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REPORT ON COMPLIANCE TESTING

Zug Island

Pushing Emissions Control System Stack

EES Coke Battery, LLC

1400 Zug Island Road

River Rouge, MI 48218

Client Reference No. 4701239002

CleanAir Project No. 13665-2

A2LA ISO 17025 Certificate No. 4342.01

A2LA / STAC Certificate No. 4342.02

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1. PROJECT OVERVIEW

Test Program Summary

EES Coke Battery, LLC contracted CleanAir Engineering (CleanAir) to complete testing at the Zug Island plant located in River Rouge, Michigan for compliance purposes. The test program met the following objective:

- Perform emissions testing on the Pushing Emissions Control System (PECS) Stack to show it is in operating compliance with Michigan Permit to Install (MI-PTI) No. 51-08C.

All testing was conducted in accordance with the regulations set-forth by the United States Environmental Protection Agency (EPA) and the Michigan Department of Environmental Quality (MDEQ) and was performed at normal operating conditions throughout the test program.

The PECS Stack has a baghouse to control particulate emissions during each oven push. Process conditions provided by EES Coke include the following:

- oven number
- push time
- amount of coke pushed
- coke volatile matter content
- fan amps
- baghouse pressure drop

A summary of the permit limits is shown below. Test program information, including the test parameters, on-site schedule and a project discussion, begin on page 2.

Table 1-1:
Summary of Results

Source Constituent	Sampling Method	Average Emission	Permit Limit[1]
PECS Stack			
PM (lb/Ton Coke)	EPA 5	0.01	0.02
PM (ton/yr)	EPA 5	3.0	9.7
PM_{10} (lb/hr)[2]	EPA 5/202	1.15	0.69
$PM_{2.5}$ (lb/hr)[2]	EPA 5/202	1.15	0.69
Oxides of NO_x (lb/hr)[2]	EPA 7E	1.37	2.61

[1] Permit limits obtained from Michigan Permit to Install number: MI-PTI-51-08C.

[2] The source does not emit continuously; lb/hr values are operating hour of the PECS exhaust fan.

Test Program Details

Parameters

The test program included the following measurements:

- filterable particulate matter (FPM)
- particulate matter less than 10 microns in diameter (PM_{10})
- particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)
- condensable particulate matter (CPM)
- nitrogen oxide (NO_x)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas temperature
- flue gas flow rate

Schedule

Testing was performed the week of September 17, 2018. 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	PECS Stack	USEPA Method 5/202	FPM/CPM	09/18/18	11:00	17:57
2	PECS Stack	USEPA Method 5/202	FPM/CPM	09/19/18	08:16	12:36
3	PECS Stack	USEPA Method 5/202	FPM/CPM	09/20/18	11:41	16:16
1	PECS Stack	Method 3A, 7E	O_2, CO_2, NO_x	09/18/18	09:55	14:01
1	PECS Stack	Method 3A, 7E	O_2, CO_2, NO_x	09/19/18	08:09	12:44
1	PECS Stack	Method 3A, 7E	O_2, CO_2, NO_x	09/20/18	11:33	15:16

Discussion

Emission Calculation Explanation

Due to the intermittent operations of the facility, the approach to the emission calculations was adjusted. Each PM test run consisted of 72 minutes of sampling time. However, it required a minimum of 4.5 hours to obtain each sample since sampling can only occur while the PECS exhaust fan is operating. A ratio of the metered sample time to elapsed test time was applied to the emission rate values to ensure representative results based on the process operations. The units of measure were pound per hour (lb/hr) of clock time. This was done to compensate for the intermittent operations and the NOx lb/hr concentrations were similarly calculated.

Verification of the Absence of Cyclonic Flow

A cyclonic flow check was performed in accordance with EPA Method 1, Section 2.4. This procedure is referred to as the "nulling" technique. An S-type pitot tube connected to an inclined manometer will be used in this method. This is the same apparatus as referenced in EPA Method 2.

The pitot tube was positioned at each of the EPA Method 1 traverse point locations so that the face openings of the pitot tube are orientated perpendicular to the stack or duct cross-sectional plane. This position was referenced as the "0° reference." The velocity pressure (ΔP) measurement at this position was recorded. If the ΔP reading was zero, a cyclonic angle of 0° was recorded. If the ΔP reading was not zero, the pitot tube was rotated clockwise (positive) or counter-clockwise (negative) as required to obtain a zero ΔP reading. The angle required to obtain the zero reading was measured using a digital protractor (±0.1degree) attached to the pitot tube.

After all the traverse points have been checked, the average of the absolute values of each angle was calculated. This resultant angle was ≤ 20 degrees and the flow condition at the location was acceptable.

Test Program Summary

The test program was completed over the span of three test days with each day completing one test run. Due to the intermittent nature of the process at current operations, a minimum of 4.5 hours was required to complete one test run. This does not account for any delays in operations. A push occurred approximately every 10-20 minutes and during each push, roughly three minutes of sample was collected.

Each Method 5/202 test run was completed so that 12 total points were sampled. Each point was sampled for approximately six minutes. Samples were collected isokinetically so that a minimum of 35 dry standard cubic feet (dscf) of sample was collected.

CEMS testing for O_2, CO_2 and NO_x was measured during the duration of the particulate testing. This provided at least 60 minutes of total sample. During previous mobilizations, the O_2/CO_2 values were observed for only about two minutes per push while the NOx values showed non-zero values for much longer.

Following an on-site discussion with Tom Gasloli of MDEQ, it was determined that ambient readings for all analytes would be eliminated. The O_2/CO_2 values were displayed only when pushing gas was being measured and this was the same for the NO_x values. All CEMS results were provided with the non-push readings omitted from the average results calculations.

The extended nature of the testing was a potential concern. Typically, bias checks are completed only before and after a test run. However, CleanAir performed bias checks during each test since test runs were at least 6 hours in duration. CleanAir attempted to perform all bias checks between pushes in order to maximize the sample collected. These checks were required to monitor analyzer bias and drift over the day of sampling.

USEPA Method 5/202 Testing

Total particulate matter (Total PM or TPM) results from USEPA Method 5/202 were considered as both PM_{10} and $PM_{2.5}$ emissions since the process characteristics were intermittent in nature. Per MDEQ, most of the particulate matter was PM_{10} and $PM_{2.5}$ because the sample was collected after the baghouse. Therefore, the likelihood of overstating actual emissions was small. Tom Gasloli at MDEQ agreed to substitute Method 5 in place of Method 201A, per previous discussions with Stephen Zervas of DTE Energy at the time. Reported results for PM_{10} and $PM_{2.5}$ emissions were equal and calculated from Total PM gravimetric analysis due to this methodology selection.

Filterable particulate matter (FPM) was withdrawn isokinetically and collected on a quartz fiber filter maintained at a temperature of 248 ± 25°F. The FPM mass was determined gravimetrically by analyzing the gain in filter weight along with the mass gained during the acetone wash of the probe liner. Test runs were 72 minutes in duration. The laboratory analysis was performed at CleanAir's analytical laboratory located in Palatine, Illinois.

The condensable particulate matter was collected in dry impingers after the FPM was collected on the Method 5 filter. Total CPM was represented by the impinger fractions and the CPM filter. Immediately following a test run, Method 202 sample trains were purged with Ultra High Purity Nitrogen at a rate of 14 liters per minute for 60 minutes to remove any potential dissolved sulfur dioxide gases from the impinger.

Continuous Emissions Testing (USEPA Methods 3A and 7E)

O_2, CO_2 and NO_x were continuously measured from a heated probe, filter, and sample line assembly run from the stack location to the test trailer. The heated sampling system remained sufficient to prevent condensation of the sample in the sample lines. The sample was extracted and conditioned prior to being sent to a flow panel. The flow panel diverts a sufficient flow rate to the dry analyzers.

CleanAir performed a stratification check in conjunction with the first CEM test run. Three points were located at 15.75, 39.37 and 78.74 inches (0.4, 1.2 and 2.0 meters) per EPA Method 7E, Section 8.1.2 criteria. The results of the stratification check met the unstratified criteria (each point was ±5.0 percent or ±0.5 ppm from the mean concentration). A subsequent CEM test runs were performed using a single point which most closely represented the stack mean concentration.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices, specifically Appendix C Parameters.

Table 2-1:
PECS Stack – PM, PM_{10}, $PM_{2.5}$

Run No.		1	2	3	Average
Date (2018)		Sep 18	Sep 19	Sep 20	
Start Time (approx.)		11:00	08:16	11:41	
Stop Time (approx.)		17:57	12:36	16:16	
Process Conditions					
R_P	Production rate (ton/hr)	101	104	107	**104**
P_1	Oven Number	60	19	30	**36**
P_2	Elapsed push time (minutes)	417	260	275	**317**
P_3	Amount of coke pushed (tons)	703	451	489	**548**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	**8,760**
Gas Conditions					
O_2	Oxygen (dry volume %)	19.8	20.0	19.3	**19.7**
CO_2	Carbon dioxide (dry volume %)	1.0	0.8	1.4	**1.1**
T_s	Sample temperature (°F)	149	133	129	**137**
B_w	Actual water vapor in gas (% by volume)	1.6	1.4	2.6	**1.9**
Gas Flow Rate					
Q_a	Volumetric flow rate, actual (acfm)	192,000	193,000	190,000	**192,000**
Q_s	Volumetric flow rate, standard (scfm)	162,000	169,000	167,000	**166,000**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	159,000	166,000	163,000	**163,000**
Sampling Data					
V_{mstd}	Volume metered, standard (dscf)	50.12	49.10	47.67	**48.96**
%I	Isokinetic sampling (%)	104.8	98.5	97.6	**100.3**
Laboratory Data					
m_n	Total FPM (g)	0.00901	0.00377	0.00794	
m_{CPM}	Total CPM (g)	0.00494	0.00513	0.00330	
m_{Part}	Total particulate matter (g)	0.01395	0.00890	0.01124	
n_{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
Total Particulate Matter Results					
$E_{lb/hr}$	Particulate Rate (lb/hr)[1]	1.0132	1.1035	1.3303	**1.1490**
$E_{T/yr}$	Particulate Rate (Ton/yr)	4.4377	4.8334	5.8268	**5.0326**
E_{Rp}	Particulate Rate - Production-based (lb/ton)	0.0100	0.0106	0.0125	**0.0110**

Average includes 3 runs.

Detection level classifications are defined as follows:

ADL = Above Detection Level - all fractions are above detection limit

DLL = Detection Level Limited - some fractions are below detection limit

BDL = Below Detection Limit - all fractions are below detection limit

[1] lb/hr emissions are corrected to account for operation hours of PECS exhaust fan.

Table 2-2:
PECS Stack – CEMS, O_2, CO_2, NO_x

Run No.	1	1	1	Average
Date (2018)	Sep 18	Sep 19	Sep 20	
Start Time	9:55	8:09	11:33	
End Time	16:22	10:43	13:56	
Elapsed Time	6:27	2:34	2:22	
Gas Parameters[1]				
Oxygen (O2) - PECS Stack (%dv)	19.79	19.96	19.75	**19.79**
Carbon Dioxide (CO2) - PECS Stack (%dv)	0.781	0.895	1.041	**0.94**
H2O - PECS Stack (%)	1.64	1.35	2.62	**1.72**
Actual Gas Flow Rate - PECS Stack (acfm)	192,451	193,336	190,190	**192,353**
Standard Gas Flow Rate - PECS Stack (scfm)	162,084	168,514	167,279	**165,695**
Dry Standard Gas Flow Rate - PECS Stack (dscfm)	159,420	166,236	162,905	**162,843**
Nitrogen Oxides (NOX) - PECS Stack				
Concentration (ppmdv)	4.88	4.70	4.47	**4.62**
Mass Rate (lb/hr)	0.96	1.55	1.37	**1.28**

Note:
[1] Flow and moisture data obtained from USEPA Method 5/202 testing.

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 will be performed at the pushing PECS Stack location. The process includes the PECS Baghouse, Pushing Stack (PECS Stack) and a Combustion Stack.

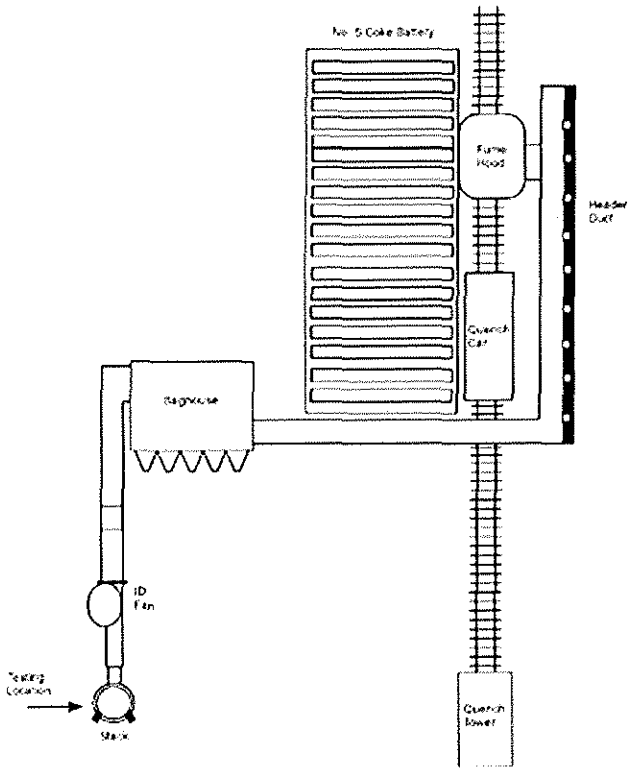
The No. 5 Coke Battery consists of 85, six-meter-high ovens producing furnace coke. A coal blend is used to charge each oven on timed intervals depending on the current production of the battery. Coking of the coal occurs in an oxygen free environment for 17 to 30 hours and the gases produced are collected, 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 per year. The design capacity heating requirement of the battery is approximately 375 MMBtu per hour. The heating requirements of the battery at the current production rate are approximately 325 MMBtu per hour.

Process source description information above was taken from written information provided by EES Coke.

A schematic of the process, indicating proposed sampling locations, is shown in Figure 3-1.

Figure 3-1:
Process Schematic



Test Location

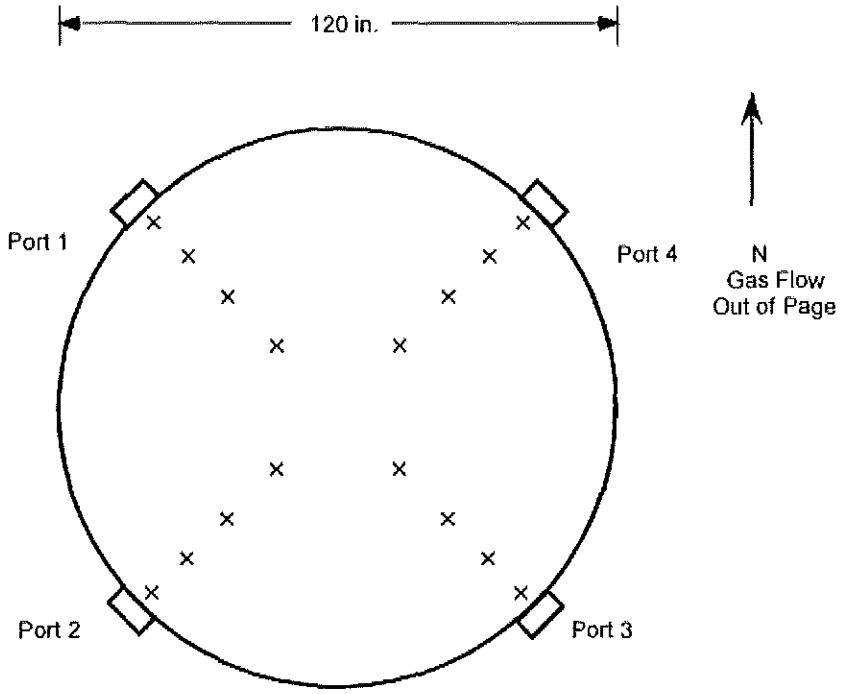
EPA Method 1 specifications determined the sample point locations. Table 3-1 presents the sampling information for the test location. The figure shown on page 9 represents the layout of the test location.

Table 3-1:
Sampling Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
PECS Stack							
PM, PM_{10}, $PM_{2.5}$	EPA 5/202	1-3	2	6	6	72	3-2
O_2, CO_2, NOx	EPA 3A, 7E	1-3	1	3	20 (minimum)	60 (minimum)	NA

Note: CEM measurements were collected at three points during the first test run. It was determined that the location was unstratified and a single point that was closest to the stack mean was selected for the remaining test runs.

Figure 3-2:
PECS Stack Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	95.6	114.7
2	85.4	102.5
3	70.4	84.5
4	29.6	35.5
5	14.6	17.5
6	4.4	5.3

Duct diameters upstream from flow disturbance (A): 2.0 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 8.0 Limit: 2.0

End of Section

4. METHODOLOGY

Procedures and Regulations

The test program sampling measurements followed procedures and regulations outlined by the USEPA and Michigan Department of Environmental Quality (DEQ). 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 7E	"Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)"

Title 40 CFR Part 51, Appendix M

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

End of Section