NO. 5 COKE BATTERY COMBUSTION STACK PARTICULATE EMISSION TESTING REPORT
EES COKE BATTERY, LLC
ZUG ISLAND, RIVER ROUGE, MICHIGAN

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Permit to Install No. 51-08

Test Dates: August 20 and 21, 2014

Report Date: September 15, 2014

Prepared for:

EES Coke Battery, LLC
1400 Zug Island Road
River Rouge, Michigan 48209

Prepared by:

Air/Compliance Consultants, Inc.
1050 William Pitt Way
Pittsburgh, Pennsylvania 15238
412-826-3636

PA Lab Registration #: 02-04775

Project Number 14-221

CERTIFICATION STATEMENT

This statement certifies that "to the best of their knowledge," based on state and federal regulations, operating permits, plan approvals applicable to each source tested, and reasonable inquiry, the statements and information presented in the attached document are true, accurate, and complete.

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Project No. 14-221

Paul A. Jadlowiec 9/15/2014

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Brenna Harden 9/12/2014

Brenna Harden
Environmental Engineer
DTE Energy Services

Date

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1 TEST RESULTS SUMMARY

Permit To Install No.: 51-08			
Source Name: No. 5 Coke Battery		**Source ID: EUCOKE-BATTERY** **Stack ID: SVCOKE-UNDERFIRE**	
Pollutant	**Average Result**	**Permit Limit**	**Compliant / Non-Compliant**
Particulate Matter	6.29 lb/hr	25.7 lb/hr	Compliant
	0.013 lb/1,000 lb @ 50% EA	0.095 lb/1,000 lb @ 50% EA	Compliant

2 INTRODUCTION

EES Coke Battery, LLC (EES) contracted Air/Compliance Consultants, Inc. (ACCI) to conduct a particulate matter (PM) emission evaluation at the No. 5 Coke Battery Combustion Stack located at the Zug Island facility in River Rouge, Michigan. The EES No. 5 Coke Battery Combustion Stack emissions are regulated by State of Michigan Permit to Install No. 51-08. The source was tested as detailed in the Test Protocol submitted July, 2014 to the Michigan Department of Environmental Quality (MDEQ). A copy of the Test Protocol and MDEQ correspondence are contained in Appendix A.

3 CONTACT INFORMATION

Facility	Testing Firm	USEPA Method 5
Ms. Brenna Harden Environmental Engineer DTE Energy Services 414 South Main Street, Suite 600 Ann Arbor, Michigan 48104 (313) 297-4183 Telephone (734) 320-5255 Facsimile harden@dteenergy.com	Mr. Paul A. Jadlowiec, QSTI Senior Project Manager Air/Compliance Consultants, Inc. 1050 William Pitt Way Pittsburgh, Pennsylvania 15238 (412) 826-3636 – Telephone (412) 826-3640 – Facsimile pjadlowiec@air-comp.com	Mr. Robert N. Frey District Manager Air/Compliance Consultants, Inc. 1050 William Pitt Way Pittsburgh, Pennsylvania 15238 (412) 826-3636 –Telephone PA Lab Registration #02-04775 rfrey@air-comp.com

4 TEST DATES AND PERSONNEL INFORMATION

Emission testing at the No. 5 Coke Battery Combustion Stack was conducted on August 20 and 21, 2014. The following table details the field personnel regarding this test program:

Organization	Personnel	Responsibility
EES Coke Battery	Ms. Brenna Harden	Test Liaison
MDEQ Air Division	Mr. Thomas Maza	Agency Representative
ACCI	Mr. Josh S. Varner, QSTI, Project Scientist	Mobile Laboratory, Sample Recovery
	Mr. C. Kenji Kinoshita, QSTI, Scientist II	Equipment Handler, Sample Recovery
	Mr. Thomas E. Payne, QSTI, Scientist II	Operator RM 5, Sample Recovery

5 PROCESS DESCRIPTION AND PROCESS DATA

5.1 No. 5 Coke Battery

No. 5 Coke Battery consists of eighty-five six-meter high ovens for producing furnace coke. Coke oven gas (COG) is used as the under-firing fuel for the battery. The products of combustion from the under-firing system are exhausted to the atmosphere through a single exhaust stack (combustion stack). There are no emission control devices on the combustion stack.

A blend of coal is charged to individual ovens on a timed interval of 11 to 22 minutes, depending on the current production of the battery. Each charge consists of approximately 32 dry tons of coal. Current permit limits allow for the charging of up to 1.365 million dry tons of coal.

Coking of the coal occurs in an oxygen free environment for 17 to 30 hours. Gases produced during the coking cycle are collected, cleaned, and used to under-fire the battery, supply fuel for other site combustion sources, and sold to off-site utilities.

After coking, the coke is pushed from each oven. Emissions from the pushing activities are collected using a belted duct and directed to a pushing control system (PEC) baghouse. The hot coke is water quenched. Approximately 25 tons of dry coke is produced per oven.

The exhausting of emissions to the combustion stack is a steady operation, except during a reverse. Reversing cycles attempt to distribute the heat input to the coal charged at controlled rates and uniform temperatures by alternate firing into the battery flues. A firing cycle is 20-minutes in duration. At the end of a cycle the firing stops for one to two minutes and the firing is reversed to provide the alternate flue heating. COG flow to the under-fire combustion system is regulated to supply enough COG to maintain a desired temperature. The heating requirement of the battery at design capacity is approximately 375 million British thermal units per hour (MMBtu/hr). The heating requirement of the battery at the current production rate is approximately 350 MMBtu/hr.

5.2 Process Data

The following process data was provided by EES.

- Number of ovens charged per run and day
- Number of ovens pushed per run and day
- Amount of coal charged per run and day
- Amount of coal pushed per day
- Amount of coke oven gas under-fired per day
- Amount of coke oven gas heat input per run and day
- Average hourly heat input for under-fire combustion per run

Process data is contained in Appendix B.

6 TEST PROCEDURES

Testing was conducted in accordance with United States Environmental Protection Agency (USEPA) Title 40, Code of Federal Regulations (CFR) Part 60, Appendix A, Method 5, MDEQ, Air Quality Division, Source Testing Guidelines, Method 5C and the procedures described below. ACCI Field Data Sheets are contained in Appendix C.

6.1 Issues Encountered During Testing

Test Run 2 was aborted 70-minutes into the 120-minute test run when the test crew was notified that the coke battery was not operating at a normal maximum operating capacity. Testing resumed the next day with the completion of Test Runs 3 and 4. The average of Test Runs 1, 3 and 4 constituted the test.

6.2 Testing Station and Traverse Locations – USEPA Method 1

The sampling station for the collection of gas-flow data is located at the stack sampling platform. The sampling location along with the nearest upstream and downstream disturbances and the traverse point locations are detailed in Figure 1. USEPA Method 1, *Sample and Velocity Traverses for Stationary Sources,* was utilized to determine the number and location of the traverse points. There are four test ports located 90 degrees to center. A total of 24 traverse points were chosen with 6 points sampled in each of four test ports.

6.3 Gas Flow and Temperature Measurements – USEPA Method 2

The gas-flow rate and temperature profiles for the gas stream were measured by conducting simultaneous velocity and temperature traverses during each sampling run using USEPA Method 2, *Determination of Stack Gas Velocity and Volumetric Flow Rate (S Type Pitot Tube).* Gas velocity head was measured using a calibrated S Type Pitot tube connected to a digital manometer. The static pressure was measured using the same S Type Pitot tube and digital manometer. A Chrome-Alumel thermocouple attached to a digital indicator was used to measure the gas temperature at each of the traverse points. A copy of the cyclonic flow check data is contained in Appendix C.

6.4 Determination of Gaseous Emissions – Carbon Dioxide and Oxygen

6.4.1 Sampling System Setup

The carbon dioxide (CO_2) and oxygen (O_2) sampling system was set up and operated in accordance with the guidelines contained in the operating manual for each specific continuous emission monitor (CEM). The ACCI sampling system consisted of a heated stainless-steel sampling probe, heated filter holder with a glass-fiber filter, calibration "T" at the probe exit to introduce calibration gas during the system bias check, heated sample line, customized stainless-steel condenser with a peristaltic pump to minimize contact between sample gas and condensate, 0.375″ ID Teflon® sample line to transport sample gas, and 0.25″ ID Teflon® line to transport calibration gases. Data acquisition was conducted with a multi-channel Yokogawa data logger collecting data continuously at 2-second intervals, then calculating 1-minute averages from those readings. After the ACCI CEM system (CEMS) setup was complete, the sampling line, calibration gas line, probe, and condenser were leak checked by capping off the calibration gas line at the inlet and placing the system in a system bias calibration mode. The CEM sampling pump was used to draw a vacuum on the sampling system (sample line, conditioner, and calibration gas line). An acceptable leak check was indicated by the sample gas rotometer showing zero flow as the sampling system reached maximum vacuum (15" mercury [Hg]). This leak check was performed at the beginning of the test program.

6.4.2 Pre-Test Determinations

Before testing, a stratification test was performed following an alternative 3-point procedure detailed in Section 8 of USEPA Method 7E, *Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure).* A gas sample was continuously extracted from three sampling points on a line passing through the centroidal area at 16.7%, 50.0%, and 83.3% of the measurement line. The gas was passed through the heated probe, filter, and line into a gas conditioner, and then a portion of the sample was conveyed to each analyzer. Each point was sampled for a minimum of twice the system response time. The concentrations at each traverse point for carbon dioxide and oxygen did not differ from the mean by more than ± 0.3%; therefore, a single point sampling strategy was employed, approximately 6 feet into the gas stream. The CEMS probe was moved once per test run to allow the USEPA Method 5 sampling train to traverse all four available ports without interference from the CEM probe. The data collected during the time the CEM probe was out of the stack and moved to an available port was deleted from the data run set. For each test run there were 120-minutes of CO_2 and O_2 concentration data collected. A copy of the stratification check can be found in Appendix C.

6.4.3 Testing Procedures

An internal calibration error (CE) check was performed on each analyzer at the beginning of the test program. A zero gas and calibration gases at 40 to 60% of span and 100% of span were introduced to the analyzers. The internal calibration response was then checked against the known cylinder gas value. The difference between the cylinder value and analyzer response was divided by the span value of the gas to give the CE. An allowable CE is 2% of analyzer span. All analyzers demonstrated acceptable CE at all times.

The CEM was then placed in a system calibration bias mode. Zero and upscale gases were introduced at the probe exit to allow evaluation of the sampling line, gas conditioner and analyzer in a normal sampling mode. No adjustments to the sampling system were made and the response of each gas was recorded. The difference between the sampling system responses in the bias mode minus the analyzer response during the internal calibration check was divided by the analyzer span value. This calculated value represented the sampling system bias and did not exceed ± 5% for any analyzer at any time.

When each individual test run was completed, a post-test sampling system bias check was conducted for each analyzer. No adjustments to the sampling system were made and the response of each gas was recorded. The difference between the sampling system response in the bias mode minus the analyzer responses during the internal checks were divided by the analyzer span values. This calculated value represented the sampling system bias and did not exceed ± 5% for any analyzer at any time.

The responses from the second bias check were compared with those from the pre-test system bias check. The difference between the post-test and pre-test bias check responses were divided by the analyzer span value. This value was the amount of drift between the pre-test and post-test bias checks. A drift of $\leq$ 3% is acceptable. The sampling system calibration drifts did not equal or exceed 3%.

6.4.4 Carbon Dioxide and Oxygen Determination – USEPA Method 3A

The O_2 and CO_2 concentrations were measured continuously for each test run using the principles presented in USEPA Method 3A, *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure).* A portion of the sample was conveyed to a Servomex Model 1400 single beam single wavelength infrared and paramagnetic analyzer to determine the percent by volume of CO_2 and O_2 in the gas. Nitrogen (N_2) was determined by the difference. The CO_2 and O_2 concentration data were used to calculate the exhaust gas density. The O_2 concentration data was also used to correct the PM emissions to 50% excess air.

6.5 Moisture Content Sampling – USEPA Method 4

Moisture content sampling was conducted concurrently with each sampling run using the principles presented in USEPA Method 4, *Determination of Moisture Content in Stack Gases.* Parameters evaluated in order to determine the gas stream moisture content were sample gas volume, temperature, pressure and impingers, and silica gel moisture gain.

6.6 Determination of Particulate Emissions – USEPA Method 5 and MDEQ Method 5C

Particulate emissions were determined in accordance with USEPA Method 5, *Determination of Particulate Emissions from Stationary Sources* and MDEQ Source Testing Guidelines, Method 5C-Outstack Filtration Method.

6.6.1 Sampling Train Setup

The sampling apparatus contained a stainless steel-lined temperature-controlled (248°F ± 25°F) probe equipped with a S Type Pitot tube and a sharp-edged stainless steel button-hook nozzle. The probe liner and nozzle were connected utilizing a stainless steel union and graphite ferrules. The exit of the probe was connected to a high-efficiency glass-fiber filter, supported in a glass-filter holder, inside an oven, heated to maintain the exiting filter temperature at 248°F ± 25°F. The exit of the filter holder was connected to a standard USEPA Method 5 impinger. Flexible tubing was used to connect exit of the filter holder to the impinger train.

The impinger train was connected to a commercially available metering system. Prior to sampling, the dry gas meter was calibrated utilizing the critical orifice procedures detailed in Section 16.2 of USEPA Method 5. A critical orifice, which is calibrated annually and set to cover the anticipated sampling rates, was utilized. Along with pre-test and post-test meter calibrations, the S Type Pitot, thermocouple and nozzle were calibrated prior to and following use in the field according to USEPA Method 5 procedures.

6.6.2 Sampling Train Operation

The sample train was assembled, allowed to reach operating temperature, and leak checked by plugging the nozzle with a rubber septum and pulling a vacuum of 15" of Hg. Once an acceptable leak check of less than 0.02 cubic feet per minute (cfm) was achieved, the sampling train was placed at the first traverse point and sampling began immediately. The sampling train was operated at an isokinetic rate with an isokinetic variation greater than 90% and less than 110%. Each test run lasted 120 minutes with a minimum sample volume of 109.629 dry standard cubic feet (DSCF). At the conclusion of each test run, the sample train was cooled sufficiently, utilizing ambient air or ice, to allow the nozzle to be plugged. The sampling train was leak-checked at a vacuum equal to or greater than the maximum value reached during sampling. An acceptable leakage rate, less than 0.02 cfm or 4% of the average sampling rate (whichever was less), was observed for the sample train at the end of each test run.

6.6.3 Sample Recovery and Analysis

The filter (Container 1) was removed from the filter holder and placed in a labeled polystyrene Petri dish for transport to the laboratory. The filter was desiccated for a minimum of 24 hours and weighed to a constant weight. The term constant weight means a difference of no more than 0.5 milligrams (mg) or 1% of total weight less tare weight (whichever is greater) between two consecutive weighings, with no less than 6 hours of desiccation time between weighings.

The acetone rinse (Container 2) was performed a minimum of 6 times, and consisted of at least 200 milliliters (ml) or 30 ml per foot of probe length. The rinse consisted of the nozzle, probe, and front half of the filter holder and was collected in a high-density polypropylene (HDPE) sample bottle, sealed, labeled and transported to the laboratory. The sample was evaporated to dryness in a glass 250 ml pre-weighed beaker, desiccated, and weighed to a constant weight. The particulate catch was the sum of the acetone rinse plus the filter catch. Laboratory data is contained in Appendix D.

Particulate emissions are reported in grains per DSCF (gr/DSCF), pounds per hour (lb/hr), pounds per 1,000 pounds of exhaust gas (lb/1,000 lb) and lb/1,000 lb corrected to 50% excess air (lb/1,000 lb @ 50% EA).

6.7 Equipment Calibrations

The following field equipment calibrations are contained in Appendix E.

- Nozzle
- Pitot Tube
- Thermocouple
- Dry Gas Meter (Pre and Post-Test)

- Analyzer Interference Checks
- USEPA Protocol 1 Gas Calibration Certificates
- Qualified Source Testing Individual (QSTI) Certifications

6.8 Calculations

Emission calculations were completed using a computer spreadsheet format. The results of each pertinent parameter are detailed on the spreadsheet for each sampling run. In accordance with MDEQ Method 5C, emission calculations used 70°F as standard temperature and emission equations in Michigan Administrative Code, Part 10 Intermittent Testing and Sampling. A sample calculation is contained in Appendix F.

7 TESTING SUMMARY

The results of the testing performed are presented in Table 1. Table 2 contains the nomenclature.

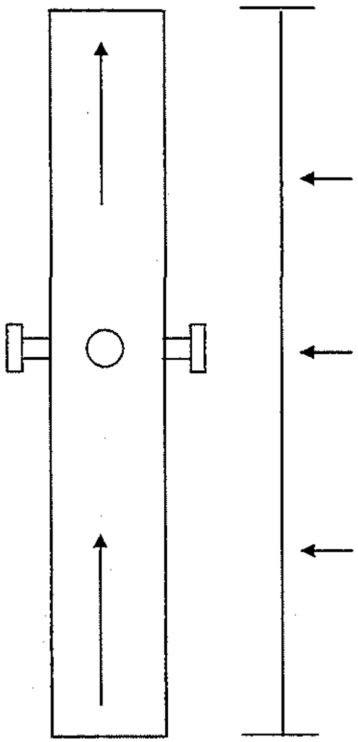
8 CONCLUSION

A compliance emission evaluation has been conducted for EES Coke Battery, LLC, Zug Island, located in River Rouge, Michigan, on the No. 5 Coke Battery Combustion Stack. Test results represent data that is considered to be representative of the emission rates at the prevailing operating conditions.

To the best of ACCI's knowledge, this source test report has been checked for completeness and the results contained herein are accurate, error-free, and representative of the actual emissions measured during testing

REPORT – FIGURE

AIR/COMPLIANCE CONSULTANTS, INC.
USEPA METHOD 1 DATA SHEET



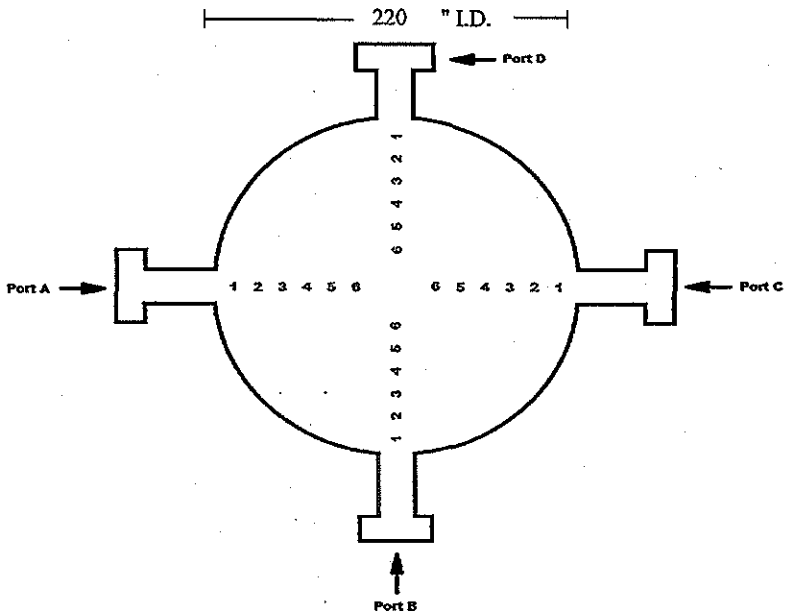
200 Feet Upstream from Nearest Disturbance

10.9 Duct Diameters

4 Sampling Ports Located 90° Apart

50 Feet Downstream from Nearest Disturbance

2.7 Duct Diameters



Point Number Each Port	Method 1 Value (inches)
6	78.32
5	55.00
4	38.94
3	25.96
2	14.74
1	4.62

Note: Test Port and Stack Wall = 70 inches

Air/Compliance Consultants, Inc.

No. 5 Coke Battery Combustion Stack Sampling Location Schematic EES Coke Battery, Zug Island, River Rouge, Michigan	Figure 1

REPORT – TABLES

Table 1. Particulate Matter Emission Test Results, No. 5 Coke Oven Battery, Combustion Stack
EES Coke Battery LLC, Zug Island, River Rouge, Michigan

Test Data		**Run 1**	**Run 3**	**Run 4**	**Average**	
Date		8/20/2014	8/21/2014	8/21/2014		
Start Time		8:06 AM	8:05 AM	11:02 AM		
End Time		10:29 AM	10:25 AM	1:21 PM		
Flow Rate	(ACFM)	241,540	237,557	237,334	238,810	
Flow Rate	(SCFM)	134,109	132,272	132,263	132,881	
Flow Rate	(DSCFM)	111,954	111,728	111,741	111,807	
Sample Volume	(DSCF)	112.193	109.833	109.629	110.552	
Carbon Dioxide (CO_2)	(dry volume %)	5.37	5.09	5.37	5.28	
Oxygen (O_2)	(dry volume %)	9.88	10.62	10.15	10.22	
Water Vapor (H_2O)	(volume %)	16.52	15.53	15.52	15.86	
Stack Temperature	(°F)	487.8	489.3	489.5	488.9	
Percent of Isokinetic Sampling	(%)	106.9	104.8	104.6	105.4	
Results						**Limit**
Filterable Particulate Matter (Method 5)						
Particulate Mass (m_n)	(mg)	53.5	27.1	60.9	47.2	
Emission Concentration	(gr/DSCF)	0.0073	0.0038	0.0086	0.0066	
Emission Rate	(lb/hr)	7.04	3.64	8.19	6.29	25.7
Emission Concentration	(lb/1,000 lbs)	0.012	0.006	0.014	0.011	
Corr. Factor to 50% Excess Air (EA)		1.17	1.25	1.20	1.21	
Emission Concentration (Corrected)	(lb/1,000 lb @ 50% EA)	0.014	0.008	0.017	0.013	**0.095**

Table 2.

TABLE NOMENCLATURE

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
%	Percent	gpm	Gallons per minute	O_2	Oxygen
% Volume	Percent by volume	gr/DSCF	Grains per dry standard cubic feet	OSHA	Occupational Safety & Health Administration
°F	Degrees Fahrenheit	H_2O	Water	PADEP	PA Department of Environmental Protection
<	Less than	H_2SO_4	Sulfuric acid	Pb	Lead
>	Greater than	HAP	Hazardous air pollutant	PEL	Permissible exposure limit
AB	Acetone Blank	Hg	Mercury	PM	Particulate matter
ACFM	Actual cubic feet per minute	HI	Heat input	PM_{10}	Particulate matter less than 10 microns
BACT	Best Available Control Technology	Hp	Horsepower	ppb	Parts per billion
BHP	Brake horsepower	hr	Hour	PPE	Personal protective equipment
BTU	British thermal units	IC	Ion chromatography	ppm	Parts per million
BTU/scf	British thermal units per standard cubic feet	in H_2O	Inches of Water	ppm_{dv}	Parts per million, dry volume
C_3H_8	Propane	in Hg	Inches of Mercury	ppm_{wv}	Parts per million, wet volume
CE	Capture efficiency	Kg	Kilograms	psia	Pounds per square inch absolute
CEMS	Continuous emission monitor system	lb	Pound	psig	Pounds per square inch gauge
cf	Cubic foot	lb/hr	Pound per hour	PTI	Permit to Install
CFR	Code of Federal Regulations	lb/lb-mole	Pound per pound mole	PTE	Permanent total enclosure
CH_4	Methane	lb/1000 lb	Pound per 1000 pounds of exhaust gas	RA	Relative Accuracy
C_2H_6	Ethane	lb/1000 lb @ 50% EA	Pound per 1000 pounds of exhaust gas at 50 percent excess air	RATA	Relative Accuracy Test Audit
Cl_2	Chlorine	MDL	Minimum detection limit	RM	Reference Method
CO	Carbon monoxide	mg	Milligrams	RMD	Relative mean difference
CO_2	Carbon dioxide	mg/g	Milligrams per gram	rpm	Revolutions per minute
COG	Coke oven gas	min	Minute	S	Sulfur
DACF	Dry actual cubic feet	mL	Milliliter	SCF	Standard cubic feet
DACM	Dry actual cubic meters	mm HG	Millimeters of mercury	SCFM	Standard cubic feet per minute
DE	Destruction efficiency	MMBtu	Million British thermal units	SCM	Standard cubic meters
DSCF	Dry standard cubic feet	MNOC	Maximum normal operating capacity	SO_2	Sulfur dioxide
DSCFM	Dry standard cubic feet per minute	MSDS	Material Safety Data Sheet	STD	Standard
FID	Flame Ionization Detector	MW	Megawatts	TEQ	Toxicity Equivalence Quotient
ft	Foot	N_2	Nitrogen	THC	Total hydrocarbons
ft/sec	Feet per second	ND	Non-detectable	tph	Tons per hour
Ft^2	Square feet	NDO	Natural draft opening	tpy	Tons per year
Ft^3	Cubic feet	NESHAP	National Emission Standard for Hazardous Air Pollutants	µg	Micrograms
ft^3/lb-mole	Cubic feet per pound mole	ng	Nanograms	USEPA	United States Environmental Protection Agency
g	Grams	NMEVOC	Non-methane, non-ethane volatile organic compounds	VE	Visible emissions
g/bhp-hr	Grams of brake horsepower per hour	NMVOC	Non-methane volatile organic compound	VOC	Volatile organic compound
g/mL	Gram per milliliter	NO_2	Nitrous Oxide	vol.	Volume
GC	Gas Chromatography	NO_x	Oxides of Nitrogen	w/o	With out