



Marathon Petroleum Company LP  
1300 South Fort Street  
Detroit, MI 48217

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**REPORT ON RATA & COMPLIANCE TESTING**

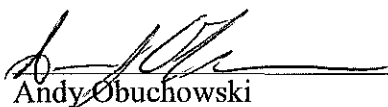
Performed for:  
**MARATHON PETROLEUM COMPANY LP**  
**FCCU CHARGE HEATER STACK (SV11-H1)**  
**DETROIT REFINERY**

Client Reference No: 4100356132  
CleanAir Project No: 12799  
Revision 0: September 29, 2015

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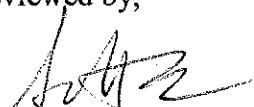
To the best of our knowledge, the data presented in this report are accurate, complete, error free, legible and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air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

Submitted by,



Andy Obuchowski  
Midwest Engineering Group Leader  
aobuchowski@cleanair.com  
(800) 627-0033 ext. 4537

Reviewed by,



Scott Lehmann  
Engineering Group Business Leader  
slehmann@cleanair.com  
(800) 627-0033 ext. 4660

MICHIGAN DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT  
AIR QUALITY DIVISION

**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 Natural Resources and Environment, 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-A9831-2012b ROP Section No. 01

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 10/2/2015 To 10/2/2015

Additional monitoring reports or other applicable documents required by the ROP are attached as described:  
Submission of the FCCU Charge Heater emissions compliance and RATA testing performed  
August 4 & 5, 2015.

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

**MPC Investment LLC,**  
**its General Partner**  
**Deputy Assistant Secretary**  
Title

Mr. Dave Roland  
Name of Responsible Official (print or type)

313-843-9100  
Phone Number

Signature of Responsible Official

10/2/2015  
Date

\* Photocopy this form as needed.

EQP 5736 (Rev 2-10)

## PROJECT OVERVIEW

1-1

### INTRODUCTION

Marathon Petroleum Company LP (MPC) contracted Clean Air Engineering (CleanAir) to perform emission measurements at the Detroit Refinery for relative accuracy test audit (RATA) and compliance purposes. Additional emission measurements were also made for diagnostic purposes.

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 (DEQ). The permit limits are referenced in Michigan Department of Environmental Quality, Air Quality Division Permit to Install No. 63-08D, issued May 12, 2014.

### Key Project Participants

Individuals responsible for coordinating and conducting the test program were:

Crystal Davis – MPC  
Joe Reidy – MPC  
Thomas Gasloli – DEQ  
Medel Cendana – CleanAir

### Test Program Parameters

The testing was performed at the FCCU Charge Heater Stack (Emission Unit ID No. EU11-FCCUCHARHTR-S1; Stack ID No. SV11-H1) on August 4-5, 2015, and included the following emissions measurements:

- particulate matter (PM), assumed equivalent to filterable particulate matter (FPM) only
- volatile organic compounds (VOCs), assumed equivalent to total hydrocarbons (THC) minus the following constituents:
  - methane (CH<sub>4</sub>)
  - ethane (C<sub>2</sub>H<sub>6</sub>)
- carbon monoxide (CO)
- flue gas composition (e.g. O<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>O)
- flue gas flow rate

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**PROJECT OVERVIEW**

1-2

**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 Charge Heater Stack	USEPA Method 5	FPM	08/04/15	10:42	13:15
2	FCCU Charge Heater Stack	USEPA Method 5	FPM	08/04/15	14:17	16:34
3	FCCU Charge Heater Stack	USEPA Method 5	FPM	08/04/15	17:09	19:21
4	FCCU Charge Heater Stack	USEPA Method 5	FPM	08/05/15	09:20	11:34
5	FCCU Charge Heater Stack	USEPA Method 5	FPM	08/05/15	12:15	14:26
6	FCCU Charge Heater Stack	USEPA Method 5	FPM	08/05/15	14:54	17:16
1	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	10:37	10:58
2	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	11:07	11:28
3	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	11:40	12:01
4	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	12:10	12:31
5	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	12:41	13:02
6	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	13:10	13:31
7	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	13:41	14:02
8	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	14:18	14:39
9	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	15:00	15:21
10	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	15:36	15:57
11	FCCU Charge Heater Stack	USEPA Method 3A/10	O <sub>2</sub> /CO <sub>2</sub> /CO	08/04/15	16:06	16:27
1	FCCU Charge Heater Stack	USEPA Method 3A/18/25A	O <sub>2</sub> /CO <sub>2</sub> /CH <sub>4</sub> /C <sub>2</sub> H <sub>6</sub> /THC	08/04/15	10:37	12:01
2	FCCU Charge Heater Stack	USEPA Method 3A/18/25A	O <sub>2</sub> /CO <sub>2</sub> /CH <sub>4</sub> /C <sub>2</sub> H <sub>6</sub> /THC	08/04/15	12:10	13:31
3	FCCU Charge Heater Stack	USEPA Method 3A/18/25A	O <sub>2</sub> /CO <sub>2</sub> /CH <sub>4</sub> /C <sub>2</sub> H <sub>6</sub> /THC	08/04/15	13:41	15:21

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**PROJECT OVERVIEW**

1-3

**Results Summary**

Tables 1-2 and 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 2-9.

**Table 1-2:  
Summary of Emission Compliance Results**

<u>Source</u>				
Constituent (units)	Fuel type	Sampling Method	Average Emission	Permit Limit <sup>1</sup>
<u>FCCU Heater Stack</u>				
PM (lb/MMBtu)	Refinery gas & Disulfide off-gas	USEPA 5	0.0027	N/A
VOC (lb/MMBtu)	Refinery gas & Disulfide off-gas	USEPA 18/25A	<5.2E-04	0.0055
CO (lb/MMBtu)	Refinery gas & Disulfide off-gas	USEPA 10	<0.0004	0.02
PM (lb/MMBtu)	Refinery gas	USEPA 5	0.0015	0.0019

<sup>1</sup> Permit limits obtained from MDEQ Permit To Install No. 63-08D.

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**Table 1-3:  
Summary of RATA Results**

<u>Source</u>				
Constituent (Units)	Reference Method (USEPA)	Applicable Specification	Relative Accuracy <sup>1</sup>	Specification Limit <sup>2</sup>
<u>FCCU Charge Heater Stack</u>				
O <sub>2</sub> (% dv)	3A	PS3	0.3	±1.0% dv
CO (lb/MMBtu)	10	PS4A <sup>3</sup>	0.0	5% of Standard

<sup>1</sup> Relative Accuracy is expressed in terms of comparison to the reference method (% RM) or applicable emission standard (% Std.).

<sup>2</sup> Specification limits obtained from 40 CFR 60, Appendix B, Performance Specifications.

<sup>3</sup> For any sources emitting less than 200 ppmv of CO, PS4A applies. The PS4A RA limit is either < 10% of RM, < 5% of Standard, or ± 5 ppmv (abs. average difference plus 2.5 x confidence coefficient).

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**PROJECT OVERVIEW**

1-4

***Discussion of Test Program******FPM Testing - USEPA Method 5***

For this test program, PM emission rate is assumed equivalent to FPM emission rate. Three (3) 120-minute Method 5 test runs were performed on August 4, 2015, with the unit firing refinery gas and disulfide off-gas for diagnostic purposes. The final result was expressed as the average of three (3) valid runs.

The moisture value for Run 1 was not determined because the water contents of the knockout jars were partially spilled during the recovery process. The average moisture value from Runs 2 and 3 was applied to Run 1 for all calculations. Tom Maza of MDEQ was on-site to witness this and approved of the alternative approach.

Three (3) 120-minute Method 5 test runs were performed on August 5, 2015, with the unit firing refinery gas only for compliance purposes. The final result was expressed as the average of three (3) runs and was below the permit limit for PM.

***O<sub>2</sub> and CO Emissions / RATA Testing - USEPA Methods 3A and 10; Performance Specifications 2 and 4/4A***

Minute-average data points for O<sub>2</sub> and CO (dry basis) were collected over a period of 21 minutes for each RATA Reference Method (RM) run. The average result for each RM run was calculated and compared to the average result from the facility's CEMS over an identical time interval in order to calculate relative accuracy (RA).

Eleven (11) RATA test runs were performed at the FCCU Charge Heater Stack on August 4, 2015. The RATA results are as follows:

- For O<sub>2</sub>, RA is expressed as the average absolute difference between the RM and facility CEMS runs. The final result was below the limit of  $\pm 1.0\%dv$  set by PS3.
- For CO (ppmdv), the RA is expressed as the average absolute difference between the RM and facility CEMS runs, plus the 2.5% confidence coefficient. The final result was below the limit of  $\pm 5$  ppmdv set by PS4A.
- For CO (lb/MMBtu), RA is expressed as the percent difference between RM and the facility CEMS. The final result was below the limit of 5% (as % of applicable emission standard) set by PS4A.

## PROJECT OVERVIEW

1-5

Reference method and facility RATA test run averages which were negative were treated as zero when calculating the relative accuracy.

The facility CEMS results as lb/MMBtu were calculated and provided by MPC along with all other applicable RATA and process data and can be found in Appendix H.

RM CO results from the RATA were used to demonstrate compliance with the permit limit. The final results were expressed as the average of the 11 valid RM RATA runs for CO. The final results were below the permit limit.

CleanAir measured CO drift-corrected concentrations which were negative and consequently below the assumed detection limit of 1% of the instrument calibration span for all test runs. The worst-case concentration results used to calculate mass-based emissions in regards to the emission compliance test is defined as some number "less than" 1% of the calibration span.

### *VOC Testing - USEPA Methods 25A and 18*

VOC testing was performed concurrently with the RATA testing. Nine (9) 21-minute Method 25 test runs for THCs were performed concurrently with three (3) Method 18 bag collections for CH<sub>4</sub> and C<sub>2</sub>H<sub>6</sub>, with each Method 18 sample collected over a period of about 63 minutes.

The Method 18 samples on the FCCU Charge Heater were collected as follows:

- Method 18 Run 1: Collected during Method 25A Runs 1, 2 and 3
- Method 18 Run 2: Collected during Method 25A Runs 4, 5 and 6
- Method 18 Run 3: Collected during Method 25A Runs 7, 8 and 9

VOC emission rate is normally equivalent to THC emission rate, minus CH<sub>4</sub> and C<sub>2</sub>H<sub>6</sub> emission rate (lb/MMBtu for all constituents). For CH<sub>4</sub> and C<sub>2</sub>H<sub>6</sub>, a non-detectable result was obtained for all runs, so no correction was made to the THC results. Therefore, VOC emissions are equivalent to THC emissions. The final results were expressed as the average of three (3) valid runs and were below the permit limit.

**PROJECT OVERVIEW**

1-6

*Fuel Analysis & Calculation of Final Results*

Testing on August 5, 2015, occurred with the unit firing refinery gas only; MPC provided CleanAir with a refinery gas analysis corresponding to the date of testing. An oxygen-based fuel factor ( $F_d$ ) for refinery gas was calculated per USEPA Method 19 specifications, from percent volume composition analytical data included in the fuel gas analysis and tabulated heating values for each of the measured constituents. The calculated  $F_d$  was used to convert emission results in units of dry volume-based concentration (lb/dscf) to units of pounds per million Btu (lb/MMBtu).

Testing on August 4, 2015, occurred with the unit firing refinery gas and disulfide off-gas. When the unit utilizes both of these gases, natural gas must also be added to the fuel stream. MPC provided CleanAir with a gas analysis for refinery gas (sampled August 4, 2015), disulfide off-gas (sampled August 4, 2015), and natural gas (sampled August 13, 2015).

MPC also provided CleanAir with fuel flow rates for all 3 gases for the duration of each test run. The fuel flow rates for refinery gas and disulfide off-gas was corrected by MPC based on a meter correction factor, and the fuel flow rate for natural gas was estimated by MPC.

An  $F_d$  for refinery gas and disulfide off-gas was calculated in the same manner as outlined on the previous page. A default  $F_d$  for natural gas was utilized and obtained from USEPA Method 19, Table 19-2. Heat input was calculated using the respective  $F_d$  and fuel flow rate for each fuel. A combined  $F_d$  for each test run was calculated utilizing the fraction of total heat input for each fuel. The calculated combined  $F_d$  was used to convert emission results in units of dry volume-based concentration (lb/dscf and ppm<sub>dv</sub>) to units of lb/MMBtu.

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*End of Section 1 – Project Overview*



**RESULTS****Table 2-1:  
FCCU Charge Heater Stack – Runs 1-3 – FPM Emissions (USEPA 5)**

Run No.		1	2	3	Average
Date (2015)		Aug 4	Aug 4	Aug 4	
Start Time (approx.)		10:42	14:17	17:09	
Stop Time (approx.)		13:15	16:34	19:21	
<b>Process Conditions</b>					
R <sub>p</sub>	FCC charge rate (BPD)	38,003	37,986	38,000	<b>37,996</b>
P <sub>1</sub>	Refinery gas flow rate (Mscf/day)	1,556	1,543	1,515	<b>1,538</b>
P <sub>2</sub>	Disulfide off-gas flow rate (Mscf/day)	111	110	111	<b>110</b>
P <sub>3</sub>	Natural gas flow rate (Mscf/day)	37	37	37	<b>37</b>
F <sub>d</sub>	Oxygen-based F-factor (dscf/MMBtu)	8,341	8,345	8,346	<b>8,344</b>
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	<b>8,760</b>
<b>Gas Conditions</b>					
O <sub>2</sub>	Oxygen (dry volume %)	3.2	3.1	3.3	<b>3.2</b>
CO <sub>2</sub>	Carbon dioxide (dry volume %)	10.2	10.6	10.6	<b>10.5</b>
T <sub>s</sub>	Sample temperature (°F)	526	525	519	<b>523</b>
B <sub>w</sub>	Actual water vapor in gas (% by volume)	16.5	16.8	16.2	<b>16.5</b>
<b>Gas Flow Rate</b>					
Q <sub>a</sub>	Volumetric flow rate, actual (acfm)	39,700	37,900	37,600	<b>38,400</b>
Q <sub>s</sub>	Volumetric flow rate, standard (scfm)	20,700	19,900	19,800	<b>20,100</b>
Q <sub>std</sub>	Volumetric flow rate, dry standard (dscfm)	17,300	16,500	16,600	<b>16,800</b>
<b>Sampling Data</b>					
V <sub>mstd</sub>	Volume metered, standard (dscf)	64.01	61.96	61.52	<b>62.50</b>
%I	Isokinetic sampling (%)	98.8	100.3	99.3	<b>99.4</b>
<b>Laboratory Data</b>					
m <sub>n</sub>	Total FPM (g)	0.00719	0.00825	0.00798	
n <sub>MDL</sub>	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
<b>FPM Results</b>					
C <sub>std</sub>	Particulate Concentration (lb/dscf)	2.48E-07	2.94E-07	2.86E-07	<b>2.76E-07</b>
E <sub>lb/hr</sub>	Particulate Rate (lb/hr)	0.257	0.291	0.284	<b>0.278</b>
E <sub>T/yr</sub>	Particulate Rate (Ton/yr)	1.13	1.27	1.25	<b>1.22</b>
E <sub>Fd</sub>	Particulate Rate - F <sub>d</sub> -based (lb/MMBtu)	0.00244	0.00288	0.00283	<b>0.00272</b>

Average includes 3 runs.

Detection level classifications are defined as follows:

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

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**RESULTS**

**Table 2-2:  
FCCU Charge Heater Stack – Runs 1-3 – Uncertainty Analysis – FPM (USEPA 5)**

Method Run No.	FPM Results (lb/dscf)		FPM Results (lb/hr)		FPM Results (lb/MMBtu)	
	1	5	1	5	1	5
	2	2.48E-07	2	0.257	2	0.00244
	3	2.94E-07	3	0.291	3	0.00288
		2.86E-07		0.284		0.00283
<b>SD</b>		2.46E-08		0.0178		2.41E-04
<b>AVG</b>		<b>2.76E-07</b>		<b>0.278</b>		<b>0.00272</b>
<b>RSD</b>		8.9%		6.4%		8.9%
<b>N</b>		3		3		3
<b>SE</b>		1.42E-08		0.0103		1.39E-04
<b>RSE</b>		5.2%		3.7%		5.1%
<b>P</b>		95.0%		95.0%		95.0%
<b>TINV</b>		4.303		4.30		4.303
<b>CI +</b>		3.37E-07		0.322		0.00331
<b>AVG</b>		<b>2.76E-07</b>		<b>0.278</b>		<b>0.00272</b>
<b>CI -</b>		2.15E-07		0.233		0.00212
<b>TB +</b>		4.64E-07		0.414		0.00456

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-distribution 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 2-3:  
FCCU Charge Heater Stack – Runs 4-6 – FPM Emissions (USEPA 5)**

Run No.		4	5	6	Average
Date (2015)		Aug 5	Aug 5	Aug 5	
Start Time (approx.)		09:20	12:15	14:54	
Stop Time (approx.)		11:34	14:26	17:16	
<b>Process Conditions</b>					
P <sub>r</sub>	Refinery gas flow rate (Mscf/day)	1,552	1,561	1,550	<b>1,554</b>
F <sub>d</sub>	Oxygen-based F-factor (dscf/MMBtu)	8,308	8,308	8,308	<b>8,308</b>
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	<b>8,760</b>
<b>Gas Conditions</b>					
O <sub>2</sub>	Oxygen (dry volume %)	3.5	3.2	3.6	<b>3.4</b>
CO <sub>2</sub>	Carbon dioxide (dry volume %)	10.4	10.4	10.2	<b>10.3</b>
T <sub>s</sub>	Sample temperature (°F)	528	527	525	<b>527</b>
B <sub>w</sub>	Actual water vapor in gas (% by volume)	16.6	16.5	16.4	<b>16.5</b>
<b>Gas Flow Rate</b>					
Q <sub>a</sub>	Volumetric flow rate, actual (acfm)	38,200	37,900	38,900	<b>38,300</b>
Q <sub>s</sub>	Volumetric flow rate, standard (scfm)	20,000	19,900	20,400	<b>20,100</b>
Q <sub>std</sub>	Volumetric flow rate, dry standard (dscfm)	16,700	16,600	17,100	<b>16,800</b>
<b>Sampling Data</b>					
V <sub>mstd</sub>	Volume metered, standard (dscf)	63.00	62.11	63.51	<b>62.87</b>
%I	Isokinetic sampling (%)	100.8	100.1	99.4	<b>100.1</b>
<b>Laboratory Data</b>					
m <sub>n</sub>	Total FPM (g)	0.00453	0.00432	0.00393	
n <sub>MDL</sub>	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
<b>FPM Results</b>					
C <sub>sd</sub>	Particulate Concentration (lb/dscf)	1.59E-07	1.53E-07	1.36E-07	<b>1.49E-07</b>
E <sub>lphr</sub>	Particulate Rate (lb/hr)	0.159	0.153	0.140	<b>0.151</b>
E <sub>T/yr</sub>	Particulate Rate (Ton/yr)	0.696	0.669	0.613	<b>0.659</b>
E <sub>Fd</sub>	Particulate Rate - F <sub>d</sub> -based (lb/MMBtu)	0.00158	0.00150	0.00137	<b>0.00149</b>

Average includes 3 runs.

Detection level classifications are defined as follows:

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

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**RESULTS**

**Table 2-4:  
FCCU Charge Heater Stack – Runs 4-6 – Uncertainty Analysis – FPM (USEPA 5)**

	FPM Results (lb/dscf)		FPM Results (lb/hr)		FPM Results (lb/MMBtu)	
<b>Method</b>	<b>5</b>		<b>5</b>		<b>5</b>	
<b>Run No.</b>	<b>1</b>	1.59E-07	<b>1</b>	0.159	<b>1</b>	0.00158
	<b>2</b>	1.53E-07	<b>2</b>	0.153	<b>2</b>	0.00150
	<b>3</b>	1.36E-07	<b>3</b>	0.140	<b>3</b>	0.00137
<b>SD</b>		1.16E-08		0.0097		1.07E-04
<b>AVG</b>		1.49E-07		0.151		0.00148
<b>RSD</b>		7.7%		6.5%		7.2%
<b>N</b>		3		3		3
<b>SE</b>		6.67E-09		0.0056		6.19E-05
<b>RSE</b>		4.5%		3.7%		4.2%
<b>P</b>		95.0%		95.0%		95.0%
<b>TINV</b>		4.303		4.30		4.303
<b>CI +</b>		1.78E-07		0.175		0.00175
<b>AVG</b>		1.49E-07		0.151		0.00148
<b>CI -</b>		1.21E-07		0.126		0.00122
<b>TB +</b>		2.38E-07		0.225		0.00230

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-distribution 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 2-5:  
FCCU Charge Heater Stack – THC, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub> & VOC Emissions (USEPA 25A/18)**

Run No.		1	2	3	Average
Date (2015)		Aug 4	Aug 4	Aug 4	
Start Time (approx.)		10:37	12:10	13:41	
Stop Time (approx.)		12:01	13:31	15:21	
<b>Process Conditions</b>					
R <sub>p</sub>	FCC charge rate (BPD)	38,000	38,007	37,993	<b>38,000</b>
P <sub>1</sub>	Refinery gas flow rate (Mscf/day)	1,555	1,558	1,541	<b>1,551</b>
P <sub>2</sub>	Disulfide off-gas flow rate (Mscf/day)	111	110	110	<b>110</b>
P <sub>3</sub>	Natural gas flow rate (Mscf/day)	37	37	37	<b>37</b>
F <sub>d</sub>	Oxygen-based F-factor (dscf/MMBtu)	8,341	8,345	8,345	<b>8,344</b>
<b>Gas Conditions</b>					
O <sub>2</sub>	Oxygen (dry volume %)	2.9	2.8	2.9	<b>2.9</b>
CO <sub>2</sub>	Carbon dioxide (dry volume %)	10.7	10.8	10.8	<b>10.8</b>
B <sub>w</sub>	Actual water vapor in gas (% by volume) <sup>1</sup>	16.5	16.5	16.8	<b>16.6</b>
<b>THC Results</b>					
C <sub>sd</sub>	Concentration (ppmdv as C <sub>3</sub> H <sub>8</sub> )	<0.501	<0.417	<0.501	<b>&lt;0.473</b>
C <sub>sd</sub>	Concentration (lb/dscf)	<5.74E-08	<4.77E-08	<5.74E-08	<b>&lt;5.42E-08</b>
E <sub>Fd</sub>	Emission Rate - F <sub>d</sub> -based (lb/MMBtu)	<5.55E-04	<4.60E-04	<5.55E-04	<b>&lt;5.23E-04</b>
<b>Methane Results</b>					
C <sub>sd</sub>	Concentration (ppmdv)	<0.124	<0.124	<0.124	<b>&lt;0.124</b>
C <sub>sd</sub>	Concentration (lb/dscf)	<5.16E-09	<5.16E-09	<5.16E-09	<b>&lt;5.16E-09</b>
E <sub>Fd</sub>	Emission Rate - F <sub>d</sub> -based (lb/MMBtu)	<5.00E-05	<4.97E-05	<5.00E-05	<b>&lt;4.99E-05</b>
<b>Ethane Results</b>					
C <sub>sd</sub>	Concentration (ppmdv)	<0.0826	<0.0826	<0.0826	<b>&lt;0.0826</b>
C <sub>sd</sub>	Concentration (lb/dscf)	<6.45E-09	<6.45E-09	<6.45E-09	<b>&lt;6.45E-09</b>
E <sub>Fd</sub>	Emission Rate - F <sub>d</sub> -based (lb/MMBtu)	<6.24E-05	<6.21E-05	<6.24E-05	<b>&lt;6.23E-05</b>
<b>VOC Results</b>					
E <sub>Fd</sub>	Emission Rate - F <sub>d</sub> -based (lb/MMBtu)	<5.55E-04	<4.60E-04	<5.55E-04	<b>&lt;5.23E-04</b>

Average includes 3 runs.

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<sup>1</sup> Moisture data used for ppmwv to ppmdv correction obtained from nearly-concurrent M-5 runs.

For THC, '&lt;' indicates a measured response below the detection limit (assumed to be 1% of the instrument calibration span).

For methane and ethane, '&lt;' indicates a measured response below the analytical detection limit determined by the laboratory.

For VOCs, '&lt;' indicates at least one non-detectable fraction was used in the calculations. '&lt;' values for methane and ethane are treated as the entire value of the analytical detection limit.

For all calculated averages, '&lt;' values are treated as the entire value of the detection limit.

**RESULTS****Table 2-6:  
FCCU Charge Heater Stack – CO Emissions (USEPA 10)**

Run No.		1	2	3	4	5	6
Date (2015)		Aug 4	Aug 4	Aug 4	Aug 4	Aug 4	Aug 4
Start Time (approx.)		10:37	11:07	11:40	12:10	12:41	13:10
Stop Time (approx.)		10:58	11:28	12:01	12:31	13:02	13:31
<b>Process Conditions</b>							
R <sub>p</sub>	FCC charge rate (BPD)	37,996	38,012	37,997	37,994	38,027	38,014
P <sub>1</sub>	Refinery gas flow rate (Mscf/day)	1,561	1,554	1,552	1,557	1,564	1,558
P <sub>2</sub>	Disulfide off-gas flow rate (Mscf/day)	111	111	111	111	111	109
P <sub>3</sub>	Natural gas flow rate (Mscf/day)	37	37	37	37	37	37
F <sub>d</sub>	Oxygen-based F-factor (dscf/MMBtu)	8,341	8,345	8,345	8,345	8,345	8,345
<b>Gas Conditions</b>							
O <sub>2</sub>	Oxygen (dry volume %)	2.9	2.9	2.8	2.8	2.8	2.8
CO <sub>2</sub>	Carbon dioxide (dry volume %)	10.7	10.7	10.8	10.8	10.8	10.8
<b>Carbon Monoxide Results</b>							
C <sub>sd</sub>	Concentration (ppmdv)	<0.489	<0.489	<0.489	<0.489	<0.489	<0.489
C <sub>sd-x</sub>	Concentration @ 0% O <sub>2</sub> (ppmdv)	< 0.568	< 0.567	< 0.566	< 0.564	< 0.564	< 0.564
C <sub>sd</sub>	Concentration (lb/dscf)	<3.55E-08	<3.55E-08	<3.55E-08	<3.55E-08	<3.55E-08	<3.55E-08
E <sub>Fd</sub>	Emission Rate - F <sub>d</sub> -based (lb/MMBtu)	<3.45E-04	<3.44E-04	<3.43E-04	<3.42E-04	<3.42E-04	<3.42E-04

Run No.		7	8	9	10	11	Average
Date (2015)		Aug 4	Aug 4	Aug 4	Aug 4	Aug 4	
Start Time (approx.)		13:41	14:18	15:00	15:36	16:06	
Stop Time (approx.)		14:02	14:39	15:21	15:57	16:27	
<b>Process Conditions</b>							
R <sub>p</sub>	FCC charge rate (BPD)	38,004	37,953	38,017	37,986	37,991	37,999
P <sub>1</sub>	Refinery gas flow rate (Mscf/day)	1,546	1,545	1,538	1,537	1,551	1,551
P <sub>2</sub>	Disulfide off-gas flow rate (Mscf/day)	110	110	110	110	110	110
P <sub>3</sub>	Natural gas flow rate (Mscf/day)	37	37	37	37	37	37
F <sub>d</sub>	Oxygen-based F-factor (dscf/MMBtu)	8,345	8,345	8,345	8,345	8,345	8,345
<b>Gas Conditions</b>							
O <sub>2</sub>	Oxygen (dry volume %)	2.9	2.9	2.8	2.8	2.9	2.8
CO <sub>2</sub>	Carbon dioxide (dry volume %)	10.8	10.8	10.8	10.9	10.7	10.8
<b>Carbon Monoxide Results</b>							
C <sub>sd</sub>	Concentration (ppmdv)	<0.489	<0.489	1.19	<0.489	<0.489	<0.552
C <sub>sd-x</sub>	Concentration @ 0% O <sub>2</sub> (ppmdv)	< 0.567	< 0.568	1.37	< 0.564	< 0.567	<0.639
C <sub>sd</sub>	Concentration (lb/dscf)	<3.55E-08	<3.55E-08	8.62E-08	<3.55E-08	<3.55E-08	<4.02E-08
E <sub>Fd</sub>	Emission Rate - F <sub>d</sub> -based (lb/MMBtu)	<3.44E-04	<3.45E-04	8.33E-04	<3.42E-04	<3.44E-04	<3.88E-04

Average includes 11 runs.

For CO, '&lt;' indicates a measured response below the detection limit (assumed to be 1% of the instrument calibration span).

For all calculated averages, '&lt;' values are treated as the entire value of the detection limit.

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**RESULTS**

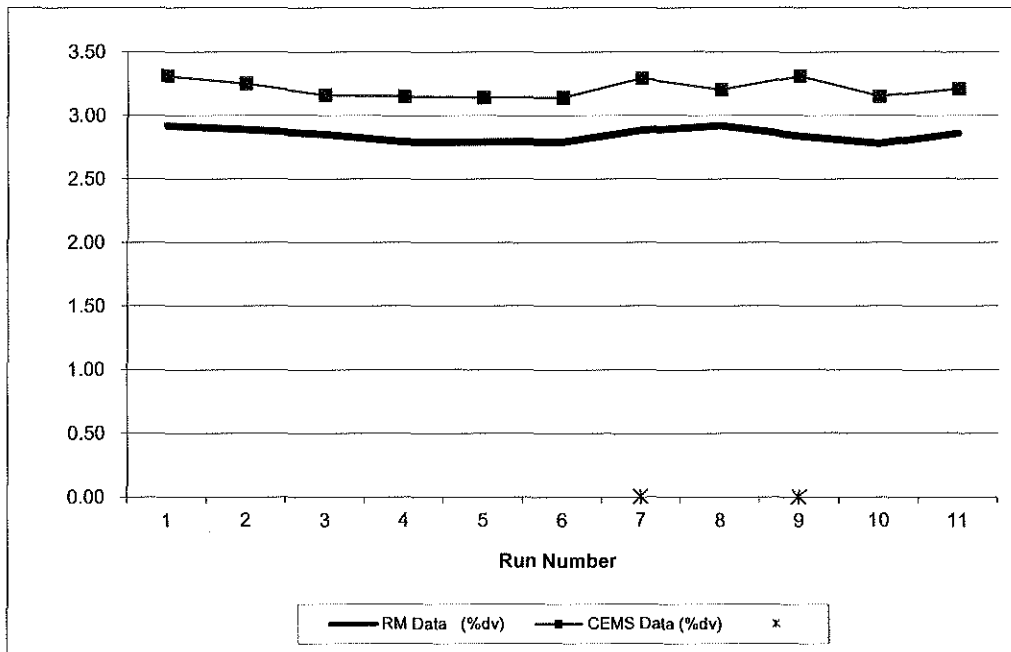
**Table 2-7:  
FCCU Charge Heater Stack – O<sub>2</sub> (%dv) RATA (USEPA 3A / PS3)**

Run No.	Start Time	Date (2015)	RM Data (%dv)	CEMS Data (%dv)	Difference (%dv)	Difference Percent
1	10:37	Aug 4	2.92	3.31	-0.39	-13.4%
2	11:07	Aug 4	2.89	3.25	-0.36	-12.5%
3	11:40	Aug 4	2.85	3.16	-0.31	-10.9%
4	12:10	Aug 4	2.79	3.15	-0.36	-12.9%
5	12:41	Aug 4	2.79	3.14	-0.35	-12.5%
6	13:10	Aug 4	2.79	3.14	-0.35	-12.5%
7 *	13:41	Aug 4	2.88	3.29	-0.41	-14.2%
8	14:18	Aug 4	2.92	3.20	-0.28	-9.6%
9 *	15:00	Aug 4	2.84	3.31	-0.47	-16.5%
10	15:36	Aug 4	2.78	3.15	-0.37	-13.3%
11	16:06	Aug 4	2.86	3.21	-0.35	-12.2%
<b>Average</b>			<b>2.84</b>	<b>3.19</b>	<b>-0.35</b>	<b>-12.2%</b>

**Relative Accuracy Test Audit Results**

Standard Deviation of Differences	0.033	
Confidence Coefficient (CC)	0.025	
t-Value for 9 Data Sets	2.306	
<b>Avg. Abs. Diff. (%dv)</b>	<b>0.347</b>	<b>Limit 1.0</b>

RM = Reference Method (CleanAir Data) 092215 114208  
 CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)  
 RATA calculations are based on 9 of 11 runs. \* indicates the excluded runs.



**RESULTS**

2-8

**Table 2-8:  
FCCU Charge Heater Stack – CO (ppmdv) RATA (USEPA 7E / PS2)**

Run No.	Start Time	Date (2015)	RM Data (ppmdv)	CEMS Data (ppmdv)	Difference (ppmdv)
1	10:37	Aug 4	0.00	2.67	-2.67
2	11:07	Aug 4	0.00	2.74	-2.74
3	11:40	Aug 4	0.00	2.69	-2.69
4	12:10	Aug 4	0.00	2.70	-2.70
5	12:41	Aug 4	0.00	2.83	-2.83
6	13:10	Aug 4	0.00	2.82	-2.82
7	13:41	Aug 4	0.00	2.67	-2.67
8	14:18	Aug 4	0.00	2.79	-2.79
9	15:00	Aug 4	1.19	2.85	-1.66
10	15:36	Aug 4	0.00	2.74	-2.74
11	16:06	Aug 4	0.00	2.66	-2.66
<b>Average</b>			<b>0.11</b>	<b>2.74</b>	<b>-2.63</b>

**Relative Accuracy Test Audit Results**

Standard Deviation of Differences	0.329	
Confidence Coefficient (CC)	0.221	
t-Value for 11 Data Sets	2.228	
		Limit
Avg. Abs. Diff. + CC (ppmdv)	<b>2.85</b>	<b>5.0</b>

RM = Reference Method (CleanAir Data)

092215 114208

CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)

RATA calculations are based on all 11 runs.



**RESULTS**

2-9

**Table 2-9:  
FCCU Charge Heater Stack – CO (lb/MMBtu) RATA (USEPA 7E / PS2)**

Run No.	Start Time	Date (2015)	RM Data (lb/MMBtu)	CEMS Data (lb/MMBtu)	Difference (lb/MMBtu)
1	10:37	Aug 4	0.00	0.00	0.00
2	11:07	Aug 4	0.00	0.00	0.00
3	11:40	Aug 4	0.00	0.00	0.00
4	12:10	Aug 4	0.00	0.00	0.00
5	12:41	Aug 4	0.00	0.00	0.00
6	13:10	Aug 4	0.00	0.00	0.00
7	13:41	Aug 4	0.00	0.00	0.00
8	14:18	Aug 4	0.00	0.00	0.00
9	15:00	Aug 4	0.00	0.00	0.00
10	15:36	Aug 4	0.00	0.00	0.00
11	16:06	Aug 4	0.00	0.00	0.00
<b>Average</b>			<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

**Relative Accuracy Test Audit Results**

Standard Deviation of Differences	0.000	
Confidence Coefficient (CC)	0.000	
t-Value for 11 Data Sets	2.228	
Relative Accuracy (as % of Appl. Std.)	<b>0.0%</b>	Limit <b>5.0%</b>
Appl. Std. = 0.02 lb/MMBtu		

RM = Reference Method (CleanAir Data)

092215 114208

CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)

RATA calculations are based on all 11 runs.

*End of Section 2 – Results*