Cold Springs 12

Emission Test
of
Small Glycol Dehydration Unit

ANR Pipeline Company
Cold Springs 12
Compressor Station

10000 Pflum Road
Mancelona, Michigan

TransCanada
In business to deliver

State Registration No. B7198

Prepared for
TransCanada
Houston, Texas

February 26, 2016

Bureau Veritas Project No. 11016-000012.00

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Executive Summary

TransCanada retained Bureau Veritas North America, Inc. to test air emissions at the ANR Pipeline Company (ANR) Cold Springs 12 Compressor Station in Mancelona, Michigan. TransCanada stores natural gas in underground reservoirs and transports gas via pipelines to other companies and end-users after the gas is processed through glycol dehydration units. Testing was conducted on the Cold Springs 12 Compressor Station glycol dehydration unit. The purpose of the testing was to:

- Measure benzene, toluene, ethylbenzene, and xylenes (BTEX) emissions from the Cold Springs 12 glycol dehydration unit's thermal oxidizer exhaust stack.

- Evaluate compliance with 40 CFR Part 63, National Emissions Standards for Hazardous Air Pollutants for Source Categories, Subpart HHH, "National Emissions Standards for Hazardous Air pollutants for Natural Gas Transmission and Storage Facilities," incorporated in Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP- B7198-2014a.

The glycol dehydration system is defined as an "existing small glycol dehydration unit" in accordance with 40 CFR 63, Subpart HHH, and subject to:

- BTEX, total organic compound (TOC), or total hazardous air pollutants (HAPs) emission standards for the control device (thermal oxidizer).

The testing was completed in accordance with United States Environmental Protection Agency (USEPA) Reference Methods 1 through 4 and 18. On January 27, 2016, testing was conducted at Cold Springs 12 and consisted of three 60-minute test runs to (1) measure BTEX emissions and (2) evaluate compliance with the emission limit of the thermal oxidizer, which controls air emissions from the glycol dehydration system.

Detailed results of the testing are presented in Table 1 after the Tables Tab of this report. The results of the testing are summarized in the following table.

BTEX Emission Results
Compared to Permit Emission Limits

Date (2016)	Glycol Dehydration Unit	Emission Unit	Parameter	Units	Average Result[1]	Emission Limit[2]
Cold Springs 12						
Jan. 27	Cold Springs 12	EU CS12GLYDHY	Benzene[†]	lb/hr	<0.00043	NA
			Toluene[†]		0.00092	NA
			Ethylbenzene[†]		<0.00092	NA
			Total xylenes[†]		<0.00187	NA
			Mass rate of BTEX	lb/hr	0.0041	NA
				Mg/yr	0.0164	103.78

[†] Corrected for spike recovery following USEPA Method 18.
[1] Based on typical maximum operating hours for the total withdrawal season.
[2] Emission limit was calculated based on the annual average daily throughput rates from 2009 through 2013 using Equation 1 of the regulation (40CFR63.1275(b)(1)(iii)).
lb/hr: pound per hour
Mg/yr: megagram per year
NA: not applicable
BTEX: benzene, toluene, ethylbenzene, total xylenes

The BTEX measurements demonstrate that estimated annual air emission from the thermal oxidizer controlling the glycol dehydration unit is within the allowable limit.

1.0 Introduction

1.1 Summary of Test Program

TransCanada retained Bureau Veritas North America, Inc. to test air emissions at the ANR Pipeline Company (ANR) Cold Springs 12 Compressor Station in Mancelona, Michigan. TransCanada stores natural gas in underground reservoirs and transports gas via pipelines to other companies and end-users after the gas is processed through glycol dehydration units. Testing was conducted on the Cold Springs 12 Compressor Station glycol dehydration unit. The purpose of the testing was to:

- Measure benzene, toluene, ethylbenzene, and xylenes (BTEX) emissions from the Cold Springs 12 glycol dehydration unit's thermal oxidizer exhaust stack.

- Evaluate compliance with 40 CFR Part 63, National Emissions Standards for Hazardous Air Pollutants for Source Categories, Subpart HHH, "National Emissions Standards for Hazardous Air pollutants for Natural Gas Transmission and Storage Facilities," incorporated in Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP- B7198-2014a.

The glycol dehydration system is defined as an "existing small glycol dehydration unit" in 40 CFR 63, Subpart HHH, and subject to:

- BTEX, total organic compound (TOC), or total hazardous air pollutants (HAPs) emission standards.

The emission testing was conducted to evaluate compliance with the emission limit of the thermal oxidizer, which control air emissions from the glycol dehydration system.

The thermal oxidizer is subject to the following emission limit:

Unit-specific BTEX emission limit in megagrams (Mg) per year, calculated using Equation 1 of the regulation (40CFR63.1275(b)(1)(iii)):

$$EL_{BTEX} = 3.10x10^{-4} \times \text{Throughput} \times C_{i,BTEX} \times 365\frac{\text{day}}{\text{yr}} \times \frac{1\ \text{Mg}}{1x10^{6}\ \text{gram}}$$

Where:

EL_{BTEX} = Unit-specific BTEX emission limit, megagram per year

$3.10x10^{-4}$ = BTEX emission limit, gram BTEX/standard cubic meter-ppmv

Throughput = Annual average daily natural gas throughput, standard cubic meter

$C_{i,BTEX}$ = Annual average BTEX concentration of the natural gas at the inlet to the glycol dehydration unit, ppmv

The throughput values were measured at the custody transfer meter and based on annual average daily throughput rates from 2009 through 2013.

The testing was completed in accordance with USEPA Reference Methods 1 through 4 and 18 identified in §63.1282 of Subpart HHH of 40 CFR Part 63—Test Methods, Compliance Procedures, and Compliance Demonstrations. Measurement of BTEX concentrations following USEPA Method 18 incorporates the analytical procedures of Occupational Health and Safety Administration (OSHA) 7 and USEPA SW-846 Method 8260.

On January 27, 2016, Bureau Veritas conducted the following for the Cold Springs 12 unit:

- Three 60-minute test runs at the exhaust of the unit to measure BTEX concentrations.

The sampling conducted is summarized in Table 1-1.

Table 1-1
Sources Tested, Parameters, and Test Dates

Source	Test Parameter	Test Date
Cold Springs 12		
Cold Springs 12 thermal oxidizer exhaust	BTEX	January 27, 2016

BTEX: benzene, toluene, ethylbenzene, total xylenes

1.2 Key Personnel

Key personnel involved in this test program are listed in Table 1-2. Mr. Thomas Schmelter, Senior Project Manager with Bureau Veritas, led the emission testing program under the direction of Dr. Derek Wong, Director and Vice President with Bureau Veritas.

Ms. Jennifer Sterly, Environmental Project Manager, with TransCanada; Mr. Stephen Cornell, RAR Control Specialist with TransCanada Blue Lake; and Ms. Melinda Holdsworth, Environmental Air Emissions and GHG Advisor with TransCanada coordinated with Bureau Veritas and arranged for process data to be recorded.

The testing was witnessed by Mr. Jeremy Howe, Environmental Quality Analyst, and Ms. Becky Radulski, Environmental Engineer, both with MDEQ.

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Table 1-2
Key Personnel

TransCanada	
Jennifer Sterly Environmental Project Manager TransCanada 5250 Corporate Drive Troy, Michigan 48098 Phone: 248.205.4586 jennifer_sterly@transcanada.com	Melinda Holdsworth Environmental Air Emissions & GHG Advisor TransCanada 700 Louisiana St., Suite 700 Houston, Texas 77002-2700 Phone: 832.320.5665 Melinda_Holdsworth@TransCanada.com Stephen Cornell RAR Control Specialist TransCanada 10000 Pflum Road Mancelona, Michigan 49659 Phone: 231.587.2172 stephen_cornell@transcanada.com
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2.0 Source and Sampling Locations

2.1 Process Description

ANR, a wholly owned subsidiary of TransCanada, operates natural gas pipeline systems that connect supply basins and markets throughout the Midwest and south to the Gulf of México. ANR owns and operates several facilities in Michigan that are used in both natural gas transmission and storage. The location evaluated as part of this test program is a natural gas transmission and compression station that operates a natural gas storage field.

The pipeline transports natural gas from the storage reservoir field. During the storage period, natural gas absorbs hydrocarbons and water while in the underground geologic formation. Gas withdrawn from the storage field is conditioned through a glycol dehydration system to remove water. Dehydration is necessary in order to (1) meet contract sales specifications, (2) remove water vapor that may form hydrates—ice-like structures that can cause corrosion or plug equipment lines, and (3) to improve fuel heating values. Glycol dehydration is an absorption process in which a liquid glycol absorbent directly contacts the natural gas stream, which is circulated counter-current to the glycol flow, and absorbs water vapor in a contact tower or absorption column.

At the existing small glycol dehydration unit, natural gas is pumped into a tower, where the gas passes over a series of glycol trays. The glycol in these trays absorbs water and hydrocarbons in the natural gas. The conditioned natural gas can be fed into a separator to remove liquids that remain before being compressed and/or transported into the pipeline for distribution.

The rich, or "dirty," glycol that contains water and hydrocarbons accumulates in the bottom of the tower and is transported to a three-phase separator that separates heavy hydrocarbons from the glycol. The glycol is filtered before being transported into a re-boiler unit. The re-boiler evaporates water from the glycol. The resulting lean, or "clean," glycol is recirculated into the glycol tower.

Water from the re-boiler is condensed and transported to condensate and brine tanks, when necessary. The re-boiler vapors, which may contain volatile organic compounds (VOCs)—including HAPs such as BTEX—are directed to a condenser and/or thermal oxidizer for control prior to exhausting to atmosphere.

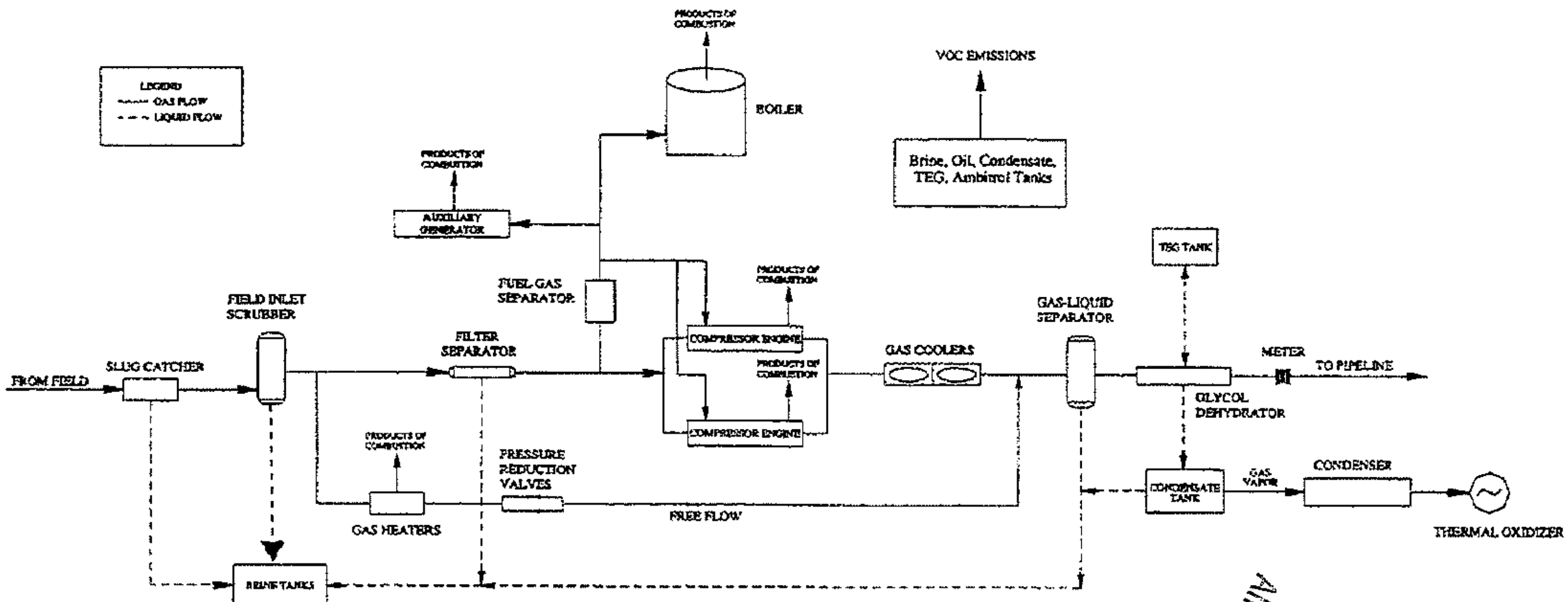
The small glycol dehydration unit was tested when natural gas was being processed at the maximum routine operating conditions. The natural gas throughput rate was measured at the custody transfer meter. Process and control equipment data recorded during testing are included in Appendix F. Table 2-1 summarizes the process and control equipment data.

Table 2-1
Summary of Process Operating Parameters

Parameter	Units	Run 1	Run 2	Run 3	Average
Cold Springs 12 (EU CS12GLYDHY)					
Natural gas throughput rate during testing	MMCFH	12.1	12.1	12.0	12.1
Thermal oxidizer combustion temperature	°F	1,451	1,451	1,451	1,451
Glycol recirculation Rate	gpm	8	8	8	8

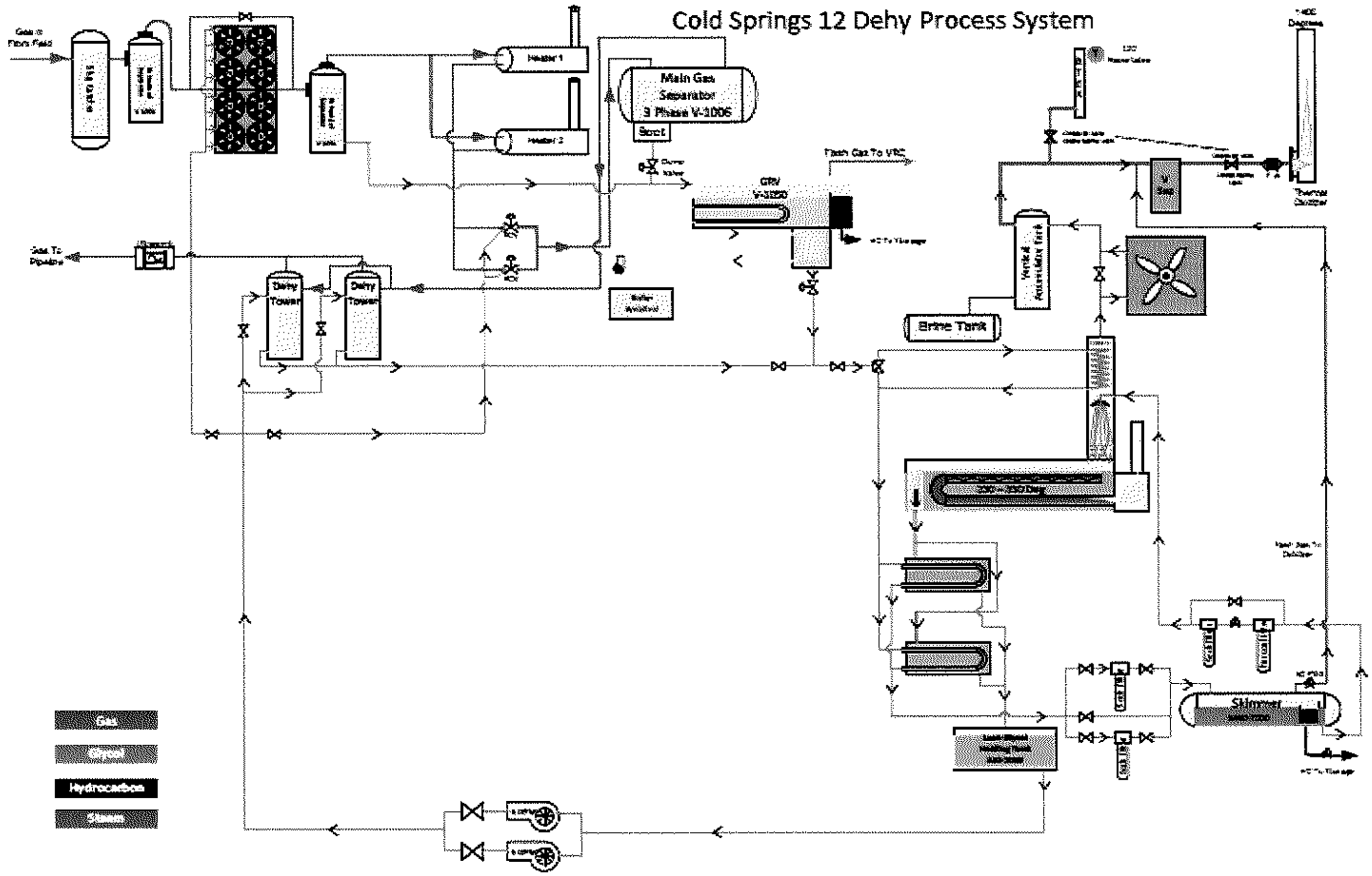
MMCFH: million cubic foot per hour
gpm: gallon per minute
Notes
1. The throughput values were measured at the custody transfer meter.
2. As provided by TransCanada, the maximum facility withdrawal rate for Cold Springs 12 is 12.5 MMCFH.

Figures 2-1 through 2-2 depict the natural gas withdrawal and small glycol dehydration unit processes for Cold Springs 12.



Source: TransCanada.

Figure 2-1. General Gas Withdrawal Process Flow



Source: TransCanada.

Figure 2-2. Cold Springs 12 Dehydration Unit Process Flow

2.2 Control Equipment

From the gas conditioning process, the glycol dehydration re-boiler vent is the primary source of emissions. These emissions can be controlled by vapor recovery (condensation), combustion, and pollution prevention.

A condenser controls emissions from the small glycol dehydration unit. The condenser converts components in the vapor phase to the liquid phase by reducing the temperature of the process vent stream. The condenser not only reduces emissions, but also recovers condensable hydrocarbon vapors that can be used or sold for hydrocarbon liquid production or disposed.

Residual VOCs and HAPs in the exhaust gas of the condenser are combusted in the thermal oxidizer. Process gas enters the combustion chamber, where the burner heats the gas to approximately 1,400°F to oxidize VOCs, producing primarily water vapor and carbon dioxide. The treated gas exiting the combustion chamber is discharged to the atmosphere through the exhaust stack. The incinerator is designed to obtain a minimum VOC destruction efficiency greater than 95%.

Pollution prevention refers to system optimization of the small glycol dehydration units by adjustment of process variables to reduce air emissions. For example, small glycol dehydration units may circulate more glycol than necessary to meet contract specifications. High glycol circulation rates increase the amount of BTEX absorbed from the natural gas stream; therefore, more BTEX and VOCs are released from the small glycol dehydration unit re-boiler vent during regeneration of the glycol. Optimizing the glycol circulation rate and other process variables may reduce associated air emissions.

Process and control equipment data recorded during testing are included in Appendix F. Table 2-1 summarizes the process and control equipment data.

2.3 Flue Gas Sampling Locations

Based on the current configuration, the Cold Springs 12 exhaust stack does not contain sampling ports. Figure 2-3 presents the current stack sampling port configuration at the Cold Springs 12 Compressor Station.

Because installing sampling ports would have potentially compromised the integrity of the exhaust stack, Bureau Veritas completed the air emissions testing using a temporary stack extension. The stack extension has pre-installed sampling ports that meet USEPA Method 1 sampling location requirements. The stack extension is constructed of carbon steel with a melt point of 2,500 °F and is not insulated. The stack extension was attached to the existing stack flange. This sampling approach was described in the Intent-to-Test, and approved by MDEQ prior to testing.

A description of the flue gas sampling location is presented in Section 2.3.1.

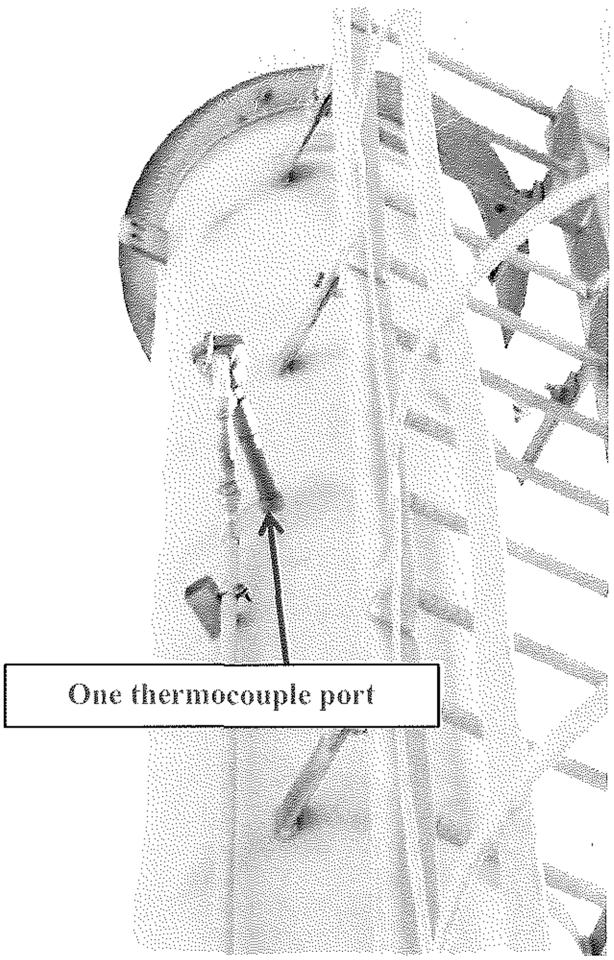


Figure 2-3. Cold Springs 12 Exhaust Stack without the Stack Extension

The Cold Springs 12 thermal oxidizer exhaust stack is 19 inches in diameter with 2 inches of high temperature insulation, and the stack extension has two 2-inch-diameter sampling ports. Six traverse points were used to measure stack gas velocity. The sampling ports are located:

- 38 inches (2 duct diameters) from the nearest downstream disturbance.
- 200 inches (10.5 duct diameters) from the nearest upstream disturbance.

The port was accessible using an articulating boom lift.

Figure 2-4 is a photograph of the Cold Springs 12 thermal oxidizer sampling location with the stack extension in place. Figure 1 in the Appendix depicts the sampling ports and traverse point locations.

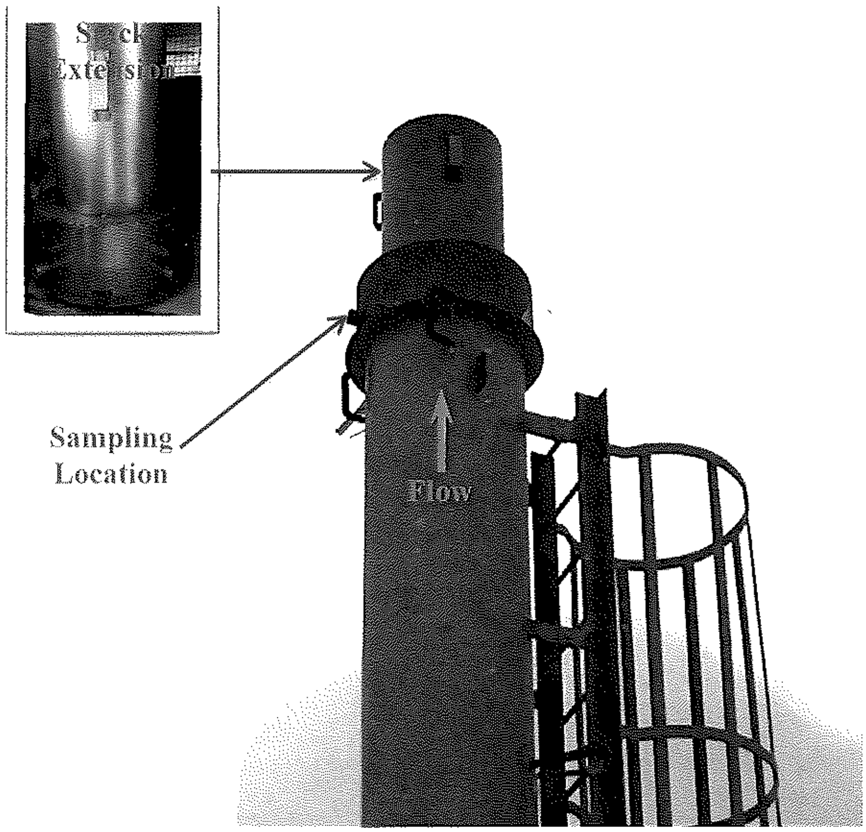


Figure 2-4. Cold Springs 12 Thermal Oxidizer Exhaust Stack with the Stack Extension

3.0 Results

3.1 Objective

The objective of the testing was to test air emissions of the small glycol dehydration unit for:

- BTEX emissions from the Cold Springs 12 glycol dehydration unit's thermal oxidizer exhaust stack.
- Compliance with 40 CFR Part 63, National Emissions Standards for Hazardous Air Pollutants for Source Categories, Subpart HHH, "National Emissions Standards for Hazardous Air pollutants for Natural Gas Transmission and Storage Facilities" incorporated in MDEQ ROP MI-ROP- B7198-2014a.

Table 3-1 summarizes the sampling and analytical matrix.

Table 3-1
Test Matrix

Sampling Location	Sample/Type of Pollutant	Sampling Method	No. of Test Runs and Duration	Analytical Method	Analytical Laboratory
Cold Springs 12 (EU CS12GLYDHY)	BTEX	1, 2, 3, 4, and 18	Three 60-minute runs	Field measurement Gas chromatography	Bureau Veritas and Fibertec Environmental Services

3.2 Field Test Changes and Issues

Communication between TransCanada, MDEQ, and Bureau Veritas allowed the testing to be completed without field test changes.

3.3 Summary of Results

The results of the BTEX testing are summarized in Table 3-2. Detailed results of the BTEX testing are presented in Table 1 after Table Tab of this report. A graph of the BTEX emission rates is provided after the Graphs Tab in the Appendix. Sample calculations are presented in Appendix B.

Table 3-2
Summary of Air Emission Test Results

Date (2016)	Glycol Dehydration Unit	Emission Unit	Parameter	Units	Average Result[1]	Emission Limit[2]
Cold Springs 12						
Jan. 27	Cold Springs 12	EU CS12GLYDHY	Benzene†	lb/hr	<0.00043	NA
			Toluene†		0.00092	NA
			Ethylbenzene†		<0.00092	NA
			Total xylenes†		<0.00187	NA
			Mass rate of BTEX	lb/hr	0.0041	NA
				Mg/yr	0.0164	103.78

† Corrected for spike recovery following USEPA Method 18.
[1] Based on typical maximum operating hours for the total withdrawal season.
[2] Emission limit was calculated based on the annual average daily throughput rates from 2009 through 2013 using Equation 1 of the regulation (40CFR63.1275(b)(1)(iii)).
lb/hr: pound per hour
Mg/yr: megagram per year
NA: not applicable
BTEX: benzene, toluene, ethylbenzene, total xylenes

The BTEX measurements demonstrate that estimated annual air emissions from the thermal oxidizer controlling the glycol dehydration unit are within the allowable limit.