



## REPORT ON COMPLIANCE TESTING

Zug Island  
Underfire Combustion Stack

EES Coke Battery, LLC  
1400 Zug Island Road  
River Rouge, Michigan 48218  
Client Reference No. 4701352744

CleanAir Project No. 13938  
A2LA ISO 17025 Certificate No. 4342.01  
A2LA / STAC Certificate No. 4342.02  
Revision 0, Final Report  
October 21, 2019

## COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

*Report Submittal:*

  
\_\_\_\_\_ @ 10/21/19

Josh Childers, EIT, QSTI  
Project Manager  
jchilders@cleanair.com  
(800) 632-1619 ext. 2072

10/21/19  
\_\_\_\_\_

Date

I hereby certify that the information contained within the final test report has been reviewed and, to the best of my ability, verified as accurate.

*Independent Report and Appendix Review:*

  
\_\_\_\_\_

Jeff Reppert, QSTI  
Project Manager  
jreppert@cleanair.com  
(800) 632-1619 ext. 2145

10/21/2019  
\_\_\_\_\_

Date

---

## REPORT REVISION HISTORY

Version	Revision	Date	Pages	Comments
Draft	D0a	10/08/19	All	Draft version of original document.
Final	0	10/21/19	All	Final version of original document.

---

## PROJECT PERSONNEL

Name	Affiliation	Project Responsibility
Brenna Harden	EES Coke Battery, LLC	Primary Client Contact
Tom Durham	EES Coke Battery, LLC	Client Contact
Elise Ciak	EES Coke Battery, LLC	Client Contact
Robert Sanch	EES Coke Battery, LLC	Client Contact
Regina Angellotti	EGLA AQD	State Representative
Jonathan Lamb	EGLA AQD	On-Site State Representative
Josh Childers	CleanAir	Project Manager / Report Submittal
Chad Eilering	CleanAir	Project Field Leader
Jeff Reppert	CleanAir	Independent Review of Report
Jason Fugiel	CleanAir	Field Engineer
Josh Lord	CleanAir	Field Engineer
Matthew Reynolds	CleanAir	Field Engineer
Jonathan Kolling	CleanAir	Field Engineer
Jennifer Wright	CleanAir	Report Coordinator

---

# TABLE OF CONTENTS

1. Project Overview.....	1
Test Program Summary .....	1
Test Program Details.....	2
Parameters.....	2
Schedule.....	2
Discussion .....	3
2. Results.....	6
3. Description of Installation.....	9
Process Description.....	9
Test Location.....	10
4. Methodology.....	13
Procedures and Regulations .....	13
Title 40 CFR Part 60, Appendix A .....	13
Title 40 CFR Part 51, Appendix M .....	13
Methodology Discussion.....	13
Verification of the Absence of Cyclonic Flow – EPA Method 1 .....	13
Determination of Flue Gas Composition – Methods 1-4.....	14
Non-sulfate Filterable Particulate Matter – Method 5F (modified) .....	14
Total Particulate Matter Determination – Method 5/202.....	14
Volatile Organic Compounds, Excluding Methane – Method 25A .....	15
5. Appendix .....	16
Appendix A: Test Method Specifications .....	A
Appendix B: Sample Calculations.....	B
Appendix C: Parameters .....	C
Appendix D: QA/QC Data.....	D
Appendix E: Field Data .....	E
Appendix F: Field Data Printouts .....	F
Appendix G: Monitor Data.....	G
Appendix H: Laboratory Data .....	H
Appendix I: Facility Operating Data .....	I
Appendix J: Fuel Analysis .....	J
Appendix K: CleanAir Resumes and Certifications.....	K

## LIST OF TABLES

Table 1-1: Summary of Results .....	1
Table 1-2: Test Schedule .....	2
Table 1-3: Test Comparison – 2017 vs. 2019 .....	3
Table 2-1: Underfire Combustion Stack – NSFPM, Method 5F (Modified).....	6
Table 2-2: Underfire Combustion Stack –TPM, Method 5/202 .....	7
Table 2-3: Underfire Combustion Stack –VOC, Method 25A.....	8
Table 3-1: Sampling Information .....	10

## LIST OF FIGURES

Figure 3-1: Process Schematic .....	9
Figure 3-2: Underfire Combustion Stack Sample Point Layout (EPA Method 1) .....	11
Figure 3-3: Underfire Combustion Stack EPA Method 25A Stratification Check (EPA Method 7E) .....	12

## ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)  
acfm (actual cubic feet per minute)  
ACI (activated carbon injection)  
ADL (above detection limit)  
AIG (ammonia injection grid)  
APC (air pollution control)  
AQCS (air quality control system(s))  
ASME (American Society of Mechanical Engineers)  
ASTM (American Society for Testing and Materials)  
BDL (below detection limit)  
Btu (British thermal units)  
CAM (compliance assurance monitoring)  
CARB (California Air Resources Board)  
CCM (Controlled Condensation Method)  
CE (capture efficiency)  
°C (degrees Celsius)  
CEMS (continuous emissions monitoring system(s))  
CFB (circulating fluidized bed)  
CFR (Code of Federal Regulations)  
cm (centimeter(s))  
COMS (continuous opacity monitoring system(s))  
CT (combustion turbine)  
CTI (Cooling Technology Institute)  
CTM (Conditional Test Method)  
CVAAS (cold vapor atomic absorption spectroscopy)  
CVAFS (cold vapor atomic fluorescence spectrometry)  
DI H<sub>2</sub>O (de-ionized water)  
%dv (percent, dry volume)  
DLL (detection level limited)  
DE (destruction efficiency)  
DCI (dry carbon injection)  
DGM (dry gas meter)  
dscf (dry standard cubic feet)  
dscfm (dry standard cubic feet per minute)  
dscm (dry standard cubic meter)  
ESP (electrostatic precipitator)  
FAMS (flue gas adsorbent mercury speciation)  
°F (degrees Fahrenheit)  
FB (field blank)  
FCC (fluidized catalytic cracking)  
FCCU (fluidized catalytic cracking unit)  
FEGT (furnace exit gas temperatures)  
FF (fabric filter)  
FGD (flue gas desulfurization)  
FIA (flame ionization analyzer)  
FID (flame ionization detector)  
FPD (flame photometric detection)  
FRB (field reagent blank)  
FSTM (flue gas sorbent total mercury)  
ft (feet or foot)  
ft<sup>2</sup> (square feet)

ft<sup>3</sup> (cubic feet)  
ft/sec (feet per second)  
FTIR (Fourier Transform Infrared Spectroscopy)  
FTRB (field train reagent blank)  
g (gram(s))  
GC (gas chromatography)  
GFAAS (graphite furnace atomic absorption spectroscopy)  
GFC (gas filter correlation)  
gr/dscf (grains per dry standard cubic feet)  
> (greater than)/ ≥ (greater than or equal to)  
g/s (grams per second)  
H<sub>2</sub>O (water)  
HAP(s) (hazardous air pollutant(s))  
HI (heat input)  
hr (hour(s))  
HR GC/MS (high-resolution gas chromatography and mass spectrometry)  
HRVOC (highly reactive volatile organic compounds)  
HSRG(s) (heat recovery steam generator(s))  
HVT (high velocity thermocouple)  
IC (ion chromatography)  
IC/PCR (ion chromatography with post column reactor)  
ICP/MS (inductively coupled argon plasma mass spectrometry)  
ID (induced draft)  
in. (inch(es))  
in. H<sub>2</sub>O (inches water)  
in. Hg (inches mercury)  
IPA (isopropyl alcohol)  
ISE (ion-specific electrode)  
kg (kilogram(s))  
kg/hr (kilogram(s) per hour)  
< (less than)/ ≤ (less than or equal to)  
L (liter(s))  
lb (pound(s))  
lb/hr (pound per hour)  
lb/MMBtu (pound per million British thermal units)  
lb/TBtu (pound per trillion British thermal units)  
lb/lb-mole (pound per pound mole)  
LR GC/MS (low-resolution gas chromatography and mass spectrometry)  
m (meter)  
m<sup>3</sup> (cubic meter)  
MACT (maximum achievable control technology)  
MASS® (Multi-Point Automated Sampling System)  
MATS (Mercury and Air Toxics Standards)  
MDL (method detection limit)  
µg (microgram(s))  
min. (minute(s))  
mg (milligram(s))  
ml (milliliter(s))  
MMBtu (million British thermal units)

MW (megawatt(s))  
NCASI (National Council for Air and Stream Improvement)  
ND (non-detect)  
NDIR (non-dispersive infrared)  
NDO (natural draft opening)  
NESHAP (National Emission Standards for Hazardous Air Pollutants)  
ng (nanogram(s))  
Nm<sup>3</sup> (Normal cubic meter)  
% (percent)  
PEMS (predictive emissions monitoring systems)  
PFGC (pneumatic focusing gas chromatography)  
pg (picogram(s))  
PJFF (pulse jet fabric filter)  
ppb (parts per billion)  
PPE (personal protective equipment)  
ppm (parts per million)  
ppmdv (parts per million, dry volume)  
ppmwv (parts per million, wet volume)  
PSD (particle size distribution)  
psi (pound(s) per square inch)  
PTE (permanent total enclosure)  
PTFE (polytetrafluoroethylene)  
QA/QC (quality assurance/quality control)  
QI (qualified individual)  
QSTI (qualified source testing individual)  
QSTO (qualified source testing observer)  
RA (relative accuracy)  
RATA (relative accuracy test audit)  
RB (reagent blank)  
RE (removal or reduction efficiency)  
RM (reference method)  
scf (standard cubic feet)  
scfm (standard cubic feet per minute)  
SCR (selective catalytic reduction)  
SDA (spray dryer absorber)  
SNCR (selective non-catalytic reduction)  
STD (standard)  
STMS (sorbent trap monitoring system)  
TBtu (trillion British thermal units)  
TEOM (Tapered Element Oscillating Microbalance)  
TEQ (toxic equivalency quotient)  
ton/hr (ton per hour)  
ton/yr (ton per year)  
TSS (third stage separator)  
USEPA or EPA (United States Environmental Protection Agency)  
UVA (ultraviolet absorption)  
WFGD (wet flue gas desulfurization)  
%wv (percent, wet volume)

# 1. PROJECT OVERVIEW

## TEST PROGRAM SUMMARY

EES Coke Battery, LLC contracted CleanAir Engineering (CleanAir) to complete compliance testing on the Underfire Combustion Stack at the Zug Island facility located in River Rouge, Michigan.

The test program objective is to perform total particulate matter (TPM), non-sulfate filterable particulate matter (NSFPM), and volatile organic compound (VOC) testing to demonstrate compliance with Michigan Permit to Install (MI-PTI) No. 51-08C. Emissions were sampled while the process operated at  $\geq 90\%$  operating capacity.

A summary of the test program results is presented below. Section 2 Results provides a more detailed account of the test conditions and data analysis.

**Table 1-1:  
Summary of Results**

Source Constituent	Sampling Method	Average Emission	Permit Limit <sup>1</sup>
<i>Underfire Combustion Stack</i>			
PM (lb/hr) <sup>2</sup>	EPA 5F	1.6	25.7
PM (gr/dscf) <sup>2</sup>	EPA 5F	0.0015	0.012
PM (lb/1000 lb exhaust gas @50% EA)	EPA 5	0.028	0.095
PM <sub>10</sub> (lb/hr) <sup>3</sup>	EPA 5/202	33.1	73.3
PM <sub>2.5</sub> (lb/hr) <sup>3</sup>	EPA 5/202	33.1	73.0
VOC (lb/hr) <sup>4</sup>	EPA 25A	27.8	43.1
VOC (lb/MMBtu, heat input) <sup>4</sup>	EPA 25A	0.0633	0.0956

<sup>1</sup> Permit limits obtained from MI-PTI No. 51-08C.

<sup>2</sup> Excludes sulfates.

<sup>3</sup> TPM from Method 5/202 is compared to PM<sub>10</sub> and PM<sub>2.5</sub> limits.

<sup>4</sup> Excludes methane concentrations.

## TEST PROGRAM DETAILS

### PARAMETERS

The test program included the following measurements:

- total particulate matter (TPM), filterable and condensable particulate matter (FPM and CPM), reported as:
  - particulate matter less than 10 microns in diameter (PM<sub>10</sub>)
  - particulate matter less than 2.5 microns in diameter (PM<sub>2.5</sub>)
- non-sulfate filterable particulate matter (NSFPM)
- volatile organic compounds (VOC), measured as non-methane hydrocarbons (NMHC)
- flue gas composition (e.g., O<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>O)
- flue gas temperature
- flue gas flow rate

### SCHEDULE

Testing was performed on September 10, 11, and 12, 2019. The on-site schedule followed during the test program is outlined in Table 1-2.

**Table 1-2:  
Test Schedule**

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	Underfire Combustion Stack	USEPA Method 5F	NSFPM	09/10/19	13:35	16:09
2	Underfire Combustion Stack	USEPA Method 5F	NSFPM	09/11/19	11:16	15:55
3	Underfire Combustion Stack	USEPA Method 5F	NSFPM	09/12/19	07:57	11:18
1	Underfire Combustion Stack	USEPA Method 5/202	FPM/CPM	09/10/19	13:35	16:09
2	Underfire Combustion Stack	USEPA Method 5/202	FPM/CPM	09/11/19	08:00	10:21
3	Underfire Combustion Stack	USEPA Method 5/202	FPM/CPM	09/11/19	16:21	18:54
1	Underfire Combustion Stack	USEPA Methods 3A, 25A	O <sub>2</sub> /CO <sub>2</sub> , VOC	09/11/19	09:32	10:32
2	Underfire Combustion Stack	USEPA Methods 3A, 25A	O <sub>2</sub> /CO <sub>2</sub> , VOC	09/11/19	11:00	12:00
3	Underfire Combustion Stack	USEPA Methods 3A, 25A	O <sub>2</sub> /CO <sub>2</sub> , VOC	09/11/19	16:30	17:30



## DISCUSSION

## Test Program Details

Process delays, weather delays (observed lightning strikes in the vicinity), and equipment issues with two sample probes contributed to the test program not being completed within the 36-hour period required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) and PTI 51-08C. EGLE representative Jonathan Lamb was on-site during most of September 10, 2019 testing.

The process delay on September 10 was due to the failure of the coal conveyor belt that resulted in repairs taking longer than coal accumulated in the coal bin. It takes several coking cycles to eliminate a production delay of this magnitude, hence affecting September 11 and 12 events.

Despite not completing the test program within the 36-hour requirement, CleanAir and EES believe the 2019 results are representative when compared to the results of the 2017 test program (see Table 1-3). With an increase in production from 2017, results are expected to be slightly improved as the battery, or any process, functions more efficiently, closer to its design production rates.

**Table 1-3:  
Test Comparison – 2017 vs. 2019**

Parameter	Method	2017 Test	2019 Test	Difference
NSFPM (lb/hr)	EPA 5F	5.4	1.6	-3.8
NSFPM (gr/dscf)	EPA 5F	0.0044	0.0015	-0.0029
FPM (lb/1000 lb exhaust gas @50% EA)	EPA 5	0.019	0.028	+0.009
PM <sub>10</sub> (lb/hr)	EPA 5/202	30.2	33.1	+2.9
PM <sub>2.5</sub> (lb/hr)	EPA 5/202	30.2	33.1	+2.9
Ovens Charged (per run)	--	13	10	-3
Underfire Rates (kscf/run)	--	2,400	2,000	-400

## PM<sub>10</sub>/PM<sub>2.5</sub>

Appendix A of MI-PTI No. 51-08C states that testing for PM<sub>10</sub> and PM<sub>2.5</sub> follow EPA Methods 201A and 202. The test duration is listed as 120 minutes, with a minimum sample volume requirement of 60 dscf, respectively. The appendix states that any changes to the test methodology must be approved by the EGLE Air Quality Division (AQD) District Supervisor.

### Modifications to PM<sub>10</sub>/PM<sub>2.5</sub> Testing

The test ports at the sample location are not an adequate size to accommodate the Method 201A PM<sub>10</sub>/PM<sub>2.5</sub> cyclone head. Numerous issues with broken glass due to the narrow and long test ports occurred during the 2015 test campaign. CleanAir used EPA Method 5 in lieu of Method 201A.

CleanAir has performed a results comparison between Method 201A/202 versus Method 5/202. Test data from the 2015 compliance program highlight a similarity between the readings with the Method 5/202 results being biased slightly higher than the Method 201A/202 results. For example, the three-run average (gr/dscf) of TPM for Methods 201A/202 and 5/202 were 0.0466 and 0.0484, respectively. The Method 5/202 results were approximately 3.7% higher than the 201A/202 results.

TPM is defined as the sum of filterable and condensable particulate matter. Method 5/202 does not provide unique values for PM<sub>10</sub> and PM<sub>2.5</sub> and TPM was instead used to determine PM<sub>10</sub> and PM<sub>2.5</sub> emissions. The use of Method 5 rather than Method 201A was approved during the 2017 and 2019 test programs.

In addition, this location experiences high winds that increase the likelihood of broken glassware during port changes. CleanAir requested approval to use stainless steel-lined probes and nozzles in lieu of borosilicate glass or quartz liners during the 2019 compliance campaign. This was approved during the 2017 and 2019 test program.

An excerpt from Section 6.1.1.2 of EPA Method 5 reads:

*"Alternatively, metal liners (e.g., 316 stainless steel, Incoloy 825 or other corrosion resistant metals) made of seamless tubing may be used, subject to the approval of the Administrator."*

## NSFPM

Appendix A of MI-PTI No. 51-08C states that requirements for particulate matter determinations (excluding sulfates) must be conducted per EPA Method 5, corrected for sulfate. The permit also requires a sample time of 60 minutes, with a minimum sample volume of 30 dscf. Any changes to the testing methods must be approved by the AQD District Supervisor.

### Modifications to NSFPM Testing

CleanAir sampled particulate matter isokinetically and collected on a filter maintained at a temperature in the range of 320 ±25°F, with a minimum of 60 dscf of sample gas collected over a 120-minute test period for each run. The modification was followed during compliance testing in 2015, 2017, and 2019 based on the conversation documented below.

A conference call between EES, EGLE, and CleanAir representatives was held on Monday, January 26, 2015 to discuss the best methodology for the determination of sulfate free particulate emissions at the Underfire Combustion Stack. It was agreed upon to perform EPA Method 5F for the sulfate-free filterable particulate matter measurements. This method is contained in Appendix A of 40 CFR 60.

Concern was raised by EGLE that the recovery of the probe with a water rinse would not be adequate and requested a change to acetone. The following deviations to the method were agreed upon during the conference call and were performed on-site:

1. The sample train nozzle, probe liner, and front-half filter holder were rinsed and recovered with acetone (Method 5F outlines the use of deionized distilled water; ASTM D1193–77 or 91 Type 3).
2. Due to the use of acetone, additional analytical steps were taken by the CleanAir Analytical laboratory, located in Palatine Illinois, during the first analytical step:
  - a. The acetone was evaporated in a tared FEP beaker liner while the filter was digested.
  - b. The acetone residue was combined with the filter digestate and brought to volume in a 500 mL flask.
  - c. The flask was settled, and an aliquot was removed for sulfate determinations.
  - d. The solution was re-evaporated in the original tared FEP beaker liner and the normal analytical steps, as outlined in Method 5F, were followed.

In addition, CleanAir requested approval to use stainless steel-lined probes and nozzles in lieu of borosilicate glass or quartz liners during the 2019 compliance campaign as mentioned in the PM<sub>10</sub>/PM<sub>2.5</sub> discussion above. This was approved during the 2017 and 2019 test program.

## VOC

VOC emission rates from the Underfire Combustion Stack were completed following EPA Method 25A. A total of three 60-minute tests was performed at a single point following a stratification check performed during Run 1. Results of the stratification check are in Appendix D. VOC results were reported on a propane-basis. The Methodology section provides additional information on the approach to VOC determination.

---

*End of Section*

## 2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices.

**Table 2-1:  
Underfire Combustion Stack – NSFPM, Method 5F (Modified)**

Run No.		1	2	3	Average
Date (2019)		Sep 10	Sep 11	Sep 12	
Start Time (approx.)		13:35	11:16	07:57	
Stop Time (approx.)		16:09	15:55	11:18	
<b>Process Conditions</b>					
P <sub>1</sub>	No. of ovens charged (per run)	11	9	9	10
P <sub>2</sub>	Coal charged (dry tons/run)	343	290	282	305
P <sub>3</sub>	COG used for Underfire combustion (kscf/run)	2,154	1,864	1,854	1,957
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
<b>Gas Conditions</b>					
O <sub>2</sub>	Oxygen (dry volume %)	11.7	11.9	12.0	11.9
CO <sub>2</sub>	Carbon dioxide (dry volume %)	4.5	4.2	4.2	4.3
T <sub>s</sub>	Sample temperature (°F)	491	489	489	490
B <sub>w</sub>	Actual water vapor in gas (% by volume)	13.3	14.4	13.3	13.7
<b>Gas Flow Rate</b>					
Q <sub>a</sub>	Volumetric flow rate, actual (acfm)	285,000	241,000	288,000	271,000
Q <sub>s</sub>	Volumetric flow rate, standard (scfm)	156,000	132,000	157,000	148,000
Q <sub>std</sub>	Volumetric flow rate, dry standard (dscfm)	135,000	113,000	136,000	128,000
<b>Sampling Data</b>					
V <sub>mstd</sub>	Volume metered, standard (dscf)	77.61	65.40	77.43	73.48
%I	Isokinetic sampling (%)	99.1	100.1	98.1	99.1
<b>Laboratory Data</b>					
m <sub>n</sub>	Total NSFPM(g)	0.00809	0.00635	0.00666	
<b>NSFPM Results</b>					
C <sub>sd</sub>	Particulate Concentration (lb/dscf)	2.30E-07	2.14E-07	1.90E-07	2.11E-07
C <sub>sd</sub>	Particulate Concentration (gr/dscf)	0.00161	0.00150	0.00133	0.00148
E <sub>lb/hr</sub>	Particulate Rate (lb/hr)	1.86	1.45	1.55	1.62
E <sub>T/yr</sub>	Particulate Rate (Ton/yr)	8.16	6.34	6.78	7.09

Average includes 3 runs.

**Table 2-2:  
Underfire Combustion Stack –TPM, Method 5/202**

Run No.		1	2	3	Average
Date (2019)		Sep 10	Sep 11	Sep 11	
Start Time (approx.)		13:35	08:00	16:21	
Stop Time (approx.)		16:09	10:21	18:54	
<b>Process Conditions</b>					
EA	Excess Air (%)	126	108	112	116
P <sub>1</sub>	No. of ovens charged (per run)	11	9	9	10
P <sub>2</sub>	Coal charged (dry tons/run)	343	291	321	318
P <sub>3</sub>	COG used for Underfire combustion (kscf/run)	2,154	1,924	1,770	1,949
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
<b>Gas Conditions</b>					
O <sub>2</sub>	Oxygen (dry volume %)	12.3	11.5	11.7	11.8
CO <sub>2</sub>	Carbon dioxide (dry volume %)	4.2	4.7	4.5	4.5
T <sub>s</sub>	Sample temperature (°F)	492	490	491	491
B <sub>w</sub>	Actual water vapor in gas (% by volume)	14.0	13.8	12.9	13.6
<b>Gas Flow Rate</b>					
Q <sub>a</sub>	Volumetric flow rate, actual (acfm)	268,000	307,000	267,000	281,000
Q <sub>s</sub>	Volumetric flow rate, standard (scfm)	146,000	168,000	145,000	153,000
Q <sub>std</sub>	Volumetric flow rate, dry standard (dscfm)	126,000	144,000	127,000	132,000
<b>Sampling Data</b>					
V <sub>mstd</sub>	Volume metered, standard (dscf)	72.70	85.67	72.47	76.95
%I	Isokinetic sampling (%)	99.6	102.3	98.8	100.2
<b>Laboratory Data</b>					
m <sub>n</sub>	Total FPM (g)	0.01835	0.04258	0.10788	
m <sub>CPM</sub>	Total CPM (g)	0.11584	0.11328	0.03908	
m <sub>Part</sub>	Total particulate matter (g)	0.13419	0.15585	0.14696	
<b>FPM Results</b>					
C <sub>sd</sub>	Particulate Concentration (lb/dscf)	5.57E-07	1.10E-06	3.28E-06	1.65E-06
C <sub>sd</sub>	Particulate Concentration (gr/dscf)	0.00389	0.00767	0.0230	0.0115
E <sub>lb/hr</sub>	Particulate Rate (lb/hr)	4.20	9.50	24.9	12.9
E <sub>T/yr</sub>	Particulate Rate (Ton/yr)	18.4	41.6	109	56.4
E <sub>Rp</sub>	Particulate Rate (lb per 1000lb exhaust gas at 50% EA)	0.0101	0.0182	0.0561	0.0281
<b>CPM Results</b>					
C <sub>sd</sub>	Particulate Concentration (lb/dscf)	3.51E-06	2.92E-06	1.19E-06	2.54E-06
C <sub>sd</sub>	Particulate Concentration (gr/dscf)	0.0246	0.0204	0.00832	0.0178
E <sub>lb/hr</sub>	Particulate Rate (lb/hr)	26.5	25.3	9.03	20.3
E <sub>T/yr</sub>	Particulate Rate (Ton/yr)	116	111	39.5	88.8
<b>Total Particulate Matter Results</b>					
C <sub>sd</sub>	Particulate Concentration (lb/dscf)	4.07E-06	4.01E-06	4.47E-06	4.18E-06
C <sub>sd</sub>	Particulate Concentration (gr/dscf)	0.0285	0.0281	0.0313	0.0293
E <sub>lb/hr</sub>	Particulate Rate (lb/hr)	30.7	34.8	33.9	33.1
E <sub>T/yr</sub>	Particulate Rate (Ton/yr)	135	152	149	145

Average includes 3 runs.

**Table 2-3:  
Underfire Combustion Stack –VOC, Method 25A**

Run No.	1	2	3	Average
Date (2019)	Sep 11	Sep 11	Sep 11	
Start Time	9:32	11:00	16:30	
End Time	10:32	12:00	17:30	
Elapsed Time	1:00	1:00	1:00	
<b>Process Conditions</b>				
Fd1 - Underfire Combustion Stack (dscf/MMBtu)	7,872	7,872	7,872	<b>7,872</b>
No. of ovens charged (per run)	4	4	5	<b>4</b>
Coal charged (dry tons/run)	129	129	161	<b>140</b>
COG used for Underfire combustion (kscf/run)	853	845	881	<b>860</b>
Heat Input - Underfire Combustion Stack (MMBtu/hr)	437	433	451	<b>440</b>
<b>Gas Conditions</b>				
Oxygen (O2) - Underfire Combustion Stack (%dv)	10.9	11.1	11.0	<b>11.0</b>
Carbon Dioxide (CO2) - Underfire Combustion Stack (%dv)	4.9	4.7	4.9	<b>4.8</b>
Dry Standard Gas Flow Rate - Underfire Combustion Stack (dscfm)	144,425	112,733	126,540	<b>127,899</b>
H2O - Underfire Combustion Stack (%)	13.81	14.45	12.94	<b>13.73</b>
<b>Non-Methane Hydrocarbons (NMHC) - Underfire Combustion Stack</b>				
Concentration (ppmwv)	29.9	25.6	26.0	<b>27.2</b>
Concentration (ppmdv)	34.6	30.0	29.8	<b>31.5</b>
Mass Rate (lb/hr)	34.4	23.2	25.9	<b>27.8</b>
Mass Rate (lb/MMBtu) - Heat Input	0.0787	0.0536	0.0575	<b>0.0633</b>

**Notes:**

Flow rate and moisture data for Runs 1 and 3 obtained from USEPA Method 5/202 testing, Runs 2 and 3.

Flow rate and moisture data for Run 2 obtained from USEPA Method 5F testing, Run 2.

*End of Section*

### 3. DESCRIPTION OF INSTALLATION

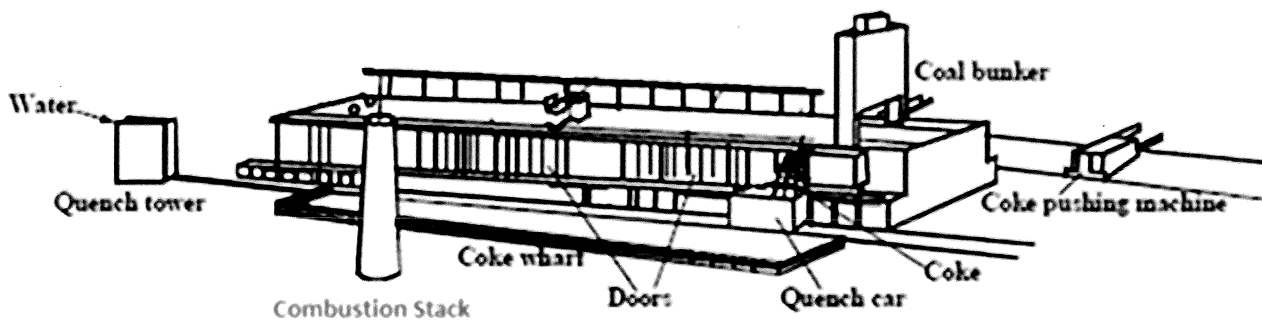
#### PROCESS DESCRIPTION

EES Coke Battery, LLC is a facility located on Zug Island in River Rouge, Michigan. The testing described in this document was performed at the Combustion Stack.

The No. 5 Coke Battery consists of 85 six-meter-high ovens producing furnace coke. A coal blend is used to charge each oven on timed intervals depending on the current production of the battery. Coking of the coal occurs in an oxygen free environment for 17 to 30 hours and the gases produced are collected, cleaned, and used to under fire the battery, supply fuel for other site sources, and sold to permitted off-site utilities.

The current permit limits allow for the charging of up to 1.420 million dry tons of coal. The design capacity heating requirement of the battery is approximately 375 MMBtu per hour. Also, the heating requirements of the battery at the current production rate are approximately 325 MMBtu per hour. Process source description information above was taken directly from written information provided by EES Coke. A schematic of the process indicating sampling locations is shown in Figure 3-1.

**Figure 3-1:**  
**Process Schematic**



*Note: The EES Coke Battery Underfire Combustion Stack is located on the other side of the battery as depicted in the drawing.*

## TEST LOCATION

---

EPA Methods 1 and 7E specifications determined the sample point locations. Table 3-1 presents the sampling information for the test location. The figures shown on pages 11 and 12 represent the layout of the test location.

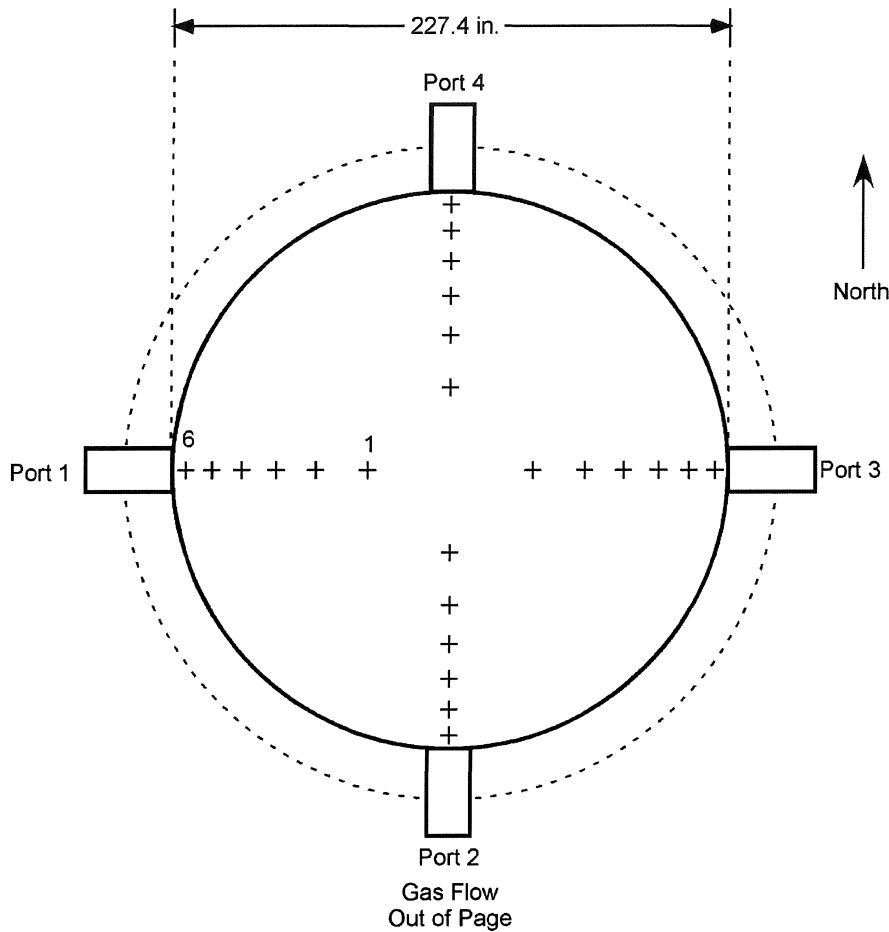
**Table 3-1:  
Sampling Information**

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
<i>Underfire Combustion Stack</i>							
NSFPM	EPA 5F	1-3	4	6	5	120	3-2
TPM	EPA 5/202	1-3	4	6	5	120	3-2
VOC <sup>1</sup>	EPA 25A	1	1	3	20	60	3-3
VOC	EPA 25A	2-3	1	1	60	60	NA

<sup>1</sup> VOC measurements for Run 1 were part of a stratification check of the sampling location. The location was unstratified and testing for Runs 2 and 3 were conducted at a single point that most closely matched the mean calculated during the stratification check.



**Figure 3-2:  
 Underfire Combustion Stack Sample Point Layout (EPA Method 1)**

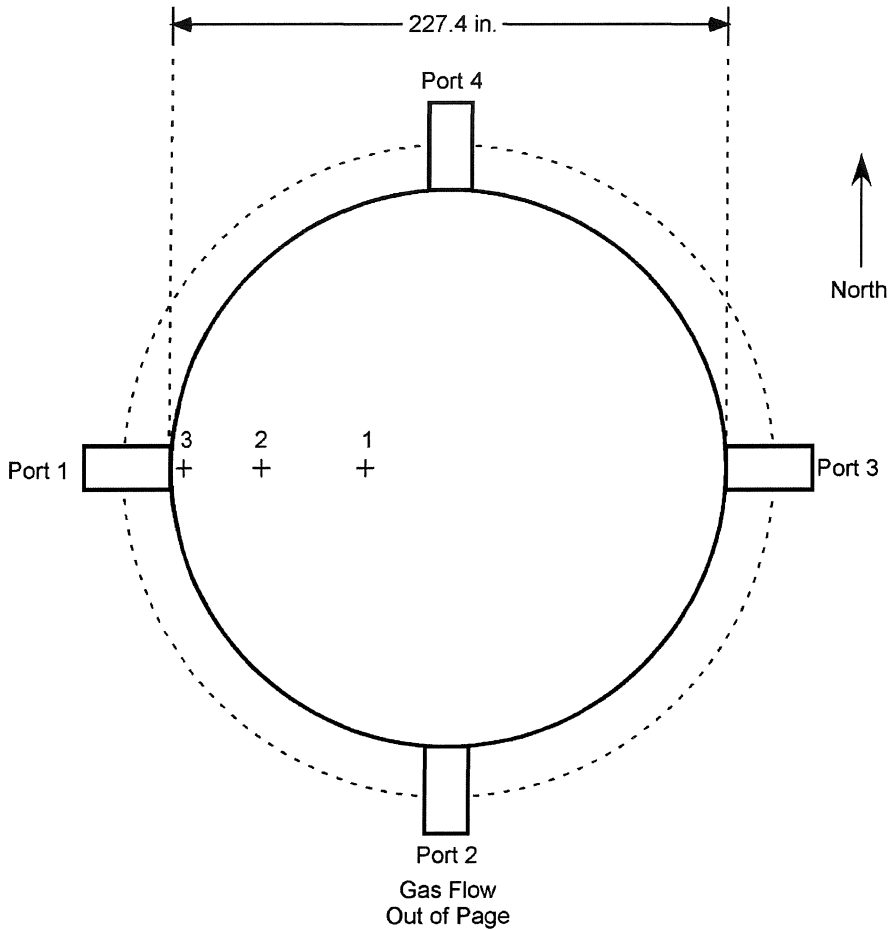


Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	35.6	81.0
2	25.0	56.9
3	17.7	40.2
4	11.8	26.8
5	6.7	15.2
6	2.1	4.8

Duct diameters upstream from flow disturbance (A): 10.9  
 Duct diameters downstream from flow disturbance (B): 2.7

Limit: 0.5  
 Limit: 2.0

**Figure 3-3:  
 Underfire Combustion Stack EPA Method 25A Stratification Check (EPA Method 7E)**



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	2.0	78.7
2	1.2	47.2
3	0.4	15.7

Duct diameters upstream from flow disturbance (A): 10.9  
 Duct diameters downstream from flow disturbance (B): 2.7

Limit: 0.5  
 Limit: 2.0

**Note:**

Stratification Check performed during Run 1.

## 4. METHODOLOGY

### PROCEDURES AND REGULATIONS

---

The test program sampling measurements followed procedures and regulations outlined by the USEPA and Michigan Department of Environment, Great Lakes and Energy (EGLE). These methods appear in detail in Title 40 of the CFR and at <https://www.epa.gov/emc>.

Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery, and analytical procedures. Any modifications to standard test methods are explicitly indicated in this appendix. In accordance with ASTM D7036 requirements, CleanAir included a description of any such modifications along with the full context of the objectives and requirements of the test program in the test protocol submitted prior to the measurement portion of this project. Modifications to standard methods are not covered by the ISO 17025 and TNI portions of CleanAir's A2LA accreditation.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

#### TITLE 40 CFR PART 60, APPENDIX A

- Method 1 "Sample and Velocity Traverses for Stationary Sources"
- Method 2 "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
- Method 3A "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
- Method 4 "Determination of Moisture Content in Stack Gases"
- Method 5 "Determination of Particulate Matter Emissions from Stationary Sources"
- Method 5F "Determination of Nonsulfate Particulate Matter Emissions from Stationary Sources"
- Method 25A "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"

#### TITLE 40 CFR PART 51, APPENDIX M

- Method 202 "Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"

### METHODOLOGY DISCUSSION

---

#### VERIFICATION OF THE ABSENCE OF CYCLONIC FLOW – EPA METHOD 1

The cyclonic flow check procedure is referred to as the "nulling" technique. An S-type pitot tube connected to an inclined manometer is used in this method. This is the same apparatus as referenced in EPA Method 2.

*Note: A cyclonic flow check per EPA Method 1, Section 2.4 was completed during the compliance test program in 2015. The results of that test indicated an absence of cyclonic flow. This test was not repeated, and results are available in Appendix E of this report.*

## DETERMINATION OF FLUE GAS COMPOSITION – METHODS 1-4

CleanAir measured flow rates using S-type pitot tubes following sampling point requirements of EPA Methods 1 and 2. The testing occurred in four test ports at six points per port for a total of 24 points. The pitot tube measurements were used to determine the stack gas velocity and volumetric flow rate. EPA Method 3A was followed to determine the oxygen and carbon dioxide content of the flue gas. Values were obtained via continuous extraction of CleanAir CEMS or via grab samples. EPA Method 4 was followed to determine the moisture content of the sample.

The methods mentioned above were utilized to determine the flue gas volumetric flow rate and composition.

## NON-SULFATE FILTERABLE PARTICULATE MATTER – METHOD 5F (MODIFIED)

Particulate matter was withdrawn isokinetically and collected on a quartz fiber filter maintained at a temperature of  $160^{\circ}\text{C} \pm 14^{\circ}\text{C}$  ( $320^{\circ}\text{F} \pm 25^{\circ}\text{F}$ ). A minimum of 60 dry standard cubic feet of sample gas was collected over a two-hour test period for each run. Flue gas volumetric flow rate, moisture concentration and flue gas molecular weight were also determined as part of the sample method.

## TOTAL PARTICULATE MATTER DETERMINATION – METHOD 5/202

The front-half (Method 5 portion) of the sampling train consisted of a glass nozzle, glass liner, filter holder heated to  $250^{\circ}\text{F}$ , and a quartz fiber filter. Flue gas samples were extracted isokinetically, per Method 5 requirements.

Flue gas exiting the front-half heated filter passed through a coiled condenser and dry impinger system jacketed by water continually circulated at ambient temperature. Moisture was removed from the flue gas without bubbling through the condensed water. Flue gas then passed through a Teflon membrane filter at ambient temperature. The temperature of the flue gas at the exit of the filter was directly measured with an in-line thermocouple and maintained in the temperature range of  $65^{\circ}\text{F}$  to  $85^{\circ}\text{F}$ .

After exiting the ambient filter, the flue gas passed through two additional impingers surrounded by ice in a "cold" section of the impinger bucket. The moisture collected in these impingers was not analyzed for CPM and was only collected to determine the flue gas moisture and thoroughly dry the gas prior to the metering device.

The front-half portion of the sample train (nozzle, probe and heated filter) was recovered per Method 5 requirements, using acetone as the recovery solvent. The back-half of the sample train (heated filter outlet, condenser, dry impingers and TFE membrane filter) were recovered per Method 202 requirements. The impinger train was purged with  $\text{N}_2$  at a rate of 14 liters per minute (lpm) for one hour following each test run and prior to recovery.

A field train blank was assembled, purged, and recovered as if it were an actual test sample. Analysis of the field train blank was used to blank-correct the test run results. Reagent blanks were also collected to quantify background contamination. All samples and blanks were returned to CleanAir Analytical Services for gravimetric analysis. Method 202 samples were maintained at a temperature  $< 85^{\circ}\text{F}$  during transport to the laboratory.

Three 120-minute Method 5/202 test runs were performed. The results are expressed as the average of three valid runs.

## VOLATILE ORGANIC COMPOUNDS, EXCLUDING METHANE – METHOD 25A

Monitoring of O<sub>2</sub>, CO<sub>2</sub>, and THC emissions was performed using a combination of EPA Methods 3A and 25A. A gas sample was continuously extracted and delivered to a series of gas analyzers, which measured the pollutant or diluent concentrations in the gas. The analyzers were calibrated on-site using certified mixtures of EPA Protocol 1 calibration gases.

The system utilized a heated stainless-steel probe for gas withdrawal. The heated stainless-steel probe tip was equipped with a sintered stainless-steel filter for particulate removal. The end of the probe was connected to a heated Teflon sample line that delivered the sample gases from the stack to the CEM system. The heated sample line is designed to maintain the gas temperature above 250°F, to prevent condensation of stack gas moisture within the line.

A stratification check was performed during the first sample run as described in 40 CFR 60, Appendix A, Method 7E, §8.1.2. The stack measurement line was traversed at 2.0m, 1.2m, and 0.4m of the stack diameter to verify the absence of a stratified flue gas.

The concentration at each traverse point differed from the mean concentration for all traverse points by no more than  $\pm 5.0\%$  of the mean concentration. The gas stream was considered unstratified and a single point that most closely matched the mean was used.

Calibration error checks were performed by introducing zero nitrogen (N<sub>2</sub>), high range and mid-range calibration gases to the inlet of each analyzer during calibration error checks. Bias checks were performed before and after each sampling run by introducing calibration gas to the inlet of the sampling system's heated filter.

Minute-average data points for O<sub>2</sub>, CO<sub>2</sub>, (dry basis), and THC (wet basis) were collected over a period of 60 minutes for each run. CleanAir directly measured NMHC using a Thermo Model 55i Non-Methane Hydrocarbon Analyzer. The 55i analyzer utilizes a back-flush GC/FID system to cut the methane (GC) and measure non-methane hydrocarbons (FID) directly. It has lower detection limits of 20 ppb methane and 50 ppb NMHC. The proprietary column design is unaffected by the oxygen content of the sample and provides complete recovery of low volatility compounds while achieving absolute separation of methane from all carbon (C<sub>2</sub>) compounds.

---

*End of Section*