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Marathon Petroleum Company LP
1001 Oakwood
Detroit, MI 48217

REPORT ON COMPLIANCE TESTING

Performed for:
MARATHON PETROLEUM COMPANY LP
DETROIT REFINERY

FCCU REGENERATOR STACK (SVFCCU)

Client Reference No: 4100665755
CleanAir Project No: 12993-2
Revision 0: October 27, 2016

To the best of our knowledge, the data presented in this report are accurate, complete, error free, legible 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.

Submitted by,

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DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: Marathon Petroleum Company LP County: Wayne

Source Address: 1300 South Fort Street City: Detroit

AQD Source ID (SRN): A9831 ROP No.: MI-ROP-A9831-2012c ROP Section No.:

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From 08/30/2016 To 09/14/2016

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Submittal of Stack Testing and RATA results.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

David T. Roland		313-843-9100
Name of Responsible Official (print or type)	Title	Phone Number
		10/29/2016
Signature of Responsible Official		Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

PROJECT OVERVIEW

INTRODUCTION

Marathon Petroleum Company LP (MPC) contracted Clean Air Engineering (CleanAir) to perform emission measurements at the Detroit Refinery for compliance purposes.

All testing was conducted in accordance with the regulations set-forth by the United States Environmental Protection Agency (USEPA) and the Michigan Department of Environmental Quality (DEQ). The permit limits are referenced in Michigan Department of Environmental Quality, Air Quality Division Permit to Install No. 63-08E, issued June 10, 2016.

Key Project Participants

Individuals responsible for coordinating and conducting the test program were:

Crystal Davis – MPC
Joe Reidy – MPC
Thomas Gasloli – Michigan DEQ
Ken Sullivan – CleanAir

Test Program Parameters

The testing was performed at the FCCU Regenerator Stack (Emission Unit ID No. EU11-FCCU-S1; Stack ID No. SVFCCU) on August 30 - September 1, 2016, and included the following emissions measurements:

- particulate matter (PM), assumed equivalent to non-sulfate filterable particulate matter (NSFPM)
- total particulate matter less than or equal to 10 microns (μm) in diameter (Total PM_{10}), assumed equivalent to the sum of the following constituents:
  - non-sulfate filterable particulate matter (NSFPM)
  - condensable particulate matter (CPM)
- ammonia (NH_3)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas flow rate
- flue gas velocity decay (wall effects)

PROJECT OVERVIEW

TEST PROGRAM SYNOPSIS

Test Schedule

The on-site schedule followed during the test program is outlined in Table 1-1.

Table 1-1:
Schedule of Activities

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	FCCU Regenerator Stack	USEPA CTM-027	NH_3	08/30/16	10:45	11:57
2	FCCU Regenerator Stack	USEPA CTM-027	NH_3	08/30/16	13:56	15:06
1	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	08/30/16	10:45	11:57
2	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	08/30/16	13:56	15:06
3	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	08/31/16	08:35	09:48
4	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	08/31/16	10:43	11:50
5	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	08/31/16	15:26	16:33
6	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	08/31/16	17:38	18:45
7	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	08/31/16	19:23	00:00
8	FCCU Regenerator Stack	USEPA Method 5F/202	NSFPM/CPM	09/01/16	11:42	12:51
1	FCCU Regenerator Stack	USEPA Method 2H	Wall Effects	08/30/16	08:10	08:38
1	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/30/16	08:47	09:11
2	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/30/16	12:48	13:15
3	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/30/16	15:44	16:09
4	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/31/16	08:34	09:27
5	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/31/16	10:42	11:28
6	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/31/16	15:25	16:14
7	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/31/16	17:39	18:21
8	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	08/31/16	19:22	20:06
9	FCCU Regenerator Stack	USEPA Method 2F	3-D Velocity & Flow Rate	09/01/16	11:42	12:28

09 16 16 144047

PROJECT OVERVIEW

Results Summary

Tables 1-2 through 1-4 and Figures 1-1 through 1-3 summarize the results of the test program. A more detailed presentation of the test conditions and results of analysis are shown on pages 2-1 through 2-4.

Table 1-2:
Summary of NSFPM, CPM and Total PM_{10} Results (USEPA 5F/202) Runs 1-4

FCCU Regenerator Stack			NSFPM Rate (lb/Mlb coke)	CPM Rate (lb/Mlb coke)	Total PM_{10} Rate (lb/Mlb coke)
Test Dates: 8/30/16 & 8/31/16					
Coke Burn Rate (lb/hr)	**24,469**	Run 1	0.8	0.3	1.1
FCC Rate (bpd)	**41,005**	Run 2	0.8	0.3	1.1
Aqueous NH_3 Injection (lb/hr)	**27.6**	Run 3	0.8	0.3	1.1
ESP Operation	**Both/LPR**	Run 4	0.9	0.4	1.2
		Average	**0.8**	**0.3**	**1.1**
		Limit	**0.8**		**1.1**

Note: Average includes 4 runs for all parameters. 10/27/2016 12:26

Table 1-3:
Summary of NSFPM, CPM and Total PM_{10} Results (USEPA 5F/202) Runs 5-8

FCCU Regenerator Stack			NSFPM Rate (lb/Mlb coke)	CPM Rate (lb/Mlb coke)	Total PM_{10} Rate (lb/Mlb coke)
Test Dates: 8/31/16 & 9/1/16					
Coke Burn Rate (lb/hr)	**23,536**	Run 5	0.8	0.5	1.3
FCC Rate (bpd)	**40,998**	Run 6	0.7	0.3	1.0
Aqueous NH_3 Injection (lb/hr)	**29.3**	Run 7	0.8		
ESP Operation	**Both/LPR**	Run 8	0.8	0.3	1.1
		Average	**0.8**	**0.4**	**1.1**
		Limit	**0.8**		**1.1**

Note: Average includes 4 Runs for NSFPM, and 3 Runs for CPM & Total PM_{10}. 9/16/2016 14:47

Table 1-4:
Summary of NH_3 Results (USEPA CTM-027) Run 1-2

FCCU Regenerator Stack			NH_3 Conc. (ppmdv)	NH_3 Slip (lb/hr)	NH_3 Slip (lb/Mlb coke)
Test Dates: 8/30/16					
Coke Burn Rate (lb /hr)	**24,469**	Run 1	7.9	1.6	0.064
FCC Rate (bpd)	**41,005**	Run 2	7.6	1.5	0.061
Aqueous NH_3 Injection (lb/hr)	**27.6**				
ESP Operation	**Both/LPR**	**Average**	**7.8**	**1.5**	**0.063**

Note: Average includes 2 runs for all parameters. 10/27/2016 12:26

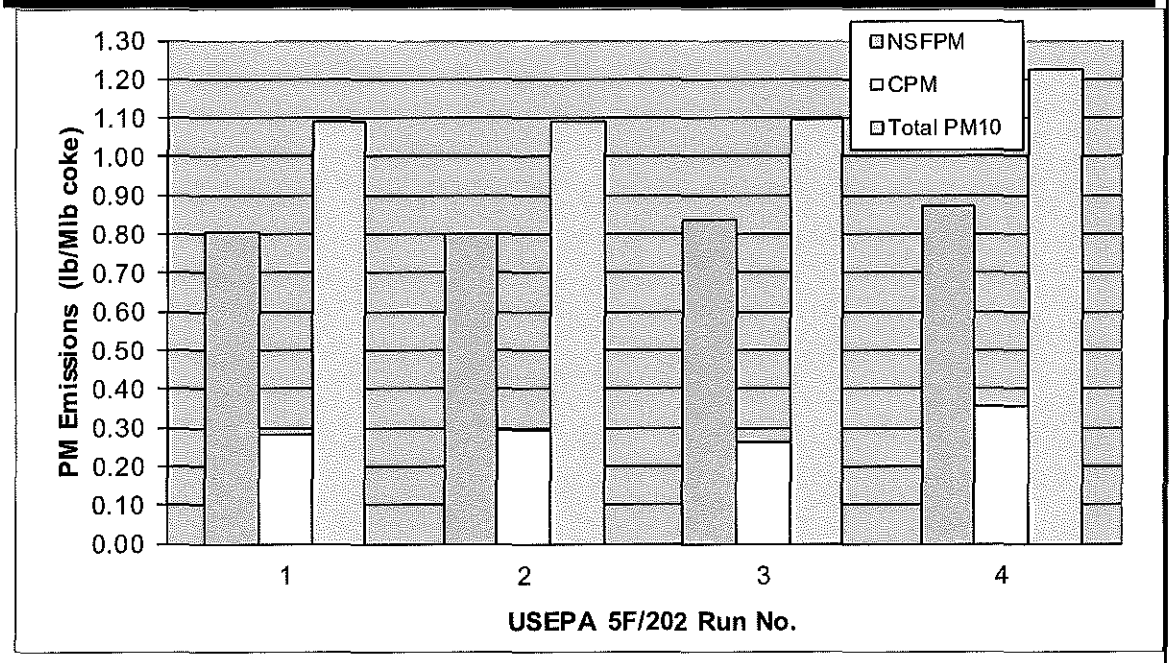


Figure 1-1: NSFPM, CPM and Total PM_{10} Results Runs 1-4

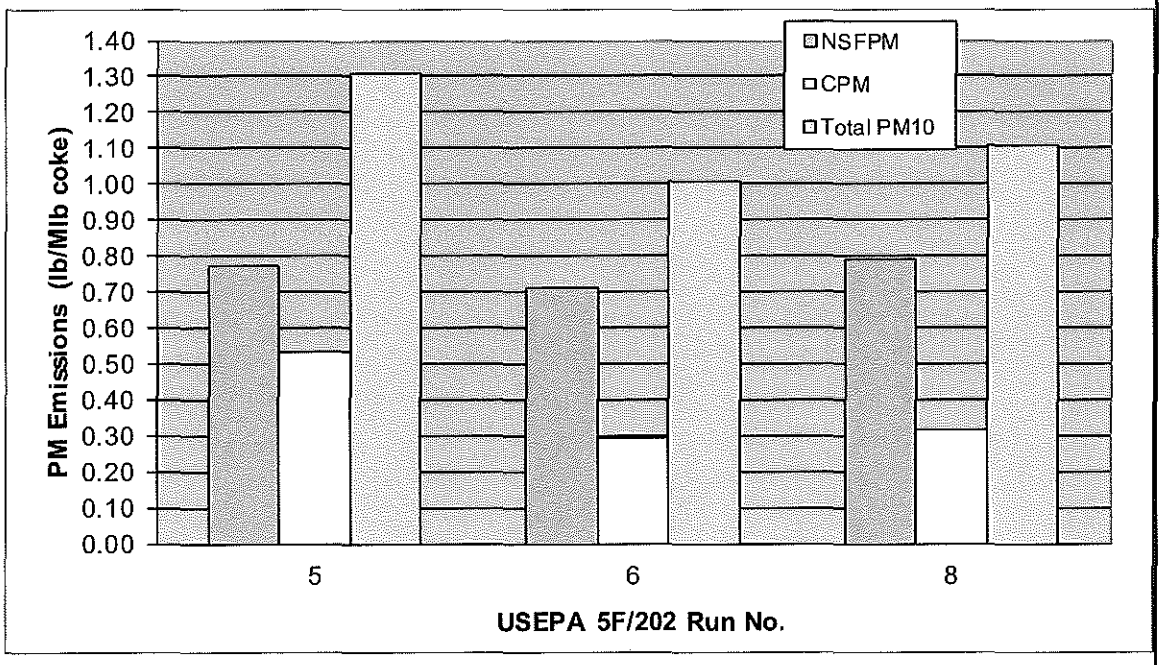


Figure 1-2: NSFPM, CPM and Total PM_{10} Results Runs 5-8

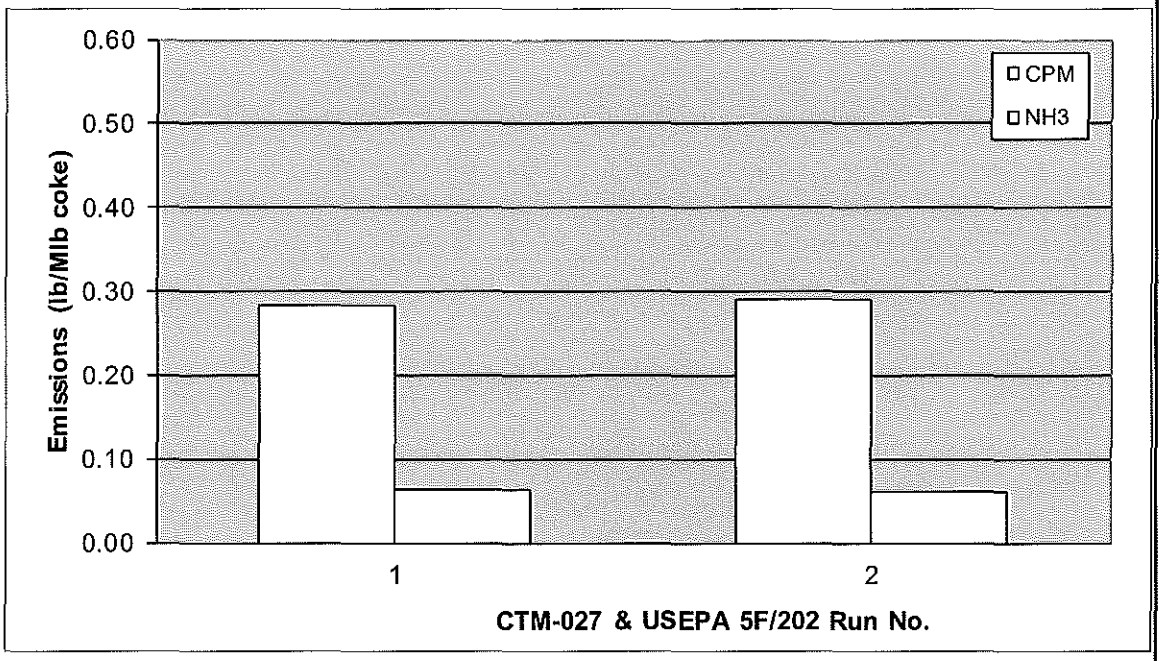


Figure 1-3: CPM and NH_3 Results

Discussion of Test Program

Flow Rate Measurements

A wall-effects adjustment factor (WAF) was determined per Method 2H prior to the start of the first test run.

3-D flow traverses per Method 2F were performed before and after each Method 5F/202 test run for Runs 1 and 2 based on port availability. 3-D flow traverses per Method 2F were performed during each Method 5F/202 test run for Runs 3-8 based on port availability.

NSFPM and CPM Testing - USEPA Method 5F/202

For this test program, PM emission rate is assumed equivalent to NSFPM emission rate and PM_{10} emission rate is assumed equivalent to the sum of NSFPM and CPM emission rates (units of lb/hr, Ton/yr, or lb/Mlb coke for all constituents). For emissions inventory purposes, MPC applies a correction factor to NSFPM to eliminate particles with a diameter less than 10 microns. Application of that correction factor is not included in this test report.

PROJECT OVERVIEW

Based on the preliminary results of the first three Method 5F/202 test runs MPC requested a fourth run to be performed. Four (4) 60- minute test runs were performed with the unit operating at "condition 1" on August 30-31, 2016.

MPC requested an additional set of Method 5F/202 testing with the unit operating at "condition 2". Runs 5 through 7 were completed on August 31, 2016. Following Run 7 the condenser and first impinger were cracked during the recovery process. The Method 5F portion of Run 7 remained intact, however the 202 portion was considered invalid. The Method 202 portion of the sample train was recovered to the extent possible, however a post test purge could not be performed. The Method 202 samples for Run 7 were not analyzed. A fourth test run (Run 8) was performed on September 1, 2016, at "condition 2". Four (4) 60- minute test runs were performed with the unit operating at "condition 2" on August 31 - September 1, 2016.

Upon reporting it was noticed that the measured total liquid volume collected during Run 3 was significantly higher than the other test runs and the expected amount. CleanAir believes that there was an error in measuring and recording this liquid volume following the test run. The moisture utilized during the following test run (Run 4) was utilized for Run 3 result calculations.

The analytical procedures in EPA Method 202 include an ammonium titration of the inorganic sample fractions with pH less than 7.0 to neutralize acids with hygroscopic properties such as H_2SO_4 that may be present in the sample. This step speeds up the sample desiccation process and allows the samples to come to a constant weight prior to weighing. The weight of ammonium added to the sample as a result of the titration is subtracted from the analytical result.

The laboratory performing the gravimetric analysis (Clean Air Analytical Services) has determined that only samples with an initial pH less than 4.5 require a significant amount of ammonium neutralization, resulting in a correction in excess of 0.5 mg. Based on this observation, the laboratory has altered their procedures. Only samples with a pH lower than 4.5 are titrated.

All of the inorganic sample fractions analyzed from Runs 1 through 8 had a pH less than 4.5 and were titrated. The field train reagent blanks had a pH above 4.5 and were not titrated. The sample fractions were observed to come to a constant weight without having to titrate the sample.

NH_3 Testing – USEPA CTM-027 - Stack

Two (2) 60-minute CTM-027 test runs were performed on August 30, 2016. Each test run was performed concurrently with Method 5F/202 testing.

Calculation of Final Results

Sample flow rates as determined by EPA Method 2 without the WEF corrections factor were used to calculate isokinetic sampling conditions.

Mass-based emission rates in units of pounds per hour (lb/hr) for Method 5F/202 and CTM-027 were calculated using the applicable average (pre-run and post run) or concurrent flow rate determined by Method 2F combined with the respective WEF correction factor.

Emission rates in units of tons per year (Ton/yr) were calculated using an assumed capacity factor of 8,760 operating hours per year. Emission rates in units of pounds per 1,000 pounds of coke burn (lb/Mlb coke) were calculated using coke burn rate data provided by MPC.

Ammonia (NH_3) injection rates shown in Tables 2-1 through 2-4 are the aqueous ammonia, (11FC2032), times 0.2.

End of Section 1 – Project Overview

RESULTS

Table 2-1:
NSFPM, CPM and Total PM_{10} (USEPA 5F/202) – Runs 1-4

Run No.		1	2	3	4	Average
Date (2016)		Aug 30	Aug 30	Aug 31	Aug 31	
Start Time (approx.)		10:45	13:56	08:35	10:43	
Stop Time (approx.)		11:57	15:06	09:48	11:50	
Process Conditions						
R_P	Production rate (lb coke/hr)	24,514	24,371	24,498	24,493	**24,469**
P_1	FCC charge rate (bpd)	41,007	41,008	41,004	40,999	**41,005**
P_2	NH3 Injection (lb/hr)	5.47	5.47	5.53	5.58	**5.51**
P_3	ESP Operation	Both/LPR	Both/LPR	Both/LPR	Both/LPR	
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	**8,760**
Gas Conditions						
O_2	Oxygen (dry volume %)	1.5	0.9	1.4	1.3	**1.3**
CO_2	Carbon dioxide (dry volume %)	15.9	16.6	16.7	16.8	**16.5**
T_s	Sample temperature (°F)	533	534	532	530	**532**
B_w	Actual water vapor in gas (% by volume)[1]	9.4	10.4	11.7	11.7	**10.8**
Gas Flow Rate[2]						
Q_a	Volumetric flow rate, actual (acfm)	155,000	156,000	151,000	154,000	**154,000**
Q_s	Volumetric flow rate, standard (scfm)	82,500	82,700	80,800	84,800	**82,700**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	74,800	74,100	71,300	74,800	**73,800**
Sampling Data						
V_{mstd}	Volume metered, standard (dscf)	38.20	38.36	38.37	38.79	**38.43**
%I	Isokinetic sampling (%)[3]	96.4	99.1	100.9	100.6	**99.2**
Laboratory Data						
m_n	Total NSFPM (g)	0.07624	0.07634	0.08319	0.08357	
m_{CPM}	Total CPM (g)	0.02680	0.02777	0.02600	0.03410	
m_{Part}	Total particulate (expressed as PM-10) (g)	0.10304	0.10412	0.10919	0.11767	
DLC	Detection level classification	ADL	ADL	ADL	ADL	
NSFPM Results						
C_{sd}	Particulate Concentration (lb/dscf)	4.4E-06	4.4E-06	4.8E-06	4.8E-06	**4.6E-06**
$E_{lb/hr}$	Particulate Rate (lb/hr)	20	20	20	21	**20**
$E_{T/yr}$	Particulate Rate (Ton/yr)	86	85	90	93	**89**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb coke)	0.8	0.8	0.8	0.9	**0.8**
CPM Results						
C_{sd}	Particulate Concentration (lb/dscf)	1.5E-06	1.6E-06	1.5E-06	1.9E-06	**1.6E-06**
$E_{lb/hr}$	Particulate Rate (lb/hr)	6.9	7.1	6.4	8.7	**7.3**
$E_{T/yr}$	Particulate Rate (Ton/yr)	30	31	28	38	**32**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb coke)	0.3	0.3	0.3	0.4	**0.3**
Total Particulate (as PM10) Results						
C_{sd}	Particulate Concentration (lb/dscf)	5.9E-06	6.0E-06	6.3E-06	6.7E-06	**6.2E-06**
$E_{lb/hr}$	Particulate Rate (lb/hr)	27	27	27	30	**28**
$E_{T/yr}$	Particulate Rate (Ton/yr)	117	117	118	132	**121**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb coke)	1.1	1.1	1.1	1.2	**1.1**

Average includes 4 runs.

Detection level classifications are defined as follows: 102716 122836

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

[1] The moisture results from Run 4 were utilized for Run 3.

[2] Gas flow rates obtained from bracketing or concurrent Method 2F test runs combined with the WAF determined by Method 2H.

[3] Sample flow rates as determined by EPA Method 2 were used to calculate isokinetic sampling conditions.

RESULTS

Table 2-2:
NSFPM, CPM and Total PM_{10} (USEPA 5F/202) – Runs 5-8

Run No.		5	6	7*	8	Average
Date (2016)		Aug 31	Aug 31	Aug 31	Sep 1	
Start Time (approx.)		15:26	17:38	19:23	11:42	
Stop Time (approx.)		16:33	18:45	20:29	12:51	
Process Conditions						
R_P	Production rate (lb coke/hr)	23,512	23,492	23,435	23,605	**23,536**
P_1	FCC charge rate (bpd)	40,997	41,010	41,005	40,986	**40,998**
P_2	NH3 Injection (lb/hr)	5.97	6.03	5.94	5.59	**5.86**
P_3	ESP Operation	Both/LPR	Both/LPR	Both/LPR	Both/LPR	
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	**8,760**
Gas Conditions						
O_2	Oxygen (dry volume %)	1.9	1.7	2.1	2.0	**1.9**
CO_2	Carbon dioxide (dry volume %)	16.1	16.5	16.1	16.2	**16.3**
T_s	Sample temperature (°F)	526	526	525	525	**525**
B_w	Actual water vapor in gas (% by volume)	11.1	11.0	11.1	10.1	**10.7**
Gas Flow Rate[1]						
Q_a	Volumetric flow rate, actual (acfm)	148,000	151,000	144,000	146,000	**148,000**
Q_s	Volumetric flow rate, standard (scfm)	83,900	82,500	85,600	83,500	**83,300**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	74,600	73,500	76,100	75,100	**74,400**
Sampling Data						
V_{mstd}	Volume metered, standard (dscf)	37.73	37.46	38.28	38.75	**37.98**
%I	Isokinetic sampling (%)[2]	100.5	100.8	101.2	101.1	**100.8**
Laboratory Data						
m_n	Total NSFPM (g)	0.06947	0.06450	0.06850	0.07270	
m_{CPM}	Total CPM (g)	0.04804	0.02671		0.02922	
m_{Part}	Total particulate (expressed as PM-10) (g)	0.11751	0.09122		0.10191	
DLC	Detection level classification	ADL	ADL	ADL	ADL	
NSFPM Results						
C_{sd}	Particulate Concentration (lb/dscf)	4.1E-06	3.8E-06	3.9E-06	4.1E-06	**4.0E-06**
$E_{lb/hr}$	Particulate Rate (lb/hr)	18	17	18	19	**18**
$E_{T/yr}$	Particulate Rate (Ton/yr)	80	73	79	82	**78**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb coke)	0.8	0.7	0.8	0.8	**0.8**
CPM Results						
C_{sd}	Particulate Concentration (lb/dscf)	2.8E-06	1.6E-06		1.7E-06	**2.0E-06**
$E_{lb/hr}$	Particulate Rate (lb/hr)	13	6.9		7.5	**9.0**
$E_{T/yr}$	Particulate Rate (Ton/yr)	55	30		33	**39**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb coke)	0.5	0.3		0.3	**0.4**
Total Particulate (as PM10) Results						
C_{sd}	Particulate Concentration (lb/dscf)	6.9E-06	5.4E-06		5.8E-06	**6.0E-06**
$E_{lb/hr}$	Particulate Rate (lb/hr)	31	24		26	**27**
$E_{T/yr}$	Particulate Rate (Ton/yr)	135	104		114	**118**
E_{Rp}	Particulate Rate - Production-based (lb/Mlb coke)	1.3	1.0		1.1	**1.1**

Average includes 3 runs. * indicates that the run is not included in the average.

Detection level classifications are defined as follows: 102716 122626

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

[1] Gas flow rates obtained from concurrent Method 2F test runs combined with the WAF determined by Method 2H.

[2] Sample flow rates as determined by EPA Method 2 were used to calculate isokinetic sampling conditions.

RESULTS

Table 2-3:
Uncertainty Analysis – NSFPM, CPM and Total PM_{10} – Runs 1-4

	NSFPM Results (lb/Mlb coke)		CPM Results (lb/Mlb coke)		Total PM (as PM10) Results (lb/Mlb coke)
Method	**5F**		**202**		**5F/202**
Run No.	**1** 0.805	**1**	0.283	**1**	1.088
	2 0.800	**2**	0.291	**2**	1.091
	3 0.835	**3**	0.261	**3**	1.097
	4 0.871	**4**	0.355	**4**	1.226
SD	0.0324		0.0404		0.0669
AVG	**0.828**		**0.298**		**1.126**
RSD	3.9%		13.6%		5.9%
N	4		4		4
SE	0.0162		0.0202		0.0335
RSE	2.0%		6.8%		3.0%
P	95.0%		95.0%		95.0%
TINV	3.18		3.18		3.18
CI +	0.879		0.362		1.232
AVG	**0.828**		**0.298**		**1.126**
CI -	0.776		0.233		1.019
TB +	0.995		0.506		1.47

AVG (average) is the mean value of the runs; N is the number of individual runs.
SD (standard deviation) and RSD (relative standard deviation) are measures of the variability of individual runs.

SE (standard error) and RSE (relative standard error) are measures of the variability of the average of the runs.
P (probability) is the confidence level associated with the two-tailed Student's t-distribution.
TINV (t-value) is the value of the Student's t-distrubution as a function of P (probability) and N-1 (degrees of freedom).

CI (confidence interval) indicates that if the test is conducted again under the same conditions, the average would be expected to fall within the interval (CI- to CI+) about 95% of the time.
TB+ (upper tolerance bound) is the value below which 95% of future runs are expected to fall (assuming testing at the same conditions).

RESULTS

Table 2-4:
NH_3 (USEPA CTM-027) – Runs 1-2

Run No.		1	2	Average
Date (2016)		Aug 30	Aug 30	
Start Time (approx.)		10:45	13:56	
Stop Time (approx.)		11:57	15:06	
Process Conditions				
RP	Coke burn-off rate (lb coke/hr)	24,514	24,371	**24,443**
P_1	FCC charge rate (bpd)	41,000	41,000	**41,000**
P_2	ESP operation	Both/LPR	Both/LPR	
P_3	NH3 injection (lb/hr)	5.47	5.47	**5.47**
Cap	Capacity factor (hours/year)	8,760	8,760	**8,760**
Gas Conditions				
O_2	Oxygen (dry volume %)	1.0	0.6	**0.8**
CO_2	Carbon dioxide (dry volume %)	16.5	16.8	**16.7**
T_s	Sample temperature (°F)	531	532	**532**
B_w	Actual water vapor in gas (% by volume)	11.7	11.5	**11.6**
Gas Flow Rate[1]				
Q_a	Volumetric flow rate, actual (acfm)	155,000	156,000	**156,000**
Q_s	Volumetric flow rate, standard (scfm)	82,500	82,700	**82,600**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	74,800	74,100	**74,500**
Sampling Data				
V_{mstd}	Volume metered, standard (dscf)	39.69	40.99	**40.34**
%I	Isokinetic sampling (%)[2]	96.1	99.7	**97.9**
Laboratory Data				
m_n	Total NH_3 collected (mg)	6.31537	6.21117	
Ammonia (NH_3) Results				
C_{sd}	Ammonia Concentration (lb/dscf)	3.51E-07	3.34E-07	**3.42E-07**
C_{sd}	Ammonia Concentration (ppmdv)	7.94	7.56	**7.75**
$E_{lb/hr}$	Ammonia Rate (lb/hr)	1.57	1.49	**1.53**
$E_{T/yr}$	Ammonia Rate (Ton/yr)	6.90	6.51	**6.70**
E_{Rp}	Ammonia Rate - Production-based (lb/Mlb coke)	0.0642	0.0609	**0.0626**

Average includes 2 runs. 091616 144047

[1] Gas flow rates obtained from concurrent Method 2F test runs combined with the WAF determined by Method 2H.

[2] Sample flow rates as determined by EPA Method 2 were used to calculate isokinetic sampling conditions.

End of Section 2 – Results

DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

MPC's facility in Detroit, Michigan, produces refined petroleum products from crude oil. MPC must continue to demonstrate that select process units are in compliance with permitted emission limits.

The Fluid Catalytic Cracking Unit (EU11-FCCU-S1) utilizes a primary reactor, a distillation column and a catalyst regeneration unit to continuously generate light hydrocarbon products from heavy oil feeds. The FCCU is equipped with an ESP with two (2) bays and variable aqueous NH_3 injection to control emissions. Emissions are vented to the atmosphere via the FCCU Regenerator Stack (SVFCCU).

The testing described in this document was performed at the FCCU Regenerator Stack.

DESCRIPTION OF SAMPLING LOCATIONS

Sampling point locations were determined according to USEPA Method 1 and 2H.

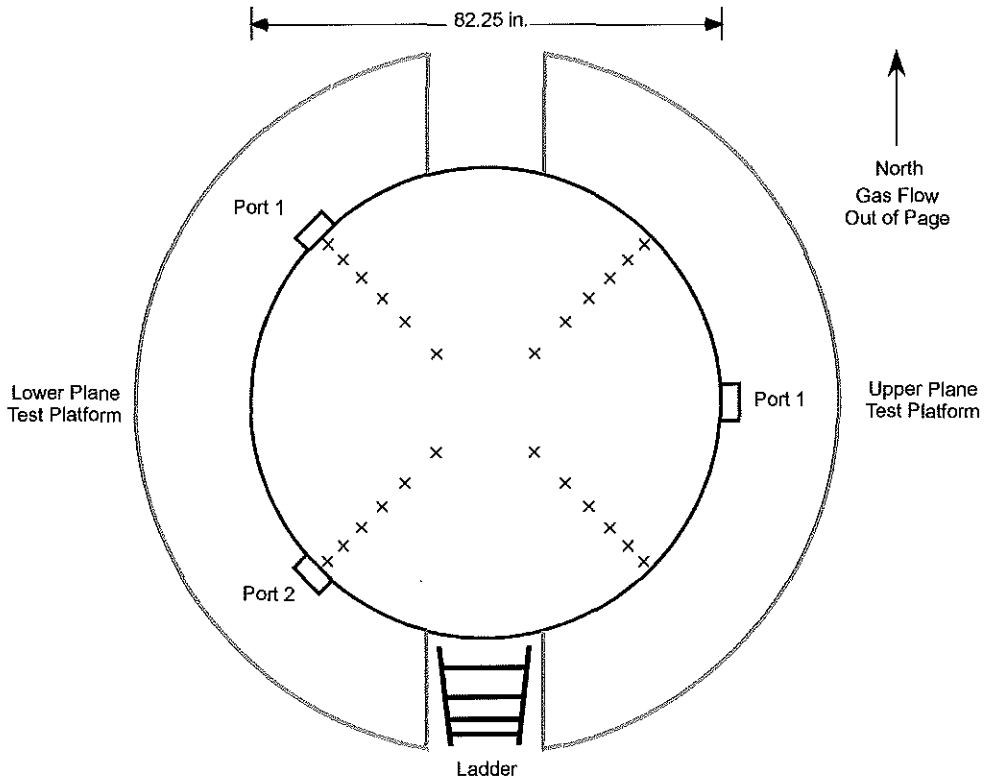
Table 3-1 outlines the sampling point configurations. The figures shown on pages 3-2 and 3-3 illustrate the sampling points and orientation of sampling ports.

Table 3-1:
Sampling Points

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
FCCU Regenerator Stack							
Flow Rate	USEPA 2F	1-9	2	12	varied	varied	3-1
Velocity Decay	USEPA 2H	1	2	6	varied	varied	3-2
NSFPM / CPM	USEPA 5F / 202	1-8	2	12	2.5	60	3-1
NH_3	USEPA CTM-027	1-2	2	12	2.5	60	3-1

100716 161227

DESCRIPTION OF INSTALLATION



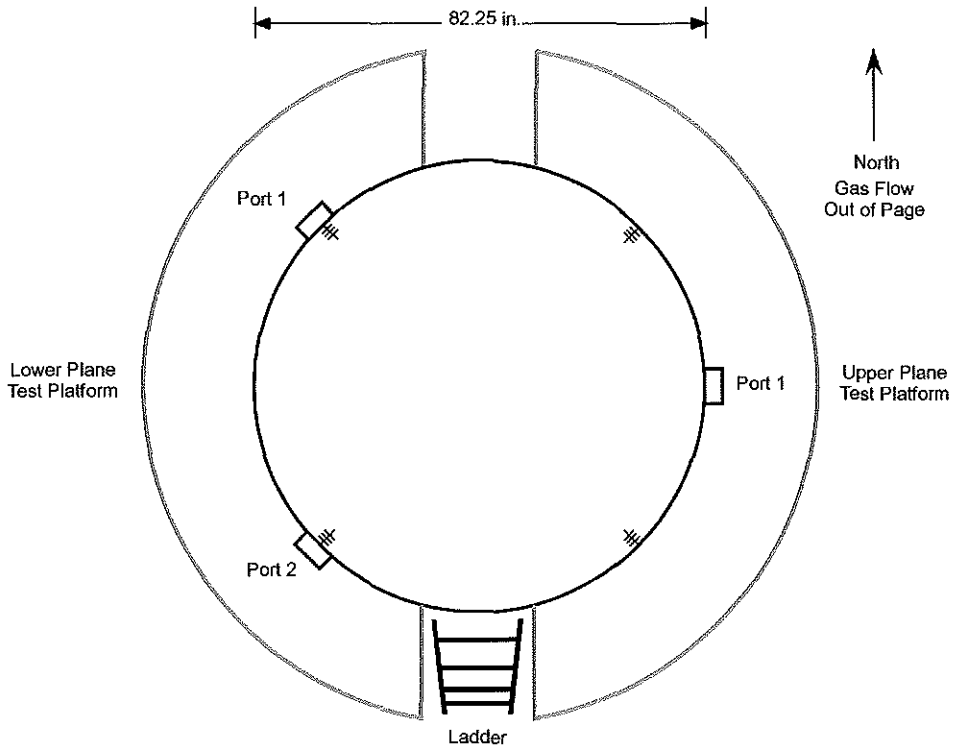
Note: Ports on the lower plane were used for these points.

Traverse Point	Port to Point Distance (in.)
1	80.5
2	76.7
3	72.5
4	67.7
5	61.7
6	53.0
7	29.3
8	20.6
9	14.6
10	9.7
11	5.5
12	1.7

Duct diameters upstream from flow disturbance (A):	2.2	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	3.4	Limit: 2.0

Figure 3-1: USEPA Method 2F, 5F/202 and CTM-027 Traverse/Sampling Points

DESCRIPTION OF INSTALLATION



Note: Ports on the lower plane were used for these points.

Traverse Point	Port to Point Distance (in.)
1	81.25
2	80.25
3	79.25
4	3.0
5	2.0
6	1.0

Duct diameters upstream from flow disturbance (A):	2.2	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	3.4	Limit: 2.0

Figure 3-2: USEPA Method 2H Traverse Points

End of Section 3 – Description of Installation

METHODOLOGY

Clean Air Engineering followed procedures as detailed in USEPA Methods 1, 2, 2F, 2H, 3, 3A, 4, 5F, 202 and CTM-027. The following table summarizes the methods and their respective sources.

Table 4-1:
Summary of Sampling Procedures

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 2F	"Determination of Stack Gas Velocity And Volumetric Flow Rate with Three-Dimensional Probes"
Method 2H	"Determination of Stack Gas Velocity Taking into Account Velocity Decay near the Stack Wall"
Method 3	"Gas Analysis for the Determination of Dry Molecular Weight"
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 5F	"Determination of Nonsulfate Particulate Matter Emissions from Stationary Sources"
Title 40 CFR Part 51 Appendix M	
Method 202	"Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources"
Conditional Test Methods (CTM)	
CTM-027	"Procedure for Collection and Analysis of Ammonia in Stationary Sources"

These methods appear in detail in Title 40 of the Code of Federal Regulations (CFR) and are located on the internet at http://ecfr.gpoaccess.gov.

Diagrams of the sampling apparatus and major specifications of the sampling, recovery and analytical procedures are summarized for each method in Appendix A.

CleanAir followed specific quality assurance and quality control (QA/QC) procedures as outlined in the individual methods and as prescribed in CleanAir's internal Quality Manual. Results of all QA/QC activities performed by CleanAir are summarized in Appendix D.

METHODOLOGY

PM and PM_{10} Testing - USEPA Method 5F/202

PM and PM_{10} emissions were determined using USEPA Method 5F/202.

- For this test program, PM is assumed equivalent to non-sulfate filterable particulate matter (NSFPM). Per 40 CFR Subpart Ja §60.104a, USEPA Method 5F is permitted for measuring front-half PM emissions from FCCUs.
- PM_{10} is equivalent to the sum of filterable particulate matter less than 10 micrometers (μm) in diameter (FPM_{10}) and condensable particulate matter (CPM). The Method 5F/202 sample train yields a front-half, non-sulfate FPM result and a back-half, CPM result. The total non-sulfate PM result (NSFPM plus CPM) from Method 5F/202 can be used as a worst-case estimation of Total PM_{10} since Method 5F will collect all non-sulfate filterable particulate matter present in the flue gas (regardless of particle size).

The front-half (Method 5F portion) of the sampling train consisted of a glass nozzle, glass liner and filter holder heated to 320°F, and a quartz fiber filter heated to 320°F. Flue gas samples were extracted isokinetically; nozzle and probe liner recoveries were performed using de-ionized water (DI H_2O) as the recovery solvent.

The back-half (Method 202 portion) of the sampling train is designed to mimic ambient conditions and collect only the particles that would truly form CPM in the atmosphere by minimizing the sulfur dioxide (SO_2) and nitrogen oxide (NO_X) interferences observed with earlier versions of the method, in which flue gas was bubbled through cold water and SO_2 and NO_X were absorbed and partially oxidized before they could be purged out with nitrogen (N_2).

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 tetrafluoroethane (TFE) 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 to 85°F.

After exiting the ambient filter, the flue gas passed through two (2) 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. The sample gas then flowed into a calibrated dry gas meter where the collected sample gas volume was determined.

METHODOLOGY

The front-half portion of the sample train (nozzle, probe and heated filter) was recovered per Method 5F requirements. The back-half of the sample train (heated filter outlet, condenser, dry impingers and TFE membrane filter) was recovered per Method 202 requirements. The impinger train was purged with nitrogen (N_2) at a rate of 14 liters per minute (lpm) for one (1) 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°F during transport to the laboratory.

NH_3 Testing – USEPA CTM-027

NH_3 emissions were determined using a CTM-027 and an isokinetic, multi-point sample train. The sampling system consisted of a glass nozzle, in-stack quartz filter, glass-lined heated probe, impinger train (for NH_3 collection and H_2O removal and measurement) and a dry gas meter. The NH_3-collecting impingers were charged with 0.1 N sulfuric acid (H_2SO_4) solution.

The sampling system traversed all of the Method 1 points during each run. A minimum volume of 0.9 dry standard cubic meters (dscm), or 31.8 dry standard cubic feet (dscf), were sampled during each sixty (60) minute run.

The sample train was recovered per CTM-027 requirements. The front-half assembly (components prior to the in-stack filter) was not recovered or analyzed, as gaseous NH_3 passed through without reacting or changing state. The three (3) NH_3-collecting impingers were recovered separately per CTM-027 requirements. The back-half of the sample train prior to Impinger 1 (heated probe and connecting glassware) was rinsed into Impinger 1.

Samples from Runs 1 and 2 were analyzed by CleanAir Analytical Services using ion chromatography (IC) analysis.

METHODOLOGY

General Considerations

A traditional verification of the absence of cyclonic flow following Method 1 specifications was not performed. However, absence of cyclonic flow was demonstrated by measuring the resultant angle of flow during each Method 2F flow traverse which yielded less than 20° in all instances. Data is included in Appendix G.

H_2O data used for moisture correction of concentration data was obtained (when required) for Method 5F/202 and CTM-027 by Method 4 measurements incorporated into the sampling and recovery procedures.

O_2, CO_2, H_2O data used for Method 2H and Method 2F flow calculations was obtained from the most concurrently operated Method 5F/202 sample trains.

End of Section 4 – Methodology