Muttonville

Emission Test and LDAR Assessment of Small Glycol Dehydration Unit

ANR Pipeline Company
Muttonville Compressor Station

36555 29 Mile Road
Lenox Township, Michigan

TransCanada
In business to deliver

State Registration No. B8337

Prepared for
TransCanada
Houston, Texas

April 27, 2015

Bureau Veritas Project No. 11015-000004.00

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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 Permit (ROP) 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 specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: ANR Pipeline Company, Muttonville Compressor Station — County: Macomb

Source Address: 36555 29 Mile Road — City: Lenox Township

AQD Source ID (SRN): B8337 — ROP No.: MI-ROP-B8337-Propo — ROP Section No.: C and D

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

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 ROP, 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 ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, 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 ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP 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 ROP 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 _____ To _____

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

Test Report evaluating compliance with 40 CFR 63, Subpart HHH for the existing small glycol dehydration unit. This form shall certify that the testing was conducted in accordance with the approved test plan and that the facility operating conditions were in compliance with permit requirements or at maximum routine operating conditions.

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

ANTHONY KORNAGA	DIRECTOR, FIELD OPERATIONS	248-205-7465
Name of Responsible Official (print or type)	Title	Phone Number
Signature of Responsible Official		4/27/2015 Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

Executive Summary

TransCanada retained Bureau Veritas North America, Inc. to evaluate the closed-vent system and test air emissions at the ANR Pipeline Company (ANR) Muttonville Compressor Station in Lenox Township, 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 Muttonville glycol dehydration unit. The purpose of the testing was to:

- Evaluate the glycol dehydration unit's closed-vent system for leaks.
- Measure benzene, toluene, ethylbenzene, and xylenes (BTEX) emissions from the Muttonville 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-B8337-Proposed.

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

- Leak Detection and Repair (LDAR) standards.
- Control device BTEX, total organic compound (TOC), or total hazardous air pollutants (HAPs) emission standards.

The testing was completed in accordance with United States Environmental Protection Agency (USEPA) Reference Methods 1 through 4, 18, and 21. On March 4, 2015, testing was conducted at Muttonville and consisted of completion of the LDAR assessment and three 60-minute test runs to measure BTEX.

Leak Detection and Repair

Detailed results of the LDAR assessment are presented in Table 3-2. Documentation of the LDAR assessment was recorded on LDAR Recordkeeping and Field Inspection Forms, which are included in Appendix C of this report. The results of the LDAR assessment are summarized in the following table.

LDAR Assessment Results

Date (2015)	Glycol Dehydration Unit	Number of Components Evaluated	Number of Readings Below Leak Criterion of 500 ppmv	Number of Readings Exceeding Leak Criterion of 500 ppmv	Comment
Mar 4	Muttonville	30	30	0	No leaks detected

ppmv; part per million by volume

Based on the results of the LDAR assessment, no volatile organic compound (VOC) readings were measured at a concentration exceeding the criterion of a leak (i.e., 500 part per million by volume [ppmv]).

Performance Testing

The emission testing was conducted to evaluate compliance with the emission limit of the thermal oxidizer, which controls air emissions from the glycol dehydration system. Emission testing was conducted on the Muttonville glycol dehydration unit.

Detailed results of the Muttonville 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 (2015)	Glycol Dehydration Unit	Emission Unit	Parameter	Units	Average Result[1]	Emission Limit[2]
Muttonville						
Mar 4	Muttonville	EUGLYCDEHYDE	Benzene[†]	lb/hr	<0.00031	NA
			Toluene[†]		<0.00064	NA
			Ethylbenzene[†]		<0.00067	NA
			Total Xylenes[†]		<0.0013	NA
			Mass rate of BTEX	lb/hr	<0.0029	NA
				Mg/yr	<0.0048	9.41

[†] 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: megagrams 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.

1.0 Introduction

1.1 Summary of Test Program

TransCanada retained Bureau Veritas North America, Inc. to evaluate the closed-vent system and test air emissions at the ANR Pipeline Company (ANR) Muttonville Compressor Station in Lenox Township, 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 Muttonville glycol dehydration unit. The purpose of the testing was to:

- Evaluate the glycol dehydration unit's closed-vent system for leaks.
- Measure benzene, toluene, ethylbenzene, and xylenes (BTEX) emissions from the Muttonville 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- B8337-Proposed.

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

- Leak Detection and Repair (LDAR) standards.
- Control device BTEX, total organic compound (TOC), or total hazardous air pollutants (HAPs) emission standards.

Leak Detection and Repair

The LDAR assessment was conducted following the LDAR plan that Bureau Veritas prepared which outlined procedures to detect volatile organic compound (VOC) leaks from equipment components of the closed-vent system and identify necessary repairs as required by 40 CFR 60, Subpart HHH and MDEQ MI-ROP-B8337-Proposed.

When compliance with the emission standard is achieved using a control device or combination of control devices, the closed-vent system shall have no detectable emissions. A potential leak interface is evaluated to operate with no detectable organic emissions if the organic concentration is less than 500 parts per million by volume (ppmv).

Bureau Veritas conducted the following LDAR activities:

- Identified, tagged, and listed the components to be monitored and those that are difficult to inspect.
- Established procedures if the leak criterion is exceeded.
- Monitored components through initial visual inspection and LDAR monitoring following United States Environmental Protection Agency (USEPA) Method 21 guidelines.
- Communicated findings to TransCanada for leak repair (if applicable) and reporting by TransCanada.
- Reported the initial inspection findings.

Documentation of the LDAR assessment was recorded on LDAR Recordkeeping and Field Inspection Forms, which are included in Appendix C of this report.

Performance Testing

The emission testing was conducted to evaluate compliance with the emission limit of the thermal oxidizer, which controls air emissions from the glycol dehydration system. Emission testing was conducted on the Muttonville glycol dehydration unit.

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, megagrams per year
$3.10x10^{-4}$	=	BTEX emission limit, grams BTEX/standard cubic meter-ppmv
Throughput	=	Annual average daily natural gas throughput, standard cubic meters
$C_{i,BTEX}$	=	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, 18, and 21 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 March 4, 2015, Bureau Veritas conducted the following for the Muttonville unit:

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

The sampling conducted is summarized below in Table 1-1.

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

Source	Test Parameter	Test Date
Muttonville		
Muttonville thermal oxidizer exhaust	BTEX	March 4, 2015
Closed vent system joints	VOC leaks	

BTEX: benzene, toluene, ethylbenzene, total xylenes
VOC: volatile organic compound

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.

Mr. Jeff Punjak, Controls Specialist, Plant Reliability with TransCanada; Mr. Pedro Amieva, US Plant Reliability with TransCanada; Ms. Melinda Holdsworth, Environmental Air Emissions and GHG Advisor with TransCanada; and others coordinated with Bureau Veritas and arranged for process data to be recorded.

Portions of the testing were witnessed by Mr. Erik Gurshaw, Environmental Quality Analyst, with MDEQ.

Table 1-2
Key Personnel

TransCanada	
Jeff Punjak Controls Specialist, Plant Reliability TransCanada P.O. Box 336, Forest Road 241 Iron River, Wisconsin 54847 Phone: 248.205.7554 jeffrey_punjak@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 Pedro Amieva US Plant Reliability TransCanada 717 Texas Street Houston, Texas 77002 Phone: 832.320.5839 pedro_amieva@transcanada.com
Michigan Department of Environmental Quality	
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Bureau Veritas	
Derek Wong, Ph.D., P.E. Director and Vice President Bureau Veritas North America, Inc. 22345 Roethel Drive Novi, Michigan 48375 Tel. 248.344.2669 Fax. 248.344.2656 derek.wong@us.bureauveritas.com	Thomas Schmelter Senior Project Manager Bureau Veritas North America, Inc. 22345 Roethel Drive Novi, Michigan 48375 Tel: 248.344.3003 Fax: 248.344.2656 thomas.schmelter@us.bureauveritas.com

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 to and from the storage reservoir field. Natural gas is injected into underground field in spring and summer and withdrawn in fall and winter for residential and commercial heating purposes. During injection, natural gas flows into the reservoir until the field pressure approaches pipeline pressure. When the pressures near equilibrium, one or more engines are used to compress the natural gas into the reservoir. Compression injection usually continues until the field reaches its maximum rated pressure.

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.

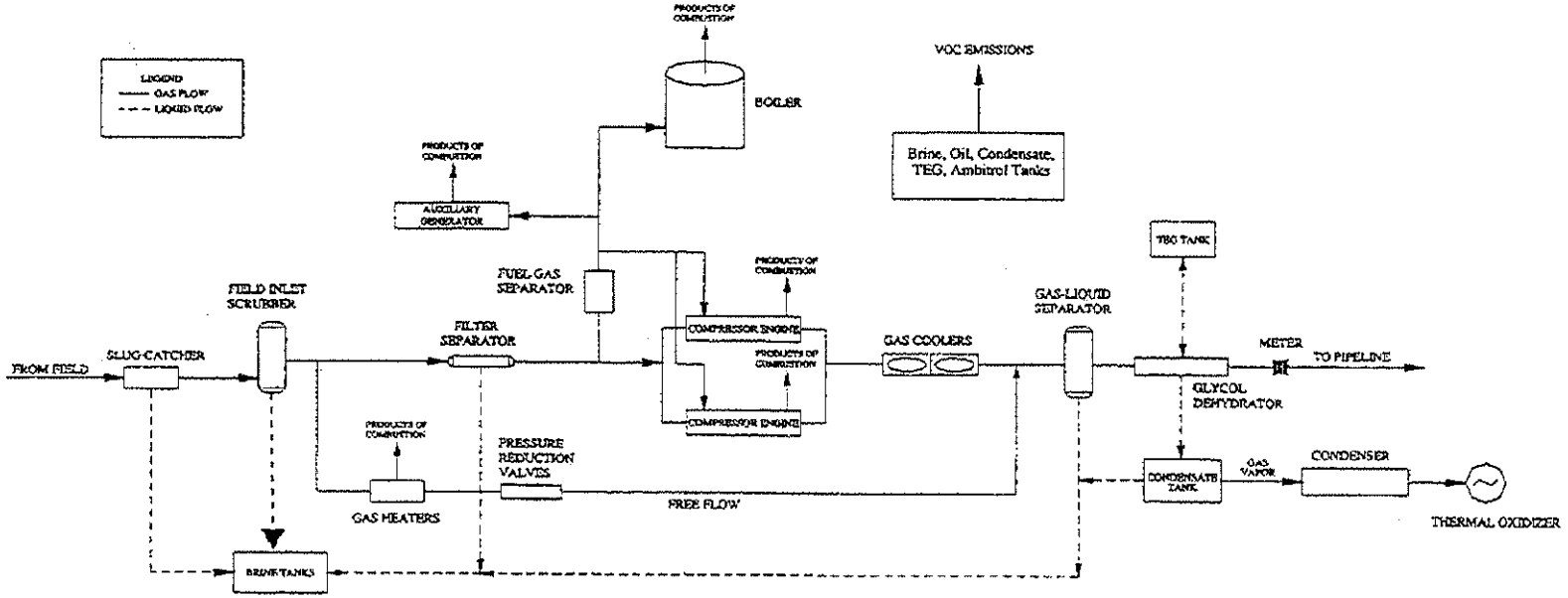
Figures 2-1 and 2-2 depict the general natural gas withdrawal and small glycol dehydration unit processes for Muttonville.

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

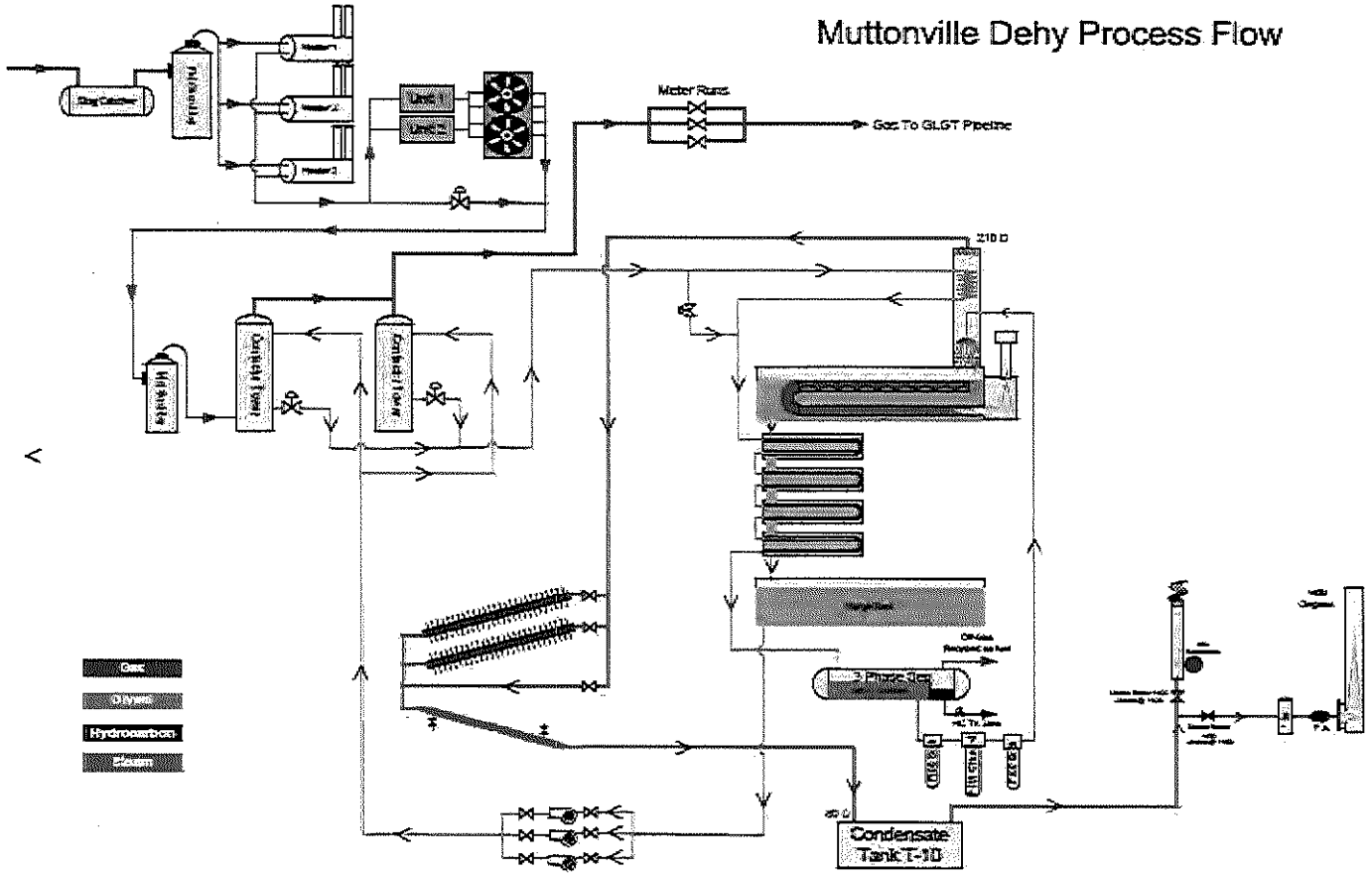
Parameter	Units	Run 1	Run 2	Run 3	Average
Muttonville (EUGLYCDEHYDE)					
Natural gas throughput rate during testing	MMCFH	6.2	6.1	6.3	6.2
Thermal oxidizer combustion temperature	°F	1,490	1,484	1,489	1,488
Glycol recirculation Rate	GPM	6	6	6	6

MMCFH: million cubic feet 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 Muttonville is 16.7 MMCFH.



Source: TransCanada.

Figure 2-1. General Gas Withdrawal Process Flow



Source: TransCanada.

Figure 2-2. Muttonville 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 is combusted in the thermal oxidizer. Process gas enters the combustion chamber, where the burner heats the gas to 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 incinerators are 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 Location

The sampling port location meets the upstream and downstream siting requirements of USEPA Method 1; however, only one sample port is available at the Muttonville sampling location. Because two sampling ports were not present Muttonville sampling location, a single sampling port was used for volumetric flowrate measurements. This sampling approach was approved by MDEQ prior to testing.

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

2.3.1 Muttonville Thermal Oxidizer Exhaust

The Muttonville thermal oxidizer exhaust stack is 20 inches in diameter and has one 2-inch-diameter sampling port. Six traverse points were used to measure stack gas velocity. The port is located:

- 55 inches (2.75 duct diameters) from the nearest downstream disturbance.
- 252 inches (12.6 duct diameters) from the nearest upstream disturbance.

The port was accessible via an articulating boom lift.

Figure 2-3 is a photograph of the Muttonville thermal oxidizer sampling location. Figure 1 in the Appendix depicts the sampling ports and traverse point locations.

2.4 LDAR Sampling Locations

The process equipment at the Muttonville location that was evaluated for LDAR included valves, flanges, pressure relief devices, and other connections.

Bureau Veritas conducted the initial LDAR monitoring by inspecting closed-vent system joints, seams, or other connections that are permanently or semi-permanently sealed (e.g., a welded joint between two sections of hard piping or a bolted or gasketed ducting flange).

The inspection consisted of a (1) visual examination and (2) no-detectable-emission evaluation. The visual examination evaluated defects that could result in air emissions, such as visible cracks, holes, gaps in piping, loose connections, or broken or missing caps or other closure devices. The no-detectable-emissions evaluation was performed following USEPA Method 21 procedures discussed in Section 4.0.

Where metal wrap pipe insulation was present around a pipe joint, seam, or other connection and a visual inspection could not be performed without damage, the Method 21 monitoring was performed at the seams in the metal pipe wrap insulation near the inaccessible joint, seam, or other connection.

TransCanada identified the LDAR locations evaluated at the Muttonville small glycol dehydration unit. The LDAR test locations are presented in Figure 2-4.

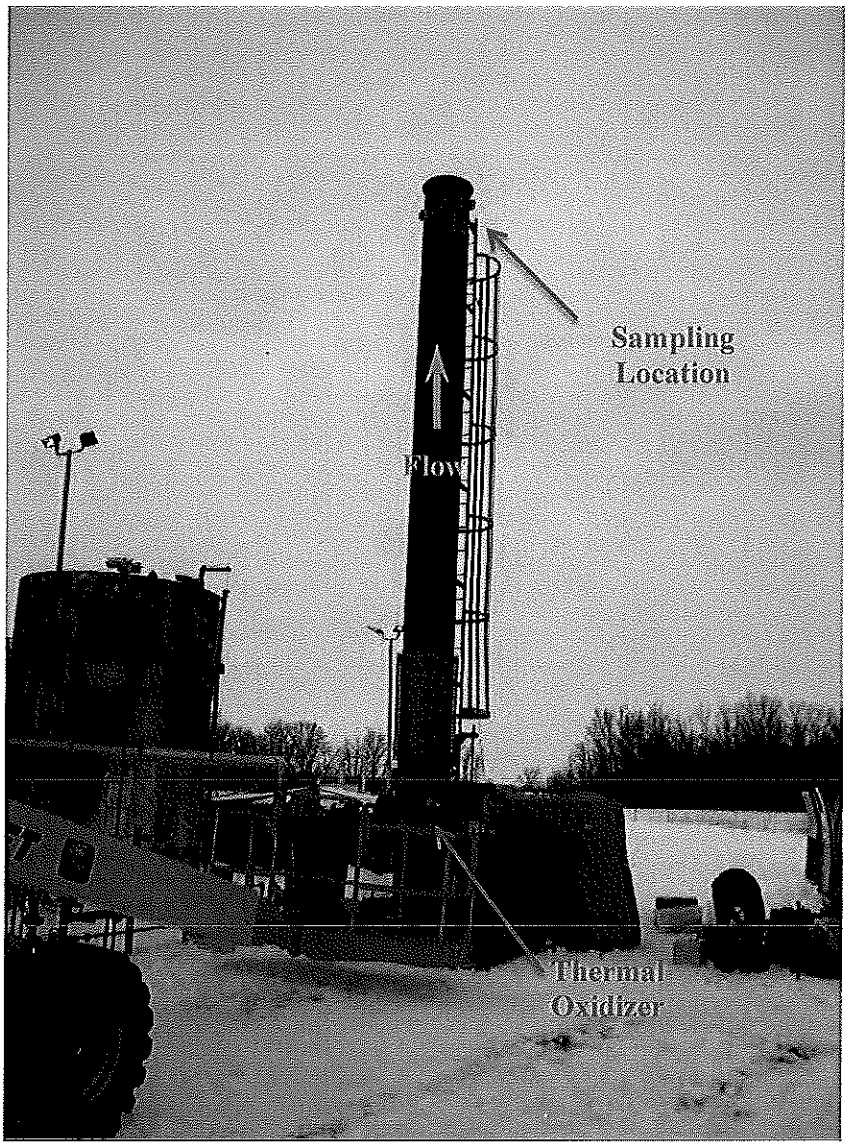


Figure 2-3. Muttonville Thermal Oxidizer Exhaust Stack

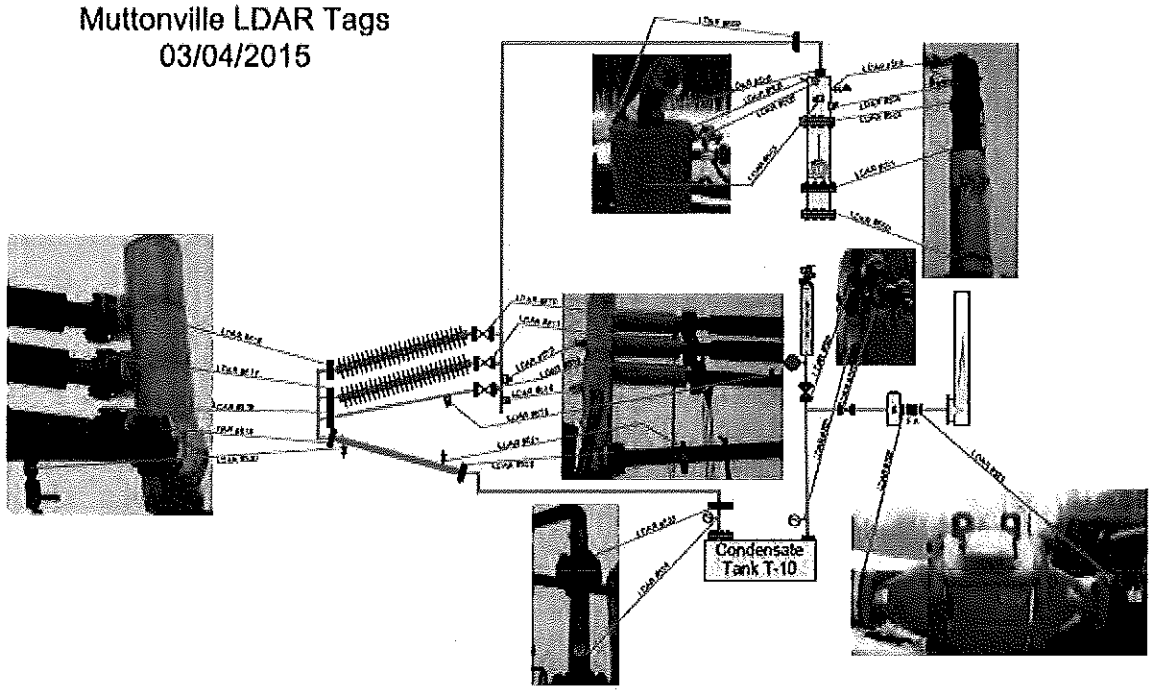


Figure 2-4. Muttonville LDAR Sampling Locations

3.0 Results

3.1 Objective

The objective of the testing was to evaluate the closed-vent system and test air emissions of the small glycol dehydration unit for:

- Leaks of VOCs.
- BTEX emissions from the Muttonville 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- B8337-Proposed.

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
Muttonville (EUGLYCDEHYDE)	BTEX	1, 2, 3, 4, and 18	Three 60-minute runs	Field measurement Gas chromatography	Bureau Veritas and Fibertec Environmental Services
	VOC leaks	21	NA	Flame ionization detector	NA

3.2 Field Test Changes and Issues

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

3.3 Summary of Results

Detailed results of the LDAR assessment are presented in Table 3-2. Documentation of the LDAR assessment was recorded on LDAR Recordkeeping and Field Inspection Forms, which are included in Appendix C of this report.

The results of the BTEX testing are summarized in Table 3-3. Detailed results of the BTEX testing are presented in Table 1 after the 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.