

BOARD MEETING DATE: February 6, 2015

AGENDA NO. 5

PROPOSAL: Execute Contracts for Advanced Optical Remote Sensing Technologies at Refineries, Other VOC Sources and Marine Vessels

SYNOPSIS: Recent advances in optical remote sensing (ORS) technology have made it possible to quantify fugitive emissions from an entire refinery complex and other sources. In September 2014, an RFP was issued to conduct a series of measurements intended to fully characterize and quantify fugitive and stack emissions from large refineries, other important VOC sources and marine vessels and to develop remote sensing technologies with the intent of providing real-time data capability. Several proposals were received from different contractors and evaluated to select the most competitive bids. This action is to execute contracts with multiple contractors employing a variety of different advanced ORS technologies in an amount not to exceed \$1,100,805 from the Rule 1118 Mitigation Fund (54).

COMMITTEE: Technology, January 23, 2015; Recommended for Approval

RECOMMENDED ACTIONS:

Authorize the Chairman to execute the following contracts from the Rule 1118 Mitigation Fund (54):

- A. FluxSense AB (FluxSense) in an amount not to exceed \$511,861 to conduct three measurement projects intended to better characterize and quantify fugitive and stack emissions from large refineries, small point sources and marine vessels and improve current emission inventory estimates (Projects 1 through 3 in Table 1);

- B. National Physical Laboratory (NPL) in an amount not to exceed \$288,762 to conduct validation measurements on a refinery and a subset of small point sources;
- C. Atmosfir Optics (Atmosfir) in an amount not to exceed \$145,000 to conduct validation measurements on a refinery; and
- D. Kassay Field Services, Inc. (Kassay) in amount not to exceed \$155,182 to conduct validation measurements on a subset of small point sources.

Barry R. Wallerstein, D.Env.
Executive Officer

MMM:LT:AP

Background

On September 5, 2014, the Board issued RFP #P2014-07 to solicit proposals for a series of three measurement and evaluation projects to better characterize and quantify fugitive and stack emissions from large refineries and other important sources of VOCs (e.g., gas stations, oil wells, marine vessels, barges and railyards) and to improve current emission inventory estimates (Projects 1 through 3; Table 1). RFP #P2014-07 was also to further develop spectroscopic techniques and capabilities for continuous near-real time emission monitoring (Projects 4 and 5 in Table 1). This RFP sought qualified, independent vendors, academic institutions, national laboratories and other public and private organizations with proven expertise in developing, manufacturing, installing, operating and maintaining advanced Optical Remote Sensing (ORS) technologies.

Outreach

In accordance with SCAQMD's Procurement Policy and Procedure, a public notice advertising the RFP/RFQ and inviting bids was published in the Los Angeles Times, the Orange County Register, the San Bernardino Sun, and Riverside County's Press Enterprise newspapers to leverage the most cost-effective method of outreach to the South Coast Basin.

Additionally, potential bidders may have been notified utilizing SCAQMD's own electronic listing of certified minority vendors. Notice of the RFP/RFQ has been e-mailed to the Black and Latino Legislative Caucuses and various minority chambers of commerce and business associations, and placed on the Internet at SCAQMD's website (<http://www.aqmd.gov>).

Bid Evaluation

Twenty-one proposals were received from seven different contractors in response to this RFP. All proposals were reviewed and evaluated by a diverse, technically qualified panel of experts comprised of an SCAQMD Assistant Deputy Executive Officer, Quality Assurance Manager and Program Supervisor as well as BAAQMD's Director of Technical Services and a U.S. EPA Research Environmental Scientist, in accordance with specific criteria contained in the RFP. The panel consisted of five Caucasian males.

Based on technical and cost considerations, FluxSense was selected as the most qualified contractor to conduct Projects 1 through 3 (Table 2). In addition, the panel strongly recommended conducting validation measurements using different ORS methods to better evaluate the accuracy and reliability of the FluxSense emission data. In an effort to provide the recommended validation but also allow for a comprehensive comparison between different ORS methods, three other technically qualified contractors - National Physical Laboratory (NPL), Atmosfir Optics (Atmosfir) and Kassay Field Services, Inc. (Kassay) were selected. Staff was able to identify additional funding to complete these important validation measurements. The next section summarizes the strategies and techniques that have been chosen by the panel to accomplish the goals and objectives of Projects 1 through 3 in Table 1.

Proposal

Project 1: Quantification of Fugitive Emissions from Large Refineries

FluxSense will conduct a comprehensive five-week study at five different refineries in the Los Angeles Basin to characterize and quantify total facility-wide emissions of methane, non-methane VOCs (i.e., alkanes, BTEX and alkenes), nitrogen oxides (NO_x), and sulfur dioxide (SO₂) using Solar Occultation Flux (SOF), Differential Optical Absorption Spectroscopy (DOAS) and Fourier Transformed InfraRed (FTIR) measurements on a mobile platform. ORS measurements will be complemented by wind data from ground wind sensors and from a wind LIDAR that will be procured by SCAQMD as part of this fence-line monitoring project. The total emission data will be compared to the reported annual emission inventories. Any discrepancies between reported annual inventories and measured emissions will be further investigated to identify the specific emission sources. These optical techniques will be validated by a controlled release exercise in the vicinity of one of the targeted refineries. Measurements will be carried out primarily at the fence-line of the selected refineries but also inside the facilities to identify specific emission sources and to further validate the fence-line data. The SCAQMD will work with the refineries and other local authorities to facilitate the measurements.

To validate the emissions flux estimations provided by FluxSense and also allow for comparison between different ORS methods, two additional measurement studies will be conducted concurrently at one selected refinery by NPL and Atmosfir. NPL will

operate their state-of-the-art Differential Absorption Lidar (DIAL) facility downwind of the selected refinery for two consecutive weeks. In its typical configuration, a DIAL laser beam is scanned in a vertical plane to identify individual emission plumes from the refinery and to map the distribution of the target gases. By combining this information with wind data this technique provides a direct measure of the emission rate of the target gases and their spatial distribution. Although DIAL does not allow for mobile measurements around a refinery perimeter and does not fully satisfy the long-term measurement requirements of this particular project, it can be operated during the day and at night (SOF methods can only be used in the presence of sunlight). Also, the ability of DIAL to rapidly change the direction in which the measurements are made enables emission plumes to be tracked from their source to different downwind distances. Given its proven capabilities and the detailed emission data it provides, DIAL is ideal for field validation purposes.

At the same time, Atmosfir will conduct a five-week study to measure refinery-wide emissions of methane, VOCs, NO_x, and SO₂ using a well-established strategy based on U.S. EPA Other Test Method 10 (OTM-10), "*Optical Remote Sensing for Emission Characterization from Non-Point Sources*." This method includes the use of two monostatic, open-path FTIR instruments (i.e., one upwind and one downwind of a selected refinery) and of multiple retro-reflector mirrors mounted at ground level and on a vertical structure. The system will be designed and operated to maximize plume capture from the refinery and minimize interferences from external sources. Also in this case, continuous gas pollutant concentrations will be combined with wind information to estimate facility-wide emission rates for the refinery of interest. Although this method does not allow for mobile measurements around a refinery perimeter and the detection limit for BTEX compounds is typically higher than that obtained using SOF or DIAL, this technique has been thoroughly validated by the U.S. EPA and can be used to detect gaseous emissions during the day and at night.

Project 2: Quantification of Gaseous Emissions from Gas Stations, Oil Wells and Other Small Point Sources

A five-week study will be carried out by FluxSense to characterize and quantify fugitive VOC emissions from gas stations, oil wells and other small point sources using a combination of SOF, DOAS, and FTIR techniques. Measurements of methane and non-methane VOCs will be taken from a mobile vehicle at 50 to 100 oil wells, 20 to 40 gas stations, and at several other point sources (e.g. tank depots, fuel loading from barges and railyards), all located in the South Coast Basin. ORS measurements will be complemented by wind data from ground-based sensors and from a wind LIDAR. The optical techniques will be validated by a controlled release exercise in the vicinity of one or more of the sources. The SCAQMD will help identify suitable measurement sites located in areas with good access to wind and other meteorological data.

To validate the fugitive emission results provided by FluxSense and also allow for comparison between different ORS methods, two concurrent measurement studies will

be conducted at selected oil wells, gas stations, tank depots and barges by NPL and Kassay. Specifically, NPL will operate their DIAL facility to characterize and quantify methane and non-methane VOC emissions from seven of the same individual point sources selected by FluxSense. The DIAL technique is well suited to map the full distribution of emissions from these types of sources including emissions at high and low elevations and to identify potential local background contributions. As mentioned earlier, DIAL is ideal for field validation purposes and a side-by-side comparison between this technique and FluxSense's SOF method would provide invaluable quality assurance information and direct validation of the SOF results.

Validation measurements will also be carried out by Kassay for five consecutive weeks using an open-path FTIR instrument mounted on a trailer to independently measure fugitive VOC emissions from 50 of the same individual point sources selected by FluxSense. The FTIR, along with a portable meteorological tower, will be transported to each source location and positioned in an orientation to best capture the plume. A retro-reflector will be deployed at a distance to reflect the infrared beam while intercepting prevailing winds that transport VOCs from the source towards critical receptors. FTIR, meteorological and location data will be processed to calculate and present a "snap-shot" emission rate for the sample period. Upwind, off-wind and synthetic backgrounds, a dispersion modeling software, and ground-based meteorological data will be used to correctly identify and subtract potential background contributions. As for Project 1, the proposed open-path FTIR method does not allow for mobile measurements around the targeted point sources, and the detection limit for some of the targeted compounds may be higher than that obtained using SOF of DIAL. However, the method proposed by Kassay has been successfully used in the past for similar applications and adheres to the guidelines that are recommended by U.S. EPA's "*Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*" (TO-16).

Project 3: Quantification of Stack Emissions from Marine Vessels

FluxSense will conduct a four-week study to measure "real world" emissions (g/s) of SO₂ and NO₂ and emission factors (g/Kg fuel burnt) of SO₂, NO_x and particulates from individual ships moving in and out of either the Los Angeles or Long Beach Ports. Land and mobile (i.e. on-vessel) measurements will be carried out using a combination of optical methods and a real-time "sniffer" system based on more traditional air monitoring techniques. In addition, total "bubble" emissions of NO₂ and possibly SO₂ will be conducted from the Los Angeles or Long Beach harbors. The equipment will be initially placed "on-shore" (e.g., deployed on a van or set-up inside a container) for about two weeks and then on a marine vessel for about two weeks. Such measurements will then be used to estimate "actual" emission factors for individual ships and total emissions in various modes of ship operation. The optical technique will be validated by a controlled release exercise in the vicinity of one or more of the sources. The SCAQMD will work with the ports and other local authorities to facilitate all land- and

vessel-based activities. None of the other proposals submitted as part of RFP #P2014-07 has been selected to validate the measurement approach proposed by FluxSense.

Based on feedback received by the evaluation panel, staff concluded that further discussion and evaluation is needed before selecting one or more contractors to develop a remote sensing “Optical Tent” that would provide early warning and real-time alerts to schools and communities downwind of a refinery (Project 4), and a portable I-DOAS system to make survey scans of smoke stacks, flares and other similar sources (Project 5). Staff intends to come back with a recommendation on these two projects at a later date. Table 1 shows a list of all contractors that have been proposed to accomplish the goals and objectives of Projects 1 through 3, the scope of their measurements (i.e., Main vs. Validation), and the cost of each proposal.

Benefits to SCAQMD

This proposed work will provide SCAQMD and its stakeholders with advanced capabilities for continuous monitoring of a number of trace gas pollutants in the air in and around the refinery complex, with low detection limits and high temporal resolution. The successful deployment and implementation of these ORS techniques will establish SCAQMD as the first air monitoring agency in the country with such capabilities. Enhanced monitoring capabilities will greatly contribute to improving emission inventory estimates by narrowing the gap between measured and reported fugitive emission levels from refineries. The results of these studies will also serve as valuable input to improving future air quality model performance and refining future attainments/control strategies and environmental decision-making. In addition, measured data on VOC emissions will allow SCAQMD to refine its air quality forecasting capabilities by better predicting ozone and particle formation in the South Coast Basin.

Resource Impacts

The Rule 1118 Mitigation Fund (54) will be used to fund the contract awards listed in Table 1. Sufficient funding exists in the Rule 1118 Mitigation Fund (54).

Attachments

Table 1 - Proposed Contractors & Objectives

Table 2 - Summary of Proposal Scores

Table 1 – Proposed Contractors & Objectives

List of all contractors proposed to accomplish the goals and objectives of Projects 1 through 3, scope of their proposed measurements (i.e., Main vs. Validation/Comparative), and the cost of each proposal.

| | Main Measurements | | Validation/Comparative Measurements | | | | | | |
|---|---|------------------|-------------------------------------|------------------|----------|------------------|---------|------------------|--------------------|
| | Company | Cost | Company | Cost | Company | Cost | Company | Cost | Total Cost |
| PROJECT 1: Quantification of Fugitive Emissions from Large Refineries | FluxSense | \$173,081 | NPL | \$243,665 | Atmosfir | \$145,000 | | | \$561,746 |
| PROJECT 2: Quantification of Gaseous Emissions from Gas Stations, Oil Wells and Other Small Point Sources | FluxSense | \$179,543 | NPL | \$45,097 | | | Kassay | \$155,182 | \$379,822 |
| PROJECT 3: Quantification of Stack Emissions from Marine Vessels | FluxSense | \$159,237 | | | | | | | \$159,237 |
| PROJECT 4: Development of a Remote Sensing “Optical Tent” for Continuous Near-Real Time Emissions | <i>No contractor selected for Projects 4 and 5 yet (Proposals under further evaluation)</i> | | | | | | | | |
| PROJECT 5: Development of a Portable Imaging-DOAS System to Survey Emissions from Individual Smoke Stacks and Flares | | | | | | | | | |
| | | \$511,861 | | \$288,762 | | \$145,000 | | \$155,182 | \$1,100,805 |

Table 2 – Summary of Proposal Scores

Total scores summarizing the cumulative points awarded to all proposals received to address the goals and objectives of Projects 1 through 3.

| PROJECT 1: Quantification of Fugitive Emissions from Large Refineries | | PROJECT 2: Quantification of Gaseous Emissions from Gas Stations, Oil Wells and Other Small Point Sources | | PROJECT 3: Quantification of Stack Emissions from Marine Vessels | |
|--|-----------------------------|--|-----------------------------|---|--|
| Company | Total Score (56-100) | Company | Total Score (56-100) | Company | Total Score (56-100) |
| FluxSense | 94.5 | FluxSense | 94.3 | FluxSense | 93.7 |
| Atmosfir | 71.9 | Kassay | 93.2 | NPL | 91.5 |
| NPL | 64.3 | NPL | 72.2 | Rebellion Photonics* | <i>Below minimal technical score (<56 & no cost provided)</i> |
| Rebellion Photonics* | <i>No cost provided</i> | Atmosfir | 68.9 | | |
| | | Rebellion Photonics* | <i>No cost provided</i> | | |

*Although Rebellion Photonics did not submit any cost information and was disqualified from the evaluation process, their proposed technology will be further evaluated by SCAQMD staff for future potential fence-line applications