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EMISSIONS COMPLIANCE STUDY

Prepared For
Plains All American Pipeline, LP

Performed At
Plains Natural Gas, LLP
Bluewater Gas Storage
EU-COMPEAST, EU-COMPWEST, EU-COMPNORTH
Columbus, Michigan

Test Dates
October 3 and 4, 2016

Report No.
TRC Environmental Corporation Report 262082A

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1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed an emissions compliance test program on the EU-COMPEAST, EU-COMPWEST, and EU-COMPNORTH at the Bluewater Gas Storage of Plains Natural Gas, LLP in Columbus, Michigan on October 3 and 4, 2016. The tests were authorized by and performed for Plains All American Pipeline, LP.

The purpose of this test program was to determine compliance with Michigan Department of Environmental Quality – Air Quality Division (MDEQ-AQD) Permit to Install (PTI) 77-14 and United States Environmental Protection Agency (USEPA), Title 40 Code of Federal Regulations Part 63 (40CFR63), Subpart ZZZZ - National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. The test program was conducted according to the Test Protocol 262082 dated July 26, 2016.

1.1 Project Contact Information

Participants		
Test Facility	Plains Natural Gas, LLP Bluewater Gas Storage 333 South Wales Center Road Columbus, Michigan 48063 Facility No. B7551	Mr. Stephen Kepics Env. & Reg. Compliance Specialist 757-898-9756 (phone) sjkepics@paalp.com
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 7521 Brush Hill Road Burr Ridge, Illinois 60527	Mr. Ben Cacao Field Team Leader 312-533-2042 (phone) 312-533-2070 (fax) bcacao@trcsolutions.com

The tests were conducted by Johnathan Kell and Ben Cacao of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) can be located in the appendix to this report.

Mr. Sebastian Kallumkal of the MDEQ-AQD observed the testing on October 4, 2016.

2.0 SUMMARY OF RESULTS

The results of this test program are summarized in the table below. Detailed individual run results are presented in Section 6.0.

Unit ID	Pollutant Tested		Measured Emissions	Emission Limit
EU-COMPEAST	Nitrogen Oxide (NO_x)	lb/hr	6.65	7.4
	Carbon Monoxide (CO)	lb/hr	0.70	1.85
		ppmvd @ 15% O_2	11.6	47
EU-COMPWEST	NO_x	lb/hr	5.45	7.4
	CO	lb/hr	0.70	1.85
		ppmvd @ 15% O_2	11.6	47
EU-COMPNORTH	NO_x	lb/hr	2.72	4.50
	CO	lb/hr	0.01	0.40
		ppmvd @ 15% O_2	0.4	47

The table below summarizes the test methods used, as well as the number and duration of each at each test location:

Source	Parameter Measured	Test Method	No. of Runs	Run Duration
EU-COMEAST, EU-COMPWEST, EU-COMPNORTH	Volumetric Flow Rate, and Fuel Factor (Fd Factor)	USEPA 19	3	15 min
	O_2	USEPA 3A	3	15 min
	NO_x	USEPA 7E	3	15 min
	CO	USEPA 10	3	15 min

3.0 DISCUSSION OF RESULTS

No problems were encountered with the testing equipment during the test program. Source operation appeared normal during the entire test program.

Unit operating data was recorded by plant personnel. Heat content of the natural gas was determined to support the performance tests. The fuel analysis reports are appended.

4.0 SAMPLING AND ANALYSIS PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed in accordance with the methods presented in the following sections. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, USEPA 600/R-94/038c, September 1994 was used to supplement procedures.

4.1 Determination of the Concentration of Gaseous Pollutants Using a Multi-Pollutant Sampling System

Concentrations of the pollutants in the following sub-sections were determined using one sampling system.

A straight-extractive sampling system was used. A data logger continuously recorded pollutant concentrations and generated one-minute averages of those concentrations. All calibrations and system checks were conducted using USEPA Protocol 1 gases. Three-point linearity checks were performed prior to sampling, and in the event of a failing system bias or drift test (and subsequent corrective action). System bias and drift checks were performed using the low-level gas and either the mid- or high-level gas prior to and following each test run.

The Low Concentration Analyzers (those that routinely operate with a calibration span of less than 20 ppm) used by TRC are ambient-level analyzers. Per Section 3.12 of Method 7E, a Manufacturer's Stability Test is not required for ambient-level analyzers. Analyzer interference tests were conducted in accordance with the regulations in effect at the time that TRC placed an analyzer model in service.

4.1.1 O_2 Determination by USEPA Method 3A

This method is applicable for the determination of O_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The O_2 analyzer was equipped with a paramagnetic-based detector.

4.1.2 NO_x Determination by USEPA Method 7E

This method is applicable for the determination of NO_x concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The NO_x analyzer utilized a photomultiplier tube to measure the linear and proportional luminescence caused by the reaction of nitric oxide and ozone.

4.1.3 CO Determination by USEPA Method 10

This method is applicable for the determination of CO concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The non-dispersive infrared analyzer (NDIR) CO analyzer was equipped with an internal gas correlation filter wheel, which eliminates potential detector interference. As such, use of an interference removal trap was not required.

4.2 Determination of F-Factors by USEPA Method 19

This method is applicable for the determination of the pollutant emission rate using oxygen (O_2) or carbon dioxide (CO_2) concentrations and the appropriate F factor (the ratio of combustion gas volumes to heat inputs) and the pollutant concentration. The appropriate F-Factor was calculated from fuel analyses using the equations in Section 12.3.2.1 of Method 19.

5.0 QUALITY ASSURANCE PROCEDURES

TRC integrates our Quality Management System (QMS) into every aspect of our testing service. We follow the procedures specified in current published versions of the test Method(s) referenced in this report. Any modifications or deviations are specifically identified in the body of the report. We routinely participate in independent, third party audits of our activities, and maintain:

- Louisiana Environmental Lab Accreditation Program (LELAP) accreditation;
- Accreditation from the Stack Testing Accreditation Council (STAC) and the American Association for Laboratory Accreditation (A2LA) that our operations conform with the requirements of ASTM D 7036 as an Air Emission Testing Body (AETB).

These accreditations demonstrate that our systems for training, equipment maintenance and calibration, document control and project management will fully ensure that project objectives are achieved in a timely and efficient manner with a strict commitment to quality.

All calibrations are performed in accordance with the test Method(s) identified in this report. If a Method allows for more than one calibration approach, or if approved

alternatives are available, the calibration documentation in the appendices specifies which approach was used. All measurement devices are calibrated or verified at set intervals against standards traceable to the National Institute of Standards and Technology (NIST). NIST traceability information is available upon request.

ASTM D7036-04 specifies that: *"AETBs shall have and shall apply procedures for estimating the uncertainty of measurement. Conformance with this section may be demonstrated by the use of approved test protocols for all tests. When such protocols are used, reference shall be made to published literature, when available, where estimates of uncertainty for test methods may be found."* TRC conforms with this section by using approved test protocols for all tests.

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GASEOUS TEST RESULTS SUMMARY

Project Number:	262082	Start Date:	10/4/16
Customer:	Plains All American Pipeline	End Date:	10/4/16
Unit Identification:	EU-COMPEAST	Facility:	Bluewater Gas Storage
Sample Location:	Stack	Recorded by:	Ben Cacao
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	80 Percent	Fd Factor:	-

Reference Method Results, As Measured Moisture Basis						
Run #	Date	Start Time	End Time	NOx ppmvd	CO ppmvd	O_2 % v/v dry
1	10/4/16	11:20	11:34	116.9	19.8	10.8
2	10/4/16	12:02	12:16	114.9	20.1	10.8
3	10/4/16	12:41	12:55	112.9	20.0	10.8
Average				**114.9**	**20.0**	**10.8**

Emission Rate Calculation Summary						
Run #	NOx lb/MMBtu	CO lb/MMBtu	NOx lb/hr	CO lb/hr	Heat Input MMBtu/Hr	Fd Factor
1	0.250	0.026	6.76	0.70	27.08	8672
2	0.246	0.026	6.65	0.71	27.08	8672
3	0.242	0.026	6.54	0.71	27.08	8671
Average	**0.246**	**0.026**	**6.65**	**0.70**	**27.08**	**8672**

Results Corrected to a Reference O_2 Concentration		Emission Rate Test Calculation Summary g/HP-hr Determined Using lb/hr and horsepower-hour		
Run #	CO ppmvd corrected to 15% Oxygen	BHP HP-hr	NO_X g/HP-hr	CO g/HP-hr
1	11.5	3,404	0.90	0.093
2	11.7	3,417	0.88	0.094
3	11.7	3,416	0.87	0.094
Average	**11.6**	**3,412**	**0.88**	**0.094**

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GASEOUS TEST RESULTS SUMMARY

Project Number:	262082	Start Date:	10/4/16
Customer:	Plains All American Pipeline	End Date:	10/4/16
Unit Identification:	EU-COMPWEST	Facility:	Bluewater Gas Storage
Sample Location:	Stack	Recorded by:	Ben Cacao
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	82 Percent	Fd Factor:	-

Reference Method Results, As Measured Moisture Basis						
Run #	Date	Start Time	End Time	NOx ppmvd	CO ppmvd	O_2 % v/v dry
1	10/4/16	9:13	9:27	91.6	19.0	11.0
2	10/4/16	9:53	10:07	94.1	19.8	10.9
3	10/4/16	10:39	10:53	92.8	19.9	10.9
Average				**92.8**	**19.6**	**10.9**

Emission Rate Calculation Summary						
Run #	NOx lb/MMBtu	CO lb/MMBtu	NOx lb/hr	CO lb/hr	Heat Input MMBtu/Hr	Fd Factor
1	0.199	0.025	5.39	0.68	27.04	8671
2	0.204	0.026	5.52	0.71	27.08	8670
3	0.201	0.026	5.43	0.71	27.07	8671
Average	**0.201**	**0.026**	**5.45**	**0.70**	**27.06**	**8671**

Results Corrected to a Reference O_2 Concentration		Emission Rate Test Calculation Summary g/HP-hr Determined Using lb/hr and horsepower-hour		
Run #	CO ppmvd corrected to 15% Oxygen	BHP HP-hr	NO_X g/HP-hr	CO g/HP-hr
1	11.3	3,390	0.72	0.091
2	11.7	3,398	0.74	0.094
3	11.7	3,390	0.73	0.095
Average	**11.6**	**3,393**	**0.73**	**0.093**

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GASEOUS TEST RESULTS SUMMARY

Project Number:	262082	Start Date:	10/3/16
Customer:	Plains All American Pipeline	End Date:	10/3/16
Unit Identification:	EU-COMPNORTH	Facility:	Bluewater Gas Storage
Sample Location:	Stack	Recorded by:	Ben Cacao
RM Probe Type:	Extractive (Dry)	Fc Factor:	-
Load Level/Condition:	59 Percent	Fd Factor:	-

Reference Method Results, As Measured Moisture Basis						
Run #	Date	Start Time	End Time	NOx ppmvd	CO ppmvd	O_2 % v/v dry
1	10/3/16	18:44	18:58	256.0	0.9	7.7
2	10/3/16	19:33	19:47	251.9	0.9	7.7
3	10/3/16	20:16	20:30	256.2	0.8	7.7
Average				**254.7**	**0.9**	**7.7**

Emission Rate Calculation Summary						
Run #	NOx lb/MMBtu	CO lb/MMBtu	NOx lb/hr	CO lb/hr	Heat Input MMBtu/Hr	Fd Factor
1	0.420	0.001	2.74	0.01	6.52	8670
2	0.414	0.001	2.71	0.01	6.55	8669
3	0.420	0.001	2.71	0.01	6.45	8670
Average	**0.418**	**0.001**	**2.72**	**0.01**	**6.51**	**8670**

Results Corrected to a Reference O_2 Concentration		Emission Rate Test Calculation Summary g/HP-hr Determined Using lb/hr and horsepower-hour		
Run #	CO ppmvd corrected to 15% Oxygen	BHP HP-hr	NO_X g/HP-hr	CO g/HP-hr
1	0.4	608	2.04	0.004
2	0.4	609	2.02	0.004
3	0.4	609	2.02	0.004
Average	**0.4**	**609**	**2.03**	**0.004**