Air Emissions Testing
at
The Andersons Albion Ethanol, LLC
26250 B Drive North
Albion, Michigan

Prepared for

The Andersons, Inc.

Maumee, Ohio

Bureau Veritas Project No. 11017-000048.00
September 21, 2017

Move Forward with Confidence

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Executive Summary

The Andersons, Inc. retained Bureau Veritas North America, Inc. to conduct air emissions testing at The Andersons Albion Ethanol, LLC facility located at 26250 B Drive North in Albion, Calhoun County, Michigan. The purpose of the air emission testing was to evaluate compliance with certain emission limits in Permit to Install 144-15A, issued by Michigan Department of Environmental Quality (MDEQ) on August 31, 2016.

The emission units tested were:

- FGFERM (controlled by Scrubber C-40)
- FGFERM2 (controlled by Scrubber C-40A)
- FGMILL2 (controlled by Baghouses C-30A-1;2;3;4)
- EU-COOLINGDRUM (controlled by Baghouse C-70A)
- FGOXID2 (venting to Thermal Oxidizer C-10A)
- FGCHP [controlled by a dry low oxides of nitrogen (NO_x) burner for NO_x control of the turbine]

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 5, 7E, 9, 10, 25A, 202, 205, and 320. Testing consisted of three 60-minute runs at each location.

Detailed results are presented in Tables 1 through 13 after the Tables Tab of this report. The following tables summarize the results of the testing conducted July 25 through August 2, 2017.

BUREAU VERITAS

FGFERM Emissions Results

Parameter	Unit	Result	Emission Limit
Scrubber C-40			
VOCs	lb/hr	12.6	13
Acetaldehyde	lb/hr	0.85	1.3

VOC: volatile organic compound
lb/hr: pound per hour

FGFERM2 Emissions Results

Parameter	Unit	Result	Emission Limit
Scrubber C-40A			
VOCs	lb/hr	8.5	10
Acetaldehyde	lb/hr	0.82	0.93

VOC: volatile organic compound
lb/hr: pound per hour

FGMILL2 Emissions Results

Parameter	Unit	Result	Emission Limit
Baghouses C-30A-1;2;3;4			
PM_{10} and $PM_{2.5}$	lb/hr	0.39	0.64
Visible emissions	% opacity as a 6-minute average	0	5

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
lb/hr: pound per hour

EU-COOLINGDRUM Emissions Results

Parameter	Unit	Result	Emission Limit
Baghouse C-70A			
PM_{10} and $PM_{2.5}$	lb/hr	1.7	2.14
VOCs	lb/hr	**7.1**	3.54
Visible emissions	% opacity as a 6-minute average	0	5

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
VOC: volatile organic compound
lb/hr: pound per hour

FGOXID2 Emissions Results

Parameter	Unit	Result	Emission Limit
Thermal Oxidizer C-10A			
PM_{10} and $PM_{2.5}$	lb/hr	3.9	5.01
VOCs	lb/hr	0.35	4.5
VOC DE	%	99	98
NO_x	lb/hr	10.3	10.8
CO	lb/hr	3.4	9.1
Acetaldehyde	lb/hr	<0.24	0.33
SO_2	lb/hr	3.5	10.8
Visible emissions	% opacity as a 6-minute average	0	5

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
VOC: volatile organic compound
VOC DE: volatile organic compound destruction efficiency
NO_x: nitrogen oxides
CO: carbon monoxide
SO_2: sulfur dioxide
lb/hr: pound per hour

FGCHP Emissions Results

Operating Condition	Parameter	Unit	Result	Emission Limit
Combined heat and power system				
Turbine On, Duct Burner Off	PM_{10} and $PM_{2.5}$	lb/hr	1.0	2.9
	VOCs	lb/hr	0.065	3.2
	NO_x	ppmvd at 15% O_2	5.5	42
		lb/hr	1.8	15.6
	CO	lb/hr	0.42	42.8
Turbine On, Duct Burner On	PM_{10} and $PM_{2.5}$	lb/hr	0.78	2.9
	VOCs	lb/hr	<0.7	3.2
	NO_x	ppmvd at 15% O_2	12	42
		lb/hr	5.4	15.6
	CO	lb/hr	1.0	42.8
Turbine Off, Duct Burner On	NO_x	ppmvd at 15% O_2	30	54
		lb/hr	9.5	35.0

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
VOC: volatile organic compound
NO_x: nitrogen oxides
CO: carbon monoxide
lb/hr: pound per hour
ppmvd: pound per million by volume, dry

1.0 Introduction

1.1 Summary of Test Program

The Andersons, Inc. retained Bureau Veritas North America, Inc. to conduct air emissions testing at The Andersons Albion Ethanol, LLC facility located at 26250 B Drive North in Albion, Calhoun County, Michigan. The purpose of the air emission testing was to evaluate compliance with certain emission limits in Permit to Install 144-15A, issued by Michigan Department of Environmental Quality (MDEQ) on August 31, 2016.

The emission units tested were:

- FGFERM (controlled by Scrubber C-40)
- FGFERM2 (controlled by Scrubber C-40A)
- FGMILL2 (controlled by Baghouses C-30A-1;2;3;4)
- EU-COOLINGDRUM (controlled by Baghouse C-70A)
- FGOXID2 (venting to Thermal Oxidizer C-10A)
- FGCHP [controlled by a dry low oxides of nitrogen (NO_x) burner for NO_x control on the turbine)

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1 through 5, 7E, 9, 10, 25A, 202, 205, and 320. Testing consisted of three 60-minute runs at each location.

Table 1-1 lists the emission sources tested, parameters, and test dates.

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

Source	Test Parameter	Test Date
FGFERM (controlled by Scrubber C-40)	VOCs Acetaldehyde	July 25, 2017
FGFERM2 (controlled by Scrubber C-40A)	VOCs Acetaldehyde	July 25, 2017
FGMILL2 (controlled by Baghouses C-30A-1;2;3;4)	Particulate matter Visible emissions	July 26, 2017
EU-COOLINGDRUM (controlled by Baghouse C-70A)	Particulate matter VOCs Visible emissions	July 27, 2017
FGOXID2 (venting to Thermal oxidizer C-10A)	Particulate matter VOCs VOC DE NO_x CO Acetaldehyde SO_2 Visible emissions	July 28 and 31, 2017
FGCHP (controlled by a dry low NO_x burner for NO_x control on the turbine)	Particulate matter VOCs NO_x CO	August 1 and 2, 2017

1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-2. Mr. David Kawasaki, Air Quality Consultant II with Bureau Veritas, led the emission testing program. Mr. Lyle Blausey, Compliance and Safety Administrator with The Andersons, Inc. and Mr. Evan Dankert, Ethanol Compliance and Safety Administrator with The Andersons Albion Ethanol, LLC, provided process coordination and recorded operating parameters. Mr. Mark Dziadosz, Mr. Rex Lane, and Mr. Matt Deskins, with MDEQ, witnessed the testing and verified production parameters were recorded.

2.0 Source and Sampling Locations

2.1 Process Description

The Andersons Albion Ethanol, LLC, facility is a dry-mill corn processing ethanol plant. Figure 2-1 outlines the basic processing steps for ethanol and distiller's grain with solubles production (Note: air emission control units, such as baghouses, are not shown).

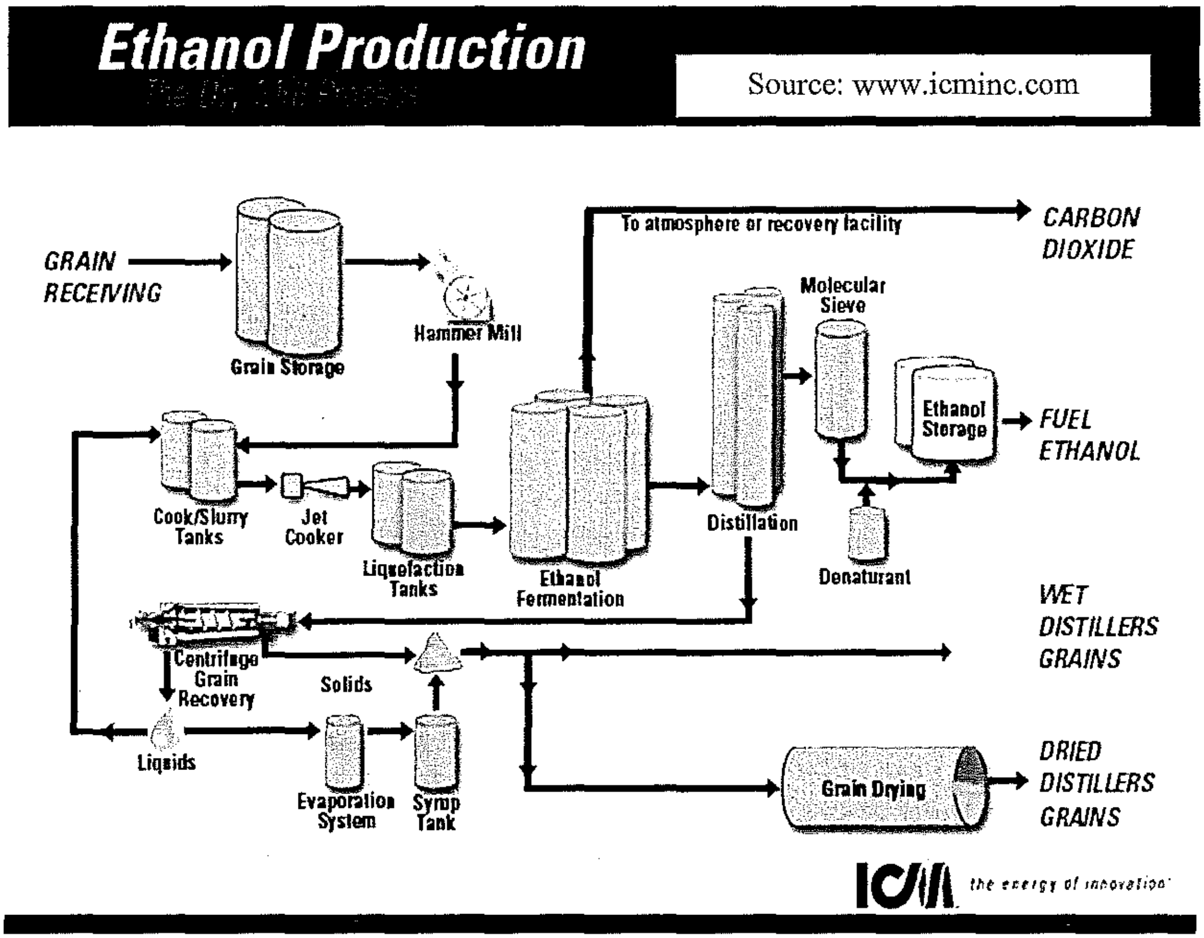

Figure 2-1. Ethanol production process

2.2 Process Flow

The main processes are:

- **Grain Receiving.** Grain is received via truck and/or rail car and transferred to the grain storage silo prior to processing.
- **Hammermills.** After a scalper cleans the grain, hammermills grind the grain into coarse flour.
- **Cook/Slurry Tanks.** Ground grain is mixed with water and alpha amylase in the cook tanks, which are heated to 180 to 195 °F.
- **Jet Cooker.** The jet cooker heats the slurry to 225 °F, which is then chilled in a condenser.
- **Liquefaction Tanks.** The slurry is stored in the liquefaction tanks for 1 to 2 hours to allow the alpha amylase to convert corn starch into sugar.
- **Ethanol Fermentation.** Mash from the liquefaction tanks is transferred to fermentation tanks. Urea, enzymes, and yeast are added to prepare the mash for fermentation. At the end of the fermentation process, the fermentation tank's contents are transferred to the beer well (this transfer is referred to as a "fermenter drop"). After the drop, the fermentation tank is "cleaned in place" (CIP) to prepare for the next mash filling.
- **Distillation.** The distillation process separates ethanol from water and solids. The water and solids (stillage) are recovered and reused in ethanol production or as livestock feed.
  - The water in the stillage is extracted with centrifuges. Some water is transferred to the cook/slurry tanks where it is re-used for ethanol production, while the remaining water is transferred to evaporators where it is concentrated into syrup. Some syrup is added to the stillage, which is then dried or shipped offsite as livestock feed. The syrup adds nutrients to the feed.
  - The solids from the stillage are either stored as wet distiller's grain with solubles (WDGS) or transferred to dryers. The dryers remove moisture from the stillage and the resulting product is called dry distiller's grains with solubles (DDGS). WDGS and DDGS are primarily used as animal feed.
  - After passing through the dryers, the DDGS is cooled through pneumatic conveyance and a rotating cooling drum to allow for storage without biodegradation.
  - The DDGS is stored prior to loadout via truck and rail.
- **Molecular Sieves.** Residual water in the ethanol is removed by molecular sieves.

- **Denaturant.** Gasoline is used to render the 200 proof product non-potable.

Storage/Loadout. Ethanol is stored in tanks and transferred to rail and truck tankers for shipment.

2.3 Operating Parameters

Operating parameters were measured and recorded by The Andersons Albion Ethanol, LLC personnel during testing. Table 2-1 summarizes the operating temperature of the thermal oxidizer during the testing of FGOXID2. Table 2-2 summarizes the flowrates of the turbine and duct burner during the testing of FGCHP. Operating parameters for FGFERM, FGFERM2, FGMILL2, and EU-COOLINGDRUM are presented in Section 2.4 and additional operating parameters are included in Appendix F.

Table 2-1
Summary of FGOXID2 Operation Data

FGOXID2		
Run	**July 28, 2017**	**July 31, 2017**
	Temperature (°F)	
1	1,650	1,650
2	1,650	1,650
3	1,650	1,650
Average	**1,650**	**1,650**

Table 2-2
Summary of FGCHP Operation Data

FGCHP			
August 1, 2017			
Operating Condition	**Run**	**Turbine Gas Flowrate (lb/hr)**	
Turbine On, Duct Burner Off	1	3,473	
	2	3,407	
	3	3,358	
Average		**3,413**	
August 1, 2017			
Operating Condition	**Run**	**Turbine Gas Flowrate (lb/hr)**	**Duct Burner Gas Flowrate (lb/hr)**
Turbine On, Duct Burner On	1	3,334	4,611
	2	3,310	4,616
	3	3,351	4,618
Average		**3,332**	**4,615**
August 2, 2017			
Operating Condition	**Run**	**Duct Burner Gas Flowrate (lb/hr)**	
Turbine Off, Duct Burner On	1	6,471	
	2	6,454	
	3	6,515	
Average		**6,480**	

2.4 Control Equipment

The Andersons Albion Ethanol, LLC facility controls air emissions from processes through use of air filtration baghouses, a scrubber, and recuperative thermal oxidizers. The following control equipment is associated with the emission units tested:

- FGFERM - controlled by Scrubber C-40.
- FGFERM2 - controlled by Scrubber C-40A.
- FGMILL2 - controlled by Baghouses C-30A-Hammermill 5;6;7;8.
- EU-COOLINGDRUM - controlled by Baghouse C-70A.
- FGOXID2 - venting to Thermal Oxidizer C-10A.
- FGCHP - controlled by a dry low NO_x burner for NO_x control on the turbine.

Operating parameters were measured and recorded by The Andersons Albion Ethanol, LLC personnel during testing is included in Appendix F.

2.4.1 Packed Bed Scrubbers

Packed-bed fermentation scrubbers are used to control emissions from the fermentation process. Water from the facility's production well flows from the top of the scrubber column through a series of water distribution panes (steel plates with holes) and a packed bed of hollow, perforated scrubber balls that increase the surface area on which the flue gas contacts the water before it exits at the bottom of the column.

Ammonium bisulfite is added to the water to increase the solubility of the aldehydes in the scrubber water and remove them from the flue gas. As the flue gas flows from the bottom of the scrubber upward and through the packed bed, the gas is "scrubbed" by the water before discharge to the atmosphere. The used scrubber water is transferred to the cook tanks, where it is mixed with ground grain and alpha amylase to be reused in another batch of ethanol production.

The operating parameters measured by The Andersons Albion Ethanol, LLC during the testing are presented in Appendix F and summarized in Table 2-3.

Table 2-3
Summary of Fermentation CO_2 Scrubber Operating Data

Date	Run	Differential Pressure (in H_2O)	Scrubber Water Flowrate (gpm)	Ammonium Bisulfite Addition (ml/min)
FGFERM				
July 25, 2017	1	12.4	65	200
	2	12.4	65	200
	3	11.8	65	200
Average		**12.2**	**65**	**200**
FGFERM2				
July 25, 2017	1	11.4	53	215
	2	11.0	53	215
	3	10.6	53	215
Average		**11.0**	**53**	**215**

2.4.2 Baghouses

Baghouses control particulate matter emissions from grain handling, receiving, and loadout operations. The resistance to airflow — head drop (commonly referred to as "pressure difference") –was measured during the testing. The typical hydraulic head difference across the baghouses (inlet minus outlet) is 0.21 to 2.1 inches of water (in H_2O).

The pressure differences across the baghouses were recorded by Mr. Blausey. Table 2-4 presents the pressure difference readings across Baghouses C-30A- Hammermill 5;6;7;8 during testing of FGMILL2 and Baghouse C-70A during testing of EU-COOLINGDRUM. Refer to Appendix F for additional operating parameters recorded during this emission testing program.

Table 2-4
Summary of Baghouse Control Equipment Operation Data

FGMILL2					
Date	**Run**	**Differential Pressure (in H_2O) – Hammermill 5**	**Differential Pressure (in H_2O) – Hammermill 6**	**Differential Pressure (in H_2O) – Hammermill 7**	**Differential Pressure (in H_2O) – Hammermill 9**
July 26, 2017	1	2.1	1.3	2.1	1.7
	2	2.1	1.3	2.1	1.7
	3	2.1	1.3	2.1	1.7
Average		**2.1**	**1.3**	**2.1**	**1.7**

EU-COOLINGDRUM			
Date	**Run**	**Differential Pressure (in H_2O) – DPI7816**	**Differential Pressure (in H_2O) – DPI-7817**
July 27, 2017	1	0.21	0.55
	2	0.25	0.57
	3	0.24	0.57
Average		**0.23**	**0.56**

2.5 Flue Gas Sampling Locations

Figures 1 through 7 in the Appendix (after the Figures Tab) depict the sampling ports and traverse point locations at the sampling locations. A description of the sampling locations is presented in the following sections.

2.5.1 FGFERM Outlet Sampling Location

The FGFERM scrubber outlet duct is 23.5 inches in diameter and has two 4-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Flue gas velocity, VOC, and acetaldehyde were measured at this location. Eight traverse points, four traverse points per sampling port, were used to measure flue gas velocity. Figure 2-2 is a photograph showing the FGFERM outlet sampling location. Figure 1 in the Appendix depicts the source sampling ports and traverse point locations.

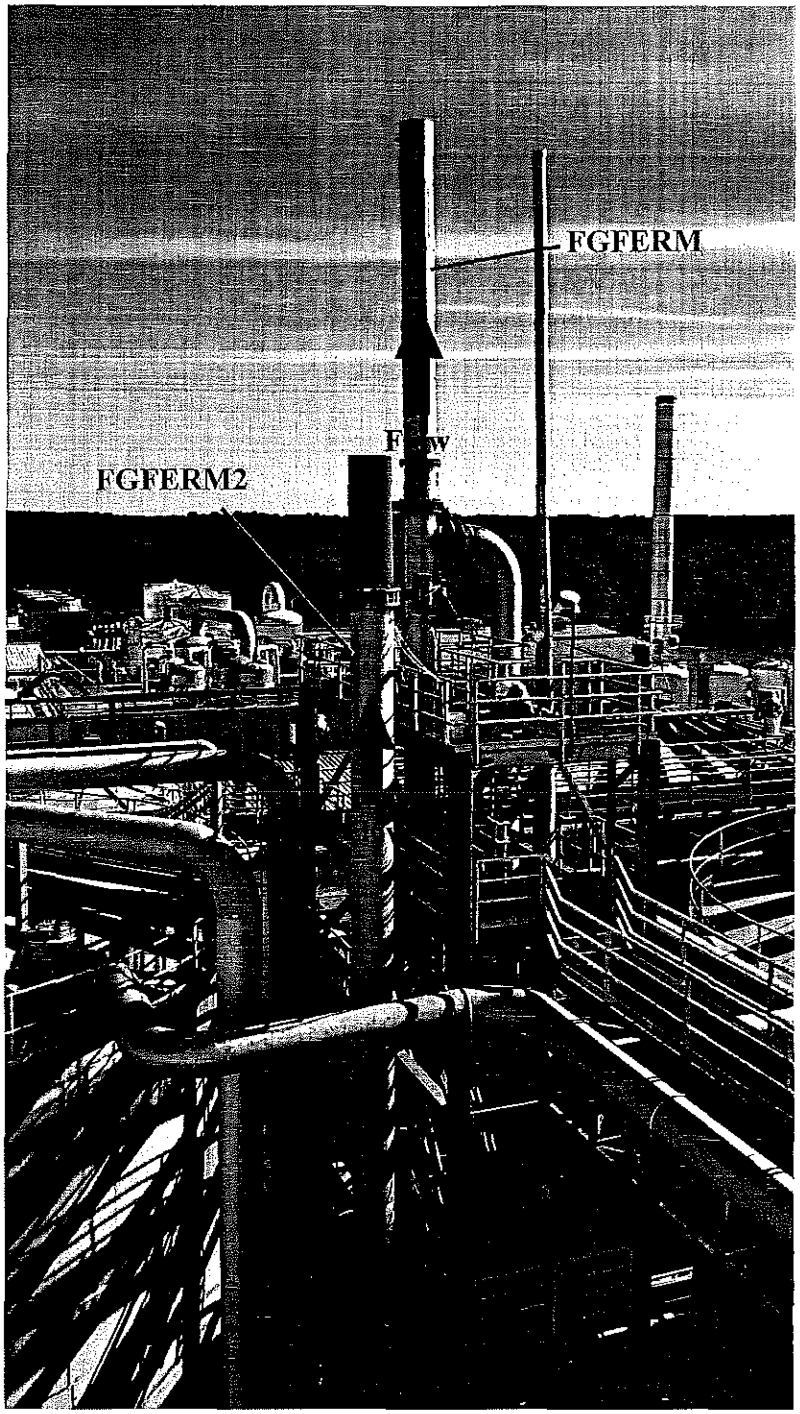

Figure 2-2. FGFERM and FGFERM2 Outlet Sampling Locations

2.5.2 FGFERM2 Outlet Sampling Location

The FGFERM2 scrubber outlet duct is 23.5 inches in diameter and has two 4-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Flue gas velocity, VOC, and acetaldehyde were measured at this location. Eight traverse points, four traverse points per sampling port, were used to measure flue gas velocity. Figure 2-2 is a photograph showing the FGFERM2 outlet sampling location. Figure 2 in the depicts the source sampling ports and traverse point locations.

2.5.3 FGMILL2 Outlet Sampling Location

The FGMILL2 outlet duct is 31 inches in diameter and has two 4-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Flue gas velocity and particulate matter were measured at this location. Eight traverse points, four traverse points per sampling port, were used to measure flue gas velocity and particulate matter. Figure 2-3 is a photograph showing the FGMILL2 outlet sampling location. Figure 3 in the Appendix depicts the source sampling ports and traverse point locations.

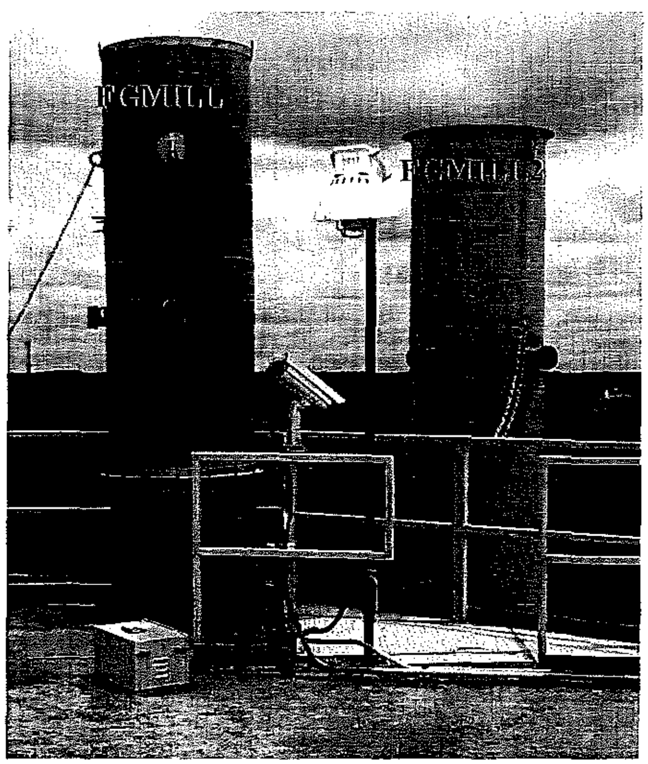

Figure 2-3. FGMILL2 Outlet Sampling Location

2.5.4 EU-COOLINGDRUM Outlet Sampling Location

The EU-COOLINGDRUM outlet duct is 49 inches in diameter and has two 4.5-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Flue gas velocity, particulate matter, and VOC were measured at this location. Twenty-four traverse points, twelve traverse points per sampling port, were used to measure flue gas velocity and particulate matter. Figure 2-4 is a photograph showing the EU-COOLINGDRUM outlet sampling location. Figure 4 in the Appendix depicts the source sampling ports and traverse point locations.

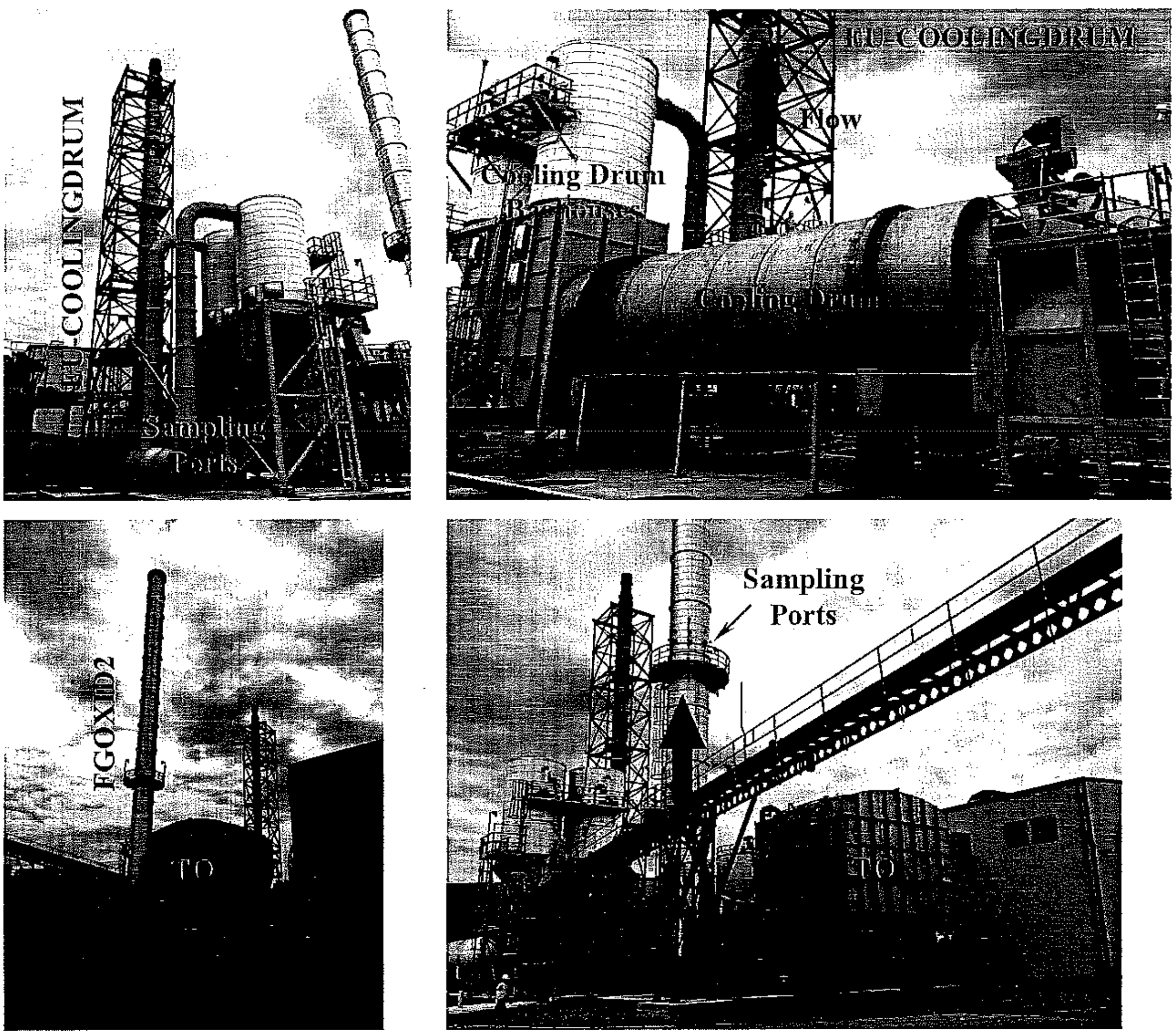

Figure 2-4. EU-COOLINGDRUM and FGOXID2 Outlet Sampling Locations

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2.5.5 FGOXID2 Outlet Sampling Location

The FGOXID2 outlet duct is 84 inches in diameter and has two 4-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Flue gas velocity, particulate matter, VOC, NO_x, CO, acetaldehyde, and SO_2 were measured at this location. Sixteen traverse points, eight traverse points per sampling port, were used to measure flue gas velocity and particulate matter. Figure 2-4 is a photograph showing the FGOXID2 outlet sampling location. Figure 6 in the Appendix depicts the source sampling ports and traverse point locations

2.5.6 FGOXID2 Inlet Sampling Location

The FGOXID2 inlet duct has a depth of 36 inches and width of 59 inches. It has four 3-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Flue gas velocity and VOC were measured at this location. Sixteen traverse points, four traverse points per sampling port, were used to measure flue gas velocity. Figure 2-5 is a photograph showing the FGOXID2 inlet sampling location. Figure 5 in the Appendix depicts the source sampling ports and traverse point locations.

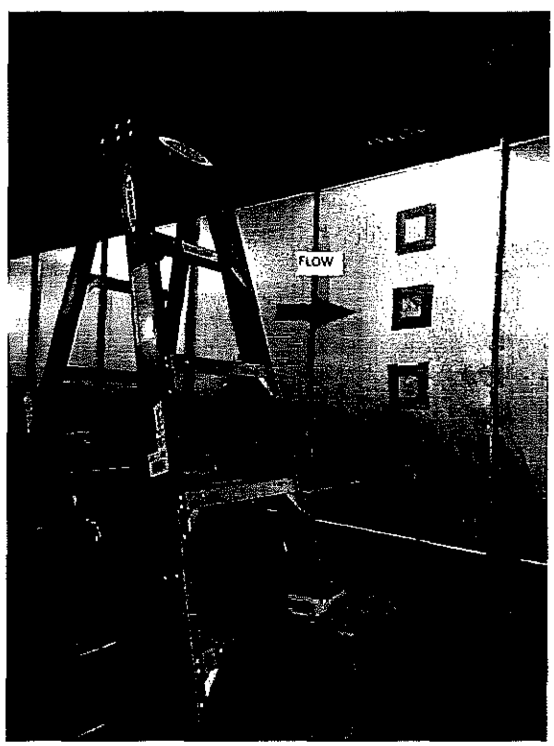

Figure 2-5. FGOXID2 Inlet Sampling Location

2.5.7 FGCHP Outlet Sampling Location

The FGCHP outlet duct is 54 inches in diameter and has two 4.5-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Flue gas velocity, particulate matter, VOC, NO_x, and CO were measured at this location. Sixteen traverse points, eight traverse points per sampling port, were used to measure flue gas velocity and particulate matter. Figure 2-6 is a photograph showing the FGCHP outlet sampling location. Figure 7 in the Appendix depicts the source sampling ports and traverse point locations.

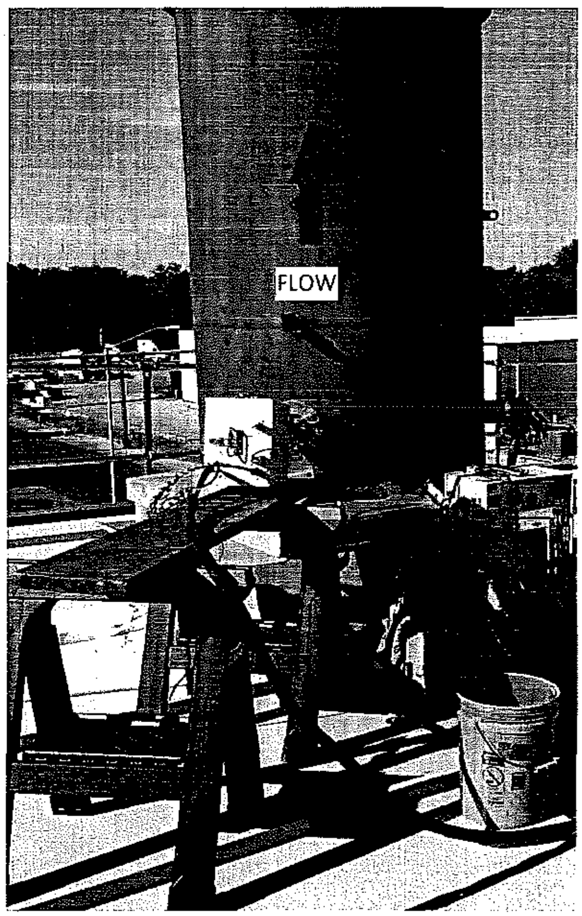

Figure 2-6. FGCHP Outlet Sampling Location

2.6 Process Sampling Locations

Process sampling was not required during this test program. A process sample is a sample that is analyzed for operational parameters, such as calorific value of a fuel (e.g., natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).

3.0 Summary and Discussion of Results

3.1 Objectives

The air emission testing was performed to satisfy testing requirements and to evaluate compliance with certain emission limits in Permit to Install 144-15A, issued by MDEQ on August 31, 2016.

Table 3-1 summarizes the sampling and analytical matrix.

Table 3-1
Test Matrix

Sampling Location	Sample/Type of Pollutant	USEPA Sampling Method	No. of Test Runs and Duration	Analytical Method	Analytical Laboratory
FGFERM Controlled by Scrubber C-40	Flowrate, molecular weight	1 and 2	Three 60-minute test runs	Pitot tube, thermal conductivity detector	Not applicable
	Molecular weight	3C		Thermal conductivity detector	ALS
	VOCs	25A		Flame ionization analyzer	Not applicable
	Acetaldehyde and moisture content	320		Extractive Fourier Transform Infrared	Not applicable
FGFERM2 Controlled by Scrubber C-40A	Flowrate	1 and 2	Three 60-minute test runs	Pitot tube, thermal conductivity detector	Not applicable
	Molecular weight	3C		Thermal conductivity detector	ALS
	VOCs	25A		Flame ionization analyzer	Not applicable
	Acetaldehyde and moisture content	320		Extractive Fourier Transform Infrared	Not applicable
FGMILL2 Controlled by Baghouses C-30A-1;2;3;4	Flowrate, molecular weight, moisture content	1, 2, 3, and 4	Three 60-minute test runs	Pitot tube, chemical absorption analyzer, gravimetric	Not applicable
	PM_{10}	5 and 202		Gravimetric	Bureau Veritas
	Opacity	9		Trained observer	The Andersons

Table 3-1
Test Matrix

Sampling Location	Sample/Type of Pollutant	USEPA Sampling Method	No. of Test Runs and Duration	Analytical Method	Analytical Laboratory
EU-COOLINGDRUM Controlled by Baghouse C-70A	Flowrate, molecular weight, moisture content	1, 2, 3, and 4	Three 60-minute test runs	Pitot tube, chemical absorption analyzer, gravimetric	Not applicable
	PM_{10} and $PM_{2.5}$	5 and 202		Gravimetric	Bureau Veritas
	Opacity	9		Trained observer	The Andersons
	VOCs	25A		Flame ionization analyzer	Not applicable
FGOXID2 Venting to Thermal Oxidizer C-10A	Flowrate, molecular weight, moisture content	1, 2, 3, 3A, and 4	Three 60-minute test runs	Pitot tube, chemical absorption analyzer, gravimetric	Not applicable
	NO_x, CO	7E and 10		Instrument analyzers	Not applicable
	VOCs	25A		Flame ionization analyzer	Not applicable
	Acetaldehyde and SO_2	320		Extractive Fourier Transform Infrared	Not applicable
	PM_{10} and $PM_{2.5}$	5 and 202		Gravimetric	Bureau Veritas
	Opacity	9		Trained observer	The Andersons
FGCHP Controlled by a dry low NO_x burner for NO_x control on the turbine	Flowrate, molecular weight, moisture content	1, 2, 3A, and 4	Three 60-minute test runs	Pitot tube, chemical absorption analyzer, gravimetric	Not applicable
	NO_x, CO	7E and 10		Instrument analyzers	Not applicable
	VOCs	25A		Flame ionization analyzer	Not applicable
	PM_{10} and $PM_{2.5}$	5 and 202		Gravimetric	Bureau Veritas

3.2 Field Test Changes and Issues

Communication between The Andersons, Inc., Bureau Veritas, and MDEQ allowed the testing to be completed as proposed in the July 13, 2017, Intent to Test Plan, with the following field test changes and issues discussed in the sections below. Changes were approved by Mr. Mark Dziadosz with MDEQ.

3.2.1 Additional Test Condition for FGCHP

During verbal communications with the MDEQ and as noted in the MDEQ Test Plan approval letter dated July 11, 2017, MDEQ requested that the FGCHP be tested under three conditions, (1) turbine on, duct burner off, (2) turbine on, duct burner on, and (3) turbine off, duct burner on. A test plan amendment was submitted to the MDEQ on July 5, 2017 to include all three test conditions. The amendment was approved by Mr. Dziadosz on July 18, 2017.

3.2.2 Addition of Testing the FGFERM Source

The Andersons, Inc. requested VOC and acetaldehyde testing for the FGFERM source so that the facility could use ammonium bisulfite in the scrubber water. A test plan amendment was submitted to the MDEQ on July 13, 2017. The amendment was approved by Mr. Dziadosz on July 18, 2017.

3.2.3 Oxygen and Carbon Dioxide Testing on FGFERM and FGFERM2

Due to the high CO_2 concentrations in the exhaust of FGFERM and FGFERM2, CO_2 could not be measured by USEPA Method 3. Mr. Dziadosz requested that O_2 and CO_2 concentrations be measured using USEPA Method 3C. Three samples per source location were collected in glass vacuum containers after the runs, and the average was used for molecular weight calculations. Due to a leak during transport in Sample Container 3 for the FGFERM source, only Sample Containers 1 and 2 were used to average O_2 and CO_2 calculations.

3.2.4 USEPA Method 5 Particulate Matter Testing

On July 26, 2017, Bureau Veritas requested that particulate matter for all sources be tested using USEPA Methods 5 and 202 in lieu of USEPA Methods 201A and 202. The sampling ports for some sources were too small to fit the nozzle head required for EPA Method 201A. USEPA Method 5 is an acceptable alternative as it provides a more conservative sample of particulate matter. Bureau Veritas also requested that the sample run times for particulate matter be reduced from 120 minutes to 60 minutes. The request was verbally accepted by Mr. Dziadosz on July 26, 2017, and formally accepted by email on August 1, 2017.

3.2.5 USEPA Method 320 Sulfur Dioxide Testing

On July 28, 2017, Bureau Veritas requested that sulfur dioxide testing at the FGOXID2 outlet be tested using Alternative Method ALT-046, or USEPA Method 320, in lieu of EPA Method 6C. ALT-046 allows for USEPA Method 320 to be used as an alternative method for sulfur dioxide testing. The request was verbally accepted Mr. Dziadosz on July 28, 2017, and formally accepted by email on August 1, 2017.

3.3 Summary of Results

The results of the testing are presented in Tables 3-2 through 3-7. Detailed results are presented in the Appendix Tables 1 through 13 after the Tables Tab of this report. Graphs are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.

Table 3-2
FGFERM Emissions Results

Parameter	Unit	Result	Emission Limit
Scrubber C-40			
VOCs	lb/hr	12.6	13
Acetaldehyde	lb/hr	0.85	1.3

VOC: volatile organic compound
lb/hr: pound per hour

Table 3-3
FGFERM2 Emissions Results

Parameter	Unit	Result	Emission Limit
Scrubber C-40A			
VOCs	lb/hr	8.5	10
Acetaldehyde	lb/hr	0.82	0.93

VOC: volatile organic compound
lb/hr: pound per hour

Table 3-4
FGMILL2 Emissions Results

Parameter	Unit	Result	Emission Limit
Baghouses C-30A-1;2;3;4			
PM_{10} and $PM_{2.5}$	lb/hr	0.39	0.64
Visible emissions	% opacity as a 6-minute average	0	5

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
lb/hr: pound per hour

Table 3-5
EU-COOLINGDRUM Emissions Results

Parameter	Unit	Result	Emission Limit
Baghouse C-70A			
PM_{10} and $PM_{2.5}$	lb/hr	1.7	2.14
VOCs	lb/hr	**7.1**	3.54
Visible emissions	% opacity as a 6-minute average	0	5

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
VOC: volatile organic compound
lb/hr: pound per hour

Table 3-6
FGOXID2 Emissions Results

Parameter	Unit	Result	Emission Limit
Thermal Oxidizer C-10A			
PM_{10} and $PM_{2.5}$	lb/hr	3.9	5.01
VOCs	lb/hr	0.35	4.5
VOC DE	%	99	98
NO_x	lb/hr	10.3	10.8
CO	lb/hr	3.4	9.1
Acetaldehyde	lb/hr	<0.24	0.33
SO_2	lb/hr	3.5	10.8
Visible emissions	% opacity as a 6-minute average	0	5

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
VOC: volatile organic compound
VOC DE: volatile organic compound destruction efficiency
NO_x: nitrogen oxides
CO: carbon monoxide
SO_2: sulfur dioxide
lb/hr: pound per hour

Table 3-7
FGCHP Emissions Results

Operating Condition	Parameter	Unit	Result	Emission Limit
Combined heat and power system				
Turbine On, Duct Burner Off	PM_{10} and $PM_{2.5}$	lb/hr	1.0	2.9
	VOCs	lb/hr	0.065	3.2
	NO_x	ppmvd at 15% O_2	5.5	42
		lb/hr	1.8	15.6
	CO	lb/hr	0.42	42.8
Turbine On, Duct Burner On	PM_{10} and $PM_{2.5}$	lb/hr	0.78	2.9
	VOCs	lb/hr	<0.7	3.2
	NO_x	ppmvd at 15% O_2	12	42
		lb/hr	5.4	15.6
	CO	lb/hr	1.0	42.8
Turbine Off, Duct Burner On	NO_x	ppmvd at 15% O_2	30	54
		lb/hr	9.5	35.0

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
VOC: volatile organic compound
NO_x: nitrogen oxides
CO: carbon monoxide
lb/hr: pound per hour
ppmvd: pound per million by volume, dry

4.0 Sampling and Analytical Procedures

Bureau Veritas used USEPA sampling Methods 1 through 5, 7E, 9, 10, 25A, 202, 205, and 320. Tables 4-1 and 4-2 present the emissions test parameters and sampling methods.

Table 4-1
Emission Test Parameters

Parameter	Source				Reference	
	FGFERM	FGFERM2	FGMILL2	EU-COOLING DRUM	Method	Title
Sampling ports and traverse points	•	•	•	•	EPA 1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	•	•	•	•	EPA 2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight			•	•	EPA 3	Gas Analysis for the Determination of Dry Molecular Weight
Molecular weight	•	•			EPA 3C	Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen From Stationary Sources
Moisture content			•	•	EPA 4	Determination of Moisture Content in Stack Gases (approximation method)
Particulate matter <2.5 microns ($PM_{2.5}$) and <10 microns (PM_{10})			•	•	EPA 5	Determination of Particulate Matter Emissions From Stationary Sources
Visible emission (VE)†			•	•	EPA 9	Visual Determination of the Opacity of Emissions From Stationary Sources
Volatile organic carbon (VOC)	•	•		•	EPA 25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Condensable particulate matter (PM)			•	•	EPA 202	Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources
Acetaldehyde and moisture content	•	•			EPA 320	Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Infrared (FTIR) Spectroscopy

† Visible emission was measured by The Andersons Albion Ethanol, LLC personnel.

Table 4-2
Emission Test Parameters

Parameter	Source			Reference	
	FGOXID2 Inlet	FGOXID2 Outlet	FGCHP	Method	Title
Sampling ports and traverse points	•	•	•	EPA 1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	•	•	•	EPA 2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight	•	•		EPA 3	Gas Analysis for the Determination of Dry Molecular Weight
Molecular weight		•	•	EPA 3A	Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)
Moisture content	•	•	•	EPA 4	Determination of Moisture Content in Stack Gases (approximation method)
Particulate matter <2.5 microns ($PM_{2.5}$) and <10 microns (PM_{10})		•	•	EPA 5	Determination of Particulate Matter Emissions From Stationary Sources
Nitrogen oxides (NO_x)		•	•	EPA 7E	Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)
Visible emission (VE) †		•		EPA 9	Visual Determination of the Opacity of Emissions From Stationary Sources
Carbon monoxide (CO)		•	•	EPA 10	Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)
Volatile organic carbon (VOC)	•	•	•	EPA 25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Condensable particulate matter (PM)		•	•	EPA 202	Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources
Acetaldehyde and sulfur dioxide (SO_2)		•		EPA 320	Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Infrared (FTIR) Spectroscopy

† Visible emission was measured by The Andersons Albion Ethanol, LLC personnel.

4.1 Test Methods

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

Method 1, "Sample and Velocity Traverses for Stationary Sources," from 40 CFR 60, Appendix A, was used to evaluate the sampling location and the number of traverse points for the measurement of velocity profiles. Details of the sampling location and number of velocity traverse points are presented in Table 4-3.

Table 4-3
Sampling Location and Number of Traverse Points

Sampling Locations	Duct Diameter (inch)	Distance to Upstream Flow Disturbance (diameter)	Distance to Downstream Flow Disturbance (diameter)	Number of Ports	Traverse Points per Port	Total Points
FGFERM	23.5	>8	2.3	2	4	8
FGFERM2	23.5	14.3	5.4	2	4	8
FGMILL2	31	26	2.0	2	4	8
EU-COOLINGDRUM	49	4.6	15.9	2	12	24
FGOXID2 Outlet	84	6.1	>11.4	2	8	16
FGOXID2 Inlet	Length = 36 Width = 59 Eqiv. D = 44.7	6.0	1.6	4	4	16
FGCHP	54	5.1	>13.3	2	8	16

Figures 1 through 7 in the Appendix depict the sampling locations and traverse points for the sources tested.

Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrate. S-type Pitot tubes and thermocouple assemblies calibrated in accordance with Method 2, Section 10.0, and connected to digital manometer, were used. Because the dimensions of the Pitot tube met the requirements outlined in Method 2, Section 10, and were within the specified limits, a baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned.

The digital manometer and thermometer that were used are annually calibrated using calibration standards which are traceable to National Institute of Standards (NIST). Refer to Appendix A for the calibration and inspection sheets. Sample calculations and field data sheets are included in Appendices B and C. Appendix D provides the computer generated data sheets.

Cyclonic Flow Check. Bureau Veritas evaluated whether cyclonic flow is present at the sampling locations.

Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head readings—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20°, the flue gas flow is considered to be cyclonic at that sampling location and an alternative location should be found.

The average of the measured traverse point flue gas velocity null angles were less than 20° at the sampling locations. The measurements indicate the absence of cyclonic flow.

4.1.2 O_2 and CO_2 Concentrations (USEPA Methods 3 and 3C)

Molecular weight was measured using USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." Flue gas was extracted from the stack through a probe positioned near the centroid of the duct and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by chemical absorption with a Fyrite® gas analyzer to within ±0.5%. The average CO_2 and O_2 result of the grab samples were used to calculate molecular weight.

Molecular weight was measured using USEPA Method 3C, "Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen From Stationary Sources." Flue gas was extracted from the stack through a probe positioned near the centroid of the duct and directed into an evacuated glass container. The containers were sent to ALS Environmental's laboratory in Simi Valley, California for analysis. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by a thermal conductivity detector. The average CO_2 and O_2 result of the grab samples were used to calculate molecular weight.

4.1.3 Oxygen, Carbon Dioxide, Nitrogen Oxides, and Carbon Monoxide (USEPA Methods 3A, 7E, and 10)

USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure);" Method 7E, "Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrument Analyzer Procedure);" and Method 10 "Determination of Carbon Monoxide Emissions from Stationary Sources (Instrument Analyzer Procedure)" were used to measure O_2, CO_2, NO_x, and CO concentrations. Flue gas was continuously sampled from the stack and conveyed to an ultraviolet absorption, chemiluminescence, and infrared analyzer for O_2, CO_2, NO_x, and CO concentration measurements.

Flue gas was extracted from the stack through:

- A stainless steel probe.
- Heated Teflon sampling line to prevent condensation.
- A chilled Teflon impinger train (equipped with a peristaltic pump) to remove moisture from the sampled gas stream prior to entering the analyzer.
- O_2, CO_2, NO_x, and CO gas analyzers.

Figure 4-1 depicts the USEPA Methods 3A, 7E, and 10 sampling train. Data were recorded at 1-second intervals on a computer equipped with data acquisition software.

Prior to testing, a 3-point stratification test was conducted at 17, 50, and 83% of the stack diameter for at least twice the response time to determine the minimum number of traverse points to be sampled.

The pollutant concentrations were measured using O_2, CO_2, NO_x, and CO gas analyzers calibrated with zero-, mid-, and high-level EPA-Traceability-Protocol-certified calibration gases. The mid-level gas was 40 to 60% of the high-level (also referred to as span) gas.

A calibration error check was performed by introducing zero-, mid-, and high-level calibration gases directly into the analyzer. The calibration error check was performed to verify the analyzer response was within ±2% of the calibration span of the analyzer. Prior to each test run, a system-bias test was performed where known concentrations of calibration gases were introduced at the probe tip to measure if the analyzers response was within ±5% of the introduced calibration gas concentrations. At the conclusion of each test run, an additional system-bias check was performed to evaluate the analyzer drift from the pre- and post-test system-bias checks. The system-bias check evaluated the analyzer drift against the ±3% quality assurance/quality control (QA/QC) requirement. The analyzer drift data was used to correct the measured flue gas concentrations. Recorded concentrations were averaged over the duration of each 60-minute test run.

An NO/NO_2 conversion check was performed by introducing an approximate 50 part per million (ppm) NO_2 calibration gas into the NO_x analyzer. The analyzer's NO_x concentration response was greater than 90% of the introduced NO_2 calibration gas concentration. The analyzer's NO/NO_2 conversion met the converter efficiency requirement of Section 13.5 of USEPA Method 7E.

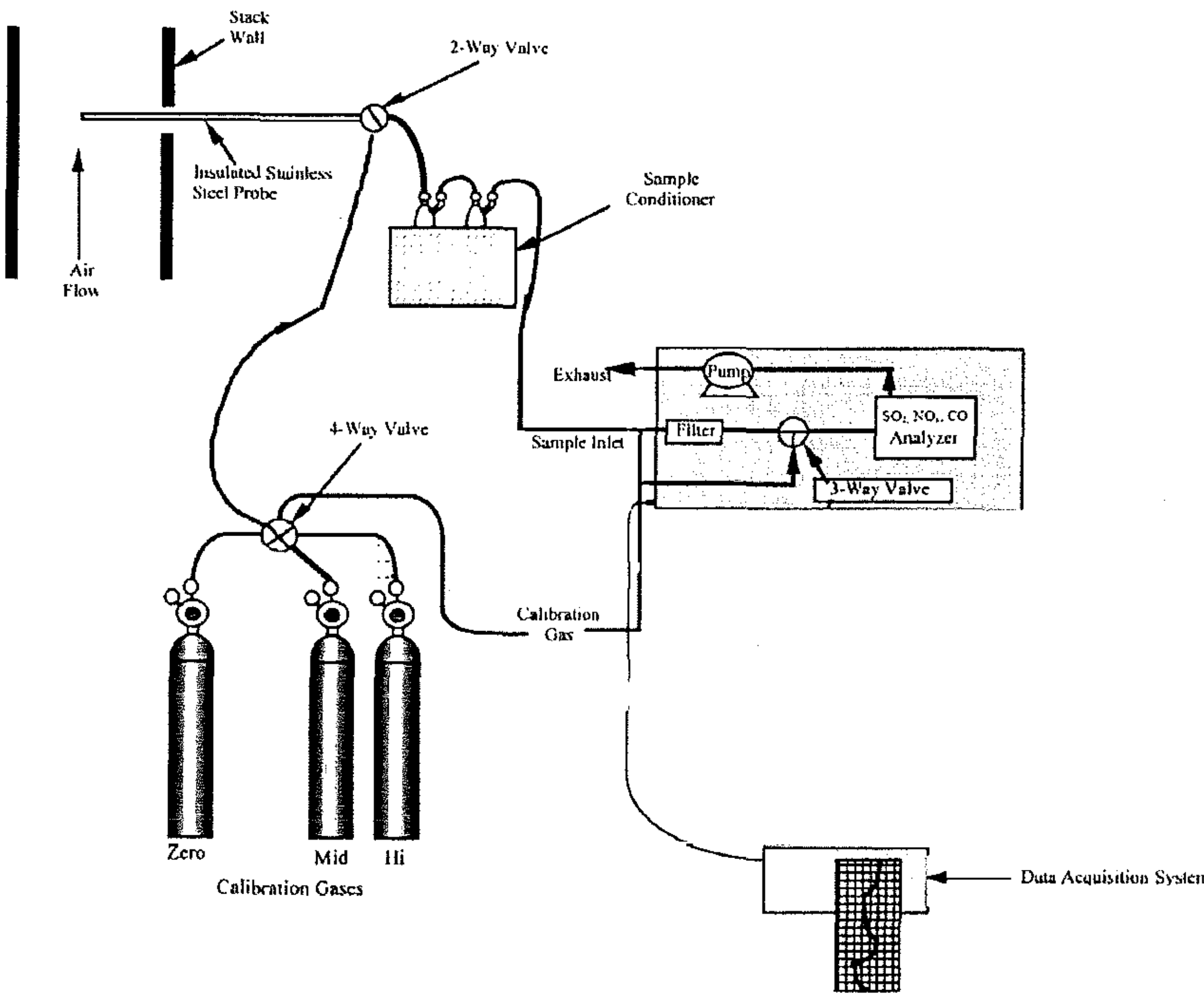

Figure 4-1. USEPA Methods 3A, 7E, and 10 Sampling Train

4.1.4 Moisture Content (USEPA Method 4)

The moisture content of the flue gas was measured following USEPA Method 4, "Determination of Moisture Content in Stack Gases," in conjunction with USEPA Method 5. Prior to testing, Bureau Veritas estimated the moisture content using previous stack test data, wet bulb-dry bulb measurements, and/or psychrometric tables.

4.1.5 Filterable Particulate Matter (USEPA Methods 5 and 202)

USEPA Methods 5, "Determination of Particulate Matter Emissions from Stationary Sources" and 202, "Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources," were used to measure particulate matter emissions at The Andersons Albion

Ethanol, LLC facility. USEPA Method 5 measures filterable particulate matter (FPM), while the Method 202 train collects condensable particulate matter (CPM).

CPM is defined as material that is in vapor phase at stack conditions, but that condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid FPM immediately after discharge from the stack. Method 202 collects CPM using a water-dropout impinger, modified Greenburg-Smith impinger, and a Teflon filter.

The sum of the Method 5 (FPM) and Method 202 (CPM) mass collected represent total particulate matter, which was used as a conservative measurement of particulate matter with diameter less than 10 microns (PM_{10}) and particulate matter with diameter less than 2.5 microns ($PM_{2.5}$).

Bureau Veritas' modular Methods 5 and 202 isokinetic stack sampling system consists of the following (in order from the stack to the control case):

- A stainless steel button-hook nozzle.
- A heated (248±25°F) stainless steel probe.
- A desiccated and pre-weighed 83-millimeter-diameter glass fiber filter (manufactured to at least 99.95% efficiency (<0.05 % penetration) for 0.3-micron dioctyl phthalate smoke particles) in a heated (248±25°F) filter box.
- An USEPA Method 23-type stack gas condenser with water recirculation pump.
- A set of four GS impingers with the configuration shown in Table 4-4.
- A second (back-half) CPM Teflon filter inserted between the second and third impingers and maintained at a temperature between 65 and 85°F.
- A sampling line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Figure 4-2 depicts the USEPA Methods 5 and 202 sampling train.

Table 4-4
USEPA Methods 5 and 202 Impinger Configuration

Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Amount
1	Modified – dropout	Empty	0 milliliter
2	Modified	Empty	0 milliliter
CPM Filter			
3	Modified	HPLC water	100 milliliter
4	Modified	Silica gel desiccant	~200-300 grams

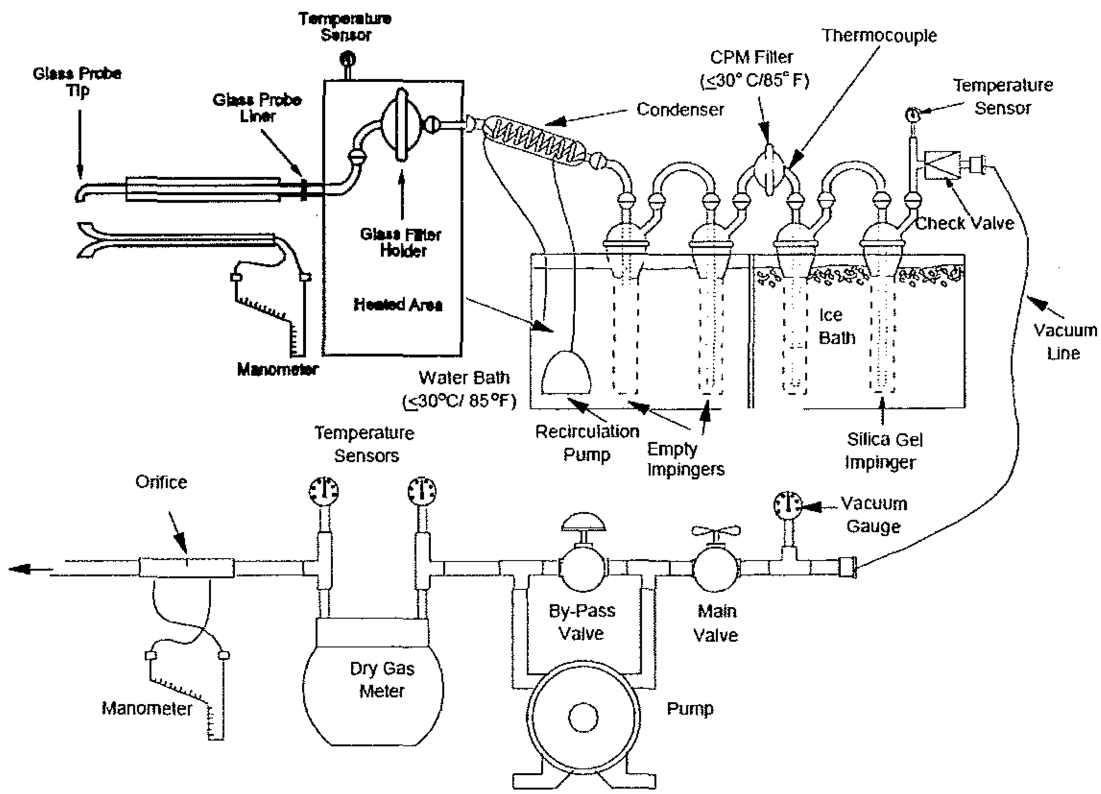

Figure 4-2. USEPA Methods 5 and 202 Sampling Train

4.1.6 Opacity (USEPA Method 9)

Representatives from The Andersons Albion Ethanol, LLC conducted opacity readings in accordance with USEPA Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources." Opacity of the emissions from the stacks was observed at the point of greatest opacity in the portion of the plume where condensed water vapor was not present. As required by the method, the Method 9 observer did not look continuously at the plume but instead observed the plume momentarily at 15-second intervals.

The observer recorded the emission location, facility type, observer's name and affiliation, and the date on a field data sheet. The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background were also recorded. The Andersons Albion Ethanol, LLC personnel performed the visual emissions testing on site. Visual emissions field data sheets are presented in Appendix F.

4.1.7 Volatile Organic Compounds (USEPA Method 25A)

VOC concentrations were measured following USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer." Samples were collected through a probe and heated sample line into the analyzer.

A flame ionization detector (FID) measures the average hydrocarbon concentration in part per million by volume (ppmv) of VOC as the calibration gas methane. The FID is fueled by 100% hydrogen, which generates a flame with a negligible number of ions. Flue gas is introduced into the FID and enters the flame chamber. The combustion of flue gas generates electrically charged ions. The analyzer applies a polarizing voltage between two electrodes around the flame, producing an electrostatic field. Negatively charged ions, anions, migrate to a collector electrode, while positively charged ions, cations, migrate to a high-voltage electrode. The current between the electrodes is directly proportional to the hydrocarbon concentration in the sample. The flame chamber is depicted in Figure 4-3.

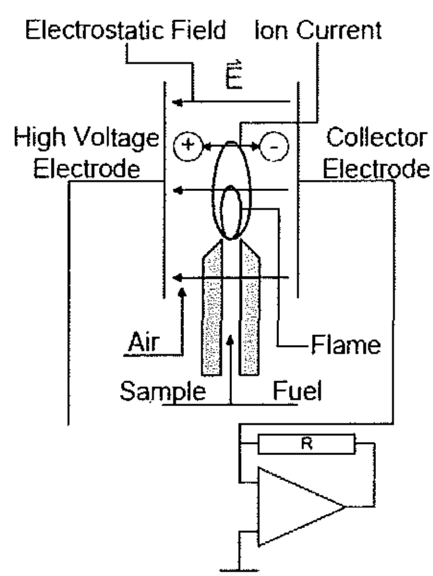

Figure 4-3. FID Flame Chamber

Using the voltage analog signal, measured by the FID, the concentration of volatile organic compounds was recorded by a data acquisition system (DAS). The average concentration of VOC is reported as the calibration gas (i.e., propane) in equivalent units.

Before testing, the FID analyzers were calibrated by introducing a zero-calibration range gas (<1% of span value) and high-calibration range gas (80-90% span value) to the tip of the sampling probe. The span value was set to 1.5 to 2.5 times the expected concentration (e.g., 0 to 100 ppmv). Next, a low-calibration range gas (25-35% of span value) and mid-calibration range gas (45-55% of span value) were introduced. The analyzers are considered calibrated when the analyzer response is ±5% of the calibration gas value.

At the conclusion of a test run, a calibration drift test was performed by introducing the zero- and mid-calibration gas to the tip of the sampling probe. The test run data is considered valid if the calibration drift test demonstrates the analyzers are responding within 3% of calibration span from pre-test to post-test calibrations.

Figure 4-4 depicts the USEPA Method 25A sampling train.

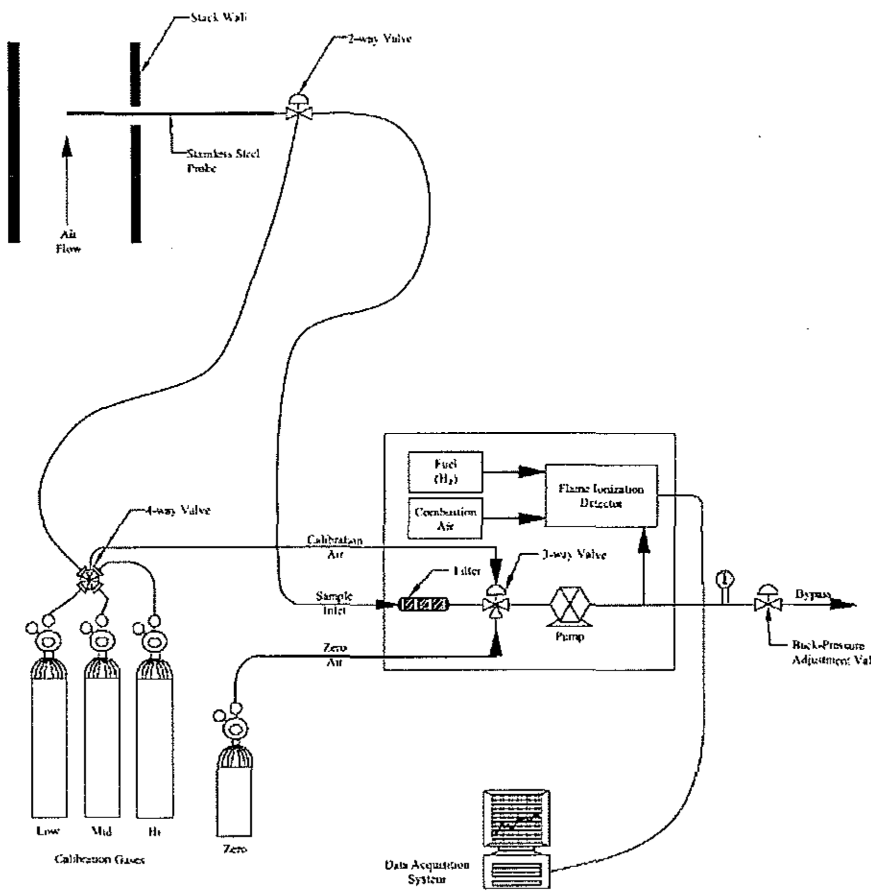

Figure 4-4. USEPA Method 25A Sampling Train

4.1.8 Gas Dilution (USEPA Method 205)

A gas dilution system was used to introduce calibration gases into the analyzers. The gas dilution system consists of calibrated orifices. The system dilutes a high-level calibration gas to within ±2% of predicted values.

Before the start of testing, the gas divider dilution was verified to be within ±2% of predicted values. Two sets of dilutions of the high-level calibration gas were performed. Subsequently, a certified mid-level calibration gas was introduced into the analyzer; the calibration gas concentration was within ±10% of a dilution. Refer to Appendix A for the certified calibration gas certifications and the gas dilution field calibration.

4.1.9 Vapor Phase Organic and Inorganic Emissions (USEPA Method 320)

Acetaldehyde and sulfur dioxide emissions, as well as moisture content were measured in accordance with USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy." Gaseous samples were drawn from the ducts and transferred to an MKS Instruments MultiGas 2030 FTIR spectrometer.

The samples were directed through a heated probe, heated filter, and heated transfer line to the FTIR. The probes, filters, transfer lines, and FTIRs were maintained at 191°C (375°F) during testing. The compounds' concentrations were measured based on their infrared absorbance compared to reference spectra. The FTIR analyzer scans the sample approximately once per second. A data point consists of the co-addition of 64 scans, with a data point generated every minute.

FTIR quality assurance followed USEPA Method 320. A calibration transfer standard (CTS) was analyzed before and after testing. Analyte spiking was performed before testing.

The analyte spikes were set to a target dilution ratio of 1:10. Analyte spike recoveries were evaluated against the Method 320 allowance of ±30%. Spike recoveries were within the Method 320 allowance.

Figure 4-5 depicts the USEPA Method 320 sampling train.

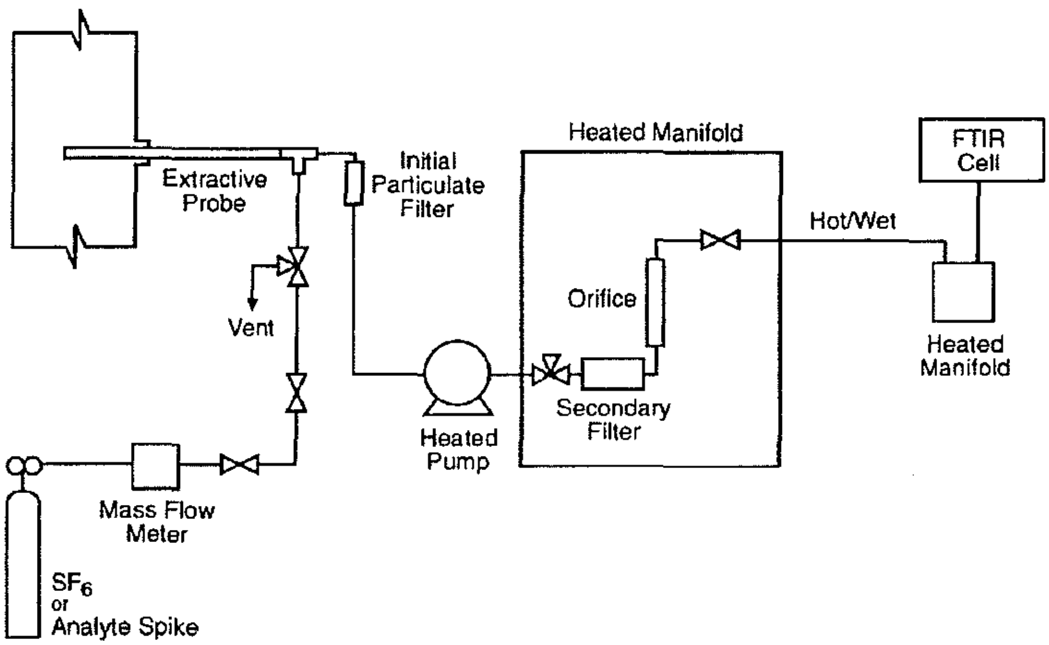

Figure 4-5. USEPA Method 320 Sampling Train

4.2 Procedures for Obtaining Process Data

The Andersons Albion Ethanol, LLC personnel recorded process data during testing. MDEQ personnel verified the requested operating and process data were recorded. The process data are included within Appendix F.

4.3 Sampling Identification and Custody

Mr. David Kawasaki, Air Quality Consultant II with Bureau Veritas, was responsible for the handling and procurement of the data collected in the field. Mr. Kawasaki ensured the data sheets were accounted for and completed in their entirety. Recovery and analytical procedures were applicable to the sampling methods used in this test program. Applicable Chain of Custody procedures followed guidelines outlined within ASTM D4840-99 (Reapproved 2010), "Standard Guide for Sample Chain-of-Custody Procedures." Detailed sampling and recovery procedures are described in Section 4.0. For each sample collected (i.e., filter and probe rinse) sample identification and custody procedures were completed as follows:

- Containers were sealed with Teflon tape to prevent contamination.
- Containers were labeled with test number, location, and test date.

- The level of fluid was marked on outside of sample containers to evaluate whether the containers leaked before delivery of the samples to the laboratory.
- Containers were placed in a cooler for storage.
- Samples will be logged using guidelines outlined in ASTM D4840-99 (Reapproved 2010).
- Samples will be transported to the laboratory under chain of custody.

Chains of custody and laboratory analytical results are included in Appendix E.

5.0 QA/QC Activities

Equipment used in this emissions test program passed QA/QC procedures. Refer to Appendix A for equipment calibrations.

5.1 Pretest QA/QC Activities

Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling method and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III, Stationary Source-Specific Methods."

5.2 QA/QC Audits

Quality assurance (QA) audit samples were not proposed during this test program. Currently, audit samples for the parameters to be measured are not available from the EPA Stationary Source Audit Program.

Onsite QA/QC procedures (i.e., Pitot tube inspections, nozzle size verifications, leak check, calculation of isokinetic sampling rates, calibrations) were performed in accordance with the respective USEPA sampling methods. Equipment inspection and calibration measurements are presented in Appendix A.

Offsite QA audits include dry-gas meter and thermocouple calibrations.

5.2.1 Sampling Train QA/QC Audits

The sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. Table 5-1 summarizes the QA/QC audits conducted on each moisture and particulate matter sampling train.

Table 5-1
Methods 5 and 202 Sampling Train QA/QC Audits

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
FGMILL2					
Average velocity pressure head (in H_2O)	1.64	1.68	1.64	>0.05 in $H_2O^{\dagger}$	Valid
Sampling train leak check Post–test	0 ft^3 for 1 min at 6 in Hg	0 ft^3 for 1 min at 6 in Hg	0 ft^3 for 1 min at 8 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	4 to 5	5	6		
EU-COOLINGDRUM					
Average velocity pressure head (in H_2O)	1.68	1.66	1.63	>0.05 in $H_2O^{\dagger}$	Valid
Sampling train leak check Post–test	0 ft^3 for 1 min at 8 in Hg	0 ft^3 for 1 min at 8 in Hg	0 ft^3 for 1 min at 8 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	5 to 6	6 to 7	5 to 6		
FGOXID2					
Average velocity pressure head (in H_2O)	0.18	0.19	0.20	>0.05 in $H_2O^{\dagger}$	Valid
Sampling train leak check Post–test	0 ft^3 for 1 min at 11 in Hg	0 ft^3 for 1 min at 10 in Hg	0 ft^3 for 1 min at 10 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	5 to 9	6 to 8	6 to 8		
FGCHP (Turbine On, Duct Burner Off)					
Average velocity pressure head (in H_2O)	1.44	1.41	1.45	>0.05 in $H_2O^{\dagger}$	Valid
Sampling train leak check Post–test	0 ft^3 for 1 min at 9 in Hg	0 ft^3 for 1 min at 8 in Hg	0 ft^3 for 1 min at 10 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	7 to 8	7	6 to 8		

Table 5-1
Methods 5 and 202 Sampling Train QA/QC Audits

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
FGCHP (Turbine On, Duct Burner On)					
Average velocity pressure head (in H_2O)	1.34	1.36	1.39	>0.05 in $H_2O^{\dagger}$	Valid
Sampling train leak check Post–test	0 ft^3 for 1 min at 9 in Hg	0 ft^3 for 1 min at 10 in Hg	0 ft^3 for 1 min at 10 in Hg	<0.020 ft^3 for 1 minute at a vacuum $\geq$ recorded during test	Valid
Sampling vacuum (in Hg)	6 to 7	6 to 9	6 to 9		

5.2.2 Instrument Analyzer QA/QC Audits

The instrument analyzer sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Table 5-2 summarizes gas cylinders used during this test program and QA/QC audits. Refer to Appendix A for additional calibration data.

Table 5-2
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Air	Airgas	CC262447	-	1/14/2024
Nitrogen	Airgas	CC183736	99.9995%	11/2/2023
Hydrogen	Airgas	76137	99.999%	N/A
Propane	Airgas	CC313717	301.5 ppm	9/13/2024
Propane	Airgas	CC13790	3,001 ppm	7/25/2022
Propane	The American Gas Group	EB0031014	5,003 ppm	2/21/2020
Acetaldehyde	Airgas	XC030760B	199.2 ppm	08/31/2017
Sulfur hexafluoride	Airgas	XC030760B	4.097 ppm	08/31/2017

Table 5-2
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Ethylene	Airgas	CC497404	100.0 ppm	6/9/2020
Carbon monoxide	Airgas	XC034476B	126.8 ppm	10/29/2022
Nitrogen oxides	Airgas	XC033685B	491.7 ppm	12/2/2021
Nitrogen dioxide	Airgas	CC500773	50.18 ppm	11/11/2017
Sulfur dioxide	Airgas	CC131966	88.21 ppm	10/23/2022
Oxygen	Airgas	CC3829B	19.94 %	6/2/2024
Carbon dioxide	Airgas	CC3829B	19.78 %	6/2/2024

5.2.3 Dry-Gas Meter QA/QC Audits

Table 5-3 summarizes the dry-gas meter calibration checks in comparison to the acceptable USEPA tolerance. Refer to Appendix A for complete DGM calibrations.

Table 5-3
Dry-gas Meter Calibration QA/QC Audit

Dry-Gas Meter	Pre-test DGM Calibration Factor (Y) (dimensionless)	Post-Test DGM Calibration Check Value (Y_{qa}) (dimensionless)	Difference Between Pre- and Post-test DGM Calibrations	Acceptable Tolerance	Comment
3	0.991 (3/15/2017)	0.976 (8/16/2017)	0.015	±0.05	Valid
7	1.015 (3/15/2017)	1.006 (8/16/2017)	0.009	±0.05	Valid

5.2.4 Thermocouple QA/QC Audits

Temperature measurements using thermocouples and digital pyrometers were compared to a reference temperature (i.e., ice water bath, boiling water) prior to and after testing to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperature within

±1.5% of the reference temperatures and were within USEPA acceptance criteria. Thermocouple calibration sheets are presented in the Appendix A.

5.2.5 QA/QC Blanks

Reagent, field train recovery, and field train proof blanks were analyzed for the parameters of interest. The results of the blanks are presented in the Table 5-4. Acetone blank corrections were not applied to the particulate matter results. Refer to Appendix E for the laboratory data.

Table 5-4
QA/QC Blanks

Sample Identification	Result (mg)	Comment
Method 5 Filter Blank	<0.30	Reporting limit is 0.30 milligrams.
Method 5 Acetone Blank	0.6	Reporting limit is 0.5 milligrams. Sample volume was approximately 87 grams. Blank corrections not applied.
Method 202 Reagent Water Blank	1.0	Reporting limit is 0.5 milligrams. Sample volume was approximately 110 grams. Blank corrections not applied.
Method 202 Reagent Acetone Blank	<1.0	Reporting limit is 1.0 milligrams. Sample volume was approximately 100 grams. Blank corrections not applied.
Method 202 Reagent Hexane Blank	< 1.0	Reporting limit is 1.0 milligrams. Sample volume was approximately 63 grams. Blank corrections not applied.
Method 202 Inorganic Proof Blank	1.0	Reporting limit is 0.5 milligrams. Sample volume was approximately 76 grams.
Method 202 Organic Proof Blank	< 1.0	Reporting limit is 1.0 milligrams. Sample volume was approximately 60 grams.
Method 202 Inorganic Field Blank	1.8	Reporting limit is 0.5 milligrams. Sample volume was approximately 88 grams.
Method 202 Organic Field Blank	< 1.0	Reporting limit is 1.0 milligrams. Sample volume was approximately 60 grams.

5.3 QA/QC Checks for Data Reduction and Validation

The emissions testing Project Manager and/or the QA/QC Officer validated the computer spreadsheets onsite. The computer spreadsheets were used to evaluate whether field calculations are accurate. Random inspection of the field data sheets were conducted to evaluate whether data has been recorded appropriately. At the completion of a test, the raw field data were entered into computer spreadsheets to provide applicable onsite emissions calculations. The computer data sheets were checked against the raw field data sheets for accuracy during review of the draft report.

5.4 QA/QC Problems

Equipment audits and QA/QC procedures demonstrate sample collection accuracy for the test runs.

6.0 Limitations

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Table 1

FGFERM VOC and Acetaldehyde Emission Results

The Andersons Albion Ethanol, LLC

Albion, Michigan

Bureau Veritas Project No. 11017-000048.00

Sampling Date: July 25, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			July 25, 2017			
Sampling Time			7:40	9:01	10:15	
Duration		min	60	60	60	60
Outlet	Gas Stream Volumetric Flowrate	scfm	9,299	9,098	8,895	9,097
	VOC Concentration	ppmv, as propane	187.1	211.1	210.1	202.8
	Acetaldehyde Concentration	ppmv	13.5	14.0	13.5	13.7
	VOC Mass Emission Rate	lb/hr, as propane	11.9	13.2	12.8	12.6
	Acetaldehyde Mass Emission Rate	lb/hr	0.86	0.87	0.82	0.85

Standard conditions: 68°F and 29.92 in Hg
scfm: standard cubic feet per minute
ppmv: part per million by volume
lb/hr: pound per hour

Table 2

FGFERM2 VOC and Acetaldehyde Emission Results

The Andersons Albion Ethanol, LLC

Albion, Michigan

Bureau Veritas Project No. 11017-000048.00

Sampling Date: July 25, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			July 25, 2017			
Sampling Time			13:28	14:47	16:08	
Duration		min	60	60	60	60
Outlet	Gas Stream Volumetric Flowrate	scfm	9,679	9,121	8,885	9,229
	VOC Concentration	ppmv, as propane	149	144	108	134
	Acetaldehyde Concentration	ppmv	12.7	13.5	12.4	12.9
	VOC Mass Emission Rate	lb/hr, as propane	9.9	9.0	6.6	8.5
	Acetaldehyde Mass Emission Rate	lb/hr	0.84	0.85	0.76	0.82

Standard conditions: 68°F and 29.92 in Hg
scfm: standard cubic feet per minute
ppmv: part per million by volume
lb/hr: pound per hour

Table 3 - FGMILL2 Particulate Matter Emission Results

Facility		The Andersons Albion Ethanol, LLC			
Source Designation		FGMILL2			
Test Date		Jul 26, 2017	Jul 26, 2017	Jul 26, 2017	
Meter/Nozzle Information		Run 1	Run 2	Run 3	Average
Meter Temperature, T_m	°F	79	82	84	82
Meter Pressure, P_m	in Hg	29.14	29.15	29.14	29.15
Measured Sample Volume, V_m	ft^3	45.92	46.98	45.48	46.12
Sample Volume, V_m	std ft^3	43.42	44.16	42.61	43.40
Sample Volume, V_m	std m^3	1.23	1.25	1.21	1.23
Condensate Volume, V_w	std ft^3	1.13	1.38	1.27	1.26
Gas Density, ρ_s	std lb/ft^3	0.0741	0.0739	0.0739	0.0740
Total weight of sampled gas	lb	3.299	3.366	3.240	3.302
Nozzle Size, A_n	ft^2	0.0001787	0.0001787	0.0001787	0.0001787
Isokinetic Variation, I	%	100	101	98	100
Stack Data					
Average Stack Temperature, T_s	°F	92	92	94	93
Molecular Weight Stack Gas-dry, M_d	lb/lb-mole	28.80	28.80	28.80	28.80
Molecular Weight Stack Gas-wet, M_s	lb/lb-mole	28.53	28.47	28.49	28.50
Stack Gas Specific Gravity, G_s		0.99	0.98	0.98	0.98
Percent Moisture, B_{ws}	%	2.53	3.03	2.89	2.82
Water Vapor Volume (fraction)		0.025	0.030	0.029	0.028
Pressure, P_s	in Hg	28.90	28.90	28.90	28.90
Average Stack Velocity, V_s	ft/sec	75.15	76.09	75.37	75.54
Area of Stack	ft^2	5.24	5.24	5.24	5.24
Exhaust Gas Flowrate					
Flowrate	ft^3/min, actual	23,635	23,930	23,702	23,756
Flowrate	ft^3/min, standard wet	21,850	22,118	21,823	21,930
Flowrate	ft^3/min, standard dry	21,297	21,447	21,192	21,312
Flowrate	m^3/min, standard dry	603	607	600	603
Collected Mass					
Particulate Matter Acetone Wash	mg	1.3	2.0	1.4	1.6
Particulate Matter Filter	mg	<0.30	<0.30	<0.30	0.3
Total Filterable Particulate Matter (FPM)	mg	1.6	2.3	1.7	1.9
Inorganic CPM	mg	4.6	2.4	2.4	3.1
Organic CPM	mg	<1.0	<1.0	1.1	1.0
Total Condensable Particulate Matter (CPM)	mg	5.6	3.4	3.5	4.2
Total FPM and CPM	mg	7.2	5.7	5.2	6.0
Concentration					
Particulate Matter (FPM)	mg/dscf	0.037	0.052	0.040	0.043
Particulate Matter (FPM)	grain/dscf	0.00057	0.00080	0.00062	0.00066
Total Condensable Particulate Matter (CPM)	mg/dscf	0.13	0.077	0.082	0.096
Total Condensable Particulate Matter (CPM)	grain/dscf	0.0020	0.00119	0.0013	0.0015
Total FPM and CPM	mg/dscf	0.17	0.13	0.12	0.14
Total FPM and CPM	grain/dscf	0.0026	0.0020	0.0019	0.0021
Total FPM and CPM	$\mu g/m^3$	5,856	4,558	4,310	4,908
Mass Emission Rate					
Particulate Matter (FPM)	lb/hr	0.10	0.15	0.11	0.12
Total Condensable Particulate Matter (CPM)	lb/hr	0.36	0.22	0.23	0.27
Total FPM and CPM	lb/hr	0.47	0.37	0.34	0.39

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Table 4
EU-COOLINGDRUM VOC Emission Results
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 27, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			July 27, 2017			
Sampling Start Time			8:15	9:35	11:00	
Duration		min	60	60	60	60
Outlet	Gas Stream Volumetric Flowrate	scfm	54,464	54,127	53,698	54,096
	VOC Concentration	ppmv, as propane	17.5	19.7	20.2	19.1
	VOC Mass Emission Rate	lb/hr, as propane	6.5	7.3	7.4	7.1

Standard conditions: 68°F and 29.92 in Hg
scfm: standard cubic foot per minute
ppmv: part per million by volume
lb/hr: pound per hour

Table 5 - EU-COOLINGDRUM Particulate Matter Emission Results

Facility		**The Andersons Albion Ethanol, LLC**			
Source Designation		**EU-COOLINGDRUM**			
Test Date		**Jul 27, 2017**	**Jul 27, 2017**	**Jul 27, 2017**	
Meter/Nozzle Information		**Run 1**	**Run 2**	**Run 3**	**Average**
Meter Temperature, T_m	°F	76	88	88	84
Meter Pressure, P_m	in Hg	29.05	29.05	29.04	29.05
Measured Sample Volume, V_m	ft^3	46.43	46.18	46.44	46.35
Sample Volume, V_m	std ft^3	44.04	42.79	43.04	43.29
Sample Volume, V_m	std m^3	1.25	1.21	1.22	1.23
Condensate Volume, V_w	std ft^3	1.81	2.00	2.06	1.96
Gas Density, ρ_s	std lb/ft^3	0.0737	0.0735	0.0735	0.0735
Total weight of sampled gas	lb	3.377	3.292	3.252	3.307
Nozzle Size, A_n	ft^2	0.0001787	0.0001787	0.0001787	0.0001787
Isokinetic Variation, I	%	103	101	103	102
Stack Data					
Average Stack Temperature, T_s	°F	104	106	108	106
Molecular Weight Stack Gas-dry, M_d	lb/lb-mole	28.80	28.80	28.80	28.80
Molecular Weight Stack Gas-wet, M_s	lb/lb-mole	28.37	28.32	28.31	28.33
Stack Gas Specific Gravity, G_s		0.98	0.98	0.98	0.98
Percent Moisture, B_{ws}	%	3.94	4.46	4.57	4.32
Water Vapor Volume (fraction)		0.039	0.045	0.046	0.043
Pressure, P_s	in Hg	29.02	29.02	29.02	29.02
Average Stack Velocity, V_s	ft/sec	76.37	76.16	75.75	76.09
Area of Stack	ft^2	13.10	13.10	13.10	13.10
Exhaust Gas Flowrate					
Flowrate	ft^3/min, actual	60,009	59,841	59,519	59,790
Flowrate	ft^3/min, standard wet	54,464	54,127	53,698	54,096
Flowrate	ft^3/min, standard dry	52,319	51,711	51,244	51,758
Flowrate	m^3/min, standard dry	1,482	1,464	1,451	1,466
Collected Mass					
Particulate Matter Acetone Wash	mg	0.5	1.1	3.9	1.8
Particulate Matter Filter	mg	0.90	0.40	0.90	0.7
Total Filterable Particulate Matter (FPM)	mg	1.4	1.5	4.8	2.6
Inorganic CPM	mg	3.2	12	6.7	7.3
Organic CPM	mg	<1.0	1.0	<1.0	1.0
Total Condensable Particulate Matter (CPM)	mg	4.2	13.0	7.7	8.3
Total FPM and CPM	mg	5.6	14.5	12.5	10.9
Concentration					
Particulate Matter (FPM)	mg/dscf	0.032	0.035	0.112	0.059
Particulate Matter (FPM)	grain/dscf	0.00049	0.00054	0.0017	0.00092
Total Condensable Particulate Matter (CPM)	mg/dscf	0.10	0.30	0.18	0.19
Total Condensable Particulate Matter (CPM)	grain/dscf	0.0015	0.0047	0.0028	0.0030
Total FPM and CPM	mg/dscf	0.13	0.34	0.29	0.25
Total FPM and CPM	grain/dscf	0.0020	0.0052	0.0045	0.0039
Total FPM and CPM	$\mu g/m^3$	4,491	11,967	10,257	8,905
Mass Emission Rate					
Particulate Matter (FPM)	lb/hr	0.22	0.24	0.76	0.41
Total Condensable Particulate Matter (CPM)	lb/hr	0.66	2.1	1.2	1.3
Total FPM and CPM	lb/hr	0.88	2.3	2.0	1.7

Table 6

FGOXID2 VOC Destruction Efficiency, SO_2, and Acetaldehyde Emission Results

The Andersons Albion Ethanol, LLC

Albion, Michigan

Bureau Veritas Project No. 11017-000048.00

Sampling Date: July 28, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Sampling Date			July 28, 2017			
Sampling Time			11:42 to 12:42	13:37 to 14:37	15:30 to 16:30	
Inlet	Gas Stream Volumetric Flowrate	scfm	55,777	53,898	55,092	54,922
	VOC Concentration	ppmv, as propane	159	179	194	177
	VOC Mass Emission Rate	lb/hr, as propane	60.9	66.1	73.1	66.7
Outlet	Gas Stream Volumetric Flowrate	scfm	57,105	58,271	57,810	57,728
	VOC Concentration	ppmv, as propane	0.9	0.7	1.1	0.9
	Acetaldehyde	ppmv	< 0.6	< 0.6	< 0.6	< 0.6
	Sulfur Dioxide	ppmv	6.0	5.5	6.6	6.1
	VOC Mass Emission Rate	lb/hr, as propane	0.33	0.28	0.45	0.35
	Acetaldehyde Mass Emission Rate	lb/hr	< 0.24	< 0.24	< 0.24	< 0.24
	SO_2 Mass Emission Rate	lb/hr	3.4	3.2	3.8	3.5
VOC Destruction Efficiency Results		**%**	**99**	**100**	**99**	**99**

Standard conditions: 68°F and 29.92 in Hg
scfm: standard cubic feet per minute
ppmv: part per million by volume

Table 7

FGOXID2 O_2, CO, and NO_x Emission Results

The Andersons Albion Ethanol, LLC

Albion, Michigan

Bureau Veritas Project No. 11017-000048.00

Sampling Date: July 31, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			July 31, 2017			
Sampling Time			9:50 to 10:50	11:05 to 12:05	12:20 to 13:20	
Duration		min	60	60	60	60
Outlet	Gas Stream Volumetric Flowrate	dscfm	27,128	27,744	28,268	27,713
	O_2 Concentration	%	10.3	10.3	10.3	10.3
	CO Concentration	ppmv	28.4	28.2	27.9	28.2
	NO_x Concentration	ppmv	51.0	52.7	51.8	51.8
	CO Mass Emission Rate	lb/hr	3.4	3.4	3.4	3.4
	NO_x Mass Emission Rate	lb/hr	9.91	10.5	10.5	10.3

Standard conditions: 68°F and 29.92 in Hg
scfm: standard cubic feet per minute
ppmv: part per million by volume
lb/hr: pound per hour

Table 8 - FGOXID2 Particulate Matter Emission Results

Facility		The Andersons Albion Ethanol, LLC			
Source Designation		FGOXID2 Outlet			
Test Date		Jul 28, 2017	Jul 28, 2017	Jul 28, 2017	
Meter/Nozzle Information		Run 1	Run 2	Run 3	Average
Meter Temperature, T_m	°F	74	76	76	75
Meter Pressure, P_m	in Hg	28.92	28.93	28.94	28.93
Measured Sample Volume, V_m	ft^3	40.74	42.51	42.57	41.94
Sample Volume, V_m	std ft^3	38.57	40.14	40.20	39.64
Sample Volume, V_m	std m^3	1.09	1.14	1.14	1.12
Condensate Volume, V_w	std ft^3	43.17	44.57	45.71	44.48
Gas Density, ρ_s	std lb/ft^3	0.0602	0.0603	0.0601	0.0602
Total weight of sampled gas	lb	4.923	5.107	2.485	4.171
Nozzle Size, A_n	ft^2	0.0009991	0.0009991	0.0009991	0.0009991
Isokinetic Variation, I	%	108	106	105	106
Stack Data					
Average Stack Temperature, T_s	°F	315	311	316	314
Molecular Weight Stack Gas-dry, M_d	lb/lb-mole	29.02	29.02	29.02	29.02
Molecular Weight Stack Gas-wet, M_s	lb/lb-mole	23.20	23.22	23.16	23.19
Stack Gas Specific Gravity, G_s		0.80	0.80	0.80	0.80
Percent Moisture, B_{ws}	%	52.81	52.61	53.21	52.88
Water Vapor Volume (fraction)		0.528	0.526	0.532	0.529
Pressure, P_s	in Hg	28.75	28.75	28.75	28.75
Average Stack Velocity, V_s	ft/sec	32.11	33.73	34.80	33.55
Area of Stack	ft^2	38.48	38.48	38.48	38.48
Exhaust Gas Flowrate					
Flowrate	ft^3/min, actual	74,142	77,881	80,354	77,459
Flowrate	ft^3/min, standard wet	48,514	51,259	52,516	50,763
Flowrate	ft^3/min, standard dry	22,895	24,290	24,574	23,920
Flowrate	m^3/min, standard dry	648	688	696	677
Collected Mass					
Particulate Matter Acetone Wash	mg	1.7	1.9	1.9	1.8
Particulate Matter Filter	mg	3.40	4.70	5.10	4.40
Total Filterable Particulate Matter (FPM)	mg	5.1	6.6	7.0	6.2
Inorganic CPM	mg	64	24	28	39
Organic CPM	mg	3.8	4.8	4.8	4.5
Total Condensable Particulate Matter (CPM)	mg	68	29	33	43
Total FPM and CPM	mg	73	35	40	49
Concentration					
Particulate Matter (FPM)	mg/dscf	0.13	0.16	0.17	0.16
Particulate Matter (FPM)	grain/dscf	0.0020	0.0025	0.0027	0.0024
Total Condensable Particulate Matter (CPM)	mg/dscf	1.8	0.72	0.82	1.1
Total Condensable Particulate Matter (CPM)	grain/dscf	0.027	0.011	0.013	0.017
Total FPM and CPM	mg/dscf	1.9	0.88	0.99	1.3
Total FPM and CPM	grain/dscf	0.029	0.014	0.015	0.019
Total FPM and CPM	$\mu g/m^3$	66,740	31,142	34,965	44,282
Mass Emission Rate					
Particulate Matter (FPM)	lb/hr	0.40	0.53	0.57	0.50
Total Condensable Particulate Matter (CPM)	lb/hr	5.3	2.3	2.7	3.4
Total FPM and CPM	lb/hr	5.7	2.8	3.2	3.9

Table 9

FGCHP - Turbine On, Duct Burner Off VOC, CO, and NO_x Emission Results

The Andersons Albion Ethanol, LLC

Albion, Michigan

Bureau Veritas Project No. 11017-000048.00

Sampling Date: August 1, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			August 1, 2017			
Sampling Start Time			8:35	9:57	11:18	
Duration		min	60	60	60	60
Operation condition			Turbine On Only			
Outlet	Gas Stream Volumetric Flowrate	scfm	51,594	52,102	52,835	52,177
	Gas Stream Volumetric Flowrate	dscfm	47,609	48,268	48,880	48,252
	VOC Concentration	ppmv, as propane	-0.1	0.2	0.4	0.2
	O_2 Concentration	%	15.5	15.5	15.4	15.4
	CO Concentration	ppmv	1.4	1.8	2.8	2.0
	NO_x Concentration	ppmv	5.0	5.1	5.0	5.0
	NO_x Concentration, @15% O_2	ppmv	5.5	5.5	5.4	5.5
	VOC Mass Emission Rate	lb/hr, as propane	0.0	0.075	0.14	0.065
	CO Mass Emission Rate	lb/hr	0.28	0.39	0.60	0.42
	NO_x Mass Emission Rate	lb/hr	1.6	1.8	1.8	1.8

Molecular weight of propane: 44.00
Molecular weight of NO_x 44.00
Molecular weight of CO 28.00
Standard conditions: 68°F and 29.92 in Hg
dscfm: dry standard cubic feet per minute
ppmv: part per million by volume
lb/hr: pound per hour

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Table 10

FGCHP - Turbine On, Duct Burner On VOC, CO, and NO_x Emission Results

The Andersons Albion Ethaonl, LLC

Albion, Michigan

Bureau Veritas Project No. 11017-000048.00

Sampling Date: August 1, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			August 1, 2017			
Sampling Start Time			14:20	15:40	16:57	
Duration		min	60	60	60	60
Operation condition			Turbine and Duct Burner On			
Outlet	Gas Stream Volumetric Flowrate	scfm	52,590	52,962	53,496	53,016
	Gas Stream Volumetric Flowrate	dscfm	45,293	45,382	45,673	45,449
	VOC Concentration†	ppmv, as propane	<2.0	<2.0	<2.0	<2.0
	O_2 Concentration	%	7.3	7.4	7.5	7.4
	CO Concentration	ppmv	4.9	5.6	4.4	5.0
	NO_x Concentration	ppmv	28	28	27	28
	NO_x Concentration, @15% O_2	ppmv	12	12	12	12
	VOC Mass Emission Rate†	lb/hr, as propane	<0.7	<0.7	<0.7	<0.7
	CO Mass Emission Rate	lb/hr	1.0	1.1	0.88	1.0
	NO_x Mass Emission Rate	lb/hr	8.8	3.8	3.7	5.4

Molecular weight of propane: 44.00
Molecular weight of NO_x 44.00
Molecular weight of CO 28.00
Standard conditions: 68°F and 29.92 in Hg
dscfm: dry standard cubic feet per minute
ppmv: part per million by volume
lb/hr: pound per hour
† VOC concentration is calculated based on equipment detection limit

Table 11

FGCHP - Turbine Off, Duct Burner On O_2 and NO_X Emission Results

The Andersons Albion Ethanol, LLC

Albion, Michigan

Bureau Veritas Project No. 11017-000048.00

Sampling Date: August 2, 2017

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			August 2, 2017			
Sampling Start Time			9:35	10:49	12:00	
Duration		min	60	60	60	60
Operation condition			Duct Burner On Only			
Outlet	Gas Stream Volumetric Flowrate	dscfm	29,719	28,844	29,311	29,291
	O_2 Concentration	%	4.7	4.7	4.4	4.6
	NO_x Concentration	ppmv	82	81	86	83
	NO_x Concentration, @15% O_2	ppmv	30	29	31	30
	NO_x Mass Emission Rate	lb/hr	17	5.8	6.2	9.5

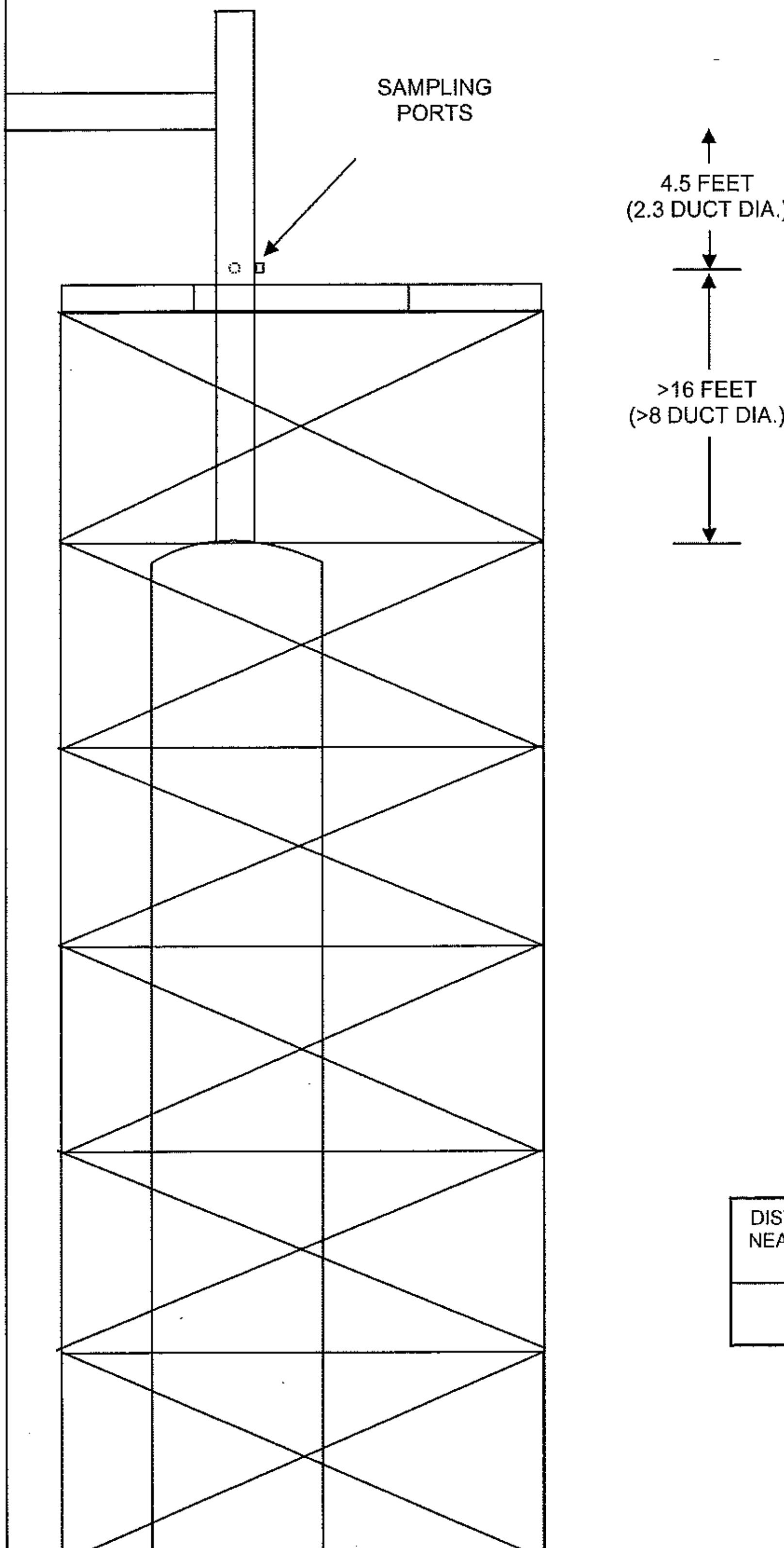
Molecular weight of propane: 44.00
Molecular weight of NO_x 44.00
Molecular weight of CO 28.00
Standard conditions: 68°F and 29.92 in Hg
dscfm: dry standard cubic feet per minute
ppmv: part per million by volume
lb/hr: pound per hour

Table 12 - FGCHP Turbine On, Duct Burner Off Particulate Matter Emission Results

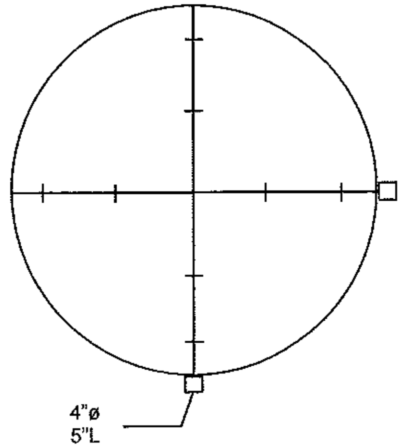
Facility		The Andersons Albion Ethanol, LLC			
Source Designation		FGCHP			
Test Date		Aug 1, 2017	Aug 1, 2017	Aug 1, 2017	
Meter/Nozzle Information		Run 1	Run 2	Run 3	Average
Meter Temperature, T_m	°F	80	95	100	92
Meter Pressure, P_m	in Hg	28.20	29.20	29.21	28.87
Measured Sample Volume, V_m	ft^3	54.05	54.19	55.32	54.52
Sample Volume, V_m	std ft^3	49.40	49.86	50.47	49.91
Sample Volume, V_m	std m^3	1.40	1.41	1.43	1.41
Condensate Volume, V_w	std ft^3	3.96	4.08	4.14	4.06
Gas Density, ρ_s	std lb/ft^3	0.0735	0.0735	0.0733	0.0734
Total weight of sampled gas	lb	3.922	3.963	3.804	3.897
Nozzle Size, A_n	ft^2	0.0003012	0.0003012	0.0003012	0.0003012
Isokinetic Variation, I	%	91	91	91	91
Stack Data					
Average Stack Temperature, T_s	°F	312	306	309	309
Molecular Weight Stack Gas-dry, M_d	lb/lb-mole	29.14	29.14	29.08	29.12
Molecular Weight Stack Gas-wet, M_s	lb/lb-mole	28.32	28.30	28.24	28.29
Stack Gas Specific Gravity, G_s		0.98	0.98	0.98	0.98
Percent Moisture, B_{ws}	%	7.42	7.57	7.57	7.52
Water Vapor Volume (fraction)		0.074	0.076	0.076	0.075
Pressure, P_s	in Hg	27.92	28.92	28.92	28.59
Average Stack Velocity, V_s	ft/sec	84.81	81.99	83.43	83.41
Area of Stack	ft^2	15.90	15.90	15.90	15.90
Exhaust Gas Flowrate					
Flowrate	ft^3/min, actual	80,928	78,236	79,615	79,593
Flowrate	ft^3/min, standard wet	51,653	52,102	52,844	52,200
Flowrate	ft^3/min, standard dry	47,819	48,158	48,842	48,273
Flowrate	m^3/min, standard dry	1,354	1,364	1,383	1,367
Collected Mass					
Particulate Matter Acetone Wash	mg	3.7	3.8	4.1	3.9
Particulate Matter Filter	mg	0.50	<0.30	<0.30	0.37
Total Filterable Particulate Matter (FPM)	mg	4.2	4.1	4.4	4.2
Inorganic CPM	mg	3.3	2.8	1.9	2.7
Organic CPM	mg	1.0	1.0	<1.0	1.0
Total Condensable Particulate Matter (CPM)	mg	4.3	3.8	2.9	3.7
Total FPM and CPM	mg	8.5	7.9	7.3	7.9
Concentration					
Particulate Matter (FPM)	mg/dscf	0.085	0.082	0.087	0.085
Particulate Matter (FPM)	grain/dscf	0.0013	0.0013	0.0013	0.0013
Total Condensable Particulate Matter (CPM)	mg/dscf	0.087	0.076	0.057	0.074
Total Condensable Particulate Matter (CPM)	grain/dscf	0.0013	0.00118	0.0009	0.0011
Total FPM and CPM	mg/dscf	0.17	0.16	0.14	0.16
Total FPM and CPM	grain/dscf	0.0027	0.0024	0.0022	0.0024
Total FPM and CPM	$\mu g/m^3$	6,076	5,595	5,108	5,593
Mass Emission Rate					
Particulate Matter (FPM)	lb/hr	0.54	0.52	0.56	0.54
Total Condensable Particulate Matter (CPM)	lb/hr	0.55	0.49	0.37	0.47
Total FPM and CPM	lb/hr	1.1	1.0	0.93	1.0

Table 13 - FGCHP Turbine On, Duct Burner On Particulate Matter Emission Results

Facility		**The Andersons Albion Ethanol, LLC**			
Source Designation		**FGCHP**			
Test Date		**Aug 1, 2017**	**Aug 1, 2017**	**Aug 1, 2017**	
Meter/Nozzle Information		Run 1	Run 2	Run 3	Average
Meter Temperature, T_m	°F	95	102	98	99
Meter Pressure, P_m	in Hg	29.23	29.24	29.24	29.24
Measured Sample Volume, V_m	ft^3	57.71	58.59	58.90	58.40
Sample Volume, V_m	std ft^3	53.15	53.27	53.95	53.46
Sample Volume, V_m	std m^3	1.51	1.51	1.53	1.51
Condensate Volume, V_w	std ft^3	8.56	8.90	9.24	8.90
Gas Density, ρ_s	std lb/ft^3	0.0726	0.0724	0.0723	0.0725
Total weight of sampled gas	lb	4.479	4.503	4.014	4.332
Nozzle Size, A_n	ft^2	0.0003012	0.0003012	0.0003012	0.0003012
Isokinetic Variation, I	%	103	103	104	104
Stack Data					
Average Stack Temperature, T_s	°F	269	269	270	270
Molecular Weight Stack Gas-dry, M_d	lb/lb-mole	29.56	29.56	29.56	29.56
Molecular Weight Stack Gas-wet, M_s	lb/lb-mole	27.96	27.91	27.87	27.91
Stack Gas Specific Gravity, G_s		0.97	0.96	0.96	0.96
Percent Moisture, B_{ws}	%	13.87	14.31	14.62	14.27
Water Vapor Volume (fraction)		0.139	0.143	0.146	0.143
Pressure, P_s	in Hg	28.94	28.94	28.94	28.94
Average Stack Velocity, V_s	ft/sec	78.69	79.28	80.13	79.37
Area of Stack	ft^2	15.90	15.90	15.90	15.90
Exhaust Gas Flowrate					
Flowrate	ft^3/min, actual	75,095	75,650	76,468	75,738
Flowrate	ft^3/min, standard wet	52,576	52,965	53,496	53,013
Flowrate	ft^3/min, standard dry	45,282	45,385	45,673	45,447
Flowrate	m^3/min, standard dry	1,282	1,285	1,293	1,287
Collected Mass					
Particulate Matter Acetone Wash	mg	3.6	1.2	1.4	2.1
Particulate Matter Filter	mg	0.50	0.70	0.40	0.53
Total Filterable Particulate Matter (FPM)	mg	4.1	1.9	1.8	2.6
Inorganic CPM	mg	2.8	2.8	3.4	3.0
Organic CPM	mg	1.2	1.5	1.3	1.3
Total Condensable Particulate Matter (CPM)	mg	4.0	4.3	4.7	4.3
Total FPM and CPM	mg	8.1	6.2	6.5	6.9
Concentration					
Particulate Matter (FPM)	mg/dscf	0.077	0.036	0.033	0.049
Particulate Matter (FPM)	grain/dscf	0.0012	0.00055	0.00051	0.00075
Total Condensable Particulate Matter (CPM)	mg/dscf	0.075	0.081	0.087	0.081
Total Condensable Particulate Matter (CPM)	grain/dscf	0.0012	0.0012	0.0013	0.0013
Total FPM and CPM	mg/dscf	0.15	0.12	0.12	0.13
Total FPM and CPM	grain/dscf	0.0024	0.0018	0.0019	0.0020
Total FPM and CPM	$\mu g/m^3$	5,382	4,110	4,255	4,582
Mass Emission Rate					
Particulate Matter (FPM)	lb/hr	0.46	0.21	0.20	0.29
Total Condensable Particulate Matter (CPM)	lb/hr	0.45	0.48	0.53	0.49
Total FPM and CPM	lb/hr	0.91	0.70	0.73	0.78



23.5" INTERNAL DIAMETER



TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	1.57
2	5.88
3	17.63
4	21.93

DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
>16 FEET (>8 DIAMETERS)	4.5 FEET (2.3 DIAMETERS)

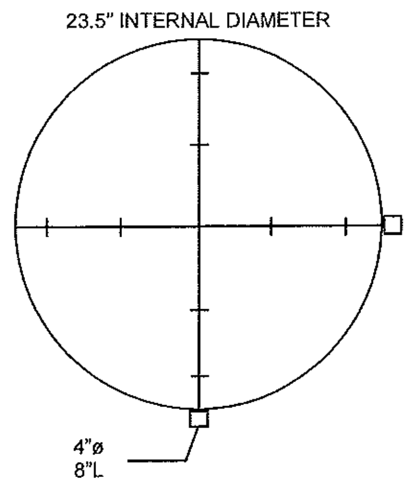
SCALE	NOT TO SCALE
DATE	AUGUST 16, 2017
PRJ NO.	11017-000048.00

FGFERM
SAMPLING PORTS AND TRAVERSE POINT LOCATIONS

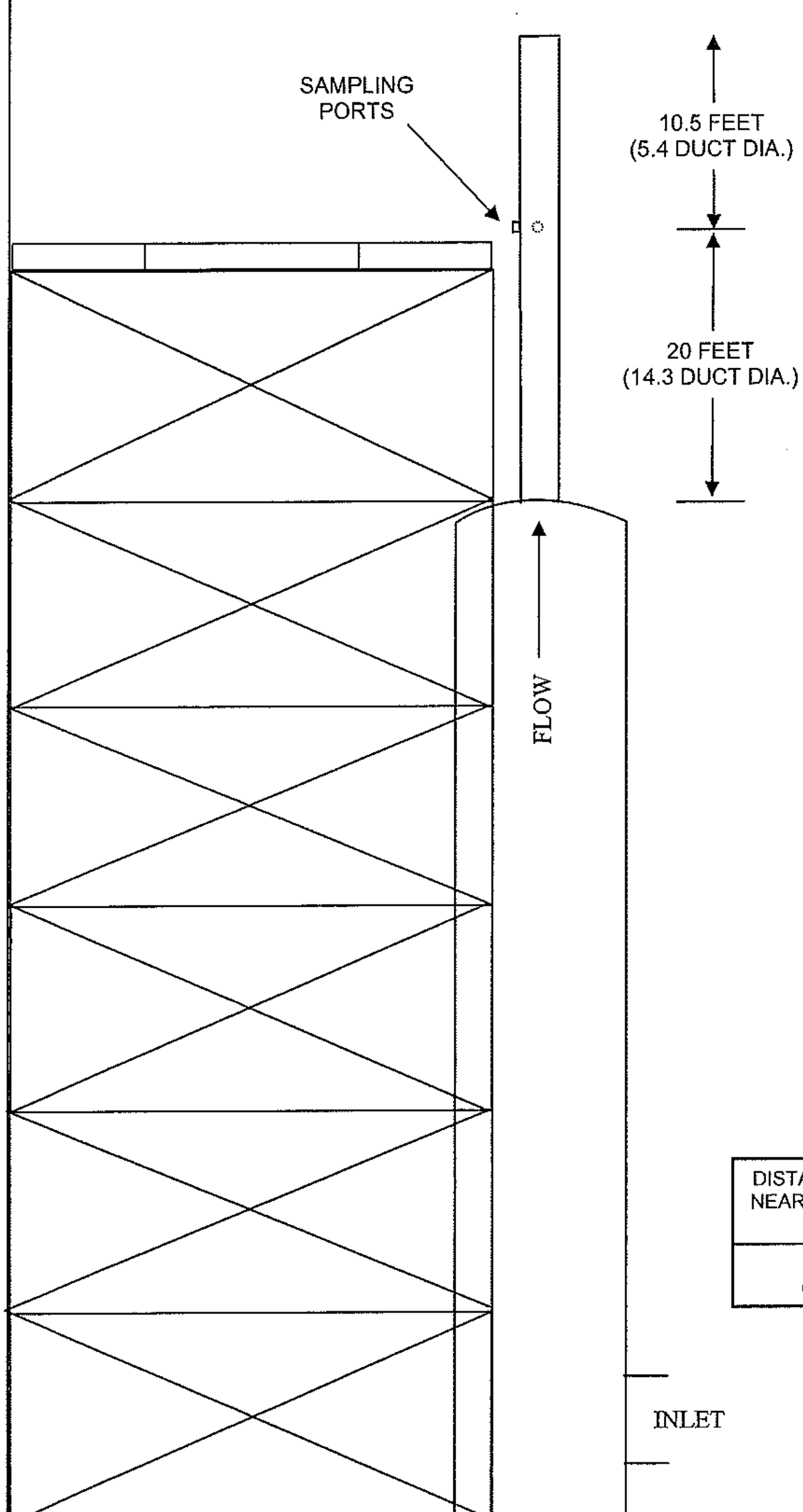
The Andersons Albion Ethanol, LLC
Albion, Michigan

FIGURE

1



TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	1.6
2	5.9
3	17.6
4	21.9



DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
20 FEET (14.3 DIAMETERS)	10.5 FEET (5.4 DIAMETERS)

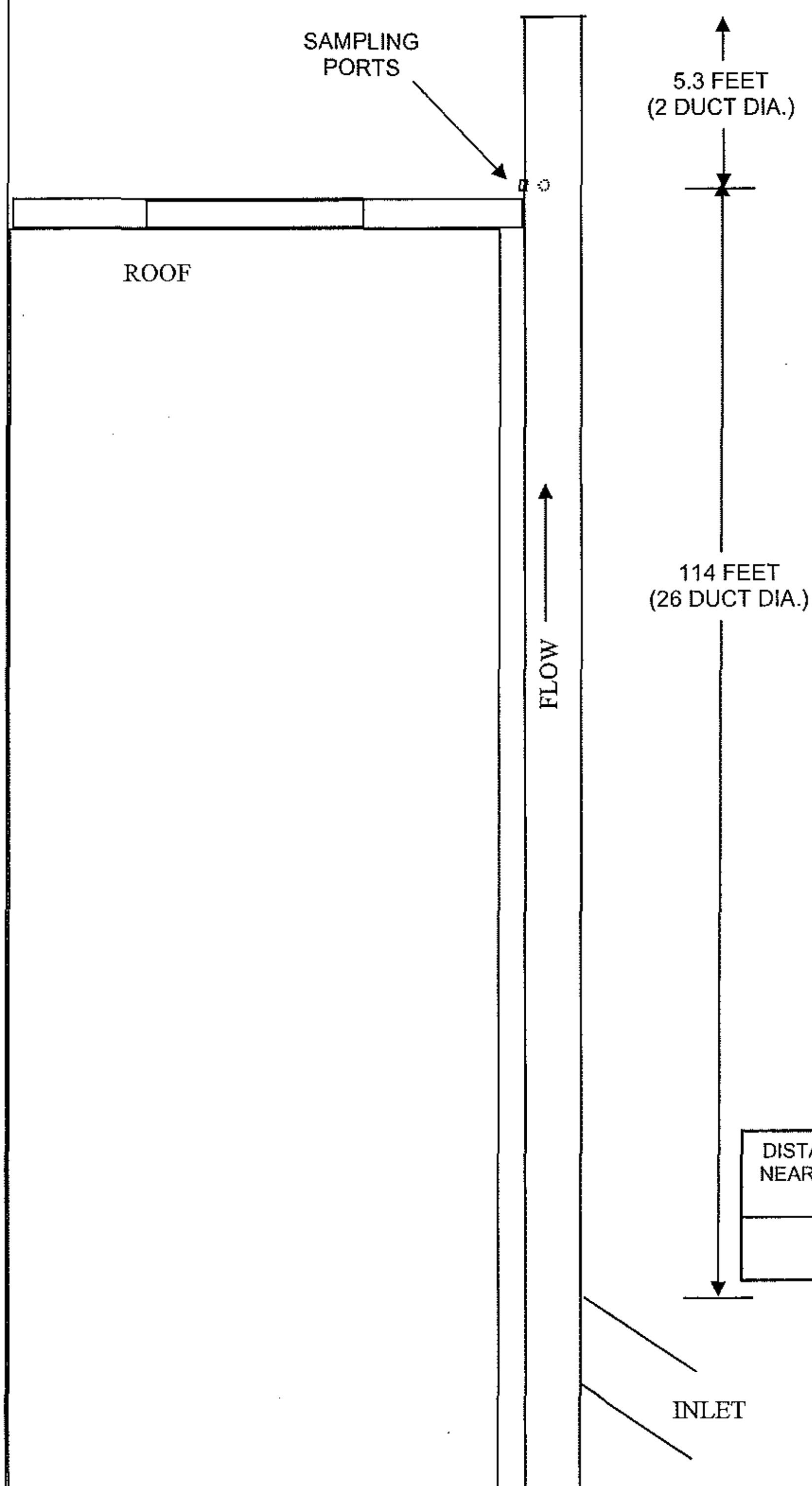
SCALE	NOT TO SCALE
DATE	AUGUST 16, 2017
PRJ NO.	11017-000048.00

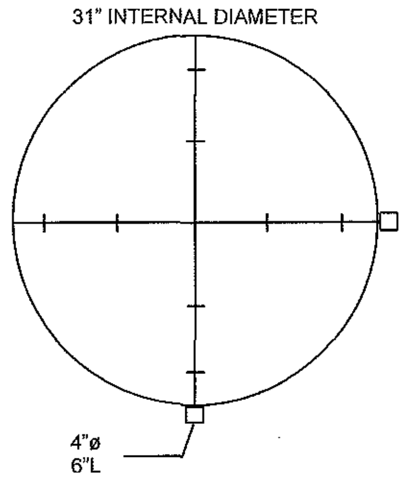
FGFERM2
SAMPLING PORTS AND TRAVERSE POINT LOCATIONS

The Andersons Albion Ethanol, LLC
Albion, Michigan

BUREAU VERITAS

FIGURE 2





TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	2.1
2	7.8
3	23.3
4	28.9

DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
114 FEET (26 DIAMETERS)	5.3 FEET (2 DIAMETERS)

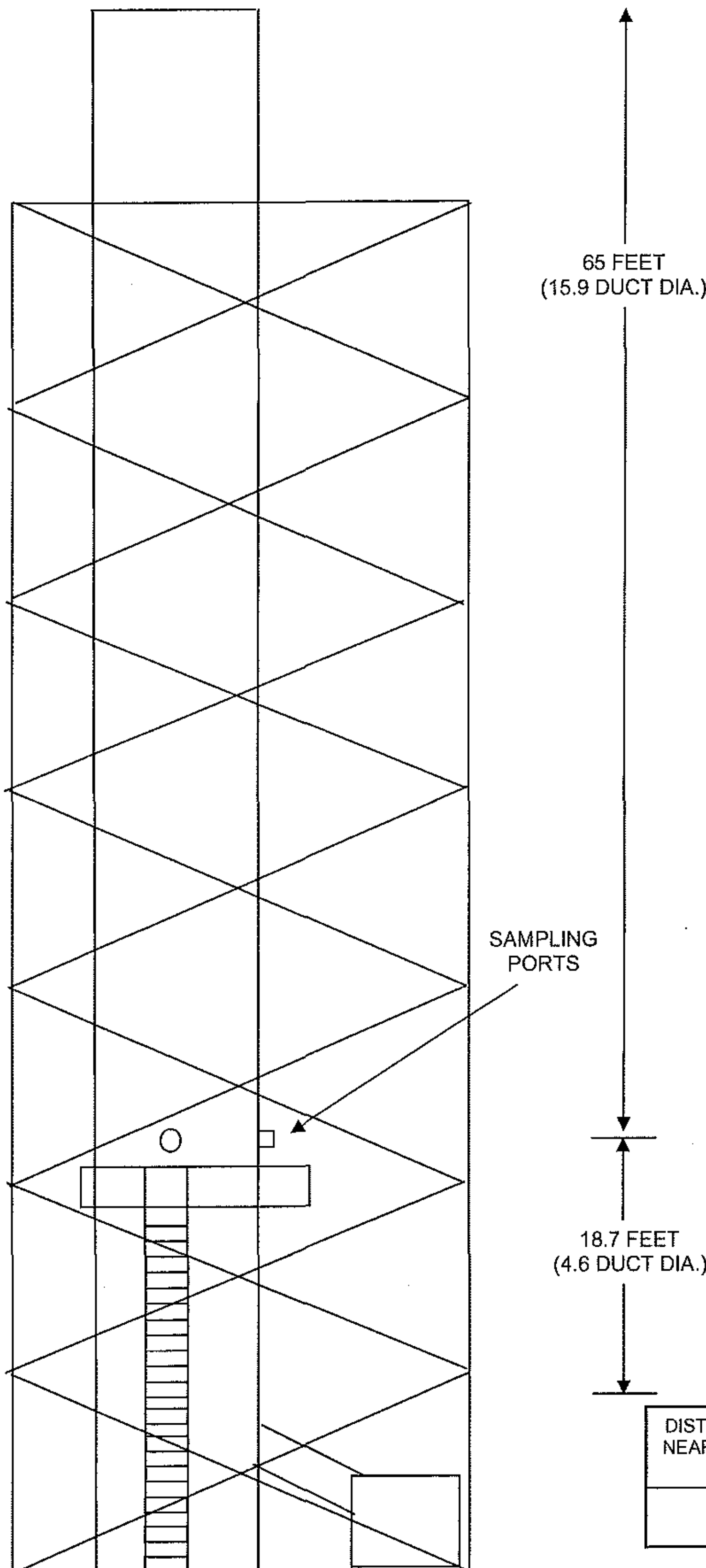
SCALE	NOT TO SCALE
DATE	AUGUST 16, 2017
PRJ NO.	11017-000048.00

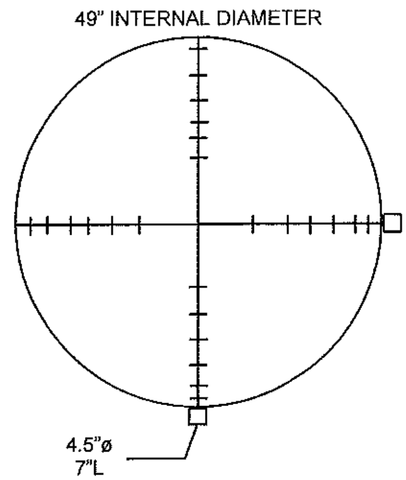
FGMILL2
SAMPLING PORTS AND TRAVERSE POINT LOCATIONS

The Andersons Albion Ethanol, LLC
Albion, Michigan

BUREAU VERITAS

FIGURE 3





TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	1.0
2	3.3
3	5.8
4	8.7
5	12.3
6	17.4
7	31.6
8	36.8
9	40.3
10	43.2
11	45.7
12	48.0

DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
18.7 FEET (4.6 DIAMETERS)	65 FEET (15.9 DIAMETERS)

SCALE	NOT TO SCALE
DATE	AUGUST 16, 2017
PRJ NO.	11017-000048.00

EUCOOLINGDRUM
SAMPLING PORTS AND TRAVERSE POINT LOCATIONS

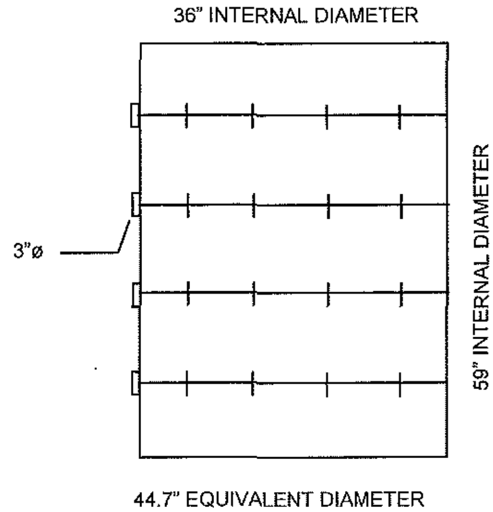
The Andersons Albion Ethanol, LLC
Albion, Michigan

BUREAU VERITAS

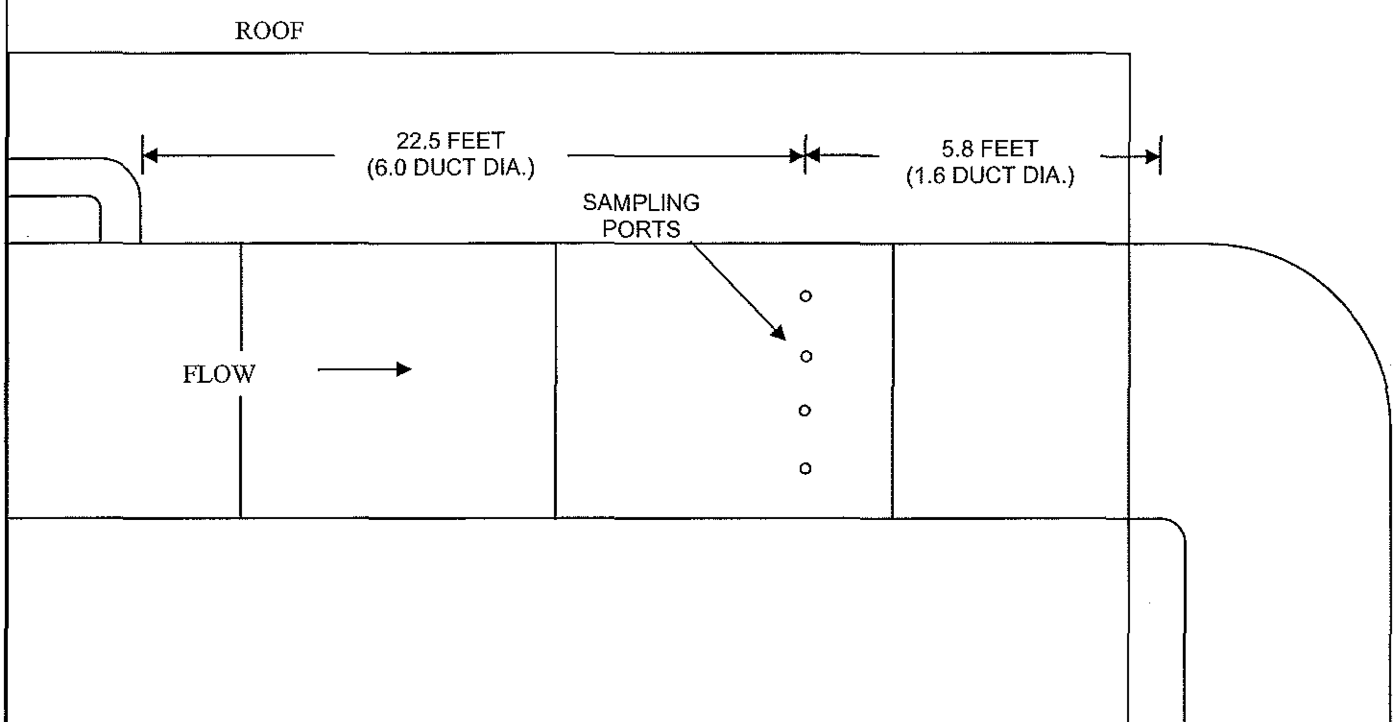
FIGURE

4

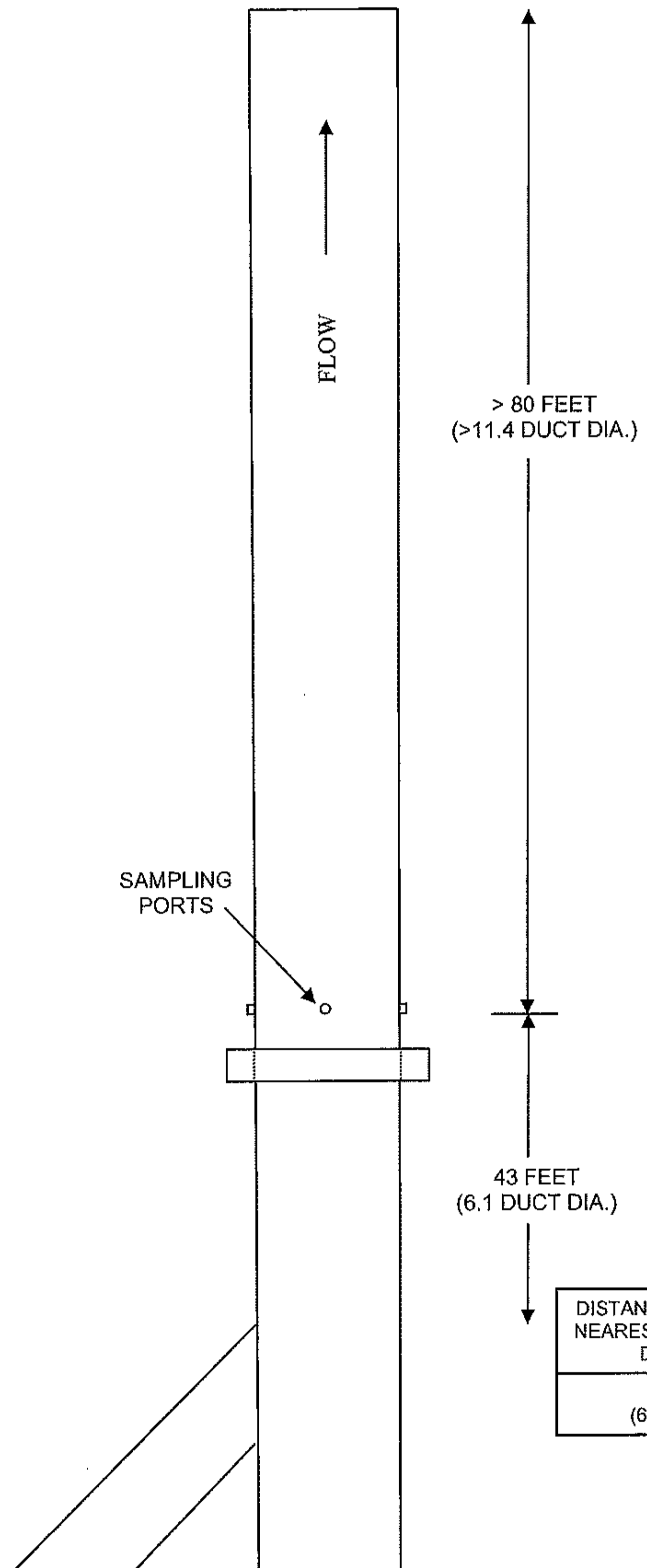
TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	4.5
2	13.5
3	22.5
4	31.5

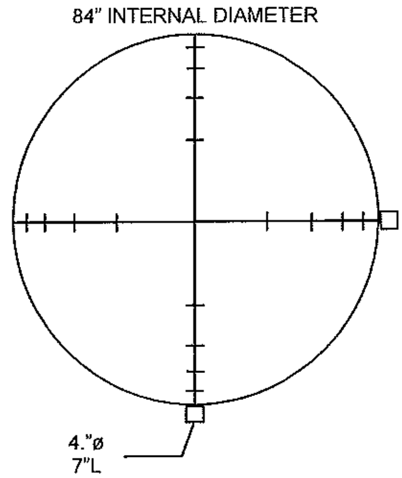


DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
22.5 FEET (6.0 DIAMETERS)	5.8 FEET (1.6 DIAMETERS)



SCALE NOT TO SCALE	**FGOXID2 INLET** **SAMPLING PORTS AND TRAVERSE POINT LOCATIONS** **The Andersons Albion Ethanol, LLC** **Albion, Michigan**	BUREAU VERITAS 1828	FIGURE 5
DATE AUGUST 16, 2017			
PRJ NO. 11017-000048.00			





TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	2.7
2	8.9
3	16.3
4	27.1
5	56.9
6	67.7
7	75.1
8	81.3

DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
43 FEET (6.1 DIAMETERS)	> 80 FEET (>11.4 DIAMETERS)

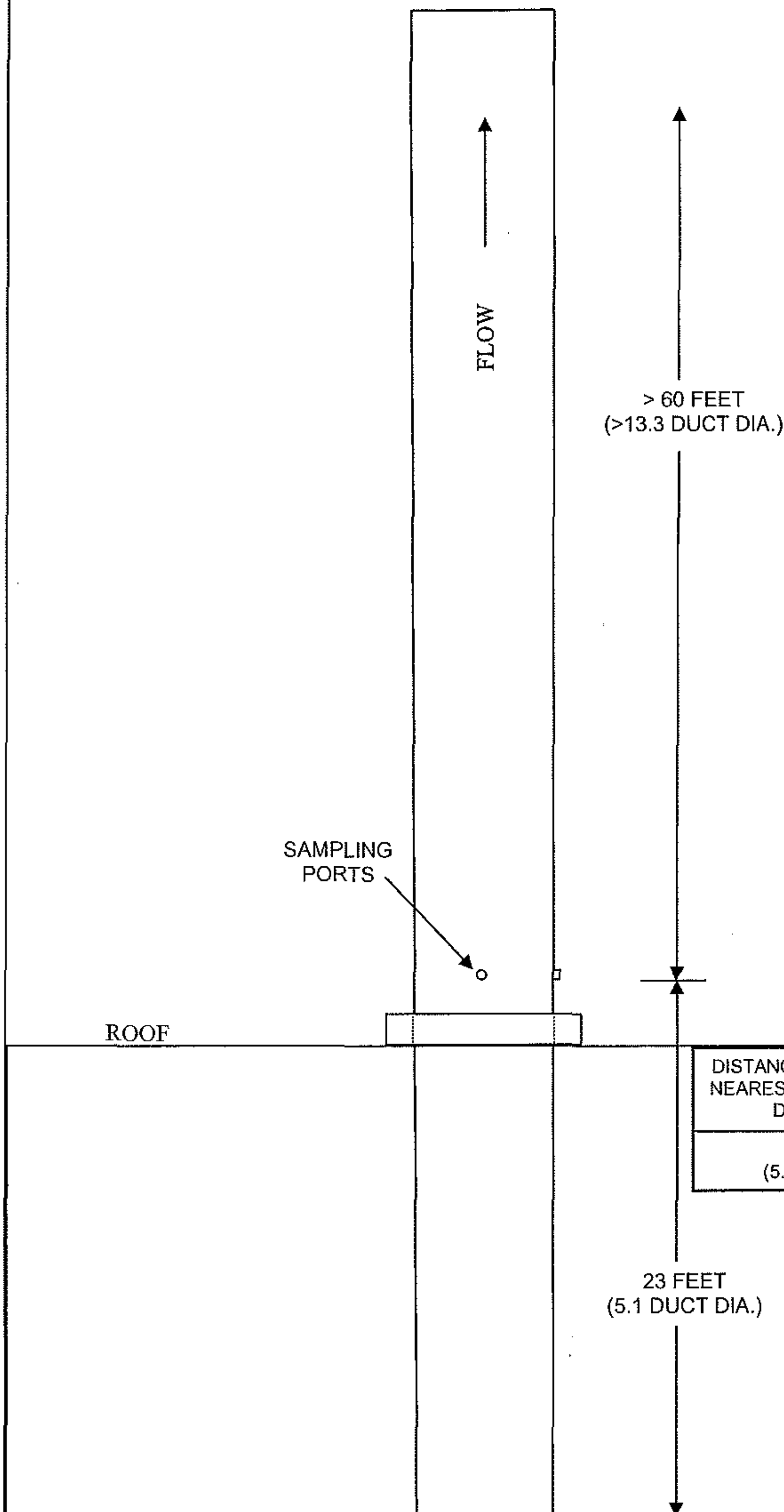
SCALE	NOT TO SCALE
DATE	AUGUST 16, 2017
PRJ NO.	11017-000048.00

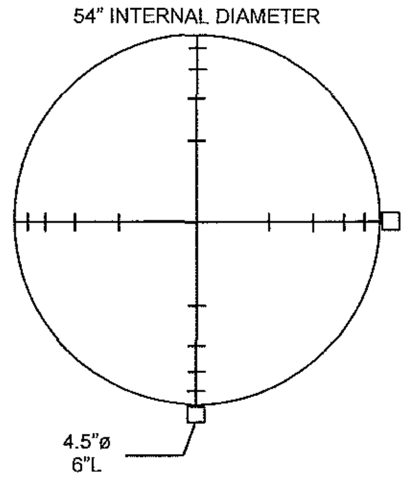
FGOXID2 OUTLET
SAMPLING PORTS AND TRAVERSE POINT LOCATIONS

The Andersons Albion Ethanol, LLC
Albion, Michigan

BUREAU VERITAS

FIGURE 6





TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
1	1.7
2	5.7
3	10.5
4	17.4
5	36.6
6	43.5
7	48.3
8	52.3

DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
23 FEET (5.1 DIAMETERS)	> 60 FEET (>13.3 DIAMETERS)

SCALE	NOT TO SCALE
DATE	AUGUST 16, 2017
PRJ NO.	11017-000048.00

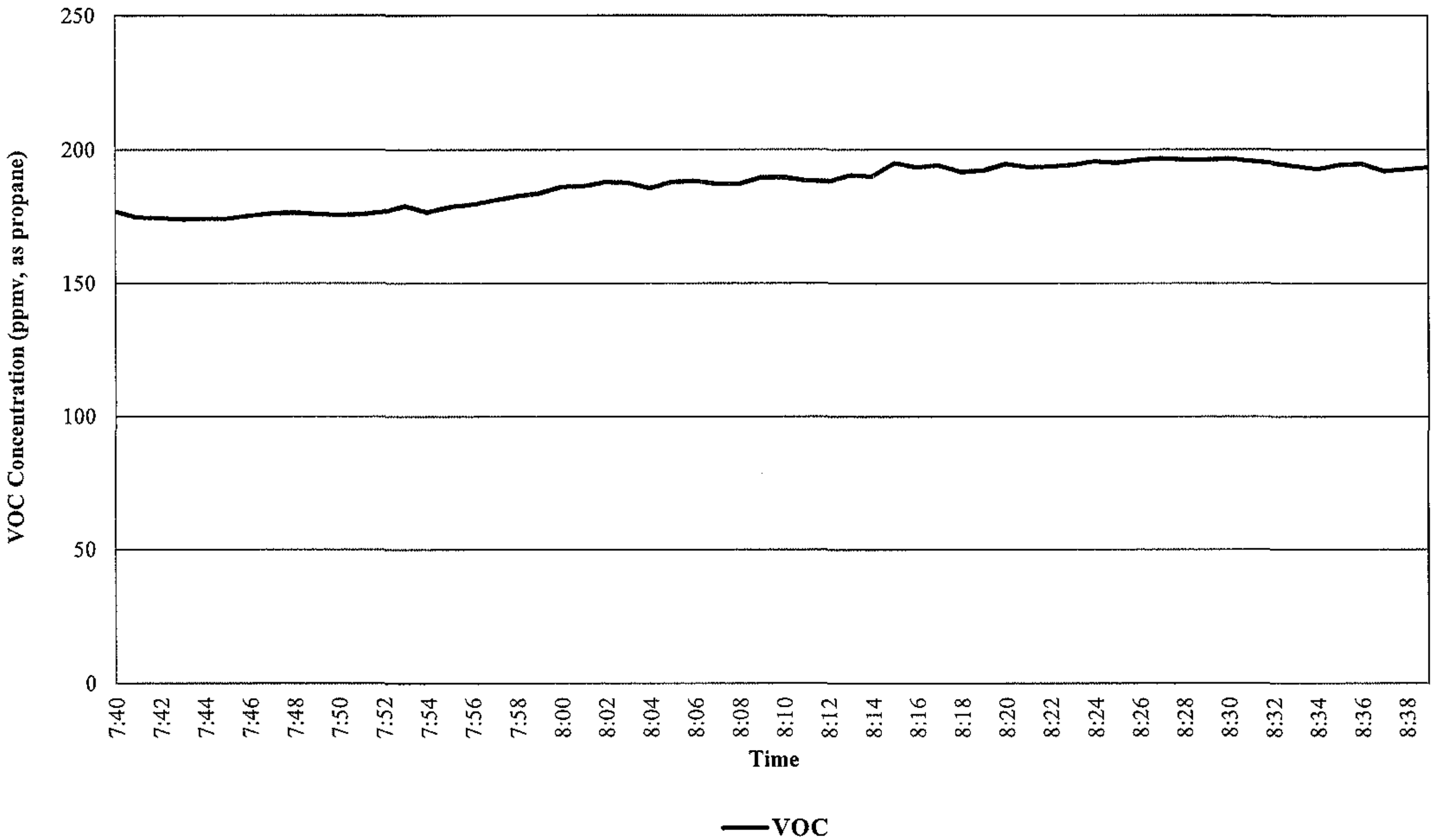
FGCHP
SAMPLING PORTS AND TRAVERSE POINT LOCATIONS

The Andersons Albion Ethanol, LLC
Albion, Michigan

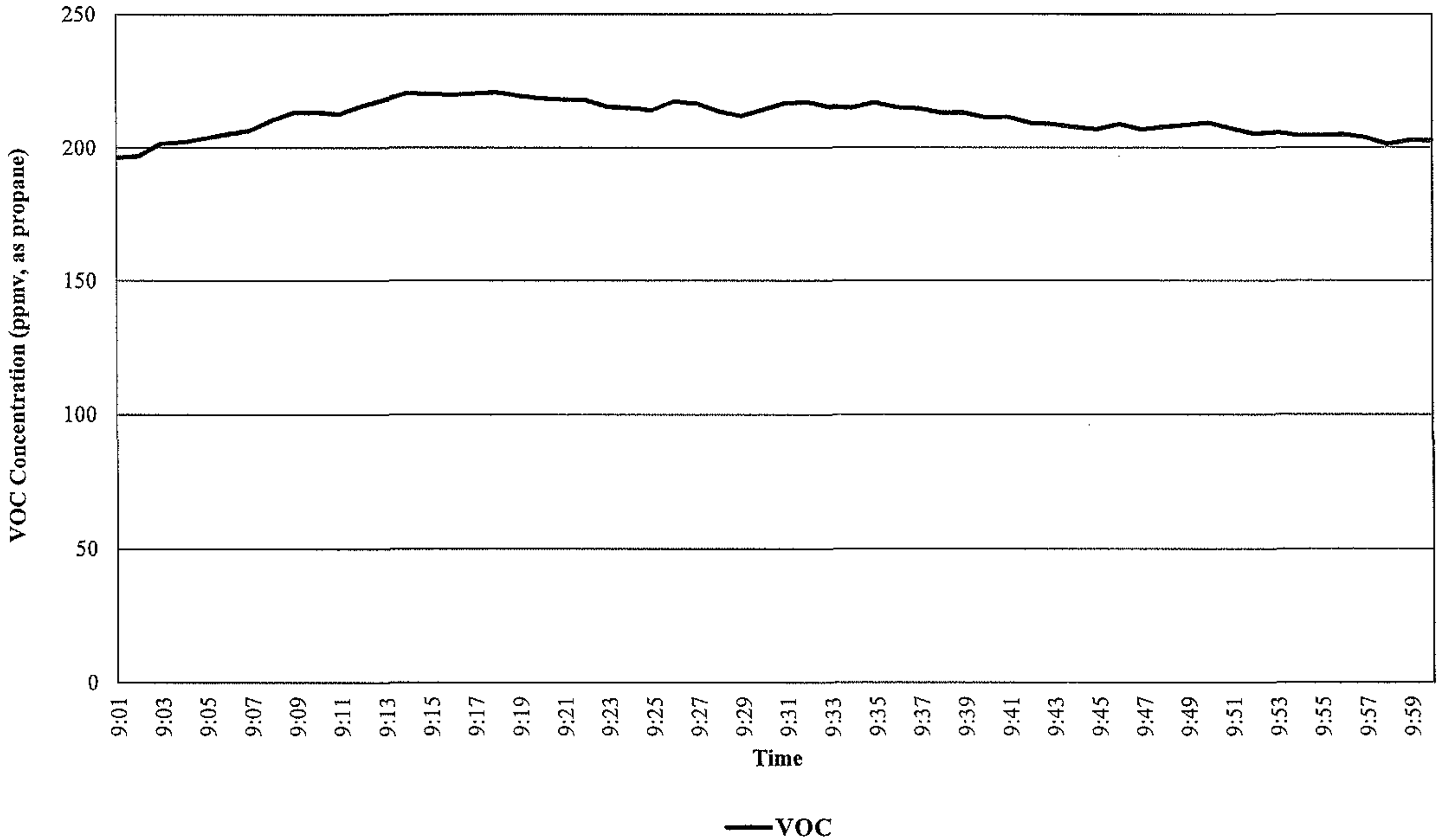
BUREAU VERITAS

FIGURE 7

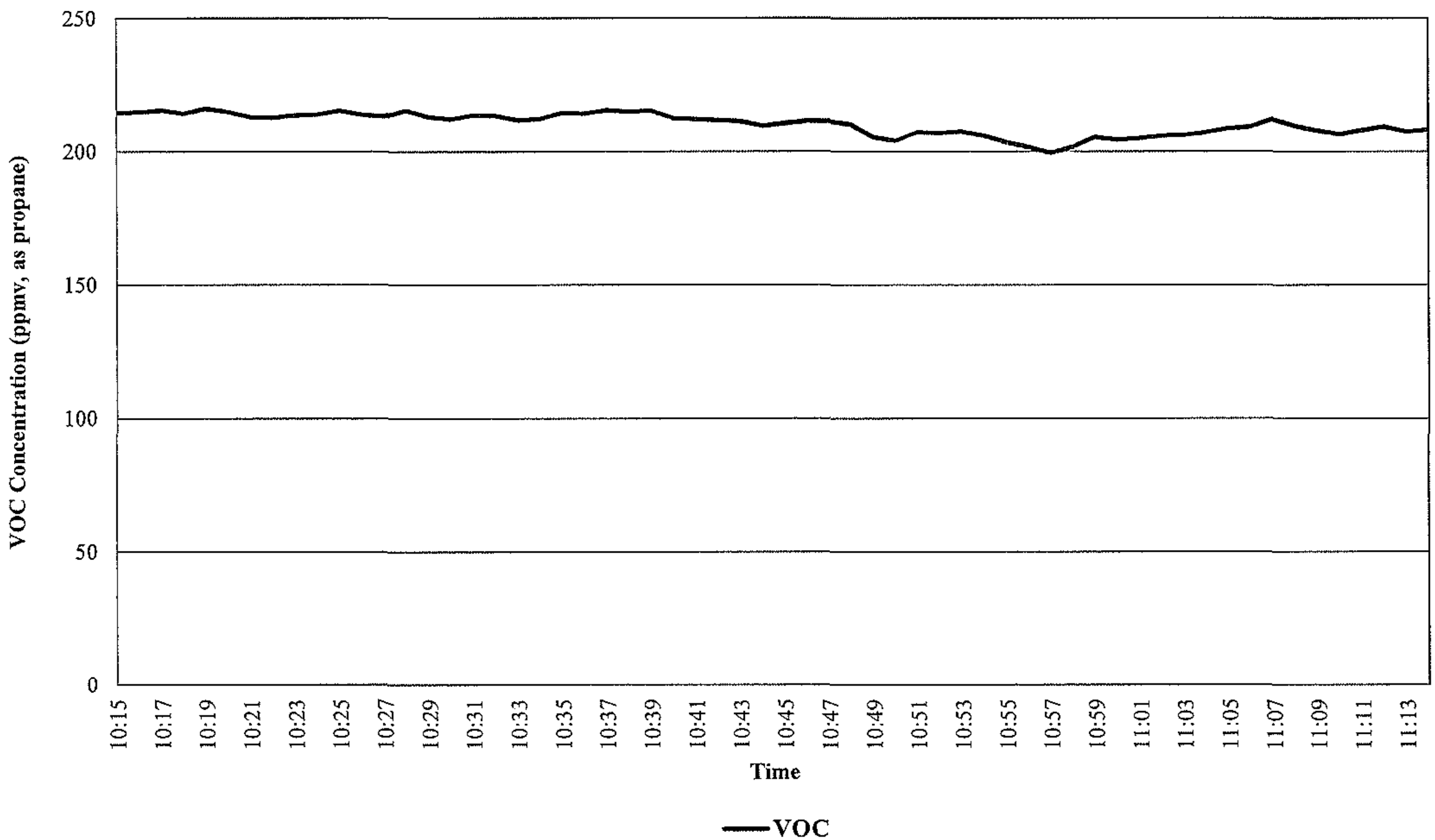
FGFERM VOC Concentrations - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 25, 2017



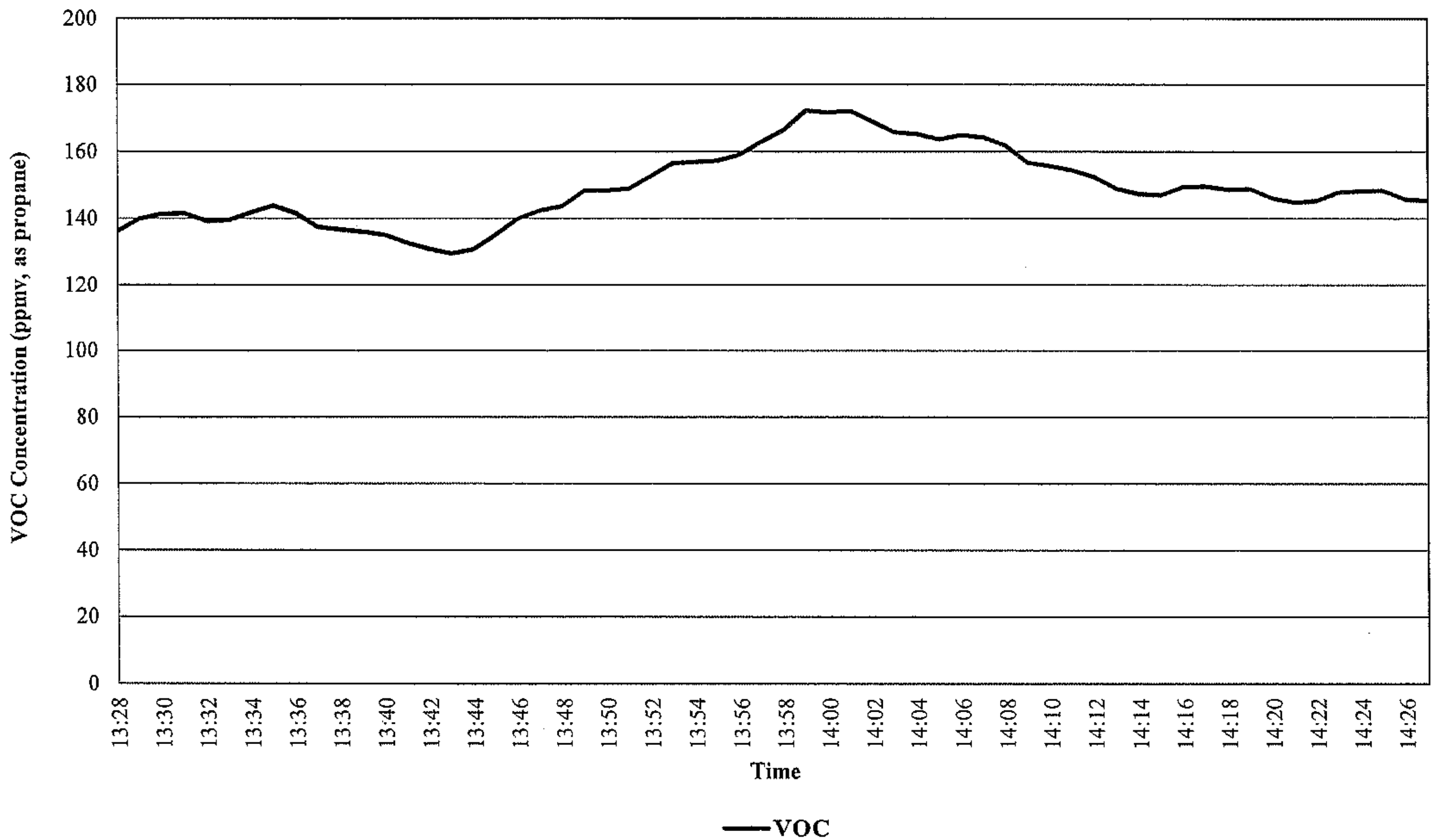
FGFERM VOC Concentrations - Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 25, 2017



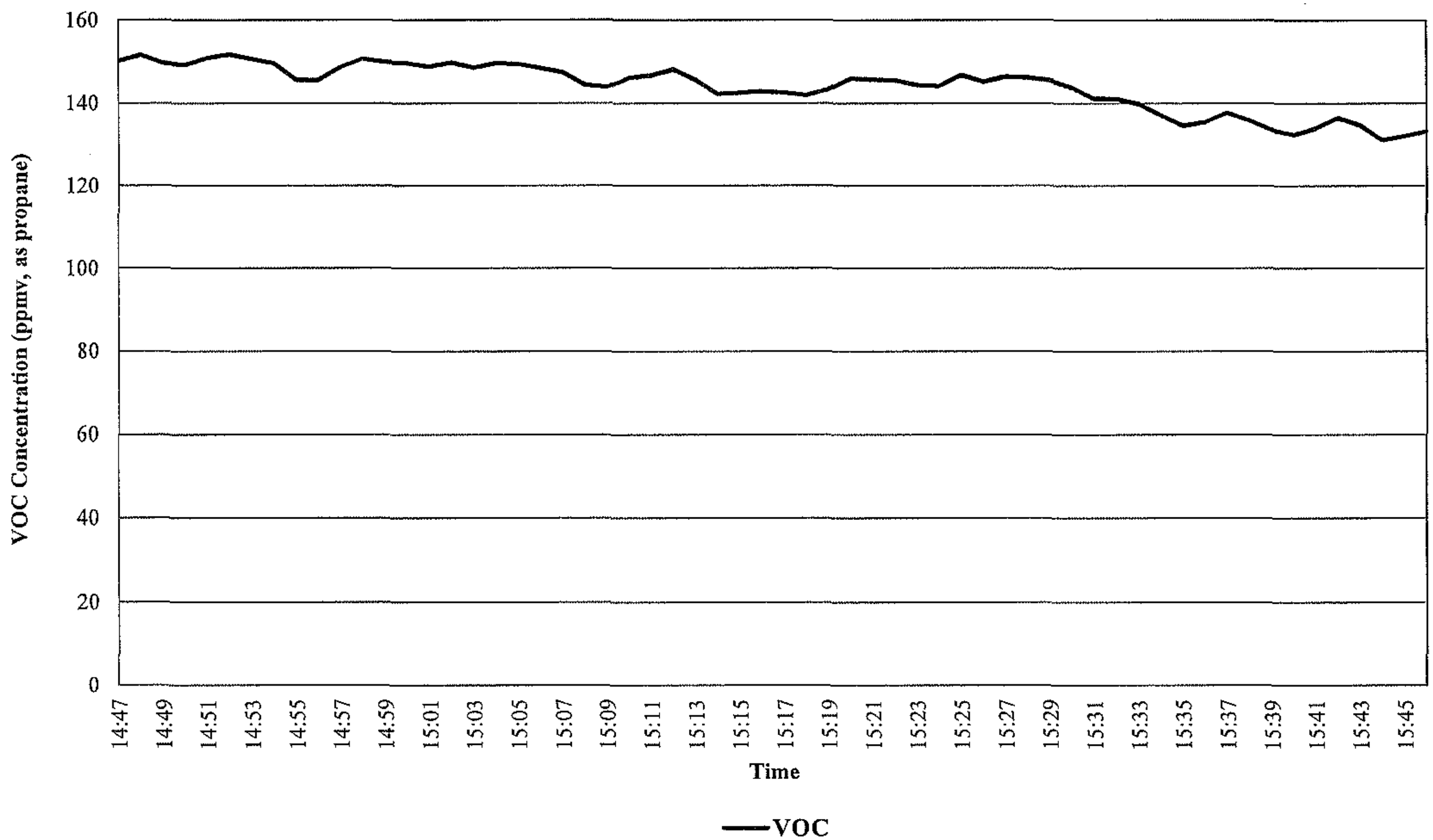
FGFERM VOC Concentrations - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 25, 2017



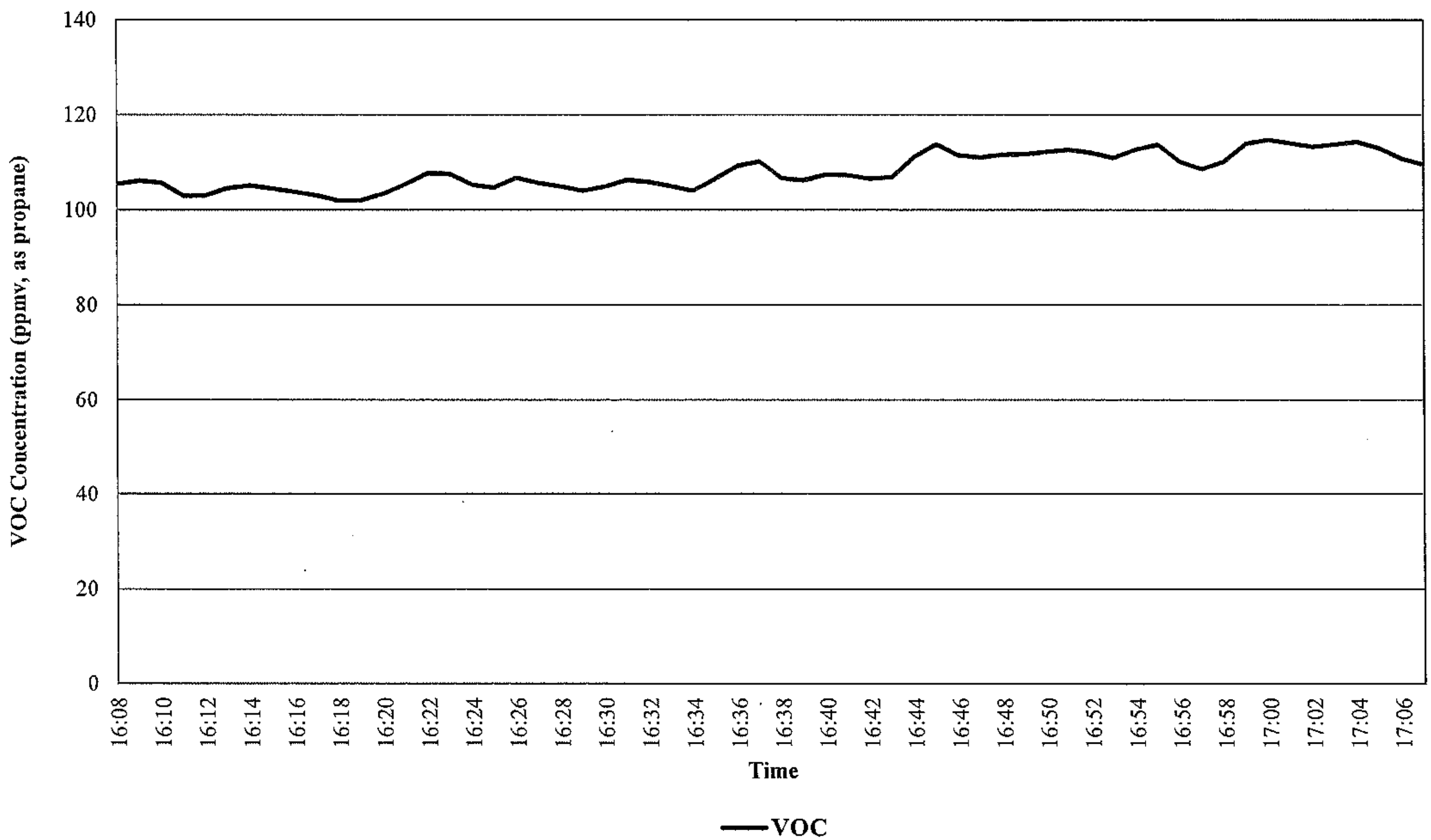
FGFERM2 VOC Concentrations - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 25, 2017



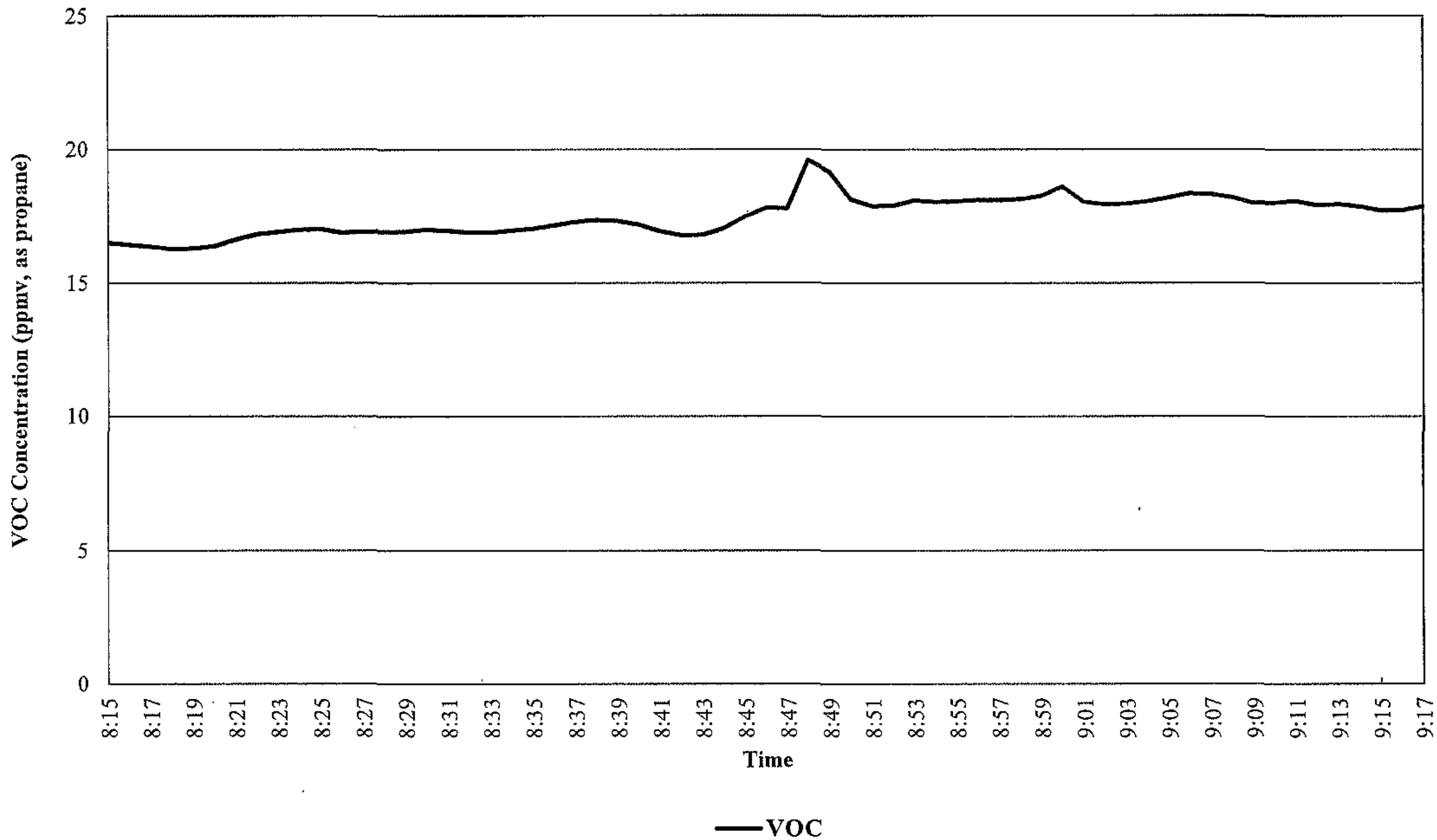
FGFERM2 VOC Concentrations - Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 25, 2017



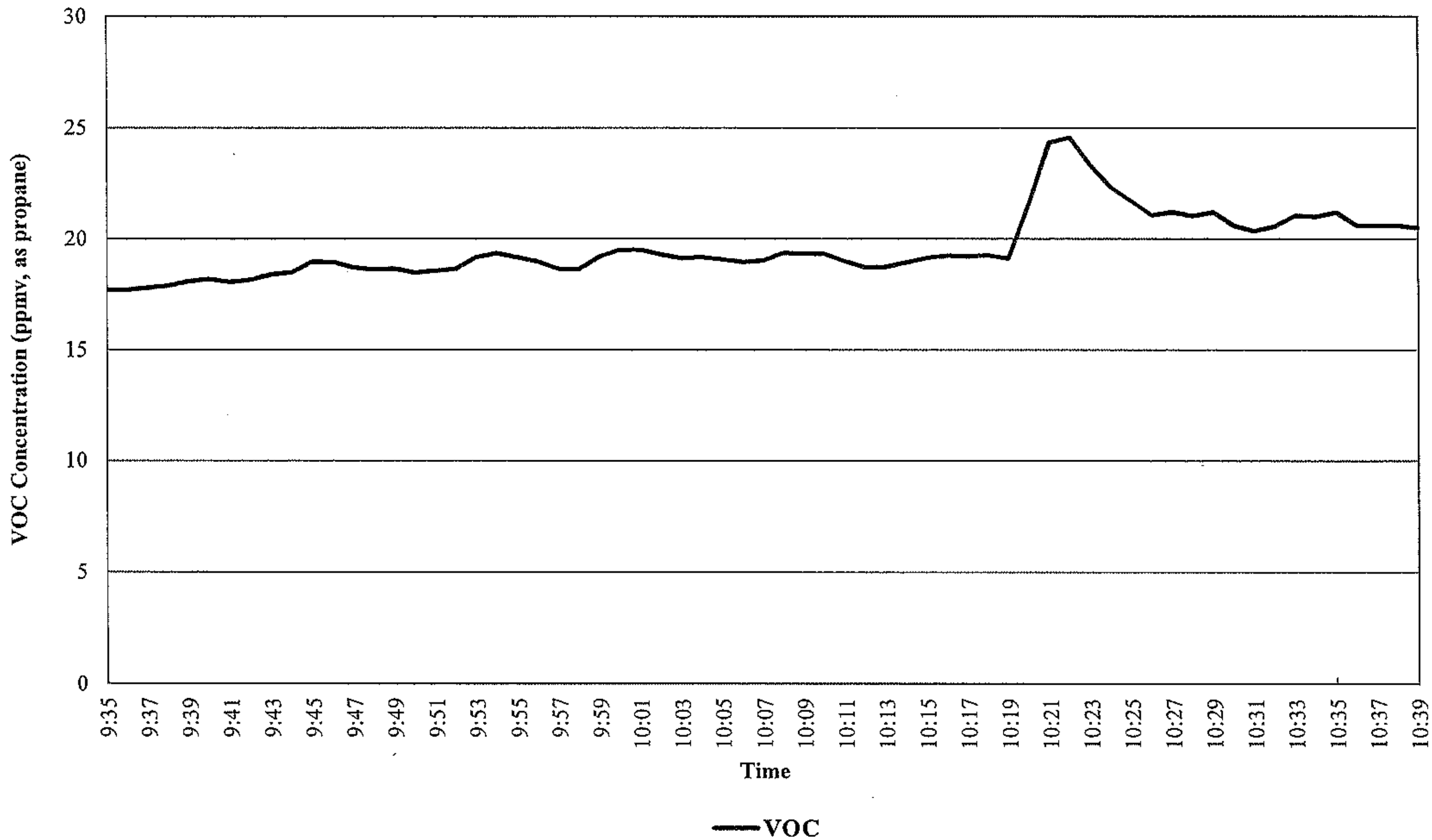
FGFERM2 VOC Concentrations - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 25, 2017



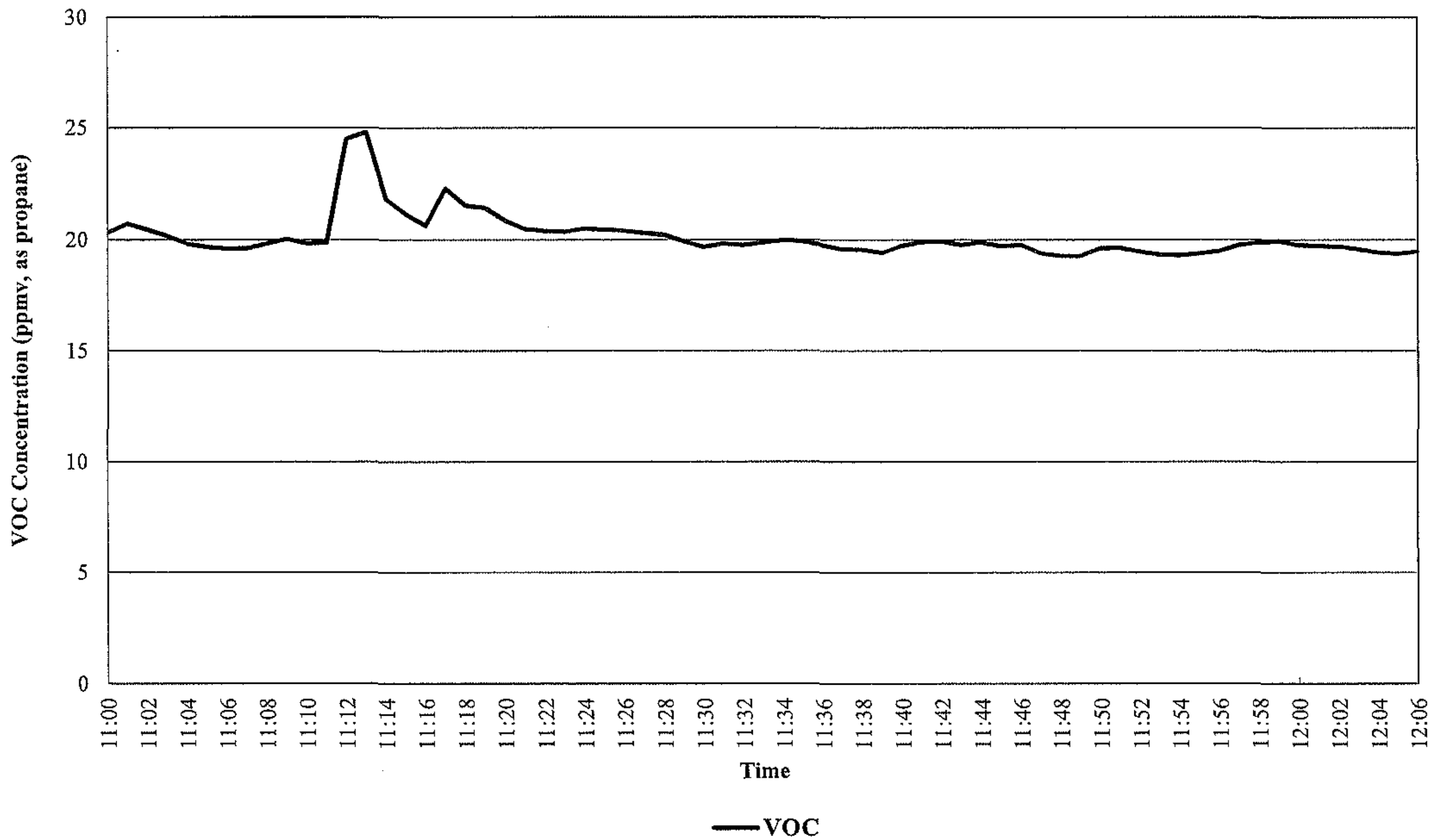
EU-COOLINGDRUM VOC Concentrations - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 27, 2017



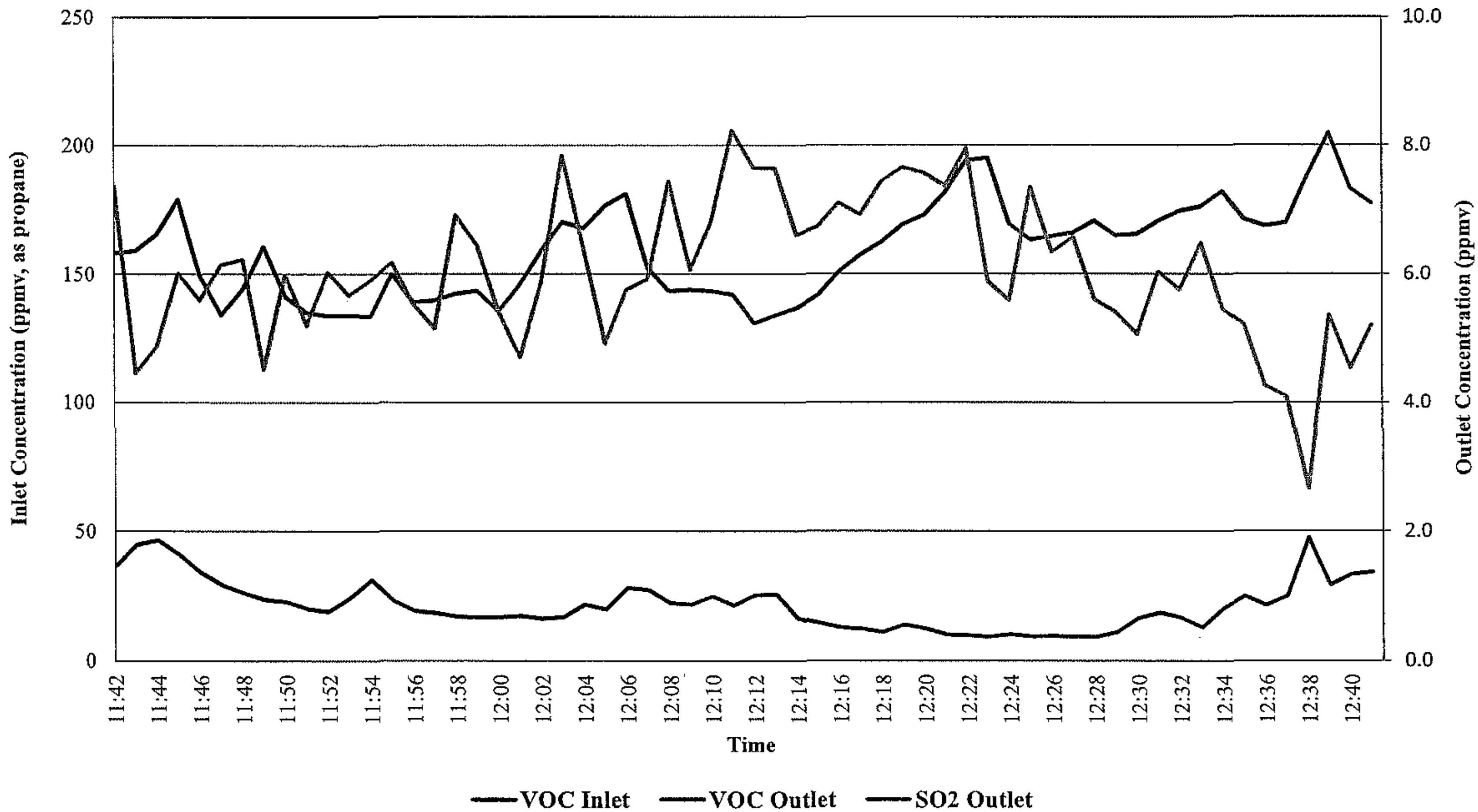
EU-COOLINGDRUM VOC Concentrations - Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 27, 2017



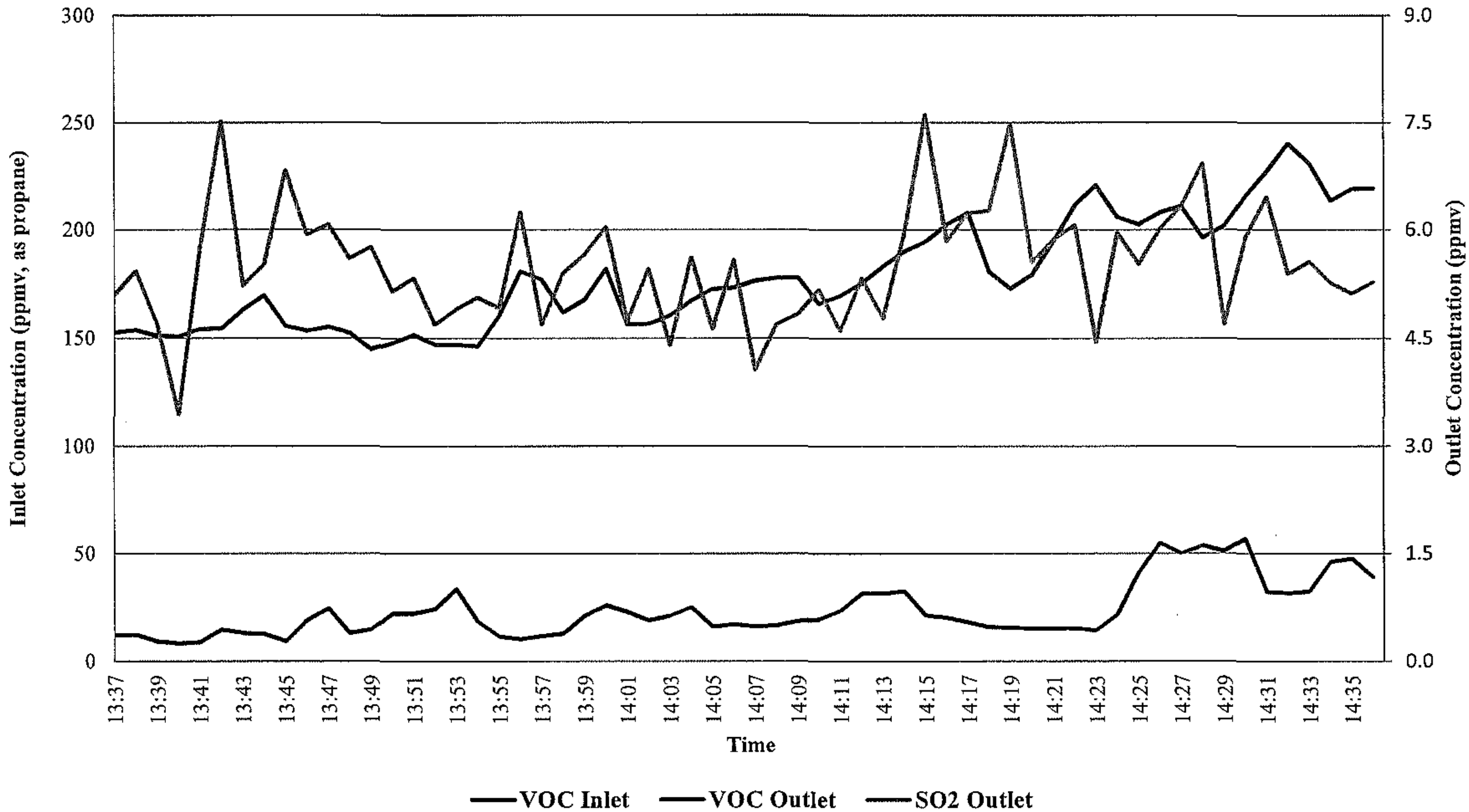
EU-COOLINGDRUM VOC Concentrations - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 27, 2017



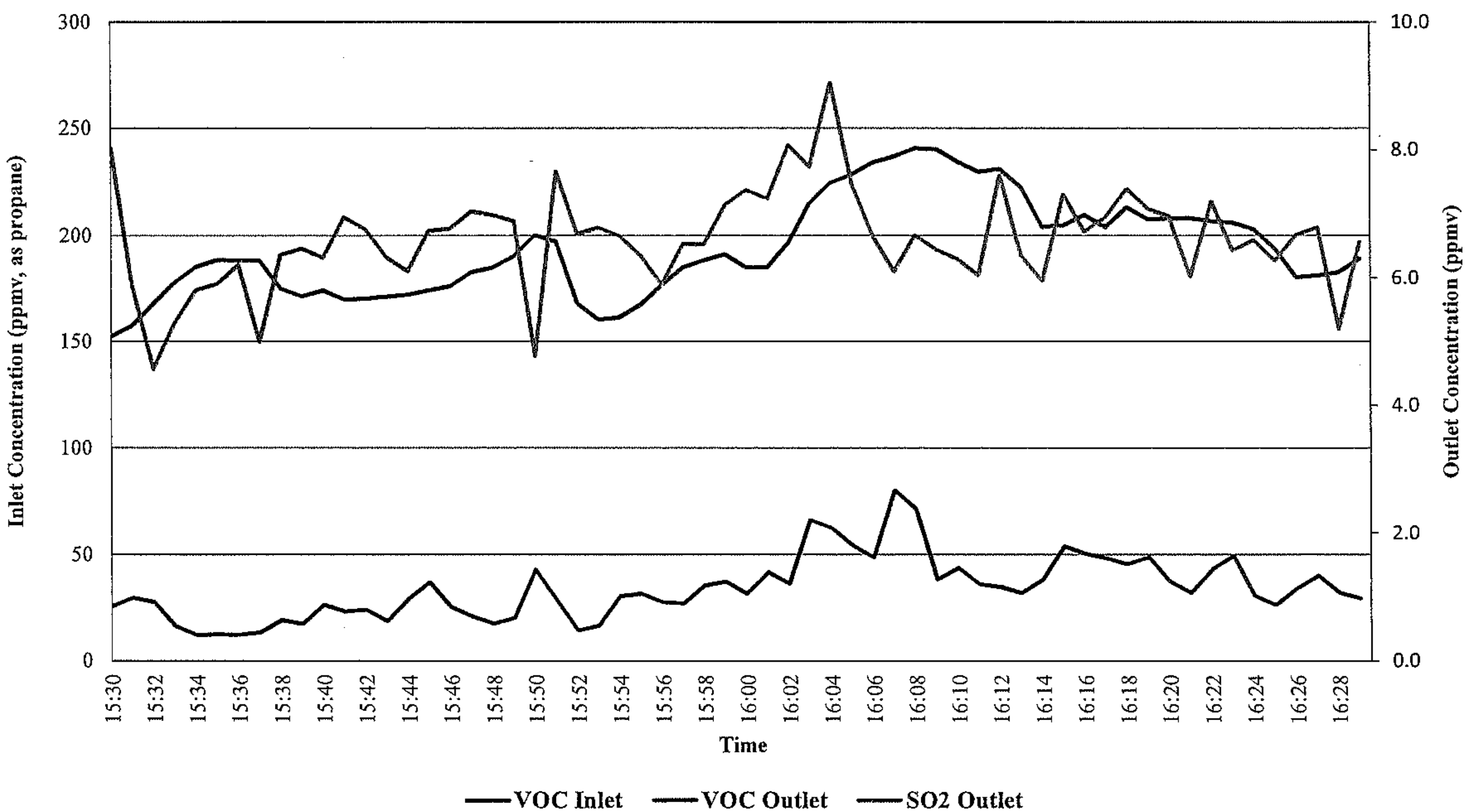
FGOXID2 VOC and SO_2 Concentrations - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 28, 2017



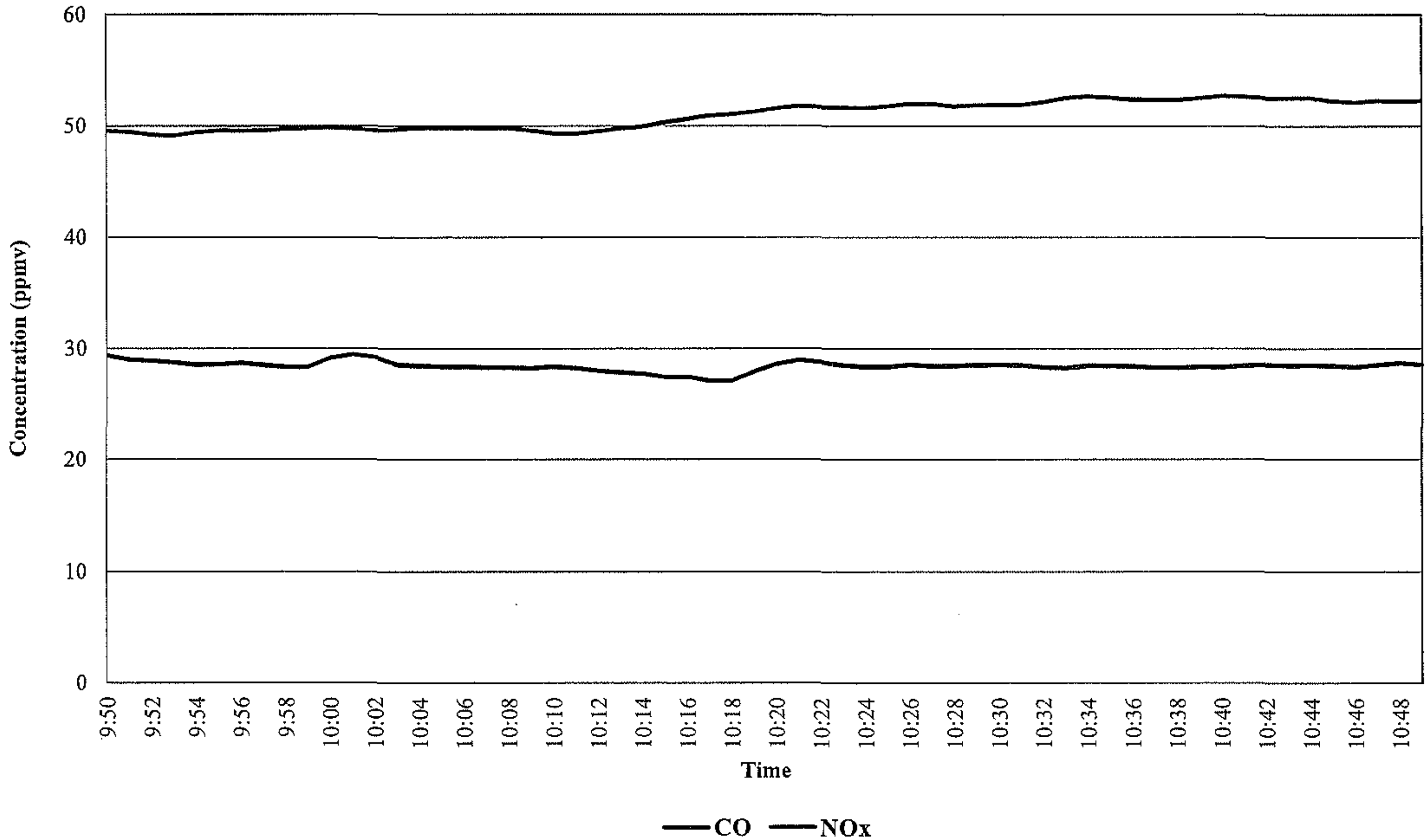
FGOXID2 VOC and SO_2 Concentrations - Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 28, 2017



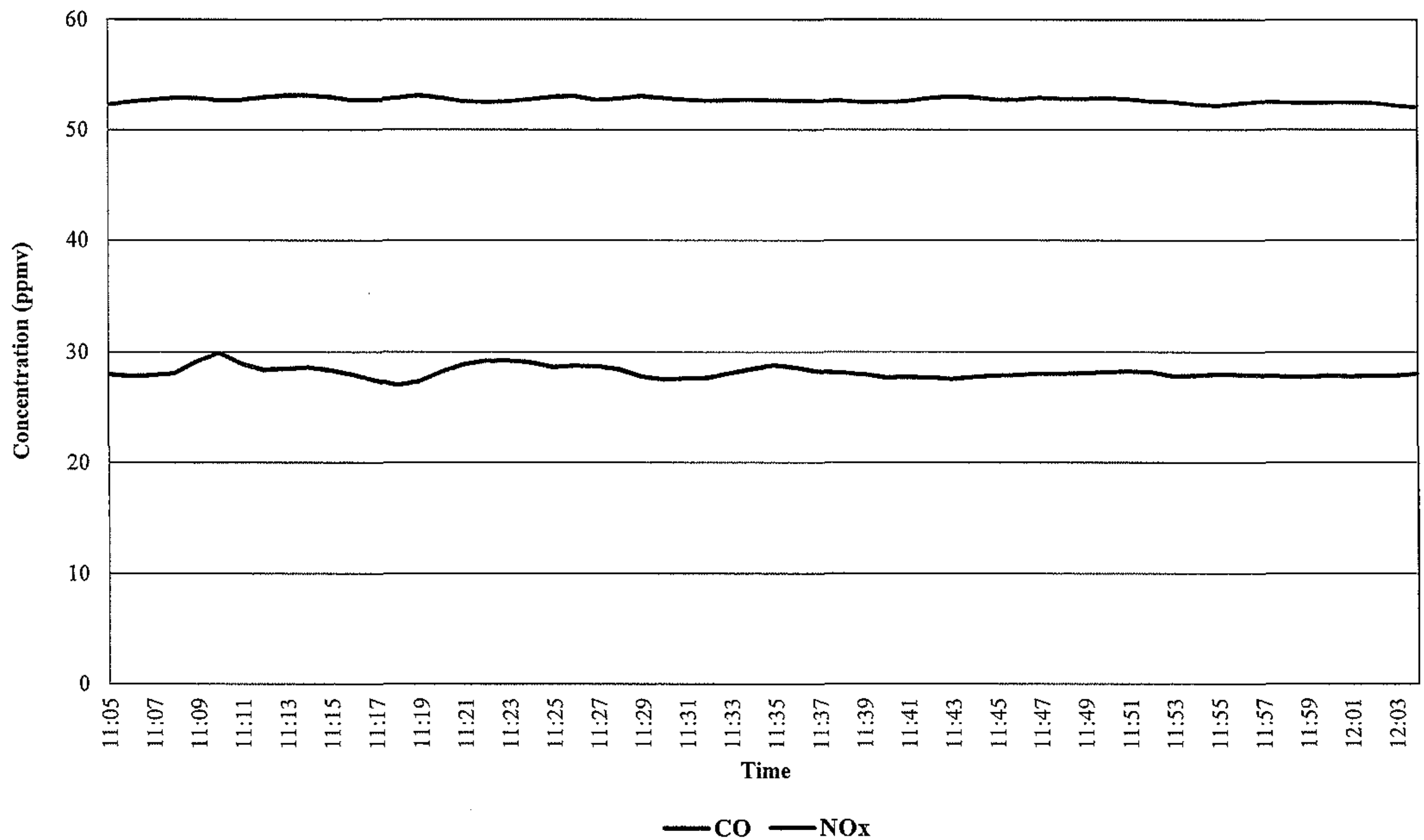
FGOXID2 VOC and SO_2 Concentrations - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 28, 2017



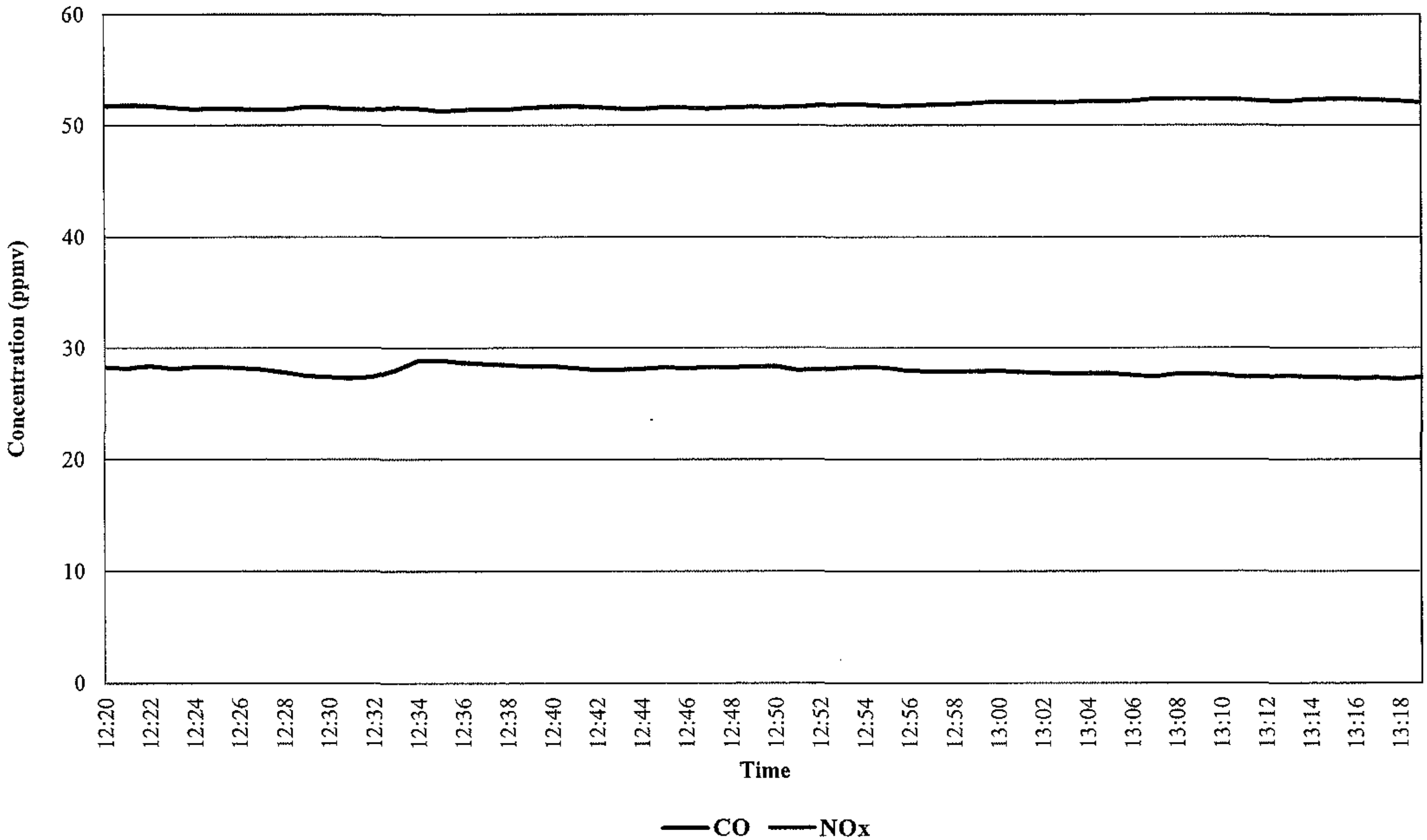
FGOXID2 CO and NO_x Concentrations - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 31, 2017



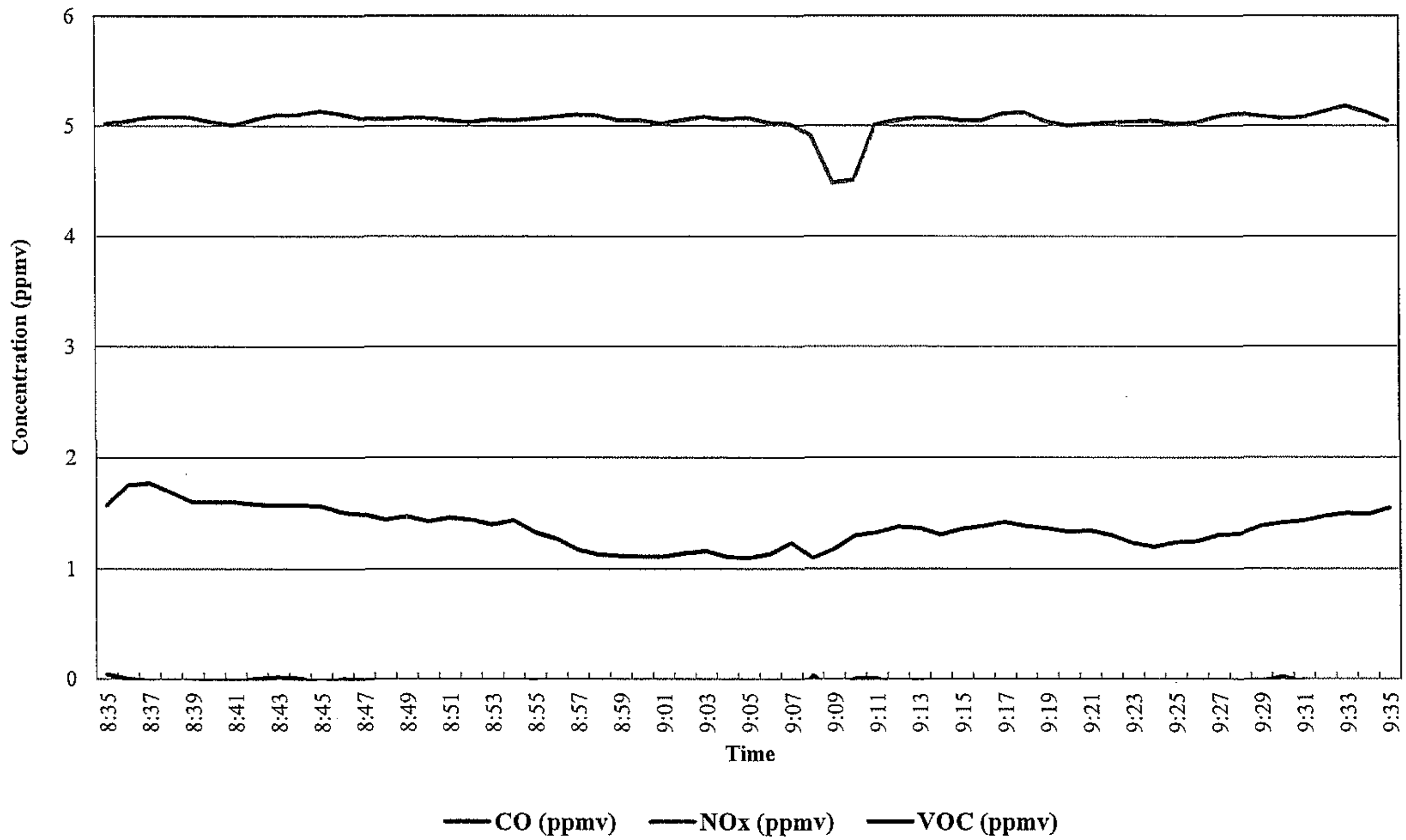
FGOXID2 CO and NO_x Concentrations - Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 31, 2017



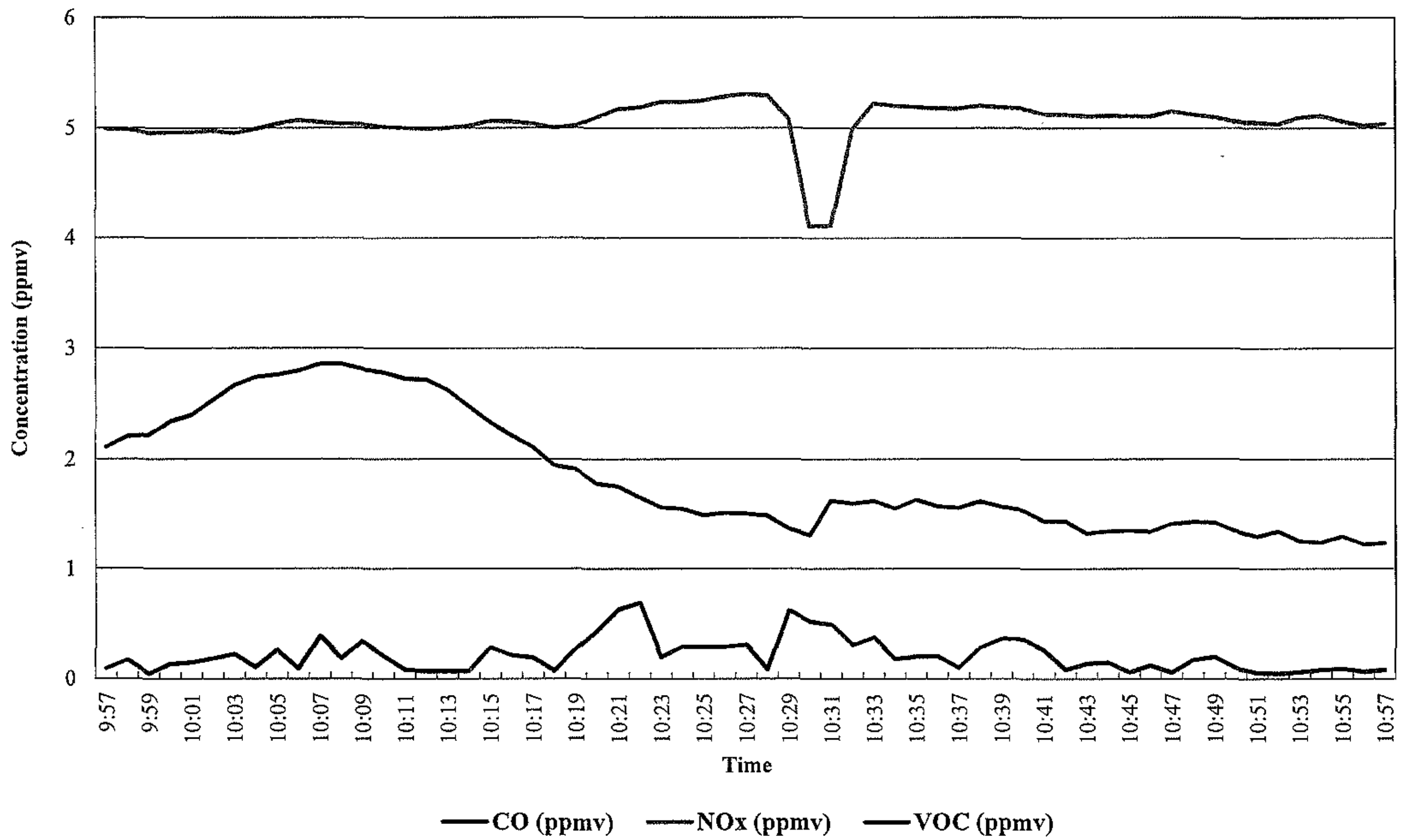
FGOXID2 CO and NO_x Concentrations - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: July 31, 2017



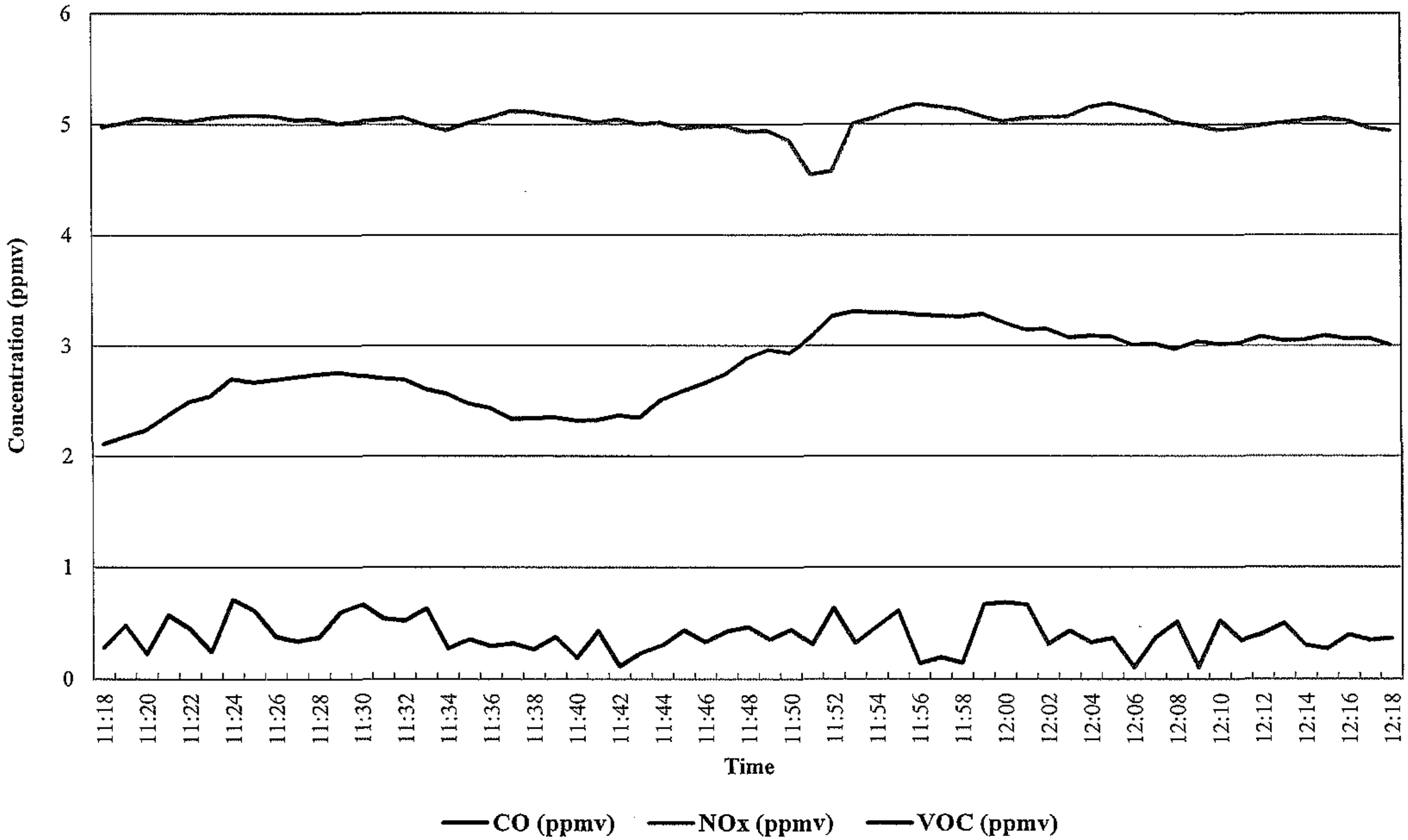
FGCHP Turbine On, Duct Burner Off - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 1, 2017

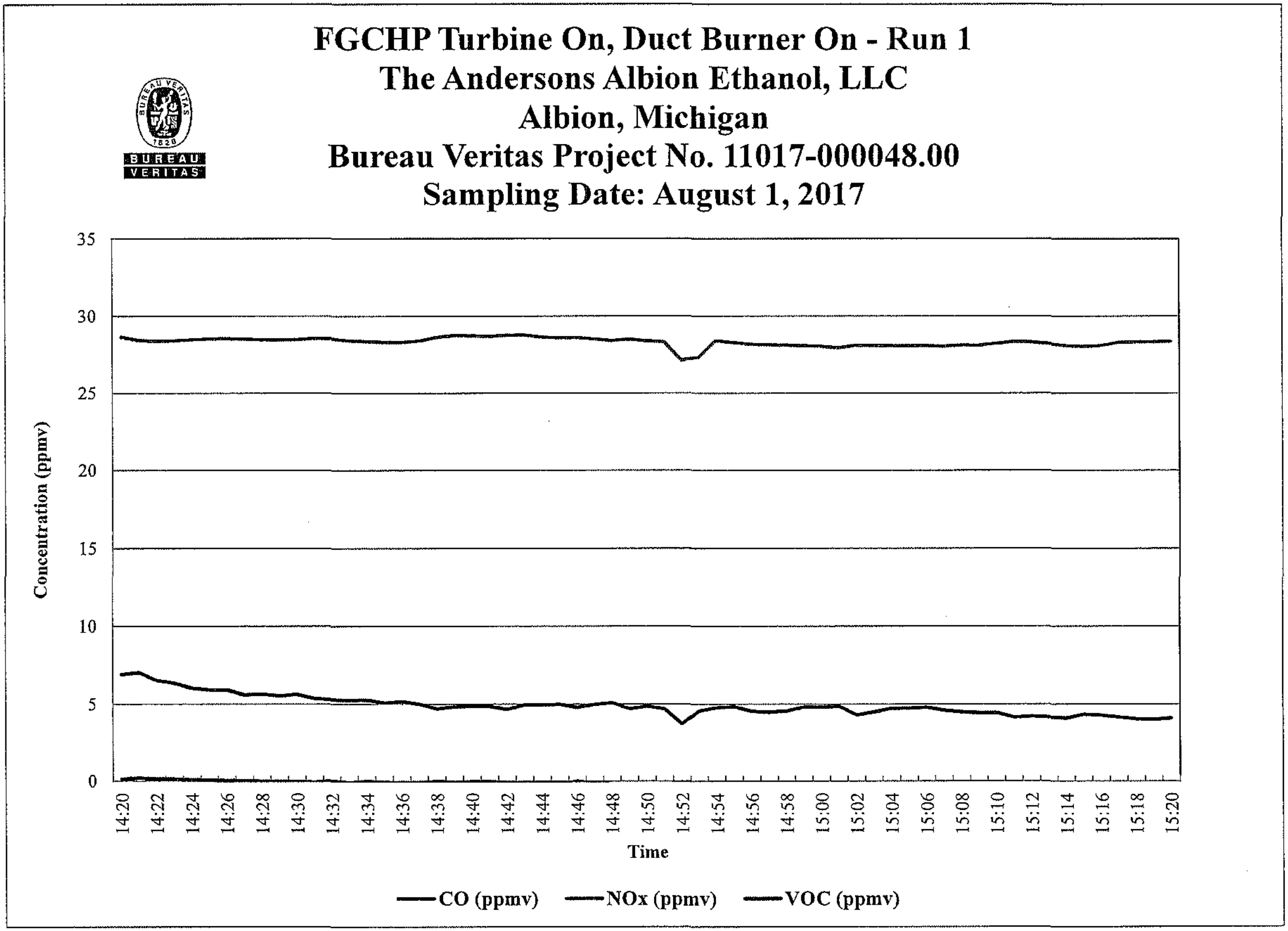


FGCHP Turbine On, Duct Burner Off - Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 1, 2017

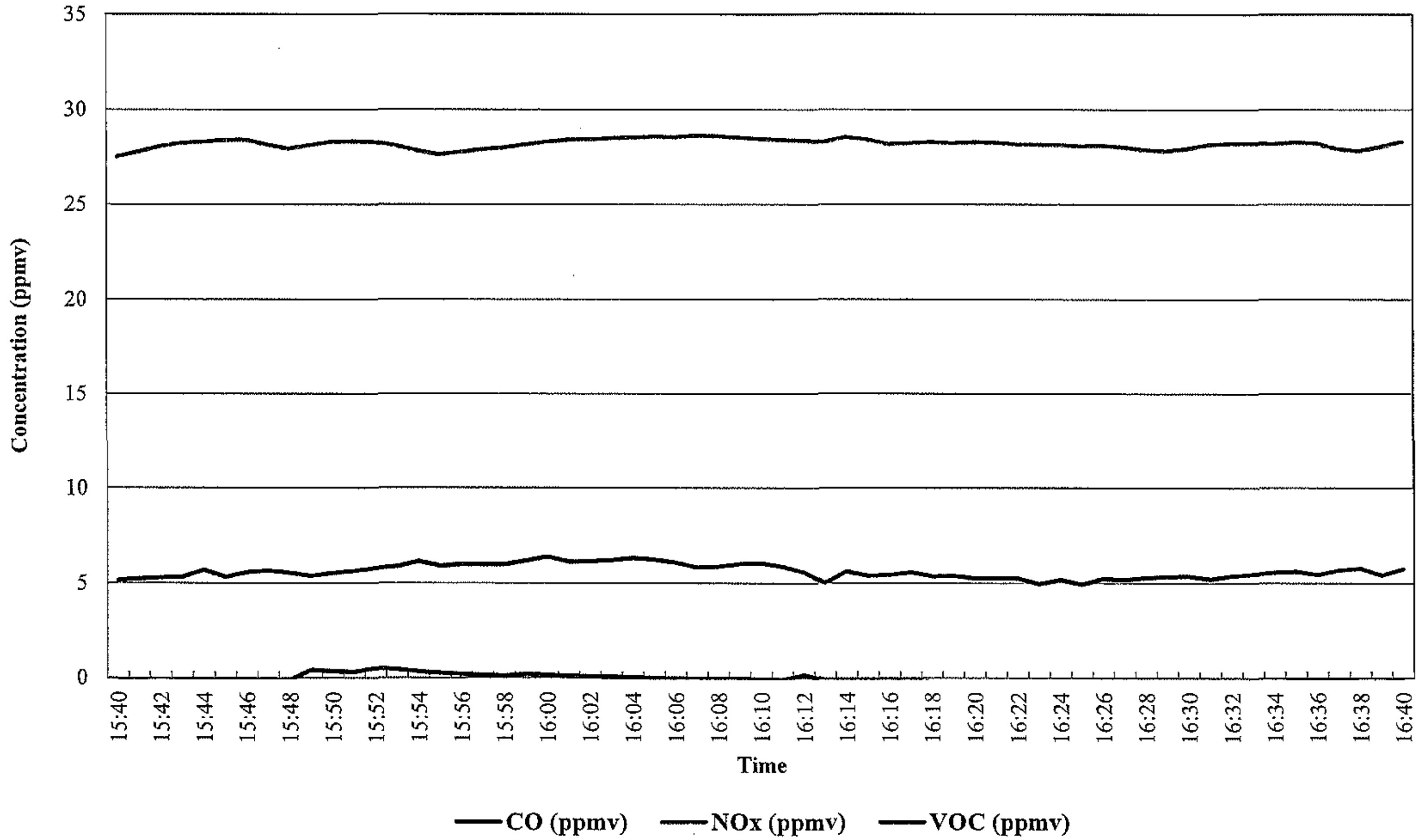


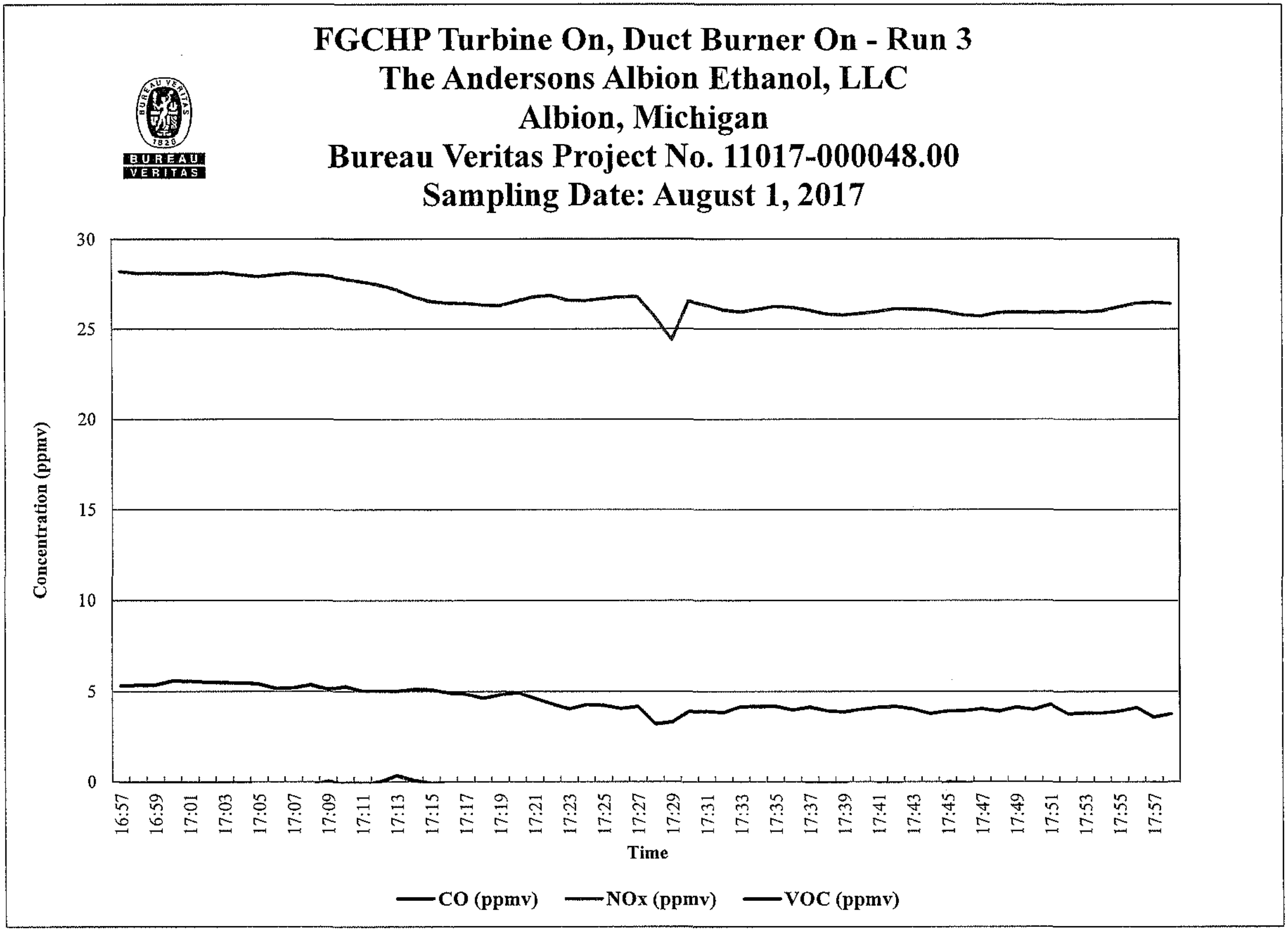
FGCHP Turbine On, Duct Burner Off - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 1, 2017




FGCHP Turbine On, Duct Burner On - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 1, 2017
BUREAU VERITAS
Concentration (ppmv)
0
5
10
15
20
25
30
35
14:20
14:22
14:24
14:26
14:28
14:30
14:32
14:34
14:36
14:38
14:40
14:42
14:44
14:46
14:48
14:50
14:52
14:54
14:56
14:58
15:00
15:02
15:04
15:06
15:08
15:10
15:12
15:14
15:16
15:18
15:20
Time
CO (ppmv)
NOx (ppmv)
VOC (ppmv)

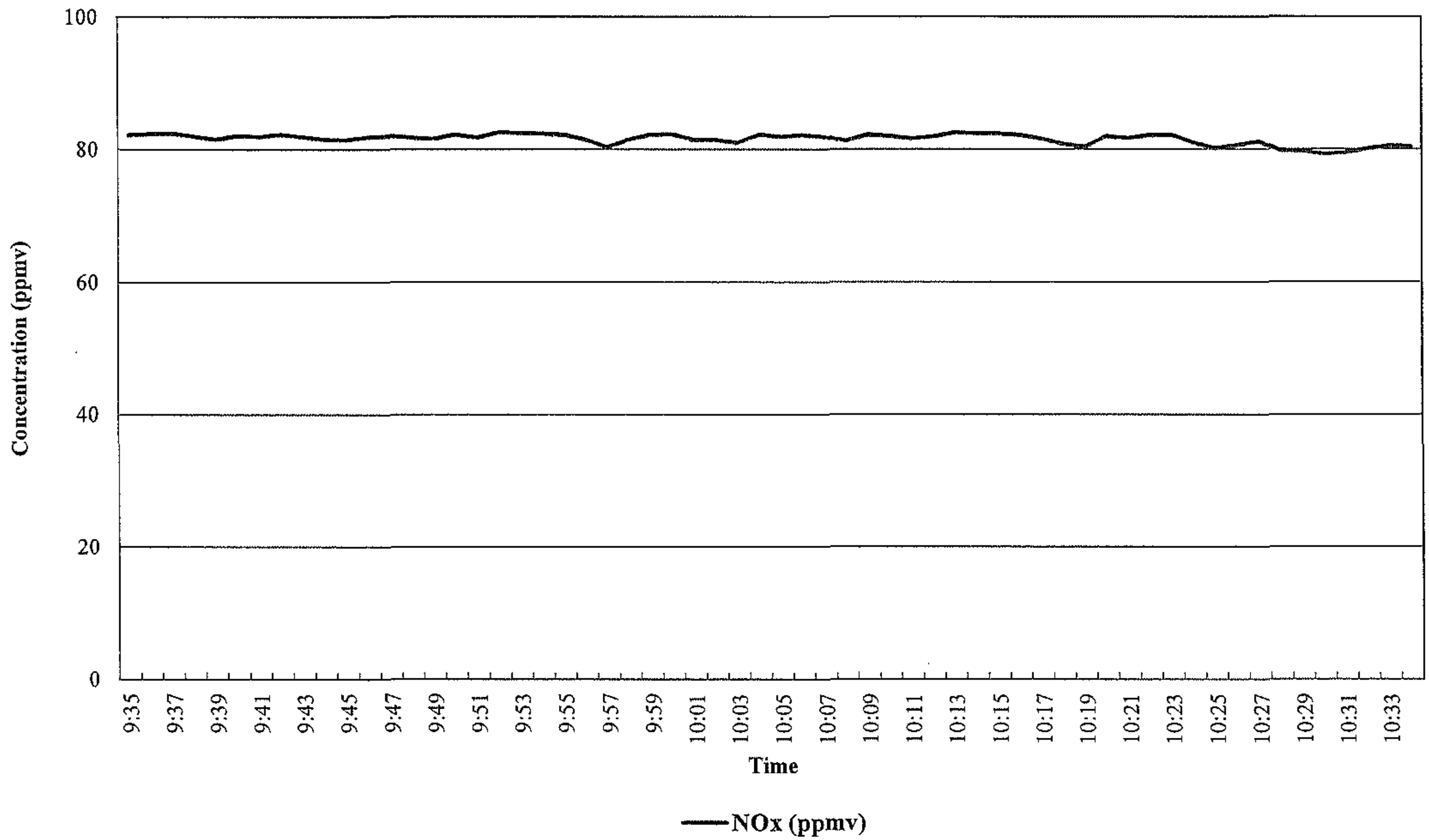
FGCHP Turbine On, Duct Burner On- Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 1, 2017



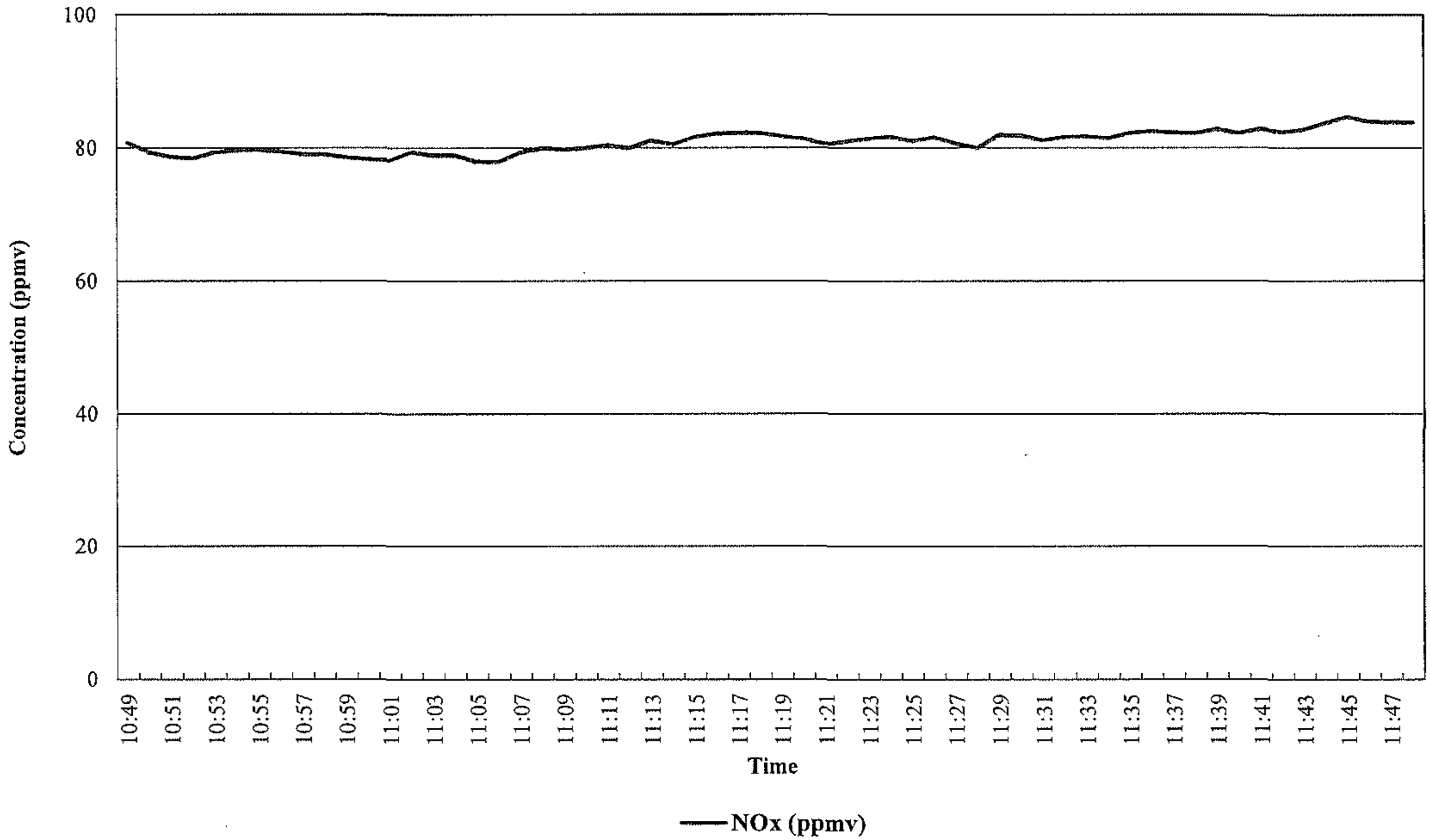


FGCHP Turbine On, Duct Burner On - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 1, 2017
Concentration (ppmv)
30
25
20
15
10
5
0
16:57
16:59
17:01
17:03
17:05
17:07
17:09
17:11
17:13
17:15
17:17
17:19
17:21
17:23
17:25
17:27
17:29
17:31
17:33
17:35
17:37
17:39
17:41
17:43
17:45
17:47
17:49
17:51
17:53
17:55
17:57
Time
CO (ppmv)
NOx (ppmv)
VOC (ppmv)

FGCHP Turbine Off, Duct Burner On - Run 1
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 2, 2017



FGCHP Turbine Off, Duct Burner On- Run 2
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 2, 2017



FGCHP Turbine Off, Duct Burner On - Run 3
The Andersons Albion Ethanol, LLC
Albion, Michigan
Bureau Veritas Project No. 11017-000048.00
Sampling Date: August 2, 2017