE	3017.8	0.52	0.52	3270.1	0.5591871	0.56
I-PENTANE	3707.6	0.28	0.28	4011.1	0.30003028	0.30
N-PENTANE	3715.5	0.13	0.13	4018.2	0.14304792	0.14
HEXANE +	4900.5	0.73	0.73	5288.8	0.7880312	0.79
		LHV real	911.75		HHV real	1011.70
Constituent	SG	SG(i) ideal	b	b(i)		
NITROGEN	0.96723	0.010223621	0.0044	0.000046508		
CARBON DIOX.	1.51955	0.011613921	0.0197	0.000150567	Compressibility	
METHANE	0.55392	0.533923488	0.0116	0.01118124	0.997934407	
ETHANE	1.03824	0.016380312	0.0239	0.00037707		
PROPANE	1.52256	0.002285363	0.0344	5.16344E-05		
I-BUTANE	2.00684	0.000357218	0.0458	8.1524E-06		
N-BUTANE	2.00684	0.00034317	0.0478	8.1738E-06		
I-PENTANE	2.49115	0.000186338	0.0581	4.34588E-06		
N-PENTANE	2.49115	8.86849E-05	0.0631	2.24636E-06		
HEXANE +	3.3127	0.000493592	0.0802	1.19498E-05		
	SG real	0.576851129		0.011841888		
					8.46546E-07	

Table 13. EPA Gas Composition-Heater B

GAS COMPOSITION (Based onEPA standard conditions of 14.696 psia and 68 F)

Constituent	Mol. Fraction	MW	weighted MW		
NITROGEN	0.0106	28.0134	0.2961		
CARBON DIOX.	0.0076	44.01	0.3364		
METHANE	0.9639	16.04315	15.4640	Carbon Wt. % :	0.727703
ETHANE	0.0158	30.0703	0.4744	Hydrogen Wt. % :	0.239882
PROPANE	0.0015	44.0975	0.0662	Oxygen Wt. % :	0.014663
I-BUTANE	0.0002	58.1246	0.0103	Nitrogen Wt. % :	0.017752
N-BUTANE	0.0002	58.1246	0.0099		1.0000
I-PENTANE	0.0001	72.1518	0.0054		
N-PENTANE	0.0000	72.1518	0.0026		
HEXANE +	0.0001	95.958	0.0143		
	1.0000	MW	16.6796		

Upper Dry Heat Value	1010	btu/dscf	Mole Weight	16.6796	btu/dscf
Low Dry Heat Value	913	btu/dscf	A F-Factor (calc)	8690	dscf/MMbtu
Specific Gravity	0.5769				
Density	0.0443	lb/scf			
Total Carbons	1.0105	Total H	3.9694		

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	880.04	881.86	1010	973.539	975.55
ETHANE	1624	25.62	25.67	1769.6	27.9189792	27.98
PROPANE	2322	3.49	3.49	2516.1	3.7766661	3.78
I-BUTANE	3010	0.54	0.54	3251.9	0.5788382	0.58
N-BUTANE	3020	0.52	0.52	3262.3	0.5578533	0.56
I-PENTANE	3711	0.28	0.28	4000.9	0.29926732	0.30
N-PENTANE	3718	0.13	0.13	4008.9	0.14271684	0.14
HEXANE +	4904	0.73	0.73	5278	0.786422	0.79
		LHV real	913.23		HHV real	1009.69

Constituent	SG	SG(i) ideal	b	b(i)	
NITROGEN	0.96723	0.010223621	0.0044	0.000046508	
CARBON DIOX.	1.51955	0.011613921	0.0197	0.000150567	Compressibility
METHANE	0.55392	0.533923488	0.0116	0.01118124	0.997934407
ETHANE	1.03824	0.016380312	0.0239	0.00037707	
PROPANE	1.52256	0.002285363	0.0344	5.16344E-05	
I-BUTANE	2.00684	0.000357218	0.0458	8.1524E-06	
N-BUTANE	2.00684	0.00034317	0.0478	8.1738E-06	
I-PENTANE	2.49115	0.000186338	0.0581	4.34588E-06	
N-PENTANE	2.49115	8.86849E-05	0.0631	2.24636E-06	
HEXANE +	3.3127	0.000493592	0.0802	1.19498E-05	
	SG real	0.576851129		0.011841888	

Table 14. Fuel Orifice Flow Calculations- Heater B

ORIFICE FLOW CALCULATIONS				
Run Number	1	2	3	AVERAGES
Supply Pressure	0.0	0.0	0.0	0.0
Differential	0.0	0.0	0.0	0.0
Temperature	0.0	0.0	0.0	0.0
PIPE I.D.	0	0	0	0
ORIFICE I.D.	0	0	0	0
PRESS TAP? (1-UP,2-DN)	2	2	2	2
SP. GRAVITY	0.583817634	0.5838176	0.5838176	0.583817634
Fpb	1	1	1	1
Ftb	1	1	1	1
Ftf	1.063263101	1.0632631	1.0632631	1.063263101
FG	1.308764167	1.3087642	1.3087642	1.308764167
Fpv	1.001761483	1.001756	1.001756	1.001757828
R	0	0	0	0

3. PROCESS DESCRIPTION

TransCanada's ANR Blue Lake Compressor Station (ANR) is located in Mancelona, Michigan and operates two Sivalls withdrawal gas heaters labeled Unit EGBLHTR-A and Unit EGBLHTR-B. The plant is located at 10000 Pflum Road, Mancelona, Michigan.

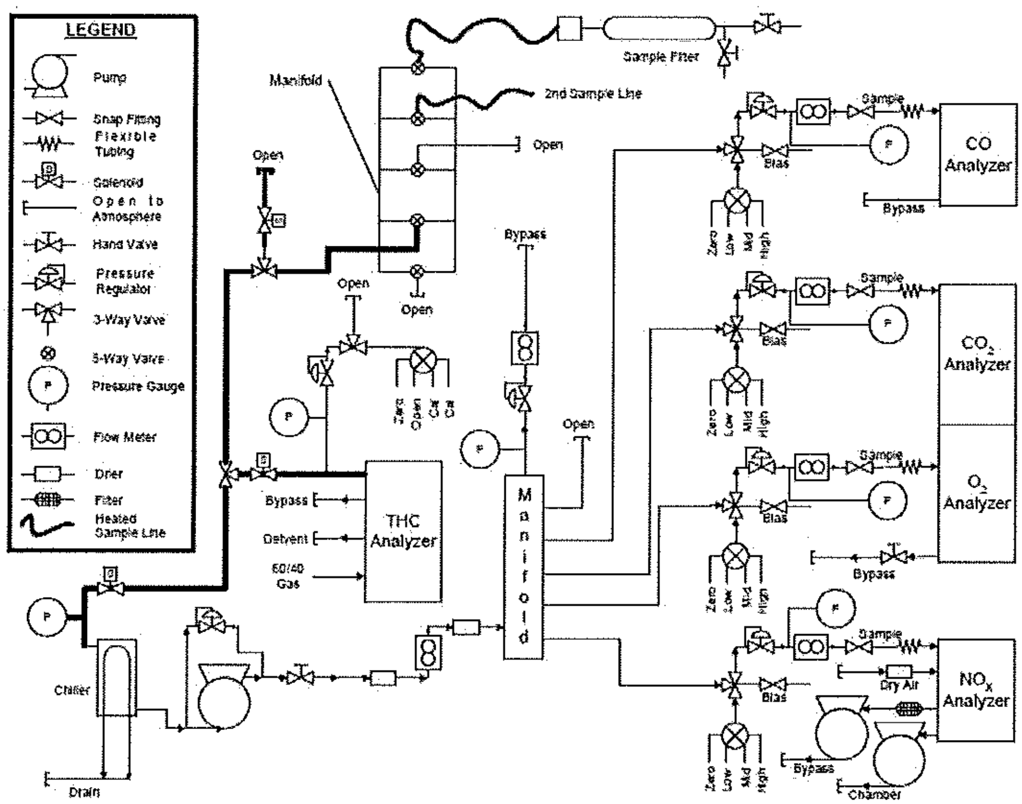
In the process of withdrawing the gas from its underground storage facilities during winter time, and while depressurizing it to pipeline conditions (from around 4,000 psi to 800-900 psi), the reduction in pressure implies also a reduction in the temperature of the gas. To prevent the gas to reach temperatures below the minimum temperature rating of the pipe, the gas heaters preheat the gas using burners before the pressure cut.

The following tables provide a summary of the production rates for the Heaters A and B during the tests:

Table 15. Heaters A & B- Fuel Flow (SCFH)

Fuel Flow (SCFH)		
Run No.	**Heater A**	**Heater B**
1	9,100	8,690
2	9,260	9,260
3	9,080	9,100
Average	9,146.7	9,016.7

Figure 1. Heaters A and B-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 1 – Sample and Velocity Traverses for Stationary Sources
- U.S EPA Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
- 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 Moisture Content in Stack Gases
- 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 Engine 1110 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 Calculations g/bhp-hr

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

Where:

Em: Pollutant emissions rate
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

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. 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 Heaters A and Heater B at TransCanada's ANR Pipeline Company's Blue Lake Compressor Station located in Mancelona, MI. The testing was conducted on December 8, 2016.

During the course of the testing, the Heater A and Heater B conformed to the requirements of Code of Federal Regulations, Title 40, Part 60, Appendix A, National Emission Standards for Hazardous Air Pollutants for withdrawal gas heaters.

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

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