CleanAir

CleanAir Engineering
500 W. Wood Street
Palatine, IL 60067-4975
www.cleanair.com

Marathon Petroleum Company
1300 South Fort Street
Detroit, MI 48217

REPORT ON COMPLIANCE TESTING

Performed for:
MARATHON PETROLEUM COMPANY
DETROIT REFINERY

COMPLEX 2 SRU INCINERATOR STACK (SV72-V22)

Client Reference No: CN00081321
CleanAir Project No: 12384-2
Revision 0: January 3, 2014

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
Project Manager
abuchowski@cleanair.com
(800) 627-0033 ext. 4537

Reviewed by,

Peter Kaufmann
Quality and Training Leader
pkaufmann@cleanair.com
(800) 627-0033 ext. 4560

REVISION HISTORY

REPORT ON COMPLIANCE TESTING

DRAFT REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
D0a	12/27/13	All	Draft version of original document.

FINAL REPORT REVISION HISTORY

Revision:	Date	Pages	Comments
0	01/03/14	All	Final version of original document.

CONTENTS

PROJECT OVERVIEW

INTRODUCTION

Marathon Petroleum Company (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. 63-08C, issued January 11, 2012.

Key Project Participants

Individuals responsible for coordinating and conducting the test program were:

Crystal Davis – MPC
Joe Reidy – MPC
Thomas Gasloli – DEQ
John Rooney – CleanAir

Test Program Parameters

The testing was performed at the Complex 2 SRU Incinerator Stack (Emission Unit ID No. EG42-43SULrecov; Stack ID No. SV43-H2) on November 6-7, 2013, and included the following emissions measurements:

- sulfur dioxide (SO_2)
- carbon monoxide (CO)
- flue gas composition (e.g., O_2, CO_2, H_2O)
- flue gas flow rate

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	Complex 2 SRU Incinerator Stack	USEPA Method 4	Moisture	11/06/13	12:45	13:45
2	Complex 2 SRU Incinerator Stack	USEPA Method 4	Moisture	11/06/13	14:49	15:49
3	Complex 2 SRU Incinerator Stack	USEPA Method 4	Moisture	11/06/13	16:59	17:59
1	Complex 2 SRU Incinerator Stack	USEPA Method 2	Flow Rate	11/06/13	11:40	12:00
2	Complex 2 SRU Incinerator Stack	USEPA Method 2	Flow Rate	11/06/13	14:28	14:35
3	Complex 2 SRU Incinerator Stack	USEPA Method 2	Flow Rate	11/06/13	16:10	16:20
4	Complex 2 SRU Incinerator Stack	USEPA Method 2	Flow Rate	11/06/13	18:03	18:11
1	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	12:44	13:05
2	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	13:14	13:35
3	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	13:48	14:09
4	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	14:35	14:56
5	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	15:06	15:27
6	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	15:36	15:57
7	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	16:19	16:40
8	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	16:52	17:13
9	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C/10	$O_2/CO_2/SO_2/CO$	11/06/13	17:23	17:44
10	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	11/07/13	09:14	09:35
11	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	11/07/13	09:43	10:04
12	Complex 2 SRU Incinerator Stack	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	11/07/13	10:13	10:34

122013 111634

Results Summary

Table 1-2 and Table 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 2-6.

Table 1-2:
Summary of Emission Compliance Test Results

Source Constituen (Units)		Sampling Method	Average Emission	Permit Limit[1]
Complex 2 SRU Incinerator Stack				
CO	(lb/MMBtu)	USEPA M-10	0.01	0.04
SO_2	(ppmdv @ 0% O_2)	USEPA M-6C	61.6	250

[1] Permit limits obtained from MDEQ Permit To Install No. 63-08C.

122013 111634

Table 1-3:
Summary of RATA Results

Source Constituent (Units)	Reference Method (USEPA)	Applicable Specification	Relative Accuracy (%)	Specification Limit[1]
Complex 2 SRU Incinerator Stack				
O_2 (% dv)	M-3A	PS3	0.05	±1.0% dv
SO_2 (ppmdv @ 0% O2)	M-6C	PS2	4.6%	10% of Standard[2]

[1] Specification limits obtained from 40 CFR 60, Appendix B, Performance Specifications.
[2] Applicable emission standard (% Std.) is equivalent to the permit limit in Table 1-2.

122013 111634

PROJECT OVERVIEW

Discussion of Test Program

O_2, SO_2, and CO Emissions / RATA Testing - USEPA Methods 3A, 6C, and 10; Performance Specifications 2 and 3

Minute-average data points for O_2, CO_2, and SO_2 (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 CEMs over an identical time interval in order to calculate relative accuracy (RA). RATA results are expressed using nine (9) of the twelve (12) test runs performed.

- For O_2, RA is expressed as the average absolute difference between the RM and facility CEMs runs. The final result was below the limit of ±1.0%dv set by PS3.
- For SO_2, RA is expressed as the percent difference between RM and the applicable emission standard (permit limit) listed in Table 1-2. The final result was below the limit of 10% of the standard set by PS2.
- CO_2 data was collected only as supplemental information.

CO testing was performed concurrently with Runs one (1) through nine (9) of the RATA testing.

SO_2 and CO results from the RATA were converted from units of dry volume-based concentration (ppmdv) to mass-based emission rate units (lb/hr, Ton/yr, and lb/MMBtu) to demonstrate compliance with permit limits. The final results for SO_2 and CO were expressed as the average of the first nine (9) RATA runs. The final results were below the permit limits.

Calculation of Final Results

Emission results in units of dry volume-based concentration (lb/dscf, ppmdv) were converted to mass-based emission results in units of pounds per hour (lb/hr) and tons per year (Ton/yr), then converted to units of pounds per million Btu (lb/MMBtu) using the heat input from auxiliary fuel (natural gas) to the unit.

PROJECT OVERVIEW

Gas flow rate data (used in calculation of mass-based emissions) was obtained from bracketing USEPA Method 2 runs. On November 6, 2013, a Method 2 run was performed prior to RATA Run 1 and following RATA Runs 3, 6, and 9. The flow rate applied to each RATA run was the average of the nearest Method 2 runs prior to and following each RATA run respectively.

Moisture data was obtained from nearly concurrent modified USEPA Method 4 sampling trains.

- Sample gas was extracted using an unheated stainless steel tube set at a single point at least one (1) meter from the stack wall. Moisture stratification is not expected at test locations without free water droplets present in the flue gas.
- After passing through the tube, the sample gas was drawn through gum rubber tubing and into four (4) iced knock-out jars. The knock-out jars were arranged in a series and contained identical contents as the impinger train prescribed by Method 4, but with gum rubber connections and stainless-steel internal components.
- Sample gas was extracted at a constant rate. At least 21 scf of flue gas was sampled.

End of Section 1 – Project Overview

RESULTS

Table 2-1:
C2 SRU Incinerator Stack – SO_2 and CO Emissions (USEPA M-6C/10)

Run No.		1	2	3	4
Date (2013)		Nov 6	Nov 6	Nov 6	Nov 6
Start Time (approx.)		12:44	13:14	13:48	14:35
Stop Time (approx.)		13:05	13:35	14:09	14:56
Process Conditions					
H_i	Actual heat input (MMBtu/hr)	8.69	8.70	8.69	8.66
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	3.8	4.2	4.6	4.7
CO_2	Carbon dioxide (dry volume %)	2.9	2.9	2.9	2.9
B_w	Actual water vapor in gas (% by volume)[1]	9.4	9.4	9.4	10.2
Gas Flow Rate[2]					
Q_{std}	Volumetric flow rate, dry standard (dscfm)	8,370	8,370	8,370	8,600
Sulfur Dioxide Results					
C_{sd}	Concentration (ppmdv)	50.7	64.9	54.1	49.0
C_{sd-x}	Concentration @ 0% O_2 (ppmdv)	62.1	81.2	69.2	63.1
C_{sd}	Concentration (lb/dscf)	8.44E-06	1.08E-05	8.99E-06	8.14E-06
$E_{lb/hr}$	Emission Rate (lb/hr)	4.2	5.4	4.5	4.2
$E_{T/yr}$	Emission Rate (Ton/yr)	18.5	23.7	19.8	18.4
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.4875	0.6227	0.5198	0.4852
Carbon Monoxide Results					
C_{sd}	Concentration (ppmdv)	2.24	2.49	1.35	1.61
C_{sd}	Concentration (lb/dscf)	1.63E-07	1.81E-07	9.80E-08	1.17E-07
$E_{lb/hr}$	Emission Rate (lb/hr)	0.082	0.091	0.049	0.060
$E_{T/yr}$	Emission Rate (Ton/yr)	0.358	0.397	0.215	0.265
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.00940	0.01043	0.00566	0.00698

[1] Moisture data from nearly-concurrent M-4 runs.

[2] Flow data used in lb/hr calculations was obtained from the average of M-2 traverses that bracketed runs.

080410 154528

RESULTS

Table 2-1 (Continued):
C2 SRU Incinerator Stack – SO_2 and CO Emissions (USEPA M-6C/10)

Run No.		5	6	7	8
Date (2013)		Nov 6	Nov 6	Nov 6	Nov 6
Start Time (approx.)		15:06	15:36	16:19	16:52
Stop Time (approx.)		15:27	15:57	16:40	17:13
Process Conditions					
H_i	Actual heat input (MMBtu/hr)	8.64	8.63	8.60	8.58
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760
Gas Conditions					
O_2	Oxygen (dry volume %)	4.5	4.5	4.4	4.5
CO_2	Carbon dioxide (dry volume %)	2.9	2.9	2.9	2.9
B_w	Actual water vapor in gas (% by volume)[1]	10.2	10.2	10.4	10.4
Gas Flow Rate[2]					
Q_{std}	Volumetric flow rate, dry standard (dscfm)	8,600	8,600	8,540	8,540
Sulfur Dioxide Results					
C_{sd}	Concentration (ppmdv)	45.8	43.1	43.5	46.6
C_{sd-x}	Concentration @ 0% O_2 (ppmdv)	58.5	54.8	55.3	59.4
C_{sd}	Concentration (lb/dscf)	7.62E-06	7.16E-06	7.24E-06	7.76E-06
$E_{lb/hr}$	Emission Rate (lb/hr)	3.9	3.7	3.7	4.0
$E_{T/yr}$	Emission Rate (Ton/yr)	17.2	16.2	16.2	17.4
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.4549	0.4285	0.4311	0.4629
Carbon Monoxide Results					
C_{sd}	Concentration (ppmdv)	0.99	0.74	1.21	0.85
C_{sd}	Concentration (lb/dscf)	7.18E-08	5.35E-08	8.78E-08	6.17E-08
$E_{lb/hr}$	Emission Rate (lb/hr)	0.037	0.028	0.045	0.032
$E_{T/yr}$	Emission Rate (Ton/yr)	0.162	0.121	0.197	0.139
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.00429	0.00320	0.00523	0.00369

[1] Moisture data from nearly-concurrent M-4 runs.

[2] Flow data used in lb/hr calculations was obtained from the average of M-2 traverses that bracketed runs.

080410 154528

RESULTS

Table 2-1 (Continued):
C2 SRU Incinerator Stack – SO_2 and CO Emissions (USEPA M-6C/10)

Run No.		9	10	11	12	Average
Date (2013)		Nov 6	Nov 7	Nov 7	Nov 7	
Start Time (approx.)		17:23	09:14	09:43	10:13	
Stop Time (approx.)		17:44	09:35	10:04	10:34	
Process Conditions						
H_i	Actual heat input (MMBtu/hr)	8.57	8.60	8.65	8.71	**8.64**
Cap	Capacity factor (hours/year)	8,760	8,760	8,760	8,760	**8,760**
Gas Conditions						
O_2	Oxygen (dry volume %)	4.4	5.6	5.6	5.7	**4.7**
CO_2	Carbon dioxide (dry volume %)	2.9	2.7	2.7	2.8	**2.8**
B_w	Actual water vapor in gas (% by volume)[1]	10.4	N/A	N/A	N/A	**10.0**
Gas Flow Rate[2]						
Q_{std}	Volumetric flow rate, dry standard (dscfm)	8,540	N/A	N/A	N/A	**8,503**
Sulfur Dioxide Results						
C_{sd}	Concentration (ppmdv)	46.0	44.2	43.8	42.0	**47.8**
C_{sd-x}	Concentration @ 0% O_2 (ppmdv)	58.2	60.3	59.9	57.8	**61.6**
C_{sd}	Concentration (lb/dscf)	7.65E-06	7.36E-06	7.29E-06	6.99E-06	**7.95E-06**
$E_{lb/hr}$	Emission Rate (lb/hr)	3.9	N/A	N/A	N/A	**4.18**
$E_{T/yr}$	Emission Rate (Ton/yr)	17.2	N/A	N/A	N/A	**18.3**
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.4572	N/A	N/A	N/A	**0.483**
Carbon Monoxide Results						
C_{sd}	Concentration (ppmdv)	0.80	N/A	N/A	N/A	**1.36**
C_{sd}	Concentration (lb/dscf)	5.85E-08	N/A	N/A	N/A	**9.91E-08**
$E_{lb/hr}$	Emission Rate (lb/hr)	0.030	N/A	N/A	N/A	**0.0504**
$E_{T/yr}$	Emission Rate (Ton/yr)	0.131	N/A	N/A	N/A	**0.221**
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.00350	N/A	N/A	N/A	**0.00582**

Average includes 9 runs for moisture, flow, and CO results and 12 runs for all other results.

080410 154528

[1] Moisture data from nearly-concurrent M-4 runs.

[2] Flow data used in lb/hr calculations was obtained from the average of M-2 traverses that bracketed runs.

RESULTS

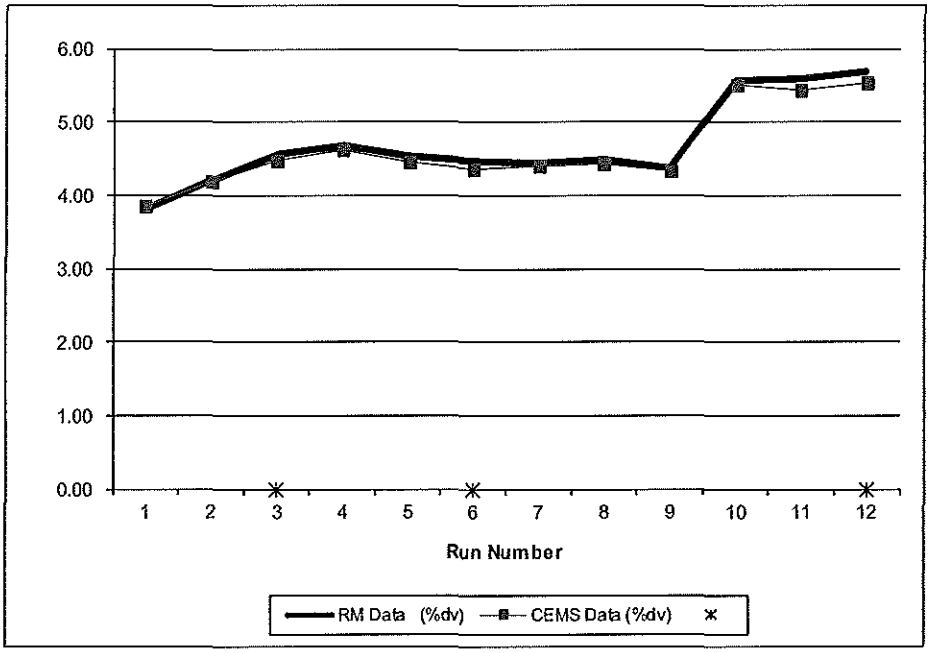
Table 2-2:
C2 SRU Incinerator Stack – O_2 (%dv) Relative Accuracy (USEPA M-3A / PS3)

Run No.	Start Time	Date (2013)	RM Data (%dv)	CEMS Data (%dv)	Difference (%dv)
1	12:44	Nov 6	3.82	3.84	-0.02
2	13:14	Nov 6	4.20	4.20	0.01
3 *	13:48	Nov 6	4.57	4.46	0.10
4	14:35	Nov 6	4.68	4.63	0.05
5	15:06	Nov 6	4.53	4.46	0.07
6 *	15:36	Nov 6	4.46	4.37	0.10
7	16:19	Nov 6	4.45	4.40	0.04
8	16:52	Nov 6	4.48	4.44	0.04
9	17:23	Nov 6	4.38	4.34	0.04
10	09:14	Nov 7	5.58	5.50	0.08
11	09:43	Nov 7	5.59	5.43	0.16
12 *	10:13	Nov 7	5.70	5.53	0.17
	Average		**4.63**	**4.58**	**0.05**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.051	
Confidence Coefficient (CC)	0.039	
t-Value for 9 Data Sets	2.306	
		Limit
Avg. Abs. Diff. (%dv)	**0.057**	**1.0**

RM = Reference Method (CleanAir Data) 122713 101751
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.



RESULTS

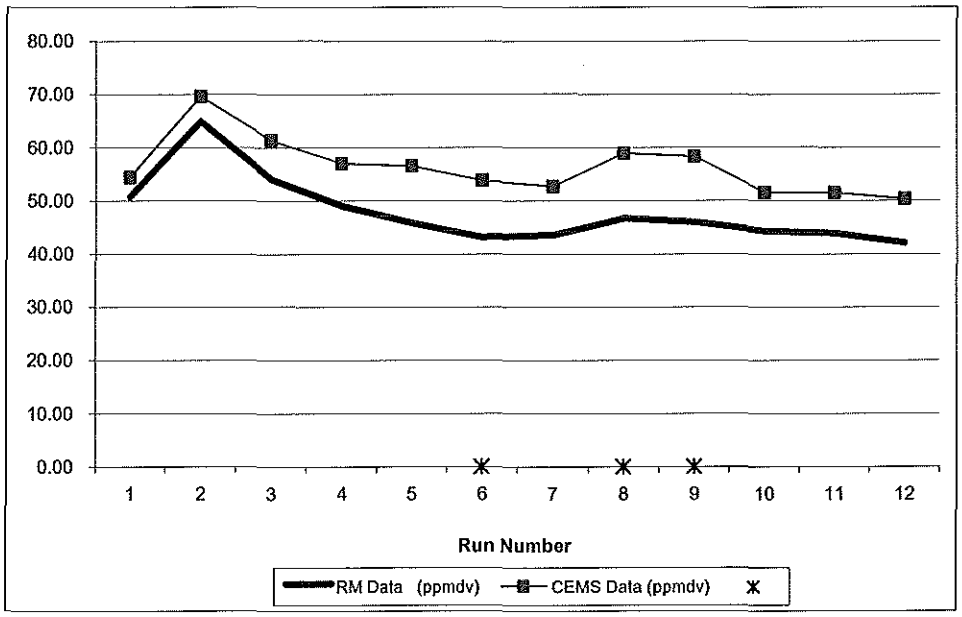
Table 2-3:
C2 SRU Incinerator Stack – SO_2 (ppmdv) Relative Accuracy (USEPA M-6C / PS2)

Run No.	Start Time	Date (2013)	RM Data (ppmdv)	CEMS Data (ppmdv)	Difference (ppmdv)	Difference Percent
1	12:44	Nov 6	50.73	54.38	-3.65	-7.2%
2	13:14	Nov 6	64.87	69.58	-4.71	-7.3%
3	13:48	Nov 6	54.08	61.36	-7.28	-13.5%
4	14:35	Nov 6	48.97	56.99	-8.02	-16.4%
5	15:06	Nov 6	45.82	56.49	-10.67	-23.3%
6 *	15:36	Nov 6	43.08	53.80	-10.73	-24.9%
7	16:19	Nov 6	43.53	52.70	-9.17	-21.1%
8 *	16:52	Nov 6	46.64	58.86	-12.22	-26.2%
9 *	17:23	Nov 6	45.98	58.28	-12.30	-26.8%
10	09:14	Nov 7	44.24	51.49	-7.25	-16.4%
11	09:43	Nov 7	43.83	51.48	-7.65	-17.4%
12	10:13	Nov 7	42.02	50.31	-8.28	-19.7%
Average			**48.68**	**56.09**	**-7.41**	**-15.2%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	2.134	
Confidence Coefficient (CC)	1.640	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**18.6%**	**20.0%**

RM = Reference Method (CleanAir Data) 122013 170647
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.



RESULTS

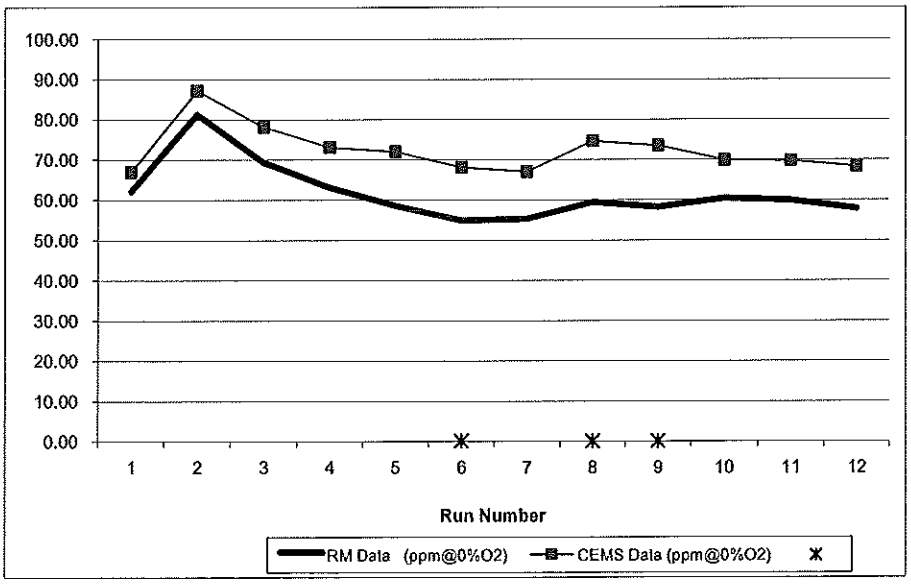
Table 2-4:
C2 SRU Incinerator Stack – SO_2 (ppmdv @ 0% O_2) Relative Accuracy (USEPA M-6C / PS2)

Run No.	Start Time	Date (2013)	RM Data (ppm@0%O2)	CEMS Data (ppm@0%O2)	Difference (ppm@0%O2)	Difference Percent
1	12:44	Nov 6	62.08	66.87	-4.79	-7.7%
2	13:14	Nov 6	81.21	87.07	-5.87	-7.2%
3	13:48	Nov 6	69.19	78.11	-8.92	-12.9%
4	14:35	Nov 6	63.08	73.06	-9.98	-15.8%
5	15:06	Nov 6	58.49	71.95	-13.46	-23.0%
6 *	15:36	Nov 6	54.77	68.03	-13.26	-24.2%
7	16:19	Nov 6	55.29	66.97	-11.68	-21.1%
8 *	16:52	Nov 6	59.38	74.62	-15.24	-25.7%
9 *	17:23	Nov 6	58.17	73.49	-15.32	-26.3%
10	09:14	Nov 7	60.34	69.85	-9.51	-15.8%
11	09:43	Nov 7	59.85	69.68	-9.83	-16.4%
12	10:13	Nov 7	57.77	68.33	-10.56	-18.3%
Average			**63.03**	**72.43**	**-9.40**	**-14.9%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	2.683	
Confidence Coefficient (CC)	2.062	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**18.2%**	**20.0%**
Relative Accuracy (as % of Appl. Std.)	**4.6%**	**10.0%**
Appl. Std. = 250 ppm@0%O2		

RM = Reference Method (CleanAir Data) 122013 170647
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)
RATA calculations are based on 9 of 12 runs. * indicates the excluded runs.



End of Section 2 – Results

DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

MPC's facility in Detroit, Michigan, produces refined petroleum products from crude oil. As part of the Detroit Heavy Oil Upgrade Project (DHOUP), new equipment is being installed to process heavy crude oil from Canada. As a condition of proceeding with the DHOUP, MPC must demonstrate that select process units are in compliance with permitted emission limits.

The Sulfur Block (EG42-43SULRECOV) removes hydrogen sulfide (H_2S) from acid gas and converts it to elemental sulfur using the Claus Process (Trains A, B, and C), the SCOT Tail Gas Treating Unit process (Trains No. 1 and No. 2), and associated amine treating equipment. Tail gas is routed to a thermal oxidizer, or incinerator, which oxidizes the remaining H_2S in the tail gas to SO_2 before exhausting to the atmosphere via the SRU Incinerator Stack (SV43-H2). The emission group also consists of process vessels (including thermal reactors, an absorbing tower and a stripping tower), heaters, tanks, containers, compressors, seals, process valves, flanges, connectors, etc.

The testing reported in this document was performed at Complex 2 SRU Incinerator Stack.

DESCRIPTION OF SAMPLING LOCATIONS

Sampling point locations were determined according to USEPA Methods 1, 7E and Performance Specification 2.

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

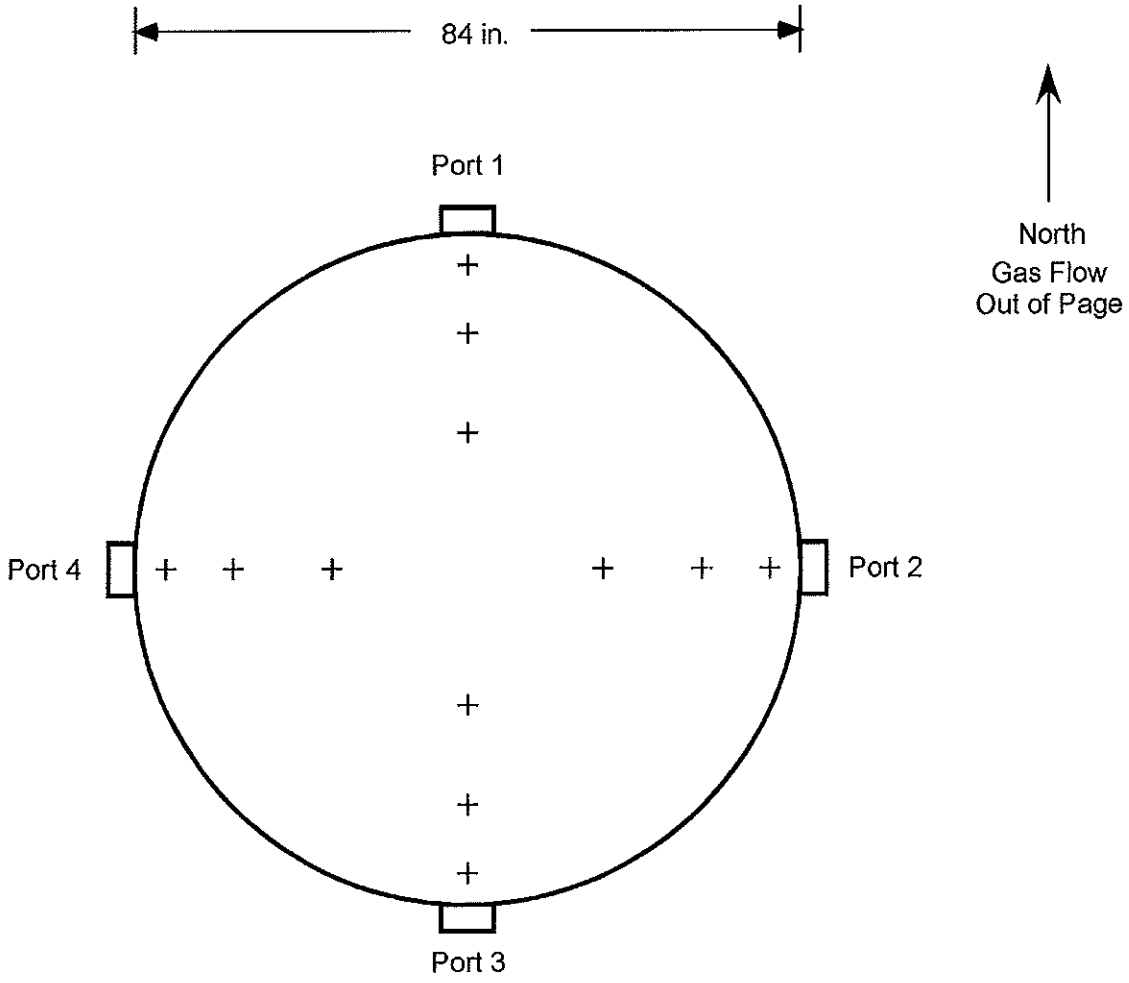
Table 3-1:
Sampling Points

Source Constituent	Method (USEPA)	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Complex 2 SRU Incinerator Stack							
Flow Rate	M-2	1-4	4	3	varied	varied	3-1
Moisture	M-4	1-3	1	1	60	60	N/A[1]
O_2 / SO_2 / CO	M-3A+PS3 / 6C+PS2 / 10	1-9/12	1	3	7	21	3-2

[1] Sampling occured at a single point at least one (1) meter from the stack wall.

122013 163359

DESCRIPTION OF INSTALLATION

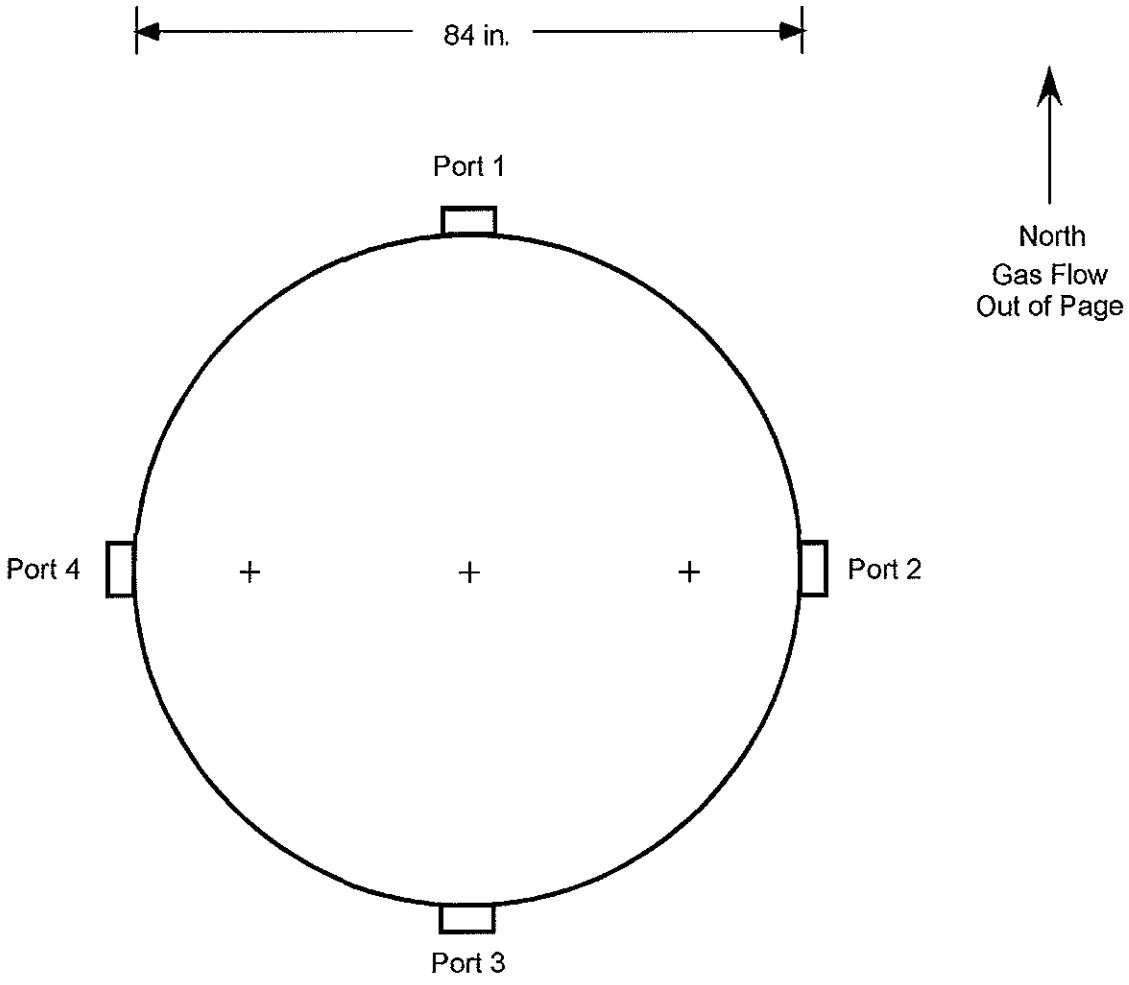


Sampling Point	Port to Point Distance (in.)
1	24.9
2	12.3
3	3.7

Duct diameters upstream from flow disturbance (A):	20	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	15	Limit: 2.0

Figure 3-1: USEPA M-2 Traverse Points

DESCRIPTION OF INSTALLATION



Sampling Point	Port to Point Distance (in.)
1	70.0
2	42.0
3	14.0

Duct diameters upstream from flow disturbance (A):	20	Limit: 0.5
Duct diameters downstream from flow disturbance (B):	15	Limit: 2.0

Figure 3-2: USEPA M-3A/6C/10 Sampling Points – RATA / Emission Testing

End of Section 3 – Description of Installation

METHODOLOGY

Clean Air Engineering followed procedures as detailed in USEPA Methods 1, 2, 3, 3A, 3B, 4, 6C, 10, and Performance Specifications 2 and 3 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 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 3B	"Gas Analysis for the Determination of Emission Rate Correction Factor or Excess Air"
Method 4	"Determination of Moisture Content in Stack Gases"
Method 6C	"Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)"
Method 10	"Determination of Carbon Monoxide Emissions from Stationary Sources"
Title 40 CFR Part 60 Appendix B (Performance Specifications (PS))	
PS2	"Specifications and Test Procedures for SO_2 and NO_x Continuous Emission Monitoring Systems in Stationary Sources"
PS3	"Specifications and Test Procedures for O_2 and CO_2 Continuous Emission Monitoring Systems 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

O_2, CO_2, SO_2, and CO Emissions / RATA Testing - USEPA Methods 3A, 6C, and 10; Performance Specifications 2 and 3

Reference method O_2 and CO_2 emissions were determined using a paramagnetic/NDIR CEMs analyzer per EPA Method 3A and Performance Specification 3. Reference method SO_2 emissions were determined using an ultraviolet (UV) analyzer per EPA Method 6C and Performance Specification 2. Reference method CO emissions were determined using an infrared CEMs analyzer per EPA Method 10.

The sampling system consisted of a heated probe, heated filter and heated sample line. Flue gas was extracted at a constant rate at the points specified by the specification and delivered at 250°F to a gas conditioner which removed moisture. The flue gas was then delivered via a flow panel to an analyzer bank. Each analyzer measured concentration on a dry basis (units of %dv or ppmdv).

Calibration error checks were performed by introducing zero nitrogen (N_2), high-range and mid-range calibration gases to the inlet of each analyzer during calibration error checks. Bias checks were performed before and after each sampling run by introducing calibration gas to the inlet of the sampling system's heated filter. Per M-3A, 6C, and 10, the average results for each run were drift-corrected.

Data from Run 1 of the O_2 RATA was used as a stratification check for O_2, following the alternate specifications in M-7E, §8.1.2. Results allowed for sampling to occur at a single point, however, sampling occurred at 3 points along with the RATA testing. Documentation is included in Appendix D.

General Considerations

A verification of the absence of cyclonic flow was performed at the Complex 6 SRU Incinerator Stack on November 6, 2013, following M-1 specifications. Documentation is included in Appendix E.

End of Section 4 – Methodology