Attachment – B Vendor Questions

I. General Questions

1. What scale of operation would be required to bid on a future RFP of the concept described here? Are there any minimum requirements necessary at which below you would not be interested in bidding on a proposal of this nature?

   Mobile Monitoring

   - Required campaign length for mobile measurement services: 2 – 4 weeks
   - Maximum number of campaigns per year for mobile measurement services: 3 – 4 (depending on length of each)
   - Exploratory and research-oriented projects are preferred. Routine monitoring of novel or challenging compounds to demonstrate world-class precisions of Aerodyne instruments or projects requiring extensive instrument manifests to answer complex scientific questions are other examples of attractive opportunities.

   Aerodyne Mobile Laboratory purchase

   - Aerodyne seeks to develop collaborative or working relationships with customers to ensure the highest quality measurements with our instruments and platforms.
   - Aerodyne Mobile Laboratory purchases must include Aerodyne instruments, with space for 3rd-party or collaborator instruments.

2. What types of monitoring objectives have you explored using your company's mobile monitoring approaches?

   Aerodyne is a pioneer in the field of mobile measurements and has run and operated mobile laboratories since the 90's for a range of applications. Recent examples include ambient hazardous species mapping for the purpose of human exposure studies; emissions quantification via tracer-release or plume inversion, often for methane/natural gas sources like cattle farms, oil and gas facilities; source characterization and mapping at industrial sources like ethylene oxide sterilizers, rendering facilities, refineries, etc.

3. What are the advantages and limitations of your company's mobile monitoring services?

   Advantages: Aerodyne uses top-of-the-market research-grade instrumentation in our mobile monitoring services, ideal for community-scale exposure studies and concentration mapping downwind. These instruments are also commercially available. Aerodyne scientists have decades of experience in mobile monitoring, including specific experience at many California industrial sites. Aerodyne actively seeks out collaborative, science-driven projects. Aerodyne's labor rates are competitive versus academic institutions due to our overhead rates.

   Disadvantages: Aerodyne is a small business located in Massachusetts and cannot commit to continuous (weekly) mobile monitoring throughout the year. Aerodyne instruments and services may be more expensive that some of our competitors due to our state-of-the-art technical specifications.

II. Engagement and Coordination

1. Describe your interpretation of what community engagement should look like throughout the process of conducting mobile air monitoring in communities.

We would defer to the State of California. Aerodyne scientists are willing to attend community meetings to answer scientific questions if they arise.

During mobile operations, our standard operating procedures include travelling with informational hand-outs developed by the project sponsor for distribution to community members. We are careful to limit any technical dissemination of results prior to official reporting. Projects we have worked on have also sometimes set up a “tip line” where residents can call in odor or other complaints during monitoring campaigns, if requested by project managers. We frequently do more general science outreach and mobile laboratory tours with school children.

2. What experience do you have with community and public engagement? Is any of this experience directly related to air monitoring activity and data dissemination?

   See point II. 1 above.

   We have worked collaboratively with the Harvard School of Public Health on Massachusetts air monitoring issues at Logan Airport, and on the impact of construction projects on neighborhood pollution around Boston. Aerodyne performed measurements and contributed to scientific data dissemination.

3. What is your experience coordinating with community members, CBOs, regulated industry, academia, and governmental agencies when planning monitoring objectives and data analysis and communication?

   We routinely coordinate with industry, academia, and government in the planning stages of monitoring campaigns.

   We have participated in numerous projects involving collaborations between a regulated industry, academia, and, in select cases, government regulators. We have found that setting up a scientific advisory panel including key stakeholders to be crucial to the success of these collaborations. Formalized agreements relating to data anonymity and dissemination/publication are also important. For example, in several EDF methane studies (https://www.edf.org/climate/methane-research-series-16-studies), individual companies’ data were anonymized and pooled for publication, but each company had access to their own full dataset.

   Aerodyne also routinely volunteers time and expertise to the National Academies of Science, allowing scientists to serve as scientific experts on a variety of topics.

4. Please provide the number and size ($) of technical projects previously managed for coordination and communication with both community and technical contractors.

   Not applicable.

5. How would you apply your engagement and coordination model on a statewide scale?

   Not applicable.

III. **Mobile Monitoring Technologies and Capabilities**

1. How many mobile monitoring platforms do you currently own and operate? How long have these platforms been in operation?

   We currently own and operate two mobile laboratories (self-propelled, self-powered, continuously measuring mobile monitoring platforms), that have been in operation since 2015. The Aerodyne Mobile Laboratory (AML) is a large box truck capable of hosting numerous research-grade instruments for live mobile data acquisition that is limited only by staffing restrictions. The Miniature Aerodyne Mobile Laboratory (minAML) is a cargo van with similar capabilities (though reduced power capacity) to the AML but designed for targeted measurement campaigns that focus on a more selective set of compounds. Two previous incarnations of the Aerodyne Mobile Laboratory have been retired. The earliest mobile laboratory at Aerodyne was deployed in 1992.

   a. What areas/sources/locations do you have experience conducting mobile monitoring?

      Aerodyne has conducted extensive mobile monitoring in numerous cities across the U.S., including Los Angeles, New York City, Houston, Detroit, and Philadelphia. Urban sources include industrial facilities, rendering plants, transportation depots, hospitals, warehouses, medical sterilizers, concrete production, infrastructural leaks, and several more categories. Other sources include agricultural sites (dairy farms in California), oil and gas facilities (on-site at refineries, flares, well pads, compressor stations), and biomass burning events (wildfires in Idaho, prescribed burns in Michigan). Mobile platforms have even been brought to Canada, Mexico, and parts of Europe (The Netherlands, Norway) to characterize real-time emissions.

   b. Has collected data been used to support community emission reduction, enforcement, or other actions? Please provide examples.

      Data collected during monitoring campaigns in the Los Angeles Basin has been used to identify and alert enforcement agencies (SCAQMD) of industrial emissions that exceed regulation concentrations for hexavalent chromium and ethylene oxide. Measurements at oil and gas facilities have been used to support existing LDAR programs and discover unexpected leaks at storage tanks, well heads, and a wide variety of equipment types.

2. Please provide operational information on your company's current mobile monitoring capabilities. This should answer the following questions:

   a. What frequency can platforms be deployed?

      Without prior notice, platforms can typically be deployed every 2-3 months. With planning, more frequent or staggered deployments are possible. Depending on the complexity of the monitoring project (duration, instrument manifest, staffing need), preparation efforts require 1-3 weeks. A regular measurement program (trips at a known interval, planned in advance) with a set instrument manifest could be accommodated and result in more frequent "rapid deployments".

   b. What days/hours are the platforms generally in use?

These platforms have no typical schedule. Usage is entirely driven by the project needs. Routine monitoring assignments would primarily occur during normal business hours, but there is no limitation for pursuing "off-hour" periods to better understand the full character of industrial emissions (irregular venting activities, nights and weekends). Studies that track emissions around-the-clock have been performed but are considered extremely intense and occur for a limited duration.

c. What pollutants can be monitored and with what frequency?

A wide range of gaseous and particulate pollutants can be monitored in real-time (1 Hz). Some example hazardous gases include benzene, toluene, xylenes, ethylene oxide, styrene, and acrolein. Other gases provide context for a source origin or type, such as combustion (NOx, CO), biogenic emissions (N_2O), biomass burning (HCN), thermogenic emissions (C_2H_6, CH_4), or atmospheric oxidative capacity (O_3, HCHO). Fine particulate matter (PM 2.5) can be chemically characterized at various time scales. Additional species and advanced isomer speciation of gaseous species are possible with additional instruments at slower rates (e.g. 10 minute sample every 30 minutes). The table below lists all species in the RFI, whether those species can currently be measured as part of our mobile monitoring program, and whether Aerodyne instruments are available for purchase for those species. Aerodyne's mobile laboratory uses a combination of Aerodyne instruments and 3rd party instruments for optimal coverage of important species within power and space limitations. Attachment C contains sample instrument manifests.

List of Species in RFI	Mobile Measurement Services	Aerodyne Instrument Capability
Particulate Matter ($PM_{2.5}$ & PM_{10})	yes	SP-AMS; n/a for PM_{10}
Black Carbon (BC)	yes	SP-AMS
Diesel PM	yes	SP-AMS
Ozone (O_3)	yes	TILDAS
Carbon Monoxide (CO)	yes	TILDAS
Carbon Dioxide (CO_2)	yes	TILDAS
Nitrogen Oxides (NO & NO_2)	yes	CAPS or TILDAS
Methane (CH_4)	yes	TILDAS
Hydrogen Sulfide (H_2S)	possible with notice, but not currently available	TILDAS
Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX)	yes	Vocus-PTR and GC-EI
Formaldehyde	yes	TILDAS
Acrolein	yes	TILDAS
Arsenic	partial (elemental ultrafine particulate matter arsenic via SP-AMS)	SP-AMS (elemental)
Ethylene Oxide	yes	TILDAS
1,3-Butadiene	yes (30 min measurement)	Vocus-CIMS or GC-EI
Sulfur containing compounds	some	Vocus PTR, GC-EI
Carbonyls	yes	Vocus PTR; GC-EI
Polycyclic Aromatic Hydrocarbons (PAHs)	some (naphthalene via Vocus-PTR; Particulate matter PAH via SP-AMS)	Vocus PTR, SP-AMS, GC-EI

List of Species in RFI	Mobile Measurement Services	Aerodyne Instrument Capability
Metals	some (elemental ultrafine particulate matter metals via SP-AMS). 3rd party metals instruments possible.	SP-AMS (elemental)
Hexavalent Chromium	no	no
Ammonia	possible with notice, but space-limited with other instruments	TILDAS
Methyl bromide	yes	Vocus PTR, GC-EI

d. What types of instrumentation do you use? Describe all relevant methodologies.

We primarily deploy research-grade instruments developed and manufactured by Aerodyne. Sometimes, prototype or newly developed instruments are used for novel or difficult measurements (e.g., “sticky molecules”). Gases are measured using infrared spectroscopy (TILDAS), chemical ionization mass spectrometry (PTR-MS or other reagent ions, such as NO+), and cavity attenuated phase shift (CAPS) and gas chromatography mass spectrometry (GC-MS) techniques. Particles are measured using mass spectroscopy techniques (AMS, SMPS). Collaborator or 3rd-party instrumentation is sometimes employed, for example a Cooper XACT for metals quantification.

Instrument specifications are included in Attachment C.

e. What level of coverage or scale of monitoring can be accomplished within a community? (For example, how would you approach characterizing emissions from a source or identifying a leak? How long would that take?)

If road access is available, the mobile laboratory will drive loops around the perimeter of a source and look for enhanced concentrations of pollutants. If wind conditions permit (>3 m/s upwind of accessible public roads), it should require only a few repeats to find the general location of a leak (if present). Emission rates can be determined using tracer release methods or prolonged stationary measurements combined with modeling approaches. Depending on the size of the community, repeated street-by-street concentration mapping of the area is possible and can show migration of an emission plume into and across a residential area. Sampling at a given site can require between 15 – 90 min depending on the source scale and level of characterization desired (concentration mapping vs emission rate determination).

f. How do you determine that you’ve adequately characterized a given area?

As a rule of thumb based on previous studies, we attempt to collect as many repeated plume encounters as possible (drives downwind perpendicular to a source) but find 8 – 12 data points to typically provide statistically meaningful data when characterizing a point source emission.

g. What workflow processes or software do you have for managing mobile monitoring?

Aerodyne uses proprietary analysis software written for Igor Pro for live data streaming visualization and generating data products during post-processing. Each instrument type has custom software to convert raw data (e.g., spectral absorbances) into mixing ratios or other concentration units.

3. Describe your usual approach or strategy to mobile monitoring. Include, if possible:

   An example sampling day could include the following activities. A morning meeting with the sponsor determines the sources or areas of interest for the day or week. A crew visits five potential sources clustered in one area in the morning before traveling to another area to inspect another grouping of sites. Events in the live data are marked with time-stamped observational notes. Simple plots, correlation analysis, and/or heat maps are generated to share with project management. Significant emission findings can be quickly relayed with supporting evidence to instruct further actions.

   Drivers of the AML are limited to 14 hours of work per day (11 hours of driving) and require 30-minute breaks every 8 hours. Sustainable staffing plans typically have a driver, navigator, and 1-2 instrument specialists operate the mobile laboratory for 8 hours per day on 5-6 days per week over 1-4-week periods. Our AML platform has two diesel generators (12.5 kW) and a 100-gallon diesel fuel tank. Our minAML platform has one gasoline generator (7 kW) and a 15-gallon gas fuel tank. Uninterruptable power supplies offer protection from power glitches and assist switchover from shore to mobile power.

   Instruments on board require various consumables. Regular backgrounding with ultra zero air occurs for TILDAS and other gas-phase instrumentation. Frequent calibrations with known standard mixtures are scheduled for chemical ionization mass spectrometers. Various liquids (butanol, HPLC water, laser chiller coolant) are used as well.

   Quality control of data starts in the field. Note-taking and marking of plumes (including interferences – such as exhaust) benefits later interpretation. Daily and inter-day instrument checks (spectral fits, changes to instrument precision, hardware status, overall stability) are performed by the experts who build and develop these instruments.

   Data logging is centrally managed by computers on-board the AML and backed up to a local server. External hard drives are used for daily backups. Preliminary analysis off-site is immediately possible.

4. Please provide an estimated cost to operate all applicable mobile monitoring platforms as a function of time (e.g. 1 week of monitoring) deployed and/or measurements taken.
   a. These cost estimates should include all costs associated with mobile monitoring operation. This includes but is not limited to:
      i. Direct costs – instrumentation consumables and repairs, vehicle operation costs, staff cost to operate platforms, recharging requirements.
      ii. Indirect costs – support staff costs, associated insurance for operation, administrative overhead, any required permits.
      iii. Data Management – costs to move data from raw data collected by instrumentation to the final data products requested by CARB.
   b. How often are invoices and payments typically required.

   See Attachment C for costing.

5. If an RFP is developed based on the information provided here, how much preparation time is required to deploy the platforms and begin monitoring?

   Approximately 2 weeks - 2 months are required for development of a written proposal for mobile measurement services. Sufficient notice (at least 3 months) is required to ensure the necessary resources (instruments, platforms, staff, consumables) are available. Approximately 1-3 weeks are required for the physical preparation of the mobile platform for a monitoring campaign.

   See costing document for details on a mobile laboratory purchase.

   a. Do you have recommendations for a minimum timeline to achieve potential monitoring objectives described here?

      Expansion of air monitoring by mobile sampling for affected communities and elsewhere could occur swiftly, given the amount of resources available. Finding a balance between full-time monitoring and validating techniques to achieve cost-efficient and meaningful datasets (temporally and spatially) could require 2-3 years of discussion and testing with multiple groups and types of platforms to build up an effective program. Aerodyne is ready in the near and long term to assist with these efforts using our in-motion mobile platforms and research-level instrumentation.

   b. What is the maximum number of platforms that you could deploy by early 2025?

      It is feasible that we could have three platforms of different scales (AML, minAML, 3rd platform TBD) available for deployment in early 2025. Our main two platforms (AML and minAML) are available currently as-is to deploy with a flexible instrumentation suite. Construction of a third platform dedicated to a single measurement (or small manifest) has been considered to meet potential monitoring needs, and could be done rapidly given notice of interest. Other platforms (1-2) could be built before 2025, but would require a significant internal (or external) investment that is not expected at this time.

6. Do you have experience developing Community Air Monitoring Plans (CAMPs) as defined by the CARB Community Air Protection Program Blueprint[5] or similar? Please provide examples of community-focused monitoring plans or similar.

   We have no specific CAMPs. However, we have collaborated on several projects to measure hazardous pollutants in impacted neighborhoods. For example, in 2015, the AML performed mapping measurements in several neighborhoods nestled in between refineries and petrochemical plants in Houston's shipping channel [*Yacovitch et al.*, 2015]. The strategies employed in that study included repeated mapping measurements in impacted neighborhoods under a variety of wind directions. Similar monitoring strategies were undertaken in Dearborn, MI, as part of the MOOSE study [*Yacovitch et al.*, 2023]. We have also recently performed measurements for research groups including atmospheric scientists and risk and exposure scientists (working in public health). These measurements focused again on communities near industrial or petrochemical corridors with known toxic emissions.

7. Do you have existing standard operating procedures (SOPs) or quality assurance project plans (QAPPs) for your mobile monitoring approach?

   We have developed QAPPs for a number of mobile monitoring projects, including projects funded by the Texas Air Quality Research Program, and by the EPA.

IV. **Data Collection, Storage, Reporting**

1. In what format do you generally provide data to your clients? What is your final data product?

   Our final data product typically consists of a final report (pdf or Word docx), final dataset, and quality-assurance document (pdf or docx) accompanying and describing the dataset.

   Datasets themselves can be output in any number of formats, most commonly comma-separated-value ascii files (.dat or .txt), or NASA's ICARTT format (https://www.earthdata.nasa.gov/esdis/esco/standards-and-practices/icartt-file-format).

   We typically time-align all instruments and output all 1-Hz data onto the same time basis for ease of use.

2. Do you have off-the-shelf, or modifiable-off-the-shelf, data management products compatible with mobile monitoring data?

   Aerodyne maintains a rigorous data archive, backed up offsite. Dataset management is done on a campaign-by-campaign basis, with data organized in folders based on campaign, instrument, and data revision.

3. What is your experience in mobile monitoring data analysis and visualization? Specifically, do you have any experience using ESRI products to manage and visualize data?

   Mobile monitoring data analysis is typically done using custom software developed in Igor Pro. This software mimics the live data maps and displays in the mobile labs, with additional analyses possible. We have existing Igor Pro software to pull in licensed Google Maps satellite and roadmap images into all of our plots. We do not have specific expertise in ESRI mapping products.

4. What is your experience in public dissemination of complex information? To what extent have you generated data visualization for the public?

   We have generated numerous data visualizations for scientific audiences, including non-expert audiences like undergraduates, engineers or technicians, industrial clients, and lawyers. Mobile measurement data visualizations most often use maps, sometimes animated in time to show evolution of hotspots or plumes. We have produced video abstracts for certain studies, including the 2015 mapping study in Houston [*Yacovitch et al.*, 2015].

For certain projects, we have worked with hired photographers and videographers while in the field. The photographs were used to enhance scientific presentations, and for social media. These externally contracted firms have produced videos for a more general audience.

5. What suggestions do you have for handling large amounts of data from a variety of sources (e.g. multiple mobile monitoring platforms) into cohesive data visualizations?

   Generating heatmaps per hour of day over a given study area may be a good place to start.

V. **Feedback**

1. Provide input on the requirements or areas listed in this RFI. Specifically, CARB is looking for:
   a. Availability of existing systems that perform all or a portion of the requirements in Section II – C. New systems cannot be built using funds in a potential RFP

      See response to Section III. 5 b above. Aerodyne currently has 2 mobile laboratories and many (but not all) instruments to satisfy the requirements. The production of an additional mobile laboratory and/or specific Aerodyne instruments to measure any missing high-priority species may be possible.

   b. Questions, suggested modifications, or additions to the proposed environment that would allow or encourage potential bidders. Please include justifications for any suggested changes and concept modifications.

      This RFI is focused on finding a contractor to perform mobile measurement services, and Aerodyne has produced a bid for this (see Attachment C).

      However, an alternate approach, which may be cost-effective in the long run, and might provide more continuous time coverage, would be to purchase a fully equipped mobile laboratory and develop the in-house expertise to operate this platform. Aerodyne has produced an alternate costing for a highly-instrumented Aerodyne Mobile Lab.

References

Yacovitch, T. I., S. C. Herndon, J. R. Roscioli, C. Floerchinger, W. B. Knighton, and C. E. Kolb (2015), Air Pollutant Mapping with a Mobile Laboratory During the BEE-TEX Field Study, *Environ. Health Insights*, 7-13, doi:10.4137/EHI.S15660.

Yacovitch, T. I., B. M. Lerner, M. R. Canagaratna, C. Daube, R. M. Healy, J. M. Wang, E. C. Fortner, F. Majluf, M. S. Claflin, J. R. Roscioli, E. M. Lunny, and S. C. Herndon (2023), Mobile Laboratory Investigations of Industrial Point Source Emissions during the MOOSE Field Campaign, *Atmosphere*, *14*(11), 1632.