Emissions Test Report (Part I)

Unit E08: A Natural Gas Fired Internal Combustion Reciprocating Engine

Permit No.: MI-ROP-B7220-2017a

ANR Pipeline Company
Woolfolk Compressor Station
Mecosta, Michigan

Date: August 24, 2022
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Introduction

The Air Compliance team of TCenergy' s US Pipelines Central conducted monitoring at ANR Woolfolk Compressor Station (SRN: B7220) pursuant to the Compliance Plan ANR submitted to comply with R336.1818(3)(a). The Compliance Plan has been approved by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division, formerly Michigan Department of Environmental Quality (MDEQ).
The purpose of the monitoring was to comply with the ozone season monitoring requirement in the ANR Compliance Plan and is in accordance with R336.1818(4)(a)(ii)(A)(2).

Summary

The compliance testing was performed on Unit 2008 in accordance with the requirements of the Code of Federal Regulations, Title 40, Part 60, Appendix A, and the Permit MI-ROP-B7220-2017a requirements.
An initial report, sent to EGLE last June 2022, did include all the units at Woolfolk compression station affected by the above mentioned Federal and State regulations, except unit 2008, which was unavailable at that time. This report completes the "ozone" testing requirements at the location for 2022.
For a NOx limit of 20.5 g./BHP-hour, test results show an average of 4.2 g./BHP-hour. Therefore, unit 2008 meets the acceptance criteria. A complete list of the performance parameters for the unit is provided in the Appendix.

Facility & Process Description

Woolfolk compressor station operates nine NOx SIP affected engines; 2001 through 2005 are Ingersoll-Rand KVG-103, 1,000 HP each and 2006 through 2009 are Ingersoll-Rand KVG-123, 1,320 HP each. The engines are a four stroke, rich burn, natural gas fired, reciprocating internal combustion engine used in Natural Gas Transmission. More specifically, the engine is used in the compression of natural gas from an initial "suction" pressure to a final "discharge" pressure, which creates the pressure gradient necessary to transport natural gas through ANR Pipeline's interstate pipeline system.

Methodology

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 was employed for determination of compliance.

Sample System

Sample system components, as outlined in Method D6522-00, were utilized for monitoring. These components include, but are not limited to, sample probe, heated sample line, sample transport lines, calibration assembly, moisture removal system, particulate filter, sample pump, sample flow rate control, gas analyzer, data recorder, and external interference gas scrubber.

Sample Location

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 of any flow disturbance and three duct diameters upstream of the discharge to atmosphere.
All the stratification sampling for all the units showed a variance in concentration of less of 5%, therefore, as per section 10.1.4 of Method D6522-00, sampling was taken from a single point located in the center of the stack.

Sample Time

Monitoring was conducted during normal engine operation, i.e., not during periods of startup, shutdown, or malfunction. Each engine was monitored at the maximum load achievable based upon pipeline and ambient conditions.
The engine was sampled at three 30-minutes test runs. Samples were taken at a frequency of once per minute.

Results

Results of the monitoring demonstrated that all units tested below the permitted levels of 20.5 g/BHP-hr. Detailed emissions summaries and calibration records can be found in the following pages.

Sample Calculations

Sample Calculation

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:	589.74	ppmvd
C_O:	10.25	ppmvd
C_M:	2494.5	ppmvd
C_{MA}:	2520	ppmvd
C_{GAS} =	**587.831**	**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-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-NO2}:	15.0	ppm NO
C_{NO2G}:	150.2	ppm NO_2
C_{NO2S}:	53.4	ppm NO_2
C_{NOxS}:	654.6	ppm NO_x
I_{NO} =	**0.82**	%

Gas Analysis