



Tesoro Refining & Marketing Company LLC

A subsidiary of Marathon Petroleum Corporation

Los Angeles Refinery – Carson Operations
2350 E. 223rd Street
Carson, California 90810
310-816-8100

May 12, 2021

VIA Certified Mail and eMail (wnastri@aqmd.gov)
Return Receipt Requested

Wayne Nastri
Executive Officer
South Coast Air Quality Management District
21865 Copley Drive
Diamond Bar, CA 91765

Re: Fourth Set of Comments on SCAQMD Revised Draft of Proposed Rule 1109.1 – Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Industries
(Revision Date: December 24, 2020)

Dear Mr. Nastri:

On behalf of Tesoro Refining & Marketing Company LLC, a wholly owned subsidiary of Marathon Petroleum Corporation (collectively, “MPC”), MPC appreciates this opportunity to provide South Coast Air Quality Management District (SCAQMD) with additional comments on the Revised Preliminary Draft Proposed Rule 1109.1 Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Industries (Proposed Rule 1109.1) that was issued on December 24, 2020.¹ Throughout the rulemaking process, MPC staff continues to be active participants in Proposed Rule 1109.1 working group meetings and discussions with SCAQMD staff.

This set of comments supplements MPC’s three previous comment letters submitted to SCAQMD on December 22, 2020, February 1, 2021, and April 7, 2021, and describes the retrofit co-pollutant emissions impacts associated with installing and operating selective catalytic reduction (SCR) at refinery fuel gas-fired boilers and heaters to meet the NOx Best Available Retrofit Control Technology (BARCT) limit, as proposed.

Specifically, MPC is concerned with the resulting increase in emissions of particulate matter less than 10 microns (PM₁₀) and particulate matter less than 2.5 microns (PM_{2.5}), referred to as fine particulate matter in this letter, due to installing SCR to meet the proposed NOx BARCT standard at these refinery combustion units. The level of increase may be significant such that the project is a “major modification” under U.S. EPA’s New Source Review (federal NSR) program. Triggering federal NSR for fine particulate matter at refinery fuel gas-fired combustion sources is a time and resource-intensive permitting

¹ SCAQMD, “Revised Preliminary Draft Proposed Rule 1109.1”, <http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1109.1/r1109-1-rule-language---12-24-20.pdf>

effort for both the regulated source and the District, yet which has not been considered in the implementation time frame for NO_x BARCT. Unless a categorical exclusion to federal NSR is included for these Proposed Rule 1109.1 compliance projects, SCAQMD's analysis must then also include consideration of the emissions control costs, air quality impacts, permitting considerations and implementation time frame associated with triggering federal NSR for fine particulate matter due to installation of SCR for NO_x BARCT.

For the District's reference, this co-pollutant emissions concern for federal NSR was initially raised by the SCAQMD in this rulemaking process over two years ago as well as by MPC in its December 22, 2020 comment letter.² Although SCAQMD is proposing a narrow BACT exemption for PM₁₀ in the District's New Source Review (NSR) program at Regulation XIII, it has not appropriately addressed the impact of co-pollutant emissions on federal NSR applicability for major modifications.³ For reference, PM₁₀ is designated in attainment with the National Ambient Air Quality Standards (NAAQS) and is subject to 40 CFR § 52.21 for the Prevention of Significant Deterioration (PSD) permit program. SCAQMD Rule 1325 - Federal PM_{2.5} New Source Review Program – applies to new and modified major sources that trigger the NSR threshold for PM_{2.5}. Rule 1325 incorporates and adopts U.S. EPA requirements for PM_{2.5}, which is designated nonattainment with the NAAQS.

Moreover, if a facility triggers federal NSR, it may then be required to apply best available control technology (BACT) for PM₁₀ emissions or lowest achievable emission rate (LAER) for PM_{2.5}. BACT and LAER have been determined in the past to be the installation of an additional fuel gas sulfur treatment system at the mix drum that delivers fuel to the heater(s) or boiler(s) with SCR. A fuel gas sulfur treatment project is a significant capital cost as well as a time- and resource-intensive effort. If such a project would be required to satisfy the federal NSR permit for the NO_x BARCT project, then the emissions control costs should be also considered in the cost-effectiveness analysis for NO_x BARCT. To MPC's knowledge, these costs have not yet been considered by SCAQMD in the cost-effectiveness analysis for NO_x BARCT.

It should also be recognized that Rule 1325 regulates direct ammonia emissions in the same manner as PM_{2.5}. Thus, if there is a significant emissions increase of ammonia from a project, then that will also require LAER and trigger other permitting obligations under the nonattainment NSR regulation. Whereas we have focused our comments on the implications of triggering federal NSR for fine particulate matter in this letter, we reserve the right to comment on the potential impacts of an ammonia increase due to implementation of NO_x BARCT that also could trigger applicability as a major modification under Rule 1325.

Summary of the SCR Retrofit Co-pollutant Emissions Issue During the 1109.1 Rulemaking Process

The chemistry and formation of ammonium sulfate and ammonium bisulfate aerosols from ammonia in an SCR and sulfur from refinery fuel gas are well-known. These aerosols contribute to and are measured as direct PM₁₀ and PM_{2.5} emissions (referred to as fine particulate matter).

At SCAQMD's February 18, 2020 Working Group presentation, the agency noted that concerns had been expressed by stakeholders regarding the co-pollutant emissions impacts due to SCR installation that were

² See SCAQMD, Presentation: "Proposed Rule 1109.1 - NO_x Emission Reduction for Refinery Equipment, Working Group Meeting #7", April 30, 2019, Accessed at <http://www.aqmd.gov/default-source/rule-book/Proposed-Rules/1109.1/pr1109-1-wgm7.pdf?sfvrsn=6> in May 2021. See slide 13.

³ SCAQMD, Presentation: "Regulation XIII - New Source Review, Working Group Meeting", May 13, 2021, Accessed at <http://www4.aqmd.gov/enewsletterpro/uploadedimages/000001/Laura/REG%20XIII/NSR%20WGM%20May%202021%20-%20Final.pdf> in May 2021. See slide 4.

needed to comply with the proposed NOx BARCT limit, particularly as a function of sulfur present in the refinery fuel gas.⁴ SCAQMD consequently issued a survey to gather information on fuel gas treatment project that were anticipated by refineries and the associated costs. At this time, the detailed results of the “SOx/PM Survey” have not been made public.

During SCAQMD’s July 17, 2020 presentation, the District stated that “all permitting costs associated with co-pollutant issues will be addressed in the cost-effectiveness analysis.”⁵ In its subsequent August 12, 2020 presentation, SCAQMD stated that “staff views this as an NSR issue and is continuing to work with EPA.⁶ Since then, the first and only written indication of whether co-pollutant emissions of fine particulate matter due to SCR retrofits may trigger EPA’s federal NSR program is in the RECLAIM Transition Plan, excerpted as follows with relevant text underlined for emphasis:⁷

“Co-Pollutant Emissions from Installation of SCR on Refinery Equipment

During the rulemaking for Proposed Rule 1109.1 - Emissions of Oxides of Nitrogen from Petroleum Refineries and Related Operations, industry stakeholders highlighted that when an SCR is installed on a refinery boiler or heater, that particulate matter emissions from the boiler or heater may trigger BACT requiring sulfur clean-up in the refinery fuel gas. For boilers and heaters that are using refinery gas that install SCRs, SO₂ emissions from the boiler and heater are converted to SO₃ on the SCR catalyst. The unreacted ammonia from the SCR reacts with the SO₃ to form ammonium sulfate which is emitted as particulate matter. The cost for sulfur clean-up can be over \$100 million for refineries that are currently not at BACT.

Staff has been working with U.S. EPA and CARB on different approaches to address this issue. Staff believes that the NOx reductions from implementation of Proposed Rule 1109.1 should be the first priority since the region is in extreme nonattainment of federal ozone standards. U.S. EPA agrees that if the modification does not exceed the federal significant emission rates, that major new source review would not be required. Initial estimates indicate that the increase in particulate matter emissions would likely be below federal major modification thresholds which are 15 ton per year for PM₁₀ and 10 tons per year for PM_{2.5}. Under this approach, a demonstration is still needed to show that there is no backsliding under SB 288. CARB staff did identify that other air districts throughout California have a provision that exempts sources from meeting BACT when complying with a BARCT requirement. It is staff’s understanding that the objective is to ensure BACT does not interfere with the ability of a region to achieve air quality requirements that can only be achieved through the implementation of BARCT requirements. Staff is continuing to work with U.S. EPA and CARB to evaluate potential options on how to evaluate these types of projects and a potential path forward in the event SB 288 is triggered.”

Although the District believes that the corresponding emissions increase “would likely be below federal major modification thresholds,” SCAQMD provides no information corroborating or explaining the “initial estimates” for fine particulate matter emissions due to SCR.

⁴ SCAQMD, Presentation: “Proposed Rule 1109.1 - NOx Emission Reduction for Refinery Equipment, Working Group Meeting #9”, February 18, 2020. Accessed at http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1109.1/pr1109-1-wgm_10_final.pdf?sfvrsn=18 in May 2021. See slide 4.

⁵ SCAQMD, Presentation: “Proposed Rule 1109.1 - NOx Emission Reduction for Refinery Equipment, Working Group Meeting #9”, July 17, 2020. Accessed at http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1109.1/pr1109-1-wgm_12_final.pdf?sfvrsn=4 in May 2021. See slide 13.

⁶ SCAQMD, Presentation: “Proposed Rule 1109.1 - NOx Emission Reduction for Refinery Equipment, Working Group Meeting #9”, August 12, 2020. Accessed at http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1109.1/final_pr1109-1_wgm_13.pdf?sfvrsn=12 in May 2021. See slide 36.

⁷ SCAQMD, “RECLAIM Transition Plan Draft Version 2.0,” December 2020. Accessed at <http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/regx111/reclaim-transition-plan-draft-version-2-0.pdf?sfvrsn=6> in May 2021. See page 7-6.

SCAQMD has not since provided its analysis of the federal NSR applicability analysis related to co-pollutant impacts. Since SCAQMD has not definitively concluded that co-pollutant impacts will not trigger federal NSR, this critical issue remains unresolved as part of the Proposed Rule 1109.1 rulemaking process.

Applicability of Federal NSR for Fine Particulate Matter Due to NO_x BARCT SCR Project(s)

The criteria for determining applicability of a project to federal NSR for major modifications is different from the District's minor NSR regulations. A major modification under federal NSR is triggered for a project when the emissions increase of a regulated pollutant, in this case PM₁₀ or PM_{2.5}, exceeds the corresponding significant emissions rate for that pollutant, which is 15 tons per year (tpy) PM₁₀ and 10 tpy PM_{2.5}.

An SCR retrofit project at an existing refinery fuel gas-fired process heater will experience decreased NO_x emissions, but the emissions factor for fine particulate matter pollutants will correspondingly increase, the level of which depends primarily on the concentration of ammonia and sulfur in the exhaust and actual heat input of the unit.

Based on tests conducted at refinery fuel gas-fired heaters with SCR by MPC and other companies, it was found that the fine particulate matter emissions factor from refinery fuel gas fired combustion units with SCR generally are in the range of 0.010 and 0.015 pounds per million British thermal units (lb/MMBtu). Fine particulate matter emissions factors for refinery fuel gas-fired heaters and boilers with SCR are variable to a degree due to the level of fuel gas sulfur and SCR ammonia concentration that a heater or boiler may experience as well as the reference test method and procedures that are being used to measure particulate matter. Attached for reference is an engineering emissions test report in 2017 for the H-100 heater with SCR that measured 0.013 lb/MMBtu of fine particulate matter emissions using SCAQMD Method 5.2.^{8 9}

By comparison, the fine particulate matter emissions factor for similar types of refinery heaters without SCR are normally reported at 0.0075 lb/MMBtu or, in some cases, an emissions factor lower than that based on the results of particulate matter emissions testing.

The PM₁₀ and PM_{2.5} emissions increase for determining federal NSR applicability at project-affected existing emissions units being modified with SCR is calculated as the difference in post-project annual emissions and the pre-project baseline actual annual emissions. The post-project annual emissions may be calculated either as a projection of the expected highest level of annual utilization or its potential to emit, whereas the baseline emissions is calculated as an annual average of a consecutive 24-month historical period.

As a simplified example of federal NSR applicability for illustrative purposes, an SCR retrofit project is planned for heaters at a refinery process unit such as a crude unit or for boilers at a refinery steam boiler complex.¹⁰ The 24-month average baseline actual annual heat input for this example was 425 MMBtu/hr.

⁸ Almega Environmental & Technical Services, "Source Test Report: Engineering Emissions Testing of DCU Heater H-100 for NO_x, SO_x, CO, ROG, NH₃, and PM". Prepared for Tesoro Refining & Marketing Company LLC, Los Angeles Refinery - Wilmington Operations, Project: 10280, Test date: November 8, 2017, Report date: December 11, 2017.

⁹ The attached engineering emissions test report does not include the appendices. The complete report is available upon request.

¹⁰ This example is illustrative of a SCR retrofit project at a refinery process unit's heater(s) or at a refinery steam boiler complex, depending on the actual level of fine particulate matter emissions before and after the SCR project and the application of the NSR "project aggregation" policy noted in this

The highest projection of future annual actual heat input from these units for federal NSR applicability is normally higher than the 24-month historical average. For this simplified example, the future annual duty is set at the same level as the historical baseline. Also for this example, the fine particulate matter emissions factor from these heaters or boilers is 0.0075 lb/MMBtu without SCR and is projected to be 0.013 lb/MMBtu with SCR. The emissions increase of fine particulate matter under the federal NSR regulations is calculated in Table 1 below to be 10.2 tpy.

Table 1: Federal NSR applicability calculation for SCR NO_x BARCT project example.

NSR Calculation Element	Pre-project (no SCR) Baseline Actual Emissions	Post-project (with SCR) Projected Actual Emissions
Annual heat input (MMBtu/hr)	425	425
PM ₁₀ and PM _{2.5} emissions factor (lb/MMBtu)	0.0075	0.013
PM ₁₀ and PM _{2.5} emissions increase under federal NSR (tpy)	14.0	24.2
Emissions increase = post-project - pre-project emissions = 24.2 – 14.0 = 10.2 tpy		

Since this level of emissions increase exceeds the significant emissions rate for PM_{2.5} of 10 tpy, it will trigger federal NSR permitting.

This example is intended to illustrate that federal NSR can potentially be triggered for fine particulate matter, especially PM_{2.5}, as a result of retrofitting existing refinery fuel gas-fired heaters and boilers with SCR. It is also relevant to note that projects involving the installation of pollution control technology are no longer categorically excluded from federal NSR as a result of a 2005 U.S. Court of Appeals decision.¹¹ Therefore, the emissions increase test for federal NSR applicability is required even for projects that only involve the installation of a pollution control technology if the project could result in an emissions increase of a regulated NSR pollutant.

Furthermore, when determining applicability as a major modification, EPA’s “project aggregation” policy for federal NSR will also need to be considered on a case-by-case basis to determine if the emissions increase from a heater or boiler SCR retrofit should be combined with other SCR retrofits at the refinery.¹² If the emissions increase from all heater and boiler SCR retrofits in a process unit to meet NO_x BARCT must be aggregated as a single project, there will be a much higher likelihood that federal NSR is triggered for fine particulate matter.

Based on the aforementioned information and particular set of circumstances we have described, a refinery could trigger federal NSR for fine particulate matter as a function of completing SCR retrofit projects required to meet NO_x BARCT. Further examination of this issue by SCAQMD is warranted due to the substantial impacts on time and costs if federal NSR is triggered.

letter. For the Los Angeles Refinery, this example may potentially be applicable to the #1 Crude Unit heater with a heat input capacity of 550 MMBtu/hr or to the Boilerhouse with a combined heat input capacity of its boilers of 734 MMBtu/hr.

¹¹ *New York v. EPA*, 413 F.3d 3 (D.C. Cir.) and 431 F.3d 801; June 24, 2005.

¹² 83 Fed. Reg. 57324; November 15, 2018.

Key Implications of Triggering Federal NSR for Fine Particulate Matter Due to NOx BARCT SCR Project(s)

Federal NSR for fine particulate matter requires a pre-construction air permit that addresses air quality impacts, emissions control technology, and other time-intensive and costly review elements, depending on the attainment status of the pollutant(s) that may experience a significant emissions increase. For example, PM_{2.5} is a nonattainment pollutant in the South Coast Basin that would subject the modified heater(s) and boiler(s) to a level of emissions control for PM_{2.5} that meets LAER. Generally, the best level of emissions control for fine particulate matter at refinery fuel gas-fired combustion units is to remove the sulfur in the fuel gas mix drum system. Fuel gas sulfur treatment is a complex and large capital project which could cost over \$100 million, as mentioned in the RECLAIM Transition Plan.

The costs for fuel gas sulfur treatment or other emissions controls as well as the related permitting costs for federal NSR would be inherent to achieving NOx BARCT. This has not been considered by SCAQMD in the cost-effectiveness of NOx BARCT, and MPC believes that these costs need to be addressed in the analysis.

Also, the time frame for obtaining a federal NSR permit is a several months long process that could stretch into multiple years. Onsite construction cannot begin until the permit is issued. The air permit timing followed by the long lead-time for installing an integrated fuel gas sulfur treatment system prior to the SCR retrofit(s), will likely extend the schedule for implementation of NOx BARCT.

Conclusion

SCAQMD is currently working to address the District's minor NSR rules regarding co-pollutant particulate matter emissions, but it has not appropriately addressed federal NSR applicability for a major modification and its consequences as part of the NOx BARCT process. MPC believes that federal NSR could be triggered for a project as a result of completing SCR retrofits necessary to meet the proposed NOx BARCT, unless SCAQMD and EPA identify and implement a categorical exclusion to federal NSR for these projects. Unless an exclusion to federal NSR applicability is provided for these projects, the SCAQMD's analysis for Proposed Rule 1109.1 needs to appropriately consider the emissions control costs, air quality impacts, permitting considerations, and implementation time frame associated with triggering federal NSR for fine particulate matter.

Please note that in submitting this letter, MPC reserves the right to supplement its comments as it deems necessary, especially if additional or different information is made available to the public regarding the Proposed Rule 1109.1 rulemaking process.

Mr. Wayne Nastri
May 12, 2021
Page 7

Thank you for the opportunity to provide comments. We are glad to discuss further and look forward to continued dialogue.

Sincerely,



Brad Levi
Vice President – Los Angeles Refinery

Attachment

cc: **SCAQMD**
Sarah Rees – Deputy Executive Officer
Susan Nakamura – Assistant Deputy Executive Officer
Michael Krause – Planning and Rules Manager

cc: **SCAQMD Governing Board**
Dr. William Burke – Governing Board Member
Hon. Ben Benoit – Governing Board Chair
Hon. Lisa Bartlett – Governing Board Member
Hon. Joe Buscaino – Governing Board Member
Hon. Michael Cacciotti – Governing Board Member
Hon. Vanessa Delgado – Governing Board Vice-Chair
Hon. Gideon Kracov – Governing Board Member
Hon. Sheila Kuehl – Governing Board Member
Hon. Larry McCallon – Governing Board Member
Hon. V. Manuel Perez – Governing Board Member
Hon. Rex Richardson – Governing Board Member
Hon. Carlos Rodriguez – Governing Board Member
Hon. Janice Rutherford – Governing Board Member

Mr. Wayne Nastri

May 12, 2021

Page 8

ecc: 2021-05-12 MPC Fourth Comment Letter on Revised Draft of SCAQMD PR1109.1

Greg Busch, MPC RE

Ruth Cade, MPC RE

Chris Drechsel, MPC RE

Ben Franz, MPC LAW

Denis Kurt, MPC LAR

Robert Nguyen, MPC LAR

Tim Peterkoski, MPC EA

Robin Schott, MPC LAR

Vanessa Vail, MPC LAW

Attachment



SOURCE TEST REPORT

Engineering Emissions Testing of DCU Heater H-100 for NO_x, SO_x, CO, ROG, NH₃, and PM

Facility ID: 800436

Device ID: D33

Prepared for:

Tesoro Refining & Marketing Company LLC

Los Angeles Refinery- Wilmington Operations

2101 E. Pacific Coast Highway

Wilmington, California 90744

Test Date(s): November 8, 2017

Report Date: December 11, 2017

Project: 10280

Prepared by:

Almega Environmental & Technical Services

10602 Walker Street

Cypress, CA 90630

Prepared by & Title: _____


Surya Adhikari, Project Manager

Reviewed by & Title: _____



Charles M. Figueroa, Sr. Project Manager

TABLE OF CONTENTS

<u>No.</u>	<u>Section</u>	<u>Page</u>
1.0	Executive Summary	1
1.1	Summary of Results	2
2.0	Introduction	4
2.1	Document Outline	4
3.0	Test Results and Discussion	5
3.1	Test Results	5
3.2	Miscellaneous	5
3.3	Test Chronology	7
4.0	Equipment and Process Description	10
4.1	Process Description	10
4.2	Operating Conditions During Testing	10
4.3	Sampling Locations	10
5.0	Sampling and Analytical Procedures	13
5.1	SCAQMD Methods 1.1-4.1 – Stack Gas Parameters and Sampling Locations... 13	13
5.2	SCAQMD Method 5.2 – Particulate Matter Emissions	16
5.3	SCAQMD Method 25.3 – VOC, as TGNMO (ROG)	19
5.4	SCAQMD Method 10.1 – CO, O ₂ , and CO ₂ by GC/TCD	21
5.5	SCAQMD Method 207.1 – Ammonia Emissions	21
6.0	Quality Assurance / Quality Control	23
6.1	General QA/QC	23
6.2	Project-Specific QA/QC	23

TABLE OF CONTENTS - Continued

Appendices

Appendix A - General Calculations and Formulae

Appendix B - Approvals and Certifications

B1 - SCAQMD and CARB Testing Approvals

B2 - Certification of No Conflict of Interest

Appendix C - SCAQMD Method 5.2 – Particulate Matter Emissions

C1 - Particulate Matter Emissions – Results and Calculations

C2 - Particulate Matter Emissions – Field Data

C3 - Particulate Matter Emissions – Laboratory Data

C4 - Anions Analytical Data by EPA 300/300.1

Appendix D - SCAQMD Method 207.1 – Ammonia

D1 - Ammonia– Results and Calculations

D2 - Ammonia – Field Data

D3 - Ammonia – Laboratory Data

Appendix E - SCAQMD Method 25.3/10.1 – VOC, as TGNMO & CO, O₂/CO₂

E1 - VOC, as TGNMO & CO, O₂/CO₂ – Results and Calculations

E2 - VOC, as TGNMO & CO, O₂/CO₂ – Field Data

E3 - VOC, as TGNMO & CO, O₂/CO₂ – Laboratory Data

Appendix F - Quality Assurance and Quality Control (QA/QC)

F1 - Test Equipment Calibration Data

Appendix G - Facility CEMS DAS Data

Appendix H - SCAQMD Permit to Operate

Appendix I - SCAQMD Checklist for Source Test Reports, Form Str.

Attachment

Attachment 1 – Laboratory Report and Data Package for TGNMO per SCAQMD Method 25.3/10.1

1.0 EXECUTIVE SUMMARY

Key project information is provided in the summary below. Test results are summarized in Table 1-1.

Customer	Tesoro Refining & Marketing Company LLC Los Angeles Refinery- Wilmington Operations 2101 E. Pacific Coast Highway Wilmington, California 90744 Contact: Mr. Parvez Abbas, tel. (310) 847-5266
Equipment Location	Same
Facility ID	800436
Equipment	DCU Heater H-100
Device ID Number	D33
Test Objective	To conduct Engineering Emissions Testing for carbon monoxide (CO), oxides of nitrogen (NO _x), oxides of sulfur (SO _x) as SO ₂ , oxygen (O ₂), ammonia (NH ₃), particulate matter (PM), and reactive organic gases (ROG) at the exhaust stack of H-100.
Test Requested by	Mr. Parvez Abbas of Tesoro Refining & Marketing Company LLC, Los Angeles Refinery
Test Date (s)	November 8, 2017
Testing Firm	Almega Environmental & Technical Services 10602 Walker Street Cypress, CA 90630 Contact: Mr. Surya Adhikari, tel (714) 889-4000
Test Personnel	Tom Tran, Greg Rubin, George Munoz, Jose Zamora, Matt Kilgore, and Luke Barrow of Almega Environmental & Technical Services
Regulatory Agency	South Coast Air Quality Management District (SCAQMD) 21865 East Copley Drive Diamond Bar, CA 91765-4182 Contact: Mr. Glenn Kasai, tel. (909) 396-2271

TABLE 1-1. SUMMARY OF RESULTS

Facility: Tesoro LAR Wilmington Operations
 City: Wilmington, CA
 Source: H-100

TEST DATA	Units	4 RUNS AVERAGE
Location	-	
Test Information		
Test Date	mm/dd/yy	11/08/17
Start Time	hh:mm	8:28
End Time	hh:mm	18:23
Facility Data*		
Firing Rate, rated total	MMBtu/hr	252
Fuel Flow Rate, total	Mscfh	189
Fuel Gas Higher Heating Value (HHV)	Btu/Scf	1,278
Firing Rate, calculated total	MMBtu/hr	247
Operating Capacity	%	98.0
Facility CEMS Measured O2	%	5.29
Facility CEMS Measured NOx	ppmv	11.10
Facility CEMS Stack Gas Flow Rate	dscfm	47,257
Sampling Data		
Stack Temperature	°F	628.0
Moisture	%	14.6
Oxygen, O2	% v/v	5.44
Carbon Dioxide, CO2	% v/v	10.65
Stack Flow Rate	dscfm	53,671
Facility CEMS		
SOx Concentration	ppmv	4.22
SOx Emission Rate	lb/hr	2.02
SOx Emission Rate	lb/day	48.42
SOx Emission Rate	lb/MMBtu	0.008
NOx Concentration	ppmv	11.10
NOx Emission Rate	lb/hr	4.48
NOx Emission Rate	lb/day	107.58
NOx Emission Rate	lb/MMBtu	0.018
SCAQMD Method 5.2 - PM		
Filterable PM		
Catch	mg	8.05
Concentration	gr/dscf	2.23E-03
Emission Rate	lb/hr	1.02
Condensable PM		
Catch	mg	16.94
Concentration	gr/dscf	4.68E-03
Emission Rate	lb/hr	2.16
Total Particulate without NH4SO4 adjustment		
Total Catch	mg	24.99
Concentration	gr/dscf	6.91E-03
Emission Rate	lb/hr	3.18
Emission Rate	lb/day	76.32
Emission Rate	lb/MMBtu	0.013
Total Particulate with NH4SO4 adjustment		
Total Catch	mg	10.38
Concentration	gr/dscf	2.87E-03
Emission Rate	lb/hr	1.32
Emission Rate	lb/day	31.66
Emission Rate	lb/MMBtu	0.0053

TABLE 1-1. SUMMARY OF RESULTS, CONTINUED

Facility: Tesoro LAR Wilmington Operations
 City: Wilmington, CA
 Source: H-100

TEST DATA	Units	4 RUNS AVERAGE	
Location	-		
<u>Solid Particulate without NH4SO4 adjustment</u>			
Total Catch	mg	23.59	
Concentration	gr/dscf	6.53E-03	
Emission Rate	lb/hr	3.00	
Emission Rate	lb/day	72.04	
Emission Rate	lb/MMBtu	0.012	
<u>Solid Particulate with NH4SO4 adjustment</u>			
Total Catch	mg	8.98	
Concentration	gr/dscf	2.48E-03	
Emission Rate	lb/hr	1.14	
Emission Rate	lb/day	27.38	
Emission Rate	lb/MMBtu	0.0046	
<u>SCAQMD Method 25.3-ROG/VOC</u>			
Concentration	ppmv	2.64	
Emission Rate as methane	lb/hr	0.36	
Emission Rate as methane	lb/day	8.53	
Emission Rate as methane	lb/mmbtu	0.001	
<u>Carbon Monoxide (CO)</u>			
Concentration	ppmv	<	10.0
Emission Rate	lb/hr	<	2.37
Emission Rate	lb/day	<	56.82
Emission Rate	lb/mmbtu	<	0.010
<u>SCAQMD Method 207.1 - Ammonia</u>			
Concentration	ppmv	6.66	
Concentration @ 3% O2	ppmv	7.64	
Mass Emission Rate	lb/hr	0.96	

Facility data was provided by the facility.

2.0 INTRODUCTION

Almega Environmental & Technical Services (Almega) has been contracted by Tesoro Refining & Marketing Company LLC, Los Angeles Refinery to conduct engineering emissions testing of the Delayed Coking Unit (DCU) Heater H-100 located at its facility in Wilmington, California.

The purpose of the test was to determine emissions from the exhaust of this unit for oxides of nitrogen (NO_x), carbon monoxide (CO), sulfur oxides (SO_x), ammonia (NH₃), particulate matter (PM), and reactive organic gases (ROG) to establish emissions factors.

The emissions factors established during the source test will be used in the permitting process to increase the firing rate of the subject heater. The source test was conducted in accordance with the protocol approval provided by the SCAQMD (STE File P 17289).

Table 2.1 lists the test matrix employed during the test.

TABLE 2-1. TEST MATRIX

PARAMETER	LOCATION	TEST METHOD	# OF TEST RUNS	TEST TIME
Stack Gas Parameters (Flow Rate/Moisture)	Exhaust	SCAQMD Methods 1.1-4.1	4 (in conjunction with PM)	72 min.
Particulate Matter (PM/PM10)	Exhaust	SCAQMD Method 5.2	4	72 min.
CO, O ₂ , and CO ₂	Exhaust	SCAQMD Method 10.1	4 (concurrent with VOC sampling for Method 10.1)	60 min.
VOC as TGNMO (ROG)	Exhaust	SCAQMD Method 25.3	4 (Duplicate)	60 min.
Ammonia	Exhaust	SCAQMD Method 207.1	4	60 min.
NO _x and O ₂	Exhaust	Facility CEMS	4	72 min.
SO _x as SO ₂	Exhaust	Facility ACEMS	4	72 min.

On November 8, 2017, Almega performed the source testing when the equipment was operated at greater than 80% of its proposed maximum design capacity (302.4 MMBTU/hr) under normal operating condition. It should be noted that the heater firing rate was maintained below the existing permitted maximum of 252 MMBTU/hr. Sampling was performed at the exhaust stack. Testing was conducted as specified in the reference methods approved test protocol dated September 7, 2017, and subsequent addendum to the approved test protocol on November 3, 2017.

2.1 Document Outline

This report is organized as follows. Section 1.0 is a summary of the project and test results. Section 2.0 describes the project, its objectives and approach. Section 3.0 discusses test results. Section 4.0 describes the equipment tested and applicable sampling locations. Section 5.0

describes the sampling and analytical procedures used to conduct the testing. And Section 6.0 describes Quality Assurance and Quality Control activities performed. The Appendices contain test results, calculated data, raw field data, facility process and test data, and calibration records, certification documents, and laboratory data package.

3.0 TEST RESULTS AND DISCUSSION

The testing was conducted after the arrival of Almega's test personal and set-up of test equipment. The source was operated by plant personnel during testing activities. The testing was conducted when the heater was operating at greater than 80% of its proposed maximum operating capacity (302.4 MMBTU/hr).

3.1 Test Results

Total particulate matter was determined by SCAQMD Method 5.2 and reported as PM10 emissions. The VOC/ROG was determined by SCAQMD Method 25.3. The CO, O₂, and CO₂ concentrations were obtained from the laboratory analysis using SCAQMD Method 10.1 from the SCAQMD Method 25.3 sampling train. The NO_x and O₂ was measured via the RECLAIM certified facility CEMS. SO_x as SO₂ was determined from the RECLAIM certified facility ACEMS using the SO_x CEMS at H-203 (primary) and H-510 (secondary).

The test results were summarized in Table 1-1. Detailed test results are shown in Table 3-1 and discussed below. A total of four test runs were conducted and the average result was reported.

- The facility CEMS measured NO_x concentration was 11.10 ppmv. The corresponding NO_x mass emission rate was 4.48 lb/hr, 107.58 lb/day, and 0.018 lb/mmbtu.
- The facility ACEMS reported SO_x concentration was 4.22 ppmv. The corresponding SO_x mass emission rate was 2.02 lb/hr, 48.42 lb/day, and 0.008 lb/mmbtu.
- The measured CO concentration as determined by SCAQMD Method 10.1 was <10 ppmv. The corresponding CO mass emission rate was <2.37 lb/hr, <56.82 lb/day, and <0.010 lb/mmbtu.
- The measured VOC concentration, TGNMO as methane, was 2.64 ppmv. The corresponding mass emission rate was 0.36 lb/hr, 8.53 lb/day, and 0.001 lb/mmbtu.

The results of the VOC duplicate sampling deviated by more than 20% from the average of the two values for Run 1. The maximum result is reported for the worst-case evaluation in accordance with SCAQMD Method 25.3.

During the VOC Run 3A sampling, the flowrate limiting orifice may have been clogged as the final vacuum recorded was only 18-inch Hg. This did not meet the minimum numerical vacuum criteria of 15-inch Hg as specified in the method. Additionally, the sample was received under minimal vacuum, indicating a leak occurred post-sampling (confirmed by the elevated oxygen (14.9%) reported). Furthermore, issues were encountered for Samples 3A

and 3B in which when trying to conduct the post leak check, the ¼ inch “T” connector was found stripped and the impinger probes were cut off. The leak may have been introduced in Sample 3A during this occurrence. Therefore, the Run 3A result was excluded from the Run 3 average calculation. Only Run 3B result is used for reporting purposes.

- For this testing program, the total PM determined by Method 5.2 was considered as PM10 and therefore, reported as PM10 emissions. The measured total particulate matter concentration (Total PM as PM10) without the ammonium sulfate adjustment was 0.00691 gr/dscf. The corresponding PM10 emission rate was 3.18 lb/hr, 76.32 lb/day, and 0.013 lb/mmbtu.
- The measured total particulate matter concentration (Total PM as PM10) with the ammonium sulfate adjustment was 0.00287 gr/dscf. The corresponding PM10 emission rate was 1.32 lb/hr, 31.66 lb/day, and 0.0053 lb/mmbtu.
- The average measured ammonia concentration was 6.66 ppm and 7.64 ppm corrected to 3% O₂. The corresponding ammonia emission rate was 0.96 lb/hr.

3.2 Miscellaneous

- All three fractions of each particulate samples: probe, filter, and impinger catches were analyzed for both acid and sulfate contents (See Appendix C3).
- As requested in the protocol evaluation letter, anions from both Part A and Part B lists of EPA Method EPA 300/300.1 were analyzed and results are included in Appendix C4.
- CO, O₂ and CO₂ gases were sampled using canisters during SCAQMD Method 25.3 testing and analyzed by SCAQMD Method 10.1 (See Appendix E).
- The average measured stack flow rate during the particulate testing was 53,671 dscfm and average facility CEMS flow rate was 47,257 dscfm. The facility CEMS flow rate is within 12% of the reference method measured flow rate.
- Per the addendum to the approved test protocol, single ammonia train was sampled in conjunction with each particulate test runs instead of duplicate trains in series specified in Method 207.1.
- The average moisture content measured from particulate train was 14.6% while the average the average moisture content measured from ammonia train was 17.8%. These values are within 18% of each other.

Testing was performed as specified in the reference methods, approved test protocol and subsequent addendum to the approved test protocol as mentioned above. No modifications to proposed sampling and analysis procedures other than those noted above were required.

3.3 Test Chronology

Testing for CO, O₂, CO₂, VOC, NH₃, and PM/PM₁₀ testing was conducted. The following are reported:

Run No.	Parameter-Measurement	Test Date & Time
Run 1	VOC (Method 25.3), CO, O ₂ , CO ₂ (M10.1)	11/08/2017: 8:30-9:30
	NH ₃ (Method 207.1)	11/08/2017: 8:28-9:28
	PM/PM ₁₀ (Method 5.2)	11/08/2017: 8:28-9:57
	NO _x /SO _x - Facility CEMS	11/08/2017: 8:28-9:57
	Drum switch and stabilization	11/08/2017: 10:00 – 12:55
Run 2	VOC (Method 25.3), CO, O ₂ , CO ₂ (M10.1)	11/08/2017: 13:02-14:02
	NH ₃ (Method 207.1)	11/08/2017: 13:00-14:00
	PM/PM ₁₀ (Method 5.2)	11/08/2017: 13:00-14:26
	NO _x /SO _x - Facility CEMS	11/08/2017: 13:00-14:26
Run 3	VOC (Method 25.3), CO, O ₂ , CO ₂ (M10.1)	11/08/2017: 14:56-15:56
	NH ₃ (Method 207.1)	11/08/2017: 14:55-15:55
	PM/PM ₁₀ (Method 5.2)	11/08/2017: 14:55-16:19
	NO _x /SO _x - Facility CEMS	11/08/2017: 14:55-16:19
Run 4	VOC (Method 25.3), CO, O ₂ , CO ₂ (M10.1)	11/08/2017: 16:59-17:59
	NH ₃ (Method 207.1)	11/08/2017: 16:58-17:58
	PM/PM ₁₀ (Method 5.2)	11/08/2017: 16:58-18:23
	NO _x /SO _x - Facility CEMS	11/08/2017: 16:58-18:23

TABLE 3-1. TEST RESULTS

Facility: Tesoro LAR Wilmington Operations
 City: Wilmington, CA
 Source: H-100

TEST DATA	Units	TEST RESULTS				4 RUNS AVERAGE
		SCR-Outlet				
Location	-	Run 1	Run 2	Run 3	Run 4	
Test Information						
Test Date	mm/dd/yy	11/08/17	11/08/17	11/08/17	11/08/17	
Start Time	hh:mm	8:28	13:00	14:55	16:58	
End Time	hh:mm	9:57	14:26	16:19	18:23	
Facility Data*						
Firing Rate, rated total	MMBtu/hr	252	252	252	252	252.0
Fuel Flow Rate, total	Mscfh	185	188	190	194	189.3
Fuel Gas Higher Heating Value (HHV)	Btu/Scf	1,318	1,293	1,266	1,235	1,278.1
Firing Rate, calculated total	MMBtu/hr	247.56	247.42	246.63	245.86	246.9
Operating Capacity	%	98.2	98.2	97.9	97.5	98.0
Facility CEMS Measured O2	%	5.29	5.28	5.23	5.36	5.29
Facility CEMS Measured NOx	ppmv	13.39	10.86	10.20	9.94	11.10
Facility CEMS Stack Gas Flow Rate	dscfm	47,533	47,515	46,918	47,063	47,257
Sampling Data						
Stack Temperature	°F	636	628	624	624	628.0
Moisture	%	14.51	14.7	14.2	14.9	14.55
Oxygen, O2	% v/v	5.35	5.40	5.40	5.60	5.44
Carbon Dioxide, CO2	% v/v	10.30	10.65	11.30	10.35	10.65
Stack Flow Rate	dscfm	52,562	54,056	54,487	53,580	53,671
Facility CEMS						
SOx Concentration	ppmv	6.27	3.68	3.48	3.45	4.22
SOx Emission Rate	lb/hr	3.01	1.77	1.65	1.64	2.02
SOx Emission Rate	lb/day	72.24	42.48	39.6	39.36	48.42
SOx Emission Rate	lb/MMBtu	0.012	0.007	0.007	0.007	0.008
NOx Concentration	ppmv	13.39	10.86	10.20	9.94	11.10
NOx Emission Rate	lb/hr	5.45	4.42	4.05	4.01	4.48
NOx Emission Rate	lb/day	130.8	106.1	97.20	96.24	107.58
NOx Emission Rate	lb/MMBtu	0.022	0.018	0.016	0.016	0.018
SCAQMD Method 5.2 - PM						
Filterable PM						
Catch	mg	10.68	7.72	4.62	9.17	8.05
Concentration	gr/dscf	2.96E-03	2.13E-03	1.27E-03	2.55E-03	2.23E-03
Emission Rate	lb/hr	1.336	0.988	0.592	1.170	1.021
Condensable PM						
Catch	mg	12.28	20.41	16.46	18.62	16.94
Concentration	gr/dscf	3.41E-03	5.64E-03	4.52E-03	5.17E-03	4.68E-03
Emission Rate	lb/hr	1.536	2.611	2.110	2.376	2.16
Total Particulate without NH4SO4 adjustment						
Total Catch	mg	22.96	28.13	21.08	27.79	24.99
Concentration	gr/dscf	6.37E-03	7.77E-03	5.79E-03	7.72E-03	6.91E-03
Emission Rate	lb/hr	2.872	3.60	2.70	3.55	3.18
Emission Rate	lb/day	68.92	86.37	64.87	85.11	76.32
Emission Rate	lb/MMBtu	0.012	0.015	0.0110	0.0144	0.013
Total Particulate with NH4SO4 adjustment						
Total Catch	mg	11.82	11.10	7.94	10.66	10.38
Concentration	gr/dscf	3.28E-03	3.06E-03	2.18E-03	2.96E-03	2.87E-03
Emission Rate	lb/hr	1.478	1.420	1.018	1.360	1.319
Emission Rate	lb/day	35.48	34.076	24.43	32.65	31.66
Emission Rate	lb/MMBtu	0.0060	0.0057	0.0041	0.0055	0.0053

TABLE 3-1. TEST RESULTS, CONTINUED

Facility: Tesoro LAR Wilmington Operations
 City: Wilmington, CA
 Source: H-100

TEST DATA	Units	TEST RESULTS				4 RUNS AVERAGE
Location		SCR-Outlet				
<u>Solid Particulate without NH4SO4 adjustment</u>						
Total Catch	mg	21.63	26.68	19.41	26.64	23.59
Concentration	gr/dscf	6.00E-03	7.37E-03	5.33E-03	7.40E-03	6.53E-03
Emission Rate	lb/hr	2.705	3.41	2.49	3.40	3.00
Emission Rate	lb/day	64.93	81.92	59.7	81.6	72.0
Emission Rate	lb/MMBtu	0.011	0.014	0.0101	0.0138	0.012
<u>Solid Particulate with NH4SO4 adjustment</u>						
Total Catch	mg	10.49	9.65	6.27	9.51	8.98
Concentration	gr/dscf	2.91E-03	2.66E-03	1.72E-03	2.64E-03	2.48E-03
Emission Rate	lb/hr	1.312	1.23	0.804	1.213	1.141
Emission Rate	lb/day	31.48	29.62	19.29	29.12	27.38
Emission Rate	lb/MMBtu	0.0053	0.0050	0.0033	0.0049	0.0046
<u>SCAQMD Method 25.3-ROG/VOC</u>						
Concentration	ppmv	** 5.40	1.80	*** 1.40	1.95	2.64
Emission Rate as methane	lb/hr	0.718	0.246	0.19	0.26	0.355
Emission Rate as methane	lb/day	17.23	5.91	4.63	6.34	8.53
Emission Rate as methane	lb/mmbtu	0.0029	0.001	0.0008	0.0011	0.001
<u>Carbon Monoxide (CO)</u>						
Concentration	ppmv	<10.00	<10.00	<10.00	<10.00	<10.00
Emission Rate	lb/hr	<2.33	<2.39	<2.41	<2.34	<2.37
Emission Rate	lb/day	<55.84	<57.43	<57.89	<56.11	<56.82
Emission Rate	lb/mmbtu	<0.009	<0.010	<0.010	<0.010	<0.010
<u>SCAQMD Method 207.1 - Ammonia</u>						
Concentration	ppmv	4.53	6.68	8.12	7.32	6.66
Concentration @ 3% O2	ppmv	5.20	7.66	9.26	8.44	7.64
Mass Emission Rate	lb/hr	0.64	0.97	1.19	1.05	0.96

Facility data was provided by the facility.

** Results of duplicate sampling deviated by more than 20% from the average of two values, maximum result is reported for worst case scenario.

*** One of the duplicate tank (R3-A) had ambient air intrusion, excluded from the run average.

4.0 EQUIPMENT AND PROCESS DESCRIPTION

Tesoro Refining & Marketing Company LLC is a petroleum refining company that refines oil and produces oil products. The process and equipment tested are described below.

4.1 Process Description

Feedstock to the DCU is cold crude from tankage and hot reduced crude from the Crude Unit. All the cold crude, and slop from storage is pumped through a series of heat exchangers and charged to the Desalter.

Reduced crude from the Crude Unit Fractionator Tower Bottoms is routed hot to the outlet of the Desalter. The combined stream is further heated via a series of heat exchangers. The preheated and partially vaporized mixture flows into the Fresh Feed Flash Drum. The Flash Drum serves a dual purpose. The first is to flash and remove light ends venting them to the Fractionator tower. The second is to act as a surge drum for the Fresh Feed Charge Pumps. The heated oil is then charged through the Fresh Feed Heater.

Heater H-100 burns a refinery fuel gas and has a rated heat capacity of 252 MMBTU/HR. The heater is equipped with Englehard SCR with a fixed bed reactor, Vanadia-Titania Catalyst, Honeycomb type, 635 CU. FT with Ammonia injection.

Figure 4-1 shows a process flow diagram for the unit.

4.2 Operating Conditions During Testing

The heater was operated above 80% of its proposed maximum operating capacity during the test period. After the completion of Run 1, drum switch took place at around 10:00. After the process stabilization at around 13:00, Runs 2 through 4 were completed consecutively. The following operating parameters were observed during the test period. Supporting information for process conditions during the testing are found in the respective Appendix.

Parameter	Value	Unit
Average Firing Rate, Calculated	246.9	MMBtu/hr
Maximum Firing Rate, Rated	252	MMBtu/hr
Proposed Maximum Firing Rate	302.4	MBtu/hr
Average Fuel Flow Rate	189.3	Mscfh
Operating Capacity	98.0	%

4.3 Sampling Locations

The reference method sampling locations are located on the exhaust stack. A schematic of the stack with sampling locations are shown in Figure 4-2. The reference method sampling locations meet the following specifications:

Sampling Location Configuration for Reference Method CEMS Probe:	
Upstream	240 in. (2.0 duct diameter)
Downstream	648 in. (5.4 duct diameter)
Port Length	7.0 in. (measured from outside of wall)
Port Inside Diameter	4.0 in
Number of Sampling Ports	2 (located at 90° intervals)
Stack Diameter	120 in. (Internal diameter)

The sampling location complies with the requirements of SCAQMD Method 1.1.

Figure 4-1. Process Schematic

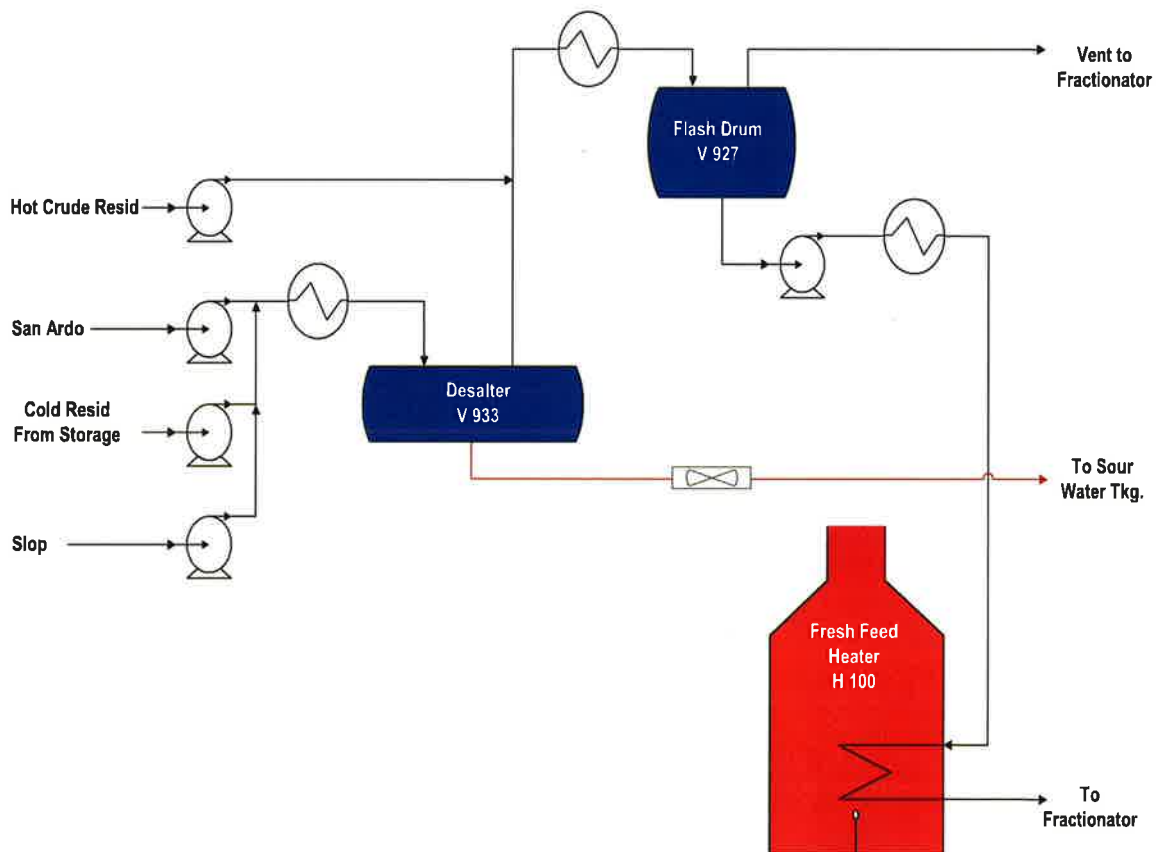
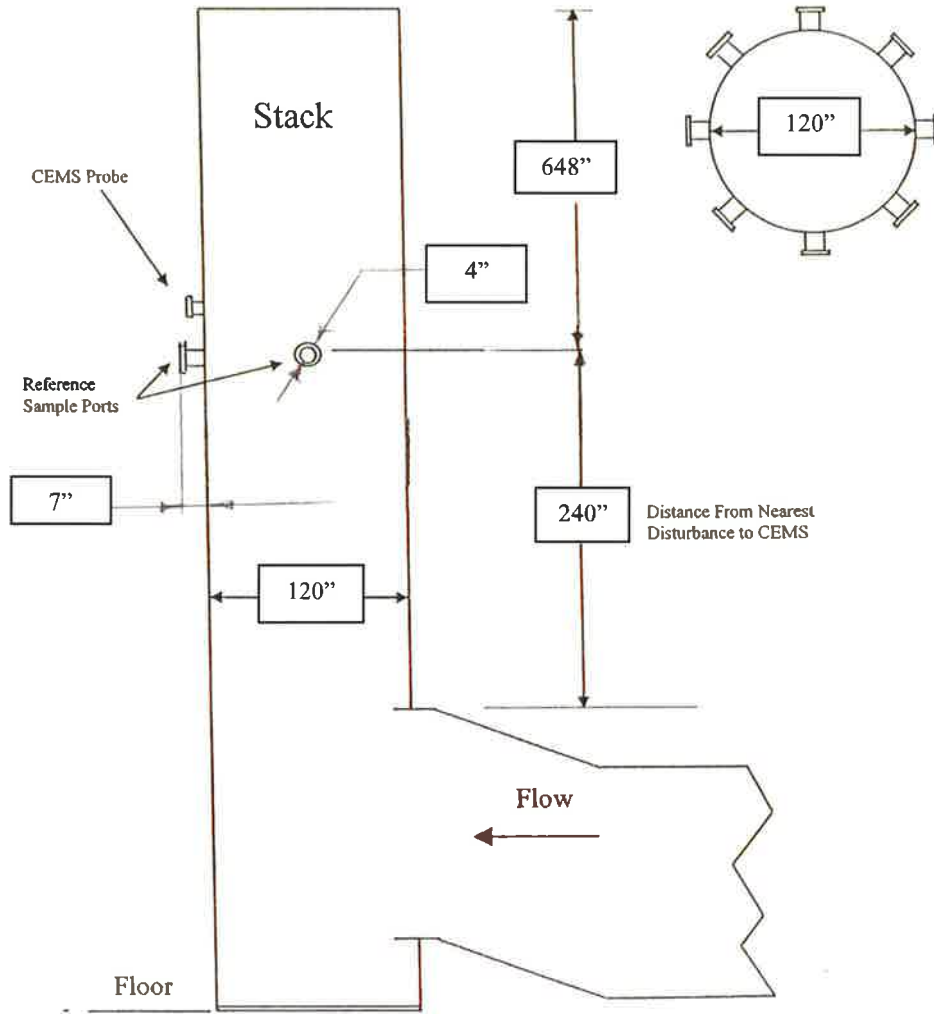


Figure 4-2. Stack Schematic



5.0 SAMPLING AND ANALYTICAL PROCEDURES

Test measurements were performed according to sampling and analysis procedures promulgated by the South Coast Air Quality Management District (SCAQMD), California Air Resources Board (CARB), or US Environmental Protection Agency (EPA). The sampling and analysis procedures used for this test program are summarized below. Any modifications or deviations not addressed herein are discussed in Section 3 of this report.

- 5.1 SCAQMD Methods 1.1-4.1 – Determination of Stack Gas Volumetric Flow Rate, Molecular Weight, and Moisture Content
 - 5.1.1 SCAQMD Method 1.1 – Sampling Traverse Points
 - 5.1.2 SCAQMD Method 2.1 – Stack Gas Flow Rate
 - 5.1.3 SCAQMD Method 3.1 – Stack Gas Molecular Weight
 - 5.1.4 SCAQMD Method 4.1 – Stack Gas Moisture Content
- 5.2 SCAQMD Method 5.2 – Particulate Matter (PM/PM10)
- 5.3 SCAQMD Method 25.3 – VOC, as TGNMO (ROG)
- 5.4 SCAQMD Method 10.1 – CO, O₂, and CO₂ by GC/TCD
- 5.5 SCAQMD Method 207.1 – Ammonia Emissions

5.1 SCAQMD Methods 1.1-4.1 – Determination of Stack Gas Volumetric Flow Rate, Molecular Weight, and Moisture Content

The flue gas flow characteristics (i.e. flow rate, molecular weight, and moisture content) were determined according to SCAQMD Methods 1.1 through 4.1. The testing is conducted as follows:

5.1.1 SAMPLING AND VELOCITY TRAVERSE POINTS

The number and location of traverse points are determined according to SCAQMD Method 1 based on the physical dimensions of the sampling location and process parameters. In principle, the stack cross-section is divided into equal areas, each of which is represented by a “traverse point”. Generally, the number of traverse points diminishes as the flow profile at the sampling location becomes uniform. In most cases, the maximum number of sampling points is 24 for particulate testing and 16 for velocity traverses. Fewer traverse points are permitted as described in the method.

5.1.2 STACK GAS VELOCITY AND FLOW RATE

The velocity and volumetric flow rate of the stack gas was determined according to SCAQMD Method 2. In this method, the velocity head (differential pressure) and temperature are measured at the required traverse points. The stack gas differential pressure head was determined using an "S" type pitot tube in combination with inclined liquid manometer as a differential pressure gauge. The temperature was measured using a type "K" thermocouple and digital temperature readout.

Prior to testing, the measurement system was set-up and leak-checked. Then the velocity head and temperature were recorded at predetermined traverse points. After the last traverse was completed, the system was again leak-checked. After completion of the traverse, the static pressure in the stack was determined in the centroid of the stack. The stack gas velocity was calculated using the velocity head, and stack gas temperature, pressure and molecular weight.

QA/QC for the method included field performance checks, and periodic calibrations of test equipment including the pitot tube, differential pressure gauge, TC and TC-readout. Recent RATA testing performed in March 2017 demonstrated the absence of cyclonic flow.

5.1.3 STACK GAS MOLECULAR WEIGHT

The stack gas molecular weight (MW) was calculated based on the fraction of its major constituents including: oxygen (O₂), carbon dioxide, (CO₂), nitrogen (N₂), carbon monoxide (CO), and water (H₂O). The dry MW was calculated based on the partial fractions of O₂, CO₂, N₂, and CO. Specifically, the O₂ and CO₂ fractions were determined by CEMS, integrated sampling, or grab sampling, and the balance was assumed to be N₂ and CO. The wet MW was calculated based on the fractions of dry gas and water vapor. The dry and wet MW were calculated according to the following equations:

$$MW_{\text{DRY}} = 0.32 \times \%O_2 + 0.44 \times \%CO_2 + 0.28 \times (\%N_2 + \%CO)$$

$$MW_{\text{WET}} = 0.18 \times \%H_2O + MW_{\text{DRY}} \times (1 - \%H_2O/100)$$

where: MW_{DRY} = stack gas molecular weight, dry-basis
 MW_{WET} = stack gas molecular weight, wet-basis
 0.32 = molecular weight fraction for O₂
 0.44 = molecular weight fraction for CO₂
 0.28 = molecular weight fraction for N₂ and CO
 0.18 = molecular weight fraction for H₂O (water vapor)
 %X = fraction of X in stack gas, dry basis, where X = O₂, CO₂, N₂, CO
 %H₂O = fraction of water vapor in stack gas, wet-basis

O₂ and CO₂ measured by SCAQMD Method 10.1 were used for gas density calculation.

5.1.4 SCAQMD METHOD 4.1- STACK GAS MOISTURE CONTENT

The stack gas moisture content was determined according to SCAQMD Method 4.1. In this method, water vapor is collected in a condenser while the dry stack gas volume is measured using a dry gas meter. The volume of water vapor was calculated from the amount of water condensed and the total gas volume was the sum of water vapor plus dry stack gas. The moisture content was determined as a fraction of the total wet stack gas volume. The following calculations were used.

$$B_{WS} = \frac{V_{W,Std}}{V_{M,Std} + V_{W,Std}}$$

$$V_{W,Std} = K_1 \times V_{H_2O}$$

$$V_{M,Std} = T_{Std}/P_{Std} \times Y_M \times V_M \times P_M/T_M$$

- where:
- B_{WS} = Fraction of water vapor in stack gas
 - $V_{W,Std}$ = Volume of water vapor (scf)
 - $V_{M,Std}$ = Volume of stack gas sampled (dscf)
 - K_1 = Unit volume of water vapor (0.04707 scf @68°F or 0.0464 scf @60°F)
 - T_{Std} = Standard Temperature (528°R or 520°R)
 - P_{Std} = Standard Pressure, 29.92 in. Hg
 - Y_M = Dry gas meter calibration factor
 - V_M = Measured volume of stack gas sampled
 - P_M = Dry gas meter pressure (in. Hg)
 - T_M = Dry gas meter temperature (°R)

Moisture content was determined simultaneously with the isokinetic sampling of particulate matter.

5.2 SCAQMD Method 5.2 – Total Particulate Matter

The particulate matter emissions at the heater exhaust was determined by SCAQMD Method 5.2. A series of preliminary measurements were made prior to conducting the particulate test. SCAQMD Methods 1.1, 2.1, and 4.1 were performed to determine location and number of traverse points, average gas velocity, molecular weight, and moisture content, respectively. The results of these measurements were used to determine the appropriate nozzle size for isokinetic sampling.

Figure 5-1 is a schematic of the sampling train used for SCAQMD Method 5.2. The sampling train consists of a nozzle, heated probe, heated jumper line and filter, a set of glass impingers, umbilical line, a vacuum pump, dry gas meter, and calibrated orifice. Impingers #1 and #2 in the absorption train were charged with 100 ml of distilled water, impinger #3 was left empty, and impinger #4 was filled with approximately 200 g of silica gel. The probe was brushed out, rinsed with acetone prior to sampling. The filter was tared and placed in the filter holder. The sampling apparatus was sealed and transported to the sampling site where it was assembled and leak tested at a minimum of 15 inches of mercury (Hg.) vacuum.

The probe and filter temperatures were set at 180-200 deg. F and the probe was positioned in the duct at the first traverse point with the nozzle out of the flow.

After the initial gas meter reading was appropriately recorded, the nozzle was positioned into the gas flow. The vacuum pump was started immediately and adjusted to obtain an isokinetic sample rate. A complete traverse was performed. Stack gas temperature, velocity pressure (dP), meter temperature, gas volume, and meter pressure vacuum were monitored and recorded at each sample point.

Upon completion of sampling, the apparatus was leak checked at a vacuum greater than the highest vacuum observed during testing. After the leak rate was recorded, the apparatus was disassembled, sample was taken to a secured area (i.e. Mobile test van) and recovered on-site.

Samples were recovered and analyzed per Method 5.2.

The filter and any loose particulate were carefully removed from the filter holder with tweezers. The filter was placed into a labeled petri dish and secured until analysis (Container #1). The glass nozzle, probe and front half of filter housing were rinsed and brushed more than three times with distilled water as instructions per SCAQMD Method 5.2. The wash fluid was subsequently transferred to clean, labeled Nalgene bottles, where the fluid level was appropriately marked for transportation to Almega laboratory for analysis (Container #2-Front half).

The absorption train was inspected for abnormalities and subsequently disassembled. The water gain in the impingers was weighed on a digital scale in order to determine percent moisture. The contents of the impingers, and washes of back half of filter housing and connecting glassware were quantitatively transferred into separate bottles, sealed, labeled and fluid levels marked for transportation to Almega laboratory for analysis (Container#3-Back half).

A field blank was prepared, leaked checked and recovered in an identical manner as the test samples. No adjustments based on the results of this field blank was included in the test report, it was reported separately as an QA/QC indicator.

The recovered samples were entered into Almega's Sample Custody Program and delivered to the laboratory for analysis. At the laboratory, samples were analyzed as follows:

Aliquot of the reagent grade water and methylene chloride used for recovery and analysis were analyzed in the lab for blank. The filter was transferred to an oven and heated to 105 deg. C for 2-3 hours and then placed in desiccators for 24 hours. The filter was then weighed on a digital scale to the nearest 0.1 mg and to a constant weight (± 0.5 mg).

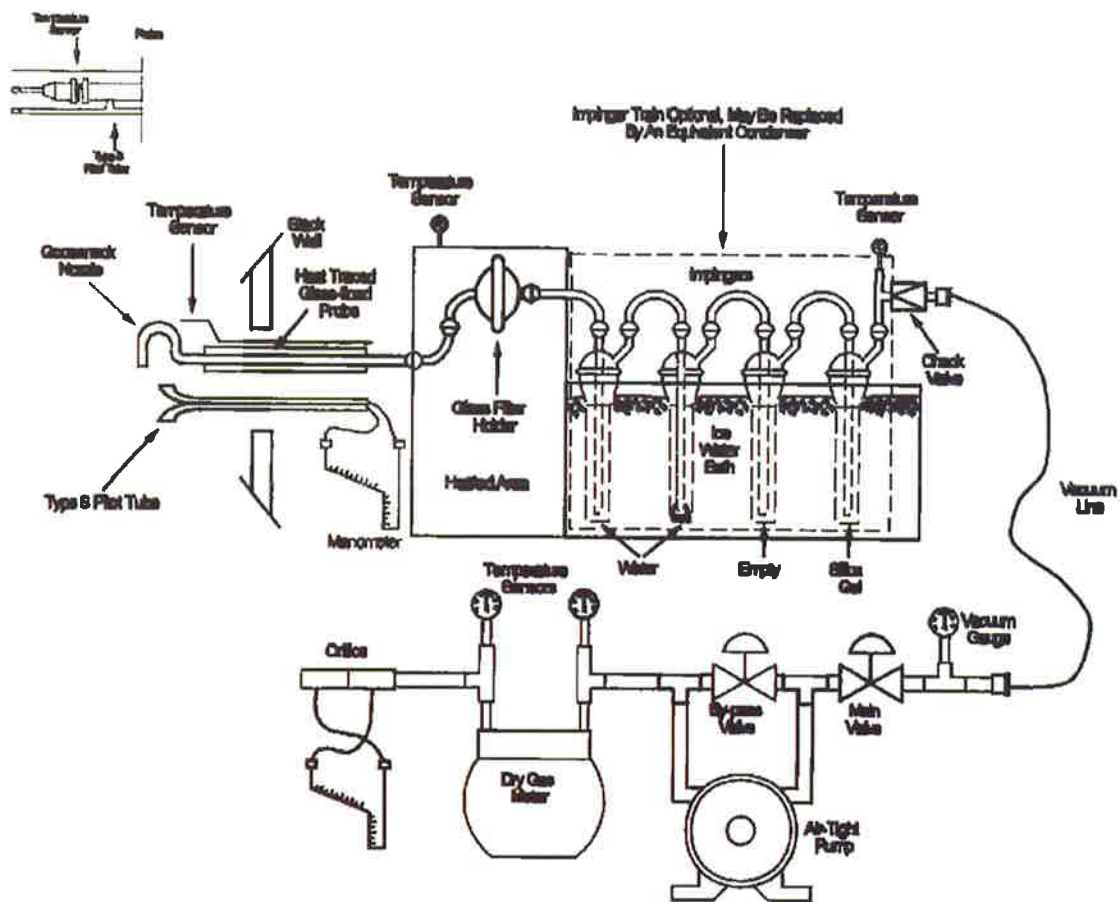
The nozzle, probe and front half of filter (Container #2-Front half) was examined for any leakage during transportation and transferred to an evaporation beaker. The sample was then evaporated at an elevated temperature but below the boiling point of sample to prevent bumping. When sample was concentrated in about 50 ml, it was transferred to a tared beaker and evaporated in an oven at 105°C (220°F) to dryness. The residue was then desiccated and weighed on a digital scale to the nearest 0.1 mg and to a constant weight (± 0.5 mg).

The back-half sample (Container #3) was inspected and processed for organic extraction as per the instruction in Method 5.1. After the extraction was performed, the organic residue was evaporated at room temperature and residue was then desiccated and weighed on a digital scale to the nearest 0.1 mg and to a constant weight (± 0.5 mg). The soluble catch was evaporated at an elevated temperature but below the boiling point of sample to prevent bumping. When sample was concentrated to about 50 ml, it is transferred to a tared beaker and evaporate in an oven at 105°C (220°F) to dryness. The residue was then desiccated and weighed on a digital scale to the nearest 0.1 mg and to a constant weight (± 0.5 mg).

Condensable particulate matter included both organic and soluble residues.

Finally, all three fractions: filter, probe, and impinger catches were analyzed for acid and sulfate contents as requested in protocol evaluation letter. Field and laboratory data were used to calculate sample volume corrected to standard conditions, stack gas flow rate, and particulate emissions. Emissions are reported in gr/dscf, lb/hr, lb/day, and lb/mmmbtu. Both total particulate matter and solid particulate matter with or without ammonium sulfate adjustment were reported as requested by the protocol evaluation letter.

Figure 5-1. Sampling Apparatus for Particulate Matter



5.3 SCAQMD Method 25.3 – VOC, as TGNMO (ROG)

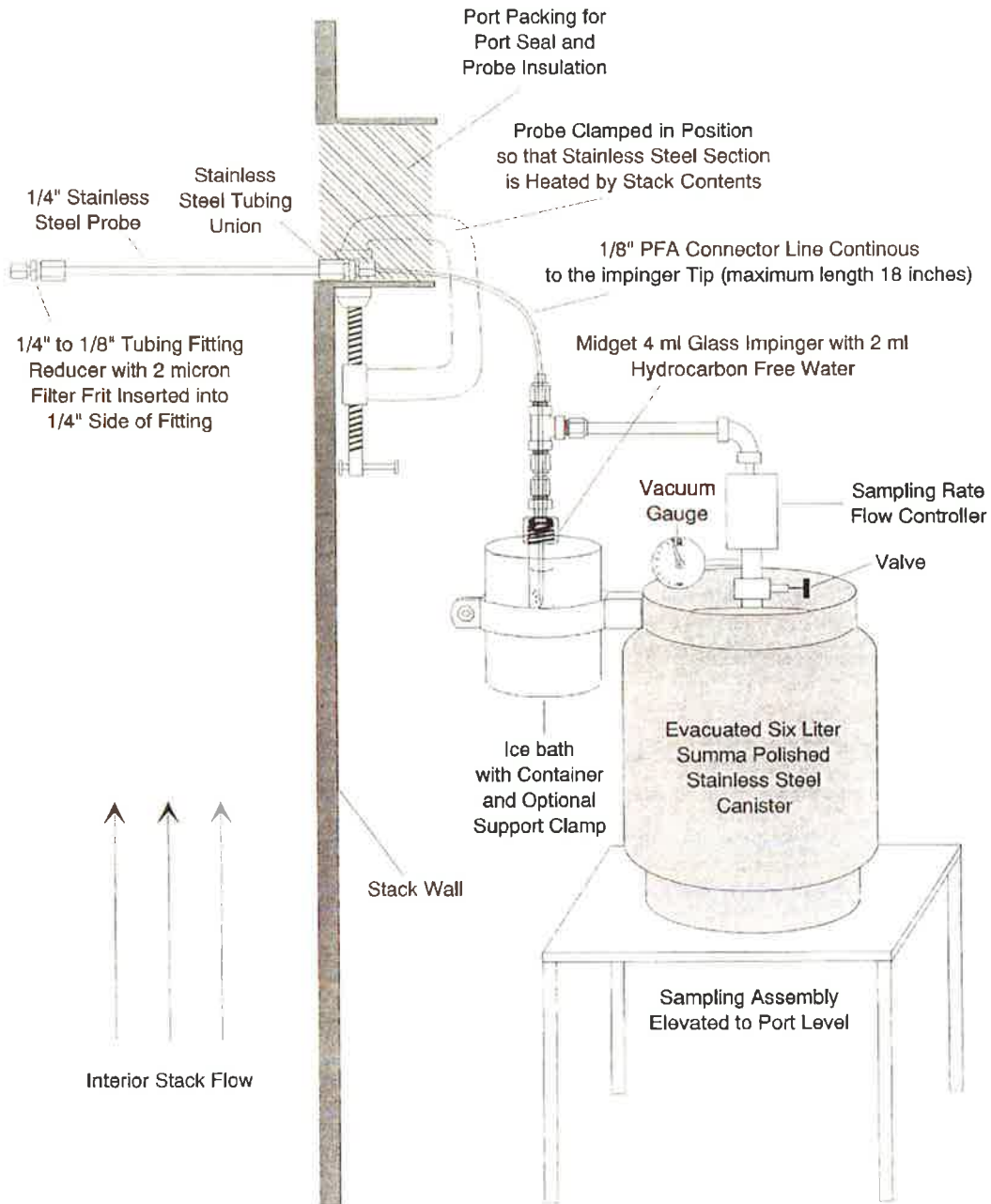
This method applies to the measurement of low-concentration (≤ 50 ppmv) Volatile Organic Compounds (VOC) or total gaseous non-methane organics (TGNMO) as carbon in source emissions. In this Method, gaseous samples are withdrawn from the gas stream at a constant rate through duplicate chilled condensate traps and collected in evacuated sample tanks. The sampling system is depicted in Figure 5-2. Each sampling train (there are two) consists of an in-stack filter (optional), sample probe, water-chilled mini-impinger, a flow control system, and an evacuated sample tank. The flow controller incorporates a combination vacuum/pressure gauge, which was connected directly to the canister. The TGNMO is determined by combining the analytical results obtained from independent analyses of the condensate traps (condensable fraction) and the sample tanks (gaseous fraction).

Prior to testing, the sampling system is pre-cleaned and evacuated in preparation for sample collection. On-site, the sampling system is leak-checked and the impingers are placed in an ice-slurry (the impingers are chilled for at least 30 minutes prior to sampling). Then the sample probe is placed in the stack, facing downstream to prevent collection of particulate matter. Pretest data is recorded and the sample valve is opened. The flow controller is based on a critical orifice that is preset to flow at a rate of 80-cc/min \pm 15%. Periodically, sampling train readings (i.e. tank vacuum) are recorded on the field data sheet. Sampling is stopped when one hour has elapsed and/or and tank vacuum reaches 2 inches as indicated by the vacuum gauge. Then, the sampling train is removed from the stack and a leak check is performed. Samples are logged in and delivered to the laboratory for analysis.

The analytical system consists of two major sub-systems: a total organic carbon (TOC) analyzer capable of differentiating between total carbon (TC) and inorganic carbon (IC) and a non-methane organics (NMO) analyzer. The NMO analyzer is a gas chromatograph (GC) with back flush capability for NMO analysis and is equipped with an oxidation catalyst, reduction catalyst, and flame ionization detector (FID). The system for the recovery and conditioning of the organics captured in the condensate trap consists of a heat source, oxidation catalyst, non-dispersive infrared (NDIR) CO₂ analyzer and an intermediate collection vessel (ICV). Analyses are performed as follows.

NMO collected in the water impinger are analyzed in the TOC analyzer. Generally, the TOC analyzer determines both TC and IC. And the TOC is calculated as the difference between TC and IC. The organic content of the sample fraction collected in the sampling tank is measured by injecting a gas sample into the GC to separate the NMO from carbon monoxide (CO), CO₂ and CH₄. The NMO are oxidized to CO₂, reduced to CH₄, and measured by the FID. In this manner, the variable response of the FID (associated with different type of organic compounds) is eliminated. The sampling apparatus and sample analysis services are provided by Atmospheric Analysis and Consulting, Inc (AAC) laboratory based in Ventura, California.

Figure 5-2. Sampling Apparatus for TGNMO per SCAQMD Method 25.3
(Figure shows one train – actual method was run in duplicate simultaneously)



5.4 SCAQMD Method 10.1 – CO, O₂, and CO₂ by GC/TCD

In this method, gaseous components of the stack gas (e.g. CO, O₂, & CO₂) are measured using integrated sampling in accordance with the procedures specified in SCAQMD Method 10.1. Gaseous components CO, O₂, and CO₂ samples were collected in Method 25.3 tanks along with the VOC sampling for normal operating condition (see sampling procedure in section 5.3 above). Carbon monoxide and fixed gases (carbon dioxide and oxygen) were determined by analysis of the canister portion of the samples by SCAQMD Method 10.1. The sampling system is depicted in Figure 5-2.

5.5 SCAQMD Method 207.1 - Ammonia

The sampling procedure followed SCAQMD Method 207.1 with the modification of using single sample train per run. In this method, free and combined NH₃ is withdrawn non-isokinetically from the source using a sampling train consisting of a probe, glass impingers containing a sulfuric acid solution, a calibrated meter, and a pump (Figure 5-3). The sampling rate was approximately 0.75 cubic feet per minute and the sampling duration was 60 minutes for each test run. The probe rinse and impinger solutions were recovered in the field and analyzed on-site inside the mobile testing trailer by ion selective electrode (ISE). To calculate the ammonia emissions, the following equations were used:

$$\text{NH}_3 \text{ (gr/dscf)} = 0.01543 \times \text{NH}_3 \text{ net} / \text{VmStd}$$

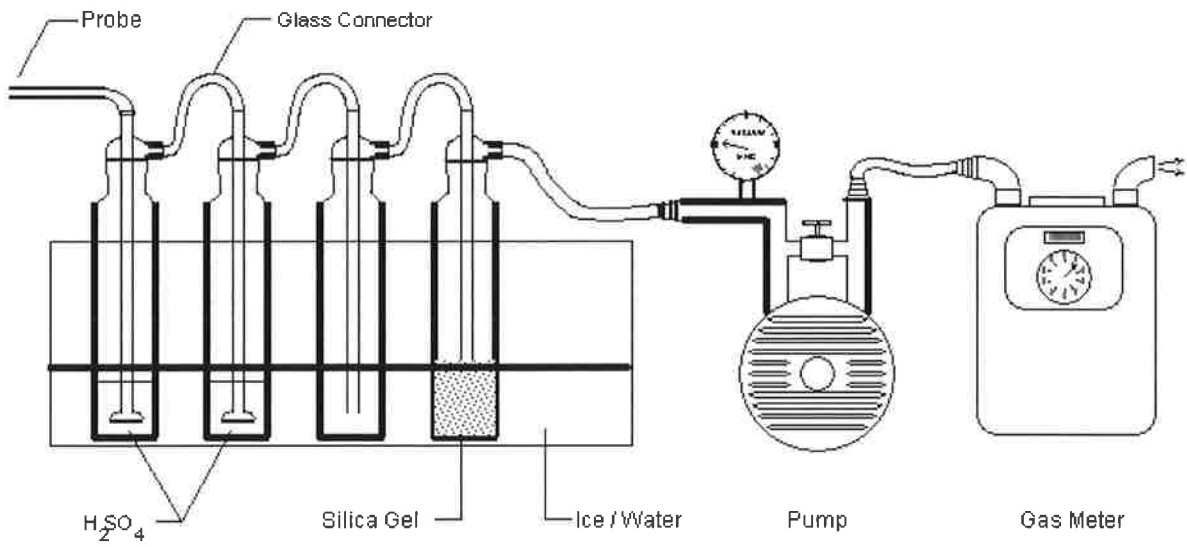
$$\text{NH}_3 \text{ (ppmv)} = 54,143 \times \text{NH}_3 \text{ (gr/dscf)} / \text{MWNH}_3$$

$$\text{NH}_3 \text{ (ppmv @ 3\% O}_2\text{)} = \text{NH}_3 \text{ ppm} \times (20.9 - 3) / (20.9 - \text{O}_2)$$

$$\text{NH}_3 \text{ (lb/hr)} = 0.00854 \times \text{Qsd} \times \text{NH}_3$$

Oxygen concentration was determined via analysis of tank samples by SCAQMD Method 10.1. Stack flow rate was measured during isokinetic sample of particulate matter per SCAQMD Method 5.2.

Figure 5-3. Sampling Apparatus for Ammonia



6.0 QUALITY ASSURANCE AND QUALITY CONTROL

Almega applies stringent quality assurance and quality control (QA/QC) procedures to ensure the validity of measurements for all test methods. The following section discusses general and project-specific QA/QC measures.

6.1 General QA/QC

Almega's QA/QC procedures follow guidelines from the "Quality Assurance Handbook for Air Pollution Measurement Systems," Volume I through III. And, procedures for pretest preparation and calibration of sampling equipment are followed. Standardized written procedures, calculator programs, and computer spreadsheets are used for test planning, pre-survey, equipment checklist, preliminary calculations, testing, data analysis, and reporting. Pretest equipment preparation and maintenance include organization of the following equipment prior to testing:

- Mobile RM CEM test van: Check fluids, fuel, mechanical conditions, verify operation of CEM instruments, sample lines and sample conditioner prior to the date of the source test.
- Sampling Equipment: Check meter boxes, pitot tubes, manometers and thermocouples to ensure in good working conditions and in proper calibrations. Preclean sampling trains and seal all openings prior to use.

Calibrations are performed in accordance with Chapter III of the SCAQMD Source Test Manual (March 1989). Table 6-1 shows the test equipment calibration schedules. Table 6-2 shows the test equipment maintenance schedules.

6.2 Project-Specific QA/QC

This project included specific QA/QC activities required to validate the test results. These QA/QC activities are based on the test methods discussed in Section 5 and generally acceptable test procedures. Reference Methods used for source testing are promulgated by the South Coast Air Quality Management District (SCAQMD), the California Air Resource Board (CARB), or the US Environmental Protection Agency (EPA). Any deviations from published Methods are approved in advance by the regulatory agency (i.e. SCAQMD), prior to implementation if possible. Project-specific QA/QC activities and results that may impact test results are discussed in Section 3.

TABLE 6-1. TEST EQUIPMENT CALIBRATION SCHEDULE

Equipment	Calibration Period	Standard or Method of Calibration
Thermocouples	6 Months and 2 Months	Mercury Thermometer, three point (ice, boiling water, hot oil)
Dry Gas Meters	6 Months and 2 Months	Critical Orifice
Field Barometers	6 Months, Check prior to usage	Mercury Barometer
S-Type Pitot	6 Months Check prior to usage	EPA Method 2, Measure physical configuration. Reshape pitot tips or calibrate if configuration does not meet the limits.
Pressure gauges	6 Months	Five-point calibration against manometer
	2 Months	Three-point check
Temp. Meters	6 Months	Precision Potentiometer
CEM Systems	Bimonthly, or as needed	Specified by Manufacturer

TABLE 6-2. TEST EQUIPMENT MAINTENANCE

Equipment	Check For	Correction	Frequency
CEM Systems	Absence of malfunction, noise, drift, conversion efficiency for NOx anlzr.	As required by the manufacture, or depending on performance	Bimonthly
Pumps	Absence of leakage, flow, proper vacuum	Replace parts, inspect, clean	300 hours of usage
Flow Devices	Levelling, zeroing, obstruction, deformation	Clean, replace, or recalibrate	300 hours of usage
Calibration Gases	Expiration date, tank pressure	Re-certify, order new gases	2 months and prior to field testing
Regulators	Malfunction, Gauge precision	Repair or replace	3 months and prior to field testing
Gas Divider	Malfunction, precision	Repair or replace	Monthly and before field testing
Condensers	Leakage, temperature	Repair or replace	Monthly and before field testing
Heated lines	Leakage, temperature, cleanliness	Repair, replace, clean	Monthly and before field testing