Source Test Report for 2022 Compliance Testing
Two Fuel Gas Water Bath Heaters
DTE Electric Company
Blue Water Energy Center, Facility ID No B2796
China Township, Michigan

Prepared For:

Kiewit Power Constructors
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Prepared By:

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For Submission To:

Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, Michigan 48933

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Review and Certification

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature: [signature] **Date:** 6/13/2022

Name: John Hamner **Title:** Account Manager

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature: [signature] **Date:** 6/13/2022

Name: Roy Slick **Title:** Reporting QC Specialist II

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1.0 Introduction

1.1 Summary of Test Program

Kiewit Power Constructors (Kiewit) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance emissions test program on the outlet stacks of two natural gas-fired Fuel Gas Heaters at the DTE Electric Company (DTE) Blue Water Energy Center (BWEC) facility located in China Township, Michigan.

The tests were conducted to demonstrate compliance with the permit limits listed in the facility's plan approval (Permit No: 19-18).

The specific objectives were to:

- Measure emissions of volatile organic compounds (VOC) at the outlets of the HP and LP Heaters
- Measure emissions of Particulate Matter ($PM_{10/2.5}$) at the outlets of the HP and LP Heaters
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

Table 1-1
Summary of Test Program

Test Date(s)	Unit ID/ Source Name	Activity/Parameters	Test Methods	No. of Runs	Duration (Minutes)
4/13 4/14	HP HEATER LP HEATER	Velocity/Volumetric Flow Rate	EPA 1 & 2	3	60
4/13 4/14	HP HEATER LP HEATER	O_2, CO_2	EPA 3A	3	60
4/13 4/14	HP HEATER LP HEATER	Moisture	EPA 4	3	60
4/13 4/14	HP HEATER LP HEATER	TPM	EPA 5	3	60
4/13 4/14	HP HEATER LP HEATER	VOC	EPA 25A/18	3	60
4/13 4/14	Grab Sample	Fuel Factor	EPA Method 19/ASTM D-1945	1	Fuel Gas Grab Sample
4/13 4/14	HP HEATER LP HEATER	Post-test meter calibration check	EPA ALT-009	--	--
4/13 4/14	HP HEATER LP HEATER	Post-test thermocouple calibration check	EPA ALT-011	--	--

To simplify this report, a list of Units and Abbreviations is included in Appendix D.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Table 1-2 and Table 1-3. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

The testing was conducted by the Montrose personnel listed in Table 1-4. The tests were conducted according to the test plan (protocol) dated September 21th, 2021 that was submitted to and approved by the Michigan Department of Environment, Great Lakes, and Energy

Table 1-2
Summary of Average Compliance Results – HP HEATER

April 13, 2022

Parameter/Units	Average Results	Emission Limits
Particulate Matter (PM)		
gr/dscf	0.000518	XX
lb/hr	0.017	0.15
Total Non-Methane/Non-Ethane Hydrocarbons, as Propane (VOC)		
ppmvd	0.00	XX
lb/hr	0.00	0.17

Table 1-3
Summary of Average Compliance Results – LP Heater

April 14, 2022

Parameter/Units	Average Results	Emission Limits
Particulate Matter (PM)		
gr/dscf	0.000963	XX
lb/hr	0.005	0.03
Total Non-Methane/Non-Ethane Hydrocarbons, as Propane (VOC)		
ppmvd	0.00	XX
lb/hr	0.00	0.03

1.2 Key Personnel

A list of project participants is included below:

Facility Information

Source Location:	DTE Electric Company Blue Water Energy Center 4400 River Road East China, MI 48054	
Project Contact:	Mr. Jon Campbell	Mr. Mark Grigereit
Role:	Commissioning & Start Up Manager	
Company:	Kiewit	DTE Electric Company
Telephone:	913-522-2634	313-412-0305
Email:	Jonathan.campbell@kiewit.com	mark.grigereit@dteenergy.com

Agency Information

Regulatory Agency:	Michigan Department of Environment, Great Lakes, and Energy
Agency Contact:	Gina Angellotti
Telephone:	313-418-0895
Email:	angellottir1@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC
Contact:	Mr. John Hamner
Title:	Account Manager
Telephone:	630-519-5135
Email:	jhamner@montrose-env.com

Laboratory Information

Laboratory:	Montrose Air Quality Services	Texas Oil Tech Laboratories
City, State:	Elk Grove Village, Illinois	Houston, Texas
Method:	EPA Methods 5, 18	ASTM 1945

Test personnel and observers are summarized in Table 1-4.

Table 1-4
Test Personnel and Observers

Name	Affiliation	Role/Responsibility
John Hamner	Montrose	Project Manager
Justin Merryman	Montrose	Project Manager/Qualified Individual (QI)
Sam Grunky	Montrose	Qualified Individual (QI)
Cody Shifflett	Montrose	Qualified Individual (QI)
Jon Campbell	Kiewit Power Constructors	Observer/Client Liaison/Test Coordinator
Mark Grigereit	DTE Electric	Observer
Gina Angellotti	Michigan EGLE	Observer

2.0 Plant and Sampling Location Descriptions

2.1 Process Description, Operation, and Control Equipment

The Blue Water Energy Center consists of two combustion turbines in a combined cycle configuration. A combined cycle electric generating unit consisting of two (2) General Electric ("GE") "H"-class combustion turbines each with maximum fuel type-based heat input of 3,658 million British Thermal Units per hour (MMBtu/hr) (natural gas) coupled with a heat recovery steam generator (HRSG) was constructed. Each HRSG is equipped with a natural gas-fired duct burner rated at 800 MMBTU/hr to provide heat for additional steam production. The HRSG is not capable of operating independently from the CTG on each unit. The CTG/HRSG is equipped with a combined oxidation catalyst for the control of CO and VOCs, and selective catalytic reduction (SCR) with dry low NOx burners for the control of nitrogen oxides. Exhaust emissions from each HRSG will be controlled by oxidation catalyst and selective catalytic reduction (SCR). In support of the gas turbines two (2) natural gas fired Fuel Gas Heaters were installed.

Two (2) natural gas-fired fuel gas heaters are located at Blue Water. One heater (EUFUELHTR1) is a high pressure heater rated at 12.2 MMBtu/hr and the other heater (EFFUELHTR2), is a low pressure heater rated at 2.4 MMBtu/hr.

2.2 Flue Gas Sampling Location

Information regarding the sampling location is presented in Table 2-1.

Table 2-1
Sampling Location

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	Number of Traverse Points
HP Heater	30	60/2.0	36/1.2	Isokinetic: 24 (12/port) Flow: 24 (12/port) Gaseous: 3
LP Heater	23	46/3.8	27/1.5	Isokinetic: 24 (12/port) Flow: 24 (12/port) Gaseous: 3

The sample location was verified in the field to conform to EPA Method 1. Acceptable cyclonic flow conditions were confirmed prior to testing using EPA Method 1, Section 11.4. See Appendix A.1 for more information.

2.3 Operating Conditions and Process Data

Emission tests were performed while the source/units and air pollution control devices were operating at the conditions required by the permit. The unit was tested when operating normally. During the testing, the heat input of the natural gas was greater than 90% of 12.2 MMBTU/hr for HP Heater and greater than 90% of 2.4 MMBtu/hr for the LP Heater.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B. Data collected includes the following parameters:

- Fuel Flow, SCFH

3.0 Sampling and Analytical Procedures

3.1 Test Methods

The test methods for this test program have been presented in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)

EPA Method 2 is used to measure the gas velocity using an S-type pitot tube connected to a pressure measurement device, and to measure the gas temperature using a calibrated thermocouple connected to a thermocouple indicator. Typically, Type S (Stausscheibe) pitot tubes conforming to the geometric specifications in the test method are used, along with an inclined manometer. The measurements are made at traverse points specified by EPA Method 1. The molecular weight of the gas stream is determined from independent measurements of O2, CO2, and moisture. The stack gas volumetric flow rate is calculated using the measured average velocity head, the area of the duct at the measurement plane, the measured average temperature, the measured duct static pressure, the molecular weight of the gas stream, and the measured moisture.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - S-type pitot tube coefficient is 0.84

The typical sampling system is detailed in Figure 3-1.

3.1.2 EPA Method 3A – Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)

EPA Method 3A is an instrumental test method used to measure the concentration of O2 and CO2 in stack gas. The effluent gas is continuously or intermittently sampled and conveyed to analyzers that measure the concentration of O2 and CO2. The performance requirements of the method must be met to validate data.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - Calibration span values are 20.12% O_2 and 19.87% CO_2
- Target and/or Minimum Required Sample Duration: 60 minutes

The typical sampling system is detailed in Figure 3-2.

3.1.3 EPA Method 4 – Determination of Moisture Content in Stack Gas

EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - The reference method is used to measure moisture
  - Moisture sampling is performed as part of the pollutant sample trains
  - Since it is theoretically impossible for measured moisture to be higher than psychrometric moisture, the psychrometric moisture is also calculated, and the lower moisture value is used in the calculations
- Target and/or Minimum Required Sample Duration: 60 minutes
- Target and/or Minimum Required Sample Volume: 21 scf

The typical sampling system is detailed in Figure 3-1.

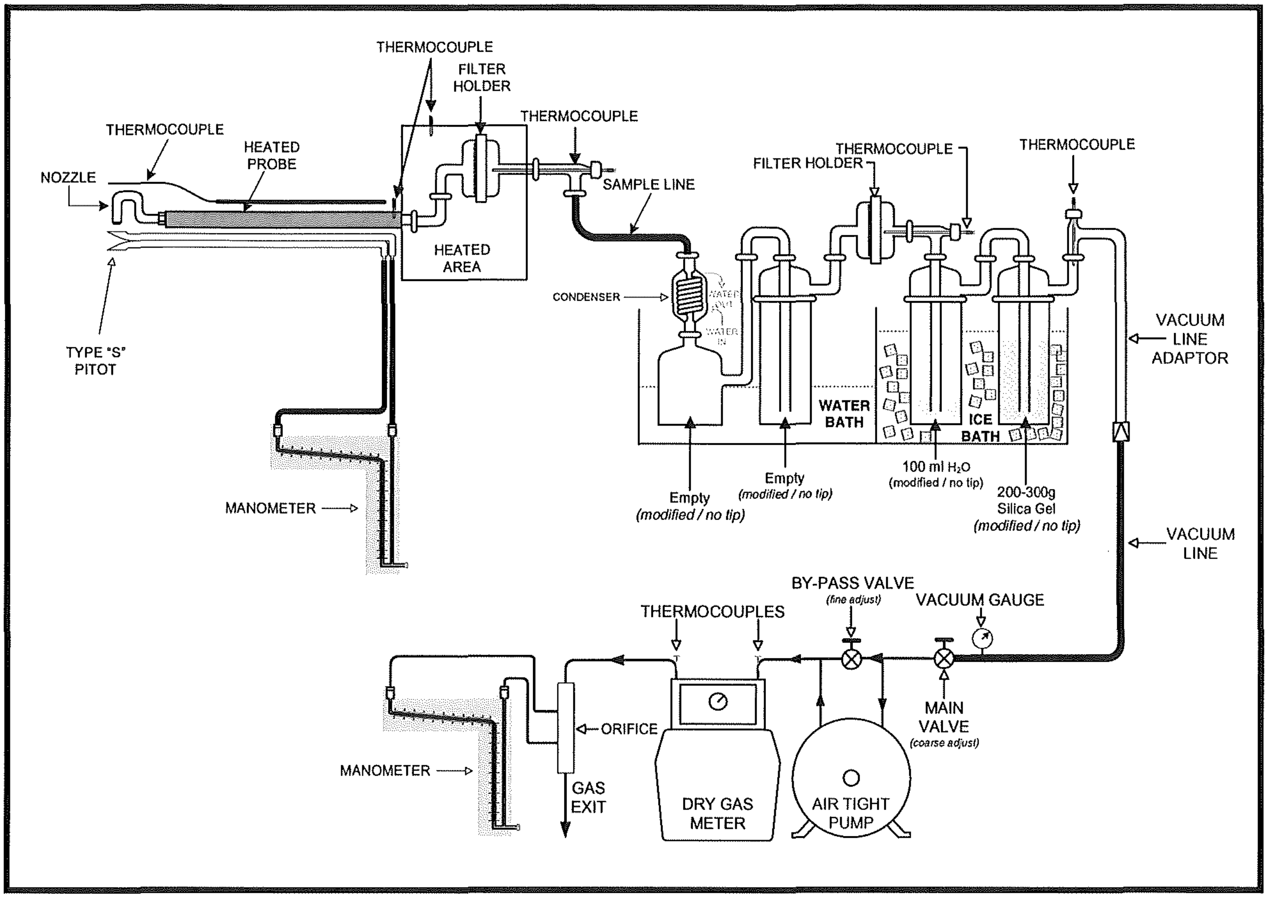
3.1.4 EPA Method 5 – Determination of Particulate Matter from Stationary Sources

EPA Method 5 is a manual, isokinetic method used to measure FPM emissions. The samples are analyzed gravimetrically. This method is performed in conjunction with EPA Methods 1 through 4. The stack gas is sampled through a nozzle, probe, filter, and impinger train. FPM results are reported in emission concentration and emission rate units. Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - Glass sample nozzles and probe liners are used
  - Condensed water is measured gravimetrically
- Target and/or Minimum Required Sample Duration: 60 minutes
- Target and/or Minimum Required Sample Volume: 40 dscf
- Analytical Laboratory: Montrose, Elk Grove Village, IL

The typical sampling system is detailed in Figure 3-1.

Figure 3-1
US EPA METHOD 5 SAMPLING TRAIN



3.1.5 EPA Method 25A and 18 – Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer and Measurement of Gaseous Organic Compound Emissions by Gas Chromatography

EPA Method 25A is an instrumental test method used to measure the concentration of THC in stack gas. A gas sample is extracted from the source through a heated sample line and glass fiber filter to an FIA. Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

EPA Method 18 is used to measure gaseous organic compounds from stationary sources. The major organic components of a gas mixture are separated by GC and are individually quantified using a FID, PID, ECD, or other appropriate detection principles. The retention times of each separated component are compared with those of known compounds under identical conditions. The GC analyst confirms the identity and approximate concentrations of the organic emission components beforehand. With this information, the analyst then prepares or purchases commercially available standard mixtures to calibrate the GC under conditions identical to those of the samples. The analyst also determines the need for sample dilution to avoid detector saturation, gas stream filtration to eliminate particulate matter, and prevention of moisture condensation.

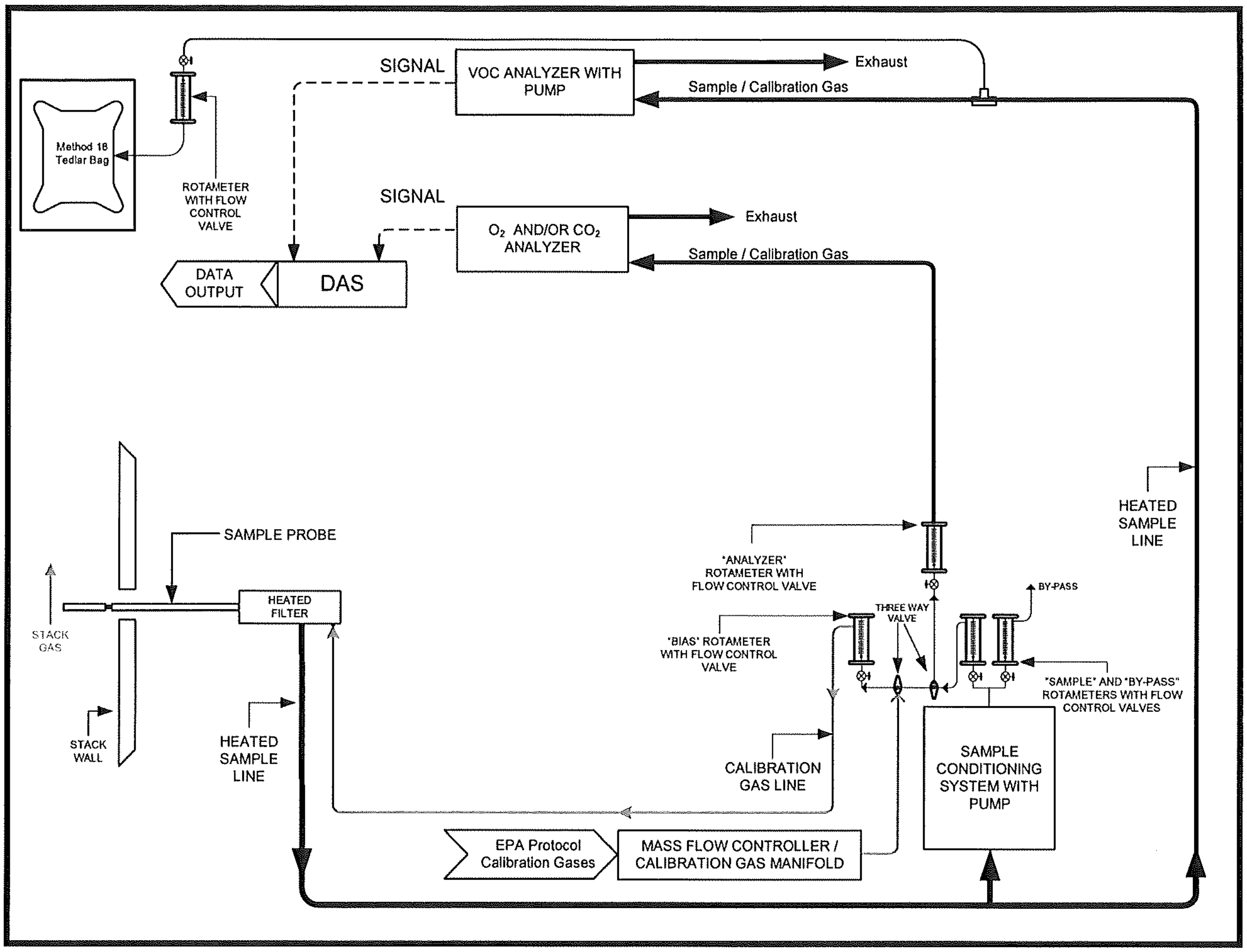
Total non-methane/non-ethane hydrocarbons concentrations are determined by subtracting methane and ethane from THC.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - Results are reported in terms of propane
  - Span value for THC is 17.13 ppmvw
  - VOC emissions on a C_3H_8 basis will be calculated by dividing the concentrations as CH_4 by a factor of 3 and concentrations as C_2H_6 by a factor of 2/3
  - Integrated bag sampling and analysis is performed for Method 18
- Method Exceptions:
  - If the gas bags are not analyzed within 48 hours of sampling time, one sample is spiked for the recovery study after analysis. The spiked bag is stored for the same period of time as the samples before analysis.
- Target Analytes: Total non-methane, non-ethane hydrocarbons excluding exempt compounds as defined by EGLE
- Target and/or Minimum Required Sample Duration: 60 minutes
- Analytical Laboratory: Montrose, Elk Grove Village, IL

The typical sampling system is detailed in Figure 3-2.

Figure 3-2
US EPA METHOD 3A 18 (BAG), AND 25A SAMPLING TRAIN



3.1.6 EPA Method 19 – Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is a manual method used to determine (a) PM, SO_2, and NO_x emission rates; (b) sulfur removal efficiencies of fuel pretreatment and SO_2 control devices; and (c) overall reduction of potential SO_2 emissions. This method provides data reduction procedures, but does not include any sample collection or analysis procedures.

EPA Method 19 is used to calculate the stack gas volumetric flow rate from the measurement of the heat input rate, stack concentration of O_2 or CO_2, and an F factor determined from fuel analysis. Volumetric flow rates are used to calculate mass emission rates in units of lb/hr. The metered fuel flow rate is recorded during each test period. A fuel sample is collected and analyzed for higher heating value (HHV) and composition (C,H,O,N,S) to calculate the F factor. F factors are determined daily, if not more frequently, from each unique fuel supply.

Pertinent information regarding the performance of the method is presented below:

- Method Options:
  - F factor is the oxygen-based F factor, dry basis (F_d)
  - F factor is calculated from analysis of fuel samples collected on the test day
  - Heat input data is calculated based on the fuel flow rate and higher heating value
  - Higher Heating Value data is obtained from analysis of fuel samples

3.2 Process Test Methods

One sample from each turbine's natural gas supply pipeline was collected into a sample container during testing of that unit. Each container was submitted to Texas Oil Tech for analysis of samples. The analysis provided results of trace fuel sulfur content by ASTM Method D-5504.

4.0 Test Discussion and Results

4.1 Field Test Deviations and Exceptions

A Dwyer Series 477AV Digital Manometer (S/N MW-MFC003) was used for flow measurements because the average ΔP was under 0.05 in. H_2O on the LP Heater.

Run 3 on the HP Heater was aborted and restarted because the unit was not up to 90% of capacity when the run began.

4.2 Presentation of Results

The average results are compared to the permit limits in Table 1-2 and 1-3. The results of individual compliance test runs performed are presented in Tables 4-1 through 4-4. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

Table 4-1
VOC Emissions Results -
HP Heater

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	4/13/2022	4/13/2022	4/13/2022	
Time	11:52-12:51	14:49-15:48	19:12-20:11	
Process Data				
Fuel Flow Rate, SCFH	11666	11782	11704	
Heat Input, MMBtu/hr	12.13	12.25	12.17	
Sampling & Flue Gas Parameters				
sample duration, minutes	60	60	60	60
O_2, % volume dry	1.63	1.36	2.21	1.73
CO_2, % volume dry	10.89	11.02	10.58	10.83
flue gas temperature, °F	447.9	456.3	449.7	451.3
moisture content, % volume	17.97	18.01	16.68	17.55
volumetric flow rate, dscfm	3,756	3,784	3,942	3,828
Total Non-Methane/Non-Ethane Hydrocarbons, as Propane (VOC)				
ppmvw	0.00	0.00	0.00	0.00
lb/hr	0.00	0.00	0.00	0.00

Table 4-2
PM Emissions Results -
HP Heater

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	4/13/2022	4/13/2022	4/13/2022	
Time	11:53-12:56	14:49-15:52	19:12-19:42	
Process Data				
Fuel Flow Rate, SCFH	11666	11782	11704	
Heat Input, MMBtu/hr	12.13	12.25	12.17	
Sampling & Flue Gas Parameters				
sample duration, minutes	60.00	60.00	60.00	60.00
sample volume, dscf	47.469	44.625	45.633	45.909
isokinetic rate, %	108.54	101.29	99.42	103.09
O_2, % volume dry	1.63	1.36	2.21	1.73
CO_2, % volume dry	10.89	11.02	10.58	10.83
flue gas temperature, °F	447.9	456.3	449.7	451.3
moisture content, % volume	17.97	18.01	16.68	17.55
volumetric flow rate, dscfm	3,756	3,784	3,942	3,828
Filterable Particulate Matter (PM)				
mg	1.5	2.2	0.9	1.5
gr/dscf	0.000488	0.000761	0.000304	0.000518
lb/hr	0.016	0.025	0.010	0.017

Table 4-3
VOC Emissions Results -
LP Heater

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	4/14/2022	4/14/2022	4/14/2022	
Time	17:29-18:40	19:16-20:34	21:05-22:16	
Process Data				
Fuel Flow Rate, SCFH	2141.44	2162.85	2194.90	
Heat Input, MMBtu/hr	2.23	2.25	2.28	
Sampling & Flue Gas Parameters				
sample duration, minutes	60	60	60	60
O_2, % volume dry	1.89	1.83	1.76	1.83
CO_2, % volume dry	10.68	10.73	10.85	10.75
flue gas temperature, °F	508.5	509.7	500.8	506.3
moisture content, % volume	15.68	16.72	15.68	16.03
volumetric flow rate, dscfm	634	626	649	637
Total Non-Methane/Non-Ethane Hydrocarbons, as Propane (VOC)				
ppmvw	0.00	0.00	0.00	0.00
lb/hr	0.00	0.00	0.00	0.00

Table 4-4
PM Emissions Results -
LP Heater

Parameter/Units	Run 1	Run 2	Run 3	Average
Date	4-14-22	4-14-22	4-14-22	
Time	17:29-18:45	19:16-20:35	21:06-22:18	
Process Data				
Fuel Flow Rate, SCFH	2141.44	2162.85	2194.90	
Heat Input, MMBtu/hr	2.23	2.25	2.28	
Sampling & Flue Gas Parameters				
sample duration, minutes	60.00	60.00	60.00	60.00
sample volume, dscf	45.776	44.828	44.633	45.079
isokinetic rate, %	103.29	102.38	98.30	101.32
O_2, % volume dry	1.89	1.83	1.76	1.83
CO_2, % volume dry	10.68	10.73	10.85	10.75
flue gas temperature, °F	508.5	509.7	500.8	506.3
moisture content, % volume	15.68	16.72	15.68	16.03
volumetric flow rate, dscfm	634	626	649	637
Filterable Particulate Matter (PM)				
mg	5.2	1.2	2.1	2.8
gr/dscf	0.001753	0.000410	0.000726	0.000963
lb/hr	0.010	0.002	0.004	0.005

5.0 Internal QA/QC Activities

5.1 QA/QC Audits

The meter boxes and sampling trains used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes, minimum sample durations, and percent isokinetics met the applicable QA/QC criteria, except where noted in Section 5.2.

EPA Method 3A calibration audits were all within the measurement system performance specifications for the calibration drift checks, system calibration bias checks, and calibration error checks, except where noted in Section 5.2.

EPA Method 25A FIA calibration audits were within the measurement system performance specifications for the calibration drift checks and calibration error checks, except if noted in Section 5.2.

EPA Method 5 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met, except if noted in Section 5.2. An EPA Method 5 reagent blank was analyzed. The maximum allowable amount that can be subtracted is 0.001% of the weight of the acetone used. The blank did not exceed the maximum residue allowed.

EPA Method 18 analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met, except where noted in Section 5.2.

5.2 QA/QC Discussion

All QA/QC criteria were met during this test program.

5.3 Quality Statement

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

Appendix A
Field Data and Calculations

Appendix A.1
Sampling Locations