TECHNICAL PAPER #0610

DESIGNING EMISSION TESTING PROGRAMS TO SUPPORT REFINERY NSPS, MACT, AND EPA CONSENT DECREE REQUIREMENTS: THE EIGHT-STEP PROGRAM

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For Presentation at:

NPRA 2006 Environmental Conference

18-19 September 2006
San Antonio, TX, USA

06P-1030

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INTRODUCTION

The petroleum refining industry is subject to at least 15 different air quality standards or initiatives as summarized in Attachment 1. These standards or initiatives cover virtually every point or fugitive emission source at a refinery and require approximately 40 different emission testing methods for compliance demonstration. Emission testing, one of the most challenging environmental measurement disciplines, is therefore a critical component of a refinery's compliance strategy. Thus, it is important that emission test programs be properly planned and performed if a refinery is to generate valid and defensible emission test data that demonstrate compliance with a complex matrix of regulatory requirements.

Proper planning and execution of an emission monitoring program requires a solid understanding of program objectives and the right combination of test methodology, expertise, process operations, and regulatory agency coordination. Because there are many variables and potential sources of error, many emission monitoring programs are not properly completed or completed at significant - and often unanticipated - expense. This presentation outlines eight key steps that will help refinery environmental managers design and implement emission testing programs that achieve their compliance demonstration objectives while controlling cost, quality, and schedule.

STEP 1: ESTABLISH THE PURPOSE OF THE TEST PROGRAM

Refinery emission testing programs can be conducted for a number of reasons including:

- Engineering Evaluations, including collection of air pollution control device (APCD) design or vendor guarantee data.
- New Source Performance Standards (NSPS), Maximum Achievable Control Technology (MACT), or Consent Decree (CD) Compliance Demonstration
- Performance Specification Testing (PST) of Continuous Emission Monitoring Systems (CEMS)

The intended use of the data drives the structure of the emission testing program and the structure varies with each test program focus. For example, a PST or APCD demonstration program might be performed to establish compliance with an NSPS, MACT, or CD compliance demonstration requirement **and** specific aspects of the vendor's guarantee. Similarly, evaluation of an APCD in terms of NSPS or MACT may focus on achievement of the emission standard at

90 percent of capacity; however, the vendor's guarantee may include additional operational criteria that need to be considered such as pollutant loading or different operating capacities. Such test programs must be designed to include the range of process conditions, test methodology, number of runs, data evaluation criteria, and reporting requirements that satisfy all objectives.

Qualified emission testing firms can help refinery environmental managers with the design of emission test programs that satisfy multiple objectives. It is not unreasonable for a refinery environmental manager to contact select emission testing firms during the planning phase to develop a project approach that satisfies the range of test program objectives.

STEP 2: DEFINE TEST CONDITIONS

Establishing and maintaining proper test conditions can represent the most costly and challenging aspect of emission testing. In some cases, there may be only a few chances each year to conduct testing for a highly specialized product or production scenario. Feedstocks may have to be stockpiled, additional energy may be required for the process, APCD may have to be serviced or operated at different conditions for the test, or it may take several hours to reach steady-state operating conditions. On the other hand, market demand for a product may be low at the time testing is required resulting in additional product storage costs. Thus, it is important to match the test conditions to the test program purpose.

Although emission testing programs can be quite expensive, testing program costs pale in comparison to the cost of operating the refinery at test conditions. To reduce overall testing program costs, rely on an emission testing firm that recognizes that the company's investment in the testing program greatly exceeds the contract value of the testing.

STEP 3: SELECT THE PROPER TEST METHODS

There are roughly 40 different emission test methods that apply to refineries, with specific applications defined by NSPS, MACT, or the refinery's operating permit. The relationship between air quality regulations and emission test methods is somewhat different from test methods and regulations for other environmental media. Emission standards have been established using empirical data derived from specific test methods. Thus, it is important that compliance demonstration testing be conducted in full accordance with the test method that was used for standards development.

One of the reasons that test methods have changed very little since publication in the 1970's is because of the connection between the standard setting process and the test method. Changes to test methods could alter the compliance status of stationary sources and undermine the integrity of the regulatory system. Nonetheless, test methods do change and those changes must be incorporated into test programs.

An important recent change in test methods involved revision of EPA instrumental test methods for the measurement of oxygen, carbon dioxide, sulfur dioxide, nitrogen oxides, and carbon monoxide. Although the core measurement methodology for these methods has not been altered, there are significant changes that affect sample location and measurement range. These revised

methods are effective August 14, 2006 and must be used after that date unless there is a specific exemption from the agency with source oversight. Failing to use the current revision of these test methods for test programs after August 14, 2006 is tantamount to using the wrong test method.

Maintaining expertise in the specific application of emission testing methods is typically beyond the responsibility of most refinery environmental managers. Yet, proper application and execution of emission testing methods is central to a refinery's compliance strategy. For this reason, refinery environmental managers are best served by working with emission testing firms that keep them apprised of, or can knowledgably discuss, changes or developments in emission testing methodology.

STEP 4: DEVELOP A TEST PROGRAM SCHEDULE

Once the test program purpose, conditions, and test methods have been identified, the test program schedule can be developed. This is often an iterative process requiring the refinery environmental manager to balance production schedules, vacation schedules, agency notification requirements, regulatory deadlines, and test team availability. Refinery environmental managers will find that responsive emission testing firms will be able to assist with the documentation of schedules and the development of multiple scheduling scenarios or options that support test program objectives.

STEP 5: COMMIT THE TEST PROGRAM TO PAPER

The best way to communicate test program purpose, test conditions, test methods, and schedule is to develop a written test plan. Unfortunately, many test plans are so voluminous that they are useless to time-constrained refinery personnel. So instead of accepting a document with limited usefulness, refinery environmental managers should insist on the preparation of an abbreviated test plan that incorporates the following information in summary form:

Test Plan Component	Component Content
Program Matrix	Table showing sources, test conditions, parameters, and test methods
Schedule	A Gantt chart showing overall schedule and a table for daily schedule
Assignment Matrix	A table showing program personnel, contact information, program assignment, and project tasks.
Process Operations	A table presenting test conditions including target load, time to steady state, test duration, anticipated source conditions (temperature, moisture, flow, analyte concentrations), and documentation requirements.
Data Processing and Reporting	For each program component (i.e., source and analyte), describe applicable QC requirements, calculation procedures, and data presentation procedures.
Supporting Data	Excerpts from permits or previous test reports.

If the agency with regulatory oversight responsibility requires a specific format for the test plan, those requirements will have to be fulfilled; however, in most cases agency requirements can be fulfilled by incorporating the foregoing components into the test plan.

Once these summary documents have been prepared, they can be distributed to management, operation, environmental, and test team personnel as appropriate. This approach, even if more work on the front end, makes it easy for everyone to understand why the testing is being conducted and what they must do to make the test program a success. The total working test plan may span ten pages; however, the structure and format of the test plan makes it easy to provide only those two or three pages that are applicable to the responsibilities of each party involved in the test program.

Refinery environmental managers should expect their emission testing firm to facilitate the communication of test program information in depth and formats appropriate to the needs of the intended user. This may mean that the testing firm prepares two versions of the test plan information: one for regulatory agency review and the other for refinery use. The additional effort in developing relevant test plan information for program participants will pay off when it comes time for test program execution because program participants will have a clear understanding of their responsibilities, how their responsibilities affect or relate to the work of others, and perhaps most important, the role they play in completing a successful emission test program.

STEP 6: PREPARE THE SITE FOR TESTING

Emission testing occurs infrequently and in some of the least traveled areas of the refinery. These locations can easily fall into the "out-of-sight, out-of-mind" category. On the day of scheduled testing, the refinery environmental manger and the test team visit the test locations to find that access routes have changed, port caps have seized, and electric power circuits have been eliminated. It then takes several hours to prepare the sample location for testing. In the meantime, operators have ramped the process up to full load to support the testing and then sustain that load while final test preparations are completed. As a result, the overall cost of the test program has escalated and the schedule has been delayed.

The actual sample location has always been an important test program consideration and has become increasingly important with the recent changes to instrumental test methods. In the past, the primary concern about sample location was related to volumetric flow measurement with secondary consideration being given to source gas stratification issues. The revised instrumental test methods provide specific, quantitative requirements for stratification. As a result, the sampling strategy - and the time required for a test - changes with the degree of stratification at the sample location. Thus, it is important to ensure that sample locations are selected that meet the requirements of the method and allow for efficient testing.

Another factor to consider relative to site preparations is specific test contractor requirements. Testing firms use different brands of test equipment and use custom-built mobile laboratories. Consequently, different test companies may require different port sizes, different monorail supports, or different power requirements. Failure to recognize these differences can result in last minute test program delays.

Because site preparation requirements are determined by both test method and testing firm requirements, refinery environmental managers will find it efficient and expedient to rely on testing firms to inspect and approve test locations in advance of the test program. This is typically performed in connection with the development of a site-specific test plan and completed in advance of test team arrival; however, even in the case of accelerated test programs, refinery environmental managers should expect testing firms to advocate advance inspection of all testing locations, even if just the day before the scheduled test. Advance inspections will allow the refinery and the test team to properly prepare for the upcoming test or re-arrange the overall test program to accommodate extensive efforts associated with the preparation of problem test locations.

STEP 7: REVIEW TEST PROGRAM PROGRESS

The test program actually begins when the testing contractor is selected. Often, the testing firm will have test program responsibilities that extend beyond onsite work. For example, the testing firm may have to conduct a preliminary visit, identify source modifications to accomplish testing, prepare a test plan, interface with regulatory agencies, or complete drug tests or refinery-specific safety training programs. It is therefore important to establish mechanisms that ensure completion of important pre-test activities.

Once the onsite work begins, it is important to review progress on a daily basis to ensure that the test program stays on schedule, that the proper sources were tested under the proper test conditions, and that the proper supporting data were collected by operations personnel. Many of the test methods used at refineries provide results in the field. It is important to review flow values, concentration data, and in the case of PST programs, relative accuracy calculations, each test day. This daily review of progress, data, and documentation will help ensure proper completion of the test program and timely reporting of the test data.

An emission testing program is a "project" and requires the dedicated effort of a project manager from the testing firm. Refinery environmental managers should expect the testing firm's project manager to assist with front-end preparations including site visits, test plans, and agency interface; review test team progress and problems daily; share preliminary results; assist with the resolution of challenging or outlying data; manage project costs and promptly communicate situations that affect project costs; and deliver a timely report.

STEP 8: ENSURE TIMELY REPORTING

A common complaint regarding emission testing firms is the failure of the contractor to submit a timely test report. There are several reasons why test reports may be submitted late. For example, missing process data, calibration drift data problems for CEMS, or delays in audit sample reporting may delay preparation of the final report. Often though, report delays can be attributed to organization and management of the testing firm. Testing firms often rely on test personnel to prepare the test report, a difficult task when these personnel are in the field performing a test at another facility.

The most effective way to eliminate test report delays is to insist on the delivery of a draft report in template form before the test team arrives to conduct the test. The template should include all elements including data table numbers and titles. Note that this is not an outline, but rather a skeletal report. For example, data tables should include source identification data and indicate

permit limits and reporting units. This document will help the refinery environmental manager understand the planned organization and presentation of data and facilitate revisions early in the process. The template will also help the test team secure all required process or refinery information and will focus a significant part of the reporting effort on the front-end of the project.

CONCLUSION

Emission testing is perhaps the most challenging of environmental measurement disciplines. As one of the most regulated industries, refineries represent one of the most challenging applications of emission testing. Although refinery emission testing programs are challenging and vary in complexity and purpose, any refinery emission testing programs can be completed efficiently, cost-effectively, and in a technically-sound manner by applying discipline to its design and execution.

Attachment 1: Summary of Key Regulations and Emission Testing Requirements for the Petroleum Refining Industry			
Citation	**Covered Sources**	**Parameter/Pollutant**	**Test Method**
40 CFR 60 Subpart J: Standards of Performance for Petroleum Refineries	Fuel Gas System Incinerators Combustion Sources Sulfur Recovery Units Fluidized Catalytic Cracking Units FCCU Catalyst Regenerator	Volumetric Flow Particulate Matter (PM) Sulfur Oxides (SO_2) Carbon Monoxide (CO) Hydrogen Sulfide (H_2S) Total Reduced Sulfur (TRS) Opacity	EPA Methods: 1, 2, 3, 3A, 3B, 4, 5B, 5F, 6, 6C, 8, 10, 11, 15, 15A, 16 PS 1, 2, 3, 4, 4A
40 CFR 60 Subpart K, KA, and KB: Standards of Performance for Volatile Organic Liquid Storage Vessels	Storage Vessels	Volatile Organic Compounds (VOC)	Inspection, gap measurement, vapor pressure
40 CFR 60 Subpart GG: Standards of Performance for Stationary Gas Turbines	Stationary Gas Turbines	Nitrogen Oxides (NO_x) SO_2	EPA Methods: 1, 2, 3, 3A, 4, 7E, 10, 20
40 CFR 60 Subpart GGG: Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries	Compressors, valve, pump, pressure relief device, sampling connection system, open-ended valve or line, and flange or other connector in VOC service	Total Hydrocarbons (THC)	EPA Method 21
40 CFR 60 Subpart NNN: Standards of Performance for VOC Emissions from SOCMI Distillation Operations	Distillation Operations	Total Organic Compounds (TOC)	EPA Methods: 1, 1A, 2, 2A, 2C, 2D, 18
40 CFR 60 QQQ: Standards of Performance for VOC Emissions from Petroleum Wastewater Systems	Drain systems, oil water separators	VOC	EPA Method 21

Attachment 1: Summary of Key Regulations and Emission Testing Requirements for the Petroleum Refining Industry			
Citation	**Covered Sources**	**Parameter/Pollutant**	**Test Method**
40 CFR 61 Subpart E: National Emission Standards for Mercury	Wastewater treatment plant sludge incinerator	Mercury (Hg)	EPA Method 101A
40 CFR 61 Subpart J: National Emission Standards for Equipment Leaks of Benzene	Compressors, valve, pump, pressure relief device, sampling connection system, open-ended valve or line, and flange or other connector in benzene service	Benzene as THC	EPA Method 21
40 CFR 61 Subpart V: National Emission Standards for Equipment Leaks (Fugitive Emission Sources)	Compressors, valve, pump, pressure relief device, sampling connection system, open-ended valve or line, and flange or other connector in benzene service	Benzene as THC	EPA Method 21
40 CFR 61 Subpart Y: National Emission Standards for Benzene Storage Tanks	Storage Vessels	Benzene	Inspection, gap measurement
40 CFR 61 Subpart BB: National Emission Standards for Benzene Emissions from Benzene Transfer Operations	Benzene storage tanks and transfer piping systems	Benzene as THC	EPA Methods: 1, 1A, 2, 2A, 2C, 2D, 25A, 25B
40 CFR 61 Subpart FF: National Emission Standards for Benzene Waste Operations	Piping and equipment systems that process benzene waste streams	Benzene	EPA SW 846 Methods: 8020, 8021, 8240, 8260, 602

Attachment 1: Summary of Key Regulations and Emission Testing Requirements for the Petroleum Refining Industry			
Citation	**Covered Sources**	**Parameter/Pollutant**	**Test Method**
40 CFR 63 Subpart UUU: National Emission Standards for Hazardous Air Pollutants for Petroleum Refineries: Catalytic Cracking Units, Catalytic Reforming Units, and Sulfur Recovery Units	Catalytic Cracking Units, Catalytic Reforming Units, and Sulfur Recovery Units	PM Hydrogen Chloride (HCl) Nickel (Ni)	EPA Methods: 1, 2, 3, 3A, 3B, 4, 5B, 5F, 26, 26A 29
40 CFR 63 Subpart DDDDD National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters.	Boilers and Process Heaters	Volumetric Flow PM Total Selected Metals (Arsenic, Beryllium, Cadmium, Chromium, Lead, Manganese, Nickel, Selenium) CO HCl	EPA Methods: 1, 2, 2F, 2G, 3A, 3B, 4, 5, 10, 10A, 10B, 17, 19, 26, 29
EPA's Refinery Initiative NSR/PSD	Fluidized Catalytic Cracking Units Heaters and Boilers	Described in NSPS requirements	
EPA's Refinery Initiative NSPS	Flares Sulfur Recover Units Fuel Gas Combustion Devices Sources subject to leak detection and repair programs (LDAR)	Described in NSPS requirements	
EPA's Refinery Initiative NESHAPS	Sources subject to 40 CFR 61 J, V, Y, BB, FF	Described above in indicated section	