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Test Report
Total Non-Methane Hydrocarbons

EUBOILER01 and EUBOILER02

CMS Enterprises
TES Filer City Station
700 Mee Street
Filer City, Michigan 49634
SRN: N1685

Test Date: August 16, 2017

Report Date: October 4, 2017

Test Performed by the Consumers Energy Company
Regulatory Compliance Testing Section – Air Emissions Testing Body
Laboratory Services

Work Order No. 4101584
Revision No. 0

EXECUTIVE SUMMARY

Consumers Energy Company (Consumers Energy) Regulatory Compliance Testing Section (RCTS) conducted total non-methane hydrocarbon (NMHC) air emissions testing at the stack exhausts associated with emissions units EUBOILER01 and EUBOILER02 operating at the Tondu Energy Systems (TES) Filer City Station in Filer City, Michigan. The air emissions tests were performed to satisfy testing requirements and evaluate compliance with the total NMHC emission limits in Renewable Operating Permit MI-ROP-N1685-2015b issued and last revised by the Michigan Department of Environmental Quality (MDEQ) on June 19, 2017.

Three 60-minute NMHC tests were performed at each boiler exhaust on August 16, 2017 following the procedures described in the Test Protocol submitted by Consumers Energy to MDEQ on July 15, 2017. The Test Protocol was reviewed and approved by MDEQ in their August 1, 2017 letter. There were no deviations from the approved stack test protocol or the USEPA reference methods, with the exception of:

- Applying the analyzer bias calculations from USEPA method 7E to the method 25A NMHC measurements (at the request of the MDEQ)

The preceding deviation was requested and/or approved by MDEQ prior to testing.

NMHC emissions were measured using United States Environmental Protection Agency (USEPA) reference methods 1 and 25A and adjusted for analyzer bias following USEPA reference method 7E.

The following table summarizes the results of the testing.

Summary of Emission Results

Unit	NMHC (ppmv, as propane)†	Flow Rate (SCFH)	NMHC (lb/hr)	NMHC Limit (lb/hr)
EUBOILER01	0.25	6,386,093	**0.18**	4.6
EUBOILER02	-0.03	6,774,175	**-0.02**	4.6

† concentrations adjusted for analyzer bias using USEPA Reference Method 7E equation7E-5b.
ppmv part per million by volume
SCFH standard cubic feet per hour measured by the facility's certified continuous emissions monitoring system
lb/hr pound per hour

The results of this test program indicate EUBOILER01 and EUBOILER02 are in compliance with the applicable NMHC permit limits. The measured NMHC concentrations at EUBOILER02 adjusted for analyzer bias resulted in a negative value, suggesting NMHC concentrations were near or below the detection limit of the analyzer. The unadjusted and analyzer bias adjusted results are presented in Appendix Tables 1 and 2.

Detailed results are presented in Appendix Tables 1 and 2. Sample calculations and field data sheets are presented in Appendices A and B. Process operating data and supporting information are provided in Appendices C and D.

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1.0 INTRODUCTION

Consumers Energy Company (Consumers Energy) Regulatory Compliance Testing Section (RCTS) conducted total non-methane hydrocarbon (NMHC) air emissions testing at the stack exhausts associated with emissions units EUBOILER01 (Unit 1) and EUBOILER02 (Unit 2) operating at the Tondu Energy Systems (TES) Filer City Station in Filer City, Michigan. The purpose of the test program was to satisfy testing requirements and evaluate compliance with the total NMHC emission limits in Renewable Operating Permit MI-ROP-N1685-2015b issued and last revised by the Michigan Department of Environmental Quality (MDEQ) on June 19, 2017. The applicable emission limits are summarized in Table 1-1.

Table 1-1
NMHC Emission Limits

Parameter	Emission Limit	Units	Applicable Requirement
NMHC	4.6	lb/hr	Michigan Air Pollution Control Rule 336.1702(a)

lb/hr: pound per hour

The facility is a cogeneration power plant that utilizes the Unit 1 and Unit 2 boilers to produce a rated output of approximately 60-megawatts net (MW_n) of electricity and 50,000 pounds of process steam per hour. The electric output is sold pursuant to a long-term power purchase agreement with Consumers Energy Company. The process steam is sold to an adjacent industrial customer.

A test protocol was submitted to the Michigan Department of Environmental Quality (MDEQ) on July 15, 2017 and subsequently approved by Mr. Jeremy Howe, MDEQ Environmental Quality Analyst, in his letter dated August 1, 2017. The test program was conducted August 16, 2017 following the test protocol and procedures in United States Environmental Protection Agency (USEPA) reference methods 1 and 25A. NMHC concentrations were adjusted for analyzer bias following USEPA reference method 7E. Deviations from the approved stack test protocol or the USEPA reference methods were requested and/or approved by the MDEQ prior to testing and are discussed in Section 5.0.

1.1 CONTACT INFORMATION

Table 1-2 presents the test program organization, major lines of communication, and names and phone numbers of responsible individuals.

Table 1-2
Contact Information

Program Role	Contact	Address
Regulatory Agency Representative	Ms. Karen Kajiya-Mills Technical Programs Unit Manager 517-335-4874 kajiya-millsk@michigan.gov	Michigan Department of Environmental Quality Technical Programs Unit 525 W. Allegan, Constitution Hall, 2nd Floor S Lansing, Michigan 48933
Regulatory Agency Inspector	Ms. Caryn Owens Environmental Engineer 231-876-4414 owensc1@michigan.gov	Michigan Department of Environmental Quality Cadillac District 120 W. Chapin Street Cadillac, Michigan 49601
Regulatory Agency Representative	Mr. Jeremy Howe Environmental Quality Analyst 231-876-4416 howejl@michigan.gov	Michigan Department of Environmental Quality Cadillac District 120 W. Chapin Street Cadillac, Michigan 49601
Responsible Official	Mr. Henry Hoffman General Manager 231-723-6573, Ext 102 henry.hoffman@cmsenergy.com	CMS Generation Filer City Operating, LLC Filer City Station 700 Mee Street Filer City, Michigan 49634
Plant Representative	Mr. Austin S. Swiatlowski Plant Operator 231-723-6573, Ext 108 austin.swiatlowski@cmsenergy.com	CMS Generation Filer City Operating, LLC Filer City Station 700 Mee Street Filer City, Michigan 49634
Test Team Representative	Mr. Calvin J. Mason, QSTI Engineering Technical Analyst 616-738-3385 joe.mason@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460
Test Team Representative	Mr. Thomas R. Schmelter, QSTI Engineering Technical Analyst 616-738-3234 thomas.schmelter@cmsenergy.com	Consumers Energy Company L&D Training Center 17010 Croswell Street West Olive, Michigan 49460

2.0 SUMMARY OF RESULTS

2.1 OPERATING DATA

In accordance with Michigan Air Pollution Control Rule 1003(3) the boiler operations were at the maximum routine operating conditions during the test program. The boilers fired blends of coal, tire derived fuel, and/or wood during testing. The average steam generating rates during the tests were approximately 308,000 lbs/hr for Unit 1 and 308,000 lbs/hr for Unit 2. These steam generating rates are approximately 96% of the full load ratings of 320,000 lbs/hr. Recorded operating data, including fuel blend firing rate and composite fuel factor data, is included in Appendix C.

2.2 APPLICABLE PERMIT INFORMATION

The TES Filer City Station is currently operating pursuant to the terms and conditions of State of Michigan Registration Number (SRN) N1685 air permit MI-ROP-N1685-2015b. The air permit incorporates state and federal regulations. The USEPA has assigned a Facility Registry Service (FRS) identification number of 110056958225. EUBOILER01 and EUBOILER02 are the emission unit sources listed within the permit and collectively comprise the FGBOILERS flexible group.

Section D, FGBOILERS Flexible Group Conditions, Special Condition V.2. of MI-ROP-N1685-2015b require the Permittee to conduct stack testing to determine NMHC emissions rates from EUBOILER01 and EUBOILER02 at least once every five years. Such testing was last conducted in 2012.

2.3 RESULTS

The results of the air emissions testing indicate the 3-run average NMHC mass emission rates are in compliance with the applicable limits. Refer to Table 2-1 for a summary of the NMHC results. Refer to Section 5.0 for further discussion.

Table 2-1
Summary of Emission Results

Unit	NMHC (ppmv, as propane)†	Flow Rate (SCFH)	NMHC (lb/hr)	NMHC Limit (lb/hr)
EUBOILER01	0.25	6,386,093	0.18	4.6
EUBOILER02	-0.03	6,774,175	-0.02	4.6

† concentrations adjusted for analyzer bias using USEPA Reference Method 7E equation7E-5b.
ppmv part per million by volume
SCFH standard cubic feet per hour measured by the facility's certified continuous emissions monitoring system
lb/hr pound per hour

3.0 SOURCE DESCRIPTION

TES Filer City Station is a clean burning coal facility consisting of two solid-fuel fired boilers. The electricity output is sold pursuant to a long-term power purchase agreement with Consumers Energy Company. Process steam is sold to an adjacent industrial customer.

3.1 PROCESS

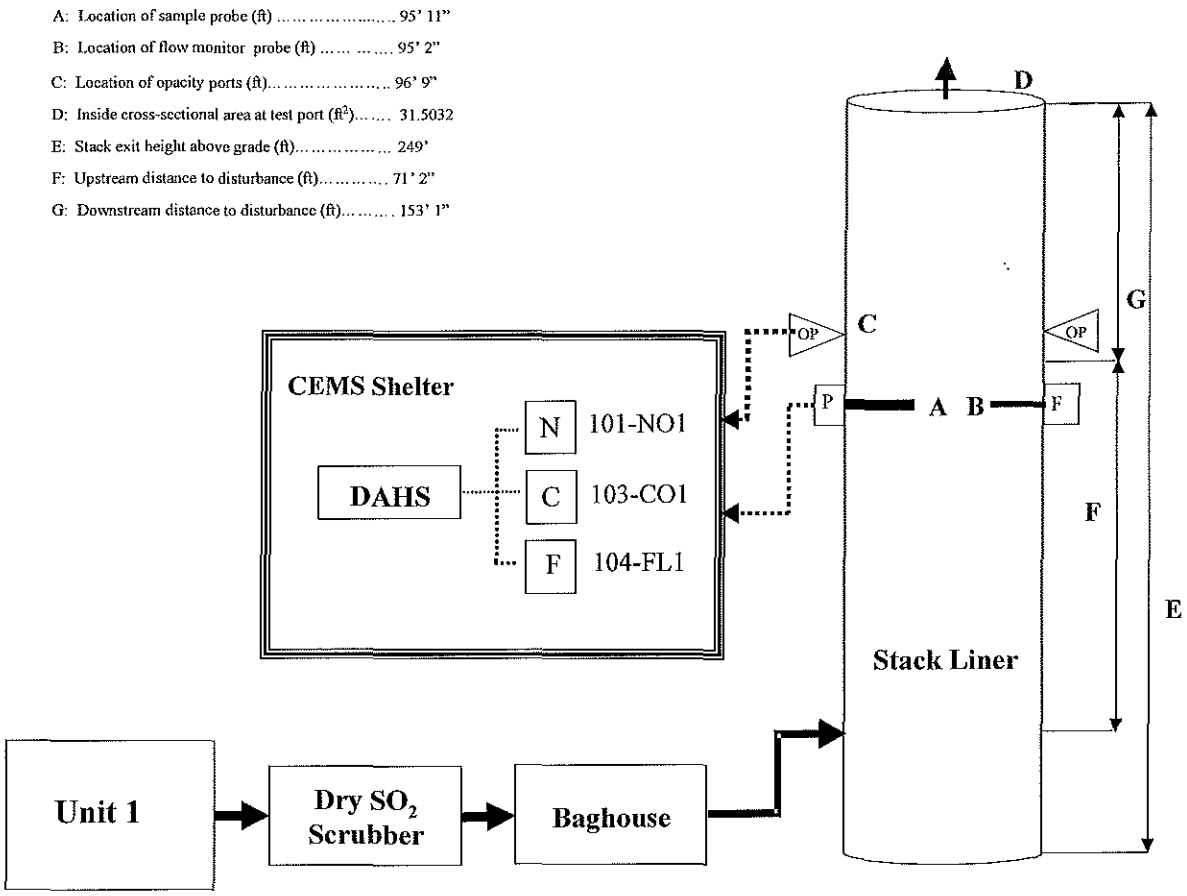
TES Filer City Station operates as a cogeneration electric power plant with a rated output of approximately 60-megawatts net (MW_n) and is also capable of generating 50,000 pounds of process steam per hour. The electricity and process steam are sold under contract to public and/or private companies. The facility was constructed in 1988 with commercial operations beginning in 1990.

3.2 PROCESS FLOW

EUBOILER01 and EUBOILER02 are spreader stoker boilers used to generate steam. Each unit has a nominal heat input rating of approximately 384 mmBtu/hour and are currently allowed to combust bituminous coal, wood and wood waste, petroleum coke, industrial construction/demolition wood waste, tire derived fuel, and natural gas. The fuel is fired in the furnace where the combustion heats water within boiler tubes producing steam. At full load, each unit is capable of producing approximately 320,000 pounds per hour of steam. This steam is used to turn a common steam turbine that is connected to an electricity producing generator. The electricity is routed through the transmission and distribution system to customers.

The exhaust gas from each boiler is vented to a spray dryer absorber (SDA) flue gas desulfurization (FGD) system for sulfur dioxide (SO_2) and acid gas control and a baghouse to control particulate matter. The abated exhaust gases are discharged through separate circular flues housed within a single exhaust stack. The separate flues discharge approximately 250 feet above grade. Refer to Figure 3-1 for a Process Flow Diagram of Unit 1 which is representative of Unit 2.

Figure 3-1. Process Flow Diagram



3.3 Raw and Finished Materials Processed

At the time of testing, Units 1 and 2 were capable of firing mixtures of coal (bituminous and subbituminous), wood and wood waste, construction/demolition (C/D) material, tire-derived-fuel (TDF) and natural gas. During the tests, coal, TDF, and wood were fired. Refer to Appendix C for facility operating data recorded during the test program.

In March of 2016, two low NO_x natural gas-fired burners were installed each boiler. Natural gas is utilized as a clean startup fuel, as well as at other times for flame stabilization and other purposes.

TES executed an Administrative Consent Order with the EPA which resulted in all petroleum coke having been removed from the site by March 31, 2016, and TES does not anticipate firing petroleum coke in the near future.

3.4 Rated Capacity

EUBOILER01 and EUBOILER02 each have a nominally rated heat input capacity of 384 mmBtu/hr and a steam generation capacity of 320,000 lbs/hr; they can generate a combined net electrical output of approximately 60 MW_n and 50,000 pounds of process steam per hour. The boilers normally operate in a continuous manner near their rated capacity in order to meet the contractual electrical and steam requirements of TES Filer City Station customers.

3.5 Process Instrumentation

The process was continuously monitored by boiler operators, environmental technicians, and data acquisition systems during testing. The following operating parameters were recorded during the test program and are included in Appendix C:

- Steam load flow (1,000s lb/hr) [In lieu of electrical load, which is only determined on a combined basis.]
- Volumetric flowrate (standard cubic foot per hour [scfh])
- Total heat input (mmBtu/hr)
- Fuel blend (coal, natural gas, TDF, and wood) firing rates (lb/hr) (scfm for natural gas)

Due to the various instrumentation monitoring systems, the reference method test times were correlated to facility instrumentation time stamps which were logging 64 minutes earlier than local daylight savings time (DST). The reference method data acquisition system clock was adjusted to match the facility time stamp after accounting for average sampling system response time difference and facility instrumentation time differences.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

TES tested for total non-methane hydrocarbons using the USEPA test methods presented in Table 4-1. Descriptions of the sampling and analytical procedures are presented in the following sections.

Table 4-1
Test Methods

Parameter	USEPA	
	Method	Title
Sampling location	1	Sample and Velocity Traverses for Stationary Sources
NMHC	25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer

4.1 DESCRIPTION OF SAMPLING TRAIN AND FIELD PROCEDURES

The test matrix presented in Table 4-2 summarizes the sampling and analytical methods performed for the specified parameters during this test program.

Table 4-2
Test Matrix

Date (2017)	Run	Sample Type	Start Time (DST)	Stop Time (DST)	Test Duration (min)	EPA Test Method	Comment
August 16	1	Unit 1 NMHC	8:10	9:09	60	1, 25A	Facility CEMS flowrate used to calculate NMHC mass emission rate
	2	Unit 1 NMHC	10:01	11:00	60	1, 25A	
	3	Unit 1 NMHC	11:22	12:21	60	1, 25A	
August 16	1	Unit 2 NMHC	13:09	14:08	60	1, 25A	
	2	Unit 2 NMHC	14:28	15:27	60	1, 25A	
	3	Unit 2 NMHC	16:00	16:59	60	1, 25A	

Start and stop times are based on facility data acquisition system times which were approximately 64 minutes earlier than local daylight savings time.

4.1.1 Sample Location (USEPA Method 1)

The selection of the measurement site was evaluated using the procedure in USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources.* Each exhaust gas flue is 76 inches in diameter with two 6-inch internal diameter sample ports that extend 20 inches from the flue interior wall. The sample ports are situated:

- Approximately 90 feet or 14 duct diameters downstream of a duct bend disturbance where the combustion gases exit the baghouse, and
- Approximately 150 feet or 24 duct diameters upstream of the exhaust to atmosphere.

Because the sampling locations are at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame and meet the requirements of USEPA Method 1, a single opening probe was positioned to collect NMHC gas samples from the centrally located 10 percent area of the stack cross-section.

A dimensioned sketch of the sample location showing the sampling ports in relation to breeching and to upstream and downstream disturbances or obstructions in gas flow is presented as Figure 4-1. The Unit 1 duct cross section and sampling point detail is presented as Figure 4-2; Unit 2 is identical to Unit 1 with the exception the two test ports are located at the northeast and northwest compass positions.

Figure 4-1. Unit 1 and 2 Sample Location

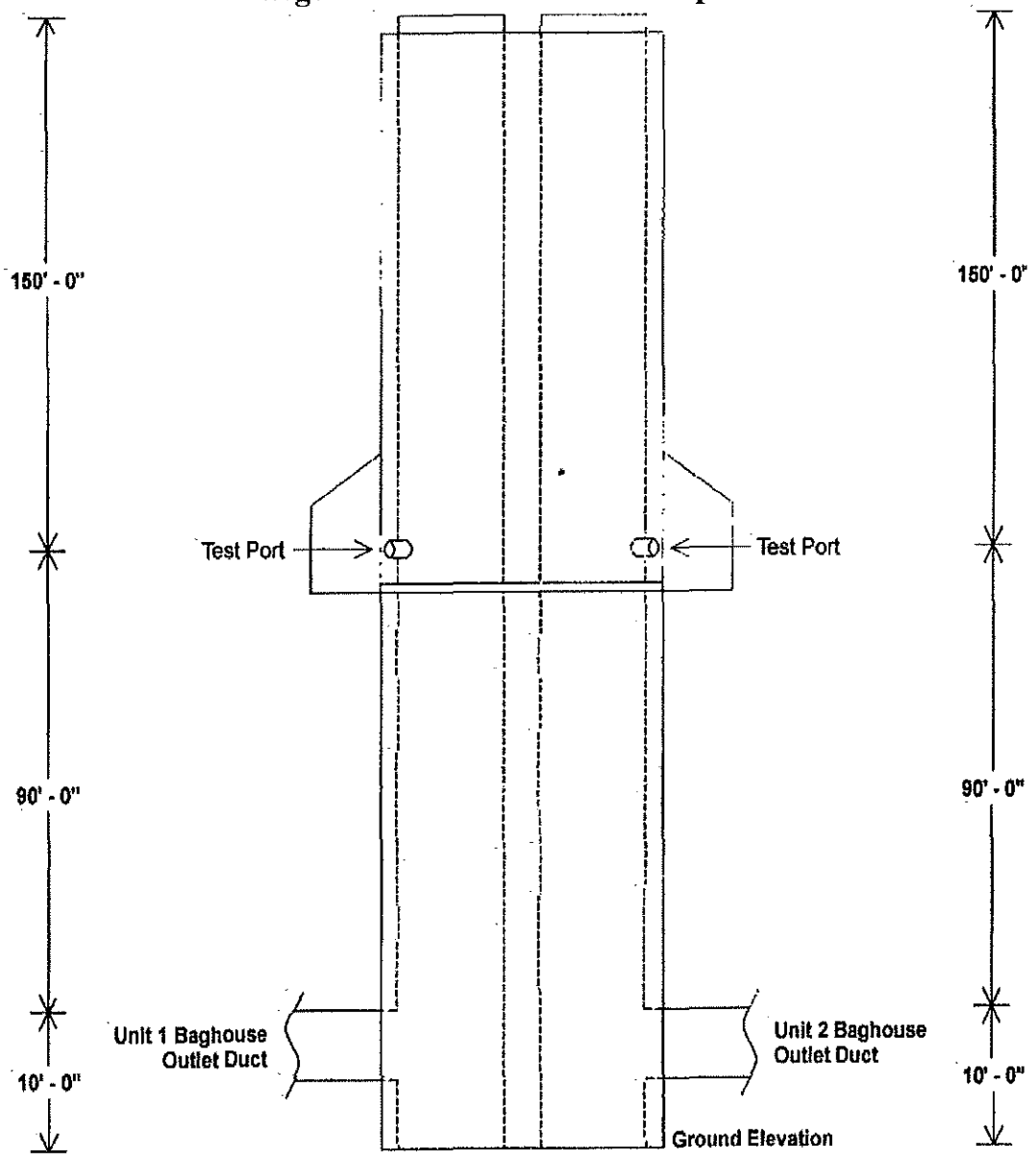
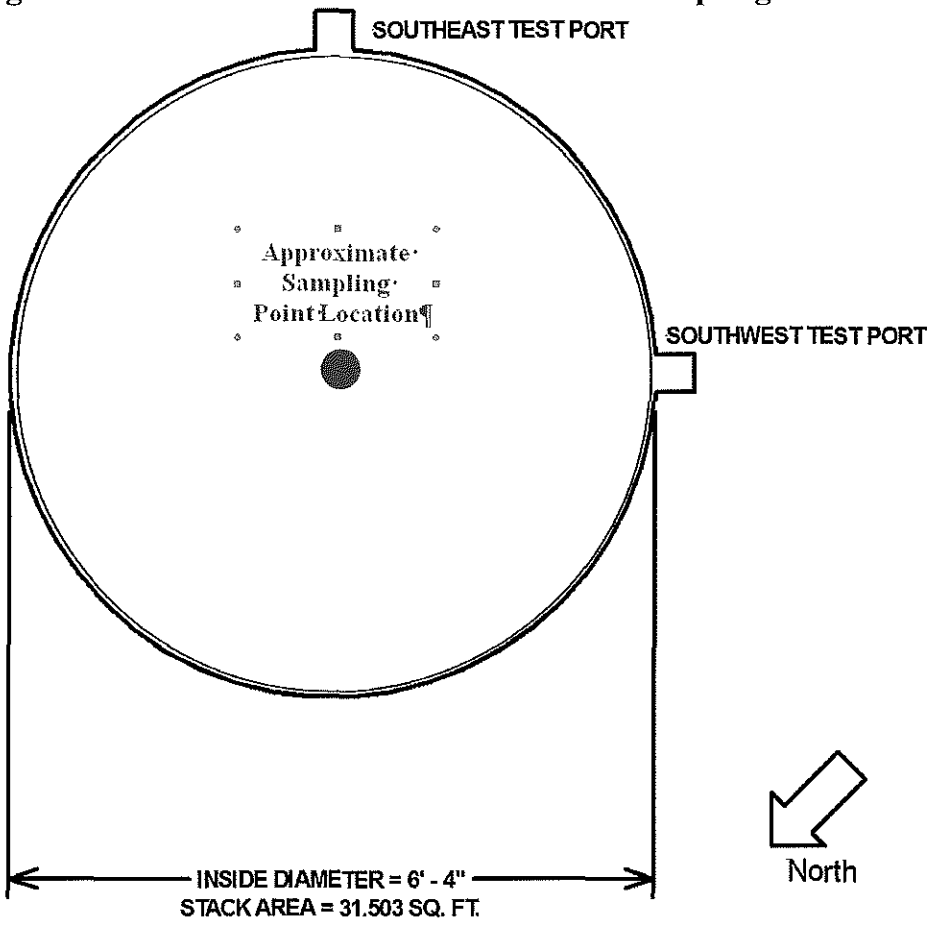


Figure 4-2. Unit 1 Duct Cross Section and Sampling Point Detail



4.1.2 Non-Methane Hydrocarbons (USEPA Method 25A)

RCTS conducted triplicate, one-hour NMHC test runs following the specifications described in 40 CFR Part 60, Appendix A, reference method 25A, "*Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer.*" Figure 4-3 depicts the NMHC sample apparatus configuration.

The components of the extractive NMHC sample interface apparatus are constructed of Type 316 stainless steel and Teflon. Flue gas was sampled from the stack via a heated sample probe and sample line and into the analyzers communicating with data acquisition handling systems (DAHS) via output signal cables. The analyzer uses a rotary valve and gas chromatograph column to separate methane from hydrocarbons in the sample and quantifies these components using a flame ionization detector.

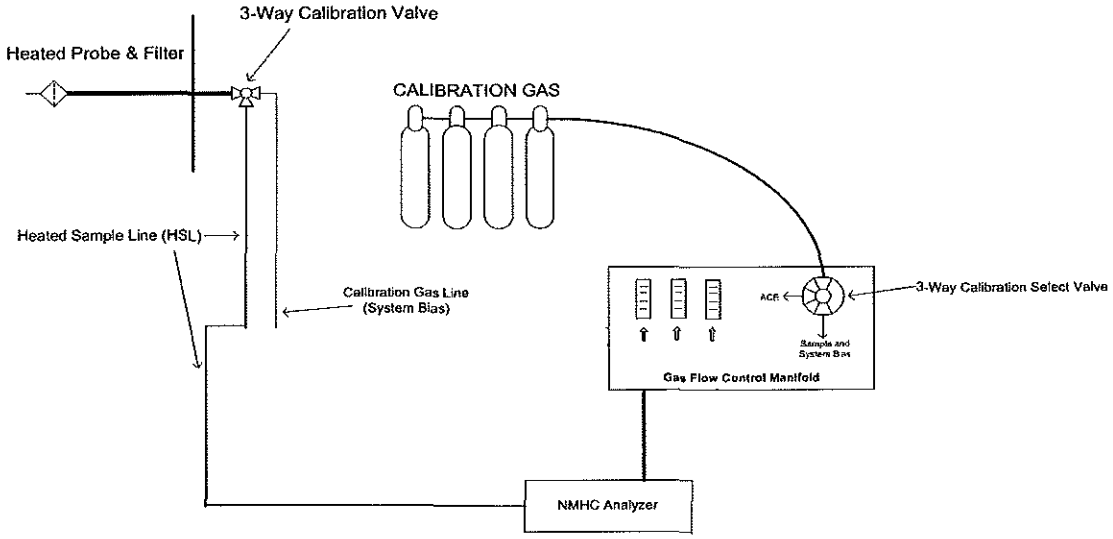
Prior to testing, the analyzer was calibrated by introducing known concentrations of hydrocarbon free zero gas and high-level methane and propane USEPA Protocol calibration gas standards to the analyzer and adjusting its signal output to appropriate levels. A method 25A calibration error test was completed by introducing low- and mid-level calibration gases to the sample system to evaluate if the analyzer's response was within ±5% of the calibration gas concentration.

During this procedure the system response time was measured to determine the time from the concentration change to the measurement system response equivalent to 95% of the step change. The sampling system response time was referenced when the reference method DAHS clock time was adjusted to align with the facility instrumentation and average CEMS response times.

Immediately following the completion of a test period, the zero and low-level calibration gases, one at a time, were introduced into the measurement system to evaluate analyzer drift. The analyzer's response was recorded and if the drift values were within ±3% of span, the test data was validated.

As requested by the MDEQ, the measured NMHC concentration was adjusted for analyzer bias using USEPA Method 7E equation 7E-5b. The adjusted NMHC concentration and the volumetric flowrate measured by the facility's certified CEMS system were used to calculate the NMHC mass emission rate and evaluate compliance with the applicable permit limits.

Figure 4-3: USEPA Method 25A NMHC Sample Apparatus



5.0 TEST RESULTS AND DISCUSSION

The test program results summarized in Section 2.3 indicate Units 1 and 2 are in compliance with the NMHC ROP performance testing requirements and emission limits. Adjusting for NMHC analyzer bias at EUBOILER02 resulted in negative concentrations, suggesting NMHC concentrations were near or below the detection limit of the analyzer used, which is specified by the instrument vendor to be accurate within ±1% of the 0-50 part per million (ppm) measurement range or ±0.5 ppm. To validate the appropriateness of the NMHC instrument used, RCTS estimated NMHC concentrations that would result in non-compliance using facility volumetric flow rates and permit limits. The calculations indicated that if NMHC concentrations were less than approximately 6 ppm as propane, each boiler would be in compliance with the 4.6 lb/hr ROP Limit. Based on these estimates the NMHC analyzer, measurement range, and calibration gases used for this test program were appropriate and accurate.

Although the NMHC analyzer passed all reference method quality assurance criteria, in general the analyzer's response was biased high when the zero and upscale calibration gases were introduced. Applying the analyzer bias equation 7E-5b from USEPA Method 7E to the measured NMHC concentrations thus reduced the NMHC concentrations, which were then applied with the facility flow rate data yielding the NMHC mass emission rates presented. The unadjusted and bias adjusted results are presented in Appendix Tables 1 and 2.

5.1 VARIATIONS AND UPSET CONDITIONS

At the request of the MDEQ, the measured NMHC concentrations were adjusted for bias following the procedures in USEPA Method 7E. Adjusting the NMHC concentration for analyzer bias is not a procedure within USEPA Method 25A, and thus a variation of the method. Applying this variation to the measured NMHC concentrations resulted in negative concentrations for the EUBOILER02 source.

The operating span of the analyzer was set to the high-level calibration gas concentration value of 45.58 ppm, instead of 50 ppm or 100 percent of the analyzer measurement scale. This variation affected the calculation of the zero- and upscale- calibration gas drift results because the span concentration is used as the denominator in the calculation of system bias / drift in Method 7E and in the calculation of drift in Method 25A. Using a lower span concentration reduces the allowable difference between pre- and post-test analyzer responses to calibration gas standards to comply with the QA/QC criteria of each method.

No boiler operating condition variations that could have affected the results were encountered during the test program. The process and control equipment were operating under maximum routine conditions and no upsets were encountered.

5.2 Air Pollution Control Device Maintenance

No significant air pollution control device maintenance has occurred during the three months prior to the testing.

5.3 Field Quality Assurance / Quality Control Procedures

The USEPA reference methods performed state reliable results are obtained by persons equipped with a thorough knowledge of the techniques associated with each method. Factors with the potential to cause measurement errors are minimized by implementing quality control (QC) and assurance (QA) programs into the applicable components of field testing. QA/QC components are included in this test program. Table 5-1 summarizes the primary field quality assurance and quality control activities performed. Refer to Appendix D for supporting documentation.

Table 5-1
QA/QC Procedures

QA/QC Activity	Purpose	Procedure	Frequency	Acceptance Criteria	QA/QC Met
M1: Sampling Location	Evaluate if the sampling location is suitable for sampling	Measure distance from ports to downstream and upstream flow disturbances	Pre-test	≥2 diameters downstream; ≥0.5 diameter upstream.	Yes
M1: Duct diameter/ dimensions	Verify area of stack is accurately measured	Review as-built drawings and field measurement	Pre-test	Field measurement agreement with as-built drawings	Yes
M25A: Calibration gas standards	Ensure accurate calibration standards	Traceability protocol of calibration gases	Pre-test	Calibration gas uncertainty ≤2.0%	Yes
M25A: Calibration Error	Evaluates operation of analyzers	Calibration gases introduced through sample system	Pre-test	±5.0% of the calibration gas value	Yes
M25A: Zero and Calibration Drift	Evaluates ability of sampling system to deliver stack gas to analyzers and analyzer accuracy over the duration of test	Calibration gases introduced through sample system	Pre-test and Post-test	±3.0% of the analyzer calibration span	Yes

5.3.1 NMHC Analyzer QA/QC Checks

The instrument analyzer sampling apparatus described in Section 4.2 was audited for measurement accuracy and data reliability. The analyzer passed the applicable calibration, bias and drift criteria. Refer to Appendix D for supporting documentation.

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Table 1
EUBOILER01 NMHC Emissions Results
TES Filer City Station
August 16, 2017

Parameter	Run 1	Run 2	Run 3	Average
CEMS Stack Gas Flow Rate, SCFH:	6,456,539	6,353,326	6,348,413	6,386,093
CEMS Stack Gas CO_2 Concentration, Wet Basis Vol-%:	11.19	11.33	11.35	11.29
DAHS Composite CO_2 Based Fuel Factor, scf CO_2/mmBtu:	1,800.0	1,800.6	1,800.6	1,800.4
Average Unadjusted NMHC Concentration, ppmv as propane:	0.63	0.55	0.37	0.52
Unadjusted NMHC Emission Rate, lb/hr, as propane:	0.47	0.40	0.27	0.38
Unadjusted NMHC Emission Rate, lb/mmBtu, as propane:	1.16E-03	1.01E-03	6.68E-04	9.45E-04
Average Effluent NMHC Concentration Adjusted for Bias, ppmv as propane:	0.49	0.23	0.01	0.25
Adjusted NMHC Emission Rate, lb/hr, as propane:	**0.36**	**0.17**	**0.01**	**0.18**
Adjusted NMHC Emission Rate, lb/mmBtu, as propane:	9.03E-04	4.26E-04	1.87E-05	4.49E-04
NMHC Permit Limit, lb/hr:				**4.6**

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Table 2
EUBOILER02 NMHC Emissions Results
TES Filer City Station
August 16, 2017

Parameter	Run 1	Run 2	Run 3	Average
CEMS Stack Gas Flow Rate, SCFH:	6,722,877	6,759,203	6,840,446	6,774,175
CEMS Stack Gas CO_2 Concentration, Wet Basis Vol-%:	11.00	10.95	10.88	10.94
DAHS Composite CO_2 Based Fuel Factor, scf CO_2/mmBtu:	1,800.7	1,800.7	1,800.7	1,800.7
Average Unadjusted NMHC Concentration, ppmv as propane	0.35	0.41	0.38	0.38
Unadjusted NMHC Emission Rate, lb/hr, as propane:	0.27	0.32	0.29	0.29
Unadjusted NMHC Emission Rate, lb/mmBtu, as propane:	6.53E-04	7.77E-04	7.12E-04	7.14E-04
Average Effluent NMHC Concentration Adjusted for Bias, ppmv as propane:	-0.04	0.05	-0.10	-0.03
Adjusted NMHC Emission Rate, lb/hr, as propane:	**-0.03**	**0.04**	**-0.08**	**-0.02**
Adjusted NMHC Emission Rate, lb/mmBtu, as propane:	-7.94E-05	9.67E-05	-1.82E-04	-5.49E-05
NMHC Permit Limit, lb/hr:				**4.6**