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Emissions Performance Test for Establishment of Differential Pressure Baseline Across Catalysts.

Emissions Test Report

Three (3) Caterpillar G-3516 Generator Engines

Permit No.: MI-ROP-B7198-2014

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TransCanada-ANR
Blue Lake Storage Facility
Mancelona, MI.

Date:	**September 18, 2014**
Prepared for:	**Michigan Department of Environmental Quality. Air Quality Division**
Prepared by:	**Pedro Amieva. Plant Reliability (832) 320-5839**

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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: Kalkaska

Source Address: 10000 Pflum Road NE   City: Mancelona, MI

AQD Source ID (SRN): B7198   RO Permit No.: MI-ROP-B7198-2014   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 7/23/14 To 7/23/19

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

Establishment of baseline diff. pressure across catalysts on EGBLGEN-A to -C

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.

Randy Schmidgall	Vicepresident Operations US	(832) 320-5505
Name of Responsible Official (print or type)	Title	Phone Number

[signature] 9/19/2014

Signature of Responsible Official   Date

* Photocopy this form as needed.

1. Introduction

1.1. The Plant Reliability Department of TransCanada's US Pipelines Central conducted emission performance monitoring at the ANR Blue Lake Storage Facility (SRN B7198) on three generator engines (EUBLGEN-A to –C as approved by the MDEQ.

The purpose of the performance was to establish a differential pressure baseline across the catalysts installed in the three generators while monitoring compliance with the existing NOx and CO emissions limits as required by the ROP. This baseline will set the allowable variance (+/- 2" of H_2O) respect the baseline. Generators permit limits:

5.7 lb/hr and 2 g/bhp.-hr of NOx.

1.6 lb/hr and 1.4 g/bhp-hr of CO

1.2. Testing protocol was sent to MDEQ on August 7, 2014. Mechanical specialist James Winger conducted the monitoring. MDEQ sent a representative to observe the monitoring. Table 1 shows the summary of results for the units.

Unit	Test Date	Average Results	
		NOx	CO
Gen-A	8/28/14	2.11 lbs./hr; 1.6 g/bhp-hr	No appreciable numbers
Gen-B	8/27/14	2.4 lbs./hr; 1.8 g/bhp-hr	No appreciable numbers
Gen-C	8/27/14	2.36 lbs./hr; 1.8 g/bhp-hr	No appreciable numbers

Table 1. Blue Lake summary of results

Table 2 shows the differential pressure baseline for each engine.

Unit	DP Baseline ("H_2O)
Gen-A	5
Gen-B	6
Gen-C	6

Table 2. DF baseline

1.3. Facility Information:

1.3.1. ANR Blue Lake Storage Facility
10000 Pflum Road. Mancelona, MI 49659

1.3.2. Environmental Contact
Melinda Holdsworth
717 Texas Street, Suite 24155A
Houston, TX 77002
(832) 320-5665

2. Process Description

2.1. Blue Lake storage operates three Caterpillar G-3516, 1,125 HP generator engines to satisfy the electrical needs at the facility. The generators are 4 stroke lean burn natural gas driven units with 3 way catalysts.

3. Methodology

3.1. American Society of Testing and Materials test method D6522-00: Standard Test Method for Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Concentrations in Emissions from Natural Gas-Fired Reciprocating Engines, Combustion Turbines, Boilers, and Process Heaters Using Portable Analyzers will be employed for determination of compliance with Section 1.2.1 of this test plan.

3.2. Method D6522-00 prescribes the use of an appropriate portable emission analyzer, utilizing electrochemical cells, which can meet the documented calibration and preparation requirements. The make and model of analyzer employed will be documented in the submitted test results.

3.3. Electrochemical cell operational theory is based on chemical reactions that produce electricity. Each cell utilizes diffusion limited oxidation and reduction reactions to produce an electrical potential between a sensing electrode and a counter electrode. The chemical reaction that occurs produces electricity and the amount of electricity produced is directly related to the concentration of the constituent in the exhaust gas. The electricity is thus measured to give a concentration of the constituent. The relationship between the concentration of the constituent and the amount of electricity that is produced is linear and thus it is easily converted to engineering units.

4. Sample System

4.1. Sample system components, as outlined in Method D6522-00, were utilized for testing. These components include, but are not limited to, sample probe, heated sample line, sample

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transport lines, calibration assembly, moisture removal system, particulate filter, sample pump, sample flow rate control, gas analyzer, data recorder, and external interference gas scrubber.

5. Instrument Preparation

5.1. This emission performance test program followed procedures prescribed in ASTM test method D6522-00.

6. Sample Location

6.1. Sampling location was selected as specified in sections 10.1.1 and 10.1.2 of method D6522-00 at a location of five duct diameters downstream and three duct diameters upstream of any flow disturbance. Each test point was sampled for a period of no less that twice the response time of the entire sample system.

6.2. Monitoring during previous tests showed that the gas concentration did not vary significantly across the duct diameter; therefore, as per section 10.1.4 of Method D6522-00, sampling was taken from a single point located at the center of the stack.

7. Sample Time

7.1. Test was conducted during normal engine operation, i.e. not during periods of startup, shutdown, or malfunction

7.2. For the purposes of this emission performance test, and considering the specifications outlined above, a total of three test runs was employed for compliance determination. Each test run lasted for a period of 30-minutes.

8. Report Details

8.1. The engines were tested at the standard running conditions at the facility. This will ensure that testing data shows typical values during normal running time.

8.2. In addition, all assumptions that were made to estimate or calculate percent load during the testing were clearly explained and documented.

9. Results of Emission Performance Test

9.1. After completing the emission performance test outlined in this test plan, a summary of test results is submitted to MDEQ prior to the 60 days allowed after the completion of the test.

10. Calculations

10.1. Calibration Correction

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

Where:

C_{GAS}: Corrected emission concentration (ppmvd)
C_R: 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)

10.2. 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

10.3. Mass Emissions Calculations

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

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

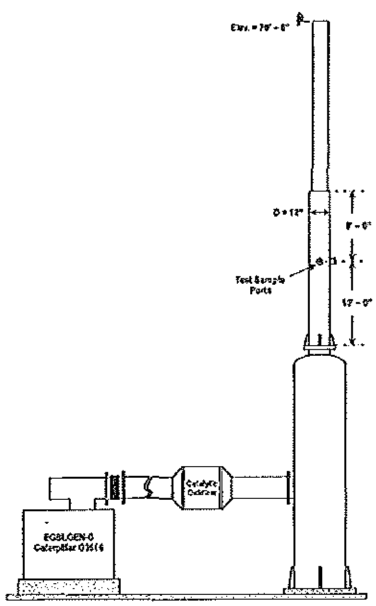
GCV: Upper dry heating value of fuel, Btu/dscf

10.4. Mass Emissions Calculations

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

Conversion from lbs/hr. to g/bhp-hr divides the mass emission rate converted from pounds to grams by the horsepower.

Description of Sampling Point



Effluent gas was sampled from a single point, located at the approximate center of the duct.

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Appendix A. Generator A

Section 1: Detailed Emission Summary
- Emissions Data Sheet Summary
- Sample Calculations

Section 2: Instrument Checks and Calibration
- General Information
- Linearity Check
- NO Stability Check
- NO_2 Stability Check
- CO Stability Check
- Calibration Error

Section 3: Raw Test Run Data
- Engine Operating Data
- Fuel Gas Analysis
- Run 1 – 3

Section 1: Detailed Emission Summary Generator A

Data Summary

General Information

Start Date: 8/28/2014

Company: TransCanada - ANR Pipeline

Station: Blue Lake

Unit Information

Unit No.: GEN-A

Manufacturer: Caterpillar

Model: G-3516

Rated BHP: 1100

Rated RPM: 1200

Gas Analysis

Nitrogen:	0.8365	- Butane:	0.0226
Carbon Dioxide:	0.8333	- Butane:	0.026
Methane:	94.898	· Pentane:	0.0002
Ethane:	3.1076	· Pentane:	0.0001
Propane:	0.2618	Hexane +:	0.014

Total: 100.000

Test Data

General Data				
Run	1	2	3	Averages
Date	8/28/14	8/28/14	8/28/14	
Time	08:24:46	09:36:59	10:15:44	
Operating Data				
Horsepower	588	580	589	**586**
Generator KiloWatts	439	432	439	**437**
Speed (rpm)	1,200	1,200	1,200	**1,200**
% Load	53.5%	52.7%	53.5%	**53.2%**
% Torque	53.5%	52.7%	53.5%	**53.2%**
Fuel Use (scfh)	5,843	5,593	5,545	**5,660**
UDHV (BTU/dscf)	1,026.6	1,026.6	1,026.6	**1,026.6**
AMP (psig)				
AMT (^{O}F)				
Catalyst Inlet Temp. (^{O}F)	786	790	790	**788**
Catalyst Outlet Temp. (^{O}F)	809.5	807.8	807.0	**808.1**
Catalyst Diff. Pressure ("H_2O)	5.1	5.1	5.0	**5.1**
Emissions Data				
NO (ppm)	194.90	183.33	189.90	**189.38**
$NO_{\text{Bias corrected}}$ (ppm)	194.80	183.21	189.79	**189.26**
NO_2 (ppm)	25.97	24.63	24.47	**25.02**
$NO_{2\ \text{Bias corrected}}$ (ppm)	25.97	24.63	24.47	**25.02**
NO_X (ppm)	220.76	207.84	214.25	**214.28**
NO_X (lb/hr)	2.24	2.03	2.06	**2.11**
NO_X (g/bhp-hr)	1.7	1.6	1.6	**1.6**
CO (ppm)	0.0	0.0	0.0	**0.0**
$CO_{\text{Bias corrected}}$ (ppm)	0.0	0.0	0.0	**0.0**
CO (lb/hr)	0.00	0.00	0.00	**0.00**
CO (g/bhp-hr)	0.00	0.00	0.00	**0.00**
O_2 (%)	8.04	8.11	8.06	**8.07**

Sample Calculations

General Information

Date: 8/28/2014

Company: TransCanada - ANR Pipeline

Station: Blue Lake

Unit Information

Unit No.: GEN-A

Manufacturer: Caterpillar

Model: G-3516

Rated BHP: 1100

1) 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)

Example: Run 1 - NO

C_R:	194.90	ppmvd
C_O:	0.5	ppmvd
C_M:	491.5	ppmvd
C_{MA}:	492	ppmvd
C_{GAS} =	**194.80**	**ppmvd**

2) NO Interference Response

$$I_{NO} = \left[\left(\frac{R_{NO-NO2}}{C_{NO2G}} \times \frac{C_{NO2S}}{C_{NOxS}}\right)\right] \times 100$$

Where:

I_{NO}: NO interference response (%)

$R_{NO\text{-}NO2}$: NO response to NO_2 span gas (ppm NO)

C_{NO2G}: Concentration of NO_2 span gas (ppm NO_2)

C_{NO2S}: Concentration of NO_2 in stack gas (ppm NO_2)

C_{NOxS}: Concentration of NO_x in stack gas (ppm NO_x)

Example:

$R_{NO\text{-}NO2}$:	10.0	ppm NO
C_{NO2G}:	152.0	ppm NO_2
C_{NO2S}:	25.0	ppm NO_2
C_{NOxS}:	214.4	ppm NO_x
I_{NO} =	**0.77**	**%**