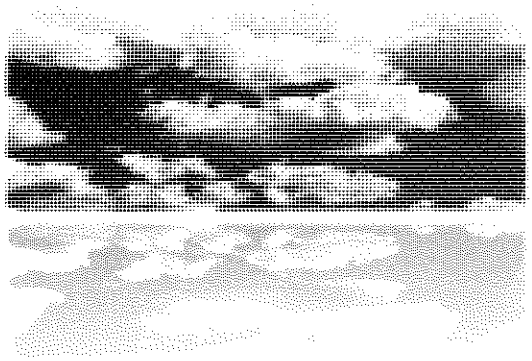
CleanAir

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

RECEIVED
NOV 09 2017
AIR QUALITY DIVISION



REPORT ON COMPLIANCE & RATA TESTING

Detroit Refinery

Complex 6 SRU Incinerator Stack

Marathon Petroleum Company LP
1300 South Fort Street
Detroit, MI 48217
Client Reference No. 4101004604

CleanAir Project No. 13362-2
STAC Certificate No. 2007.002.0113.1217
Revision 1, Final Report
November 1, 2017

1. PROJECT OVERVIEW

Test Program Summary

Marathon Petroleum Company LP (MPC) contracted CleanAir Engineering (CleanAir) to successfully complete testing at the Complex 6 SRU Incinerator (EU72-SULRBLOCK2-S1) at the Detroit Refinery located in Detroit, Michigan. The test program included the following objectives:

- Perform particulate matter (PM), volatile organic compounds (VOCs) and nitrogen oxides (NO_X) testing to demonstrate compliance with the Michigan Department of Environmental Quality (DEQ) Permit No. MI-ROP-A9831-2012c.
- Perform a relative accuracy test audit (RATA) on the facility's continuous emissions monitoring system (CEMS) for oxygen (O_2) and sulfur dioxide (SO_2).

A summary of the test program results is presented below. Section 2 Results provides a more detailed account of the test conditions and data analysis. Test program information, including the test parameters, on-site schedule and a project discussion, begins on page 2.

Table 1-1:
Summary of Compliance Results

Source Constituent	Sampling Method	Average Emission	Permit Limit[1]
Complex 6 SRU Incinerator			
PM (lb/hr)	USEPA 5	0.41	2.85
PM_{10} (lb/hr)	USEPA 5 / 202	0.76	2.85
VOC (lb/MMBtu)	USEPA 18 / 25A	< 0.0024	0.0055
NO_X (lb/MMBtu)	USEPA 7E	0.06	0.20

[1] Permit limits obtained from MDEQ Renewable Operation Permit No. MI-ROP-A9831-2012c.

Table 1-2:
Summary of RATA Results

Source Constituent (Units)	Reference Method	Relative Accuracy (%)[1]	Applicable Specification	Specification Limit[2]
Complex 6 SRU Incinerator				
O_2 (% dv)	USEPA 3A	0.06	PS3	±1.0% of RM
SO_2 (ppmdv @ 0%O_2)	USEPA 6C/3A	8.4	PS2	20% of RM

[1] Relative Accuracy is expressed in terms of comparison to the reference method (% RM).

[2] Specification limits obtained from 40 CFR 60, Appendix B, Performance Specifications.

Schedule

Testing was performed on September 14, 2017. The on-site schedule followed during the test program is outlined in Table 1-3.

Table 1-3:
Test Schedule

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	C6 SRU Incinerator	USEPA Method 5/202	FPM/CPM	09/14/17	08:33	10:44
2	C6 SRU Incinerator	USEPA Method 5/202	FPM/CPM	09/14/17	11:26	13:33
3	C6 SRU Incinerator	USEPA Method 5/202	FPM/CPM	09/14/17	15:00	17:21
4	C6 SRU Incinerator	USEPA Method 5/202	FPM/CPM	09/14/17	18:33	20:42
1	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	10:06	10:27
2	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	10:41	11:02
3	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	11:14	11:35
4	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	14:53	15:14
5	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	15:29	15:50
6	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	17:10	17:31
7	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	17:32	17:53
8	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	18:01	18:22
9	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	18:35	18:56
10	C6 SRU Incinerator	USEPA Method 3A/6C	$O_2/CO_2/SO_2$	09/14/17	19:11	19:32
1	C6 SRU Incinerator	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/14/17	10:06	11:35
2	C6 SRU Incinerator	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/14/17	14:53	17:31
3	C6 SRU Incinerator	USEPA Method 3A/7E	$O_2/CO_2/NO_X$	09/14/17	17:32	18:56
1	C6 SRU Incinerator	USEPA Method 25A/18	VOC	09/14/17	10:06	11:35
2	C6 SRU Incinerator	USEPA Method 25A/18	VOC	09/14/17	14:53	17:31
3	C6 SRU Incinerator	USEPA Method 25A/18	VOC	09/14/17	17:32	18:56

Discussion

Test Scope Synopsis

PM & PM_{10} Testing

A total of four (4) 120-minute EPA Method 5/202 test runs were performed. FPM/CPM emission results were calculated in units of pounds per hour (lb/hr). The Run 3 sample train was compromised during the traversing process which ultimately led to a contamination of the samples. Run 3 was deemed invalid and not included in the final results. The final result was expressed as the average of the three (3) valid runs (Runs 1, 2 and 4).

PM is assumed equivalent to FPM, and PM_{10} is assumed equivalent to the sum of FPM less than 10 micrometers (µm) in diameter (FPM_{10}) and CPM. The Method 5/202 sample train yields a front-half, FPM result and a back-half, CPM result. The total PM result (FPM plus CPM) from Method 5/202 can be used as a worst-case estimation of total PM_{10} since Method 5 collects all FPM present in the flue gas (regardless of particle size).

O_2 & SO_2 RATA Testing

Minute-average data points for O_2 and SO_2 (dry basis) were collected over a period of 21 minutes for each run utilizing EPA Methods 3A and 6C. Relative accuracy was determined based on nine (9) of ten (10) total runs conducted per procedures outlined in Performance Specification (PS) 2, Section 8.4.4.

Sampling occurred at the three (3) points as specified in Section 8.1.3.2 of PS 2 during each run. The average result for each run was converted to identical units of measurement as the facility CEMs and compared for relative accuracy.

NO_X Testing

NO_X emissions were determined using EPA Method 7E. NO_X emission results were calculated in units of heat input-based lb/MMBtu.

Nine (9) 21-minute Method 7E test runs were performed concurrently with VOC compliance, and O_2 and SO_2 RATA testing utilizing the same sample system. The final result for each NO_X compliance run was expressed as the average of three (3) consecutive 63-minute runs. Method 7E Run 1 is the average NO_X concentration for RATA Runs 1 through 3, Run 2 is the average of RATA Runs 4 through 6, and Run 3 is the average of RATA Runs 7 through 9.

VOC Testing

VOC emissions were determined using EPA Method 25A to quantify THC emissions and EPA Method 18 to quantify methane (CH_4) and ethane (C_2H_6) emissions. VOC emissions are assumed equivalent to THC emissions minus CH_4 and C_2H_6.

Nine (9) 21-minute Method 25A test runs were performed concurrently with three (3) 63-minute Method 18 bag collections. Method 25A Runs 1 through 3 were concurrent with Method 18 Run 1. Method 25A Runs 4 through 6 were concurrent with Method 18 Run 2. Method 25A Runs 7 through 9 were concurrent with Method 18 Run 3. The final result for each VOC run was expressed as the average of three (3) consecutive 63-minute runs. Other CEMS methods referencing Methods 6C and 7E were performed simultaneously using the same sampling system. Data was collected from all of the required Method 7E points rather than from the centroid of the duct as specified by Method 25A.

THC, CH_4 and C_2H_6 emission results were calculated in units of heat input-based lb/MMBtu as propane. THC data was converted from an actual (wet) basis to a dry basis using moisture data collected from averaging overlapping Method 5/202 runs.

For multiple 21-minute Method 25A runs, the measured concentrations of THC were below the detection limit defined as 'less than 1%' of the calibration span of THC instrument. For all runs, C_2H_6 was below analytical detection limits. For runs resulting in non-detects, the final result is treated as 'less than' the entire value of the detection limit. Assuming worst-case scenario, if the resultant VOC emissions were less than the defined THC detection limit then they were reported as 'less than' the defined THC detection limit corrected to dry conditions.

Test Conditions

The unit was operated at the maximum normal operating capacity during each of the emissions compliance test runs and no less than 50% of the maximum normal operating capacity during RATA test runs. MPC was responsible for logging any relevant process-related data and providing it to CleanAir for inclusion in the test reports.

End of Section

2. RESULTS

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

Table 2-1:
C6 SRU Incinerator – PM & PM_{10} Emissions

Run No.		1	2	3*	4	Average
Date (2017)		Sep 14	Sep 14	Sep 14	Sep 14	
Start Time (approx.)		08:33	11:26	15:00	18:33	
Stop Time (approx.)		10:44	13:33	17:21	20:42	
Process Conditions						
H_i	Actual heat input (MMBtu/hr)	32.6	32.5	33.2	32.6	**32.6**
Gas Conditions						
O_2	Oxygen (dry volume %)	3.2	3.4	3.3	3.3	**3.3**
CO_2	Carbon dioxide (dry volume %)	4.8	4.7	4.7	4.7	**4.7**
T_s	Sample temperature (°F)	640	641	642	642	**641**
B_w	Actual water vapor in gas (% by volume)	10.6	10.4	10.4	10.5	**10.5**
Gas Flow Rate						
Q_a	Volumetric flow rate, actual (acfm)	49,300	47,000	49,600	49,700	**48,700**
Q_s	Volumetric flow rate, standard (scfm)	23,500	22,400	23,600	23,700	**23,200**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	21,000	20,100	21,200	21,200	**20,800**
Sampling Data						
V_{mstd}	Volume metered, standard (dscf)	68.21	66.84	69.60	71.17	**68.74**
%I	Isokinetic sampling (%)	98.6	101.1	100.0	102.1	**100.6**
Laboratory Data						
m_{FPM}	Total FPM (g)	0.01293	0.00912	0.00343	0.00894	
m_{CPM}	Total CPM (g)	0.00870	0.00877	0.00897	0.00837	
m_{Part}	Total particulate matter (as PM_{10}) (g)	0.02163	0.01789	0.01240	0.01731	
FPM Results						
C_{sd}	Particulate Concentration (lb/dscf)	4.18E-07	3.01E-07	1.09E-07	2.77E-07	**3.32E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.527	0.363	0.138	0.352	**0.414**
CPM Results						
C_{sd}	Particulate Concentration (lb/dscf)	2.81E-07	2.89E-07	2.84E-07	2.59E-07	**2.77E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.355	0.349	0.361	0.330	**0.345**
Total Particulate Matter (as PM_{10}) Results						
C_{sd}	Particulate Concentration (lb/dscf)	6.99E-07	5.90E-07	3.93E-07	5.36E-07	**6.09E-07**
$E_{lb/hr}$	Particulate Rate (lb/hr)	0.882	0.712	0.499	0.682	**0.759**

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

Table 2-2:
C6 SRU Incinerator – O_2 (% dv) RATA

Run No.	Start Time	Date (2017)	RM Data (%dv)	CEMS Data (%dv)	Difference (%dv)	Difference Percent
1 *	10:06	Sep 14	2.77	2.89	-0.12	-4.3%
2	10:41	Sep 14	2.74	2.81	-0.07	-2.6%
3	11:14	Sep 14	2.85	2.81	0.04	1.4%
4	14:53	Sep 14	2.78	2.86	-0.08	-2.9%
5	15:29	Sep 14	2.75	2.79	-0.04	-1.5%
6	17:10	Sep 14	2.79	2.86	-0.07	-2.5%
7	17:32	Sep 14	2.75	2.80	-0.05	-1.8%
8	18:01	Sep 14	2.77	2.85	-0.08	-2.9%
9	18:35	Sep 14	2.77	2.83	-0.06	-2.2%
10	19:11	Sep 14	2.73	2.82	-0.09	-3.3%
	Average		**2.77**	**2.83**	**-0.06**	**-2.0%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	0.0391	
Confidence Coefficient (CC)	0.0300	
t-Value for 9 Data Sets	2.306	
		Limit
Avg. Abs. Diff. (%dv)	**0.06**	**1.0**

RM = Reference Method (CleanAir Data) 101017 180324
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data
RATA calculations are based on 9 of 10 runs. * indicates the excluded run.

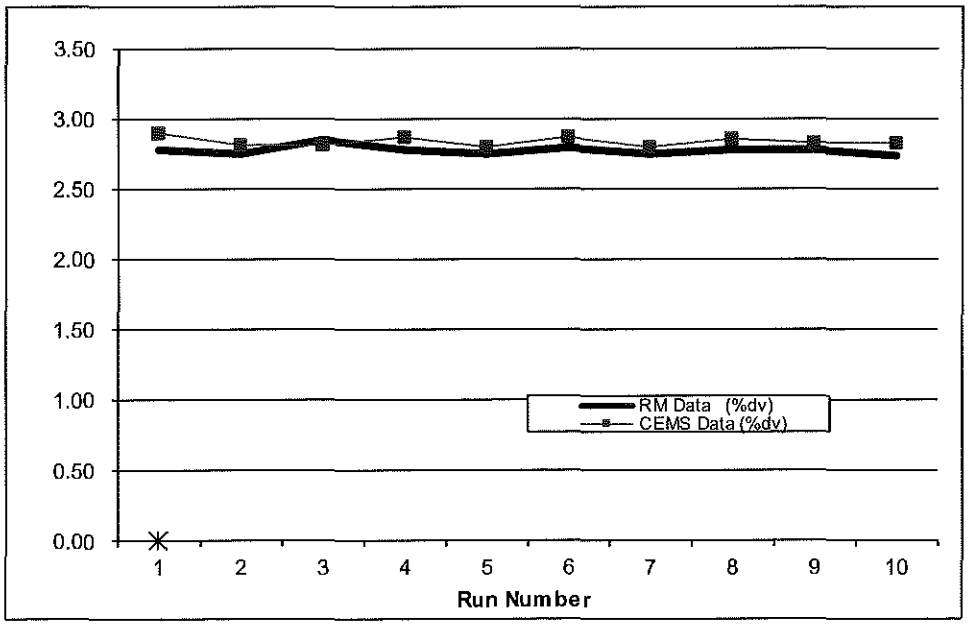


Table 2-3:
C6 SRU Incinerator – SO_2 (ppmdv @ 0%O_2) RATA

Run No.	Start Time	Date (2017)	RM Data (ppm@0%O2)	CEMS Data (ppm@0%O2)	Difference (ppm@0%O2)	Difference Percent
1	10:06	Sep 14	71.33	74.33	-3.00	-4.2%
2	10:41	Sep 14	71.50	73.79	-2.29	-3.2%
3	11:14	Sep 14	73.53	72.90	0.63	0.9%
4 *	14:53	Sep 14	66.16	73.83	-7.67	-11.6%
5	15:29	Sep 14	67.01	72.52	-5.51	-8.2%
6	17:10	Sep 14	60.49	67.33	-6.84	-11.3%
7	17:32	Sep 14	61.73	66.83	-5.10	-8.3%
8	18:01	Sep 14	62.66	67.81	-5.15	-8.2%
9	18:35	Sep 14	62.69	67.21	-4.52	-7.2%
10	19:11	Sep 14	63.92	67.05	-3.13	-4.9%
Average			**66.10**	**69.97**	**-3.88**	**-5.9%**

Relative Accuracy Test Audit Results

Standard Deviation of Differences	2.2117	
Confidence Coefficient (CC)	1.7001	
t-Value for 9 Data Sets	2.306	
		Limit
Relative Accuracy (as % of RM)	**8.4%**	**20.0%**
Relative Accuracy (as % of Appl. Std.)	**5.6%**	**10.0%**
Appl. Std. = 100 ppm@0%O2		

RM = Reference Method (CleanAir Data) 101017 180324
CEMS = Continuous Emissions Monitoring System (Marathon Petroleum Company Data)
RATA calculations are based on 9 of 10 runs. * indicates the excluded run.

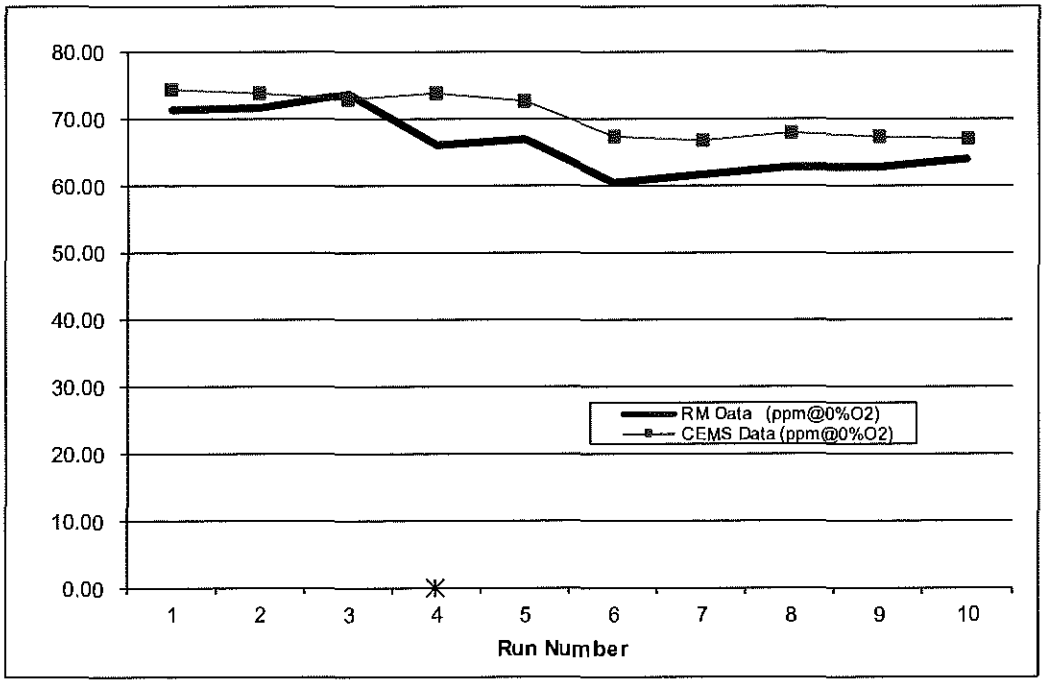


Table 2-4:
C6 SRU Incinerator – VOCs & NO_X Emissions

Run No.		1	2	3	Average
Date (2017)		Sep 14	Sep 14	Sep 14	
Start Time (approx.)		10:06	14:53	17:32	
Stop Time (approx.)		11:35	17:31	18:56	
Process Conditions					
H_i	Actual heat input (MMBtu/hr)	32.7	33.1	33.2	**33.0**
Gas Conditions					
O_2	Oxygen (dry volume %)	2.8	2.8	2.8	**2.8**
CO_2	Carbon dioxide (dry volume %)	4.9	4.9	4.8	**4.9**
B_w	Actual water vapor in gas (% by volume)[1]	10.5	10.4	10.5	**10.5**
Gas Flow Rate[2]					
Q_a	Volumetric flow rate, actual (acfm)	48,522	49,616	49,669	**49,300**
Q_s	Volumetric flow rate, standard (scfm)	23,156	23,628	23,659	**23,500**
Q_{std}	Volumetric flow rate, dry standard (dscfm)	20,720	21,165	21,179	**21,000**
THC Results[3]					
C_{sd}	Concentration (ppmdv as C_3H_8)	<0.530	0.582	<0.508	**<0.540**
C_{sd}	Concentration (lb/dscf)	<6.07E-08	6.66E-08	<5.82E-08	**<6.18E-08**
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	< 0.00230	0.00256	< 0.00222	**< 0.00236**
Methane Results[4]					
C_{sd}	Concentration (ppmdv)	3.48	3.53	2.94	**3.32**
C_{sd}	Concentration (lb/dscf)	1.45E-07	1.47E-07	1.22E-07	**1.38E-07**
$E_{lb/hr}$	Emission Rate (lb/hr)	0.180	0.187	0.156	**0.174**
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.00550	0.00564	0.00468	**0.00527**
Ethane Results[4]					
C_{sd}	Concentration (ppmdv)	<0.23	<0.23	<0.23	**<0.23**
C_{sd}	Concentration (lb/dscf)	<1.79E-08	<1.79E-08	<1.79E-08	**<1.79E-08**
$E_{lb/hr}$	Emission Rate (lb/hr)	< 0.0223	< 0.0228	< 0.0228	**< 0.0226**
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	< 0.00068	< 0.00069	< 0.00069	**< 0.00069**
VOC Results[5]					
C_{sd}	Concentration (ppmdv as C_3H_8)	<0.530	0.582	<0.508	**<0.719**
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	< 0.00230	0.00256	< 0.00222	**< 0.00236**
Nitrogen Oxides Results					
C_{sd}	Concentration (ppmdv)	14.7	13.8	13.6	**14.0**
C_{sd}	Concentration (lb/dscf)	1.75E-06	1.64E-06	1.62E-06	**1.67E-06**
$E_{lb/hr}$	Emission Rate (lb/hr)	2.18	2.09	2.06	**2.11**
E_{Hi}	Emission Rate - Heat input-based (lb/MMBtu)	0.0666	0.0631	0.0620	**0.0639**

[1] Moisture data used for ppmwv to ppmdv correction obtained from nearly-concurrent M-5/202 runs.

[2] Flow data used in lb/hr calculations was obtained from nearly-concurrent M-5/202 runs.

[3] For THC, '<' indicates a measured response below the detection limit (assumed to be 1% of the instrument calibration span).

[4] For methane and ethane, '<' indicates a measured response below the analytical detection limit determined by the laboratory.

[5] For VOCs, '<' indicates at least one non-detectable fraction was used in the calculations.

End of Section

3. 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 Sulfur Block (EU72-SULRBLOCK2) removes hydrogen sulfide (H_2S) from acid gas and converts it to elemental sulfur using the Claus Process (Trains A and B), 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 (SV72-V22). 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 6 SRU Incinerator Stack.

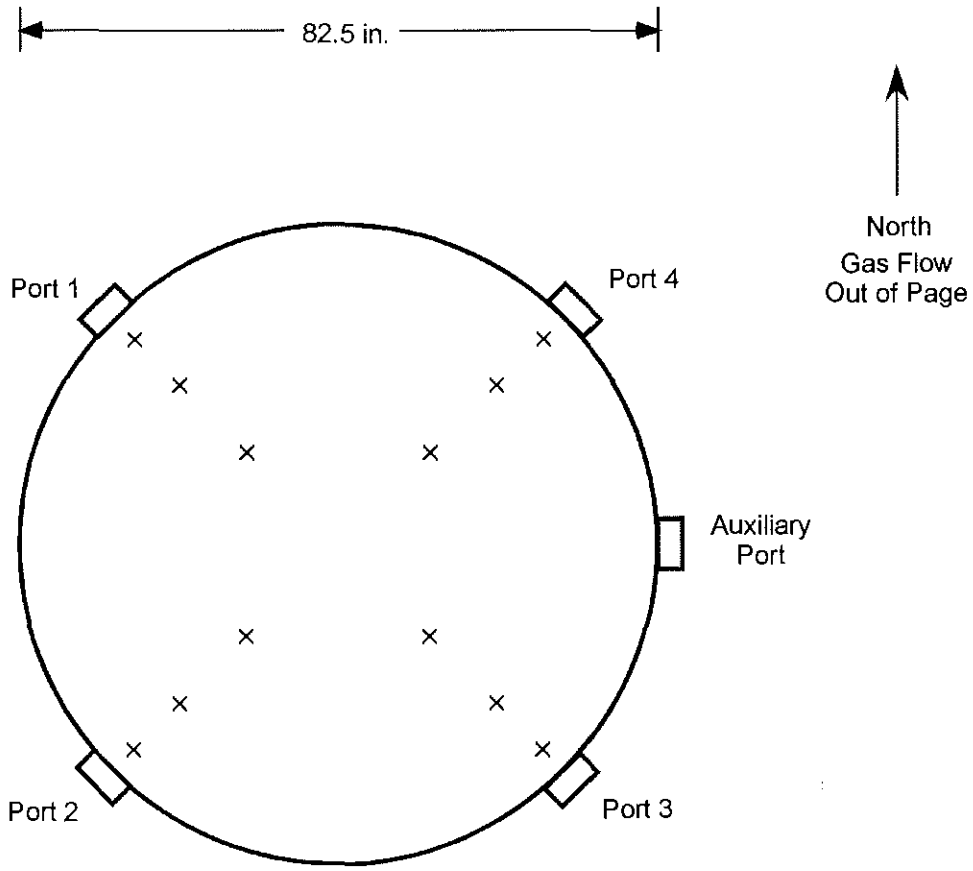
Test Location

The sample point locations were determined by EPA Methods 1 and 7E specifications. Table 3-1 presents the sampling information for the test location described in this report. The figures shown on pages 11 and 12 represent the layout of the test location.

Table 3-1:
Sampling Point Information

Source Constituent	Method	Run No.	Ports	Points per Port	Minutes per Point	Total Minutes	Figure
Complex 6 SRU Incinerator							
FPM / CPM	5 / 202	1-4	4	3	10	120	3-1
O_2 / CO_2 / SO_2	3A / 6C	1-10	1	3	7	21	3-2
O_2 / CO_2 / NO_X / CH_4 / C_2H_6 / THC	3A / 7E / 18 / 25A	1-3	1	3	21	63	3-2

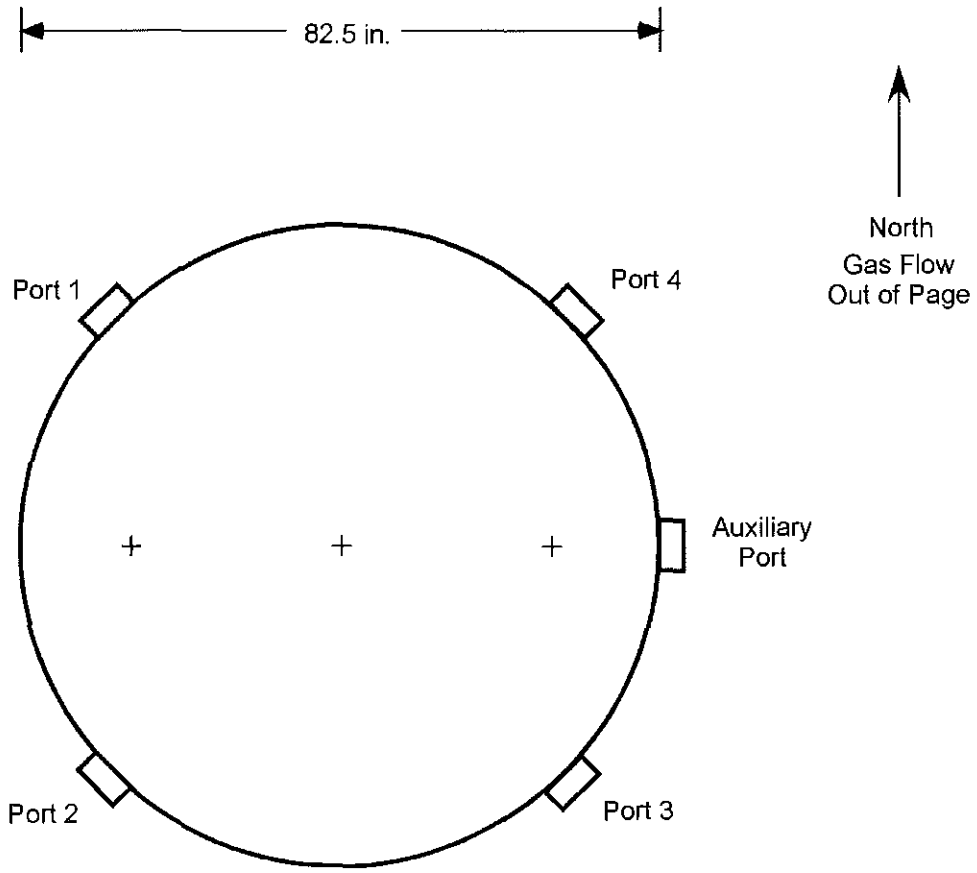
Figure 3-1:
PM & PM_{10} Sample Point Layout (EPA Method 1)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	29.6	24.4
2	14.6	12.0
3	4.4	3.6

Duct diameters upstream from flow disturbance (A): 14.5 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 14.5 Limit: 2.0

Figure 3-2:
O_2, SO_2, NO_X & THC Sample Point Layout (EPA Method 7E)



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	83.3	68.8
2	50.0	41.2
3	16.7	13.8

Duct diameters upstream from flow disturbance (A): 14.5 Limit: 0.5
Duct diameters downstream from flow disturbance (B): 14.5 Limit: 2.0

End of Section

4. METHODOLOGY

Procedures and Regulations

The test program sampling measurements followed procedures and regulations outlined by the United States Environmental Protection Agency (USEPA) and the DEQ. These methods appear in detail in Title 40 of the CFR and at https://www.epa.gov/emc. Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery and analytical procedures.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir's internal Quality Manual.

Title 40 CFR Part 60, Appendix A

Method 1	"Sample and Velocity Traverses for Stationary Sources"
Method 2	"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)"
Method 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 5	"Determination of Particulate Matter Emissions from Stationary Sources"
Method 6C	"Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure"
Method 7E	"Determination of Nitrogen Oxide Emissions from Stationary Sources (Instrumental Analyzer
Method 18	"Measurement of Gaseous Organic Compound Emissions by Gas Chromatography"
Method 25A	"Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"

Title 40 CFR Part 60, Appendix B Performance Specifications

PS2	"Specifications and Test Procedures for SO_2 and NOx 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"

Title 40 CFR Part 51, Appendix M

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

Methodology Discussion

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

The front-half (Method 5 portion) of the sampling train consisted of a glass nozzle, glass liner and filter holder heated to 248°F ± 25°F and a quartz fiber filter. Flue gas samples were extracted isokinetically per Method 5 requirements.

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 SO_2 and 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°F 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 were 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.

The front-half portion of the sample train (nozzle, probe and heated filter) was recovered per Method 5 requirements, using acetone as the recovery solvent. 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 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.

O_2, CO_2, SO_2 and NO_X Testing – USEPA Methods 3A, 6C and 7E

Reference method O_2 and CO_2 emissions were determined using a paramagnetic/NDIR analyzer per EPA Method 3A. Reference method SO_2 emissions were determined using an ultraviolet - photometric analyzer per EPA Method 6C. Reference method NO_X emissions were determined using a chemiluminescent analyzer per EPA Method 7E.

Sample gas was extracted at a constant rate, conditioned to remove moisture and delivered to an analyzer bank which measured the concentration of each pollutant on a dry basis (units of %dv or ppmdv).

Calibration error checks were performed by introducing zero 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 Methods 3A and 7E, the average results for each run were drift-corrected.

The mid-level gas (approximately 5% O_2) utilized for the calibration error and bias checks on the O_2 analyzer was approximately 25% of the calibration span as opposed to the 40% to 60% range outlined in the methodology. The results are believed to be just as accurate since the measured O_2 during every test set was less than 5%.

VOCs Testing – USEPA Methods 25A and 18

The Method 25A sampling system consists of a heated probe, heated filter and heated sample line. Flue gas was delivered at 250°F to a flame ionization analyzer (FIA), which continuously measures minute-average THC concentration expressed in terms of propane (C_3H_8) on an actual (wet) basis. FIA calibration was performed by introducing zero air, high, mid- and low range C_3H_8 calibration gases to the inlet of the sampling system's heated filter. Bias checks were performed before and after each sampling run in a similar manner.

The Method 18 sampling system consists of a gas conditioner (for moisture removal), TFE sample lines, TFE-coated diaphragm pump and a mass flow meter ("Direct Pump Sampling Procedure"). This system pulled a slipstream of the flue gas from the Method 25A sample delivery system and delivered it into a FlexFoil bag at a constant rate. The moisture condensate was not collected for analysis as CH_4 and C_2H_6 are insoluble in water.

Analysis for CH_4 and C_2H_6 was performed off-site by CleanAir Analytical Services using gas chromatography (GC). Since moisture was removed from the sample prior to collection, the GC analyzer measured concentration on a dry basis. At least five (5) sample injections were analyzed for each run.

Analyzer calibration was performed by generating a calibration curve from triplicate injections of three (3) distinct CH_4 and C_2H_6 concentrations introduced directly into the GC. Upon completion of calibration, a recovery study was performed by spiking one of the bag samples with a known concentration of CH_4 and C_2H_6, storing the bags for the same period of time prior to analysis as the field samples, and analyzing the bags to determine percent recovery.

End of Section